Summary of United States Environmental Protection Agency Office of Water (4607) EPA 815-R-99-016, April 1999 "Guidance Manual for Conducting Sanitary Surveys of Public Water Systems; Surface Water and Ground Water Under the Direct Influence (GWUDI)"

Editor's Disclaimer:

This summary was extracted from EPA's 182-page guidance for sanitary surveys. It was created as a helpful tool for new operators, manager, engineers, or regulators. It generally describes how anyone can evaluate whether a public water system is adequately protecting public health. The summary provides the main points of the original document, especially the questions that are asked by someone doing a sanitary survey. No changes were intended

Before EPA was created, each State had their own standards for sanitary surveys. Texas was no exception. When the guidance was developed, EPA brought in stakeholders including Texas regulators to develop consensus recommendations for sanitary surveys that would enhance the nation's ability to provide safe and adequate drinking water to customers.

If you have a deeper interest in any particular section–the original document has more information. Though the guidance was originally focused on new surface water rules that were coming on-line at the turn of this century, it also has guidance on how to survey wells and distribution systems.

The original document is available on the web at:

http://www.epa.gov/safewater/mdbp/pdf/sansurv/sansurv.pdf

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1. INTRODUCTION

1.1 Objective of this Manual

This manual provides guidance on how to conduct a sanitary survey of surface water and ground water under the direct influence (GWUDI) of surface water drinking water systems. A comprehensive sanitary survey is an important element in helping water systems protect public health. Sanitary surveys are carried out to evaluate:

(1) the capability of a drinking water system to consistently and reliably deliver an adequate quality and quantity of safe drinking water to the consumer, and

(2) the system's compliance with federal drinking water regulations.

Much of the information generated by a sanitary survey helps identify existing and potential sanitary risks. This guidance manual will identify **assessment criteria** to be evaluated for sanitary risks. The manual also describes how to identify **significant deficiencies** that represent an imminent health risk and require immediate correction.

1.2 Background

Conducting sanitary surveys on a routine basis is an important element in preventing contamination of drinking water supplies. EPA recognizes the importance of sound sanitary surveys in helping water systems protect public health. Sanitary surveys are an opportunity to work and communicate with water systems in a preventative mode. As stated in the December *1995 EPA/State Joint Guidance on Sanitary Surveys*, the primary purpose of a sanitary survey is:

> "to evaluate and document the capabilities of the water system's sources, treatment, storage, distribution network, operation and maintenance, and overall management to continually provide safe drinking water and to identify any deficiencies that may adversely impact a public water system's ability to provide a safe, reliable water supply."

In addition, the joint guidance notes that sanitary surveys provide an opportunity for state drinking water officials or approved third party inspectors to establish a field presence at the water system and educate the operators about proper monitoring and sampling procedures, provide technical assistance, and inform them of any upcoming changes in regulations.

1.3 Regulatory Context

Under 40 CFR 142.10(b)(2), as a condition of state primacy, states are required to have

> "a systematic program for conducting sanitary surveys of public water systems in the State, with priority given to sanitary surveys of public water systems not in compliance with State primary drinking water regulations."

1.4 EPA/State Joint Guidance on Sanitary Surveys

EPA and the states (through the Association of State Drinking Water Administrators) have issued a joint guidance on sanitary surveys entitled *EPA/State Joint Guidance on Sanitary Surveys*. The guidance outlines the following elements as integral components of a sanitary survey:

- Source (Protection, Physical Components and Condition)
- Treatment
- Distribution System
- Finished Water Storage
- Pumps/Pump Facilities and Controls
- Monitoring/Reporting/Data Verification
- Water System Management/Operations
- Operator Compliance with State Requirements.

1.5 Rationale for Sanitary Surveys

1.5.1 Goal of a Sanitary Survey

As stated earlier, sanitary surveys are a means by which a comprehensive inspection of the entire water delivery system and its operations and maintenance (O&M) can be performed. These surveys are structured to determine whether a system's source, facilities, equipment, operation, maintenance, and management are effective in producing safe drinking water. Sanitary surveys also evaluate a system's compliance with federal drinking water regulations, as well as state regulations and operational requirements. In addition, a sanitary survey evaluates water quality data and administrative issues and draws conclusions about the system's integrity and its capability for consistently and reliably delivering an adequate supply of safe drinking water to consumers. Conducting sanitary surveys on a regular basis is the best means of identifying potential problems and possible reasons for trends in finished water quality and demand that may need to be addressed by enhanced O&M or a system upgrade.

1.5.2 Benefits of a Sanitary Survey

EPA believes that periodic sanitary surveys, along with appropriate corrective measures, are indispensable for assuring the long-term quality and safety of drinking water. Properly conducted sanitary surveys help public water systems protect public health.

2. PLANNING THE SURVEY

Prior to initiating other activities for a survey, an inspector should review the previous sanitary survey report and other relevant records to determine if a system has an outstanding performance designation. Information that should be collected includes:

the treatment process(es) in place,
monitoring requirements,
the compliance history of the facility, and
the condition of the system during the previous sanitary survey.

This information is used to compile a list of questions/assessment criteria for the onsite inspection. Familiarity with federal and state requirements (e.g., operational requirements, operator certification, design standards) can assist the inspector in preparing for the sanitary survey. This chapter also includes a list of equipment which the inspector should take to the onsite inspection. A list of persons to contact before the inspection is provided with some suggestions for the types of topics to be discussed. The chapter concludes with an overview of the onsite inspection process.

2.1 Determination of Outstanding Performance

Community water systems that are classified as having outstanding performance are eligible for having sanitary surveys conducted less frequently than other community systems. Each state, as part of its application for primacy, is required to develop a means for determining whether a system has outstanding performance.

2.2 Review of Pertinent Files on Physical Facilities

Office files and files provided by the water system owner and operator will provide insight into the design, construction, operation, maintenance, management, and compliance status of the facility. The sanitary survey inspector should thoroughly review all pertinent documents before the onsite inspection in order to fully understand the site-specific issues. The following subsections describe important types of documentation which the inspector should review if possible. While not all-inclusive, the following subsections discuss significant types of information often available. Information to review includes:

- Previous sanitary survey reports;
- Water system plans;
- Water system schematic/layout maps;
- Project reports;
- Construction documents;
- Water source information; and
- Source protection information.

If available, cross connection control plans should also be reviewed.

2.2.1 Previous Sanitary Survey Reports

Previous sanitary survey reports provide valuable information on the system's history and compliance status. The sanitary survey report includes a record of system treatment processes, operations, and personnel and their compliance with SDWA requirements.

2.2.2 Water System Plans

Some states may require water systems to develop and maintain comprehensive plans describing the operations, financing, and planned improvements for the system. The level of detail in the plans depends on the size, complexity, past performance, and use of the water system.

2.2.3 Water System Schematic/Layout Maps
A schematic or layout map of the public water system will enable the inspector to obtain a quick understanding of the complete drinking water system.

2.2.4 Project Reports
The water system may need to submit project reports to the state for approval before any change in equipment, chemical treatment, or operation, or installation or construction of any new water system, water system extension, or improvement, or when requested.

2.2.5 Construction Documents
Water systems typically are required to submit the construction documents to the state for approval prior to installation of any new water system, or any significant modification to an existing water system (e.g., change in treatment or water system extension or improvement). At the completion of construction, the water system may be required to submit an as-built or record set of the construction drawings and a certificate of completion.

2.2.6 Water Source Information
A water system seeking source approval may need to provide the state with sufficient documentation, in a project report or in supplemental documents, for demonstrating the feasibility of using the water source.

2.2.7 Source Protection Information
The system may have prepared a plan to control sources of pollutants before they reach the source water under Source Water Assessment and Protection Programs (SWAP and SWPP), the Wellhead Protection Program (WHPP), and the Watershed Control Program.

2.3 Review of Pertinent Files on Water Quality
A review of pertinent files addressing water quality is a useful tool in identifying potential problems with a public water system. Monitoring plans and compliance reporting are the two primary sources of water quality information.

2.3.1 Monitoring Plans
EPA drinking water regulations and state equivalents establish minimum requirements for the contaminants to monitor and acceptable concentrations for each in the finished water stream.

2.3.2 Compliance Reporting
The water system should submit reports to the state on a regular basis (typically monthly) detailing the system operations and identifying any problems encountered during the month. Federal regulations require the water system to issue notices to the public when the system:

· Violates an MCL or treatment technique requirement; or

· Fails to comply with monitoring requirements or analytical method requirements.

2.4 Assessment Criteria
As part of planning for a sanitary survey, the inspector should prepare a set of criteria to evaluate during the onsite inspection. Inspectors should generally start with a standard set of criteria that are used for all sanitary surveys done by the state primacy agency. This standard set should then be tailored as appropriate based on water system-specific information obtained from the pre-survey file review and onsite observations. These criteria assist the inspector with evaluating key processes where potential significant deficiencies may exist.

