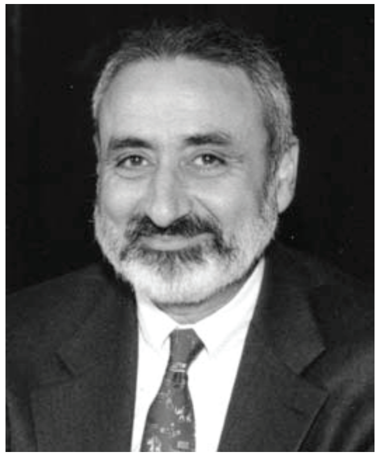
Wastewater Management Handbook for Local Representatives

Second Edition

January 2013

Photo courtesy of NYS EFC



Dedication

We dedicate this handbook to N.G. Kaul who passed away on February 25, 2004. He had 27 years of service with the NYSDEC and retired as the former Director of the Division of Water. Well known for his management and engineering skills, he is most fondly remembered for his people skills. He was a strong leader for environmental protection and the mission of protecting public health. Recognizing the critical role that wastewater treatment plays, N.G. was an avid supporter of operators and the need for ongoing training. He worked to assure that funding and support were available to maintain high standards in the wastewater profession.

Acknowledgements

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Introduction

Local officials play an integral part in the administration of wastewater treatment plants within their communities. Wastewater treatment plants are a critical capital asset and as a local official it is your responsibility to understand the operations and management procedures associated with it. As public managers, local officials need the skills and tools to address problems that may arise at their community's plants. Because wastewater may impede public health or the environment within a community, it is important that elected officials familiarize themselves with basic terminology and responsibilities relating to wastewater treatment plants.

This handbook is designed to be a reference tool for local officials, public administrators, and managers. In addition to the basic treatment operations, this handbook will discuss the strategies to ensure compliance, funding, adequate training, and public education. This reference will also help public officials familiarize themselves with financial management tools, loan and grant assistance, as well as learn about capital improvement planning to enhance long term economic viability. The handbook is broken into different sections. Each section discusses important topics and subject matters that will provide public officials with the basic information needed to understand how wastewater treatment plants operate. There are additional resources located at the end of each chapter for those who would like to learn more. In the appendices, topics such Advanced Evaluation Techniques, including the time value of money, are discussed in more detail, as well as sample forms for reporting and gathering information to properly manage their wastewater systems. In addition, this handbook has a comprehensive glossary of terms and glossary of financial terms.

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NYWEA

Environmental Finance Center
Syracuse University

Introduction to Wastewater Management

Wastewater Treatment is one of the most important services a municipality may provide and one of the least visible. This chapter provides an overview of the process of wastewater treatment and provides information appropriate for municipal leaders, the general public and operators.

NYWEA

Environmental Finance Center Syracuse University

Chapter 1:
Introduction to Wastewater Management

Wastewater 101

Overview

The section provides an overview of wastewater treatment and is intended to provide a brief description of what processes may be at your wastewater plant. Although each plant is designed for particular conditions, there are many similarities in how different processes operate. There may be differences between your plant and a neighboring plant in terms of size, ground area, shape of tanks (circular or rectangular), or the types of treatment processes they use.

What is wastewater?

Wastewater or sewage is the byproduct of many uses of water. There are the household uses such as showering, dishwashing, laundry and, of course, flushing the toilet. Additionally, companies use water for many purposes including processes, products, and cleaning or rinsing of parts. After the water has been used, it enters the wastewater stream, and it flows to the wastewater treatment plant. When people visit a treatment plant for the first time, often it is not what they perceived it would be. These wastewater plants are complex facilities and provide a high quality end product.

> **"When people visit a treatment plant for the first time, often it is not what they perceived it would be. These wastewater plants are complex facilities and provide a high quality product."**

Why treat wastewater?

We need to remove the wastewater pollutants to protect the environment and protect public health. When water is used by our society, the water becomes contaminated with pollutants. If left untreated, these pollutants would negatively affect our water environment. For example, organic matter can cause oxygen depletion in lakes, rivers, and streams. This biological decomposition of organics could result in fish kills and/or foul odors. Waterborne diseases are also eliminated through proper wastewater treatment. Additionally, there are many pollutants that could exhibit toxic effects on aquatic life and the public.

How do we collect the wastewater?

The sewer or collection system is designed so that it flows to a centralized treatment location. The collection system is comprised of smaller sewers with a diameter of about four inches. As more homes and companies are connected along the system, the pipes become larger in diameter. Where gravity systems are not practical, pumping stations are often included to lift the wastewater.

In New York State and in many other states, there are some very old collection systems. Some sewer piping was actually installed in the late 1800s! Materials of construction and methods of construction have changed significantly over the years. Many systems experience problems during wet weather periods with inflow and infiltration. This is commonly referred to as "I&I." Wet weather operating periods typically occur when the snow melts in the spring and/or during heavy rainstorms. Water resulting from snowmelt or storms should flow into a storm water system and not into the sanitary sewer system. Unfortunately, this isn't always the case.

What is Inflow & Infiltration (I&I)?

Inflow is water from a sump pump or a roof leader. This is relatively clean water that should be discharged to a storm water system. In some cases, homeowners in low lying areas connect sump pumps (illegally) to the sewer because it is relatively easy and inexpensive. In many communities, there are "combined sewers" that carry street runoff, as well as wastewater.

Infiltration is water from high groundwater levels. Older sewer pipes may have leaking joints or cracks that allows the water to enter the system. Infiltration usually occurs in the spring when melting snow and rain saturate the ground.

Excessive I&I can lead to Combined Sewer Overflow (CSO) and Sanitary Sewer Overflow (SSO) points in a collection system. If you have CSOs or SSOs, the NYSDEC is probably talking to you about it!

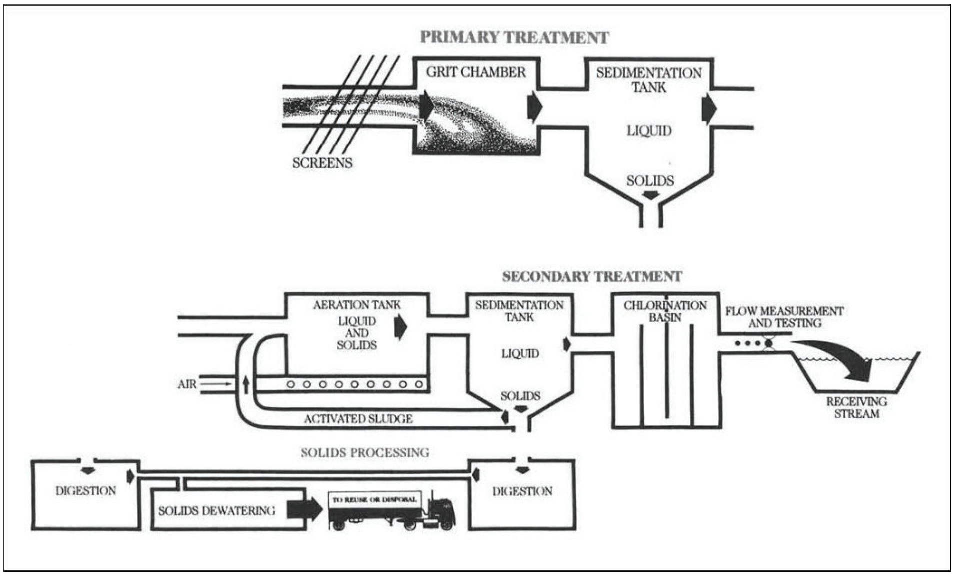


Diagram of Wastewater Treatment Processes from "Clean Water For Today: What is Wastewater Treatment?" Courtesy of Water Environment Federation.

What happens after collection of the wastewater?

The wastewater continues to flow through the collection system and eventually reaches the wastewater treatment plant. Upon reaching the plant, the flow first encounters preliminary treatment. Preliminary treatment is followed by primary treatment, then secondary treatment, and perhaps advanced or tertiary treatment. The solids or "sludge" removed from the wastewater stream also needs to be treated.

What is Preliminary Treatment?

Preliminary treatment processes are the first processes that the wastewater encounters. This typically involves flow measurement so that the operator can quantify how much wastewater is being treated. Flow monitoring is commonly followed by screenings removal. Screenings are string like materials and large foreign objects like sticks or perhaps an errant golf ball. These materials need to be removed because they can damage machinery or clog processes. Screenings can be removed using bar screens and other devices designed for this purpose.

The next process in preliminary treatment is grit removal. Grit is comprised of inorganic material such as sand, gravel, eggshells, etc. It is desirable to remove grit to prevent wear and abrasion on pumps and other mechanical equipment. Grit can also plug lines and pipes. In this influent area, sampling equipment is often used to collect small portions of the wastewater for analysis. Sampling enables the operator to determine the pollutant loadings entering the plant (influent).

Preliminary treatment commonly includes raw sewage pumps. Screening and grit removal are important to the proper operation of the raw sewage pumps. These materials will cause clogging and cause wear on the internal parts. These raw sewage pumps deliver the flow to the next phase of treatment: Primary Treatment.

What is Primary Treatment?

Primary treatment is a physical settling process that removes solids. Wastewater that enters the primary settling tank (or clarifier) is slowed down to enable the heavier solids to settle to the bottom. Lighter materials, such as grease, will float to the top of the tank. Settling tanks are designed with mechanisms to remove both the settled solids, as well as the floating solids. Primary clarifiers are either circular or rectangular. Both types work equally well when properly designed and maintained. Not all plants have primary treatment.

Primary treatment generates primary sludge. The sludge is removed and pumped to the solids treatment process for ultimate removal.

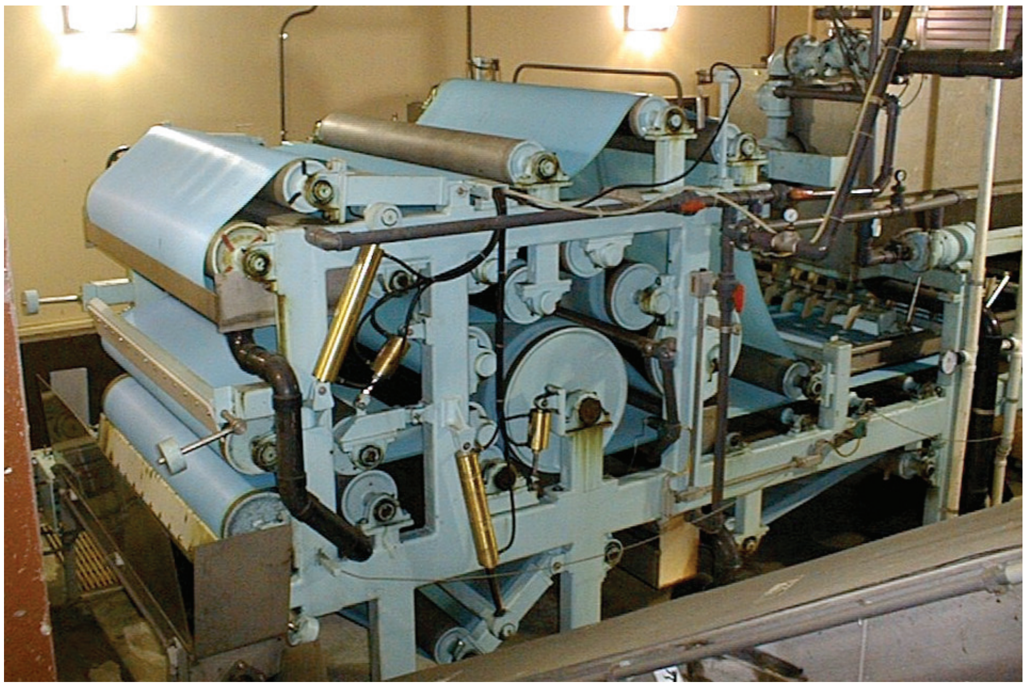
What's left after we remove the pollutants that settle and float? The wastewater still has solids remaining after primary treatment. These solids are either dissolved or suspended. Dissolved solids are very small solids (e.g., dissolving sugar in water). You cannot see the solids but they are there. Suspended solids can be likened to the same ends of a magnet. The solids repel each other. These solids are small, but are visible to the human eye. We remove these dissolved and suspended solids through the next phase of treatment: Secondary Treatment.

What is Secondary Treatment?

Secondary treatment is a biological treatment process used to stabilize the dissolved solids. Microorganisms (e.g., bacteria) feed on the organic solids (food) in the wastewater and convert the organics into a cellular or biological mass that can later be removed. These biological processes are aerobic processes. Oxygen must be provided for these aerobic organisms to work properly and efficiently.

An integral part of secondary treatment processes is another set of settling tanks or clarifiers. These secondary clarifiers (final clarifiers) remove the biological mass that has grown during biological treatment.

There are many different kinds of secondary processes that can be employed. A very common secondary process is known as activated sludge. In activated sludge treatment, the wastewater is mixed with organisms that are returned from the secondary clarifiers. There is a continuous return of organisms from the secondary clarifiers. This is called return sludge or return activated sludge. Oxygen is provided in the aeration tank either by blowers and diffusers or by a mechanical mixing process. A variation of the activated sludge process that is becoming more popular is known as Sequential Batch Reactors (SBR's). This process differs from the more conventional activated sludge systems in that it also uses the aeration tank as a settling tank. This is accomplished by turning off the air to the diffusers or the mixers and allowing the solids to separate from the wastewater. During this settling period, the flow is diverted into a second SBR tank for continuous treatment. Advantages of this SBR process include a relatively small footprint and the capability of removing nutrients (both nitrogen and phosphorus).



A belt press is often used to dewater sludge.

Lagoon systems are also a form of biological or secondary treatment. These lagoons systems are used where there is a lot of land available and/or the wastewater flows (quantities) are low. Lagoons are constructed with lined earthen bottoms and are less expensive to construct than are activated sludge processes that use concrete tanks. Limitations of lagoons may include excessive algae growth (solids violations) and poor performance in the winter.

Another type of secondary treatment is known as fixed film processes. Fixed film processes consist of two types: Trickling Filters or Rotating Biological Contactors (RBC). Trickling filters are sometimes called Bio Towers. Trickling filters are beds with a synthetic material (media). An under-drain system and a rotary distribution system apply the wastewater to the media. The microorganisms grow attached to the rocks or synthetic media as opposed to liquid suspension in the activated sludge. A circular rotary distributor moves over the media bed and the wastewater is trickled onto the media. As the wastewater flows over the media, it comes into contact with the microorganisms and picks up oxygen. When the biological growth becomes too thick, it falls off the media and flows with the wastewater to a secondary settling tank for removal. Many trickling filter plants that originally were designed with rock media have changed to the more efficient plastic media.

The RBC is similar to the trickling filter in that it uses an attached biological growth. An RBC has panels that are circular and mounted to a shaft. The wastewater flows into a basin beneath the media and the media rotates with the shaft. The microorganisms are contacted with the wastewater. Since the RBC's expose the media to the air, oxygen is picked up and transferred into the growth. RBCs have low energy requirements.

Intermittent sand filter (Secondary Treatment).

These systems need to be protected from cold weather by a building.

Intermittent sand filters are employed in some smaller applications. As wastewater passes through the filter bed, solids are removed. Microorganisms grow in the removed solids layer and provide biological treatment of the wastewater as it flows through the sand bed. The sand will need to be replaced at some point in time. Additionally, these sand filter systems generally perform poorly in the winter.

All of the secondary treatment processes produce biosolids. These biosolids are pumped to the solids treatment system for further processing.

What comes after Secondary Treatment?

In many plants, the next process is called disinfection. Disinfection means the inactivation of disease-causing organisms. It is sometimes confused with sterilization which means the killing of all organisms. In disinfection, the wastewater following secondary treatment is usually treated in one of two ways: (1) chlorination or (2) ultra-violet radiation.

Chlorination involves the use of chlorine, either in the form of a gas (less common today), or as a liquid (sodium hypochlorite). The chlorine oxidizes the microorganisms. The effectiveness of this process is monitored by testing the fecal coliform group. This indicator group of microorganisms are easy to grow in a laboratory and are tougher to kill than pathogens. Some chlorination systems also have dechlorination systems to remove any residual chlorine.

Ultraviolet (UV) disinfection systems contact the treated secondary wastewater with UV light bulbs that are encased in clear housings. The UV light kills pathogenic organisms by using a germicidal photochemical wavelength. Unlike chlorination, UV leaves no residual in the wastewater with which to be concerned. Plants that use UV must either have dual UV systems or have chlorination as a backup. Additionally, these UV systems are energy consumptive.

What is Advanced Treatment?

Some treatment plants may be required to remove nutrients (nitrogen and phosphorus) due to the possible negative impacts on the receiving stream (e.g., ammonia toxicity to fish). Advanced treatment processes are used to remove nutrients, additional solids, and/or biochemical oxygen demand. Advance treatment provides a very high level of treatment that goes beyond secondary treatment. In the case of nitrogen removal, the processes are biological. For phosphorus removal, chemical additives are normally required.

Where do all the solids go?

Solids that settle out in the primary and secondary clarifiers are referred to as sludge. Sludge from biological treatment processes (e.g., activated sludge) are referred to as biosolids. Sludge is the byproduct of

Rotating biologial contactors (Secondary Treatment).

treating the liquid wastewater. Proper solids handling is of paramount importance. If sludge is not removed, problems will occur in other areas of the plant. Excess solids can also lead to State Pollution Discharge Elimination System (SPDES) Permit violations and odor problems. There are many different options available for solids handling. Local conditions usually dictate which option is best for your particular facility. General categories of sludge handling include digestion processes, hauling of liquid sludge to a larger treatment plant, thickening, dewatering by mechanical means (belt filter presses, centrifuges), incineration, land filling, and land application.

The Herkimer County Wastewater Plant is designed for 6.1 million gallons per day (mgd). Sludge is pumped to a gravity thickener, treated to reduce odors, and dewatered using a belt filter press. The dewatered solids are treated using dry lime for stabilization and loaded into a roll off container. A contractor takes the container and stores the solids. The sludge is later land applied on crop fields.

The City of Little Falls Wastewater Plant is a 5.0 mgd design and pumps the sludge to a gravity thickener. Solids are dewatered using a belt filter press and then incinerated. The remaining ash is landfilled.

The Village of Clinton Wastewater Plant is a 2.5 mgd design that gravity thickens the sludge before pumping into an anaerobic digester. In the past, solids removed from the digester were pumped to a drying bed and landfilled. The drying beds were troublesome due to weather dependency e.g. rain and winter. Solids from the anaerobic digesters now go to a belt filter press, and then to a landfill.

The Old Forge Wastewater Plant (0.45 mgd) pumps the sludge to an aerobic digester. When the digester approaches capacity, the solids are then treated with polymer and processed through a thickening device. The solids are stored in another aerated tank until it is time to call for a tank truck. A contractor hauls 6,000 gallons to the Watertown Wastewater Plant for further treatment and disposal.

In summary, there are many options available for sludge treatment and handling.

Where does the water go after treatment?

The treated wastewater is referred to as effluent. The effluent is discharged to a water body such as a lake, river, stream, or groundwater. Conditions contained in the SPDES Permit are designed to minimize the

Sand drying beds can be problematic, particularly with rainy conditions.

Fixed film and old trickling filter stone, left, are sometimes replaced with more efficient plastic media, right.

impact that the effluent may have on the receiving stream. Small streams that have a classification of trout spawning or that are used downstream for drinking purposes have more stringent (tighter) permit limits than streams that discharge into a water body with a higher flow and/or sizeable tributaries.

What are common wastewater terms?

In wastewater vernacular, there are acronyms for many processes. Some of the most common terms are listed below with a brief description. A more comprehensive glossary of wastewater terms can be found at the end of the handbook.

Aerobic: A process that requires dissolved oxygen to operate properly. The microorganisms need the oxygen to "eat" the food properly.

Anaerobic: A process that can operate or needs to operate without oxygen being present. A good example is an anaerobic digester used for solids handling.

Biochemical Oxygen Demand (BOD5): A test that measures the organic strength of a sample of wastewater. It provides information on the organic load or how much "food" there will be for organisms. The load can be either to a treatment plant unit or to a receiving water body.

Clarifier or settling tank: Tanks designed for the physical separation of wastewater floatable solids and settleable solids. These two terms are widely used interchangeably.

Disinfection: Killing disease-causing organisms, differing from sterilization, which kills all organisms.

Dissolved Oxygen (DO): A test usually performed by an electronic meter that measures the dissolved oxygen of a sample or process unit. It is important because many of the treatment processes require oxygen (aerobic) to operate properly. Too much oxygen can mean that money is wasted through excess energy consumption to provide the oxygen, which is relatively insoluble in water.

Effluent: Wastewater or other liquid, partially or completely treated, flowing from a reservoir, basin, treatment process, or treatment plant.

Influent: Wastewater or other liquid flowing into a reservoir, basin, or treatment plant.

Parts per million (ppm) or milligrams per liter (mg/L): These terms refer to the results of analyses such as TSS or BOD5. These terms are used interchangeably and mean exactly the same thing.

Total Suspended Solids (TSS): Data from a test that measures by weight how much particulate material is contained in wastewater samples by filtering the sample through a special fiberglass filter. For example, TSS measures the solids that can be seen in a beaker.

Additional Resources

Biosolids Recycling: An Environmentally Sound Way to Put a Valuable Resource to Work for All of Us Nature's Way: How Wastewater Treatment Works For You Clean Water for Today: What is Wastewater Treatment? Be in the Know, Go with the Flow!

All available from:

Water Environment Federation

601 Wythe Street Alexandria, VA 22314-1994

Phone: 703-684-2452

Fax: 703-684-2492

www.wef.org

Personnel Management

Communities should consider personnel management as important as funding for equipment repair and replacement. Local officials must realize that an adequate, well-trained staff is necessary both to provide cost-effective Operations and Maintenance (O&M) of their facilities and to ensure compliance with all regulatory requirements.

This section will provide some guidelines to help local officials determine the necessary steps to develop the best possible staff.

Developing an Adequate Staffing Plan

Generally, staffing is the largest component of an O&M budget for a wastewater facility. For small communities, these costs comprise the main budget component. Local officials should not try to reduce O&M direct labor costs as a way of cutting budgets. For example, it may be that large amounts of overtime pay are being spent on existing staff. Hiring additional personnel may be a more cost-effective approach to spending personnel dollars. Another factor involved in determining staffing cost effectiveness is the use of outside contractors to perform certain O&M functions. A community might consider using contractors for functions such as major maintenance or overhaul.

Aerated lagoons are secondary treatment processes.

Development of a staffing plan will not only ensure cost effectiveness, but will also help local officials meet their responsibility to ensure that wastewater facilities comply with state and federal regulations. Inadequate or poorly trained staff inevitably leads to non-compliance problems and potential fines. In addition to complying with appropriate regulations, local officials also have a responsibility to the citizens of their communities to provide uninterrupted utility service. Protection of the environment is the key consideration in the management of a utility system. An adequate staffing plan is essential to achieving that goal. Here are the steps for preparing a staffing plan:

1. Develop an organizational chart. It is important to have a clear organizational chart to determine how utilities need to be managed. The current trend is to separate water and wastewater utilities from other public works to improve performance, and to enable technical personnel to develop comprehensive expertise in their areas of responsibility. To effectively implement this organizational approach, local officials need adequate information about specific job responsibilities to then determine the number and type of personnel required. The product of this first step in developing a staffing plan is an organizational chart showing all lines of supervision and authority, all filled and unfilled positions, and an approximation of all needed, but as yet unauthorized positions.
2. Conduct a task analysis. A detailed task analysis will help determine how many workers are needed and the level of experience and expertise necessary for each wastewater facility job. Begin by identifying all O&M tasks that must be accomplished to ensure adequate performance by the facility. Include tasks that are currently being accomplished, as well as those that should be done but might not be due to lack of time, talent, or other resources. The task list should reflect all routine O&M tasks required for the entire year. Some tasks may be daily, while others might be performed weekly, monthly, or even yearly. To develop a comprehensive task list that truly reflects the needs of the facility, an experienced supervisor familiar with the facility should be involved at all stages of the task analysis. The product of this second step in developing a staffing plan is a comprehensive task list, organized by unit processes.
3. Determine staffing requirements. The next step is to review the task list and estimate the time each task normally requires. It is necessary to compute the total number of person-hours per task, per technical skill, per year required to provide adequate O&M of the facility. Once that number is determined, it may be divided by the total number of hours that each worker is available per year, taking into account vacations, holidays, etc. In this way it will be

possible to derive a number that approximates the personnel hours needed to provide adequate O&M for the facilities in question. The product of this third step in developing a staffing plan is a break out of required staffing hours, by skill and by task.

4. Create job descriptions. Once the estimated number of staff hours is determined, the organizational chart should be appropriately modified and each staff member's responsibilities redefined. Detailed job descriptions for each position identified on the chart should be prepared or old job descriptions should be modified and updated. Remember to get input from the people actually doing the job. Job descriptions should include areas of responsibility, summaries of required tasks, subordinates supervised, and supervisors to whom reports are made. The product of this fourth step in developing a staffing plan is an updated set of written job descriptions.
5. Implement staffing changes. After approving the staffing changes recommended by steps 3 and 4, the O&M budget must be modified appropriately. In addition to follow-up budget monitoring relating to these staff changes, management should periodically assess them in terms of improved efficiency and performance of the utility's O&M.

The product of this final step in developing a staffing plan is a new written staffing plan and corresponding budget.

Plant Coverage

Plant coverage guidelines call for enough time for the operators to collect, analyze, and record required samples. The plant should be staffed by the Chief Operator or Assistant/Shift Operator a minimum of two (2) hours every day. Additionally, the Chief Operator should be on-site not less than 30 days per calendar quarter. Note that these are the minimum levels of coverage and NYSDEC's Regional Water Engineer may require more coverage depending upon plant size, the receiving water, permit limits, etc.

Certification and Training

The "Grades" of certification are divided into the following levels: 1, 2, 3, and 4. Grade 1 is the lowest level of certification and applies primarily to the smallest plants. Activated sludge plants have an "A" designation. A "Scoring System" is used to determine the required Grade of Chief and Assistant/Shift Operators.

Education requirements vary depending upon Grade. The minimum education required is High School Diploma or High School Equivalency. Classroom training also varies as a function of Grade. For a Grade 2A applicant, the following training is required:

- Basic Operations Course (10 days)
- Activated Sludge Course (5 days)
- Laboratory Proficiency (5 days)

Grade 3/3A operators would also need the Supervision and Technical Operations Course (5 days). Grade 4/4A operators would go on to take the Management Course (4 days).

All applicants must have hands-on operating experience and must have his/her actual operating experience verified. Applications with the necessary documentation are sent to the New York Water Environment Association (NYWEA) and also filed with the NYSDEC Regional Offices and for water operators sent to County Health Department where appropriate.

All certified wastewater operators are required to renew their certificates every five (5) years. Treatment technologies are changing and operators need to keep abreast with the latest operational approaches. Operators are required to attend seminars and obtain between 20 and 80 training contact hours. Failure to renew means that the certificate has expired and that the operator is not certified. If the Chief Operator's certificate has expired, he/she is not certified and the plant may not be under responsible supervision. In a well-run facility, good training will result in a substantial payback. Local officials need to vigorously support continuing education to comply with the regulations. Certified operators generally do a better job. Annual budgets should include line items for certification training (when appropriate) and for renewal training. Work plans and schedules should allow for time to attend training.

Regulations provide for the suspension and/or revocation of operator certificates if the operator was negligent, or practiced fraud or deceit in the performance of his/her duties. The operators are expected to keep up on maintenance and routine sludge removal. Local officials have to financially support these activities. Falsification of data and discharge monitoring reports is very serious and criminal.

All the certification requirements are described in 6NYCRR Part 650 – Qualifications of Operators of Wastewater Treatment Plants and in the Wastewater

Treatment Plant Operator (WWTPO) Manual. For electronic copies of Part 650 and the WWTPO Manual, visit the following website: http://www.dec.state.ny.us/website/dow/bwcp/opcert.html For paper copies, contact NYSDEC's Facility Operations Assistance Section, 625 Broadway, Albany, NY 12233-3506 or call 518-402-8089.

Additional Training Needs

In addition to ensuring compliance with certification regulations, a comprehensive training program for wastewater operators will provide other significant benefits for a local government. A well-trained staff is essential for efficient utility O&M. Good training will result in a substantial payback over the years in terms of well-run facilities. Far-sighted local officials will make sure that O&M budgets provide adequate funds for staff to go to the best training available. This may mean sending staff to off-site training events, paying the cost of course registration as well as travel expenses, or having staff attend training programs during working hours and directing other personnel to fill in during that time.

Another training option is to contract on-site training customized to the individual wastewater facility. Not all training needed is technical in nature. Training programs relating to management, supervision, and other important skills, such as effective report writing and use of the computer, are also important in developing a more efficient and productive staff.

If the staff size is sufficiently large, it may be a good idea to designate a training coordinator. This individual can determine staff training needs and watch for appropriate training opportunities or courses. The training coordinator can schedule employees for off-site training, set up on-site training classes, and monitor the training budget. The coordinator should also evaluate the training programs and determine which ones are most effective in improving staff performance. The individual coordinating training should have some technical experience in water or wastewater treatment.

Training Sources

Many sources of training are available for operators of wastewater treatment facilities. Training will be available through the following organizations:

- State environmental training centers
- State regulatory agencies
- Operator associations
- Professional organizations such as the Water Environmental Federation, the American Water Works Association, and the Rural Water Association In addition, a local government may contract training, including on-site programs, using operations and maintenance consultants, consulting engineers, or manufacturer's representatives.

Quality training opportunities are important for staff development. The best training is not necessarily the cheapest. It is up to local officials to work with their staff to ensure that training being considered develops a staff that can provide effective O&M of the water and wastewater facilities.

Examples of Training Providers

NY Water Environment Association
525 Plum Street, Suite 102
Syracuse, NY 13204
Phone: 315-422-7811
Fax: 315-422-3851
www.nywea.org

NY Rural Water Association
PO Box 487
Claverack, NY 12513
Phone: 518-828-3155
Fax: 518-828-0582
www.nyruralwater.org

New England Interstate Water Pollution
Control Commission
116 John Street
Lowell, MA 01852-1124
Phone: 978-323-7929 or 978-323-7930
Fax: 978-323-7919
www.neiwpcc.org

New York State Department of Environmental
Conservation (NYSDEC)
Facility Operations Assistance Section
625 Broadway,
Albany, NY 12233-3506
Phone: 518-402-8089
Fax: 518-402-8082
www.dec.state.ny.us/website/dow/bwcp/
foas_main.html

Environmental Finance Center
at Syracuse University
727 E Washington St
Syracuse, NY 13210
Phone: 315-443-4445
efc.syracusecoe.org

NYSDOL, Public Employee Safety and Health
State Office Campus, Building 12
Albany, NY 12240
Phone: 518-457-5508
Fax: 518-485-1150
www.labor.state.ny.us./workerprotection/safetyhealth/DOSH_DIRECTORY.shtm

US DOL, Occupational Safety and
Health Administration
201 Varick Street, Room 670
New York, NY 10014
Phone: 212-337-2378
Fax: 212-337-2371
www.osha.gov/oshdir/r02.html

Collection System and Plant Maintenance

Overview

Maintenance is essential to the sustainability of every wastewater system. A preventive maintenance program combined with good operational practices will reduce the need for much of the corrective or emergency maintenance. A good preventive maintenance program will service not only mechanical and electrical equipment, but also the distribution and collection systems, grounds and buildings.

Maintenance includes all functions required to keep a facility operating in accordance with its original design capacities and performance. This includes repairs to broken, damaged, or worn-out equipment (emergency maintenance), and the periodic replacement of equipment and facilities that have reached the end of their design life (corrective or replacement maintenance).

Maintenance Program Elements

A comprehensive preventive maintenance program will have the following components:

- Equipment and component inventory
- Manufacturer's literature
- Preventive maintenance task list
- Records of maintenance performed
- Technical resources
- Tools and equipment
- Spare parts inventory
- Personnel training
- Budgeting
- Scheduling and monitoring
- Recordkeeping

Equipment and Component Inventory

The backbone of any preventive maintenance program is a comprehensive listing or inventory of all system components and equipment. This listing should include a name and code number to every part of the system.

Manufacturer's Literature

For each piece of equipment or component identified in the inventory, the manufacturer's literature should be obtained and compiled. For a new or upgraded facility, it is often the contractor's responsibility to provide manufacturer's information for all installed equipment.

Preventive Maintenance Task List

Once all of the equipment and components have been itemized and the manufacturer's literature has been collected, it is time to develop the comprehensive list of preventive maintenance tasks and to schedule them. Working systematically through each component of the facility, and remembering to address additional areas such as building and grounds maintenance, all preventive maintenance tasks must be identified and a frequency for scheduling should be assigned.

Records of Maintenance Performed

Records must be kept indicating which maintenance tasks have been performed and when. This is helpful for two reasons. First, it is imperative to verify the completion of each maintenance task. Second, to schedule future maintenance activities or to verify the condition of certain equipment, it is always helpful to be able to refer back to the record of past maintenance performed. All tanks should be inspected once per year.

Technical Resources

Manufacturer's maintenance specifications do not always provide complete information on all maintenance tasks. Certain general maintenance tasks are not covered in detail in manufacturer's maintenance manuals, and many general maintenance tasks are not addressed in manufacturer's information at all.

Tools and Equipment

Every wastewater system must have suitable tools and the required specialized equipment available to perform maintenance. These tools and equipment should be of good quality, because they are likely to be used for many years.

Spare Parts Inventory

It is important to maintain an inventory of spare parts required for preventive maintenance, as well as for corrective and emergency maintenance. The initial inventory must be developed based on the requirements of each preventive maintenance task. Procedures also should be implemented to make sure that parts are replaced in the inventory as they are used. Database management of spare parts inventories is usually necessary in larger utilities.

Personnel Training

Even a well-developed maintenance program with a full staff for implementation will not be able to complete the required work unless the staff are trained in both how to carry out the maintenance program and in the precise skills required to perform specific maintenance tasks. If the maintenance program has not been developed internally, the consultant or entity that developed it should be required to provide training in its implementation.

Budgeting for Maintenance

Budgeting for maintenance will require that sufficient funding is available for the following:

- Preventive Maintenance—Operating budget
- Labor (staff time, person hours) Parts and supplies Equipment
- Emergency Maintenance—Operations reserve account
- Labor (overtime) Materials, parts, supplies Replacement equipment Contractors
- Equipment Replacement—Capital reserve account
- Evaluation and design Labor Equipment cost Contractors

Estimating Staff Hours for Various Maintenance Functions (Task Analysis)

Sufficient labor must be available and funded for preventive maintenance functions. A good preventive maintenance program will document the schedule and work plan for each maintenance function. This schedule serves as the basis for estimating the labor requirements for preventive maintenance.

To determine trade and person-hour requirements for each preventive maintenance function, the function should be broken down into tasks. The tasks can then be analyzed further to determine person-hours required for the specific maintenance function and the specific trades needed.

Setting Up a Reserve Account for Emergency Maintenance

Development of an annual budget for maintenance is relatively easy and straightforward, if emergency maintenance is sufficiently funded as annual reserve account contributions.

Emergency maintenance is perhaps the most difficult function to address when trying to anticipate the funding requirements for an emergency repair reserve account. A good preventive maintenance program will cut down on emergency maintenance requirements. Unforeseen conditions, defective equipment and materials, and acts of nature make it certain that some emergency maintenance will always be a fact of life.

Devising Management Systems to Ensure Timely and Cost-Effective Maintenance

Basic preventive maintenance and record keeping systems are typically card systems that can be adapted to the complexity of the facility being served. Simple single card systems use one card for each piece of equipment, with the front detailing the equipment and its maintenance requirements and the back recording maintenance performed (see the Sample Equipment Maintenance Card). Multiple card systems are similar, but use separate cards for equipment information, maintenance requirements, and records of maintenance performed.

Many utilities are moving away from card systems and using one of the many software programs developed specifically for scheduling and tracking preventive maintenance. When used as part of an asset management strategy, these software programs can be very useful for the wastewater facilities.

A very important part of the preventive maintenance program development and improvement is appropriate scheduling of maintenance activities. Preventive maintenance schedules must consider variations in plant and equipment utilization. For example, in wastewater systems, this may involve scheduling to accommodate seasonal wet weather flows or intermittent industrial discharges.

Scheduling should consider weather and its effect on maintenance activities and personnel. Whenever possible, outdoor maintenance activities should be scheduled when favorable seasonal weather conditions can be expected.

Maintenance Reporting and Record Keeping

Once maintenance is performed, it must be properly recorded in a timely fashion, usually on the same day as performed. Preventive maintenance tasks are not complete until their accompanying paperwork is done.

Protecting and Maintaining Wastewater Infrastructure

This section is a compilation of material provided by J. Kirk Rowland, a NYWEA Past President and Division Head – Water & Sewer Maintenance for the Town of Tonawanda and Keneck Skibinski, a NYWEA Past President and Chief Operator for the Town of Orangetown.

Overview

Wastewater infrastructure is a huge capital investment which must be protected and maintained. It is the responsibility of the elected officials and board members to effectively carry out the associated financial and administrative responsibilities for positive, long term stewardship of this capital asset.

Wastewater infrastructure systems are comprised of many components including the collection system pumping stations, treatment plant and personnel. As was emphasized in "Wastewater 101," problems with any one component can have an adverse impact on the rest of the system, often with costly consequences. In many municipalities, wastewater infrastructure is the most significant budget expense next to highway projects.

In addition to the costs incurred to design and build infrastructure systems, both capital and operations expenses are affected by current events. Remember the rise in fuel costs during 2005 that was stimulated by Hurricanes Rita and Katrina? Many communities have also been impacted by changing regulations on Combined Sewer Overflows (CSOs) and Sanitary Sewer Overflows (SSOs). Increasingly stringent regulations and rising fuel and materials costs are significantly impacting your wastewater system's bottom line. To ensure proper long term stewardship, local officials and board members should be familiar with the bottom line.

Budgeting Basics for Wastewater Utilities

In a general sense, the budget can be divided into two basic categories: Operation & Maintenance (O&M) and Capital Expenditures.

The O&M budget provides for the support of routine maintenance, daily operations, and scheduled repairs. Every piece of equipment has a life cycle and will eventually deteriorate to the point of replacement. Without a long term Capital Improvement Plan (CIP) and a funded reserve account to support the CIP, your municipality could find itself without the funds to support needed replacements.

User fees, typically based on metered water consumption, are collected to fund the O&M component. A proper budget ensures that staff, chemicals, and parts are available to keep the system properly operating. A proper budget also helps the municipality to meet their SPDES Permit, which is a legal obligation.

Municipal debt obligations are paid by funds that are typically raised by a tax levy based upon assessed valuation. These funds pay for the debt service on the original bond issued to construct the plant and any other projects that have been undertaken and financed by bonds or bond anticipation notes.

Case Studies

The following case study is intended to illustrate the critical importance of budgeting and project planning to help in maintaining a healthy bottom line.

Village of Weedsport

The Village of Weedsport is a small village in Cayuga County with a total population of approximately 1,800. The Village owns and operates a sanitary sewer system consisting of gravity collector sewers and a wastewater treatment plant (WWTP) with a permitted capacity of 550,000 gallons per day. The sanitary sewage collection and treatment system was originally constructed in 1967 and the WWTP, with an original capacity of

0.35 MGD, was operated for over 35 years without a major upgrade. As of 2009, the plant was operating at its full capacity, and experienced peak wet weather flows up to 10 times its average flow, forcing operators to use emergency bypass pumping to prevent sewer surcharging and basement flooding.

The village's sanitary sewer budget for 2009 was approximately $350,000. The budget can be broken down into the following categories, with percentages of the total budget for each category indicated:

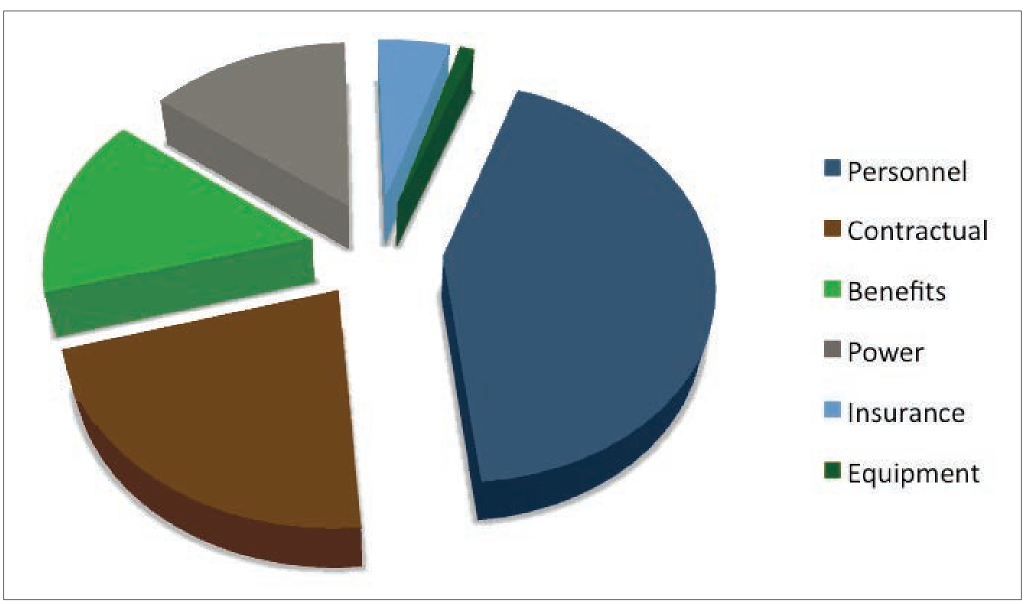
- Personnel 43%
- Contractual 22%
- Benefits 15%
- Power 14%
- Insurance 5%
- Equipment 1%

A portion of the contractual costs, since approximately 2001, has been allocated toward an annual sewer televised inspection and grout sealing program. This is where approximately 15 to 20 percent of the village's gravity sewers undergo internal video inspection followed by pressure testing and grout sealing of leaking pipe joints. Although the program does not appear to have removed I/I (inflow and infiltration) from the system to a significant degree, it was reported that the program was successful in keeping I/I rates from increasing further. It also provided valuable information to the village DPW regarding the condition of the pipelines and identifying defects in the sewer system which could not be repaired by grout injection and required further evaluation.

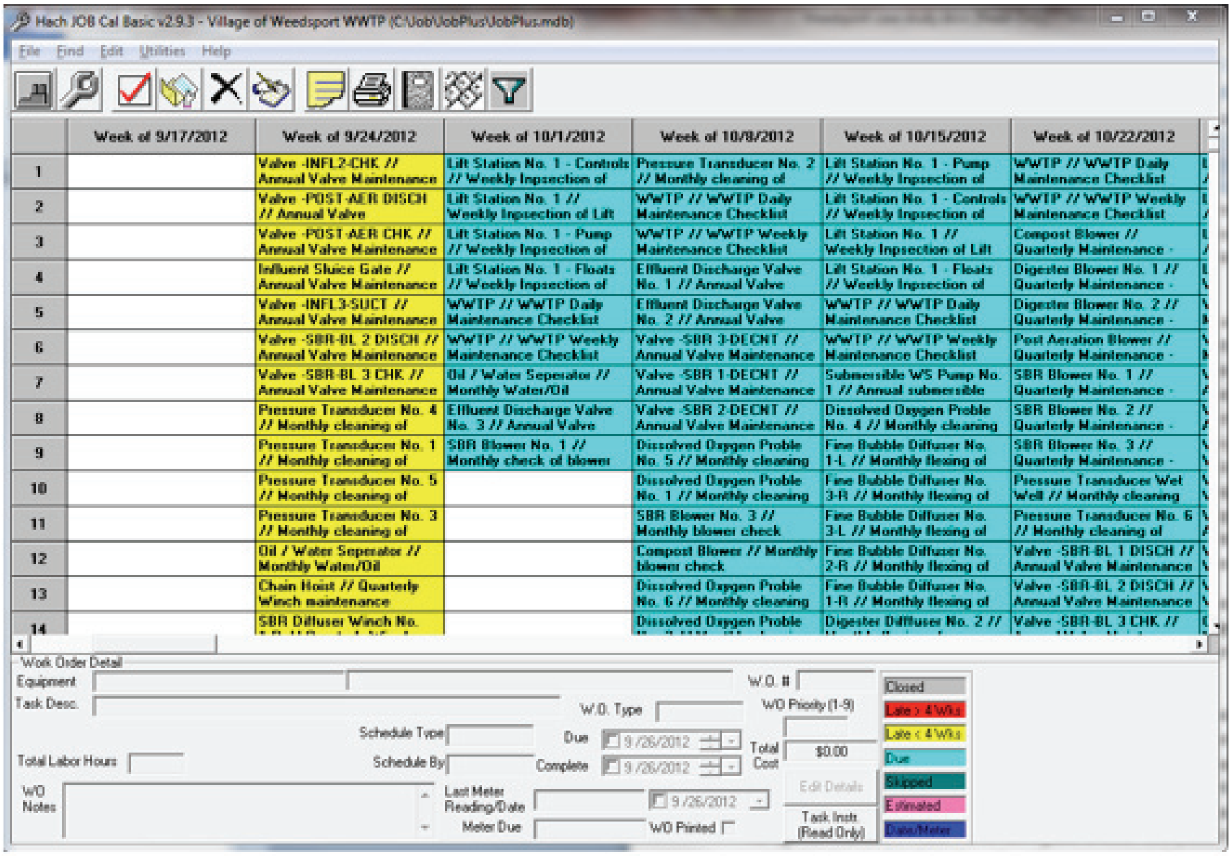
The village has also maintained capital reserve accounts to pay for unexpected repairs, engineering studies, etc., as needed. As of 2009, the village had approximately $74,000 in capital reserves. Capital reserves are replenished annually with sewer fund surplus funds.

The Village Board, recognizing that the WWTP was at the end of its useful life, authorized an engineering study in 2004. It was through the preliminary data collection and analysis phase of the study that the 10 times peaking factor during wet weather was quantified. In accordance with NYSDEC design standards (i.e., "10 State Standards"), any upgrade to the village's WWTP would have to be designed with tanks and equipment sized to handle these peak flows, effectively resulting in oversizing the facilities for the normal flow conditions which otherwise prevail at the plant. On this basis, the village board authorized an I/I evaluation; but because of the information gathered through the televising program initiated years earlier, the areas in the system with severely deteriorated gravity sewers and suspected storm sewer cross connections were identified. The village was able to complete the I/I study for significantly less cost by directing the engineer's study efforts to the worst areas. Through the I/I study, a sanitary sewer rehabilitation project was developed to include lining of severely deteriorated sections of gravity sewer piping, and sealing and redirection of two (2) significant storm sewer cross connections. The total cost of the sanitary sewer rehabilitation project was approximately $570,000, saving an estimated $1 million to $1.2 million in additional costs for oversized WWTP equipment and structures.

The Village of Weedsport completed the engineering study in 2006 which included recommendations for WWTP improvements to increase treatment capacity from 0.35 to 0.55 MGD, combined with I/I



Weedsport's sanitary sewer budget breakdown.



Weedsport's Asset Management Program.

reduction for a total estimated cost of $6.3 million. The project was eligible for loan financing through both the NYSEFC Guarantee Financing Program and USDA Rural Development, with a best case scenario debt service charge of approximately $400 per year per household, on top of an average sewer system operations and maintenance charge of $160 per year per household. The village decided to proceed with design improvements in 2008, and had permits and approvals in place for construction by February 2009. The project was positioned to take advantage of significant funding through the American Recovery and Reinvestment Act (ARRA) of 2009, which included a 50 percent "principal forgiveness" grant as well as an additional grant for "green" energy efficiency measures incorporated into the design (including oxygen level based aeration control, building insulation exceeding state code requirements, and LED light fixtures).

Construction of the sanitary sewer rehabilitation and WWTP improvement projects were completed in 2010, and in spite of increasing the plant's capacity by 57 percent, the Village has seen no noticeable increase in power consumption at the plant. With the ARRA funding for the project, the village debt service charge was reduced to $127 per year per household.

In order to protect its considerable investment in its sewer infrastructure, the village decided to develop an Asset Management Plan (AMP), including a software based maintenance tracking program. Through these efforts, the village is now performing all scheduled maintenance on new equipment, and is keeping records of labor, materials and equipment expended in maintenance on the new plant, so that it can accurately budget for annual maintenance costs. Additionally, the asset management software tracks the remaining useful life of every asset in the sewer system, and includes a capital planning module that allows the village to anticipate future capital expenditures for major equipment repairs and replacement. This will allow the village to establish capital reserves to repair and replace critical pieces of equipment, and anticipate the need for a capital project, if necessary, once large portions of the sanitary sewer system near the end of their useful life.

The Village of Weedsport's experience with the process of upgrading its sanitary sewer infrastructure illustrates several important points:

1. Take a proactive approach to addressing issues with sanitary sewer infrastructure. In Weedsport's case, completing the project planning and design without being forced through a NYSDEC order was essential to take advantage of the ARRA funding received. Project readiness will typically put a project at "the front of the line" for funding, and requires forethought and initiative on the part of municipal officials.
2. Maintain the sewer infrastructure, which serves several purposes:
    a. Get familiar with your infrastructure: Had the village not engaged in annual televising, testing and grout sealing of its collector sewers, it would not have been able to pinpoint some of the large sources of I/I in the system, leading to additional costs and time for study, and potential diminished results from the sewer rehabilitation project.
    b. Extend the useful life of the system. The useful life of WWTP equipment is typically 20 to 30 years maximum. Through diligent maintenance, the village was able to keep the plant operating for over 40 years without a major upgrade. This would not have been possible without investing in equipment maintenance.
    c. Asset management. With the AMP initiated by the village immediately after completing the sewer improvement project, they will be able to protect and sustain the investment made in their sanitary sewer infrastructure through the maintenance scheduling and tracking module in their asset management software. Going forward, the Village will be able to use the asset management software's financial module to set annual budgets for collection system and plant maintenance as well as plan long-term capital reserves to "self-finance" future capital improvements.

This chapter prepared by Keneck Skibinski, Chief Operator for the Herkimer County Sewer District; Phil Smith, former Section Chief at NYSDEC; David Cross, Associate Engineer Monroe County Pure Waters and Brian Skidmore, Managing Engineer, Barton & Loguidice.

Chapter 2

Asset Management and Sustainability

Every wastewater collection system and treatment plant is a community asset that is comprised of many other assets that need to be maintained. Assets such as pumps, pipes, valves and gauges need to be inventoried, assessed for condition and criticality, and maintained regularly to extend service life.

NYWEA

Environmental Finance Center
Syracuse University

Chapter 2: Asset Management and Sustainability

Overview of Asset Management

All wastewater systems are made up of assets, some that are buried and some that are above ground. The physical components that make up a wastewater system may include: pipes, valves, tanks, pumps, blowers, screens, sophisticated electrical and control equipment, and any other component that supports the conveyance and treatment of wastewater for your community. The assets lose value over time as the system ages and the assets deteriorate and, eventually, will need to be rehabilitated or replaced. In addition, these assets require regular maintenance, repairs, rehabilitation, inspections, and possibly improvements throughout their lives.

As the assets deteriorate, it may be more difficult to deliver the quality of service that residents have come to expect, and to meet the requirements of the regulatory agencies. The costs of operating and maintaining these wastewater systems will increase as the assets age, and the community may be faced with excessive costs that it can no longer afford.

There is an approach that can assist the community in making better decisions on managing aging assets, and better planning for the future. This approach is called asset management, and it includes techniques that have been refined by many organizations that own and operate assets. The International Infrastructure Management Manual (NAMS 2011) defines the goal of asset management as, "meeting a required level of service in the most cost effective way through the planning, acquisition, operation, maintenance, rehabilitation and disposal of assets to provide for present and future customers."

"The costs of operating and maintaining these wastewater systems will increase as the assets age, and the community may be faced with excessive costs that it can no longer afford. "

A community should care about managing its wastewater utility assets in a cost effective manner for several reasons:

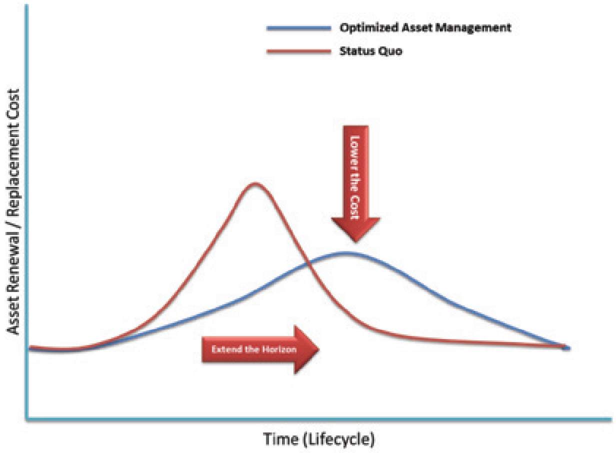
1. These assets represent a major public or private investment
2. Well run infrastructure is important for economic development
3. Proper operation and maintenance of a wastewater utility is essential for public health and safety
4. Water and wastewater assets provide an essential customer service
5. Asset management promotes efficiency and innovation in the operation of the system

The intent of asset management is to ensure the long-term sustainability of the wastewater infrastructure. By helping the utility make better decisions on when it is most appropriate to repair, replace, or rehabilitate particular assets and by developing long-term inspection, maintenance, renewal, and funding strategies, the community can ensure its ability to protect the environment and public health by having a healthy sustainable wastewater system.

Plunger pump at Lake Placid WWTP.

Benefits of Asset Management

There are many positive benefits of asset management. Communities that fully embrace asset management principals may achieve many or all of these benefits. Organizations may receive some of these benefits just by starting an asset management program. The benefits of asset management include, but are not limited to, the following:



Lower lifecycle costs.

- Better operational decisions and more efficient operations
- Increased knowledge of the condition, maintenance requirement and location of the assets
- Better internal communication and communications with customers
- Greater ability to plan and pay for future repairs and replacements
- Increased knowledge of what assets are critical to the community and which ones are not
- Improved emergency response
- Improve financial health and bond rating
- Setting rates based on sound operational information
- Have more efficient and focused operations
- Capital improvement projects that meet the true needs of the system
- Reduce environmental violations due to failed or poorly performing assets
- Improve the security and safety of infrastructure assets
- Better succession planning

Organizations should strive to achieve as many benefits as they can with their asset management program.

Core Components of Asset Management

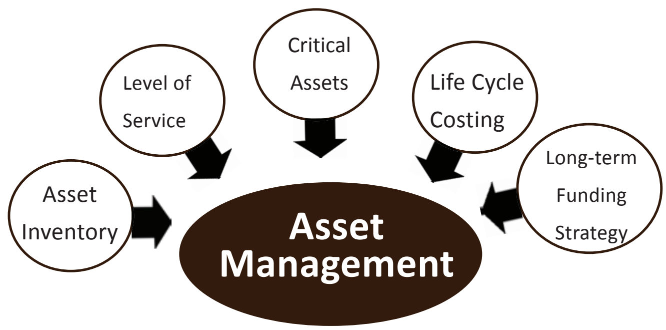
There are five core components of any comprehensive asset management program. Each of these five components will be discussed in greater depth:

1. Asset Inventory
2. Level of Service
3. Critical Assets
4. Life Cycle Costing
5. Long-term Funding Strategy

Asset Inventory

The first component of any asset management program is the asset inventory. This is most important as it underlies all other aspects of asset management. The types of questions that should be addressed in developing asset inventories are:

- What do we own?
- Where is it?
- What condition is it in?
- What is its remaining useful life?
- What is its value?



Asset Management Components.

What Do We Own?: The most fundamental question a wastewater utility can ask is what assets does it have? It is absolutely critical for a utility to understand what it owns. It is hard to manage something effectively if the utility doesn't know what that "something" comprises.

Although "what do I own?" is a seemingly straightforward question, it is not always easy to answer. The difficulties arise from several factors: some of the assets are underground and cannot be seen; assets generally are put in at different times over a long period of time; records regarding what assets have been installed may be old, incomplete, inaccurate or missing; and staff turnover in operations, maintenance and management may limit the historical knowledge of system assets. Given these difficulties, it will probably not be possible to form a complete asset inventory the first time it is attempted. It is important to recognize that the goal is to form the best inventory possible and develop an approach to adding to or improving the data over time.

To develop the initial inventory, several approaches can be used and these are listed below. However, the utility should be as creative as possible with other approaches to obtaining this information.

- Determine who was operating, managing and/or owning the system at the time of the major construction periods (when a large number of assets were installed). Interview these individuals and gather as much information as possible regarding their recollections of what assets were installed and where. If there are maps of the system, these can be used during the discussions.
- Examining any as-built or other engineering drawings of the system.
- Visually observe or perform field reconnaissance of above-ground or visible assets (e.g., pump stations, manholes, treatment plant assets).
- Estimates on buried assets using above ground assets as a guide (e.g., using manholes to estimate locations, size and types of pipe between the manholes)

Several approaches may be necessary to get a good start on the asset inventory. Use as many approaches as necessary to get the best initial inventory of assets.

