Emergency Response and Preparedness

FlaWARN
Best Management Practices
for
Water and Wastewater Systems

Version 2, Updated May 2008

Acknowledgements

Editor's Note:

Florida Water/Wastewater Agency Response Network (FlaWARN) is a water and wastewater utility organization dedicated to assisting member utilities in restoration activities in the aftermath of a disaster. The organization, through its member networks, coordinates emergency response activities in Florida, and if needed outside of Florida. This document includes Best Management Practices (BMPs) for Water/Wastewater Emergency Response that have been prepared by FlaWARN members and compiled to more effectively meet the approaching hurricane season.

As with all good emergency response plans, this compilation is a "living document" and we welcome further input as more lessons are learned. FlaWARN members are encouraged to provide comments via email to info@FlaWARN.org.

We would like to acknowledge the Florida Department of Environmental Protection and the United States Environmental Protection for the grant that has made FlaWARN possible and to the many utility organizations and individuals that have provided assistance with the preparation of this document.

We would also like to recognize the following for their contributions.

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Center for Training, Research and Education for Environmental Occupations (UF/TREEO)

The mission of UF/TREEO, *Excellence in Environmental Education & Training*, ensures that Water and Wastewater operators receive up-to-date information that can be applied and used directly in their jobs.

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FlaWARN and Storm Tracker Systems

Florida's Water/Wastewater Agency Response Network, referred to as FlaWARN is a program funded by the Florida Department of Environmental Protection (FDEP) with a grant from the US Environmental Protection Agency (EPA). FlaWARN includes a formalized system of 'utilities helping utilities' to address mutual aid during emergency situations such as hurricanes.

The goal of FlaWARN is to provide immediate relief for member utilities during emergencies. FlaWARN works by matching personnel with the necessary tools and equipment to both assess and assist impacted water and wastewater systems as quickly as possible until permanent solutions to the devastation may be implemented. This method of assistance is analogous to triage at a hospital.

FlaWARN assists its members with the following issues:

- Recovery coordination
- Resource inventory and availability status
- Information exchange
- Vulnerability assessment tools
- Preparation protocols
- Emergency Response Plan updates and checklists
- Updated best management practices reference library
- Up-to-date status reports
- Pertinent legislation briefings

FlaWARN Database of Water & Wastewater Systems

FlaWARN is made up of volunteers from member utilities that coordinate with Florida Department of Environmental Protection (FDEP) to obtain updated contact information for those facilities not a member of FlaWARN. FlaWARN maintains and continuously updates information on all its member utilities.

FDEP sources for obtaining this information are the FDEP representative on the steering committee and the FlaWARN grant administrator in Tallahassee.

Generally, the individual FDEP districts maintain emergency contact spreadsheets that may include more extensive information than systems want to have posted on the FDEP database (such as personal cell phone numbers). This information can be requested from FDEP representatives on an as-needed basis.

FlaWARN will send messages to members 60 days prior to hurricane season, requesting all members update their emergency contact information on the FlaWARN website. Prior to hurricane season, utilities will be notified about changes to the website from last season and encouraged to fully utilize any new capabilities.

As the FlaWARN website is developed, additional capability may be incorporated to provide expanded utility system information.

FlaWARN Operation During an Emergency

When there is knowledge of an event in advance, such as a hurricane, the steering committee starts pre-planning three to four days out. As the hurricane is tracked, utilities out of the path of the storm gear up to help the targeted areas. Member utilities are able to request assistance through the FlaWARN web site.

Since electricity is often out during an emergency, FlaWARN administrators and steering committee members attempt to contact, using emergency contact information, all utilities in the area of the storm and determine their needs. Contacting individual utilities is closely coordinated with FRWA. Administrators will then post any needs to the web page. This is an innovative process because it allows member utilities to match their available resources to requests for assistance.

FlaWARN's mission is to get the correct resources to the appropriate location within the first days after an event. FlaWARN gears up without any notice, using the contact information on its web page and responds to both man-made emergencies as well as natural disasters.

FlaWARN Organizational Structure

A steering committee provides leadership for FlaWARN. It is composed of representatives of five state water/wastewater professional organizations including: FSAWWA, FWEA, FWPCOA, FRWA, SEDA; three at large members and a representative from FDEP. The University of Florida Center for Training, Research and Education for Environmental Occupations (UF/TREEO) is responsible for implementing the program.

Florida Department of Environmental Protection Storm Tracker

The Storm Tracker system is a FDEP web based program designed to provide status for all Florida water and wastewater utilities. Systems in impacted counties will be asked by FDEP to update the website with their current operational status and the needs of the utility can be submitted here which will greatly expedite the FlaWARN updating process and the resultant response efforts. The Storm Tracker website address is:
http://tlhdwf2.dep.state.fl.us/stormtracker/information.asp

The FlaWARN organization encourages the full use of Storm Tracker in pre-storm messages to member organizations. FlaWARN administration will monitor the Storm Tracker website to ensure all utilities need assistance will be reached.

In addition to facility status, additional information is available from Storm Tracker, including total number and power availability for treatment plants and lift stations. It should be noted that in the aftermath of a storm, both FlaWARN and FDEP personnel would typically be present at ESF-10 in the state EOC. These contacts can and should be used to pass information as needed between FlaWARN and FDEP, including information obtained from Storm Tracker.

Pre-Storm Calls to All Water & Wastewater Systems Within Likely Hurricane Track

Prior to storm landfall, the FlaWARN steering committee will assign members to contact systems in the path of the approaching storm. This will be closely coordinated with FRWA. FlaWARN representatives will attempt to verify contact information, including emergency after-hours phone numbers; obtain information on the preparation status of each facility; inquire as to assets available if the system is not impacted by the storm; and encourage systems to join FlaWARN and execute the Mutual Aid Agreement if they have not already done so.

Obtain Tracking/Mission Number or Emergency Mutual Aid Contract Authorization

The FlaWARN steering committee will attempt to obtain a tracking/mission number from the state or impacted county EOC prior to storm landfall. The request will then be confirmed, updated, or deleted after storm landfall based on actual conditions. Obtaining a tracking or mission number prior to storm landfall will facilitate response activities by ensuring responding systems have authorization to proceed prior to departure, without having to request an initial tracking number during the chaos that may exist in the affected EOC just after storm landfall. Each utility should also coordinate with their local ECO regarding mission numbers and their actions.

For interstate relief activities, an EMAC (Emergency Mutual Aid Compact) request and authorization will need to be obtained from the governors of the receiving and providing states. FlaWARN, FDEP, and FRWA personnel will coordinate efforts with state emergency response staff to obtain authorization. For more information on EMAC go to: http://www.emacweb.org/

FlaWARN Member List available at www.flawarn.org.

Chapter 2: Emergency Preparedness Planning Overview

Introduction to Emergency Preparedness Planning

Disasters may strike at any time. However, being prepared for a particular disaster requires time, training, financial resources, and a response plan. Emergency Preparedness for hurricanes requires four primary considerations:

- Actions taken before the storm
- Actions taken during the storm
- Actions taken after the storm
- A program of scheduled maintenance to keep the plan effective and relevant.

The Florida Rural Water Association's Emergency Response Plan (ERP) templates and guides can be downloaded on-line at www.frwa.net by clicking on "security."

Emergency Preparedness Planning Objectives

The purpose of Emergency Preparedness Planning is to identify those components of normal operation disrupted by the emergency so the utility can respond appropriately and protect the health of customers and the community.

Objectives of Emergency Planning

- Quickly identify the emergency, and initiate timely and effective response actions
- Quickly notify local, state, and federal agencies to assist in the response if needed
- Determine if the water is not safe to drink or use and being able to rapidly notify customers effectively of the situation and advise them of appropriate protective action
- Identify and prioritize wastewater facilities that have been impacted and that present a threat to the public or to the receiving environment
- Respond to and repair damage to minimize or prevent system down time.

Organizational Chart and Chain of Command Responsibilities

When an emergency occurs, there can be confusion, lack of coordination, and poor communication. Timely and effective response can minimize the effects of an emergency. Often, the initial response sets the tone for the entire emergency.

Having a chain of command that defines clear lines of authority and responsibilities for system personnel during an emergency speeds up response time and helps eliminate confusion. System

personnel need to know who to report the emergency to, who manages the emergency, who makes decisions, and what their own responsibilities are.

Components of an Organizational Chart

- Identification of staff, their job titles and to whom they report
- Their responsibilities in the emergency response activities

The organizational chart should be accompanied by written procedures for quickly disseminating information to appropriate parties. These components are described in the following sections.

Development of Personnel Rosters, Emergency Duty Assignments

A major hurricane can make communication with utility employees difficult or impossible. The development of personnel rosters and pre-storm duty assignments (including pre-storm, during storm and after-storm reporting responsibilities) can make this task manageable. Enhancements to this list include the skill levels of personnel in water, wastewater areas, various utility construction, electrical and electronic equipment.

At a minimum, the utility should maintain an updated list of each employee, their home addresses and contact numbers. Additionally, rosters of contactors, outside agency emergency personnel, and fuel and chemical vendors that may provide assistance should be prepared and disseminated to people with decision making responsibilities prior to the storm.

Personnel and Emergency Staffing Responsibilities

How the response effort will be managed requires developing personnel and emergency staffing responsibilities. After development of organizational charts that include the chain of command with clear lines of authority and responsibilities; the standard operating procedures for the emergency may be developed.

Procedures are written standard operating instructions, which describe special hurricane duty assignments and are established for all facets of the storm preparation and response. These procedures should include operating responsibilities for assessing, monitoring, reporting, and staff responsibilities that include support functions such as handling communications and providing meals. Most utilities will need to use personnel from other departments to handle support functions during emergency operation.

No plan will be useful unless employees are trained in how to on its use. Once written procedures are established; review of the plan with employees and mock drills are helpful and reveal areas that need improvement. Drills should be conducted in cooperation with other emergency agencies.

Maintenance of the plan is essential and should be assigned to one individual who has responsibility for updating the plan and providing updates to affected employees. Using the

systems approach of plan, do, check and act can ensure the plan is reviewed and updated annually.

Components of Standard Operating Procedures

Operating Procedures are the core of an emergency preparedness plan. Procedures will include base systems mapping and development of an operational inventory of all of operating facilities. The following is a checklist that may be helpful in preparing the base system mapping components:

Base System Mapping and Informational Requirements Checklist for Performing a Base System Operational Assessment

- Location Map (lift stations, wells, booster stations)
- Location Directions (major intersections and street directions and GPS coordinates)
- Facility Configurations (# units, power service, nameplate info)
- Valve Locations (major/minor valve for water and force mains)
- Facility Relationships (relay pumping, force main interconnections)
- Facility Redundancy (duplex, triplex, permanent generators)
- Facility Emergency Equip (alt. electrical disconnects, pump-arounds)
- Special Facility Requirements (plug configuration, special connections)
- Facility Security (gate, electrical panel, wet well, pump house)

Mutual Aid and Inter-local Agreements

A significant hurricane might inflict damages that will exceed the utility's ability to restore normal service in a timely manner. Written agreements with other agencies and utilities can be very helpful in this situation. Some of the best resources in an emergency are other organizations, neighboring utilities and cities that may have equipment and/or staff that can used temporarily.

In an emergency, demand for resources will come from many places and can exceed capacity. The best way to access scarce resources in an emergency is through a Mutual Aid Agreement or an Inter-local Agreement. Mutual Aid Agreements and Inter-local Agreements exist to provide local jurisdictions with the opportunity to quickly exchange services during an emergency or disaster and provide the framework for the procedures to be used for transfer and billing. These types of agreements have distinct features.

A Mutual Aid Agreement (MAA) is general in nature and is basically an understanding that, other jurisdictions will assist if resources are available during an emergency. The type of service to be provided is frequently open ended.:

FlaWARN provides a generic Mutual Aid Agreements available on the web that can be quickly implemented well before the time that assistance is needed. An example is provided in the Appendix.

The American Water Works Association published a document, "Utilities Helping Utilities: An Action Plan For Mutual Aid And Assistance Networks For Water And Wastewater Utilities", By Kevin Morley, American Water Works Association and Ray Riordan, California Utilities Emergency Association, that includes a sample MAA and a comparison of three states MAAs and their compliance to NIMS, FlaWARN is compliant in 12 of the 21 requirements. To access this document go to:
http://www.awwa.org/Advocacy/Govtaff/Documents/Utilities_Helping_Utilities.pdf

An Inter-local Agreement is specific in perspective and it is more contractual in design. With an Inter-local Agreement, specific services are agreed upon and provided under defined conditions. An Inter-local Agreement provides a much clearer understanding of what support may be received during an emergency or disaster, but is less flexible. Although highly recommended, Inter-local Agreements may not provide any assurance in a time when large regions of the state may be devastated.

Emergency Coordination with Emergency Agencies

Emergency coordination with local, state and federal emergency planning agencies is essential in the development of an emergency preparedness plan. This planning consists of the development of your plan in cooperation with the local county emergency operations manager and local law enforcement agencies. This may include setting up procedures for identifying utility vehicles and personnel that will include company identification (utility ID badges or identification) as well as SERT IDs.

Coordination will also include emergency response planning, training, rehearsals, and mock exercises with emergency planning agencies.

The Florida Rural Water Association provides Emergency Response Planning templates and guidelines and training through its regular training programs.

Operational Preparedness and Response Plan(s)

Emergencies will exhibit a wide range of damages and severity. The level of severity will determine the appropriate operational response actions. Emergency Preparedness Plans must have provisions for quickly analyzing the emergency and methods to confirm and prioritize appropriate response action. Assessing the severity of the damages and being able to communicate them clearly to others will help system personnel keep their response efforts effective. Response actions and repairs should be based on established written priorities. In some cases, response activities will be dictated by public health or safety concerns such as hospitals, emergency shelters, nursing homes and emergency operation centers to maintain pressure, flow and disinfection.

Each disaster-specific preparedness/response plan should incorporate the results, an assessment of actions, resources, and equipment that can lessen the impact of such a disaster and temporarily restore minimal levels of service.

Objectives of a Damage Assessment

- Analyze and confirm the type and severity of damages
- Identify resources that can be effectively used in mitigating damages
- Take immediate actions to protect public health and safety
- Take action to reduce injuries and system damage
- Make repairs based on priority demand
- Return the system to normal operation

Restoring the systems to normal operation is not the immediate goal, and many factors need to be considered before returning to normal operation. For example:

Considerations in Achieving Normal Utility System Operation

- The system is repaired to the point that it can meet demand.
- The system operator has made a safety and operational inspection of all system components and they are properly functioning.
- The water system has been properly flushed, disinfected and pressure tested.
- The water has been adequately tested in accordance with sampling regulations.
- The water quality meets primary and secondary standards.
- Adequate staff is available to operate and manage the system.
- Federal, state, and local agencies support returning the system to normal operations.

Vulnerability Assessment

As part of a viable emergency response plan, water system personnel should identify and assess the vulnerability of each system component for natural emergencies. Community water systems serving populations greater than 3,300 persons are required by Ch. 62-555 FAC to incorporate the vulnerability assessment into emergency response planning. Vulnerability assessment is the process by which the water system personnel evaluate each water system component for weaknesses or deficiencies that may make the system susceptible to damage or failure during a natural or man-made emergency under various operating scenarios.

In conducting the vulnerability assessment, the water system personnel must estimate how the system and its facilities may be affected in emergency situations. Although not currently required by law, systems are strongly advised to perform the same vulnerability assessments for wastewater facilities. This information is essential for determining what preventive actions or improvements are needed and identifying the response actions to incorporate in the event of an emergency.

Vulnerability Assessment Process

- Identify and map the system's components, to include water sources, treatment facilities, pump-houses, storage reservoirs, transmission lines and distribution lines, for wastewater collection systems, lift stations, forcemains, treatment plants, and for water and wastewater systems key valves, electrical power requirements and power service, communication systems, telemetry control, and computer systems
- Determine the level of severity for these systems based on the likelihood of a major hurricane that inflicts significant damage and the response actions to be implemented. Evaluate the potential effects on various types equipment.
- Identify key emergency resources and personnel and how they are to be deployed. Assess the impact of the disaster on the system's operations personnel from both a safety standpoint and the added stress of working in these conditions.
- Define the system's expectations or set performance goals for system components for different severities of disaster.
- Identify improvements that have already been made, and any additional ones planned or proposed.

Standby Power Requirements

The major impact to utilities for any hurricane will be the loss of power. It is important then to describe how the utility water system meets the standby power requirements required by FDEP rules. The guidelines below are essential in facilitating a timely and effective restoration effort.

Identification of Power Requirements for Water/Wastewater Facilities

- Describe facilities serviced by permanent standby power source and its location or connection with two independent power feeds from separate substations
- Describe facilities where a portable standby power source will need to be provided.
- Describe auto-power transfers and audio-visual alarm system activation and the operator(s) to be notified in the event any power source fails.
- Document the number of motors, power requirements, horsepower, phase, electrical provision (wye or delta), voltage, and amperage for each facility.
- Determine the amount of fuel to maintain on site, and the amount of fuel to hold in reserve under contracts with fuel suppliers, for operation of auxiliary power sources and the maximum period of operation without refueling.

Treatment Chemicals and Disinfectants

Hurricanes can significantly disrupt the ability of a utility to obtain chemicals essential to the treatment process. It is important that the utility identify the amount of chemicals on hand and the rate used in the treatment process. In the event of an impending hurricane, the utility must

identify the minimum amount of chemicals to maintain in inventory. The inventory will be dependant upon the location and reliability of chemical suppliers, the status of impending disasters, chemical storage capacity, and chemical availability.

Fiscal Planning Considerations

Fiscal planning will be required to obtain necessary equipment/supplies and specialized training. Time should allocated for meetings, drills and inspections. Good fiscal planning includes cash reserves required to effectively operate in the event of an unexpected disaster.

Fund reserves are typically set by the utility's bond resolution documents. Funds will include:

- debt service fund (funds used to pay principle and interest for outstanding debt),
- subordinated debt funds (funds used to pay principle and interest on short-term borrowing)
- construction fund (funds accumulated to pay for costs of acquisition and extension of the system) utility plant improvement fund (funds used to pay for certain capital projects or redemption of bonds
- the rate stabilization fund (funds used to stabilize rates for future periods or for meeting unanticipated capital or operating expenses.)

Most large utilities will have a fund set-aside called the "Rate Stabilization Fund." The Rate Stabilization Fund is built over time to a fixed amount using incoming proceeds. This fund is used to stabilize the effects of rate shock caused by future planned capital improvements. These funds are typically set at a dollar value that is both large enough to absorb rate shock and sufficient to provide operating reserves in an emergency situation where incoming revenues may be severely depleted.

Most large utilities will use a 10- to 15-year planning horizon and a 5- to 7-year capital budgeting process. Capital projections are very accurate in the 3-year horizon and become less accurate over the longer term. Making financial adjustments year to year using actual capital expenditures and funds encumbered (payments yet to be made) allows the utility to plan cash flows for both operating and capital programs within $\pm$ 5 percent of planning projections during a normal year.

Failure to plan for the devastating financial effects that a utility could experience based on a large hurricane can quickly deplete operating reserves putting the utility's ability to maintain normal functions in jeopardy. Although monthly fees or revenue collected from customers' will be allocated differently, it is not uncommon for utilities to allocate as much as 30 percent of the utility's revenue to the payment of debt service and for future capital projects. Taxes or transfers to the city operating fund for publicly owned utilities could approach 25 percent. Without good financial planning for this kind of crisis, operating funds will quickly disappear in the aftermath of a disaster, putting extreme stress on cash reserves and making normal operations difficult.

Equipment, Parts and Tool Inventory Assessment and Procurement

Systematic planning of equipment acquisitions and the purchase of supplies are also critical. For example, lumber for hurricane protection should be purchased during the first quarter of the year to ensure proper supplies and lower costs. Changes in equipment storage and improvements to systems should also take into account disaster response issues such as evacuation routes vulnerability.

Thorough disaster preparedness, response, and restoration plans involve each facility and its operations. Equipment must be kept in good working order by implementation of strict preventive maintenance programs. Facilities and their operations must be ready at all times to implement disaster response activities. This process involves proper planning at all levels of operational activities.

Resource planning is another important tool for effective response. The most likely contingencies should be taken into consideration when identifying the required types and quantities of a particular product/material that should be on hand.

Essential Communication after a Disaster

In many emergencies the first step may be to communicate system status to the local EOC. This requires that the person responsible for managing the emergency and making key decisions assess the situation and initiate a series of actions based on the type and severity of the emergency.

The local emergency management center is equipped with various types of emergency communications equipment and may be in a position to provide valuable assistance with notifying the public. A partnership with the local emergency manager should be established to coordinate this assistance well in advance of hurricane season.

Larger systems may have a variety of people involved in the assessment and communication functions. However, small systems may only have one person, usually the system operator, in their chain of command. These systems will need to make sure each responsibility is clearly defined so the person does not forget any task during an emergency.

Key Communication Responsibilities in an Emergency

- Handle incoming phone calls and provide administrative support
- Provide information to the public and media
- Inform the customers and the media of the restoration actions
- Update the public on the system restoration and priority operations in the field

Developing a Communication Plan

Every agency involved in restoration efforts will be involved in communications and public relations whether intentional or not. An active communication plan can change communication from an unneeded interruption and disruption of business to an alignment of emergency response and communication activities that provide a needed flow of information to those that need it most. Effective communication builds confidence and credibility in the agency's response efforts and continually allows monitoring information be made available to those that need it for both decision-making and updated on the progress of agency efforts.

There are three functions required for effective communication in an emergency response activity. These are shown below:

Functions in an Emergency Response Activity

Function	**Responsibilities**
Operational	The operational members of the response team who have to get the disruption under control as quickly as possible so that normal business can be resumed
Management	Those who manage and allocate resources and make critical decisions needed to rapidly and effectively resolve the situation
Communications	Those responsible for making sure stakeholders who need information concerning the response activities are briefed initially and then kept informed until the response activities have been completed

An effective communicator understands the roles and responsibilities of the various response functions and work assignments and assists each member of the response team by providing information essential to the response activities.
The communication function is essential for receiving and disseminating information necessary for effectively managing the restoration efforts and in keeping regulatory agencies and the public informed. Communication, like all other emergency response assignments, should be part of a written plan that is well rehearsed prior to an event and treated with the same importance as other operational and management activities contained in the emergency response plan.

Communication Functions and Assignments

In a disaster event communication can be categorized according to the three types of informational needs. These are:

- Internal communication

- Interagency communication
- External communication.

Internal and interagency communications are concerned with both obtaining and providing accurate and timely information to management and operating personnel. External communication is concerned with providing information to the interested public and the media. It is important that each of these functional communication requirements be included in a plan that designates clear communication responsibilities. These assignments are as important as any other emergency assignment and lead to optimal use of timely information and a higher level of effectiveness.

Internal Communication Function

Internal communication deals with the two-way flow of information pertinent to the internal resources and personnel engaged in the response effort.

The goal of the internal communication responsibility is to provide the type of information that allows operating staff and management to effectively work together on a common task or toward a common goal in a coordinated manner. Major components of the tasks related to the internal communication function are described below:

Internal Communication Function Tasks

- An ongoing assessment of the disaster and the documentation and transmittal of information pertinent to responding to the disaster. **The communication function requires recording all incoming and outgoing information in a manner that makes it accessible and useful to those involved in the emergency response activities.**
- An ongoing determination of available resources and where they are most needed to undertake the restoration effort. This requires knowledge of available resources, resources in use, and out-of service- resources: their capacity and how long it will take to put them into service where they are needed.
- An understanding of the priority of resource allocation as the guiding principle in providing information to responders
- Knowledge of personnel skills, departments, or organizations responsible for the various tasks necessary to accomplish the work. This requires an in-depth knowledge of the emergency response plan, staff roles and responsibilities.

As can be seen from the task assignments, effective internal communications require that the communication officer thoroughly understands the emergency response plan and is able to identify information and transmit it to operating staff or management in an expeditious manner.

Interagency Communication Function

Some agencies group the internal communication and the interagency communications into the same category. However, large catastrophic events such as hurricanes mandate that multiple

public, private, and regulatory agencies and organizations cooperate and collaborate to manage the crisis and respond to the emergency. The efficient flow of information among agencies is critical in effectively carrying out the mission and meeting expectations set by the coordinating agency. The interagency communication function requires a centralization of interagency information that includes the communication needs of requesting responder agencies and the information needs of federal, state, and local governments involved or impacted by the restoration efforts. For this reason the internal communication function and the interagency function are usually separated.

Due of the critical nature of providing emergency information about progress and work assignments of multi-agencies in disaster areas, the time spent mobilizing, organizing, and planning using multi-agency crews and personnel, responding to an event can take a significant amount of time that may lead to unacceptable wait states that are detrimental to morale. These wait states also lead to inefficiencies, confusion, and a loss of focus. By maintaining a centralized and effective communication function, joint resources can be managed in a more effective and timely manner and duplication of effort can be minimized.

The use of a coordinated interagency communication function allows for accurately tracking and maintaining restoration work, records, and information. Use of this information leads effective response while improving the ability to conduct post-incident assessments. These assessments are critical in making improvements for future emergency response actions.

Interagency communication is an integral function of the communication officer in responding to large multi-agency events. Some of the most important tasks in an interagency communication assignment are described below:

Interagency Communication Tasks

- Receive, document, and transmit all outside interagency requests to the appropriate personnel
- Document interagency resource availability of outside responder utility agencies
- Document where interagency resources are currently assigned
- Identify what and when interagency resources may become available for other assignments
- Coordinate actions with local EOC operations, FEMA, and the US Army Corp of Engineers. This consists of identifying independent restoration activities and availability or needs for interagency resources
- Communicate with regulatory agencies such as EPA, DEP and health department officials

Interagency Checklist

Checklist for Preparing a Communications Chart and Contact List

- Local Leaders - City Manager, Mayor, County Commission Chairperson

- State Warning Point
- Local Law Enforcement
- Fire Department
- Emergency Medical Services
- Water Operators
- Emergency Contracts and Contractors (construction, fueling, generators, septic haulers)
- County Health Department
- FDEP District Office
- Local Emergency Operations Center
- FEMA

For smaller restoration efforts, the interagency tasks can be combined with the internal communication requirements. However, for large multi-agency responses the duties should be separated to retain proper attention and importance.

External Communication

Immediately after an incident occurs, there is a high demand for information from the public about the extent of damages, the timeline for repair and any special conditions for public health and safety. Whether the incident is large or small, the media and the public will require accurate and timely information. Providing this information will build the public's confidence that the restoration efforts are proceeding effectively.

To effectively manage external communication, a communication spokesperson should be designated. The internal communication spokesperson has the responsibility of disseminating timely and updated communication to the media. Communication with the media should proceed immediately after the onset of the restoration activities. To disseminate the information effectively requires a few primary considerations. The checklist below illustrates those tasks that are essential in providing external communication to the public and the media:

- Develop contact lists of media that will need information about the response. The contact list can be accessed by telephone, fax blasts, email, written press releases or notifying the media of press conferences.
- Buffer the command center from information requests that will use time that could be more effectively spent on managing or performing restoration activities.
- Support restoration activities by developing, recommending, and disseminating public information plans and strategies on behalf of the command center.
- Maintain public trust and confidence by providing the first and best source of restoration progress information.
- Continually gather pertinent information about the progress of the restoration. This requires the presence of the communication officer in morning updates and visibility at the command center.
- Ensure the timely and coordinated release of accurate information to the public by providing a single point of information release.

- Monitor public perception of the response and inform the command center of public reaction, attitude, and information needs.
- Ensure that the various response agencies' information personnel work together to minimize conflicting communication.
- Advise the control center concerning public affairs issues that could positively or negatively impact the response efforts.
- Facilitate the control of rumors.

Good external communication requires information updates even when information has not changed. It also requires the communication officer to be accessible to the media. Information should be concise, timely, accurate, and pertinent. A good communication officer addresses major issues and directs the communication to key audiences.

The communication plan should also include responsibilities and work assignments for other aspects of information processing and communications that include the following:

Checklist for Establishment of Public Communications Assignments

- Public Education Programs
- Contacting Customers
- Press Releases – Develop Possible Messages in Advance
- Update Press Releases as Emergency Develops
- Handle Incoming Phone Calls & Administrative Support
- Health Advisories – Boil Water Notices
- Records Management and Hurricane Documentation

Information Management

Information management is a process of providing accurate and timely information to both operating personnel and to the public about emergency response efforts. Development of a communications plan is the first step in preparation.

Information management is one of the most important aspects of planning and preparedness for disasters. Records and data are the heart of a utilities operation. Therefore, an organization should maintain back-up systems and security to assure that all data is secure and accessible. At a minimum, backup data for all vital records needs to be kept at least five miles from the main facility. In addition, disaster preparedness retrieval and secure remote access systems assure data accessibility in the event of an unexpected disaster.

Development and Maintenance of Emergency Procedures

Most water and wastewater utilities have developed their own emergency procedures as part of standard operation practice. These procedures should be reviewed in early June following the official start of hurricane season.

Quality Assurance in Emergency Planning

Quality assurance procedures should include a management-designated employee who is responsible for maintaining and updating procedures on a regular basis. Good quality assurance procedures include written procedures that designate employee responsibilities for preparing and responding to severe storms. Plans should include periodic reviews and coordinated updating of the procedures, including all employees who are affected.

Training Requirements for Emergency Planning

Training is very important and plans should include actual set-up and operation of all equipment, communication devices, and tools that may be used in the aftermath of a real storm.

Other Sources for Obtaining Emergency Planning Information

Additional information can be obtained from other related websites:
Federal Emergency Management Agency, http://www.fema.gov
National Hurricane Center, http://www.nhc.noaa.gov
Florida Department of Community Affairs, http://www.floridadisaster.org

Procedures to be Included in all Hurricane Preparedness Plans

Before the Hurricane

1. Establish partnerships with the local individuals in the emergency management community; know the local emergency manager and the functions/services available from the department. Work to help establish partnership with local, regional, and statewide utilities to create a network of mutual aid assistance designated to help facilitate rapid response to emergency needs. Brief the emergency management staff on system capabilities and specific needs that may be encountered during an emergency.

2. Ensure that updated copies of as-built drawings of the facility and collection system including all lift stations are available. These may be invaluable in locating valves, electrical boxes, manholes, and force mains. Many utilities have Geographic Information Systems (GIS) that provide accurate facility location information and attributes.

3. Maintain all mechanical equipment in good repair.

4. Familiarize personnel with hurricane procedures. Be sure that all staff is fully aware of and understand their responsibilities and emergency assignments as well as reporting protocols. Conduct regular training exercises.

5. Areas prone to flooding include pump wells, pipe galleries, outside open tanks, manholes' and other similar areas should be studied. Any special equipment required when these areas are flooded should be purchased.

6. Prepare a list of key personnel and how they can be contacted Maintain accurate employee lists, emergency contact lists and detailed action protocols. Communication networks can be damaged or disrupted after a hurricane. Some type of communication other than telephone is essential. Citizen band, cellular, or satellite phones are suggested.

7. Make sure extra batteries and chargers are available. Some communication equipment may require inverters in order to charge in a vehicle. Develop protocols to follow if land lines and cell phones will fail.

8. Power outages may be common after a hurricane. Check all auxiliary and standby equipment. Correct any malfunctions. Battery charges and adequate fuel supplies (10 - 14 day period) to operate auxiliary equipment should be provided. Fill all fuel tanks.

9. Know the electrical requirements of the system that must be powered during an emergency so that you can specify portable generator needs. A general rule when sizing generators to meet minimum demand is to multiply the sum of horsepower ratings of the equipment you intend to operate by 1.34. This will yield your minimum kilowatts required. Experience suggests that securing a larger kilowatt generator than required is economical in saving fuel, stretching manpower and minimizing fuel deliveries. Maintain a list of both generator size needed and electricians capable of safely wiring generators.

10. Check and stock critical spare parts. These should include spare lift station pumps in small sizes, electrical inventory such as starters, breakers and relays, backup SCADA transmitter and receivers, and other types of electronic equipment that may be damaged by water from flooding or from the storm.

11. Check all essential chemical inventories (such as chlorine, sulfur dioxide, lime, sodium hydroxide and polymer) to make sure that they are adequately stocked in amounts that will last 10- to 14-days.

12. Check all vehicles for proper operation and top-off the fuel tank.

13. Designate personnel that will be on duty (unless unsafe) during the hurricane allowing sufficient time to make arrangements for the protection of their homes and family. Make arrangements for the comfort and well being of personnel to be on duty (coffee, cots, non-perishable food, potable water, emergency supplies, first aid kits, and flashlights).

14. Board up windows and tie down or secure any supplies or materials to prevent them from becoming airborne during the hurricane.

15. Drain wastewater-holding ponds as completely as practical.

16. Cease shipment of biosolids to any land application site that is expected to be impacted by the storm.

17. Biosolids land application sites should ensure that any biosolids sent to a land application site prior to the storm have either been spread or are staged, stockpiled, or stored at the land application site in a secure manner so that they will not wash out and leave the land application site. Any storage should be at a high point on the site and away from bodies of water.

18. Secure computers and create redundant backup of all data at remote locations.

19. Large chlorine gas facilities may need to be turned off and secured for safety considerations. An alternative method to feed chlorine should be available.

20. After the storm has passed, accessing the facility may be challenging. Make sure there is an adequate supply of chain saws (including gas and oil) and axes for clearing debris.

21. Assistance and additional information can be obtained by contacting your district DEP office at the phone numbers listed below:

Southeast District (West Palm Beach)	561/681-6600
South District (Feet. Myers)	239/332-6975
Southwest District (Tampa)	813/744-6100
Central District (Orlando)	407/894-7555
Northeast District(Jacksonville)	904/807-3300
Northwest District (Pensacola)	850/595-8300

The Florida Rural Water Association (FRWA) is another resource that can provide assistance to utilities in preparing an emergency preparedness plan. FRWA's circuit riders provide assistance in restoration efforts to water and wastewater systems following hurricanes or other disasters. FRWA provides direct operator assistance and/or can help in locating needed equipment and coordinating emergency repairs. FRWA can be contacted at: 850/668-2746.

Emergency Power for Critical Facilities

Critical facilities include both the utility's own facilities and facilities such as emergency shelters, emergency operation centers, hospitals, and nursing homes. For these emergency facilities it will be necessary to perform an analysis on the utility's ability to provide critical water and/or wastewater service after the storm.

As part of utility risk assessment process, each utility should determine the acceptable level of risk and requirements for continuing operations in the event of a power outage. Based on this assessment, each utility should install emergency generators at sites that must be maintained, or at the very least, install manual transfer switches in advance of an event to permit a safe and reliable connection of a generator to the site.

In the event that after advance planning and contracting, emergency generators are still required, site surveys will permit faster deployment of these assets.

The most common reason for delay in installing emergency power is that not enough information is known about the site, true surge power requirements, method of connection to the facility, access to the site and other critical factors.

A form, "Emergency Generator Critical Facility Site Survey" has been developed by the State Emergency Response Team at the Florida Department of Community Affairs, www.floridadiaster.org to survey each site for future power requests. Contact the County Emergency Management Office to become familiar with the information required on the form.

After The Hurricane

An important component of any emergency preparedness plan includes employee responsibilities for reporting to duty after a storm. Responsibilities for responding should also be assigned in the plan and are listed below:

- Survey and assess the damage. List repairs needed and estimate work time to correct the damage. Proceed on repairs according to a priority list.

- Determine if power loss is local or area-wide. If loss is local, check all electrical circuits for shorts or system overload. If loss is area-wide, contact power company and coordinate repair and start-up operations with them.

- Shut off electrical current to damaged equipment and initiate critical repair(s). Electrical current to submerged lines or equipment should be shut off. Portable pumps should be provided to aid in the dewatering process. Gas or oxygen deficiency in flooded areas should be checked. Ventilate closed areas, but do not enter alone. Do not use unprotected lights or electrical equipment during clean-up operations.

- Flooding of wastewater or biosolids could expose personnel to hazards of waterborne diseases, areas or pockets of toxic and or explosive gases, oxygen deficient areas, or electrical shock. Wastewater also can contaminate public and private wells in the area, so spills should be minimized and contained as quickly as possible. Special consideration should be given to preventing contamination of the potable water supply.
- Coordinate with the local water utility and establish priorities for repairing lines and facilities. The water supply system may suffer major damage resulting in low pressure conditions and with very little or no flow reaching customers and utility facilities such as the wastewater treatment facility. Bottled water will have to be provided. Not all lift stations will have back-up generators. If left unattended for long, spills and discharge of raw wastewater will result.

- Keep the public informed of facility damage and outages, and advise them of associated potential public health or environmental concerns.
- Provide for lime application to decontaminate spills.
- Provide for disinfection of any discharges of raw, partially treated, and fully treated wastewater. If chlorination equipment has been damaged, manual dosing with High Test Hypochlorite may be necessary.
- Any major damage to the wastewater system should be immediately reported to the local DEP office. Spills of 1,000 gallons or more need to be reported to the State Warning Point at 1-800-320-0519. Reports concerning any minor damage should be reported as soon as possible.

Chapter 3: Detailed Emergency Hurricane Procedures for Water and Wastewater Facilities

Generator Startup and Fuel Requirements and Availability Issues

In preparation for hurricanes and tropical storms, it is important to know generator capacity load and fuel consumption. Before hurricane season begins, generators should be load tested and serviced, and the fuel tank should be topped off. In calculating fuel, estimate the hours of service a generator will provide when the tank is topped off.

Another important factor to consider is how to secure fuel after the storm has occurred. Most water and wastewater generators will not run more than a couple of days without refueling. Larger systems will have fuel tanker trucks that should be topped off for refueling in emergencies. Smaller tanks that can be transported on the back of pickup trucks are also recommended. It is suggested that several fuel vendors be contacted with estimated fuel volumes required if a storm occurs. Inland vendors may be less likely to be affected by a hurricane or tropical storm. When making contact with vendors, make sure they know that you are a utility and how long you will be able to run on a tank of fuel.

Generator testing (by connecting them to the anticipated loads) and servicing (by a company engaged in this business if a full time mechanic is not available) also needs to be performed prior to hurricane season. If any problems are found with the generator, have it fixed immediately. Make sure that the service provider has checked belts, batteries, and coolant and assure the generator will start and run for several days with no problems. Some suppliers equip generators with sight tubes to check oil levels while the generator is running. Generator appurtenances such as connecting cords, and extra wire, receptacles and plugs should be in inventory in case they are needed.

Every 3-5 years main breakers and automatic transfer switches need to be tested for proper function. If breakers are not functioning properly, they will not trip at proper amp loading, which could damage the generator and wiring. They can be tripped manually to determine slop and checked with an infrared sensor to ensure that heat is not building, a sure sign of imminent failure.

Condition of Pumps and Process Equipment Prior to the Storm

Evaluate all plant equipment and pumps. A wastewater plant is only as good as its ability to move water, so pumps should get a preseason checkout. Submersible pumps should be pulled, serviced, and cleaned. Pump impellors, wear plates, power cables, and oil should be checked. Pumps should also be checked to make sure that they are pumping the proper amount of water. A simple draw-down test can show if a pump is operating properly. But if a pump is still not pumping on the curve (performance graph provided by manufacturer), then a faulty check valve could be the cause.

Vertical turbine pumps also need to be checked to make sure they are pumping properly as well. Pumps should be checked for vibration; oil should be changed; and packing or seal operation and strainer should be cleaned. Vertical pumps should also be checked to make sure they are pumping on the curve.

All the plant process equipment should be evaluated. In some cases, not all of the parts for the equipment are "shelf items." Parts may need to be manufactured, leaving the facility without that piece of equipment when it is most needed. Other items for the plant equipment such as motors, fuses, three-phase monitors, relays, and wiring (of various sizes) should be kept on hand for emergency situations.

Protection of Computers, PLC's, and Other Electronic Equipment

Special consideration should be given to plant computers, electrical equipment, and programmable logic controllers. Rolls of heavy plastic sheeting should be kept on-hand in amounts sufficient to cover all computers and electric cabinets that are not watertight. Computers and battery-operated uninterrupted power supplies systems should be moved as far above the floor as possible. This will help to prevent damage to equipment in case minor flooding should occur. Backup data and redundant systems should be kept in a secure, safe, and dry location offsite.

In-Plant Process Management

When a hurricane or tropical storm watch or warning is issued for the area, solids handling should be a major concern. Plants should be wasted to a minimum level to adequately treat levels of carbonaceous biochemical oxygen demand (CBOD) and total suspended solids (TSS) coming into the plant. Digester levels should also be lowered to the minimum operating point. The reason to lower solids inventory to minimum levels is that sludge haulers, drying beds, and other means of disposing of solids may be out of operation for several days or weeks, due to the high volume of rain. Also, flow is going increase greatly while most of the population may have evacuated. The lowered solids in the treatment process will be enough to treat the reduced levels of CBOD and TSS entering the facility and will also help to maintain sludge blanket levels in your clarifiers.

Maintenance of Chemical Supplies

Any consumable chemicals such as chlorine, hypochlorite, sulfur dioxide, sodium dioxide, and polymers should be stockpiled in order to have a minimum of two weeks supply at maximum feed rate. Suppliers and chemicals may be in short supply due to high demand, inability to obtain components to make chemical compounds, or unable to ship chemicals due to damaged infrastructure. A list of backup chemical suppliers should be maintained in the event the

preferred supplier is unable to deliver. With polymer, an alternative vendor's stock may not work as well as the preferred polymer, but will work for a couple of weeks.

Shutdown of On-Site Construction

If on-site construction is occurring when a hurricane or tropical storm is imminent, trash should be cleaned up and disposed of properly. Backfill any large construction opening or trenches, tie down any loose material, and suspend all construction operations until it is safe to return.

Shutdown of Treatment Facilities During the Storm and Duty Assignments

If the plant needs to be abandoned in case of a major storm, plant personnel should be instructed of their duties on a case-by-case basis. Notify the DEP district office or FlaWARN. Provide contact names and cellular phone numbers so that people can be contacted after the storm has passed.

Final tasks required prior to leaving the facility would include securing remaining hurricane panels over doorways, tightening all latches on outdoor panels, turning off all non-essential equipment, completing a final walk though for any loose debris that could become a projectile, and starting generator and transfer power. Before leaving, explain very clearly to employees what the utilities' policy is on returning after the storm.

Instructions for Re-Start of Electrical and Process Equipment

Upon returning after the storm, perform a visual inspection of the facility to prioritize items that need to be repaired first. The immediate labor force may be small, so communication with other departments may be necessary to complete tasks.

Equipment will need to be assessed for return to an operational state. Check the motor control room to make sure flooding or roof damage did not occur. All of the equipment should be checked for water or mechanical damage. Once equipment is determined ready for return to service, begin putting it back online starting with equipment that has the smallest load. For equipment that cannot be returned to service, prepare parts lists so parts can be found to get equipment running again.

Operation of Lift Stations Without SCADA

Lift stations without SCADA should be checked immediately after it is safe to return to work. The city should be divided into segments to best utilize manpower. The stations should be checked for downed trees, power availability, and any damage to the control panel. The checklist of the stations should include; if the station is online or offline, level of water in the station and damage to the site. Once everyone has returned from completing his or her assignments, compare notes and prioritize the order in which stations need to be repaired first. Repeat visits will need to be made as often possible.

Manual Operation of Mechanical Bar Screens

During extreme, wet weather, a large amount of debris will get flushed through the sewer system. This debris, such as leaves, pine needles, clean-out caps, and grease, can plug or hinder the operation of the mechanical bar screen. For this reason it may be necessary to run the bar screen in manual operation. Normally a Hand-Off-Auto switch is located on the local control panel for the bar screen. By selecting the hand position, this should place the bar screen into manual operation. Once debris is no longer an issue, return the bar screen to automatic operation. Extended manual operation may cause guide rails, and other components to fail prematurely.

Training and Capability of Staff for Manual Operation After the Storm

Programmable logic controllers (PLC) and other automatic controllers in the facility may not be operational after the storm. Operating staff should be familiar with how to place equipment into manual run mode. Most new systems have redundant backup modes, which may also need to be manually switched. A standard operating procedure for manual operation of the facility should be developed because PLCs and automatic controllers can go down at any time.

Instruction of the Use of Wastewater Bypass and Methods of Disinfection

Although wastewater bypasses are strictly prohibited in the State of Florida, under emergency conditions a bypass may occur. If a bypass should occur notify the DEP district office and the State Warning Point, letting them know the bypass is occurring, how much water has bypassed and when return to normal operation is planned. If possible, contain bypassed wastewater to on-sight storage, rapid infiltration basins or spray irrigation fields. Bypassing wastewater directly into a body of water should only be considered as a last result, for it can further contaminate homes that are being flooded from rising water in lakes, rivers and streams. If a bypass occurs at the facility, a base line measurement should be developed by chlorinating raw wastewater to achieve a desired fecal coliform reduction. FDEP may require additional follow up measures.

