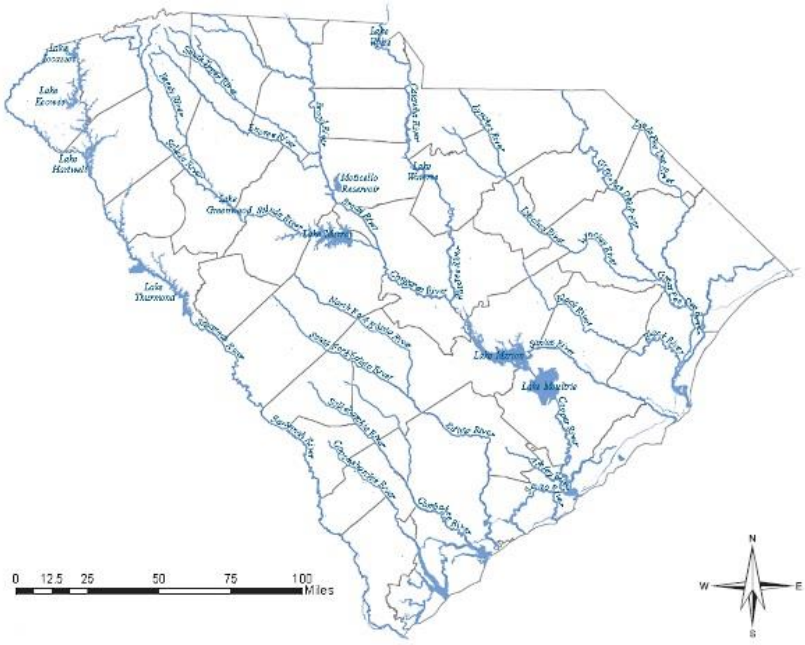
Bureau of Water

South Carolina Department of Health and Environmental Control

Guidelines for Conducting a Ground Water and Distribution System Sanitary Survey



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Introduction

This manual is intended for use by South Carolina Department of Health & Environmental Control (Department) staff as guidance for conducting sanitary surveys on public water systems with ground water sources or wholesale master meter connections. Experienced staff members will find this manual useful as a source of reference information concerning regulatory requirements for specific elements of the sanitary survey. Staff members who are new to the sanitary survey program will find this manual to be a useful training tool in conjunction with on-site training received from regional and central office staff.

The completion of this manual has been made possible by many hours of hard work from many dedicated current and former Department employees.

Public Water System Sanitary Survey Report
Ground Water Systems

Site name:

System number: **Last Survey:** **Survey Date: ___/___/_____**

Type Inspection/Visit Operator/Owner present? **Overall Rating**

Source:

1. *Protection from Contam
2. Quantity
3. Security
4. Wellhead Piping

Water Treatment:

5. *Chemical Feed
6. Chemical Storage & Hand
7. Chemical Injection Points
8. Filtration
9. Equipment Maintenance

Distribution:

10. *Water Quality
11. Adequate Pressure
12. Disinfectant Residual
13. Cross Connection Control
14. Fire Flow
15. Valve/Hydrant Maintenance
16. Flushing Program
17. Leak Detection and Repair
18. Water Audit
19. System Map

Storage:

20. *Protection from Contam
21. Capacity
22. Security
23. Appurtenances
24. Maintenance

Pumps, Pump Facilities & Controls:

25. * Reliable Capacity
26. Operation & Control
27. Pumps
28. Flow Measuring Device

Monitoring, Reporting & Data Verification:

29. *Monitoring/Record Keeping
30. Testing Equipment
31. Sample Siting Plan

System Management & Operation:

32. *Corrections from Previous Survey
33. Emergency Plan
34. Plant Security
35. Facility Maintenance
36. Supplies/Spare Parts Inv
37. Waste Disposal
38. Procedures Manual
39. Stand-by Power
40. Is system presently under order?

If Yes, is system complying w/order?

Operator Certification:

41. *Certified Operator
42. Staffing
43. System Group (I - V)
44. Treatment Operator Grade
    - A.
    - B.
    - C.
    - D.
    - T.

44. Dist. Group (I - V)
46. Distribution Operator Grade
    - A.
    - B.
    - C.
    - D.
    - T.
    - G.

Other Requirements:

47. Drought Response Plan
48. Source Water Protection Plan
49. Are all services metered?
    Percent metered
50. Field Tests (Location or address)

Chlorine
pH
Pressure
Flow
Other (Specify)
Other Result

51. Samples Taken

Bacteriological
Inorganic
Organic
Radiological
Other

52. Follow up scheduled?
    Date scheduled

***Items with an asterisk are significant deficiency items.**
This form represents neither a final approval of the water system, nor an approval to operate the system.

Public Water System Sanitary Survey Report
Ground Water Systems

Site name:

System number: **Last Survey:** **Survey Date: ___/___/_____**

Comments

DHEC Representative

System Representative Title

DHEC 2113 (10/2012)

How To Conduct A Sanitary Survey

The Sanitary Survey Program is based on three Federal Regulations: the *Total Coliform Rule, the Surface Water Treatment Rules*, and the *Ground Water Rule*. The importance of a consistent, statewide sanitary survey program is more critical than ever. The following protocol may be different than what each inspector or Region has done in the past, but with the renewed importance placed on the program, coupled with new federal regulations on ground water systems, it will be necessary for everyone to conduct the program in a consistent fashion. Statewide consistency for both the inspection and all follow up actions is critical.

It is fundamental for each inspector to have a working knowledge of this manual and the current state Primary Drinking Water Regulations. While these two documents may not address every issue that is discussed during the sanitary survey, they are the best sources of information concerning the Department's requirements for properly operating a public water system. It is also important for the inspector to note that most items addressed on the sanitary survey are items outlined in Regulation R.61-58.7 Operation and Maintenance and Regulation R.61-58.16 Ground Water Rule. The sanitary survey is not limited to items listed in these sections. Regulation R.61-58.2 Ground Water Sources and Treatment and Regulation R.61-58.4 Finished Water Pumping, Storage and Distribution Facilities should be referred to when there is a concern with the treatment processes or water quality. Often, deficiencies with the requirements listed in R.61-58.2 Ground Water Sources and Treatment and R.61-58.4 Finished Water Pumping, Storage and Distribution Facilities are addressed with the stipulation that during the next plant up-grade those items would be upgraded to meet current regulatory standards.

While the federal Ground Water Rule includes a timetable for survey frequency, the Department-required minimum frequency for conducting a sanitary survey is:

1. **Community** water systems (Type C) are required to have **annual** sanitary surveys.

2. **Non-Transient, Non-Community** water systems (Type P) are required to have sanitary surveys every **two (2) years.**

3. **Transient, Non-Community** water systems (Type N) are required to have sanitary surveys every **three (3) years.**

4. **State** water systems (Type S, subtypes 1 & 2) are required to have sanitary surveys every **five (5) years.**

Other factors that could trigger a sanitary survey would include, but not be limited to:

1. Concerns over system operations, i.e.; customer complaints, laboratory or other sampling results, recent history of operational problems, etc.;

2. Unsatisfactory results on previous survey;

3. Changes in ownership or operators;

4. Changes in system configuration, i.e. master meter connections, additional wells constructed, additional storage capacity, etc.

Preparing for the Sanitary Survey

Once a system has been identified as needing a sanitary survey, print a copy of the system's water supply information from the Environmental Facility Information System (EFIS). After logging into EFIS, the sanitary survey forms can be found by clicking on the "reports" button. Under the Report Groups section, select WATER – Drinking Water Systems. Under the Categories section, select GENERAL. After making these selections, the available reports are shown on the right side of the window. Select the desired report and enter the appropriate information when prompted. The following information should be printed from the database and the inspector should make notes of any information that is missing or seems inaccurate.

1. Public Water System Inventory Report Form (DHEC 2109). Note: when selecting this report, several check box options are included: system information, code listing, source information, and plant information. For a sanitary survey, the inspector will need the system information, source, and plant information.

2. Public Water System Sanitary Survey Report (DHEC 2113).

The next step will be to contact the system representative and set up the survey time, date, who will be involved, location of the meeting, directions to the site, and any other pertinent information. Send a letter to the system representative to reiterate the date and time of the survey along with a list of all the documentation and information that the system will need. This letter should be sent in a timely manner to allow the system representative to review and contact the inspector if any changes need to be made.