The 1995 *EPA/State Joint Guidance on Sanitary Surveys* recommended that states develop assessment criteria for each of the eight minimum elements reviewed during a sanitary survey. As outlined in the joint guidance, the eight essential elements of a sanitary survey are:

- · Source (Protection, Physical Components and Condition)
- · Treatment
- · Distribution System
- · Finished Water Storage
- · Pumps/Pump Facilities and Controls
- · Monitoring/Reporting/Data Verification
- · Water System Management/Operations
- · Operator Compliance with State Requirements.

2.5 Inspection Tools

Prior to the onsite inspection, sanitary survey inspectors should ensure that their field equipment is in good working order. Preventive maintenance is essential for all types of equipment. Equipment which is broken, dirty, in disrepair, out of calibration, or otherwise improperly maintained will not provide dependable, reproducible, or accurate data. For best results, the inspector should follow the manufacturer's specifications for preventive maintenance. The inspector also should check expiration dates and keep up with and use current standard testing procedures and calibration methods. Recommended types of field equipment include but are not limited to: portable ph meter with digital readout; hand held colorimeter, portable spectrophotometer, or other mechanical residual chlorine test kit; accurate pressure gauge; portable geographic positioning system (gps) equipment; camera with automatic time/date stamp;· binoculars; small mirror (to inspect areas that are not accessible or are not in the direct line of sight); and flashlight.

2.6 Communication Activities

Coordination and communication between the inspector and the primacy agency, local health department, and water system management personnel are essential in preparing for a sanitary survey.

Entity	**Activities**
Primacy agency	The primacy agency should provide the inspector with information on which water systems to consider for sanitary surveys (based on when the previous survey was done), past sanitary survey reports, and other information in the agency files for the relevant water systems. The primacy agency should also provide the inspector with agency inspection requirements and guidelines, such as assessment criteria, a list of significant deficiencies, and any sanitary survey forms used by the agency.
Local health department	The inspector should contact the local health department to find out if the water system is in compliance with OSHA (Occupational Safety and Health Administration) requirements and has been issued a rodent/pest control permit. The inspector should also ask the health department if there have been any reported illnesses attributed to drinking water.
Water system management personnel	The inspector should contact the water system and first determine the appropriate personnel for further sanitary survey discussions. With the appropriate personnel, the inspector should describe the purpose of the sanitary survey and the steps of the survey, particularly the onsite inspection (described in the next section). Preliminary discussions should also include: – a review of previous sanitary survey reports and the system's historical records (including chemical and bacteriological data), – correspondence, – engineering studies, – past violations, and – any records that are needed for review but are not available from the primacy agency's

2.7 Parts of the Onsite Inspection

The onsite inspection includes the following parts:

(1) Opening interview

– Introductions
– Review of the purpose of the sanitary survey
– Review of the parts of the onsite inspection and the schedule for the inspection
– Review of the facility layout and location of the intake(s) and treatment processes
– General discussion of basic system information; the condition of the system and its operation, staffing, and management; whether relevant plans and procedures have been developed and are adequate
– Discussion of deficiencies identified in previous sanitary survey reports and any violations/compliance problems since the last survey, and corrective actions taken and their effectiveness in addressing the deficiencies and problems.

(2) Walk through

– Physical inspection of all eight elements of a sanitary survey
– Asking questions of appropriate personnel for clarification, to determine the knowledge of system personnel, and to check information obtained during records review and other aspects of survey planning and preparation
– Note taking for documentation and writing up the findings in the sanitary survey report.

(3) Organization of findings and documentation

– Filling in any gaps in inspection notes and add detail where needed
– Completing sanitary survey checklists/forms (if used)
– Clarification of any remaining issues with water system personnel
– Obtaining any documentation still needed
– Preparation for closing interview.

(4) Closing interview/debriefing the system on inspection findings

– Presentation of findings, particularly any significant deficiencies, to the water system
– Informing water system management of next steps (i.e., writing and submitting the report, corrective action).

3. CONDUCTING THE SURVEY

Previous chapters of this manual have provided a definition of a sanitary survey, the regulatory framework for conducting a survey, and the critical steps for planning a sanitary survey. This chapter presents the essential elements for completing the walkthrough inspection of an onsite sanitary survey. The onsite sanitary survey includes visiting the water supply source and source facilities, pump stations, the treatment plant, storage facilities, the distribution system, and sampling locations. One of the most important functions of the onsite portion of the survey is to determine whether the existing facilities are adequate to meet the needs of the water system's customers at all times. Therefore, this visit should include review and verification of the capability and capacity, construction and operation, and physical condition of the water system's facilities.

There are eight elements that are considered essential for review in the proper conduct of a thorough sanitary survey. These eight elements are listed below:

- Source (Protection, Physical Components, and Condition)
- Treatment
- Distribution System
- Finished Water Storage
- Pumps/Pump Facilities and Controls
- Monitoring/Reporting/Data Verification
- Water System Management/Operations
- Operator Compliance with State Requirements.

3.1 Source (Protection, Physical Components, and Condition)

The water supply source is the beginning of the drinking water system. As such, the source can provide the opportunity for the reduction of contaminants, pathogens, and macroparticles. Preventing source water contamination is the most effective means of preventing contaminants from reaching consumers. Source water protection also helps ensure that additional, potentially more costly treatment is not necessary to remove further contaminants. As the first opportunity for controlling contaminants, the reliability, quality, quantity, and vulnerability of the source should be evaluated during the sanitary survey.

3.1.1 Watershed Management Program

The primary goal of watershed management programs are to maintain the highest quality feasible for a surface water source.

3.1.1.1 Watershed Description

A description of the watershed provides valuable information to both the inspector and the system personnel to evaluate the vulnerability of the source.

3.1.1.2 Watershed Characteristics and Activities

The characteristics and activities that may affect the source water quality should be identified by the system.

3.1.1.3 Land Ownership/Agreements with Owners

For a water system to have the best opportunity to realize the goals of a watershed management program, the water system should have complete ownership of the watershed.

3.1.1.4 Annual Reports

A watershed management report should be prepared annually that outlines the steps taken to acquire all or critical elements of the land within the watershed, efforts made to monitor the watershed activities, a list of activities that cause special concern, efforts to mitigate the detrimental affects to water quality, and known future activities that may impact water quality and a plan to reduce the potential impacts. This report should be submitted to the state primacy agency for review and approval.

3.1.2 Wellhead Protection Program

A Wellhead Protection Program (WHPP) is designed to protect the quality of a water system's ground water source by monitoring and minimizing the impact of the activities in the source recharge area as well as the portion of the aquifer that supplies the system. This program applies to ground water and the associated recharge area.

3.1.3 Source Vulnerability Assessment

A vulnerability assessment is used to determine the likelihood that potential contaminant sources in the watershed or drinking water protection area will degrade the public water system's source water quality.

3.1.4 Source Water Quality

Impurities can be found in any natural water source. Surface waters are very different from ground water. Historical information should be gathered from the operators. The inspector also needs records concerning the fluctuations of raw water quality for use prior to the survey and during the onsite inspection. The steps taken by the water system to mitigate significant changes should be evaluated to determine their effectiveness.

1. What is the quality of the source? Is the source water quality monitored by the system? What are the ranges of the required water quality parameters?
2. Is there an emergency spill response plan for events that are man-made which may affect water quality?
3. Is the area around the intake restricted in accordance with primacy agency rules?
4. Are there any sources of pollution at or near the intake? If so, what is the water system doing to mitigate the sources of pollution?
5. Have there been any significant fluctuations in water quality? If so, what was the cause and how is the water system preventing future fluctuations? If improvements are in place to mitigate the fluctuations, how well are they performing? Are any further improvements needed?

3.1.5 Source Water Quantity

One of the most important requirements for any water system is the ability to meet the water quantity demands of customers at all times. In many places, particularly in arid and heavily populated areas, water conservation is necessary. Suggested assessment criteria for evaluating the adequacy of the source water supply are:

1. What is the water quantity required to meet the needs of the water system?
2. What is the available water quantity of the source?
3. Is the source adequate to meet the current and future expected needs of the water system, even during times of drought? If not, what other sources are being investigated to meet the needs? Has the water system developed and implemented a water conservation plan?
4. Does the system have a meter to monitor production? Does the system measure usage by consumers?

3.1.6 Location of Source Facilities

The location of source water supply facilities is an important factor in determining the ability of the water system to meet the customer needs at all times. For instance, the facilities should not be located in the flood plain, because the operation of the water system could be seriously impaired by flooding of the structure(s) and equipment necessary to supply source water. The following assessment criteria are suggested for the location of source water facilities:

1. What is the flood level in the area of the source facility? What is the level of the floor for the source facility? Can the source facility be flooded?
2. Has the source facility ever been flooded? If so, was the operation of the source facility impaired? If the source facility has been flooded and operation not impaired, what is the access to the source facility during a flood?
3. What measures have been taken to prevent contamination of the raw water at the source facility during a flood event?