Chapter 4: Preparing Lift Stations for Hurricanes

Flooding Issues Ingress and Egress to Facilities

Flooding of pump stations during storms can have a severe negative affect on the operation of the Collection System. These include introduction of surface water into an already surcharged system as well as electrical failures. Flooding may also create an access problem getting to the site to address issues. It is imperative that an audit be performed prior to hurricane season to identify sites that have potential issues with flooding and make the necessary corrections. This may include removing of wet well lids, checking valve vaults and installing risers to increase the top grade of the structure. Building protective barriers using sand bags or other materials to divert floodwaters away from the structure is another option. If none of the mentioned actions are practical, consider bypassing the pump station in these situations if possible.

Ingress and Egress Issues Due to Downed Trees

It is common knowledge that 75percent of lift station and pump station failures during hurricanes are due to loss of power. In most cases downed trees and limbs coming in contact with overhead power lines cause this. Failure to maintain tree growth in the right of way and at station sites can cause unnecessary loss of power during storms. In some cases, the main power line maintenance is out of the utilities' control. Though at the utility owned sites preventative measures can be taken against such problems. An annual audit should be standard operating procedure at all sites to identify and eliminate overgrowth near power supplies. Some of this work can be done in-house if there are no potential safety issues as far as working to close too live power lines. If this is the case, there are several outside contractors available who are qualified to perform this work safely. In the case of maintenance in the right of way, contact the utility and meet with them to discuss issues concerning water and wastewater utilities. With the exception of medical facilities, hurricane shelters and special needs facilities, water and wastewater facilities should receive priority during hurricanes.

Flood Protection for Lift Stations Sand Bag Protection

The use of sand bags for flood protection can be a very effective and cost efficient means for flood prone sites. During a pre-hurricane season audit, sites can be identified that need to have sand bags installed or other material delivered for building barriers prior to the arrival of the storm. One benefit of this method is that the sandbags do not deteriorate and break-up in sunlight and rain. Strategically staging inventory and bags in advance can be less labor intensive and can help save time in an emergency.

Power Service Considerations: Overhead vs. Underground

When planning new developments and expansions or retrofits to existing systems, consider underground power versus overhead power. Overhead power is subject to more problems during hurricanes. Most new developments are opting for underground power due to less obtrusiveness and higher levels of reliability. Even with underground power, severe storms can down trees resulting in pulling up electric lines. However, damages to power lines feeding lift stations can be significantly minimized by the use of underground service.

Storm Surge, Saltwater, and Debris Issues

All coastal areas as far as five miles inland are subject to storm surge during tropical storms and hurricanes. In most severe storms, such as Category 3 or higher, this area will have mandatory evacuation. It is possible that utility installations closer to the coast will be a total loss. Plans should be in place to have damage assessment teams evaluate the situation and initiate plans of action to return service to these areas. Resources such as portable generators, components to rebuild control panels, and bypass pumps are essential.

Identification of Likely Discharge Points and Post Storm Inspection Man Hole Lids

Gravity sewer systems in low-lying areas are extremely vulnerable to problems with inflow and infiltration and sewer overflows into surface waters. Another issue is gravity sewer main blockages caused by debris entering the system or existing materials such as grease, sand, and grit being dislodged from high flows. One solution is to identify these areas and install devices in the manholes to prohibit water from entering into the system, to allow influent to release via a pressure relief valve. There are several types of these devices on the market today. Inspections in these areas will also identify loose or broken manhole covers that may need to be replaced. It may be necessary to set up bypass pumping around a low-lying manhole to prevent overflow.

Identification of Pipelines Subject to Stream Erosion and Post Storm Inspection

During tropical storms and hurricanes, excessive flooding will cause rivers, streams, and drainage systems to rise and create enough velocity to cause severe erosion to embankments and surrounding areas. Gravity sewer lines and force mains may be exposed, creating stress and possible failure of the piping. All of these pipelines should be identified and some plan of action should be in place if this occurs. Plans for bypass pumping or redirecting flow into another parallel pipeline may be considered. Another safeguard is to encase pipelines located in the bottom of ditches and swales in concrete for protection.

Importance of Lift Station Facility Addresses, Directions, and GPS Locations

Proper identification and mapping of water and sewer systems are a critical parts of post storm recovery. After a storm the landscape and landmarks used to identify certain areas may be completely different. The use of GPS mapping can be a lifesaver in terms of locating valves to isolate systems for repair. Another important tool is to have all pertinent information on pumping stations documented such as meter numbers, pump sizes, location of valves, and plans for bypass pumping. Each site should have some type of identification number other than an address and cross streets to help in locating after storms. All of this information should be in the possession of the power company, and emergency management teams, and be made available to responding FlaWARN crews. Lists of pump stations, in an order of restoration priority in returning to service, should also be made available.

Another important use of GPS mapping is the locations of strategic force main isolation valves. It may be necessary to isolate certain areas of the system for repairs or to divert flow to another pipeline for post-storm operations.

Preparing Wastewater Force Mains for Hurricanes

Protection of force mains is critical if you expect to have any type of system operations post-storm. Vulnerable sub aqueous force mains or bridge crossings may be exposed to storm surge or wind damage. Also force mains along barrier islands and shorelines may be at risk. Shallow force mains with minimal cover can also be an issue if soil erosion occurs. Taking steps to protect these lines may include installing extra supports or piers under piping, protecting shallow mains by adding additional cover, or diverting water flow around surface area.

Vacuum Truck, Portable Generators, and By-Pass Pumps

The most important factors following storms and hurricanes are: assuring all personnel are safe, getting accurate reports of damage, and a having plan of action to restore service. Aside from the workforce, three of the most important tools for recovery are portable and fixed generators to keep the stream flowing toward the treatment plant, pumps for bypassing damaged systems, and vacuum and jetting trucks to clear blockages. Consider negotiating an agreement in advance with outside contractors; otherwise this type of equipment may not be available after major storms. There are also governmental programs available for assistance if needed.

Disaster Plan Upkeep and Maintenance

The year 2005, was a monumental year for natural disasters. Hurricane Katrina was the largest natural disaster in terms of damage and cost ever recorded in the United States. This storm affected the entire country, not only New Orleans and the Gulf Coast States. Katrina proved that we can never be prepared enough for disasters. However, steps, can be taken to better prepare individuals and the utility to deal with the issues that come with such events. Disasters are not limited only to storms and hurricanes. Disasters can strike without warning and without time to plan ahead. This makes it even more important to review disaster preparedness plans often and update them at least annually, conduct necessary training, and keep the organization aware and updated at all times.

Chapter 5: Guidelines for Response and Restoration of Water and Wastewater Utility Services

Post-Hurricane Damage Assessment Objectives and Setting of Restoration Priorities

The objectives of a post-hurricane assessment are to identify the extent of damages inflicted on critical utility infrastructure, determine the priorities for restoration, and determine the resources necessary to restore them to minimum operating condition.

Hazards associated with a hurricane are high, sustained winds; flooding from storm surge or heavy rains; battering from heavy waves; and a variety of secondary hazards. Generally, the largest problem to be faced by a utility manager following hurricane damage is loss of line power from wind damage. Damage may also occur from flooding and from windblown debris that can destroy electrical controls. Hurricane hazard agents are described in the following table.

Hurricane Hazard Agents Posing Threats to Water and Wastewater Infrastructure

High Winds	High winds impose significant loads on structures, both direct wind pressure and drag, and tend to propel loose objects at high velocity.
Flooding	The hurricane can cause many different types of flooding. Along the coast the flooding may occur from storm surge, wind-driven water in estuaries and rivers, or torrential rain. The flooding can be still water flooding or velocity flooding caused by wave action associated with wind-driven water along the coast. The rainfall associated with a hurricane is on the order of 6 to 12 inches, with higher levels common. The rain may precede landfall by hours and may persist for many hours after landfall, causing severe flooding.
Heavy Waves	The storm may generate waves up to 25 feet high. These can batter the coastline, causing devastating damage to the shoreline itself and to structures near the shore. The velocity of the water moving back and forth undermines the foundations of buildings and piers by removing the soil and sand from around them. Debris driven inland with the waves can cause severe structural damage; persons exposed to the moving water and debris are likely to receive severe injuries.
Secondary Hazards	Hurricanes can also cause numerous secondary hazards. Tornadoes and electric power outages are common. Contamination of water supplies, flooding of sewage treatment facilities, and even dam failure may occur.

Identification of Hurricane Landfall and Path of Storm (NOAA)

Information from local news networks can facilitate identifying hurricane landfall and the likely path of the storm. Information can also be obtained from the web from the National Oceanic and Atmospheric Administration (NOAA) their websites provide updates on the development of storms, storm tracks, and more specific information on storms that reach hurricane status. These sites are provided below:

http://www.nws.noaa.gov/om/hurricane/index.shtml
http://www.stormtracker.noaa.gov/
http://www.nhc.noaa.gov/

Pre-hurricane Preparation and Coordinated Utility Response (FlaWARN)

FlaWARN is Florida's Water/Wastewater Agency Response network. FlaWARN's mission is to provide an effective communication mechanism that allows Florida's water and wastewater utilities to provide assistance to sister utilities that are in need.

There is no special requirement for membership in FlaWARN and utilities can register online at: http://www.flawarn.org/.

FlaWARN works with various industry groups and public agencies linking the Florida water community including:

- The latest interactive models for security protocols to aid in continual risk assessment and updating ERPs
- A series of continually updated boilerplate public information and press release templates tailored to meet the latest developments and provide immediate public response
- Quarterly regional and annual statewide meetings to bring together both significant state authorities and national interests, providing the best and latest insights to power the agencies ongoing preparedness process. These meetings include workshops in utilizing FlaWARN to the agencies best advantage.
- Technologies to facilitate sharing of information among members
- Outreach -- Through the existing UF/TREEO network and other cooperating entities, FlaWARN will offer onsite emergency preparedness and related regulatory liaison services to requesting agencies.

Reporting Hurricane Damages to DEP (Storm Tracker)

Storm Tracker is a web-based application that can be used by utilities to report the condition of damaged utility facilities to DEP. Users are prompted to enter contact information and provide facility reports on pre-prepared spreadsheets. The system currently tracks the condition of water

and wastewater utilities that have service populations for water that are greater than 3,300 people or wastewater systems that have treatment capacities of more than 100,000 GPD of wastewater.

The system allows DEP to maintain contact with system operators, update status conditions and prioritize state assistance efforts. The system can be accessed via the web at: http://tlhdwf2.dep.state.fl.us/stormtracker/facility.asp

To open the program, the user name is "florida" and the password is "storm" (please note: ***all*** lower case).

Authorized State Emergency Management Agencies

The Florida Division of Emergency Management provides valuable information about how Florida utilities can prepare for disasters and access State and Federal resources after a hurricane strikes. The information can be accessed at: http://www.floridadisaster.org/DEMinformation.htm

Priorities for the Restoration of Water and Wastewater Facilities

Restoration of water supply, transmission, and distribution receive precedence over other activities. Drinking water is essential in allowing normal activities of the affected population to resume. Contaminated drinking water can be rendered safe by boiling (sterilization) or by the addition of chlorine or iodine (disinfection). Providing drinking water to the affected population, even at low pressures, is essential in restoring normal lifestyle activities such as cooking and bathing.

Once the water transmission and distribution system is restored, water treatment capability is the next item of importance. If the water has been exposed to bacterial contamination, the following guidelines are suggested:

Requirements for Sterilization of Bacterially Contaminated Water by Boiling

Sterilization	**Heat Source**
Vigorous boiling for a period of one minute destroys cysts, viruses, and bacteria	May be range, wood fire or microwave oven. Extreme care should be used to prevent accidental fires

Requirements for Disinfection of Bacterially Contaminated Water by Chemical Addition

Volume of Water	**Condition**	**Number of Drops**	**Chemical Disinfectant**
Gallon	Clean	20	Tincture of Iodine
Gallon	Cloudy	40	Tincture of Iodine

Gallon	Clean	8	Chlorine Bleach
Gallon	Cloudy	16	Chlorine Bleach

Tincture of Iodine is over the counter pharmaceutical quality.
Chlorine Bleach is unscented commercial laundry product at 5.25percent available chlorine. Highly contaminated water should be filtered through cloth to remove any suspended matter.

In a post-hurricane event, water transmission and distribution restoration should provide water at any volume and pressure to a water customer. The utility should work from minimal service to customers to its standard service pressure at a minimum pressure at 20 psi. The quality of water obtained from a public water source can be more easily confirmed than from sources of unknown origin.

As transmission and distribution service is restored, the next priority is to provide water to critical installations. Restoration should then proceed to reestablish acceptable treatment levels to remove any restrictions in water use. Once water transmission, distribution, and treatment have been restored, wastewater restoration can then proceed. The following are recommended priorities for restoration of water and wastewater service.

Priorities for Restoring Water and Wastewater Services to the General Populous

1. Restore water transmission and distribution capability to critical customers such as hospitals shelters, emergency operations centers and special needs locations.
2. Restore water transmission and distribution capability to general population.
3. Restore water treatment capability.
4. Isolate and control leaks in water transmission and distribution piping.
5. Restore wastewater collection and transmission capability in areas where wastewater contamination could threaten public drinking water supplies.
6. Restore wastewater collection and transmission capabilities in areas where wastewater flow can result in public nuisance (flow into public roadways, private property, or water courses).
7. Restore wastewater treatment capability.

Damage Response upon Hurricane Arrival

The term “hurricane” describes a severe tropical cyclone with sustained winds of 74 miles per hour (mph) or greater.

The damages inflicted on utility infrastructure will generally be proportional to the intensity of the hurricane measured by the Saffir-Simpson scale. The scale is a widely recognized, accepted and practical tool that estimates the destructive forces associated with hurricanes. This scale classifies hurricanes into five categories based on wind speed and describes the destructive forces caused by wind, storm surge, and wave action for each category. The categories are listed below.

Saffir-Simpson Scale Hurricane Category and Sustained Wind Speed (mph)

Category 1 Hurricane:

Winds 74-95 mph (64-82 kt or 119-153 km/hr). Storm surge generally 4-5 feet above normal. No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Some damage to poorly constructed signs. Also, some coastal road flooding and minor pier damage can occur.

Category 2 Hurricane:

Winds 96-110 mph (83-95 kt or 154-177 km/hr). Storm surge generally 6-8 feet above normal. Some roofing material, door, and window damage to buildings may occur. Considerable damage to shrubbery and trees with some trees blown down. Considerable damage to mobile homes, poorly constructed signs, and piers. Coastal and low-lying escape routes flood 2-4 hours before arrival of the hurricane center. Small craft in unprotected anchorages break moorings.

Category 3 Hurricane:

Winds 111-130 mph (96-113 kt or 178-209 km/hr). Storm surge generally 9-12 feet above normal. Some structural damage to small residences and utility buildings with minor amount of curtainwall failures. Damage to shrubbery and trees with foliage blown off trees and large trees blown down. Mobile homes and poorly constructed signs are destroyed. Low-lying escape routes are cut by rising water 3-5 hours before arrival of the center of the hurricane. Flooding near the coast destroys smaller structures with larger

structures damaged by battering from floating debris. Terrain continuously lower than 5 feet above mean sea level may be flooded inland 8 miles (13 km) or more. Evacuation of low-lying residences within several blocks of the shoreline may be required.

Category 4 Hurricane:

Winds 131-155 mph (114-135 kt or 210-249 km/hr). Storm surge generally 13-18 feet above normal. More extensive curtain wall failures with some complete roof structure failures on small residences. Shrubs, trees, and all signs are blown down. Complete destruction of mobile homes. Extensive damage to doors and windows. Low-lying escape routes may be cut off by rising water 3-5 hours before arrival of the center of the hurricane. Major damage to lower floors of structures near the shore. Terrain lower than 10 feet above sea level may be flooded requiring massive evacuation of residential areas as far inland as 6 miles (10 km.

Category 5 Hurricane:

Winds greater than 155 mph (135 kt or 249 km/hr). Storm surge generally greater than 18 feet above normal. Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. All shrubs, trees, and signs blown down. Complete destruction of mobile homes. Severe and extensive window and door damage. Low-lying escape routes are cut off by rising water 3-5 hours before arrival of the center of the hurricane. Major damage to lower floors of all structures located less than 15 feet above sea level and within 500 yards of the shoreline. Massive evacuation of residential areas on low ground within 5-10 miles (8-16 km) of the shoreline may be required.

The hurricane season runs from the first of June until the end of November. Although the actual landfall of a hurricane will typically produce the most damage, gale force winds and rain prior to hurricane landfall and the sustained storm activity after the passage of a hurricane can produce significant damage to and flooding of utility infrastructure. Typically, a hurricane will produce a sustained storm event that may last for several days and bring excessive amounts of rain. The time phases associated with a hurricane are:

Hurricane Readiness Requirements – Time to Arrival of Storm

Awareness 72 hours before the arrival of gale force winds (32-63 mph).

Stand-by 48 hours before the arrival of gale force winds. It is likely that a tropical storm watch would be issued by the National Weather Service during this period. **Suspend all normal business activities.**

Response 24 to 48 hours before arrival of gale force winds through termination of the emergency. Hurricane watches and warnings will be issued by the National Weather Service during this period.

Shelter 24 hours before landfall sustained gale force winds will exceed 40 MPH as determined by the National Weather Service. All personnel should seek shelter immediately.

As the hurricane approaches, utility infrastructure will begin to be impacted. Power failures will begin to appear as trees are blown into overhead power lines. Utility crews will be dispatched to begin emergency restoration procedures. Larger utilities will generally use SCADA equipment that will give instantaneous operational status of critical water and wastewater facilities. Crews will then be dispatched to respond to locations that indicate loss of power conditions. Response activities will generally consist of maintaining water source capabilities at well fields or surface water pumping stations, and setting up of pump-down routes for smaller lift stations and placement of portable generators for larger lift stations. Larger lift stations with permanent generators will have automatically started in some instances.

Water and Wastewater Treatment facilities may need to start permanent generators during this period since power blips caused by the downed trees and limbs across overhead wires resulting

from wind gusts can degrade power quality to the degree that it can damage plant electrical equipment. Permanent generators at larger lift stations may also need to be started at this time. As storm conditions worsen, winds will begin to approach gale force. When winds reach a sustained velocity of 40 mph as determined by the National Weather Service, utility crews must be ordered to discontinue activities and seek immediate shelter. Under these types of wind conditions, falling trees and wind blown debris will jeopardize worker safety in the field and vehicle travel is no longer safe. All utility repair and mitigation activities, no matter how important, should cease at this point and workers should be ordered to seek shelter.

Chapter 6: Conducting Post Hurricane and Tornado Assessments

Post Hurricane Employee Safety – Sustained Wind Speed

As the hurricane makes landfall and then passes, sustained tropical force winds will subside to less than 40 mph sustained allowing damage assessment to begin. Communication infrastructure during this period will likely be damaged and unreliable. Prearranged instructions for employee reporting and field deployment of assessment crews consist of the following protocol:

Protocol for Contacting Employees for Post-Hurricane Damage Assessment

Instructions received directly from a supervisor via telephone landline
Instructions received directly from a supervisor via cell phone
Instructions received directly from a supervisor via mobile radio
Instructions received from a message delivered via local radio or TV station
Prearranged time period for reporting (generally 24 hours after landfall)

In a post-hurricane event for a Category 3 storm, generally about 25 percent of the normal workforce will be unable to report immediately to work in the aftermath of a storm. In Category 4 and 5 storms, in some instances, as much as 75 percent of the workforce may be unable to report immediately to work after the storm and this situation may extend for several days after the storm. For this reason it is imperative that the utility build depth into its organization by training additional employees in damage assessment techniques.

Types of Damage Assessments

Damage assessment consists of two types; Rapid Damage Assessment and a follow-up Detailed Damage Assessment.

Rapid Damage Assessments

The purpose of the rapid damage assessment is to quickly develop a preliminary understanding of the extent of damages to individual utility installations that prevent the facility equipment from operating normally. The rapid damage assessment will determine both the extent of electrical power damages and damages to facility equipment.

In most instances, the damages to utility structures will be limited to loss of power. In other instances damages may be to overhead power drops or to electrical control equipment. Utility personnel that perform damage assessments should be trained in recognizing specific types of

problems. Forms can be very useful in obtaining needed information, but assessors should be trained to include field notes. These field notes can be very informative and give the context in which the information was collected. Since there are many variables that will not be captured on a form, assessors should be trained to recognize and record pertinent and special conditions that are observed while at the site. These variables, when documented, allow the restoration of a facility to be better prioritized.

Assessors should also be instructed to record information that can be used to design response efforts that can mitigate conditions or prevent additional damages to a facility or equipment. This information should be recorded on the rapid assessment form. Drawings, diagrams, and pictures should be provided in the event that they might be useful for later interpretation and to facilitating the analysis of the collected information.

The following form is recommended for use by the rapid damage assessment team.

Rapid Damage Assessment Form

Date: _____ Time: _____ Pictures Taken? Yes __ No __ Water Installation ___ Wastewater Installation ___ Treatment Facility ___ Plant Facility Name: _____ Address or Location: _____ Person Making Report: _____		
1. Power Supply	Line Power Condition: Power is On ____ Power is Off ____ (if Line Power is On Skip to #2)	
	Are there visible damages to overhead lines?	Yes __ No __
	Are line fuses open?	Yes __ No __
	Are there trees or limbs visible on electrical lines?	Yes __ No __
	Is the service line to electrical cabinet damaged?	Yes __ No __
2. Flooding	Is the facility accessible?	Yes __ No __
	Is the facility under water?	Yes __ No __
	Is there evidence of inundation (high water marks)?	Yes __ No __
3. Electrical Status	Is there a generator on-site?	Yes __ No __
	Is generator operating? Comments: _____	
	Is the electrical panel damaged?	Yes __ No __
	Is SCADA equipment operable?	Yes __ No __
	Are there any breakers tripped inside panel?	Yes __ No __
	Number of pumps on-site ___, Are all operational?	Yes __ No __
4. Other Damages	Are piping systems functioning?	Yes __ No __
	Is there evidence of spills or other reportable activity?	Yes __ No __
5. Comments:	For recording Comments, for your explanation of any Box checked "Yes," and for recording you Field Notes, use the back of this sheet.	

Rapid assessment teams will generally work in pairs as a safety precaution since field conditions will continue to be unsafe due to flooding, downed trees and wires, rain and slippery pavement.

Facilities that have been inspected and found to pose threats or damages to the public, to other employees or to private property should be reported immediately. These include downed electric lines, broken water or wastewater mains, gas leaks, ruptured water service lines, or manholes where covers are removed or from which sewage is seeping out in roadways or is flowing.

Those facilities that are not operational and affect the ability to properly treat drinking water, are spilling over 1,000 gallons of wastewater, or are incapable of treating wastewater must be reported to the State Emergency Warning Point at 850-320-0519. The DEP District and/or the ACHD should be notified if the spill is less than 1,000 gallons.

Once a facility has received a rapid assessment inspection, it should be tagged to alert other employees that the inspection has been completed.

Outside Assistance in Performing a Rapid Assessment

Generally the first step in determining resource needs is the performance of a rapid assessment by the damaged utility. The damaged utility has insight into the facility requirements, their locations and other pertinent information that will not be readily available to an outside assisting agency.

However, in cases of catastrophic damage, the damaged utility may seek assistance from other utilities and state and federal agencies. In these cases it is imperative that the damaged utility provide employees who have utility information and can assist with locating and inspecting damaged facilities.

All utilities are advised to prepare location maps of utility infrastructure, instructions on how to find the facilities, the voltage, phase, FLA, number and rated horsepower of motors used at the location. Also information should be provided on disconnects, pump-arounds, system by-pass (in-pipe hydraulic surcharging) or any other pertinent information about the facility that can help assisting agencies in restoring minimum operating levels.

Detailed Damage Assessment

Detailed damage assessments are initiated at the conclusion of the rapid damage assessment period. The purpose of the detailed damage assessment is to prioritize system needs that provides for a continuous improvement in operational status of equipment based on its critical need, in the shortest amount of time possible at a reasonable expense to the affected utility.

A detailed damage assessment will typically begin about 24 hours after the rapid damage assessment has been completed. The purpose of a detailed damage assessment is to locate and identify specific critical locations where restoration can most effectively be provided. The

detailed damage assessment will give the utility a clear picture of the resources necessary to return the system to acceptable operation.

In the detailed damage assessment period, the utility will be reliant on the power company to restore service to the maximum number of facilities in the shortest amount of time. Many utilities work with the power company to ensure that critical facility installations are on a high priority restoration status list. Typically, the operation of hospitals, critical care facilities, emergency shelters and even emergency operation centers need water and wastewater services to function normally and thus utility facilities will need the same priority restoration status.

Maintaining contact with the electric provider after the storm is very beneficial. Most power companies will have restoration plans in place and can give preliminary estimates about the restoration of power in many areas. Electrical restoration generally progresses from the larger transmission lines to the smaller feeders. For Category 3 storms, power is typically restored in three to five days in urban areas. For Category 4 and 5 storms power restoration can be several weeks to several months depending on location. Knowing how power restoration is progressing will allow the utility to estimate the number of generators, pumps and/or tank trucks that are necessary to keep water supply intact and from keeping sewage from spilling.

In identifying restoration priorities the first step is to segregate the number of facility installations that are currently without power from those that require repair or maintenance actions.

Those facilities that do not have power can then be provided on a most critical basis, with portable generators to be left on-site, can be serviced by rotating generators from location to location, can be by-passed using portable liquid or propane fueled pumps or can be serviced with tanker trucks. It is imperative in these instances that the utility documents which locations have automatic transfer switches, have portable pump connections, or have operating storage that allows them to be used as holding tanks for pump down operations. The power, pumping requirements and storage capabilities of water and wastewater facilities must be known before emergency equipment can be dispatched. Recording this information **well in advance of a hurricane** will greatly facilitate the detailed damage assessment and the subsequent utility restoration response.

A detailed damage assessment can be initiated as soon as the rapid damage assessment has been completed. The steps to be followed are listed below:

Steps in Conducting a Detailed Damage Assessment and Facility Recovery Program

1. Compile rapid assessment information
2. Categorize into power outages and facility damage
3. Determine extent of power outages and prognosis for power recovery
4. Dispatch any unused portable generators to critical areas
5. Dispatch skilled personnel to facility damage locations
6. Complete detailed assessment form

7. Develop status monitoring system (status board)
8. Prioritize response plan according to critical needs
9. Dispatch available in-house resources
10. Request outside assistance

The detailed damage assessment categories listed below will be helpful in determining priorities and for quantifying requests for outside assistance. Generally, damage assessment reports will be sent to the designated emergency manager and outside requests will go to FlaWARN at Carol Hinton at: 352.392.9570 ext. 209 or Chris Roeder at: 352.392.9570 ext.203 or via the web at FlaWARN.ORG. If damages are catastrophic FEMA assistance should be requested in addition to assistance from FlaWARN.

Detailed Damage Assessment Classifications

Category	**Duration/Resolution**	**Examples**
Routine damage to facilities and/or power outages in some areas	Disruption can be resolved within 24 hours. Restoration is made using in-house resources	• Line breaks • Minor mechanical problems • Short term power outage • No threat to public health
Minor damage to facilities and/or Power outages in most areas	Disruption can be resolved within 72 hours. Restoration is made using local contracted service and in-house resources.	• Minor disruption in treatment • Minor damage to power grid • Damage requiring specialized equipment or parts
Significant damage to facilities and significant damage to power infrastructure	Disruption can take up to a week to resolve. Restoration requires the short-term use of outside utility resources and some assistance from FEMA.	• Major damage to utility infrastructure • Loss of portions of power grid • Multiple line breaks • Loss of supply pressure in some areas of system
Catastrophic damage to facilities and Loss of power infrastructure	Disruption can take several weeks to months to resolve. Restoration requires significant and long-term use of outside utility resources and assistance from FEMA.	• Total loss of supply pressure or treatment capability • Power grid severely damaged • Significant mechanical, electrical or contamination problems

Below is a detailed damage assessment form that may be used to assess the severity of damages to utility facilities. When the repairs have been completed, the information should be submitted to the supervisor including the tracking number.

Detailed Damage Assessment Form

Date: _____ Time: _____ Pictures Taken? Yes __ No __

Water Installation ___ Wastewater Installation ___ Treatment Facility ___

Plant Facility Name: _____

Address or Location: _____

Person Making Report: _____ Title: _____

Tracking Number: _____

1. Type of damage to facility:

_____

_____

_____

_____

2. Resources needed for repairs:

Materials: _____

_____

Equipment: _____

_____

Labor: _____

3. Estimated time to repair facility:

_____

_____

4. Recommendations for mitigating problem or damages:

_____

_____

5. Comments: For recording Comments, and for recording Field Notes, please use the back of this sheet.

Facility Assessment: Component Information Form

Water Installation ___ Wastewater Installation ___ Treatment Facility ___

Plant Facility Name: _____

Does the facility receive flow from other stations? Yes ___ No ___

Address or Location: _____

Person Making Report: _____ Title: _____

Motor Information: Inside Structure? Yes ___ No ___

HP Rating of Each: Motor #1 ___ Motor #2 ___ Motor #3 ____

Voltage Requirement _____

Full Load Amp (FLA): Motor #1 ___ Motor #2 ___ Motor #3 ____

Motor Model #: Motor #1 _____ Manf. _____

Motor #2 _____ Manf. _____

Motor #3 _____ Manf. _____

Motor Serial #: Motor #1 _____ Manf. _____

Motor #2 _____ Manf. _____

Motor #3 _____ Manf. _____

Site Information: Gated Facility? Yes ___ No ___

Has a location map been provided: Yes ___ No ___

Is a key required for access? Yes __ No __; Electrical Panel? Yes ___ No ___

Is there an electrical disconnect at this site? Yes ___ No ___

Are there by-pass capabilities or pump-around connections? Yes ___ No ___

Tornado Response Assessment

Tornadoes produce a tremendous amount of very localized wind and are capable of completely leveling water and wastewater facilities. Unlike hurricanes, tornado damages are extremely localized thus businesses and facilities just a mile or less from the storms center will be fully operational and thus response will not require the mobilized planning of a hurricane.

With a tornado the best source of information as to the locations of damages to will typically be through the State Emergency Management network and the local news media. To obtain rapid information on damages to small utility facilities it is best to contact local contract operations companies who often manage several small utilities in local geographic areas. Circuit riders who are assigned to these areas should maintain current cell phone numbers and contacts for contract operations personnel.

Damages to utility structures damaged by hurricanes will be extensive. The Fujita scale (F-Scale), or Fujita-Pearson scale, is the scale used for rating tornado intensity. It is based on the damage tornadoes inflict on human-built structures and vegetation. The official Fujita scale category was determined by meteorologists and engineers after examining damage, ground-swirl patterns, radar tracking, eyewitness testimonies, media reports and damage imagery, as well as photogrammetry and videogammetry if video was available. The scale below indicates the corresponding estimated tornado wind speeds that are required to inflict the damages shown below by the F rating.

F1
Corresponding tornado wind speed: 73-112 mph
F2
Corresponding tornado wind speed: 113-157 mph
F3
Corresponding tornado wind speed: 158-206 mph
F4
Corresponding tornado wind speed: 207-260 mph
F5
Corresponding tornado wind speed: 261-318 mph

Response to hurricane damage differs from hurricane response because local resources will be adequate to respond to utility needs. It will be incumbent upon Florida Rural Water Association personnel to coordinate resources quickly to put basic water and wastewater facilities back into temporary operation as soon as possible.

Equipment needed in Tornado Response

The following equipment is very helpful in dealing with a Tornado response:

No.	Equipment	Application
1.	Leather Work Gloves	Protecting hands from abrasion
2.	Leather Type Boots	Protecting feet from nails and sharp objects
3.	Cross Cut Hand Saw	Quick removal of branches and small trees
3.	Crow Bar	Removal of damaged lumber
4.	Small Sledge Hammer	Breaking apart damaged masonry
5.	Grappling Hook	Removal of debris from treatment basins
7.	Nylon Rope	Use with grappling hook for pulling debris
8.	Nylon Ratchet/Sling	Pulling debris from treatment basins
9.	Wire Cutters	Cutting away damaged electrical wire
10.	Chain Saw	Cutting away large trees for access
11.	Flat Shovel	Scooping debris away from basins
12.	Push Broom	General cleanup around basins
13.	Swimming Pool Net	Removing floating debris inside basins
14.	Protective Rain Parka	Protection from additional stormy weather

Those responding in a tornado response mode to repair damaged utility facilities, should be prepared to perform demanding physical work. Since damage will be localized, it will not be necessary to stay overnight in the area, thus personal affects will not be needed.

Large Equipment Needs

Restoration to damaged water and wastewater treatment facilities will require the use of equipment such as a tractor or rubber tired backhoe. Much of the debris blown into basins by a tornado will be too heavy to remove by hand. These needs should be coordinated with the local utility.

It will also be necessary to transport a generator to the site. Generators capable of handling even a small treatment plant will be too heavy to move by hand.

Electrical Repair Equipment

Basic electrical safety, monitoring and repair equipment will be the same as noted in the hurricane response section of this manual. The major difference between the needs in a hurricane response and a tornado response will be the availability of repair supplies and equipment from easily accessible local suppliers such as Lowes and Home Depot.

Chapter 7: Contamination in Restoration of Utility Services

Public Health Concerns

Addressing public health issues is the first concern when entering the disaster area. The restoration of water service is always the highest priority. Establishing water pressure will help in fire fighting and clean up efforts and that is important but making the water potable is paramount and urgent. Wells need to be energized and then need to be cleaned up. In most cases, super-chlorinating is necessary with flushing to obtain a reasonable residual. Maintaining pressure in the distribution system is necessary so that leaks can be found and repaired or isolated. Rescinding boil water advisories is important and knowledge of local regulations is necessary.

DEP Protocols for Contaminated Drinking Water

The following protocols are intended to guide and clarify requirements for public water systems (PWS) that have been contaminated or have the potential to become contaminated following a severe storm event. These guidelines are intended to enhance communication and coordination between the impacted water system, your customers, your regulatory food agency (DBPR, DOH or DACS), the county health department, and the DEP District Office. Effective communication between entities and consistency of application for these guidelines is critical for public health protection during emergencies.

Precautionary Boil Water Notice

When an emergency event occurs that warrants a precautionary boil water notice (PBWN), it is vital that the public water system first notifies its water regulatory agency (DEP District Office or Approved County Health Department) about the situation as is required under Rules 62-555.350(10)(b) and 62-560.410(1)(a)1 and (9), Florida Administrative Code (FAC). When the water system is regulated by DEP, they request that the county health department (CHD) is also notified about an event requiring a PBWN. By rule, it is the water system owner's responsibility to provide public notification to its affected consumers; however the approved CHD and DEP must be consulted and they will initiate customer notification (a PBWN) if the PWS cannot or will not do so. If food is prepared, the regulatory food agency (DACS, DOH, or DBPR) also requires notification if there is an emergency. Following the issuance of a PBWN, communication and coordination must continue.

Sample public notices are provided in the Appendix.

Power Outages and System Malfunction Requirements

In the event of a power outage or system malfunction that results in zero pressure in the water system, the following are needed:

- Call, and email or fax the PBWN to the local DEP District Office, or Approved County Health Department
- Call, and email or fax the PBWN to the county health department
- Post the PBWN at drinking water outlets in the building(s)
- The PBWN must state the name of the PWS, the time and date of issuance, what happened, what corrective measures are being taken, what the public should do, and other appropriate information required in Rule 62-560.410(5), FAC
- Undertake those corrective actions to the water system, restore pressure and maintain disinfectant residual, perform flushing as needed, and test for coliform bacteria as prescribed by the agency overseeing the system
- After lab results prove satisfactory, send a copy of the lab results to the applicable regulatory agency, obtain their approval, and rescind the PBWN if locally issued; if issued by DEP or the CHD they will rescind

Procedures for Rescinding Boil Water Notices

The rules for lifting boil water notices vary from state to state. If there is time prior to deploying, research the notices before going into another state or ask the FlaWARN staff to assist. Getting chlorinators and chlorine injection pumps re-piped and running needs to be a concerted effort. Finding the proper equipment, tubing, and fittings can be challenging.

Procedures for Collection of Water Samples

When corrective actions are completed, water samples must be collected and tested to validate the microbiological safety of drinking water provided to consumers. The water system owner is responsible to assure they are collected and tested. For a non-community system, two water samples collected at locations where water is available for consumption (taps or fixtures) is adequate to assess the microbiological safety of the system. Ensure that the water samples are collected in a sanitary manner and chilled with ice during storage before delivery to a DOH certified laboratory for analyses. The PBWN Guidance requires at least one day of satisfactory samples before rescinding (lifting) the notice. Laboratory test results of the samples must be provided to the regulatory water agency prior to rescinding the notice. Request the lab to send those results directly to the regulatory office. If there is a water main break, two consecutive days of samples are required to be satisfactory. If any sample is found to contain coliform bacteria, the boil water notice must be sustained, and two consecutive days of satisfactory samples are required before the water is deemed safe to drink. Whichever entity (the Water System, DEP, or CHD) issues the PBWN, must also properly rescind it after the above task list is completed.

DEP approved Standard Operating Procedures (SOP's) for sampling and analysis can be found at: http://www.dep.state.fl.us/labs/qa/sops.htm.

Contacts for Additional Guidance

If there are any questions regarding the information in this letter, please contact either your DEP District Office drinking water program staff or Approved County Health Department drinking water section. The rule referenced Precautionary Boil Water Notice Guidance with notice and rescission examples are online at: http://www.doh.state.fl.us/environment/water/manual/boil.htm

Prioritizing to Re-establish Water Service and Minimize Contamination

The priority for an assisting agency will be to restore drinking water service to a safe and reliable condition. However, inoperative lift stations and wastewater facilities will threaten drinking water sources if left inoperable for long. Since resources will be limited, it is imperative that the assisting agency work with the receiving agency to establish restoration priorities. The list below is a suggested priority restoration schedule. However it should be adapted to the specific conditions at the location based on the impacts to public health.

Suggested Priorities for Restoring Service in Disaster Areas

1. Water – Wells, Supply & High Service Pumps
2. Lift Stations – Get wastewater out of the streets & homes
3. Water Quality – Disinfection if deficient
4. Wastewater Treatments – Operational
5. Water Pressure & Leaks – Locating / Isolating Leaks, Storage Issues

Chapter 8: Procedures for Response and Receiving Agencies for Restoration Activities

Preparation Procedures for Receiving Agencies

Being prepared to receive assistance in the wake of a storm is just as important as responding to someone in need. The receiving agency can do much to make the recovery go quickly and efficiently. Being ready when the responder utilities show up and putting them to work will include providing system information and in some cases facilities for their use.

Preparation of System Maps

System maps showing locations of key facilities will be needed. Some receiving utilities are prepared to provide CD's of their utility Geographic Information System (GIS). Other utilities are providing complete hard copy maps and data sheets. There is also some discussion of placing utility GIS on the World Wide Web by other utilities. Global Positional System (GPS) coordinates can be vital since road signs tend to disappear and the landscape can drastically change. Street addresses for each facility are necessary since many map software packages operate from street addresses and have proved very helpful in navigating damaged areas. Data for water wells, water treatment facilities, pumping stations, wastewater treatment facilities, and lift stations should be provided. Information that would be helpful includes pump types and motor specifications, treatment processes, and flow schematics. Valve maps with locations shown can be important since many of these tend to get covered. Identifying make and model of generator receptacles can help responding teams prepare. Maps and system information should be stored outside surge areas and in waterproof containers if possible. If it's necessary to provide responders direct access to data stored on the server of the receiving utilities, it is advisable to place the information in a separate file and protect it with a password for use by the responding utilities.

Providing Shelter and Sleeping Arrangements

Providing shelter and sleeping quarters or arrangements will be very helpful. Responding utilities are expected arrive self-sufficient and ready for any conditions except for a place to sleep and shower out of the weather. Some utilities set up to feed responding workers. Some are able to provide cots but air mattresses seem to be a quick and easy way to provide a decent place to sleep. An extended stay by a crew will necessitate laundry facilities. The responding utility workers will arrive prepared to work 12 - 16+ hour days and that must be factored into their accommodations.

Security and Storage of Service Vehicles and Equipment

A place for the trucks and equipment must be found so that security is not a concern. Most crews will want to be near their equipment and other belongings. Round the clock access at the secured facility must be available if at all possible.

Identifying Work Task for Responder Agency

Be prepared upon the arrival of the responding crews to provide them assignments immediately. Have a map highlighted with the system that needs coverage as well as specific locations and tasks itemized that can be handed out. If at all possible, do not have the crews wait to go to work. This means that priorities need to be understood and be ready to put into action. The receiving utility may not know in advance the number and capabilities of responding crews so they must be ready to deal with what assistance arrives. In the FlaWARN experience in Mississippi, it was found that no preparation had been done for receiving assistance. In most cases, utilities needing aid had no staff available to assist and no maps to disburse. This makes the task or providing aid much more difficult generally although, the crews that arrive will be able to handle even that situation.

Identification of Special Receiving Agency Safety Requirements

Before the dispatch of responding crews, they need to be made aware of any potential safety issues and should be given the keys to control panels, motor control centers, and hatches. Written lockout/tag-out documents are helpful. Knowing disinfection processes will be vital although crews will be prepared to identify and handle just about any disinfection process.

Providing Points of Contact to Responder Agency

Provide responding crews with points of contact with the utility. The points of contact should be readily available at all times. If there are open accounts for materials and supplies and it is cleared for the responding crews to use them, have the appropriate purchase order numbers or identifying information available is necessary.

Curfews and Checkpoint Considerations

If crews arrive after curfew, please make arrangements at the necessary checkpoints to allow them access or arrange to meet and escort them to the facility. Security credentials, that include a picture ID from your utility, will facilitate travel through checkpoints. SERT badges issued through the Florida Department of Emergency Management are necessary to travel through restricted sites and for accessing county EOC command centers.

Equipment Operation Qualification Requirements

If only equipment is being provided by the responding utility, then the receiving utility must be prepared and qualified to use it properly. In this situation it is important to always treat equipment as your own and to return it to the responding utility in like or better condition. This is the good neighbor policy and at the heart of mutual aid. Additional information and guidelines have been provided in other sections of this document.

Proper Assessment and Prioritization of Receiving System Requests

While making physical arrangements, the receiving utility must also be cognizant of the incoming requests for assistance. It is unlikely that enough people and equipment will be available to handle all requests immediately; therefore these resources must be apportioned so that the greatest good is done for the greatest number. Prioritize your needs as soon as assessments are made. Here are some non-optimal requests that have been experienced:

1. Some requests have been general in nature. Such as: "all lift stations are down and I need every available vacuum truck." More specificity needs to be provided in the request.
2. Requests exceed reasonability standards. Such as: I have 167 lift stations down and I need 167 generators.
3. Requesting equipment even though your own is not being fully utilized just in case something else happens.
4. Requesting assistance based on field reports. These requests can be unreliable and can be very outdated. The most accurate information will be obtained from utility field assessments using the forms provided in this document.

It is important that the receiving utility points of contact get out in the field to understand the situations and be able to relay these in a timely manner that gets assistance on site and prepared to work quickly and efficiently.

As a receiving utility, please keep in mind that many other utilities in the area are in the same situation. Responding utilities will arrive to help get the system in some degree of service. They are not there to help return the facility to normal operations. Construction and longer term rebuilding activities are the responsibility of the host utility. Being able to efficiently utilize assistance when it arrives not only helps the utility but it helps the community.

Consideration in the Selection of Responding Agency Team Members

Responsibility for selecting response team members after a disaster can be difficult due to the long list of volunteers. Finding the right people out of that list will be an exercise in management.

Desirable Characteristics for Response Team Members

Following are some qualities team members should exhibit.

- The right attitude, a positive attitude and a history free from complaining
- A proven ability to work together in a team environment
- Willingness to "rough it" for many days
- Confidence they are capable of handling any situation
- Ability to control their temper and their emotions
- A proven record of being able to work under stress
- A strong work ethic and be willing to take on any task whether in or outside their specialty

The team members should be in reasonably good health and have an up-to-date inoculation record. While working long hours they must be able to remain alert at all times in all conditions. Team members will be expected to look after each other and care for their equipment. Needless to say, they should be experienced with water and wastewater work and have the ability to work independently. Experience with past restoration projects will be that much more valuable on a new assignment. The desire to do a good job at all times under any condition is important while not letting poor working conditions or lousy weather be an impediment. Most importantly, their attitude must be spiced with a heavy dose of altruism.