The system's file should be reviewed. Some of the information included in the file may be monitoring results, complaint history, or enforcement history. It is often beneficial to copy the report and carry it into the field to help remember items that may be of particular concern. Also, check the personal file on the system to see if any notes or concerns need to be addressed during the survey.

Be prepared to conduct any field sampling that may be required. Chlorine and pH meters should be calibrated, the appropriate sample bottles should be gathered with the necessary preservatives, and coolers may be necessary for sample transportation.

During The Sanitary Survey

It is important to arrive on time at the appropriate location as documented in the letter written to the system representative. Dress comfortably and professionally and wear the DHEC ID badge. If the system is large and requires a full day to cover, it is important to outline the day's events with the system's representative(s) during the kickoff meeting. That is also a good time to let the system know exactly what needs to be reviewed and to reiterate the reason(s) the sanitary survey

is being conducted. The representative can usually suggest the most efficient way to conduct the survey in a timely manner. Small systems usually require little, if any, driving time to evaluate the system so many items can be addressed without the need for official meetings.

Conduct the survey in a logical, professional manner following the guidelines outlined in this text. Be sure to discuss items as they are discovered and make appropriate notes for use when writing up the survey report. Discuss all items that were rated "Needs Improvement" or "Unsatisfactory" during the last survey. It is also important to discuss any significant deficiencies that were found during the previous survey and the corrective action plan that the system should be following. Discuss past complaints, monitoring results, or any other items that affect the way the water system operates.

Review all of the database forms with the system representative to confirm all the data, note any changes directly on the inventory report form (or PDA) and forward all changes to the Bureau of Water's Central office for correction within the database.

When the survey is complete, conduct an exit interview. Review each item that requires attention as discussed during the survey. Review each item on the sanitary survey form and let the system representative know what the rating will be. Sometimes a rating should not be given in the field if the inspector is not sure how that item has been addressed in the past or if there are extenuating circumstances. Letting the system representative know you plan to discuss the topic with other Department representatives is a viable option. It is best to give the system an indication as to which rating you expect to give them.

After The Sanitary Survey

When the survey is complete a report must be written discussing the items mentioned during the survey. The report should consist of general system information, a system description, a finding and recommendations section, and a conclusion.

The system description section should include an overview of all the following information: type of system, owner and operator, region served, number of residential taps and number of non-residential taps (listed separately), population served (primary and secondary), master meter connections, the water sources, treatment trains, storage capacities, etc.

The findings and recommendations section must include all the items discussed during the survey that would rate a "Needs Improvement" or "Unsatisfactory" rating. The inspector must address all of the items that were not rated "Satisfactory" and give the reason the item was not rated as satisfactory. Any further discussion of treatment, monitoring protocols, contaminant levels, and operational concerns can be restated in this section.

The conclusions section should address the overall system rating and re-emphasize major concerns the Department may have. The conclusions section is also a good medium for addressing concerns with a system's operations, but it is equally a good medium for commending a system on a job well done. If a system has successfully addressed a problem, the sanitary survey is a prime opportunity to document the process so others can benefit from the

water system's experience. If there are special concerns with a system, they can be documented in the conclusion section for future reference.

If a significant deficiency is identified during the inspection, several additional steps must be taken. These steps are outlined in the significant deficiencies section of this manual. Because significant deficiencies are potential threats to public health, an accelerated enforcement schedule and tracking program are required.

Follow up After the Survey

Any system that has been given an unsatisfactory rating must be scheduled for a follow-up survey within six (6) months. During the follow-up, the inspector should determine whether or not changes and corrections have been made. If the overall rating cannot be upgraded to needs improvement or satisfactory, then another unsatisfactory must be given and the system should be referred to enforcement. Inspectors should not let more than six months pass without a follow-up survey or give multiple unsatisfactory ratings year after year without enforcement referrals.

For systems that earn a needs improvement on the sanitary survey, inspectors should perform a follow-up survey within a year to determine if corrections have been made. During the follow-up inspection, the rating should either be upgraded to satisfactory, or downgraded to unsatisfactory. Water systems should not be given needs improvement ratings year after year.

The Department is responsible for ensuring public health with respect to drinking water. The follow-up inspections are critical once a system is not found to be in a satisfactory condition. At that point, the water system is out of compliance with Department regulations and could also pose a risk to public health.

Significant Deficiencies

During sanitary surveys, inspectors often discover a wide range of deficiencies. Some are minor and have little potential for public health risk. Other more serious deficiencies have the potential to make the water unsafe and pose an increased risk to public health. This section of the guidance manual provides guidelines for inspectors to use when determining whether or not a deficiency is significant. Significant deficiencies can be identified during sanitary surveys, or any other time that the Department determines public health may be at risk.

The first step is to define what characteristics constitute significant deficiencies. In South Carolina, the term significant deficiency means a deficiency that is causing or may have the potential to cause risks to public health or safety and requires immediate correction.

The second step is for inspectors to evaluate the system for defects and determine the significance of each defect (i.e. whether or not a defect meets the criteria for a significant deficiency). Below are a few general questions that may help inspectors in making these determinations:

- Is there the potential for contaminants to be introduced to the drinking water due to the deficiency?
- If left uncorrected, will the deficiency cause the potential for the introduction of contaminants at some point in the future?
- Does the deficiency affect treatment in an unacceptable manner?
- Does the deficiency pose risks to the safety of the public or operators?

Below are listed several of the most common significant deficiency examples. Each of the eight areas of the sanitary survey has one significant deficiency identified. This is not an exhaustive list as there may be other items not listed below that the inspector might deem significant.

Source: Protection from contamination.
This item would be considered a significant deficiency when the condition of the well pad, piping, or other equipment has caused or has the potential to cause contamination of the source. Some examples include a severely cracked well pad, missing vent screen, or an improper seal.

Treatment: Chemical feed.
This item would be considered a significant deficiency when there is inadequate application of treatment chemicals or feeding chemicals that are not certified through the National Sanitation Foundation (NSF). Some common examples include, but are not limited to: inadequate feed control resulting in inconsistent chemical dosing, severely leaking or spraying chemical feed points, or using a chemical that has not been approved by the Department.

Distribution: Water quality.

This item would be considered a significant deficiency when there are health-related water quality problems in the distribution system. Some examples include violations for the Total Coliform Rule, disinfection byproducts, or other persistent chemical MCL violations. An MCL violation that is already being addressed through the normal enforcement process would not be considered a significant deficiency.

Storage: Protection from contamination.
This item would be considered a significant deficiency when the condition of the storage tank(s) causes or has the potential to cause contamination of the system. Some examples include improper sizing (volume), clogged pressure relief valve, or inadequate internal cleaning or maintenance of storage tanks.

Pumps, Pump Facilities, & Controls: Reliable capacity.
This item would be considered a significant deficiency when there is inadequate pump capacity to maintain system flows and pressures. Some examples include, but are not limited to: routinely pumping wells more than 16 hours a day, wells permanently out of service with no plans for adding capacity, or unresolved problems with well pumping such that system reliability is affected, or pressure drops below 25 psi due to inadequate pumping or controls.

Monitoring, Reporting, & Data Verification: Monitoring & Recordkeeping.
This item would be considered a significant deficiency when a water system is not adequately monitored or is not meeting the recordkeeping requirements. Some examples can include: not monitoring according to the Department-approved monitoring plan or site sampling plan, or not keeping adequate process control records. Data falsification is another serious issue that would constitute a significant deficiency.

System Management & Operation: Corrections from a previous survey.
This item would be considered a significant deficiency when a water system does not correct items identified on a previous survey that can be associated with potential health risks. Some examples can include inoperable equipment, cracked well pad, potential for contamination from storage, using improper disinfection after repairs, or other corrections, major or minor, that if not corrected could introduce contamination into the system.

Operator Certification: Certified Operator.
This item would be considered a significant deficiency when the system is not in compliance with the state operator certification requirements. Examples of this include operators failing to make daily facility visits where required, improper grade operators operating a system, or a person operating without a license.