3.1.7 Capacity of Source Facilities

The initial step of the onsite visit should be determining the required capacity of the source facilities. The following are suggested assessment criteria to determine the adequacy of the source facility capacity:

1. What is the design capacity of the source water facilities? What is the historical maximum daily demand of the water system? What is the storage capacity of the system? Given service connections or population, are they reasonable?
2. If the state primacy agency has specific unit capacity requirements, does the system meet the requirements?
3. Is the system structure silting up? Is the sump of the source water supply pumps silting up? Are there any dead fish or wildlife animals floating? Is there plant or manmade debris floating?
4. Are the source water supply facilities capable of meeting the required capacity with the largest unit (e.g., raw water pump) out of service?
5. Can the operating characteristics of the existing units be checked? If so, does the system check them periodically? How does the existing operational point compare to the original operational characteristics of the unit? Should the capacity of the unit be derated? If so, what is the new capacity?

3.1.8 Design of Source Facilities

This section is divided into five subsections addressing different raw water sources, because each source has unique design characteristics. These different sources are grouped as ground water facilities; surface water facilities; infiltration galleries; springs; and catchments and cisterns.

Ground Water Supply Facilities

Ground water is water withdrawn from underground aquifers. To get the ground water to the distribution system, a well is drilled and a pump installed below the water level. A major concern in the design of a well is preventing contaminants from entering the aquifer. The following are suggested assessment criteria for a groundwater supply well:

1. What is the depth of the well? Is the well encased the full length? If not, how long is the casing? Is the annular space around the well casing filled with grout or bentonite clay?
2. What is the screen constructed of? What is the depth of the screen?
3. Is the well properly sealed at the surface? Does the casing extend at least 18 inches above the well slab, floor, or ground surface? Does the well vent terminate above the maximum flood level with a turned down gooseneck and corrosion resistant bug screen?
4. Is there an acceptable tap for raw water sampling?
5. Is the wellhead protected from vandalism and accidents?
6. What is the general condition of the piping and valving, the site, and the electrical system? Do they appear to be well maintained? Does the electrical system have lightning protection? Can the pump be maintained easily and the water for the system continually supplied?
7. Has the source been evaluated for GWUDI? If the well is under the direct influence of

surface water, is proper treatment provided (filtration, disinfection)?

Surface Water Supply Facilities

The design of a surface water source facility should provide some flexibility to accommodate fluctuating water quality. The location and position of the intake point in a river or reservoir can greatly affect the quality of water coming into the intake. Intake points should be located a sufficient distance (preferably upstream) from potential sources of contaminants.

The following assessment criteria are appropriate for a surface water supply facility:

1. Is the source water quality the best possible? Can the best quality of water be withdrawn? If so, how? Is there an area around the source facility that is restricted? How is the area marked? Is the existing marking adequate? Are there any nearby sources of contamination evident? If so, what is being done to protect the source water?
2. What conditions cause fluctuations in the raw water quality?
3. Can a unit be taken out of service for maintenance and the facility remain operational? If so, how? Can the unit be locked out at the electrical service? If not, what is the method for preventing the starting of the unit during maintenance?
4. Can water be withdrawn during a prolonged drought? What is the minimum projected water level? What is the level of the lowest withdrawal point?

Infiltration Galleries

An infiltration gallery is one means of using the natural filtration benefits of the ground to reduce water quality variances. The infiltration gallery consists of a perforated pipe in a gravel or sand bedding constructed along or beneath the source. Typically, sand backfill is placed over the bedding to improve the filtration of the natural soils in which the gallery is constructed. Infiltration galleries are often under the direct influence of surface water and therefore are frequently classified as GWUDI. The design and construction of an infiltration gallery is similar to a ground water well, therefore the assessment criteria for wells applies to an infiltration gallery; however, there are a few differences. The following additional assessment criteria are appropriate for an infiltration gallery:

1. Is the water system experiencing any significant fluctuations in water quality? If so, when and why?
2. Is the infiltration gallery still providing an adequate supply of water? If not, when and why was the supply inadequate? When was the infiltration gallery last inspected? Was there any damage to the gallery—pipe, bedding, and backfill? Does it appear that the backfill and bedding, if visible, were clogged with silt? If so, how was it changed or cleaned?
3. Has the source been evaluated for GWUDI? If the source is under the direct influence of surface water, is proper treatment provided (filtration, disinfection)?

Springs

Springs occur where the natural flow of ground water rises to the surface. There are two types of springs, gravity and artesian. Springs may be considered either surface water or ground water sources, depending on their characteristics and on the way a state classifies springs. The water system needs to determine if the spring is under the direct influence of surface water and if it would be classified as a surface water source under the definition used by its state. Due to the similarity of the spring water collection system to a ground water well or an infiltration gallery, the assessment criteria for those facilities apply to the collection systems for springs; however, there are some differences. The following additional assessment criteria are appropriate for springs:

1. Is the spring area protected from contact with animals and vandalism?
2. Is the spring box or storage tank watertight, with a lockable, watertight, overlapping lid or cover? Does the springbox have a screened overflow? Is there a drain with a screen and shutoff valve? Is the supply intake properly located and screened?
3. Is there a diversion ditch around the upper end of the spring area? Is there an impervious

barrier over the spring area to keep out rainwater and surface contamination?

4. Does the spring meet requirements for setbacks from sanitary hazards?

Catchments and Cisterns

In some areas, catchments and cisterns are used to collect rain water from the roofs of structures. Sometimes, the quantity and quality of the collected rain water may be doubtful, but it may be the best (or only) source available for individuals or small communities (UFTREEO, 1998). To assess catchment and cistern designs, the following criteria are appropriate:

1. Is the water supply adequate to meet the needs of the community? If not, what other sources are available?
2. What is the condition of the roof and the gutters? If signs of deterioration are evident, when will the system be renovated?
3. Is there a diversion box? Is the diversion operable?
4. Is the cistern properly constructed? Does the water quality appear acceptable in the cistern (no floating debris, etc.)?
5. Are there screens at the entrance to the cistern, at the drain overflow and intake to the system? Are the screens in good condition?

3.1.9 Condition of Source Facilities

The physical condition of the source facility can be a good indicator to the inspector of how often the facility is visited and how well it is maintained. Regardless of the location, all critical facilities should be visited at least once a day to determine that all equipment is operating correctly. Suggested assessment criteria for the physical condition of the source facility include:

1. How often is the facility visited?
2. Does the facility appear to be well maintained – grass mowed, equipment painted, facilities kept clean, etc.?
3. Is the facility required by the state or local government to have a rodent and pest control permit? Does the facility have one? Are there any visible places where wildlife can enter the facility and take shelter (including rodents, birds, and snakes)?

3.1.10 Transmission of Source Water

Untreated water travels from the source to the treatment plant through a transmission system of pipes. Some source water facilities are at a considerable distance from treatment facilities. The transmission lines present a potential opportunity for liquids and materials to both enter and leave the system. Suggested assessment criteria for the raw water transmission lines include:

1. Do the transmission lines deliver all the raw water directly to the treatment plant?
2. Are the transmission lines reliable for providing a continuous supply of raw water to the treatment plant?

3.1.11 Priority Criteria

The following criteria related to the source water element of the sanitary survey are considered high priority based on their potential for impacting public health:

- **Source Water Quality**
- **Source Water Quantity**
- **Location of Source Facilities**
- **Capacity of Source Facilities**
- **Condition of Source Facilities**
- **Transmission of Source Water**

3.2 Treatment

The type of treatment processes and facilities used to achieve safe drinking water are dictated primarily by the quality of the source water and the regulatory requirements that must be met. A sanitary survey of a treatment facility should:

· Analyze all the distinct parts of the treatment process, including but not limited to coagulation/flocculation, sedimentation, filtration, disinfection, chemical feed systems, hydraulics, controls, and wastewater management;

· Review source water quality data that may impact the treatment process, such as turbidity, pH, alkalinity, and water temperature;

· Identify features that may pose a sanitary risk, such as cross connections in the plant; and

· Review the criteria, procedures, and documentation used to comply with regulatory requirements – adequate disinfection based on CT study, individual filter turbidities, finished turbidities, post backwash turbidity profiles, etc.

3.2.1 Location of Treatment Facilities

Theoretically and preferably, all water treatment plants should be located above 100-year flood levels. Suggested criteria for assessing the location of treatment facilities:

1. Is the treatment plant located at a level below the 100-year flood line?
2. Are there any sources of contamination in the vicinity of the treatment plant?

