The standards and best practices contained in this document are required elements for new projects seeking State funding under the New Jersey Environmental Infrastructure Finance Program (NJEIFP). Further information on the NJEIFP can be found at the following link(s): https://www.njeit.org/ and http://www.nj.gov/dep/dwq/mface.htm

Asset Management Guidance and Best Practices

Managing Utility Assets in New Jersey

Introduction

The NJDEP is responsible for evaluating, managing and protecting New Jersey's water resources to ensure that a safe, adequate, and reliable water supply is available to the public and to restore, enhance, and maintain the chemical, physical, and biological integrity of the waters of the State. To ensure drinking water and wastewater systems are adequately maintained and operated to continually and reliably meet customer service expectations as well as comply with applicable permit conditions, NJDEP rules generally require drinking water and wastewater utilities to demonstrate that they have adequate facilities, and equipment, and that they regularly perform operation and maintenance to meet the conditions in their permits.[i] This includes conducting an inventory of system assets, providing adequate staffing and training, performing preventative maintenance, and demonstrating adequate funding. In order to meet these requirements, a utility must identify its needs and costs, and develop long-range financial plans. The current best management practice for ensuring such financial planning is through the development and implementation of an Asset Management Plan.

Asset management planning consists of developing a plan to reduce costs while increasing the efficiency and the reliability of the assets. An asset management plan incorporates detailed asset inventories, operation and maintenance tasks and long-range financial planning to ensure that annual revenue reserves and reinvestment are sufficient to facilitate long-term viability of the system. The five major, generally recognized components of a utility asset management plan include:

- Performing an inventory and condition assessment of the system's assets;
- Defining level of service goals;
- Identifying critical assets;
- Establishing life cycle costs, and
- Developing a long-term funding strategy.

AP Photo/Mel Evans

Purpose

Many systems currently practice asset management to varying degrees. To ensure that all utilities operate their facilities so that they achieve compliance with the rules and/or terms and conditions of their permits, the Department has developed this technical guidance that summarizes the elements of an asset management strategy that will meet applicable regulatory requirements and promote more responsible investment and rehabilitation of New Jersey's drinking water and wastewater system infrastructure.

The phrase “asset management” is a widely accepted industry practice through which capital assets are inventoried, monitored, and managed over time to ensure the longevity and sustained viability of the assets as components of an effectively functioning system. While NJDEP rules do not use the phrase “asset management plan”, the rules do require that systems monitor, plan, and maintain facility assets to ensure the reliable operation of the utility. DEP is currently promulgating new rules to incorporate the term “asset management plan”.

Systems are encouraged to use this information in concert with the variety of related material that can be accessed through the links provided under “Resources” below as they begin or enhance their on-going asset management efforts in conformance with the rules.

Implementing Asset Management for New Jersey’s Wastewater and Drinking Water Utilities

To facilitate meaningful, cost-effective water and wastewater system rehabilitation and maintenance and to support appropriate asset management endeavors, the Department is rededicating its efforts to ensure that permittees fulfill their long-standing “asset management” requirements. This strategy will be implemented in stages to allow sufficient flexibility for all systems while providing the Department an opportunity to assist its regulated partners.

1. As part of and to initiate the first phase of its comprehensive asset management strategy, the NJDEP expects to offer financial assistance to offset the costs of developing an asset management plan.

   A. Through the USEPA’s designated Sandy appropriation, the financing package for this effort is expected to consist of the following:

      - $15 million for asset management planning assistance ($5 million under the Hurricane Sandy Drinking Water SRF and $10 million under the Sandy Clean Water SRF).
      - Individual assistance packages will include a principal forgiveness loan for 30% of allowable costs, an interest-free loan for 45% of the costs, and an NJEIT market-rate loan for 25%.

   In accordance with USEPA requirements, activities for which Sandy-related SRF monies are provided must result in direct capital projects.

   B. In addition, the 2014 Clean Water and Drinking Water SRF Intended Use Plans continue to provide bonus points for sponsors that have an asset management plan and projects that are identified in an asset management plan. The additional points serve to prioritize those entities with an established asset management plan in place over other project sponsors that have yet to develop a plan.

      - At a minimum, the expected deliverable must contain an inventory of system components (e.g. source, treatment, distribution/conveyance, storage, pump stations, hydrants, manhole covers, discharges/outfalls, etc.) including the mapped location (see mapping requirements under Asset Inventory/Condition Assessment section below), a description of age, criticality and remaining useful life.