Where Are My Assets?: The next question in inventorying the assets is where are they? Once one knows what assets there are, it is important to know where they are. This component involves two steps:

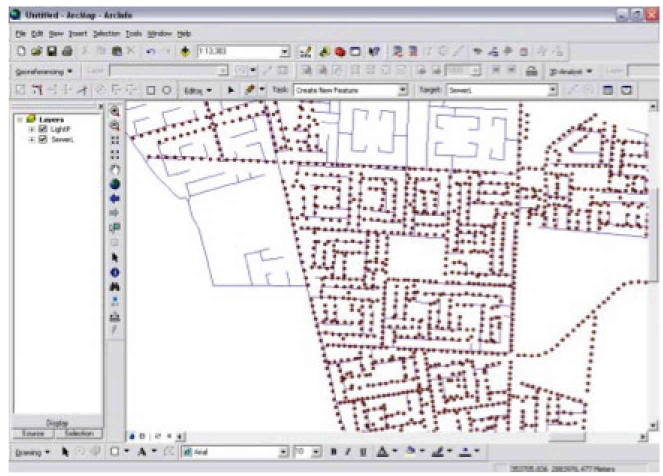
1. Mapping the assets
2. Putting a location in the inventory

In terms of mapping, the most important factor is to have a visual picture of the asset locations, especially the buried assets. The map can be as simple (hand drawn) or more complex (Geographic Information System – GIS). The most important factor is that it is useable to find the assets, track any changes to the asset, and can be used to track failures in the system. The second aspect involves putting a location in the asset inventory indicating where the asset is located. Generally, this would be a facility, building, floor, room, or possibly an area where assets are located. These location descriptions are necessary for above ground assets located at treatment plants, pump stations and other facilities. It is also useful to assign all assets a type or class to each asset (i.e., valves, pumps, motors, manholes, etc.).

What is the Condition of the Assets?: After the asset inventory is developed, it is important to know the condition of these assets. A condition assessment can be completed in many different ways, depending on the capability and resources available. The simplest approach is to gather people who have current or historical knowledge of the assets and capture the information they have on paper or electronically. The group can then select an appropriate condition ranking approach:

- 0 through 5 (example in table)
- A through F
- Excellent through Unacceptable

The team can then look at the inventory of assets and rate the condition of each asset using the selected



GIS Map of Wastewater Collection System Assets.

approach. This method uses the best information available and does not require the collection of specific data or advanced investigations in order to rate the condition of the assets.

A more sophisticated approach, or next step after the initial ratings are assigned, could include systematic data collection, such as CCTV of the sewers, organized manhole inspections, and other asset condition assessment methodologies.

What is the Remaining Life of the Assets?: All assets will eventually reach the end of their useful lives, depending on the type of asset; it will either reach that point through amount of use or age. For example, a pump will wear out sooner if it is used more and will last longer if it is used less. The actual age of the pump is not as important as the amount of work the pump has done. On the other hand, pipe assets wear out based more on the length of time in the ground. If a pipe is in the ground for decades, it has had considerable time to

Condition Rating	Condition/Description	Maintenance Required
0	New	Normal
1	Perfect/Excellent Condition	Normal
2	Minor Defects Only	Minor
3	Backlog Maintenance Required	Significant
4	Requires major renewal	Renew
5	Almost unserviceable	Replace

Condition rating.

contact the soil around it and the wastewater within it will contribute to its corrosion.

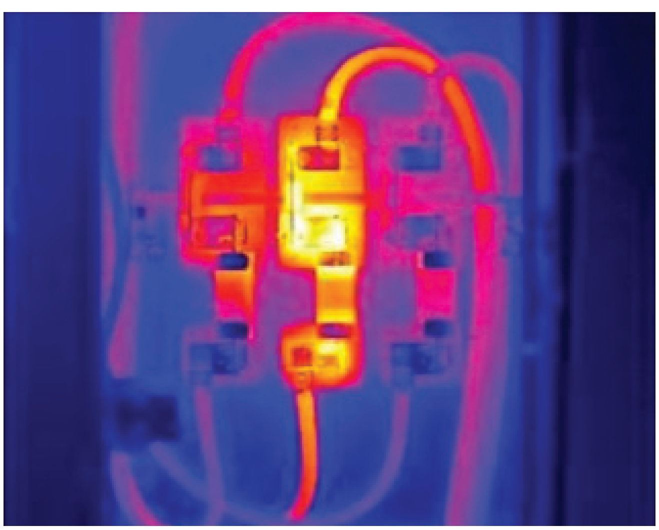
There are many additional factors that will affect how much life an asset will have. Factors such as poor installation, defective materials, poor maintenance and corrosive environment may all shorten an asset's life. Factors such as good installation, high quality materials, proper maintenance, and a non-corrosive environment will tend to lengthen an asset's life. Because of these site-specific characteristics, asset life must be viewed within the local context and its particular conditions. Clay sewer pipe may last 100 years at one location, and 30 years at another. It is best to make judgments on asset life based on past experience, system knowledge, existing and future conditions, prior and future operation and maintenance. In the absence of any better information, default values for the asset type can be used as a starting point. However, over time, an organization should use its own experiences to refine the expected life of assets.

What is the Value of the Assets?:

Generally, when utilities consider the value of assets, they think about the cost of initially installing the assets. This cost has no importance other than historical information or it can be used by a system that depreciates the costs of assets over time. However, the installation cost does not have a direct bearing on what it will cost to replace that asset when it has reached the end of its useful life. The asset may not be replaced by the same type of asset (e.g., clay pipe may be replaced by PVC pipe) or it may be replaced by a different technology entirely. Furthermore, costs of various assets may change drastically over time, such that the cost of installing pipe in 1956 in no way reflects the costs of installing pipe 60 years later in 2016. Some prices may increase, such as materials, while technological advances may decrease other costs. The real value of the assets is the cost it would be to replace the assets and allow (as a minimum) the same service to be delivered.

Although the idea behind an asset value is relatively simple, obtaining costs for the asset replacement is not easy. Small utilities may not have the expertise to estimate replacement costs. In these cases, the utility should either estimate in the best manner possible or leave this portion of the inventory blank for the initial stages of the asset management strategy. This information can be added later as the system gathers more information or expertise, and better determines which assets are most critical and need to be replaced in the near future.

If estimation is done, the possible approaches include:



Conditions Assessments with Thermopgraphy.

Vibration Conditions Assessment.

- Information regarding the cost per linear foot from recent projects can be used for linear assets such as gravity sewers and pressure mains
- Recent work done on neighboring systems
- Resources such as the Environmental Facilities Corporation, Rural Development, Environmental Finance Center, or New York Department of Environmental Conservation may have cost information for similar recent projects around the state
- Standard references such as the RS Means can be used to develop rough estimates
- Contact local vendors for estimates of equipment costs

Organizing the Asset Inventory

There are many options regarding how to manage the data collected and developed for the assets. Specific options include:

- Commercially available software for asset inventory, which will likely have other features including maintenance management
- Generic database software such as Microsoft Access
- Spreadsheet software
- Hand written inventory

The best option is a specifically designed asset management software program. This type of program provides the greatest level of flexibility in terms of use and is already programmed to contain asset inventory data. However, this type of program may be expensive and will require a computer system to make it accessible to the appropriate operational and management personnel. There are many software vendors that make packages to support these features, some specific to wastewater utilities. Some parameters that go into selecting the best software solution to manage the asset management data include:

- The size of the utility
- The number and nature of the assets the software will manage
- The available computer network and hardware
- Information technology support available to the utility
- Existing software owned and utilized by the utility
- Specific functionality desired
- Cost

Software costs may vary from free software available through the Environmental Protection Agency (CUPSS) to sophisticated software tools that cost several hundred-thousand dollars. There are software tools in every price range with the features and capabilities for any size utility.

The next option, generic database software, is much less expensive but will require a time commitment on the part of someone within the utility with the skills to set up the database and input the data. This option will, however, allow the utility to customize the tool to their specific needs.

Generic database software.

If the utility cannot initially purchase software, or develop a custom database for their asset inventory, they should develop a plan for how they will get a software tool in the future. For example, if they need to purchase a computer or software, they should begin setting aside funds for that purpose.

The other options available, spreadsheets and handwritten inventories should only be considered temporary solutions until the system can obtain a database of some type (the first two options). Neither of these approaches allows the system to easily categorize information and both should be considered temporary. Neither spreadsheets nor handwritten data allow the type of querying and analysis that an advanced asset management program requires.

Summary

It is critical for utilities to understand that they do not need to get bogged down with the details of the data quality when creating the initial asset inventory. The most important step is to develop at least a rudimentary asset inventory with the characteristics mentioned. The data quality can be improved over time as more information is discovered and the staff becomes more comfortable with the concepts of asset management.

Utilities should also be careful to not let themselves get overwhelmed in this step. This step is important but it should not be all consuming. The utility should complete this step to the extent possible and then move on to the other steps. In taking a long-term view of asset management, utilities should consider ways in which they can make the inventory more sophisticated. As an example, a GIS map and database may be a goal within five years. Utilities can also work with neighboring communities or parent towns or counties to share GIS equipment or GIS specialists to reduce the costs for all participants.

Level of Service

A Level of Service Agreement (LOS) defines the way in which the utility owners, managers, and operators want the system to perform over the long term. The LOS can include any technical, managerial or financial components the system requests, as long as all regulatory requirements are met. The established LOS should become a fundamental part of how the system is operated.

Why a Level of Service Agreement? There are two key facets to asset management – defining the level of service the system will strive to provide its customers over the long term; and, determining the most efficient and economical way to deliver that service (the least cost approach). Therefore, determining and detailing the level of service that the system is going to provide is a key step in the overall process.

Level of Service Agreement: This is the document that will spell out the service the system is to provide – it is a multi-faceted tool that can fulfill a wide array of purposes further described as follows:

- Communicate the system's operation to the customers (residential, industrial or commercial)
- Determine critical assets
- Provide a means of assessing overall system performance
- Provide a direct link between costs and service
- Serve as an internal guide for system management and operations staff and the board
- Provide information for system annual report or annual meeting presentation
- Reduce system costs through customer involvement

UV disinfection.

Customer Communication

It is important for a water or wastewater utility to communicate with its customers to avoid confusion, bad feelings, accusations of improper operation, and to make clear what the customer's expectations should be.

Determine Critical Assets

The LOS can be one factor in determining critical assets. Further considerations for determining critical assets are discussed in the next section. An example of how the LOS can impact criticality is where a system's LOS includes the factor: "Effluent water quality standards will be met 100 percent of the time." If the system has no redundancy in the wastewater disinfection system, this asset will be a critical asset for the system. It must be kept operational at all times in order to meet this level of service.

Provide Means for Assessing Overall System Performance: If at least some of the LOS factors include measurable items, the system can keep information regarding how well they are meeting these criteria and use that as one measure in assessing the overall operation. For example, consider a system that includes the following measures in its LOS:

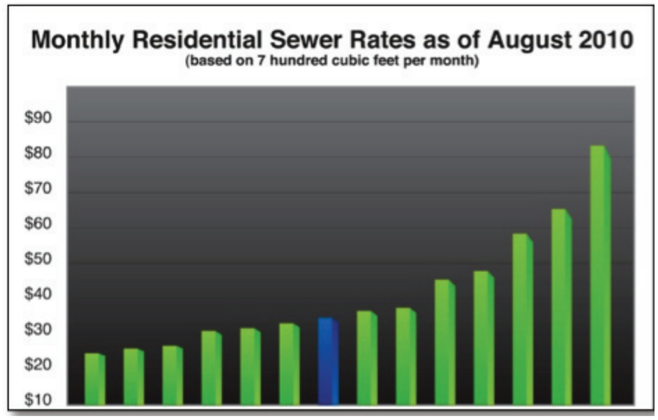
- Sewer main breaks will be repaired within six hours of initiation of repair 95 percent of the time.
- Customer complaints will be responded to within 24 hours, Monday through Friday.
- System will meet all state and federal regulations. All of these items are measurable if the system collects the appropriate data. Assume the system has the following data from its past year of operation:
- 250 sewer main breaks occurred, 230 were fixed in less than six hours
- 30 complaints were received, all 30 responded to within 24 hours
- System met all regulations; no violations. Based on this data, the system met some, but not all of its LOS factors. The following items were met:
- The customer complaints were responded to on time
- The system met all the state and federal regulations. The following items were not met:
- Sewer main breaks were not repaired within six hours

The utility can look at these results and determine the items that it needs to work harder on in order to meet the level of service requirements.

Provide Direct Link between Costs and Service: There is a direct link between the Level of Service provided and the cost to the customer. When a higher LOS is provided, the costs to the customers will increase. This relationship provides an opportunity for the wastewater system to have an open dialogue with its customers regarding the LOS desired and the amount the customers are willing to pay for this level of service.

Serve as Internal Guide to System Operation and Management: It is much easier to operate or manage a system when the operations and maintenance staff as well as the management staff understand the goals and priorities of the operation. Defining the LOS sets these goals for the system. These goals allow the operations staff to have a better understanding of what is desired from them and the management has a better understanding of how to use staff and other resources more efficiently and effectively. Checking how well the system is meeting LOS also allows the management to shift resources if need be from one task to another to meet all the goals more effectively.

What is the Minimum Starting Point for the Level of Service? All systems must operate within the state and federal regulations and requirements. These regulations are generally specified in the Clean Water Act and Safe Drinking Water Act, but there are additional rules and regulations at the state and federal level. All systems should already be aware of these rules and should already be following them. Because there are many elements to the regulations, it is not necessary to spell out conformance with each and every regulation in the LOS. Instead, the LOS could contain a basic statement indicating that "the system will meet all applicable state and federal regulations." Alternatively, the LOS may include statements that describe categories of compliance such as, "will meet all water quality requirements," "will conform to all operator certification requirements," or "will meet all requirements of the open meetings act."



Residential Sewer Rates.

What Else Should be Included in the LOS? The maximum level of the LOS is defined by the maximum capabilities of the assets. A system cannot include something within a LOS that the system is not capable of doing. Within the range of the minimum (regulations) and maximum (capabilities of assets) there are numerous items a system could include within its LOS. Some considerations for level of service are:

- Number and duration of service interruptions (such as backups) experienced by customers.
- Number of times and quantity of untreated wastewater discharged per year.

- Quality of treated effluent: Does it comply with federal/state standards? Does it satisfy community expectations? Does it impact the health and safety of the community?
- Time to respond to customer complaints or questions.
- Nature of system's "environmental footprint" — is it a "green" system?
- Outreach and public education.
- Opportunities for customer input and involvement.

The LOS does not have to be lengthy; it can concentrate on a few key items the utility really wishes to focus on. It can also start out with a few items and grow from there to include additional items as the system gains more experience with asset management.

Critical Assets

Not all assets are equally important to the system's operation; some assets are highly critical to operations and others are not critical at all. Certain assets or types of assets may be critical in one location but not critical in another. For example, one system may believe their bar screen is a critical asset because it lacks redundancy and has been known to fail. Another system may feel their bar screen is not a critical asset because they have a redundant screen and adequate spare parts to fix the broken bar screen quickly. A system must examine its own assets very carefully to determine which assets are critical and why.

Determining Criticality: In determining criticality, two questions are important. The first is how likely the asset is to fail and the second is the consequence if the asset does fail. Criticality has several important functions, such as allowing a system to manage its risk and aiding in determining where to spend operation and maintenance dollars and capital expenditures.

As a first step in determining criticality, a system needs to look at what it knows about the likelihood that a given asset is going to fail. The data available to assist in this determination is: asset age, condition assessment, failure history, historical knowledge, experiences with that type of asset in general, and knowledge regarding how that type of asset is likely to fail. An asset may be highly likely to fail if it is old, has a long history of failure, has a known failure record in other locations, and has a poor condition rating. An asset may be much less likely to fail if it is newer, is highly reliable, has little to no history of failure and has a good to excellent condition rating.

The following describes each of the components that can go into a determination of likelihood of failure. Any additional information or resources that a system has to supplement these components should be considered also.

Asset Age: The asset's age can be a factor in determining likelihood of failure, but should not be a sole factor. Over time, assets deteriorate, either from use or from physical conditions such as interaction with wastewater or soil, and are more likely to fail. There is no "magic age" at which an asset can be expected to fail. An asset's useful life is highly related to the conditions of use, the amount of maintenance, the original construction techniques, and the type of material it is constructed out of. A piece of ductile iron pipe may last 75 to 100 years in one application, 150 years in another, and 50 years in yet another. Rather than being sole predictor of likelihood of failure, age should be supplemental to other information. If there are no other issues with an asset than its age, the likelihood of failure can still be relatively low even if the asset is quite old.

Asset Condition: One of the most important factors in determining an asset's likelihood of failure is the condition of the asset. As the asset's condition deteriorates, it will become much more likely to fail. It is important, therefore, to make the best attempt possible to give the asset a reasonable condition assessment. The condition assessment should also be updated over time, so that criticality can likewise be updated. Assets given poor or fair condition ratings are more likely to fail than those given excellent or good ratings. When the asset condition is combined with other factors, the utility can begin to make predictions regarding the likelihood of a given asset failing.

Failure History: It is important to monitor when assets fail and record the type of failure that occurred. This information should be as specific as possible to assist in understanding its failure modes. Track when the asset failed (or at least when the failure was discovered), how the failure was determined (customer report, operator observation, etc.), type of failure, specific location of failure, and any field observations that may help explain the failure (lack of bedding sand, subsidence of soil, overheating, etc.) Also track failure history on all of the asset types or categories.

Past failure is not a complete predictor of future

It's important to be prepared for any type of failure.

failure, but it can provide some indication of the likelihood of future failure, especially if detailed information on the failures is collected and reviewed. If the asset failed because its construction was poor or the pipe was severely corroded, it is likely to fail again unless some action was taken to correct the problem. If the asset failed because a construction crew broke the pipe, it is not likely to fail again if this is the only failure the pipe had. If a pipe has failed several times in the past few years, it would be more likely to fail again.

General Familiarities with the Asset: Although likelihood of failure is site specific, some guidance regarding likelihood of failure can be gained by examining experience with that type of asset in general. For example, if there is a history of a certain type of pump failing frequently after five years of use, and you have that type of pump and it is currently four and a half years of age, the asset may be given a higher likelihood of failure than it would be if there was no general experience of this type.

Knowledge of the Asset: John Moubray defines failure as follows: "Failure is defined as the inability of an asset to do what its users want it to do." In that regard, asset failure can be any time the asset is not able to meet the level of service the system wants. For example, a meter may be reading, but reading 25 percent less than what it should be reading. If the LOS states, "all meters will read within a 10 percent accuracy range" then this meter reading 25 percent less has failed, even though it is still operational. This is not a failure in the classical sense – i.e., a meter leak or a plugged meter – but it is failure in the sense that it is not meeting the operational expectations.

Failure in the more classical sense depends on the type of asset. Passive assets (such as pipes) decay over time and active assets (pumps, motors) decay with use. Passive and active assets do not fail in the same manner so they must be considered differently.

The factors discussed above can be taken together to predict how likely an asset is to fail. The rating can be a simple rating on a scale from 1 to 5 or may be more sophisticated. The ability to produce a more sophisticated failure rating is dependent on the amount and quality of data available. It may be necessary to start with a more basic analysis and then increase the sophistication over time as more data, knowledge and experience are developed.

In terms of the consequence of failure, it is important to consider all of the possible costs of failure. The costs include: cost of repair, social cost associated with the loss of the asset, repair/replacement costs related to collateral damage caused by the failure, legal costs related to additional damage caused by the failure, environmental costs created by the failure, and any other associated costs or asset losses. The consequence of failure can be high if any of these costs are significant or if there are several of these costs that will occur with a failure. Further information on each of these factors is presented below.

Cost of Repair: When an asset fails, it will be necessary to fix the asset in some way. Depending on the type of the asset and the extent of the failure, repair may be simple or extensive. A small leak in a pipe can be repaired with a clamp. A chlorine pump can be replaced with a spare pump or perhaps the diaphragm can be replaced inside the pump. The cost of the repair of the failed asset should be considered in the analysis of the consequence of failure. If the asset can be repaired easily and without a tremendous financial cost, then there is a lower consequence. If the cost of repair is higher, then the consequence of the failure is also greater.

Social Costs Related to Asset Failure: When an asset fails, there may be an inconvenience to the customer. In some cases, this inconvenience may be minor, while in other cases, the social costs may be much higher. If a sewer backs up or collapses there may be flooding or other significant impact to some residents. When an asset fails, in some cases, damage may be caused to other assets unrelated to the wastewater system. Examples of this type of damage would be the following: a sewer collapses causing a sinkhole which then causes damage to the foundation of a building or a house, or causes major sections of a road to collapse. The damage from the pipe failure without the sinkhole would be fairly minimal. With the sinkhole, there is collateral damage including the road, the building or house. Another example would be a sewer pipe leak that leaks sewage into a home or yard or onto a schoolyard or playground. In this type of case, a significant amount of cleaning will be required to restore the building, house or property. The utility will be held responsible for this collateral damage, so the costs related to this type of failure

Asset failure never comes at a convenient time; better management means better preparation.

need to be considered in the assessment of costs of the consequence of failure. There are likely also significant political consequences to a failure such as this.

Legal Costs Related to Asset Failure: In some cases, individuals or businesses may sue the utility for damages or injuries caused by an asset failure. These costs would be in addition to the costs of repairing and replacing damaged property or other assets.

Environmental Costs Related to Asset Failure: Some types of asset failures can cause environmental impacts. The costs related to these impacts may not always be easy to assess in monetary terms. However, some attempt should be made to establish some type of monetary value to the environmental consequences. An example of an environmental cost related to a failure would be a sewer pipe that leaked sewage into a waterway or onto land. A value, either monetarily or qualitatively, would need to be placed on this type of consequence.

Reduction in Level of Service: The assets must be in working order to deliver the level of service desired by the utility and its customers. If the assets fail, the ability to deliver the desired level of service may be compromised. An asset that has a major impact on the ability to meet the LOS would be considered more critical to the system than an asset whose failure would not have a significant impact on the LOS.

Other Factors to Consider with Failure or Loss of Asset: The costs in this category are any other costs that can be associated with an asset failure that are not adequately defined within the previous categories. Sometimes referred to as the "Triple Bottom Line," the goal is to identify and incorporate a broader economic evaluation of impacts of asset failures that include: financial, social, and environmental impacts. Some examples include loss of confidence in the wastewater system or loss of the utility's image. Certain types of failures may negatively impact the public's confidence in the water or wastewater system and this may have a cost to the system. Examples include: loss of income related to the inability to provide service for a period of time, loss of the service itself, or health impacts to workers or customers. Other examples include:

- Traffic Congestion
- Aesthetics
- Habitat Protection
- Health Factors
- Noise and Odor
- Air Quality
- Safety

In assessing the consequence or cost associated with the asset failure, the system should consider all the costs associated with all of the categories above. The assessment can be a simplistic ranking of the consequences from 1 to 5. In this type of structure, the assets would be ranked against each other, but a specific monetary amount would not be calculated for the failure of each asset.

Assessing Criticality: Assessing criticality requires an examination of the likelihood of failure and the consequence of failure as already discussed. The assets that have the greatest likelihood of failure and the greatest consequences associated with the failure will be the assets that are the most critical.

A technique such as a ranking table as presented here can be a good place to start in assessing criticality.

To use this table, estimate the probability of failure for each asset from 1 to 5 with 5 being very high probability of failure and 1 being a very low probability of failure. Then assess the consequence of failure for each asset from 1 to 5 in the same manner. Using the number for probability of failure, move across the row until the column associated with the number for consequence of failure is reached. Alternatively, move down the column for the consequence of failure until the row for probability of failure is reached. Locate the number that is in the box where the row and column intersect. That is the number for criticality for that asset. Once an analysis of this type is done, the results can be reviewed to determine if they make sense to the utility. If the utility does not believe the results for a particular asset make sense (i.e., the asset seems to have the wrong relative ranking), a re-evaluation can be completed to achieve reasonable results.

Multiplied		**Consequence (Cost) of Failure**				
		1	**2**	**3**	**4**	**5**
Probability of Failure	**1**	1	2	3	4	5
	2	2	4	6	8	10
	3	3	6	9	12	15
	4	4	8	12	16	20
	5	5	10	15	20	25

Assessing Asset Risk.

Criticality Analysis over Time: The condition of the asset will change over time as the consequences related to failure may also change. Costs of repair may go up, the community may grow, new roads may be built or similar factors may occur that cause the consequence of failure to change. Therefore, it is necessary to periodically review the criticality rankings and make adjustments to account for changes in the likelihood of failure and the consequence of failure. The criticality analysis must be kept up to date to ensure that the utility is spending its time and resources on the appropriate assets as discussed in the next section. Also, the analysis must incorporate replacement of assets. If an asset that was critical primarily due to its likelihood of failure is replaced with a new asset, the criticality number will go down since the likelihood of failure is much less.

Life Cycle Costing

Lifecycle Asset Management focuses on management options and strategies considering all relevant economic and physical consequences, from initial planning through to disposal. The Lifecycle components include:

- Asset Planning
- Asset Design
- Asset Creation/Acquisition/Construction
- Financial Management
- Asset Operation and Maintenance
- Asset Condition and Performance Monitoring
- Asset Rehabilitation/Renewal
- Asset Disposal
- Asset Audit and Review

As communities begin to develop their Asset Management plans, these components can seem overwhelming. It does not make sense to try to begin with all components at once. Therefore, this manual will guide you through the basics of the components that can easily be started.

Options for Dealing with Assets Over Time:

There are four basic strategies for managing assets over time:

1. Operate and maintain the existing assets
2. Repair the assets as they fail
3. Rehabilitate the assets
4. Replace the assets

These options are intimately connected to each other. Choosing to do more or less of one impacts how much of the others is done, whether or not the other is done at all, or the time frame in which one of the others is done. For example, choosing to spend more on operating and maintaining assets will decrease the need to repair the asset and will increase the amount of time until the asset needs to be replaced. Choosing to rehabilitate an asset will postpone the need to replace the asset. This will also reduce the amount of operation and maintenance that needs to be done and may reduce the need for repairs.

Each of these options has its own costs and considerations. The expenditure of funds becomes a balance between monies spent in each of these four categories. The purpose of asset management is to try to determine the optimal way to employ resources between each of these categories, while maintaining the LOS desired. Generally, the most expensive option is replacement of the assets. Therefore, keeping the assets in service longer by performing routine maintenance, while still meeting LOS conditions, will usually be the most economical for the utility over the long term.

Asset Operation and Maintenance: Operation and maintenance (O&M) functions relate to the day-to-day running and upkeep of assets and are particularly relevant to short-lived dynamic assets (such as pumps) where deterioration through lack of regular maintenance may result in rapid failure.

Properly operating and maintaining assets is critical to the success of the overall asset management program. O&M is directly linked to Level of Service and Critical Assets. Some key points of an O&M program are to have regular maintenance that is performed on assets.

1. Performing the correct O&M procedures regularly achieves maximum asset life and reduces O&M costs
2. Documenting and Standardizing O&M procedures helps utility personnel to operate all assets within acceptable operational levels and ensures that each person is following the same routines.

By standardizing the operations of all assets, maximum asset life can be obtained (assuming that periodic maintenance is performed as required).

In order to develop O&M procedures the reference materials must be located. Reference materials include manufacturer and vendor O&M manuals, process and instrumentation drawings, vendor submittals, shop drawings, specifications, pictures, design data, design drawings, as-built drawings, and interviews with experienced staff.

Developing operational procedure s includes:

1. Creating a title for the procedure that appropriately describes it, so it is easily identified. (e.g., "Annual Maintenance of Aeration Blowers")
2. Introduction: lists associated information such as the reason for the procedure, responsible parties, desired outcomes, safety procedures, lockout / tag out requirements, required materials, special equipment requirements, and notification requirements
3. Steps and/or Activities: example – "Step 1, Shut power off at the breaker located on the south wall labeled for the Aeration Blower to be worked on."
4. Note any cautions or hazardous conditions with each step or activity before the activity is performed

Maintenance procedures can be initially developed using vendor-supplied information, and enhanced over time based on experiences and staff knowledge.

If standard procedures are not implemented system wide, O&M procedures will be created on an ad-hoc basis, which can lead to fluctuations in process efficiencies, discord between operations and maintenance, increased asset downtime, wasting of chemicals and energy, and other similar problems.

The greatest reward for developing O&M procedures is that all maintenance activities are backed by management and standardized across all shifts by all personnel. It is also a useful way to determine what and how many spare parts should be kept on hand for both routing and emergency maintenance. This ensures consistency of personnel activities, product quality and O&M costs. The application of standardized maintenance procedures can reduce asset downtime and ensure lifetime productivity.

Asset Maintenance.

Operation and Maintenance and Critical Assets

One of the purposes for identifying critical assets is to allow the utility to make more informed decisions regarding the use of its operation and maintenance dollars. As discussed previously, the most critical assets are those assets that are likely to fail and have a significant consequence if they do fail. Therefore, it is most advantageous to the utility to spend the greatest portion of its operation and maintenance budget on assets that are critical to delivering the established levels of service.

Repair of Assets: In addition to operating and maintaining the assets, systems will need to plan for the repair of assets as they fail. Systems need to consider how long they will keep an asset in service prior to replacement of the asset. To some extent, these two items—repair and replacement—are off-setting.

If more resources (personnel and money) are spent on repair, there will be a decreased need for replacement. On the other hand, if greater resources are applied to replacing the assets, fewer resources will be applied to repair. There is a balance between how much to spend in each category: maintenance, repair, and replacement to achieve the most efficient system.

In developing a wastewater system repair schedule, the utility must determine its own approach to repairing verses replacing assets. The utility will need to decide when it is spending more money (including personnel hours) to repair the asset than it would cost to replace the asset.

Replacement of Assets: Eventually, all assets will need to be replaced. There will reach a point where the asset can no longer be kept in service through maintenance or repair or where the asset is no longer capable of meeting the LOS, either economically or may not have sufficient capacity. At that point, the asset will need to be replaced. Replaced assets can either be part of a replacement schedule or a capital improvement plan.

In both cases, the assets are replaced. The main difference is that the replacement schedule includes those items that are routinely replaced, smaller dollar replacements, and items replaced using the water or wastewater system revenues or reserve funds. The capital improvement plan indicates items that are major expenditures that do not routinely occur and that generally require outside funding for at least a portion of the project.

Sometimes repair is not possible and equipment must be replaced. Good maintenance strategies can prevent catastrophic failure.

Repair and Replacement Schedule: A replacement schedule should be developed that indicates assets that will be replaced within the next 20 years. This schedule can also be expanded to include programmed maintenance or repair, making it a Repair and Replacement Schedule. The types of activities that can be included here are major repair elements, such as a pump rebuilds, tank overhauls, digester cleaning, sewer rehabilitations, etc. This Schedule does not replace the operation and maintenance schedules discussed above, but works in conjunction to develop the total management strategy for each asset and forecast total lifecycle costs. The repair/ replacement schedule reflects those elements that are major budget items and that will occur routinely, but much less often than daily, weekly or monthly. These are generally items that are annually or greater in schedule and that constitute a major expenditure.

The schedule should include all of the recurring and non-recurring items for a minimum 20 year period, ideally the replacement schedule should forecast into the future enough to cover one complete life-cycle of each asset in the inventory. The Repair and Replacement Schedule should be updated annually so that it is always at least 20 years into the future.

The type of information to include on a Repair and Replacement Schedule includes:

- Year
- Asset Identifier
- Asset Criticality Score
- Description
- Estimated Cost
- Method of Estimation
- One Time or Recurring
- Time Period of Reoccurrence

It is absolutely critical that the items in the Repair and Replacement Schedule be considered in the rate setting process. These items must be funded out of system revenues, so they must be accounted for in the annual budget and reflected in the sewer rates. The Schedule will probably not be uniform from year to year in terms of amount of expenditure. To address this issue, you may wish to set an annual annuity payment to cover the Repair and Replacement Schedule expenses over the long term. Some years, the payment would be greater than that year's expenses, so money would go into a Repair and Replacement Reserve fund. Other times, the amount collected would be less than required so the additional funds would come from the reserve account.

The annual annuity set would have to be sufficient to cover all of the expenses over the 20 year or forecasted period. It may need to be increased over time if expenses increase and it can be decreased if it turns out too much money was dedicated to this purpose.

Capital Improvement Planning

A long-term capital improvement plan should look at the needs for current and the future. Ideally, the planning period would be at least 20 years, with a minimum of five years. It is understood that the specific expenditures and needs in the latter years forecasted, say 20 or more years, are more speculative than the needs for the first five to 10 years. However, the inclusion of the needs for this longer time period will provide a better opportunity for planning for the capital needs of all assets in the inventory.

Annual Review of Asset Replacement Projects: Asset replacement projects will be included in the Repair and Replacement Schedule and the Capital Improvement Plan. It is a good idea to review both of these documents on an annual basis to determine if all of the listed projects are indeed necessary. Sometimes another look at the list may reveal that some projects can safely be pushed back for several years or may not be needed due to changing conditions. Alternatively, the projects may also have changed in terms of specifically what technology or approach is best. The types of questions to examine in the completion of this type of review include the following:

- Is the reason/need for the project still valid?
- Have the costs changed since originally projected?
- Is there a better approach or a better technology that can be used to address the need?
- Can the project be safely delayed?
- Does the project need to be completed sooner?
- Is there a method of rehabilitation that could be used rather than replacement to save costs?
- Would it be more reasonable to reduce the LOS than increase the asset's capability?
- Will funding be available for the project?

Each year, the overall Repair and Replacement Schedule and Capital Improvement Plan must be revised to reflect completion of the current year's projects or the new schedule for those projects if they were not completed, any changes to the projects on the list, and to add the additional year at the end of the project period to keep the list at least 20 years.

Long-Term Funding Strategy

The first four components of the asset management strategy should lead to a discovery of what actions are most appropriate to take to manage the system at the desired level of service at the lowest life-cycle cost. The final factor in the asset management strategy is determining the best manner in which to sustainably fund the operation and maintenance, repair, rehabilitation, and replacement of assets. There are several sources of funding available to a system, so it is important to evaluate the item needing funding and the various options.

Funding Sources Available:

The sources of funding for the overall operation and maintenance of a wastewater system, including asset repair, replacement and rehabilitation include the following:

System revenues:

- User fees
- Hookup fees
- Stand-by fees
- Late fees
- Penalties
- Developer impact fees
- System reserve funds
- Emergency reserves
- Capital improvement reserves
- Debt reserves

System generated replacement funds:

- Bonds
- Taxes

Non-System revenues:

- State grants
- State loans
- Federal grants
- Federal loans
- State or federal loan/grant combinations

Rates and Asset Management: System revenues are a major component of an asset management plan. The system revenues will fund the operation and maintenance of the system; there generally are no outside funding sources for routine operation and maintenance of a wastewater utility. In addition, the rates will need to fund reserve accounts for emergencies, repairs and debt coverage (for any loans.)

A well developed rate structure will take into account needs for the current year as well as needs for future years, through reserve accounts. For example, if it is anticipated that a new regulation will require a higher level of treatment, the system should be collecting money through the rates to help pay for the needed equipment to meet the anticipated permit requirements.

The rate structure should also anticipate routine replacements of parts, particularly those parts that wear out regularly. If one engages asset management concepts to assist in setting rates, the rates may increase as the system moves from traditionally being underfunded (i.e., collecting insufficient revenues to cover all expenses) to being properly funded. However, rates that are set based on sound asset management principles are very defensible to the public. Asset management brings transparency to the process so that it is clear on what the rate is based. The more clearly the rate can be defended, the more likely it is to be accepted by the public.

There are many sources of rate setting assistance, including trainings and free rate setting tools and programs. Any approach that includes all costs of operation, considers the long-term view, includes reserve accounts, and considers conservation or other utility goals, is acceptable.

Sustainability

What Does “Sustainable” Mean?

The 1987 Bruntland report from the World Commission on Environment and Development defined sustainability as, “meeting the needs of the present generation without compromising the ability of future generations to meet their needs.” Applying this to infrastructure, sustainability means having an active and effective program for renewal and replacement of components at a rate that allows for that infrastructure to continually serve a community into the future. Achieving sustainability requires the establishment of a long-term plan to gradually and continually repair, rehabilitate and replace all infrastructure assets (asset management) — a plan that ensures wise spending practices and a stable revenue stream for continuous support of needed future investments.

What Does Sustainable Water Infrastructure Look Like For My Community?

The path to sustainability is the same for a community as it is for the nation and has two basic elements:

1. Costs that include infrastructure replacement and operations, and
2. The revenue stream to support those costs.

Because of under-investment in the past, many communities have a gap between costs and revenues that can only be closed by pressure on those two variables. Strategies must be developed which lower the long-term costs or raise revenues to meet those costs. For most communities, the solution will lie in both, with the control of costs limited by the opportunities for efficiency and the raising of revenues limited by how much the members of a community can afford to pay.

What Can Be Done to Help Ensure Infrastructure in My Community is Managed Effectively?

Managing today’s utilities is a complex and challenging endeavor. Across the wastewater sector, there are numerous programs to help utilities manage various aspects of their operations. In an effort to develop a common framework for utility management, the US Environmental Protection Agency (USEPA) and six major professional associations in the water sector have come together to define and promote an approach through the Effective Utility Management (EUM) partnership. Based on the experiences and recommendations of leading utility managers from across the nation, EUM is built around “Ten Attributes of Effectively Managed Water Sector Utilities,” -- a structured, 360-degree framework for assessing utility operations and tackling the area’s most important to improving utility-wide performance and efficiency. The goal of the EUM initiative is to help utilities address a full range of challenges and help them move toward sustainable operations and infrastructure.

While these associations have enthusiastically endorsed the EUM framework and the Ten Attributes, they were actually developed by utilities for utilities. They are based on improvement initiatives that many utility managers have already implemented to save money for their communities, help keep rates at affordable levels, and help improve their economic competitiveness. In addition, these utilities have also been able to improve their environmental performance by using the Effective Utility Management approach. The Ten Attributes include:

1. Product Quality
2. Customer Satisfaction
3. Employee and Leadership Development
4. Operational Optimization (efficiency)
5. Financial Viability

6. Infrastructure Stability (management of assets)
7. Operational Resiliency (safety and security)
8. Community Sustainability (environmental sensitivity)
9. Water Resource Adequacy
10. Stakeholder Understanding and Support

Five Things Local Officials Should Do to Support Sustainable Water Infrastructure

1. **Manage Infrastructure for the Long Term:** The demands of daily operations and the constraints of tight budgets can make it difficult to invest the time and resources necessary for successful long-term planning. However, managing and planning for the long term reduces overall costs and leaves the community with a legacy of sustainability.

The communities across the world that are leading the way in infrastructure sustainability have adopted and institutionalized an approach called Asset Management. When all the parts of an Asset Management effort are working together, the community will know where it stands and where it is going, and each investment made will give the greatest value for the infrastructure's dollar.

2. **Maximize Dollars through Efficiency:** Regional water quality issues, high energy costs, and the increasing impacts of a changing climate, have elevated water treatment and energy efficiency to one of the most pressing concerns in the water sector.

Drinking water and wastewater services are typically the largest energy consumers of municipal governments, accounting for 30 to 40 percent of total energy consumed—no community can afford to pay for inefficiency.

Energy Efficiency—Why Pursue It?: An estimated three percent of national electricity consumption, equivalent to approximately 56 billion kilowatts (kW), or $4 billion, is used in providing drinking water and wastewater services to communities each year. The good news is that water and wastewater plants often have the potential to reduce energy use by 15 to 30 percent. Depending on the size of the utility, this can save thousands, or even hundreds of thousands of dollars in operating costs, which can be applied to needed infrastructure.

Water and wastewater treatment facilities in New York State alone consume more than billion kWh of electricity per year. New York State Energy Research and Development Authority (NYSERDA) is a public benefit corporation created in 1975 with the goal of reducing the state's petroleum consumption. Today, NYSERDA's aim is to help New York meet its energy goals: reducing energy consumption, promoting the use of renewable energy sources, and protecting the environment. NYSERDA has numerous programs that municipalities can take advantage of to help identify and fund energy efficiency measures for a municipality.

The Village of Old Forge was recognized for their Asset Management Plan.

What is the first step in pursuing it? Work with utilities to identify areas for energy savings by pursuing an initial energy audit. Then make it a priority to support targets and strategies for improvement. Make sure least life cycle cost solutions become part of the utility's ongoing business model, as part of an asset management program.

Utilities also have numerous opportunities for onsite production of energy. Some of the country's leading utilities have combined efficiency and onsite generation to offset the need for outside energy sources; in some cases, coming close to 100 percent self-powered.

3. **Ask About Alternative Solutions:** Leading wastewater sector utilities are finding new, innovative ways to meet the challenges of their aging infrastructure. Each community's wastewater and stormwater needs and challenges are unique. As stewards of the community, local officials can facilitate the exploration of viable alternative solutions that:

- Have lower long-term costs than traditional approaches, and
- Provide the best overall benefits to the community.

Technology is constantly evolving, and successful strategies are being employed across the country every day. Ask for an analysis of the alternative solutions available in order to spark new ideas for meeting your own community's needs.

Green Infrastructure can be both a cost-effective and an environmentally preferable approach to reduce stormwater and other excess flows entering combined or separate sewer systems. Runoff reducing approaches include: green roofs, trees and tree boxes, rain gardens, and porous pavements.

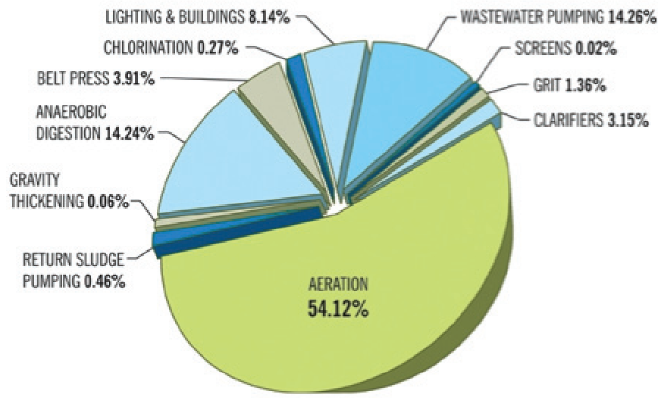
Smart Growth is development that serves the economy, the community and the environment. It changes the terms of the development debate away from the traditional growth/no growth question to, "how and where should new development be accommodated?" It also affects long-term wastewater infrastructure needs. Sprawl and poorly planned growth has, in many cases, left everyone with more extensive infrastructure to support and maintain—and by growing "smartly," the community's future infrastructure can be put on a more sustainable footing.

Use the best technology. Innovative, cost-effective technologies can make a real difference in a wide variety of infrastructure investments. Some examples include:

- Lining existing pipes instead of replacing them.
- Using pipe inspection technologies to target the portions of pipes that most require attention.
- Using nutrient removal technologies.
- Using automated systems.
- Using biosolids that are by-products of wastewater treatment.

On-site/Decentralized Wastewater Management can be a viable and cost-effective alternative to centralized wastewater collection and treatment. Septic system regulation is usually a state, tribal and local responsibility. The USEPA provides information to homeowners and assistance to state and local governments to improve the management of septic systems and prevent failures that could harm human health and water quality.

4. **Talk about Sustainable Wastewater Infrastructure:** Community support of long-term wastewater infrastructure investment is critical to achieving a greater level of sustainability. Local officials play a key role in communicating the state-of-the-community infrastructure, the value of infrastructure investments, and the benefits to the community.



Wastewater Energy Consumption

Community awareness is vital to securing support for the investments that all communities must make, and to securing the funding to do so.

Communicating why wastewater infrastructure is important includes these key elements:

- Have the answers about rates
- Additional resources
- Communicating why water infrastructure is important

The Water Environment Federation (WEF) has developed "Water is Life and Infrastructure Makes it Happen," an education program designed to teach the value of water infrastructure and the importance of investing in its long-term stability.

Additional campaign materials provided on the WEF website include:

- Successful communication campaign case studies
- Communication Toolkit (bill stuffers, media guide, presentation material, sample press releases, etc.)

Talking Points: The National Water Research Institute has established a Utility Branding Network to help water sector organizations communicate the value of the services they provide to their communities.

Have the Answers about Rates: Most of the funding for wastewater infrastructure comes from the revenues generated by utilities. No local official needs to be told that rates for these essential services are a touchy point for their constituents; however, holding rates steady for the long term is not sustainable. Due to inflation, the revenues that utilities bring in today will have less buying power in the future; therefore, keeping rates steady actually decreases a utility's budget each year.

One way to support sustainability of a community's infrastructure is to know and communicate the facts about water rates to its constituents.

Additional Resources: Liquid Assets: The Story of Our Infrastructure—this PBS documentary has been shown all around the country and has proven very effective at communicating the value of water sector infrastructure and the challenges that many communities face. Get it shown in your community!

5. **Initiate or Expand Collaboration:** Local officials are in a unique position to ensure that all the right people are talking and working together toward long-term infrastructure sustainability. The right collaborations can produce both cost savings and better, multi-benefit solutions for each community. Below are examples of some of the realms where "collaboration gaps" can occur. Consider where greater collaboration might benefit your community and initiate or expand a dialogue with key stakeholders.

- Collaboration among drinking water and wastewater and stormwater
- Collaboration across the watershed
- Collaboration among water sector, city planning and other infrastructure sectors

Collaboration among Drinking Water, Wastewater and Stormwater: All three of these utilities or departments have issues that overlap as they address water issues in the community. Drinking water is used and becomes wastewater. Wastewater effluent and stormwater enter the streams and/or aquifers, which are used as drinking water sources. All three need a plan for their infrastructure renewal. Coordinated renewal and an integrated plan for all aspects of water in a community achieve efficiencies and help ensure long-term supply. While many communities have all three areas working closely together, others have drinking water, wastewater and stormwater issues addressed by distinct departments and could benefit from increased coordination.

Water Collaboration across the Watershed: Reach outside of the community to partner with others who affect the drinking water and wastewater infrastructure. Upstream wastewater discharges and stormwater management affect downstream drinking water supplies. Higher capability utilities can share experiences and strategies with lower capability ones. Collaborating to buy chemicals in bulk, share resources and expenses, or even consolidate some functions with other utilities in the same watershed can achieve economies of scale—and make dollars go further.

This Chapter prepared by Timothy Taber, PE, BCEE, Associate at Barton & Loguidice, P.C.

Rain garden at Mott Road Elementary School in Central New York.

Chapter 3

Financial Management & Rate Structures

Financial management is the process of organizing, monitoring, planning, directing and controlling the monetary resources of an entity. When broken down into steps, the process becomes much easier to understand and can be a great benefit to any system that uses it.

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Chapter 3:
Financial Management and Rate Structures

The recession of 2008 began with the "housing bubble," bursting. It continued to bankrupt major businesses, financial institutions and governments causing financial stress in every sector of American society. To add to the stress, New York State has approximately 610 municipal wastewater treatment plants with over 22,000 miles of sewer piping. Most of these plants are now between 30 and 60 years old and are in need of upgrades and repairs. It is estimated that just to upgrade and maintain this existing infrastructure will require more than *$36 billion* over the next 20 years. New wastewater infrastructure to address economic development needs will cost even more. Increasingly, Americans are realizing that sewer and water services are not a right of citizenship and are raising concerns about how much they must pay for these services. In effect, citizens are questioning the financial health of their communities and the management capabilities of their leaders.

As a direct result of all these economic pressures, the federal government and New York State have made changes to the municipal reporting requirements at every level and division of government. These changes are designed to help financial analysts, borrowers, auditors and residents better evaluate the credit worthiness of a municipality. The goal of these reports is to gauge the financial health and managerial capability of each fund of a municipality and, thereby, the local government as a whole. In this review, it is extremely important that all financial and managerial actions be "transparent" (i.e., easily understood, easily explained and traceable) should questions arise.

For all governments, regardless of size, there must be an increased focus not only on the daily running of the sewer system, but also on financial management. While many people shrink from the task of analyzing or managing finances associated with local government funds, this does not have to be overly difficult or complex. By definition, financial management is simply the process of organizing, monitoring, planning, directing and controlling the monetary resources of an entity. When broken down into steps, the process becomes much easier to understand and analyze.

Tools for Financial Management

As with most things, the proper tool can make a job much easier, and financial management is no different. The tools here consist of data that can be used to answer the following basic questions:

Questions	Tools
What are the components that make up the system and how much are they worth?	Asset Inventory and Valuation
What are the costs to run the system and what are included in these costs?	Detailed Expenses- Operating and Maintenance Budget
How do I pay for normal, expected daily operating expenses?	Detailed Revenues- Operating and Maintenance Budget
How do I pay for an unexpected expenses, or something not planned for, such as an equipment or pipe break?	Reserves, Fund Balance, Contingency, Borrowing
How do I keep track of all of this information and how do I know what the current status is?	Budgets, Plans, Financial Statements

Asset Inventory and Valuation

In order to determine what is actually being managed, it is important to know what components make up the system and to have an inventory of the actual items or assets that belong to the system. A basic listing of the major components, along with their costs and a determination of how long they will last, will be a good start in developing an asset inventory.

Once the components of the wastewater system are known, the original cost of acquisition can be researched and estimates developed on the cost to repair or replace each specific element. Knowing the current condition of each piece of infrastructure will help decide if it is best to pursue a replacement, repair or upgrade. It will also help in determining how much useful life is left in each component and when money should be spent to maintain, improve or replace the asset—this year, next year or later. If the answer is later, an annual inflation factor (percentage) may be added to the current replacement or repair cost to arrive at a cost estimate for replacement at that future date.

Gathering and quantifying all of the above data into one spreadsheet creates a simple but effective asset management plan. This plan is now a useful tool that defines the system and directs managers to where and when money can be best spent. Armed with this information, it is now possible to plan for upcoming expenses rather than just react to emergencies. The goal is to gradually build up funds so that much needed repairs, upgrades and replacements can be handled in a timely manner that will not over burden the users or the budget. *(For more detailed information on asset inventory and management, please see Chapter 2.)*

Many communities will have to pay for old sewer system failures.

Operation and Maintenance Budget

An operation and maintenance (O&M) budget is a detailed estimate of the anticipated annual revenues and expenses of the wastewater system. Each water or sewer system should be self-sustaining and not dependent on interfund transfers or the previous years' fund balance to cover the cost of operation and maintenance. Revenues raised should fully cover the expenses of the system.

In order to effectively develop an O&M budget, the real cost of running the system must be determined. To do this, an evaluation of every expense of the system must be made to ensure that it is allocated to the appropriate fund. Many municipalities do not recognize that some expenses, such as the time the clerk or the public works superintendent spends on certain tasks, may need to be allocated to the water, sewer, highway and general fund budgets. It may also be necessary to talk to employees about what they really do and to track their time differently than in the past to capture this information. Another area to review is the coding of expenses. Actual invoices should be reviewed to ensure that they are classified properly into meaningful subcategories, such as electric, telephone, gas, water, chemicals, lab testing, billing, employee time for emergency repairs, and the like. The subcategories will vary among systems and should be divided into modes that are meaningful to the particular system.

"New York State has approximately 610 municipal wastewater treatment plants and more than 22,000 miles of pipes. Just to upgrade and maintain this existing infrastructure could require more than $36 billion during the next 20 years. New wastewater infrastructure will cost even more."

In a similar way, a detailed review of all sources of revenue should take place to ensure that all revenues of the sewer system are assigned to the sewer fund and that they are correctly allocated into meaningful categories and subcategories. The majority of the revenue for the sewer system will be generated from user's rates and fees. A small portion of the revenue of the system may be from sources such as penalties, interest earnings and, in some cases, debt service charges that have been placed on the tax bill. It is helpful to determine when revenues should come in, and if they are one-time occurrences or regularly recurring, such as quarterly water charges. Knowing the cycle of these revenues will make it easier to predict cash flow and should highlight any issues that arise, such as a shortfall.

A spreadsheet may be used to track these expenses and revenues on a monthly basis. In many cases, the bookkeeper may already generate monthly reports that show the annual budget, revenues and expenses to date, and the budget remaining. This report may be sufficient, provided that it breaks down the expenses into the same meaningful subcategories that are being tracked.

To touch on something that often confuses those new to local government, every municipality develops its own annual budget to estimate the cost of operating and maintaining its government, including the water and sewer systems. These budgets often do not appear to allow the level of detail covered here. This is because New York State has developed a Uniform System of Accounts that all local governments must use when preparing their budgets and for revenue and expenses accounts.

Generally speaking, each line of the budget is classified by fund and then function, such as Sewer Administration, Sewage Collecting System or Sewage Treatment and Disposal. The fund is designated by a letter classification, such as "G" for sewer fund or "S" for special district. Each function is given a four-digit account code. In addition, each function is further classified into the categories. For example, line 8110.1 of the Sewer Fund budget refers to personal services for sewer administration and could include the time spent on sewer administrative functions, such as billing and bookkeeping by the clerk, and meter reading by the operator.

Fund Name	Fund Letter	Function Name	Function Number	Category Number	Category Name
Sewer	G	Sewer Administration	8110	.1	Personal Service
				.3	Equipment/Capital Outlay
				.4	Contractual

While this system of classification is effective and promotes uniformity in reporting, it can be somewhat limited. It may not capture expenditures or categorize them into the desired groups to track unless adjustments are made to further define each category. The category numbers can be expanded to two or three digits to create a more detailed picture. In the previous example, the clerk and the sewer operator were both classified as 8110.1. Yet how much of the expense is attributable to the clerk and how much to the operator? In order to further define the categories, a second digit can be added. The clerk's personal service time can be classified as 8110.11, and the operator can be 8110.12 –the second digit indicating who performs the work. By expanding on this idea additional digits can be added to each category for an even more detailed picture. The clerk's time for working on sewer billing could be classified as 8110.111, and sewer bookkeeping could be 8110.113.

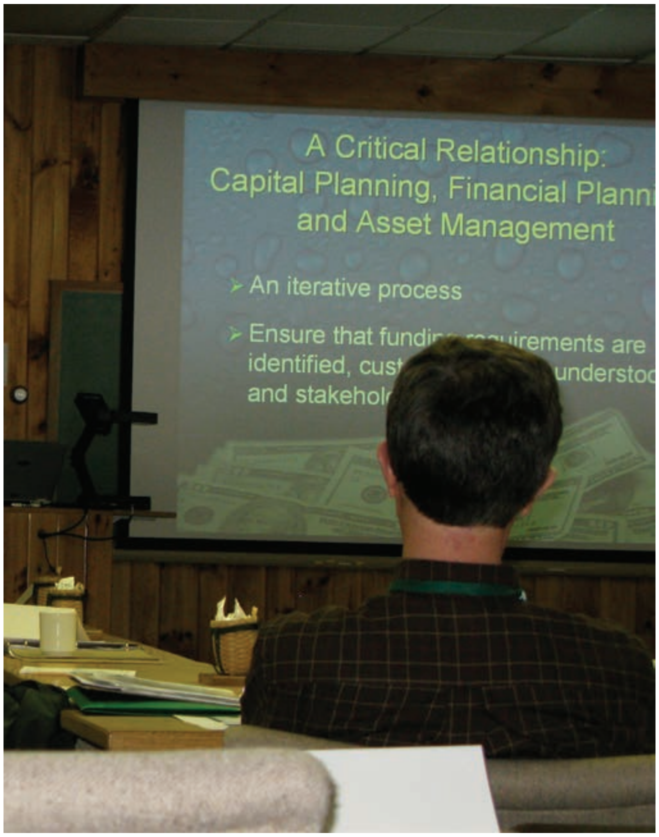
It should be noted that in expanding the expense categories in the budget, the clerk and bookkeeper may need assistance in correctly allocating invoices to each new category. It may be useful to have sewer department personnel assist in coding each invoice to the appropriate category to help ensure that reports are accurate. *(For more information on the Uniform System of Accounts, see the Accounting and Reporting Manual published by the New York State Comptroller's Office, January 2009 and revised January 2011.)*

Reserves, Fund Balance, Contingency and Borrowing

The operating and maintenance (O&M) budget should cover the daily operation of the sewer system. But what happens when there is an unexpected expense —a leak, a broken part or staff time for a repair? The easiest way to deal with small unplanned expenses is to establish a contingency line in the O&M budget. While many municipal boards are resistant to this concept, it is a necessary budget line since no one can predict the expenses and revenues of a system to the exact penny. The New York State Comptroller's Office recognizes the need for contingency funds and has established maximum contingency amounts for many funds, including special (water and sewer) districts. The recommended contingency is 10 percent of the amount estimated as necessary to meet the expense of maintaining the district, excluding debt service. *(See the Office of the State Comptroller's (OSC) Local Management Guide: Understanding the Budget Process, for more details.)*

What if the unplanned expense is a substantial one —a major repair or unplanned replacement—and the contingency line of the O&M budget will not be large enough to handle the expense? If there is sufficient unreserved fund balance in the sewer operating fund, it may be accessed to cover this expense. If there is not sufficient unreserved fund balance, or if using that fund balance would leave the operating fund with no fund balance and no cash flow to handle daily expenses, then it may be wise to see if reserve funds exist that could be used to pay all or a portion of the unplanned expenses.

If an equipment, capital or repair reserve fund has been established, funds from it may be used to cover the expense; however, before spending reserve funds, it is important to understand how and why the fund was originally established. Was the fund established for a specific purpose like repairing a generator, or for a much broader use, such as general sewer plant upgrades? Was a permissive referendum or vote held when the fund was established and is this now required to access



Continued training, and a comprehensive approach to financing and management provide managers with the tools they need.

the fund? Since these issues can be complicated, it is best to seek the advice of the municipal attorney and/or financial advisor, before spending these reserve funds.

If the unexpected expense cannot be covered by contingency, fund balance or reserve funds, then it is time to look at borrowing. By borrowing, the repayment of the repair can be spread over a period of time. Before borrowing, consider the work that needs to be done and if other work should also be included. A realistic budget, which includes the cost of all work to be done as well as the cost of any engineering, legal, fiscal advisory services, along with a contingency line, should be developed. This budget, called a capital project budget, can become the basis for the resolutions needed to authorize the borrowing. The budget can also be used by the fiscal advisor to develop repayment (maturity) schedules to show what the annual debt payment may look like.