3.2.2 Treatment Plant Schematic/Layout Map

A schematic or layout map of the public water supply treatment plant will enable the inspector to obtain a quick understanding of the treatment type(s), what water quality problems the plant was designed to treat, and how the plant is laid out. Suggested criteria for assessing treatment plant schematic or layout drawing(s) are:

1. Does the drawing(s) shows the name of the facility and date of the last modification made to the drawing(s)? Are the drawings up-to-date?
2. Does the schematic or layout map(s) contain the proper information (e.g., a legend that explains key symbols used in the drawing(s), a numerical or a graph scale on the layout map)?
3. Does the schematic or layout map(s) identify treatment type(s)?
4. Are all treatment units shown on the schematic or layout map(s)? Is there a treatment unit (including chemical injection points) that appears to be out of place?

3.2.3 Capacity of Treatment Facilities

One of the initial steps of the onsite visit should be determining the required capacity of the treatment facilities. Operating records for the last few years should be checked to determine the historic maximum daily demand. The state primacy agency may have rules and regulations that specify the capacity requirements for source water supply facilities and individual treatment units. The following are suggested assessment criteria to determine the adequacy of the treatment facility capacity:

1. What is the design capacity of the treatment facilities? What is the historical maximum daily demand of the water system? What is the storage capacity of the system? Given service connections or population, are treatment facilities reasonable?
2. If the state primacy agency has specific treatment unit capacity requirements, does the system meet the requirements?
3. Are treatment facilities capable of meeting the required capacity with the largest unit out of service?
4. Can the treatment process be interrupted by power outages, etc.? What backup or standby provisions are available? If a generator is provided for emergency power, how often is the generator used? Can the operator demonstrate that the backup systems are operational?

5. Can the operating characteristics of the existing units be checked? If so, does the system check them periodically? How does the existing operational point compare to the original operational characteristics of the unit? Should the capacity of the unit be derated? If so, what is the new capacity?

3.2.4 Treatment Processes and Facilities

The specific treatment processes and facilities at a surface water treatment plant and a GWUDI of surface water treatment plant depend on the quality of the source water and the regulatory requirements that must be met. The various combinations of these processes and facilities are sometimes classified based on the overall treatment objective of the plant as follows:

- *Conventional Filtration*
- *Direct Filtration*
- *In-Line Filtration*
- *Slow Sand Filtration*
- *Single Stage Softening*
- *Two Stage Softening*
- *Conventional Filtration/Softening*
- *Split and Complex Treatment Trains*
- *Membrane Filtration*
- *Greensand Filtration*
- *Simple Aeration Plant*
- *Disinfection Treatment*

3.2.4.1 Presedimentation

Presedimentation basins are typically used at treatment plants with raw water sources that are highly turbid.

Suggested criteria for assessing presedimentation facilities include:

1. Is the total capacity of the presedimentation basins large enough to accomplish the purpose of reducing turbidity?
2. How often are the presedimentation basins cleaned?
3. Do waterfowl cause a problem during certain periods and how does the plant operator(s) deal with this problem?

3.2.4.2 Flow Control and Metering Systems

Two types of flow measurement are encountered in a water treatment plant: open channel flow measurement and closed pipe flow measurements. Suggested criteria for assessing flow control and metering systems are:

1. Are flow measurement devices installed at source water inlet and finished water outlet? Are they functioning? Are they calibrated to assure accuracy?
2. Are there adequate flow measurement devices thoughout the treatment process?

3.2.4.3 Rapid Mix

In a typical water treatment plant, the coagulant chemicals are introduced into the raw water ahead of or directly in the rapid or flash mix unit. Suggested assessment criteria for the rapid mix process include:

1. Does the rapid mix unit visually appear adequate?
2. Are coagulant chemicals being fed continuously during treatment plant operations?
3. Does the plant have multiple mix units? How often is maintenance done?
4. Is the mechanical equipment working? Are there any hydraulic inadequacies?
5. Is the rate of mixing adjustable, so that the correct mixing can be provided at all

flows? If so, can the operator adjust the rate of mixing?

6. What is the design *G*? Is it within the generally accepted range? What is the detention time? Is it within the generally accepted range?
7. Have rapid mix units been evaluated for cross-connections?

3.2.4.4 Chemicals and Chemical Feed Systems

The type of chemicals that are used at a surface water treatment plant and a GWUDI of surface water treatment plant depend on the specific treatment facilities and objectives. The two most common chemicals that are used in surface water treatment process are coagulants and disinfectants.
Suggested assessment criteria for chemical feed systems include:

1. What chemicals are used? Are the chemicals approved for use in drinking water?
2. Are the chemicals that are used for treating water appropriate for meeting the water quality goals of the system?
3. What chemical amounts are used – average and maximum? Are the various systems sized to feed more than the maximum amount required?
4. Where are various chemicals applied?
5. What type of chemical feed equipment is used? Are the materials used for each chemical feed system compatible with the chemical? What is the general condition of the chemical feed equipment?
6. How often is the feed rate checked for each chemical? How does the operator determine the amount of chemicals used on a daily – weekly – monthly basis? Is a measurement device provided – flow meter or calibration cylinder for liquid chemicals and scale for dry chemicals? Are there provisions to calibrate the chemical feed equipment?
7. Is the chemical feed equipment adjustable? Is the control of the chemical feed equipment manual or automatic? What is the control parameter (e.g., raw water flow rate) for each chemical feed system? Does the system use day tanks for liquid chemicals bought in large quantities?
8. Is a standby feeder and/or metering pump provided for each chemical? Is it operable? Is it large enough to replace the largest unit that might fail?
9. Is backflow prevention provided on the water lines used for chemical feed makeup?
10. What type of storage facilities are provided? Is the storage area for each chemical adequate and safe? Is containment provided for a potential spill? What provisions are provided for cleanup of a spill? If a drain is provided, where does it discharge? Are incompatible chemicals stored together? Are facilities properly labeled?
11. How much storage is provided at average/maximum usage? What is required by the state primacy agency? If storage provided is less than required, what is the local resupply availability?
12. What is the general condition of the building/room housing the chemical feed equipment? Are dusty and dry chemicals, and feed equipment housed separately? Is proper and adequate ventilation provided?

3.2.4.5 Coagulation/Flocculation

The coagulation/flocculation process at a surface water treatment plant is essential to properly condition raw water for effective particle removal through sedimentation and filtration.

1. What type of flocculation facilities are being used? Does the coagulation/flocculation process visually appear adequate?
2. Is there any evidence of clumps of coagulants in the first compartment of the flocculator?
3. Is the mechanical equipment working? Are there any hydraulic inadequacies?

4. Does a preventive maintenance program exist?
5. Is the rate of mixing adjustable, so that the correct mixing can be provided at all flows? If so, can the operator adjust the rate of mixing?
6. What is the *G*, *GT*, and tip speed? Is it within the generally accepted range? What is the detention time? Is it within the generally accepted range?

3.2.4.6 Sedimentation/Clarification

One of the most important processes in a water treatment facility is the settling of flocculated particles following coagulation/flocculation, called sedimentation or clarification. Floc Typically, a clarifier will have four zones, each with a characteristic function. The four zones and their associated functions are:

· Inlet zone
· Settling zone
· Outlet zone
· Sludge zone

Suggested assessment criteria for the clarification process include:

1. What type of sedimentation/clarification process and facilities are being used? Does the sedimentation/clarification process visually appear adequate?
2. Is the flow distributed evenly to all basins? Is the inlet flow distributed uniformly over the full cross section?
3. Does the plant have multiple units with some that are not in use? Are the idle basins in a condition to be used if needed?
4. Is the mechanical equipment working? Are there any hydraulic inadequacies?
5. What is the surface overflow rate, detention time, and the velocity flow? Is it within the generally accepted range?
6. Does there appear to be too much sludge in the basin(s)? Is it impacting settled water performance? How is sludge removed from the clarifier(s)? How often is sludge removed?
7. What is the settled water turbidity? Does it meet the general criteria?

3.2.4.7 Filtration

The filtration process is the final barrier for physical removal of particles at a surface water treatment plant.

Suggested assessment criteria for filtration include:

1. What type of filtration system is being used (gravity or pressure; constant or declining rate) and what kind of media has been installed (mono media, dual media, or multi media)?
2. Is the monitoring instrumentation (loss-of-head, effluent flow rate, and filtered water turbidity) working for all filters? What condition is the instrumentation in?
3. What criteria are used by operators to determine when a filter requires backwashing? Do all operators of the treatment plant use the same criteria? Are filters ever stopped, then started-up again without backwashing them first? Are filters ever “bumped” to extend filter runs?
4. What equipment is included in the backwash system? What is the capacity of this system? Is there a backup backwash system? What is its capacity? Is it operable? Is there a means of measuring the backwash flow rate? Is it working? What is its condition? When was the flowmeter calibrated last? Can the backwash flow be varied to allow for varying conditions? If so, can the operator adjust the rate of flow?
5. Are newly backwashed filters brought back into service at low rates that are gradually increased (ramped-up) in order to minimize post-backwash turbidity

spikes? Are operating filter flow rates reduced when another filter is backwashed?