More specific asset management requirements may be outlined in permit conditions, developed policy guidance, or in future rulemaking, as appropriate.

What is Asset Management?

Asset management is the management of the physical components of a drinking water or wastewater system and can include: pipe, valves, tanks, pumps, wells, hydrants, treatment facilities, and any other components that make up the system. While asset management planning can also include human resources necessary for the proper operation of the facility, this guide focuses on the 'hard assets' or infrastructure only. The assets that make up a water or wastewater utility generally have a fixed life cycle and lose value over time as the system ages and deteriorates. Along with this deterioration, the ability of the utility to reliably deliver the level of service that the utility's customers expect may be compromised. As physical system assets age and deteriorate, the costs of operation and maintenance increase – a classic example of "pay me now or pay considerably more later". Similarly, if sufficient revenues are not reserved and the system's assets are not adequately maintained, the utility may be faced with excessive costs that it cannot afford when system components falter or fail altogether. Proper asset management allows a system to plan responsibly and make more informed decisions about proactively managing aging assets on a continual basis to ensure the long-term sustainability of the entire system.

Why Manage Assets?

According to the USEPA, successful asset management enables a drinking water or wastewater system to maintain a desired level of service in the most cost-effective manner. Generally, this allows utility managers to proactively rehabilitate or replace system components on a continual basis rather than waiting to repair failing or damaged assets when it is considerably more expensive and disruptive to system operations. Asset Management is important for several reasons:

- Utility assets represent a major public or private investment;
- Increased knowledge of the system allows better financial decisions, and can influence choices when considering options to address various system challenges (e.g. meeting regulatory requirements or upgrading system security).
- Enables efficient and cost-effective operation of the system;
- Reliable infrastructure promotes economic development; and
- Efficient system operation and maintenance is essential to public health and safety and protection of water quality.
- May provide greater access to financial assistance. Some funding sources give applicants extra credit (higher priority ratings) for having an asset management plan or a capital improvement plan.

Benefits of Asset Management

Systems that fully embrace asset management principles may achieve many benefits. The benefits of asset management include, but are not limited to:

- Ensuring the long-term sustainability of the utility.
- Identifying asset location, condition, and criticality
- Prolonged asset life through sound decision-making and focused operations and management
- Promote system reliability, resilience and sustainability
- Consistently meeting customer demands

- Setting realistic rates based on sound operational and financial planning
- Budgeting focused on activities critical to sustained performance
- Meeting service expectations and regulatory requirements
- Reducing occurrences of and improving response to emergencies
- Reduced energy needs and costs
- Improving system security and safety of assets

Public Outreach

Explaining the importance of asset management to the decision makers and the public is essential because the benefits of a successful asset management plan are realized over time and may not be readily apparent (i.e. the number and severity of emergencies minimized/avoided). Therefore utilities should consider working with NJDEP to do appropriate public education in conjunction with asset management planning efforts. Communicating the successes and realized benefits (e.g. the reduced costs of proactive maintenance vs. emergency costs and service disruptions) is essential to justifying full-cost utility rates and retention of sufficient revenues to ensure long-term capital reinvestment and system viability.

Core Elements of Asset Management Planning

The USEPA's Asset Management Framework identifies the following elements that an Asset Management Plan should address:

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

Asset Inventory and Condition Assessment

Some water and wastewater utilities do not have a complete inventory of their infrastructure assets, not to mention an accounting of the age, condition, and expected life of such assets. It is critical as a first step in managing utility assets to complete a comprehensive inventory of all system components.

1) Locate/Identify the assets
2) Evaluate asset condition
3) Determine the remaining life and value of the assets
4) Determine the energy use of the assets

Given the known vulnerabilities of the State's infrastructure, systems must locate and evaluate the condition of all system assets, and identify funding opportunities with which to support this effort. Typically, such an inventory will consist of the following:

- All above and below-ground infrastructure (pipes, pumps, treatment facilities, reservoirs, storage tanks, valves, electrical components, power service (primary and auxiliary), and other related "hard" infrastructure) shall be identified;
- The location, age, composition, size, condition, design life, remaining life, value or replacement/repair cost of the assets.

  ***An inventory for each service area (for systems with multiple, non-adjacent service areas) should be prepared as distinct reports or sections of the report.

Each utility should maintain the inventory in GIS or similar acceptable electronic mapping format.