Planning and Policy Making

Once a basic asset inventory/asset management plan and an operation and maintenance budget are completed, the basic tools will have been created to determine the current status as well as the "big picture" or overall goal. Depending on the breadth of overall needs, it may take several years to reach an objective. Establishing smaller, more realistic milestones will make it easier to stay on track and to reach the final goal.

It is a good practice to set aside time each month to compare the O&M budget and the assets management plan in place to what is actually happening. This will provide a good idea of where the system is today and if there needs to be any adjustments to keep on course. At least once a year, as part of a municipality's overall budget process, all plans should be reviewed, updated and re-evaluated. This is a good time for the Board and the operators to discuss the status of the system, the goals that were set and where they are in relation to these goals. An evaluation should also be made to determine what has changed in the community since the previous year and does or will it impact the plans and budgets now in place? Remember, plans are not absolute–they should change and adapt to fit the system's needs.

It may also be helpful to put policies in place that will help guide future budgets, plans and decision making. A policy is basically a written plan of action adopted by the Board that sets forth principles to govern actions that may be taken in the future. These actions can include: when to use fund balance, how much contingency should be budgeted for each fund, when to replace an asset rather than repair it, etc. A policy does not have to be overly elaborate or cumbersome to be effective. A concise statement of a principle, or situation that may arise, and the action to be taken is all that is required. The purpose is to establish a uniform way of dealing with an issue so that everyone handles it the same way. It promotes transparency of action and understanding of the municipality's goals, principles and ideals.

Basic Steps in Rate Setting

The following are steps that should be taken when formulating and employing user rates for water and sewer services.

1. Determine the full cost of running the system
2. Determine current revenues
3. Assess repair and capital needs for the next one to 10 years, or longer
4. Evaluate/design appropriate rate structures
5. Implement the rate structure

6. Assess the effectiveness of the rate structure and change it, if needed.

Definition: A rate structure is a set of fees (rates) a water or sewer system charges customers for use of the system. The purpose of rate structures is to generate sufficient revenue to cover the full cost of operating and maintaining the water or sewer system.

1. Determine the full cost of running the system

As discussed in the O&M portion of this chapter, the full cost of operating and maintaining a water or sewer system includes the collection or production, treatment, storage, distribution, regulatory compliance costs, administrative costs, repair and maintenance costs and debt service. In order to forecast these expenses, it is helpful to predict when they will happen—one time during the year, or at regular or irregular intervals.

Collection/production, treatment and storage costs include operator and staff time spent working in each of these functions, as well as the cost of chemicals, power, etc. Regulatory compliance costs can include expenses for permits, testing, operator certification, training and regular reporting to various agencies. Administrative costs include expenses for accounting, meter reading, preparation of bills, postage for bills, collection of fees, budget preparation and review, mailing of notices to users, cell phones, copiers, computer technical support, office supplies, etc. Debt service is simply any annual principal or interest payment due that is related to the sewer system. Repair and maintenance costs include planned repairs of the system, as well as general maintenance items that must be carried out on a regular schedule.

To cover small unplanned repairs or maintenance (including staff time or overtime) a small contingency should be built into the budget for up to 10 percent of the overall operating budget outside of debt service. This number does not have to be particularly large, just realistic for the particular community. The amount of contingency needed may also be determined by calculating the amount spent on unanticipated expenses in the previous five to 10 years and then taking the average. Unexpected expenses will often show in the operating budget as transfers from other funds, transfers from reserves or use of fund balance on the year-end operating budget. Board meeting minutes may also shed light on the purpose of any transfers that may have taken place. If the contingency is not used at the end of the year, it can remain in fund balance or could be transferred to a repair or capital reserve for later use. The unused contingency could be re-allocated (transferred) the following year to cover contingency again so that additional revenue would not have to be raised for this item. If left in fund balance indefinitely and not included in the operating budget as contingency, it could be forgotten and may have been used for other purposes or may be less than expected and not sufficient to cover the unplanned expense.

It is important when determining the full cost of running a system, that all costs of the municipality be reviewed to make sure they are being properly coded and captured in the sewer operating and maintenance fund. It is rare that a clerk would work only on general fund related tasks and a public works superintendent serve exactly half the time on sewer and half the time on water. Because salaries, wages and benefits for these and other workers may be arbitrarily split between the water, sewer and general fund or lumped into one fund for convenience, it warrants some research. A discussion with these key people and a review of the actual time spent on work for each fund may reveal that adjustments need to be made to better align their salaries, wages and benefits to where the work is actually performed. The goal is to capture and charge the actual cost of running the system to the appropriate fund.

Another good exercise while looking at all of the sewer or water system expenses is to determine if they are broken down into meaningful budget categories for tracking. Does the current budget and bookkeeping system provide enough detail about expenses to differentiate utility costs so that phone, electric, gas or fuel oil, and internet costs are known? What about for testing—does it show which are chemicals or lab tests, and which are done in-house and which are completed by an outside professional? What about administrative costs? How much is charged for billing, for collecting service charges, and for producing newsletters or required informational mailings?

Answers to these questions could mean that budgeted expenses need to be broken down into more "trackable" categories. By understanding what current needs for a particular item are, it may be possible to anticipate or avoid cost increases in certain areas, such as gas or electric, by shopping for services that provide the most value for each dollar. Additionally, it could be determined that the system no longer needs certain items or that further budgeting is needed for others. In short, the information captured will have new meaning because it will now become easier to compare and track.

One thing to note is that when changing the way invoices have been coded, it is a good idea to have the sewer or water department assist the clerk, treasurer and bookkeeper in coding the bills. Often these bills, while self-explanatory to a sewer or water operator, may not be understood by those coding the bills. To ensure that the tracking system remains useful, continue to check that all invoices are properly coded, and this may be the best opportunity to do so. (If there is difficulty reconciling New York State's accounting system with the level of detail that is needed for a meaningful budget, refer to the section under Operation and Maintenance Budget earlier in this chapter for clarification.)

2. Determine current revenues

Just as all invoices are reviewed to ensure they were properly allocated to the sewer fund, the same inspection should be made of all revenues. It is helpful to determine when the revenues come in—all at once, or throughout the year. Are they one-time occurrences or do they arrive at regular intervals? Municipalities derive most of their revenues from taxes and user fees. The user fees may be for water, sewer or even electric services. These user fees may be collected monthly, quarterly or another regular schedule—the key here being that they are collected at several times throughout the year. Taxes, on the other hand, only come in once a year. Some municipalities may have placed the debt service charges for a particular project or district on the tax levy. This does not mean they are a tax, but rather that they are assessable improvements and, as such, can be charged annually to the users along with their taxes.

Just as expenditures must be scrutinized to determine if they are properly classified, revenues too must be reviewed and reallocated where necessary. Particular attention needs to be paid to interfund transfers. What was the purpose of the transfer? Was it a temporary transfer or permanent? Does it have to be repaid and, if so, over what period of time? Is there a pattern of fund balance being used annually to balance the budget? The answers to these questions will help determine if the water or sewer fund is truly self-sufficient or if that is a goal to work toward.

Good fiscal management of your system requires a collaborative, team approach.

3. Assess repair and capital needs for a future period of time

The best tool to assess a system's current repair and capital needs is an asset management plan. The asset management plan is designed to evaluate a particular sewer or water system and to help plan for minor repairs and major upgrades. Upgrades and replacements may be due to age or wear, but also could be necessary because of changes in technology and/or upcoming changes to current regulatory requirements. As major capital replacements or upgrades become necessary, capital improvement plans can help communities determine when major projects will need to be undertaken and what the effects will be on system finances. When used properly, these plans provide needed time to develop financial strategies to pay for improvements.

While the terms asset management and capital plans may bring to mind reams of spreadsheets, complicated formulas and endless hours of work, they really do not have to be overly complex to be useful. At its most basic, the asset management plan should include a listing of the major components of the water or sewer system, a determination of how long they will last and an estimate of their cost. The capital plan should be based on the asset management plan's assessment of when major components of the system need to be replaced or upgraded. Both plans should be written down so that everyone is working from the same information concerning the assets of the system and their conditions. Both plans should be reviewed and updated on a regular basis as part of the budgeting process of the municipality. In this way, the plans become useful tools that provide solid information for decision making by those responsible for preparing the budget and for public discussion.

4. Evaluate/design appropriate rate structures

There are several factors in evaluating which rate structure to use: rate stability, rate predictability, number and type of customers, usage and ease of billing. Rate stability refers to how stable the rate is throughout the fiscal year. Are the payments the same or similar, and are they spaced evenly throughout the year? Most users prefer to make the same payment at regular intervals during the year. Closely related to rate stability is rate predictability which refers to the municipality's ability to accurately predict when annual revenues will be received. It is important from a cash flow stand point to know when revenues will come in and how much they will be.

Municipal water or sewer customers may be residential or commercial, industrial or agricultural-type users. Each of these user classes tends to process differing amounts of water or sewage annually—they may be seasonal users or have peak demands at different times throughout the year. Knowing the number and type of customers and their particular usage needs can help determine how best to set a water or sewer rate.

As important as the customers are in setting water or sewer rates, it is imperative that the billing structure be easy to understand, to apply and to invoice Complicated formulas or rate structures generally mean more billing errors will be made, which will have to be researched and corrected. Simpler structures tend to have less billing errors.

There are several rate structures, or methods of setting water or sewer rates that are commonly used to bill customers:

Fixed Fee: All customers, regardless of type of user or the amount used, pay the same amount. This type of structure may make sense for very small systems where all the customers have the same or nearly the same usage. It does mean that some customers will be subsidizing others, if some use more than others. Water metering is not required for this structure to work. (Please note that sewer usage is often based on water consumption as captured by individual water meters.) This type of structure is very easy to bill and it is very easy to predict annual revenues. Revenue shortfalls could arise with this structure if there are unplanned periods of higher than normal usage.

Flat Rate: All customers are charged a uniform rate regardless of the user type (class) to which they belong and regardless of the amount they use. For example, all customers are charged $2.50 per 1,000 gallons of water consumption. This includes residential, small business and large industrial users. Water meters are required to successfully use this structure. This method encourages water conservation, since charges are directly related to actual use. Water usage can be expressed in equivalent dwelling units (EDU), gallons or cubic feet, if desired. It is very easy to bill and to predict annual revenues using this type of structure.

Block Rate: Customers are charged based on block of water consumption. For example, users can pay $2.50 for zero to 5,000 gallons, and $3.00 for 5,001 to 10,000 gallons. These blocks can be in increasing or decreasing increments. Water meters are required to accurately bill this structure. This method can be very useful when there are large differences in the amount

Appropriate fees to fund our water infrastructure today, provide for clean water in the future.

of water each class of customer uses. However, a large number of blocks can be confusing to users and can be difficult to bill.

Combination of Rates: This means two common rate structures are combined, such as fixed fee and block rate or fixed fee and flat rate. In these cases, the fixed fee is used to cover fixed expenses of the system. Fixed expenses are ones that will occur regardless of the volume of water or sewer used. They include items such as debt service, salaries and benefits, etc. The block rate or flat fee portion of the rate structure covers the variable costs of the system and includes items such as chemicals, testing, phone usage, etc.

5. Implement the rate structure

By reviewing the rate structures, it usually becomes apparent which will work for your community, and which will not. Once a structure is decided, the amount of revenue to be raised must be determined. To determine what is needed, take the current operating budget expenses and add the capital and repair reserve needs and subtract any non-user based revenues and any transfers from reserves, fund balance or other funds.

6. Assess the effectiveness of the rate structure and if change is needed

After rates have been chosen and are in use, it is a good idea to assess the effectiveness of the rates and the rate structure. Should it be necessary to adjust rates during a fiscal year, it is a good idea to check the local laws to know if there are any rules governing when a rate change can be made and what requirements, if any, there are to notify the public of the change. It is imperative that rates be re-examined annually during the budget process. At this time, it may be necessary to make adjustments to account for more water conservation than expected, more use than expected, the opening or failure of a business, or even to make billing easier. Questions to consider include: was enough raised to cover expenses? How easy was the billing process? Was the expected amount of revenue accurate and were there unforeseen complications? What can be improved next year?

In closing, it is good to remember that rate setting is as much an art as it is a science. There will always be more than one way to calculate the rate and each way will be correct. The main objective in rate setting is to fully cover the cost of operating the system with the revenues generated from the rate structure. So the "correct" rate may be $20 for 5,000 gallons per quarter plus $2.50 for every thousand gallons after that; or it may be $30 per quarter for all users regardless of amount used. To be correct, the rate structure and the rate itself must make sense for the sewer system it was designed for.

This Chapter prepared by Mary Chappell, Vice President, Municipal Solutions, Inc.

Regulatory Overview and Legal Responsibilities

Water is Life. And, sometimes we need regulation to ensure water quality standards are met. This chapter provides an overview of wastewater regulations and how they affect and influence work conducted at your facility.

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Chapter 4:
Regulatory Overview and Legal Responsibilities

Overview of Water Quality Regulations

Governmental efforts to regulate pollution of the waters of the United States date back as far as the Rivers and Harbors Act of 1899, which made the act of discharging refuse matter into navigable waters and their tributaries without permit unlawful. Known as the oldest federal environmental law, the Rivers and Harbor Act still retains independent vitality. However, the effects of the industrial revolution and rapid population growth on the nation's waterways signaled that more was required to maintain healthy and pure waters, and to restore those that had become impaired.

> "Regular communication with NYSDEC is encouraged to develop a rapport with the agency and better lines of communication to address permit and compliance issues."

To address these pollution concerns, Congress introduced the Federal Water Pollution Control Act (FWPCA) of 1948, the first comprehensive legislation aimed at restoring and maintaining the natural properties of the nation's waters. This act placed greater responsibilities on the states to develop and enact their own water pollution protection guidelines, established state and federal cooperative program development, and limited federal enforcement and financial assistance. A primary focus of the act was on sewage treatment plants, leading early efforts to revolve around "point source" pollution. Since its origin, the FWPCA has been amended numerous times to include and coincide with other acts such as the Water Pollution Control Act of 1956 and the Water Quality Act of 1965. However, the best-known amendments came in 1972 as public awareness and concern regarding polluted water bodies and unhealthy wetlands could no longer remain stagnant.

These 1972 amendments brought a new name to the Water Pollution Control Act, thereafter commonly known as the Clean Water Act (CWA). The CWA amendments:

- Established the basic structure for regulating pollutants discharges into the waters of the United States.
- Gave USEPA the authority to implement pollution control programs such as setting wastewater standards for industry.
- Maintained existing requirements to set water quality standards for all contaminants in surface waters.
- Made it unlawful for any person to discharge any pollutant from a point source into navigable waters, unless a permit was obtained under its provisions.
- Funded the construction of sewage treatment plants under the construction grants program.
- Recognized the need for planning to address the critical problems posed by nonpoint source pollution." (USEPA, 2012)

The CWA also called for all waterways in the United States to be fishable and available to swim in by 1985. This act has been revised several times since

Sometimes a plant upgrade is needed to maintain SPDES compliance. (Lake Placid) its establishment, including funding process changes leading to the Clean Water State Revolving Fund and increased focus on Great Lakes water quality.

The FWPCA, like many comprehensive environmental laws, contains provisions related to research, grants for construction of treatment works and state water pollution control revolving funds, as well as provisions requiring the establishment of water quality standards and a system to permit the discharge of pollutants to the waters of the United States. That system, the National Pollutant Discharge Elimination System (NPDES), provides the framework within which discharges from municipal, industrial and other pollution sources are regulated. Discharges which are not authorized by or are not in compliance with a permit are illegal and subject the owner and operator to possible enforcement and legal liability.

In enacting FWPCA, Congress authorized the USEPA to issue detailed regulations to carry out the requirements of the law. Those details are set forth in the Code of Federal Regulations. The USEPA implements the NPDES in states and territories where authority has not been delegated to a state or territory.

New York, which has been authorized by the federal government, has demonstrated a long-standing and vigorous commitment to protection of its waters, which includes 87,000 miles of rivers and streams, over 1,000 square miles of lakes and ponds, and over 400 miles of Great Lakes coastlines. These efforts date back to 1953 with the Department of Health's Pure Waters Program and certification of wastewater treatment plant operators in 1937. In 1972, the New York legislature enacted the modern version of the state's Water Pollution Control Act, which is codified in the New York Environmental Conservation Law (ECL). Article 17 of the ECL authorizes the New York State Department of

National and Statewide Wastewater Regulation Timeline

1899 — *Rivers and Harbors Act*

Early 20th Century — New scientific knowledge about water-borne diseases like typhoid and cholera gained national interest

1904 — New York State adopts the first water pollution control law, requiring health department permits to discharge municipal and industrial wastewater

1912 — U.S. Public Health Service begins investigating the connection of polluting navigable rivers and lakes to adverse health effects from those who used the waters for household purposes

1918 — International Joint Commission reported the extent of pollution of boundary waters between the US and Canada, emphasizing a need for discharge policies

1924 — *Oil Pollution Act*

1934 — National conference held to assess the nation's water quality issues and discuss federal approaches for resolution

1935 — A legislative proposal to launch an active federal program in water quality management was rejected

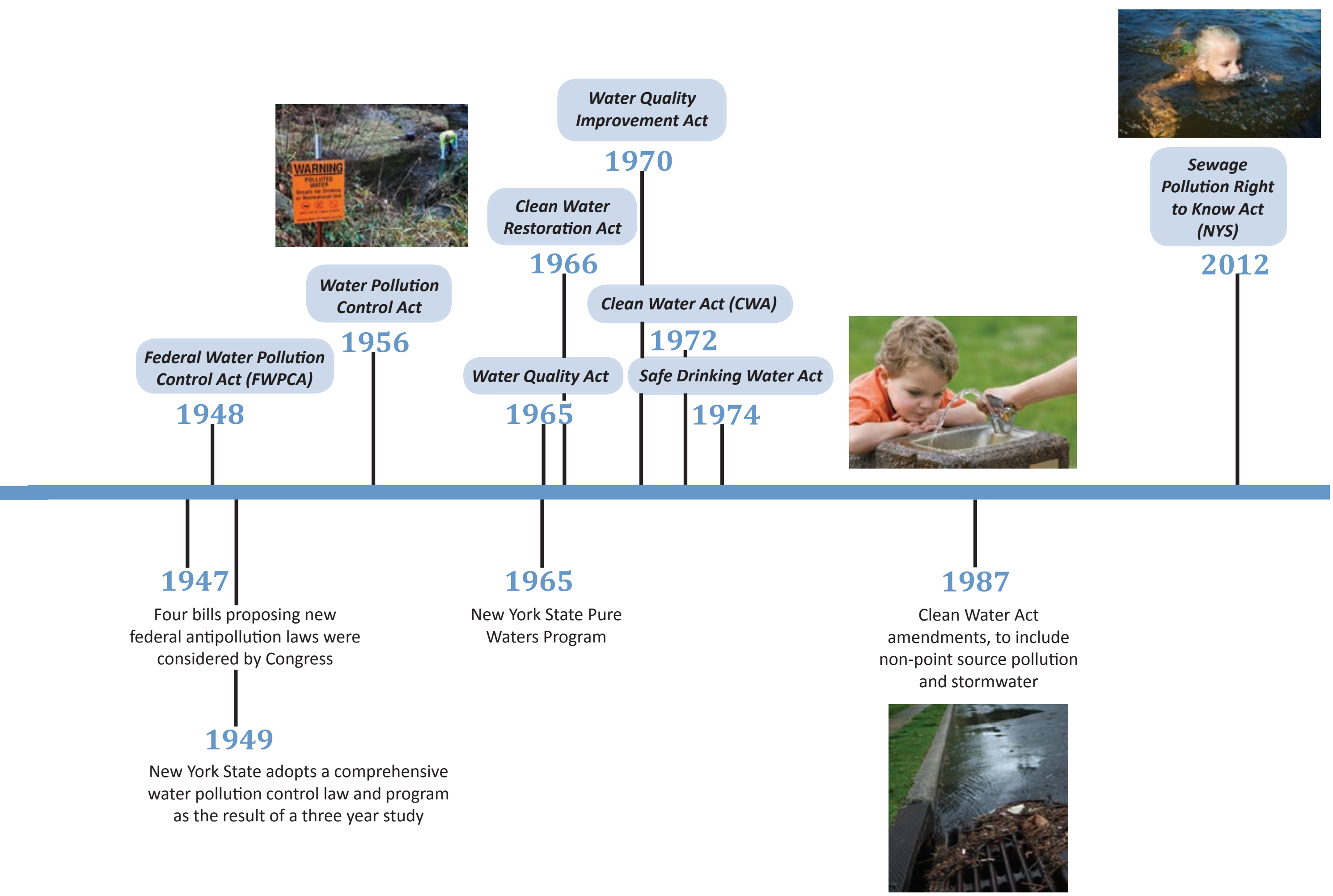
1936 — NYS Health Department takes legal action against City of Buffalo, ordering it to provide sewage treatment due to disease outbreaks occurring downstream of raw discharge

1936, 1937, 1938 — Provisions to the legislative proposal for a federal water pollution control program were turned down

1940-1945 — World War II, three federal water pollution control bills introduced to Congress but were not carried through

Environmental Conservation (NYSDEC) to implement New York's State Pollutant Discharge Elimination System (SPDES) permitting program. The NYSDEC has promulgated detailed regulations which are set forth in Title 6 of the Official Compilation of New York Codes, Rules and Regulations (NYCRR), and has issued written guidance documents known as the Technical and Operational Guidance Series (TOGS). The Sewage Right to Know Act is the most recent addition to New York State water protection regulations, requiring publicly owned sewage treatment plants and sewer systems to notify the general public whenever the facility discharges untreated or partially treated sewage. The Act was passed by New York State Legislature in July 2012, signed into law by Governor Cuomo in August 2012, and scheduled to take effect in May 2013. Also required is notification of routine sewage releases, such as CSOs and similar permitted discharges due to stormwater events. Public notification is required within 4 hours of the event and is announced through electronic media and posted on the NYSDEC website. The NYSDEC then produces an Annual Report stating discharge events and following remedial actions.

Virtually all aspects of wastewater treatment in New York are specifically regulated. The initial design and construction of a wastewater treatment plant must be reviewed and approved by NYSDEC before a permit is issued. Regulations require the operators of municipal wastewater treatment plants to be certified, and the effectiveness of treatment must be continually monitored with performance results regularly self-reported to NYSDEC. With all federal and state laws, regulations, and guidance documents available online, owners and operators of wastewater treatment plants have instant access to the authorities under which they operate. After more than 35 years of administering



the Clean Water Act, federal and state environmental enforcement authorities have no sympathy for public or private owners or operators who feign ignorance of applicable and relevant legal requirements or fail to comply therewith.

Clean Water Act Regulation Standards

Substantive regulation of the discharge of pollutants to water bodies under the Clean Water Act (CWA) is accomplished from two perspectives—technology standards and ambient water quality standards. These substantive approaches are implemented through the procedural device of issuing a State Pollutant Discharge Elimination System (SPDES) permit (detailed later herein) which contains legally enforceable discharge limits for pollutants.

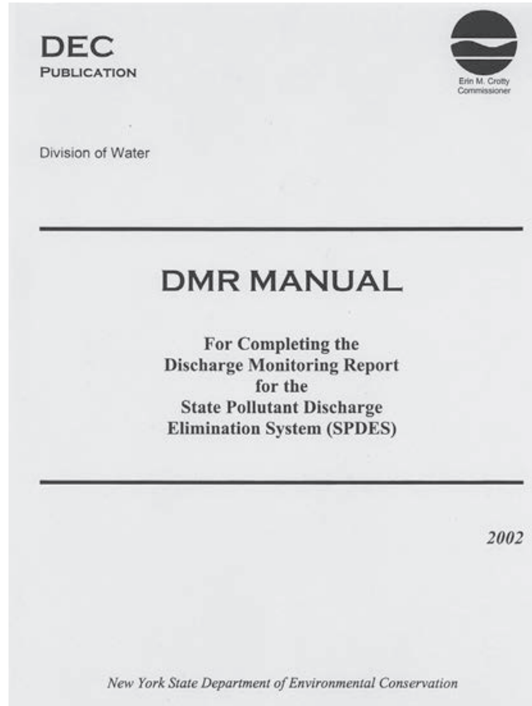
Technology Standards

The CWA sets up technology standards that differ based on the type of pollutant and whether the discharge is new or existing at the time the standard is established. Examples include: best available technology economically achievable (BAT); best available demonstrated control technology (BADCT); and best conventional pollutant control technology (BCT). Much of the differences between these standards relate to the degree to which cost can be considered in selecting the technology and the reliability of the technology.

Each of the technology standards are defined conceptually in statute and more particularly set by EPA/NYSDEC for individual permits. The USEPA/NYSDEC will determine the technology that satisfies the relevant standard and will set an effluent limit (generally a concentration of pollutant per unit of discharge) that is reflective of the use of that technology. This approach is intended to encourage continual improvement of control technologies which in turn will result in increasingly more stringent effluent limits.

With respect to Publicly Owned Treatment Works (POTWs), the CWA sets the highest level of required technology for domestic wastewater as secondary treatment. Thus, from a technology standard point of view, POTWs must implement primary treatment (solids removal) and secondary treatment (generally, biological treatment).

Treatment of non-domestic wastewater is usually not handled by processes at the POTW. Rather, if system users contribute non-domestic wastewater (industrial/



DEC
PUBLICATION

Erin M. Crotty
Commissioner

Division of Water

DMR MANUAL

For Completing the
Discharge Monitoring Report
for the
State Pollutant Discharge
Elimination System (SPDES)

2002

New York State Department of Environmental Conservation

Discharge Monitoring Report Manual

commercial operations), those waste streams must be pre-treated prior to entering the municipal system. Local governments address this issue by requiring industrial/commercial sources of non-domestic wastewater to obtain local discharge permits as a condition of using the public sewer system and which establish the legal requirements related to pre-treatment.

Water Quality Classifications

The second approach used by the CWA considers the impact of the discharge on the receiving water body. The CWA requires states to classify receiving waters by their highest and best use. New York's classification differentiates between surface and ground water and between fresh and saline waters. Waters are generally classified by the following list:

- Classifications A, AA, A-S and AA-S: indicating a best usage for a source of drinking water, swimming and other recreation, and fishing.
- Classification B: indicating a best usage for swimming and other contactrecreation, and fishing.
- Classification C: indicating a best usage for fishing.
- Classification D: indicating a best usage of fishing, but these waters will not support fish propagation.

- Classification SA (marine waters): indicating a best usage for shellfishing for market purposes, swimming and other recreation, and fishing.
- Classification SB (marine waters): indicating a best usage for swimming and other recreation, and fishing.
- Classification SC (marine waters): indicating a best usage for fishing.
- Classification I (marine waters): indicating a best usage for secondary contact recreation, and fishing.
- Classification SD (marine waters): indicating a best usage for fishing, but these waters may not support fish propagation.
- GA: Fresh groundwater. Best usage = potable water
- GSA: Saline groundwater. Best usage = potable mineral waters; conversion to potable water; manufacture of salts.
- GSB: Saline groundwater. Best usage = receiving water for disposal of wastes.

Waters with classifications AA, A, B and C may also be designated as:

- T: indicating trout waters.
- TS: indicating suitability for trout spawning.

Regulators then determine ambient concentrations of pollutants that are consistent with these uses. The most important factors regarding whether a particular discharge can potentially cause a violation of any given water quality standard are the natural background concentration of the pollutant; the man-made inputs of that pollutant into the water body (i.e. pollutant discharges); and the flow of the water body (the greater the flow, the greater the ability to absorb pollutants).

Since meeting the technology standards does not guarantee that a discharge will not create or contribute to exceedance of the ambient water quality standards, regulators must examine the impact of a discharge on water quality even though the discharge of pollutants will be restricted by application of the appropriate technology limit. Based on modeling, regulators will determine whether the discharge could cause or contribute to an exceedance. Where an exceedance is possible, notwithstanding the fact that the effluent discharge is at a level that satisfies the technology requirement, a more stringent effluent limit (a water quality based effluent limit – WQBEL) must be considered. If the out-of-compliance parameter is industrial/commercial in nature, the water quality based requirements can be passed along upstream to the industrial/ commercial user via the local pre-treatment permit.

Protecting the receiving waters and, by extension, downstream communities's source waters, is critical.

Where multiple entities are discharging to a receiving water body which results, or potentially could result, in an exceedance of an ambient water quality parameter, regulators will look to establish a total maximum daily load (TMDL) for pollutant discharges that can impact the impaired portion of the water body. The TMDL limits the addition of quantities of the pollutant of concern and acts as a management tool to reduce the concentrations of that pollutant over time so that the water body can be restored. The DEC has adopted guidance documents which are invaluable in implementing a wide variety of requirements. These are known as the Technical and Operational Guidance Series (TOGS). All of these documents are available on DEC's website.

Legal Responsibilities

Owners and operators of wastewater treatment plants face many challenges in complying with the applicable laws and regulations. NYSDEC and other agencies will often work cooperatively with owners and operators of wastewater treatment plants to write appropriate SPDES permits and to achieve compliance with the permits. Regular communication with NYSDEC is encouraged to develop a rapport with the agency and better lines of communication to address permit and compliance issues.

In New York, owners and operators who regularly violate applicable water pollution control laws, regulations, or permits and fail to take appropriate measures to abate such violations will attract the enforcement attention of NYSDEC and the relationship with the agency can rapidly change from cooperative to adversarial. That attention, and the legal proceedings which often follow, can result in civil or criminal prosecution and liability for owners and operators. Municipal bodies that own wastewater treatment plants are not immune from enforcement.

The self-monitoring and reporting conditions of SPDES permits present obvious opportunities and incentives for owners and operators to effect less than full compliance, so a substantial amount of governmental enforcement efforts are focused on improper monitoring and reporting. Through such efforts, enforcement authorities seek to directly punish owners and operators for violations, and deter others from engaging in the same or similar illegal conduct.

SPDES Report Monitoring and Related Resources

The program controls point source discharges to ground waters and surface waters (see glossary for definitions).

Special Conditions of Permits: For your assistance, a sample SPDES Permit is included in Appendix A. The Special Conditions of the permit details information on the wastewater facility location, receiving water discharge point(s), permit limits, levels and monitoring and other requirements such as implementing Best Management Practices or a compliance schedule. Permit limits are the maximum allowable concentrations or ranges for various physical, chemical and/or biological parameters. The permit may also specify limits for flow (million gallons per day) and mass loadings (pounds per day). Monitoring requirements are noted in terms of frequency of collection, sample type (composite vs. grab), and sample location (influent or effluent). Recording, reporting and additional monitoring requirements are shown on Page 4 of Part 1.

Part 750 of the Official Compilation of Codes, Rules and Regulations of the State of New York (NYCRR) provides the statutory authority for requiring a SPDES Permit and operating in accordance with a SPDES Permit. For the complete regulation, visit the following website: www.dec.ny.gov/regs/4585.html.

Some important sections of Part 750 include:

- Public Notification of Discharges (750-1.12) requires that a sign be erected or posted where wastewaters are discharged to surface waters.
- Modification of SPDES Permits (750-1.18) provides the grounds for Permit changes.
- General Provisions of a SPDES Permit (750-2.1) indicate that any Permit noncompliance constitutes a violation of the Environmental Conservation Law (ECL) and the Clean Water Act.
- Inspection and Entry (750-2.3) allows for the NYSDEC to enter onsite, inspect, sample, request various records, etc.
- Operator and Permittee Liability (750-2.4) clearly outlines the possible criminal and administrative liabilities to the operator and/or the owner.
- Routine Monitoring, Recording and Reporting (750-2.5) discusses the kinds of records that must be maintained, the testing and analytical procedures required, and the need to submit Discharge Monitoring Reports (DMRs).
- Incident Reporting (750-2.7) outlines the procedures for reporting of a bypass, upset or other incident.
- Disposal System Operation and Quality Control (750-2.8) requires that the plant has preventive and corrective maintenance programs as well as written procedures for O&M, training of new operators, and laboratory QA/QC. The system shall not receive wastes beyond design capacity. The plant will have sufficient staff to satisfactorily operate and maintain the treatment works.
- National Pretreatment Standards (750-2.9) requires the plant to develop a pretreatment

Sludge treatment and disposal is an important part of the process.

program to monitor and control industrial users. This section also requires that excessive infiltration and inflow be identified and removed.

For questions and clarification of these regulations, contact the Regional Water Engineer in your area, or visit the "Regulations" section of NYSDEC's website.

Discharge Report Monitoring

The SPDES program requires that wastewater facilities complete and submit Discharge Monitoring Reports (DMRs). DMRs are legal documents and any falsification of data can result in legal implications. Failure to submit the DMR is a violation of the SPDES Permit, Article 17 of the NYS Environmental Conservation Law, and the Federal Clean Water Act. Records must be kept for at least five (5) years. DMRs are either mailed to a facility or the facility downloads them from a NYSDEC website. All DMRs must be signed and mailed to NYSDEC. The NYSDEC and USEPA are working together to allow electronic submission of the DMR through USEPA's Net DMR system, an effort that may eventually be mandated by USEPA regulations.

Across the top of the DMR is the mailing information for the permittee and facility, the SPDES permit number, discharge or outfall number, and the monitoring period. Monitoring can take place monthly, quarterly, semi-annually or annually. The DMR form lists the parameters and the monitoring locations for each outfall number down the left side. The form lists up to seven (7) parameters; therefore, outfalls with more than seven (7) parameters will require several DMR forms. These parameters and monitoring locations correspond with the SPDES permit limits, which are listed under the quantity (loading) and quality (concentration) columns on each DMR form. Data is entered in the open "Sample Measurement" boxes. On the right side of the DMR, there is a column titled "No. Ex." (Number of Excursions). Report the number of days in violation of a permit limit in this column. The NYSDEC's SPDES Compliance Coordinator tracks all SPDES permit violations.

Discharges are regulated and monitored, signage is also required.

Across the bottom of the DMR is the signature information. The Name/Title Principal Executive Officer (PEO) is the person who is authorized to sign the DMR or may authorize other representatives to sign the DMR. By signing the DMR, the PEO or authorized representative concedes that the data on the DMR is true, accurate, and complete to the best of his or her knowledge. Submit all changes in the authorized signer in writing to the NYSDEC using the Discharge Monitoring Report Signature Authorization Form in Appendix B.

Visit the following website for the DMR Manual that explains how to complete the DMR, for Frequently Asked Questions about DMR reporting, and for various forms that may not be available in this manual: www.dec.ny.gov/chemical/8461.html.

Enforcement

Governmental enforcement of water pollution control laws in New York is almost exclusively by NYSDEC, although USEPA has reserved in its delegation of authority to New York and other states the ability to step in and "overfile," (i.e., commence a federal enforcement action if USEPA determines that state enforcement is inadequate or insufficient).

Governmental enforcement actions against owners and operators can be initiated in several ways. The NYSDEC Division of Water staff identifies the majority of violations of water pollution control laws, regulations and permits. The agency's Division of Law Enforcement and Bureau of Environmental Conservation Investigations, staffed by fully authorized investigators and law enforcement officers with specialized environmental training, also identify many violations. These uniformed and plain-clothed police officers follow up on referrals from NYSDEC staff and tips from the public, and have authority to take civil or criminal action.

Violations and Penalties

Depending on several factors, including the mental state of the violator and seriousness of a violation, enforcement can be in the form of criminal, civil, and/or administrative prosecution.

When an owner or operator commits a knowing and willful violation of a water pollution control law, regulation, or permit, or commits an act or omission so negligent or extreme, he/she exposes themselves to criminal prosecution and liability. According to NYSDEC, the most common criminal violation committed by owners and operators of wastewater treatment plants is the submission of monthly discharge monitoring reports containing false information concerning the levels of pollutants discharged, the level of treatment achieved, or the operation of the facility.

If NYSDEC determines that criminal prosecution of an owner or operator is warranted and appropriate, it can refer the matter to a United States Attorney to commence legal proceedings in Federal District Court, or to the New York State Attorney General or a county district attorney for prosecution in New York State Courts.

As in all criminal proceedings, where the loss of one's personal liberty may be at stake, the prosecution bears a high burden and must prove beyond a reasonable doubt that the owner or operator committed the alleged violations. An owner or operator convicted of a criminal violation could face prison, in addition to monetary and other criminal penalties.

If NYSDEC determines that in committing a violation an owner or operator lacked the required knowing and willful mental state, the Department can still initiate civil enforcement proceedings. Civil enforcement can seek correction or abatement of violations, remediation or restoration of environmental damage, as well as monetary penalties. Article 71 of the ECL provides for civil penalties for most violations of water pollution control laws, regulations, and permits of up to $37,500 per day of violation. Civil enforcement also serves to punish violators and deter others from engaging in the same or similar conduct.

The NYSDEC often resolves civil enforcement proceedings through an Order on Consent. An Order on Consent is a legally binding contract between the violator, known as a Respondent, and NYSDEC. In entering into an Order on Consent, the Respondent waives his/her right to the hearing which he/she is entitled to by law, and agrees to do certain things, typically including the payment of a penalty and the taking of appropriate remedial measures to correct the violation. Violation of the terms of an Order on Consent can result in penalties of up to $37,500 per day of violation, and renewed prosecution of the original violations. The penalty normally has a "Payable Amount," and the Order on Consent may contain "Stipulated Penalties" for violations of its terms.

Administrative Proceedings

If a violation cannot be resolved in an Order on Consent, NYSDEC can initiate an administrative proceeding before an Administrative Law Judge (ALJ) where NYSDEC can seek an order to require compliance, as well as civil penalties. Such an administrative proceeding is commenced by the filing and service of a Notice of Hearing and Administrative Complaint, or a Notice of Motion for an Order Without Hearing. The ALJ, an employee of NYSDEC, conducts a hearing, hears the testimony of witnesses, reviews evidence put forward by NYSDEC staff and the Respondent, and makes a recommendation to the NYSDEC Commissioner.

The Commissioner can adopt the ALJ's report and recommendation, or make his or her own determination. Decisions of the ALJ and Commissioner will be upheld as long as such decisions are not arbitrary or capricious. Penalties imposed after an administrative hearing will often be greater than the original amount sought by NYSDEC in an Order on Consent.

The NYSDEC has issued qualifications for operators of wastewater treatment plants which are set forth at 6 NYCRR Part 650. Pursuant to this regulation, NYSDEC is authorized to issue a certification to an operator who satisfies those qualifications. If NYSDEC determines that an operator certification was issued by mistake or as a result of fraud, or if NYSDEC determines that an operator was negligent, or practiced fraud or deceit in the performance of his or her duties, NYSDEC can commence an administrative proceeding before an ALJ to revoke the operator's certification.

Owners and operators should understand that criminal prosecution of violations of water pollution control laws, regulations and permits does not preclude simultaneous or subsequent civil and administrative enforcement, and vice versa. As such, a single violation of a water pollution control law, regulation or permit could result in a scenario where an operator faces criminal prosecution by a United States Attorney and is subject to an administrative proceeding concerning the revocation of his or her certification, while the owner of the facility, which could be a municipal body, faces a civil enforcement action which could result in civil penalties and expensive corrective action.

If the Commissioner of NYSDEC determines that a condition or activity presents an imminent danger to the health or welfare of the people of the state or is likely to result in irreparable damage to natural resources, the Commissioner can issue a Summary Abatement Order requiring the immediate cessation of such condition or activity. Because this remedy is considered drastic, an administrative hearing must be provided within 15 days of the issuance of the Commissioner's Summary Abatement Order.

Because Congress recognized that the federal and state governments could not effectively monitor compliance of all discharges and enforce all violations, it included in FWPCA a "Citizen Suit" provision which allows any citizen to commence civil enforcement proceedings in Federal District Court to enforce compliance with FWPCA and violations of NPDES and SPDES permits. Since citizen suits may not be maintained for wholly past violations or where the federal or state government is diligently prosecuting such violations, it is in owners' and operators' best interests to immediately abate the violation if possible, and it may be advisable to seek the initiation of government enforcement activities so as to preempt a citizen suit.

Compliance: Best Strategy

Wastewater treatment is highly regulated at the federal, state and, sometimes, even the regional and local levels. Given that criminal violations of water pollution control laws, regulations, and permits can result in incarceration and civil penalties as high as $37,500 per day, and given that an operator's certification and source of livelihood can be revoked for cause, there is simply no substitute for compliance. Compliance requires proper planning by the owner, proper monitoring and maintenance by the operator, and cooperation and assistance by the relevant regulatory authority. Though non-compliance may appear in certain instances to provide some illusory short-term savings, compliance is, over the long term, a much more cost effective strategy.

Useful Liability Resource: The Local Government Environmental Assistance Network offers the The Primer for Local Governments on Environmental Liability at: www.lgean.org/documents/primer.pdf.

Certification on the Discharge Monitoring Report

The SPDES permit may require the permittee to submit a monthly Wastewater Facility Operation Report. This report, also known as the Monthly Operating Report, is a legal document that the PEO or authorized agent must sign conceding that the data is true, accurate, and complete. The certification section of this form (which appears on page 4) requires the PEO or authorized signer to acknowledge the statement shown here:

Questions regarding DMRs:
NYSDEC - SPDES Compliance Information Section
625 Broadway
Albany, NY 1233-3506
518-402-8177

SPDES Compliance System and You

Wastewater treatment facilities are monitored by NYSDEC to verify compliance with the SPDES Permit using a combination of approaches, including Discharge Monitoring Reports (DMRs), onsite inspections and reconnaissance, and effluent sampling/analyses. The NYSDEC responses to violations of the SPDES Permit may include:

- Phone Call from the Regional Inspector
- Onsite Inspection
- Technical Assistance
- Warning Letter from the Regional Inspector
- Compliance Conference
- Notice of Violation (NOV)
- Sewer Moratorium
- Penalties
- Order on Consent
- Notice of Hearing and Complaint (NOHC)
- State or Federal Prosecution
- SPDES Permit Modification

The level of NYSDEC response is a function of several factors including the number, severity and duration of violations, and the extent of cooperation by the community. The compliance of small wastewater treatment plants is monitored by NYSDEC. The NYSDEC and USEPA monitor the compliance of large treatment plants through the Significant Noncompliance Action Program (SNAP). Effluent violations, not filing a DMR or missing deadlines for a construction upgrade, each may result in a facility entering the SNAP process. The USEPA and NYSDEC meet quarterly to discuss appropriate compliance strategies to achieve SPDES permit limits and restore compliance at these facilities. If violations continue, the US EPA requires that NYSDEC use its enforcement mechanisms to restore compliance. As part of its agreement with NYSDEC, USEPA retains the right to conduct its own enforcement, an action known as overfiling. As an operator and local official, it is important to note that like most agency information, the public has access to the USEPA compliance database, under the Enforcement and Compliance History Online (ECHO) provision. Anyone can have access to up to 800,000 facilities nationwide and can review up to three (3) years of data for a center. You can visit the following website to check if your community's wastewater treatment facility is compliant: www.epa.gov/echo.

Envirofacts Data Warehouse is another USEPA database that can be searched to check for violations and compliance records specific to treatment plants. The Water Discharge Permits Query Form allows for the retrieval of selected data from the Integrated Compliance Information System (ICIS) that includes the National Pollutant Discharge Elimination System (NPDES). You can access this information on the following website: www.epa.gov/enviro.

Compliance, staying off SNAP, and avoiding possible legalities brought by public interest groups involve good management and operations procedures. The following list is just a few suggestions in order to maintain compliance:

- Meet SPDES Permit Limits
- Comply with Part 750
- Meet Deadlines in Orders and Permits
- Work with your NYSDEC Inspector
- Report Sampling and Monitoring Results Honestly
- Renew Operator Certifications On Time
- Establish an Adequate O&M Budget
- Revisit Sewer Rates
- Capital Improvement Plan and Reserve
- Preventive Maintenance and Process Control Systems
- Attend Ongoing Operator Training
- Train and Retain Good Staff

Additional Resources:

For SPDES Permit Regulations - 6 NYCRR PART 750

NYSDEC - Bureau of Water Permits
625 Broadway
Albany, NY 12233-3505
518-402-8111
www.dec.ny.gov/regs/2485.html

Manual for Completing the Discharge Monitoring Report for the State Pollutant Discharge Elimination System.

NYSDEC - Bureau of Water Compliance Programs
625 Broadway
Albany, NY 12233-3506
518-402-8177
www.dec.ny.gov/chemical/8461.html

This Chapter prepared by Brad DeFrees, Project Assistant at the Environmental Finance Center at Syracuse University; Douglas H. Zamelis, Esq.; Robert H. Feller, Esq., Bond, Schoeneck & King, PLLC and NYSDEC; Robyn Adair, Victoria Schmitt, Michelle Schwank, Bob Wither, Alan Cherubin and Mary Wojcik, NYSDEC.

Educating and Engaging the Public on Wastewater Treatment: Tools & Tips

Educating and engaging the public is perhaps one of the most important, yet least incorporated aspects of any municipal service. An informed public, and an informed Board, can be your best assets. There are several simple ways described in this chapter to let people know what you do.

NYWEA

Environmental Finance Center
Syracuse University

Chapter 5: Educating and Engaging the Public on Wastewater Treatment: Tools & Tips

Developing and maintaining a positive relationship with the public being served is vital. However, the intricacies of wastewater systems operations and maintenance along with financing and rate structures are foreign to the vast majority of the public. Most people may never think about wastewater, where it goes or the complexities involved in providing this service. Despite this, citizens often want to provide input to local government on the impact and cost of these facilities and services. For this public input to be useful there should be both public education and an established, easy and efficient process by which the public may participate in deliberative discussions regarding their wastewater utility. There are many organizations and resources available to assist communities with education and public participation programs. The following includes tips and ideas on how to better educate the public your utility serves: what information to share, and how to educate and better engage the public in the decision making process regarding one of the community's most valuable assets—the wastewater treatment plant.

> **"Make it fun and interesting—it is your job and your plant and no one knows it better than you."**

Mission: cleaner water for future generations

How to Reach Consumers

Because local government generally acts as the primary provider of wastewater treatment for its citizens, government also becomes their link to understanding the operations, maintenance, cost and proper use of those services. Utilities have the opportunity (and the duty) to educate their customers regarding the services, user responsibilities, and the water quality goals that those utilities support. Here are some key elements for reaching out to, and educating the community:

- Mission Statement
- Community Surveys
- Presentations at schools, civic groups, etc.
- Bill stuffers
- Newsletters
- Open House events
- Public Service Announcements

Mission Statement

A treatment plant has a clear and distinct mission, but is there a mission statement describing it to the community? Mission statements are generally only two to three sentences and can be created easily, but should be well thought out as they are the single most important tool in helping the public understand what a treatment plant does. Many communities already have a mission statement for their wastewater treatment plant.

Customer Surveys

A utility can often lose contact with its users. This may be the result of not actively engaging the community, or listening to only a select and vocal few. To obtain a representative set of consumer opinions, it helps to conduct a customer survey. The survey may

Here is just one example from the Onondaga County Department of Water Environment Protection, stipulating its Mission, as well as its Vision and Core Values:

VISION: To be a respected leader in wastewater treatment, stormwater management, and the protection of our environment using state of-the-art innovative technologies and sound scientific principles as our guide.

MISSION: To protect and improve the water environment of Onondaga County in a cost-effective manner ensuring the health and sustainability of our community and economy.

CORE VALUES:

Excellence
Teamwork
Honesty
Innovation
Cost-Effectiveness
Safety

also be used to gauge the level of customer satisfaction and to direct efforts for service improvements. Survey development, marketing or public relations professionals are generally quite helpful in conducting a customer survey. These professionals are familiar with the procedures for proper survey preparation, distribution, validation and interpretation. However, if the cost to hire a professional is a challenge, consider contacting a local college or university—generally there are faculty, staff and/or students who are well trained in survey development and can help for free or for a more affordable rate.

Public Meetings and Presentations

As a public body, a community's utility commission will have regular public meetings. These meetings must be orderly, well managed and productive. Technical presentations at these meetings should be well prepared and should be both technically complete and, especially if requiring budgetary appropriations, easily understood by the public. Business at public meetings should be completed in a professional manner, and unnecessary or repetitive discussion should be minimized.

While public participation should be encouraged, these open meetings should be conducted and managed in a professional manner. Members of the public should be required to keep their remarks brief and to the point. At times, it may be necessary to place a time limit on public comments to allow sufficient time for all public input. It is important to manage the presentation so that public comments are relevant to the discussion and not repetitive. Leaders should be ready to refocus the discussion if individuals provide irrelevant testimony or repeat comments.

As stamped on the manhole cover above, communication is at the heart of good management.

Don't be reluctant to go out and talk about what you do and the services provided to consumers in the community. Accept invitations to speak at community and civic meetings, and look for opportunities to be invited to present and discuss what you do. Prepare a PowerPoint presentation and/or handouts as aids in your appearance. Make it fun and interesting—it is your job and your plant and no one knows it better than you.

Bill Stuffer Announcements

The bill stuffer has long been a favorite tool of many water and wastewater utility managers. Bill stuffer informational packets are available from a number of commercial suppliers and trade organizations. These are professionally prepared documents that cover a wide range of public education topics of interest to water and wastewater customers.

Some bill stuffers are specific to topics that may be of growing importance to the community, such as source water protection, biosolids (sludge) management or wastewater recycling. Bill stuffers provide an opportunity to begin the educational process for the consumer and community. Most bill stuffers can be customized to include specific information about the utility. The Water Environment Federation (www.wef.org) has many of these pieces of literature available and are designed to be customizable. They are generally inexpensive and cover a wide variety of topics.

Newsletters

An annual, biannual or quarterly newsletter is an excellent way to communicate to customers the plans and accomplishments of a water or wastewater utility. Newsletters should be brief and to the point. They should include, whenever appropriate or possible, pictures, graphs, figures, tables and charts. Overly lengthy articles or pages full of text generally do not attract the attention of your customers. Also, as more people are moving into the digital age, you can create and send email newsletters using free web-based programs that are easy to use.

However, an important consideration in deciding to publish a newsletter is consistency. Once a utility decides it is going to publish a newsletter, it must maintain that commitment. Consistency in length, font type and size, time of year sent, consistency in layout and design, and in voice, are all things to consider. Failure to follow through will reflect poorly on the professionalism of the operation.

Open Houses

An open house, tour or other special event can be an excellent way to get the public and perhaps the media to see what goes on in water or wastewater systems. It can also be an event in which employees and public officials may involve their families in their work.

The event should be well organized, with a specific schedule of events. Tours should be in small groups along a safe (and, if possible, odor-free) route. If necessary, safety equipment such as hard hats and hearing protection should be provided. Wearing appropriate shoes should be communicated in advance with no flip-flops or open toe shoes allowed. Speakers should be well prepared and ready to answer questions from their audience. Some communities will invite other organizations, consulting firms, educational institutions and the like, to set-up informational tables at the event so attendees can learn more about water treatment and its importance to the environment and public health. Consider a barbecue, coffee and doughnuts, or other refreshments that could be provided for free, or provided by a local civic group for purchase to support its organization. Make it truly a community event. It is incredibly important to publicize the event to make sure it is successful and worth the time invested. Think about developing a publicity plan that includes ads in the local newspaper, community, church and civic newsletters, fliers, mailings and other efforts that may help spread the word to as many people as possible for as inexpensively as possible. Again, some private consulting firms can help with this, though a few ambitious and savvy community members can be equally as valuable.

Public Service Announcements

Public service announcements are a good way to promote environmental and safety messages to the

Plant tours can be very educational and enlightening for the public.

public on behalf of utility operations. Local media outlets can provide more information on the specific requirements for placing a public service announcement. However, public service announcements are being harder to place due to budgetary constraints often found in local broadcast media. Sometimes the local media outlets will help produce the commercial; if not, it can become an additional cost. Consider partnering with other operators in the area to create a public service announcement that will be broadcast to all of those communities—this will make more practical sense both to the media outlet (which often covers several counties) and to all the utilities/communities involved in the message.

What to Talk About

Now that you have the tools to reach out and educate your community, what should you inform them? Obviously, you will want to frame the message in terms of local issues, current events and the needs of the treatment plant and its community. In other words, keep it real!

Promoting Best Practices/Consumer Responsibility

As important as it is to educate your community on the operations, maintenance and finances of its treatment plant, it is equally important to let the consumers know how they can help, why their behaviors and contributions make plant operators' jobs easier, and why it is important to do—or not do—some rather simple things to support water quality efforts. Keep in mind that the actions or inactions of the community in regards to water quality issues can have deleterious effects on other things the community might value. In promoting consumer responsibility, answer these questions: What is your receiving water body? Could it be negatively affected, or improved by the actions of the surrounding community? Does your community value local water bodies for hunting, fishing, boating, swimming and other recreation? How can community actions help the plant and others in efforts to advance community values?

Human Health and Safety

It is often helpful to educate consumers about how their actions can protect the environment, their own health and safety and that of the community. More importantly, let them know that the wastewater treatment plant through its efficient operation protects public health and the environment, as is mandated by the Clean Water Act. The cost of inaction or short-term cost-cutting is much more expensive for the community in the long term, and can cause immediate, long term and potentially dangerous situations both for the local community and those downstream.

You may also want to discuss, particularly if hosting a public event at the plant, all of the requirements and procedures necessary to ensure human health and safety at the plant.

Water and Energy Conservation

Water conservation is an important issue on two levels. First, as consumers conserve water, they conserve the capacity of the facilities that perform treatment. Excessive water use wastes the capacity of the systems producing the water and treating the resulting wastewater. Second, with increasing regularity, public demand for water exceeds locally available supplies, which can increase supply costs in the short and long-term. Water conservation efforts are the best tool for stretching those supplies as far as possible to serve the present and future needs of communities.

Experience and public opinion surveys indicate that most customers are interested in conserving water and appreciate the cost savings from reduced usage. However, they may not know how to conserve, despite the fact that water conservation techniques are convenient and easy to implement. Effective public education campaigns can substantially improve water conservation, contribute to system capacity and build appreciation for the important work of treatment plant staff and local officials.

Topics related to water conservation:

- **Leak Protection**: know if you have one and how much water a leak can waste.
- **Lawn and Garden**: how much water generally is used for landscaping; the type of landscaping that uses less water; and more efficient ways to water.
- **Car Washing**: how to reduce water use with driveway car washing; how water can be saved in commercial car washing.
- **Household Use:** changes in household water use habits that save on water usage.
- **Industrial and Commercial**: pollution prevention to reduce water usage and in wastewater generation.
- **Water Metering**: how water usage is affected

by billing based on usage vs. flat rates with no restrictions on usage.

Source Water Protection

The actions of irresponsible individual consumers can have disastrous effects on groundwater and surface water supplies. These impacts on water supplies can also prevent recreational usage and natural habitats. Customers must be informed about how their actions, such as the use and disposal of chemicals, fertilizers, pharmaceuticals and household cleaning products, can affect water supplies. Educate the community on what happens when individuals flush these items down the drain. To protect water supplies from contamination, communities need watershed management plans (surface water supplies) and wellhead protection programs (groundwater supplies).

Storm Sewers

While the operation of storm sewers may not be governed by the sewer authority, storm sewers are an important and often misunderstood part of a community's infrastructure. Misuse of storm sewers can lead to significant water pollution.

Many people do not know that sanitary sewers flow to treatment plants that provide significant treatment to remove pollutants before discharge. Most storm sewers flow directly to natural waters, with little or no treatment. Often these natural waters are drinking water supplies.

Chemicals, trash, leaves and other debris discharged into storm sewers, or that run off into storm sewers from lawns or driveways, are not removed before they reach those natural waters. Many communities have started educational programs to help the public understand the importance of limiting polluting discharges into storm sewers. These programs have often included painted messages next to street drains to indicate that only rainwater should go down the drain. (*More information on stormwater management can be found in Chapter 6.)*

Proper Disposal of Hazardous Waste

Improper disposal of hazardous waste can cause contamination of surface water supplies, groundwater and soil. Hazardous waste can also adversely affect the biological treatment processes at wastewater plants and can contaminate landfills that were not designed to receive these materials. Many communities have started household hazardous waste programs to inform the public of the proper disposal procedures for various waste products.

Often the first step in a household hazardous waste program is to educate the public about the types of common materials that are hazardous. Many products used daily are considered hazardous when they become waste. For example, the used or leftover contents of household products, such as paints, cleaners, stains and varnishes, car batteries, motor oil and pesticides, are all household hazardous wastes.

Brochures and bill stuffers can be used to address the issues relating to proper hazardous waste disposal. In addition, most state environmental protection agencies offer hazardous waste disposal programs that can help communities address this matter.

Communicating and Managing Facility's Public Image

Many people say perception is reality. What is the perception of your treatment plant to your users—is it clean, well-kept, with nice curb appeal? If not, the perception may soon become a reality as you struggle to build and maintain community confidence in the level of service the plant delivers. It is essential for the public to know that the community's facilities are well managed. Because the public is quick to realize when there are problems with local facilities, assumptions can be associated with poor management. Consequently, it is important that all aspects of wastewater service, including management, provide the highest quality service and render a professional impression that begins with reliable service.

Learn more about the "Ten Steps" at the next Panel on Wastewater for Local Representatives. Contact NYWEA at (315) 422-7811.

Open house at Cooperstown celebrating their new UV system.

Managing the Media

Absent an effort to bring the good work of community utility systems to the media's attention, the media will probably not call until there is a problem. Positive events like Household Hazardous Waste Take Backs, Open Houses and other programs will garner positive media; but even if the utility receives media coverage for the positive aspects of its operations, the potential for negative media attention always exists. To make a good impression, leaders should be as open and honest as possible, being ready with and certain of the facts, and offering fact sheets or summaries to avoid any misstatements about events or accidents.