Management and Supervision of Response Team Members

An experienced system manager should accompany the crews if possible. This manager can be the team leader and be well versed in all aspects of utility operation. Crews can go to work immediately upon arrival while the manager is doing a more complete assessment of the overall situation. The manager can be the buffer between the assisting crews and the receiving utility managers and crews until a rapport is established or they can establish an overall work plan. In Mississippi, hostility to responding utilities was a common first reaction. An experienced manager can overcome this initial hostility and gain the trust of the receiving utility. As more and more states enter into mutual aid agreements, accepting help will become easier and more common.

Desirable Licenses and Training for Response Team Members

Credentials for team members include:

- CDL's with endorsements
- Confined space entry training and trench safety training
- First aid training including CPR and defibrillator use
- Hazmat training
- Use of personal protective equipment including SCBA
- Lockout/tag out training and electrical safety training

- Heavy equipment certification
- Fire extinguisher training
- Training in the use of Power Operated Equipment including chain saws

Skills needed may vary but usually the more experienced personnel should be first in line to go no matter their specialty. Some of the skills needed include:

- Master Electricians
- Electrical technicians
- Instrumentation technicians
- Heavy equipment operators
- Equipment maintenance staff
- Plant and station operators
- Distribution and collection technicians
- General laborers
- Mechanic, skilled in diesel, automotive, heavy equipment and generators
- Procurement specialist

Since it will be impossible to equip a work team with individual specialists, it is best to choose personnel that have knowledge of these work skills and are self-motivated to provide assistance in supporting the response effort wherever and to whomever it may be needed.

Consideration in the Duration of Restoration Work Assignments

Teams should be planned for 7 - 10 day rotations with overlap of at least one day when the relief crew arrives so knowledge can be transferred. Some team members will be reluctant to rotate out at all and the manager must make a determination if that will lead to harm in any way.

Observing Responder Agency Work Rules and Union Agreements

Before dispatching crews, union agreements and work rules must be clarified and modified for any special conditions. Compensation issues must be addressed. Reimbursements for any personal items brought along for benefit of the team should be clarified. Some team members may want to bring travel trailers or RV's to assist with accommodations and payment for these must be decided prior to deployment. Crews must understand that they are going to a scene of human misery, shock and loss of focus due to the overwhelming job ahead. Crewmembers must be able to effectively carry out their mission in this environment. The emotional preparation must not be neglected. The crews must understand that they are not there to hinder, they are there to help and keep in mind that the receiving utility does not belong to them and they are not in charge of the recovery. Their assignments will come from the utility operator. In actuality, crews may find that they are asked or welcomed to taking over all aspects of a recovery but gaining the trust of the receiving utility must happen first.

Chapter 9: Organizing Work for First Responders

Triage Mission of First Responder

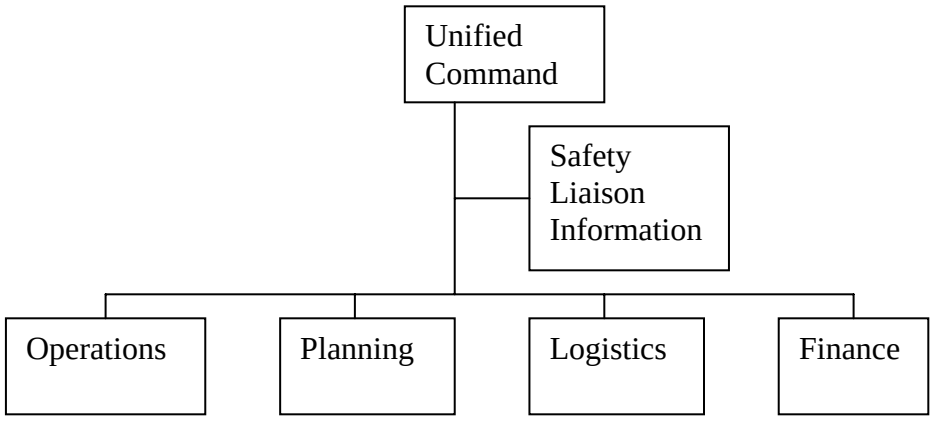
The mission of the first responder is to restore water and wastewater facilities to operating conditions that provide adequate service levels to the population affected. It is not the mission of first responders to make permanent repairs to equipment or initiate long-term corrective actions.

First responders should be able to maintain their own existence for a period of ten days; this includes water, food, bedding, and personal supplies, including their own medicines.

Establishing an Incident Command Operations Center

Because responder restoration activities many times involve personnel from multi-agencies, establishment of a coordinated management structure should be the first item of business for the first responder.

The Incident Command management structure is very effective in situations where many different agencies will be involved with the restoration activities. The five management functions shown below are the foundation of the Incident Command structure and can be used effectively by a first responder upon arrival. An Incident Command organizational chart is shown below:



Incident Command sets incident objectives, strategies and priorities and has overall responsibility for managing field operations. The major function and responsibilities for each personnel assignment are shown on the next page:

Major Function	Responsibility
Operations	Develops tactical objectives, conducts tactical operations to carry out the plan and directs all tactical resources
Planning	Prepares Incident Action Plan to meet incident objectives, collects and evaluates information, and maintains both resource status and incident documentation
Logistics	Provides support, resources, and all services to meet operational objectives
Finance/Administration	Monitors costs, provides accounting, procurement, time recording, and costs

These responsibilities are assigned to one or more responder staff depending on the size of the effort. It is essential however to have one employee on the team that is accustomed to working with higher management staff, coordinating repairs with local government officials, identifying priorities and alternatives, and organizing work groups to effectively return systems to operating conditions.

It is also essential that responsibilities for coordinating work with other relief agencies such as the County EOC, COE and FEMA be assigned to a responder staff member. First responders need to work with local, state, and federal agencies, to bring the system back on line as soon as possible. Long-term responders will be able to better make repairs based on the first group's information received during the first ten days.

Logistics is also important upon arrival. The proper type of equipment and trained manpower will be essential in making needed repairs. Assure that equipment and manpower sent to the site has been adequately described and can provide the support they have been sent there to accomplish. This analysis is essential in requesting additional resources for the restoration effort.

Equipping Response Teams

Crews must be properly equipped. Supplies and equipment must be sufficient to carry out the mission for at least 7 days without re-supply.

Each crewmember must bring their personal supplies such as shaving cream, toothpaste, blankets and pillows, soap, shampoo, towels and washcloths. Work clothes for an extended stay are needed. Changes of boots and shoes should be brought along. Duffle bags are particularly handy for transporting personal items. At a minimum, the team leader must take cash and credit cards along. Each crew should have cash with them at all times.

In addition to personal necessities many other items necessary for self-sufficiency must be packed for at least a 7-day stay. Among the things that should be considered are:

- Cameras and film
- Rain Gear and safety vests

- Watches and alarms clocks
- Sewing kit
- Spare batteries for all battery operated equipment
- Flashlights
- Aspirin, antiseptics, antacids, bandages, gauze pads
- Paper towels and wet wipes
- Eating utensils
- Reading material
- Water bottles and day packs
- Sun screen and insect repellent
- Pen, pencil, notepaper

While it is difficult to ascertain the exact work to be done based on anticipated damage, experience has shown that in the event of a major hurricane the initial damage assessment should read – "everyone needs everything." Therefore take the equipment that will be best utilized. Included in this may be:

- Generators
- Bypass pumps
- Service trucks
- Excavation equipment
- Diesel fuel tanks, either truck mounted or skid mounted
- Miscellaneous repair parts and equipment such as pipe, fittings, and electrical parts

The tools and supplies needed to perform repairs may cover a large range since precise damage cannot be ascertained at the time of deployment but the following have been items that have proven useful:

- GPS and Mapping software with laptops or handhelds
- Shovels
- Chainsaws
- Nighttime project lighting
- Wrenches, socket sets, pliers
- Valve wrenches and extensions
- Barrel pumps, either electric powered or manual
- Volt meters
- Amp meters
- Insulated screwdrivers
- "Hot gloves"
- Wire stripper
- Hacksaw
- Electrical lugs and various wire sizes for short splices
- Electrical tape and wire connectors
- Pipe repair clamps

- Small single phase generators
- Chlorine tablets (these were needed everywhere in Mississippi)
- Spare chlorinator and chlorine injection pump
- Bolt cutters

Crews will be going into areas for which there are no supply outlets and no services of any kind. Being properly equipped becomes that much more important. It is impossible to predict the specifics needed to affect a recovery so being stocked for the broadest range of circumstances is very important.

Coordination of First Responders with FlaWARN

Each City, County, or Authority has an Emergency Operations Center or staging area that should have employees designated as the FlaWARN contact point for the First Responders Team that has traveled to the location of the emergency. Coordinating with these centers will be important since it is likely that new work tasks will be added as progress is made.

Setting Operational Priorities for First Responders

Addressing public health issues should be the first concern when entering the disaster area. The restoration of water service is always the first concern. In most cases, the loss of power will dictate the installation of power generators. Establishing water pressure will help in fire fighting and clean up efforts and that is important but making the water potable is paramount and urgent. Wells need to be energized and then need to be cleaned up. In most cases, super-chlorinating is necessary with flushing to obtain a reasonable residual. Some pressure in the distribution system is necessary so that leaks can be ascertained and repaired or isolated. Rescinding boil water advisories is important and knowledge of local regulations in this arena is necessary. The rules for lifting boil water notices are not the same from state to state. Getting chlorinators and chlorine injection pumps repiped and running needs to be a concentrated effort. Finding the equipment, tubing, and fittings can be challenging.

Environmental issues such as overflowing lift stations need to be addressed next. After concern for medical facilities, operations centers and shelters, lift stations will be the next priority for restoration. In some cases addressing lift station contamination potential can prioritize these. Procedures for performing this analysis are provided in another section. An overflowing lift station will contaminate water supplies, disrupt traffic and can impede the operation of critical government and medical facilities. Wastewater treatment plant issues should be addressed quickly since without their operation, it may be difficult to put upstream lift stations in service.

Wastewater treatment plant issues should be addressed quickly since without their operation, it may be difficult to put lift stations in service. Some level of service needs to be provided to wastewater treatment facilities. If at least flow cannot be established through the plant, it will result in “solids on the ground” at the plant site. During Katrina, many plants in Mississippi were inundated. Control panels and motor control centers were rendered inoperable. Clarifier

drive motors and aeration equipment was damaged and inoperable. All these had to be cleaned, dried, and/or rebuilt or replaced. In one case in Mississippi, one vessel in the plant was able to be operated at a low treatment level before discharging to surface waters but it did enable lift stations to discharge and prevent sewage from spilling on the ground in populated areas.

Environmental issues such as overflowing lift stations need to be addressed next. In some cases going after stations near population concentrations first can prioritize these. An overflowing lift station at the Hancock County Medical Center in Mississippi after Katrina became a great priority. A heroic effort to stop this hazard was successfully performed.

The largest issue getting lift stations in service is getting power to them. In most cases the physical damage is not great so getting hooked to a generator is the main issue. In Florida, generator receptacles are installed on most lift stations; however, there is no standardization on receptacles so finding a male to female match may involve luck. Direct connection to the control panel terminal posts should be contemplated and may be the only way to get connected. Only experienced electricians or electrical/lift station technicians should be involved in this activity. Entire control panels may be destroyed in which case a skeleton set-up for connection to pump motors must be rigged. If grid power is available at the time a more extensive control panel needs to be built and installed. Scavenging parts and pieces from other locations may have to be done in order to rebuild or build a control panel. Extreme care should be employed when working on electrical equipment since grid power can be re-established without warning.

Damage Assessment

Information about the conditions of water and wastewater facilities in a severely damaged area may be sketchy or non-existent. It is unlikely that enough people and equipment will be available to handle all requests immediately; therefore these resources must be apportioned so that the greatest good is done for the greatest number. Here are some non-optimal requests that should be expected:

Non-Optimal Requests from Devastated Areas

1. Non-Specific Information: Example; "all lift stations are down and I need every available vacuum truck." More specificity needs to be provided in the request.
2. Non-Reasonable Equipment Requests: Example: "I have 167 lift stations down and I need 167 generators."
3. Requests for Standby or Redundant Equipment: Example: " I need additional generators for those that will fail."
4. Requests for Assistance based on Outdated Field Reports. Example: "All systems are completely down and not repairable."

These types of requests will impede restoration efforts and it is incumbent upon the Responder to obtain reliable, specific, substantiated, field information.

It is important that the receiving utility points of contact get out in the field to understand the situations and be able to relay these in a fashion that gets assistance on site and prepared to work quickly and efficiently.

Damage Assessment should proceed in the following manner:

Damage Assessment for First Responders

1. Send out a team to determine the number of leaks within the system and the location of the line. Evaluate the impact of the spill based on the environmental surroundings.
2. Evaluate the damage to the facilities in the community and prioritize repair of the facilities with consideration to flow, customers and emergency services located in the same proximity.
3. Report the information to the ICC. First responders should also be equipped with a satellite phone to be able to have communications if none are available.

Perform Damage Assessments on Individual Lift Stations

1. Have Lift Station maps with G.I.S. locations available.
2. Compile list of Lift Station priorities for power providers that will require power so that there are fewer back-ups to hospitals, medical offices, food stores and shelters to limit impacts on the community.
3. List of stations that have are equipped with emergency power but will require a re-fueling schedule. Determine that roads to stations are accessible for fuel trucks, and that you've made arrangements for with the fuel depot.
4. Develop schedules for staff working 12-hour shifts with breaks for food and rest.
5. Develop a schedule for pumping stations down that do not have power but would have an impact on the priority list created in item b.
6. Develop an emergency center where staff can bring back work orders and cost factors for personnel in the emergency center to calculate and transpose to FEMA reports and records
7. Develop and practice good safety procedures with staff that are being sent as first responders relating to electrical issues, first aid, and respiratory issues.

Perform Damage Assessments on Wastewater Treatment Plants

1. Complete damage assessment of facilities to determine priorities for repairs.
2. Establish that emergency power is available and on-line if or when necessary.
3. Develop and schedule re-fueling for emergency generators based upon loads and hourly fuel consumption, along with storage capacity.
4. Institute modified personnel shift rotations based upon Emergency Response Plan.
5. Exercise any unit by passes due to extreme abnormal flows.
6. Institute disinfection dosing rates due to conditions of abnormal flow, consider higher long-term dosing rates and make plans for chlorine deliverers.

7. Make sure that you have good supervisors with each crew you send (water, wastewater, lift stations, etc.) due to the locals not sure of what really needs to be accomplished.

FEMA Work Documentation Requirements

Financial recovery is an essential aspect in any restoration effort. The key to successful financial recovery when providing aid to other communities is consists of three items:

1. Documentation
2. Communication
3. Follow-up

The following are guidelines for documenting responder restoration work activities:

Documenting Restoration Work Activities

1. Establish authorized contacts in impacted area
    a. Have at least two (2) contacts in the impacted area that can assist with directing work crews in the relief effort

2. Keep a detailed daily log of assigned recovery activities, for example:
    a. Type of vehicle used and miles logged
    b. Type of work assigned and completed (include personnel assigned to effort)
    c. Type of equipment used and/or loaned
    d. Give a brief description of work performed (i.e. 6" water line repaired). Be specific as possible; identify street name, address, intersection etc.
    e. Log hours worked for both regular-time and overtime
    f. Log meals, lodging arrangements, and other required items purchased

3. Use digital cameras, PDAs, laptops to facilitate detailing recovery effort
    a. Most PDAs have the ability to take digital photo and act as a recorder. Use technology to capture "before and after" pictures.
    b. If necessary, use administrative personnel to dictate front-line work over the phone to get a good coherent log of events and recovery effort.

4. Retain all receipts
    a. When possible use purchase or credit cards
    b. All cash advances must have receipts to be reimbursed
    c. Have a debriefing process once employees return from relief effort
    d. Have employees turn-in logs, receipts, photos, recovery documentation within twenty-four (24) hours of their return

5. Scan all recovery documents submitted for reimbursement

6. Establish contact(s) for the reimbursement and follow-up process

Labor costs are typically the bulk of the reimbursement request so it is important that you maintain records to justify all labor charges and benefit rates. It is equally important that those responsible for billing be familiar with and updated on FEMA reimbursement rates that are subject to change.

Standard reporting forms for FEMA documentation and reimbursement are very helpful and have been developed and are available through FlaWARN. Sample forms are found in the Appendix.

FEMA Schedule of Equipment Rates

FEMA maintains a schedule of allowable rates for both labor and equipment for work performed in restoration efforts. This Schedule is periodically updated. It is recommended that responders and contractors obtain a current copy of the schedule. It can be down loaded from the FEMA web site by searching: FEMA Schedule of Equipment Rates or at: http://www.escambia.k12.fl.us/eert/fema/Equipment.

Organizing Emergency Responder Work

An emergency responder, team leader or situation leader must give careful consideration to where to base response efforts. This is commonly referred to as a “staging area”. The staging area will be the base of operations. It should help protect equipment from theft and vandalism, facilitate access to work locations, and provide a place for organizing response efforts. It may also provide a location for personnel accommodations such as eating, sleeping and personal security for crews.

Selection of a staging area will depend on how the response is organized. An organized FlaWARN or FRWA effort may include a secure utility staging area for equipment in a centralized area close to the damage work area. In many cases sleeping arrangements may be located away from the staging site.

Many responders will be working out of a variety of vehicles. These may include standard or extra duty pickup trucks; lift vehicles, tractor-trailer vehicles, etc. Remember that any response effort must first have a centralized location to house equipment and dispatch it to the work areas. Some equipment may serve multi-purpose use for transporting fuel, materials and employees to job sites. Keeping equipment in one location is highly beneficial.

First responders may be tasked with locating an area to stage equipment and work crews. Typically this begins by making telephone calls to response coordinators such as FlaWARN or FRWA. Sometimes calling damaged utilities directly may be more effective. Communication may include email exchanges and preliminary assessment meetings to determine types of equipment and personnel needed in the response efforts and what responsibilities must be covered. There may not be any communications near the impact area due to the loss of power and phone service.

It is recommended that the response effort start as early as possible after a storm hits. First, determine the locations where assistance may be needed. Remember that hurricanes are unpredictable and severe damage can occur several hundred miles from landfall. Make sure that response organizations know that you are available to assist. Call utility managers in the storm's path before the storm and make your availability known. Familiarity and proximity to the damaged area can be highly beneficial. Becoming a member of FlaWARN is a good way to get that message out. FlaWARN can coordinate the organization's resources where they are most needed.

After the storm makes landfall there will be a short lag period as damage assessments in the area are being made and these assessments may take a few days. Attempting to assist before assessments are complete is highly counterproductive. Attempt to be as flexible as possible in lending assistance. Remember, help is in the eye of the person making the request. The damaged utility will have the best insight as to what is damaged and how to best respond. Also be flexible in selecting response location(s). You may be called upon to send assistance to several locations depending on your utility's capabilities and on the severity of the storm.

The need and location of staging sites are usually determined by the damaged utility(s). Getting to the damaged area quickly from the staging area will be the most important consideration. Expect many limitations and challenges. The following outline is intended to offer guidance. Enlist help from several individuals who have geographical knowledge of the area. This knowledge base will provide a much clearer snapshot. The best choices may be medium to large sized utilities located just outside the impact zone. Utilities within this zone may not have any essential utility services.

Advance Team

1. Arriving early will be essential to ensure timely restarting of affected water and wastewater utility services.
2. Early advance teams should carry area maps. Plan on having a large wall map of the affected area as well. This map will be used in coordination meetings to accurately deploy teams of responders as needed. The map will be the focal point and will assist in the exchange of knowledge.
3. Early advance teams can be more effective than one individual.
4. As the early advance team travels into the affected area note passable routes and fueling locations and communicate this information back to response teams early on to allow them time to effectively prepare their approach. By relaying this level of familiarity to responders, they in turn may be better prepared.
5. Communicate route and fueling locations to state EOC and FlaWARN folks as well so they in turn can assist others.
6. Remember to include items such as chain saws, fuel, and personal protective gear such as gloves, boots etc., that may need to make it into the affected area.
7. The arriving advance team should be prepared to become self sufficient by having adequate food, water, cooking utensils, grills (portable of gas), cook stoves, spare cooking fuel, crock pots, coolers with ice and plenty of drinks, chairs, ground tarps, smaller portable generators, extension cords and small cooking tables. Prepare before leaving home as if for an extended camping trip.
8. Communications into or out of the damaged area may be unstable or non-existent; make plans to relay information prior to reaching core-damaged areas. Plan an alternate form of communication, for example, designate someone that would travel to a usable telephone, or travel away from damaged areas to cell phone range. This option may provide the only form of communications out of core damaged areas, and be acceptable at least until cell phones are back in operation.
9. In addition, the goal is to arrive in an area suitable for responses, and set up a mobile office. This office would need notepads, pencils, highlighters, permanent markers, tape, note boards, staplers and paper clips for example.

Location

1. Limit driving distance. The staging area should be as close as possible to the planned area of response. Locate outside of the affected area 60 to 75 miles for the first several weeks. Generally speaking, after 3 to 4 weeks it is possible to move closer to the affected area as repairs are made to utility services.
2. Probably the absolute best staging areas will be the ones that can be initiated at medium to large sized utilities outside of the impact zone. Obviously, these locations offer what others will not in terms of ready crews, equipment, fueling locations, manpower, parking areas, electricity and other essentials. Some other examples, which incorporate some of

these items, are: Schools, campgrounds, parks, large civic and convention centers and fairgrounds.

3. The staging area should be centrally located in relation to response area. Plan to establish the staging area within 24 hours following the storm.
4. Staging area size. The response effort will be aided by allowing the physical room for responders, their equipment and travel trailers, motor homes etc.
5. Ease of access. Responders may not be mentally sharp at all times due to fatigue, therefore attempt to locate an area that has ease of entry and exit for large pieces of equipment and smaller vehicles.
6. Try to select a site that is unaffected by or has very limited damage from the storm. National Guard staffed water and food stations may be a good selection.
7. It may be necessary to track arriving crews depending on the size of the response. Communicate to crews the time of initial deployment and scheduled coordination meetings. Ask responding crews to pass the word around if possible. Plan daily coordination meetings; develop an effective communications list exchanging cell phone numbers, CB radio information and team member names. Track team locations and work assignments and chart repair progress on your wall maps.
8. Group response teams as needed to cover the damaged areas. Coordinate fueling efforts with each team leader. Team leaders and fueling operators meet at each coordination meeting, note fueling locations and any changes in crew locations.
9. Be sure to effectively communicate regular status reports to state DEP, Emergency Offices, FlaWARN and the next wave of responders.

Identification Requirements in Hurricane Damaged Areas

Because curfews, vehicle inspections and security at emergency operation centers and compounds is likely to be in place, each responder should obtain a SERT identification badge, These can be obtained by contacting Greg Lee DEP.

Greg.Lee@dep.state.fl.us or esf10dep@dep.state.fl.us

Security at Staging Area Sites

1. Locate the staging area in such a way that side roads, fencing, security lights and the physical location provide a limited access point. Do not place responders in a location, which jeopardizes their personal safety or the safety of their gear and equipment. By having a limited access to the staging area, situations where curious onlookers may place themselves and others in harms way can be eliminated.
2. This safeguard may not be achieved in some locations, in this event consider alternatives such as: barricades, reflective tape and traffic cones. Contact with the area law enforcement personnel requesting some patrols in the area is another option.

3. Security should include personal security as well as security of responding equipment, trucks, trailers, campers, motor homes and automobiles.
4. It is recommended that the responding utility assign a managerial employee to oversee tasks such as time reporting, delegation of work assignments, maintaining appropriate levels of discipline, and making decisions on behalf of the responding utility.

Food and Fuel for Utility Response Personnel

1. One of the most important considerations is how to adequately feed utility response personnel. In many instances storm damage has shut down restaurants and grocery stores. It may be possible to find some places still in operation, but remember that all telephone lines may be down therefore credit or debit cards will be of no use. This could mean that responders would need cash to purchase food items if not provided elsewhere. MRE's are a great food source in emergencies.
2. Responding crews may not be able to locate meals during their workday. Circumstance may dictate providing food through a mobile kitchen arrangement.
3. Some of the utility crews will arrive at the staging area with their own fueling trucks. In order to keep these units working in the recovery effort a ready source of nearby fuel will be needed. Fueling sites may be set up for responders and proper identification may be needed. Contact FlaWARN to locate these fueling sites. A mobile fueling truck or a plan to transfer fuel at base staging area will be needed.

Personal Accommodations for Utility Response Personnel

Response crews will work long hours and will need reasonable accommodations to recharge and be ready to return to work the next day. Air conditioned sleeping arrangements are by far one of the essentials, as well as hot showers (may need as many as 6 to 8 stalls depending on number of responders) and a potable water source. Meals or the ability to feed large groups of people, close by fueling stations, and access to retail stores are a necessity as well. Response teams will need to prepare personal items. A list of suggested items is provided:

Personal Gear, Tools and Equipment for Utility Response Personnel

- Cash, credit cards, business cards and personal identification, area maps, cell phones and chargers
- Clothing for 6 to 10 days (including gloves, boots, hat, large duffle bag, rain gear, day pack)
- First-Aid supplies (including aspirin, Tylenol, personal medication, bug spray, sunscreen)
- Food (including high protein snacks, granola bars, bottled water)
- Meal preparation needs (including cook stove, matches, garbage bags, utensils)

- Miscellaneous items (electricians and duct tape, extension cord)
- Personal items (including pen, paper, notepads, alarm clock, flashlight, radio, batteries, watch, fan, sunglasses, sewing kit, pocket knife, calculator, camera)
- Sleep provisions (including tent, sleeping bag, blankets, sheets, ground pads, cot, pillows)
- Toiletries (including soap, shampoo, toothbrush and paste, shaving supplies, mirror, anti-bacterial gel, wet wipes, toilet paper, paper towels)

Additionally, crews should be outfitted with tools and equipment that are appropriate for the jobs they are expected to perform. Remember in post hurricane response work, standard electrical repair parts, electrical wire, pipe fittings, wire lugs, electrical taped, etc. may not be available. Maintain inventories of standard parts and supplies for a wide range of repair work. Generally, responders will send service trucks fitted with tools and inventories of spare parts and equipment. Specialized equipment such as pipe locating equipment, water sampling kits and a laptop computer for recording information can be extremely valuable in many situations.

Chapter 10: Loaning and Receiving Equipment in Responder Operations

Transferring and Loaning Equipment

The aftermath of a major hurricane will result in severe resource shortages. Utilities will be called upon to lend equipment to damaged areas. The purpose of this best Management Practices Guideline is to ensure that the transferring and loaning of equipment during hurricane response is performed in a manner to promote efficient use of the resources while protecting the interests of the loaning agency.

Membership in the FlaWARN Mutual Aid and Assistance Network (no matter the size of the system) ensures that labor and equipment resources are dispatched as effectively as possible. Membership in the FlaWARN Network includes a mutual aid agreement that provides for efficient deployment and tracking of loaned equipment and loaned labor resources. Membership in the FlaWARN Network also ensures that Loaning Agencies are compensated for the use of resources and for any equipment damages that may occur through a reimbursement agreement.

Entities not working through the FlaWARN Network should develop separate Mutual Aid agreements between each entity that provides assistance. The Agreement should describe the procedures for lending equipment, for providing labor resources and for compensation by the Receiving Agency to the Lending Agency.

Best Management Practices for Loaned Equipment

The following Best Management Guidelines have been found to provide for the efficient procurement, security, deployment and operation and maintenance of loaned equipment and it is recommended that Loaning and Receiving Agencies use them to avoid problems that may develop during or after equipment is used by the Receiving Agency.

Equipment Description and Contact Information to Be Recorded by the Loaning Agency

Lending utilities should record the following equipment information prior to arrival at the damaged location.

1. Owner of Equipment
2. Manufacturer of Equipment
3. Type of Equipment
4. Serial # and Model # of Equipment
5. Authorized Agent for Loaner's Equipment
6. Mailing Address and Phone Number(s) of Loaner Agency
7. Current Hours on Equipment

8. Physical Condition of Equipment

Receiving Agency Contact Information to be recorded by the Lending Agency

Lending utilities should record the following information from the Utility where the Equipment is being received:

1. Utility Name
2. Physical Location of Equipment and Mailing Address, Phone Numbers
3. Address and Location where Equipment is received, i.e. water/wastewater plant, utility compound, etc.
4. Location Physical Address, i.e. major intersection, street etc.
5. Authorized Party name, title and phone numbers
6. Who's responsible for checking equipment, i.e. fueling, maintenance etc

Equipment Transfer, Inspection and Contact Information to be recorded by the Receiving Agency

The Receiving Agency should record the following information to ensure that Lender Equipment is free from damages and ready for field deployment when received.

1. Owner of Equipment
2. Manufacturer of Equipment
3. Type of Equipment
4. Identification # and Model # of Equipment
5. Authorized Party of Equipment
6. Physical and Mailing Address, Phone Numbers
7. Current Hours on Equipment
8. Physical Condition of Equipment

Field Deployment and Set-Up of Lender Agency Equipment to be recorded by Receiving Agency

The Receiver Agency (or the Lender Agency if field setting equipment) should record basic information to ensure that equipment is properly tracked, secured, and operated and maintained in good condition.

1. Owner of Equipment
2. Manufacturer of Equipment
3. Type of Equipment
4. Serial # and Model # of Equipment
5. Authorized Agent for Loaner's Equipment
6. Responsible Party and Contact Number(s) of Receiving Agency

7. Physical Condition of Equipment and any Special Operating or Maintenance Requirements
8. Physical Location, i.e. major intersections, directions to site location
9. Utility Designation. i.e. lift station number or utility name
10. Name of Agency and Responsible Party for Fueling and Maintenance
11. Address of Set-Up Location
12. Method used to Secure Equipment, i.e. chain or security lock and who has keys

Recommended Procedures for Transfers of Loaned Agency Equipment to Other Entities

Other utilities will be calling asking for equipment. Lending Agency equipment should not be transferred to another utility without written permission from the Loaning Utility. Loaning Utilities shall be notified by the Receiving Agency before proceeding with such action.

Responsibility for Equipment Security by the Receiving Agency

Receiving facilities shall be responsible for Damages to Loaner Equipment that may occur by theft, vandalism or neglect. The following minimum procedures should be implemented by the Receiving Agency.

1. Establishing a secure staging area
2. Maintaining an Up-to-date Inventory of Received equipment
3. Maintaining Procedures for Deployment of equipment from staging areas
4. Reasonable Security and Safeguarding equipment at all times.
5. Operating, maintaining and repairing of equipment to prevent damage once the equipment has been deployed

Pre-Deployment and Daily Equipment Checks to be made by Receiving Agency for Transport and Set-Up of Portable Generators

Equipment lending agencies should be aware that access to basic maintenance supplies such as oil, filters, belts and hoses will be severely limited in a post hurricane event. It is highly recommended that oil be supplied with the generator and if the equipment is old or has excessive hours that filters, belts and hoses be stored with the equipment to facilitate timely field repairs.

This BMP is targeted toward the lending large three phase generators, however, other equipment such as trailer mounted pumps, mud pumps, single phase generators fuel wagons and VFD motor controllers may also be loaned. In some instances construction equipment such as trailers, back hoes or front end loaders may also be loaned. The same procedures should be used to properly inventory the equipment and appurtenances such as suction and discharge hose or any special operating instructions.

Prior to field deployment and set-up of Lender Agency Equipment the following Pre-deployment Checks should be made. This list shall also be used for Daily checks on equipment while in operation.

1. Check fluid levels, i.e. water, oil and fuel
2. Check battery status and water level
3. Check condition and tightness of belts
4. Check condition of hoses
5. Check equipment for proper power cords and connections; frayed or dirty terminations should be cut off and new terminations established
6. Check to ensure that access panel covers are properly attached and latches are operable
7. Ensure that security locks can be opened with keys that have been provided
8. Check tire pressures and condition of tires
9. Check condition of hitches
10. Check to see that break lights and power brakes are operating
11. Check condition of safety chain and attachment
12. Ensure that pull vehicle is adequate for load and is equipped with proper hitch attachments.
13. Operate Generator in place for 10 minutes; observe run condition (dark smoke likely indicative of dirty air filter, rough operation likely indicator of plugged or moisture in fuel filter)
14. Ensure that emergency power down (kill) switch is working if one is provided

Inspection and Maintenance of Engines on Powered Equipment

Equipment records should be maintained on loaned equipment. The form below is recommended for use to ensure proper maintenance on loaned generators.

Inspection Chart for Servicing Engines on Power Driven Equipment

Inspection and Maintenance of Engine		10 Hrs. Daily	250 Hrs.	500 Hrs.	1000 Hrs.
1	Check Engine Fluid Levels	X			
2.	Check Air Cleaner	X			
3.	Check Battery Acid Levels	X			
4.	Check Fan Belt Condition and Tension	X			
5.	Check for Water, Trans. and Oil Leaks	X			
6.	Check for Loose Parts		X		
7.	Replace Engine Oil Filter		X		
8.	Drain Bottom of Fuel Tank		X		
9.	Clean Unit inside and outside		X		
10.	Change Fuel Filter			X	
11.	Flush Radiator and Replace Coolant			X	
12.	Replace Air Filter Element				X
13.	Check all Hoses and Clamps				X

14.	Check Inside and Outside of Fuel Tank				X

Procedures for Returning Equipment to Lender Agency by the Receiving Agency

Lending utilities and Receiving Agencies should determine the method of returning equipment left with the Receiving Agency. Equipment should be returned as soon as possible and in good working condition back to the Loaning Utility unless there are previous arrangements made. The following information should be recorded:

1. Physical Address, Phone Numbers of location to deliver returned equipment
2. Contact name of person in charge of receiving returned equipment.
3. If equipment is being shipped back by tractor-trailer, the arrangements for unloading the equipment have been identified, i.e. does the loaner have a way to unload the equipment, and will a crane or forklift be needed? Make sure prior arrangements have been made for this before shipping equipment.

Chapter 11: Operating Agreement for Loaning and Receiving Equipment

Scope of Policy and Procedures

These Operating Policies and Procedures and the attached Forms have been found to be extremely helpful to Agencies that Loan or Receive equipment used in post hurricane utility restorations. These policies and procedures address the most common situations that develop and provide effective methods for safeguarding loaned equipment.

Policy Statement

All equipment obtained by the Receiving Agency is subject to Receiving Agency control and may be utilized only in accordance with established agreement between the Receiving and Lending Agencies. Equipment obtained by the Receiving Agency includes that equipment loaned or contracted by public or private Receiving Agencies, equipment received as a gift, or obtained by other means.

Receiving Agencies that procure loaned equipment are responsible for its use, maintenance, and safeguarding. Receiving Agencies are responsible for notifying the Loaning Agency of any equipment status changes such as transfers, breakdowns, destruction, vandalism or theft of loaned equipment.

Receipt and Protection of Equipment

The Receiving Agency shall designate a responsible party and receive equipment at a designated Staging Area. The Designated Receiver Agent is established as the party responsible for securing and safeguarding loaned equipment and is the official spokesperson for communications with the Lending Agency about equipment matters. The Receiver Agent is responsible for tracking the equipment that is deployed for use under this Agreement.

The Receiving Agent is responsible for obtaining relevant data for each piece of equipment, assigning unique identification numbers, recording and maintaining the information on a tracking form using a prescribed tracking system, and retaining equipment records for internal tracking purposes.

The Receiving Agent is also responsible for coordinating the placement of equipment and for maintaining equipment records that are precise and up-to-date.

Receiving Agency Equipment Responsibilities

The Receiving Agency is responsible for ensuring that equipment is used for its designated purpose and that it is properly secured, protected from accidental mishap, vandalism and tampering. The Receiving Agency is responsible and accountable for all equipment provided under the Agreement and agrees to hold harmless and protect the Loaner Agency from all personal and private lawsuits, fines, and judgments imposed by any party, resulting from the transport, placement, and operation of the Loaning Agency's Equipment.

Lost, Damaged, Destroyed or Stolen Equipment

The Receiving Agent is required to have appropriate safeguards in place to prevent loss, damage, destruction, vandalism, or theft of equipment.

If Loaned Agency equipment becomes damaged for any reason, it is the Receiving Agency's responsibility to notify the Loaning Agency as soon as the facts become known. For the purpose of this Agreement damages consist of loss, damage, vandalism, destruction or theft of equipment procured by the Receiving Agency.

Receiving Agency is responsible for any and all damages and shall repair or compensate Loaner Agency as needed to return the equipment to the Loaner Agency in the condition in which it was received by the Receiving Agency.

Equipment Information Requirements

The Parties shall maintain equipment and contact information for each piece of loaned equipment. The following are minimum requirements for each Party to this Agreement.

Information to be Recorded and Maintained by Receiving Agency

1. Owner of Equipment
2. Manufacturer of Equipment
3. Type of Equipment
4. Identification # and Model # of Equipment
5. Authorized Party of Equipment
6. Physical and Mailing Address, Phone Numbers
7. Current Hours on Equipment
8. Physical Condition of Equipment
9. Who's responsible for returning equipment

Information to be Recorded and Maintained by Loaning Agency

1. Facility Name
2. Physical and Mailing Address, Phone Numbers
3. Location of Equipment, i.e. lift station #, water plant etc.
4. Location Physical Address, i.e. major intersection, street etc.
5. Authorized Party name, title and phone numbers
6. Who's responsible for checking equipment, i.e. fueling, maintenance etc
7. Return / Delivery Method

Maintenance Checks to be Performed by Receiving Agency

The Receiving Agent shall be required to exercise prudent utility maintenance practices when operating Loaning Agency equipment. Typical maintenance checks are described below:

Receiving Agency Maintenance and Daily Checks of Equipment

1. Equipment Start up and Shut down - periodic checks of equipment.

   a. Perform minor maintenance checks, such as oil checks, battery, air filters, radiator coolant levels, fan belt tension and fuel level checks on equipment.
   b. Make sure the generator is level. With the dipstick inserted all the way, verify that the oil level is maintained between the two notches on the dipstick. When checking the engine oil, be sure to check if the oil is clean and viscous. If the oil is not clean, drain the oil by removing the oil drain plug, and refill with the specified amount of oil as outlined in the **Engine Operator's Manual.**
   c. Always maintain battery fluid level between the specified marks. Battery life will be shortened, if the fluid level is not properly maintained. Add only distilled water when replenishment is necessary. DO NOT over fill.
   d. Periodic cleaning/replacement is necessary for the air filter.
   e. Day-to-day addition of coolant is done from the reserve tank. When adding coolant to the radiator, **DO NOT** remove the radiator cap until the unit has completely cooled. Make sure the coolant level in the reserve tank is always between the "H" and the "L" markings.
   f. A loose fan belt may contribute to overheating, or to insufficient charging of the battery. Inspect the fan belt for damage and wear and adjust or replace as needed.
   g. Fill the fuel tank with clean and fresh diesel fuel. **DO NOT** fill the tank beyond capacity. Pay attention to the fuel tank capacity when replenishing fuel.

2. Perform routine preventative / corrective maintenance on equipment; for example:
    a. Tires may need to be replaced or repaired if damaged.
    b. Oil and filter may need to be changed and replaced after significant hours on equipment.
    c. Air filter and fuel filters may need to be replaced after significant hours on equipment.
    d. Cleaning and minor touch up painting may be needed on equipment.

Minimum Safety Requirements to be Employed by Receiving Agency

The Receiving agency agrees to conduct safety inspections, follow safety rules for equipment, and also develop and conduct tailgate safety meetings to inform those responsible for the transport, mobilization, set-up and operation of Loaning Agency equipment is conducted according to prudent utility practices.

The Receiving agency agrees to refer to operating and maintenance manual for all equipment safety procedures that are in question.

Chapter 12: Transport of Equipment, Materials and Personnel to Staging Areas

Importance of Safety

Water and Wastewater utilities responding to calls for aid must do so in a safe and efficient manner with sufficient equipment, materials, personnel, and supplies to be able to assist the effected utility. They must also ensure that they are self-sufficient since equipment resources and access may be severely stressed and/or unavailable. Listed are methods for the efficient and safe movement of utility equipment over public roadways.

Pre-Vehicle Inspection

Prior to moving any equipment, basic pre-vehicle inspections should be made on each piece of equipment that will be moved to the impacted site. These inspections guidelines are requirements for CDL equipment and should be used for all equipment that travels on public roadways.

Pre-Trip Vehicle Inspection Checklist

Engine Compartment (Engine Off)

Leaks/Hoses

- Look for puddles on the ground.
- Look for dripping fluids on underside of engine and transmission.
- Inspect hoses for condition and leaks.

Oil Level

- Indicate where dipstick is located.
- See that oil level is within safe operating range. Level must be above refill mark.

Coolant Level

- Inspect reservoir sight glass, or (If engine is not hot), remove radiator cap and check for visible coolant level.

Power Steering Fluid

- Indicate where power steering fluid dipstick is located.
- Check for adequate power steering fluid level. Level must be above refill mark.

Engine Compartment Belts

- Check the following belts for snugness (up to 3/4 inch play at center of belt), cracks, or frays: power steering belt, water pump belt, alternator belt, air compressor belt. Note: If any of the components listed above are not belt driven, you must make sure component(s) are operating properly, are not damaged or leaking, and are mounted securely.

Clutch/Gearshift

- Depress clutch.
- Place gearshift lever in neutral (or park, for automatic transmissions).
- Start engine, then release clutch slowly.

Cab Check/Engine Start

Oil Pressure Gauge

- Make sure oil pressure gauge is working.
- Check that pressure gauge shows increasing or normal oil pressure or that the warning light goes off.
- If equipped, oil temperature gauge should begin a gradual rise to the normal operating range.

Temperature Gauge

- Make sure the temperature gauge is working.
- Temperature should begin to climb to the normal operating range or temperature light should be off.

Ammeter/Voltmeter

- Check that gauges show alternator and/or generator is charging or that warning light is off.

Mirrors and Windshield

- Mirrors should be clean and adjusted properly from the inside.
- Windshield should be clean with no illegal stickers, no obstructions, or damage to the glass.

Emergency Equipment

- Check for spare electrical fuses.
- Check for three red reflective triangles.
- Check for a properly charged and rated fire extinguisher.

Steering Play

- Non-power steering: Check for excessive play by turning steering wheel back and forth. Play should not exceed 10 degrees (or about two inches on a 20-inch wheel).

- Power steering: With the engine running, check for excessive play by turning the steering wheel back and forth. Play should not exceed 10 degrees (or about two inches on a 20-inch wheel) before front left wheel barely moves.

Wipers/Washers

- Check that wiper arms and blades are secure, not damaged, and operate smoothly.
- If equipped, windshield washers must operate correctly.

Lighting Indicators

- Test that dash indicators work when corresponding lights are turned on:
- Left turn signal.
- Right turn signal.
- Four-way emergency flashers.
- High beam headlight.

Horn

- Check that air horn and/or electric horn work.

Heater/Defroster/Air Conditioner

- Test that the heater, defroster and the air conditioner are working.

Parking Brake Check

- Apply parking brake only and make sure that it will hold the vehicle by shifting into a lower gear and gently pulling against the brake.

Hydraulic Brake Check

- Pump the brake pedal three times, and then hold it down for five seconds. The brake pedal should not move (depress) during the five seconds.
- If equipped with a hydraulic brake reserve (back-up) system, with the key off, depress the brake pedal and listen for the sound of the reserve system electric motor.
- Check that the warning buzzer or light is off.

Air Brake Check (Air Brake Equipped Vehicles Only)

- Air brake safety devices vary. However, this procedure is designed to see that any safety device operates correctly as air pressure drops from normal to a low air condition. For safety purposes, in areas where an incline is present, you will use wheel chocks during the air brake check. The proper procedures for inspecting the air brake system are as follows:
  - With the engine running, build the air pressure to govern cut-out (100-125 psi).
  - Shut off the engine, chock your wheels, if necessary, release the tractor protection valve and parking brake (push in), fully apply the foot brake and hold it for one minute. Check the air gauge to see if the air pressure drops more than three pounds in one minute (single vehicle) or four pounds in one minute (combination vehicle).
  - Begin fanning off the air pressure by rapidly applying and releasing the foot brake. Low air warning devices (buzzer, light, flag) should activate before air pressure drops below 60 psi.

- Continue to fan off the air pressure. At approximately 40 psi on a tractor-trailer combination vehicle, the tractor protection valve and parking brake valve should close (pop out). On other combination vehicle types and single vehicle types, the parking brake valve should close (pop out).