6. What is the condition of the piping in the filter gallery? Is it color coded for the use or service in accordance with local/state requirements? Are there any cross-connections?
7. Is there a floor drain to remove all leaking water from the filter gallery floor?

3.2.4.8 Disinfection

The practice of disinfection has proven to be one of the most important advances in reducing the incidence of waterborne disease. Suggested assessment criteria for the disinfection process include:

1. What type of disinfection process and facilites are used at the treatment plant? Does the operator understand the disinfection process?
2. How was T_{10} determined – calculated or field tracer study? How was *C T* determined at this facility? How many inactivation logs are required? What are the disinfection zones in the plant? How is compliance with this requirement demonstrated – minimum disinfectant residual level or calculated? Is continuous disinfectant monitoring being done? Are adequate records kept showing compliance with the *CT* requirement?
3. What is the chlorine residual leaving the treatment plant? Does it meet SWTR requirements? What is the chlorine residual at the first customer and throughout the distribution system? Does the residual provide adequate protection out in the distribution system? Do disinfectant residuals meet state requirements?

3.2.4.9 Waste Streams

Waste streams (primarily backwash water) from a water treatment plant have been historically discharged either to a receiving stream or the nearest sanitary sewer. Suggested assessment criteria for recycling of waste streams include:

1. How are wastewater from the backwash process and sludge from the sedimentation process managed? Is filter backwash water wasted or recycled? Are all discharge and disposal activities in accordance with applicable requirements?
2. If recycled, does backwash water receive any treatment to decrease pathogen densities?
3. Do the recycle pumps operate manually or automatically? What is the recycling rate of the waste streams? How does this compare to the normal treatment rate (percentage basis)? Is it constant or variable flow?
4. How much solids are in the recycled waste streams? How does this compare to the solids in the raw water?
5. Are the coagulant dosages adjusted to accommodate the recycle flows? If so, how? Are any jar tests performed to determine the impact of the recycle stream and what changes to the coagulant dosages are needed?

3.2.4.10 In-Plant Cross-Connection Control

Cross-connections are links between a potable and a non-potable water supply and/or waste water or chemical supply line, through which contaminating materials may enter a potable water supply. Cross-connections present a serious sanitary risk to a drinking water supply since they can be the source of contamination of drinking water, leading to illness and disease. There are two types of backflow: back pressure backflow and backsiphonage backflow:

· **Back pressure backflow** is the flow of non-potable, contaminated water toward a potable water supply because the contaminated water has a greater pressure.

· **Backsiphonage backflow** occurs when there is a vacuum in the distribution pipes of a water system, causing untreated, non-potable water to be sucked out toward the potable water.

(EPA, 1989)

Suggested assessment criteria for cross-connection control in-plant include:

1. Does the water system have a cross connection control plan for the plant? Is the program active and effective in controlling cross connections?
2. What are the water uses in the plant? Where does the supply for these uses come from? Are proper backflow prevention devices installed to protect potable water at the plant?
3. Are the appropriate backflow preventers used for all existing cross connections?

3.2.5 Priority Criteria

The following criteria related to the water treatment element of the sanitary survey are considered high priority based on their potential for impacting public health:

· **Capacity of Treatment Facilities**
· **Rapid Mix, Chemicals and Chemical Feed Systems, and Coagulation/Flocculation**
· **Sedimentation/Clarification**
· **Filtration**
· **Disinfection**
· **Waste Streams**
· **In-Plant Cross-Connection Control**
· **Treatment Plant Schematic/Layout Map**

3.3 Distribution Systems

The water distribution system is the final link between the water source and the consumer. The distribution system is the primary means of delivering drinking water produced at the water treatment facility to the water system's customers. A typical water distribution system comprises miles of water pipes constructed in a network which includes numerous valves, fire hydrants, pumps, storage tanks, meters, and other appurtenances. Water distribution systems are generally considered to be a composite of three basic elements: treated water storage facilities (ground storage tanks, elevated storage tanks, standpipes, hydropneumatic tanks), pumping facilities (booster pumps, piping, control, pump building, etc.), and the distribution lines (piping, valves, fire hydrants, meters, etc.). These components should be integrated in order to function as a comprehensive system that can meet various schedules of demand. The objectives of surveying the water distribution system are to:

· Determine the potential for degradation of the water quality in the distribution system;
· Determine the reliability, quality, quantity, and vulnerability of the distribution system; and
· Ensure that the sampling and monitoring plan(s) for the system conform with requirements and adequately assess the quality of water in the distribution system.

3.3.1 Distribution Maps and Records

The inspector will need to review the mapping and other records for a distribution system to assess the components and size of the system to be evaluated. Maintaining accurate mapping and records of the distribution system is essential for a water utility to repair and maintain the existing system, as well as to plan for future improvements or expansion. The mapping should show the location, size, and material of all pipes, valves, and fire hydrants in the distribution system. The mapping should also show any pressure zone
boundaries, pumping facilities, storage tanks, and interconnections with other public water systems. Suggested assessment criteria for mapping and records include:

1. Are there maps of the distribution system? Are all major features shown – line and valve location, size, and material; fire hydrant location; dead end mains; pressure zone(s) boundary, (if any); ground and elevated storage tank(s); and booster pump station(s)?

2. When were the maps last updated? How are changes or additions reported and the map(s) updated?
3. Is there a record system? Does it include documentation of operation and maintenance repairs, leak detection, and construction standards?
4. Are customer complaints and investigation reports kept? Is there an apparent/common problem indicated by the customer complaints?

3.3.2 Field Sampling/Measurements

Some of the most important data collected by the inspector to evaluate the distribution system for sanitary risks are found in the field. The inspector should take measurements and samples for analysis at representative locations throughout the system to determine that an adequate disinfectant residual and pressure are being maintained. The disinfectant residual should be measured at the points of lowest potential residual (e.g., areas of stagnant water) because these areas represent the greatest challenge for maintaining a residual. Suggested assessment criteria for data collection include:

1. What are the maximum and minimum residuals at the extremities of the distribution system or pressure plane? What is the normal residual range in the distribution system or pressure plane?
2. What are the maximum and minimum pressures at the high and low points in the distribution system or pressure plane? What is the normal operating pressure in the distribution system or pressure plane?
3. How often are pressure readings taken in the distribution system? Are they representative of the system?

3.3.3 Distribution System Design and Maintenance

The integrity of the distribution system should be maintained at the highest level possible to protect public health.

3.3.3.1 Design/Material Standards

The major component of the distribution system is the underground pipe. As the largest element, a design standard should be established that specifies the minimum requirements for all water lines. Suggested assessment criteria for design/material standard include:

1. What kind of piping materials are in the distribution system?
2. Does the water system have a construction standard for water mains? If not, what are the criteria for sizing water line, selecting pipe materials, installing the lines, etc.?
3. Is the standard or method adequate to protect the integrity of the distribution system initially, as well as over time?
4. Are standards actually followed?

3.3.3.3 Disinfection of New Water Lines

The distribution system integrity could be compromised if procedures are not followed to protect it from contamination when installing new lines or repairing existing lines. The primary barrier to contamination in the distribution system is the initial disinfection of new or repaired water lines. Following an adopted procedure or standard ensures that the barrier is created to protect the system. Suggested assessment criteria for disinfection and flushing procedures for new water lines include:

1. Does the water system have a procedure for disinfecting and flushing new water lines? If not, what steps does the system follow when installing new lines?
2. Are there reports or test results which document the flushing and disinfection of new water mains and the subsequent testing?

3.3.3.4 Disinfection of Repaired Water Lines

The disinfection and flushing procedures for new lines typically cannot be used when repairing existing water lines, because of the need to minimize the disruption of service to customers. Repairs can range from the easy, such as installing a repair clamp, to the very difficult, such as replacing a joint of pipe in a very deep hole where there is a lot of erosion due to the leaking water. Procedures should cover the extreme as well as all the various situations in between. Suggested assessment criteria for disinfection and flushing procedures for repairing water lines include:

1. Does the public water system have a procedure for disinfecting and flushing repaired water lines? If not, what steps does the system follow when repairing existing lines?
2. Are there adequate repair materials on hand?
3. Are there reports or test results which document disinfection of repaired water mains and any subsequent bacteriological testing?

3.3.3.5 Flushing Procedures

Flushing is normally used to clear up colored water or to remove sediment and biofilm in an existing main and improve the disinfectant residual in dead-end lines. Suggested assessment criteria for flushing procedures include:

1. Does the public water system have a procedure for flushing a portion of the distribution system on a regular basis?
2. Are there reports or records which document the portions of the system which have been flushed and the date of the flushing?