This table is not intended to be all-inclusive. Each inspector should keep in mind the definition of significant deficiencies and apply that definition when encountering other deficiencies or situations that are not listed but could also pose a public health risk.

Once an inspector determines that a significant deficiency exists, several steps must be followed.

1. The individual significant deficiency item as well as the overall survey rating should be rated unsatisfactory.

2. The regional inspector immediately sends an electronic mail alerting the identification of a significant deficiency to the Enforcement Section Manager, Karen Ramos, and the Drinking Water Protection Division Director, Doug Kinard. The e-mail should contain a brief summary of the deficiency as well as the system name, number and contact information.

3. When notified by a regional office, the enforcement section manager will notify the water system by sending out a notice of violation/notice of enforcement conference (to be scheduled within 2 to 3 weeks) by certified mail.

4. Prior to the enforcement conference, the inspector should also send in a formal enforcement referral along with the sanitary survey report.

How To Rate The Overall Survey

The following pages offer guidance and recommendations on how to rate each of the fifty-one items on the Ground Water Sanitary Survey Form. However, after rating each of those items using the guidelines provided, the inspector will need to determine the overall sanitary survey rating. As with each of the individual items, the inspector will issue a rating of Satisfactory (S), Needs Improvement (I), or Unsatisfactory (U). A Not Applicable (N) rating should not be used when rating the overall survey.

While there is no set formula that can be used to determine the overall survey rating, certain guidelines may be used to ensure consistency from one inspector to another. The inspector should take a number of issues into account when rating the overall survey, including the following:

- Past sanitary surveys
- The number of deficiencies noted
- The seriousness of the deficiencies noted
- The degree to which the owner commits to correcting deficiencies
- The potential risk to public health

Interpreting the impact of past sanitary surveys on the overall rating is somewhat subjective but is also relatively simple. If a past survey noted many deficiencies that have not been addressed, then the inspector may determine that the overall rating should be downgraded. Also, if little effort is made to improve on a previous overall Needs Improvement rating, then an overall Unsatisfactory rating is most likely warranted.

There is no magic number of individual Unsatisfactory or Needs Improvement item ratings that would lead to a corresponding overall rating, but obviously the fewer individual Satisfactory item ratings there are, the less likely an overall Satisfactory rating is deserved. Even so, the rating of the overall survey should never be reduced to a decision based strictly on numbers. The inspector must take the seriousness of the deficiencies noted into account. Deficiencies in a single area such as Protection from Contamination, Water Quality, or Adequate Pressure can be of sufficient importance to dictate the overall survey rating. Other items such as Quantity, Capacity, or plant/facility/storage tank Security may dictate the overall survey rating if noted deficiencies are such that they present a potential risk to the safety of the drinking water and/or have the potential for greater public health risk.

The one exception to the guidelines listed above is significant deficiencies. There is at least one (marked with an asterisk) significant deficiency for each of the required elements. If the starred item is found to be a significant deficiency, the overall survey must be rated Unsatisfactory and an enforcement referral made. Although there are only eight items on the survey form denoted with an asterisk, there are other items that could also be found significant. These items can also be given a significant deficiency rating thereby warranting an overall unsatisfactory survey and enforcement referral.

Perhaps the most difficult intangible to judge is the owner's commitment to correcting the deficiencies noted during the survey. If the owner shows little or no interest in improving the state of the water system, then an overall Unsatisfactory rating with an accompanying enforcement referral would be in order. However, if the owner does agree that improvements are needed and commits to addressing the noted deficiencies that might otherwise warrant an Unsatisfactory rating, the inspector may give an overall Needs Improvement rating pending a follow-up inspection. The key to allowing the owner time to improve the overall system is a timely follow-up inspection.

SOURCE

1. Protection from Contamination* Significant Deficiency Item

Purpose:

The purpose of this item is to ensure that all ground water sources (wells, springs, etc.) are properly protected from contamination due to surface water runoff, local ground contamination and/or contamination due to animals or insects. The inspection covers two topics, source location and well construction.

Inspection Guidelines:

Location

The State Primary Drinking Water Regulations (SPDWR) requires that each well be properly located to prevent source, storage, or distribution system contamination. The design standards for well construction require a 100-foot pollution-free radius around a well, and that an appropriate easement or deed restriction be recorded such that the 100 foot pollution-free radius is maintained. If a pollution-free radius has been established, the inspector should verify during the survey that use of this land has not been altered to allow potential sources of contamination into the area.

Existing wells that do not have the required 100-foot pollution-free radius must be evaluated based on their own merits. The inspector should determine the age of the well, the construction methods used, and the depth of the grouting. If well logs (or DHEC form 1903) are available, the inspector should ask to review them to verify well construction data. The inspector should also identify any potential sources of contamination, note them on the survey report and point them out to the owner during the survey. These potential contamination sources should be eliminated when possible.

If potential contamination sources exist, the inspector should review the well monitoring plan to determine if the current monitoring is sufficient to detect contamination. If the well monitoring is not sufficient to detect contamination, the inspector should prescribe additional monitoring, either by the water system or by DHEC, to ensure that the well is protected against pollution sources.

Well Construction

The SPDWR also require that the well is properly constructed and sealed to prevent contamination from surface water runoff, local surface contamination, or small animals and insects. Proper maintenance of the well casing, well pad, sanitary seal, and venting will help to prevent contamination at the wellhead. The well must be centered on a pad that has a three-foot radius (from the center of the well) and at least 4-inches thick. The pad must be free of full-

depth cracking that would allow surface water down through the pad and into the soil surrounding the well casing.

The casing should extend twelve inches (12") above the pad and should also be free of cracks. If the casing only extends eight inches (8") above grade, and there is no evidence of site flooding, it may not be practical to ask that the casing be extended an additional four inches (4") to meet this requirement. Where there is evidence of site flooding, a twelve-inch (12") casing may prove to be insufficient.

A screened vent is required to prevent the entrance of contaminants into the well except for packer jet wells. All other openings that allow access to the well must be properly protected (screened or caulked).

Evaluation Criteria:

Location

(N) A Not Applicable rating should be given for this item if the system does not have a well (i.e. a master metered system).

(S) Based on the information available to the inspector and after a thorough review of all past and present water quality records, the inspector may determine that the location of the well, while not the most desirable, can be rated Satisfactory. All wells that have and maintain a 100-foot pollution-free radius should be rated Satisfactory.

(I) Generally the rating of Needs Improvement is not used when referring to the location of a well. However, if there is a potential contamination source located in close proximity to the well that could be readily removed, a Needs Improvement rating may be warranted.

(U) When the inspector determines that the well is highly susceptible to a potential contamination source that cannot be removed from the proximity of the well, this item should be rated Unsatisfactory. The inspector should also determine if the potential for contamination represents a significant deficiency.

Construction

(N) A Not Applicable rating should be given for this item if the system does not have an independent water source (i.e. master metered system).

(S) If all of the necessary steps have been taken to prevent source water contamination through proper well construction and maintenance of protective measures, this item should be marked Satisfactory.

(I) If proper sanitary protection measures (i.e. vent screens, seal, etc.) are in place, but are poorly maintained, then a Needs Improvement rating should be given.

(U) If the site is subject to flooding above the casing height or the well pad is severely cracked or the vent is not screened or there are unprotected opening through the well seal or the top of the well casing is below grade, then this item should be marked Unsatisfactory. The inspector should also determine if the potential for contamination represents a significant deficiency.

Overall

This item should be rated unsatisfactory and denoted as a significant deficiency if there is a potential or high likelihood for contamination. Some common examples that would warrant a significant deficiency include: a severely cracked well pad, missing vent screen, or an improper seal.

The overall rating for this item should reflect the lowest rating given for either the location or well construction categories. If an Unsatisfactory rating is warranted for any element listed in the Inspection Guidelines, then the item should be given an overall rating of Unsatisfactory. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

R.61-58.2.B (3) (a): (Design Criteria) - Location

R.61-58.2.B (3) (b): (Design Criteria) - Location

R.61-58.2.B (3)(c): (Design Criteria) - Location

R.61-58.2.B (6) (d): (Design Criteria)

R.61-58.2.B (16): (Design Criteria)

R.61-58.2.C (1): (Design Criteria)

R.61-58.7.D (8): (Operation and Maintenance Criteria)

R.61-58.7.D (9): (Operation and Maintenance Criteria)

R.61-58.7.D (10): (Operation and Maintenance Criteria)

R.61-58.16.F (1) (a) – (c): (Ground Water Rule Treatment Techniques)

2. Quantity

Purpose:

The purpose of this item is to ensure that the water system has a sufficient quantity of source water available to meet demand at all times.