Safety Belt

- Check that the safety belt is securely mounted, adjusts, and latches properly.

Lights/Reflectors

- Check that all external lights and reflective equipment are clean and functional. Light and reflector checks include:
  - Clearance lights (red on rear, amber elsewhere).
  - Headlights (high and low beams).
  - Taillights.
  - Turn signals.
  - Four-way flashers.
  - Brake lights.
  - Red reflectors (on rear) and amber reflectors (elsewhere).
  - Note: Checks of brake, turn signal and four-way flasher functions must be done separately.

Steering

Steering Box/Hoses

- Check that the steering box is securely mounted and not leaking. Look for any missing nuts, bolts, and cotter keys.
- Check for power steering fluid leaks or damage to power steering hoses.

Steering Linkage

- See that connecting links, arms, and rods from the steering box to the wheel are not worn or cracked.
- Check that joints and sockets are not worn or loose and that there are no missing nuts, bolts, or cotter keys.

Suspension

Springs/Air/Torque

- Look for missing, shifted, cracked, or broken leaf springs.
- Look for broken or distorted coil springs.
- If vehicle is equipped with torsion bars, torque arms, or other types of suspension components, check that they are not damaged and are mounted securely.
- Air ride suspension should be checked for damage and leaks.

Mounts

- Look for cracked or broken spring hangers, missing or damaged bushings, and broken, loose, or missing bolts, u-bolts or other axle mounting parts. (The mounts should be checked at each point where they are secured to the vehicle frame and axle[s]).

Shock Absorbers

- See that shock absorbers are secure and that there are no leaks.

Note: Perform the same suspension components inspection on every axle (power unit and trailer, if equipped).

Brakes

Slack Adjustors

- Look for broken, loose, or missing parts.
- For manual slack adjustors, the brake rod should not move more than one inch (with the brakes released) when pulled by hand.

Brake Chambers

- See that brake chambers are not leaking, cracked, or dented and are mounted securely.

Brake Hoses/Lines

- Look for cracked, worn, or leaking hoses, lines, and couplings.

Drum Brake

- Check for cracks, dents, or holes. Also check for loose or missing bolts.
- Brake linings (where visible) should not be worn dangerously thin.

Brake Linings

- On some brake drums, there are openings where the brake linings can be seen from outside the drum. For this type of drum, check that a visible amount of brake lining is showing.

Note: Perform the same brake components inspection on every axle (power unit and trailer, if equipped).

Wheels

Rims

- Check for damaged or bent rims. Rims cannot have welding repairs.

Tires

The following items must be inspected on every tire:

- Tread depth: Check for minimum tread depth (4/32 on steering axle tires, 2/32 on all other tires).
- Tire condition: Check that tread is evenly worn and look for cuts or other damage to tread or sidewalls. Also, make sure that valve caps and stems are not missing, broken, or damaged.
- Tire inflation: Check for proper inflation by using a tire gauge, or inflation by striking tires with a mallet or other similar device.

Hub Oil Seals/Axle Seals

- See that hub oil/grease seals and axle seals are not leaking and, if wheel has a sight glass, oil level is adequate.

Lug Nuts

- Check that all lug nuts are present, free of cracks and distortions, and show no signs of looseness such as rust trails or shiny threads.

- Make sure all bolt-holes are not cracked or distorted.

Spacers

- If equipped, check that spacers are not bent, damaged, or rusted through.
- Spacers should be evenly centered, with the dual wheels and tires evenly separated.

Note: Perform the same wheel inspection on every axle (power unit and trailer, if equipped).

Door(s)/Mirror(s)

- Check that door(s) are not damaged and that they open and close properly from the outside.
- Hinges should be secure with seals intact.
- Check that mirror(s) and mirror brackets are not damaged and are mounted securely with no loose fittings.

Fuel Tank

- Check that tank(s) are secure, cap(s) are tight, and that there are no leaks from tank(s) or lines.

Battery/Box

- Wherever located, see that battery(s) are secure, connections are tight, and cell caps are present.
- Battery connections should not show signs of excessive corrosion.
- Battery box and cover or door must be secure.

Drive Shaft

- Check that drive shaft is not bent or cracked.
- Couplings should be secure and free of foreign objects.

Exhaust System

- Check system for damage and signs of leaks such as rust or carbon soot.
- System should be connected tightly and mounted securely.

Frame

- Look for cracks, broken welds, holes or other damage to the longitudinal frame members, cross members, box, and floor.

Rear of Vehicle

Splash Guards

- If equipped, check that splashguards or mud flaps are not damaged and are mounted securely.

Doors/Ties/Lifts

- Check that doors and hinges are not damaged and that they open, close, and latch properly from the outside, if equipped.
- Ties, straps, chains, and binders must also be secure.

- If equipped with a cargo lift, look for leaking, damaged or missing parts and explain how it should be checked for correct operation.
- Lift must be fully retracted and latched securely.

Tractor/Coupling

Air/Electric Lines

- Listen for air leaks. Check that air hoses and electrical lines are not cut, chafed, spliced, or worn (steel braid should not show through).
- Make sure air and electrical lines are not tangled, pinched, or dragging against tractor parts.

Catwalk

- Check that the catwalk is solid, clear of objects, and securely bolted to tractor frame.

Mounting Bolts

- Look for loose or missing mounting brackets, clamps, bolts, or nuts. Both the fifth wheel and the slide mounting must be solidly attached.
- On other types of coupling systems (i.e., ball hitch, pintle hook, etc.), inspect all coupling components and mounting brackets for missing or broken parts.

Locking Jaws

- Look into fifth wheel gap and check that locking jaws are fully closed around the kingpin.
- On other types of coupling systems (i.e., ball hitch, pintle hook, etc.), inspect the locking mechanism for missing or broken parts and make sure it is locked securely. If present, safety cables or chains must be secure and free of kinks and excessive slack.

Platform (Fifth Wheel)

- Check for cracks or breaks in the platform structure, which supports the fifth wheel skid plate.

Release Arm (Fifth Wheel)

- If equipped, make sure the release arm is in the engaged position and the safety latch is in place.

Kingpin/Apron/Gap

- Check that the kingpin is not bent.
- Make sure the visible part of the apron is not bent, cracked, or broken.
- Check that the trailer is laying flat on the fifth wheel skid plate (no gap).

Locking Pins (Fifth Wheel)

- If equipped, look for loose or missing pins in the slide mechanism of the sliding fifth wheel. If air powered, check for leaks.
- Make sure locking pins are fully engaged.
- Check that the fifth wheel is positioned properly so that the tractor frame will clear the landing gear during turns.

Emergency Equipment

- In addition to checking for spare electrical fuses (if equipped), three red reflective triangles, and a properly charged and rated fire extinguisher.

Lighting Indicators

- In addition to checking the lighting also check the following lighting indicators (internal panel lights):
  - Alternately flashing amber lights indicator, if equipped.
  - Alternately flashing red lights indicator.
  - Strobe light indicator, if equipped.

Lights/Reflectors

- In addition to checking the lights and reflective check the following (external) lights and reflectors:
  - Strobe light, if equipped.
  - Stop arm light, if equipped.
  - Alternately flashing amber lights, if equipped.
  - Alternately flashing red lights.

Seating

- Look for broken seat frames and check that seat frames are firmly attached to the floor.
- Check that seat cushions are attached securely to the seat frames.

Securing Cargo

Cargo that is not secure or loaded incorrectly can be a danger. Loose cargo that falls off a vehicle can cause traffic problems and others could be hurt or killed and loose cargo could hurt or kill during a quick stop or crash. The vehicle could be damaged by an overload. Steering could be affected by how a vehicle is loaded, making it more difficult to control the vehicle.

The driver is responsible for the following elements relating to properly loading and securing the cargo:

- Inspecting the cargo
- Recognizing overloads and poorly balanced weight
- Knowing the cargo is properly secured and does not obscure the view ahead or to the sides
- Knowing the cargo does not restrict access to emergency equipment

Pulling Trailers or other Combination Vehicles

Combination vehicles (those pulling trailers, generators, lowboys) are usually heavier, longer, and require more driving skill than single commercial vehicles. This means that drivers of combination vehicles need more knowledge and skill than drivers of single vehicles

Rollover Risks

More than half of truck driver deaths in crashes are the result of truck rollovers. When more cargo is piled up in a truck, the "center of gravity" moves higher up from the road. The truck becomes easier to turn over. Fully loaded rigs are ten times more likely to roll over in a crash than empty rigs.

The following two things will help prevent rollover--keep the cargo as close to the ground as possible, and driving slow around turns. Keeping cargo low is even more important in combination vehicles than in straight trucks. Also, keep the load centered on the rig. If the load is to one side it makes a trailer lean, and rollover is more likely. Make sure the cargo is centered and spread out as much as possible.

Rollovers happen when you turn too fast. Drive slowly around corners, on ramps, and off ramps. Avoid quick lane changes, especially when fully loaded.

Towing Safety Precautions

The following guidelines are to be used when towing loads.

- Make sure the hitch and coupling of the towing vehicle are rated equal to, or greater than the trailer "gross vehicle weight rating" (GVWR).
- **ALWAYS** inspect the hitch and coupling for wear. **NEVER** tow a trailer with defective hitches, couplings, chains etc.
- Check the tire air pressure on both towing vehicle and trailer. Also check the tire treads wear on both vehicles.
- **ALWAYS** make sure the trailer is equipped with a "**Safety Chain**".

Towing Precautions for Transporting Portable Generators and Pumps

- **ALWAYS** attach trailer's safety chain to bumper of towing vehicle.
- **ALWAYS** make sure the vehicle and trailer directional, backup, brake, and trailer lights are connected and working properly.
- The maximum speed unless otherwise posted for highway towing is **55 MPH**. It is not recommended for off-road towing. However, if necessary, do not exceed **15 MPH** or less depending on type of terrain to prevent damage to the axles.

- Place chocked blocks underneath wheel to prevent rolling, when parked.
- Place support blocks underneath the trailer's bumper to prevent tipping, when parked.
- Use the trailer's hand winch to adjust the height of the trailer, then insert locking pin to lock wheel stand in place, when parked.
- Avoid sudden stops and starts. This can cause skidding, or jackknifing. Smooth, gradual starts and stops will improve gas mileage.
- Avoid sharp turns to prevent rolling.
- Remove wheel stand when transporting.
- **DO NOT** transport generator with fuel vent in place. Always install plug.

Steering Precautions with Combination Vehicles

Trucks with trailers have a dangerous "crack-the-whip" effect. When you make a quick lane change, the crack-the-whip effect can turn the trailer over. There are many accidents where only the trailer has overturned.

"Rearward amplification" causes the crack-the-whip effect and is most pronounced in quick lane changes. Steer gently and smoothly when you are pulling trailers. If you make a sudden movement with your steering wheel, your trailer could tip over.

Follow far enough behind other vehicles (at least 1 second for each 10 feet of your vehicle length, plus another second if going over 40 mph). Look far enough down the road to avoid being surprised and having to make a sudden lane change. At night, drive slow enough to see obstacles with your headlights before it is too late to change lanes or stop gently. Slow down to a safe speed before going into a turn.

Braking Precautions when Hauling Cargo or Operating Combination Vehicles

Control your speed whether fully loaded or empty. Large combination vehicles take longer to stop when they are empty than when they are fully loaded. When lightly loaded, the very stiff suspension springs and strong brakes give poor traction and make it very easy to lock up the wheels. The trailer can swing out and strike other vehicles and can jackknife very quickly. Also must be very careful about driving "bobtail" tractors (tractors without semi trailers). Tests have shown that bobtails can be very hard to stop smoothly. It takes them longer to stop than a tractor-semi trailer loaded to maximum gross weight.

In any combination rig, allow lots of following distance and look far ahead, so you can brake early. Don't be caught by surprise and have to make a "panic" stop.

Considerations for Railroad-Highway Crossings

Railroad-highway crossings can also cause problems, particularly when pulling trailers with low underneath clearance.

These trailers can get stuck on raised crossings:

- Low slung units (lowboy, car carrier, moving van, possum-belly livestock trailer).
- Single-axle tractor pulling a long trailer with its landing gear set to accommodate a tandem-axle tractor.

If for any reason you get stuck on the tracks, get out of the vehicle and away from the tracks. Check signposts or signal housing at the crossing for emergency notification information. Call 911 or other emergency number. Give the location of the crossing using all identifiable landmarks, especially the DOT number, if posted.

Preventing Trailer Skids

When the wheels of a trailer lock up, the trailer will tend to swing around. This is more likely to happen when the trailer is empty or lightly loaded. This type of jackknife is often called a "trailer jackknife:

The procedure for stopping a trailer skid is:

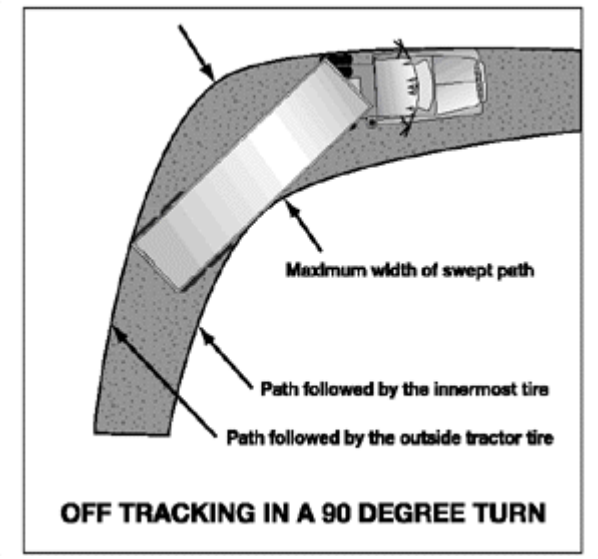
Recognize the Skid. The earliest and best way to recognize that the trailer has started to skid is by seeing it in your mirrors. Any time you apply the brakes hard, check the mirrors to make sure the trailer is staying where it should be. Once the trailer swings out of your lane, it's very difficult to prevent a jackknife.

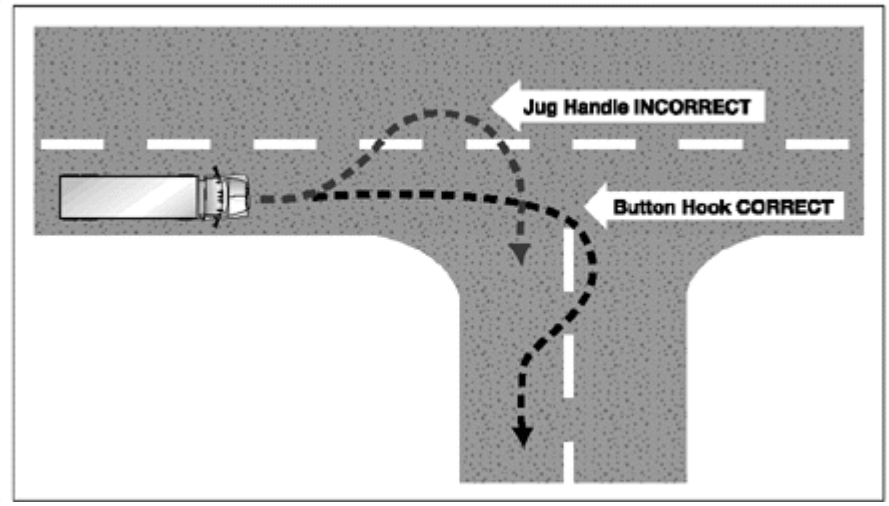
Stop Using the Brake. Release the brakes to get traction back. Do not use the trailer hand brake (if you have one) to "straighten out the rig." This is the wrong thing to do since the brakes on the trailer wheels caused the skid in the first place. Once the trailer wheels grip the road again, the trailer will start to follow the tractor and straighten out.

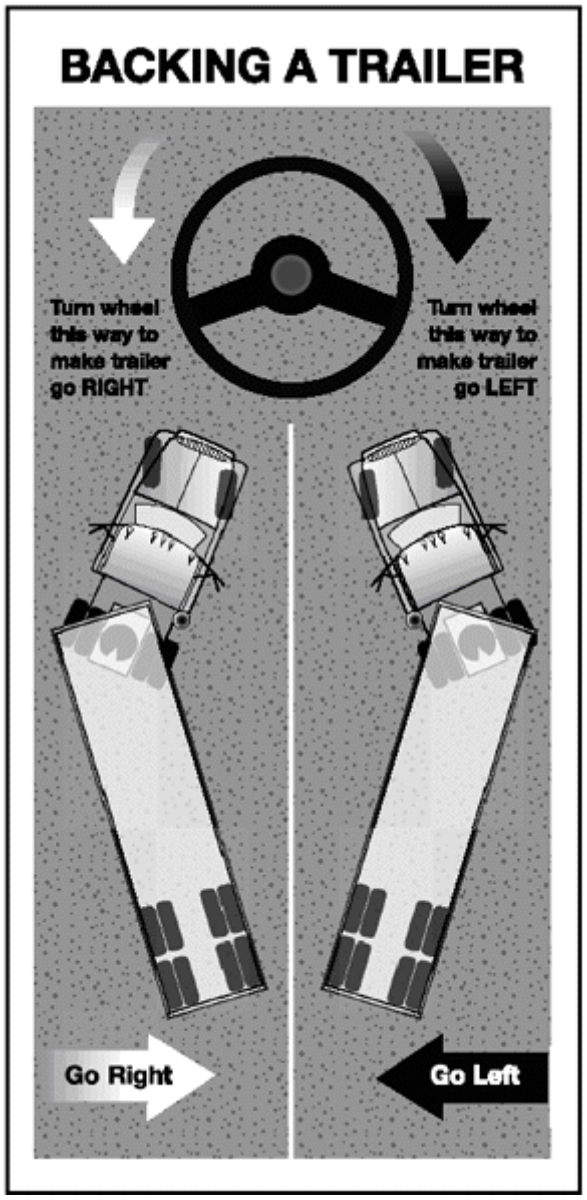
Turning and Backing Combination Vehicles

When a vehicle goes around a corner, the rear wheels follow a different path than the front wheels. This is called off-tracking or "cheating." The Figures on the following page show how off-tracking causes the path followed by a tractor to be wider than the rig itself. Longer vehicles will off-track more. The rear wheels of the powered unit (truck or tractor) will off-track some, and the rear wheels of the trailer will off-track even more. If there is more than one trailer, the rear wheels of the last trailer will off-track the most. Steer the front end wide enough around a corner so the rear end does not run over the curb, pedestrians, etc. However, keep the rear of

your vehicle close to the curb. This will stop other drivers from passing you on the right. If you cannot complete your turn without entering another traffic lane, turn wide as you complete the turn. This is better than swinging wide to the left before starting the turn because it will keep other drivers from passing you on the right.







Backing with a Trailer.

When backing a car, straight truck, or bus, you turn the top of the steering wheel in the direction you want to go. When backing a trailer, turn the steering wheel in the opposite direction. Once the trailer starts to turn, turn the wheel the other way to follow the trailer.

Whenever backing up with a trailer, try to position the vehicle so it will back in a straight line. If backing on a curved path, back to the driver's side for better visibility.

Look at the line of travel before beginning. Get out and walk around the vehicle. Check the clearance to the sides and overhead, in and near the path of the vehicle.

Check the outside mirrors on both sides frequently. Get out of the vehicle and re-inspect the path if unsure.

Back Slowly**.** This allows for corrections before getting too far off course.

Correct Drift Immediately. As soon as you see the trailer getting off the proper path, correct it by turning the top of the steering wheel in the direction of the drift.

Pull Forward. When backing a trailer, make pull-ups to re-position the vehicle as needed.

Driver's License Requirements

It is important that drivers only operate equipment that they are legally licensed to drive. Failure to adhere to these requirements can lead to a serious accidents and result in both significant personal liability to the unlicensed driver as well as liability to the agency.

Commercial Driver Licenses (CDL)

Class A: Commercial motor vehicles - trucks or truck combinations weighing with a Gross Vehicle Weight Rating of 26,001 lbs. or more, provided towed vehicle is more than 10,000 lbs.

Class A exam requirements - Minimum age 18
General Knowledge test
Combinations vehicle test
Air Brakes
Applicable endorsement exams
Vision - 20/40 in each eye
Hearing - must hear a whisper
Pre-trip
Basic skills
Driving
Note: Drivers under 21 years of age will be restricted to intrastate operation only.

Class B: Commercial motor vehicles - straight trucks weighing 26,001 lbs. Gross Vehicle Weight Rating or more.

Class B exam requirements
General Knowledge test
Air brakes if applicable
Vision - 20/40 in each eye
Hearing - must hear a whisper

Pre-trip (not required for Class C)
Basic skills (not required for Class C)
Driving
Note: Drivers under 21 years of age will be restricted to intrastate operation only.

Class C: Vehicles transporting placard able amounts of hazardous materials, or vehicles designed to transport more than 15 persons including the driver with a Gross Vehicle Weight Rating of less than 26,001 lbs.

Class C exam requirements
General Knowledge test
Air brakes if applicable
Vision - 20/40 in each eye
Hearing - must hear a whisper
Pre-trip (not required for Class C)
Basic skills (not required for Class C)
Driving
Note: Drivers under 21 years of age will be restricted to intrastate operation only.

Non-Commercial Driver Licenses

Class E: Any non-commercial motor vehicles with Gross Vehicle Weight Rating (GVWR) less than 26,001 pounds, including passenger cars, 15 passenger vans including the driver, trucks or recreational vehicles and two or three wheel motor vehicles 50 cc or less, such as mopeds or small scooters (see below). Farmers and drivers of authorized emergency vehicles who are exempt from obtaining a commercial driver license must obtain a Class E license.

Emergency Food Considerations

After determining the number of personnel to be sent, make sure there are enough supplies (food, water, fuel) to keep the group self-sufficient for at least five days. There is a possibility that personnel may arrive before other emergency supplies so take into account all basic needs before departing to a stricken area.

Transportation and Other Equipment Fuel Considerations

All vehicles, as well as equipment, should use the same fuel type. Past disaster response activities have shown fuel to be in short supply, especially gasoline. Diesel seemed to be easier to come by but don't count on any fuel being available. If all equipment uses the same fuel, then only one type of fuel needs to be hauled while on the road. Coordination with other local and responder utilities is essential.

Suggestions for Providing and Equipping a Service Truck

A service truck with spare tires, a compressor, spare parts, and a trained mechanic for vehicles and equipment is a must. You will be driving into an area where debris will be prevalent and tires will be damaged. Service station and or tire shops may not be available in the effected areas and the damaged utility may not be able to provide any help. There is also the possibility of breakdowns along the way to or from the effected area.

Equipment Security Provisions

Make sure all equipment is secured and locked. Unfortunately, experience has shown that, supplies have been taken from vehicles at staging areas and other places. Backhoes, tractors and other heavy equipment need to be secured for a long haul over interstate highways as well as back roads.

Mapping and Locating Unfamiliar Facilities

A Global Positioning System (GPS) with back-up hand maps are very helpful in locating both equipment that is deployed in unfamiliar areas and for locating landmarks. These are recommended for inclusion with each vehicle. Maps of the area can be obtained from convenience stores. This allows the convoy to keep moving even if a few get separated or have to stop for repairs. Also, street signs and utility markers (as well as buildings!) may not be available for locating sites in the affected area. A plan defining checkpoints along the way needs to be clearly communicated to every driver before deploying. In the even of separation, each driver should know where the next stop is and can wait for others to catch up.

Vehicle to vehicle radios for communication during travel and upon arrival should be in every vehicle. With these the convoy can stay notified if changes are to be made while traveling with out stopping. Spare radios, batteries and charging/power units should be taken as well.

Movement of Equipment and Personnel on Public Roadways

Traveling in convoys can be very dangerous since other drivers will attempt to go around and cut in creating potentials for accidents. It is very important to observe proper driving rules and to travel at or below posted speeds. Safe breaking distances should always be maintained. The primary objective of travel is to arrive safely with no accidents.

Considerations for Driver Fatigue

Employees may be in for a long drive. Make sure that there are relief drivers in every vehicle, so drivers may rotate every few hours. Under no conditions should a driver be allowed to drive for

more than 8 consecutive hours. Fatigue will cause accidents. Each driver should be familiar with the preplanned route.

A lead and rear truck should be established so everyone has a vehicle to follow and one responsible for brining up the rear so no one gets left behind. Communication between these trucks is essential.

Reporting to a Staging Area

Your first destination may be a staging area. Upon arrival, report in to the staging area coordinator. They may be able to assist with disaster placards for your vehicles, food, fuel, and personnel identification. This will also let others know you are working in the area so they can be on the lookout for you.

Expected Disaster Area Conditions

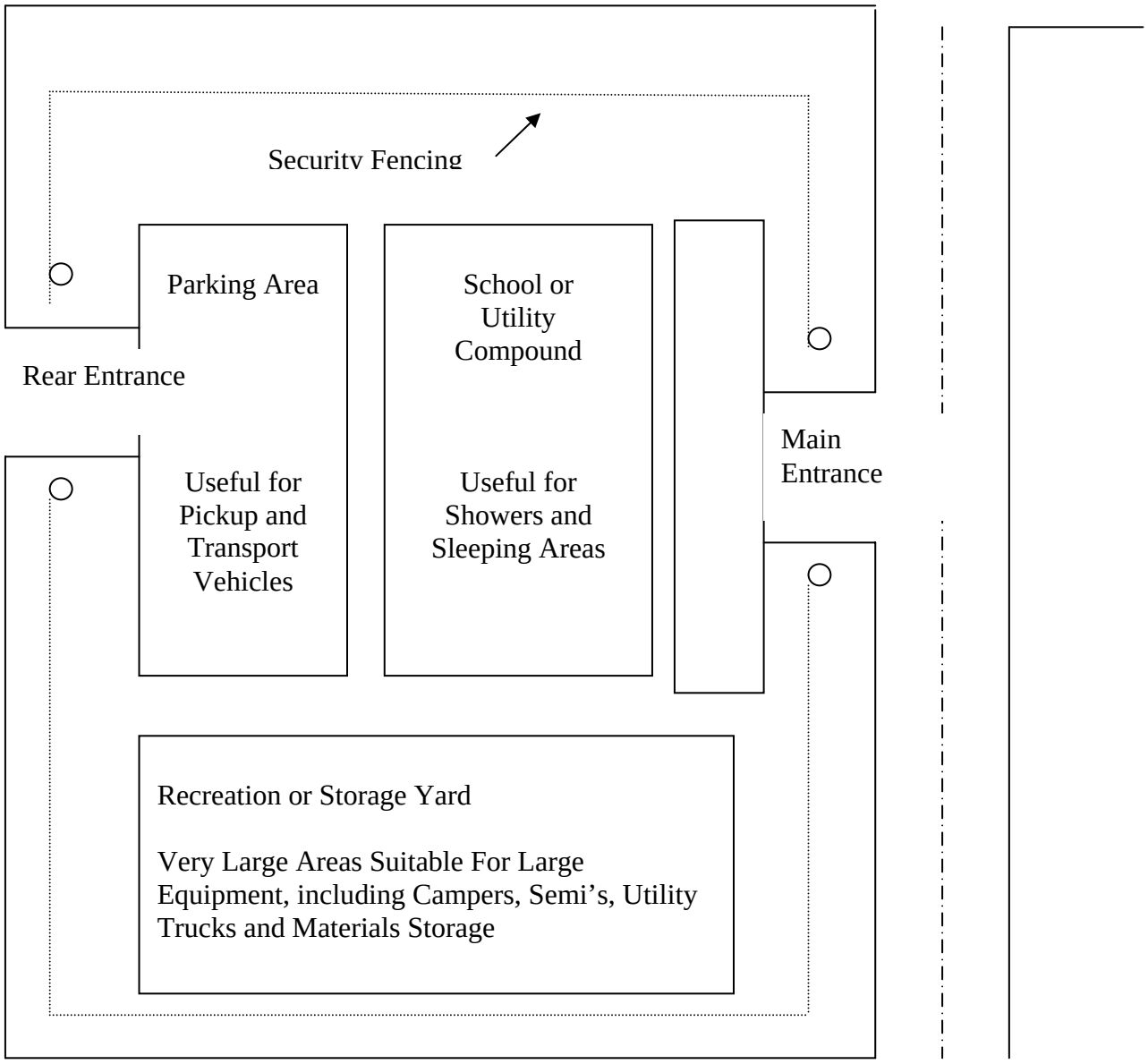
To safely and rapidly convoy to a disaster area requires planning. Without a plan, you run the risk of adding to an already bad situation. Self-sufficiency cannot be understated. When you arrive, more than likely there will be no water, no food, and no fuel. You may encounter exhausted and stressed out responders and survivors. Roll in ready to relieve these workers as they may need to deal with family and other issues or may not be available at all.

If you are equipped, supplied and ready to work, your restoration efforts will be much more effective.

Chapter 13: Effective Staging Area Set Up

Figure 1

Example of a Staging Area Near Work Location



This depiction is not typical, however does show some points that are key, such as sleeping and bath areas in an air conditioned building and expanded unpaved parking area for large vehicles.

Staging Area Planning

- Staging areas should be located as close as possible to work locations or travel time will greatly decrease productive work time. They should not be located farther than 45 minutes from any work site.
- Staging area should be located and secured by Requesting Utility or Agency.
- If at all possible, provide responders with maps to assist in locating the staging area after nightfall. Many lights may be out further complicating landmark visibility.
- Please refer to the attached layout. This may or may not resemble an actual site, however some key points are shown: highway location, security, sleeping and shower arrangements, and parking area suitable for heavy equipment and large trucks.
- Some locations may not have all these elements and you may be forced to settle for less than these. However, some meager (at best) responder comforts will go a long way to speeding up the water and wastewater recovery.
- Succession planning is important to note here. A seamless response effort is successful if planned ahead. As quickly as possible after initial staging area set-up, communicate staging area conditions including location, food and fuel provisions, to the next response team. This progress report will be vital in replacement response crew effectiveness.

Staging Area Housekeeping, Organization and Cleanliness

- It may be useful to note that some planning will be necessary to maintain your site in as clean a manner as possible. Housekeeping, organization and cleanliness is important since animals, rodents and insects will be attracted to unsanitary conditions.
- You may need to have some members of your staff locate and place trash containers at several locations in the staging area.
- Each day the trash will need to be cleaned up, and moved to a large dumpster.
- It may be possible to locate a waste management facility near the staging area and task them with the job of removing trash dumpsters.
- Housekeeping will include maintaining showers and bath facilities. Probably the best time to meet this challenge is at the coordination meetings. It may be necessary to rotate this duty around to several of the team members.
- Normally, during the course of responses, some of the responders may report in to the staging area during the day to refuel or pick up parts or materials, you may need to enlist help from these crews in this effort.

Chapter 14: Dealing with Post-Hurricane Shock, Stress and Trauma

Recognizing Post Traumatic Stress

When entering storm-ravaged areas, it can be hard to comprehend the misery and the utter and total destruction of the area. Being prepared to simply get down to work is the best thing responding utilities can do. Knowing that nothing will come easy will be obvious and must not act as a deterrent. It is important to render assistance and get water flowing and sewage flows contained. Be prepared for situations where people are not ready to think and act rationally and may be more worried about their family and their community than providing assistance. Good judgment in these situations is critical so appropriate action can be taken and no one becomes a hindrance. Through the responders' hard work, hope will replace despair and that's an important step in the recovery of a community.

Sometimes people face situations that are so traumatic that they may become unable or impaired in coping and functioning effectively following the devastation resulting from a severe hurricane. For these people, getting beyond the trauma and overcoming the post traumatic stress requires consideration on the part of the responder. The symptoms experienced are much like those of a Post Traumatic Stress Syndrome disorder. Specifically:

- Confusion and distraction may develop following exposure to extreme trauma.
- Extreme trauma is a terrifying event or ordeal that a person has experienced, witnessed or learned about, especially one that is life threatening or causes physical harm. It can be a single event such as a hurricane that has overwhelmed them with the degree of destruction and the current facility conditions
- The experience causes that person to feel an intense sense of helplessness.
- The stress caused by trauma can affect all aspects of a person's life, including mental, emotional and physical well-being.
- Research suggests that prolonged trauma may disrupt and alter brain chemistry.

Additionally operating managers may be taxing their mental and physical ability to function because of fatigue. In many cases 16-hour days for weeks at a time may be the norm. Managers under these conditions may exhibit signs of:

- Loss of Concentration and Focus
- Loss of Appetite
- Memory Loss
- Irritability
- Becoming Overly Opinionated
- Confusion, Numbness, and Flashbacks
- Inability to interpret incomplete and ever-changing field Information

- Anger and Frustration caused by, upper management demands or the slow pace of restoration

Responders should also expect to encounter management frustration resulting from the inability to respond to personal issues related to their family or to the status of personal property that has been damaged. Managers will also be faced by large-scale job abandonment that may approach as much as 80percent.

Recognizing Effects of Post Traumatic Stress in the Work Place

Empathy and recognition of stressful conditions is most helpful in dealing with effected managers in when post stress conditions have been identified. Effective integration of the response team is usually optimized when the responder helps the receiving manager to recognize his/her fatigue and helps him/her to refocus on differentiating between high and low priorities. Once the capability of the responder is recognized, the receiving manager can be encouraged to get proper rest and shore up personal problems.

Emotional preparation for responders is also important. Personnel should be instructed as to what to expect in damaged areas, made aware of the working conditions, lack of prepared food and other commonly available essentials and advised against sightseeing, scavenging and picture taking unless they are pertinent for documenting damages.

Preparation should also include instructions on being patient and understanding that there will be some confusion and inefficiencies in work assignments and these should be expected and will improve as information and conditions improve. Responder personnel should be reminded that assistance is always to be evaluated by the receiver not the responder.

Recognizing the symptoms of stress in receiving agency managers can be helpful in opening dialog that can facilitate improved restoration prioritization. The following responses should be expected in stressed and fatigued managers:

Characteristics of Stressed and Fatigued Managers

- Expect a holding pattern and transition as responders build credibility
- Expect focus on non-optimal priorities and "tunnel vision" caused by sensory overload and shutdown by the receiving manager
- Expect unnecessary bureaucracy and inefficient SOPs and work procedures that are time consuming, inefficient and inappropriate for the emergencies
- Expect rejection of outside help or feeling disappointed with the level of outside help

Minimizing Post-Hurricane Stress for Operating Managers

The most effective method of relieving stress is quick integration of the Responder's work force into the restoration environment. Thus, those systems that have high levels of pre-storm planning and preparations will be easier to transition than those systems that do not.

Effective Measures for Dealing with Stressed Utility Managers and Staff

Effectively working with stressed utility staff can be improved by using the following techniques:

Effective Measures for Dealing with Stressed Utility Managers and Staff

- Demonstrate empathy for the facility condition and responsibility of the utility operating manager
- Assure the manager that your purpose is to provide assistance
- Listen to the problems without suggesting alternate solutions
- Attempt to understand the predicament from the manager's viewpoint and from the demands placed on him/her by the supervisor, system failure or health hazard
- Explain what resources are available and how they might be immediately deployed to assist
- Establish credibility by performing assisting actions and maintaining a commitment to assist; never show frustration or apathy over restoration or restoration assignments
- Keep communication with the manager timely and relevant

Chapter 15: Power Outages and Procedures for Emergency Generator Installations

Introduction

Hurricanes are notorious for destroying overhead electric infrastructure and in many situations the devastation is considerable. Power restoration can take several weeks or even months and during this time period small water and wastewater systems will be without power making normal life activities and access to basic necessities such as food, water, and sanitation extremely difficult and stressful to those effected.

The lack of power, coupled with flooding and loss of sanitation, results in acute health concerns. Wells, normally dry and protected become either inundated or impacted by groundwater that is now under the influence of contaminated surface water caused by inoperative wastewater treatment facilities and resultant sewage discharge. Pathogens such as Giardia, Cryptosporidium, Salmonella, Shigella and viruses such as Hepatitis E and Rotavirus can be present in raw sewage and as long as power is out, direct pathways to drinking water can be present. Lack of power, access to and knowledge of the proper application of disinfectants to sterilize water renders all forms of water excluding bottled water from secure sources, as potentially harmful to the public.

Given this scenario, the reestablishment of power to waster and to wastewater treatment facilities is paramount in restoring normal conditions and protecting public health. Because the time needed to restore electric power can be long and uncertain, small emergency power generators must be employed to power both public and private water and wastewater treatment facilities. These guidelines examine the proper procedures for selection, installation, and maintenance procedures to ensure safe and reliable application of this type of generating equipment. They are not intended to supersede the guidance or the experience of a certified electrician.

Identifying Power Requirements

In making emergency power generation selection, it is first necessary to determine the voltage and amperage requirements of the facility to be powered by the generator.
Electrical connections to public and private water and wastewater treatment facilities generally require three phase power. The power company via transformers that reduce overhead line voltage into a voltage that can power electrical motors supplies three-phase power and other devices used in the treatment facilities. There are a wide variety of voltages that are supplied for these types of equipment applications by the power company. The table below illustrates the possible voltages and configurations for electrical supply from the power company to service plant equipment.

Typical Transformer Load Configurations from Power Company to Plant Equipment

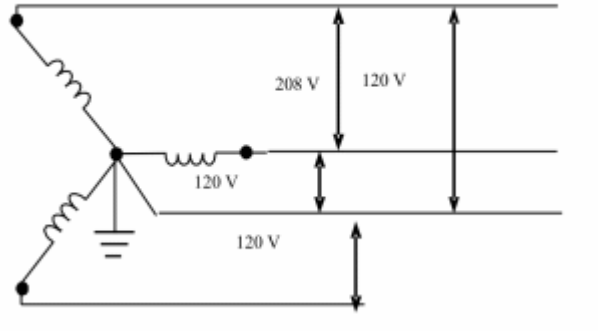
Power Transformer Load Configuration	Single Phase	Three Phase
Single Phase, 3-Wire	120 V 240 V	Not Available
Wye, Three Phase, 4-Wire (208/120 V)	120 V 208 V	208 V
Wye, Three Phase, 4-Wire (480/277 V)	277 V 480 V	480 V
Delta, Three Phase, 3 Wire (240 V)	240 V	240 V
Delta, Three Phase, 3 Wire (480 V)	480 V	480 V
Open Delta, 3 Phase, 3 Wire (240 V)	240 V	240 V

As can be observed from the table, the power company supplies voltage in two different configurations Wye or Delta. The difference between them is that in the 120/208Y configuration, the phase to neutral voltage is the same 120V between all three legs.

Identification of Three Phase Wye Power Feed

As shown below in this configuration 120 volts can be derived from any phase to neutral connection.

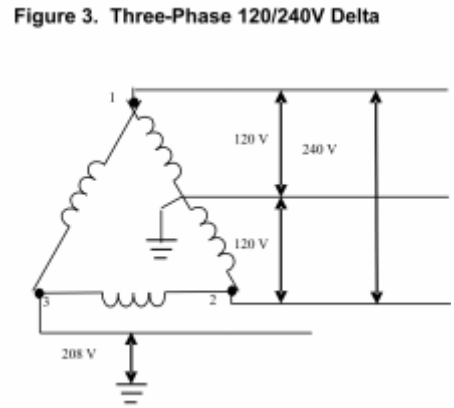
Figure 1. Three-Phase 120/208Y



Identification of a Delta Power Connection

In a Delta connection, the 120V can be derived from only two of the three phases to neutral connections. This is shown below:

Figure 3. Three-Phase 120/240V Delta



In this case, the 120V connection must be derived from connections one or two. Connection three is called a "high leg" and must be identified by the power company. If this leg is improperly connected, 208 volts will be supplied to120 volt equipment which will lead to equipment damage and/or a possible heating of circuits that could lead to combustion.

It is important to note that three phase equipment does not operate on neutral to ground and it does not matter which how the phases are connected. It only becomes important if the voltage is used to supply auxiliary 120V to other equipment.

Typically, the high leg will be identified by the power company by a marking or tape on the incoming wire at the top of the breakers or at the electric meter, or it can be determined using a volt meter by measuring phase to ground. Unfortunately, there are not electric utility standards for the high leg configuration and it must be identified in the field.

Voltage Supply Availability from Three Phase Generators

Table 2 illustrates the commercially available generators in ranges from 20 KW to 200 KW for the various configurations for three-phase standby power. Standby power application is provided for supplying emergency power for normal power interruptions. These types of units do not provide sustained overload capacity. Generators are available for applications up to 2700 KW for larger treatment facilities.

Prior to making a generator connection, it will be necessary to determine the voltage requirements of the facility where power is to be supplied. The voltage needs can be identified from the equipment inside the motor control panel, from electrical drawings when available or from ratings found on the nameplates fixed to plant equipment.

Some generators will have switches that allow the generator to supply different voltages.

Table 2

Available Three Phase Voltage Options for Commercially Available Generators Ranges from 20 to 150 KW Sizes

Three Phase Generator Options
120/208 V
127/220 V
139/240 V
120/240 V
240/416 V
254/440 V
277/480 V

To avoid damage to plant equipment, it is essential in making an electrical connection that the voltage requirements of the plant equipment be identified. Voltage requirements will be found on the motor nameplate.

Sizing of Generators for Powering Facility Equipment

Sizing the generator for power needs requires knowledge of the equipment to be operated at the treatment plant. This requires that the amperage draw of each piece of equipment be known. This analysis is important because generators continuously operating generators at 30 percent less than the rated load can lead to engine damage.

A generator can be best sized if it can be determined from a direct match with the transformer provided by the power company. In this instance one must determine the wye or delta arrangement and ensure that the load is supplied by either one line transformer providing three phase power or three line transformers providing step down power to each phase.

If two transformers are used to provide three phase power the available power or KW is only 87 percent of the summation of the KW rating of the two transformers. For example if two 25 KW transformers are provided the available KW is (2 x 25 x .87percent =) 43.5 KW.

Lacking power company transformer service information, *it would be necessary to determine the KW generator needs by summing the horsepower requirements of all plant equipment that is to be operated.* Because the equipment used may not be efficiently designed, it is common to add a 20percent additional power requirement to account for power factor adjustment. In general**, for a temporary installation, a good rule of thumb is to size a generator from 1.5 to 2.0 times the total horsepower requirements.**

Transport and Set Up of Generators

Generators may be supplied as either skid mounted or trailer mounted units. With the larger skid mounted units, lifting, transport and set up at the emergency site will require specialized equipment.

Various trailer connections may be supplied for portable generators. The receiver hitch is the primary device that is attached to the rear of the vehicle that allows towing. There are six classes of hitches. It is very important to choose the correct class of receiver hitch. Gross trailer weight and tongue weight will determine the hitch that is needed. The two most common are ball and military hitch type connections. Ball type connections may be in 1 7/8", 2" or 2 5/16" diameters. Unfortunately these sizes are not interchangeable and using a smaller diameter ball with a larger diameter trailer mount is extremely dangerous since the trailer can come loose during transport to the emergency site. Never exceed the lowest rating of any component of a towing system. Safety chains are a requirement and should be crossed under the tongue of the trailer so that the tongue will not drop to the road if it becomes separated from the hitch. Always leave enough slack so you can turn. Never allow the safety chains to drag on the ground and never attach the safety chains to the bumper because the weight of the generator can pull the bumper loose from a vehicle.

Allowable Pull Vehicle and Towing Weights for Generators

It is recommended that at a minimum a ¾ ton pickup or larger be used to pull trailer-mounted generators to ensure safe travel control and site maneuverability. The vehicle should always be equipped with the proper hitch and the trailer and tongue weights should not exceed the pull vehicle's specifications. Many times generator units must be pulled in sloped or wet areas and four-wheel drive vehicles are preferable.

Table 3

Gross Trailer Weight Allowances for Ball Type Hitches

Class	Gross Trailer Weight (lbs)	Nominal Size Receiver Ball (inches)
Class 1	1000 to 2500	1 7/8
Class 2	3500	2
Class 2.5	4,000	2 and above
Class 3	6,000	2 and above
Class 4	8,000	2 and above
Class 5	10,000	2 and above

Lifting of skid mounted generator units also requires pre-planning. Smaller units may be lifted with a front-end loader and transported to the site via trailer where it will again have to be lifted and set. Larger units will require the use of a boom truck since placing the unit on the trailer and lifting it in place at the site will require specialized equipment.

Weights and Lifting Considerations for Three Phase Generators

The weight of skid-mounted units is shown below. Moving of these units will require equipment rated for these lifting capacities and proper rigging and use of slings and cables to prevent injury to workers and damage to equipment.