Many publications and training courses are available to help staff deal with the media. It may be best to delegate responsibility for media contact to a single individual with good communication skills and to assure that they are trained in the specifics of media interaction. This individual can then coordinate media contacts with technical staff relating to specific issues.

Responding to Correspondence

It is important that the utility respond promptly to all correspondence from its customers. If an issue is likely to take some time to address, a reply should nevertheless be sent immediately, indicating when the customer may expect a specific response. The response should be thorough and attempt to fully address the issues raised in the original correspondence. Replies to correspondence may require a meeting to discuss more difficult issues, and a summary of the results of that subsequent meeting should be sent to the correspondent.

All correspondence should be professionally prepared and signed by an authority representing the organization. A file of all incoming correspondence and replies should be maintained for future reference.

Water Environment Federation Public Education Program

As a leading source of water quality information, the Water Environment Federation (WEF) develops programs and materials to help its members communicate with their target audiences about key water quality issues. As a not-for-profit technical and education organization for water quality professionals, its goal is to increase an understanding of the direct role water and wastewater services have in the protection of public health, the economy and the environment.

Since 1928, WEF has worked to provide its members, public officials and the general public with the necessary tools to engage in or learn ways to improve quality of life through water resources management, water protection, and water and wastewater treatment.

For the general public, WEF offers a full brochure series, videos, posters and CD-ROMs on a wide range of water quality topics including wastewater treatment processes, careers, point and non-point source pollution, watershed management, water and wastewater infrastructure, fats, oils and greases, and water and biosolids recycling. Developed by water quality professionals, the materials can be used as informational mailers, bill inserts, and handouts for community meetings, exhibits, plant tours and school programs.

For educators, WEF offers, "The Water Sourcebook," a supplemental K-12 school curriculum on water quality. The popular hands-on series is designed to be an easy way for teachers, non-formal educators and water quality professionals to teach elementary and secondary grades about today's most important water quality issues which include wastewater and drinking water treatment, ground and surface water and wetlands.

To supplement this effort, WEF also offers a full-day, hands-on training workshop for high school science teachers at WEFTEC®, the Federation's annual technical exhibition and conference. Featuring Sewer Science, a mobile wastewater treatment plant equipped with specially designed tanks, real-life laboratory analytical equipment and workbook, the award-winning simulation guides teachers through the wastewater treatment process. The miniature laboratory and supplemental materials, through a unique partnership of corporations, municipalities, consultants, community organizations and area high schools, are then provided exclusively to high schools in the conference host city for a full academic year.

For students, WEF organizes the Stockholm Junior Water Prize (SJWP), the most prestigious international youth award for a high school water science research project. Organized in the United States by WEF and its member associations, its purpose is to increase students' interest in water-related issues and research, and to sensitize them as future leaders to global water challenges.

Understanding the influential role of the general public, public officials and the media in the formation of public opinion and policy, WEF also works to inform those audiences about water quality through educational tours, congressional testimony, newsletters, news releases, press events, formal comments on regulatory and legislative matters, and grassroots public education programs.

The Water Environment Federation has also developed a new campaign titled WATER'S WORTH IT, that aims to raise awareness about the value and importance of water, water-related issues, and the water profession. The campaign helps to answer the question about how our actions, attitudes, and the things we most value are so closely connected with water. The program is designed to inform a range of audiences, including the general public, media, opinion leaders, decision-makers, and elected officials.

The goals of the campaign are to:

- Demystify water and wastewater treatment by showing the direct connections between what water sector professionals do and what the public values — create jobs, protect health, protect the environment, and provide clean water.
- Expand and deepen the awareness of the value of water.
- Explain that water is a precious and limited resource that needs to be recycled and reused.
- Elevate the profile of water sector professionals by building respect and appreciation for the services they provide.
- Create a foundation of public awareness to support needed infrastructure investments.
- Support cutting-edge practices to deliver, recover, and reuse water resources.

How Does It Work?

Everyone who uses water is encouraged to join this coordinated effort to raise awareness about the value and importance of water. By joining our voices behind this campaign, each of us can contribute to a positive change.

Public Education means being enthusiastic. Here, Ronnie the Raindrop educates attendees about stormwater at Onondaga County's Metro Wastewater Treatment Plant Annual Open House.

For members of the water sector, the campaign will:

- Provide you with communication tools you will need to succeed,
- Help you to build alliances at the state, regional, and community level, and
- Help you coordinate a flexible outreach and education effort that is easily tailored to what's happening in your state, region, community or agency.

For the general public, the campaign will:

- Provide you with the information you need to be an educated and responsible consumer,
- Help you to create a personal connection with water
- Show you how your life is inextricably linked to this vital resource, and
- Help you to understand how important the water profession is and the essential services that it provides to your quality of life.

We encourage you to learn more about this program and how you can help be a voice for water.

This chapter prepared by Khris Dodson, Communications and Program Manager at the Environmental Finance Center at Syracuse University.

Stormwater Management and MS4s

Stormwater picks up pollutants as it flows over roadways, sidewalks, parking lots, construction sites, lawns, buildings, etc. These pollutants flow untreated through gutters, storm drains and drainage ways into surface waters. It is estimated that more than one-half of the pollution in the nation's waterways comes from stormwater runoff.

NYWEA

Environmental Finance Center
Syracuse University

Chapter 6: Stormwater Management and MS4s

What is Stormwater Pollution?

Stormwater is water from rain or melting snow that doesn't soak into the ground. Stormwater begins as clean water and flows directly into our rivers, lakes and streams. Along the way, it picks up pollutants with which it comes in contact as it flows over roadways, sidewalks, parking lots, construction sites, lawns, buildings, etc. These pollutants become part of the stormwater runoff that flows untreated through gutters, storm drains, canals and drainage ways into local surface waters. It is estimated that more than one-half of the pollution in the nation's waterways comes from stormwater runoff.

"When rainwater and snowmelt come into contact with pollutants that have accumulated over time on pavement, lawns, rooftops and other surfaces, those pollutants are carried directly, or through the drainage system, to nearby surface water bodies."

Why It's Necessary to Manage Stormwater

During runoff events, pollutants carried by stormwater (rainwater or snowmelt) enter and degrade the quality of lakes, rivers, wetlands and other waterways. Nutrients such as phosphorus and nitrogen can promote excessive growth of algae, deplete dissolved oxygen and harm other aquatic life. Oil and toxic chemicals from automobiles, sediment from construction activities, litter and trash, and careless application of pesticides, herbicides and fertilizers threaten the health of receiving waterways, impair recreational use and can cause death to fish and other aquatic life. Bacteria from animal waste and illicit connections to sanitary sewer systems can make lakes unsafe for wading, swimming and fishing. Stormwater runoff can also lead to streambank erosion, flooding and damage to infrastructure and personal property. This is why the control of stormwater volume (quantity) is just as important as control of stormwater quality.

Pollutants of Most Concern

Stormwater runoff from impervious surfaces carries large amounts of various pollutants to surface waters. These pollutants include nutrients, silt/sediment, pathogens, oil/grease, metals, debris and litter. The following summary outlines some of the stormwater pollutants warranting awareness.

Phosphorus: Phosphorus and other nutrients promote weed and algae growth in lakes and streams. Excessive weed growth clogs waterways and blocks sunlight. When algae die, they sink to the bottom and decompose in a process that removes oxygen from the

Better stormwater management, and appropriately sized infrastructure, can help mitigate some flood damage.

water. Many fish and other aquatic organisms cannot exist in water with low dissolved oxygen levels. Sources of nutrients include fertilizer, failing septic tanks and detergents.

Silt and Sediment: Stormwater runoff that contains silt and sediment can damage the habitat needed by aquatic plants and animals. Aquatic habitat, including fish spawning areas, may be destroyed, food supplies reduced, and recreational activities may be impaired when sediment fills swimming areas and navigation channels. In addition to blocking sunlight needed for aquatic plant growth, sediment can transport toxic chemicals to bodies of water.

Toxic Substances (gasoline, household products, paint thinner, metals, etc.): Toxic substances may enter surface waters either dissolved in runoff or attached to sediment or organic material. The principal concerns in surface water are entry of these substances into the food chain with toxic effects on fish, wildlife and microorganisms, along with the degradation of habitats and the potential degradation of public water supplies. Toxins such as heavy metals bioaccumulate, meaning that they become more concentrated and toxic the higher in the food chain they progress. Toxic substances can originate from residential areas, businesses and construction sites. They include oil and grease from petroleum products, which form a film over the water that blocks oxygen transfer.

Pathogens (bacteria, viruses): Bacteria and viruses include infectious agents and disease producing organisms normally associated with human and animal waste, leakage from sanitary sewers, and seepage from septic tanks. Because pathogens can harm aquatic and human health, their presence can render lakes and streams unsafe for drinking, swimming, fishing and other forms of water recreation. Pathogens or biological contaminants come from litter, organic matter and animal waste.

Oxygen Demanding Organics: Natural or synthetic organic materials (including human and animal waste, decaying plants and animals, discarded litter and food waste) can enter surface waters either dissolved or suspended in stormwater runoff. Natural decomposition of the material can deplete dissolved oxygen supplies in the waters. When dissolved oxygen is reduced below a critical threshold level, it can impair or kill fish and other aquatic plants and animals.

Thermal Stress (sunlight): When streams lack nearby trees and shade, elevated water temperatures can exceed fish tolerance limits, reduce survival and lower resistance to disease. Street surfaces and other impervious areas which have been heated by sunlight may also transport thermal energy to a stream during a storm event. Cold water fish populations (such as trout) may be reduced or eliminated.

Litter: Floating litter in water may be contaminated with toxic chemicals and bacteria and can be harmful or fatal to aquatic organisms. Obviously, aesthetics of the water are also negatively impacted.

History and Intent of Phase II Stormwater Permit Program

The Phase II Stormwater Program is a federal permit program designed to reduce the introduction of nonpoint source pollutants to surface waters via stormwater runoff. Its history began with the passage of the Clean Water Act in 1972. Under the Clean Water Act, the US Environmental Protection Agency (USEPA) initiated the National Pollutant Discharge Elimination System (NPDES) program. The purpose of NPDES is to protect the quality of the nation's water resources. In the early stages of the program, the focus was on regulation of "point source" pollution discharges from discrete, identifiable "outfalls" such as pipes carrying wastewater from a sewage treatment plant or industrial process facility to a water body. As a result of this permit program, point source pollution has been effectively controlled.

Keeping stormwater out of the system using green infrastructure is part of the solution.

The majority of current water quality problems originate from nonpoint sources. Nonpoint source pollution originates from multiple, diffuse sources spread across the landscape. When rainwater and snowmelt come into contact with pollutants that have accumulated over time on pavement, lawns, rooftops and other surfaces, those pollutants are carried directly, or through the drainage system, to nearby surface water bodies.

In 1990, the USEPA mandated the issuance of NPDES permits to control nonpoint source stormwater pollution, known as the "Phase I" Stormwater Permits. Authority for administering the NPDES permit program in New York State was delegated to the New York State Department of Environmental Conservation (NYSDEC). The NYSDEC initiated its Phase I State Pollutant Discharge Elimination System (SPDES) permit program for stormwater in 1995. Most types of industrial facilities, construction sites disturbing over five acres of soil surface, and municipalities with separate storm sewer systems serving populations of over 100,000 were required to obtain coverage under the Phase I permit program.

What is an MS4?

A Municipal Separate Storm Sewer System (MS4) is any system of open or closed pipes, ditches or conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels or storm drains) designed or used for collecting or conveying stormwater and which is not a combined sewer. The MS4s are owned and operated by a government entity such as a town, city, village, state, county or publicly funded district or institution.

Investing in stormwater infrastructure protects the number one customer—the receiving stream.

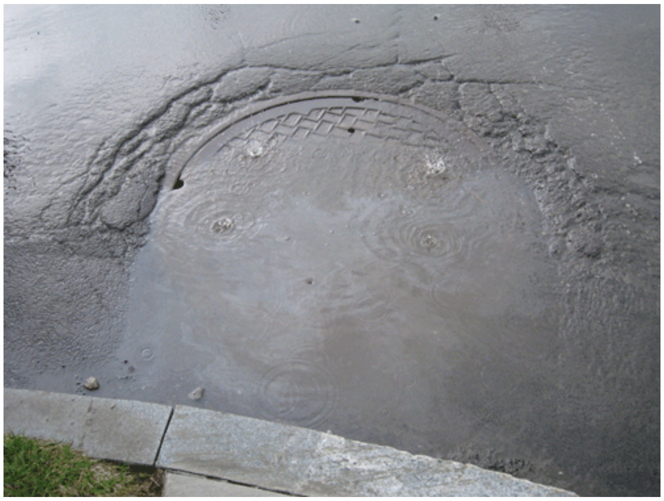
It is important to understand the difference between a separate storm sewer system and a combined sewer system. Separate storm sewers carry only runoff from rainwater and snowmelt, whereas combined sewer systems carry a combination of stormwater runoff and sanitary sewage. The latter are present and serve significant proportions of many medium-sized cities in upstate New York. The MS4 permit regulations apply only to those areas served by separate storm sewer systems rather than combined systems.

NPDES Phase II

The NPDES program was expanded in 2003 to include construction sites disturbing between one and five acres of soil surface and municipalities with separate storm sewer systems serving 50,000 to 100,000 people with a population density of at least 1,000 people per square mile and that are contiguous to a centralized urban area. Referred to as Phase II of the program, automatically designated cities, towns, villages and counties, as well as special districts and government institutions within the urbanized areas, are required to control the quantity and quality of stormwater discharged from their Municipal Separate Storm Sewer Systems (MS4s). These entities are referred to as "regulated MS4s."

The Statewide General Construction Permit required developers to control the quantity and quality of stormwater runoff from construction projects that disturb more than one acre of soil, regardless of whether or not the development is located within the boundary of an automatically designated MS4.

The term "disturbance" refers to any activity resulting in the exposure or movement of soil. This can include clearing, grubbing, excavation, grading, demolition, stockpiling, burrowing, or any other such activity. It is important to bear in mind that the one



Aging infrastructure often exceeds capacity when handling increasing volumes of stormwater.

acre threshold is cumulative. In other words, the one acre threshold is the total disturbed area over the life of the project and is not the maximum area disturbed simultaneously.

Also, two projects that are constructed as part of a larger common plan of development in a contiguous area, even if they do not each individually disturb one acre, are subject to the permit if combined disturbed area is one acre or more. The following are illustrative examples: two parts of a road improvement or utility project occurring within less than a quarter mile of each other; two single-family homes on lots originating from the same subdivided plot along a common road frontage; or commercial development by two different owners within the same industrial or office park.

Stormwater Program Objectives and Minimum Control Measures

The objectives of the Phase II MS4 General Permit are as follows:

- Reduce the discharge of pollutants to the maximum extent practicable
- Protect water quality
- Satisfy the appropriate water quality requirements of the Clean Water Act.

The USEPA determined that in order to satisfy these requirements, municipal stormwater management programs (SWMPs) must address six distinct elements of control commonly referred to as minimum control measures (MCMs). The six MCMs are summarized next.

MCM 1: Public Education and Outreach

The regulated MS4 must develop and implement a formal program to educate the public concerning the issues of stormwater pollution. This involves identifying the pollutants of concern, target audiences (including elected and appointed municipal officials, municipal staff members, citizens, the land development industry and businesses), and intended education and outreach methods (mailings, print media, television or radio announcements, displays, presentations, school programs, etc.).

Recordkeeping and Reporting Requirements for MCM 1: The information maintained will be heavily dependent on the specifics of the municipality's program.

MCM 2: Public Involvement and Participation

The regulated MS4 must involve the public in the stormwater program. The regulated municipality should identify the constituents from which feedback is desired and the types of input particularly sought. Regulated MS4s are encouraged to support or sponsor stewardship programs, such as stream cleanups, storm drain stenciling programs and membership in watershed organizations as a means of encouraging local residents to become involved in protecting and maintaining local water resources. As a required element of this MCM, the municipality must make its annual report available for public review and comment, and must document its intended response to comments and inquiries received. (NOTE: MCM 2 differs from MCM 1 in that MCM 1 focuses on fostering awareness of the stormwater pollution problem in the hope of promoting behavior changes; whereas, MCM 2 actively solicits participation and input from the public.)

Recordkeeping and Reporting Requirements for MCM 2:

- Names and contact information for relevant local officials and representatives with responsibilities for the stormwater program
- Comments received on the draft MS4 Annual Report and intended responses
- Date of public notice and date of public meeting each year, or date that the annual report was posted on the municipal website
- Information specific to your municipality's public involvement and participation program, such as date, location, and number of participants in public involvement activities
- Complaints or inquiries relating to local stormwater issues with follow-up action

MCM 3: Illicit Discharge Detection and Elimination

The regulated MS4 must develop a program to identify and eliminate sources of non-stormwater flow to the separate storm sewer conveyance system. Common examples include septic system, sanitary line and floor drain connections to storm sewers, and dumping of any non-stormwater substances directly into storm drains. Regulated MS4s are required to develop and adopt a local law or regulatory mechanism prohibiting non-stormwater discharges to the MS4, map stormwater outfalls and their associated drainage areas (sewersheds), establish an outfall monitoring program to identify non-stormwater discharges and determine their source, conduct public education regarding the problems created by non-stormwater discharges, and conduct enforcement actions or provide oversight of voluntary compliance to eliminate these discharges.

Recordkeeping and Reporting Requirements for MCM 3:

- Number and percentage of total outfalls inspected (20 percent is a suggested goal to ensure inspection of 100 percent every five years)
- Number of potential illicit discharges identified
- Number of illicit discharges eliminated
- Enforcement actions (Code Enforcement Officer)

MCM 4: Construction Site Runoff Control

The regulated MS4 must develop and implement a local law or regulatory mechanism to control erosion of sediment and pollution of stormwater runoff from construction sites during construction activity. The program must ensure development and implementation of Stormwater Pollution Prevention Plans (SWPPPs) in accordance with NYSDEC's standards as discussed in the Construction General Permit, including the current New York Standards and Specifications for Erosion and Sediment Control (2005).

A local law is required to give the municipality the authority to review SWPPPs, enforce the standards, and require proper management and stabilization of construction sites to prevent water quality violations. Regulated MS4s must also provide education to the construction industry on proper methods of erosion control (keeping sediment in place) and sediment control (capturing eroded sediment onsite); and, contractors performing work in all regulated MS4s must receive four hours of NYSDEC endorsed training every three years.

Previously, MCM 4 applied only to the designated urbanized area. As of the issuance of new permits in May 2010, the requirements now extend to the boundaries of the entire municipality regardless of the extent of the urbanized area.

Recordkeeping and Reporting Requirements for MCM 4:

- Number of SWPPPs reviewed
- Number of SWPPPs accepted
- Public comments received on SWPPPs with records of responses
- Number of sites inspected
- Number of inspections at each site
- Number of violation notices issued
- Number of corrective actions taken in response to violation notices
- Inventory of active construction sites

MCM 5: Post-Construction Stormwater Control

The regulated MS4 must develop and implement a local law or regulatory mechanism to manage the quantity and quality of stormwater runoff from construction sites through permanent stormwater management practices following the completion of construction activity. The program must ensure development and implementation of stormwater pollution prevention plans (SWPPP) in accordance with NYSDEC's standards as required in the Construction General Permit. All design components included in the SWPPP must be in conformance with the current New York State Stormwater Management Design Manual (2010). The 2010 Design Manual places a significant emphasis on Better Site Design and Green Infrastructure in stormwater management. This has changed the process for design and review of SWPPPs.

A local law is required to give the municipality the authority to review projects, enforce the standards, and ensure maintenance of stormwater facilities following completion of construction. The MCM 5 also requires regulated MS4s to identify water quality problems and implement stormwater retrofits to address those problems.

Previously, MCM 5 applied only to the designated urbanized area. As of the issuance of new permits in May 2010, the requirements now extend to the boundaries of the entire municipality regardless of the extent of the urbanized area.

In addition to previously mentioned requirements, during development of municipal comprehensive plans, open space preservation programs, and other local laws and regulations, MS4s must consider principles of Low Impact Development, Better Site Design and Green Infrastructure. These principles may include elements such as "smart growth," natural resource protection, impervious area reduction, maintenance of natural hydrology, and use of buffer zones or setbacks to protect environmentally sensitive areas, such as streams, wetlands and erodible soils.

Redevelopment Projects: Special design criteria apply to redevelopment projects (previously developed sites with existing impervious surface that is replaced or restored to pervious ground). Under certain circumstances detailed in Chapter 9 of the New York State Stormwater Management Design Manual, the water quality volume requirement may be reduced and some water quantity controls might be waived.

Impaired Waters: If a small MS4 discharges a stormwater pollutant of concern (POC) to an impaired water body (listed in Appendix 2 of the permit), the MS4 must ensure that there is no net increase in its discharge of the pollutant to that water. By January 8, 2013, MS4s must assess potential sources of the pollutant of concern (POC) in stormwater, and identify control measures that may reduce the pollutant. The Stormwater Management Program Plan (SWMP) must be updated if necessary. For the portions of the MS4 that drain to the listed water body, the effectiveness of the SWMP must be evaluated in drainage basins that have undergone significant alterations. Examples include changes to land use and impervious cover greater than one acre, or implementation of stormwater management practices during the time the MS4 has been covered under the MS4 general permit. The NYSDEC requires that approved computer models be utilized to complete the assessment. If the modeling shows increases in loading of the POC, the SWMP must be modified to reduce discharge of the pollutant so that no net increase occurs. Annual reports must contain an assessment of priority stormwater problems, potential management practices that are effective for reduction of stormwater POCs, and a gross estimate of the extent and cost of the proposed improvements. Guidance concerning the modeling process can be found online at: http://www.dec.ny.gov/docs/water_pdf/ms4rsappend.pdf.

Tioga County Soil and Water Conservation District Wetland Restoration mitigates flooding from storm events. Photo credit: Melissa Yearick, Tioga County SWCD.

Recordkeeping and Reporting Requirements for MCM 5:

- Number of SWPPPs reviewed
- Number of SWPPPs accepted
- Public comments received; records of comments and responses
- Post-construction stormwater management practices inspected
- Maintenance activities for post-construction stormwater management practices

MCM 6: Pollution Prevention and Good Housekeeping

The regulated MS4 must inventory all of its department operations and identify sources of pollutants of concern (POC) created by the operations. These operations include maintenance of municipal roadways and drainage systems, buildings and infrastructure, parks and open or common spaces, and solid waste disposal. Policies, procedures and best management practices must be identified and implemented to eliminate (or reduce to the maximum extent practicable) these pollutants. Municipal staff must be trained on the hazards of stormwater pollution and the practices required for preventing and mitigating those hazards.

At a minimum of every three years, MS4s must complete a self-assessment of all operations and facilities to ensure that discharges of POC are being eliminated to the maximum extent possible. Procedural changes must be implemented and communicated among various municipal departments.

Recordkeeping and Reporting Requirements for MCM 6:
Typical quantities that are recorded in the annual report include, but are not limited to, the following:

- Acres of parking lots swept multiplied by number of times swept
- Miles of streets swept multiplied by number of times swept
- Catchbasins inspected and cleaned when necessary
- Post-construction stormwater control practices inspected and cleaned when necessary
- Phosphorus applied in chemical fertilizer (lbs.)
- Nitrogen applied in chemical fertilizer (lbs.)
- Pesticides and/or herbicides applied

NOTE: This list is required data specifically mentioned in the permit text; NYSDEC expects that the municipal departments will also report on any and all other quantities that specifically relate to their unique operating circumstances. This includes, for example, quantities of deicer applied, recycling of hazardous waste or yard waste, miles of roadside ditches and embankments stabilized, and any changes or improvements to the operations of municipal departments that would be expected to reduce or eliminate sources of stormwater pollutants. The number of staff trained in the pollution prevention program on an annual basis should also be reported. A goal of 100 percent of staff receiving initial training or refreshment of training on an annual basis is suggested.

Determining MS4's Responsibilities and Measurable Goals

Regulated MS4s were required to submit a Notice of Intent (NOI) as a prerequisite for obtaining coverage under the General Permit for Stormwater Discharges from Municipal Separate Storm Sewer Systems (MS4s) in 2003. The NOI outlined the specific elements of the permittee's intended stormwater management program relative to each of the six Minimum Control Measures. The NOI also identified the timeline and schedule for completion of the various program elements and discusses specific processes for accomplishing stated goals. In summary, the completed NOI provided a framework for the regulated MS4's stormwater program, although goals and methods may change as the program is re-evaluated on an annual basis.

In May 2010, the permit was updated and designated as SPDES GP-0-10-002. All municipalities previously covered under the 2008 permit automatically had their coverage transferred to the new permit (designated SPDES GP-0-10-002). The current permit is available on the NYSDEC website at: http://www.dec.ny.gov/chemical/43150.html. The permit will be updated and re-issued in 2015.

The MS4 officials should thoroughly review the full MS4 Permit (GP-0-10-002), particularly Part VII, to determine what specific activities are required under each minimum control measure (MCM). For each of the six MCMs, the NYSDEC requires regulated MS4s to set measurable goals by which progress can be assessed on an annual basis. Measurable goals are a critical component of the program because they are the

Yonkers Sawmill River Daylighting project; Photo courtesy of NYS EFC.

units by which progress is reported and compliance is assessed. Some typical examples of measurements that may be used to assess progress include the following:

- Quantity of educational materials distributed
- Number of outfalls checked for illicit discharges and percentage of total
- Number of SWPPPs reviewed and percentage approved
- Number of construction sites inspected and percentage of total in operation
- Number of stormwater management practices inspected and percentage of the total
- Number of catchbasins cleaned and percentage of the total
- Number of miles of roadway swept and percentage of total in the municipality
- Number of staff training programs and targeted departments

NOTE: For most goals, progress is assessed as either the total, the percentage of the total, or the target number achieved. Demonstrating achievement of measurable goals requires maintenance of good records for every aspect of the MS4 stormwater program. The specific measurable goals selected, and progress toward their achievement, should be documented in the annual report submitted to NYSDEC each year, as well as in the MS4 program documents maintained by responsible municipal departments and staff on a day-to-day basis throughout the year.

The NYSDEC has determined that a number of the impaired water bodies (Appendix 2 of the MS4 General Permit) that appear on the 303(d) list are impacted by pollutants specifically as a result of stormwater runoff. These pollutants generally include one or more of the following: nutrients (particularly phosphorus), silt or sediment, pathogens and floatables. If an MS4 discharges directly to a listed water body designated as impaired due to urban runoff, the municipality should focus its stormwater control program on reducing the target pollutants for that particular water body.

Municipal Staff Involvement

The Municipal Board is responsible for designating one or more individuals responsible for the stormwater program. Officially, there may be up to four individuals designated for various aspects of the program. These are listed in the Municipal Compliance Certification portion of the Annual Report, and are described as follows:

- Principal Executive Officer, Chief Elected Official or Duly Authorized Representative
- Stormwater Management Program (SWMP) Coordinator (responsible for coordination and implementation of the Stormwater Management Program)—may not be a private consultant acting on behalf of the municipality
- Local Stormwater Public Contact (published contact who receives inquiries from the public)—may not be a private consultant acting on behalf of the municipality
- Annual Report Preparer—may be a private consultant acting on behalf of the municipality

Various technical representatives may be involved in SWPPP reviews or other activities requiring technical expertise. These may be private consultants and are not formally designated.

The responsibilities of the SWMP Coordinator may be assigned to one person (usually the Code Enforcement Officer) or divided among one or more individuals (i.e. the Clerk or Highway Superintendent may become involved in non-enforcement activities that are part of the program, including public education, preparation of the Annual Report and acting as the point of contact with the public). Many aspects of the stormwater program can be accomplished through cooperative arrangements with local agencies or other MS4s.

The duties of the SWMP Coordinator include construction site inspections and post-construction monitoring of stormwater management practices. The SWMP Coordinator provides assistance to the Planning Board in review of Stormwater Pollution Prevention Plans (SWPPPs) for development projects. While a consultant may assist with preparation of the annual report, SWPPP reviews, and the inspection of construction sites and stormwater management facilities, a consultant may not be designated as the SWMP Coordinator (this must be a municipal official). Some duties automatically fall to parties other than the SWMP Coordinator (for example, funding decisions made by the Municipal Governing Board or decisions to grant or withhold acceptance of SWPPPs made by the Planning Board).

The SWMP Coordinator also is responsible for

Onondaga County's nationally-recognized Save the Rain program involves multiple levels of government and the non-profit and private sectors.

development and tracking of specific information to continuously evaluate the effectiveness of the stormwater program on a year-to-year basis. This may require coordination with other departments and officials to examine progress in achieving measurable goals, as well as reassessment of the goals themselves to ensure that they have been effective at controlling stormwater pollution.

Interaction between Construction General Permit and MS4 General Permit

There are two stormwater general permits that make up the Phase II program. The MS4 General Permit (SPDES GP-0-10-002) regulates stormwater discharges from the separate sewer system via the six minimum control measures. Proper regulation of construction site runoff by the municipality is required in order to maintain compliance with the MS4 General Permit.

All construction projects exceeding one acre of soil disturbance require coverage under the Statewide Construction General Permit (SPDES GP-0-10-001). It is the developer or owner of the project site that obtains this coverage. Additionally, all such projects require the preparation of a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP must contain a description of Best Management Practices (BMPs) to be implemented to prevent degradation of the water resources that receive runoff from the site.

This information holds true regardless of whether or not the project is located within the boundaries of a regulated MS4. If the project is located outside a regulated MS4, the developer obtains permit coverage directly from NYSDEC under the Construction General Permit, without direct involvement by the municipality. Within the jurisdictional boundaries of an MS4, permit coverage is also obtained through NYSDEC under GP-0-10-001; however, the developer must have the SWPPP for the project reviewed and accepted by the MS4's Planning Board as a prerequisite for obtaining coverage under the statewide construction permit.

If the SWPPP is found to be acceptable to the MS4 following its review, the MS4 must issue a SWPPP Acceptance Form to the developer. The form becomes part of the developer's initial application to NYSDEC for construction permit coverage. The SWPPP Acceptance Form can be found online at the NYSDEC website, along with the Notice of Intent for coverage under the Construction General Permit, at http://www.dec.ny.gov/chemical/43150.html. It is the Planning Board's responsibility to ensure that adequate review of the SWPPP has taken place prior to granting acceptance by signing off on the form.

Municipalities undertaking construction projects that disturb one or more acres are required to obtain coverage under the Construction General Permit, whether or not they are regulated MS4s. The control practices selected must comply with New York State standards (the New York Standards and Specifications for Erosion and Sediment Control and the New York State Stormwater Management Design Manual).

Roles of Municipal Officials and Departments Clerk

In many regulated MS4s, the Clerk serves as the initial point of contact with the public and is responsible for addressing general questions pertaining to the stormwater program and general public outreach activities. He or she should gain a familiarity with all aspects of the program. The strategies and activities employed in each MS4 stormwater program will vary depending on specific local concerns, needs and capabilities. To determine actual components of a program, refer to the original NOI, changes documented in annual reports to NYSDEC, and any third party or intermunicipal agreements that may be in effect.

There are a number of potential ways of setting up measurable goals to quantify education efforts. Where possible, it may be advantageous to report the number of copies of a particular notice or publication that are distributed, such as through mailings or newspaper articles. The use of a display might be documented by providing a listing of the events at which the material was presented, along with an account of the target audience and approximate attendance at the event. The number of events or presentations annually can then be set as the measurable goal. The objective is to create behavior change in as many individuals as possible.

It can be challenging to determine the effectiveness of education efforts. The quantification of how many people have been reached is a measure of program effectiveness rather than a measureable goal. Effectiveness of an outreach program might be evaluated through the use of an attitude survey or other similar methodology.

Regulated MS4s are required to publicize contact information for the designated stormwater public contact. Citizens may occasionally voice questions or complaints related to stormwater quality or drainage issues. In many cases, the first point of contact will be the clerk, who should systematically document the inquiries and forward them to the appropriate municipal officials for resolution. Follow-up and responses should also be documented.

Stormwater picks up litter, debris and chemicals which often end up in our waterbodies.

Municipal Governing Board

The municipal governing board—the Town Supervisor or Mayor, and the Town Board, Board of Trustees or City Council—is responsible for:

- Certifying the MS4 Annual Report and ensuring that it is completed
- Allocating the necessary funds to enable proper implementation of the stormwater program
- Ensuring that local laws relating to stormwater runoff control and illicit discharge detection and elimination have been adopted and contain the minimum control requirements specified in the MS4 General Permit

Annual Reporting for Regulated MS4s

On an annual basis, all regulated MS4s are required to prepare a report using a standard form provided by NYSDEC on its website at: http://www.dec.ny.gov/chemical/43150.html. The report summarizes the progress of the program pertaining to the six minimum control measures. Regulated MS4s are required to present a draft report to the public in one of two ways—at a public hearing advertised using the standard meeting notice procedure, or on the municipality's website. Either way, the public must have adequate opportunity to review the report and provide comments in writing prior to the report being finalized. If the MS4 chooses to present its Annual Report on the internet and subsequently receives two or more requests that a public meeting be held to further discuss the report, the MS4 must comply.

The municipality must document all comments received as part of the annual reporting process. Intended responses and follow-up actions also must be noted. The final Annual Report is due to NYSDEC on or before June 1 of each year. Following review and approval by the Municipal Governing Board, the Chief Elected Official (Principal Executive Officer) is required to sign a Municipal Compliance Certificate (MCC) as part of the annual reporting process. The MCC, which is found at the front of the Annual Report form, certifies the accuracy of all information in the report and provides a brief overall evaluation of the municipality's progress toward compliance with program goals. The municipal governing body should review and approve the complete Annual Report prior to signing the MCC form.

Funding the Stormwater Program

Regulated MS4s are required to identify and/or develop sustainable funding sources to ensure continuous implementation of all aspects of the stormwater management program. Funding options presently available to support program implementation may include drainage districts, user fees and the general fund. The publication, "MS4 Funding Document," is available in draft form at the NYSDEC website, and describes the formation of drainage districts and other means of funding various aspects of the stormwater program. While grant dollars are occasionally available from state or federal sources to support program objectives, grant funding is not considered to be a long-term, sustainable funding source.

Stormwater Management Local Laws and Fee Schedules

Regulated MS4s are required to adopt local laws related to stormwater runoff control and illicit discharge detection and elimination. Model laws for Stormwater Management and Erosion and Sediment Control, as well as for Illicit Discharge Detection, can also be found on NYSDEC's website. It should be noted that these laws, even if they initially followed the model law, must be regularly updated for consistency with the current construction and MS4 permit. For example, changes have recently been made concerning the determination of projects requiring municipal review, stormwater management standards and permit closure procedures.

Local laws are required under Minimum Control Measures 3, 4 and 5 of the MS4 permit. Local laws provide the municipality with the authority to review Stormwater Pollution Prevention Plans (SWPPPs) that manage runoff associated with different development proposals, and to enforce the implementation of the SWPPPs on sites during construction. Local laws grant the municipality the authority to require owners of non-stormwater discharges to designated separate storm sewer systems to disconnect those discharges.

The Municipal Board may elect to set an appropriate fee schedule for all permit applications under the stormwater management local law based upon soil disturbance area and/or the impervious area to be created in each project. An escrow account can be established for each development project. This escrow is held as bond pending the completion of stormwater management facilities and the delivery of the site to municipal ownership in properly constructed, stabilized and maintained condition.

Encouraging Intermunicipal Cooperation

Many of the responsibilities municipalities face under the MS4 General Permit are mutually similar and can be shared for greater efficiency with other regulated MS4s, particularly within the same watershed. Jointly funded public education and municipal training efforts and the sharing of equipment and staff may reduce program costs. Other services may be shared if a formal intermunicipal agreement or third party service contract exists. Such services may include program elements such as inspection of outfalls and monitoring of stormwater management practices.

Public Works Departments (Highway, Parks, Buildings and Grounds, Utilities and Sanitation)

Pollution Prevention and Good Housekeeping: All municipal departments are required to develop and implement a pollution prevention and good housekeeping program to ensure, to the maximum extent practicable, that their operations do not contribute to stormwater pollution. This requirement may have particular relevance to highway/DPW and parks departments.

Regulated MS4s are required to develop an inventory of municipal facilities and operations, identify training needs, and assess their policies, procedures and the adequacy of existing staff and equipment to meet program goals for all operation categories. A self-assessment of all municipal operations, including updates of inventories, policies and procedures where appropriate, must be completed once every three years. Policies and procedures should, to the maximum extent possible, be consistent across and among different departments. Coordination and sharing of resources, such as hydroseeders and vacuum trucks, with state and county agencies and other municipalities are encouraged.

A comprehensive pollution prevention program will include best management practices relating to the following aspects of municipal operations:

- Street and bridge maintenance
- Winter road maintenance
- Vehicle and fleet maintenance
- Stormwater drainage system maintenance
- Municipal building maintenance
- Parks and open space maintenance
- Solid waste management

Grassed ditches and culverts slow and help infiltrate water.

- New construction or land disturbances
- Right-of-way maintenance
- Marina management (if applicable)
- Hydrologic habitat modification (i.e., stream channel and floodplain management)

Ongoing staff training is a critical aspect of the MS4 pollution prevention program. Employees must be made aware of best management practices related to all aspects of the pollution prevention program outlined.

Appropriate de-icing application and road maintenance practices are a core component to municipal good housekeeping practices.

The MS4s that operate facilities which, if not municipally owned, would be subject to the Multi-Sector General Permit for Stormwater Discharges from Industrial Activity (GP-0-06-002), can terminate coverage under the Multi-Sector Permit. Such facilities can be covered as part of their MS4 permit (thus avoiding administrative duplication). However, they are required to maintain Stormwater Management Plans for the facilities that meet the requirements of the Multi-Sector General Permit. Some common examples of such facilities include the highway garage, asphalt or concrete plants, transfer stations, landfills and bulk petroleum fueling stations. More information on the Multi-Sector General Permit can be found on the NYSDEC website at: http://www.dec.ny.gov/chemical/9009.html.

Services provided by outside parties that complete work on behalf of a regulated MS4 have a potential to contribute to pollution of stormwater runoff. These include turf and grounds maintenance companies, snow removal contractors, solid or hazardous waste collectors and haulers, and septic system pumpout services, as well as construction contractors who perform labor for the municipality. Regulated MS4s must include provisions in their contract documents that require third parties to comply with any applicable SPDES permit requirements pertaining to the activity that they are performing, and to utilize proper practices that will prevent their activities from causing or contributing to stormwater pollution.

For guidance on development of the municipal pollution prevention program, refer to the NYSDEC guidance document available on NYSDEC's website at: http://www.dec.ny.gov/chemical/8695.html. This document includes a self-assessment for municipal operations, guidance on establishing measurable goals, and numerous sources of best management practices for various aspects of municipal department operations.

The municipality must report on items identified in its original NOI, as well as additional items documented as part of the annual reporting process. Measurable goals should be set for all items reported on so that progress toward achievement of these goals can be periodically assessed. Section 1.3 of the guidance document contains information about recordkeeping and reporting of measurable goals.

Illicit Discharge Detection and Elimination: The MS4 General Permit requires that all separate storm sewer system outfalls within the regulated MS4 be inspected for dry weather flows once every five years. Inspection of at least 20 percent of existing stormwater outfalls per year will ensure this requirement is met. The inspections must be done following at least 48 consecutive hours of dry weather. Flow during dry weather is typically an indication that a discharge other than stormwater runoff is entering the system. If left unchecked, this discharge may constitute a violation of the MS4 General Permit. Other obvious indicators of non-stormwater discharges at stormwater outfalls should be noted and documented (staining, deposits, atypical turbidity or color, presence of foam or suds, unusual odors such as sewage, etc.).

Responsibility for monitoring dry weather flows often falls upon the Highway Department because it is convenient for it to perform this work in association with its daily operations. However, the task of monitoring can be assigned to another department or individual, such as the Code Enforcement Officer or a consultant, if deemed appropriate.

Upon discovery of a dry weather flow or other evidence of non-stormwater discharge, additional information should be obtained in an effort to determine the source of the discharge, if it is not readily apparent. Numerous options, including monitoring using field instruments and laboratory chemical tests, exist to assist in making this determination. Refer to the New England Interstate Water Pollution Control Commission (NEIWPCC) Illicit Discharge Detection and Elimination Manual at: http://www.neiwpcc.org/neiwpcc_docs/iddmanual.pdf.

Regulated MS4s must also map new outfalls added to the drainage system, whether due to new development, sewer separation or other reasons. Typically, the highway department is most familiar with the status of any new conveyances or points of drainage from the municipal roadway drainage system. The Highway Department may communicate this data to other departments or individuals who may be tasked with maintaining the records and maps. The municipality is required to maintain a map showing the locations of all outfalls, names of receiving waters and sewershed boundaries (the area of land draining or contributing to the discharge of a specific outfall). While mapping is only required within the portions of the municipality formally designated as "urbanized area," full system mapping throughout the municipality is recognized to provide long-term compliance benefits.

Post-Construction Stormwater Management: The Highway Department is generally responsible for maintenance of permanent stormwater management facilities that are deeded to the municipality, including such practices as stormwater wet detention ponds, stormwater wetlands, infiltration basins and trenches, filtration systems, swales, bioretention systems and proprietary practices. Inspection of these practices on an annual basis and after major storm events is typically performed by either the Highway Department or the Code Enforcement Officer, during which time maintenance needs are identified. Although maintenance requirements vary widely among different types of stormwater management practices, common maintenance issues include the removal of accumulated sediment and debris, re-establishment of appropriate vegetation, and structural repairs. Appendix G of the NYS Stormwater Management Design Manual, available on the NYSDEC stormwater website, contains full details of operation and maintenance requirements and outlines items to look for during inspections. Inspection and maintenance of post-construction stormwater management practices is required for the entire municipality, not just the portion that is within the designated urbanized area.

Planning Boards and SWPPPs

Development projects that disturb one or more acres of land are subject to coverage under the Phase II Stormwater construction regulations, and require development of a Stormwater Pollution Prevention Plan (SWPPP) by the developer. The review and acceptance of SWPPPs is the responsibility of the Planning Board in regulated MS4s. (See definition of SWPPPs in next section.)

Previously, regulated MS4s only had to review SWPPPs for projects taking place within the designated urbanized area. With the update of the MS4 permit to GP-0-10-002 in April 2010, the requirement for SWPPP review was extended to the boundaries of the entire municipality, regardless of the extent of the urbanized area. For work performed in municipalities designated as regulated MS4s, the developer is required to obtain a signed SWPPP Acceptance Form from the Planning Board of the municipality in which the project is located prior to obtaining permit coverage under the Statewide Construction General Permit. Disturbance refers to actual soil disturbance (i.e., excavating, grading, and removal of rooted vegetation—not simply cutting). The following types of projects are exempt from the requirement to obtain permit coverage:

- Agricultural activity and silvicultural activity, except landing areas and log haul roads
- Routine municipal maintenance activities that disturb less than five acres and are performed to maintain the original line and grade, hydraulic capacity or original purpose of a facility, including roadways and right-of-ways
- Repairs to any stormwater management practice or facility deemed necessary by the Stormwater Management Officer

- Cemetery graves
- Installation of fence, sign, telephone, and electric poles and other kinds of posts or poles
- Emergency activity immediately necessary to protect life, property or natural resources
- Activities of an individual engaging in home gardening by growing flowers, vegetables and other plants primarily for use by that person and his or her family
- Landscaping and horticultural activities in connection with an existing structure

All regulated MS4 Planning Boards are required to review SWPPPs under their stormwater runoff control local laws, which are adopted in compliance with the MS4 General Permit. The SWPPPs must be developed in compliance with the requirements of the General Construction Permit (available online at http://www.dec.ny.gov/chemical/43133.html).

SWPPP Defined

A Stormwater Pollution Prevention Plan, or SWPPP, is a document or set of documents that ensures that runoff from a particular construction site does not adversely impact receiving water resources during or following development. The SWPPP describes the project site, the scope of the project, and the best management practices to be employed to protect water resources. The SWPPP is made up of a series of components that work together to accomplish these objectives:

- Notice of Intent for coverage under Construction General Permit
- The Construction General Permit (SPDES GP-0-10-001)
- Erosion and Sediment Control Plan and supporting design
- Water Quality Control Plan and supporting calculations and design
- Water Quantity Control Plan and supporting calculations and design
- Construction sequencing, operations and maintenance plan
- Construction drawings, site plan, details and specifications, showing best management practices
- Construction Site Waste Management Plan
- Certifications by site owner/developer and all contractors performing work
- Site inspection reports
- Formal maintenance agreement or dedication of permanent stormwater management facilities

The requirements summarized are spelled out in greater detail in the Stormwater Management and Erosion and Sediment Control Model Local Law, available in the Guide for Local Officials on the NYSDEC website at: http://www.dec.ny.gov/chemical/8695.html.

There are two general categories of SWPPPs, and it is important to know which is required for the project that is being reviewed.

Basic SWPPP

This consists solely of an Erosion and Sediment Control Plan, developed in accordance with the New York Standards and Specifications for Erosion and Sediment Control, and a Construction Site Waste Management Plan. The Basic SWPPP is acceptable only for a limited number of projects. The following is a list of common types of projects that are exempted from the requirement to prepare a full SWPPP. These projects are only exempted if they are located outside of watersheds listed in Appendix C of the SPDES General Construction Permit (GP-0-10-001), and do not discharge directly to an impaired water body listed in Appendix E of GP-0-10-001. A full list can be found in SPDES GP-0-10-001, available on the NYSDEC stormwater website.

- Linear utility projects that do not create impervious surface
- Agricultural BMPs and buildings disturbing less than 5 acres
- Athletic fields with no associated impervious surface
- Spoil stockpiling or demolition projects where site will be revegetated
- Bicycle or walking trails
- Environmental enhancement or slope stabilization projects
- Sidewalks not associated with other improvements
- Single-family residential projects between 1 and 5 acres that result in less than 25 percent of the site in impervious area at the end of construction

Full SWPPP

This compares post-development (proposed) conditions to pre-development (existing) conditions, reduces the amount of resulting runoff from the proposed project to the maximum extent practicable, and incorporates best management practices to mitigate for hydrologic changes and addition of impervious surfaces (e.g., paved areas or rooftops). A full SWPPP contains the following data:

- Erosion and Sediment Control Plan using standard practices from the New York Standards and Specifications for Erosion and Sediment Control
- Incorporation of Runoff Reduction using the planning process in the 2010 NYS Stormwater Management Design Manual
- Treatment of the Water Quality Volume using green infrastructure practices and standard NYS DEC practices with runoff reduction capacity from 2010 NYS Stormwater Management Design Manual
- Control of the Channel Protection Volume (extended detention of the one-year, 24-hour storm)
- Overbank Flood Protection (no exceedance of the pre-development peak discharge from a 10-year, 24-hour storm)
- Extreme Flood Protection (no exceedance of the pre-development peak discharge from a 100-year, 24-hour storm)
- Construction Site Waste Management Plan (ensuring that debris, waste and chemicals stored at the site do not cause or contribute to stormwater pollution)

A minimum number of controls is necessary during construction.

SWPPP Review and Acceptance Procedures

The Planning Board members are responsible for conducting a full administrative review of each SWPPP to ensure that all of the required components are present, and to address all planning-related components of the SWPPP (including preservation of natural resources, site layout and minimization of impervious surface to reduce runoff, and other elements specified in the NYS Stormwater Management Design Manual). The Planning Board is also required to determine whether the proposed project will comply with the requirements of the Construction General Permit. The Planning Board may rely on advice of a Professional Engineer (PE) to review and recommend acceptance of technical design information. The SWPPPs containing post-construction stormwater management practices must be reviewed by a PE or a trained individual under the supervision of a PE. The final decision to accept or reject the SWPPP is the responsibility of the Planning Board.

It is important to bear in mind that NYSDEC does not review SWPPPs for projects inside regulated MS4 areas unless other permits from NYSDEC (a Freshwater Wetlands Permit, for example) are needed. As such, the SWPPP review performed at the local level may be the only review a project undergoes. In order to protect public infrastructure, private property, and natural resources that are of intrinsic value to the community, the municipality must ensure the functionality of all stormwater management systems that are constructed. It is the Planning Board's duty to fulfill this role. In doing so, the Planning Board is encouraged to seek technical assistance where necessary to ensure that the requirements are met in accordance with the regulations. This may require the involvement of a PE or other appropriately qualified individual.

Local law enables the Planning Board to require the applicant (developer) to provide a performance bond, cash escrow, or irrevocable letter of credit from a financial institution guaranteeing satisfactory completion of the project and naming the municipality as beneficiary. The amount of the surety is determined by the municipality. The surety is released back to the developer upon satisfactory construction of

Porous pavers and bioswales adjacent to the municipal building in the Village of Greenwood Lake provide a visible demonstration project. Project funded by the Green Innovation Grant Program. Photo credits: NYS EFC.

all stormwater management practices and proper stabilization of the site, at which time the stormwater facilities are deeded to the municipality.

An alternative arrangement is possible in which the stormwater facilities are maintained in perpetuity by the developer or corporation that owns or manages them. In this case, the municipality may require the developer to provide an irrevocable letter of credit from an approved financial institution ensuring proper operation and maintenance of erosion and sediment control and stormwater management practices, both during and after construction. The municipality may draw upon this account if the practices are not properly operated or maintained, to cover maintenance, inspection and engineering costs incurred.

The NYSDEC suggests that language allowing the provisions here discussed or similar procedures, be written into the municipality's Stormwater Management and Erosion and Sediment Control Local Law. For an example, refer to Section 2 of the NYSDEC Model Stormwater Management and Erosion and Sediment Control Local Law (available on the NYSDEC website at: http://www.dec.ny.gov/chemical/8695.html).

Better Site Design and Green Infrastructure Practices

With the adoption of GP-0-10-002 came the requirement for the MS4 Planning Board to ensure the use of Better Site Design (BSD) principles in its review of SWPPPs. The applicant is required to demonstrate that BSD practices have been considered and utilized wherever possible to reduce the total amount of runoff generated by a project. Once BSD practices have been fully incorporated into the design, green infrastructure practices are to be considered to treat as much of the resulting Water Quality Volume as possible. The applicant should proceed through the design process looking for opportunities to:

1. Avoid the impacts
2. Reduce the impacts
3. Minimize the impacts

These principles should be considered and implemented in this sequence and order of preference.

The BSD practices focus on minimizing overall site disturbance, preserving natural vegetation or topography, and treatment of stormwater through natural processes. Within the bounds of appropriate zoning or subdivision codes of the municipality, the Planning Board has authority to promote the use of BSD practices. The BSD should be used wherever opportunity exists to meet permit requirements in a manner that reduces reliance on engineered practices, often at a cost savings to the developer. Here are some examples:

- Preservation of natural features, sensitive resource areas, and vegetation, resulting in less clearing
- Preservation of native topography and drainage patterns, resulting in less cut and fill
- Reduction in impervious cover through narrower streets, sidewalk reduction, parking lot reduction
- Reduction of building footprints through relaxation of height restrictions
- Reduction of disturbed area through clustering, reducing required lot line setbacks
- Disconnection of impervious surfaces by routing drainage to grassed or vegetated areas
- Conveyance of drainage in open channels rather than piping it in closed conveyances

If implemented properly, BSD can reduce maintenance costs to the municipality, as well as the overall footprint of stormwater facilities. Creation of a more natural setting on the lot can also increase property values.

When opportunities to incorporate BSD (thereby avoiding or reducing the impacts) have been exhausted, the applicant must consider and incorporate the use of Green Infrastructure to address the remaining Water

Many municipalities offer free or low-cost rain barrels to residents as a public education tool but also to capture stormwater.

Quality Volume. Green Infrastructure, in the context of stormwater management, is the use of natural processes, such as plant uptake, microbial action, evapotranspiration, infiltration and filtration through soil to attenuate runoff and remove pollutants from runoff. There are many other recognized benefits of Green Infrastructure as well. The following are examples of Green Infrastructure practices:

- Rain gardens
- Stormwater planters
- Rain barrels/cisterns
- Vegetated swales
- Vegetated buffers
- Vegetated filter strips
- Tree planting
- Vegetated roofs

Redevelopment Sites

Special allowances are made when a development reuses existing partially or fully impervious sites for new projects. These allowances apply only if physical constraints or space limitations make regular design process infeasible. They may include possible waivers of flood control requirements if total impervious area on the site decreases and pre-existing drainage patterns are not altered such that peak flows increase. The Water Quality Volume treatment or runoff reduction requirements may be lowered if impervious area is reduced with soil restoration in new pervious areas, and/or runoff from disturbed areas is treated or reduced. Chapter 9 of the NYS Stormwater Management Design Manual contains specific formulas explaining these circumstances and what reductions may be allowed.

Annual Recordkeeping and Reporting of SWPPPs: Planning Boards must maintain records of the number of SWPPPs received for review, the number accepted, and all comments received from the public along with the boards' responses.

Comprehensive Plan and Land Use Regulations

The MS4 permit requires that Planning Boards consider the use of Better Site Design, Low Impact Development and Green Infrastructure when they are developing or modifying Comprehensive Plans and other land use regulations such as open space preservation programs and watershed plans. This includes protecting sensitive natural resources such as streams, wetlands and erodible soils; maintaining natural hydrologic conditions in new development; exploring ways of reducing impervious cover; and minimizing disturbance of vegetative cover.

Code Enforcement Officer Responsibilities: Construction Site Runoff Control

The Code Enforcement Officer is responsible for inspection of sites during construction, to ensure that they comply with the terms of their SWPPPs as approved by the Planning Board. Under the previous MS4 permit, the requirement for a regulated MS4 to inspect sites applied only to the parts of the municipality within the designated urbanized area. As of May 2010 and the adoption of GP-0-10-002, the requirement to perform site inspections has been extended to the entire municipality.

The purposes of conducting site inspections are summarized as follows:

- Verify compliance with state SPDES permit and MS4 local laws
- Verify that the site is not causing water quality standards violations
- Determine whether or not SWPPP is appropriate and effective
- Verify whether SWPPP is being implemented
- Verify that inspections by the site owner or their representative are being performed properly (where required, these must be completed weekly by a qualified professional)

- Verify that issues identified during the owner inspection are being addressed by the contractor(s)

The Code Enforcement Officer must check to ensure that the following documents are present on the site and are current and up-to-date:

- Stormwater Pollution Prevention Plan (SWPPP) certified by owner and all contractors
- Signed Notice of Intent (NOI) and SWPPP Acceptance Form
- A copy of the Construction General Permit (SPDES GP-0-10-001)
- NYSDEC Acknowledgement Letter indicating the date permit coverage begins
- Logbook documenting inspections completed by developer or developer's consultant
- Letter authorizing disturbance of greater than five acres at any one time (where applicable)
- As of June 2010, documentation that all contractors have fulfilled site runoff control training requirements

The site is also thoroughly inspected to ensure that all work is being completed in compliance with the SWPPP, and to see that any potential for water quality violations is immediately addressed and eliminated. The developer is required to notify the regulated MS4 at each of the following stages, at which time the Code Enforcement Officer may opt, at his or her discretion, to inspect the site:

- Start of construction
- Installation of sediment and erosion control measures
- Completion of site clearing
- Completion of rough grading
- Completion of final grading
- Close of the construction season
- Completion of final landscaping
- Establishment of landscaping in public areas

These are only guidelines. The NYSDEC recommends that the inspection frequency be based on public complaints, involvement of frequent violators, the amount of area simultaneously disturbed, proximity to sensitive water resources and similar concerns.

The Building Code of the municipality grants the Code Enforcement Officer the authority to access the site. It is suggested that the Stormwater Management and Erosion and Sediment Control Local Law require the developer to allow the municipality Right of Entry whenever a connection is made between a stormwater management facility and the public drainage system. It is recommended that the Code Enforcement Officer conduct the first site inspection as an informational visit to educate the site operator regarding the requirements. The first inspection is also an opportunity for the CEO to familiarize himself or herself with the project and any site-specific issues. If conditions threatening an imminent water quality violation are present, all work should be stopped immediately except that which is necessary to prevent or cease the violation. However, enforcement action should otherwise be escalated gradually unless flagrant non-compliance is discovered. Due to the dynamic nature of construction site work, minor repair issues will inevitably be present and should be addressed, but may not require site shutdown.

Lindenhurst Library Porous Paver Parking Lot. Photo credits: RDA/RSLA Landscape Architects.

The NYSDEC recommends that Code Enforcement Officers be granted the authority to issue notices of violation, stop work orders and fines based on the process identified in the Stormwater Management Local Law. Upon the finding of a violation, the general procedure is to issue a stop work order describing, in writing, the nature of the violation. Further work, aside from stabilization of the site and correction of the problem, is not allowed to proceed until the violation is resolved through appropriate corrective actions. In the event that the stop work order is ignored, the local law should grant the municipality the authority to pursue further injunctions, including fines and imprisonment, against the violator. Certificates of Occupancy may be denied or withheld if buildings are constructed prior to resolution of the violation.

At the end of a construction project, the developer must file a Notice of Termination (NOT) with NYSDEC in order to close his or her permit coverage under the Construction General Permit. In regulated MS4 areas, it is the responsibility of the Code Enforcement Officer to ensure that the site is stabilized in compliance with the permit prior to the NOT filing. The following must occur before the permit can be closed:

- Site must be fully stabilized — meaning uniform permanent vegetative cover established over all portions of the site at 80 percent density—no bare areas
- Post-construction controls installed and functioning
- Temporary erosion and sediment control devices removed and/or replaced with permanent practices

In May 2010, a new requirement went into effect mandating that the chief elected official or duly authorized representative of a designated MS4 must sign off on the NOT for all projects occurring within the municipality, unless the MS4 itself is the applicant.