Inspection Guidelines:

The evaluation of this item requires that the inspector determine whether or not the system has an adequate number of sources, and if the capacities of the source(s) are sufficient to meet the demand requirements of the system. In order to accomplish this, the inspector should review the system files, including complaint records, to identify past problems that might be attributed to a lack of an adequate quantity of source water. Because of the severe and widespread nature of problems caused by the lack of an adequate quantity of source water, Department personnel generally know systems with a history of such problems.

While the inspector could spend a great deal of time calculating system capacity and demand, the best gauge of the adequacy of the system's source water quantity is whether or not it has been forced to over-pump its wells (more than 16 hrs per day) or has run out of water during non-emergency situations. In order to determine if the system is over-pumping its wells, the inspector should add the regulated capacity of all wells and compare it to the average daily usage. If the average daily usage exceeds the combined regulated capacity of the wells, then the system is likely over pumping their wells. Excessive run times do not necessarily indicate inadequate source quantity. Some examples where it may be acceptable to run a well more than 16 hours a day are a well that has been retrofitted with a Variable Frequency Drive (VFD), or a Reverse Osmosis (RO) plant that has to maintain water flow through the membranes.

There are two instances where this evaluation necessarily be based on historic observation. If a community ground water system serves 50 or more taps, or serves 150 or more people, then two independent sources are required regardless of performance history. This is not a requirement for non-community systems. A connection to another approved water system that would not require manual operation would satisfy the intent of this requirement. The connection to another system may be done in several ways to include:

- A metered connection to an approved system that is normally open would be considered a purchased water source and the two systems would not have to be merged,

- A metered connection to an approved system that is normally closed, but automatically opens if demand reduces pressure and the second source is needed to maintain pressure and quantity. The systems would still be independent and the second connection would likely be considered a purchased source and the systems would not need to be merged.

- A connection to an approved system that is normally open and does not include a meter or check valve should require that the systems be merged.

- If the second source is a well on the same system, it must be operational and open to the distribution system.

Connections to other approved water systems that would require manual operation should be considered as emergency sources and should not count toward the mandatory source quantity requirements. Emergency or standby wells should also not be counted toward the source quantity.

The other instance where the 16 hours a day well run time may not be an indication of water quantity is if a system with a history of satisfactory source water quantity experiences a rapid growth in their customer base. Again, Department personnel are generally aware of these areas and should reevaluate these systems periodically.

This item is closely tied to other items such as Storage Capacity (Item 20) and Adequate Pressure (Item 11) and a deficiency in this area could lead to subsequent poor ratings in these areas. The inspector should take into consideration the cumulative effect of this item on the overall survey rating. If a system routinely has low-pressure problems, then an overall system evaluation should be conducted to determine the cause of the low pressures. This item, while not specifically identified as such, could also be identified as a significant deficiency. If the item is determined to be a significant deficiency, then an overall unsatisfactory survey rating should be given and an enforcement referral made.

Evaluation Criteria:

(N) A Not Applicable rating should not be given for this item.

(S) If a system has an adequate quantity of source water with no history of water shortages, then a rating of Satisfactory should be given for this item.

(I) If system demand is approaching the maximum capacity of the system's sources, which would lead to over pumping of the system's wells, then a Needs Improvement rating should be given for this item.

(U) If a system has a history of water shortages or of low distribution system pressures caused by the lack of adequate source capacity, then an Unsatisfactory rating should be given for this item.

Note on Master Metered Systems: These systems are generally evaluated based on the availability of water from all sources. The amount of water available from a master meter connection may be limited by contractual agreements with the supplier or hydraulic restriction of the connection.

References:

R.61-58.2 B (1) (a): (Design Criteria)

R.61-58.2 B (1) (b): (Design Criteria)

R.61-58.7 D (11): (Operation and Maintenance Criteria)

R.61-58.7 D (12): (Operation and Maintenance Criteria)

3. Security

Purpose:

The purpose of this item is to ensure that all ground water sources, pumps and controls are protected against vandalism, tampering or sabotage.

Inspection Guidelines:

All well sites must be secured against entrance by unauthorized persons. This may be accomplished by enclosing the well within a fenced area or lockable well house. The owner may also choose to cover the wellhead piping with a lockable cover. All locks protecting the wellhead piping or pumps controls must remain locked and should be inspected during the survey. Any signs of recent vandalism should be noted and considered evidence of inadequate security.

Evaluation Criteria:

(N) A Not Applicable rating should be given for this item if the system does not have an independent water source (i.e. master metered system)

(S) If the wellhead area and pump controls are properly secured either inside of a locked well house, under a locked cover, or inside a fenced area, a rating of Satisfactory should be given for this item.

(I) If all necessary security measures are in place, but the owner has failed to maintain those measures (i.e. locks not in locked position, fences in need of repair), then a rating of Needs Improvement should be given.

(U) If the system does not have the required security measures in place, or if recent or continued vandalism is observed, then this item should be marked Unsatisfactory.

References:

R.61-58.2 C (1): (Design Criteria)

R.61-58.7 B (18): (Operation and Maintenance Criteria)

4. Wellhead Piping

Purpose:

The purpose of this item is to ensure that the wellhead piping is configured in such a way as to minimize the potential for contamination of the source while also providing for proper testing and control of the well.

Inspection Guidelines:

Proper Order of Appurtenances

During an inspection, the wellhead piping should be examined to determine if the configuration is appropriate for the type of well in use (See Appendix B for diagrams of each different type of well). The wellhead appurtenances should be configured in the following order to ensure proper control and testing and to prevent contamination of the source:

- Air/Vacuum Release Valve - On Vertical Turbine Pumps, this should be the first appurtenance. The valve allows air to escape and avoid entering the system during startup and to breaks the vacuum on the pump when the pump stops.

- Check Valve - Should be the first appurtenance after the well pump, except as noted above. The check valve will prevent any potentially contaminated water from entering the well when the well pump is not running. This item is not required on jet pumps.

- Pressure Gage - Must be after check valve.

- Flow Meter - Must be after the check valve and before the blow off such that all water discharged from the well will be routed through the meter.

- Sample Tap - For sampling the well before any treatment. Must be located down stream of the check valve.

- Blow-off – A valved blow-off shall be provided and located prior to any chemical feed, but downstream of the meter. The blow-off should be the same size as the pump discharge line so that the well may be flushed after disinfection or so that a well performance test may be conducted.

- Isolation Valve - For isolating the well from the system when the blow-off is being utilized.

- Chemical Injection Points - (If applicable) Must be located down stream of the check valve, flow meter and blow-off. A separate injection point shall be provided for each chemical.

- Sample Tap - (if applicable) For sampling treated water if treatment is added. A sample tap must be located after each treatment component.

- Gate Valve - Located down stream of the previous sample tap and before any storage tank or tie to the distribution system. This gate valve may be located after the storage tank if the well is equipped with a jet pump (which could lose prime if valved off) as long as the blow-off and all sample taps are protected from cross connections.

Chemical injection points should never be buried, but rather should be enclosed in a chemical injection vault if not located inside the well house.

Protection from Freezing

The well and the wellhead piping must be properly protected from freezing where necessary. Enclosure in a pump house may be the only protection required in some instances, however, additional measures may be required. This requirement is difficult to evaluate during an inspection and would generally not effect the overall rating unless continued operational problems have been experienced due to freezing.

Sample Taps

Sampling taps shall not be of the petcock type, shall not be of the mixing type, and shall not have a screen, aerator or other such appurtenances. Sample taps should be non-threaded and be pointed downward. In order to ensure a proper sampling point for taking Total Coliform samples, it is best to use a smooth-nosed type tap without interior or exterior threads, however an existing tap with threads is still acceptable if proper precaution is taken when collecting the sample. All taps must be easily accessible and located at least 12 inches above the floor or ground level.