- Mapping shall be in the form of digital Geographic Information Systems (GIS) data, at a minimum scale of 1:12,000. Digital mapping shall conform to the "New Jersey Department of Environmental Protection Mapping: Mapping and Digital Data Standards," in N.J.A.C. 7:1D, Appendix A.
- Guidance related to the mapping and digital data standards is available at the Department's website at http://www.state.nj.us/dep/gis.
- The Department will provide its GIS theme coverages, associated metadata and digital data transfer standards, as established at N.J.A.C. 7:1D, Appendix A, upon request.

Level of Service

A utility must determine the expected levels of service demanded by its customers in order to characterize the importance of each asset component and its "criticality" (i.e. its independent importance - see 2.3 below) to the day-to-day operation of the utility. This will necessarily be shaped by minimum performance requirements, such as regulations, permit conditions, water quality standards, and discharge limits, etc.

Examples of Level of Service goals include the following:

- Acceptable number of service interruptions (unplanned vs. planned)
- Acceptable number of main breaks per mile
- Notice provided prior to a shut down – timing and method
- Acceptable time for service restoration
- Water system losses (i.e. non-revenue water)
- Minimize wastewater system 'upsets'/by-passes
- Ensure proper sludge management
- Reduce Inflow and Infiltration (I & I)
- Eliminate or reduce combined sewer overflows
- Drinking water pressure will be maintained throughout the system
- Adequate storage and treatment capacity will be maintained
- Water efficiency measures will be instituted to reduce highly consumptive water uses
- Rates will be reviewed annually and adjusted to ensure adequate revenue reserves for targeted asset improvements

Once the system expectations are defined, managers can better prioritize the maintenance, repair, and replacement of assets critical to the sustained performance of the system.

1) Communicate the system's mission and function to customers (residential/ industrial/commercial) and facility staff

2) Provide a means of assessing overall system performance. For example:

- Breaks will be repaired within 6 hours of initiation of repair 95% of the time.
- There will be no discharges of untreated or 'under-treated' wastewater.
- Customer complaints will be responded to within 24 hours (Monday-Friday).
- Unaccounted-for (i.e. Non-revenue) drinking water system losses will be audited and limited in accordance with N.J.A.C. 7:19.

3) Illustrate the relationship between system costs and service/performance

4) Develop an on-going collaborative process with stakeholders to determine where and how infrastructure improvements are made in order to link sustainable infrastructure to needs of customers and communities served.

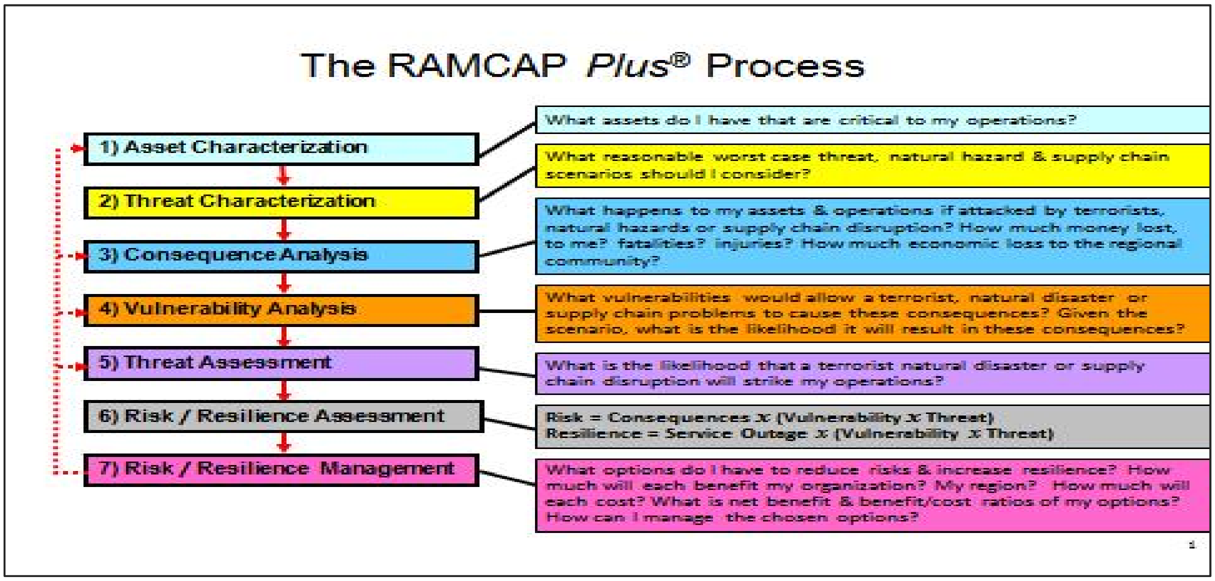
Critical/Vulnerable Asset Evaluation

Each system needs to determine which assets are most critical to the reliable operation of the utility on a sustainable basis. In addition to evaluating asset criticality, an assessment of asset vulnerability is also essential. Critical assets that are also vulnerable (due to their location or construction) to a variety of potential threats (storms, sabotage or terrorism, etc.) that could compromise the effective operation of the system should be considered for higher priority in the asset management plan.