3.3.3.6 Cross-Connection Control

A piping cross-connection is defined as an actual or potential physical connection between a water system and another water source of unknown or questionable quality. The physical connection could allow water of a questionable quality to backflow into the water system either as a result of backpressure or backsiphonage backflow. Suggested assessment criteria for cross-connection control include:

1. Does the water system have a formal program to address crossconnections? If not, what steps does the system take to eliminate crossconnections?
2. Is there an inspection of new construction as well as follow-up inspections? How often do follow-up inspections occur? Is there a log or documentation of these inspections?
3. Is there a requirement for the annual testing of the installed backflow prevention devices? What documentation is available? What qualifications must a tester have? How many certified testers of crossconnection devices are available?

3.3.3.7 Elimination of Water Loss

Water systems are currently able to, or should be able to, meter all sources and uses of treated water.

Evaluation of Service Meters

Normally, the first step of a program to reduce water losses should start by checking the accuracy of the meters at the source(s) and end user or customer.

Detection of Leaks

If the main meter(s) have been checked and recalibrated, but water losses are still too high then the system should begin looking for leaks in the distribution system.

Suggested assessment criteria for the elimination of water losses in the distribution system include:

1. Is all source water metered at the point of entry into the distribution system? Are all customers metered? How often are the meters checked and recalibrated, if necessary?
2. Is the water loss for the system calculated?
3. Is the water loss for the system greater or less than 10 percent? If greater than 10 percent, what is the system doing to reduce its water losses?

3.3.4 Priority Criteria

The following criteria related to the distribution systems element are considered high priority based on their potential for impacting public health:

· **Field Sampling/Measurements**
· **Disinfection of Repaired Water Lines**
· **Disinfection of New Water Lines**
· **Cross-Connection Control**
· **Elimination of Water Loss**
· **Distribution Maps and Records**

3.4 Finished Water Storage

Prior to the field inspection, the inspector should obtain the information available on the storage facilities for the subject water system from the state's files or the last sanitary survey. The information on storage facilities should include the type of storage (ground, elevated, or hydropneumatic) included in the system, and the volume and location of each storage tank. The objectives of surveying the finished water storage facilities are to:

· Review the design and major components of storage to determine reliability, adequacy, quantity, and vulnerability;
· Evaluate the operation and maintenance and safety practices to determine that storage facilities are reliable; and
· Recognize any sanitary risks attributable to storage facilities (UFTREEO Center, 1998).

3.4.1 Type of Storage

The inspector should determine the types of storage facilities in the system. Storage facilities are designed to provide for the (1) storage of treated water (ground storage) that can be pumped into the distribution system or (2) maintenance of an adequate service pressure (elevated, hydropneumatic, or ground storage that is built at a location to act as elevated storage). Storage facilities may be closed tanks or reservoirs. Suggested assessment criteria for the type of storage facilities include:

1. Are the storage facilities covered or otherwise protected?
2. Where do the overflow pipes end? Do they discharge to a splash pad? Are they equipped with hinged and weighted flaps?
3. Do the air and roof vents have a screen? Are they protected from rain?

3.4.2 Location of Storage

The inspector should determine the location of storage facilities to assess their potential to compromise the integrity of the delivery system. The surrounding area needs to be inspected for sources of potential contamination and sources that may cause physical damage to the tanks. Suggested assessment criteria for the location of storage facilities include:

1. Are there any potential sanitary hazards in the area? If so, what and where are the hazards? Are the hazards close enough to be of concern to the storage facilities?
2. Are there any physical features on or around the site that could damage the tank?
3. Is the site well maintained?

3.4.3 Capacity of Storage Tanks

Storage tank capacities should be adequate to meet the water demands of the system, should meet applicable state requirements and industry standards, and be consistent with accepted engineering practice. Suggested assessment criteria for the capacity of storage tanks include:

1. Is the storage capacity adequate?

2. In case of elevated storage tanks, are tanks properly sized and elevated to assure adequate pressures throughout the distribution system?

3.4.4 Design of Storage Tanks

The inspector should examine the design criteria of the storage tanks to assess their potential to meet the water demands of the distribution system and retain structural integrity. Design and construction standards need to be appropriate for the intended use of a storage tank.

3.4.4.1 Storage Tank Components

The series of standards used to design tanks with all the necessary components identified is the AWWA D-100 series. The construction material for the tank should also be examined for structural integrity as well as for any sanitary hazards. The following is a listing of the minimum criteria for a treated water storage tank, whether it is a ground or elevated storage tank:

· Roof sloped to prevent standing water;
· No leakage through the roof;
· A lockable access hatch on the roof, with a raised curb;
· Vent on the roof with openings that face downward, with a fine corrosion resistant screen;
· Water level measurement device;
· Overflow that terminates above ground with a hinged and weighted flap on the end;
· Inlet and outlet piping located to ensure proper circulation of water;
· Drain to remove accumulated silt from the bottom of the tank;
· Access openings on the side (at least 2);
· Access ladder with proper safety equipment;
· Valves on inlet and outlet for isolation;
· Bypass around the tank for maintenance;
· Control system to maintain water level in tank; and
· Alarm system for high/low water levels.

Suggested assessment criteria for the minimum design components for storage tanks include:

1. Does the tank have all the minimum components listed above? Are these components in good condition?

3.4.4.2 Hydropneumatic Tank Components

Hydropneumatic tanks are specially designed storage tanks which provide pressure maintenance for the system. Hydropneumatic tanks are not storage tanks, technically speaking, but are pressure maintenance facilities. For a hydropneumatic or pressure tank, the design criteria should include the following:

· Tank is located completely above ground
· Tank meets ASME standards with a ASME name plate attached
· Access port for periodic inspections
· Pressure relief device with a pressure gauge
· Control system to maintain proper air/water ratio
· Air injection lines equipped with filters to remove contaminants from the air line
· Sight glass to determine water level for proper air/water ratio
· Slow closing valves and time delay pump controls to prevent water hammer.

Suggested assessment criteria for the minimum design components for hydropneumatic tanks include:

1. Does the tank have all the minimum components as required? Are these components in good condition? Is the tank capacity adequate?

3.4.5 Painting of Storage Tanks

The inspector should assess the painting of storage tanks to determine the potential for lead to enter the water. Suggested assessment criteria for the painting of storage tanks include:

1. When was the last time the tank was repainted? What type of paint was used? Was it a lead-based paint? Was the paint in conformance with ANSI/NSF Standard 61 for potable water use?
2. Is the paint in good condition?

3.4.6 Cleaning and Maintenance of Tanks

The inspector should assess the frequency of general cleaning and inspection of the tanks. On a daily basis, the operator should be checking the general condition and operating level of the tank. On a weekly basis, the sanitary and structural condition of the basic tank components should be checked in more detail. Suggested assessment criteria for the cleaning and maintenance of tanks include:

1. Does the tank appear structurally sound?
2. How often are inspection and cleaning performed? How often does the water system have its storage tanks inspected by a qualified contractor?
3. How is the water supply continued when the storage tank is out of service for maintenance?
4. When interior maintenance has been performed, are storage tanks disinfected before being used?

3.4.7 Site Security

The inspector should assess the site security of the water system to determine the potential for intruder access. Any potable water storage tank should be enclosed by an intruder resistant fence with lockable access gates. In addition, all access hatches should be locked. To be intruder-resistant, the Texas Natural Resource Conservation Commission recommends that the fence around the storage tank be at least six feet tall with three strands of barbed wire extending outward at a 45$_o$angle, and be constructed of wood, masonry, concrete, or metal. Suggested assessment criteria for site security include:

1. Is the fence surrounding the tank site intruder-resistant?
2. Are access hatches locked?

3.4.8 Priority Criteria

The following criteria of the finished water storage element are considered high priority based on their potential for impacting public health:

- **Capacity of Storage Tanks**
- **Design of Storage Tanks**
- **Cleaning and Maintenance of Storage Tanks**
- **Site Security**

3.5 Pumps/Pump Facilities and Controls

In a water system, there are many applications that require a pump(s) to move a fluid (water, chemical, etc.) from one point to another. In addition to transporting water through the system, pump applications include chemical feed systems, sludge removal, air compression and sampling (UFTREEO Center, 1998). Normally, there are several types of pumps that could be used for an application. However, there are usually only one or two types of pumps that will be the best fit for the intended use. In this section, the prime movers of water will be discussed. There are numerous applications for other types of pumps in other sections of this document. The objectives of surveying the pumps/pump facilities and controls are to:

- Review the design, uses, and major components of water supply pumps;

· Evaluate the operation and maintenance as well as safety practices to determine that water supply pumping facilities are reliable; and

· Recognize any sanitary risks attributable to water supply pumping facilities (UFTREEO Center, 1998).

3.5.1 Types of Pumps

Before going into the field, the inspector should obtain the information available on all the pumping facilities for the water system from the state's files, including the last sanitary survey. The information on pumping facilities should include the type, location, age and installation date, and design conditions of the system's pump(s), pumping facilities, and controls. Suggested assessment criteria for the types of pumps include:

1. What type of pumps are provided for the system?
2. Does the information in the files reflect the actual type, number, and capacity of pumps in the system? If not, is there a potential problem?