Flow Meters

If a system does not have a flow meter, but does not have any pressure or quantity issues, then the inspector should carefully consider whether or not to require the system to install a flow meter. An example of where an exception to the flow meter requirement can be made is a small water system that is completely built-out and has no room for expansion.

Evaluation Criteria:

(N) A Not Applicable rating should be given for this item if the system does not have a well (i.e. master metered system)

(S) If the wellhead piping is configured in such a way as to minimize the potential for contamination of the source, storage and distribution system, then this item should be rated

Satisfactory. Some measures may be taken to meet the intent of the regulations even if the wellhead piping is not exactly in the order listed.

(I) Generally, the wellhead piping must be installed in the order shown. However, the key to rating this item is whether or not the owner makes a commitment to correct any deficiencies that exist. If the owner, once notified of the deficiency, makes a commitment to correct the wellhead piping arrangement, and the problem has not been noted on previous surveys, then a rating of Needs Improvement can be given. Also, if the sampling taps are simply not of the correct type, a Needs Improvement rating may be given.

(U) A rating of Unsatisfactory should be given if the wellhead piping is not in the proper order and poses a contamination risk or hinders the proper operation or control of the well. For example, an unprotected blow-off pipe located upstream of the check valve would warrant such a rating as would the absence of a blow-off.

References:

R.61-58.2 B (16) (a) (iii): (Design Criteria) - Check Valve

R.61-58.2 B (16) (a) (iv): (Design Criteria) - Sampling Taps

R.61-58.2 B (16) (a) (ix): (Design Criteria) - Blow - off

R.61-58.2 B (16) (d): (Design Criteria) - Well head piping

R.61-58.2 C (5): (Design Criteria) - Sampling Taps

R.61-58.7 (D) (4): (Operation and Maintenance Criteria) - Well head piping

R.61-58.7 (D) (5): (Operation and Maintenance Criteria) - Check valve and blow - off

R.61-58.7 (D) (6): (Operation and Maintenance Criteria) - Freeze protection

WATER TREATMENT

5. Chemical Feed* Significant Deficiency Item

Purpose:

The purpose of this item is to ensure that the water system's chemical feed system is properly installed, maintained, and housed to provide adequate treatment, to prevent the potential for contamination, and to provide operator and public safety.

Inspection Guidelines:

When chemicals are added to the drinking water they must be approved by the Department and be certified as meeting American National Standard Institute/National Sanitation Foundation International (ANSI/NSF) Standard 60 requirements. The inspector should check storage containers or receiving forms to verify that NSF International or Underwriters Laboratories (UL) has certified each chemical as meeting the requirements of ANSI/NSF Standard 60. If the storage containers or shipping forms do not bear the appropriate seal, the inspector should refer to the lists of approved chemicals published by NSF and UL. Both of these lists can be accessed via the Internet at each company's website. A list of common chemicals and their uses is presented in Appendix C.

Several feed arrangements are possible depending on the chemical being fed. Regardless of the feed arrangement, all water systems must have redundant chemical feeders for critical treatment systems (i.e. necessary to protect public health). Scales or calibration columns must also be provided to ensure a consistent chemical feed rate and double check valve assemblies or air gaps on "make-up" water lines are necessary to ensure that there are no cross-connections.

For systems adding chlorine gas, there are specific regulations detailing the chlorine feed and chlorine storage room(s). In addition, a viewing window to allow the operator to view the chlorinator's operation without entering the room, and a chlorine leak detection and alarm system must also be provided.

Where chemical solution tanks are used, tank lids must be properly seated and secured to prevent contamination of the chemical solution and enhance operator safety. If dry chemicals are put into solution prior to injection, the inspector should observe the solution tank to see how much chemical has precipitated out. It is normal for some chemical precipitant to exist in the bottom of the solution tank. However, excessive buildup in the mixing tank may be a sign that the operator is adding too much chemical to the solution tank or that the mixer is not providing adequate agitation to keep the chemical in solution.

Some chemicals such as lime have a tendency to clog feed lines resulting in varying chemical concentrations in the finished water, therefore chemical feed lines must be accessible so that they may be cleaned when needed. Chemical feed lines must also be color coded and labeled

properly to include the pipe contents and the direction of flow. Various color schemes are used and almost any is acceptable as long as it is consistent throughout the water system.

For ground water systems raw water quality is usually stable. As a result, chemical feed rates and finished water quality remains fairly constant. The inspector should check to see if chemical feed rates are proportional to flow by comparing chemical use records with raw water pumping rates. Operators should also periodically verify that the chemical feed equipment is accurately feeding the proper amount of chemicals into the water.

Evaluation Criteria:

(N) A Not Applicable rating should be given for this item if a water system does not add chemical treatment.

(S) If the water system is adding approved treatment chemicals via a properly operated feed system in such a way to minimize the potential for contamination and to maximize operator and public safety, then this item should be rated Satisfactory.

(I) If the chemical feed lines are not color coded and labeled properly or the chemical feed equipment is not well maintained, then this item should receive a Needs Improvement rating.

(U) If the water system is adding treatment chemicals that do not meet ANSI/NSF Standard 60 requirements, or if chemicals are stored or fed in such a manner that allows for contamination to occur, the item should be rated Unsatisfactory and a significant deficiency should be given. This item may also be rated as a significant deficiency if there is inadequate application of treatment chemicals. Some common examples include, but are not limited to: inadequate feed control that results in inconsistent chemical dosing, severely leaking or spraying chemical feed points, or using a chemical that has not been approved by the Department. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

R.61-58.2 E (3): (Design Criteria), and R.61-58.7 B (15)-(16): (Operation & Maintenance) - NSF Requirement

R.61-58.2 E (2) (a): (Design Criteria) – Feeder design

R.61-58.2 E (2) (b): (Design Criteria) – Feed control

R.61-58.2 E (2) (c): (Design Criteria) – Cross-connection control

R.61-58.2 E (2) (f): (Design Criteria) – Solution tanks

R.61-58.2 E (2) (g): (Design Criteria) – Feed lines

R.61-58.2 D (2): (Design Criteria) - Chlorine Gas

R.61-58.7 B (9): (Operation & Maintenance) - Chlorine Gas

R.61-58.7 B (13): (Operation & Maintenance) – Chemical Dosage

6. Chemical Storage & Handling

Purpose:

The purpose of this item is to ensure that a sufficient supply of chemicals are available on-site and that these chemicals are properly stored and handled.

Inspection Guidelines:

Chemical Storage

A water system that provides chemical treatment must properly store chemicals to ensure the safety of operators and equipment, and to ensure that the chemicals are not damaged or degraded. Common chemicals used for water treatment may be stored in dry, liquid or gaseous form. The amount of chemical required for treatment will dictate how the chemicals are stored. For example, a small water system may only need to keep two 150 lb cylinders of chlorine on hand to have a minimum of a three-day supply on site. However, a water system that treats more water may require several one-ton cylinders. The inspector should verify that at least a three-day supply of chemicals is stored on-site.

All stored chemicals should remain in sealed, labeled, and unopened shipping containers unless the chemical is transferred into an approved storage unit. Each form of chemical has unique storage requirements. Dry chemicals must be stored such that they will remain dry. The inspector should determine if the storage area is subject to flooding. Dry chemicals must be rotated as new shipments are received to ensure that they are used in approximately the same order as they are received. The inspector should ask how chemicals are rotated. The inspector should also determine if adequate ventilation is provided to control dust resulting from dry chemicals.

Liquid chemicals must be stored in properly labeled single-use containers. Adequate secondary containment capable of receiving and containing spills and overflows must be provided. This is often done with a raised curb, sump, or partial wall around the storage area. If more than one chemical is stored in a single containment area, the containment area must be capable of holding the volume of the largest holding tank. The inspector should verify that liquid chemicals are stored in proper containers and that adequate secondary containment is provided. Another common method of secondary containment is containment pallets or other similar systems. If the chemical leaks out of the primary container, the containment pallet captures the spill without release. This is often common in older water systems that may not have room to provide other means of secondary containment.