While future efforts will focus on locating critical assets out of harm's way to the extent feasible, where this is not possible or cost-effective, mitigation measures to address potential adverse impacts may have to be prioritized above other system needs. Measures to make the assets more robust and resilient to potential adverse impacts include:

- Relocating assets outside flood-prone areas
- Elevating critical structures and system components (see Infrastructure Flood Protection section above), etc., above the FEMA 500-year flood elevations[ii], and/or
- Flood-proofing those facilities that cannot be elevated in accordance with FEMA guidelines or other accepted standards.
- Ensuring auxiliary power redundancies are in place individually or through cooperative arrangements with other systems to ensure continuous operation of the system
- Additional security or barriers for critical assets deemed vulnerable to sabotage or terrorism.

A widely recognized standard for assessing vulnerability to worst-case scenario threats based on an all hazards approach is the Risk Analysis and Management for Critical Asset Protection (RAMCAP®) methodology.[iii] This standard incorporates a process for identifying vulnerabilities to both natural and human-induced threats and hazards while providing methods to evaluate available options to address these weaknesses in water and wastewater utility systems. The process consists of 7 steps:



A prioritized asset inventory can be used to establish annual funding and repair, rehabilitation, or replacement goals for targeted infrastructure. Assessing criticality/vulnerability requires an examination of the likelihood and the consequence of failure as discussed above. Assets with the greatest likelihood of failure and the most significant consequences associated with failure would be prioritized above others. Factors that influence asset criticality/vulnerability include:

1) Location (e.g. proximity/susceptibility to hazards or local soil characteristics)
2) Asset Age/Materials/Construction Characteristics
3) Historical Knowledge/Experience
4) Cost of Repair
5) Impact of Failure
6) Legal, Environmental and other costs associated with failure

Remaining assets with relatively lower likelihood and consequence of failure are obviously less critical and of correspondingly lower priority in relation to other assets in the overall inventory. A technique such as the ranking table shown in the example below is one method of assessing criticality. Identify the row and column that best matches the ranking for both probability and consequence. Where the two intersect becomes your assigned risk.

The table and summary below illustrate how a utility manager can determine criticality for each system infrastructure asset.[iv]

1	Very Low
2	Low
3	Moderate
4	High
5	Very High

Risk = Consequence x Probability

To begin, estimate the probability of failure from 1 to 5, with "5" being a very high probability of failure and "1" a very low probability. Then assess the consequence of failure from 1 to 5 in the same manner.

The following scenario provides an example of how to use the asset ranking table below:

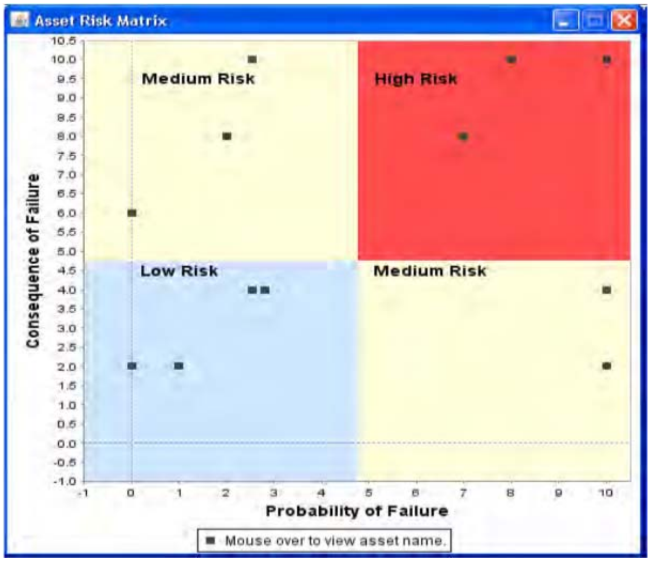
- Asset: 10-inch Cast Iron pipe (constructed in 1950), is 63 years old
- Service History: Numerous breaks in the past 5 years
- Service Area: Only residential customers (serves 3 major subdivisions), but there are loop lines available
- Likelihood of failure: **4** – pipe has broken many times, but when repaired it was still in reasonable condition
- Consequence of failure: **2** – There are loop lines so not all customers will be out of water simultaneously. Repair costs are moderate. Line is not in a critical roadway so repair is relatively easy.