3.5.2 Capacity of Pumps

The pump capacity or size required is typically dependent on the application or purpose, as well as vulnerability of the pump(s). Typically, state rules will specify the sizing criteria for each critical application. For example, Table 3-5 provides the sizing criteria for different pump applications used by the Texas Natural Resource Conservation Commission (TNRCC) for many water systems. These criteria are in general agreement with standard engineering practice. Suggested assessment criteria for the capacity of pumps include:

1. What are the capacities of the pumps? How many pumps are located at each facility?
2. What is the firm capacity and the total capacity of each pumping facility?
3. Are the pumps compliant with state rules?

3.5.3 Condition of Pumps

In addition to confirming that the pump facility complies with the approved design, the inspector should also evaluate the condition of each of the pumps in the facility to ensure that it is operating as designed. Suggested assessment criteria for the condition of pumps include:

1. Are all the pumps operational? If not then when does the system intend to repair or replace the pump?
2. Are the pumps vibrating excessively, overheated, making excessive noise, or producing an odor?
3. Are pumps regularly maintained and lubricated in accordance with the manufacturers recommendations?

3.5.4 Pumping Station

Most pumping applications rely on a pumping station that includes a pump(s), a structure to house or support the pump, piping – suction and discharge, lighting, ventilation, an electrical center and control panel for the pump(s) and lighting, and appurtenances. The inspector should determine if there are any sanitary risks by thorough inspection of all pumping facilities.

3.5.4.1 Location of Pumping Facilities

The structure for a pumping station can be as simple as a slab that supports the pump(s) to a building that houses the pump(s) and all appurtenances. However simple the structure, the location of the pump station is probably one of the most important factors to evaluate for sanitary risks. Suggested assessment criteria for pumping station/location include:

1. Is the location subject to flooding? If so, what provisions are provided to accommodate the flooding?

2. Is the location subject to electrical outages? If so, what provisions are provided to accommodate the electrical outage?

3.5.4.2 Pumping Station Structure

The type of structure provided for a pumping station is somewhat dependent on the site specific requirements, but there are general similarities for all facilities. When visiting the site, the inspector should assess the security and maintenance of the structure as well as the pumps and piping. Suggested assessment criteria for pumping station/structure include:

1. Is the structure secure from unauthorized entry and vandalism? Are all drains and vents screened to prevent the entry of animals?

3.5.4.3 Pumping Station Appurtenances

The pump station appurtenances that should be evaluated include lighting, heating, ventilation, interior drainage, signs/labeling, and controls. Suggested assessment criteria for pumping station/appurtenances include:

1. Is the lighting adequate for security and maintenance?
2. Is the area subject to freezing? Can the piping in the station freeze? If so, is heating provided?
3. Is the station equipped with ventilation? If so, does it work and is it adequate to maintain a reasonable temperature?
4. Is there a floor drain to collect all leaks? Is the floor drain operable?
5. Are the pumps, valving, and other major equipment items tagged? If not, how does the system number the equipment for maintenance purposes?

3.5.5 Priority Criteria

The following criteria related to the pumps/pump facilities and controls element of the sanitary survey are considered high priority based on their potential for impacting public health:

· **Capacity of Pumps**
· **Pump Station Location**

3.6 Monitoring/Reporting/Data Verification

An important part of any industry that produces a product for the consumer is quality control. Quality control is a defined method of checking the product to ensure the consumer that it meets or exceeds regulatory requirements as well as their minimum expectations. For the water industry, quality control consists of monitoring the product, drinking water, from the source to the tap, with in-house as well as outside laboratory testing for confirmation. A monitoring plan provides the operator with data to assist in identifying potential problems and adjusting treatment processes accordingly. It is important that all water systems create a water quality monitoring plan and document monitoring results. For most water systems, regulatory requirements, either state or federal, dictate the minimum scope of a water quality monitoring plan. The objectives of surveying the water quality monitoring/reporting/data verification are to:

· Review the water quality monitoring plan of the public water system for conformance with regulatory requirements;

· Verify that the water quality monitoring plan is being followed by checking test results;

· Verify that all in-house testing as well as equipment and reagents being used conform to accepted test procedures;

· Verify the data submitted to the regulatory agency; and

· Evaluate the procedures an operator follows to identify any problems with the process, determine the changes needed to correct the problem, and how adjustments to the process are approved and performed as needed.

3.6.1 Regulatory Records Review

Before the inspector goes into the field, the data available in the regulatory agency's files concerning the subject water system should be reviewed carefully. Reviewing the files of the subject system will indicate to the inspector how well the system is meeting its responsibilities. Suggested assessment criteria for data collection include:

1. Are there any violations or orders for the subject system? If so, is there a compliance plan? If so, what documentation is there to verify compliance?
2. Have the required sampling plans been submitted and approved? If no, what action is being taken to prepare and submit the plans?
3. Are all the required monitoring data submitted? If so, do the data appear reasonable? Do the data reported match field log books?

3.6.2 Water Quality Monitoring Plans

For all water systems, there are two levels of water quality monitoring plans: (1) the water quality monitoring plan(s) that the system institutes for quality control purposes (non-regulatory monitoring); and (2) the water quality monitoring plans required by regulation (e.g., disinfectant residual and turbidity).

3.6.2.1 Non-Regulatory Monitoring Plans

The in-house plan provides the operator with a means of monitoring and evaluating the operation of the system, normally the treatment facilities. This plan allows the operator to control processes on a continuous basis and make adjustments in treatment (e.g., chemical feed rates) as needed. Since this plan will be system-specific, the inspector will have to check each plan individually. The plan should include the location, number, and frequency of various tests that are needed to verify the process. Suggested assessment criteria for in-house water quality control monitoring plan include:

1. Does the plan appear to be adequate for this system? If not, what changes should be made and why?
2. Are proper testing procedures being followed?
3. Are the equipment and facilities for monitoring adequate? Are the reagents out of date? How are test results logged? Where are past logs stored?
4. Does the operator use test results to identify treatment adjustments?
5. Is there a procedure, and what is the frequency, for calibrating monitoring equipment, both laboratory and on-line? Is it in compliance with manufacturer's recommendations, and is the procedure adequate? Are the calibration standards acceptable?

3.6.2.2 Regulatory Monitoring Plans

With the enactment of the recent amendments to the SDWA, various monitoring plans have been required of a public water system to verify that the consumer is receiving safe drinking water. Suggested assessment criteria for regulatory monitoring plans include:

1. Are all required monitoring plans approved by the state or other primacy agency and are these monitoring plans being followed? If not, why?
2. Is a certified laboratory being used for all testing?

3.6.3 Priority Criteria

The following criteria related to the monitoring/reporting/data verification element of the sanitary survey are considered high priority based on their potential for impacting public health:

· **Non-Regulatory Monitoring Plans**

· **Regulatory Monitoring Plans**

3.7 Water System Management/Operation

Management and/or administration is a major factor that affects the performance of a water system. Management provides the direction, funding, and support that is needed for a public water system to continually supply safe drinking water. The objectives of surveying the water system management/operation are to:

· Review the water quality goals and evaluate any plan(s) the system has to either accomplish or maintain the stated goals;

· Identify and evaluate the basic information on the system, management, staffing, operations, and maintenance;

· Review and evaluate the plan(s) for safety, emergency situations, maintenance, and security to maintain system reliability; and

· Evaluate the system's revenue and budget for drinking water to establish the long-term viability of meeting water quality goals (UFTREEO Center, 1998).

3.7.1 Administrative Records Review

While much data have been collected concerning the physical features of the system, in this section, the data needed concern the management (people) area of a public water system. Suggested assessment criteria for data collection include:

1. What changes have been made since the last sanitary survey in the system management, personnel, budget, etc.?
2. Are the system's files up-to-date with the latest correspondence on compliance monitoring, plans of the system showing changes made since the last survey, sampling plans, compliance plans, and other management related issues?

3.7.2 Water Quality Goals

Water quality goals provide a target that the public water system should strive to attain to produce the best quality product possible. The water quality goals for a system should include all parameters that have a regulatory level established, as well as other quality parameters that are deemed appropriate. For parameters with established regulatory levels, the system should set goals to achieve a higher (or at least equal to) quality of drinking water than what is required by regulations. By striving to reach a goal that is higher than required, the system will be more assured of meeting the regulatory requirements at all times. The system should set other, non-regulatory water quality parameters, as appropriate, to help it achieve its overall goal of producing a reliable, high-quality water supply. Examples of some of these other water quality goals include the number of customer complaints for a month, threshold odor number, or flavor profile analysis. Suggested assessment criteria for water quality goals include:

1. Has the system established any water quality goals? If not, why?
2. Should there be any other parameters included in the goals? If so, which parameters, and what level?
3. Do the operators know what the plant goals are, and why the levels were established? Do operators monitor to assess whether goals are being met and then make any appropriate process control adjustments and measure the results of the adjustments?