Gaseous chlorine must be stored in a separate area that may be indoors or in a protected area outdoors. In either case, the inspector should verify that full and emptied gas cylinders are restrained to prevent overturning and are not exposed to direct sunlight or excessive heat. Chlorine cylinders are most often stored indoors in the chlorine feed room. In this situation, the room must be reasonably air tight and well lit. The inspector should verify that the room is

airtight by inspecting the weather stripping around the door and the room's overall condition. The room should also have a working manually controlled fan with louvers on the discharge side. There should also be inlet louvers located away from the outlet louvers to allow fresh air to be drawn into the room. The louvers and any doors must remain closed unless the room is occupied. The inspector should verify that the louvers are closed and that they open when the fan is turned on. Finally, a working chlorine leak detector and alarm for operator protection is required when gaseous chemicals are stored indoors.

When two or more chemicals are stored in close proximity, consideration must be given to the compatibility of these chemicals. For example, petroleum products and oxidants, such as diesel fuel and permanganate, should never be stored together. If these chemicals mix, a potentially explosive reaction may occur endangering operators and equipment. The table below outlines common chemicals that are not compatible.

Treatment Chemical:	**Incompatible Materials:**
Calcium Hypochlorite	Activated carbon, acids, turpentine, other organic or flammable materials
Caustic	Acids, and organic chemicals
Chlorine Gas	Anhydrous ammonia, turpentine, ether, finely divided metals, hydrocarbons (i.e. benzene or methane), or other flammable materials
Hydrofluosilic Acid	Metals
Phosphoric Acid	Metals, carbonates, alkalis
Potassium Permanganate	Activated carbon, gasoline, oils, phosphorous or flammable materials
Quicklime (CaO)	Alum, ferric sulfate
Sodium Carbonate (soda ash)	Strong Acids

Chemical Handling

The inspector should ask to see written procedures for handling chemicals. This should include provisions for disposing of empty bags, drums, or barrels and for the proper transfer of dry chemicals from shipping containers to storage bins or hoppers. These procedures should minimize the exposure of operators to dust from the chemicals. Usually, the personal protective equipment that the operators use is kept readily at hand in the same room or area where chemicals are handled. There should also be a documented procedure for measuring the appropriate quantities of chemicals for feed solutions to ensure consistency.

Evaluation Criteria:

(N) A Not Applicable rating should be given to systems that do not add chemical treatment.

(S) If an adequate supply of chemicals is stored on-site, procedures for properly measuring chemicals for feed solutions are documented, and the chemicals are stored properly, a Satisfactory rating may be given.

(I) If deficiencies that do not present an immediate risk are cited and the owner makes a commitment to correct them, a rating of Needs Improvement may be given.

(U) An Unsatisfactory rating should be given if chemicals are stored in a manner that presents a hazard. This could also constitute a significant deficiency if the magnitude of the problem(s) presents a public health threat. An Unsatisfactory rating may also be given if no action has been no taken to correct a previous Needs Improvement rating.

References:

R.61-58.2 E (2) (e): (Design Criteria) – Chemical storage

R.61-58.2 E (2) (h): (Design Criteria) - Chemical Handling

R.61-58.2 E (2) (i): (Design Criteria) - Chemical Handling

R.61-58.7 B (9) & (10): (Operation and Maintenance Criteria)

R.61-58.7 B (12): (Operation and Maintenance Criteria)

R.61-58.7 B (21): (Operation and Maintenance Criteria)

7. Chemical Injection Points

Purpose:

The purpose of this item is to confirm that chemical injection points are properly located to feed the chemical in a safe manner and does not interfere with other chemical addition.

Inspection Guidelines:

The inspector should determine if the chemical injection points are located to ensure the maximum chemical benefit with no adverse effect. The injection point may be directly into a discharge pipe, a mixing chamber, or a storage tank. All chemical injection points should be labeled and should have a consistent color code for each different chemical. Because all chemical lines are chemical specific, all injection points should also be dedicated to a specific chemical. One common exception is when a system feeds lime and chlorine. In this instance the operator may occasionally switch the lime feed line and chlorine feed line to help keep the lime feed lines free from excess buildup. All injection points located below-grade must be in a vault or similar structure.

When inspecting the chemical feed vault, the inspector should determine the spacing of the various chemical injection points to determine if adverse chemical reactions are taking place. Of particular concern is the spacing between the lime (calcium hydroxide) injection point and any sodium-based compounds (i.e., sodium carbonate or sodium fluoride). The distance between these injection points should be maximized because an insoluble precipitate may form if they are added in close proximity to each other. This will cause a build-up of precipitate in the storage facilities and increasing the usage of chemicals. Other items to look for in the vault are:

- Protection from the weather and unauthorized entry
- Drainage to a proper receptacle if chemicals are spilled
- Containment of chemical spills if drainage is not applicable
- The need for a sump pump to handle any water if the pit is subject to flooding or holding water
- Readily accessible injection points for inspection and maintenance.
- Sample taps should be located and maintained so that a well-mixed, representative water sample can be obtained following chemical addition.

Evaluation Criteria:

(N) A Not Applicable rating should be given for this item if the system does not add chemical treatment.

(S) If the chemical injection point(s) are properly color-coded & labeled, are protected from the weather and vandalism, are in good repair, and if the vault is properly maintained then a Satisfactory rating should be given.

(I) If the chemical injection points are not easily accessible, not adequately color-coded and labeled, or not properly protected from the weather and vandalism then a Needs Improvement rating should be given. In addition, if the chemical feed lines are damaged or the vault itself is poorly maintained, then a Needs Improvement rating should be given.

(U) An Unsatisfactory rating should be given if the following items are noticed: there is no access to the injection points, no chemical injection points are color coded/labeled, no protection from the weather or vandalism, or the vault is in poor condition. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

R.61-58.2 C (5): (Design Criteria)

R.61-58.2 C (6): (Design Criteria)

R.61-58.2 E (1) (b): (Design Criteria)

R.61-58.2 E (1) (c) (iii): (Design Criteria)

R.61-58.7 B (19): (Operation and Maintenance Criteria)

8. Filtration

Purpose:

The purpose of this item is to determine if water filtration units (including activated carbon, ion exchange and reverse osmosis) are properly maintained and operated.

Inspection Guidelines:

Generally, filtration treatment for ground water systems falls into three categories. The most common filtration treatment of ground water is the use of pressure filters for iron removal. Another treatment that is increasing in frequency is filtration with activated carbon to remove chemical contamination. In the coastal plains, membrane filtration technology is utilized for fluoride removal or removal of other impurities. The use of filters on ground water alters the finished water chemistry, sometimes significantly, and proper operation and maintenance are extremely important.

Most of the filtration facilities on groundwater systems are self-contained units (i.e. pressure filters). Therefore, the inspector will not be able to inspect the filters media. The primary items that do require inspection during the survey are the pipes, instrumentation, the external condition of the filters, and the backwash system. All instrumentation on the filters should be in good repair and operational. Operators should periodically verify the filtration instrumentation accuracy.

During the inspection of the backwash system the first item to review is the filter backwash protocol. The protocol should list the step-by-step procedure for a backwash cycle, the duration of the filter wash, and if the filter has rewash or filter-to-waste capability. The backwash determining criteria (i.e. headloss, turbidity, or filter run times) should be reviewed to make sure the filters are not being operated in a way that adversely affects the water quality. Other items the inspector should discuss are whether the filters are operated on an automatic or manual backwash cycle and how the wastewater is handled.

Complying with manufacturers' recommendations for filter operations is the key to maintaining and operating a contained filter unit. Although there is little to see with the contained units, the following documents require review: water quality records that show filter performance such as turbidity, particle count, iron levels; filter run times; "down time" inspections, where the filter is opened and inspected by a qualified technician; and backwash procedures. For some media types like activated carbon or greensand, the media must be replaced or reactivated. Records must be maintained if media change out is required.

For membrane filtration systems, the inspector should make sure that the units are in good physical condition. The inspector also needs to determine how the reject or wastewater is handled, and if the backwash procedures or cleaning procedures are adequate. Unfortunately, the inspector will be at a disadvantage when inspecting a membrane or reverse osmosis system for the first time due to the uniqueness of these systems and the variations in manufacturers. The

inspector will have to rely on the operator and manufacturers' literature for proper operational requirements.

Evaluation Criteria:

(N) A Not Applicable rating should be given if filtration treatment is not provided.

(S) A Satisfactory rating should be given if the filters are operated and maintained according to manufacturers' recommendations and they provide adequate treatment of the raw water and appropriate records are maintained.