In the chart below, starting from the Probability factor of **4**, move laterally until the column for **2** (the assigned Consequence value) is reached. At the intersection of the two boxes is **8,** the combined criticality factor assigned to this asset.

Multiplier		**Consequence (Cost) of Failure**				
Probability of Failure	**X**	1	**2**	3	4	5
	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

Once all of the system assets have been evaluated in this manner, the assigned Probability/Consequence values can be arranged from greatest to least as a means of prioritizing the assets/activities necessary to adequately maintain the system.

Another perspective of observing asset criticality within the system is displayed in the figure below. This "Asset Risk Matrix" is taken from USEPA's Check Up Program for Small Systems (CUPSS) asset management instructional manual. The various dots on the matrix apply to individual system assets, and the position on the matrix is determined by data entered by system managers when completing the Asset Inventory forms embedded in the CUPSS software provided by USEPA. More information on how to use the CUPSS software and to help determine whether it would prove useful for your system is available at: http://water.epa.gov/infrastructure/drinkingwater/pws/cupss/index.cfm.



Source: CUPSS v.1.3.7 User's Guide, Dec. 2007

Life-Cycle Costing

Determining the original life span as well as the useful (remaining) life of each infrastructure component is the next step in prioritizing asset improvements and cash reserve needs. In order to do this, an estimate of the remaining useful life of each of your assets is required. The USEPA suggests two steps in estimating useful life:

1. Determine the expected useful life by using the manufacturer’s recommendations or according to estimates provided in USEPA guidance. Adjust these numbers based on the specific conditions and experiences of your system.
2. Calculate an adjusted useful life by taking into account the service history and current condition of your asset.

Determining Infrastructure Repair/Replacement Costs

After prioritizing and calculating the useful life of a system’s assets, the utility will have to determine how much it will cost to rehabilitate and replace them as they deteriorate. To properly protect public health and water quality and deliver safe drinking water, utilities need to proactively rehabilitate and replace assets as a part of routinely operating the system. Many systems will need considerable lead-time to budget for, generate, and reserve the necessary funds. This may include obtaining funding assistance from private or government sources such as the New Jersey Environmental Infrastructure Financing Program (http://www.njeit.org/), adjusting utility rates, or a combination of these or other means. By developing an accurate assessment of annual system costs, managers will be able to proactively plan and allocate utility resources in the most efficient way. A preventive maintenance program will allow a system to maximize the useful lives of assets and can help avoid problems and cut down or delay replacement costs.

Long-term Funding Strategy

It is essential that each Asset Management Plan stipulate a process to ensure a sufficient, sustainable set-a-side (capital reserve) for funding targeted infrastructure improvements. An effective funding plan can be developed by the analysis performed in the previous steps and should include a funding source, estimated annual expenditures to address identified criticality/priority areas (including repairs/upgrades/treatment required to meet environmental standards or enforcement actions), and a schedule for replacing/repairing the entire infrastructure. All possible funding options (e.g. utility rate adjustments, and private, federal and State (NJEIFP) financing) should be investigated.

An acceptable funding plan will include a demonstration that rates are set at adequate levels and that a mechanism is in place to ensure that sufficient capital is routinely reserved to promote long-term system sustainability.

Since the NJDEP is not responsible for regulating utility rates and the retention of revenues generated thereby, it is critical to coordinate with the Department of Community Affairs and Board of Public Utilities to devise a mechanism through which adequate revenue reserves are maintained by the utility to cover annual repair, upgrade, and preventative maintenance costs.

Other Considerations - Energy

It is important to consider the energy use of your assets, including the asset's overall energy consumption, the type, efficiency and reliability of energy used.. It is equally important that each system ensure that sufficient back-up power sources are in place to maintain the effective operation of the system, in accordance with applicable rules administered by NJDEP. More on this topic as well as a discussion of energy alternatives to traditional auxiliary power sources are discussed in separate technical guidance for both drinking water and wastewater systems issued on the subject by NJDEP.