In addition, responsibility for maintenance of any permanent post-construction stormwater management practices must be established. In many cases, it is the municipality that will be maintaining these practices (stormwater detention ponds, bioswales, filtration devices, pervious pavement, etc.). Consequently, it is of utmost importance that the practices be installed in accordance with the approved SWPPP and be fully functional before the NOT can be filed. The practices will become the municipality's responsibility and cost. The local Highway Department is typically involved in maintaining permanent stormwater management facilities, but the Code Enforcement Officer may be responsible for regular inspection of the practices.

While most SWPPPs are reviewed by the Planning Board, the Code Enforcement Officer or Director of Planning and Development must review SWPPPs for projects that are not subject to Planning Board authority (e.g., Subdivision Review or Site Plan Review). These generally include projects such as individual single-family homes, agricultural projects, linear roadway projects or utilities in the absence of any other associated improvements, or similar projects.

This green roof on the Syracuse Center of Excellence retains stormwater, effectively increasing system capacity.

Code Enforcement Officers are required to obtain training through a program sponsored or approved by NYSDEC to ensure that they understand NYSDEC's erosion and sediment control requirements as well as any local requirements that may be more stringent than those endorsed by NYSDEC. In New York State, Soil and Water Conservation Districts (SWCD) are designated as being able to provide erosion and sediment control training on behalf of NYSDEC. Check with the local SWCD office for an upcoming training schedule, or visit the NYSDEC website at: http://www.dec.ny.gov/chemical/8699.html for a calendar of training events.

Illicit Discharge Detection and Elimination: Under the regulated MS4's Illicit Discharge Detection and Elimination (IDDE) Local Law, the Code Enforcement

Officer is typically responsible for issuing notices of violation for illicit discharges. Highway Department/ DPW staffs often play a major role in outfall monitoring as a function of their day-to-day responsibilities. Illicit discharges may be identified during dry weather outfall monitoring, discovered during compliance investigations, or found by other means. The Code Enforcement Officer may need to assist the Highway Department in tracing illicit discharges if it is apparent that the source of the illicit discharge is, for example, a cross-connection of a drain originating on private property to a separate storm sewer system.

Several types of non-stormwater discharges are considered "exempt" from the regulations as long as they are not substantial contributors of pollutants to a separate storm sewer system. These include types of discharges that are typically "clean," such as:

- Water line flushing
- Landscape irrigation
- Diverted stream flows
- Rising ground waters
- Uncontaminated groundwater or groundwater infiltration
- Discharges from potable water sources
- Foundation drains
- Air conditioning condensate
- Irrigation water
- Springs
- Water from crawl space and basement sump pumps
- Footing drains
- Lawn/landscape watering if all pesticides and fertilizers have been applied in accordance with manufacturer's label
- Water from individual residential car washing
- Flows from riparian habitats and wetlands
- Dechlorinated swimming pool discharges
- Residual street wash water
- Discharges/flows from firefighting activities
- Dechlorinated water reservoir discharges
- Any SPDES permitted discharges

It is the Code Enforcement Officer's responsibility to maintain a list of which types of non-stormwater discharges are permitted to enter the MS4 because they are considered not to be significant sources of pollutants of concern.

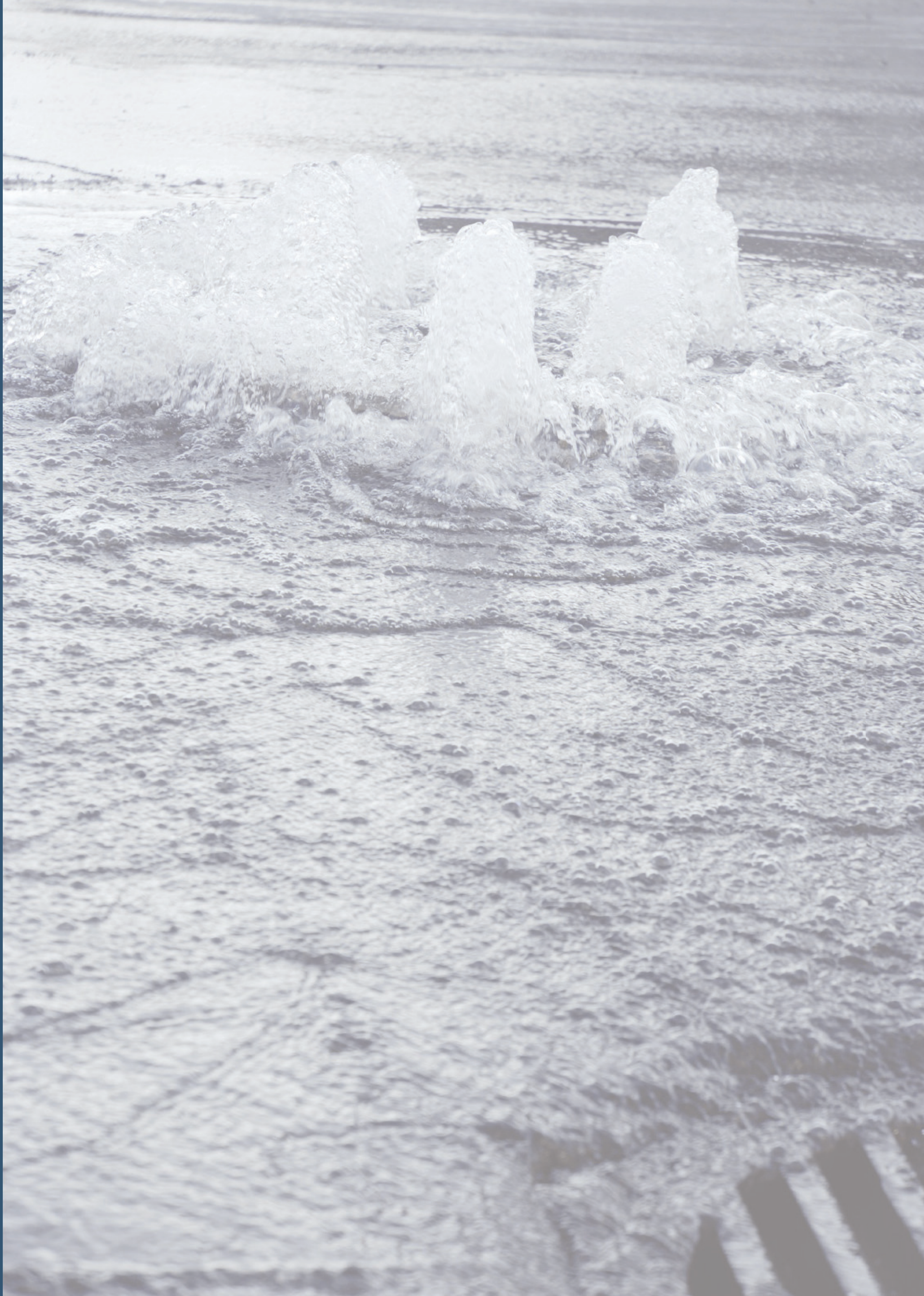
The NYSDEC has recommended that the IDDE Local Law contain a mechanism to require that all property owners must allow the Stormwater Management Officer (SWMP Coordinator) access to the premises within a reasonable timeframe following inquiry or for the purposes of due enforcement, and further allows pursuit of a search warrant in the event that such access is denied. This extends to allow the SWMP Coordinator to set up sampling or monitoring equipment, perform dye tests or other activities as necessary to investigate a potential illicit discharge.

The opportunity for voluntary compliance allows, in lieu of a civil penalty, public services outlined in the law for first-time violators. These may include storm drain stenciling, stream cleanups, or other education or participation activities that may contribute to the stormwater program of the municipality. The first priority is always to cease and ameliorate the illicit discharge or connection, rather than to focus on punishing the violator.

Regulated MS4s must maintain a map of all stormwater outfalls and their associated drainage areas to those outfalls (i.e., sewersheds). The Code Enforcement Officer may be involved in this process, and should coordinate with the Highway Department or other parties for updated information.

Annual Recordkeeping and Reporting: The Code Enforcement Officer must maintain records of all site inspections for annual reporting purposes. Records are also maintained concerning efforts to identify and eliminate illicit discharges.

This chapter prepared by the Central New York Regional Planning and Development Board.



Collection Systems

Buried and linear assets—so often forgotten—can be high-maintenance and high-cost if not managed properly.

NYWEA

Environmental Finance Center
Syracuse University

Chapter 7: Collection Systems

Municipal sanitary sewer collection and conveyance systems are an extensive, valuable and complex part of municipal infrastructure. Collection systems consist of pipelines, conduits, pumping stations, force mains and other components to collect wastewater and convey it to facilities that provide treatment prior to discharge to the environment.

The proper design, and operation and maintenance of these wastewater system components are critical factors given their relationship with potable water in the general level of good health enjoyed by us all. Most members of the general public take for granted a well operated wastewater collection system and are not fully aware of its design and technical workings. The taxpaying public expects these systems to function effectively and at a reasonable cost.

"Lack of proper maintenance results in the potential for subsequent basement back-ups, overflows, cave-ins, hydraulic overloads at treatment plants, and other safety, health and environmental problems."

The condition of many collection systems is poor and many systems have received minimal maintenance for a number of years as a result of the financial burdens of repair and upgrade in light of increasing regulations and decreasing public subsidies. Money is typically spent on above ground utilities that are more noticeable, and sewers are often the deepest infrastructure in the municipal right of way. When pipe or manhole replacement is required by a trenched excavation, the work often disturbs other utilities and roadway structures, and requires maintenance and protection of traffic. For such reasons, the sewer collection system can be one of the most expensive assets owned by a municipality. Wastewater systems usually suffer from a history of inadequate investment in maintenance and repair, often due in large part to the "out-of-sight/out-of-mind" nature of the buried asset. New York State contains 1,060 sewage collection systems, totaling 22,000 miles of sewers. More than 30 percent of these sewers are older than 60 years and beyond the expected useful life span. In 2008, the estimated monetary needs for inflow/infiltration correction, major sewer system rehabilitation, new collectors and interceptors and their appurtenances for statewide maintenance and repair totaled $6.6 billion (NYSDEC 2008). Based upon the value of the asset and its costly replacement, the maintenance of buried assets generally merits a greater level of attention.

Lack of proper maintenance results in deteriorated sewers with the potential for subsequent basement back-ups, overflows, cave-ins, hydraulic overloads at treatment plants, and other safety, health and

Proper maintenance of the collection system is critical for optimum system performance. (Town of Tonawanda) environmental problems. A most serious and environmentally threatening problem is sanitary sewer overflows (SSOs) which are a frequent cause of water quality violations and a threat to public health and the environment. Controlling leaks and blockages in sewer collection systems to prevent overflows is critical.

Capacity Management, Operation and Maintenance (CMOM) Programs

A framework for a dynamic management approach to collection systems is known as Capacity Management, Operation and Maintenance (CMOM) Programs. The USEPA in conjunction with municipal and industry representatives have developed this methodology to primarily address the need for adequate collection system capacity to convey peak flows in all parts of the sewer system to mitigate sewer overflows.

The USEPA estimates that almost one half of all flow at wastewater treatment plants is represented by

Rehabilitation Methods for Sewer Collection Systems and Underground Structures*

Operations	Type/Description	Advantages	Disadvantages	Areas of Application
Chemical Grout	Impregnation of the soil surrounding the pipe with a curable compound, thus effectively sealing the soil. Chemical grout can be used to stop leaks in pipe joints and cracks, as well as leaks around lateral connections and manholes.	• No excavation • Very flexible • Repair limited to damaged area • Quick • Economical • Longevity • Stops infiltration • Stabilizes soil outside the pipe.	• No structural repair to the pipe itself, except for the stabilization of the supporting soils outside the pipe. • Flow diversion required during inspection and application • Pipe sags or collapses require excavation for replacement	• Repair of sewer line joints • Manhole infiltration • Lateral infiltration • Underground structures
CIPP Lining	Flexible tube externally coated with a polyurethane membrane and internally with resin, is inverted on site by air/water pressure. The tube turns inside out and travels down the pipe and is later cured by hot water.	• No excavation - less disruptive than open-cut excavation • Economical compared to manhole-to-manhole replacement • New pipe within existing pipe	• Tightness of liner to pipe is questionable; an annular space exists. • Flow diversion required during inspection and application • Pipe sags or collapses require excavation for replacement	• Repair of holes and areas of extensive cracking • Structural repairs • Lateral repairs
Fold and Form Liner	A folded thermoplastic pipe is pulled into place through a manhole and then rounded, using heat or steam and pressure to conform to the internal diameter of the existing pipe.	• No excavation- less disruptive than open-cut excavation • New pipe within existing pipe	• Reduction of pipe diameter • Long-term buckling strength may be an issue • Limited to small diameter pipes • Flow diversion required during inspection and application • Pipe sags or collapses require excavation for replacement	• Repair of holes and areas of extensive cracking

Operations	Type/Description	Advantages	Disadvantages	Areas of Application
Slip Lining	Insertion by pulling or pushing a new pipe into the old one. The remaining annular space may be filled with granular material.	• No excavation - less disruptive than open-cut excavation • New pipe within existing pipe	• Reduction of pipe diameter • Full length of pipe has to be lined • Lateral connection is difficult to reconnect • Grouting of annular space may be necessary. • Flow diversion required during inspection and application • Pipe sags or collapses require excavation for replacement	• From manhole to manhole • Medium level of damage
Pipe Bursting	Technique which uses radial forces to break out and push away the pieces of the existing pipe and permit a new pipe to be simultaneously installed.	• New pipe inserted in place of existing pipe. • Limited surface disruption	• Spot excavation required • Laterals reconnected by digging • More expensive than pipe rehabilitation methods. • Flow diversion required during inspection and application • Pipe sags or collapses require excavation for replacement	• Replacement of badly damaged sewers • Interceptors or collector sewers with few laterals • Can insert larger diameter to provide capacity upgrade
New Pipe Installation	Soil is excavated and new pipe is installed.	• Completely new pipe • Longer useful life? • Modification of diameter is possible • Simple and well-known technology	• Large surface area disturbed • Risk of damaging other pipes and cables during excavation • Expensive • Time consuming	• Where collapses, sags, poorly constructed lateral connections and severe structural defects exist. • To address hydraulic deficiencies • Where trenchless options are inappropriate

**From "Methods to Control Leaks in Sewer Collection System," White Paper: Center for Innovative Grouting Materials and Technology (CIGMAT), Dept. of Civil and Environmental Engineering, University of Houston, Texas, October 2004.*

infiltration and inflow (I/I). Controlling I/I is a critical factor in effective system performance.

Sewer Rehabilitation Methods

Methods for controlling collection system leaks, infiltration and exfiltration include:

- Chemical grouting
- Cured-in-place liners
- Fold and form liners
- Slip lining
- Pipe bursting
- Complete replacement with modern materials

Asset Management Approach to Buried Infrastructure

Knowing what buried assets are owned and where they are located is the starting point in developing an asset management plan. This is vital in developing a long-term capital plan leading to the sustainability of the buried asset.

By incorporating the use of record mapping, institutional knowledge of the system, maintenance logs, and technical data on the initial construction and materials, municipalities can build an initial inventory of assets and update it as more information becomes known. It is important that a starting point be established to build upon.

Assessing the condition of the collection system and subsequent remaining life will lead to a risk-based

Minoa's sewer camera work helps the Village set priorities.

asset management protocol. Knowing the five core components of asset management will lead to a better decision-making process in assuring sustainability of the buried assets.

1) Asset Inventory
2) Level of Service
3) Critical Assets
4) Life Cycle Costing
5) Long-Term Funding Strategy

Green Technologies for Reducing Stormwater

Green technologies also play a role for maximizing existing collection capacity by decreasing I/I flows in the system by utilizing groundwater surface recharge. Many municipalities are using rain barrels, rain gardens, rooftop green areas, or porous pavements to very effectively mitigate stormwater entering the sanitary system. Inflow to the collection system is also reduced by disconnecting private property sources including storm sewer culverts, sump pumps, roof leaders, and basement drains. Keeping stormwater out of the sanitary system reduces the costs for conveyance, pumping and treatment, often far more cost effectively than building additional capacity at the treatment plant.

Funding

Funding options for support of realistic capital planning need to be evaluated and pursued in a way to maximize the leveraging power of each source. Gone are the days of utilizing only one funding source to accomplish major works. Some options include:

- Short-term Bond Anticipation Notes *(BANs)*
- USEPA
- NYSDEC
- NYS Environmental Facilities Corporation *(CWSRF)*
- USDA Rural Development *(WEP)*
- Member Item Initiatives
- Green funding opportunities - i.e., NYSEFC Green Innovation Grant Program *(GIGP)*
- NYS Regional Development Council
- NYS Department of State
- Appalachian Regional Commission
- USEDA Economic Development Administration
- NYSERDA
- CWSRF Engineering Planning Grant

Additional funding considerations

Consider project phasing, sanitary district consolidation, innovative inter-municipal agreements, public/private partnerships, Private Activity Bonding (PAB), funding that rewards "carbon footprint" reduction—such as the USDOT TIGER grants—and initiative programs, like the Clean Water State Revolving Fund Engineering Planning Grant. Also, investigate the feasibility of developing an offset plan. An offset plan establishes a program to ensure the new development flow in one or more segments of the Publicly-Owned Treatment Works (POTW) with capacity constraints will be offset by the removal of infiltration and inflow within the system in a specific volume determined by the sewer jurisdiction. This program may lead the way to discussing project cost sharing and incentive opportunities during the approval of new sewer connections and developments.

Summary and Conclusions

Municipal sanitary sewer collection and conveyance systems represent a major portion of the wastewater facility and municipal investment. Capital improvement plans must be based upon good databases. Asset

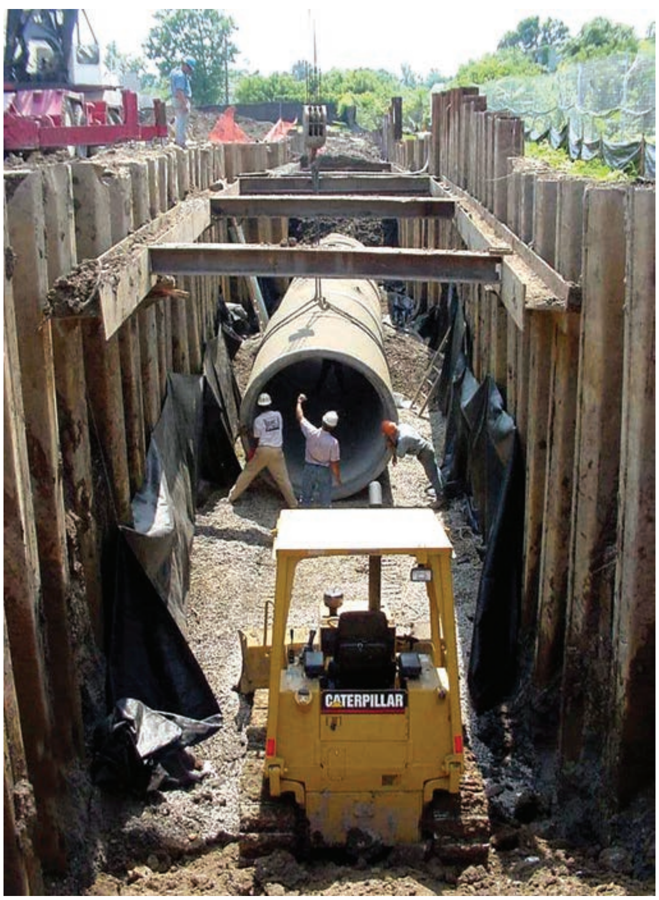


Photo courtesy of NYS EFC.

Groundwater infiltration makes efficient treatment difficult.

management must be a core activity for maintenance and protection of these tremendously high replacement cost buried assets.

These systems must be managed proactively, not reacting to problems as they occur. It is critical that investment be made in asset management strategies to identify the location, conditions and needs of the buried assets. Good asset management also is important for capital planning of scarce local resources and to ready a municipality for funding initiatives. When the next round of "stimulus," green investment funding, New York Works, or Regional Economic Development Council funding sources come along, the municipality that is first in line and well prepared will reap the best returns on grant funds. A Capital Improvement Plan established from the asset management analysis should identify the most critical system needs to be addressed on an annual basis. Good processes and good data yield high confidence decisions regarding sustainable funding of this critical infrastructure.

The bottom line is knowing component asset life, consequences of system failure, and future maintenance or replacement costs, drives good decision-making.

This chapter prepared by David Miller, PE at the Onondaga County Department of Water Environment Protection, with additional assistance from Robert Albright of CDM Smith.

Staff Training Demands, Succession Planning and Certification

In 2005, workers over 55 represented 16 percent of the workforce; by 2020, that will rise to almost 25 percent. Although these numbers are staggering, they come as no surprise based on the mass exodus public entities have been experiencing.

NYWEA

Environmental Finance Center
Syracuse University

Chapter 8:
Staff Training Demands, Succession Planning and Certification

Staff Training Demands

Over the next two decades, 78 million baby boomers will turn 65, the traditional retirement age. In 2005, workers over 55 represented 16 percent of the workforce; by 2020, that will rise to almost 25 percent. Although these numbers are staggering, they come as no surprise based on the mass exodus the public entities have been experiencing. This mass exodus will take with it years of rich technical know-how, leadership skills and detailed onsite experience that will occur without a formalized succession planning program in place—leaving a void in organizations that is all but impossible to fill!

There is also some irony in this for, as Mike Rowe, the host of Discovery Channel's "Dirty Jobs," recently testified before Congress on the US skilled labor shortage: "People can't find jobs and yet good jobs can't find qualified people. We're surprised that high unemployment can exist at the same time as a skilled labor shortage." This seems to characterize the present predicament experienced by wastewater utilities.

"People can't find jobs and yet good jobs can't find qualified people. We're surprised that high unemployment can exist at the same time as a skilled labor shortage."

Operators are our frontline defenders against water pollution.

For a number of reasons, including demographics and early retirement incentives, many Publicly Owned Treatment Works (POTWs) have been experiencing a large departure of veteran employees. The loss of these employees has created voids in leadership, skills and technical experience. This pressing problem has brought to light the following issues that POTWs are facing:

- Institutional knowledge loss
- Weak or non-existent leadership development programs
- Heavy reliance on on-the-job training (OJT) rather than formal training and development
- Employee retention

While a number of issues and barriers to adequate and timely succession planning exist, these concepts should be considered within the context of the unique workplace needs of each utility as this context may affect each workplace differently. For example, some utilities might like to hire or promote from within, while others might not. Some facilities might have separate positions for operators, maintenance and lab staff, while others might cross train as part of "the way we do businesses." Some might have proactively dealt with a specific issue such as diversity, while others are just approaching the same issue as they exist within their own community and political environments. Each utility, like the community it serves, is unique with different needs. However, every utility has some things in common. The first is that employees leave—they're always leaving. Presently, they happen to be leaving at a faster pace than ever before in the industry's history.

As an industry, these utilities must have:

- **A detailed succession plan**—to know not only when key employees are leaving, but also for a solid understanding of what skills and critical knowledge each employee holds in order to properly find and train new replacements with the necessary qualifications and competencies.
- **A suitable replacement candidate pool available**— both entering the organization and moving up into leadership roles.
- **Documentation/transfer of veteran employee knowledge base**—When veteran employees leave, they take with them a unique understanding of effective leadership and incredible amounts of institutional knowledge often regarding undocumented asset information. Employers need to document and transfer this knowledge in a usable form so that it is captured for future users.

Utilities, therefore, need to develop a succession strategy comprised of the following components:

1. Succession Planning
2. Recruitment, Retention, Candidate Pool Development
3. Leadership Development
4. Knowledge Capture and Sharing

Succession Planning

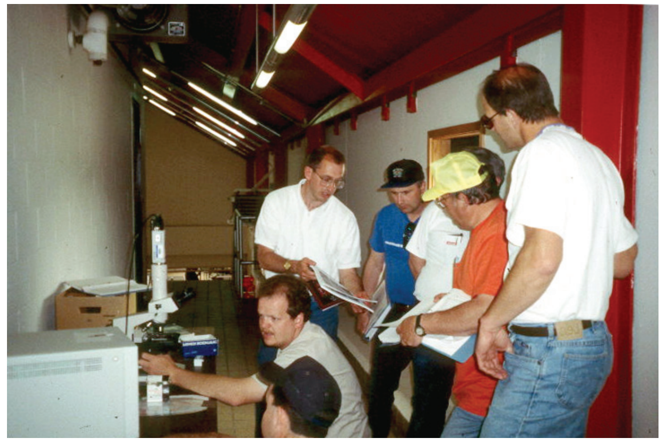
Every utility needs an adequate succession plan so it knows when it may to need to replace particular employees; what type of employee it will need to replace; as well as the core competencies those individuals need to be successful in each role. The first steps to create such a plan are:

- A comprehensive database of employees who are leaving in the next two, five, seven and 10 years, to begin to identify the gaps in the organization and future needed key resources.
- Succession planning training for key leaders and managers to broaden the organization's understanding of this complex process.
- An implementation plan for identifying and capturing critical skills and knowledge of these employees to assure the organization keeps and leverages this information into the recruitment and training processes.

NYWEA has published a white paper on succession planning that can be found on the website: www.nywea.org.

Recruitment, Retention and Candidate Pool Development

Ideally, utilities would have a continuous sufficient supply of properly educated and well trained



Ongoing training is required for certification renewal.

candidates from which to select. Healthy and dynamic organizations seek to have a balance of candidates with aligned educational backgrounds, institutional knowledge, skill sets and leadership abilities in their resource network so, the bigger and broader the pool is, the more likely it is to find better candidates. However, many utilities are finding it difficult, if not impossible, to find suitable replacement candidates. They find themselves in the position of needing to meet their own needs by actually developing their own replacement pool.

There are initiatives in progress to assist with such issues, including:

- Generating more occupational interest by altering the image of utility operations and "rebranding" it as a "green" occupation.
- Expanding the potential candidate pool by reaching out to a broader demographic base that might not have been aware of these employment opportunities.
- "Growing Our Own" candidate pool by developing interest and recruiting potential future employees by partnering with educational institutions including high schools, BOCES, trade schools, the military and colleges.

After recruiting the right person and training him or her, keeping that person can be a challenge. Having invested a great deal of resources in this employee, it is important to continue the focus on employee development. While salary is the low hanging fruit of retention efforts, utilities need to identify other ways of maintaining and supporting their workforce, including:

- Establishing clear and well displayed career paths
- Creating policies that reward employees who are certified or actively pursuing their certifications —policies giving preference for transfer or training opportunities show employees that their efforts are appreciated
- Paying for memberships to professional organizations
- Providing funding for licensing and recertification
- Creating recognition programs so employees know they are valued—this can positively impact an organization's retention rate

Leadership Development

Many retiring employees are, by choice or expertise, often in some type of leadership role. Replacement leaders need to be developed, both from a technical and managerial aspect of the business. It is, therefore, important that utilities provide leadership development training.

Formalized Leadership Development Programs (LDPs) should be developed and tailored to the various levels of leadership. This tiered approach to the LDP will ensure each level of management and leadership has the appropriate understanding of the competencies related to the specific position's roles and responsibilities, yet focusing on future role development and evolution caused by technology. Formal programs, such as the LDP, broaden the learning scope for the employee, give a well-rounded perspective on being a successful leader and, in fact, validate leadership as a skill. This can also help operations staff feel empowered by their work to protect the environment and public health.

Confined space training is necessary for linear asset maintenance.

Coaching and mentoring also play a large role in the LDP process by pairing the program participants with the valuable knowledge of the incumbent and initiating a formalized knowledge sharing process. By anticipating the need for replacements and implementing a formal succession planning process, there will be a seamless transition of key positions when they are vacated.

Institutional Knowledge

Most retiring staff, whether they are in formal leadership roles or not, possess considerable amounts of general knowledge of utility history, where things are and how things work both internally and with external vendors and partners. This information also needs to be transferred to new or remaining staff through formal institutional knowledge transfer programs. Utilities that follow these recommendations will be well positioned to benefit before critical talent and knowledge is forever lost.

Thus, through these simple steps, utilities can begin the process of being properly staffed and trained to meet the changing demands of the future in a consistent and thoughtful manner and to ensure they remain ready and able to protect the public health and enhance the water environment with the best talent and leadership available.

Operator Certifications

The Department of Environmental Conservation (NYSDEC) transitioned the administration of the Wastewater Operator Certification program to the New York Water Environment Association (NYWEA) on September 1, 2011. Any individual, municipality, organization or operator having questions or needing information related to the wastewater certification program can contact the Wastewater Certification Administrator at the NYWEA Executive Office in Syracuse, NY. All forms, requirements and the Wastewater Operator Certification Manual are available on the NYWEA website at: www.nywea.org/opcert.

Certification Types and Grades

Wastewater certification is comprised of three types: New Certification, Upgrade Certification and Renewal Certification. All applications are required to go through the NYWEA office in Syracuse, for new, upgrade and renewal certifications.

Both new certificates and certificate upgrades require three key requirements for each certification level:

1. Appropriate coursework
2. Enough hands-on operations experience
3. Correct facility point score

The following forms/materials are required for new and upgrade certificates:

- Application Form
- Statement of Experience Form
- Copies of Coursework (completed)
- Processing Fee

The certification grades are divided into four levels: 1, 2, 3 and 4, with 1 being the lowest and 4 the highest. All activated sludge wastewater treatment plant certificates are further designated with the letter "A" (1A, 2A, 3A, 4A). The following is a generalized listing of requirements for each certification level. More detail is available in the Wastewater Operator Certification Manual.

Grade 1/1A: Basic Operations, and Activated Sludge, if required, 6 months of hands-on experience and Point Score of 30 or less.

Grade 2/2A: Basic Operations, Basic Laboratory, and Activated Sludge, if required, one (1) year of hands-on experience and Point Score of 31-55.

Grade 3/3A: Basic Operations, Basic Laboratory, Supervision and Technical Operations, and Activated Sludge, if required, 4.5 years of hands-on experience (unless applicant has an AAS or approved BS or BA) and Point Score of 56-75.

Grade 4/4A: Basic Operations, Basic Laboratory, Supervision and Technical Operations, Management course, and Activated Sludge, if required, eight (8) years of hands-on experience (unless applicant has an AAS or approved BS or BA) and Point Score of 76-higher.

Fees: There is a $150 fee due with the operator's initial application to become certified. This fee is in addition to the $85 charge that is paid to Applied Measurement Professionals (AMP) for the Association of Boards of Certification (ABC) examination. If the operator fails the exam, he or she is only responsible for the $85 exam fee to AMP. If an operator decides to apply for a higher certificate grade, the $150 fee will be charged again.

ABC Exam: Once NYWEA approves the application, applicants are sent information to schedule their ABC exams with AMP for their certification levels. All applicants are required to take and pass the ABC exam with a minimum score of 70 to receive their certificates. If an applicant does not pass the specified exam, he or she can retake the exam in 90 days by coordinating the exam date and time with AMP. Approximately six to eight weeks after testing, NYWEA will send all new qualified operators a wall document and blue card for their new certifications. The blue card is the actual certificate which shows the operator's name, grade, certificate number and certificate expiration date. All certificates are valid for a period of five (5) years. During this five year period, operators need to complete a specified number of NYSDEC-approved renewal contact hours to renew their certificates.

Renewals: Renewal applications can be submitted anytime within the five year period after the successful examination. Once an applicant renews a certificate, another five years are added on to the existing expiration date and NYWEA will mail the operator a new blue card. The following forms need to be submitted in order to renew the operator's certificate:

1. Application
2. Copies of Contact Hour Coursework
3. Processing Fee

Renewal applicants have to complete contact hours from NYSDEC-approved training programs over this period to renew their certificates. If renewal applicants fail to complete the appropriate amount of contact

Staff knowledge of collection systems is crucial.

Ongoing training of operators is good business.

hours, their certificates will expire. Each certification level has a specified amount of required contact hours that the operator must complete:

Grade 1/1A: 20 Contact Hours
Grade 2/2A: 40 Contact Hours
Grade 3/3A: 60 Contact Hours
Grade 4/4A: 80 Contact Hours

Fee for Renewal: There will be a $160 fee due with the operator's five year renewal application (this works out to $32 per year).

Certificate Expiration: If an applicant's certificate expires, the following rules would typically apply:

- ***If less than one year expired:*** Applicant can submit the appropriate amount of approved contact hours and renew certificate. Only contact hours earned five (5) years from date of application receipt are accepted.
- ***If more than one year expired:*** Applicant needs to submit appropriate amount of approved contact hours and then will have to re-take the ABC exam for the appropriate certification level. Only contact hours earned five (5) years from date of application receipt are accepted.

Voluntary Wastewater Collections System

The Voluntary Wastewater Collection Systems program is not required for operator certification. Like the Wastewater Certification program, the Voluntary Wastewater Collection Systems program has new, upgrade and renewal requirements for Grade levels 1, 2, 3 and 4. All applicants for Voluntary Collection Systems Certification in New York State must have the appropriate education (minimum of high school or GED), experience and Voluntary Collection Systems Certification training. Applicants must complete the application, pay the appropriate fee, and pass the written exam in order to receive these certificates:

Grade 1: Confined Space, Operations and Maintenance (O&M) of Wastewater Systems Vol. 1, six (6) months of experience

Grade 2: Confined Space, O&M of Wastewater Systems Vol 1, O&M of Wastewater Systems Vol. 2, one (1) year of experience

Grade 3: Confined Space, O&M of Wastewater Systems Vol. 1, O&M of Wastewater Systems Vol. 2, Grade 3 Basic Supervision and Technical Operations, or

Equivalent 30-hour Supervision Training Program, 4.5 years of experience with 1.5 of those years at a Grade 3 or 4 Collection System (unless applicant has an AAS or BS Degree)

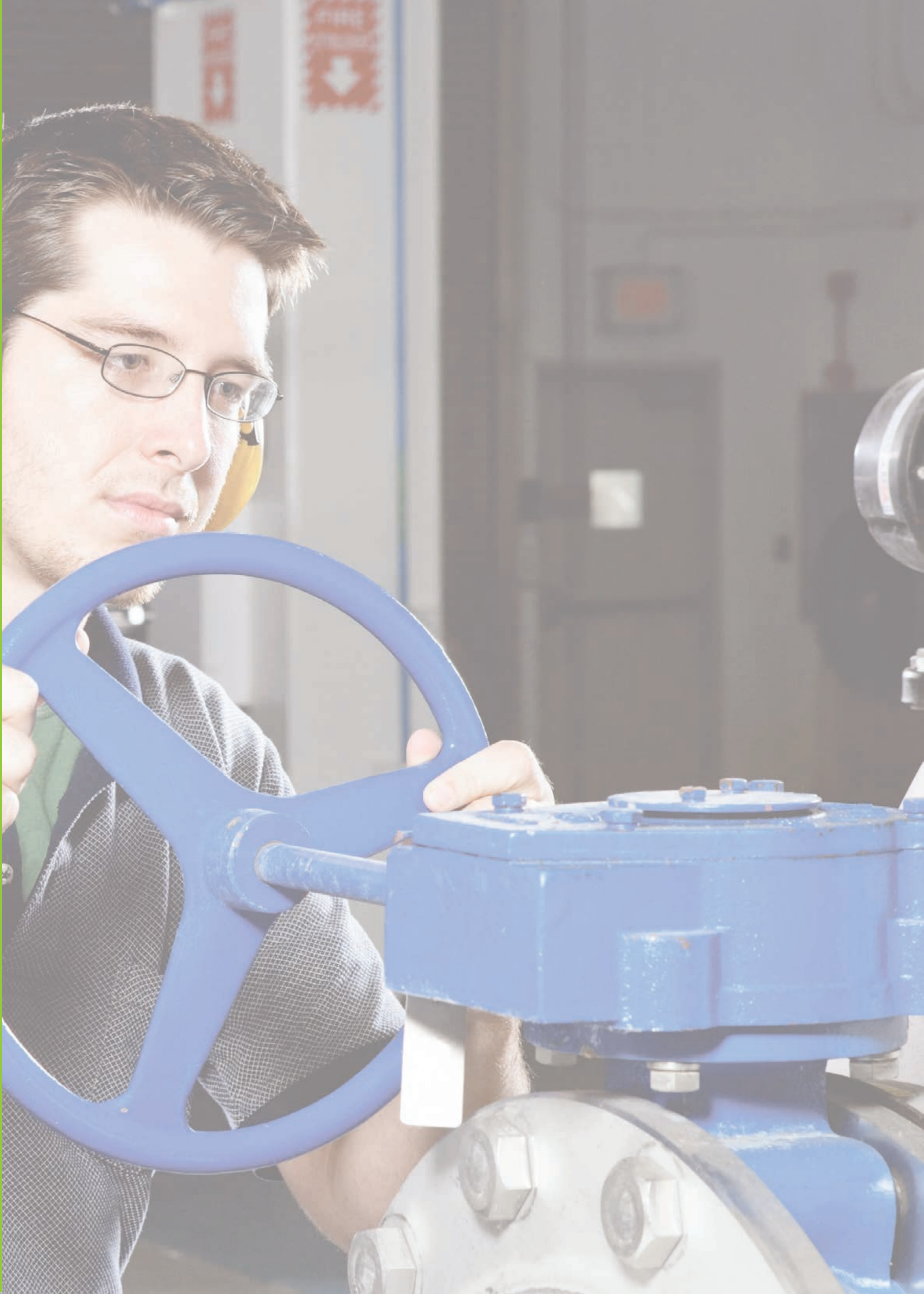
Grade 4: Confined Space, O&M of Wastewater Systems Vol. 1, O&M of Wastewater Systems Vol. 2, Grade 3 Basic Supervision and Technical Operations, or Equivalent 30-hour Supervision Training Program, eight (8) years of experience with 1.5 of those years at a Grade 3 or 4 Collection System (unless applicant has an AAS or BS Degree)

All applications need to be submitted to the NYWEA office by the required deadlines and then testing is given twice a year on the last Wednesday in April and on the last Wednesday in September.

Similar to the wastewater certification program, the voluntary collection system is valid for a five year period, and individuals are required to complete an appropriate amount of contact hours within those five years to renew their certifications.

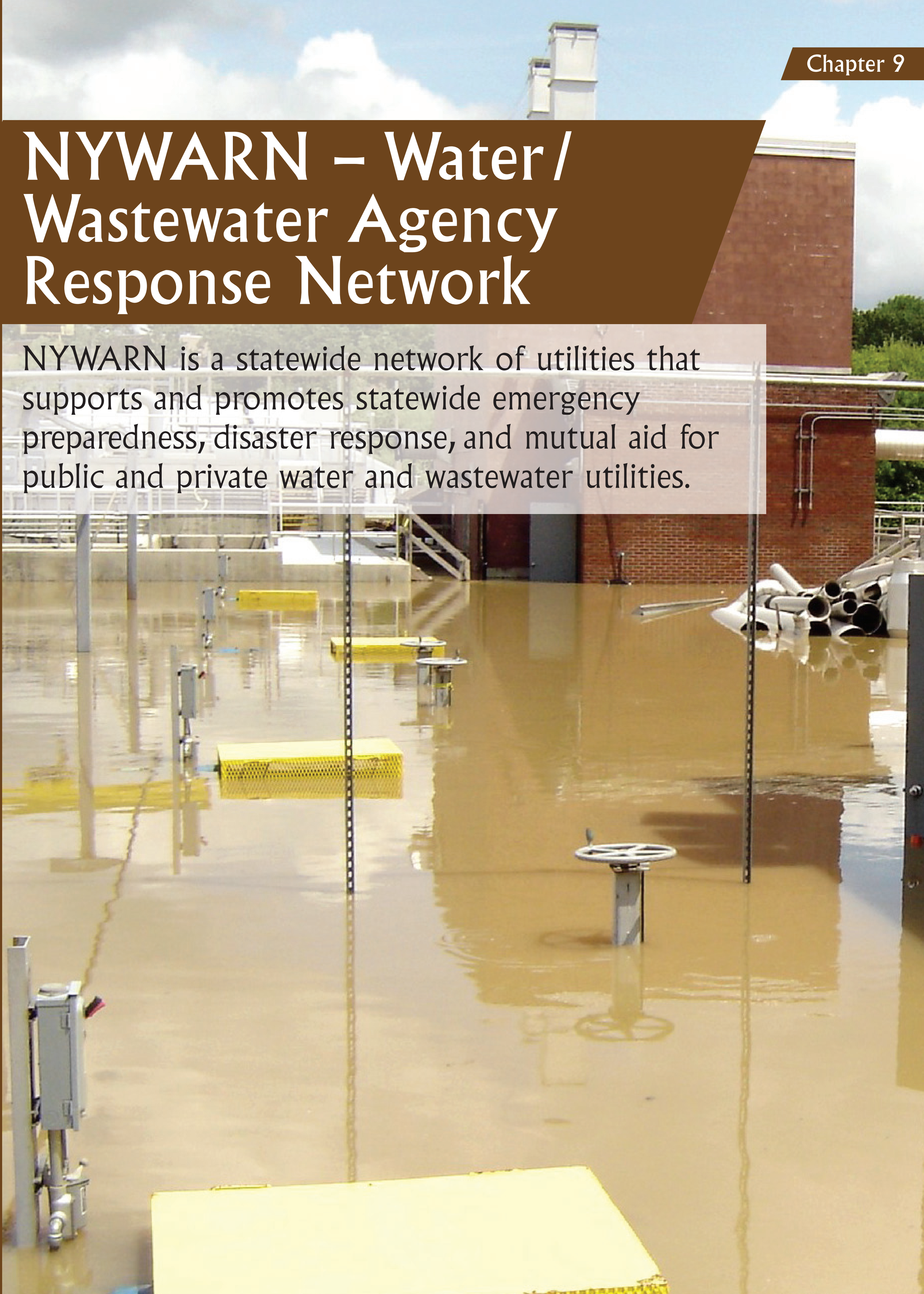
Grade 1: 10 contact hours
Grade 2: 20 contact hours
Grade 3: 30 contact hours
Grade 4: 40 contact hours

This chapter prepared by Jon P. Ruff, PE, Environmental Manager at City of Plattsburgh, Claire Baldwin, Senior Management Consultant and Principal at CDM Smith, and Tanya May Jennings, NYWEA Wastewater Operator Certification Administrator. Chapter excerpted from "Guidelines to Building an Effective Succession Plan," and "Overview of Operations Specialists Certifications," Clear Waters, Fall 2012.



NYWARN – Water/ Wastewater Agency Response Network

NYWARN is a statewide network of utilities that supports and promotes statewide emergency preparedness, disaster response, and mutual aid for public and private water and wastewater utilities.



NYWEA

Environmental Finance Center
Syracuse University

Chapter 9: NYWARN – Water/Wastewater Agency Response Network

We are taught in life to be prepared. Being prepared can help us be in control and make the right decisions when "life happens" and a natural disaster or emergency situation arises in your community. When operating a water or wastewater utility, there are times when quick decisions need to be made. By becoming a NYWARN member, your operation will have expedited access to specialized resources.

The New York Water Environment Association is part of the NYWARN team, and helps to connect utility needs with resources available. NYWEA's involvement in NYWARN came about when the need was demonstrated over the past several years during historic flooding in the Southern Tier and New York City Watershed. During these crises, NYWEA members responded overwhelmingly with offers of assistance, e.g., with equipment and offers of personnel. The response, while it was outstanding, needed better coordination and formalization.

Flooding devastated the Village of Owego in 2011.

An established response network, NYWARN was set up through the hard work of the New York Section American Water Works Association (NYSAWWA) and partnering agencies. NYWEA has joined this existing network, as the needs of drinking water and wastewater utilities are similar in times of crisis.

"By restoring water and wastewater service in the most efficient manner possible, NYWARN provides renewed hope for fast recovery from such disasters."

The NYWARN is set up with five regions around the state, with each region having a coordinator. The role of the coordinator or regional chair is to communicate within the NYWARN group to help get communities in need the equipment or services they require. The regional coordinators are also champions for NYWARN and encourage utilities to become members. There is no cost to join NYWARN and no obligation to respond to requests for assistance. This is a volunteer program.

The basis for the NYWARN program is the Mutual Aid Agreement. This agreement covers all aspects of the utility requester and responder responsibilities, including, but not limited to, voluntary aspects of the program and issues of cost reimbursement, workers compensation claims and insurance coverage.

Becoming a NYWARN member can give utilities the resources to recover more quickly from a disaster. Be prepared! Join the NYWARN team and your operation will be sure to stand ready for the next curve ball that might come your way.

Full details regarding NYWARN can be found at www.NYWARN.org.

To access a copy of the New York Water/Wastewater Agency Response Network (NYWARN) Operational Plan, use the following link:

http://nywarn.org/files/doc_5_1_3nw_NYWARNOperationalPlan.pdf

New York Mutual Aid and Assistance Agreement for Water/Wastewater Providers

AGREEMENT

This Agreement is made and entered into by public and private Water and Wastewater Utilities that have, by executing this Agreement, manifested their intent to participate in an Intrastate Program for Mutual Aid and Assistance, which is known as the New York Mutual Aid and Assistance Agreement for Water/Wastewater Providers.

ARTICLE I.
PURPOSE

Recognizing that incidents which may impact health or safety may require aid or assistance in the form of personnel, equipment, and supplies from outside the area of impact, the signatory utilities hereby establish an Intrastate Program for Mutual Aid and Assistance. Through the Mutual Aid and Assistance Program, Members coordinate response activities and share resources during incidents. This Agreement sets forth the procedures and standards for the administration of the Intrastate Mutual Aid and Assistance Program.

ARTICLE II.
DEFINITIONS

A. Authorized Official – An employee or officer of a Member utility that is authorized to:
   1. Request assistance;
   2. Offer assistance;
   3. Refuse to offer assistance or
   4. Withdraw assistance under this agreement.

B. Incident – A natural or human caused event or circumstance causing, or imminently threatening to cause, loss of life, injury to person or property, human suffering or financial loss, and includes, but is not limited to, fire, explosion, flood, severe weather, drought, earthquake, volcanic activity, spills or releases of oil or hazardous material, contamination, utility or transportation emergencies, disease, blight, infestation, civil disturbance, riot, intentional acts, sabotage and war that is, or could reasonably be beyond the capability of the services, personnel, equipment, and facilities of a Mutual Aid and Assistance Program Member to fully manage and mitigate internally.

C. Members – Any public or private Water or Wastewater Utility that manifests intent to participate in the Mutual Aid and Assistance Program by executing this Agreement.

   1. Associate Member – Any non-utility participant, approved by the State Steering Committee, that provides a support role for the WARN program, for example State Department of Public Health, or associations, who are members of the Regional or State Steering Committees and do not officially sign the WARN agreement.

2. Requesting Member – A Member who requests aid or assistance under the Mutual Aid and Assistance Program.

3. Responding Member – A Member that responds to a request for aid or assistance under the Mutual Aid and Assistance Program.

4. Non-Responding Member - A Member or Associate Member that does not provide aid or assistance during a Period of Assistance under the Mutual Aid and Assistance Program.

D. Confidential Information - Any document shared with any signatory of this Agreement that is marked confidential, including but not limited to any map, report, notes, papers, opinion, or e-mail.

E. Period of Assistance – A specified period of time when a Responding Member assists a Requesting Member. The period commences when personnel, equipment, or supplies depart from Responding Member's facility and ends when the resources return to their facility (portal to portal). All protections identified in the Agreement apply during this period. The specified Period of Assistance may occur during response to or recovery from an emergency, as previously defined.

F. National Incident Management System (NIMS): A national, standardized approach to incident management and response that sets uniform processes and procedures for incident response operations.

ARTICLE III.
ADMINISTRATION

The Mutual Aid and Assistance Program shall be administered through Regional Committees, as needed, and a Statewide Committee. The purpose of a Regional Committee is to provide local coordination of the Mutual Aid and Assistance Program before, during, and after an incident. The designated regions correspond to the previously established New York State Emergency Management Office Regions as shown on the map contained in Exhibit 1 of this Agreement. Each Regional Committee, under the leadership of an elected Chairperson, shall meet annually to address Mutual Aid and Assistance Program issues. Each Regional Committee shall also meet annually to review incident preparedness and response procedures. The Chairperson of each Regional Committee represents their Regional Committee's interests on the Statewide Committee. In addition to representing the interests of the Members, the Statewide Committee includes representatives from the New York State Health Department, New York State Emergency Management Office, Department of Environmental Conservation, New York State AWWA, New York State Rural Water Association, and others as may be designated by the Statewide Committee. Under the leadership of the Chair, the Statewide Committee members shall plan and coordinate incident planning and response activities for the Mutual Aid and Assistance Program.

ARTICLE IV.
PROCEDURES

In coordination with the Regional Committees, the emergency management and the public health system of the state, the Statewide Committee shall develop operational and planning procedures for the Mutual Aid and Assistance Program. These procedures shall be reviewed at least annually and updated as needed by the Statewide Steering Committee.

ARTICLE V.
REQUESTS FOR ASSISTANCE

A. Member Responsibility: Members shall identify an Authorized Official and alternates; provide contact information including 24-hour access and maintain resource information that may be available from the utility for mutual aid and assistance response. Such contact information shall be updated annually or when changes occur and provided to the State Steering Committee.

   In the event of an Incident, a Member's Authorized Official may request mutual aid and assistance from a participating Member. Requests for assistance can be made orally or in writing. When made orally, the request for personnel, equipment, and supplies shall be prepared in writing as soon as practicable. Requests for assistance shall be directed to the Authorized Official of the participating Member. Specific protocols for requesting aid shall be provided in the required procedures (Article IV).

B. Response to a Request for Assistance – Members of the agreement are not obligated to respond to a request. After a Member receives a request for assistance, the Authorized Official evaluates whether or not to respond, whether resources are available to respond, or if other circumstances would hinder response. Following the evaluation, the Authorized Official shall inform, as soon as possible, the Requesting Member whether it will respond. If the Member is willing and able to provide assistance, the Member shall inform the Requesting Member about the type of available resources and the approximate arrival time of such assistance.

C. Discretion of Responding Member's Authorized Official – Execution of this Agreement does not create any duty to respond to a request for assistance. When a Member receives a request for assistance, the Authorized Official shall have sole and absolute discretion as to whether or not to respond, or the availability of resources to be used in such response. The decision of a Member's Authorized Official on the availability of resources shall be final.

ARTICLE VI.
RESPONDING MEMBER PERSONNEL

A. National Incident Management System - When providing assistance under this Agreement, the Requesting Member and Responding Member shall be organized and shall function under the National Incident Management System.

B. Control - While employees so provided may be under the supervision of the Responding Member, the Responding Member's employees come under the direction and control of the Requesting Member, consistent with the NIMS Incident Command System, to address the needs identified by the Requesting Member. The Requesting Member's Authorized Official shall coordinate response activities with the designated supervisor(s) of the Responding Member(s). All services provided by a Responding Member shall be performed with a reasonable level of care and competence. At a minimum, the Responding Member's designated supervisor shall be familiar with the NIMS Incident Command System. The Responding Member's designated supervisor(s) must keep accurate records of work performed by personnel during the specified Period of Assistance.

C. Food and Shelter – Whenever practical, Responding Member personnel must be self sufficient for up to 24 hours. Whenever possible, the Requesting Member shall supply reasonable food and shelter for Responding Member personnel. If the Requesting Member is unable to provide food and shelter for Responding personnel, the Responding Member's designated supervisor is authorized to secure the resources necessary to meet the needs of its personnel. Except as provided below, the cost for such resources must not exceed the State per diem rates for that area. To the extent Food and Shelter costs exceed the State per diem rates for the area, the Responding Member must demonstrate that the additional costs were reasonable and necessary under the circumstances. Unless otherwise agreed to in writing, the Requesting Member remains responsible for reimbursing the Responding Member for all reasonable and necessary costs associated with providing food and shelter, if such resources are not provided.

D. Communication – The Requesting Member shall provide Responding Member personnel with communication equipment as available or radio frequency information to program existing equipment in order to facilitate communications with local responders and utility personnel.

E. Status - Unless otherwise provided by law, the Responding Member's officers and employees retain the same privileges, immunities, rights, duties and benefits as provided in their respective jurisdictions.

F. Licenses and Permits – To the extent permitted by law, Responding Member personnel that hold licenses, certificates, or permits evidencing professional, mechanical, or other skills shall be allowed to carry out activities and tasks relevant and related to their respective credentials during the specified Period of Assistance.

G. Right to Withdraw - The Responding Member's Authorized Official retains the right to withdraw some or all of its resources at any time for any reason in the Responding Member's sole and absolute discretion. Notice of intention to withdraw must be communicated to the Requesting Member's Authorized Official as soon as soon as is practicable under the circumstances.

ARTICLE VII.
COST- REIMBURSEMENT

The Requesting Member shall reimburse the Responding Member for each of the following categories of costs incurred during the specified Period of Assistance; provided, that any Responding Member may assume in whole or in part such loss, damage, expense, or other cost, or may loan such equipment or donate such services to the Requesting Member without charge or cost.

A. Personnel – The Responding Member shall be reimbursed by the Requesting Member for personnel costs incurred for work performed during the specified Period of Assistance. Responding Member personnel costs shall be calculated according to the terms provided in their employment contracts or other conditions of employment. The Responding Member's designated supervisor(s) must keep accurate records of work performed by personnel during the specified Period of Assistance. Requesting Member reimbursement to the Responding Member must include all personnel costs, including salaries or hourly wages, costs for fringe benefits, and reasonable indirect costs, unless otherwise agreed in writing.

B. Equipment – The Requesting Member shall reimburse the Responding Member for the use of equipment during the specified Period of Assistance, including, but not limited to, reasonable rental rates, all fuel, lubrication, maintenance, transportation, and loading/unloading of loaned equipment. All equipment shall be returned to the Responding Member in good working order as soon as is practicable and reasonable under the circumstances. As a minimum, rates for equipment use must be based on the Federal Emergency Management Agency's (FEMA) Schedule of Equipment Rates. If a Responding Member uses rates different from those in the FEMA Schedule of Equipment Rates, the Responding Member must provide such rates orally or in writing to the Requesting Member prior to supplying the equipment. Mutual agreement on which rates are used must be reached in writing prior to dispatch of the equipment. Reimbursement for equipment not referenced on the FEMA Schedule of Equipment Rates must be developed based on actual recovery of costs. If a Responding Member must lease a piece of equipment while its equipment is being repaired, Requesting Member shall reimburse Responding Member for such rental costs.

C. Materials and Supplies – The Requesting Member must reimburse the Responding Member in kind or at actual replacement cost, plus handling charges, for use of expendable or non-returnable supplies. The Responding Member must not charge direct fees or rental charges to the Requesting Member for other supplies and reusable items that are returned to the Responding Member in a clean, damage-free condition. Reusable supplies that are returned to the Responding Member with damage must be treated as expendable supplies for purposes of cost reimbursement.

D. Payment Period – The Responding Member must provide an itemized bill to the Requesting Member for all expenses incurred by the Responding Member while providing assistance under this Agreement. The Requesting Member must send the itemized bill not later than (90) ninety days following the end of the Period of Assistance. The Responding Member may request additional periods of time within which to submit the itemized bill, and Requesting Member shall not unreasonably withhold consent to such request. The Requesting Member must pay the bill in full on or before the ninetieth (90^{th}) day following the billing date. The Requesting Member may request additional periods of time within which to pay the itemized bill, and Responding Member shall not unreasonably withhold consent to such request, provided, however, that all payments shall occur not later than one (1) year after the date a final itemized bill is submitted to the Requesting Member. Any bill not paid within ninety (90) days, shall be assessed a penalty of eighteen percent (18%) per year on the unpaid portion of the bill.

E. Records - Each Responding Member and their duly authorized representatives shall have access to a Requesting Member's books, documents, notes, reports, papers and records which are directly pertinent to this Agreement for the purposes of reviewing the accuracy of a cost, bill or making a financial, maintenance or regulatory audit. Each Requesting Member and their duly authorized representatives shall have access to a Responding Member's books, documents, notes, reports, papers and records which are directly pertinent to this Agreement for the purposes of reviewing the accuracy of a cost, bill or making a financial, maintenance or regulatory audit. Such records shall be maintained for at least six (6) years after the Period of Assistance or longer where required by law.

ARTICLE VIII.
DISPUTES

If any controversy or claim arises out of, or relates to, the execution of the Agreement, including, but not limited to, alleged breach of the Agreement, the disputing Members shall first attempt to resolve the dispute by negotiation, followed by mediation and if not resolved, then the parties shall endeavor to settle the dispute by binding arbitration before a panel of three persons chosen from the members of this Mutual Aid Agreement, excluding those Members that are parties to this dispute. Associate Members shall not serve on the arbitration panel. The arbitration shall be conducted in accordance with the laws of New York State.

ARTICLE IX.
REQUESTING MEMBER'S DUTY TO INDEMNIFY

The Requesting Member shall assume the defense of, fully indemnify and hold harmless, the Responding Member, its officers and employees from all claims, loss, damage, injury and liability of every kind, nature and description, directly or indirectly arising from Responding Member's work during a specified Period of Assistance. The scope of the Requesting Member's duty to indemnify includes, but is not limited to, suits arising from, or related to, negligent or wrongful use of equipment or supplies on loan to the Requesting Member, or other negligent acts, errors or omissions by Requesting Member or the Responding Member personnel. This shall not include a duty to indemnify for intentional or grossly negligent acts of the Responding party.

The Requesting Member's duty to indemnify is subject to, and shall be applied consistent with, the conditions set forth in Article X.