Table 4

Available KW Sizes and Weight for Commercially Available Generators

Size in KW for Standby Power	Wet Weight (lbs)
20	950
25	1371
35	1668
40	1668
50	1720
60	1720
80	2000
100	2600
125	2600
150	3340
175	3350
200	6090

Connecting a Three Phase Generator to Water and Wastewater Facilities

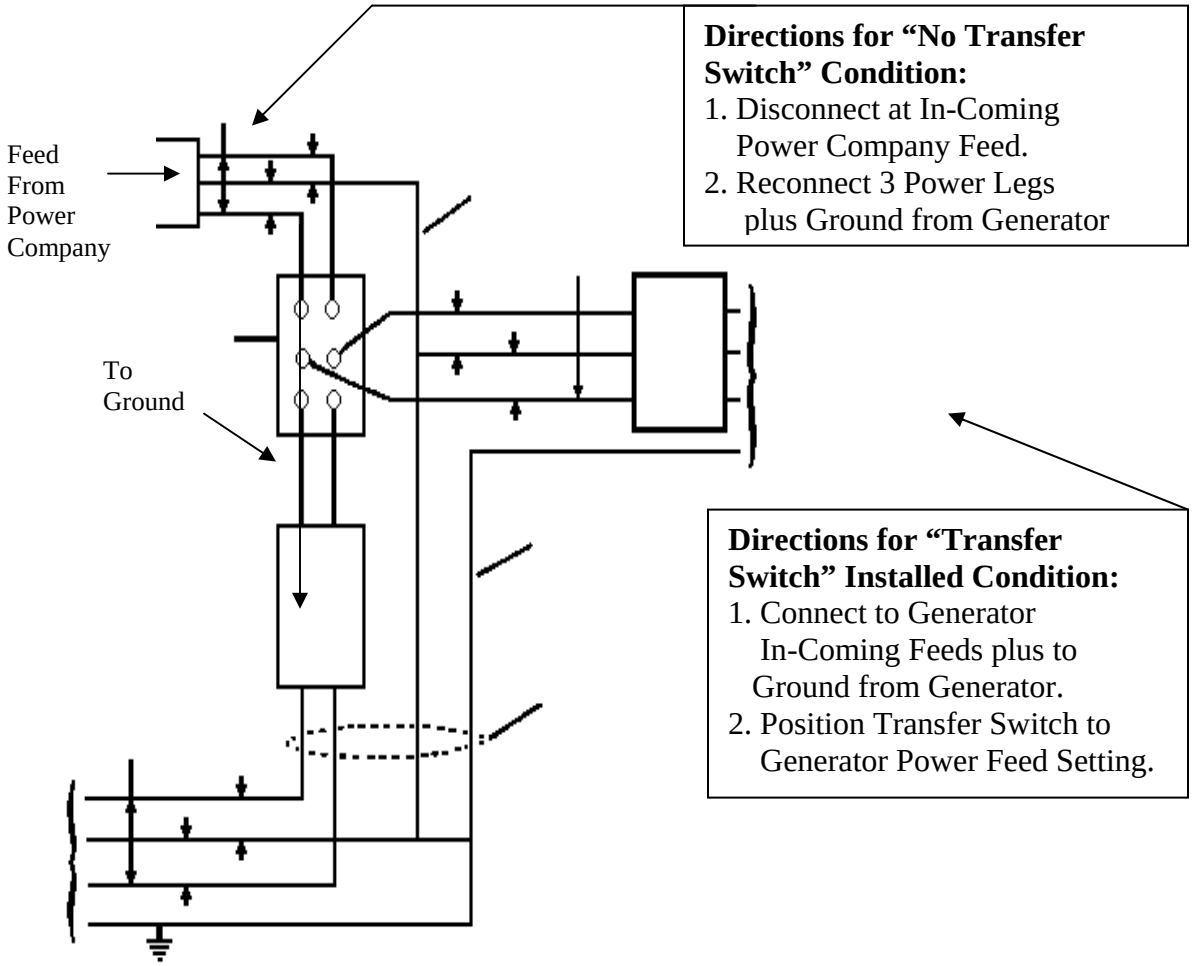
Generators are typically provided with four wire (three wires plus ground) connectors called “pig tails” that can be directly plugged into electrical control cabinets fitted with a disconnect switch. In the “On” position, the disconnect switch isolates the generator connection from the main power supply. In most cases these types of disconnect switches are not installed and even when they are installed, the type of connector provided with generator widely varies, making a direct match highly unlikely. For this reason generator connections must be direct wired to the incoming breaker inside the power control cabinet. It will be necessary to cut the manufacture’s supplied pigtail connection and direct wire the conductor to the top of the breaker.

If generator connections have been made in the past, the ends of the wires become frayed and should not be used in this condition. The installer should cut the ends with a hacksaw and strip

the wires back to a proper seat length to ensure a tight connection and to prevent an arcing condition that can lead to equipment damage.

Figure 2

Connecting a 3 Phase Power Generator to Customer Power Control Center or to Transfer Switch



Considerations for Sizing Generator Conductors

Some generators may be supplied without conductor. In these cases the generator conductor must be sized to carry the current required by the installation. Additionally, it must be capable of operating in a wet condition. Because each installation will vary, it is wise to standardize on a conductor type and size that can be used successfully at each installation. Because emergency generation installation will typically be performed for a wide variety of installations with limited up-front information it is wise to carry standard conductor of a size and type that can be used for

most installations. A minimum of AWG 10 (10 gauge wire) must be used in a generator installation.

It is recommended that the generator installer carry portable power cable (SOOW, AWG 6, 4 wire conductor) with them to the installation site. Power cable in the 6 gauge size, is large enough for most applications, flexible, can be rolled up and is approved for wet conditions. This type of conductor can easily be cut to length in the field for emergency application when manufacture's supplied pigtails are not available. A 6-gauge conductor will carry between 40 and 50 amps for a 240-volt circuit up to 100 feet with less than a 2percent voltage drop making it ideal for most all installations.

Never use damaged, undersized or worn power conductors or damage to equipment or injury can result. In some instances the power cable may be too large for the top of the breaker. In these cases it is necessary to attach a smaller cable to the end of the generator feed wire using wire lugs. Never shave a power cable to fit into a breaker this can lead to arcing and damage to equipment.

The figure below shows the power cable recommended for the wet conditions encountered for connecting an emergency generator.

Figure 3

Conductor for Wet Conditions for Water Wastewater Generator Installations

Type SOOW

- Temperature rating: -40ºC to +90ºC
- Jacket: CPE
- Insulation: EPDM
- Resistant to oil, moisture, and abrasion
- Suitable for continuous submersion in water
- Flexible bare copper stranding
- Stock color: black (yellow certain sizes)
- Non-UL SOOW available
- Approvals: UL, MSHA, CSA

Conductor Capacity (Amps) for Three Phase Generator Installations

The table below provides conductor requirements for various generator sizes. Because assisting utilities in emergency situations typically provide generators, it is recommended that a standard #6, 4-wire power cable be used for generator installations in the 40 to 125 KW when power cables are not supplied with the generator unit.

Table 5

Nominal Ratings for SOOW Power Cable For Generator Installations

Size (AWG)	Conductor	Nominal O.D.	AMPS*	LBS / 1000'
10	2	.615”	30	237
10	3	.650”	30	293
10	4	.700”	25	357
8	3	.835”	40	477
8	4	.930”	35	605
6	3	.975”	55	678
6	***4***	***1.055”***	***45***	***856***
4	3	1.135”	70	1030
4	4	1.255”	60	1297
4	5	1.365”	48	1400
2	4	1.455”	80	1768

Isolation of Generator from Main Power Source

The National Electric Code requires that a connected generator be isolated from utility power. These requirements are designed to protect the installer from unanticipated line power and the utility workers from back fed power into the utility line from the generator. Additionally, power supplied from two sources can be out of phase and this will result in as much as double the voltage quickly damaging plant equipment.

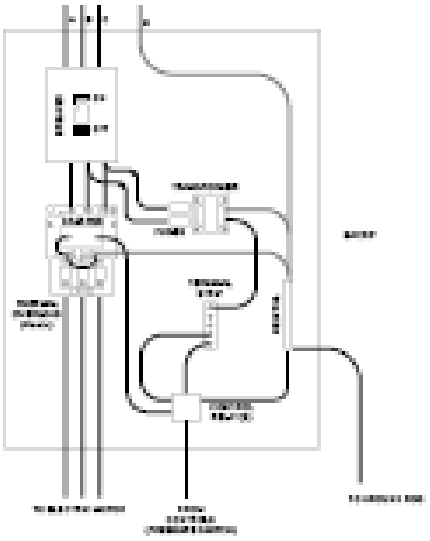
Main disconnect breakers should never be used to isolate power sources. They are not designed for this purpose and can malfunction. The malfunction can fail without any visible indication. This can be due to a mechanical failure and can go unnoticed until power is restored.

Because the plant facility will likely not have a disconnect switch, the line power must be disconnected at the main breaker to ensure isolation. Even though line power is off due to damages to power company wires and transmission equipment, the generator installer must always assume that the power is active. Power can be potentially back fed from private generator installations or could become activated by the power company while connecting generation

equipment. For this reason it is advisable to remove the electric meter prior to making any generator connection.

Figure 4

Electrical Connection Hook Up for Typical Control Panel



Interior of 3-phase
Electrici Control Panel

Electrical Safety Requirements

It will be necessary to physically remove the incoming conductors from the top of the breakers, properly wrap, secure and isolate them to prevent any chance of current flow. By OSHA standards, only a "qualified" individual can work on electrical equipment.

Electrical equipment should be checked for voltage with a volt/ohm meter prior to initiating the connection. If voltage is detected, the line may have been energized or the voltage may be the result of back feed and means of isolation should be initiated. In making generator connections, the circuit should be considered live and electrical protective equipment should be worn at all times.

After de-energizing a circuit, a "qualified" authorized individual is responsible for verifying that the equipment has been de-energized, that electrical isolation from the main power source has been accomplished and that the incoming power line has been capped, safely removed and protected.

Motor Requirements

In most cases, motor requirements at the plant facility will dictate the size of generator needed. The table below provides values for common motor installations.

Table 6

Common Full Load Amp Requirements for Electric Motor Locked Rotor Conditions*

HP of Motor	Single Ph 110V	Three Ph 220V	Three Ph 440V
.5	7	2.5	1.4
1	11	3.3	1.7
2	20	6	3
3	28	9	4.5
5	46	15	7.5
7 .5	68	22	11
10	86	27	14
15		38	19
20		52	26
25		64	32
30		77	39
40		101	51
50		125	63
60		149	75
75		180	90
100		246	123

* Amperes Full Load Current for Common Squirrel Cage Motors; ± 10percent variation

It is important to ensure that each leg of the circuit is balanced and providing amperage to the motor that is in reasonable proximity to the values provided.

Motor Rotation Considerations

Another issue with proper motor operation is to ensure proper rotation. In some cases the power company may indicate the rotation at the breaker. The best method is to match the power company's marking with a rotation meter. However, in most cases the motor rotation will have to be determined in the field.

Motor rotation is typically marked on the pump volute and can be observed by bumping the motor and making an observation after generator installation. Well motors are provided with ratcheting devices so the motor will not spin in reverse but will hum. It is important in field-testing not to allow the equipment to rotate backwards for any period of time or damage to equipment can occur. If building facilities with air conditioned fans are connected improperly, damage can result.

Motor rotation is corrected in the field by switching two connections at the breaker, making sure that the switched circuits are not the high leg connection (see 240V Delta connection above for this discussion.)

Use of Single Phase Generator/VFD Combination to Provide Three Phase Power

In a VFD/Single Phase Generator application, the VFD is used to convert single phase to three-phase power fed by a single-phase generator and to efficiently match a motor/pump combination at a lift station or a well to the conditions at the site. The use of a VFD allows water or wastewater service to be restored to minimum acceptable levels in a most timely, efficient and economical manner using much smaller and available generator equipment.

Centrifugal Pump/Motor Speed Relationships for VFD Control

Centrifugal pumps are widely used in water and wastewater treatment and exhibit characteristics that make them very adaptable to variable frequency control.

Pumping equipment in water and wastewater operation will be operated at a constant speed, or the speed provided by the motor. The variable frequency motor controller is a device that changes the frequency of the voltage applied to the motor, which in turn changes the speed of the motor. When the speed of the motor changes, the applied horsepower and the pumping characteristics also change. With a centrifugal pump, these relationships are governed the Affinity Laws. The operating conditions for a centrifugal pump may be estimated by using the Affinity Laws. The Affinity Laws are a group of relationships that may be used for estimating Flow, Head Condition and Horsepower requirements of a centrifugal pump when the speed of the pump is changed from a known speed or the specific speed, to some other value.

By using these relationships a plot for all centrifugal pumps for all pumping conditions can be developed. These relationships will be used in controlling motor speed to provide the pumping characteristics needed in a variable speed control situation. The VFD will be used to change the motor's operating characteristics from a constant speed to a variable speed. Under different speed conditions, the pump will operate at a different capacity, different head or pressure output, and at a different horsepower. In this application, the VFD operates the motor at a reduced horsepower.

Variable Speed Motor Control Application

The VFD can operate a motor both at a reduced voltage and reduced frequency. The same motor will now start at approximately 150percent torque and 150percent current as compared to 600percent current for starting motors across the line and 300percent when using a soft start. The VFD can also significantly reduce the locked rotor current because it allows the motor to operated at a reduced speed consuming only the horsepower necessary to move the load. The

VFD allows the motor to gradually reach a set speed that is less than the speed of the constant speed motor under normal operation.

Again, the VFD provides a considerable advantage over conventional equipment since it starts a motor under a reduced torque and a reduced starting current. This VFD attribute allows a small generator to be used for smaller horsepower applications, generally below 15 HP. The limitations on the use of a Single Phase Generator/VFD combination will be the amount of current that must be supplied by the single-phase generator to the VFD. Generally speaking, single-phase generators are limited to 50 amps at the single-phase breaker receptacle. This is approximately the full load current demand required by a 10 Horsepower (HP) load under single-phase conditions.

VFD's can be used to operate larger than 10 HP rated loads if they are operated at reduced HP. The advantage of a VFD is that it can be set to the HP necessary to keep the load or maintain the minimum pumping requirements, by reducing motor speed. In these applications, the motor will operate in this mode, until power is restored. The VFD is used to operate the motor efficiently under at a reduced load, at a reduced HP and thus at a reduced current draw. This condition can be found by observing check valve movement, wet well draw down or pressure conditions.

Recommended Frequency Set-up for VFD Control

The actual HP requirements will be always be dictated by the actual torque requirements (head and pumping requirements) encountered in the field. The chart below is intended to give a good starting point for VFD set up. Since the head conditions will typically be the controlling factor, a good starting point for a VFD has been found to be a speed setting around 45 hertz for most installations.

Under field conditions the VFD can be set to a minimum value of 45 hertz, and then gradually increased until the operating speed is raised enough to fully or partially establish the required flow by observation.

Recommendations for Sizing Single Phase Generators

It is always best to provide a generator sized larger than needed since the cost difference is nominal but the additional power and start up capability may be needed. Field conditions may also require full horsepower operation. The suggested sizing requirements are to multiply the HP of the installation by 1000 and then select a generator in a range that provides at least a 50percent safety factor. Below are some suggested guidelines. Note that some of the recommendations show that the generator must supply to a HP less than nominal to provide a 1.5 safety factor. In these cases the VFD would be set to a HP rating less than nominal nameplate rating on the motor. For example in the case of a 7.5 HP motor, a 6.5 HP setting using a 10,000-watt generator would provide a 1.5 safety factor. However, the power provided might not be enough to provide the needed HP in the field at the lower setting. It would be much better to use a 12,500 generator

that would provide a 1.6 safety factor for the 7.5 HP and reduce the HP in the field as appropriate. Although the smaller generator may work for a specific application, **it is not recommended that the generator be sized intentionally below these recommendations.**

Single Phase Generator Size (watts)	Approx. Weight	HP Appl.	Safety Factor
5500	160 lbs.	3	1.8
6500		<5	1.3+
8000	280 lbs	5	1.6
9,000		>5	1.6+
10,000	300 lbs.	<7.5	1.3
12,500		<10	1.3+
15,000	400 lbs	10	1.5

Methods of Connecting the VFD in the Field

The Single Phase Generator/VFD combination is limited to operating only one pump in a duplex lift station installation. Since the second pump is redundant, this operation is satisfactory for emergency restoration operations. Additionally, for most utilities, about 90percent of the lift stations will be 20 HP and below and most will fall in this category.

There are three recommended methods for connecting a VFD to a motor:

- Direct to power the pump panel
- Direct to the motor/pump using a separate control circuit
- Direct to the motor/pump with a constant setting

Direct Connection Using Existing Pump Controls

In this method of connection the line power is disconnected and the VFD is connected to one motor/pump input lead just below the breaker. The VFD is controlled through the existing pump control panel using a relay that intercepts the motor starter command and allows a 24 V start signal to initiate the VFD's run command. In this mode the generator to operate the motor controls must supply 110V. Making the connection in this way allows the lift station heaters to function.

Disconnections and re-connections to the VFD must be made at the motor starter and at the motor three phase input connection. The secondary pump is shut off to limit the current demand. The VFD can be used to operate the pump at reduced or full capacity as needed.

Direct Connection Using Supplied Control Circuit

In this method of connection the VFD is connected to the motor input leads. A supplied control circuit consisting of two float balls is set up in the field With this connection, only the disconnection of the motor input leads and re-connection to the VFD is necessary.
This type of connection is preferred since the wiring is minimized. It is also recommended in situations where lift station controls are destroyed or inoperable.

Direct Connection Using No Control Circuit

In this method of connection the VFD is connected to the motor input leads. The VFD is set to control the motor at a reduced speed. Under this mode the motor will operate continuously.

In the direct connect to the motor/pump connection, the VFD is set at a low setting that keeps the wet well pumped down, but supplies a continuous stream of water to the submersible pump/motor for cooling and lubrication. A VFD controller used in this mode is the simplest of the installation methods, and in an emergency mode following a hurricane, the VFD can be shut off at night to conserve fuel after pumping down the collection system and restarted in the morning when use of the wastewater collection system increases. This installation mode is the easiest and most common type of installation of the VFD/generator combination.

This method can also be used in a rotation to service a number of lift stations or in queuing operations where the VFD/generator is rotated, servicing the most needed lift station and then moving to the next critical one. How the VFD/generator is used is dictated by the field conditions and how many units can be made available.

Connecting the VFD directly to power a pump panel will not allow the VFD to be used below 60 Hz unless phase monitoring equipment is disengaged, and the VFD's soft start will be limited. This is not the preferred connection method although it has been used successfully in limited applications generally where horsepower requirements are below three HP.

Steps in Making a Generator Connection

Regardless of the type of generator used, three phase or single phase, the steps in making power connections are the same. Never rely on a breaker to provide a lock out. Breakers are not reliable and not designed for this type of use.

Table 7

Minimum Steps in Connecting a Generator

1. Ensure that facility operator is on-site and is knowledgeable about plant electrical requirements. It is recommended that the plant operator start and stop plant equipment.
2. Make all appropriate generator checks. Some generators will have a breather cap that breaks the fuel tank vacuum that must be installed prior to energizing the unit.
3. Determine power requirements and voltage from field information or from motor nameplate(s)
4. Determine voltage configuration, i.e. Wye (120/208V) or Delta (120/240V)
5. If Delta connection, identify "high leg" and match power company position at breaker
6. Pull electric meter
7. Check that there is no incoming voltage at panel
8. Turn all breakers and equipment to "off" position.
9. Connect generator to top of incoming breaker (Note: never bypass fuses or fail safe motor protective devices!)
10. Carefully tape all ends of wires removed at breaker including ground, to prevent accidental energizing by power company
11. Start generator in power feed "generator feed off" position at generator breaker and allow it to run a few minutes
12. Turn generator to "generator feed on" position
13. Measure phase to ground to check "high leg" position; reposition as needed in "generator off" position
14. Measure phase to phase voltages for three legs to ensure voltage balance
15. Match motor rotation, if known, by switching legs while in "generator feed off" position
16. Make all generator voltage rechecks
17. "Bump" motor to determine rotation if necessary
18. Match motor rotation by switching legs while in "generator feed off" position
19. Make generator voltage rechecks
20. Turn on facility equipment to "auto position"; Note: most equipment will have delay timers and equipment will not immediately start up.
21. Make necessary amp checks
22. Observe operation of facility equipment. In some cases it may be necessary to reset electronic protective devices inside equipment panels

Each facility will have unique electrical requirements and it is highly recommended that a plant operator knowledgeable about needs be on-site and participate in the generator hook-up and powering of facility equipment.

Generator Troubleshooting

The following are suggested procedures for checking the operation of generators before transporting them to field locations and in performing daily maintenance checks by the party using the generator. In emergency situations, it has been found that about 10percent of the generators delivered to the site will not operate. Much installation delay can be avoided by performing basic generator pre-checks before field delivery of equipment.

Table 8

Suggested Pre-Checks Prior to Field Delivery and Daily Checks at Generator Emergency Locations

Item	Problem Description/ Suggested Pre-Checks	Troubleshooting Problems
Battery	Battery weak and will not start generator. Always start the generator and run it before field delivery! Check electrolyte and make sure battery is full.	Batteries have been neglected or have been left on trickle charges and when the trickle charger is removed the battery will not start the battery will need to be replaced. It is common for weak batteries to discharge in the field. If replacements are not available sometimes daily charging is necessary.
Oil	Oil is low or a leak has developed. Check the oil level and make sure that it has been filled before field delivery. Look for leaks at the oil pan, drain plugs, front and rear seals and gaskets.	All engines will consume a certain amount of oil. Smoky exhaust is an indication of excessive oil use or an overfilled crankcase. Excessive oil loss around a seal will be noticeable. Oil should be checked each time the generator is refueled or more frequently if oil loss is observed. It is recommended that oil be left with the responsible party at the emergency generator location.
Coolant	Coolant is low or a leak has developed. Fill coolant to required levels. Check for leaks at hoses, radiator and hose connections.	Accidental damage frequently occurs to coolant system fins and hoses can become brittle and fracture resulting in visible leaks. Sometimes radiator leaks can be temporarily stopped using “stop leak.” Large leaks to the coolant system will require repair to prevent

		engine damage.
Air Filter	Check for a dirty air filter. Replace air filter as needed.	Generators are frequently operated in dirty or dusty locations. A clogged filter will reduce air intake and result in high fuel to air ratios causing rough operation and decreased power output.
Fuel	Fill fuel tank	Check for leaks or water in fuel. Generators should be refueled prior to the tank running dry to prevent movement of sediments and potential water accumulations caused by condensate. Diesel generators may be refueled while running but this practice is not recommended.

Under normal operation generator crankcase oil should be replaced every 25 operating hours and the air filter every 100 hours.

Before starting a generator ensure that the above minimum safety checks have been performed. Crank the engine no more than 20 to 30 seconds at a time. If it does not start allow the engine to cool two to three minutes before attempting to restart it. If it does not start after three attempts, there are problems that must be addressed by a mechanic to avoid serious damage to the generator.

After the generator is started, allow it to run at mid-speed for about five minutes until the oil pressure and other gauges show proper readings. Allow partial load for a few minutes until reaching maximum load. Never race a diesel engine.

If the generator runs and then shuts off, it indicates a fault condition. Generally a fault will occur that is associated with one or more of the conditions listed in the above table. To avoid extensive generator damage, more serious faults will require that the generator be shut down and serviced by a diesel mechanic.

Generator Safety and Placement

Generators should always be placed on level ground to avoid vapor locks from forming. They should also be placed in an unobstructed area as close as possible to the load to limit resistance losses in the supply conductor. Generators must never be placed in an enclosed area or exhaust to an enclosed area since the build up of carbon dioxide and toxic carbon monoxide in an enclosed space can be fatal to people who may enter the area. Generators should always be placed in well-ventilated areas to prevent them from overheating. Physical obstructions that block air movement can also cause the generator to overheat.

The generator unit can become electrically charged, proper electrical grounding of the generator is imperative. A direct ground connection can be established by an unsuspecting person touching metal in contact with the generator such as the generator cover standing on the ground. Without proper grounding, this situation could be fatal.

Protection and securing safety covers provided with the generator is essential. Generator parts become extremely hot and can cause severe burns. Children and curious by-standers should never be allowed near generators. Where areas cannot be physically secured, they should be marked with protective fencing or safety tape and cones where fencing is unavailable.

Generator Security

Theft of generators is another problem that occurs in emergency situations. Generators should be safety chained at the tires to the frame to obstruct movement. Local law enforcement should be notified to establish extra patrols in emergency locations. Any type of treatment that attracts attention or impedes the timely movement of a generator will deter theft. Some generators are equipped with GPS tracking devices.

Generator Fueling Requirements

The amount of time a generator runs will depend on the size of the fuel tank and the amount of load on the generator. For this reason it is important to determine the fuel capacity of the generator. The table below may be uses to determine the approximate fuel requirements for generators in the 20 to 60 KW range. Generators that are operating at 50percent load will consume about 50percent of the fuel listed for the maximum load values. It is important to consider fueling logistics, including ingress and egress, for installed generator service personnel.

Once an emergency generator is installed, the installer must insure that arrangements are made for fueling. In most cases the utility where it is installed will take responsibility if asked to do so.

Table 9
Fuel Consumption for Generators in Range 20 to 150 KW

Generator Size KW Standby Use	Approximate Fuel Requirements Gallons Per Hour @ Max. Load	Approximate Fuel Requirements Gallons Per Day @ Max. Load
20	1.7	41
30	2.4	17
40	3.3	80
50	4.2	100
60	5.1	125
80	6.3	150
100	7.5	180
150	11.1	270

Diesel engines develop high temperatures when working under load and should be cooled gradually before being stopped. For this reason they should never be allowed to run out of fuel since the extreme heat differential created by rapid shut down can damage engine components.

When shutting down a diesel engine the engine should be operated at half-throttle (no load) for three to five minutes and then low idle for one to two minutes before shut down. In very warm weather the shut down time should be lengthened appropriately. **Diesel engines should always be fueled to capacity to prevent condensate from forming in the tank at shut down.**

When refueling a generator it is good safety practice to shut it off and allow it to cool as a safety precaution. A fire extinguisher should be readily available to the fueling personnel. Operating personnel should use the shut down to check the oil and coolant to prevent damage to the equipment. It is highly recommended that generators be checked and serviced daily.

Use of Power Take Off Generator

Power take-off (PTO) single-phase generator units are available and may power by using a tractor rated at least 30 horsepower. PTO generators may be used in the same way as a conventional generator single-phase generator described above.

Care must be taken to ensure that the rotating shaft is within 10^{o} of horizontal. Because of the rotating shaft, the unit must be secured from unauthorized access.

If the single-phase power is to be converted to three phases, the VFD must be isolated from the machine vibration.

Employees Authorized to Work on Electrical Equipment

In emergency situations there will not be enough licensed electricians available locally to perform all the needed electrical and plant start up work. In these instances water/wastewater utilities are frequently called upon to provide needed employees to efficiently complete the emergency work. Since utility electrical installation work falls under OSHA requirements it is instructive to review these requirements.

OSHA standards require employers to establish a Program and utilize procedures for affixing appropriate lockout or tag out devices to disable machines or equipment to prevent unexpected startup or of stored release of energy that could injure employees. The standard applies to control of energy during servicing and maintenance or where an employee is required to by-pass a guard or safety device or place any part of his/her body in an area where danger exists.

The standards also define affected, authorized, qualified and unqualified employees with regard to electrical equipment. All employees must receive electrical training but only authorized employees have received electrical training that allows them to place and remove lockouts/tags.

Only qualified employees may work on or test energized equipment. Some larger utilities may have established electrical training programs that provide the appropriate electrical training to their employees that will allow them to work on de-energized equipment, including the installation of temporary generators when the electrical line feed has been disconnected. These utilities can be called on in emergencies to provide assistance.

Most utilities will conduct generator installation work using established crews. It is often effective to assign workers from other utilities to these crews for assignments to fill in needed slots or to establish additional work crews.

To ensure safety to both responder and receiving personnel all temporary service connections should be made only under a full lock out procedure, that is ensuring a physical disconnect from any power source that provides power to the facility.

Electrical Test Devices and Personal Safety

Generators will be installed in hazardous and wet conditions and electrical safety precautions should be adhered to at all times to protect workers from injury.

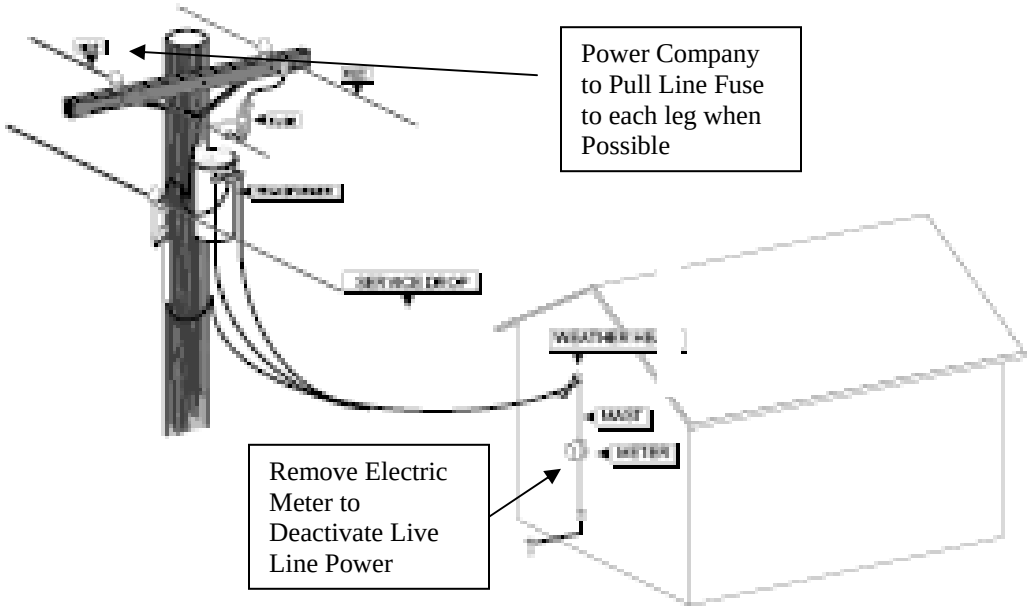
In installing generators a volt/ohm meter, amp probe and infrared temperature meter should be used to check voltage, continuity, amp draw and proper electrical connections. Generator installers should be supplied with personal protective clothing including insulated gloves, eye protection and non-flammable clothing. In making generator connections all circuits should be considered as energized.

Connection to Line Power

After the generator has been installed line power will eventually be restored and the generator will have to be disconnected. Since generators are frequently the property of assisting utilities, their timely removal is often necessary. This condition presents a significant safety threat to those unfamiliar with power company line service requirements. The figure below shows a typical connection to a small water/wastewater utility.

Figure 5

Removal of Generator and Reconnection of Line Power



When the generator is disconnected line power must be reconnected. Since the line power is energized, temporary removal of the electric meter will temporarily de-energize the circuit and allow line power leads to be reconnected to the top of the breaker without the danger of live voltage. Connecting line power and a generator to a facility at the same time can lead to equipment damage or a fire.

Minimum Information to Be Collected by Generator Installer

The following information is to be documented for each generator installation:

1. Utility name and physical street location of generator placement
2. Name of water or wastewater system where generator is placed
3. Utility responsible party name, title and 24 hour contact number
4. Size, owner and identification number of generator
5. Responsible fueling agent and equipment check party
6. Approximate date that the generator will be in use
7. Procedures for generator recovery

Chapter 16: Guidelines for Effective Rotation of Pumps, Generators and Tankers

Planning for Power Outages in Post Hurricane Recovery

Hurricanes in coastal communities have the potential to totally destroy the utility infrastructure. However, in most cases the water/wastewater utility can expect about 80 percent to 90 percent of the total utility system to be out of power immediately after a major hurricane event. Power outages will be widespread and in most areas will be out for several days for Category 3 and smaller storms and several days to several weeks for Category 4 type storms. In Category 3 type storms away from coastal devastation, 70 percent of the main electrical feeders will be up within four days. During this period the utility system will be severely stressed and auxiliary power or other means must be provided to ensure adequate water and wastewater service to customers.

Power Company Restoration Coordination

All power companies maintain a priority power restoration plan. Knowing the circuit number that feeds a water/wastewater facility can greatly improve the knowledge of when the facility power may be restored.

Additionally, water/wastewater facilities that serve critical facilities such as emergency operations centers, hospitals, and dialysis centers can receive higher priority restoration by informing the power company of power needs for restoration of service.

The table below illustrates a typical power company restoration schedule.

Priority 1	Feeder Circuits Critical Facilities, hospitals, government and public safety
Priority 2	Feeders and Branch Circuits Facilities that are not critical but important
Priority 3	Feeders and Branch Circuits Residential and Commercial Customers by number effected

DEP Emergency Power Backup Requirements for Water Systems

Each community water system (CWS) serving, or designed to serve, 350 or more persons or 150 or more service connections shall provide standby power for operation of that portion of the system's water source, treatment, and pumping facilities necessary to deliver drinking water meeting all applicable primary or secondary standards at a rate at least equal to the average daily water demand for the system. Standby power is required to be provided through:

- Connection to at least two independent power feeds from separate substations; or
- One or more auxiliary power sources (i.e., generators or engines).

Where power is provided by auxiliary power feeds, it is likely that both feeds will be down in the event of a serve hurricane.

Where standby power is provided, an in-place auxiliary power source is preferred. A portable auxiliary power source may be provided only if all of the following conditions are met:

- Where the time delay required to manually transfer electrical loads from one power source to another could result in failure to maintain the minimum water distribution system pressure required
- The supplier of water demonstrates that the water system has first priority for use of the portable auxiliary power source.
- The supplier of water demonstrates that the portable auxiliary power source will at all times be in reasonably close proximity to (i.e., within 25 miles of) the water system components for which standby power is required

In the event of a serve storm all of these situations could be disrupted.

DEP Requirements for Permanent Generators at Lift Stations

Emergency generation requirements for lift or pumping stations are found in FAC 62-604.400(2). The rules require that emergency pumping capability be provided for all pump stations. Pump stations that receive flow from one or more pump stations through a force main or pump stations discharging through pipes 12 inches or larger shall provide for uninterrupted pumping capabilities, including an in-place emergency generator.

Lift stations that receive flow from more than one or more lift stations or pump into a force-main 12" or larger, are known as master lift stations for the purpose of conducting a lift station analysis.

DEP Emergency Generator Requirements for Non-Master Lift Stations

For non-master lift stations, emergency pumping capability may be accomplished by connection of the station to at least two independent utility substations, or by providing a connection for

portable or in-place engine-driven generating equipment, or by providing portable pumping equipment.

Emergency Generator Alternatives for Non-Master Lift Stations

According to DEP requirements all lift stations that do not provide auxiliary power described above must provide one or more of the following:

- Emergency generator transfer switch that allows for a direct generator connection
- Pump-around, or allowance for direct connection of portable pump
- Use of tanker trucks for transport of wastewater

Performing a Water/Wastewater Power Requirement Inventory

Identifying the power requirements of water and wastewater facility equipment is the first step in the development of a plan to supply power using generators. Although all water and wastewater facilities require this analysis, an example of a typical lift station inventory is provided here as an example.

Development of a Lift Station Indexing System and Identification of Lift Station Attributes

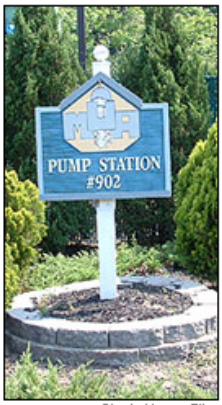
The first step is preparing a location index for storing of pertinent lift station attributes. The location and name convention allows the utility to quickly locate the effected facility.

A typical lift station indexing system is illustrated below:

Typical Lift Station Indexing System

LOCATION OF LIFT STATIONS

#901 Melva Lane (Operations)
#902 Black Horse Pike (Lift Station)
#903 Briarwood Drive
#904 Forest Drive (Lift Station)
#905 Kilburn Avenue (Lift Station)
#906 Frederick Street (Chelsea Farms)
#907 Ettore Drive (Green Meadows)
#908 Twelve Oaks
#909 Fox Hollow
#910 Blue Bell Farms
#911 Lake Avenue/Holiday City
#912 Scotland Run
#913 North Shore Drive
#914 Lake Avenue, South
#915 Williamsburg Village
#916 Deschler Farms
#917 The Ridings



Black Horse Pike
Lift Station

Developing a Lift Station Attribute File

A lift station attribute file is a file that contains pertinent information about a lift station that is necessary for emergency power restoration. A typical summary of suggested lift station attributes is illustrated in the following example.

Lift Station Master List

PG Perm Gen
PA Pump Around
GR Gen Receptacle

No.	LS Name	Address	Pr'ty	Circuit Volts Pumps	LS Pumps To	Flow Received	Comp.
001	Westgate Publix	300 Blk SWW 2nd Ave	1	934/ 480V 4- 75 HP	KWRF via FM	8,51,133,3 ,9,12,39,4 86,54,70,9 9, & 134	PG PA
003	Gainesville HS	1700 Blk NW 13th St	36	217/ 240V 2-20 HP	LS #1 Via Gray	N/A	GR
006	Edwards Ind. Prk	1900 Blk NE 31st St.	1	1432/ 240V 2-47 HP	MSWWTP via FM	85, 94- Gray. And 72 FM	PG
007	Lincoln Estates	1700 SE 15th St.	8	1432/ 240V 2-35 HP	MSWWTP via FM	17,37 & 102 Gray.	PA

Courtesy of Gainesville Regional Utilities

In this example, the lift station number, its name, the address location, the priority for restoration, circuit and electrical servicing information, the place that the lift station pumps to, the flow received from other lift stations and collection systems and any special emergency by-pass provisions such as permanent generator on-site, existence of a quick connect generator receptacle, pump around capability are all documented.

Performing a Lift Station Assessment

Wastewater utilities depend on a reliable source of electric power for running pumps at lift stations. Many mid to large size utilities have from a few hundred to several thousand lift stations in operation at any one time. Typically, these power loss needs are met by installing portable generators, which have been borrowed from assisting utilities. The need to efficiently dispatch generators to affected areas impacted by hurricanes must be based on criteria that ensure the distribution of generators to optimally supply power to the most significant number of lift stations and impacted utilities. A lift station assessment may be used to estimate utility needs based on the number of lift stations and the horsepower used.

Performance of a Lift Station Assessment

A Lift Station Assessment analysis assumes emergency conditions where a complete loss of power occurs for an extended period exceeding three days. The analysis assumes that lift stations that utilize pumps 20 HP and smaller are of the duplex variety. A duplex lift station is a lift station that includes two pumps, with one pump designed to handle incoming flow with the other pump out of service.

The analysis considers that in an emergency situation a lift station smaller than 20 HP (uses two, 20 HP pumps) can handle incoming flow for an extended period of electrical outages with an emergency generator using only one of the two pumps available at the station or in some cases has wet well capacity that can be used for storage allowing generators and other equipment to be used to evacuate wastewater in a rotation.

The numbers developed in this example are conservative and for most systems the number of generators that are required following a hurricane and long-term power outage can be reduced further.

No attempt has been made to equate these numbers to any specific wastewater system. If such a comparison is to be made it is necessary that the utility system prepare similar tables to those provided in this document.

Table 1: Lift Station Assessment Analysis Based on Number of Lift Stations and Horsepower at each Station

The following table illustrates the lift station distribution for a typical mid-sized utility.

Size of Pump Unit (HP)	**Number of Lift Stations in Category**	**percent of Entire System for Lift Stations**	**Rolling Average percent**	**Number of Perm. Gen.**	**Rolling Average Perm. Gen.**
0 to 5 HP	57	**37percent**	37percent	0	06percent
7.5 HP	1	**1percent**	38percent	0	11percent
9.4 & 10 HP	46	**29percent**	67percent	1	11percent
15 HP	3	**2percent**	69percent	1	15percent
20 HP	32	**21percent**	90percent	1	14percent
30 to 40 HP	5	3percent	*93percent*	*1*	*35percent*
47 HP	10	6percent	*99percent*	*4*	*42percent*
Above 50 HP	2	1percent	*100percent*	*1*	*50percent*

Courtesy: Gainesville Regional Utilities

The numbers in bold are a rolling average from the smallest station to the largest. The numbers in italics are a rolling average from the largest system to the smallest. From the above table several facts can be discerned:

1. Approximately 90percent of the system consists of duplex lift stations that use 20 HP and smaller pumps.
2. Only 10percent of the system (17 stations) consists of lift stations that require generators that are larger than 30 KW.
3. Of the 17 lift stations that are larger than 20 HP, 6 have permanent generators at the lift station site. If we were to include 6 portable generators, then 71percent or 12 of 17 lift stations that use 30 HP pumps and above would have auxiliary power in an emergency situation.

Performance of a Lift Station Assessment Analysis is essential in determining the need and size of three phase generators in the aftermath of a significant storm. This analysis provides information critical in determining the most effective method of initiating short-term operation.

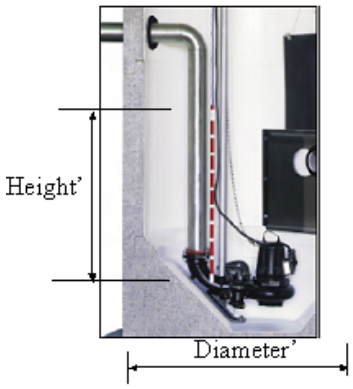
Another analysis that must be performed is to determine the number of lift stations that receive flow from other lift stations. This fact is important because DEP regulations require that emergency pumping capability be provided for all these pump stations.

This can be in one of three forms, emergency generator transfer switch that allows direct generator hook up to a receptacle, provision of a "pump around," that is a connection point that allows a portable pump to discharge from the wet well directly into the pump station discharge main or for the provision of manual transfer that is the use of tank trucks that can use either portable and/or mounted pump and suction hose to evacuate wastewater from the wet well in a manner fast enough to avoid a spill or a back-up into a private residence.

Determining Pumping Rate and Critical Wet Well Storage Rate

Determining Wet Well pumping and fill rates can be determine by performing a draw down test. Knowledge of pumping rate and refill rate is critical in establishing lift station restoration priorities. The information is invaluable in establishing lift station relief rotation schedules for servicing lift stations when insufficient numbers of generators are not available.

Determining Pumping Rate & Critical Wet Well Storage Rate



Step 1: Calculate Useable Volume

V = Height (7.5) x π x dia^2 / 4

Step 2: Pump Down Wet Well

Record Time to Empty (min)

= T_E

Step 3: Fill Up Wet Well

Record Time to Fill (min)

= T_F

Step 4: Calculate Pump Rate

PR = V /(T_E - T_F)

Setting Critical Wet Well Storage Volume Pumping Priorities

Once wet well pump rates and refill rates have been determined these rates can be used for establishing service rotation priorities. An example is illustrated below. Note that even though Master Lift Stations may have long fill rates they are always considered a top priority in a rotation because of the amount of wastewater that can be accidentally discharged to the environment.

Classification	Category	Priority
Master Stations	Critical	1
Establish Categories		
0 to 45 minutes	Critical	1
45 minutes to 2 hours	Semi-Critical	2
2 to 4 hours	Semi- Stable	3
4 to 12 hours	Stable	4

Lift stations with semi-stable to stable conditions are typically found in subdivisions and can be left for long periods of time without concern for overflows. These types of lift stations are prime candidates for servicing by rotation using a combination of generators, pumps, water tankers and pumper trucks. In a rotation method, lift stations may be serviced using existing forcemain connections and/or transporting wastewater to other lift stations that are operational.

Selection of Equipment for Servicing Lift Stations by Rotation

The guidelines below illustrate proper application of equipment for lift station failure.

Three Phase Generators Master Lift Stations > 15 HP > 1 Pump Required	Single Phase Generator/VFD's Residential Lift Stations < 15 HP 1 Pump Required (Duplex Lift Station)
Portable Pump/Tankers (5000 to 10,000 gallon variety) •Broken Forcemains •All Size Stations •Filling Large Tankers not equipped with pumps (Nurse Trucks)	Pumper Trucks (1000 to 3500 gallon variety) •Residential Lift Stations •Close Proximity •Access to Close by Disposal Point

This equipment can be used effectively in a service rotation basis after service priorities and wet well fill rates have been established. Generator and pumper truck rotation is sometimes called "hopping" and greatly reduces the number of generators needed by a utility.

In this mode a generator and/or pumper truck moves from lift station to lift station evacuating the wastewater from the wet well and moving on to the next lift station. This mode can be very effective because in many cases smaller lift stations (5 HP to 10 HP) have sufficient storage capacity to be left without power overnight without spilling. Daily routes are set according to wet well storage fill rates.