Energy use may come from assets that are not included in the inventory, such as light fixtures or heating units in buildings or pump stations or the gasoline or diesel usage of the utility's fleet of vehicles. It is important to have a method of capturing this type of energy use in your overall baseline assessment of total energy use. This assessment is important because energy usage is a significant portion of a utility's expenses. Therefore, optimizing energy consumption can have a significant impact on the cost of operating a water or wastewater facility. In order to determine the potential to reduce energy use, energy usage data should be collected for the assets in the inventory.

Also, energy efficiency goals should be considered when establishing level of service goals. Because energy costs can account for a relatively large portion of the utility's overall costs (50% to 75% of total operating costs), these goals are particularly important to the operations (and fiscal viability) of the utility.

In the case of energy efficiency projects, there are additional options for funding projects beyond those available for 'normal' operation and maintenance and capital projects. These projects have the potential to reduce energy costs and therefore have different criteria for funding. One consideration in terms of funding is the amount of potential cost savings. If the cost savings are significant compared to the amount of the capital expenditure, the investment will pay for itself in a short time. Another consideration is when to make an investment in a more energy-efficient piece of equipment. Another option is to take advantage of available financial incentives such as rebates for "green" energy offered by the energy provider, state and/or federal agencies. For the most part, energy efficiency projects will result in cost savings and each dollar saved can be spent on other important assets and resources such as employee salaries, preventive maintenance, training, or equipment purchase.

Implementing Asset Management for your System

Although the agency expects to propose asset management-related amendments to a variety of applicable administrative rules, the NJDEP currently is charged with ensuring that the State's drinking water and wastewater systems adequately maintain and operate their facilities to protect public health and safety and the environment. The planned amendments will aim to clarify, specify, and otherwise foster system compliance with these critical mandates. Again, the foregoing material is intended as best management practices and to serve as a model on how to perform asset management for your system – the amended rules will provide clear direction about satisfying the applicable requirements.

It is recognized that all aspects of asset management planning cannot be accomplished overnight and that many systems require assistance, guidance and time to complete the necessary tasks. To that end, many of the requirements will be phased in over time with the first phase involving the identification and inventorying of system assets. Ultimately, this guidance document, the referenced sources and resources herein, and a commitment to work cooperatively with our regulated partners, are focused on making this effort a success.

***DISCLAIMER*:** THIS GUIDE IS INTENDED TO PROVIDE INFORMATION ABOUT HAZARD MITIGATION AND RESOURCES THAT MAY APPLY TO YOUR SITUATION. IT IS NOT INTENDED TO BE ALL-INCLUSIVE OR REPLACE OR IMPOSE NEW REQUIREMENTS BEYOND THOSE ESTABLISHED UNDER EXISTING STATUTES AND REGULATIONS, APPLICABLE BUILDING CODES AND STANDARDS, OR FUNDING CONDITIONS ASSOCIATED WITH FEDERAL AND/OR STATE DISASTER RELIEF AND MITIGATION ASSISTANCE. ALSO, IT WILL NOT BE USED BY THE NJDEP AS A SUBSTITUTE FOR AN EXISTING STATE OR FEDERAL LAW OR RULE FOR ENFORCEMENT PURPOSES.

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[i]See, Water Supply and Wastewater Operators' Licensing rules, N.J.A.C. 7:10A-1.12, Safe Drinking Water Act rules, specifically N.J.A.C. 7:10-2.7, -13, and -11.5(c)6, the Water Supply Management Act, rules, specifically N.J.A.C. 7:19-6.6, and the Water Pollution Control Act rules, specifically N.J.A.C. 7:14A-6.12, -22.5, and -23.5(b)6.

[ii]See recommendations for critical infrastructure in: The American Society of Civil Engineers (ASCE) code referred to as "ASCE 24-05: Flood Resistant Design and Construction," FEMA's Hurricane Katrina Recovery Advisory: "*Designing for Flood Levels Above the BFE,*" and the Association of State Floodplain Mangers, Inc. position paper "*Critical Facilities and Flood* Risk."

[iii]The RAMCAP® methodology has been accepted by the water/wastewater industry through ANSI/ASME-ITI/AWWA Standard J-100, which sets the requirements for all-hazards risk and resilience analysis and management and prescribes methods that can be used for addressing these requirements. Further information on the RAMCAP Plus (SM) process and related products and activities can be found at http://www.asme-iti.org/.

[iv]New Mexico Environmental Finance Center\New Mexico Tech, "Asset Management: A Guide For Water and Wastewater Systems" (2006 Edition).