ARTICLE X.
SIGNATORY INDEMNIFICATION

In the event of a liability, claim, demand, action, or proceeding of whatever kind or nature arising out of a specified Period of Assistance, the Members who receive and provide assistance shall have a duty to defend, indemnify, save and hold harmless all Non-Responding Members, their officers, agents and employees from any liability, claim, demand, action, or proceeding of whatever kind or nature arising out of a Period of Assistance.

ARTICLE XI.
WORKER'S COMPENSATION CLAIMS

The Responding Member is responsible for providing worker's compensation benefits and administering worker's compensation for its employees. The Requesting Member is responsible for providing worker's compensation benefits and administering worker's compensation for its employees.

ARTICLE XII.
NOTICE

A Member who becomes aware of a claim or suit that in anyway, directly or indirectly, contingently or otherwise, affects or might affect other Members of this Agreement shall provide prompt and timely notice to the Members who may be affected by the suit or claim. Each Member reserves the right to participate in the defense of such claims or suits as necessary to protect its own interests.

ARTICLE XIII.
INSURANCE

Members of this Agreement shall maintain an insurance policy or maintain a self insurance program that covers activities that it may undertake by virtue of membership in the Mutual Aid and Assistance Program. The following minimum insurance limits apply:

A. Commercial General Liability - $1,000,000 each occurrence and $2,000,000 in aggregate, including products and completed operations liability
B. Automobile Liability - $1,000,000 combined single limit.
C. Excess Liability - $3,000,000 each occurrence and aggregate
D. Property Insurance – Coverage for equipment used as part of this Agreement

ARTICLE XIV.
CONFIDENTIAL INFORMATION

To the extent provided by law, any Member or Associate Member shall maintain in the strictest confidence and shall take all reasonable steps necessary to prevent the disclosure of any Confidential Information disclosed under this Agreement. If any Member, Associate Member, third party or other entity requests or demands, by subpoena or court order, that a Member or Associate Member disclose any Confidential Information disclosed under this Agreement, the Member or Associate Member shall immediately notify the owner of the Confidential Information and shall take all reasonable steps necessary to prevent the disclosure of any Confidential Information by asserting all applicable rights and privileges with respect to such information and shall cooperate fully in any judicial or administrative proceeding relating thereto.

ARTICLE XV.
EFFECTIVE DATE

This Agreement shall be effective after the Water and Wastewater Utility's authorized representative executes the Agreement and the applicable Regional Committee Chair receives the Agreement. The Regional Committee Chair shall maintain a list of all Members in the respective region. The Statewide Committee Chair shall maintain a master list of all members of the Mutual Aid and Assistance Program.

ARTICLE XVI.
WITHDRAWAL

A Member may withdraw from this Agreement by providing written notice of its intent to withdraw to the applicable Regional Committee Chair and the Statewide Chair. Withdrawal shall take effect sixty (60) days after the appropriate officials receive notice. Withdrawal from this Agreement shall in no way affect a Requesting Member's duty to reimburse a Responding Member for cost incurred during a Period of Assistance, which duty shall survive such withdrawal or termination of this Agreement.

ARTICLE XVII.
MODIFICATION

No provision of this Agreement may be modified, altered or rescinded by individual parties to the Agreement. Modifications to this Agreement may be due to programmatic operational changes to support the Agreement, legislative action, creation of an interstate aid and assistance agreement, or other developments. Modifications require a simple majority vote of Members within each region and a unanimous agreement between the regions. The Statewide Committee Chair must provide written notice to all Members of approved modifications to this Agreement. Approved modifications take effect ninety (90) days after the date upon which notice is sent to the Members.

ARTICLE XVIII.
SEVERABILITY

The parties agree that if any term or provision of this Agreement is declared by a court of competent jurisdiction to be illegal or in conflict with any law, the validity of the remaining terms and provisions shall not be affected, and the rights and obligations of the parties shall be construed and enforced as if the Agreement did not contain the particular term or provision held to be invalid.

ARTICLE XIX.
PRIOR AGREEMENTS

This Agreement supersedes all prior Agreements between Members to the extent that such prior Agreements are inconsistent with this Agreement.

ARTICLE XX.
PROHIBITION ON THIRD PARTIES AND ASSIGNMENT OF RIGHTS/DUTIES

This Agreement is for the sole benefit of the Members and no person or entity may have any rights under this Agreement as a third party beneficiary. Assignments of benefits and delegations of duties created by this Agreement are prohibited and must be without effect.

ARTICLE XXI.
INTRASTATE AND INTERSTATE MUTUAL AID AND ASSISTANCE PROGRAMS

To the extent practicable, Members of this Agreement shall participate in Mutual Aid and Assistance activities conducted under the State of New York Intrastate Mutual Aid and Assistance Program and the Interstate Emergency Management Assistance Compact (EMAC). Members may voluntarily agree to participate in an interstate Mutual Aid and Assistance Program for water and wastewater utilities through this Agreement if such a Program were established.

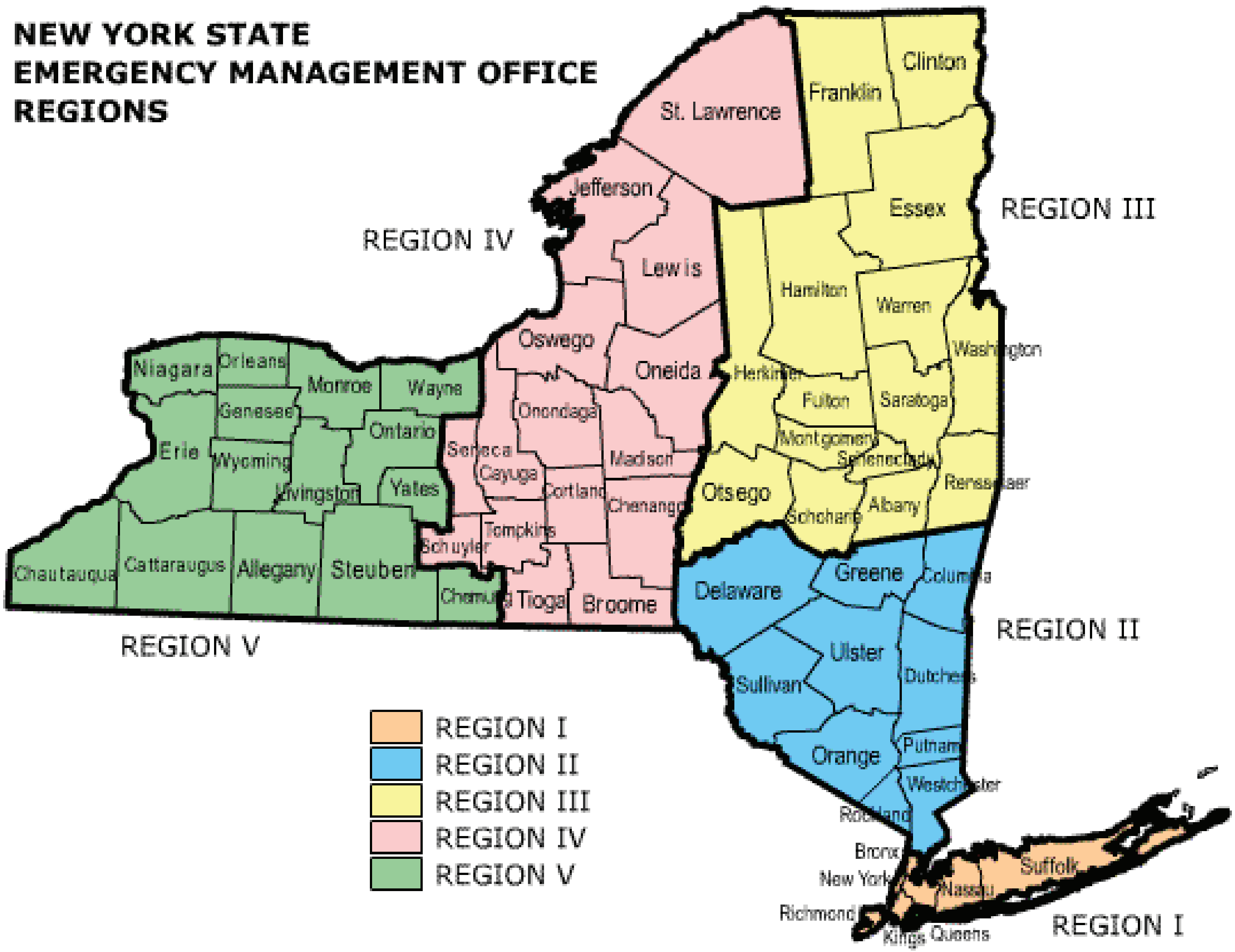
Now, therefore, in consideration of the covenants and obligations set forth in this Agreement, the Water and Wastewater Utility listed here manifests its intent to be a Member of the Intrastate Mutual Aid and Assistance Program for Water and Wastewater Utilities by executing this Agreement on this ___________ day of __________ 20___.

Water/Wastewater Utility:________________________________

By:_____________________

Title____________________

____
Please Print Name


NEW YORK STATE
EMERGENCY MANAGEMENT OFFICE
REGIONS
REGION III
REGION IV
REGION II
REGION V
REGION I
St. Lawrence
Franklin
Clinton
Jefferson
Essex
Lewis
Hamilton
Warren
Oswego
Oneida
Fulton
Saratoga
Niagara
Orleans
Monroe
Wayne
Genesee
Ontario
Onondaga
Erie
Wyoming
Yates
Cayuga
Madison
Otsego
Albany
Chautauqua
Cattaraugus
Allegany
Steuben
Tioga
Broome
Delaware
Greene
Ulster
Sullivan
Orange
Putnam
Bronx
New York
Richmond
Kings
Queens
Suffolk
REGION I
REGION II
REGION III
REGION IV
REGION V

Chapter 9:
Regional Chairperson Contact Information

Region 1:
Mike Boufis mikebwd@optonilne.net
Bethpage Water District
516-931-0093 work
516-348-0063 – Direct private line – office
631-901-4195 – personal cell - primary
516-322-3994 – work cell - secondary

Stan Carey scarey@massapequawater.com
Massapequa Water District
516-798-5266 -Office
516-204-8575 - cell

Phil Thompson pthompson@scwa.com
631-218-7031 - Desk Phone
631-704-4563 - Primary Cell
631-445-8559 - Secondary Cell

Region 2:
Judy Hansen jhansen@kingston-ny.gov
Kingston Water
845-338-5179 -office
845-943-8223 -cell

Region 3:
Chris Wheland chris.wheland@troyny.gov
Troy Water Dept
518-237-0865- office
518-369-3259- cell

Region 4:
Connie Schreppel cschreppel@mvwa.us
Mohawk Valley Water
315 792-0317- office
315 534-6218 cell
315 796-7277 secondary cell

Region 5:
Marty Aman maman@wcwsa.org
Wayne County Water and Sewer
315-986-1929- office
315-585-5875 -cell

AWWA Office
Rochelle Cassella rochelle@nysawwa.org
315-455-2614 office
315-559-9223 cell

New York Rural Water
Patricia C Scalera scalera@nyruralwater.org
1-888-697-8725
or after office hours at 1-877-239-0101

This chapter prepared by Patricia Cerro-Reehil, Executive Director of the New York Water Environment Association.

Appendix 1: Glossary of Terms

This extensive glossary can be a key resource in understanding the terminology, processes, technology and science of wastewater treatment.

NYWEA

Environmental Finance Center
Syracuse University

Appendix 1: Glossary of Terms

Abatement: Putting an end to an undesirable or unlawful condition affecting the wastewater collection system. A property owner found to have inflow sources connected to the collection system may be issued a "Notice of Abatement." Such notices will usually describe the violation, suggest corrective measures, and grant a period of time for compliance.

Absorption: The taking in or soaking up of one substance into the body of another by molecular or chemical action (as tree roots absorb dissolved nutrients in the soil).

Acid: A substance that tends to lose a proton, dissolves in water with the formation of hydrogen ions, contains hydrogen which may be replaced by metals to form salts, and is corrosive.

Acidity: The capacity of water or wastewater to neutralize bases. Acidity is expressed in milligrams per liter of equivalent calcium carbonate. Acidity is not the same as pH because water does not have to be strongly acidic (low pH) to have a high acidity. Acidity is a measure of how much base must be added to a liquid to raise the pH to 8.2.

Activated Carbon: Adsorptive particles or granules of carbon usually obtained by heating carbon (such as wood). These particles or granules have a high capacity to selectively remove certain trace and soluble materials from water.

Activated Sludge: Sludge particles produced in raw or settled wastewater (primary effluent) by the growth of organisms (including zoogleal bacteria) in aeration tanks in the presence of dissolved oxygen. The term "activated" comes from the fact that the particles are teeming with bacteria, fungi, and protozoa. Activated sludge is different from primary sludge in that the sludge particles contain many living organisms that can feed on the incoming wastewater.

Activated Sludge Process: A biological wastewater treatment process that speeds up the decomposition of wastes in the wastewater being treated. Activated sludge is added to wastewater and the mixture (mixed liquid) is aerated and agitated. After some time in the aeration tank, the activated sludge is allowed to settle out by sedimentation and is disposed of (wasted) or reused (returned to the aeration tank) as needed. The remaining wastewater then undergoes more treatment.

Adsorption: The gathering of a gas, liquid, or dissolved substance on the surface or interface zone of another substance.

Advanced Waste Treatment: Any process of water renovation that upgrades treated wastewater to meet specific reuse requirements. May include general cleanup of water or removal of specific parts of wastes insufficiently removed by conventional treatment processes. Typical processes include chemical treatment and pressure filtration. Also called "tertiary treatment."

Aeration: The process of adding air to water. Air can be added to water by either passing air through water or passing water through air. In wastewater treatment, air is added to freshen wastewater and to keep solids in suspension. With mixtures of wastewater and activated sludge, adding air provides mixing and oxygen for the microorganisms treating the wastewater.

Aeration Liquor: Mixed liquor. The contents of the aeration tank including living organisms and material carried into the tank by either untreated wastewater or primary effluent.

Aeration Tank: The tank where raw or settled wastewater is mixed with return sludge and aerated. The same as "aeration bay," "aerator," or "reactor."

Aerobic: A condition in which dissolved oxygen is present in the aquatic (water) environment.

Aerobic Bacteria: Bacteria which will live and reproduce only in an environment containing oxygen which is available for their respiration (breathing), namely atmospheric oxygen or oxygen dissolved in water. Oxygen combined chemically, such as in water molecules (H_2O), cannot be used for respiration by aerobic bacteria.

Aerobic Decomposition: Decomposition and decay of organic material in the presence of "free" or dissolved oxygen.

Aerobic Digestion: The breakdown of wastes by microorganisms in the presence of dissolved oxygen. This digestion process may be used to treat only waste activated sludge, or trickling filter sludge and primary (raw) sludge, or waste sludge from activated sludge treatment plants designed without primary settling. The sludge to be treated is placed in a large aerated tank where aerobic microorganisms decompose the organic matter in the sludge. This is an extension of the activated sludge process.

Aerobic Process: A waste treatment process conducted under aerobic (in the presence of "free" or dissolved oxygen) conditions.

AGA: American Gas Association

Agglomeration: The grouping, or coming together of dispersed suspended matter into larger particles, called "iloc", which settle more rapidly.

Air Blower: A device used to ventilate manholes and lift stations.

Air Changes: Expression of the amount of air movement or air leakage into or out of a building in terms of the number of building volumes or room volumes exchanged.

Air Conditioner: Assembly of equipment for the simultaneous control of air temperature, relative humidity, purity, and motion.

Air Conditioning System: Assembly of equipment for air treatment to control simultaneously its temperature, humidity, cleanliness, and distribution to meet the requirements of a conditioned space.

Air Gap: In plumbing, an unobstructed vertical distance through free atmosphere between the opening of a pipe or faucet supplying water to a tank and the water surface of the tank at flood level.

Air Handling Unit: Consists of a fan and one or more coils (heating and/or cooling), filters, mixing boxes, dampers and their associated controls. Typically the fan and the coils are mounted within a single cabinet.

Airlift: A device for raising liquids by injecting air near the bottom of a riser pipe submerged in the liquid.

Air-to-air Heat Exchanger: Exchanger that transfers heat from an exhaust airstream to a separated supply airstream.

Algae: Microscopic plants which contain chlorophyll and live floating or suspended in water. They also may be attached to structures, rocks or other similar substances. Algae produce oxygen during sunlight hours and use oxygen during the night hours. Their biological activities appreciably affect the pH and dissolved oxygen of the water.

Algal Bloom: Sudden, massive growths of microscopic and macroscopic plant life, such as green or blue-green algae, which develop in lakes and reservoirs.

Algicide: Any substance which will kill algae

Aliquot: Portion of a sample.

Alkali: Any of certain soluble salts, principally of sodium, potassium, magnesium, and calcium, that combine with acids to form neutral salts and may be used in chemical processes such as water or wastewater treatment. Examples include calcium carbonate, sodium hydroxide, and sodium bicarbonate.

Alkaline: The condition of water or soil that contains a sufficient amount of alkali substances to raise the pH above 7.0.

Alkalinity: The capacity of water or wastewater to neutralize acids. This capacity is caused by the water's content of carbonate, bicarbonate, hydroxide, and occasionally borate, silicate, and phosphate. Alkalinity is expressed in milligrams per liter of equivalent calcium carbonate. Alkalinity is not the same as pH because water does not have to be strongly basic (high pH) to have a high alkalinity. Alkalinity is a measure of how much acid must be added to a liquid to lower the pH to 4.5.

Alternating Current (AC): Electrical current which reverses direction repeatedly and rapidly. The change in current is due to a change in voltage which occurs at the same frequency.

Ambient Air: Surrounding air (usually outdoor air or the air in an enclosure under study).

Ambient Temperature: The temperature of the surrounding area.

American National Standards Institute (ANSI): A private organization that coordinates some US standards setting. It also approves some US standards that are often called ANSI standards. ANSI also represents the United States to the International Standards Organization. See also: International Standards Organization

American Standard Code for Information Interchange (ASCII): A standard character set that (typically) assigns a 7-bit sequence to each letter, number, and selected control character. Erroneously used now to refer to (8-bit) Extended ASCII. The other major encoding standard is EBCDIC.

American Wire Gauge (AWG): A standard used to describe the size of a wire. The large the AWG number, the smaller (thinner) the described wire.

Amination: Use of ammonia-nitrogen by bacteria to form new bacteria.

Ammonia (NH_3): A chemical combination of hydrogen (H) and nitrogen (N) found extensively in nature. An indicator of fresh pollution.

Ammonification: Conversion of organic nitrogen to ammonia-nitrogen resulting from the biological decomposition of organic matter (i.e., dead plant and animal tissue, fecal matter, etc.)

Ampacity: The amount of current (measured in amperes) that a conductor can carry without overheating

Ampere (or amp): Unit of current measurement The amount of current that will flow through a one ohm resistor when one volt is applied

Ampere-hour: The quantity of electricity equal to the flow of a current of one ampere for one hour.

Amperometric: A method of measurement that records electric current flowing or generated, rather than recording voltage. Amperometric titration is an electrometric means of measuring concentrations of substances in water.

Anaerobic: A condition in which atmospheric or dissolved molecular oxygen is not present in the aquatic (water) environment.

Anaerobic Bacteria: Bacteria that live and reproduce in an environment containing no "free" or dissolved oxygen. Anaerobic bacteria obtain their oxygen supply by breaking down chemical compounds which contain oxygen, such as sulfate.

Anaerobic Decomposition: Decomposition and decay of organic material in an environment containing no "free" or dissolved oxygen.

Anaerobic Digester: A wastewater solids treatment device in which the solids and water (about 5 percent solids, 95 percent water) are placed in a large tank where bacteria decompose the solids in the absence of dissolved oxygen.

Analog: A format that uses continuous physical variables such as voltage amplitude or frequency variation to represent information. Contrast with digital.

Annunciator: A sound generating device that intercepts and speaks the condition of circuits or circuits operations. A signaling device that gives a visual or audible signal (or both) when energized.

Anoxic: A condition in which the aquatic (water) environment does not contain enough dissolved molecular oxygen, which is called an oxygen deficient condition. Generally refers to an environment in which chemically bound oxygen, such as in nitrate, is present.

Approved Ground: A grounding bus or strap in a building that is suitable for connecting to data communication equipment. It includes a grounding subsystem, the building's electrical service conduit and a grounding conductor. See also EIA 607 and the National Electrical Code.

Aquastat: Thermostat for use in water.

Assimilation: Use of ammonia and nitrate-nitrogen by plants for growth.

Autotrophic Bacteria: Bacteria that use inorganic carbon (i.e., carbon dioxide) for energy and cell growth.

Average Power: The average over time of a modulated signal.

AWG: See American Wire Gauge.

Axial Fan: Fan that moves air in the general direction of the axis about which it rotates.

BOD5: Refers to the five-day biochemical oxygen demand. The total amount of oxygen used by microorganisms decomposing organic matter increases each day until the ultimate BOD is reached, usually in 50 to 70 days. BOD usually refers to the five-day BOD or BOD5.

Backflow: A flow condition, caused by differential pressure, resulting in the flow of liquid into the potable water supply system from sources other than those intended; or the backing up of liquid, through a conduit or channel, in a direction opposite to normal flow. Backflow Preventer - any effective device, method or construction used to prevent backflow into a potable water system.

Backwashing: The process of reversing the flow of water back through the filter media to remove the entrapped solids.

Bacteria: Primitive organisms (mostly plants) that are generally free of pigment and reproduce by dividing in one, two, or three planes. They are single-celled, do not require light for their life processes, and can be grown in special cultures out of their native environment.

Anaerobic - bacteria which can grow in the absence of "free" oxygen, deriving their oxygen from breaking down complex substances.

Coliform Group - a group of bacteria, predominantly found in the intestinal tract of warm blooded animals, used as indicators of human pollution. The major species are: Escherichia Coli (E-Coli), found in the intestines of man and Aerobactor Aerogenes/ normally found on grain and plants.

Facultative - bacteria which can adapt themselves to grow in the presence and absence of dissolved oxygen. Bacteria Primitive organisms, mostly plants and generally free of pigment, which reproduce by dividing in one, two or three planes. They are single-celled, do not require light for their life processes, and can be grown in special cultures out of their native environment.

Bacterial Culture: In the case of activated sludge, it; bacterial culture refers to the group of bacteria classed as Aerobes, and facultative organisms, which covers a wide range of organisms. Most treatment processes in the United States grow facultative organisms which utilize the carbonaceous (carbon compounds) BOD. Facultative organisms can live when oxygen resources are low. When "nitrification" is required, the nitrifying organisms are Obligate Aerobes (require oxygen) and must have at least 0.8 mg/L of dissolved oxygen throughout the whole system to function properly.

Ballast: An electrical circuit component used with fluorescent lamps to provide the voltage necessary to strike the mercury arc within the lamp, and then to limit the amount of current that flows through the lamp.

Bandwidth: Technically, the difference, in Hertz (Hz), between the highest and lowest frequencies of a transmission channel. Usually identifies the capacity or amount of data that can be sent through a given circuit.

Barometric Damper: Mechanically balanced damper that rotates from changes in pressure within breeching to bleed air into the breeching to maintain steady draft.

Bar Rack: A screen composed of parallel bars, either vertical or inclined, placed in a sewer or other waterway to catch debris. The screenings may be raked from it.

Base: A substance which takes up or accepts protons. A substance which dissociates (separates) in aqueous solution to yield hydroxyl ions. A substance containing hydroxyl ions which reacts with an acid to form a salt or which may react with metals to form precipitates.

Batch Process: A treatment process in which a tank or reactor is filled, the wastewater (or solution) is treated or a chemical solution is prepared and the tank is emptied. The tank may then be filled and the process repeated. Batch processes are also used to cleanse, stabilize or condition chemical solutions for use in industrial manufacturing and treatment processes.

Baud: A unit of signaling speed. The speed in Baud is the number of discrete conditions or signal elements per second. If each signal event represents only on bit condition, then Baud is the same as bits per second. Baud rarely equals bits per second.

Baud Rate: The rate at which data is transferred over an asynchronous RS-232 serial connection.

Better Site Design (BSD): The practice of handling stormwater through non-structural and natural approaches to new and redevelopment projects to reduce impacts on watersheds by conserving natural areas, reducing impervious cover and better integrating stormwater treatment. Better Site Design is similar to Low Impact Development (LID) and is one of the principles of Smart Growth.

Bioassay: An assay method using a change in biological activity as a qualitative or quantitative means of analyzing a material's response to biological treatment. A method of determining toxic effects of industrial wastes or other wastes by using live organisms such as fish for test organisms.

Biochemical: Chemical change resulting from biological action.

Biochemical Oxygen Demand (BOD): The rate at which organisms use the oxygen in water or wastewater while stabilizing decomposable organic matter under aerobic conditions. In decomposition, organic matter serves as food for the bacteria and energy results from its oxidation. BOD measurements are used as a measure of the organic strength of wastes in water.

Biodegradation: The breakdown of organic matter by bacteria to more stable forms which will not create a nuisance or give off foul odors.

Bioflocculation: A condition whereby organic material; tend to be transferred from the dispersed form in wastewater to settleable material by mechanical entrapment and assimilation.

Biological Aerated Filter: A biological wastewater treatment process that utilizes fixed film media (i.e., expanded shale, polystyrene beads) for growth and retention of biological microorganisms responsible for BOD removal and nitrification.

Biological Process: A waste treatment process by which bacteria and other microorganisms break down complex organic materials into simple, nontoxic, more stable substances.

Biomass: A mass or clump of organic material consisting of living organisms feeding on the wastes in wastewater, dead organisms, and other debris.

Biosolids: A primarily organic solid product produced by wastewater treatment processes that can be beneficially recycled. The word “biosolids” is replacing the word “sludge.”

Biostimulation: Stimulation of the growth of algae and other aquatic plants resulting from over- fertilization of lakes, rivers, and estuaries.

Biosurvey: A survey of the types and numbers of organisms naturally present in the receiving waters upstream and downstream from plant effluents. Comparisons are made between the aquatic organisms upstream and those organisms downstream of the discharge.

Blinding Boiler Horsepower (BHp): Media clogging in- various types of filters Equal to the evaporation of 34.5 pounds of water at 2120F, having a total heat content of 33,472 BTUs.

Bloodborne Pathogen: A disease causing organism which lives in the blood, and some other types of body fluids, of infected persons.

Blowdown: Discharge of water from a steam boiler or other recirculating system that contains high total dissolved solids.

Blower: A device used to ventilate manholes and lift stations.

BOD: See Biochemical Oxygen Demand.

Boiler: Vessel in which a liquid is heated with or without vaporization; boiling need not occur.

Boiler Feed Pump: Pump which returns condensed steam, makeup water, or both directly to the boiler.

Boiler Feedwater: Water supplied to a boiler by pumping.

Boiler Horsepower: Equivalent to 33,475 Btu/hr.

Bonding: A very-low impedance path accomplished by permanently joining non-current-carrying metal parts. It is done to provide electrical continuity and to offer the capacity to safely conduct any current.

Bonding Jumper: A conductor used to assure the required electrical connection between metal parts of an electrical system.

Bonding Conductor: The conductor that connects the noncurrent- carrying parts of electrical equipment, cable raceways, or other enclosures to the approved system ground conductor

Branch Circuit: Conductors between the last over current device and the outlets

Branch Circuit, General Purpose: A branch circuit that supplies outlets for lighting and power.

Branch Circuit, Individual: A branch circuit that supplies only one piece of equipment.

Branch Circuit, Multiwire: A branch circuit having two or more ungrounded circuit conductors, each having a voltage difference between them, and a grounded circuit conductor (neutral) having an equal voltage difference between it and each ungrounded conductor.

Branch Sewer: A sewer that receives wastewater from a relatively small area and discharges into a main sewer serving more than one branch sewer area.

Break: A fracture or opening in a pipe, manhole or other structure due to structural failure and/or structural defect.

Break Point: That point in time when the effluent contaminant concentration in a controlled air stream (usually an adsorption device) begins to increase as the adsorbing device becomes saturated.

Breakthrough: In an adsorption device, the increase in outlet concentration of the controlled contaminant from the break point, as the adsorbing media reaches saturation.

Breeching: Passage for conducting the products of combustion from a fuel-fired appliance to a vent or chimney.

British Thermal Unit (BTU): The amount of heat required to raise the temperature of one pound of water, one degree Fahrenheit.

Btu: British thermal unit.

Buffer: A solution or liquid whose chemical makeup neutralizes acids or bases without a great change in pH.

Building Sewer: A gravity-flow pipeline connecting a building wastewater collection system to a lateral or branch sewer. The building sewer may begin at the outside of the building’s foundation wall or some distance (such as 2 to 10 feet) from the wall, depending on local sewer ordinances. Also called a “house connection” or a “service connection.”

Building Wastewater Collection System: All of the wastewater drains pipes and their hardware that connect plumbing fixtures inside or adjacent to a building to the building sewers. This includes traps, vents, and cleanouts.

Bulking: A decrease in the settleability of an activated sludge, as measured by a significant rise in the Sludge Volume Index.

Burner: Part of a fuel-burning device (as a boiler or furnace) where flame is produced.

Bypass: A pipe, valve, gate, weir, trench or other device designed to permit all or part of a wastewater flow to be diverted from usual channels or flow. Sometimes refers to a special line which carries the flow around a facility or device that needs maintenance or repair. In a wastewater treatment plant, overload flows should be bypassed into a holding pond for future treatment.

Cabinet Heater: A heating unit, usually wall mounted, which enclosed in a cabinet. This device usually relies upon convection as the method of heating.

Carbonaceous Oxygen Demand (CBOD): A measure of the amount of dissolved oxygen required for the biological oxidation of compounds containing carbon in the sample. Same as Biochemical Oxygen Demand.

Carbonaceous Stage: A stage of decomposition that occurs in biological treatment processes when aerobic bacteria, using dissolved oxygen, change carbon compounds to carbon dioxide. Sometimes referred to as “first-stage BOD” because the microorganisms consume organic or carbon compounds first and nitrogen compounds later.

Catch Basin: A chamber or well used with storm or combined sewers as a means of removing grit, which might otherwise enter and be deposited in sewers.

Categorical Limits: Industrial wastewater discharge pollutant effluent limits developed by EPA that are applied to the effluent from any industry in any category anywhere in the United States that discharges to a POTW. These are pollutant effluent limits based on the technology available to treat the waste streams from the processes of the specific industrial category and normally are measured at the point of discharge from the regulated process. The pollutant effluent limits are listed in the Code of Federal Regulations.

Cathodic Protection: An electrical system for prevention of rust, corrosion, and pitting of metal surfaces which are in contact with water or soil. A low-voltage current is made to flow through a liquid (water) or a soil in contact with the metal in such a manner that the external electromotive force renders the metal structure cathodic. This concentrates corrosion on auxiliary anodic parts which are deliberately allowed to cor-rode instead of letting the structure corrode.

Cation: A positively charged ion in an electrolyte solution, attracted to the cathode under the influence of a difference in electrical potential. Sodium ion is a cation.

Cavitation: Vaporization of a pumped fluid resulting in vibration, noise and destruction of equipment. This occurs when the absolute pressure of the system equals the vapor pressure of the fluid pumped. In a centrifugal pump, the impeller usually receives the most damage.

Centrifugal Compressor: Nonpositive displacement compressor which depends for pressure rise, at least in part, on centrifugal forces. A turbocompressor.

Centrifugal Fan: Fan in which the air enters the impeller axially and leaves it substantially in a radial direction.

Centrifuge: A mechanical device in which centrifugal force is used to separate solids-from liquids and/or separate liquids of different densities.

Certification Examination: An examination administered by a state or professional association that operators take to indicate a level of professional competence.

Cfm: Cubic feet per minute.

Chain of Custody: A record of each person involved in the handling and possession of a sample from the person who collected the sample to the person who analyzed the sample in the laboratory and to the person who witnessed disposal of the sample.

Chemical Hygiene Plan: A written plan to identify and control the hazards associated with laboratory work.

Chemical Oxygen Demand (COD): A measure of the oxygen-consuming capacity of organic matter present in wastewater. COD is expressed as the amount of oxygen consumed from a chemical oxidant in mg/L during a specific test. Results are not necessarily related to the biochemical oxygen demand because the chemical oxidant may react with substances that bacteria do not stabilize.

CHEMTREC: Chemical Transportation Emergency Center: A public service of the Manufacturing Chemists Association, which provides immediate advice in the event of a hazardous material emergency. (800) 424-9300.

Chilled Water: Water used as a cooling medium, particularly in air-conditioning systems, which is at below ambient temperature.

Chiller: Refrigerating machine used to transfer heat between fluids; complete chiller—an indirect refrigerating system of compressor, condenser, and evaporator with all operating and safety controls.

Chloramines: Compounds of chlorine with organic and inorganic nitrogen.

Chlorination: The application of chlorine to water or wastewater, generally for the purpose of disinfection, but frequently for accomplishing other biological or chemical results (aiding coagulation and controlling tastes and odors).

Chlorinator: A metering device which is used to add chlorine to water.

Chlorine (Cl2): An element existing as a greenish-yellow gas about 2.5 times heavier than air under normal temperatures and pressures. In liquid form it is amber and about 1.5 times heavier than water.

Available - a measure of the oxidizing power of chlorinated lime and hypochlorites.

Contact Tank - a detention tank provided primarily to ensure sufficient time for the disinfection process to take place.

Demand - the difference between the amount of chlorine added and the residual after a specified contact time. The demand may change with dosage, time, temperature, pH and the nature and amount of impurities in the water.

Requirement - the demand plus the residual. The amount of chlorine added to produce the desired result.

Chlorine Contact Unit: A baffled basin that provides sufficient detention time for disinfection to occur.

Chlorine Demand: Chlorine demand is the difference between the amount of chlorine added to wastewater and the amount of residual chlorine remaining after a given contact time. Chlorine demand may change with dosage, time, temperature, pH, nature, and the amount of the impurities in the water.

Chlorine Requirement: The amount of chlorine which must be added to produce the desired result under stated conditions. The result (the purpose of chlorination) may be based on any number of criteria, such as a stipulated coliform density, a specified residual chlorine concentration, the destruction of a chemical constituent, or others. In each case a definite chlorine dosage will be necessary. This dosage is the chlorine requirement.

Chlororganic: Chlororganic compounds are organic compounds combined with chlorine. These compounds generally originate from or are associated with living or dead organic materials.

Cilia: Hairlike protuberances found on certain protozoans (called ciliates) and multi-celled aquatic invertibrates. They are used for locomotion or to cause flow of liquid.

Ciliates: A class of protozoans distinguished by short hairs on all or part of their bodies.

Circuit Breaker: A device used to open and close a circuit by automatic means when a predetermined level of current flows through it.

Circulating Water: Water that circulates repeatedly around a loop, used in a water-cooled device or in a device that cools or heats water or air.

Clarification: Any process or combination of processes the main purpose of which is to reduce the concentration of suspended matter in a liquid.

Clarifier: A large circular or rectangular tank or basin in which water is held for a period of time during which the heavier suspended solids settle to the bottom. Clarifiers are also called settling basins and sedimentation basins. May also be a tank or basin in which wastewater is held for a period of time during which the heavier solids settle to the bottom and the lighter materials float to the water surface.

Clean Water Act: An act passed by the US Congress to control water pollution. The Federal Water Pollution Control Act passed in 1972 (Public Law [PL] 92-500). It was amended in 1977 (the Clean Water Act, PL 95-217) and again in 1987 (the Water Quality Act, PL 100-4).

Coagulant: A chemical that causes very fine particles to clump (floc) together into larger particles. This makes it easier to separate the solids from the liquids by settling, skimming, draining or filtering.

Coagulation: The clumping together of very fine particles into larger particles (floc) caused by the use of chemicals (coagulants). The chemicals neutralize the electrical charges of the fine particles, allowing them to come closer and form larger clumps. This clumping together makes it easier to separate the solids from the water by settling, skimming, draining or filtering.

COD: See Chemical Oxygen Demand.

Code of Federal Regulations (CFR): A publication of the United States Government which contains all of the proposed and finalized federal regulations, including environmental regulations.

Coliform: A group of bacteria found in the intestines of warm-blooded animals (including humans) and also in plants, soil, air and water. Fecal coliforms are a specific class of bacteria which only inhabit the intestines of warm-blooded animals. The presence of coliform bacteria is an indication that the water is polluted and may contain pathogenic (disease-causing) organisms.

Collection System: A network of pipes, manholes, cleanouts, traps, siphons, lift stations and other structures used to collect all wastewater and wastewater-carried wastes of an area and transport them to a treatment plant or disposal system. The collection system includes land, wastewater lines and appurtenances, pumping stations and general property.

Colloids: Very small solids (particulate or insoluble material in a finely divided form that remain dispersed in a liquid for a long time due to their small size and electrical charge.

Colorimetric: A means of measuring unknown concentrations of water quality indicators in a sample by comparing the sample's color, after the addition of specific reagents, with the color of known concentrations.

Combined Sewer: A sewer designed to carry both sanitary wastewaters and storm or surface water runoff.

Combined Sewer Overflow (CSO): Wastewater that flows out of a sewer (or lift station) as a result of flows exceeding the hydraulic capacity of the sewer. CSOs usually occur during periods of heavy precipitation or high levels of runoff from snow melt or other runoff sources.

Combined Wastewater: A mixture of storm or surface runoff and other wastewater such as domestic or industrial wastewater.

Combustion: Chemical process of oxidation that occurs at a rate fast enough to produce heat and usually a flame.

Combustion Air: Air required to provide for the complete combustion of fuel, and usually consisting of primary air, secondary air and excess air.

Comminution: A mechanical treatment process which cuts large pieces of wastes into smaller pieces so they won't plug pipes or damage equipment (shredding).

Comminutor: A device used to reduce the size of the solid chunks in wastewater by shredding (comminuting). The shredding action is like many scissors cutting or chopping to shreds all the large solids material in the wastewater.

Compliance: The act of meeting specified conditions or requirements.

Composite (Proportional) Sample: A composite sample is a collection of individual samples obtained at regular intervals, usually every one or two hours during a 24-hour time span. Each individual sample is combined with the others in proportion to the rate of flow when the sample was collected. The resulting mixture (composite sample) forms a representative sample and is analyzed to determine the average conditions during the sampling period.

Compressor: Device for mechanically increasing the pressure of a refrigerant vapor.

Condensate: Liquid formed by condensation of a vapor. In steam heating, water condensed from steam; in air conditioning, water extracted from air, as by condensation on the cooling coil.

Condensate Return Pump: Pump used to transfer condensate from one point in a system to another receiver; usually installed with a receiver tank and a float valve; the pump being controlled by tank level.

Condensation: Change of state of a vapor into a liquid by extracting heat from the vapor.

Condenser: Heat exchanger in which vapor is liquefied by the rejection of heat to a heat sink.

Condensing Unit: Machine specifically designed to condense refrigerant vapor to a liquid by compressing the vapor in a positive-displacement compressor and rejecting heat to a cooling medium. The unit consists usually of one or more positive displacement compressors, motors, condensers, liquid receivers (when required), and necessary accessories, mounted on a common base.

Conditioned Air: Air treated to control its temperature, relative humidity, purity, pressure, and movement.

Conductor: A substance which offers little resistance to the flow of electrical currents. Insulated copper wire is the most common form of conductor.

Conduit Body: The part of a conduit system, at the junction of two or more sections of the system, that allows access through a removable cover. Most commonly known as conduits, LBs, LLs, and LRs.

Confined Space: Confined space means a space is three-fold, it is large enough and so configured that an employee can bodily enter and perform assigned work; it has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry); and it is not designed for continuous employee occupancy.

Confined Space Permit: A written form that assures that actual or potential hazards in a confined space are eliminated or managed prior to entry.

Coning: A condition that may be established in a sludge hopper during sludge withdrawal when part of the sludge moves toward the outlet while the remainder tends to stay in place. Development of a cone or channel of moving liquid surrounded by relatively stationary sludge.

Construction General Permit: The SPDES Permit that regulates construction activities that disturb one or more acres—Coded GP-0-10-001.

Contact Stabilization: Contact stabilization is a modification of the conventional activated sludge process. In contact stabilization, two aeration tanks are used. One tank is for separate reaeration of the return sludge (typically for at least four hours) before it is permitted to flow into the other aeration tank to be mixed with the primary effluent requiring treatment.

Contamination: The introduction into water of microorganisms, chemicals, toxic substances, wastes, or wastewater in a concentration that makes the water unfit for its next intended use.

Continuous Load: A load whose maximum current continues for three hours or more.

Continuous Process: A treatment process in which water is treated continuously (as opposed to batch treatment) in a tank or reactor. The water being treated continuously flows into the tank at one end, is treated as it flows through the tank, and flows out the opposite end as treated water.

Convection: Transfer of heat by a fluid moving by natural variations in density.

Convector: A heating unit, usually wall mounted, which relies on convection for delivery of heated air.

Conventional Treatment: The common treatment processes such as preliminary treatment, sedimentation, flotation, trickling filter, rotating biological contactor, activated sludge and chlorination wastewater treatment processes used by POTWs.

Cooling Coil: Coil that uses refrigerant or secondary coolant to provide cooling, or cooling with dehumdification.

Cooling Load: Amount of cooling per unit time required by the conditioned space.

Cooling Tower: Heat transfer device, often tower-like, in which atmospheric air cools warm water, generally by direct contact (evaporation).

Cooling Water: Water used for condensing a refrigerant.

Corrosion: The gradual decomposition or destruction of a material by chemical action, often due to an electrochemical reaction. Corrosion may be caused by (1) stray current electrolysis, (2) galvanic corrosion caused by dissimilar metals, or (3) differential-concentration cells. Corrosion starts at the surface of a material and moves inward.

Corrosion Inhibitors: Substances that slow the rate of corrosion.

Corrosive: A chemical that can cause burns to skin, eyes or the respiratory system

Corrosive Gases: In water, dissolved oxygen reacts readily with metals at the anode of a corrosion cell, accelerating the rate of corrosion until a film of oxidation products such as rust forms. At the cathode where hydrogen gas may form a coating on the cathode and slow the corrosion rate, oxygen reacts rapidly with hydrogen gas forming water, and again increases the rate of corrosion.

Cross Connection: 1. A connection between a storm drain system and a sanitary collection system. 2. Less frequently used to mean a connection between two sections of a collection system to handle anticipated overloads of one system. 3. A connection between drinking (potable) water and an unapproved water supply.

Cryptosporidium: A waterborne intestinal parasite that causes a disease called cryptosporidiosis in infected humans. Symptoms of the disease include diarrhea, cramps, and weight loss. Cryptosporidium contamination is found in most surface waters and some groundwater. Commonly referred to as "crypto."

CSO: See Combone Sewer Overflow.

Cubic Feet Per Second (CFS): Rate of flow units of expression.

Current: The flow of electricity in a circuit, measured in amperes.

Cyclical Aeration: Cycling of air supply to a portion of an aeration tank to promote anoxic conditions suitable for denitrification.

Daisy Chaining: The connection of multiple devices in a serial fashion. Daisy chaining can save on transmission facilities. If a device malfunctions all of the devices daisy chained behind it are disabled.

Damper: Device used to vary the volume of air passing through an outlet, inlet, or duct; or generally through a confined cross section by varying the cross-sectional area.

Damper Actuator: Device (motor) that provides the necessary fore to position a damper. Can be electrically, pneumatically or manually operated.

Dateometer: A small calendar disc attached to motors and equipment to indicate the year in which the last maintenance service was performed.

Dissolved Oxygen (DO): DO is the molecular (atmospheric) oxygen dissolved in water or wastewater.

Dechlorination: The deliberate removal of chlorine from water. The partial or complete reduction of residual chlorine by any chemical or physical process.

Decomposition: The breakdown of complex material into simpler substances by biological or chemical action. Also referred to as degradation.

Degradation: The conversion or breakdown of a substance to simpler compounds. For example, the degradation of organic matter to carbon dioxide and water.

Dehumidification: Removal of water vapor from air.

Dehumidifier: Air cooler, or an absorption or adsorption device used for lowering moisture content in air.

Denitrification: An anoxic process that occurs when nitrite or nitrate ions are reduced to nitrogen gas and nitrogen bubbles are formed as a result of this process. The bubbles attach to the biological floc in the activated sludge process and float the floc to the surface of the secondary clarifiers. This condition is often the cause of rising sludge observed in secondary clarifiers or gravity thickeners. Also see "nitrification."

Density: The weight per unit volume of a substance, which varies with temperature.

Deposition: The process of settling solid material from a fluid suspension.

Desiccant: Absorbent or adsorbent, liquid or solid, that removes water or water vapor from an air stream.

Detention Time: 1. The theoretical (calculated) time required for a small amount of water to pass through a tank at a given rate of flow. 2. The actual time in hours, minutes or seconds that a small amount of water is in a settling basin, flocculating basin or rapid-mix chamber. In storage reservoirs, detention time is the length of time entering water will be held before being drafted for use (several weeks to years, several months being typical).

Detritus: The heavy, coarse material carried by wastewater.

Dewater: To drain or remove water from an enclosure. A structure may be dewatered so that it can be inspected or repaired. Dewater also means draining or removing water from sludge to increase the solids concentration.

Dewaterability: A measure of the ease with which water can be removed from a substance.

Diffused-Air Aeration: A diffused air activated sludge plant takes air, compresses it, and then discharges the air below the water surface of the aerator through some type of air diffusion device.

Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging air in various directions and planes and arranged to promote mixing of primary air with secondary room air.

Digester: A tank in which sludge is placed to allow decomposition by microorganisms. Digestion may occur under anaerobic (more common) or aerobic conditions.

Direct Discharger: A point source that discharges a pollutant(s) to waters of the United States, such as streams, lakes or oceans. These sources are subject to the National Pollutant Discharge Elimination System (NPDES) program regulations.

Direct Current (DC): Electrical current which flows in one direction only.

Direct Filtration: A method of treating water which consists of the addition of coagulant chemicals, flash mixing, coagulation, minimal flocculation, and filtration. The flocculation facilities may be omitted, but the physical-chemical reactions will occur to some extent. The sedimentation process is omitted. Also see "conventional filtration" and "in-line filtration."

Direct Runoff: Water that flows over the ground surface or through the ground directly into streams, rivers, or lakes.

Disconnecting Means: A device which disconnects a group of conductors from their source of supply.

Disinfection: The process designed to kill or inactivate most microorganisms in wastewater, including essentially all pathogenic (disease-causing) bacteria. There are several ways to disinfect, with chlorination being the most frequently used in water and wastewater treatment plants.

Disinfection By-Product (DBP): A contaminant formed by the reaction of disinfection chemicals (such as chlorine) with other substances in the water being disinfected.

Dissolved Oxygen Molecular (atmospheric): Oxygen dissolved in water or wastewater, usually abbreviated DO.

Distillate: In the distillation of a sample, a portion is evaporated; the part that is condensed afterwards is the distillate.

Distributor: The rotating mechanism that distributes the wastewater evenly over the surface of a trickling filter or other process unit.

Disturbance: In the context of the stormwater program, the term "disturbance" means construction or demolition activity that results in the exposure of soil.

Diurnal: Having a daily cycle or recurring each day.

Diverting Valve: Three-way valve piped to supply a single source of fluid to either of two outlets.

Domestic: Residential living facilities. A domestic area will be predominantly residential in occupancy and is sometimes referred to as a "bedroom area" or "bedroom community."

Downstream: The direction of the flow of water. In the lower part of a sewer or collection system or in that direction.

Draft: Pressure difference which causes a current of air or gases to flow through a flue, chimney, heater, or space.

Drop Cable: Cable that provides access to and from a network system. Possibly the cable from a transceiver or an individual line in a multi-drop situation. Also the cable from a wall-mounted faceplate or jack to a user's system.

Dry-bulb Temperature: Temperature of air indicated by an ordinary thermometer.

Dual-fuel Burner: Burner designed to burn either gas or oil but not both simultaneously.

Duct: Passageway made of suitable material, not necessarily leaktight, used for conveying air or other gas at low pressures.

Ductwork: A system of ducts for distribution and extraction of air.

EPA or United States Environmental Protection Agency: A regulatory agency established by the US Congress to administer the nation's environmental laws. Also called the US EPA.

Easement: Legal right to use the property of others for a specific purpose. For example, a utility company may have a five-foot easement along the property line of a home. This gives the utility the legal right to install and maintain a sewer line within the easement.

Economizer: Control system that reduces the mechanical heating and cooling requirement. Usually refers to use of outside air.

Economizer Cycle: Cycle logic that uses the economizer mode in conjunction with mechanical cooling, typically based on return and outside air total heat.

Eductor: A device for mixing two fluids, such as air and water.

Efficiency: The ratio of actual performance to the theoretical, or perfect performance, usually expressed as a percent.

Effluent: Water or other liquid—raw (untreated), partially or completely treated—flowing from a reservoir, basin, treatment process, or treatment plant.

Effluent Limits: Pollutant limitations developed by a POTW for industrial plants discharging to the POTW system. At a minimum, all industrial facilities are required to comply with federal prohibited discharge standards. The industries covered by federal categorical standards must also comply with the appropriate discharge limitations. The POTW may also establish local limits more stringent than or in addition to the federal standards for some or all of its industrial users.

Ejector: A device for conveying a liquid by en training it in a high velocity stream of air or water.

Electromagnetic Interference (EMI): The energy given off by electronic circuits and picked up by other circuits; based on the type of device and operating frequency. EMI effects can be reduced by shielding and other cable designs. Minimum acceptable levels are detailed by the FCC. See also Radio Frequency Interference.

Elutriation: The washing of digested sludge with either fresh water, plant effluent or other wastewater. The objective is to remove (wash out) certain soluble organic and inorganic components that consume large amounts of chemicals. This process reduces the demand for conditioning chemicals and improves settling or filtering characteristics of the solids.

EMCS: Energy monitoring and control system.

Emergency Response Plan: A written plan that identifies various types of anticipated emergencies and the pre-planned response to such events.

Emulsion: A mixture of two or more liquids which cannot be combined, therefore one liquid is "suspended" in the other.

End Point: Samples are titrated to the end point. This means that a chemical is added, drop by drop, to a sample until a certain color change (blue to clear, for example) occurs which is called the end point of the titration. In addition to a color change, an end-point may be reached by the formation of a precipitate or the reaching of a specified pH. An end point may be detected by the use of an electronic device such as a pH meter.

Endogenous: A diminished level of respiration in which a micro-organism utilizes previously stored nutrients to sustain life.

Endogenous Respiration: The biological process by which living organisms oxidize some of their own cellular mass instead of new organic matter they adsorb or absorb from their environment.

Enteric: Intestinal.

Enthalpy: Thermodynamic quantity equal to the sum of the internal energy of a system plus the product of the pressure-volume work done on the system.

Enzymes: Organic substances (produced by living organisms) which cause or speed up chemical reactions. Organic catalysts and/or biochemical catalysts.

Equalizing Basin: A holding basin in which variations in flow and composition of a liquid are averaged. Such basins are used to provide a flow of reasonably uniform volume and composition to a treatment unit. Also called a balancing reservoir.

Estuaries: Bodies of water at the lower end of a river that are subject to tidal fluctuations

Ethylene Glycol: Clear, colorless liquid used to depress the freezing point of water for use as a secondary coolant.

Eutrophication: The increase in the nutrient levels of a lake or other body of water; this usually causes an increase in the growth of aquatic animal and plant life.

Evaporative Cooling: Sensible cooling obtained by latent heat exchange from water sprays or jets of water.

Evaporator: Part of a refrigerating system in which the refrigerant is evaporated to absorb heat from the contacting heat source.

Exhaust Air: Air discharged from a space to the outdoors as differentiated from air transferred from one space to an adjacent one.

Exhaust Fan: Fan used to withdraw air from a space by suction.

Expansion Tank: Partially filled tank, operating at atmospheric pressure, at the top of a water system for the accommodation of volume expansion and due to the contraction of water.

Explosimeter: An instrument used to detect explosive atmospheres. When the Lower Explosive Limit (LEL) of an atmosphere is exceeded, an alarm signal on the instrument is activated. Also called a combustible gas detector.

Explosion-proof: Term referring to the construction characteristics of a piece of equipment which will not allow sparks or high temperatures to ignite an explosive mixture of air and fuel.

Exposure Control Plan: A written plan to control work place hazards from bloodborne pathogens.

Fabric Filter: Filter having a textile-based filter medium.

Face and Bypass Damper: A dual damper arrangement at the inlet of a heating or cooling coil which acts to either direct the flow of air through the heating or cooling coil, or acts to divert the air around the coil by the way of a bypass air channel or duct. Usually controlled by a damper actuator which is positioned by a temperature controller.

Facultative: Bacteria that can use either molecular (dissolved) oxygen or oxygen obtained from food materials such as sulfate or nitrate ions. In other words, facultative bacteria can live under aerobic or anaerobic conditions.

Facultative Pond: The most common type of pond in current use. The upper portion (supernatant) is aerobic, while the bottom layer is anaerobic. Algae supply most of the oxygen to the supernatant.

Fan Coil Unit: As the name implies, this unit is composed of a fan and a heat exchange coil mounted within a common cabinet. Fan coil units can be used for both heating and cooling service.

Feeder: Circuit conductors between the service and the final branch circuit over current device.

Fiber Optics: A technology that uses light as a digital information carrier. Fiber optic cables are direct replacement for conventional cables and wire Pairs. They occupy far less physical space and are immune to electrical interference.

Filamentous: A situation in which organisms grown in a thread-like fashion, intertwining with. One another to form a mat-like structure.

Filamentous Bacteria: Organisms that grow in a thread or filamentous form. Common types are thiothrix and actinomycetes. A common cause of sludge bulking in the activated sludge process.

Filter Press: A mechanically operated device for separating solids from water.

Finned-tube Radiator: Wall-mounted heater with numerous fins bonded to a tube, usually carrying steam or hot water.

Fire Damper: Device that interrupts airflow automatically through part of an air system to restrict passage of flame. Installed in fire rated wall or floor and closes automatically in the event of fire to maintain the integrity of the fire rated separation.

Firebox: Combustion chamber in a furnace.

Fire Stat: A temperature sensing device which is either mounted within a duct or within an air handling unit and which is used to sense a high temperature condition. Typically a firestat will be interlocked with an alarm or an air handling system, such that a shut-down or alarm is initiated if a high temperature is sensed.

Fixed: The addition of chemicals which prevent the variables from changing their form or concentration until the laboratory analyses can be performed.

Fixed Film Process: Biological process where the microbes are attached to medium such as rock or plastic.

Fixed Spray Nozzle: Cone-shaped spray nozzle used to distribute wastewater over the filter medial similar to a lawn sprinkling system. A deflector or steel ball is mounted within the cone to spread the flow of wastewater through the cone, causing a spraying action. Also see Distributor.

Flame Polish: Insertion of sharp-edged glass into a flame and rotating it until the glass melts slightly and smoothes the edge. Routinely done to glassware in the laboratory.

Flame Safeguard Control: System for sensing the presence or absence of flame and for indicating, alarming, or initiating control action.

Flammable Liquids: Liquids with a flash point below 100°F. At that temperature, vapors from the substance can be ignited by a flame, spark or other source of ignition.

Flights: Scrapers, made from redwood or plastic in rectangular tanks and metal in circular tanks, which move the settled sludge to the hopper. In rectangular tanks, these same scrapers return on the surface of the tank and move the accumulated scum to its collections point.

Float (Control): A device used to measure the elevation of the surface of water. The float rests on the surface of the water and rises or falls with it. The elevation of the water surface is measured by a rod, chain, rope, or tape attached to the float.

Floatables: Litter, debris and other larger materials that enter stormwater runoff and are carried by flow to become water pollutants.

Floc: Groups or "clumps" of bacteria that have come together and formed a cluster. Found in aeration tanks and secondary clarifiers.

Flocculated: An action resulting in the gathering of fine particles to form larger particles.

Flocculation: The process of gathering small, colloidal particles together into larger, denser and more readily settleable clusters.

Flow Control Valve: One that shuts automatically when the circulating pump stops, thereby preventing gravity circulation.

Flow Recording: A record of a flow measurement past any selected point. Usually consists of time, velocity and amount (in gallons) with maximum and minimum rates as well as the total amount over a given time period.

Flue: Passage through which flue gases pass from a combustion chamber to the outside atmosphere.

Food to Microorganism (F/M) Ratio: A measure of the organic loading to an aeration tank.

Force Main: A pipe that carries wastewater under pressure from the discharge side of a pump to a point of gravity flow downstream.

Forced-draft Burner: Burner which has a fan capable of supplying all necessary air for proper combustion with positive pressure in the firebox.

Forced Draft Venting: When the burner fan provides the pressure required for the combustion gases to overcome the resistance in the boiler, breaching and chimney. The boiler is pressurized.

F/M: See Food to Microorganism (F/M) Ratio.

Free Oxygen: Molecular oxygen available for respiration by organisms. Molecular oxygen is the oxygen molecule that is not combined with another element to form a compound.

Freeboard: The vertical distance between the normal water surface elevation in a tank, channel, etc. and the top of the side walls of the same structure.

Freezestat: A temperature sensing device which is either mounted within a duct or within an air handling unit and which is used to sense a potential freezing condition. Typically a freezestat will be interlocked with an alarm or an air handling system, such that a shut-down or alarm is initiated if a low temperature is sensed.

Frequency: The number of times per second a signal regenerates itself at a peak amplitude. It can be expressed in hertz (Hz), kilohertz (Hz), megahertz (MHz), etc.

Fresh Air Makeup: Volume of outside air introduced into a space.

Fume Hood: fume collection device mounted over a closed table or shelf serving to conduct unwanted gases away form the area enclosed.

Fumes: Very small airborne particle, usually less than one micometre in size, from burning or melting materials.