Lift Station Rotation, Hopping and Queuing

Lift station rotation is a method used to move from lift station to lift station in a repetitive and prescribed pattern using a generator sized for the horsepower requirements of a specific group of lift stations. Hopping refers to using multi-equipment to effectively evacuate wastewater based on fill rate considerations. Queuing refers to servicing lift stations based on the most critical to the least critical station as conditions change during the day. In most cases, a combination of all of these methods will be used in restoration activities for a medium or large utility.

The following are recommendations for set up of servicing lift stations by the hopping method.

Developing a Transport Model for Pumper Truck Hopping

- Define Variables, i.e., number of pumper trucks available (4 max. manageable), size of transport tank, number of critical and semi-critical stations, distances to disposal point and fill and empty time (generally 15 minutes each.)
- Define transport routes, i.e., routes in miles from lift station to disposal point, travel time (assume ~ 30 MPH)
- Develop Transportation rotation plan for pumper trucks
- Record information and make field adjustments

Developing a Transport Model for Generator Hopping

- Define Variables, i.e., number of pick-up trucks available, size HP of Lift Stations, number of critical, semi-critical and stable stations, provisions for electrical connections and pump down time
- Define transport routes, i.e., routes in miles from lift station to next lift station. Generally will use queuing method (most critical to next most critical), and travel time (assume ~ 30 MPH)
- Develop Transportation rotation plan
- Record information and make field adjustments

Smaller generator units can be deployed in a timely manner after a storm since they are more available and easier to transport and maneuver in tight spots. Use of small generators also frees up larger three phase units for deployment to priority areas.

Considerations for System Using Low Pressure Collections Systems

Low Pressure Collection Systems

Collections system with wastewater customers that use individual electrically powered STEP, grinder and vacuum technologies are called low-pressure to differentiate them from gravity sewer and force main systems. Although STEP and vacuum technologies use low or negative pressures, grinder pumps typically operate at the same or higher pressures that are found in force mains.

Pumping Requirements and Loss of Power for Low Pressure Systems

All low-pressure technologies rely on power being supplied to each location and when the power is interrupted the ability for the individual residence to empty on-site tankage. These systems typically have a central collection basin (lift station or vacuum station) for repumping into the

force main system. If the power outage extends over the entire area and a long duration, then the central collection basin also cannot function.

The typical simplex grinder system is a single pump system operating on 230 volt, single-phase electrical power, in a 3-foot diameter, 4-foot deep fiberglass basin. The simplex system is used in applications where the wastewater flows are 250 gallons per day or less. Grinder pumps are typically specified as follows:

- Submersible type pump motor
- 2-horsepower at 3450 RPM
- Single phase, 230 volt, 60 Hertz
- Centrifugal design with grinder assembly
- Average flow - 35 gpm at 51 TDH
- Minimum flow - 10 gpm at 83 TDH
- Maximum flow - 43 gpm at 18 TDH

Emergency Operation of Low Pressure Systems

Strategies for emergency operation of Low Pressure Systems for long durations include conservation strategies to minimize volumes, use of portable generators, use of pump outs using tanker trucks and setup of portable wastewater facilities (Porta-Potties.)

Notification to Homeowners to Conserve Water

Notifying customers that they have limited storage capacity in their wastewater system should be a first step following an emergency. They should use no more than 10 to 15 gallons of water per day until power is restored. Assuming that most individuals don't shower with cold water, the 10 gallons per day should handle most sanitary functions and gray water could be disposed of separately. It goes without saying that customer education before the situation would be beneficial.

Pump Outs Using Tanker Truck Servicing

Utility systems may wish to have provisions for pumping on-site tankage to relieve customer backups in their emergency plans. Utility systems can put in place service contracts with local septic tank pumpers – some systems have opted to purchase pumper trucks for normal low-pressure system operation and emergency situations.

Emergency Power Generation for Low Pressure Systems

Customers may prepare for power outages by supplying emergency power generation. The power needs for each system will vary by size and capacity of pumps. It is recommend that

generators should be at least twice the total horsepower requirement. Given that one horsepower is equivalent to 1.34 kilowatts, it would seem easy to quickly estimate power generation needs, but startup power, power factors, and lost amperage through wires need to be taken into account. Generators tend to run longer, use less fuel, and overheat less frequently if they are taking a lower load. Generator sizing for low-pressure systems are estimated as flows:

- STEP Systems – 1000 to 1,500 watts
- Grinder Systems – 3,000 to 10,000 watts *
- Vacuum Systems – 250 watts

* Note: Some grinder pumps can pull up to 10,000 watts (or 50 amps) at start-up but may run on less than 3,000 watts (2.8 kVA). Homeowners may be able to keep ahead of wastewater if they run the pump for short periods of time and only as needed.

Portable Sanitary Facilities

Utility systems may wish to have provisions for placing portable sanitary facilities for areas served by low-pressure systems. Utility systems have put in place service contracts with local suppliers for emergency situations**.**

Chapter 17: Development of Exit Strategies for Responders

Providing Restoration Assistance through the FlaWARN Network

The purpose of the Florida Water and Wastewater Agency Response Network (FlaWARN) is the timely restoration of essential water and wastewater service to impacted populations. Generally, these response activities are intended to be short-term. In most cases restoration will consist of restoring temporary power and making the repairs necessary to render facility equipment operational.

Requirements for the Use of Prudent Response Procedures

In an effort to protect public health and the environment, assisting utilities will use prudent response procedures to restore essential potable water and wastewater functions. Further, efforts will be made to restore equipment at water plants, wastewater plants, and assure water quality and quantity. These repairs should be completed using many of the BMP's described in this document. In some cases unconventional repairs may be necessary to restore service quickly pending more permanent repairs. The purpose of a responder is to restore service in a safe and reliable manner, as soon as possible and/or to protect the environment from contamination. Longer-term reconstruction and repairs to the water and wastewater systems are the responsibility of the damaged utility. In the long-term, the damaged utility should secure the contractors, equipment, materials, etc., necessary to return the system to its normal condition.

Considerations for Responder Utility Personnel

In an effort to restore service in a timely manner, the assisting utilities may be expected to arrive ASAP. In an attempt to restore service efficiently and effectively, they may be expected to work long hours and extended workweeks under very adverse eating and sleeping conditions. For longer-term responses, work crews may need to be rotated in and out of the damaged area to keep workers alert, productive, and safe. An additional priority is getting the assisting utility workers back home where their normal workload is being performed by other utility employees, and to their families who may have needs of paramount importance.

Completion of Restoration Activities and Exit of Responder Agency

Once water service (including quality, pressure and quantity) along with wastewater service (including collection, pumping, treatment and disposal) can be confirmed, the damaged utility has the obligation to maintain the operation. Response activities are **not** normally intended to provide long-term replacements for utility employees, unless there is an agreement and/or a demonstrated need to do so. Before departing, the responding crews should make arrangements with the assisted utility for fueling, lubrication, and standard equipment checks. Also necessary are provisions for safekeeping of equipment when it is no longer needed and agreements

beforehand on whether the equipment can be moved by the damaged utility to other locations. When these arrangements are made, the responding utility can return home.

Determining the End Point of Responder Assistance

It can be difficult to judge when a responder utility's work is finished. The most obvious measure is when power has been restored to the impacted facility. Once power is restored it is imperative that temporarily loaned equipment be disconnected and moved to areas where power may still be lacking or returned back to the lending agency. Restoration of power is indicative of a condition where permanent repairs to equipment can be initiated by the damaged utility. Reconstruction work requests are a frequent issue and it was not the intent of FlaWARN to assist damaged utilities with these needs. Normally, the assisting utility will not remain at the damaged utility to do reconstruction, long-term repairs and recovery, or infrastructure installation. These types of long-term improvement responsibilities were not contemplated as part of the Mutual Aid Agreement and are better handled by private contractors who are licensed to do this kind of work.

For example if a damaged utility asks the assisting utility to install two and a half miles of water main to improve water service in an area of the community, this is a clear signal that the response phase has ended and the repair and reliability improvement phase had begun. It is best if the crew leaders from both damaged and assisting utilities communicate early and often in the response process as to restoration goals, including what has been achieved and what remains to complete the response. The goal should always be to place the system in a condition where the damaged utility can manage it.

It should be noted that rarely do the responders or responding utility crews ask to go home or leave the damaged utility. In less than one day, the responders may become fully invested, attached, and committed to the response effort. Because of the dire situation, the responding workers are going to work as hard as they would or harder than they do at their own system. They naturally want to stay and alleviate any suffering they can for the damaged utility and community. It is also natural that damaged utilities will want to keep good responders around as long as possible, once their abilities have been demonstrated.

When an assisting utility returns home the damaged utility may still need equipment, like generators and by-pass pumps. If the assisting utility is willing to leave behind any equipment the BMPs on loaning equipment should be followed.

Besides operating, maintaining, repairing, and safeguarding the equipment, the damaged utility should coordinate with the assisting utility to return the equipment and any accessories ASAP, in at least as good condition as it was received. If the equipment can be spared until operations return to normal at the damaged utility location, it is appropriate that the damaged utility return the equipment to the assisting utility instead of relying on the lending utility to come get it or make arrangements for its return.

When transporting equipment to the home location, the assisting utility should check all vehicles, trailers, tires, rigging, and equipment to ensure security, safety and proper working condition for the return trip home. Also, remember the need to accommodate what will likely be a very tired crew. The returning crews may need to be reminded to take great care when returning home, make frequent stops and driver rotations, and secure lodging if needed to prevent potential accidents and unnecessary risk from fatigue. At all times CDL regulations and posted traffic speeds should be adhered to, so as not to endanger the public.

Need for Debriefing of Responder Personnel

Once the assisting utility returns and the responders are rested, a debriefing meeting should be held to share experiences and insights to benefit future responders. The debriefing aids the assisting utility, helping them analyze and improve their Emergency Preparedness and Response Plan. Every response opportunity will provide learning experiences that can be used to increase effective operations at home and in the field.

Chapter 18: Flood Preparation and Response

General Discussion

Recent hurricane and other climatic events support a conclusion that more severe flooding conditions than previously experienced or predicted may occur. These flood problems may be exacerbated in communities where development has altered the natural buffering affects such as wetlands or woodland area that previously had higher levels of water retention and infiltration. Additionally, conditions that support build up antecedent wet conditions intensify floods and may produce floods of significantly high reoccurrence frequencies that have not been anticipated. Since hurricane flood surge strength is generally not predictable to a specific location and that flash floods give no warning of their intensity, new provisions are suggested to protect utility facilities that have not been used in the past.

Procedures for Operation of Flood Threatened Water and Wastewater Facilities

Importance of Maintaining Water Treatment and Distribution Pressure

Positive water pressure provides the major source of protection from microbial and chemical contamination of the water system and from the intrusion of rocks, stones and silt that may be difficult if not impossible to remove. Water pressure also provides the primary means of fighting fire for many municipal systems. Thus maintaining water pressure before, during and after a flood should be the top priority and protection and response efforts should be planned accordingly.

If positive pressure cannot be maintained in flooded sections of pipeline, these sections should be isolated by turning off valves in such a manner to protect the remainder of the water system.

Often the biggest threat to water treatment is the loss of the ability to backwash using conventional gravity methods. In these instances, sandbags may be used to direct backwash water out the top of tanks to open areas away from plant structures.

In instances where well capacity is threatened temporary connections to nearby communities through fire hydrants using pumps or pumper trucks is often employed.

It is not recommended that contaminated water be introduced into a water supply system for any purpose since the water will likely render the system inoperable for public supply in the future.

Importance of Wastewater Treatment

Wastewater Plants are often at the lowest points in a drainage basin and plant processes are often inundated in severe flooding situations. The loss of a wastewater plant in the buildup of hydraulic pressure upstream can result in the popping of manhole covers that then allow for inflow of surface water. Wastewater plants also provide a central area for collection and disposal

of wastewater and loss of treatment moves spills to areas that may not have equivalent capacity of dilution and movement of partially treated wastewater downstream.

Common problems with wastewater plants are in the preliminary treatment area, especially the bar screens. Sticks, rags, rocks and other debris will be carried to these units and they can be quickly overcome. Flow conditions will often prevent repairs that can quickly result in sewage inundating other plant processes and buildings. To prevent this occurrence, many plants have a separate small generator that can operate preliminary screens and grit removal processes in a power outage.

The importance of grit removal is another issue that wastewater treatment plant operators must address. Flood conditions will cause both inflow and infiltration to significantly increase forcing large amounts of sand and grit into the collection system. Many times grit facilities will see a 500% increase in the amount of this material that is being collected. Loss of grit removal facilities can result in treatment capacity being severely impacted by the introduction of grit into treatment basins and its deleterious affects on pumps used in the plant treatment process. Grit removal facilities should thus be kept running.

Hydraulic flows into wastewater plants under severe flooding conditions can be 3 to 4 times the average daily flow rates. These hydraulic flows can wash needed bacteria out of the plant adversely impacting treatment. During flood conditions wasting of sludge should be suspended to conserve bacteria needed in the treatment process.

Controlling inflow and infiltration is another operating concern under flooded conditions. Low lying or inundated mobile home parks are often a contributor of these problems. Thus it is incumbent on the wastewater plant manager to plug open drains in these parks before the flooding hits. After the flooding hits flow from mobile home parks that are underwater are often shut off to prevent large surface water intrusions.

Streambank erosion is another problem that operators face in storm flow conditions. Meandering streams often dislodge pipelines allowing for direct inflow of surface water. Knowing where these locations are and protecting pipelines with rip-rap are the best policy. It is difficult if not impossible in some cases to find open pipelines taking in inflow. If necessary they can be found by swirling vortexes and plugged by sinking materials to slow the inflow to smaller volumes.

After each major storm all manholes and pipelines in flood prone areas should be inspected for inflow and infiltration.

Water Tanks and Chemical Storage

Water tanks of any sort should be topped with water before a server storm to prevent floating. Likewise chemical storage tanks that are empty should be filled with water and their contents pumped to other tanks.

It is not a good idea to attempt to secure empty tanks to floor slabs since the tank may float the slab if inundated.

Planning for Pre-flood Events

Pre-flood activities include actions that identify flood prone areas where utility infrastructure is located and include relatively low cost improvements that provide higher level of protection than would normally be considered.

These activities include:

- Flood risk management identification
- Pre-flood mitigation efforts
- Improved Forecasting
- Development of Triggers for Initiation of Response

Flood Mitigation and Critical Facility Identification:

Flood Management identification targets critical facilities that are located adjacent to rivers and water impoundments used for flood management. Methods to identify these facilities can be made facilitated by the review of basic FEMA flood maps and use of SLOSH Models to determine the likelihood of flooding. Facilities are then identified and targeted in these areas and are then ranked by their importance in continuous utility operation. Major facilities such as production wells, water and wastewater treatment plants and major lift stations are targeted as primary candidates for flood mitigation actions even though they may be protected for a 100 yr. event. Where high water marks on fences or buildings have been observed at particularly higher levels from rainfall events over the past 5 to10 years than previously recorded, these should be used as references for events that are likely to be exceeded in the near future.

Targeted Pre-Flood Mitigation Actions

Unlike most conventional program for flood mitigation where structures are protected by on historical rainfall and flood events, flood mitigation does not include a risk assessment as the primary driver. This is because the probability of the event can not be reasonably determined from past history. The analysis is performed on two factors. The importance of the facility in providing continued operation of water or wastewater service and the facility's proximity to water bodies that may reach water levels that are beyond those predicted are the primary criteria used in the initial screening.

Determining the mitigation approaches are then developed by asking the following questions in three different categories, Major Construction Activities, Minor Construction Activities and Pre-flood Construction Activities:

Major Construction Activities

- Are the dikes or berms that are in-place contiguous and can they function at higher elevations by relatively minor filling or build up of surrounding ground?

- Are the existing dikes, berms or other structures adequate to withstand erosion that may be caused by changes in velocity and higher water levels and can they be strengthened by the addition of rip-rap or other erosion control measures?
- Where construction of physical barriers and raising of protective separations are not feasible, can a smaller area be protected with a cofferdam built around the facility?
- Can provisions be made to use existing block buildings as protection by sealing off doors, window vents or louvers?

Minor Construction Activities

- Can on-site transformers and motor controls be raised to elevations at least 3 feet higher than the predicted 100 yr flood?
- Can motor control panels and SCADA panels be raised to at least 3 feet higher than predicted by a 100 yr flood?
- Can a pump be permanently mounted in a dry area to allow for pumping floodwaters away that might enter the building under extreme conditions?
- Can floor drains be plugged and water under pressure be evacuated from the building by makeshift piping?
- Can any of the construction activities listed in the major construction activities above, be accomplished by the use of sandbags or permanent concrete slabs?

Pre-Flood Response Activities (these actions should be taken when the actions above were not implemented or are unlikely to prevent flooding)

- Disconnecting and Raising Electric Motors to above flood stage and providing quick disconnects (accessible electrical connections to motor pigtails to facilitate movement)
- Disconnecting and removing SCADA equipment especially UPS type units that will damage submerged equipment

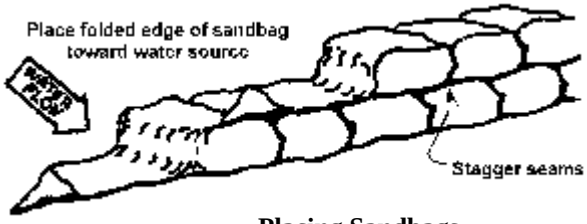
Proper Placement of Sand Bags for Flood Protection

Sandbags are often used to protect structures and equipment from floodwaters and their proper placement can be invaluable in a flood event. Sandbags are used for protection of buildings and other structures near creeks or lakes and in similar situations where water is rising with little or no current. They may also be placed to divert flowing water away from structures.

General Sand Bag Construction

The use of sandbags is a simple but effective method of preventing or reducing damage from flood water and/or debris. The following procedures should be used in constructing sandbag protection:

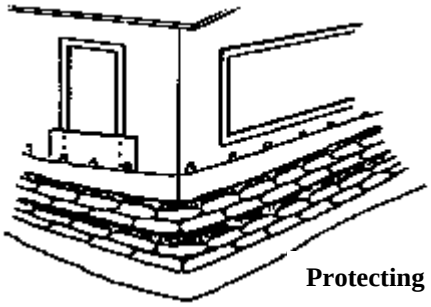
- Close-weave burlap bags are recommended for all sandbag construction.
- Fold over the empty top of the bag in a triangle to keep sand from leaking.
- Place each bag over the folded top of the preceding bag and stomp into place before placing the next layer of bags.
- Stagger the second layer of bags, stomping each bag into place before placing the next.
- Stomp each succeeding layer of bags.



Placing Sandbags

Protecting Structures

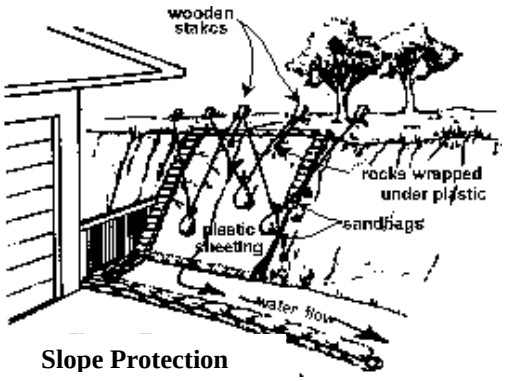
Lay plastic sheeting on the ground and up the building walls to a point at least one foot above the predicted water elevation, and far enough out on the ground to form a half pyramid of sandbags. Secure plywood over doors and vents. Overlap plastic sheeting and sandbags at corners of buildings.



Protecting Structures

Protecting Slopes

The "raincoat" method is used to prevent further saturation of levee or hillside slopes. Plastic sheeting is laid out flat on the slope, and stakes are driven into the ground just above the area to be protected. The stakes are four feet apart with a one-foot stagger. The plastic sheeting is secured to the stakes with tie-down buttons or small round rocks and rope.



Slope Protection

Stockpiling Sand for Filling Sandbags

Materials required for 100 lineal feet of sandbag wall		
Height above ground	**Bags required**	**Cubic yards of sand**
1 foot	600-800	10 to 13
2 feet	1400-2000	23 to 33
3 feet	2200-3400	37 to 57
4 feet	5300	88
5 feet	7600	137
6 feet	10000	167

Sandbag Information Courtesy:
Sacramento County Dept. of Water Resources

Flood Monitoring and Prediction

Floods are generally divided into three categories based on the utility's ability to prepare and respond. These categories are **Storm Surges** which occur in coastal ocean areas, **Flash Floods** caused by local or regional unusually high rainfall intensities and **River Flooding** caused by significant periods of moisture coupled with moderate to intense rainfalls over long durations. These categories my overlap but can generally be used for setting targets to initiate the response.

Flood and Hurricane Warnings are given by the National Weather Service and NOAA Weather Radio. Flood alerts are given according to the following descriptions:

Floods (Can Take Several Hours to Days to Develop)

- A flood WATCH means a flood is possible in your area.

- A flood WARNING means flooding is already occurring or will occur soon in your area.

Flash Floods (Can Take Only a Few Minutes to a Few Hours to Develop)

- A flash flood WATCH means flash flooding is possible in your area.
- A flash flood WARNING means a flash flood is occurring or will occur *very* soon.

Storm Surges

Storm surges are a phenomenon of hurricanes that are a danger to coastal utilities. These types of events often have several days of warning allowing the utility to prepare. The predicted impact of the expected storm surge is provided by the National Weather Service.
The extent of the surge is related to the position of the high tide at the time of hurricane landfall. In this type of flooding, the water surge is accompanied by very strong winds and the combination of wind and saltwater that inundates utility facilities will like destroy them completely. Physical protection of electrical components is the best form of protection.
Generally for any hope of recovery after saltwater inundation, motors must be kept wet to keep salt from drying out and special procedures must be used to remove saltwater that must be incorporated immediately after the flooding. Recovery techniques for saltwater damaged motors are included in the Appendix. Generally, electrical panels damaged by saltwater will not be salvageable and replacement will be necessary.

Flash Floods

The National Weather uses Doppler radar to predict flash floods. Doppler radar is accurate to the street level. This ability allows the Weather Service to provide more accurate flash flood warnings**.**

Flash floods will typically occur within a couple of hours and thus adequate response time will not be available to a utility. Like any flood threat the best approach is physical protective measures.

Motors and controls submerged in fresh water can sometimes be restored if response is timely. Procedures for restoring control panels and motors are found in the following section.

River Flooding

In general, river flooding is predicted by establishing the likely peak elevation (flood crest) reached by a river by the National Weather Service. Under normal conditions river flooding can be predicted several days in advance. Where antecedent moisture conditions are high and localize rainfall is predicted to heavy and continuous, river flooding may quickly change to a flash flood.

River flooding generally allows for protective sand bags to be placed around structures to provide dry areas for the continued operation of transformers, motor controls and motors.

Where buildings are protected with sand bags, provisions must be provided to remove water that will accumulate when the outside water level exceeds the building slab elevation. This will include water which may backflow through floor drains, and electrical conduits or flow through fan louvers or under doorways. An assessment of
protective flood measures to prevent seepage, inflow and leaks must be undertaken. A method of pumping water out of structures must be included in any flood protection plan.

Preliminary Flood Condition Assessment

Unlike preliminary assessments on facilities that have been damaged by high wind which are performed immediately after a hurricane, flood water damage occurs from the immediate post flood conditions, conditions that may deteriorate immediately after a flood and the longer-term post flood threats that continue.

Flood condition assessments identify current damages, current threats and future threats. Depending on the severity of the event, these are categorized as: forecasting, detection, assessment, warning and response. In the preliminary flood damage assessment phase recovery and mitigation are both addressed and reconstruction, flood defense and recovery are all included in the assessment.

Completing the Flood Condition Assessment Form

The purpose of the Flood Condition Assessment Form is to for providing the following information:

1. Providing a visual record showing site inundation, the scope of the flood damages and the possibility of potential flood damage that can be mitigated. This is best done through annotated photographs, sketches and measurements taken before the cleanup and restoration activities actually begin.
2. Create an inventory of equipment damages to transformers, electrical control panels, electric motors and chemical dosing equipment.
3. Use the gathered information to prioritize restoration plans and initiate corrective actions of stabilization, mitigation, repair, and restoration.

Facility Flood Condition Assessment

Inspector Name: _____	Date _____ Time _____	Attachments: Sketches ☐ Photographs ☐ Measurements Taken ☐
Facility Name:		
Flood Information	Flooding has Occurred ☐ Yes ☐ No	Flooding may Occur ☐ Yes ☐ No
Water: Standing ☐ Flowing ☐ Seeping ☐ Water Marks ☐ Other ☐ Explanation:		
Depth of Water Measured inside Structure:	Sediment In Structure ☐ Yes ☐ No	

Damage Assessment	Ground Elevation (ft) Impacted	Comments:
Flooding On-Site	☐ Yes ☐ No	
Ingress	☐ Yes ☐ No	
Egress	☐ Yes ☐ No	
Building First Floor	☐ Yes ☐ No	
Transformers	☐ Yes ☐ No	
Motor Controls	☐ Yes ☐ No	
Motors	☐ Yes ☐ No	
Chemical Feed System	☐ Yes ☐ No	
Foundation or Structural Damage	☐ Yes ☐ No	
Other	☐ Yes ☐ No	

Mitigation Assessment	Explanation (Use Back of Form if Needed)
Is Site Safe from Flood?	
Do Facilities need additional protection?	
Is Stream Bank Erosion Occurring?	
Is there Damage to Protective Berms?	
Does Flood Water need to be Redirected?	

Other:

Post-Flood Response Procedures

The safety of employees must always be the first priority in a post flood response. The following precautions apply:

- Return to the area only after it has been declared safe by local emergency management officials. Partially or totally submerged transformers that may be live are dangerous and can cause electrocution.
- Identify potential electrical hazards and solicit advice and assistance from the power company to minimize the dangers. Always report and stay clear of downed or damaged power lines.
- Turn off all utilities associated with utility facilities to prevent further damage and minimize electrical and explosive hazards.
- Never attempt to start a motor or control panels that has been submerged by water. This will result in irreversible damage to systems that may be salvageable.
- It is important to begin salvage operations for flooded electrical equipment as soon as possible (ASAP) after flood waters recede below them if they are to be salvaged in-place.

Cleaning Flooded Utility Equipment following Damage by Fresh Water

Moisture in an electrical circuit will carry stray current and result in direct shorts damage to electrical equipment. High humidity will cause the moisture to collect on electrical components when the temperature cools, such as in the evening hours. The first priority in a salvage operation is to remove all sources of moisture from the building itself.

Removing Sources of Continued Moisture

- Carefully remove trapped mud and collected water/storm debris as water recedes from buildings. Do not unnecessarily damage any electrical equipment or motors in clean up activities.
- Remove standing water and water-logged furnishings and debris that maintain a source of moisture within the structure.
- Drain the water from low areas and corner spaces. Standing water will migrate and perpetuate the moisture problems.
- All furnishings and furniture should be moved to allow air movement and ventilation around them.
- Remove and dry water soaked rugs, paper, books, boxes, and other wet materials.
- Remove any water soaked insulation; remove insulation from cavity wall construction if any.

Silt and trapped moisture inside closed electrical components will combine to reduce resistance and carry higher loads of stray current. Thus the moisture and silt must be removed. Silt is also hydroscopic, so leaving it in place will result in moisture being attracted with resultant electrical equipment failure.

Removing Trapped Water and Silt from Electrical Control Equipment, Connections and Motors

- Check and drain trapped water from mechanical chases, equipment control panels, electrical boxes and HVAC ductwork.
- Rinse remaining mud, dirt and flood debris from all surfaces with freshwater. Do not use high pressure water on electrical equipment. This will force silt areas which will not be easy to remove.
- Open electrical control panels and wash out any silt with fresh water. Do not hose electrical devices, contacts or connections. These should be carefully cleaned with rags, deionized water and a tooth brush.
- Remove any obviously damaged electrical components that contain water inside of them such as relays.
- Open electrical outlets and mechanical chases and rinse these areas thoroughly. Check wiring and connections for damage and repair as required. Leave areas open to dry before closing them.
- Open up motors that have been submerged and wash out all silt with copious amounts of low pressure fresh water.

Drying of Electrical Equipment

It is important that flooded electrical equipment be thoroughly cleaned to remove all sources of stray current such as silt and trapped moisture. After the electrical equipment is cleaned precautions must be taken to ensure that it is completely dry. This is accomplished by physical drying such as use of a hair dryer, displacing moisture with dry air and preferably by the use of a dehumidifier. The dehumidifier is preferred since it can draw moisture from areas where it may be trapped. This is accomplished by lowering the humidity within a panel and/or building that houses electrical equipment and motors that have been flushed and cleaned with water to as low as 20% humidity.

- Spot dry areas where water was used for flushing or cleaning with an electric hair dryer
- Set up a dehumidifier(s) to blow air across electrical cabinets and motors to ensure that the equipment is completely dried out. Continue the process until the inside humidity is lowered to below 40%. Dryer conditions improve the possibility of successful recovery of the electrical equipment and will pull moisture from hard to reach places.

A 1: Weather/Hurricane Terms and Acronyms

(Retrieved 4/7/06 from: http://www-nmcp.med.navy.mil/newsweath/terms.asp)

ARWO	Aerial Reconnaissance Weather
AFOS	Automation of Field Operations and Services
ASOS	Automated Surface Observing Systems
AWIPS	Advanced Weather Interactive Processing System
AOC	Army Operations Center, Pentagon
ARC	American Red Cross
ARES	Amateur Radio Emergency Services
ARRL	American Radio Relay League
CARCAH	Chief, Aerial Reconnaissance Coordination, All Hurricanes
CONUS	Continental United States
DAE	Disaster Assistance Employee
DAC	Disaster Application Center
DCO	Defense Coordinating Officer
DFO	Disaster Field Office
DOC	Department of Commerce
EAS	Emergency Alert System
EBS	Emergency Broadcast System
EICC	Emergency Information and Coordination Center (FEMA)
EMS	Emergency Medical Services
EMWIN	Emergency Manager's Weather Information Center
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
ERT	Emergency Response Team (FEMA)
ERT-A	Advance Element of the Emergency Response Team (FEMA)
ESF	Emergency Support Function
EST	Emergency Support Team (FEMA)
FAST	Field Assessment Team
FCO	Federal Coordinating Officer (FEMA)
FEMA	Federal Emergency Management Agency
FRP	Federal Response Plan
GMT	Greenwich Mean Time

GOES	Geostationary Operational Environmental Satellite
HES	Hurricane Evacuation Study
HF	High Frequency
ICS	Incident Command System
IT	Information Technology Directorate (FEMA)
KM	Kilometers
JIC	Joint Information Center
M	Statute Mile
MB	Millibars
MEOW	Maximum Envelope of Water or Maximum Envelope of Winds
MERS	Mobile Emergency Response Support (FEMA)
MPH	Miles Per Hour
MOC	MERS Operations Center (FEMA)
M/S	Meters Per Second
MT	Mitigation Directorate (FEMA)
NASA	National Aeronautics and Space Administration
NAWAS	National Warning System
NDMS	National Disaster Medical System
NECC	National Emergency Coordination Center (FEMA)
NEXRAD	Next Generation of Radar
NHC	National Hurricane Center
NM	Nautical Mile
NPSC	National Process Serving Center (FEMA)
NTC	National Teleregistration Center (FEMA)
NOAA	National Oceanic and Atmospheric Administration
NVOAD	National Voluntary Organizations Active in Disaster
NWS	National Weather Service
NWSFO	National Weather Service Forecasting Office
OSC	On-Scene Coordinator
OS	Operations Support Directorate (FEMA)
PIO	Public Information Officer
PT	Preparedness, Training and Exercises Directorate (FEMA)
PUP	Principle User Processor
RACES	Radio Amateur Civil Emergency Service
RADAR	Radio Detection And Ranging

RD	Regional Director
REACT	Radio Emergency Associated Communication Team
ROC	Regional Operations Center
RR	Response and Recovery Directorate (FEMA)
SCO	State Coordinating Officer
SITREP	Situation Report
SLOSH	Sea, Lake, and Overland Surges for Hurricanes
SOP	Standard Operating Procedure
TD	Tropical Depression
TS	Tropical Storm
TPC	Tropical Prediction Center
TAFB	Tropical Analysis and Forecast Branch (TPC)
TSB	Technical Support Branch (TPC)
USACE	United States Army Corps of Engineers
USAF	United States Air Force
USCG	United States Coast Guard
USGS	United States Geological Survey
USN	United States Navy
USAR	Urban Search and Rescue
UTC	Universal Time Coordinate
WFO	Weather Forecast Office
Z	Zulu Time

A 2: Glossary & Related Links

The US-EPA provides a thorough list of water security and response related links at http://cfpub.epa.gov/safewater/watersecurity, including a glossary and the following:

A to Z Subject Index

- Bioterrorism Act
- Emergency / Incident Planning
- EPA Contacts
- EPA Environmental Laboratory Compendium
- Grants and Funding
- Information Sharing
- Legislation / Directives
- Office of Ground Water and Drinking Water
- Office of Water
- Publications
- Guidance
- Homeland Security Presidential Directives
- Outreach Materials
- Legislation
- Newsletters
- Reports and Studies
- Webcast Presentations
- Public Involvement
- Related Links
- Trade/Industry Organizations
- Clearinghouses and Information Centers
- Federal Government
- State Homeland Security Web Sites
- State Drinking Water Protection Web Sites
- EPA Program and Regional Offices
- Security Enhancements, Research and Technology
- Tools and Technical Assistance
- Training Courses, Meetings, and Workshops
- Vulnerability Assessments
- Water Information Sharing and Analysis Center (WaterISAC)
- Water Security Home

A 3: FlaWARN Water Security

Abbreviation and Acronym List

AAR	After Action Review
AC	Alternating current
ACL	Access control list
ACOE	Army Corps of Engineers
AMSA	Association of Metropolitan Sewerage Agencies
AMWA	Association of Metropolitan Water Agencies
AP	Action Plan
ASCE	American Society of Civil Engineers
ASDWA	Association of State Drinking Water Administrators
AWWA	American Water Works Association
AwwaRF	American Water Works Association Research Foundation
BACT	Best Available Control Technology
BOD	Biological Oxygen Demand
BWN	Boil Water Notice
$Ca(OCl)_2$	Calcium hypochlorite
CaO	Calcium oxide
$CaOH_2$	Calcium hydroxide
Ca(OCL)2	Calcium hypochlorite
CBR	Chemical, biological, or radiological
CBRNE	Chemical, Biological, Radiological/Nuclear, and Explosive
CCC	Chlorine contact chamber (also, cross connection control)
CCP	Communication Cluster Phenomenon
CCTV	Closed-circuit television
CDC	Center for Disease Control
CFR	Code of Federal Regulations

CHIPS	Citizens Helping in Policy Service
CIP	Capital improvement plan
CMMS	Computerized maintenance management system
CPR	Cardio-pulmonary resuscitation
CPTED	Crime Prevention Through Environmental Design
CWS	Community Water System
DBT	Design basis threat
DEP	Department of Environmental Protection
DHS	Department of Homeland Security
DoD	Department of Defense
DoS	Department of State
EOC	Emergency Operations Center
EPA	United States Environmental Protection Agency
ERP	Emergency Response Plan
ERT	Environmental Response Team
ESF	Emergency Support Function
EWS	Early warning system
FBI	Federal Bureau of Investigation
FDEP	Florida Department of Environmental Protection
FEMA	Federal Emergency Management Agency
FlaWARN	Florida's Water/Wastewater Agency Response Network
FOIA	Freedom of Information Act
FRWA	Florida Rural Water Association
GASB	Government Accounting Standards Board
GETS	Government Emergency Telecommunications Service
GIS	Geographic information system
GPS	Geographic positioning system

GSA	General Services Administration
HAZMAT	Hazardous Materials
HAZWOPER	Hazardous Waste Operation and Emergency Response
HCl	Hydrochloric acid
HHS	Health and Human Services
HMI	Human machine interface
HSAS	Homeland Security Advisory System
HVAC	Heating, ventilation, and air conditioning
IAP	Incident Action Plan
IC	Incident Commander
ICS	Incident Command System
ID	Identification
IDS	Intrusion Detection System
IED	Improvised explosive device
IID	Improvised incendiary device
IP	Internet protocol
ISAC	Water Information Sharing and Analysis Center
JOC	Joint Operations Center (established by the FBI)
LEO	Law Enforcement Officer
LEPC	Local Emergency Planning Committees
LIMS	Laboratory Information Management System
LRN	Laboratory Resource Network
MHZ	Megahertz
MPEG	Moving Picture Experts Group
Na_2CO_3	Soda ash
NaOCl	Sodium hypochlorite
NaOH	Sodium hydroxide

NFPA	National Fire Protection Association
NIC	NIMS Integration Center
NIMCAST	NIMS Capability Assessment Support Tool
NIMS	National Incident Management System
NIOSH	National Institute of Occupational Safety & Health
NRP	National Response Plan
NRWA	National Rural Water Association
O&M	Operations and maintenance
OSHA	Occupational Health and Safety Administration
PC	Personal computer
pH	A measure of the activity of hydrogen ions (H+) in a solution and, therefore, its acidity or alkalinity
PIO	Public Information Officer
PIR	Passive infrared
PLC	Programmable logic controller
ppb	Parts per billion
PPE	Personal protection equipment
PR	Press Release
PRV	Pressure reducing valves
PSN	Public switched network
RAM	Random access memory
RAM-D	Risk Assessment Methodology for Dams
RAM-W^{TM}	Risk Assessment Methodology for Water Utilities
RFID	Radio frequency identification
RPG	Rocket propelled grenade
RPTB	Response Protocol Tool Box
RTU	Remote terminal unit
SCADA	Supervisory Control and Data Acquisition

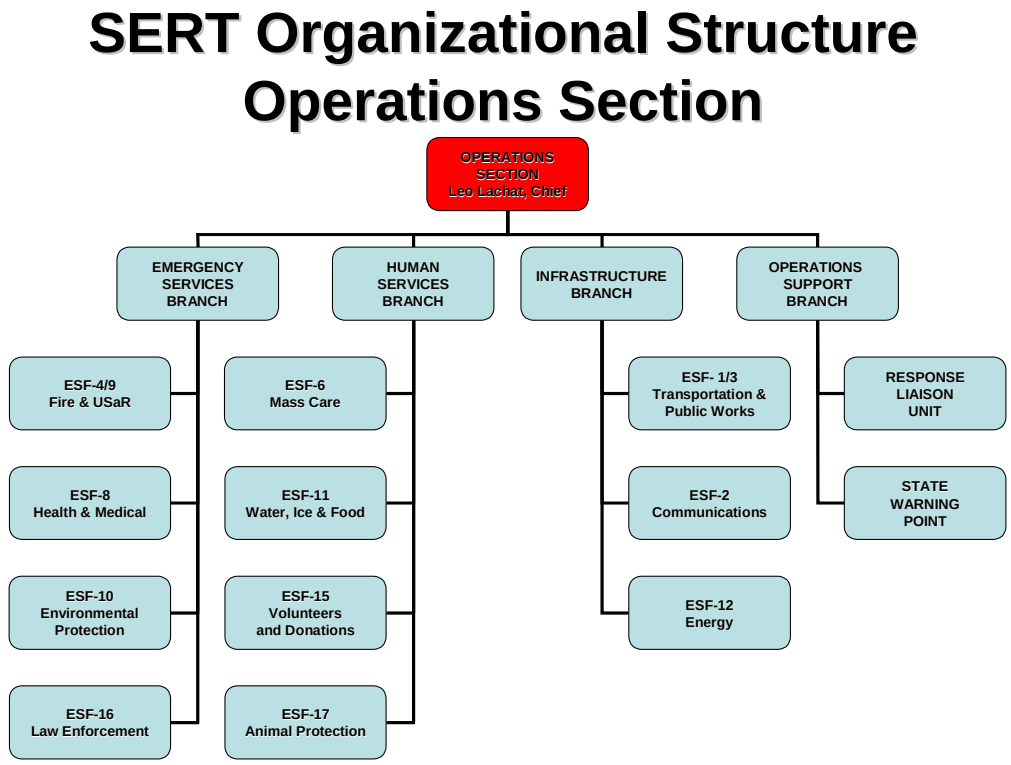
SCBA	Self-contained breathing apparatus
SERT	State Emergency Response Team
SO	Sherriff's Office
SOP	Standard Operating Procedure
TLV	Total Threshold Value
TOC	Total Organic Carbon
TREEO	Training, Research and Education for Environmental Occupations
UC	Unified Command
UF	University of Florida
UL	Underwriters Laboratory
UPS	Uninterruptible power supply
VA	Vulnerability assessment
Vac	Volts alternating current
Vdc	Volts direct current
VOCs	Volatile Organic Compounds
VSAT™	Vulnerability Self-Assessment Tool
WMD	Weapons of Mass Destruction
WTP	Water treatment plant
WWTP	Wastewater treatment plant

A 4: Florida Division of Emergency Management

Florida's Division of Emergency Management is responsible for preparing the state to respond to emergencies, recover from them, and mitigate their impacts. Bureaus include Compliance Planning & Support, Policy & Planning, Preparedness & Response, and Recovery & Mitigation.

www.floridadisaster.org is designed to support these objectives. This site provides information and planning tools to the Florida Emergency Management Community. This service is continually under development. We try to keep the information timely and accurate and will make every effort to correct errors brought to our attention.

The State Emergency Response Team (SERT) is set up to manage disasters through Emergency Operations Centers (EOC's) set up affected counties in preparation and in the aftermath of a disaster. The SERT mission is to ensure that Florida is prepared to respond to emergencies, recover from them, and mitigate against their impacts. The SERT Organizational Structure is shown below:



Hurricane Preparedness

The goal of the SERT Hurricane Preparedness Web site is to inform the public about the hurricane hazards and provide knowledge which can be used to take **ACTION**. This information can be used to save lives at work, home, while on the road, or on the water.

Up to date information on preparing and responding to hurricanes can be found at:

www.nhc.noaa.gov/HAW2/english/intro.shtml

Florida Division of Emergency Management Online Mapping

Florida's Division of Emergency Management provides an Online Mapping service. The purpose of these maps is to provide the citizens of Florida with current and accurate information which can be used to prepare for and recover from disasters. There are two types of mapping sites, a plug-in required site and a non-plug-in site. The plug-in map will provide you with many functions, while the non-plug-in is limited yet still provides the necessary information you need in times of disaster. Maps can be accessed at the interactive sites listed below:

Disaster Preparedness Maps
Interactive Florida Map
(*NEW* plug-in required, should auto-load)
- Find Evacuation Routes and Zones, Storm Surge Information, and Open Shelter Locations.
(*Need MS Windows XP, 2000, 98 SE, NT 4.0- MS Internet Explorer 5.x, need administrative rights to install*)
Other Mapping Sites
Hazard Maps - www.HazardMaps.gov
Terra Fly - Aerial Imagery
TAOS - Storm Hazard Model Outputs
USGS GEODE - Geo-Data Explorer
NOAA Fire Detection
US Forestry Service Fire Detection

Additional information can be obtained from the Florida Division of Emergency Management at the noted WEB sites.

A 5: FlaWARN Mutual Aid Agreement

MUTUAL AID AGREEMENT FOR WATER/WASTEWATER

ARTICLE I. PURPOSE

The Water/Wastewater Mutual Aid Program was established to provide a method whereby water/wastewater utilities sustaining physical damage from natural or man made disasters could obtain emergency assistance, in the form of personnel, equipment, and materials and other associated services necessary, from other water/wastewater utilities. The purpose of this Agreement is to formally document such program.

ARTICLE II. DEFINITIONS

A. AGREEMENT – The Water/Wastewater Mutual Aid Agreement. The original agreement and all signatory pages shall be kept at TREEO Center 3900 SW 63rd Blvd., Gainesville, FL 32608

B. PARTICIPATING UTILITY – Any Water/Wastewater utility which executes this Mutual Aid Agreement.

C. DAMAGED UTILITY – Any Participating Utility which sustains physical damage to its water/ wastewater system due to a natural or manmade disaster and seeks assistance pursuant to this Agreement.

D. ASSISTING UTILITY – Any Participating Utility which agrees to provide assistance to a Damaged Utility pursuant to this Agreement.

E. AUTHORIZED REPRESENTATIVE – An employee of a Participating Utility authorized by that utility's governing board to request or offer assistance under the terms of this Agreement. (A list of the Authorized Representatives for each Participating Utility shall be attached to this Agreement as Appendix A)

F. PERIOD OF ASSISTANCE – The period of time beginning with the departure of any personnel of the Assisting Utility from any point for the purpose of traveling to the Damaged Utility in order to provide assistance and ending upon the return of all personnel of the Assisting Utility, after providing the assistance requested, to their residence or place of Work, whichever is first to occur.