(I) A Needs Improvement should be given if the filters are operating properly but not according to manufacturers' recommendations.

(U) An Unsatisfactory rating should be given if the filters are not maintained, if water quality is not improved with the treatment, or if no records are kept. An Unsatisfactory rating may also be given and the system should referred to enforcement if the media is nor changed out according to schedule. (More than likely, the system is under an enforcement order to maintain treatment because of source water chemical contamination). An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

R.61-58.2 C (10): (Design Criteria)

R.61-58.7 B (6): (Operation and Maintenance Criteria)

R.61-58.7 B (12): (Operation and Maintenance Criteria)

R.61-58.7 B (13): (Operation and Maintenance Criteria)

R.61-58.7 B (15): (Operation and Maintenance Criteria)

R.61-58.7 B (16):(Operation and Maintenance Criteria)

R.61-58.2 (D) (1): (Design Criteria)

R.61-58.7 (D) (3): (Operation and Maintenance Criteria)

9. Equipment Maintenance

Purpose:

The purpose of this item is to ensure that the treatment equipment is being properly maintained. All treatment systems must be operated and maintained in accordance with the public water system's construction and operating permits and/or any modifications subsequently approved by the Department.

Inspection Guidelines:

Manuals and Records

The inspector should ensure that written maintenance procedures are available to the personnel responsible for inspection and repair of the equipment. For single unit treatment processes, these procedures may be in the form of a manual written by the equipment manufacturer. For multiple unit treatment processes, or in cases where the manufacturer's procedures are inadequate or confusing, site-specific procedures for routine inspection and maintenance of the equipment must be developed and followed.

The inspector should ask to see maintenance records for each treatment component. These records should include documentation of preventive maintenance, and routine inspections of the treatment component. The frequency of inspection shall be at least as often as recommended by the equipment manufacturer, or as often as necessary to maintain proper operation.

Facilities

The appearance of chemical feed equipment is often the best indication of how well the equipment is operated and maintained. Equipment that is extremely dirty and has excessive grease or chemical caked around moving parts is probably not well maintained. However, it is not practical to keep some chemical feed equipment "spotless." When evaluating the chemical feed facilities, the inspector should consider the type of chemical that is being fed, its storage and handling characteristics, and if needed repairs are affecting the safety of the public water supply and/or water system operator(s). Each component of the treatment system must be in operable condition, and repairs must be made in accordance with the construction and operating permits, unless otherwise approved by the Department.

Spare Parts/Backup Equipment

Spare parts and/or backup units must be available for all components of the treatment process that are subject to wear and damage. Any component that is critical to the safety or adequacy of the public water supply should be immediately available. Such items need to be in stock at the water system because quick delivery of spare parts from an outside source may be unreliable. Components that are not critical to the water system do not need to be in stock, but the

appropriate repair and parts manuals must be on hand so that the equipment can be repaired in a reasonable amount of time.

Evaluation Criteria:

(N) A rating of Not Applicable should be given to systems that do not add treatment.

Manuals and Records

(S) If the written maintenance procedures appear to be appropriate for the complexity of the system, and all maintenance records are in order and up to date, then the manuals and records may be rated Satisfactory.

(I) If written maintenance procedures are provided that do not appear to be appropriate for the complexity of the system, a rating of Needs Improvement should be given. If maintenance records are kept, but are out of date, a rating of Needs Improvement should also be given.

(U) If written operating procedures are not provided, or if maintenance records are not kept, then a rating of Unsatisfactory should be given.

Facilities

(S) If each component of the treatment system is in operable condition and appears to be properly maintained, then a rating of Satisfactory should be given.

(I) If each component of the treatment system is in operable condition, but one or more components do not appear to be properly maintained, then a rating of Needs Improvement should be given.

(U) If any component of the treatment system is not operable, or it is being maintained in an unsafe or unreliable manner, then a rating of Unsatisfactory should be given.

Spare Parts/Backup Equipment

(S) If spare parts and/or backup units are stocked or are readily available for each component necessary for operation of the water system, and repair manuals are on hand for the remaining treatment components, then a rating of Satisfactory should be given.

(I) If spare parts or backup units are stocked or are readily available for each necessary component, but no parts manuals or spare parts are on hand for other treatment components, then a rating of Needs Improvement should be given.

(U) If neither spare parts nor backup units are stocked for components necessary for the operation of the water system, then a rating of Unsatisfactory should be given. Typically, this rating would be reserved for a circumstance where failure of a component would jeopardize the safety or reliability of the public water supply due to the lack of spare parts or backup units.

Overall Rating

The overall rating should reflect the lowest rating given for the categories listed above. If an Unsatisfactory rating is warranted for any element listed in the Inspection Guidelines, then the item should be given an overall rating of Unsatisfactory. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

R.61-58.2 C (7): (Design Criteria)

R.61-58.2 C (9): (Design Criteria)

R.61-58.7 B (1): (Operation and Maintenance Criteria)

R.61-58.7 B (7): (Operation and Maintenance Criteria)

R.61-58.7 B (8): (Operation and Maintenance Criteria)

DISTRIBUTION

10. Water Quality* Significant Deficiency Item

Purpose:

The purpose of this item is to ensure that a water system consistently produces water that complies with established water quality standards.

Inspection Guidelines:

Prior to the on-site inspection, the inspector should review previous monitoring results and compliance records. Compliance monitoring results from samples that Department staff collects are mailed to each water system and copied to the Regional offices. In addition, the data are posted to the EFIS database. If the results cannot be located, the compliance monitoring manager in the Central Office may be able to help. A listing of primary and secondary Maximum Contaminant Levels (MCLs), Maximum Contaminant Level Goals (MCLGs), and Maximum Residual Disinfectant Levels (MRDLs) for drinking water is included in Appendix D. Any primary or secondary MCL violations should be noted and should be discussed with the owner or their representative during the survey.

In addition to providing drinking water that complies with established MCLs, it is important that water be aesthetically pleasing. Water should be relatively clear, colorless, and free of objectionable tastes and odors. It should not stain or corrode plumbing fixtures, clothes, or piping. In order to determine if the water is acceptable to consumers, the inspector should review customer complaints. While every water system will occasionally experience a water quality problem, a pattern of continued complaints can be indicative of larger problems. In these cases, the system should have a plan in place to reduce subsequent complaints.

The inspector may also want to perform field tests or collect samples for laboratory analysis to better evaluate water quality. In low flow areas, parameters such as pH, disinfectant residual, and total coliform will provide an indication of overall water quality. A metals analysis may be helpful in areas that experience problems due to high iron or manganese levels. If the system adds fluoride, the inspector may want to do a fluoride analysis to verify that the optimum fluoride concentration of 0.8 mg/L to 1.2 mg/L is being maintained.

Evaluation Criteria:

(N) A Not Applicable rating should not be given for this item.

(S) This item should be rated as Satisfactory if a system has complied with all primary and secondary MCLs and has not received an unreasonable number of customer complaints relating to water quality.

(I) A Needs Improvement rating may be given to a system that has violated a primary or secondary MCL, but has taken steps to reduce the likelihood of any future violations. The seriousness of a violation, potential health implications, and compliance history must be taken into account when evaluating this item. If the inspector determines that the violation does not warrant a significant deficiency rating, then a Needs Improvement rating should be given.

(U) An Unsatisfactory rating may be given to a system that violates one or more primary or secondary MCLs or has a history of numerous customer complaints due to the water quality. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey. This item would be considered a significant deficiency when there are health-related water quality problems in the distribution system. Some examples include Total Coliform Rule violations, disinfection byproducts violations, or other persistent chemical MCL violations. If this is determined to be a significant deficiency, an enforcement referral should also be made. An MCL violation that is already being addressed through the normal enforcement process would not be considered a significant deficiency.