Fungi: Small, non-chlorophyll bearing plants, without roots, stems or leaves, which tend to overpower bacteria at low pH and dissolved oxygen concentrations. They generally have a filamentous type structure and are therefore not welcome in a secondary process clarifier.

Furnace: Part of a boiler or warm air heating system in which energy is converted to heat, as by burning fuel, or by converting electrical energy.

Geographic Information System (GIS): A computer program that combines mapping with detailed information about the physical locations of structures such as pipes, valves, and manholes within geographic areas. The system is used to help operators and maintenance personnel locate utility system features or structures and to assist with the scheduling and performance of maintenance activities.

GPD: Initials standing for "Gallons Per Day."

GPM: Initials standing for "Gallons Per Minute."

Giardia: A waterborne intestinal parasite that causes a disease called giardias is in infected humans. Symptoms of the disease include diarrhea, cramps, and weight loss. Giardia contamination is found in most surface waters and some groundwater.

Gasification: The conversion of soluble and suspended organic materials into gas during anaerobic decomposition. In clarifiers the resulting gas bubbles can become attached to the settled sludge and cause large clumps of sludge to rise and float on the water surface. In anaerobic sludge digesters, this gas is collected for fuel or disposed of using a waste gas burner.

Gate: A movable barrier for the control of liquid flow. There are two types: Sluice gates have a guaranteed maximum leakage rate. Slide gates are not guaranteed to stop the flow of water and are generally used when leakage does not matter or where suspended solids in the liquid would tend to stop the leakage.

Gauge: A device for measuring a variable physical magnitude.

Grab Sample: A single sample of water collected at a particular time and place which represents the composition of the water only at that time and place.

Gravity Flow: Water or wastewater flowing from a higher elevation to a lower elevation due to the force of gravity. The water does not flow due to energy provided by a pump. Wherever possible, wastewater collection systems are designed to use the force of gravity to convey waste liquids and solids.

Grease: In a collection system, grease is considered to be the residues of fats, detergents, waxes, free fatty acids, calcium and magnesium soaps, mineral oils, and certain other nonfatty materials which tend to separate from water and coagulate as floatables or scums.

Grease Trap: A receptacle designed to collect and retain grease and fatty substances usually found in kitchens or from similar wastes. It is installed in the drainage system between the kitchen or other point of production of the waste and the building wastewater collection line. Commonly used to control grease from restaurants.

Green Infrastructure: For the purpose of this document, refers to Best Management Practices that utilize or mimic natural processes to reduce runoff and/or provide water quality treatment of stormwater. This is accomplished through infiltration of runoff into the soil, uptake and evapotranspiration of water by plants, incorporation of nutrients into plant matter and removal of pollutants by microbial action and filtration within the soil.

Grid: Term used to describe an electrical utility distribution network.

Grille: Louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.

Grinder: A device for grinding, shredding or communating material removed from wastewaters.

Grit: The heavy material present in wastewater, such as sand, coffee grounds, eggshells, gravel and cinders. Grit tends to settle out at flow velocities below 2 ft/sec and accumulate in the invert or bottoms of the pipelines. Also called "detritus."

Grit Removal: Grit removal is accomplished by providing an enlarged channel or chamber which causes the flow velocity to be reduced and allows the heavier grit to settle to the bottom of the channel where it can be removed.

Ground: An electrical connect (on purpose or accidental) between an item of equipment and the earth.

Groundwater: Sub surface water in the saturation zone from which wells and springs are fed. In a strict sense the term applies only to water below the water table. Also called "phreatic water" and "plerotic water."

Growth Rate: An experimentally determined constant that expresses the growth rate of bacteria in units of mass of solids produced per mass of matter reduced (i.e., mg VSS/mg BOD5).

HBV: Hepatitis B Virus. A virus which, upon infection, can cause inflammation of the liver and serious health effects

HDT: See Hydraulic Detention Time.

Hazard: An unsafe condition, which, if not eliminated or controlled, may cause injury, illness, or death

Hazardous Chemical: A substance that may harm the worker either physically (eg, fire, explosion) or chemically (eg, toxic, corrosive).

Hazard Communication: Employee "Right-to-Know" legislation requires employers to inform employees (pretreatment inspectors) of the possible health effects resulting from contact with hazardous substances. At locations where this legislation is in force, employers must provide employees with information regarding any hazardous substances which they might be exposed to under normal work conditions or reasonably foreseeable emergency conditions resulting from workplace conditions. OSHA's Hazard Communication Standard (HCS) (Title 29 CFR Part 1910.1200) is the federal regulation and state statutes are called Worker Right-to-Know Laws. Also see "Community Right-to-Know" and "SARA."

Hazard Communication Program: A written plan to manage the hazards associated with the use of chemicals in the workplace.

Head: Energy per unit weight of liquid at a specified point, expressed in feet of water-column W.C.) or pounds per square inch (psi).

> Dynamic - the head against which a pump works. Friction the head loss by fluid flowing as a result of the disturbances due to the contact between the moving fluid and its container. Loss of the decrease between two points. Static the vertical distance between the free level of the supply and that of the discharge.
>
> Shut Off - the total head at which a centrifugal pump will no longer create flow, though its impeller is still turning in the fluid.
>
> Total Dynamic - the difference between the dynamic head at the pump discharge flange and that at the suction flange, corrected to the same datum plane, plus the velocity head at the discharge flange, minus the velocity head at the suction flange of the pump.
>
> Velocity - the theoretical vertical height to which a liquid may be raised due to its kinetic energy. It is equal to the square of the velocity divided by twice the acceleration due to gravity (V/2g).

Head Loss: "Head" is a common term used in discussing pumps. It is a way of expressing pressure in terms of the height of a vertical column of water. In the sketch, the head loss is the height to which the water must build up until there is sufficient pressure to force that particular amount of water through the slots in the comminutor drum.

Headworks: The facilities where wastewater enters a wastewater treatment plant. The headworks may consist of bar screens, comminutors, and a wet well and pumps.

High-Velocity Cleaner: A machine designed to remove grease and debris from the smaller diameter sewer pipes with high-velocity jets of water. Also called a "jet cleaner," "jet rodder," "hydraulic cleaner," "highpressure cleaner," or "hydro jet."

Heat Exchanger: Device to transfer heat between two physically separated fluids.

Heat Pump: Thermodynamic heating/refrigerating system to transfer heat. The condenser and evaporator may change roles to transfer heat in either direction.

Heat Recovery: Heat utilized which would otherwise be wasted from a heating system.

Heating and Ventilating Unit: Another name for an air handling unit which provides only heating and ventilation capabilities.

Heating Coil: Coil that uses a heat transfer fluid, condensing refrigerant, or direct electrical resistance elements to provide heating.

Heating Load: Heating rate required to replace heat loss from the space being controlled.

Heating Value: Amount of heat produced by the complete combustion of a unit quantity of fuel.

Heavy Metals: Metals which can be precipitated by hydrogen sulfide in an acid solution, including lead, silver, gold, mercury, bismuth and copper.

HEPA filter: High efficiency particulate air filter.

Hepatitis: Hepatitis is an acute viral infection of the liver (yellow jaundice).

Hertz (Hz): International standard unit of frequency. Replaces the identical older "Cycles-per-second"

Heterotrophic Bacteria: Bacteria that utilizes organic carbon for energy and cell growth.

Hot Water Boiler: Boiler completely filled with water that furnishes hot water to be used externally to itself at pressures not exceeding 160 psig or at temperatures not exceeding 250 F at or near the boiler outlet.

Hot Water Storage Tank: Tank used to store water that is heated externally.

Humidifier: Device to add moisture to air or gases.

Humidify: To add water vapor to moisture to any moisture-adsorbing material, including the atmosphere.

Humidistat: Device which responds directly or indirectly to deviation from a desired humidity by actuating a control or initiating a control sequence.

Humidity: Water vapor within a given volume of air.

Hydraulic Cleaning: Cleaning pipe with water under enough pressure to produce high water velocities.

- Using a ball, kite, or similar sewer cleaning device
- Using a scooter
- Flushing

Hydraulic Detention Time: The amount of time that a wastewater flow is retained in a basin, tank, or reservoir for storage or completion of physical, chemical, or biological reactions.

Hydraulic Loading: Hydraulic loading refers to the flows (MGD or cu m/day) to a treatment plant or treatment process. Detention times, surface loadings and weir overflow rates are directly influenced by flows.

Hydrogen Ion Concentration [H+]: The weight of hydrogen ion in moles per liter of solution. Commonly expressed as the pH value, which is the logarithm of the reciprocal of the hydrogen ion concentration.

Hydrogen Sulfide Gas (H_2S): Hydrogen sulfide is a gas with a rotten egg odor. This gas is produced under anaerobic conditions. Hydrogen sulfide gas is particularly dangerous because it dulls the sense of smell so that you don't notice it after you have been around it for a while. In high concentrations, hydrogen sulfide gas is only noticeable for a very short time before it dulls the sense of smell. The gas is very poisonous to the respiratory system, explosive, flammable, colorless, and heavier than air.

Hydrolysis: Conversion of organic nitrogen to ammonia by enzymes secreted by bacteria, plants, and animals in a reaction that adds water.

Hydronic system: A closed loop circulating heating hot water or chilled water system which usually consists of a circulating pump or pumps, piping system, air-water separator, expansion tank and makeup water assembly.

Hygroscopic: Tending to absorb moisture from the atmosphere.

Hypochlorination: The application of hypochlorite compounds to water or wastewater for the purpose of disinfection.

Hypochlorinators: Chlorine pumps, chemical feed pumps or devices used to dispense chlorine solutions made from hypochlorites such as bleach (sodium hypochlorite) or calcium hypochlorite into the water being treated.

Hypochlorite: Chemical compounds containing available chlorine; used for disinfection. They are available as liquids (bleach) or solids (powder, granules, and pellets) in barrels, drums, and cans. Salts of hypochlorous acid.

Hypoxia: The depletion of dissolved oxygen in lakes and reservoirs resulting from excessive growth of algae and other microscopic plants.

Hz: See Hertz.

I/0 or Input-Output: Related to the process of getting data into and out of a computer or processor.

IDLH: Immediately Dangerous to Life or Health, an atmosphere that will not support human life.

Illicit Discharge: The flow of substances other than rainwater or snowmelt to a separate storm sewer system whether by direct subsurface connection, overland flow, dumping or other means.

Imhoff Cone: A conically shaped, one-liter graduated vessel used to measure the approximate volume of settleable solids in wastewater during various settling periods.

Impedance: The effects placed upon an alternating current circuit by induction, capacitance, and resistance. Total resistance in an AC circuit.

Impeller: A set of vanes designed to rotate and move a mass of fluid. The prime mover in a centrifugal.

Incineration: The combustion of organic matter in wastewater sludge solids after the evaporation of water from the solids.

Indirect Discharger: A non-domestic discharger introducing pollutants to a POTW. These facilities are subject to the EPA pretreatment regulations.

Inductance: The characteristic of a circuit that determines how much voltage will be induced into it by a change in current of another circuit.

Industrial Wastes: The solid and liquid wastes originating from industrial processes.

Industrial Pretreatment (Waste) Inspector: A person who conducts inspections of industrial pretreatment facilities to ensure protection of the environment and compliance with general and categorical pretreatment regulations. Also called an inspector and a pretreatment inspector.

Industrial Waste Survey: A survey of all companies that discharge to a POTW. The survey identifies the magnitude of the wastewater flows and pollutants in the discharge.

Industrial Wastewater: Liquid wastes originating from industrial processing. Because industries have peculiar liquid waste characteristics requiring special consideration, these sources are usually handled and treated separately before being discharged to a wastewater collection system.

Infiltration: The seepage of groundwater into a sewer system, including service connections. Seepage frequently occurs through defective or cracked pipes, pipe joints and connections, interceptor access risers and covers, or manhole walls.

Infiltration/Inflow: The total quantity of water from both infiltration and inflow without distinguishing the source. Abbreviated I & I or I/I.

Inflow: Water discharged into a sewer system and service connections from such sources as, but not limited to, roof leaders, cellars, yard and area drains, foundation drains, cooling water discharges, drains from springs and swampy areas, around manhole covers or through holes in the covers, cross connections from storm and combined sewer systems, catch basins, storm waters, surface runoff, street wash waters or drainage. Inflow differs from infiltration in that it is a direct discharge into the sewer rather than a leak in the sewer itself. See "internal inflow."

Influent: Water, wastewater, or other liquid—raw (untreated) or partially treated—flowing into an interceptor, reservoir, basin, treatment process, or treatment plant.

Inhibitory Substances: Materials that kill or restrict the ability of organisms to treat wastes.

Inlet: 1. A surface connection to a drain pipe. 2. A chamber for collecting storm water with no well below the outlet pipe for collecting grit. Often connected to a catch basin or a "basin manhole" ("cleanout manhole") with a grit chamber.

Inoculate: To introduce a seed culture into a system.

Inorganic: Material such as sand, salt, iron, calcium salts and other mineral materials. Inorganic substances are of mineral origin, whereas organic substances are usually of animal or plant origin. Also see "organic."

Inorganic Waste: Waste material such as sand, salt, iron, calcium, and other mineral materials which are only slightly affected by the action of organisms. Inorganic wastes are chemical substances of mineral origin; whereas organic wastes are chemical substances of an animal or plant origin.

Instantaneous Settling Velocity (ISV): A record of the vertical displacement down ward of the sludge solids in a sample. The readings are taken each minute.

Interceptor Sewer: A large sewer that receives flow from a number of sewers and conducts the wastewater to a treatment plant. Often called an interceptor. The term interceptor is sometimes used in small communities to describe a septic tank or other holding tank which serves as a temporary wastewater storage reservoir for a Septic Tank Effluent Pump (STEP) system.

Ion: An atom, or molecule, that has lost or gained one or more electrons.

Ionization: The process of adding electrons to, or removing electrons from, atoms or molecules, creating ions. High temperatures, electrical charges, nuclear radiation or dissolution in a liquid are some causes.

Interconnect: (1) The arrangement that allows the connection of customer's communications equipment to a common carrier network. (2) The generic term for a circuit administration point that allows routing and rerouting of signal traffic.

Isolation Transformer: A one to one transformer that is used to isolate the equipment at the secondary from earth ground.

Junction Box: A box, usually metal, that encloses cable connections for their protection.

Lateral Sewer: A sewer that discharges into a branch or other sewer and has no other common sewer tributary to it. Sometimes called a "street sewer" because it collects wastewater from individual homes.

Launders: Clarifier effluent troughs.

LEL: Lower Explosive Limit: The lowest concentration of vapors, expressed in %, that will ignite in the presence of a flame, spark or other source of ignition. Also known as the LFL, lower flammable limit.

Lift Station: A wastewater pumping station that lifts the wastewater to a higher elevation when continuing the sewer at reasonable slopes would involve excessive depths of trench. Also, an installation of pumps that raise wastewater from areas too low to drain into available sewers. These stations may be equipped with air-operated ejectors or centrifugal pumps. Sometimes called a "pump station," but this term is usually reserved for a similar type of facility that is discharging into a long force main, while a lift station has a discharge line or force main only up to the downstream gravity sewer. Throughout this manual when we refer to lift stations, we intend to include pump stations.

Lime: Any of several compounds consisting of calcium hydroxide ($Ca(OH)_2$) or calciumoxide (CaO).

Limit Control: Control device used to limit the desired maximum or minimum state of the controlled variable, or to provide an alarm if those limits are exceeded.

Lineal: The length in one direction of a line. For example, a board 12 feet long has 12 lineal feet in its length.

Liquefaction: Liquefaction as applied to sludge digestion means the transformation of large solid particles of sludge into either a soluble or a finely dispersed state.

Load: The amount of electric power used by any electrical unit or appliance at any given moment.

Loading: Quantity of material applied to a device at one time.

Location, damp (damp location): Partially protected locations, such as under canopies, roofed open porches, etc. Also, interior locations that are subject only to moderate degrees of moisture, such as basements, barns, etc.

Location, dry (dry location): Areas that are not normally subject to water or dampness.

Location, wet (wet location): Locations underground, in concrete slabs, where saturation occurs, or outdoors.

Lockout/Tagout: A systematic approach to controlling hazardous energy so it cannot harm someone who is working on a process component. DANGER: Never operate a control that has been locked or tagged by someone else.

Louver: Assembly of sloping vanes intended to permit air to pass through and to inhibit transfer of water droplets.

Low-water Cutoff: In a boiler system, a device to automatically cut off the fuel supply when the surface of the water falls to the lowest safe waterline.

Lower Explosive Limit (LEL): The lowest concentration of gas or vapor (percent by volume in air) that explodes if an ignition source is present at ambient temperature. At temperatures above 250°F the LEL decreases because explosibility increases with higher temperature.

Lower Flammable Limit (LFL): The lowest concentration of a gas or vapor (percent by volume in air) that burns if an ignition source is present.

MBH: One thousand Btu per hour (also Mbtuh).

MG: Initials for "Million Gallons."

MGD: Initials for "Million Gallons Per Day."

mg/L: See "milligrams per liter," mg/L.

MLSS: See Mixed Liquor Suspended Solids.

MLVSS: See Mixed Liquor Volatile Suspended Solids.

MPN: MPN is the Most Probable Number of coliform-group organisms per unit volume of sample water. Expressed as a density or population of organisms per 100 mL of sample water.

MS4: Municipal Separate Storm Sewer System. A sewer collection and conveyance system designed and intended to handle solely rainwater and snowmelt, in contrast to sanitary and combined sewers.

MS4 General Permit: The SPDES Permit that regulates discharges from MS4s serving a populated area totaling 50,000 or more people and having a population density of at least 1,000 people per square mile—Coded GP-0-10-002.

MS4 Operator: The person, persons or legal entity that is responsible for the small MS4, as indicated by signing the NOI to gain coverage for the MS4 under the General MS4 SPDES Permit.

MSDS: Material Safety Data Sheet: printed information which describes the properties of a hazardous chemical and ways to control its hazards.

Main Line: Branch or lateral sewers that collect wastewater from building sewers and service lines.

Main Sewer: A sewer line that receives wastewater from many tributary branches and sewer lines and serves as an outlet for a large territory or is used to feed an intercepting sewer.

Makeup Water: Water supplied to replenish the water of a system.

Manhole: An opening in a sewer provided for the purpose of permitting operators or equipment to enter or leave a sewer. Sometimes called an "access hole" or a "maintenance hole."

Manometer: Instrument for measuring head or pressure; basically a U-tube partially filled with a liquid, so constructed that the difference in level of the liquid leg indicates the pressure exerted on the instrument.

Masking Agents: Substances used to cover up or disguise unpleasant odors. Liquid masking agents are dripped into the wastewater, sprayed into the air, or evaporated (using heat) with the unpleasant fumes or odors and then discharged into the air by blowers to make an undesirable odor less noticeable.

Material Safety Data Sheet (MSDS): A document which provides pertinent information and a profile of a particular hazardous substance or mixture. An MSDS is normally developed by the manufacturer or formulator of the hazardous substance or mixture. The MSDS is required to be made available to employees and operators whenever there is the likelihood of the hazardous substance or mixture being introduced into the workplace. Some manufacturers are preparing MSDSs for products that are not considered to be hazardous to show that the product or substance is not hazardous.

Mean Cell Residence Time (MCRT): See Solids Retention Time.

Measured Flow: A flow which has been physically measured.

Mechanical Aeration: The use of machinery to mix air and water so that oxygen can be absorbed in to the water. Some examples are: paddle wheels, mixers, or rotating brushes to agitate the surface of an aeration tank; pumps to create fountains; and pumps to discharge water down a series of steps forming falls or cascades.

Media: The material in a trickling filter on which slime accumulates and organisms grow. As settled wastewater trickles over the media, organisms in the slime remove certain types of wastes thereby partially treating the wastewater. Also the material in a rotating biological contactor or in a gravity or pressure filter.

Median: The middle measurement or value. When several measurements are ranked by magnitude (largest to smallest), half of the measurements will be larger than the median value and half will be smaller.

Meniscus: The curved top of a column of liquid (water, oil, mercury, etc.) in a small tube.

Mesophilic Bacteria: A group of bacteria that grow and thrive in a moderate temperature range between 68 F. (20 C) and 113 F (45 C). The optimum temperature range for these bacteria in anaerobic digestion is 85 F (30 C) to 100 F (38 C).

Microbes: Micro-biological Organisms: Tiny, one celled organisms, like bacteria and viruses.

Microorganisms: Very small organisms that can be seen only through a microscope. Some microorganisms use the wastes in wastewater for food and thus remove or alter much of the undesirable matter.

Milligrams Per Liter, mg/L: A measure of the concentration by weight of a substance per unit volume in water or wastewater. In reporting the results of water and wastewater analysis, mg/L is preferred to the unit parts per million (ppm), to which it is approximately equivalent.

Million Gallons: A unit of measurement used in wastewater treatment plant design and collection system capacities or performances.

Mixed Liquor: When the activated sludge in an aeration tank is mixed with primary effluent or the raw wastewater and return sludge, this mixture is then referred to as mixed liquor as long as it is in the aeration tank. Mixed liquor also may refer to the contents of mixed aerobic or anaerobic digesters.

Mixed Liquor Suspended Solids (MLSS): Suspended solids in the mixed liquor of an aeration tank.

Mixed Liquor Volatile Suspended Solids (MLVSS): The organic or volatile suspended solids in the mixed liquor of an aeration tank. The volatile portion is used as a measure or indication of the microorganisms present.

Mixing Box: Compartment into which two air supplies are mixed together before being discharged.

Mixing Valve: Three-way valve to mix two fluids.

Modulating Control Valve: Valve capable of increasing or decreasing by increments the fluid flow according to deviation from the set control value.

Molar (M): A solution of one gram molecular weight of a compound dissolved in enough water to make one liter of solution.

Molecular Oxygen: The oxygen molecule, O_2, that is not combined with another element to form a compound.

Molecular Weight: The sum of the atomic weights of the elements in the compound.

Molecule: The smallest part of an element or compound which still has all the properties of the element or compound.

Most Probable Number (MPN): A density of coliform organisms per one hundred millimeters. The results of the multiple-tube fermentation technique for the analysis for coliform group bacteria are reported as a most probable number. The test procedures are given in Part 908 of “Standard Methods” and Table 908.11 on Page 924, lists most probable numbers for various combinations of positive tube results.

Motile: Capable of self-propelled movement. A term that is sometimes used to distinguish between certain types of organisms found in water.

Motor Efficiency: The ratio of energy delivered by a motor to the energy supplied to it during a fixed period or cycle. Motor efficiency ratings will vary depending upon motor manufacturer and usually will be near 90.0 percent.

Muffle Furnace: A small oven capable of reaching temperatures up to about 600°C. It is used in laboratories to determine the volatile content of a sample.

Multi-Stage Pump: A pump that has more than one impeller. A single-stage pump has one impeller.

Muriatic Acid: Another name for hydrochloric acid (HCl).

NEC: National Electrical Code, which contains safety guidelines for all types of electrical installations.

NIOSH: The National Institute of Occupational Safety and Health is an organization that tests and approves safety equipment for particular applications. NIOSH is the primary federal agency engaged in research in the national effort to eliminate on-the-job hazards to the health and safety of working people. The NIOSH Publications Catalog contains a listing of NIOSH publications concerning industrial hygiene and occupational health. To obtain a copy of the catalog, write to National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161. NTIS Stock No. PB-86-116-787.

NPDES: National Pollutant Discharge Elimination System. The national system for the issuance of wastewater and stormwater permits under the Federal Water Pollution Control Act (Clean Water Act).

NPDES Permit: National Pollutant Discharge Elimination System permit is the regulatory agency document issued by either a federal or state agency which is designed to control all discharges of pollutants from point sources and storm water runoff into US waterways. NPDES permits regulate discharges into navigable waters from all point sources of pollution, including industries, municipal wastewater treatment plants, sanitary landfills, large agricultural feedlots, and return irrigation flows.

NOI: Notice of Intent. A document filed by a permittee under the Construction General Permit or MS4 General Permit describing the nature of stormwater discharges, in order to gain coverage under the appropriate General Permit.

NOT: Notice of Termination. A document filed by a permittee to close coverage under the Construction General Permit once site work is concluded and final stabilization is complete.

National Response Center: A federal agency who must be contacted when a significant spill of oil or chemical occurs. (800) 424-8802.

Natural Draft Burner: Burner which depends primarily on the natural draft created in the chimney or venting system to induce the air required for combustion into the burner.

Neutralization: Addition of an acid or alkali (base) to a liquid to cause the pH of the liquid to move toward a neutral pH of 7.0.

Nitrification: An aerobic process in which bacteria change the ammonia and organic nitrogen in wastewater into oxidized nitrogen (usually nitrate). The second-stage BOD is sometimes referred to as the "nitrification stage" (first-stage BOD is called the "carbonaceous stage").

Nitrification Stage: A stage of decomposition that occurs in biological treatment processes when aerobic bacteria, using dissolved oxygen, change nitrogen compounds (ammonia and organic nitrogen) into oxidized nitrogen (usually nitrate). The second-stage BOD is sometimes referred to as the "nitrification stage" (first-stage BOD is called the "carbonaceous stage").

Nitrifying Bacteria: Bacteria that change the ammonia and organic nitrogen in wastewater into oxidized nitrogen (usually nitrate).

Nitrobacteria: Principal genera of autotrophic bacteria responsible for the second step of biological nitrification: conversion (oxidation) of nitrite to nitrate.

Nitrogen Fixation: The conversion of nitrogen gas to organic nitrogen, ammonia or nitrate. Nitrogen fixation can occur biologically (i.e., conversion of nitrogen gas to organic nitrogen by certain photosynthetic blue-green algae), by natural physical processes (i.e., conversion of nitrogen gas to nitrate by lightning), or by industrial processes (manufacture of fertilizers and explosives).

Nitrogenous: A term used to describe chemical compounds (usually organic) containing nitrogen in combined forms. Proteins and nitrates are nitrogenous compounds.

Nitrosomonas: Principal genera of autotrophic bacteria responsible for the first step of biological nitrification: conversion (oxidation) of ammonia to nitrite.

Nomogram: A chart or diagram containing three or more scales used to solve problems with three or more variables instead of using mathematical formulas.

Noncompatible Pollutants: Those pollutants which are normally not removed by the POTW treatment system. These pollutants may be a toxic waste and may pass through the POTW untreated or interfere with the treatment system. Examples of noncompatible pollutants include heavy metals such as copper, nickel, lead, and zinc; organics such as methylene chloride, 1,1,1-trichloroethylene, methyl ethyl ketone, acetone, and gasoline; or sludges containing toxic organics or metals.

Non-Point Sources: Sources of water pollution that are not associated with a discharge pipe or channel. The term is often associated with water pollution resulting from storm water runoff from urban and rural agricultural lands.

Nonpotable: Water that may contain objectionable pollution, contamination, minerals, or infective agents and is considered unsafe and/or unpalatable for drinking.

Nonsparking Tools: These tools will not produce a spark during use.

Normal (N): A solution containing one gram equivalent weight of compound dissolved in enough water to make one liter of solution. The equivalent weight of an acid is that weight which contains one gram atom of ionizable hydrogen, or its equivalent. For example, sulfuric acid (H2SO4) has a gram molecular weight of 98 and a gram equivalent weight of 49; while the gram molecular and gram equivalent weights of hydrochloric acid (HCl) are the same (36.5).

Notch: An opening in a dam, spillway or weir for the passage of fluid. Weir notches are available in a variety of shapes and formulae are available for accurately determining the flow through them.

Nutrient: Any substance that is assimilated (taken in) by organisms and promotes growth. Nitrogen and phosphorus are nutrients which promote the growth of algae. There are other essential and trace elements which are also considered nutrients.

Nutrient Cycle: The transformation or change of a nutrient from one form to another until the nutrient has returned to the original form, thus completing the cycle.

O&M Manual: Operation and Maintenance Manual. A manual that describes detailed procedures for operators to follow to operate and maintain specific water or wastewater treatment or pretreatment plants and the equipment of the plants.

OSHA: The Williams-Steiger Occupational Safety and Health Act of 1970 (OSHA) is a federal law designed to protect the health and safety of industrial workers, including the operators of water supply and treatment systems and wastewater treatment plants. The Act regulates the design, construction, operation, and maintenance of water supply systems, water treatment plants, wastewater collection systems, and wastewater treatment plants. OSHA also refers to the federal and state agencies which administer the OSHA regulations.

Obligate Aerobes: Bacteria that must have molecular (dissolved) oxygen (DO) to reproduce.

Odor: Quality of gases, liquids, or particulates that stimulates the olfactory organ.

Ohm: The unit of measurement of electrical resistance. One ohm of resistance will allow one ampere of current to flow through a pressure of one volt.

Open Circuit Voltage: The maximum voltage produced by a photovoltaic cell, module, or array without a load applied.

Operating Pressure: Pressure indicated by a gage when the system is in normal operation (working pressure).

Organic: Substances that come from animal or plant sources. Organic substances always contain carbon. (Inorganic materials are chemical substances of mineral origin.) Also see "inorganic."

Organic Loading: The pounds of BOD per day applied to a unit process.

Organic Waste: Waste material which comes mainly from animal or plant sources. Organic wastes generally can be consumed by bacteria and other microscopic organisms. Inorganic wastes are chemical substances of mineral origin.

Organics: 1. A term used to refer to chemical compounds made from carbon molecules. These compounds may be natural materials (such as animal or plant sources) or manmade materials (such as synthetic organics). Also see "organic." 2. Any form of animal or plant life. Also see "bacteria."

Organism: Any form of animal or plant life. Also see "bacteria."

Orifice: An opening in wall or plate used to control the rate of flow into, or out of a tank or pipe.

Orthophosphate: An acid or salt containing phosphorus (PO_4)

Orthotolidine: A colorimetric indicator of chlorine residual in which a yellow colored compound is produced.

Outfall: 1. The point, location or structure where wastewater or drainage discharges from a sewer, drain, or other conduit. 2. The conduit leading to the final disposal point or area.

Outfall Sewer: A sewer that receives wastewater from a collection system or from a wastewater treatment plant and carries it to a point of ultimate or final discharge in the environment. See "outfall."

Outlet: Downstream opening or discharge end of a pipe, culvert, or canal.

Overflow Rate: A criteria for the design of settling tanks in treatment plants. It is stated as the settling velocity of particles that are removed in an ideal basin if they enter at the surface. (volume of flow per unit water surface area of the tank.)

Oxidation: Oxidation is the addition of oxygen, removal of hydrogen, or the removal of electrons from an element or compound. In the environment, organic matter is oxidized to more stable substances. The opposite of reduction.

Oxidation Ditch: The oxidation ditch is a modified form of the activated sludge process. The ditch consists of two channels placed side by side and connected at the ends to produce one continuous loop of wastewater flow and a brush rotator assembly placed across the channel to provide aeration and circulation.

Oxidation-Reduction Potential (ORP): The electrical potential required to transfer electrons from one compound or element (the oxidant) to another compound or element (the reductant); used as a qualitative measure of the state of oxidation in wastewater treatment systems. ORP is measured in millivolts, with negative values indicating a tendency to reduce compounds or elements and positive values indicating a tendency to oxidize compounds or elements.

Oxidizing Agent: Any substance, such as oxygen (O2) or chlorine (Cl2), that will readily add (take on) electrons. The opposite is a reducing agent.

Oxygen (O): A chemical element used by all known life forms for respiration.

Available - the amount of free oxygen in the water.

Balance - the relation between the BOD of a treatment plant effluent and the available oxygen in the receiving body.

Deficiency - the additional quantity of oxygen required to satisfy the BOD in a sample.

Oxygen deficient: An atmosphere that has less than 19.5% oxygen. Such an environment puts a worker at risk of asphyxiation.

Oxygen Uptake Rate Ozone: The amount of oxygen used by an activated sludge system per unit time. A molecular form of oxygen composed of three atoms (0_3). Also a strong disinfecting agent which leaves no residual.

POTW–Publicly Owned Treatment Works: A treatment works which is owned by a state, municipality, city, town, special sewer district or other publicly owned and financed entity as opposed to a privately (industrial) owned treatment facility. This definition includes any devices and systems used in the storage, treatment, recycling and reclamation of municipal sewage (wastewater) or industrial wastes of a liquid nature. It also includes sewers, pipes and other conveyances only if they carry wastewater to a POTW treatment plant. The term also means the municipality (public entity) which has jurisdiction over the indirect discharges to and the discharges from such a treatment works.

Pounds per Square Inch Gage pressure (PSIG): The pressure within a closed container or pipe measured with a gage in pounds per square inch.

PTAC: Packaged terminal air-conditioning system.

Packaged Air Conditioner: Complete air-conditioning unit including refrigeration compressor, cooling coils, fans, filter, automatic controls, etc. assembled into one casing.

Packaged Boiler: Boiler shipped complete with heating equipment, mechanical draft equipment, automatic controls, and accessories; usually shipped in one or more major sections.

Packed Bed Scrubber: Vertical or horizontal vessels, partially filled with packing or devices of large surface area, used for the continuous contact of liquid and gas such that absorption can take place. Frequently the scrubber liquid or liquor has had chemicals added to react with the absorbed gas.

Package Treatment Plant: A small wastewater treatment plant often fabricated at the manufacturer's factory, hauled to the site, and installed as one facility. The package may be either a small primary or a secondary wastewater treatment plant.

Parallel Operation: Wastewater being treated is split and a portion flows to one treatment unit while the remainder flows to another similar treatment unit.

Parasitic Bacteria: Parasitic bacteria are those bacteria which normally live off another living organism, known as the "host."

Particulate: State of matter in which solid or liquid substances exist in the form of aggregated molecules or particles.

Parts Per Million (PPM): A measurement of concentration on a weight or volume basis. This term is equivalent to milligrams per liter (mg/L) which is the preferred term.

Pass-Through: The passage of untreated pollutants through a publicly owned treatment works (POTW) which could violate applicable water quality standards or National Pollutant Discharge Elimination System (NPDES) effluent limitations.

Pathogenic: Disease causing or harmful to man.

Pathogenic Organisms: Organisms, including bacteria, viruses or cysts, capable of causing diseases (giardiasis, cryptosporidiosis, typhoid, cholera, dysentery) in a host (such as a person). There are many types of organisms which do not cause disease. These organisms are called non-pathogenic.

Peak Demand: The maximum momentary load placed on a water treatment plant, pumping station or distribution system. This demand is usually the maximum average load in one hour or less, but may be specified as the instantaneous load or the load during some other short time period.

Peaking Factor: Ratio of a maximum flow to the average flow, such as maximum hourly flow or maximum daily flow to the average daily flow.

Percent Saturation: The amount of a substance that is dissolved in a solution compared with the amount that could be dissolved in solution, expressed as a percent.

Percolation: The flow of liquid through a filtering medium.

Permissible Exposure Limit (PEL): The maximum 8-hour time weighted average of any airborne contaminant (such as dust, mist, vapor, gas, noise) to which an operator may be exposed. At no time may the exposure level exceed the ceiling concentration for that contaminant. Ceiling levels of regulated contaminants are listed in the Code of Federal Regulations (CFR) Title 29 Part 1910, Subparts G and Z. Also see "Time Weighted Average (TWA)."

Permit-Required Confined Space: A confined space which has the potential for some sort of serious hazard, like a hazardous atmosphere, electrical hazard or drowning danger, that may cause serious injury or death.

Personal Hygiene: Personal health habits, like hand washing, which prevent infection.

Personal Protective Equipment (PPE): Clothing, like hard hats, safety glasses, gloves, etc., that are designed to protect workers from hazards.

pH: pH is an expression of the intensity of the basic or acidic condition of a liquid. The pH may range from 0 to 14, where 0 is most acidic, 14 most basic, and 7 neutral. Natural waters usually have a pH between 6.5 and 8.5.

Phase Converter: A device that derives three phase power from single phase power. Used extensively in areas (often rural areas) where only single phase power is available to run three phase equipment.

Phosphorus: A nutrient that exists in both dissolved and solid form that when present in excess, leads to poor water quality, including algal blooms and poor aquatic habitat.

Photosynthesis: A process in which chlorophyll containing organisms convert carbon dioxide (CO_2) and inorganic matter to oxygen (O_2) and new cell material, utilizing sunlight as energy.

Physical Waste Treatment Process: Physical waste treatment processes include use of racks, screens, comminutors, clarifiers (sedimentation and flotation) and filtration. Chemical or biological reactions are important treatment processes, but not part of a physical treatment process.

Pickup Load: Actual load for heating the system following setback.

Pig: Refers to a poly pig which is a bullet-shaped device made of hard rubber or similar material. This device is used to clean pipes. It is inserted in one end of a pipe, moves through the pipe under pressure, and is removed from the other end of the pipe.

Pilot Scale Study: A method of studying different ways of treating wastewater and solids or to obtain design criteria on a small scale in the field.

Pipe Capacity: In a gravity-flow sewer system, pipe capacity is the total amount in gallons a pipe is able to pass in a specific time period.

Pipe Cleaning: Removing grease, grit, roots and other debris from a pipe run by means of one of the hydraulic cleaning methods. See "balling," "hydraulic cleaning," and "kite."

Pipe Diameter: The nominal or commercially designated inside diameter of a pipe, unless otherwise stated.

Pipe Joint: A place where two sections of pipe are coupled or joined together.

Pipe Section: A single length of pipe between two joints or couplers.

Plan View: A diagram or photo showing a facility as it would appear when looking down on top of it.

Pitot Tube: Small bore tube inserted perpendicular to a flowing stream with its orifice facing the stream to measure total pressure.

Plant Hydraulic Capacity: The flow or load, in millions of gallons per day (or portion thereof), that a treatment plant is designed to handle.

Plate Heat Exchanger: Fixed plates which separate and keep separate the hot and cold fluids.

Plenum: In an air distribution system, that part of the casing to or from which the air duct system delivers conditioned air.

Plug Flow: A type of flow that occurs in tanks, basins or reactors when a slug of wastewater moves through a tank without ever dispersing or mixing with the rest of the wastewater flowing through the tank.

Point Sources: Sources of water pollution that may be traced to a single point such as a discharge pipe or channel.

Pollutant: Any substance which causes impairment (reduction) of water quality to a degree that has an adverse effect on any beneficial use of the water.

Pollution: The impairment (reduction) of water quality by agricultural, domestic or industrial wastes (including thermal and radioactive wastes) to a degree that the natural water quality is changed to hinder any beneficial use of the water or render it offensive to the senses of sight, taste, or smell or when sufficient amounts of wastes create or pose a potential threat to human health or the environment.

Polyelectrolyte: A high-molecular-weight (relatively heavy) substance having points of positive or negative electrical charges that is formed by either natural or manmade processes. Natural polyelectrolytes may be of biological origin or derived from starch products and cellulose derivatives. Manmade polyelectrolytes consist of simple substances that have been made into complex, high-molecular-weight substances. Used with other chemical coagulants to aid in binding small suspended particles to larger chemical flocs for their removal from water. Often called a "polymer."

Polymer: A long chain molecule formed by the union of many monomers (molecules of lower molecular weight). Polymers are used with other chemical coagulants to aid in binding small suspended particles to larger chemical flocs for their removal from water.

Ponding: A condition occurring on trickling filters when the hollow spaces (voids) become plugged to the extent that water passage through the filter is inadequate. Ponding may be the result of excessive slime growths, trash, or media breakdown.

Population Equivalent: A means of expressing the strength of organic material in wastewater. Domestic wastewater consumes, on an average, approximately 0.2 lbs of oxygen per person per day, as measured by the standard BOD test.

Positive Pressure: In a building, pressure greater than the pressure outside.

Post-Denitrification: Biological wastewater treatment process for nitrogen removal that utilizes an anoxic zone located at the effluent end of an aeration tank. Due to lack of organic carbon, methanol addition is typically required.

Postchlorination: The addition of chlorine to the plant effluent, following plant treatment, for disinfection purposes.

Potable Water: Water that does not contain objectionable pollution, contamination, minerals, or infective agents and is considered satisfactory for drinking.

Pre-Aeration: The addition of air at the initial stages of treatment to freshen the wastewater, removes gases, add oxygen, and promote flotation of grease, and aid coagulation.

Pre-Denitrification: Biological wastewater treatment process for nitrogen removal that utilizes an anoxic zone located at the influent end of an aeration tank. Organic matter present in the wastewater serves as a carbon source for denitrifying bacteria.

Prechlorination (wastewater): The addition of chlorine in the collection system serving the plant or at the headworks of the plant prior to other treatment processes mainly for odor and corrosion control. Also applied to aid disinfection, to reduce plant BOD load, to aid in settling, to control foaming in Imhoff units and to help remove oil.

Precipitation: When a substance dissolved in a liquid passes out of solution and into solid form.

Precursor,THM: Natural organic compounds found in all surface and groundwater. These compounds may react with halogens (such as chlorine) to form trihalomethanes (THMs); they must be present in order for THMs to form.

Preheat Coil: A coil within an air handling unit which preheats incoming air up to a minimum temperature. This coil is usually followed by a second heating coil.

Preliminary Treatment: The removal of metal, rocks, rags, sand, eggshells, and similar materials which may hinder the operation of a wastewater treatment plant. Preliminary treatment is accomplished by using equipment such as racks, bar screens, comminutors, and grit removal systems.

Pressure: The total load or force acting on a surface, per unit area.

Atmospheric - the pressure exerted by the atmosphere on a given point. It decreases as the elevation above sea level increases.

Hydrostatic - the pressure, volume per unit area, exerted by a body of water at rest.

Negative - a pressure less than atmospheric.

Pressure Reducing Valve: Valve used to reduce a high supply pressure to a usable level.

Pretreatment Facility: Industrial wastewater treatment plant consisting of one or more treatment devices designed to remove sufficient pollutants from wastewaters to allow an industry to comply with effluent limits established by the US EPA General and Categorical Pretreatment Regulations or locally derived prohibited discharge requirements and local effluent limits. Compliance with effluent limits allows for a legal discharge to a POTW.

Pretreatment Inspector: A person who conducts inspections of industrial pretreatment facilities to ensure protection of the environment and compliance with general and categorical pretreatment regulations. Also called an "industrial pretreatment (waste) inspector" and an "inspector."

Preventive Maintenance: Regularly scheduled servicing of machinery or other equipment using appropriate tools, tests and lubricants. This type of maintenance can prolong the useful life of equipment and machinery and increase its efficiency by detecting and correcting problems before they cause a breakdown of the equipment.

Primary Clarifier: A wastewater treatment device which consists of a rectangular or circular tank that allows those substances in wastewater that readily settle or float to be separated from the wastewater being treated.

Primary Treatment: A wastewater treatment process that takes place in a rectangular or circular tank and allows those substances in wastewater that readily settle or float to be separated from the water being treated.

Priority Pollutants: The EPA has proposed a list of 126 priority toxic pollutants. These substances are an environmental hazard and may be present in water. Because of the known or suspected hazards of these pollutants, industrial users of the substances are subject to regulation. The toxicity to humans may be substantiated by human epidemiological studies or based on effects on laboratory animals related to carcinogenicity, mutagenicity, teratogenicity, or reproduction. Toxicity to fish and wildlife may be related to either acute or chronic effects on the organisms themselves or to humans by bioaccumulation in food fish. Persistence (including mobility and degradability) and treatability are also important factors.

Process Variable: A physical or chemical quantity that is usually measured and controlled in the operation of a wastewater treatment plant or an industrial plant.

Propeller Fan: Fan in which the air enters and leaves the impeller in a direction substantially parallel to its axis.

Protozoa: A group of motile microscopic animals (usually single-celled and aerobic) that sometime cluster in colonies and often consume bacteria as an energy source.

Prussian Blue: A paste or liquid used to show a contact area.

Psychrophilic Bacteria: A group of bacteria that grow and thrive in temperatures below 68°F (20°C).

Pump: A mechanical device used to create flow. There are two types:

> Centrifugal - a pump which creates movement by centrifugal force. Flow variation in this type of pump is easily accomplished by throttling the discharge valve. If the valve is shut, the pump will reach its "shut-off head", generally causing no damage.
>
> Positive Displacement - a pump which creates movement by drawing in a given volume and physically pushing it out the discharge pipe - Flow rate from this type of pump is relatively constant, regardless of head, and if it is operated against a closed discharge valve, something will break.

Pump Station: Installation of pumps to lift wastewater to a higher elevation in places where flat land would require excessively deep sewer trenches. Also used to raise wastewater from areas too low to drain into available collection lines. These stations may be equipped with air-operated ejectors or centrifugal pumps. See "lift station."

Purge: Removal of unburned gases from a combustion chamber.

Purification: The removal, by natural or other methods, of pollution from a given medium.

Putrefaction: Biological decomposition of organic matter resulting in the production of foul-smelling products associated with anaerobic conditions.

Putrescible: Putrescible material will decompose under anaerobic conditions and produce nuisance odors.

Qualified Professional: A person that is knowledgeable in the principles and practices of stormwater management and treatment, such as a licensed Professional Engineer, licensed Landscape Architect or other NYSDEC endorsed individual(s). Individuals preparing SWPPPs that require the post-construction stormwater management practice component must have an understanding of the principles of hydrology, water quality management practice design, water quantity control design, and the principles of hydraulics in order to prepare a SWPPP that conforms to the NYSDEC technical standards. All components of the SWPPP that involve the practice of engineering, as defined by the NYS Education Law, must be prepared by, or under the direct supervision of, a licensed Professional Engineer.

Quicklime: A granular material, composed primarily of calcium oxide (CaO) or calcium and magnesium oxide (MgO) and capable of slaking with water.

Rack: Evenly spaced parallel metal bars or rods located in the influent channel to remove rags, rocks, and cans from wastewater.

Radiation: Transmission of energy by means of electromagnetic waves emitted due to temperature.

Radiator: Terminal unit used in hot water or steam systems to deliver heat to a space (but primarily by convection and not radiation).

Raw Wastewater: Plant influent or wastewater before any treatment.

Reagent: A substance which takes part in a chemical reaction and is used to detect and measure another substance.

Recalcination: A lime-recovery process in which the calcium carbonate in sludge is converted to lime by heating to 1,800°F (980°C).

Recarbonation: A process in which carbon dioxide is bubbled into the water being treated to lower the pH.

Receiving Body: A stream, lake or other waterway into which treated or untreated waste is discharged.

Receiving Water: A stream, river, lake, ocean, or other surface or groundwater into which treated or untreated wastewater is discharged.

Recirculated Air: Air taken from a space and returned to that space, usually after being passed through a conditioning system.

Recirculation: The return of part of the effluent from a treatment process to the incoming flow.

Reducing Agent: Any substance, such as base metal (iron) or the sulfide ion, that will readily donate (give up) electrons. The opposite is an oxidizing agent.

Reduction: Reduction is the addition of hydrogen, removal of oxygen, or the addition of electrons to an element or compound. Under anaerobic conditions (no dissolved oxygen present), sulfur compounds are reduced to odor-producing hydrogen sulfide (H_2S) and other compounds.

Refractory: A material having the ability to retain its shape and chemical composition when subjected to high temperatures, or the area of an incinerator or similar equipment which contains the high temperatures.

Refrigerant: In a refrigerating system, the medium of hat transfer which picks up heat by evaporating at a low temperature and pressure, and gives up heat on condensing at a higher temperature and pressure.

Refrigerant Compressor: Component of a refrigerating system which increases the pressure of a compressible refrigerant fluid and simultaneously reduces its volume, while moving fluid through the device.

Refrigerating System: System which, in operation between a heat source (evaporator), and a heat sink (condenser), at two different temperatures, is able to absorb heat from the heat source at the lower temperature and reject heat to the heat sink at the higher temperature.

Regulator: A device used in combined sewers to control or regulate the diversion of flow.

Reheat Coil: Heating coil installed downstream of cooling coil.

Representative Sample: A sample portion of material, water, or waste stream that is as nearly identical in content and consistency as possible to that in the larger body of material or water being sampled.

Reset Control: Control method using a remote or external signal to modify the set point of a controller.

Residual Chlorine: The amount of free and/or available chlorine remaining after a given contact time under specified conditions.

Respiration: The process in which an organism uses oxygen for its life processes and gives off carbon dioxide.

Respirator: A device designed to protect the wearer from a hazardous atmosphere

Retention Time: The time water, sludge or solids are retained or held in a clarifier or sedimentation tank. See "detention time."

Return Air: Air entering a space from an air-conditioning, heating, or ventilating apparatus.

Return Sludge: The recycled sludge in a POTW that is pumped from a secondary clarifier sludge hopper to the aeration tank.

Return Sludge Ratio (R/Q): The ratio of the return sludge flow to the wastewater flow.

Reuse: The use of water or wastewater after it has been discharged and then withdrawn by another user. Also see "recycle."

Right-to-Know Laws: Employee "Right-to-Know" legislation requires employers to inform employees (operators) of the possible health effects resulting from contact with hazardous substances. At locations where this legislation is in force, employers must provide employees with information regarding any hazardous substances which they might be exposed to under normal work conditions or reasonably foreseeable emergency conditions resulting from workplace conditions. OSHA's Hazard Communication Standard (HCS) (Title 29 CFR Part

1910.1200) is the federal regulation and state statutes are called Worker Right-to-Know Laws.

Rising Sludge: Rising sludge occurs in the secondary clarifiers of activated sludge plants when the sludge settles to the bottom of the clarifier, is compacted, and then starts to rise to the surface, usually as a result of denitrification.

Rotary Pump: A type of displacement pump consisting essentially of elements rotating in a pump case which they closely fit. The rotation of these elements alternately draws in and discharges the water being pumped. Such pumps act with neither suction nor discharge valves, operate at almost any speed, and do not depend on centrifugal forces to lift the water.

Rotifer: Microscopic multi-celled animal characterized by short cilia on the front end.

Rotor: The portion of an electrical motor or generator which rotates.

Runoff: That part of rain or other precipitation that runs off the surface of a drainage area and does not enter the soil or the sewer system as inflow.

Runoff Reduction: The process whereby practices are implemented to minimize the quantity of stormwater runoff generated, and/or attenuate runoff near its source using storage, infiltration and/or uptake by vegetation.

SARA: Superfund Amendments and Reauthorization Act of 1986. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund, has enacted in 1980. The Superfund Amendments increase Superfund revenues to $8.5 billion and strengthen the EPA's authority to conduct short-term (removal), long-term (remedial) and enforcement actions. The Amendments also strengthen state involvements in the cleanup process and the Agency's commitments to research and development, training, health assessments, and public participation. A number of new statutory authorities, such as Community Right-to-Know, are also established.

SCADA System: Supervisory Control and Data Acquisition System. Computer-monitored alarms, response, control and data acquisition systems used by operators to monitor and adjust their treatment processes and monitor their operations.

SCBA: Self-Contained Breathing Apparatus. A respirator including an air cylinder which supplies breathing air to the wearer.

SIC Code: Standard Industrial Classification Code. A code number system used to identify various types of industries. In 1997, the United States and Canada replaced the SIC code system with the North American Industry Classification System (NAICS); Mexico adopted the NAICS in 1998.

SPDES: State Pollutant Discharge Elimination System. The system established pursuant to Article 17 of the Environmental Conservation Law and 6 NYCRR Part 750 for issuance of permits authorizing discharges to the waters of the state.

SVI: See Sludge Volume Index.

SWMP: Stormwater Management Program. Development of a Stormwater Management Program plan summarizing and documenting all aspects of the MS4 program and providing a runoff history of all progress and compliance efforts is a requirement of the MS4 permit.

SWPPP: Stormwater Pollution Prevention Plan. A set of documents that describes the scope of a proposed construction or development project, bodies of water and natural resources to be protected, and erosion and sediment control and stormwater practices that will be utilized to protect the resources during the project. Consists of narrative, maps, construction drawings and permit documents.

Safety Valve: Pressure relief valve actuated by inlet pressure, and characterized by rapid opening or pop action.

Sample: A portion of a larger quantity used as representative of the whole.

<u>Composite</u> - small samples, regulated by time and/or flow rate, combined into a single volume and used to represent the average conditions over that time.

<u>Grab</u> - a single instantaneous sample used to represent the conditions at that moment only.

Sanitary Collection System: The pipe system for collecting and carrying liquid and liquid-carried wastes from domestic sources to a wastewater treatment plant. Also see "wastewater collection system."

Sanitary Sewer: A pipe or conduit (sewer) intended to carry wastewater or waterborne wastes from homes, businesses, and industries to the POTW (Publicly Owned Treatment Works). Storm water runoff or unpolluted water should be collected and transported in a separate system of pipes or conduits (storm sewers) to natural watercourses.

Saprophytes: Organisms living on dead or decaying organic mater. They help natural decomposition of the organic solids in wastewater.

Saprophytic: Living on dead or decaying organic matter.

Saprophytic Organisms: Organisms living on dead or decaying organic matter. They help natural decomposition of the organic solids in wastewater.

Scale: A combination of mineral salts and bacterial accumulation that sticks to the inside of a collection pipe under certain conditions. Scale, in extreme growth circumstances, creates additional friction loss to the flow of water. Scale may also accumulate on surfaces other than pipes.

Schedule, (pipe): A sizing system of numbers that specifies the ID (inside diameter) and OD (outside diameter) for each diameter pipe. The schedule number is the ratio of internal pressure in psi divided by the allowable fiber stress multiplied by 1,000. Typical schedules of iron and steel pipe are schedules 40, 80, and 160. Other forms of piping are divided into various classes with their own schedule schemes.

Schmutzdecke: A layer of trapped matter at the surface of a slow sand filter in which a dense population of microorganisms develops. These microorganisms within the film or mat feed on and break down incoming organic material trapped in the mat. In doing so the microorganisms both remove organic matter and add mass to the mat, further developing the mat and increasing the physical straining action of the mat.

Scooter: A sewer cleaning tool whose cleansing action depends on the development of high water velocity around the outside edge of a circular shield. The metal shield is rimmed with a rubber coating and is attached to a framework on wheels (like a child's scooter). The angle of the shield is controlled by a chain-spring system which regulates the head of water behind the scooter and thus the cleansing velocity of the water flowing around the shield.

Screen: A device used to retain or remove suspended or floating objects in wastewater. The screen has openings that are generally uniform in size. It retains or removes objects larger than the openings. A screen may consist of bars, rods, wires, gratings, wire mesh, or perforated plates.

Scrubber: System to reduce noxious substances from a flowing stream of air, usually filled with plates or packing, through which scrubbing fluid flows countercurrent or cross-current to the path of the contaminated air.

Scum: A layer or film of foreign matter (such as grease, oil) that has risen to the surface of water or wastewater; a residue deposited on the ledge of a sewer, channel, or wet well at the water surface; a mass of solid matter that floats on the surface.

Secchi Disc: A flat, white disc that is used to measure the clarity or transparency of water. The disc is lowered into the water by a rope until it is just barely visible. At this point, the depth of the disc from the water surface is the recorded secchi disc transparency.

Secondary Clarifier: A wastewater treatment device which consists of a rectangular or circular tank that allows those substances not removed by previous treatment processes that settle or float to be separated from the wastewater being treated.

Secondary Element: The secondary measuring device or flow meter used with a primary measuring device (element) to measure the rate of liquid flow. In open channels bubblers and floats are secondary elements. Differential pressure measuring devices are the secondary elements in pipes or pressure conduits. The purpose of the secondary measuring device is to (1) measure the liquid level in open channels or the differential pressure in pipes, and (2) convert this measurement into an appropriate flow rate according to the known liquid level or differential pressure and flow rate relationship of the primary measuring device. This flow rate may be integrated (added up) to obtain a totalized volume, transmitted to a recording device, and/or used to pace an automatic sampler.

Secondary Treatment: A wastewater treatment process used to convert dissolved or suspended materials into a form more readily separated from the water being treated. Usually the process follows primary treatment by sedimentation. The process commonly is a type of biological treatment process followed by secondary clarifiers that allow the solids to settle out from the water being treated.

Sediment: Soil that has washed or eroded from a land surface.

Sedimentation (wastewater): The process of settling and depositing of suspended matter carried by wastewater. Sedimentation usually occurs by gravity when the velocity of the wastewater is reduced below the point at which it can transport the suspended material.

Sedimentation Basin: Clarifier, Settling Tank. A tank or basin in which wastewater is held for a period of time during which the heavier solids settle to the bottom and the lighter materials float to the water surface.

Seed Sludge: In wastewater treatment, seed, seed culture or seed sludge refers to a mass of sludge which contains populations of microorganisms. When a seed sludge is mixed with wastewater or sludge being treated, the process of biological decomposition takes place more rapidly.

Separately Derived System: A system whose power is derived (or taken) from a generator, transformer or converter.

Septage: The sludge produced in septic tanks.

Septic (wastewater): A condition produced by anaerobic bacteria. If severe, the wastewater produces hydrogen sulfide, turns black, gives off foul odors, contains little or no dissolved oxygen, and the wastewater has a high oxygen demand.

Septic Tank: A system sometimes used where wastewater collection systems and treatment plants are not available. The system is a settling tank in which settled sludge and floatable scum are in intimate contact with the wastewater flowing through the tank and the organic solids are decomposed by anaerobic bacterial action. Used to treat wastewater and produce an effluent that flows into a subsurface leaching (filtering and disposal) system where additional treatment takes place. Also referred to as an "interceptor;" however, the preferred term is "septic tank."

Septic Tank Effluent Pump (STEP) System: A facility where effluent is pumped from a septic tank into a pressurized collection system which may flow into a gravity sewer, treatment plant, or subsurface leaching system.

Septicity: The condition in which organic matter decomposes to form foul-smelling products associated with the absence of free oxygen. If severe, the wastewater produces hydrogen sulfide, turns black, gives off foul odors, contains little or no dissolved oxygen, and the wastewater has a high oxygen demand.