G. SCHEDULE OF EQUIPMENT RATES – The latest rates published by Federal Emergency Management Agency under the response and recovery directorate applicable to major disasters and emergencies.

H. WORK OR WORK-RELATED PERIOD – Any period of time in which either the personnel or equipment of the Assisting Utility are being used by the Damaged Utility to provide assistance. Specifically included within such period of time are rest breaks when the personnel of the Assisting Utility will return to active Work within a reasonable time. Also, included is mutually agreed upon rotation of personnel and equipment.

ARTICLE III. PROCEDURE

In the event that a particular utility becomes a Damaged Utility, the following procedure shall be followed:

A. The Damaged Utility shall contact the Authorized Representative of one or more of the participating utilities and provide them with the following information:

1. a general description of the damage sustained;
2. the part of the water/wastewater system for which assistance is needed;
3. the amount and type of personnel, equipment, materials and supplies needed and a reasonable estimate of the length of time they will be needed;
4. the present weather conditions and the forecast for the next twenty-four hours; and
5. a specific time and place for a representative of the Damaged Utility to meet the personnel and equipment of the Assisting Utility.
6. The identification of Work conditions and special constraints such as availability of fuel supplies, lodging/meal support, medical facilities, security, communications, etc.

B. When contacted by a Damaged Utility, the Authorized Representative of a Participating Utility shall assess his utility's situation to determine whether it is capable of providing assistance. No Participating Utility shall be under any obligation to provide assistance to a Damaged Utility. If the Authorized Representative determines that the Assisting Utility is capable of and willing to provide assistance, the Assisting Utility shall so notify the Authorized Representative of the Damaged Utility and providing the following information:

1. a complete description of the personnel, equipment and materials to be furnished to the Damaged Utility.
2. the estimated length of time the personnel, equipment and materials will be available;
3. the work experience and ability of the personnel and the capability of the equipment to be furnished;
4. the name of the person or persons to be designated as supervisory personnel; and
5. the estimated time when the assistance provided will arrive at the location designated by the Authorized Representative of the Damaged Utility.

C. The personnel and equipment of the Assisting Utility shall remain, at all times, under the direct supervision and control of the designated supervisory personnel of the Assisting Utility. In instances where only equipment is provided by the Assisting Utility, the ownership of said equipment shall remain with the Assisting Utility and said equipment shall be returned to the Assisting Utility immediately upon request. Representatives of the Damaged Utility shall suggest Work assignments and schedules for the personnel of the Assisting Utility; however, the designated supervisory personnel of the Assisting Utility shall have the exclusive responsibility and authority for assigning Work and establishing Work schedules for the personnel of the Assisting Utility. The designated supervisory personnel shall maintain daily personnel time records and a log of equipment hours, be responsible for the operation and maintenance of the equipment furnished by the Assisting Utility, and report Work progress to the Damaged Utility.

D. The Damaged Utility shall have the responsibility of providing food and housing for the personnel of the Assisting Utility from the time of departure from their regularly scheduled Work

location until the time of return to their regularly scheduled Work location. The food and shelter provided shall be subject to the approval of the supervisory personnel of the Assisting Utility. If not agreeable, food and shelter shall be provided and paid for as determined by mutual agreement.

E. The Damaged Utility shall have the responsibility of providing communications between the personnel of the Assisting Utility and the Damaged Utility.

ARTICLE IV. REIMBURSABLE EXPENSES
The terms and conditions governing reimbursement for any assistance provided under this Agreement shall be agreed to prior to the providing of such assistance and shall be in accordance with the following provisions:

A. PERSONNEL – During the Period of Assistance, the Assisting Utility shall continue to pay its employees according to its then prevailing rules and regulations. The Damaged Utility shall reimburse the Assisting Utility for all direct and indirect payroll costs and expenses incurred during the Period of Assistance, including, but not limited to, employee pensions and benefits.

B. EQUIPMENT – The Assisting Utility shall be reimbursed for the use of its equipment during the Period of Assistance according to the SCHEDULE OF EQUIPMENT RATES established and published by FEMA. If an Assisting Utility uses an alternate basis of rates for equipment listed on the FEMA Schedule of Equipment Rates it shall provide such rates to the Damaged Utility prior to providing assistance. Rates for equipment not referenced on the FEMA Schedule of Equipment Rates shall be developed based on actual recovery of costs.

C. MATERIALS AND SUPPLIES – The Assisting Utility shall be reimbursed for all materials and supplies furnished by it and used or damaged during the Period of Assistance, unless such damage is caused by negligence of the Assisting Utility's personnel. The measure of reimbursement shall be the replacement cost of the materials and supplies used or damaged, plus ten (10) percent of such cost. In the alternative, the parties may agree that the Damaged Utility will replace, with a like kind and quality as determined by the Assisting Utility, the materials and supplies used or damaged.

D. PAYMENT – Unless mutually agreed otherwise, the Assisting Utility should bill the requesting utility for all expenses not later than ninety (90) days following the Period of Assistance. The requesting utility shall pay the bill in full not later than forty-five (45) days following the billing date. Unpaid bills shall become delinquent upon the forty-fifth (45th) day following the billing date, and once delinquent shall accrue interest at the rate of prime plus two percent (2percent) per annum as reported by the Wall Street Journal.

E. DISPUTED BILLINGS – Those undisputed portions of a billing should be paid under this payment plan. Only the disputed portions should be sent to arbitration under Article VI.

ARTICLE V. INSURANCE

Each Participating Utility shall bear the risk of its own actions, as it does with its day-to-day operations, and determine for itself what kinds of insurance, and in what amounts, it should carry. Nothing herein shall act or be construed as a waiver of any sovereign immunity or other exemption or limitation on liability that a Participating Utility may enjoy.

ARTICLE VI. ARBITRATION

All disputes between two or more participating utilities arising from participation in this Agreement, which cannot be settled through negotiation, shall be submitted to binding arbitration before a panel of three persons chosen from the members of this Mutual Aid Agreement which are participating utilities, excluding those members that are parties to the dispute.
Each party to the dispute shall choose one panel member and those panel members shall agree on one additional panel member. The panel shall adopt rules of procedure and evidence, shall determine all issues in dispute by majority vote and shall assess damages. The decision of the panel shall be final and binding upon the parties to the dispute.

NOW, THEREFORE, in consideration of the covenants and obligations contained herein, the participating utility listed here, as a Participating Utility duly executes this Water/ Wastewater Mutual Aid Agreement this _____ day of _____, 20 __ .

Water/Wastewater Utility Representative(s):
By:_____
Title:_____
_____
Please Print Name
By: _____
Title: _____
_____
Please Print Name
Name of Participating Utility: _____
Please Print Name of Utility
(Please note: Attach a copy of your FlaWARN registration form to this document when you submit it. Thank you.)

A 6: Work Management Documentation

Charge Summary for Work Performed

WATER UTILITY COMAPNY - CHARGE SUMMARY

CITY OF RECOVERY, FL RELIEF MISSION

PERSONNEL EXPENSE

POSITION	NAME LAST	NAME FIRST		REGULAR AMOUNT	BENEFIT RATE	BENEFIT COST	OVERTIME AMOUNT	OT BENEFIT RATE	BENEFIT COST	TOTAL CHARGE
ELECTRICIAN/INSTRUMENTATION TECHNICIAN	EMPLOYEE 1		A.	$1,543.04	48.92 percent	$75.48	$3,226.50	13.35 percent	$430.74	$5,955.13
SYSTEM MECHANIC	EMPLOYEE 2		B.	$1,241.60	48.92 percent	$607.39	$2,538.00	13.35 percent	$338.82	$4,725.81
UTILITY TECH I	EMPLOYEE 3		C.	$1,041.60	48.92 percent	$509.55	$1,743.55	13.35 percent	$232.76	$3,527.46
SENIOR UTILITY TECH I	EMPLOYEE 4		D.	$1,328.80	48.92 percent	$650.05	$2,275.38	13.35 percent	$303.99	$4,557.22
SYSTEM MECHANIC ASSISTANT	EMPLOYEE 5		E.	$822.40	48.92 percent	$402.32	$1,681.23	13.35 percent	$224.44	$3,130.39
SENIOR UTILITY TECH I	EMPLOYEE 6		F.	$1,148.00	48.92 percent	$561.60	$1,965.00	13.35 percent	$262.36	$3,936.93
SYSTEM MECHANIC ASSISTANT	EMPLOYEE 7		G.	$822.40	48.92 percent	$402.32	$1,711.78	13.35 percent	$228.54	$3,174.09
UTILITY TECH I	EMPLOYEE 8		H.	$931.20	48.92 percent	$455.54	$1,561.35	13.35 percent	$208.47	$3,158.80
1. PERSONNEL TOTAL				$8,879.04		$4,343.63	$16,712.79		$2,231.16	**$32,166.61**

OTHER BILLABLE EXPENSES

2. VEHICLE USE

VEHICLE

IMPORTANT NOTE:

TYPE	MILES	RATE *	AMOUNT
Vehicle# WS218 - 2000 F-350 Ford Truck			
			$ 4
		$	9
		(	2
		.	.
ROUND TRIP MILES (547 EA Way)	1,094	4 5	3 0
			$ 1
		$	6
		(	2
		.	.
MOSS POINT MILES(12 Days)	360	4 5	0 0
Vehicle# WS278 - 2003 GMC Sierra 3500 Truck			
			$ 4
		$	9
		(	2
		.	.
ROUND TRIP MILES (547 EA Way)	1,094	4 5	3 0
			$ 1
		$	6
		(	2
		.	.
MOSS POINT MILES(12 Days)	360	4 5	0 0
Vehicle# WS327 - 2004 Chevy Silverado 3500 Truck			
			$ 4
		$	9
		(	2
		.	.
ROUND TRIP MILES (547 EA Way)	1,094	4 5	3 0
		$	$
		(	1
		.	6
MOSS POINT MILES(12 Days)	360	4 5	2 .

It is essential that you provide documentation of specific utility pay policies that provide basis for calculations such as definition of overtime, overtime pay if different from standard time and a half, etc.

		0	
		0	
		$1,962.90	
	4,362		**TOTAL VEHICLE COST**

***FEMA AUTHORIZED RATE**

3. MEALS

PLACE	**MEAL AMOUNT**	
See Attached Detail	**$1,140.26**	**TOTAL MEALS**

4. LODGING

PLACE	**LODGING AMOUNT**	
Edison Wathall Hotel	**$1,238.72**	**TOTAL LODGING**

5. OTHER REQUIRED SUPPLIES

ITEMS	**OTHER AMOUNT**	
See Attached Detail	**$3,099.69**	**TOTAL OTHER**

TOTAL COST	
PERSONNEL	$32,166.61
VEHICLE	$1,962.90
MEALS	$1,140.26
LODGING	$1,238.72
OTHER SUPPLIES	$3,099.69
GRAND TOTAL	**$39,608.18**

YOUR COMPANY LOGO

YOUR COMPANY NAME

Date: 10/01/20XX
Invoice #: XXXXXX

123 Main Street
Assisting Utility, FL 12345-0000
Ph: (123) 456-7890
Fax: (123) 456-7891

Bill To

CITY OF RECOVERY
123 Main Street
Recovery, FL 12345-0000

Ph: (987) 654-3210

Copy To

FLAWARN HQ
UF/TREEO Center
3900 SW 63rd Blvd
Gainesville, FL 32608

Item	Meter #	Description	Unit	Quantity	Unit Price	Amount
1		Katrina FlaWARN Responder To: City of Recovery, FL ***SERT Mission #999***				
		8 Employees for 12 days Sept 3rd - Sept 14th, 20XX				$32,166.61
		Vehicle expense				$1,962.90

		Meal expense				$1,140.26
		Lodging expense				$1,238.72
		Other required supplies				$3,099.69
		Please see attached summary				
Notes:					Total Amount	$39,608.18
			Rate		Tax	
					Shipping	
					Total Invoice	**$39,608.18**
					Payment	
					Balance Due	**$39,608.18**

Message

Work Management Document

WATER UTILITY COMPANY
SCHEDULE OF FRINGE BENEFIT CALCULATIONS

BENEFIT COMPONENTS	REGULAR PAY	OVERTIME PAY
SICK PAY	4.80percent	0.00percent
VACATION	6.00percent	0.00percent
WORKER'S COMP	5.70percent	5.70percent
INSURANCES	11.70percent	0.00percent
FICA	6.20percent	6.20percent
MEDICARE	1.45percent	1.45percent
PENSION	13.07percent	0.00percent
TOTAL FRINGE BENEFIT RATE	**48.92percent**	**13.35percent**

Sick Pay Percentage Calculations

8 hours per month x 12 months = 96 hours per year (96/1992 hours = 4.8percent)

Vacation Pay Percentage Calculations

0-5 years of service = 10 days
5-10 years of service = 12 days
10-15 years of service = 15 days
15-20 years of service = 17 days
20+ years of service = 20 days

In 1999 FEMA used 12 days. In 2004 the workforce will shift to 15 days on average due to the low turnover rate. (120/1992 hours per year = 6%)

Holiday Adjustment:
There are 9 observed holidays plus 2 additional holidays for a total of 11 (2,080hrs - 88hrs = 1,992hrs).

A 7: Forms for Loaning and Receiving Equipment

Loaning Agency Equipment Release Form

Use this form to:

- Document the loaning of equipment
- Authorize the loaning of equipment

INSTRUCTIONS:

Complete the form below **and record the Loaner Agency's** Inventory Number, the Item Description and the Method of Delivery. Please use the comment section to provide additional information if needed. List the Receiver Agency's delivery location and any special conditions for the equipment loaned.

I hereby accept the responsibility for and authorize the loan of the equipment listed below. The property has been inspected and has been identified with the following description.

_____/_____ Authorized Loaning Agent

ID NUMBER	**DESCRIPTION**	**CONDITION**

COMMENTS: (hours, length and condition of loan etc)
_____
_____
_____

Details of Loan Agreement:

Facility Loaning Equipment: _____

Authorized Party of Loaned Equipment: _____

Physical and Mailing address of Loaned Equipment:

_____

_____

Phone numbers of Loaned Equipment: _____

Receiver of Loaned Equipment: _____

Return / Delivery Method:

Receiving Agency Equipment Acceptance Form

Use this form to:

- Document the receiving of equipment
- Authorize the acceptance and responsibility of equipment

INSTRUCTIONS:
Complete the form below with the **Receiving Facilities** Inventory Number, the Item Description and the Method of Delivery. Please use the comment section to provide additional information if needed. List the receiver, location and agreed conditions for any property loaned

I hereby accept the responsibility of the equipment listed below. The property has been inspected and has been identified with the following description.

_____/_____ Authorized Receiving Agent

ID NUMBER	**DESCRIPTION**	**CONDITION**

COMMENTS: (Fueling, hours, maintenance etc)

_____
_____

Details of Loan Agreement:

Facility Receiving Equipment: _____

Authorized Party for Facility: _____ ____

Location of Loaned Equipment: _____

_____

Contact Phone Numbers: _____

Physical and Mailing address of Loaned Equipment:

_____

_____

Return / Delivery Method:

Staging and Set-Up Equipment Tracking Form

ID Number	Equipment Description	Equipment Location	Contact Name	Phone Numbers	Comments

A 8: Sample Press Releases

City of Port St. Lucie Example Press Releases

1. Precautionary Boil Water Notice
2. News Release Lifting Precautionary Boil Water Notice
3. Loss of Power to Wastewater Grinder Stations
4. Conserving Water for Grinder Stations
5. FAQ's for Wastewater Grinder Stations
6. Connection of Generators to Grinder Stations
7. Status of W/WW Utility System
8. Power Outages & Status of W/WW Systems
9. Emergency Public Water Access Locations
10. Status of Water Storage Tanks

News Release: Precautionary Boil Water Notice

FOR IMMEDIATE RELEASE:

CONTACT: Donna M. Rhoden, Public Information Manager
Office: 772-873-6400 ♦ Cell: 772-528-2147

DATE: ~~September 5, 2004 / 8:30 AM~~
Reissue: September 6, 2004 / 7:30 AM

PORT ST. LUCIE -- A precautionary boil water advisory is in effect for all customers of the City's Utility. The advisory will remain in effect until further notice.

News Release: Lifting Precautionary Boil Water Notice

FOR IMMEDIATE RELEASE:

CONTACT: Donna M. Rhoden, Public Information Manager
Office: 772-873-6400 ♦ Cell: 772-528-2147

DATE: September 28, 2004 / 11:00 AM

PORT ST. LUCIE -- The boil water notice affecting all City of Port St. Lucie water customers has been lifted.

News Release: Loss of Power to Wastewater Grinder Stations

FOR IMMEDIATE RELEASE:

CONTACT: Donna M. Rhoden, Public Information Manager
Office: 772-873-6400 ♦ Cell: 772-528-2147

DATE: September 5, 2004 / 8:49 AM

PORT ST. LUCIE -- Power failures throughout the City will effect the operation of wastewater grinder and suburbanaire tank systems.

Therefore, all customers of the City's Utility that are served by low-pressure sewer systems (grinder tanks and suburbanaire tanks) are still advised to conserve water use. Customers should restrict all use of dishwashers and washing machines until further notice. Do not take long showers. Be conservative about toilet flushing.

News Release: Conserving Water for Grinder Stations

FOR IMMEDIATE RELEASE:

CONTACT: Donna M. Rhoden, Public Information Manager
Office: 772-873-6400 ♦ Cell: 772-528-2147

DATE: September 2, 2004

PORT ST. LUCIE -- All customers of the City's Utility that are served by low-pressure sewer systems (grinder tanks and suburbanaire tanks) are advised to conserve water use. Customers should restrict the use of dishwashers, washing machines and long showers.

News Release: FAQ's for Wastewater Grinder Stations

CONTACT: Donna M. Rhoden, Utility Public Information Manager
Office: 772-873-6400 ♦ Fax: 772-873-6405

DATE: September 24, 2004 / 10:30 AM

PORT ST. LUCIE -- The following information is offered to our customers as before, during, and after storm or hurricane instructions.

1. **Many of the City's wastewater (sewer) customers are served by low-pressure Grinder Pump or STEP (septic tank effluent pump) systems. What is a wastewater Grinder Pump or STEP system?**

   The system consists of a small electrical pump inside a fiberglass tank that is typically buried in the front yard of the customer's property.

2. **What happens when the Grinder Pump or STEP tank is full of wastewater?**

   The electrical pump will automatically run and the wastewater will be pumped through low-pressure sewer mains to one of the City's three wastewater treatment plants.

3. **How much wastewater can an empty residential grinder tank store?**

   Approximately 70 gallons. Keep in mind that a toilet uses between 1.5 – 2.5 gallons of water each time it is flushed.

4. **What happens if there is a power failure such that a residence has no electricity?**

   If the electrical power is off, the Grinder or STEP system cannot operate. Therefore, all Grinder and STEP system customers must conserve water usage until their electric power is restored. They should flush toilets only when absolutely necessary and not take long showers.

5. **What will the Utility do if a customer does not have electrical power to their Grinder or STEP system?**

   The Utility will make every effort possible to pump out or pump down a customer's Grinder or STEP system when the storm or hurricane subsides.

6. Can customers connect their private generators to operate their Grinder STEP systems?

Yes, but not until a City Utility employee instructs them on how to do it. Also, the generator must be 220 Volt and it must be a minimum of 5,000 Watts. Customers must provide their own "pigtail" (cord with plug).

7. Is it safe to drink the City's water after a hurricane?

A precautionary boil water advisory will be in effect immediately following the hurricane until such time as the City can assure the integrity of it's water distribution system and the quality of water in its system. If you are not able to boil the water, the St. Lucie County Health Dept. recommends that you add 8 drops of unscented household bleach per gallon of water, and then allow the water to sit for 30 minutes before consuming it.

8. **Should the other City water and sewer customers do anything special after a hurricane?**

Yes. All customers of the City's Utility are advised to conserve water use after the hurricane. They should be especially conservative with toilet flushing, and they should not use dishwashers or washing machines. Customers should not let water run for a long time in a sink or tub, and they should not take long showers.

9. Utility customers should call 873-6400 if they have questions.

News Release: Connection of Generators to Grinder Stations

FOR IMMEDIATE RELEASE:

CONTACT: Donna M. Rhoden, Public Information Manager
Office: 772-873-6400 ♦ Cell: 772-528-2147

DATE: September 7, 2004 / 10:45 AM

PORT ST. LUCIE -- Customers of the City's Utility who have low pressure sewer grinder systems or STEP systems are requested to contact the Utility before they make any attempt to connect their personal electric generators to the City's grinder or STEP pumps. The Utility will dispatch one of its electricians to the site to instruct customers on how to make the connections.

Call: 873-6400

News Release: Status of W/WW Utility System

FOR IMMEDIATE RELEASE:

CONTACT: Donna M. Rhoden, Public Information Manager
Office: 772-873-6400 ♦ Cell: 772-528-2147

DATE: September 5, 2004 / 8:55 AM

PORT ST. LUCIE -- Due to the continued presence of Hurricane Frances, the City's Utility has been unable to deploy damage assessment and repair crews. However, crews remain ready to activate and respond to system emergencies as soon as storm conditions subside.

News Release: Power Outages & Status of W/WW Systems

CONTACT: **City of Port St. Lucie Utilities**
Donna M. Rhoden, Public Information Manager
Office: 772-873-6400 ♦ Cell: 772-528-2147

DATE: September 5, 2004 / 8:45 PM

PORT ST. LUCIE -- The City's entire sewer system is down due to power failures throughout its utility service area. The City is currently using all available generators to provide emergency power. The delivery of additional generators is expected tomorrow to bring some relief until FPL can restore all power.

All customers of the City's Utility are still advised to limit all water use. Do not use dishwashers, washing machines, or take long showers, and flush toilets only as necessary.

News Release: Emergency Public Water Access Locations

FOR IMMEDIATE RELEASE:

CONTACT: Donna M. Rhoden, Public Information Manager
Office: 772-873-6400 ♦ Cell: 772-528-2147

DATE: September 5, 2004 / 8:15 PM

PORT ST. LUCIE -- The City's Utility Systems Department is in the process of establishing emergency water supply depots at the following locations:

1. Church of God @t Savona / California
2. Mobile gas station @ Gatlin / PSL Blvd.
3. Shell gas station @ Tulip / Darwin
4. Parkway Elementary @ Selvitz / Manville
5. Publix @ Midport / PSL
6. Publix @ Prima Vista Crossings at U.S. #1 / Prima Vista
7. Zapatas on U.S. #1 near Kitterman Rd.

Every attempt will be made to have all of the stations in service by 7:00 AM, Monday, Sept. 6th.

Residents must bring their own containers. The boil water advisory will be in effect for each site. Every attempt is being made to deploy adequate Utility staff so that each depot will be manned around the clock.

News Release: Status of Water Storage Tanks

FOR IMMEDIATE RELEASE:

CONTACT: Donna M. Rhoden, Public Information Manager
Office: 772-873-6400 ♦ Cell: 772-528-2147

DATE: September 3, 2004

PORT ST. LUCIE -- All of the City's water storage tanks have been filled to maximum levels, thus providing a total of 9 million gallons of stored water that will be available to meet post hurricane demands.

Lee County Utilities Hurricane Guide Tips

Before the Hurricane

- Locate your residence's emergency water shut-off valve and remove any shrubbery or obstructions. Test the water shut-off valve to be sure that it is operational. If the shut-off valve is not operational, have it repaired or replaced.
- Turn off the emergency water shut-off valve if you are leaving your residence prior to a storm. This will help minimize damage to your home's interior should a pipe burst inside the home.
- If you turn off the emergency shut-off valve, follow the manufacturer's recommendations on turning off your hot water heater and unplug. Some hot water heaters may be damaged if water supply is turned off for an extended period of time.
- Locate your sewer clean-out lid and remove any shrubbery or obstructions in case the clean-out needs to be located.

After the Hurricane

- Due to power outages, water treatment plants will be operating under limiting conditions. Water pressures will be reduced!
- Due to power outages, lift stations that are used to convey sewage to the wastewater treatment plants will not work or have only limited operations. Over use of toilet flushing or water going down drains may cause lift stations to overflow and backup into your home.

Because of reduced pressures and limited operations of lift stations, **WATER CONSERVATION IS A MUST!** Remember, just because power has been restored to your home, does not mean that power has been restored to all lift stations or water and wastewater treatment plants within your neighborhood.

- Limit the amount of toilet flushing.
- Abstain from running dishwashers and clothes washers.
- Limit the amount water used during a shower or the amount to fill the bathtub.
- Turn off all sprinklers! Remember to reset your irrigation timer once power has been restored.
- Abstain from pressure washing, car washing, or any other outdoor use of water that is not necessary.

Making Your Drinking Water Safe

During a storm event, trees can uproot water pipes allowing the underground pipes to be exposed to contaminated ground water or create a drop in pressure. Once the storm passes, treat your water supply as if it is unsafe to drink until you are notified otherwise. Boil water notices will be issued through your local Health Department and will be announced through your local Emergency Operations Center (EOC).

The use of bottled water should be used until bacteriological test prove that the water is safe to drink. If you do not have bottle water here are ways to disinfect your water to make it safe. Remember to disinfect any water being used for your pets.

Drinking Water

- Boil the water for at least ten minutes.
- If you do not have power and cannot boil your water, add eight (8) drops of unscented chlorine bleach per gallon of water. Let the water sit uncapped for at least 10 minutes before drinking.

Dish Washing

- Add fifteen (15) drops of unscented chlorine bleach per gallon to use for rinsing dishes. Keep them clean until next use.

Showering or Bathing

- Showering or bathing in tap water that is under a boil water notice is safe, if you cut yourself shaving use an antibiotic cream.

A 9: Sample Employee Assistance Plans

City of Tamarac Summary of Employee Assistance after Hurricane Wilma

- On Wednesday, October 26, 2005, the City resumed operations notifying employees to return to work.
- Employees were provided special bulletins as often as appropriate to provide information regarding City operations.
- Meals including breakfast, lunch and dinner were made available for all employees working on hurricane recovery operations for two weeks.
- Employees were provided ice and water on a daily basis to take home.
- Employees were allowed to fill their gas tanks at the City's fueling facilities so they could get to work without waiting in gas lines.
- Employees were paid on their regular payday schedules, and were offered the service of cashing personal checks through the City's customer service office.
- Employees were provided contact information so they could communicate with FEMA, which had already declared Broward County eligible for individual assistance.
- Employees who had 457 Deferred Compensation accounts, and were affected by the hurricane were given the option of an emergency withdrawal of up to $5,000. This option was made available for 30 days, with a recommendation that all hurricane-related expense records be kept for IRS purposes. For those wishing to withdraw greater amounts, a representative was made available for assistance. Contact information was given and the option of a wire transfer of the funds was provided for those wishing to have the money routed to their accounts.
- The City County Credit Union offered emergency interest free 6 month loans to existing members of up to $1,000, as well.
- Operation Blue Roof was being implemented in Broward County, so City employees were given application pickup information and program updates with phone numbers, hours of operations, and projected contractor installations.
- Employees were provided information regarding the status of Broward County School closures.

- Employees were provided information regarding the status of traffic lights.
- Employees were provided information regarding Broward County Mass Transit free services.
- Employees were asked to assist other employees and to offer support to those impacted by the hurricane by contributing to cleanups, opening their homes for hot showers, telephone or cell phone calls, or for laundry.
- Due to anticipated bad weather, employees who experienced significant roof damage in their homes were provided roof tarps to protect their property.
- Employees whose homes were badly damaged and had to evacuate were offered temporary housing assistance.
- Employees were advised of price gouging and asked to keep their receipts and contact the police if they suspected price gouging. A help number was also offered for employees to contact in the event they experienced gouging.
- Emergency withdrawals from 457 Deferred Compensation accounts were made available from all carriers, and requests were typically being processed within 24-48 hours of the receipt of paperwork.

A10: Boil Water Notice Guidelines

Issue Date: 9/22/97
Revise Date: 8/26/99
Revise Date: 12/11/06

DEPARTMENT OF HEALTH
DRINKING WATER PROGRAM

GUIDELINES FOR THE ISSUANCE OF PRECAUTIONARY BOIL WATER NOTICES

I. AUTHORITY AND INTENT

Pursuant to section 381.006, Florida Statutes (F.S.), the Florida Department of Health (DOH) is responsible for conducting an environmental health program consistent with the state's public health mission of preventing illness within our community. An integral component within this function is the conductance of human health risk assessments of exposure to contaminants in food, air and water.

Of major importance are risk assessments involving microbiological contaminants of waterborne origin. Through natural and manmade means, Florida's population and visitors may be subjected to microbiological contaminants in their drinking water supply. Large outbreaks involving bacteria, viruses, and protozoa have been documented throughout the country, thus arousing a high degree of awareness to these hazards. Additionally, per subsection 381.006(3)(c), F.S., the DOH is further responsible for providing guidance and technical assistance to the Florida Department of Environmental Protection (DEP) and other governmental agencies regarding actions necessary to prevent exposure to drinking water contaminants that present an imminent and substantial threat to the public's health.

As required by the Florida Legislature and as provided within s. 381.0062(3), F.S., this instrument will serve as guidelines regarding the authorization of, and applicability for, the issuance of precautionary boil water notices during instances of imminent or substantial threat of microbiological contamination. The DOH's State Health Office and its units, the county health departments, in coordination with DEP, will have the final authority in ensuring that precautionary boil water notices are issued and rescinded when appropriate, and in a manner consistent with the degree of hazard encountered. In counties where DEP has regulatory authority over all public drinking water systems, the DEP district office shall have the full authority to issue and rescind all precautionary boil water notices, and when doing so shall coordinate with the applicable county health departments. Additionally, this document serves to outline particular instances when precautionary boil water notices shall be issued, the verbiage and content of such notices, and the monitoring and clearance activities, which must be conducted prior to rescinding such notices.

These notices should be issued in a prudent manner and only when there is sufficient justification for this emergency action. Inordinate issuance of the notices will cause needless alarm and may result in the public paying less attention to future notices.

II. IMPLEMENTATION AND INTERDEPARTMENTAL COORDINATION

Under emergency conditions that require the issuance of a precautionary boil water notice, or following confirmation of the presence of microbiological pathogens within a public water supply, the public water system, as required within s. 403.857, F.S. shall

notify the local county health department, the DEP, and the affected public as soon as possible, but not later than 24 hours after the occurrence. In response, the DOH will coordinate with DEP, other state and local governmental agencies, and the public water system, immediate actions which are to be taken (including the issuance of a precautionary boil water notice) to minimize danger to the public. Adequate communication between DEP, the DOH, and the public water system is essential to ensure that all agencies are fully informed prior to the issuance of a precautionary boil water notice. Whichever department issues the notice will also be responsible for rescinding it. The DEP district offices and local county health departments shall coordinate these activities.

The public water system can issue its own precautionary boil water notice using these guidelines if it determines it is necessary. However, the DOH shall be notified as soon as possible in such a case, and a copy of the notice submitted to the DOH. Within those counties that the DEP has full regulatory authority over all public water systems, the public water system shall also notify the DEP district office as soon as possible. Public water systems that issue their own precautionary boil water notices shall also be responsible for rescinding them; however concurrence by the DEP district office or applicable county health department is required prior to rescission of such.

All precautionary boil water notices shall be issued and delivered to the general public in a manner consistent with the public notification requirements contained in Chapter 62-560.410(1)(a) 1., Florida Administrative Code (FAC), telephoned, or hand-delivered to all affected residences and businesses as soon as possible, but in no case later than 24 hours after the water system learns of the violation, exceedance, situation or failure.

Additionally, the DOH shall take the lead role in cooperating with other governmental agencies and all contacts with the media regarding emergency notices involving any and all imminent threats to public health involving private and public water supply systems.

III. TYPES OF INCIDENTS

A. Microbiological Contamination.

1. A precautionary boil water notice shall always be issued in cases where confirmatory water samples indicate the presence of fecal coliform bacteria, E. coli, or other waterborne pathogens. The presence of such indicates an acute threat to the public's health and warrants immediate action by the public water system and public health officials to alert consumers.

2. The rules contained in 62-550.817, F.A.C., "Requirements for Subpart H Surface Water Systems were developed to ensure the removal or inactivation of *Cryptosporidium, Giardia* and viruses. Finished water turbidity levels exceeding 1.0 NTU in conjunction with the failure of a public water system to maintain adequate disinfection to achieve the required removal/inactivation of *Cryptosporidium, Giardia,* and viruses would warrant the issuance of a precautionary boil water notice.

3. With the continuing threat of drinking water contamination via emerging microbial contaminants such as *Cryptosporidium*, all water utilities utilizing surface water and/or groundwater under the direct influence of surface water as their source for drinking water, should also carefully monitor certain critical water process parameters. Abrupt changes in process parameters such as turbidity, particle counts, and disinfectant

residuals may indicate a compromise in the water treatment process and a potential of increased microbial risk for consumers. Abrupt changes in the quality of the source water which cannot be accommodated by the existing treatment processes, a disruption in filtration processes, and the presence of pathogenic microbes in finished water are factors which should be considered in determining action by the public water system. Such action should be made upon the evaluation of all available water quality data (i.e. raw and finished water turbidity, the presence of fecal coliform or E. coli, particle counts, turbidity measurements on individual filters, treatment plant effluent and epidemiological information which confirms increases in gastrointestinal disease in the target community) by a task force comprised of local public health officials, public water system personnel, and health care professionals.

B. Zero or Negative Pressure. A precautionary boil water notice shall be issued in cases where pressure in any part of the water distribution system has been reduced to zero, or a negative pressure, unless the zero pressure is due to an isolated water main break and the public water system can demonstrate that the integrity of the water system has been maintained as specified in III.D below. Special attention must be given where there are multi-story buildings, or critical use facilities such as: schools, child day care establishments, assisted living facilities, nursing homes, dialysis centers, hospitals or other health care centers, or food establishments.

C. Low Water Pressures. A drop in water pressure in a water distribution system is a signal of the existence of conditions which could allow contamination to enter the public water system through backflow by back-pressure or back-siphonage. Water pressure falling below the regulated service level of 20 psi does not, in the absence of other aggravating factors, necessarily constitute an imminent health hazard, unless determined by the DOH or DEP district office. Aggravating factors include the presence of multi-story buildings not adequately protected against backflow where the static head exceeds the residual main pressure, a historical record of inadequate disinfectant maintenance in the water distribution system, analytical records indicate recurring microbiological or turbidity problems, or the water system lacks an approved cross-connection control program. The decision to issue the precautionary boil water notice would be made on a case by case basis and based upon professional judgment of the entity issuing the boil water notice, and upon the review of all available data that may indicate the extent of the problem such as type of facilities affected, duration of the low pressure condition, and possibility of infiltration into the potable water system. If however, the water pressure falls below 20 psi and affects critical use facilities such as: schools, child day care establishments, assisted living facilities, nursing homes, dialysis centers, hospitals or other health care centers, or food establishments, a boil water notice is required. Microbiological samples shall be collected immediately within the area affected at several locations, and measures shall be taken expeditiously to restore the integrity of the water system.

D. Water Main Breaks/Interruptions. Precautionary boil water notices must be issued in cases of water main breaks, or planned distribution system interruptions, which are deemed an imminent public health threat by the DOH state health office, local county health department or DEP district office, or will affect the bacteriological quality of the drinking water unless the public water system can demonstrate, by sound engineering judgment that the integrity of the water system has been maintained. Assurance from the public water system that a positive pressure has resulted in a continuous outflow of water prior to the repair, that applicable best management practices have been used

during the repair as outlined in Attachment C, and that no non-potable water, soil or other potentially contaminated material has entered, or may enter the broken water main during the repair, will serve to demonstrate that the integrity of the water system has been maintained. Water mains repaired with a clamping device while remaining full of pressurized water as required per Rule 62-555.340(1)(d), F.A.C., would not require the issuance of a precautionary boil water notice. (See Attachment C for Best Management Practices for Water Main Breaks and Repairs.) Even in cases where the public water system can demonstrate that the integrity of the water system has been maintained, the affected water main should be repaired, flushed, disinfected, sampled, and monitored for chlorine residual according to ANSI/AWWA Standard C651, as soon as possible.

E. Flooding of Wells. Precautionary boil water notices shall be issued in all cases where surface water inundation of a water supply well has occurred. The presence of disinfectant resistant strains of protozoa such as *Giardia* or *Cryptosporidium* warrant special precautions to be taken until the microbiological integrity of the water system is verified or restored. Seasonal and storm related flooding warrant special attention from public water utilities as well as private well owners.

IV. DISASTER RELATED EVENTS:

Responding to natural and man-made disasters offers unique challenges in addressing potential microbiological contamination of public drinking water supplies. Public water systems may experience a total loss of water pressure, increases in turbidity, or there may be evidence of isolated water main breaks or areas where there is a loss of pressure from detached service connections.

During a hurricane most community public water systems are able to utilize an auxiliary power source to maintain water pressure when significant power interruptions occur. However, when auxiliary power is not available or cannot be maintained, a total loss of water pressure may occur, thus resulting in the potential for contaminants to enter the water distribution system.

A. Addressing A System-wide Loss of Pressure or Increase in Turbidity:

A system-wide pressure loss or increase in turbidity exceeding the maximum contaminant level requires a degree of assurance that the water system is microbiologically safe once water pressure is restored. For all events of this nature, the respective public water system shall take the following measures:

1. Alert the affected public to only consume water that has been boiled or disinfected according to paragraph D below. Note: Increases in water turbidity at Surface Water source or UDI water plants, or flooded wells could introduce contamination by protozoa such as Cryptosporidium. In these cases, only boiling water or the utilization of bottled water should be advised to the affected population. Chlorination requires an inordinate amount of chemical concentration and time to adequately kill Cryptosporidium oocysts.

2. Elevate the disinfection residual within the entire water distribution system to no less than 1.0 mg/L free chlorine, or 3.0 mg/L total chlorine.

3. Adequately flush the water distribution system. With the most concentration at dead- ends, or areas where there is limited water flow.

4. Restore water pressure to the system, such that all service connections possess a minimum pressure of 20 psi.

5. Conduct microbiological monitoring at various sample points within the water distribution system according to the water system's approved microbiological sampling plan.

B. Addressing Isolated Water Main Breaks and Areas of Low Water Pressure:

During a hurricane or other disaster, public water systems may only lose pressure to isolated portions of their water distribution system. In response to such events, public water systems should address each water main break or isolated area as a separate point of attention, to prevent potential microbiological contamination. In responding to each water main break or area of pressure loss, the specific boundaries of the area(s) affected must first be determined.

Once the boundaries of the isolated area(s) are established, the water system shall implement the appropriate provisions described within section III above, and immediately alert the affected public via a precautionary boil water notice.

C. Non-community (NC) Public Water Systems:

A prolonged loss of electrical power at establishments served by NC public water systems can have a negative consequence on the water systems' ability to maintain the microbiological integrity of its finished water. During these events, the disinfection capacity is generally lost, and there is also an inability to maintain water pressure within the water distribution system.

Following the restoration of power, the system's water shall not be consumed until necessary repairs are completed, the water system has been properly flushed, water pressure has been restored to 20 psi or more, there is a minimum chlorine residual of 1.0 mg/L free chlorine within all portions of the water distribution system, and the water has been analyzed and determined to be free of microbiological contamination.

D. Chemical Disinfection of Drinking Water During Power Outages:

During natural or man-made disasters the boiling of water may not be possible due to the lack of power within water system's service area. If there is no power, residents and businesses should be instructed to disinfect their drinking water as follows:

Tap water can be disinfected by adding 8 drops of unscented household bleach (4 – 6 % active ingredients) to each gallon of water, then mixing the water and allowing it to stand for a minimum period of 30 minutes. Note: Cloudy water requires 16 drops of bleach and a 30 minute contact time. Also, other approved chemical disinfectants are available at stores that sell camping and hiking supplies.

V. CONTENT AND DELIVERY OF PRECAUTIONARY BOIL WATER NOTICES

The content of precautionary boil water notices shall include the following information: name of the public water system, geographical area affected, statement of the problem, date of occurrence, consumer corrective measures to be taken, and action being taken by the public water system to correct the problem. A statement indicating that consumers will be officially notified when the boil water notice is lifted following receipt of satisfactory microbiological sample results, and a telephone number directing consumer questions to an appropriate party shall also be included.

Note: The Centers for Disease Control (CDC) and the EPA have indicated that a rolling boil for a period of one minute is sufficient to render drinking water microbiologically safe, free of bacteria, viruses, and protozoa.

All precautionary boil water notices shall be issued and delivered to the general public in a manner consistent with the public notification requirements contained in Chapter 62-560.410(1)(a) 1., Florida Administrative Code (FAC), telephoned (such as reverse 911 calling for large scale incidents), or hand-delivered to all affected residences and businesses as soon as possible, but in no case later than 24 hours after the water system learns of the violation, exceedance, situation or failure.

(SEE ATTACHMENT A FOR SAMPLE NOTICE)

VI. RESCISSION OF BOIL WATER NOTICES

It shall be the responsibility of the entity issuing the precautionary boil water notice to also rescind it, following receipt of a minimum one day of representative bacteriological sample results (for water main breaks, a minimum of two representative samples shall be collected; one sample upstream and one sample downstream of the break), supplemented by appropriate disinfection residual levels and other water quality parameters indicating that the water is safe to drink and with the concurrence of the DOH, or jurisdictional DEP district office. However, even if a precautionary boil water notice is rescinded after one day of satisfactory bacteriological sample results, a second day of bacteriological samples still must be collected in accordance with Rule 62-555.340, F.A.C., following water main repairs. If unsatisfactory bacteriological levels are detected during the one day initial sampling event, the water system shall provide two consecutive days of satisfactory bacteriological sample results prior to rescission of the precautionary boil water notice. If unsatisfactory bacteriological levels are detected during the second day of sampling following water main repairs, the precautionary boil water notice shall be reissued if it was rescinded after the initial one day sampling event, and the water system shall provide two consecutive days of satisfactory bacteriological sample results prior to rescission of the precautionary boil water notice. As is required during the issuance of such, all parties involved, including DEP, other governmental agencies, the public water system, and the media, must be adequately informed of the rescission of the precautionary boil water notice.

(SEE ATTACHMENT B FOR SAMPLE RESCISSION NOTICE)

All inquiries regarding this policy should be directed to Edward A. Bettinger, R.S., M.S., Environmental Health Program Consultant in the Bureau of Water Programs, 4052 Bald Cypress Way, Bin # C22, Tallahassee, Florida 32399-1742, Suncom 205-4240 or (850) 245-4240.

ATTACHMENT A

(DATE)

PRECAUTIONARY BOIL WATER NOTICE

TO: RESIDENTS OF (NAME OF CITY, TOWN, TRAILER PARK, SUBDIVISION OR COUNTY) LIVING IN THE AREA BOUNDED BY (STREET, AVENUE, CANAL OR OTHER DESCRIPTIVE BOUNDARY)

(BRIEF DESCRIPTION OF EVENT SUCH AS: BACTERIOLOGICAL ANALYSES OF SAMPLES OBTAINED FROM YOUR WATER DISTRIBUTION SYSTEM HAVE SHOWN POSSIBLE CONTAMINATION OF THE WATER, OR A WATER MAIN BREAK HAS OCCURRED AT _____, OR A LOSS OF WATER PRESSURE HAS BEEN EXPERIENCED DUE TO _____)

THEREFORE, AS A PRECAUTION, WE ADVISE THAT ALL WATER USED FOR DRINKING, COOKING, MAKING ICE, BRUSHING TEETH, OR WASHING DISHES BE BOILED. A ROLLING BOIL OF ONE MINUTE IS SUFFICIENT. AS AN ALTERNATIVE BOTTLED WATER MAY BE USED.

(* WHERE THERE IS A LOSS OF POWER, DRINKING WATER UTILITIES SHOULD INCLUDE LANGUAGE OUTLINED IN PARAGRAPH IV D. OF THESE GUIDELINES DESCRIBING THE CHEMICAL DISINFECTION OF DRINKING WATER.)

THIS "PRECAUTIONARY BOIL WATER NOTICE" WILL REMAIN IN EFFECT UNTIL THE PROBLEM HAS BEEN CORRECTED AND A BACTERIOLOGICAL SURVEY SHOWS THAT THE WATER IS SAFE TO DRINK.

IF YOU HAVE ANY QUESTIONS YOU MAY CONTACT (NAME OF PERSON, AGENCY) AT (PHONE NUMBER).