3.7.3 Water System Management

The direction of the system is controlled by the system's management through the implementation of the budget and policies. During the inspection, the knowledge and experience of these individuals concerning drinking water should be verified. Suggested assessment criteria for system management include:

1. What is the management structure, and who are the individuals at the various levels? What is their experience level with water systems?
2. Does the water system have a planning process? Does the planning process appear to be implemented?
3. Does open, effective communication occur between management and system personnel?
4. What kind of attitude is portrayed by the system personnel?

3.7.4 Water System Staffing

The inspector should determine if a list of job descriptions for system personnel is available. The inspector can use this information to assess whether or not the system seems to have an adequate number of qualified personnel to perform all the necessary work within the system from operations to maintenance. Suggested assessment criteria for system staffing include:

1. Is the number of personnel adequate to perform the work required?
2. Is plant coverage adequate given the alarm systems used by the plan? Do variations in finished water quality when the plant is unattended indicate the need for additional plant coverage?
3. Do staff have clearly defined responsibilities and the decision making authority necessary to carry out their responsibilities?
4. Is there cross-training required of the individuals within the system?

3.7.5 O&M Manuals and Procedures

Operation and maintenance (O&M) manuals, standard operating procedures (SOPs), and standard maintenance procedures (SMPs) provide direction for the operation and maintenance of system facilities. The O&M manual, SOPs, and SMPs should include the following information:

- General description of all components within the system/facility, and its purpose;
- Performance goals for the plant;
- Design criteria for all components;
- Detailed description of the operation of each component (step-by-step);
- Procedures for monitoring and adjusting plant performance;
- Detailed description of the maintenance of each component (step-by-step), including emergency and preventative maintenance;
- Laboratory requirements – equipment, test procedures, and calibration methods;
- Safety program – spill response, emergency telephone numbers, procedures, etc.;
- Education and training responsibilities and opportunities;
- Procedures for communicating problems; and
- Records – plant and regulatory requirements.

Suggested assessment criteria for operation and maintenance manuals, SOPs, and SMPs include:

1. Is there an O&M manual for the system? Are there SOPs and SMPs for the system? Are these documents complete and accurate?
2. Do system personnel use the documents and implement the practices described in them? Where are copies of the manual, SOPs, and SMPs kept?

3.7.6 Water System Funding

When reviewing the budget and rate structure, one of the most important questions to consider to determine adequacy is "Is the system a self-supporting utility?" A self supporting utility means that the revenues are such that all budgetary requests are met, with some excess reserves remaining for future improvements or emergencies.

1. Is the system self-supporting?
2. Are there adequate monies to provide the appropriate maintenance and to support the number of personnel to operate the system correctly?
3. Does the water system subsidize other departments within the city or board? If so, is funding that is returned to the water utility sufficient to meet operation and maintenance requirements and address future growth?
4. How does this system compare to others?

3.7.7 Priority Criteria

The following criteria related to the water system management/operation element of the sanitary survey are considered high priority based on their potential for impacting public health:

· **Water System Management**
· **Water System Staffing**
· **Water System Funding**

3.8 Operator Compliance with State Requirements

The need for qualified professionals to operate and maintain water systems is becoming increasingly important in the water supply industry.

3.8.1 Certification of Operators

Personnel involved in providing consumers with drinking water need to know what is required to provide a safe and adequate supply of water. Most states require a certain level of operator certification befitting the size of the system. The requirements for operator certification vary from state to state, but they all require a certain amount of in-class (school) as well as on-the-job training and experience. Suggested assessment criteria for operator certification include:

1. Does the system employ an operator(s) of the appropriate certification level(s), as specified in state requirements?
2. Are operator certifications current for all system personnel? Are all personnel meeting the minimum renewal requirements for operator certification?

3.8.2 Competency of Operators

Like all professions, some people know all the right answers according to the book and others know what the right answer is based on experience. Operators need to know both. Suggested assessment criteria for competency of operators include:

1. Do the operators know how to operate and maintain the various components of their water system from the source to the tap? Does the system appear to be well-operated and maintained?
2. Are system personnel appropriately trained?

3.8.3 Priority Criteria

The following criterion related to the operator compliance with state requirements element of the sanitary survey is considered a high priority based on its potential for impacting public health:

· **Competency of Operators**

4. COMPILING THE SANITARY SURVEY REPORT

This chapter provides guidelines for preparing the sanitary survey report and suggestions for keeping adequate documentation of the sanitary survey. Areas addressed include: preparing the sanitary survey report; preparing adequate sanitary survey documentation; categorizing the findings; developing corrective actions; and determining outstanding performance.

4.1 Sanitary Survey Report

The sanitary survey report officially communicates the results of the survey to the owners and operators of the water system. At a minimum, the survey report should include the following elements:

- Date and time of survey;
- Name(s) of survey inspector(s);
- Name(s) of those present during the survey, besides the inspector(s);
- A schematic drawing of the system and, where appropriate, photographs of key system components;
- A statement of system capacity, including source, treatment, and distribution;
- A summary of survey findings, with the signatures of survey personnel;
- A listing of deficiencies based on a regulatory reference;
- A summary of all analyses and measurements done during the sanitary survey;
- Recommendations for improvement, in order of priority, with a timeline for compliance;
- A copy of the survey form; and
- A recommendation on whether a system has outstanding performance.

The report needs to identify all the deficiencies noted during the inspection.

4.2 Sanitary Survey Documentation

Adequate documentation of survey results is essential in the sanitary survey process, especially if the survey may result in corrective or enforcement actions. It is the inspector's responsibility to the water system and to the public to provide an accurate and detailed description of improper operations or system deficiencies in the sanitary survey report. The suggested minimum documentation for sanitary survey record files includes:

- A cover memorandum or letter with a list of deficiencies, if any, and pertinent information and recommended actions.
- A completed survey form or checklist for the water system (if used by the state).
- Any necessary additional pages of comments, drawings or sketches, and water sampling data.
- A copy of the USGS 7.5 minute topographical quadrangle map showing the location of the system.
- A summary of the components of the water system. This summary should identify any modifications made to the system.
- A listing of system operators, including the certification status.

4.3 Categorizing the Findings

The findings of a sanitary survey can range in severity from minor administrative deficiencies to situations where continued operation of the water delivery system could pose a serious health threat to the population. The inspector needs to determine which deficiencies are significant and thus require the system to take immediate corrective action (all deficiencies should ultimately be addressed). In general, significant deficiencies include those defects in a system's design, operation, or maintenance, as well as any failures or malfunctions of its treatment, storage, or distribution system, that the state determines to be causing or have the potential to cause the introduction of contamination into water delivered to customers. If a significant public health issue is determined to exist, compliance action must be required. State inspectors may judge other problems as significant enough from a public health viewpoint to require establishment of a compliance schedule with follow-up action.

4.4 Corrective Action

There are a number of problems or deficiencies that may be considered significant public health issues. If a significant public health issue is determined to exist, corrective action must be required. At a minimum, the sanitary survey report should identify the deficiencies noted during the inspection and notify the system of the actions that the state may take if the deficiencies that require action by the system owner/operator are not corrected. There are three basic approaches which may be taken to ensure significant defects are corrected:

· ***Correction of problems by the water system staff, their consulting engineers, and/or contractor***

· ***Technical assistance to the water utility by the regulatory agency, organizations that specialize in training and technical assistance, and/or peers at other water systems***

· ***Implementation of a composite correction program (CCP) applicable to surface water treatment plants***

A combination of these approaches may be appropriate, based on the type and severity of the sanitary deficiencies.

4.5 Outstanding Performance

As noted in Chapter 1, community systems that are classified as having outstanding performance are eligible for having future sanitary surveys conducted at the less frequent interval.

5. REPORT REVIEW AND RESPONSE

The previous chapters of this guidance manual described how to prepare, conduct, and report the results of a sanitary survey. This chapter describes the follow-up actions that should be undertaken by the water system operator and the state in response to the findings of a sanitary survey, including those actions that must be taken to correct any identified deficiencies. The remainder of this chapter discusses these follow up actions.

5.1 State Actions

For a state to be granted primacy authority, it must submit evidence to EPA that the state has met the requirements for a determination of primacy enforcement responsibility found in 40 CFR 142.10. These requirements are summarized in Figure 5-1. This regulatory authority effectively outlines the range of options that the state possesses in responding to the findings in a sanitary survey report.

5.2 Water System Actions

As stated above, the severity of the deficiency in a sanitary survey should dictate the appropriate response required from the water system operator. The water system's response should be returned to the state within 45 days, and must be returned within the 45-day timeframe when the sanitary survey findings include significant deficiencies. The response should include:

- A statement of the deficiency, including any real or potential impacts to delivered water quality;
- The approach to correcting the deficiency;
- The time required to correct the deficiency;
- The source of funding, if capital construction is required;
- Measures put in place to prevent the situation from recurring; and
- Additional follow-up actions planned.