Series Operation: Wastewater being treated flows through one treatment unit and then flows through another similar treatment unit.

Service: Any individual person, group of persons, thing, or groups of things served with water through a single pipe, gate, valve, or similar means of transfer from a main distribution system.

Service Drop: Overhead conductors from the last pole to the building being served.

Service Pipe: The pipeline extending from the water main to the building served or to the consumer's system.

Set Point: In process control systems, a point at which the desired value of the controlled variable is set.

Setback: Reduction of heating or cooling during hours when a building is unoccupied.

Settleable Solids: The portion of the suspended solids which are of sufficient size and weight to settle in a given period of time, usually one hour.

Sewage: The used household water and water-carried solids that flow in sewers to a wastewater treatment plant. The preferred term is "wastewater."

Sewer: A pipe or conduit that carries wastewater or drainage water. The term "collection line" is often used also.

Sewer Gas: Gas in collection lines (sewers) that result from the decomposition of organic matter in the wastewater. When testing for gases found in sewers, test for lack of oxygen and also for explosive and toxic gases. Any gas present in the wastewater collection system, even though it is from such sources as gas mains, gasoline, and cleaning fluid.

Sewer Main: A sewer pipe to which building laterals are connected. Also called a "collection main."

Sewerage: System of piping with appurtenances for collecting, moving and treating wastewater from source to discharge.

Shock Load (wastewater): The arrival at a plant of a waste which is toxic to organisms in sufficient quantity or strength to cause operating problems. Possible problems include odors and sloughing off of the growth or slime on the trickling filters media. Organic or hydraulic overloads also can cause a shock load.

Short-Circuiting: A condition that occurs in tanks or basins when some of the water travels faster than the rest of the flowing water. This is usually undesirable since it may result in shorter contact, reaction, or settling times in comparison with the theoretical (calculated) or presumed detention times.

Shredding: A mechanical treatment process which cuts large pieces of wastes into smaller pieces so they won't plug pipes or damage equipment (comminution).

Side Stream: Wastewater flows that develop from other storage or treatment facilities. This wastewater may or may not need additional treatment.

Significant Figure: The number of accurate numbers in a measurement. If the distance between two points is measured to the nearest hundredth and recorded as 238.41 feet, the measurement has five significant figures.

Significant Industrial User (SIU): A Significant Industrial User (SIU) includes: all categorical industrial users, and any non categorical industrial user that discharges 25,000 gallons per day or more of process wastewater ("process wastewater" excludes sanitary, noncontact cooling and boiler blow down wastewaters), or contributes a process waste stream which makes up five percent or more of the average dry weather hydraulic or organic (BOD, TSS) capacity of a treatment plant, or has a reasonable potential, in the opinion of the Control or Approval Authority, to adversely affect the POTW treatment plant (inhibition, pass-through of pollutants, sludge contamination, or endangerment of POTW workers).

Significant Noncompliance: An industrial user is in significant noncompliance if its violation meets one or more of the following criteria:

- Chronic violation of wastewater discharge limits, defined here as those in which 66 percent or more of all of the measurements taken during a six-month period exceed (by any magnitude) the daily maximum limit or the average limit for the same pollutant parameter
- Technical Review Criteria (TRC) violations, defined here as those in which 33 percent or more of all of the measurements for each pollutant parameter taken during a six-month period equal or exceed the product of the daily maximum limit or the average limit multiplied by the applicable TRC (TRC = 1.4 for BOD, TSS, fats, oil and grease, and 1.2 for all other pollutants except pH)
- Any other violation of a pretreatment effluent limit (daily maximum or longer-term average) that the Control Authority determines has caused, alone or in combination with other discharges, interference or pass through (including endangering the health of POTW personnel or the general public)
- Any discharge of a pollutant that has caused imminent endangerment to human health, welfare or to the environment or has resulted in the POTW's exercise of its emergency authority to halt or prevent such a discharge
- Failure to meet, within 90 days after the schedule date, a compliance schedule milestone contained in a local control mechanism or enforcement order for starting construction, completing construction, or attaining final compliance
- Failure to provide, within 30 days after the due date, required reports such as baseline monitoring reports, 90-day compliance reports, periodic self-monitoring reports, and reports on compliance with compliance schedules
- Failure to accurately report noncompliance
- Any other violation which the Control Authority determines will adversely affect the operation or implementation of the local pretreatment program

Sine Wave: A waveform corresponding to a single-frequency, periodic oscillation, which can be shown as a function of amplitude against angle and in which the value of the curve at any point is a function of the sine of that angle.

Slake: To mix with water so that a true chemical combination takes place.

Slimes: A highly viscous substance formed by microbial growth.

Sloughing: The periodic loss of biofilm that occurs in trickling filters and rotating biological contactors. Sloughing occurs when biofilm is sheared from the trickling filter or RBC media.

Sludge: The settleable solids separated from liquids during processing or the deposits of foreign materials on the bottoms of streams or other bodies of water.

Sludge Digestion: The process of changing organic matter in sludge into a gas or a liquid or a more stable solid form. These changes take place as microorganisms feed on sludge in anaerobic (more common) or aerobic digesters.

Sludge Gasification: A process in which soluble and particulate organic matter are converted into gas by anaerobic decomposition. The resulting gas bubbles can become attached to the settled sludge and cause large clumps of sludge to rise and float on the water surface.

Sludge Volume Index (SVI): This is a calculation used to indicate the tendency of activated sludge solids (aerated solids) in the secondary clarifier to thicken or to become concentrated during the sedimentation/thickening process. To determine SVI, allow a mixed liquor sample from the aeration basin to settle for 30 minutes. Also determine the suspended solids concentration for a sample of the same mixed liquor. Calculate SVI by dividing the measured (or observed) wet volume (mL/L) of the settled sludge by the dry weight concentration of MLSS in grams/L. When mixed liquor has an SVI well above 100 mL/gram of solids, it tends to form a thin slurry or billowing sludge blanket or to form bulky sludge.

Slugs: Intermittent releases or discharges of wastewater.

Smoke Test: A method of blowing smoke into a closed-off section of a sewer system to locate sources of surface inflow.

Software Programs: Computer programs; the list of instructions that tell a computer how to perform a given task or tasks. Some software programs are designed and written to monitor and control municipal water and wastewater treatment processes.

Solenoid Valve: Valve that is closed by gravity, pressure, or spring action and opened by the magnetic action of an electrically energized coil, or vice versa.

Solids (S): Material not in liquid or gaseous form.

Colloidal - fine solid particles intermediate between suspended and dissolved solids, or the difference between the total suspended solids and the settleable solids.

Dissolved - Technically an incorrect term since all the solids are not in true solution. The , as used, is all the solids which pass through the filter mat in a Gooch crucible.

Inorganic - solids which are inert and not subject to decay.

Organic - solids, generally originating from animals and plants, which contain carbon, hydrogen, oxygen and other nutrients and are combustible during the volatile solids test.

Settleable - solids of sufficient size and weight to settle in one hour in an Imhoff cone.

Suspended Solids (SS) - solids which are visible and in suspension in the water; or the solids which are retained on the filter mat of a Gooch crucible.

Total - all the solids in the wastewater.

Volatile - burnable, a measure of organic content.

Solids Concentration: The solids in the aeration tank which carry microorganisms that feed on wastewater.

Solids Retention Time: An expression of the average time that a microorganism will spend in the activated sludge process.

Soluble BOD: Soluble BOD is the BOD of water that has been filtered in the standard suspended solids test.

Specific Gravity (SG): The ratio of the weight of a given volume of a substance to the weight of an equal volume of water.

Split System: Air conditioning system with remote condenser or remote condensing unit.

Stabilization: Processes that convert organic materials to a form that resists change. Organic material is stabilized by bacteria which convert the material to gases and other relatively inert substances. Stabilized organic material generally will not give off obnoxious odors.

Stabilized Waste: A waste that has been treated or decomposed to the extent that, if discharged or released, its rate and state of decomposition would be such that the waste would not cause a nuisance or odors.

Stack: Portion of the exhaust system downstream of the draft diverter, draft hood, or barometric draft regulator.

Stasis: Stagnation or inactivity of the life processes within organisms.

Static Pressure: Pressure exerted by a fluid at rest.

Stator: The stationary part of an electric generator or motor.

Steam Boiler: Enclosed vessel in which water is converted into steam.

Steam Trap: Device for allowing the passage of condensate and preventing the passage of steam, or for allowing the passage of air as well as condensate.

Step Controller: Multiple-switch assembly in which a moving element trips multiple output steps successively.

Step-Feed Aeration: Step-feed aeration is a modification of the conventional activated sludge process. In step-feed aeration, primary effluent enters the aeration tank at several points along the length of the tank, rather than all of the primary effluent entering at the beginning or head end of the tank and flowing through the entire tank.

Sterilization: The removal or destruction of all microorganisms, including pathogenic and other bacteria, vegetative forms and spores. Compare with “disinfection.”

Storm Collection System: A system of gutters, catch basins, yard drains, culverts and pipes for the purpose of conducting storm waters from an area, but intended to exclude domestic and industrial wastes.

Storm Runoff: The amount of runoff that reaches the point of measurement within a relatively short period of time after the occurrence of a storm or other form of precipitation. Also called "direct runoff."

Storm Sewer: A separate pipe, conduit or open channel (sewer) that carries runoff from storms, surface drainage, and street wash, but does not include domestic and industrial wastes. Storm sewers are often the recipients of hazardous or toxic substances due to the illegal dumping of hazardous wastes or spills created by accidents involving vehicles and trains transporting these substances. Also see "sanitary sewer."

Stuck: A stuck digester does not decompose organic matter properly. It is characterized by low gas production, high volatile acid to alkalinity relationship, and poor liquid-solids separation. A digester in a stuck condition is sometimes called a "sour" digester.

Sump: The term "sump" refers to a structure which connects an industrial discharger to a public sewer. The structure (sump) could be a sample box, a clarifier or an intercepting sewer.

Supernatant (wastewater): Liquid removed from settled sludge. Supernatant commonly refers to the liquid between the sludge on the bottom and the scum on the surface of an anaerobic digester. This liquid is usually returned to the influent wet well or to the primary clarifier.

Surcharge: Sewers are surcharged when the supply of water to be carried is greater than the capacity of the pipes to carry the flow. The surface of the wastewater in manholes rises above the top of the sewer pipe, and the sewer is under pressure or a head, rather than at atmospheric pressure.

Surface Loading: One of the guidelines for the design of settling tanks and clarifiers in treatment plants. Used by operators to determine if tanks and clarifiers are hydraulically (flow) over- or underloaded. Also called overflow rate.

Surface Runoff: The precipitation that cannot be absorbed by the soil and flows across the surface by gravity. The water that reaches a stream by traveling over the soil surface or falls directly into the stream channels, including not only the large permanent streams but also the tiny rills and rivulets. Water that remains after infiltration, interception, and surface storage has been deducted from total precipitation.

Surfactant: Abbreviation for surface-active agent. The active agent in detergents that possesses a high cleaning ability.

Suspended Growth Processes: Wastewater treatment processes in which the microorganisms and bacteria treating the wastes are suspended in the wastewater being treated. The wastes flow around and through the suspended growths. The various modes of the activated sludge process make use of suspended growth reactors. These reactors can be used for BOD removal, nitrification and denitrification.

Suspended Solids: 1. Solids that either float on the surface or are suspended in water, wastewater, or other liquids, and which are largely removable by laboratory filtering. 2. The quantity of material removed from water in a laboratory test, as prescribed in Standard Methods for the Examination of Water and Wastewater, and referred to as Total Suspended Solids Dried at 103° to 105°C.

Suspension: A solution having small particles dispersed throughout.

TMDL: Total Maximum Daily Load. The sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. It is a calculation of the maximum amount of a pollutant that a water body can receive on a daily basis and still meet water quality standards; and, an allocation of that amount to the pollutant's sources.

TSS: See Total Suspended Solids.

Tank: An artificial container in which liquids are held or detained.

Temperature Controller: Device which responds directly or indirectly to deviation from a desired temperature by actuating a control or initiating a control sequence.

Temperature Sensor: A device that opens and closes a switch in response to changes in the temperature. This device might be a metal contact, or a thermocouple that generates minute electric current proportional to the difference in heat, or a variable resistor whose value changes in response to changes in temperature. Also called a "heat sensor."

Tertiary Treatment: Any process of water renovation that upgrades treated wastewater to meet specific reuse requirements. May include general cleanup of water or removal of specific parts of wastes insufficiently removed by conventional treatment processes. Typical processes include chemical treatment and pressure filtration. Also called "advanced waste treatment."

Thermal Protection: Refers to an electrical device which has inherent protection from over-heating. Typically in the form of a bimetal strip which bends when heated to a certain point. When the bimetal strip is used as a part of appliance's circuitry, the circuit will open when the bimetal bends, breaking the circuit.

Thermocouple: junction of two wires of dissimilar materials, not necessarily metal, with the property of generating an electrical voltage related to the temperature of their junction.

Thermophilic Bacteria: A group of bacteria that grow and thrive in temperatures above 113°F (45°C). The optimum temperature range for these bacteria in anaerobic decomposition is 120°F (49°C) to 135°F (57°C).

Thermostat: Automatic control device responsive to temperature used to maintain constant temperature.

Thickening: Treatment to remove water from the sludge mass to reduce the volume that must be handled.

Thief Hole: A digester sampling well.

Three-way Valve: Valve having either a single inlet and two outlets (diverting) or two inlets and a single outlet (mixing), in which either one or the other of the two inlets or outlets is open or partially open. Usually used for temperature control purposes.

Titrate: Laboratory procedure in which a chemical solution of known strength is added, drop by-drop, to a sample until an end point is reached (usually a color change or the formation of a precipitate).

Ton: (of refrigeration) time-rate of cooling equal to 12,000 Btu/hr

Total Kjeldahl Nitrogen (TKN): Nitrogen continued in organic compounds such as proteins or their decomposition product ammonia, as measured by the Kjeldahl Method.

Total Organic Carbon (TOC): A measure of the amount of carbon contained in organic compounds in water or wastewater.

Total Pressure: In fluid flow, the sum of the static pressure and velocity pressure.

Total Flow: The total flow passing a selected point of measurement in the collection system during a specified period of time.

Total Residual Chlorine: The amount of available chlorine remaining after a given contact time. The sum of the combined available residual chlorine and the free available residual chlorine. Also see "residual chlorine."

Total Suspended Solids: See Suspended Solids.

Totalizer: An instrument which maintains a running total of the measured variable.

Toxic: A substance which is poisonous to a living organism.

Toxicity: The relative degree of being poisonous or toxic. A condition which may exist in wastes and will inhibit or destroy the growth or function of certain organisms.

Transducer: A device for converting energy from one form to another, such as optical energy to electrical energy.

Trained Individual: An employee from a contracting (construction) firm that has received four (4) hours of training endorsed by NYSDEC, or from a Soil and Water Conservation District, CPESC, Inc., or other NYSDEC-endorsed entity

Transformer: A device which uses magnetic force to transfer electrical energy from one coil of wire to another. In the process, transformers can also change the voltage at which this electrical energy is transmitted.

Transmission: The electrical transfer of a signal, message or other form of data from one location to another.

Trap: 1. In the wastewater collection system of a building, plumbing codes require every drain connection from an appliance or fixture to have a trap. The trap in this case is a gooseneck that holds water to prevent vapors or gases in a collection system from entering the building. 2. Various other types of special traps are used in collection systems such as a grit trap or sand trap.

Trickling Filter: A treatment process in which the wastewater trickles over media that provide the opportunity for the formation of slimes or biomass which contain organisms that feed upon and remove wastes from the water being treated.

Trickling Filter Media: Rocks or other durable materials that make up the body of the filter. Synthetic (manufactured) media have been used successfully.

Trihalomethanes (THMs): Derivatives of methane, CH4, in which three halogen atoms (chlorine or bromine) are substituted for three of the hydrogen atoms. Often formed during chlorination by reactions with natural organic materials in the water. The resulting compounds (THMs) are suspected of causing cancer.

Turbidity: The cloudy appearance of water caused by the presence of suspended and colloidal matter. In the waterworks field, a turbidity measurement is used to indicate the clarity of water. Technically, turbidity is an optical property of the water based on the amount of light reflected by suspended particles. Turbidity cannot be directly equated to suspended solids because white particles reflect more light than dark-colored particles and many small particles will reflect more light than an equivalent large particle.

Turbidity Meter: An instrument for measuring and comparing the turbidity of liquids by passing light through them and determining how much light is reflected by the particles in the liquid. The normal measuring range is 0 to 100 and is expressed as Nephelometric Turbidity Units (NTUs).

Turbidity Units (TU): Turbidity units are a measure of the cloudiness of water. If measured by a nephelometric (deflected light) instrumental procedure, turbidity units are expressed in nephelometric turbidity units (NTU) or simply TU. Those turbidity units obtained by visual methods are expressed in Jackson Turbidity Units (JTU) which is a measure of the cloudiness of water; they are used to indicate the clarity of water. There is no real connection between NTUs and JTUs. The Jackson turbidimeter is a visual method and the nephelometer is an instrumental method based on deflected light.

Turbulent Mixers: Devices that mix air bubbles and water and cause turbulence to dissolve oxygen in the water.

US EPA: United States Environmental Protection Agency.

Twisted Pair: A type of cable in which pairs of conductors are twisted together to produce certain electrical properties. See also shielded twisted pair and unshielded twisted pair.

Two-Stage Filters: Two filters are used. Effluent from the first filter goes to the second filter, either directly or with a clarifier between the two filters.

Ultra filtration: A membrane filters process used for the removal of some organic compounds in an aqueous (watery) solution.

Underwriters Laboratories (UL): A non-profit organization that was established by the insurance industry to test devices, materials and systems for safety, not satisfactory operation. It has begun to set standards. Items that pass the tests are marked UL Approved.

Uninterrupted Power Supply (UPS): Designation of a power supply providing continuous uninterrupted service.

Unit Heater: Heater consisting of a fan for circulating air over a heat exchange surface or coil, all enclosed in a common casing.

Unit Process: A distinct and separate portion of the total wastewater treatment system.

Unit Ventilator: Fan-coil unit package devised for applications in which the use of outdoor and return air mixing is intended to satisfy tempering requirements and ventilation needs.

Upset Digester: An upset digester does not decompose organic matter properly. An upset digester is characterized by low gas production, high volatile acid/alkalinity relationship, and poor liquids-solids separation. A digester in an upset condition is sometimes called a “sour” or “stuck” digester.

Upstream: The direction against the flow of water; or, toward or in the higher part of a sewer or collection system.

Urbanized Area: For the purposes of this document, the term “urbanized area” refers specifically to areas designated by the 2010 U.S. Census as containing sufficient population density (1,000 people or more per square mile) and sufficient contiguity to a population center of 50,000 people or more, to be designated as “urbanized” and automatically subject to regulation as an MS4 under the SPDES program.

VAV: Variable air volume

Vacuum Breaker: A device which relieves the partial vacuum in pipelines to prevent back siphonage.

Vane Axial Fan: disc-type wheel within a cylinder, a set of air guide vanes located either before or after the wheel, and including driving mechanism supports either for belt drive or direct connection.

Variable Costs (wastewater): Costs that a utility must cover or pay that are associated with the actual collection, treatment, and disposal of wastewater. The costs vary or fluctuate. Also see “fixed costs.”

VAV Box: Variable air volume terminal device.

Velocity Pressure: In a moving fluid, the pressure due to the velocity and density of the fluid.

Vent: Opening in a tank or other piece of equipment, sealed to prevent escape of material within normal pressures, but arranged to open automatically to relieve excessive pressure.

Ventilation: Process of supplying or removing air by natural or mechanical means to or from any space. Such air may or may not have been conditioned.

Ventilator: Device for replacing air inside a room by outside air.

Volatile: A volatile substance is one that is capable of being evaporated or changed to a vapor at relatively low temperatures. Volatile substances also can be partially removed by air stripping. In terms of solids analysis, volatile refers to materials lost (including most organic matter) upon ignition in a muffle furnace for 60 minutes at 550°C. Natural volatile materials are chemical substances usually of animals or plant origin. Manufactured or synthetic volatile materials such as ether, acetone, and carbon tetrachloride are highly volatile and not of plant or animal origin.

Volatile Acids: Fatty acids produced during digestion that are soluble in water and that can be steam-distilled at atmospheric pressure. Also called “organic acids.” Volatile acids are commonly reported as equivalent to acetic acid.

Volatile Solids: Those solids in water, wastewater, or other liquids that are lost on ignition of the dry solids at 550°C for 60 minutes.

Voltage Drop: Voltage reduction due to wire resistance.

Volume Control Damper: Device mounted in a duct or opening used to vary the volume of air flowing through.

Volumetric: Measurement by volume; as opposed to gravimetric, which is measurement by weight.

Volute: A spiral shaped casing, surrounding the impeller of a centrifugal pump, which collects the liquid discharged by the impeller.

Vulnerability Assessment (water): An evaluation of drinking water source quality and its vulnerability to contamination by pathogens and toxic chemicals.

Waste Activated Sludge (WAS), mg/L: The excess growth of microorganisms which must be removed from the process to keep the biological system in balance.

Wastewater: A community’s used water and water-carried solids (including used water from industrial processes) that flow to a treatment plant. Storm water, surface water, and groundwater infiltration also may be included in the wastewater that enters a wastewater treatment plant. The term “sewage” usually refers to household wastes, but this word is being replaced by the term “wastewater.”

Wastewater Collection System: The pipe system for collecting and carrying water and water-carried wastes from domestic and industrial sources to a wastewater treatment plant.

Wastewater Facilities: The pipes, conduits, structures, equipment, and processes required to collect, convey, and treat domestic and industrial wastes, and dispose of the effluent and sludge.

Wastewater Ordinance: The basic document granting authority to administer a pretreatment inspection program. This ordinance must contain certain basic elements to provide a legal framework for effective enforcement.

Wastewater Treatment Plant: An arrangement of pipes, equipment, devices, tanks and structures for treating wastewater and industrial wastes. A water pollution control plant.

Water Cycle: The process of evaporation of water into the air and its return to earth by precipitation (rain or snow). This process also includes transpiration from plants, groundwater movement, and runoff into rivers, streams and the ocean. Also called the “hydrologic cycle.”

Water Heater: Closed vessel in which water is heated by the combustion of fuels, electricity, or any other source and is withdrawn for use external to the system at pressures not exceeding 160 psig, including the apparatus by which heat is generated, and all controls and devices necessary to prevent water temperatures from exceeding 210 F.

Water Treatment: Process that alters supply water so that it can be used for proecess or HVAC purposes without deleterious effect.

Watt: The unit of measurement of electrical power or rate of work. One amp represents the amount of current at a pressure of one volt.

Waveform: Characteristic shape of an electrical current or signal. The ace output from an inverter.

Wavelength: The distance between the same two points on adjacent waves; the time required for a wave to complete a single cycle.

Watershed: The region or land area that contributes to the drainage or catchments area above a specific point on a stream or river.

Weir: A wall or plate placed in an open channel and used to measure the flow of water. The depth of the flow over the weir can be used to calculate the flow rate, or a chart or conversion table may be used to convert depth to flow.

A wall or obstruction used to control flow (from settling tanks and clarifiers) to ensure a uniform flow rate and avoid short-circuiting.

Weir Diameter: Circular clarifiers have a circular weir within he outside edge of the clarifier, and all of the water leaving the clarifier flows over this weir. This diameter is the length of a line from one edge of a weir to the opposite edge and passing through the center of the circle formed by the weir.

Weir, Proportional: A specially shaped weir in which the flow through the weir is directly proportional to the head.

Wet Well: A tank or chamber in which the flow of liquid is contained and to which the suction of a pump is connected.

Wet-bulb Temperature: Temperature indicated by a psychrometer when the bulb of one thermometer is covered with a water saturated wich over which air is caused to flow.

Y, Growth Rate: An experimentally determined constant used to express the unit growth rate of bacteria in terms of mass per mass of organic matter degraded (i.e., mg per mg BOD5).

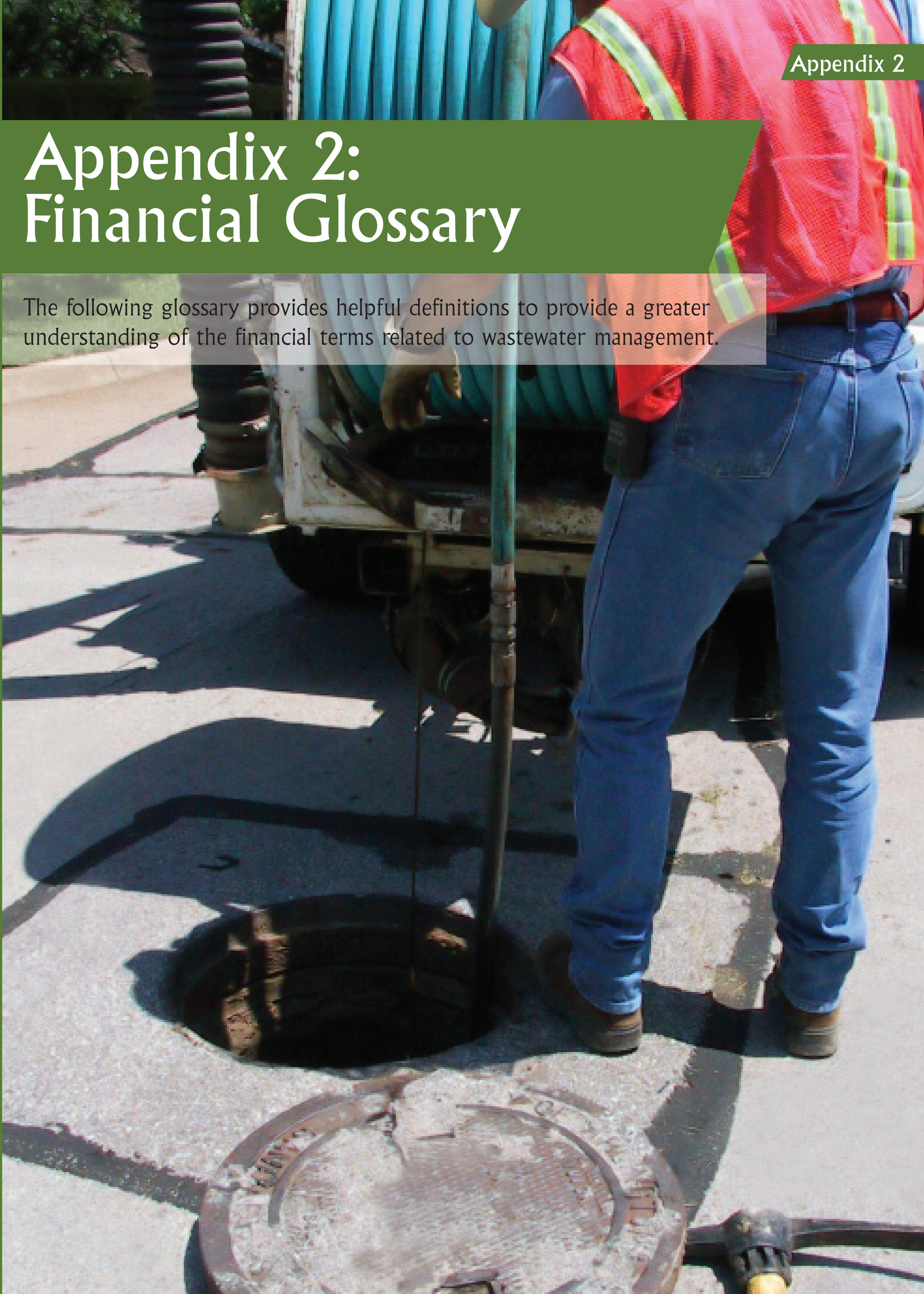
Zone: Space or group of spaces within a building with heating or cooling requirements sufficiently similar that comfort conditions can be maintained by a single controlling device.

Zoogleal Film: A complex population of organisms that form a "slime growth" on trickling filter media and break down the organic matter in wastewater. These slimes consist of living organisms feeding on organic matter in wastewater, dead organisms, silt, and other debris. "Slime growth" is a more common term.

Zoogleal Mass: Jelly-like masses of bacteria found in both the trickling filter and activated sludge processes. These masses may be formed for or function as protection against predators and for storage of food supplies.

Appendix 2: Financial Glossary

The following glossary provides helpful definitions to provide a greater understanding of the financial terms related to wastewater management.



NYWEA

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Appendix 2: Financial Glossary

Accelerated Depreciation: Any depreciation method that allows for greater deductions or charges in the earlier years of an assets depreciable life, with charges becoming progressively smaller in each successive period. Examples would include the double declining balance and sum-of-the-years digits methods.

Accrual Accounting Method: A form of reporting profits or losses based on the consummation of a transaction being accepted by form of contract or invoice without the realization of cash or an expense that has been incurred but has not yet been disbursed.

Accrual Basis: The practice of record keeping by which income is recorded when earned and expenses are recorded when incurred, even though the cash may be received or paid out later.

Ad Valorem Tax: A tax based on the assessed value of property. Counties, school districts, and municipalities usually are authorized to levy ad valorem taxes. Special districts can also be authorized to levy ad valorem taxes.

Amortization: A breakdown of periodic loan payments into two components: a principal portion and an interest portion. The gradual reduction of a debt by means of equal periodic payments sufficient to meet current interest and liquidate the debt at maturity. When the debt involves real property, often the periodic payments include a sum sufficient to pay taxes and hazard insurance.

Annualization: The process of adjusting a utility company's annual historical information to reflect a full 12-month period for known changes reasonably expected to continue into the future. Annualization adjustments are routinely made in developing a utility company's total cost of service.

Appreciation: The increase in the value of an asset in excess of its depreciable cost which is due to eco¬nomic and other conditions, as distinguished from increases in value due to improvements or additions made to it.

Asset: Anything owned by an individual or a business, which has commercial or exchange value. Assets may consist of specific property or claims against others, in contrast to obligations due others. (See also Liabilities).

Asset Based Lending: A loan to an individual or company collateralized by a specific asset or group of assets. Typically asset based loans do not require real property as collateral.

Asset Sale: An asset sale is the transfer of ownership of government assets, commercial-type enterprises, or functions to the private sector. In general, the government has no role in the financial support, management, or oversight of a sold asset. However, if the asset is sold to a company in an industry with monopolistic characteristics, the government may regulate certain aspects of the business, such as utility rates.

Assurance/Performance Bonding: Performance or assurance bonding is a requirement that users of environmental resources place in an escrow account a sum of money adequate to cover potential future environmental damages.

Authority (Lease Revenue): A bond secured by the lease between the authority and another agency. The lease payments from the "city" to the agency are equal to the debt service.

Bond: An interest-bearing certificate issued by governments and corporations when they borrow money. The issuer agrees to pay a fixed principal sum on a specified date (the maturity date) and at a specified rate of interest. In measuring municipal bond volume, a bond is a security maturing more than one year from issuance; shorter-term obligations are usually termed notes or commercial paper.

Bond Anticipation Note (BAN): A note issued by public agencies to secure temporary (often partial) financing for a project that will eventually be fully financed (and the BAN repaid) through the sale of bonds.

Bond Bank: A state-chartered organization that purchases the bonds of local governments and secures its own debt with the pool of local bonds. This arrangement cuts borrowing costs for the local issuers because the bond bank's debt usually carries higher ratings than that of the municipalities, whose issues are usually too small to be rated anyway. Credit enhancements, such as bond insurance, are also cheaper when purchased for larger issues. Localities' use of the bond bank is voluntary.

Bond Counsel: A lawyer who reviews the legal documents and writes an opinion on the security, tax-exempt status and issuance authority of a bond or note.

Bond Discount: The excess of the face value of a bond over the price for which it is acquired or sold. The price does not include accrued interest at the date of acquisition or sale.

Bond Election: The process by which voters approve or reject bond issues.

Bond-Equivalent Yield: The annualized yield to maturity computed by doubling the semiannual yield.

Bond Fund: A fund formerly used to account for the proceeds of general-obligation bond issues. Such proceeds are not accounted for in a capital-projects fund.

Bond Indenture: The contract that sets forth the promises of a corporate bond issuer and the rights of investors.

Bond Insurance: Insurance that can be purchased by an issuer for either an entire issue or specific maturities, which guarantees the payment of principal and/or interest. This security usually provides a higher credit rating and thus a lower borrowing cost for an issuer.

Bond Issued: Bond sold.

Bond Premium: The excess of the price at which a bond is acquired or sold over its face value. The price does not include accrued interest at the date of acquisition or sale.

Bond Proceeds: The money the issuer receives from its bond sale.

Bonded Debt: That portion of indebtedness represented by outstanding bonds.

Bonds Authorized and Un-issued: Bonds that have been legally authorized but not issued and which can be issued and sold without further authorization. This term must not be confused with the terms “margin of borrowing power” or “legal debt margin,” either one of which represents the difference between the legal debt limit of a government and the debt outstanding against it.

Bonds, Debenture: A form of long-term loan included in debt capital, which is secured by the general credit worthiness of the utility.

Bonds, Mortgage: A form of long-term loan, included in debt capital, which is secured by the utility’s property.

Budget: A budget is an itemized listing of the amount of all estimated revenue which a given business anticipates receiving, along with a listing of the amount of all estimated costs and expenses that will be incurred in obtaining the above mentioned income during a given period of time. A budget is typically for one business cycle, such as a year, or for several cycles (such as a five year capital budget).

Callable Bond: A bond that can be redeemed by the issuer prior to its maturity. Usually a premium is paid to the bond owner when the bond is called.

Capital: Funds necessary to establish or operate a business.

Capitalization: Also called financial leverage ratios, ratios that compare debt to total capitalization and thus reflect the extent to which a corporation is trading on its equity. These ratios can be interpreted only in the context of the stability of industry and company earnings and cash flow.

Capital Budget: This is the estimated amount planned to be expended for capital items in a given fiscal period. Capital items are fixed assets such as facilities and equipment, the cost of which is normally written off over a number of fiscal periods. The capital budget, however, is limited to the expenditures which will be made within the fiscal year comparable to the related operating budgets.

Capital Costs: Expenditures that typically result in the acquisition or addition to fixed assets that have a useful life of over one year and a cost greater than a threshold value established by the owner. Capital costs include expenditures for replacements and major additions, but not for repairs.

Capital Lease: A lease that meets at least one of the following criteria, and therefore must be treated essentially as a loan for book accounting purposes: title passes automatically by the end of the lease term; lease contains a bargain purchase option; lease term is greater that 75% of estimated economic life of the equipment; present value of lease payments is greater than 90% of the equipment’s fair market value.

Capital Outlay: Expenditures that result in the acquisition of or addition to fixed assets.

Capital-Projects Fund: A fund created to account for financial resources to be used for the acquisition or construction of major capital facilities (other than those financed by proprietary funds, special funds, and trust funds).

CERCLA: Comprehensive Environmental Response, Compensation and Liability Act.

Collateral: Assets pledged as security against a loan in case of default. The intangible or tangible property given as security to the lender by the account credit for any obligations and indebtedness of account creditor.

Commercial Loan: A loan from a privately-owned bank at market rates.

Community Water System: A water system which supplies drinking water to 25 or more of the same people year-round in their residences.

Connection Fee: A charge assessed to new users of a utility system to cover the costs of constructing capacity for their use.

Contracting Out: Contracting out is the hiring of private-sector firms or non-profit organizations to provide goods or service for the government. Under this approach, the government remains the financier and has management and policy control over the type and quality of goods or services to be provided. Thus, the government can replace contractors that do not perform well.

Cost of Capital: The weighted-average cost of funds that a firm secures from both debt and equity sources in order to fund its assets. The use of a firm's cost of capital is essential in making accurate capital budgeting and project investment decisions.

Coupon Rate: The interest rate specified on interest coupons attached to a bond. The term is synonymous with nominal interest rate.

Coverage: The ratio of revenue available for debt service to the average annual debt service requirements of an issue of revenue bonds.

Current Assets: Current assets are those assets of a company which are reasonable expected to be realized in cash or sold, or consumed during the normal operating cycle of the business (usually one year). Such assets include cash, accounts receivable and money due usually within one year, short-term investments, US government bonds, inventories, and prepaid expenses.

Current Liabilities: Liabilities to be paid within one year of the balance sheet date.

Debenture Bonds: See Bonds, Debenture.

Debt: An obligation resulting from the borrowing of money or from the purchase of goods and services. Debts of governments include bonds, time warrants, and floating debt.

Debt to Equity Ratio: A return on investment; an investment created by a form of debt, i.e., bank loan, investor funds, etc. of which is converted to profit then retained in earnings which is referred to as "owner" or "stockholder" equity.

Debt Financing: Raising funds for a business by borrowing, often in the form of bank loans.

Debt Limit (Ceiling): The legal maximum debt-incurring power of a State or locality. Debt limits are often imposed by constitutional, statutory, or local charter provisions.

Debt, Long-term: Debt that is payable more than one year from the date it was incurred.

Debt Per Capita: Bonds divided by population. When compared with other jurisdictions, this statistic serves as an indicator of the use of public debt capacity in the area in question.

Debt Ratio: The ratio of an issuer's debt outstanding to a measure of property value.

Debt Service: The amount of money necessary to pay interest and principal charges on an outstanding debt.

Debt Service Fund: A fund created by a bond indenture and held by the trustee, usually amounting to principal and interest payment for one year, and used only if normal revenues are not sufficient to pay debt service.

Debt Service Fund Requirements: The amount of revenue that must be provided for a debt service fund so that all principal and interest payments can be made in full on schedule.

Debt Service Requirements: The amount of money required to pay interest on outstanding debt, serial maturities of principal for serial bonds, and required contributions to accumulate monies for future retirement of term bonds.

Debt Service Reserve Fund: A fund created by a bond indenture and held by the trustee, usually amounting to principal and interest payment for one year, and used only if normal revenues are not sufficient to pay debt service.

Debt, Short-term: Debt that falls due in a period of under a year.

Default: The failure to make timely payment of interest or principal on a debt instrument; or the occurrence of an event as stipulated in the indenture of trust resulting in an abrogation of that agreement. An issuer does not default until it fails to make a payment.

Depreciation: The amount of expense charged against earnings by a company to write off the cost of a plant or machine over its useful life, giving consideration to wear and tear, obsolescence, and salvage value. If the expense is assumed to be incurred in equal amounts in each business period over the life of the asset, the depreciation method used is straight line (SL). If the expense is assumed to be incurred in decreasing amounts in each business period over the life of the asset, the method used is said to be accelerated. Two commonly used variations of the accelerated method of depreciating an asset are the sum-of-years digits (SYD) and the double-declining balance (DDB) methods. Frequently, accelerated depreciation is chosen for a businesses' tax expense but straight line is chosen for its financial reporting purposes.

Direct Cost: A cost that can be economically traced to a single cost object.

Discount Rate: The time value of money or the rate of interest a company wants to earn on its investments.

Easement: In most states, an easement is a legal restriction contained within a deed that prohibits certain land uses in perpetuity. For example, an easement might prohibit development of more than one house on 20 acres of oceanfront property. Private landowners who place easements on their property for natural resources protection can take a tax write-off representing the value lost on the property due to the deed restrictions.

Earmarking: Statutory or constitutional dedication of revenues to specific government projects or programs.

Economic Life of Leased Property: The estimated period during which the property is expected to be economically usable by one or more users, with normal repairs and maintenance for the purpose for which it was intended at the inception of the lease.

Environmental Cost Accounting: The addition of environmental cost information into existing cost accounting procedures and/or recognizing embedded environmental costs and allocating them to appropriate products and processes.

Estimated Useful Life: The period in which an asset is expected to be useful in trade or business.

Equity: Equity reflects the fairness of the distribution of the funding burden for an AFM among individuals. Equity can be approached from two directions: those who create or contribute to environmental problems should bear the funding burden (the "polluter" pays), or those who benefit from program activities should bear the funding burden (the "beneficiary" pays.)

Equipment Leasing: Contracting to pay monthly fees to use equipment, instead of buying it.

Fee: A fee is generally a charge for services rendered. Although laws vary widely, many states require that fees be set at rates that will cover only the costs of the services provided.

Finance Lease: A lease used to finance the purchase of equipment; not a true lease. Finance leases are generally considered to be capital leases from an accounting perspective and non-tax leases from a tax perspective.

Fines and Penalties: Fines and penalties require offenders to pay monetary damages for violating government laws or regulations.

Fixed Assets: Those assets of a permanent nature required for the normal conduct of a business, and which will not normally be converted into cash during the ensuring fiscal period. For example, furniture, fixtures, land, and buildings are all fixed assets. However, accounts receivable and inventory are not.

Fixed Cost: Fixed costs are operating expenses that are incurred by facilities and organizations which are kept in readiness to do business without regard to actual volumes of production and sales. Fixed costs remain relatively constant until changed by managerial decision. Within general limits they do not vary with business volume. Examples of fixed costs consist of rent, property taxes, and interest expense.

Full Cost Accounting: A method of financial and management accounting that allocates all direct and indirect historical costs to a product or process.

Full Cost Recovery: Full cost recovery means charging fees to completely cover costs incurred by a particular activity or service. Some state and local governments, as well as local utilities, are beginning to practice full cost recovery by legislatively requiring that fees be set to cover the complete cost of services rendered.

Full Faith and Credit: The pledge of the general taxing power of a government to pay its debt obligations.

Full Payout Lease: A lease in which the total of the lease payments pay back to the leaser the entire cost of the equipment including financing, overhead, and a reasonable rate of return, with little or no dependence on a residual value.

Fund: A fiscal and accounting entity with a self-balancing set of accounts recording cash and other financial resources, together with all related liabilities and residual equities or balances, and changes therein, which are segregated for the purpose of carrying on specific activities or attaining certain objectives in accordance with special regulations, restrictions, or limitations.

General Obligation Bond: A security backed by the full faith and credit of a state or locality. In the event of default, the holders of general obligation bonds have the right to compel a tax levy or legislative appropriation in order to satisfy the debt obligation.

Grant: A monetary sum awarded to a State or local government or non-profit organization that does not need to be repaid. Typically, grants are awarded by the federal government to State or local governments or by States to local governments, to finance a particular activity or facility.

Grant Anticipation Notes (GAN): Notes issued by public agencies to secure temporary financing for projects awaiting the receipt of permanent funding through governmental grants. The GAN is repaid from grant proceeds.

Gross Direct Debt: The total amount of bonded debt of a government (general obligation bonds plus revenue bonds).

Guarantee, loan: Promise to take responsibility for payment of part or all of a debt if the person borrowing the money fails to pay off the loan.

Guaranty or Guaranty Agreement: The agreement of a third party to pay debt service on a debt in the event of default by the issuer.

Impact Fee: A fee assessed against private developers in compensation for the new capacity requirements their projects impose upon public facilities.

Industrial-Revenue Bonds: Bonds issued by governments, the proceeds of which are used to construct facilities for a private business enterprise. Lease payments made by the business enterprise to the government are used to service the bonds. Such bonds may be in the form of general-obligation bonds, combination bonds, or revenue bonds.

Insured Bond: A municipal bond backed both by the credit of the municipal issuer and by commercial insurance policies.

Interest: The charge or cost of borrowing money, measured in terms of a percentage per annum of the principal amount.

Internal Rate of Return: A return on an investment greater than the amount described in a contract or any other investment instrument. The internal rate-of-return is measured by the ability of the investor to reduce internal expenses during the course of managing the investment; which means the investor actually makes more than what is outlined in the contract or other investment instrument.

Lease: A contract through which an owner of equipment (the leaser) conveys the right to use its equipment to another party (the lessee) for a specified period of time (the lease term) for specified periodic payments.

Lease Purchase: Full payout, net leases structured with a term equal to the equipment's estimated useful life. Because many Lease Purchases include a bargain purchase option for the lessee to purchase the equipment for one dollar at the expiration of the lease, these leases are often referred to as dollar buyout or buckout-leases. Lease purchases are generally considered to be Capital Leases from an accounting perspective and non-tax leases from a tax perspective due to their bargain purchase option and length of lease term.

Lease Rental Bonds: Bonds for which the principal and interest are payable exclusively from rental payments from a lessee. Rental payments are often derived from earnings of an enterprise that may be run by the lessee or the leaser. Rental payments may also come from taxes levied by the lessee.

Lease Schedule: A schedule to a Master Lease agreement describing the leased equipment, rentals and other terms applicable to the equipment.

Lessee: The party to a lease agreement who is obligated to pay the rentals to the leaser and is entitled to use and possess the leased equipment during the lease term.

Leaser: The party to a lease agreement who has legal or tax title to the equipment (in the case of a true tax lease), grants the lessee the right to use the equipment for the lease term and is entitled to receive the rental payments.

Leverage: Debt in relation to equity.

Leveraging: The use of grant or loan funds as reserve funds for the issuance of debt. Leveraging is used by several states participating in the Water Pollution Control State Revolving Fund program to increase the amount of funds available for loans.

Liability: Claim on the assets of a company.

Liability Assignment: Liability assigned through common law or statute, whereby individuals or companies may be held financially responsible for environmental damage resulting from their activities.

Lien: An attachment, voluntary or involuntary. A lender will apply a lien to encumber real or personal property. The lien can be granted by an abstract judgment rendered by a court of law.

Life Cycle Costing (LCC): A systematic process of evaluating the life-cycle costs of a product, product line, process, system, or facility by identifying life-cycle consequences and assigning monetary values to those consequences. Also called Life Cycle Cost Assessment (LCCA).

Life-Cycle Assessment/Analysis (LCA): A holistic approach to identifying the environmental consequences of a product, process, or activity through its entire life cycle and to identifying opportunities for achieving environmental improvements. EPA specifies four major stages in a life-cycle of a product, process, or activity: raw materials acquisition, manufacturing, consumer use/reuse maintenance, and recycle/waste management. LCA focuses on environmental impacts not costs.

Limited-Tax General Obligation Bond: A general obligation bond that is limited as to revenue sources.

Long-Term Debt: Debt that is payable more than one year from the date it was incurred.

MACRS: The Modified Accelerated Cost Recovery System (MACRS) is the current tax depreciation system in the United States. Under this system, the capitalized cost (basis) of tangible property is recovered over a specified life by annual deductions for depreciation. The lives are specified broadly in the Internal Revenue Code. The Internal Revenue Service (IRS) publishes detailed tables of lives by classes of assets. The deduction for depreciation is computed under one of two methods (declining balance switching to straight line or straight line) at the election of the taxpayer, with limitations.[1] See IRS Publication 946 for a 120 page guide to MACRS.

Moral Obligation Bond: A state or municipal bond that is not backed by the full faith and credit of the issuer. The issuer of a moral obligation bond asserts the intent of the legislative body to make appropriations sufficient to cure any deficiency in monies required to meet debt service, but the issuer has no legally enforceable obligation to do so.

Municipal Bond: A debt obligation issued by a state, state agency or authority, or a political subdivision, such as county, city, town or village. They may be issued for general governmental needs or special projects. Issuance must be approved by referendum or by an electoral body.

Municipal Bond Insurance: Insurance policies that protect investors if a municipal bond should default–the bonds will be purchased from investors at par. The insurance may either be purchased by the issuer or the investor. Two major insurers of municipal bonds are the Ambac Indemnity Corporation and the Municipal Bond Insurance Association (MBIA). Insured municipal bonds usually have the highest ratings. Subsequently, the bond's marketability increases, which lowers the costs to their issuers. However, the yield on an insured bond is usually lower than similarly rated uninsured bonds–the cost of the insurance is passed on to the investor. To obtain the extra degree of safety, many investors do not care if the yields are slightly lower.

Municipal Improvement Certificates: Certificates issued in lieu of bonds for the financing of special improvements. As a result, these certificates are placed in the contractor's hands for collection from the special assessment payers.

Municipal Lease: A lease designed to meet the special needs of state and local governments. The lease contains a non-appropriation clause which states that the only condition under which the entity may be released from its payment obligations is when the legislature or funding authority fails to appropriate funds. Since the lessee is a municipality or an organization supporting the government, it is exempt from paying federal income taxes. For this reason, the IRS does not charge the leaser income taxes on leases to these customers.

Non-Transient, Non-Community Water System: A water system which supplies water to 25 or more of the same people at least six months per year in places other than their residences. Some examples are schools, factories, office buildings, and hospitals which have their own water systems.

Operating Costs: Costs that are directly related to rendering of services, sale of merchandise, production and disposition of commodities, collection of revenues, and other ongoing activities.

Operating Lease: A lease which is treated as a true lease (as opposed to a loan) for book accounting purposes. As defined in FASB 13, an operating lease must have all of the following characteristics.

- lease term is less than 75% of estimated economic life of the equipment
- present value of lease payment is less than 90% of the equipment's fair market value
- lease cannot contain a bargain purchase option (i.e., less than the fair market value)
- ownership is retained by the leaser during and after the lease term.

An operating lease is accounted for by the lessee without showing an asset (for the equipment) or a liability (for the lease payment obligations) on his balance sheet. Periodic payments are accounted for by the lessee as operating expenses of the period.

Original Issue Discount (OID): When a long-term debt instrument is issued at a price that is lower than its stated redemption value, the difference is called Original Issue Discount (OID).

Payment-in-Kind (PIK) Bond: A bond that gives the issuer an option (during an initial period) either to make coupon payments in cash or to give the bondholder a similar bond.

Prime Rate: The interest rate banks charge their best customers.

Privatization (Public-Private Partnership): Under a public-private partnership, sometimes referred to as a joint venture, a contractual arrangement is firmed between public and private-sector partners that can include a variety of activities that involve the private sector in the development, financing, ownership, and operation of a public facility or service. It typically includes infrastructure projects and/or facilities. In such a partnership, public and private resources are pooled and responsibilities divided so that the partners' efforts complement one another. Typically, each partner shares in income resulting from the partnership in direct proportion to the contracting in that the private-sector partner usually makes a substantial cash, at-risk, equity investment in the project, and the public sector gains access to new revenue or service delivery capacity without having to pay the private-sector partner. Leasing arrangements can be used to facilitate public-private partnerships.

Private Placement: The sale of stock in a company directly to a pre-selected buyer, often an institutional investor.

Public-Private Partnership: These partnerships involve a variety of techniques and activities to promote more sector involvement in providing traditional government services. They can include involving a private partner in construction, financing, operation, and/or ownership of a facility.

Public Water System (PWS): Any water system which provides water to at least 25 people for at least 60 days annually. There is more than 170,000 PWSs providing water from wells, rivers and other sources to about 250 million Americans. The others drink water from private wells. There are differing standards for PWSs of different sizes and types.

Ratings: Credit quality evaluation of bonds and notes made by independent rating services and brokerage firm analysts. Generally, a higher bond rating lowers the interest rate expected by debtors for repayment, and therefore overall capital costs. State and local governments can improve their bond ratings by using credit enhancement mechanisms.

Recourse: A type of borrowing in which the borrower (as a leaser funding a lease) is fully at risk to the lender for repayment of the obligation. The recourse borrower (leaser) is required to make payments to the lender whether or not the lessee fulfills its obligation under the lease agreement.

Refunded Bonds: Also called a pre-refunded bond, one that originally may have been issued as a general obligation or revenue bond but that is now secured by an "escrow fund" consisting entirely of direct US Government obligations that are sufficient for paying the bondholders.

Return On Assets (ROA): A common measure of profitability based upon the amount of assets invested; ROA is equal to the ratio of either 1) net income to total assets or 2) net income available to common stockholders to total assets.

Return On Equity (ROE): A measure of profitability related to the amount of invested equity; ROE is equal to the ratio of either 1) net income to owner's equity or 2) net income available to common stockholders to common equity.

Revenue Anticipation Notes (RANs): Notes issued in anticipation of non-tax revenues, generally from other governmental entities (i.e., state aid to a school district).

Revenue Base: The revenue base is the value of the product, income, property, or the number of population against which a fee or tax is charged. For example, the revenue base for a state tax per ton of fertilizer sold would be the tons of fertilizer sold in the state, while the revenue base for a motor vehicle license fee would be the number of vehicles licensed in the state. The size and characteristics of the revenue base, along with the rate of the fee or tax, determine the revenue potential of fee and tax programs.

Revenue Bonds: Bonds whose principal and interest are payable exclusively from earnings of a public enterprise.

Revenue Potential: A measure of the amount of money that can be raised by a particular financing mechanism. For fee and tax programs, revenue potential is a function of the rate of the fee or tax and the size of the revenue base. State and local governments need to consider the revenue potential of an AFM in their jurisdiction in order to determine if it meets their financing needs.

Revenue Stability: Revenue stability refers to the pattern of revenues from a particular revenue source. Some sources provide revenues in stable amounts annually. Other revenue sources are unstable, providing only one-time or erratic revenues from year to year. State and local governments should match ongoing program costs to stable revenue sources, while non-recurring costs can be matched to less stable revenue sources.

Revolving Fund: A revolving loan fund program may consist of several accounts or revolving funds that make loans or other types of assistance available for various projects. Typically, the fund is initially capitalized by appropriations, grants, or other monies. After the initial loans are made, future loans are supported by repayments, making the fund "revolving."

Serial Bonds: Bonds whose principal is repaid in periodic installments over the life of the issue. Corporate bonds arranged so that specified principal amounts become due on specified dates. Related: Term Bonds.

Sole Proprietorship: A sole proprietorship is a form of business organization. The distinguishing characteristics of this form are only one owner for the business and the business is unincorporated.

Special Annuity Bonds: Serial bonds in which annual installments of bond principal are arranged so that the combined payments for principal and interest are approximately the same each year.

Special Assessment: A charge imposed against certain properties to defray part or all of the cost of a specific improvement or service deemed to primarily benefit those properties.

Special Assessment Bonds: Bonds payable from the proceeds of assessments imposed against properties which have been specially benefited by the construction of public improvements.

Special Assessment Fund: A fund used to account for the financing of public improvements or services deemed to benefit primarily the properties against which special assessments are levied.

Special Districts: An independent unit of local government organized to perform a single governmental function or a limited number of related functions. A single purpose or local taxing district can be organized for a special purpose such as a road, sewer, irrigation or fire district. Special districts usually have the power to incur debt and levy taxes.

Special District Bonds: Bonds issued by a special district.

Special Tax Bond: A bond that is secured by a special tax, such as a liquor tax.

Straight Line Method: A way to figure depreciation for property that ratably deducts the same amount for each year in the recovery period. The rate (in percentage terms) is determined by dividing 1 by the number of years in the recovery period.

Subordinated Debenture Bond: An unsecured bond that ranks after secured debt, after debenture bonds, and often after some general creditors in it claim on assets and earnings. Related: Debenture Bond, Mortgage Bond, Collateral Trust Bonds.

Sustainable Development: The concept of using resources in an ecologically sound manner so that they will be sustainable over the long term. Put another way by the Executive Secretary of the UN Economic and Social Commission for Asia and the Pacific, it is "an approach to progress that meets the needs of the present without compromising the ability of future generations to meet their needs."

Tax: A tax is generally a charge against sales, income or property. Unlike fees, most jurisdictions do not require that there be a direct relationship between a tax and the use of funds.

Tax Anticipation Notes (TANs): Short-term debt that will be retired with taxes to be collected at a later date.

Tax Base: See revenue base.

Tax Increment Financing: The dedication of incremental increases in real estate taxes to repay an original investment in improved public facilities that created increased real estate values.

Term Bonds: Often referred to as bullet-maturity bonds or simply bullet bonds, bonds whose principal is payable at maturity. Related: Serial Bonds.

Term Interest: A life interest in property, an interest in property for a term of years, or an income interest in a trust. It generally refers to a present or future interest in income from property or the right to use property which terminates or fails upon the lapse of time, the occurrence of an event or the failure of an event to occur.

Transient, Non-Community Water System: A system which provides water in a place such as a gas station or campground where people do not remain for long time periods. These systems do not have to test or treat their water for contaminants which pose long-term health risks because fewer than 25 people drink the water over a long period. They still must test for microbes and several chemicals.

Trust Fund: Funds created by State and local governments to receive revenues generated by a tax or other mechanism, and disburse funds for the purposes for which the revenues are collected.

Unadjusted Depreciable Basis: The basis of an item of property for purposes of figuring gain on a sale without taking into account any depreciation taken in earlier years but with adjustments for amortization, the section 179 deduction, any deduction claimed for clean-fuel vehicles or clean-fuel vehicle refueling property, and any electric vehicle credit.

Useful Life: An estimate of how long an item of property can be expected to be usable in trade or business or to produce income. Under MACRS, you recover the cost of property over a set period. The recovery period is based on your property's property class. Your property's class is usually determined by its class life. The class life for most property is set and listed in IRS Appendix B.

User Fees: User fees require those who use a government service to pay some or all of the cost of the service, rather than having the government pay for it through revenues generated by taxes. The fees charged for entry into public parks are an example of a user fee.

Value: A term which defines the worth of an object or item. Value is usually preceded by a word(s), such as Fair or Fair Market, and defined in the document where found. Not all value for an item is the same.

Working Capital: The cash available to a company for the ongoing operations of the business.

Zero-Coupon Bonds: Zero-coupon bonds are bonds priced at a large discount from face value. The bonds mature at full face value so the difference between the original issue price and the face value represents interest income. The issuer of the zero coupon bond saves on cash flow since the interest isn't paid out until the end of the bond holding period.

The "Glossary of Financial Terms" was excerpted from:
A Guidebook of Financial Tools: Paying for Sustainable Environmental Systems.

This handbook is a reference tool for elected and appointed local officials, public administrators, managers and other municipal staff. In addition to providing an understanding of wastewater treatment, this guide offers information on financing, training, compliance and public education regarding your wastewater system. This reference tool is also a guide to financial management tools, loan and grant assistance and capital improvement planning to enhance long-term viability of your system.

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