(SIGNATURE)
(NAME, TITLE AND AGENCY OF OFFICIAL ISSUING THE NOTICE)

ATTACHMENT B

(DATE)

RESCISSION OF PRECAUTIONARY BOIL WATER NOTICE

TO: RESIDENTS OF (NAME OF CITY, TOWN, TRAILER PARK, SUBDIVISION OR COUNTY) LIVING IN THE AREA BOUNDED BY (STREET, AVENUE, CANAL OR OTHER DESCRIPTIVE BOUNDARY)

THE (DATE) "PRECAUTIONARY BOIL WATER NOTICE" IS HEREBY RESCINDED FOLLOWING THE (ACTION TAKEN TO CORRECT THE PROBLEM) AND THE SATISFACTORY COMPLETION OF THE BACTERIOLOGICAL SURVEY SHOWING THAT THE WATER IS SAFE TO DRINK.

IF YOU HAVE ANY QUESTIONS, PLEASE CALL (NAME, AGENCY) AT (PHONE NUMBER).

(SIGNATURE)
(NAME, TITLE AND AGENCY OF
OFFICIAL RESCINDING THE NOTICE)

A 11: Best Management Practices for Water Main Breaks and Repairs

Best Management Practices
For
Water Main Breaks and Repairs

ATTACHMENT C

1. **Interruption of Service**

Whenever possible, repair work shall be performed without interruption of service. If an interruption is necessary, the repair plan shall include considerations to minimize the length of time for the outage. These considerations include measures to assure all equipment and supplies to effectuate the repair are available at the site to expedite the repair once service is interrupted.

2. **Pipe Conditions**

If pipe cannot be repaired under pressure by use of a repair clamp, the pipe should not be completely depressurized until the pipe is exposed and the pit meets the conditions described in 8 below. After the pipe is unpressurized, a continuous outflow of water from the pipe on each side of the repair should be maintained during the repair process to eliminate the potential for the introduction of contaminants, and to facilitate ongoing flushing action. Precautionary boil water notices shall be issued when these conditions cannot be maintained.

3. **Magnitude of Area Impacted**

Consideration shall be given to the relative size of the area impacted not only with regard to geographic size but also to the number of customers affected. A broken water main encompassing a small area, and a limited number of customers still could have negative consequences on the health of those affected. It is thus important that precautionary measures are undertaken by the water utility.

4. **Potential Hazards**

A survey of potential hazards in the vicinity of the work area shall be completed. Potential sources of contamination such as septic systems or underground storage tanks may be cause to issue a precautionary boil water notice regardless of safeguards implemented at the work site. Due consideration should be given to this potential on a case-by-case basis.

Service connections within the area of consideration should also be surveyed. Any connection without the proper type of backflow prevention device, and, or the presence of multi-story buildings shall be factored into the decision-making relative to potential for contamination.

5. **Flushing**

Whenever possible, unidirectional or bi-directional flushing towards the work site should be done before, during, and subsequent to a water main break or repair activity.

As a measure of flushing effectiveness, chlorine residuals shall be evaluated in the immediate and surrounding areas around the repair site. Flushing should be continued until system residuals are resumed and stabilized within the water distribution system, to achieve the minimum required disinfectant residual throughout the system.

6. **Isolation of Area**

In an effort to localize drops in service pressure, minimize impacts to service, and reduce opportunities for contamination, valves should be closed or throttled as needed to isolate the repair area as much as possible. The length of pipe(s) with a reduction in pressure or less than full pipe conditions should be minimized.

7. **Service Connections**

Consideration to backflow and the presence of multi-story buildings should be given in order to reduce the potential for the water main to have contaminants introduced, thus it may be prudent to valve off applicable service connections in the area impacted.

8. **Pit Considerations**

Standing surface, ground, or potable water in the pit of a water main break should not be allowed to remain during periods of unpressurized pipe conditions, less than full pipe flow, or whenever flow is not being maintained. Portable dewatering pumps shall be utilized to keep the hole dewatered below the pipe inverts during all repair activities. Additionally, soil should be excavated to a minimum depth of 12 inches below the pipe inverts. Precautionary boil water notices shall be issued when these conditions cannot be maintained.

9. **Disinfection and Bacteriological Testing**

All repair items, piping, and appurtenances shall be properly disinfected or swabbed in accordance with Rule 62-555.340, F.A.C., and AWWA Standard C651.

As a record of procedural BMP effectiveness, a minimum of one bacteriological sample should be collected on either side of the repair area for two consecutive days. In the case of precautionary boil water notices, they may be lifted after receipt of one day of satisfactory analytical results. However, if the analytical results are positive, two consecutive days of satisfactory water quality analyses are required prior to rescinding the boil water notice. The utility shall coordinate this activity with the local FDEP and/or DOH representatives.

10. Type of Event

Unplanned repair or outages have an inherently higher risk of potentially impacting public health than planned or "controlled" events. Hence, this should be duly weighted into decisions regarding issuance of precautionary boil water notices. As such, coordination between the DEP or DOH/CHD office and the affected utility is important to determine the necessity for the issuance of a precautionary boil water notice. It is important that the actions of the affected utility comply with Rule 62-555.340, F.A.C.

A 12: Disinfecting Flooded Wells

Applicability

If drinking water is obtained from a pubic well and you suspect that the well may have been contaminated, contact your local or state health department for specific advice

Contamination Threats to Wells from Flooding

Flooding provides three pathways for contamination of a well, transport of contaminated water to the well head that can be present both above and below ground, surface inflow that passes directly into the well through openings at the ground surface and subsurface infiltration that enters the well by hydraulic actions caused by the well drawdown. The first flush of water from storm water facilities is often contaminated to an extent found in raw sewage. Flooding will transport these wastes directly to the well head.

Even if a well head has not been completely covered over with flood water, a poorly constructed well can become contaminated from surface water that enters through openings in the well or seeps in below ground. If you have had any standing water around a well head from a flood, then there is a good chance the well could be or could become contaminated.

Contamination can occur in both deep well and shallow wells and is not dependant on the volume of water or flow rate provided by the well. Contamination may be more dilute in a deeper, high-capacity well, but microorganisms could still affect human health.

The most common side affects of drinking contaminated well water is diarrhea. Diarrhea can be caused by a host of bacterial and viral pathogens and may occur after a few hours after drinking or being exposed to contaminated water to several days following exposure. It is not necessary to drink water to become ill when water is contaminated. Pathways for illness include from contaminated water on the hands to body openings in the eyes and mouth and from breathing aerosols that can enter the lungs. For this reason bathing or any other type of contact with contaminated water should be discouraged.

Fuel and other chemical releases and spills are common during flood events. If floodwaters water smells like fuel, has a chemical odor, or a sheen, contact your local or state health department to request a chemical analysis. Floodwater that carries fuels, solvents, pesticides or other chemicals can contaminate a well with constituents that will not be removed in the water treatment process. Until you know the chemical constituents that can be contaminating the water and their concentrations, the well may not be capable of producing water that is safe to use in the short-term.

Safety Considerations for Cleaning and Disinfecting Wells

You will need to clear hazards away from well heads before attempting to clean and disinfect wells after floods and other natural disasters. The following precautions will help you do that safely:

Table 1

Safety Precautions for
Preparing a Well Head for Cleaning and Disinfection

1. Before beginning any action, carefully inspect the area around the well for electrical and physical hazards. Those may include broken power lines on the ground or in the water; sharp metal, glass, or wood debris; open holes; and slippery conditions.
2. Wear thick rubber-soled shoes or boots to protect against electrical shock.
3. Turn off all power to the well area before clearing debris. Inspect all electrical connections for breaks in insulation and for moisture. Turn power back on only if all connections appear unbroken and dry with no opportunity for shock.
4. Do not turn on any electrical equipment if there is a persistent smell of fuel such as gasoline coming from the well head. Allow the well to vent. If the smell persists, contact your local or state health department. Do not continue with disinfection of the well until the contamination in the well has been removed
5. Before beginning work on the well, clear debris away from it to avoid inadvertently moving debris into the well.

Once the wellhead area has been safely prepared you can proceed to clean and disinfect the well. These additional precautions are recommended as you prepare to disinfect the well(s):

Table 2

Additional Safety Precautions for
Preparing a Well for Cleaning and Disinfection

- The Chlorine solutions used to clean and disinfect a well can cause chemical burns. Use rubber gloves, protective eye wear, and waterproof aprons or rain gear when working with chlorine solutions.
- When mixing and handling chlorine solutions, work in well ventilated areas and avoid breathing vapors. When working in closed spaces, use electrical fans to provide fresh air. Exposures to chlorine fumes at high concentrations can damage lung tissue immediately and at low concentrations, exposure as low as 15 minutes duration can cause illness or injury.
- Warn users not to drink or bathe in water until all the well disinfection steps have been completed and the well has been thoroughly flushed.

Cleaning and Disinfecting Wells Following a Flooded Condition

After following the above safety and health precautions the well is ready for cleaning and disinfection. The following procedures are recommended for cleaning and disinfecting wells that may have become contaminated by harmful microorganisms in floods or other natural disasters.

The disinfection process for a well can take from a few hours to a few days to complete. This process is recommended after floods and when a well has tested positive for coliform bacteria.

Chlorination is a process of flushing your well water system with a chlorine solution to inactivate pathogens. Chlorination is an effective method to inactivate microbial contamination, but if sampling shows that continual problems exist and they are linked to the well or groundwater from flooding, chlorination is only a temporary solution and will not protect the consumer of the water from microbial illness.

If the well contamination persists, further investigation is needed to determine the source of the problem. The procedures for well investigation are found in FAC 62-555.315 and 62-555.320.

If electrical power is not available at the well head, a portable generator may be needed to operate pumps and other equipment. Be familiar with generator operation found in other sections of this document before turning on a generator, energizing pumps, or any electrical equipment and have a qualified electrical technician make any electrical connections to prevent serious injury and damage to equipment..

After ensuring that safety procedures have been addressed, the well is ready for cleaning and disinfection. The recommended procedures follow:

Table 3

Procedures for Cleaning and Disinfecting Wells

1. Scrub and/or hose off foreign material from the well head, including the well slab, sanitary seal and pumping equipment. If the well seal was not properly installed and flooding has occurred, contaminated water, sand and silt may have been deposited in the well from this source, will be a contamination source and thus will need to be removed.
2. Swab all top areas with chlorine solution. Since oil from street runoff may be contained in flood waters and is retained at the surface, it is recommended that a chlorine dose of 1,000 PPM be used for swabbing. This is about 2 ounces of bleach per gallon of water.

   Contaminated flood water may also have entered the well through the well vent opening and/or electrical conduits and these should be opened, cleaned and swabbed with chlorinated water and then flushed with clean water prior to

attempting to disinfect the well. The amount of chlorine needed will be based on the type and extent of contamination.

3. If flooding inundated the well head it may be impossible to remove all the debris deposited in the well. Special tools or pumps may be required to remove silt and sand that has settled to the bottom of the well. Heavy deposits of silt and sand may damage the well pump if not removed before the pump is started. If flooding resulted in a condition where considerable amounts of sand and silt were forced into the well, the pump column and well pump will have to be removed, any foreign substances removed and the well cleaned thoroughly before attempting disinfection.

4. In instances of inundation, the well must be opened and all floating debris removed. The well should be purged by pumping until clear, to remove any suspended materials. The inside casing will require decontamination by swabbing from the surface the casing pipe to water level or if extremely deep, by repeated flushing from the top with strong non-foaming detergent such as Calgon or Trisocium Phosphate. If the well has been flooded, contaminated materials may have deposited on the sides of the casing and can be best removed by cleaning.

5. The amount of chlorine to reach shock loading to be used to decontaminate a well will be determined from Table 5. These values are based on achieving a concentration of 50 PPM. For disinfecting a well that may have been contaminated, at least 200 PPM concentration of free chlorine residual must be maintained. If oil or high levels of organic matter have been washed into the well concentrations as high as 1000 PPM may be needed. This will also require the column and well pump to be removed and cleaned.

6. <u>If the pumping units are to be left in the well then these procedures should be followed.</u> After purging well to clear condition, clean the casing with Calgon or Trisodium Phosphate by adding about 4 oz. to each gallon of water to be removed and cycling the well up and down several times. The gallons of mixture to be used is determined by the drawdown in the well.

7. Chlorine solutions to be added to the well are determined from Table 6. How the chlorine solution is to be added is determined by whether the pumps are water or oil lubricated. If oil lubrication is used then chlorine must be added below the water well surface or it will be carried deep into the well. The solution should be added by lowering a hose into the well through the well vent if the pumps are oil lubricated.

<u>This wash water is used to both flush deposits and oxidize any residue along the sides of the casing</u>. The condition of the well can be visually observed by noting the condition of the lush water as it is removed. Empty spent rinse water from the well and repeat the process allowing the well to fill again.

8. Add a chlorine solution to the well until it produces a free chlorine concentration as shown in Table 6. To determine free chlorine residual a DPD kit must be used. Cycle the well pump several times to get good chlorine distribution.

   Table 5 provides recommended doses to reach acceptable free chlorination levels in the casing pipe. It is advisable to take a sample to determine that these levels are met or exceeded. Either unscented bleach liquid or solid chlorine can be used to disinfect a well.

   To disinfect a contaminated well, shock chlorination is necessary. Shock chlorination cleans the well by oxidation and inactivates pathogens. The more contamination that is found or suspected the higher the dose of chlorine that needs to be used.

   The highly chlorinated water must be held in the well for 24 hours before it is flushed out and the system is ready for testing. To determine the approximate amount of chlorine needed, find the corresponding well diameter in the left column of the table. Then match the amount of chlorine needed corresponding to the size of the well found on the right.

It is very important to determine the depth of your well. This information is typically recorded in an O&M manual. If a the information is not available you will need to estimate the depth based on your best educated guess, then increase the suggested amounts of chlorine by 50%.

9. The chlorine solution can be added trough the well vent or the air release valve may be removed if more diameter is needed. Once the solution is completely dispensed into the well it must be thoroughly mixed. This is accomplished by cycling the well pump on and off until a strong chlorine odor is persistent in the spent water. Drain to waste and do not pump contaminated water into any existing piping or pressure tanks. Disconnect piping between the pressure tank and pump if needed to allow contaminated water to flow away from the well and tank.
10. Once the solution is thoroughly mixed the well is ready for disinfecting. Add additional makeup solution and then repeat this procedure several times at one hour intervals making sure that the required chlorine residual is maintained. Water pumped from the well should be clear and have a heavy chlorine odor.

11. After several cycles stop the pump, note the time, and allow the chlorine solution to remain in the well. The chlorine solution should be left in the well for 24 hours. Do not leave chlorine in the well for much longer than 24 hours because at high concentrations it can be corrosive to some pump parts.

12. After the disinfectant has set in the well for the recommended period, turn on the pump and direct the water to a designated area away from the well. The water in the well contains high concentrations of chlorine that can be harmful to plants and

aquatic life. Empty the water in an area where plants or streams will not be harmed. You should continue to pump the well until no chlorine odor is present.

13. Confirm that there is no chlorine residual and take a bacteriological sample in accordance with DEP Standard Operating Procedures. Properly label, preserve and transport the sample to an approved laboratory for testing.

Table 4

Determining the amount of water inside

A Well Casing for Adding Detergent

Well Diameter (inches)	Volume (gallons per foot)
4	**0.65**
6	**1.47**
8	**2.61**
12	**5.88**
16	**10.44**
20	**16.30**
24	**23.50**

Table 5

Determining Chlorine Amounts
for Shock Chlorination (50 PPM) of a Well

Laundry bleach (about 5.25% Hypochlorite)					
Depth of water in well	**Casing diameter**				
	4 inch	**6 inch**	**8 inch**	**10 inch**	**12 inch**
10 feet	1/2 cup	1 cup	1 1/2 cups	1 pint	2 pint
25	1 cup	1 pint	2 pints	3 pints	4 1/2 pts
50	1 pint	1 quart	2 quarts	3 quarts	1 gal
100	1 quart	2 quarts	1 gal	1 1/2 gal	2 gal
150	3 pints	3 quarts	1 1/2 gal	2 gal	3 gal
High-Test Hypochlorite (HTH 65-75% Hypochlorite)					
Depth of water in well	**Casing diameter**				
	4 inch	**6 inch**	**8 inch**	**10 inch**	**12 inch**
10 feet	-	-	-	-	-
25	-	-	-	1/4 lb	1/2 lb
50	-	-	1/3 lb	1/2 lb	3/4 lb
100	-	1/3 lb	3/4 lb	1 lb	1 1/2 lb
150	1/4 lb	1/2 lb	1 lb	1 1/2 lb	4 lb

Table 6

Factors to be Applied to Table 4 for Calculating Chlorine Concentrations for Levels Greater than (50 PPM) to Remove Organic Materials

	Observed Condition of The Well	Concentration of Chlorine Required for Disinfection	Minimum Factor to Use To Reach Desired Concentration
1.	Loss of Power for extended period only, no flooding of Well Head has Occurred	100 PPM	2
2.	Any bacterial problems have been noted or expected and no flooding has occurred.	200 PPM	4
3.	Flooding is extensive in the area, standing water is observed and organic material may have reached Well Head through groundwater infiltration.	300 PPM	6
4.	Flooding is extensive and the well was been inundated or contaminated water has entered the well directly or organic material or oil has been identified in the well.	1000 PPM	20

Example:

From Table 6 a dose of 4 quarts of liquid chlorine bleach was determined to be necessary to Shock a Well. Standing water from floodwaters were observed standing near the well head. Water did not inundate the well and no organic material has been identified in the well.

From Table 5, a concentration of 300 PPM of chlorine is recommended to disinfect this well. The amount of chlorine needed is 6 X 4 quarts or 24 quarts (6 gallons of bleach.) It is always preferable to use more chlorine than necessary if direct contamination is suspected.

Sampling Wells Following Cleaning and Disinfection

Until water has been tested and determined safe, any water for human consumption should be boiled (roiling boil for 1 minute), or an alternative water source used. Wait at least 2 days after disinfection to ensure that the chlorine has been thoroughly flushed from the system. Then sample the water for total coliform and either *E. coli* or fecal coliform bacteria to confirm that the water is safe to drink. Contact the local health department to have your water sampled and tested or contact your state laboratory certification officer to find a certified lab near you. You can also get this number from the U.S. Environmental Protection Agency's Safe Drinking Water Hotline (800-426-4791 or www.epa.gov/safewater/labs/index.html).

If the sample results show no presence of both total coliform and *E. coli* or fecal coliforms, the water can be considered safe to drink from a microbial standpoint. Homeowners with private wells should follow up with two additional samples, one in the next 2 to 4 weeks and another in 3 to 4 months. To check the safety of your water over the long term, continue to monitor bacterial quality at least twice per year or more often if you suspect any changes in your water quality. Wells that serve Community Water Systems will need to meet the sampling requirements of the Florida Department of Environmental Regulation.

If sample results indicate the presence of total coliform and *E. coli* or fecal coliforms, repeat the well disinfection process and resample. If tests continue to show the presence of bacteria, contact your local health department for assistance.

A13: Best Management Practices for Bacteriological Disinfection of Water Mains

Adherence to AWWA Standard 651

Disinfection and Bacteriological Testing of Water Mains (local chlorination) is required for all pipe and fittings used to complete connections or repairs with the potable water system per AWWA Standard C651.

General Disinfection Procedures for Contaminated Water Main Repairs

1. Water mains shall be prevented from contaminating materials during storage, installation and repair.
2. Clear or flush any foreign materials that may have collected in the mains.
3. Super-chlorinate water mains to disinfect any residual contamination.
4. Flush super-chlorinated water from the water main.
5. Protect the existing distribution system from contamination during the pressure tests and by super-chlorinated water.
6. Initiate Bacteriological testing of water mains.
7. Ensure that water main bacteriological quality meets DEP standards.
8. Allow connection of disinfected water main to active distribution system.

Use of Chlorine for Disinfection of Water Mains and Main Repairs

1. Disinfection of Water mains is achieved using a chlorine solution to kill bacteria and other microorganisms after pipe installation and prior to testing. The disinfection process can take from a few hours to a few days to complete. Three (3) chlorination methods are acceptable to super-chlorinate water mains: Tablet, Continuous Feed, and Slug. The Tablet method gives a chlorine dose of approximately 25 mg/L; the Continuous Feed method gives a 24-hr chlorine residual of not less than 10 mg/L; and the Slug method gives a 3-hr exposure of not less than 50 mg/L free chlorine.

2. The chlorinating agent and method of application shall be conducted in accordance with AWWA C651. Three Chlorination Methods are acceptable: 1.) the Tablet/Granular Method, 2.) the Continuous Feed Method and, 3.) the Slug Method. These described in the following sections:

Tablet/Granular Method

- The tablet/granular method consists of placing Calcium Hypochlorite Granules or tablets in the water main as it is being installed and then filling the main with potable water when installation is complete. This method may be used only if the pipes and appurtenances are kept clean and dry during repair/construction.
- During pipe installation, Calcium Hypochlorite Granules shall be placed at the upstream end of each section of pipe and at the upstream end of each branch main.
- The quantity of granules used shall be as shown in Table 1, AWWA C651.

Table 1

Ounces of Calcium Hypochlorite Granules to be placed at the upstream end of each section of pipe and at the upstream end of each branch main at 500-ft Intervals

Pipe Diameter	Calcium Hypochlorite Granules
2-inches	0.11 ounces
4-inches	0.5 ounces
6-inches	1.0 ounces
8-inches	2.0 ounces
12-inches	4.0 ounces
16-inches and larger	8.0 ounces

- During construction, 5-gram Calcium Hypochlorite tablets shall be placed in each section of pipe. Also, one tablet shall be placed in each hydrant, hydrant branch, and other appurtenance.

Calcium Hypochlorite Tablets

Pipe Diameter	5 gram Calcium Hypochlorite Tablets per Pipe Segment			
	13-ft	18-ft	20-ft	30-ft
2-inches	- - -	- - -	- - -	- - -
4-inches	1 tablet	1 tablet	1 tablet	1 tablet
6-inches	1 tablet	1 tablet	1 tablet	2 tablets
8-inches	1 tablet	2 tablets	2 tablets	3 tablets
10-inches	2 tablets	3 tablets	3 tablets	4 tablets
12-inches	3 tablets	4 tablets	4 tablets	6 tablets
16-inches	4 tablets	6 tablets	7 tablets	10 tablets

- Tablets shall be attached to the top of the pipe by a food-grade adhesive. The adhesive shall be only on the broadside of the tablet attached to the surface of the pipe.
- If the tablets are attached before the pipe section is placed in the trench, their position shall be marked on the section to indicate that the pipe has been installed with the tablets at the top.
- Filling and contact: Introduce water into the pipes at a velocity no greater that one (1) foot per second (fps).
- The chlorinated water shall be retained in the lines for a minimum of 24-hours. If the water temperature is less than 41^{o} F (5^{o}C), the water shall remain in the pipe at least 48 hours.
- Detectable chlorine residual of not less than 10 mg/l shall be found at each sampling point after the 24 hour, or 48 hour, period.

Continuous Feed Method

- The continuous-feed method of disinfecting water mains consists of completely filling the main to remove all air pockets, flushing the completed main to remove the particulates, and filling the main with potable water.
- Chlorinated water shall be introduced into the water lines at a point not more than 10 feet downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 25 mg/L free chlorine.
- The entire main shall be filled with the chlorine solution.
- Reference Table 4, AWWA C651 for required chlorine amounts.
- Prior to and during the disinfection process, valves shall be positioned so that the chlorine solution in the newly constructed main will not flow into water mains in active service.
- The chlorinated water shall be retained in the main for a minimum of 24-hours, at which time the treated water in all portions of the main shall have a free chlorine residual of not less than 10 mg/L.
- The water purveyor shall properly and legally dispose of flushing and super-chlorinated water.

Slug Method

- The slug method consists of placing Calcium Hypochlorite granules in the main during construction, completely filling the main to eliminate all air pockets, flushing the main to remove particulates, and slowly flowing through the main a slug of water dosed with chlorine to a concentration of 100 mg/L

- Refer to Tablet / Granular Method for placing Calcium Hypochlorite granules.
- At a point not more than 10 feet downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will not have less than 100 mg/L free chlorine.
- The chlorine shall be applied continuously and for a sufficient period to develop a solid column, or "slug" of chlorinated water that will, as it moves through the main, expose all interior surfaces to a concentration of approximately 100 mg/L.
- The free chlorine residual shall be measured in the slug as it moves through the main.
- If the free chlorine drops below 50 mg/L, the flow shall be stopped, chlorination equipment moved to the head of the slug, and as flow resumes, chlorine shall be applied to restore the free chlorine in the slug to not less than 100 mg/L.
- Flow rate shall be set so that all interior surfaces are exposed to a chlorine concentration of approximately 100 mg/L for a minimum of 3 hours.

Flushing of Chlorinated Water Mains and Appurtenances

1. After the applicable retention period is achieved for the chlorination method selected, the heavily chlorinated water shall be flushed from the water lines until chlorine measurement show that the concentration in the water leaving the main is no higher than that generally prevailing in the system, or less than 1 mg/L.
2. The water purveyor shall be responsible for securing all necessary approvals from DOH/DEP or permits to ensure that no environmental damage occurs.
3. Reference Appendix B of AWWA C651 supplies a list of neutralizing chemicals.

Ensuring Bacteriological Disinfection

1. The water purveyor shall collect water samples to test for bacteriological quality to show the absence of coliform and heterotrophic organisms in the pipeline. Testing shall be done after final flushing and prior to pressure testing. Under no circumstances shall the main be pressure tested or put in service prior to bacteriological testing,
2. Water mains shall not be placed in service until written release is obtained from DOH/DEP.
3. The total coliform analyses shall be performed by a DOH approved laboratory.
4. A total of at least two (2) samples each taken on a separate day and taken at least 6-hours apart from the other sample(s). The total chlorine residual must be no more than 4 mg/L.
5. If any sample contains more than 4 mg/L total chlorine, the sample shall be considered invalid.
6. If any sample shows the presence of total coliform, mains shall be re-disinfected and re-sampled until 2 consecutive samples at each sampling location show the absence of total coliform.
7. Bacteriological test results shall be considered unacceptable if the tests were completed more than 60 days before the Department received the results. In Emergency situations, bacteriological tests may be returned within 24 hours.
8. No treatment facility, storage tank or water mains shall be placed into service until a bacteriological evaluation has been satisfactorily completed, results of the evaluation have been submitted to the appropriate DEP District Office or Approved County Health Department, and APPROVED the facilities or mains for operation.
9. A Water System may be approved to allow a water main to supply water to be used for public consumption on the basis of the first confirmed negative test. This will require concurrence of DOH/DEP. The second consecutive sampling must proceed and also show a confirmed negative result. If the test is positive, the procedures described here must be repeated.
10. If the initial disinfection, or subsequent disinfections, fail to produce satisfactory samples, the main shall be re-flushed and re-sampled. If the samples are still not satisfactory, the main shall be re-chlorinated by the continuous-feed or the slug method of chlorination until satisfactory results are obtained.

A 14: Restoring Electric Motors Flooded by Saltwater

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Introduction

According to the Electrical Apparatus Service Association, even motors submerged in salt water may be restored if properly cleaned, dried and tested. Flooded motors and transformers were sent to motor repair shops all over the U.S. and successfully restored to serviceability following Hurricane Katrina. Lessons learned here can be applied to future hurricane flooding events. Some simple steps will help those involved in hurricane restoration activities to increase the probability of success for a motor repair following saltwater flooding.

Before the Flood

There are not a lot of ways to minimize flood damages to motor drive systems, but keeping critical systems on higher ground is the best way to protect them. Here are some suggestions to help prepare for large or small equipment saltwater damage.

Table 1

Minimizing the Affects of
Saltwater Flooding of Electrical Equipment

- Track motor inventory and identify in advance which motors are candidates for replacement if they become compromised. Be sure to back up these records in an off-site location.
- Multi-facility companies should store some critical spare parts at various facilities so they will survive a disaster that hits one facility.
- Determine if company service centers have a plan for restoring a large volume of flooded motors.
- Invest in a predictive maintenance program for motors and transformers, including diagnostic equipment that assesses insulation integrity. This will provide baseline information on insulation condition and identify problem equipment that needs rewinding or replacement. It can also help improve equipment reliability even in dry times.

Minimizing Insulation Damage to Electric Motors

Seawater has a total dissolved-solids concentration of about 35,000 mg/L, of which dissolved chloride is the largest component (about 19,000 mg/L). Concentrations of chloride in fresh ground water along the Atlantic coast are typically less than about 20 mg/L, so there is a large contrast in chloride concentrations between freshwater and saltwater. Motors that have been flooded by freshwater are typically very repairable. However, saltwater flooding poses a more significant threat to a flooded motor because of the conductance of the minerals that are

present. The critical step in restoring an electric motor that has been flooded by salt water is to keep the windings flooded, or at least wet, until they can be flushed using clean fresh water. If salt water dries in a winding, it becomes almost impossible to dissolve and remove the mineral deposits by flushing. If service centers are backed up for weeks, major industrial facilities may be able to set up temporary "field hospitals" for flooded motors. However, this work needs to be at least supervised, if not performed, by trained electrical equipment service personnel.

Planning for Saltwater Damages to Motors and Electrical Equipment

Storm surges and resultant coastal flooding from hurricanes can reach several miles inland submerging electrical equipment including motors. Direct replacement of electric motors can take several weeks or longer rendering critical facilities inoperative. The overload of motor repair facilities and demands for critical repair equipment can likewise be extremely lengthy if hurricane damages caused by storm surges along the coastline are extensive. For this reason utilities are advised to review rehabilitative procedures that can return electric motors to operating status in less than 24 hours.

Utilities in coastal areas are advised to review the special rehabilitation procedures for saltwater submerged motors. These procedures are different than those typically used for freshwater flooding. Failure to adhere to these best management practices may result in irreversible damage to motors.

Coastal utilities are advised to develop operating agreements with local and regional electrical motor repair shops to ensure that the facilities are equipped to handle the extra workloads that are possible with coastal flooding and that personnel in these shops understand the rational and the special procedures that are necessary to rehabilitate electrical equipment submerged in saltwater.

Procedures for Flushing Saltwater from Motor Windings

Floods will carry dirt, sand, sediment, and other foreign materials that will lodge in all parts of the motor, particularly the windings. This material can be removed using a hose with water on low pressure, or flushing directly with fresh water until removed. Saltwater however, can not be removed with simple flushing since any mineral deposits remaining on motor surfaces will be hydroscopic and eventually lead to oxidation of metal or shorting of insulation leading to motor failure. Mineral deposits will also chemically react with insulation causing it to deteriorate.

Never attempt to restart an electric motor that has been flooded. It may permanently damage the device. The motor may be damaged internally or contain moisture that could cause electrical shock.

Saltwater is particularly problematic to motor windings and procedure have been developed that can be successful if employed quickly. These procedures provide excellent results for removal of saltwater deposits from windings if the surfaces have remained wet or if the surfaces have remained flooded with saltwater and have not dried out. The procedure will likely not be successful if the windings have been allowed to dry. The sooner the procedure is initiated after saltwater flooding the better the results will be.
The table below illustrates the preferred technique for addressing saltwater flooding of motors.

Table 2

Procedures for Restoring Electric Motors
Flooded by Saltwater

1. Keep motor windings submerged in water; fresh water is preferable but if only saltwater is available keep the windings flooded; **Do not allow the motor to dry!**
2. Transport Motor as soon as possible to an electric motor repair shop
3. The motor must be disassembled and mud, silt and deposits removed by flushing with water using a hose not to exceed a pressure of 25 psi. Tight adhering deposits will require agitation or gentle brushing or wiping. A mild non-conductive detergent diluted to 1 pint to each gallon of water, is sometimes used to aid in the cleaning process.
4. After motor parts have been thoroughly cleaned they must flushed to remove mineral deposits caused by the saltwater.
5. Immerse motor parts for 8 hours in fresh water
6. Water must be turbulent/agitated continuously in the tank
7. Water must be continuously exchanged at a rate of 20-50 gpm
8. After the procedure is completed the motor parts should be wiped with a clean cloth, grease and oil replaced in bearings and metal surfaces and the motor parts reassembled for drying

Construction of Motor Flushing Container

Most motor repair shops will not have the flushing equipment described above that is essential for removal of saltwater deposits. The following information is provided for constructing such a device.

After a strong hurricane, tidal surges can inundate a significant number of electric motors and a large flushing device can accommodate several motors at one time. A dumpster or similar sized container can be quickly constructed to serve this purpose.

Construction of a Saltwater Flush Box (See figure below)

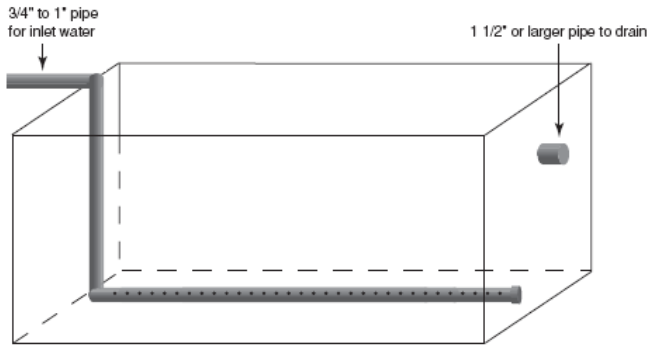
Water Inlet and Flushing Pipe

Route a 3/4” or larger pipe in from the top of the tank down to the bottom, then route pipe along the length of the bottom of the tank down to the bottom, then route pipe along the length of the bottom of the tank, roughly centered. Cap the other end of that pipe, drill holes at a slight upwards angle along both sides of pipe. This pipe serves as the water jets. Size holes appropriate for the available water pressure, no more than 1/8" diameter. The more holes, the smaller they will have to be. The holes will serve as water jets to ensure adequate agitation and flushing and to direct water toward motor parts and prevent short circuiting.

Constructing the Drain

A hole should be drilled near the top, opposite of the inlet, to allow water to be drained from the container. A nipple or sealed threaded pipe can be used to retain water tightness and serve as a connection for directing water to a suitable drain.

FIGURE 1: CONSTRUCTION OF TANK TO FLUSH SALTWATER FROM WINDINGS



Flush Box for Saltwater
Mineral Deposit Removal

Load tank with motor stators, fill with clean fresh water, and operate for 8 hours.

Remove, pressure wash, and bake stators. Drying times of windings that have been immersed require longer drying times. A good estimate is to bake coil windings twice as long as normal for the size motor that is being repaired.

Procedures for Drying Motors After Flushing

Motor windings must be thoroughly dry before the motor can be started. If windings are not thoroughly dry, the motor may short circuit when electricity is turned on. Drying can be accomplished with a controlled temperature oven, heat lamps over the motors, running DC voltage through the windings or make-shift tunnels directing heat to the motor a propane heater. Preferred baking methods are described below:

Table

Acceptable Methods for Drying
Saltwater Flooded Motors

- Baking is accomplished by use of a circulating-air oven at a temperature not to exceed 90^{o}C (194^{o} F) until the insulation resistance becomes practically constant.
- Enclose the motor with canvas or similar covering , leaving a hole at the top for moisture to escape and insert heater or heat lamps.

- Pass a DC current at 10% of the rated motor voltage (with rotor locked) through the stator windings and gradually increase the current until the winding temperature reaches 90^{o}C (194^{o} F). This temperature should not be exceeded.

A minimum of 8 hours drying time should be used for saltwater flooded and freshwater flushed motor. If windings are firm and stiff after 8 hours, drying is complete, if not, more drying time is necessary.

Directions for the Construction of a Drying Oven for Multiple Motors

In an emergency situation, there may be a large number of motors to dry. In this case the drying oven will be inadequate to accommodate the larger number of motors. In this case a field expedient oven can be constructed to expedite the work.

Construction of Drying Oven (see figure below)

Oven Construction

Energy-shield, the hard-sided-foam insulation available at building supply stores can be effectively used to construct drying ovens to accommodate large numbers of motors. This material has a layer of aluminum foil on both sides and has exceptionally good insulating value (R-29) for its thickness. The sheets are lightweight, easy to handle and cut with a knife. They are also reusable.

For motors with very large frames, box the motor by placing energy-shield directly on the frame, including the top. Seal the oven joints with aluminum duct-tape.

Place the energy-shield directly on the fame to minimize the volume of air that must be heated. This also reduces drying time because the insulation minimizes heat loss.

Recommended Drying Oven Heat Sources

The most effective heat source is a torpedo propane fueled blower. The blower should be situated so it blows hot air directly into the center of the motor bore. The sizing of the blower should provide 100,000 BTU per 1200 cubic feet of oven volume.

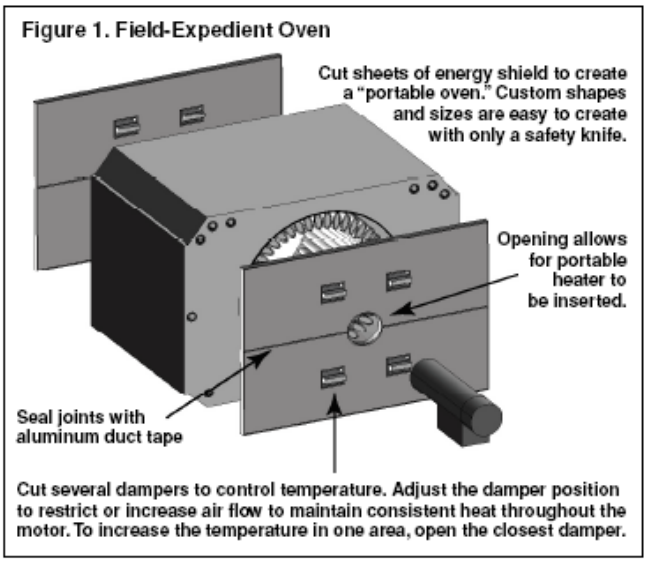
Control of Oven Temperature Gradients

For accurate measurement of motor winding temperatures directly monitor the motor's RTDs. If RTDs are not available a infrared thermometer or other heat sensing devices can be used to monitor temperature in various parts of the oven. The key is to keep the heat uniform within the motor.

Dampers should be constructed on the oven at the four corners as shown below. Dampers allow the temperature in the oven to be adjusted in various locations within the oven and allow a more uniform heat distribution. An increased flow of hot air through an area can be accomplished by opening a particular damper. Regulating temperature with dampers is more effective than using a tarp or supplying current to windings.

Determining Adequate Drying Time

Drying time should be a minimum of 8 hours and can be determined with the use of a voltage meter. The iron frame and copper windings of a motor act as two plates of a crude battery. Electrolytic action across the wet insulation causes current to flow. If voltage flow is detected then moisture is present. When voltage drops to zero, the windings are dry. If voltage is present the drying process must be extended.



Oven for Drying
Saltwater Flushed Motors

Motor Insulation Resistance Testing

The primary purpose of a motor insulation resistance test is to determine if the motor can be placed back into operation. If resistance to ground is not acceptable, the motor is likely damaged and must be rewound.

IEEE Standard 43-200, "Recommended Practice for Testing Insulation Resistance of Rotating Machinery is governs acceptable resistance limits for motor windings for placing a motor back into service. The standard serves two purposes: 1.) provides a quantitative evaluation for placing the motor in service and 2.) provides a baseline for monitoring to determine over the long-term if the repair has been completely successful.

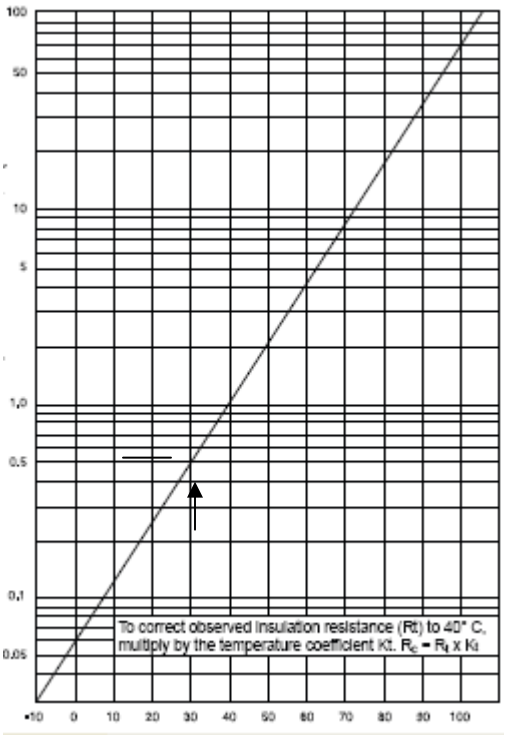
The basis of the test is to determine a resistance value (IR.) If the IR value is value is below the accepted IEEE Standard 43-200 minimum, the motor can be placed in service. The IR value in the table will be taken under an applied voltage condition for a period of 1 minute. The 1 minute holding time allows capacitive effects to stabilize giving more accurate results.

The most commonly used device for making IR readings is the 500 volt battery-powered DC megohmmeter. One lead is applied to the winding leads (typically each phase measured individually by connecting them to the instrument lead) and the other instrument lead is connected to the frame of the motor (ground.) Test voltage applied increases with the machines voltage rating. The test should be conducted at 40^{o}C (104^{o}F). The meter will display the winding megohm value (IR). The table below provides the acceptable ranges for the motor rated voltage. For most water and wastewater motors the voltage requirement will be 480 volts and below thus a test voltage of 500 V is required.

Recommended Safe Minimum Values for Rotating Machinery	
Motor type	**Insulation resistance value**
Random wound before 1974	>1 Meg-ohm+1 Meg-ohm/kV rating of motor
Random wound after 1974	>5 Meg-ohm
Form wound and DC armatures	>100 Meg-ohm
Motor voltage rating	**Test voltage**
< 600V	500V
1,000V to 2,500V	500V to 1,000V
2,500V to 5,000V	1,000V to 2,500V
> 5,000V	2,500V to 5,000V

Interpreting Motor Condition Using IR Readings

IR readings taken from a megohmmeter must be corrected for temperature. Temperature corrections are shown below: An example for use of the chart is shown on the right.



Given: 240V, 3 Phase Motor
Motor Manufactured 1985

IR Value at 30°C = 15.3 MΩ

IR Value at 40°C

IR Value Correction Factor from Chart = 0.5

IR = 15.3 MΩ X 0.5

IR = 7.65 MΩ

For this particular motor manufactured after 1985, the required minimum resistance is taken from the above table at greater than 5 megohm and the IR value is 7.65 MΩ thus the motor can be placed in operation. Should the IR value be below 5 megohm the motor could not be placed in operation.

Polarization Index (PI) Test

The purpose of the PI test is to determine the condition of the insulation. The PI test measures the leakage current change in a winding that is an indication of its integrity of the insulation and its ability to function long-term. The test is run over a 10 minute period with a constant test voltage applied. PI is the ratio of the IR at 10 minutes to the IR value at 1 minute. The PI value must be 2 or higher for a motor to be placed back in service.

In some cases, the additional motor drying may increase the PI value. A PI that can not be corrected would indicate that the windings are permanently damaged and the motor must be rewound.

Precautions in Interpreting Motor Megohm Test Results

Many factors such as humidity, temperature, accuracy and sensitivity of the equipment used and the capacitance properties of an electric motor can contribute to false readings.

Failure to recognize capacitance is a common error is performing electrical testing of motors. Capacitance problems can be minimized by connecting all circuits that are not being tested to ground.

If solvents have been used in the cleaning process, voltages applied during the testing can cause arcs that can ignite and cause explosions.

In all cases electrical integrity testing of motors and electric equipment should be performed by a skilled electrical repair specialist.

Lubrication Considerations for Saltwater Flooded Motors

Lubrication serves two functions in an electric motor, these are to lubricate contact surfaces and to prevent corrosion. Saltwater contains corrosive minerals that will hasten the breakdown of lubricants, cause oxidation and accelerate and contribute to the corrosion of metal surfaces. Thus it is recommended that all bearings be replaced if possible or if parts are not available, that all parts be purged of saltwater residue and contact surfaces be lubricated. This will require flushing parts in a warm agitated solvent bath to remove both contaminants and old oil and grease. In general, bearings should be replaced if flooded with saltwater and only reused if no other alternative available. Thus it is important to stock adequate supplies of spare parts.

Bearings should not be reused if there is evidence of wear, edge loading, fatigue embedment scoring, or lack of clearance, journal damage or other obvious problems during disassembly.

It is beyond the scope of this BMP to describe all of the requirements for proper rebuilding of a motor and a skilled technician experienced in motor rebuilds should always be employed for this purpose or much time and effort in reversing saltwater damage will have been wasted.

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