References:

R.61-58.2 B (2): (Design Criteria)

R.61-58.5 B - (MCLs for Inorganic Chemicals)

R.61-58.5 D – (MCLs for Organic Chemicals)

R.61-58.5 F – (MCLs for Microbiological Contaminants)

R.61-58.5 H – (MCLs for Radionuclides)

R.61-58.5 J – (MCLG for Radionuclides)

R.61-58.5 N – (MCLs for Volatile Synthetic Organic (VOC) Chemicals)

R.61-58.5 P – (MCLs for Disinfection Byproducts (DBPs))

R.61-58.5 Q – (MRDLs for Disinfectants)

R.61-58.5 R – (Secondary MCLs)

R.61-58.5 AA – (Treatment Techniques)

11. Adequate Pressure

Purpose:

The purpose of this item is to ensure that adequate water pressure is available to minimize the potential of contamination from cross-connections and to reduce customer complaints.

Inspection Guidelines:

A water system must maintain adequate pressure in the distribution system. The State Primary Drinking Water Regulations require that a minimum pressure of twenty-five (25) psi be maintained at every customer's tap during peak demand periods. In addition, twenty (20) psi must be maintained during unusually heavy flows (i.e. fire or flushing). The inspector should verify that adequate pressures are being maintained by reviewing system records, customer complaints, and/or by performing pressure tests.

A system that offers fire protection is required to perform flow tests on all hydrants at a minimum of once every three years. Hydrant flow test records must be available during the sanitary survey. The hydrant flow test results should indicate static pressure and residual pressure during fire flow conditions. The inspector should review these records to verify that the minimum residual pressures are being maintained during hydrant testing.

The inspector may review customer complaints to determine if there are problem areas. If a pressure problem is suspected, system pressure may be evaluated by performing pressure tests or installing pressure recorders at critical locations in the distribution system.

Evaluation Criteria:

(N) A Not Applicable rating should not be given for this item.

(S) If pressures greater than twenty-five (25) psi are being maintained during peak demands and twenty (20) psi is maintained during fire flow conditions (if applicable), then this item should be rated as Satisfactory.

(I) A Needs Improvement rating may be given for systems with minor pressure problems if the system management has committed to correcting them.

(U) An Unsatisfactory rating should be given to systems that do not maintain required distribution system pressures. Although, this item is not identified as a significant deficiency item, the item could be identified as a significant deficiency and referred to enforcement.

References:

R.61-58.4 B (2) (a): (Design Criteria)

R.61-58.4 D (15) (b): (Design Criteria)

R.61-58.6 C (8): (Reports Criteria)

R.61-58.7 E (7): (Operation and Maintenance Criteria)

12. Disinfectant Residual

Purpose:

The purpose of this item is to ensure that systems that add a disinfectant to their drinking water maintain an adequate residual at all points in the distribution system.

Inspection Guidelines:

Each public water system that adds a disinfectant during the treatment process must maintain a disinfectant residual at all points within the distribution system. The inspector should collect and analyze disinfectant residual samples in areas of the distribution system where low disinfectant residuals would be expected or have historically been found. Low disinfectant residual levels or the absence of a residual in the distribution system can lead to a number of water quality problems. The inspector should review Department files to make sure that the system has not been directed through an enforcement order to add a disinfectant. As a requirement of the ground water rule, if the system adds disinfection as a corrective action, the Department must set a minimum residual to ensure proper inactivation of microbial contaminants. If the system has been directed to add disinfection, the inspector should consult with either the Central Office drinking water compliance or drinking water enforcement sections.

Evaluation Criteria:

(N) A Not Applicable rating should be given for this item if a disinfectant is not added to the water.

(S) If adequate disinfectant residuals are maintained throughout the distribution system, then a Satisfactory rating should be given for this item.

(I) If the system generally maintains an adequate residual at most points in the distribution system, but has isolated areas that often have very low or no disinfectant residuals, then a Needs Improvement rating may be given for this item.

(U) If a system fails to maintain an adequate disinfectant residual in the distribution system, then an Unsatisfactory rating should be given for this item. This item can also be found to be a significant deficiency if the water system is failing to provide treatment as required through an enforcement order. If the item is rated as a significant deficiency, the overall survey should be rated unsatisfactory and referred to enforcement. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

R.61-58.2 D (2): (Design Criteria)

R.61-58.16 G (3): (Ground Water Rule: Treatment Technique Requirement)

13. Cross Connection Control

Purpose:

The purpose of this item is to ensure that the water system has a program in place to identify and eliminate cross-connections between the public water system and possible sources of contamination.

Inspection Guidelines:

There will be some difference in the complexity of cross-connection control programs for small systems and large systems. The term "small system" in this context means any system that has only residential customers, such as a trailer park or subdivision. The term "large system" is meant to include any system that has commercial or industrial customers. The Department requires that a system's cross-connection control program be at least as stringent as the Department's guidelines, but the system has the authority to establish more stringent guidelines, as it deems necessary.

Large Systems

When surveying a large system, the inspector should ask to see the written cross-connection program. The written program should state how the system intends to identify existing cross-connections and prevent new ones form being created. The written program should also clearly state the system's policy for selection, installation and annual testing of Double Check Valve Assemblies (DCVA) and Reduced Pressure Backflow Preventers (RP).

The inspector should also ask to see the system's files on testable devices (DCVAs and RPs). When examining the system's records on testable devices, the inspector should randomly select a few files and ensure that the most recent test date is not more than one year old. The inspector should also check for easily identifiable commercial and industrial customers who should have a testable device installed. For example, if files do not exist for institutions such as carwashes, dry cleaners, shopping centers, schools and mortuaries, which typically require testable devices, then the system has probably not been thoroughly surveyed for cross-connections.

Small Systems

Small public water systems must also establish and maintain a viable cross-connection program. However, the necessity of a written program will depend upon the circumstances of the particular system. Many systems choose to protect themselves by installing a residential dual check at every service connection. This device requires no annual test, is easy to install, relatively inexpensive and is reliable. The inspector should recommend this practice to any system that does not already do so. The inspector should also ask questions of the appropriate personnel to determine if they understand what a cross-connection is and the hazard that it can present to the system.

Another aspect of the program that the inspector should verify is the water system's residential lawn irrigation policy. Water system programs vary statewide, but all should be written and reviewed by the drinking water compliance section in the Central Office. This is another area that the individual system requirements may be more stringent than the Department's.

The benefits of a proper cross-connection control program far outweigh the required investment. The system is ultimately responsible for the safety of its customers and the protection of its distribution system from contamination. If a system requires assistance in implementing or revitalizing a cross-connection control program, the Department has a program devoted to training certified testers and offering assistance to water systems.

Evaluation Criteria:

(N) A rating of Not Applicable should not be given for this item.

(S) If the system has identified and protected all cross connections within their distribution system, utilizes backflow prevention devices, and maintains records ensuring all testable devices are tested annually, then a rating of Satisfactory should be given.

(I) If the system has a cross-connection control program in place, but does not keep adequate records or is missing some component of its program, then a rating of Needs Improvement should be given.

(U) If the system does not have an adequate cross-connection control program in place, then a rating of Unsatisfactory should be given. This item can also be found to be a significant deficiency if the condition of the program (or lack of program) represents a public health risk. If this item is found to be a significant deficiency, the overall survey should be rated Unsatisfactory and referred to enforcement. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

R. 61-58.4 D (14): (Design Criteria)

R. 61-58.7 F: (Operation and Maintenance Criteria)

14. Fire Flow

Purpose:

The purpose of this item is to ensure that the water system can provide adequate flow to protect the integrity of their water system when fire protection is provided.

Inspection Guidelines:

Water systems should confirm their ability to provide fire protection by flow testing each fire hydrant a minimum of once every three (3) years. Often there is a joint effort with the local fire departments to conduct these flow tests. If not, the water system should inform the fire departments of their flow test results. This is usually accomplished through color-coding the bonnets of hydrants (see item 15, Valve/Hydrant Maintenance).

The inspector should review the water system's flow testing records and note any substandard hydrant or areas in the distribution system that have low to moderate flows. The minimum flow required for fire protection is 500 GPM (the addition of 1/5 maximum instantaneous flow used for design purposes is not included here since the system is usually under normal operating conditions during the flow test). These records should include the time and date of flow test, hydrant location, size of line serving hydrant, flow result in gallons per minute (GPM), static and residual pressures, and duration of test in minutes.

The inspector should request that water system personnel randomly perform routine flow tests on any substandard hydrants. This will enable the inspector to evaluate the accuracy of the system's test results and testing equipment and observe the system's testing procedures. The inspector should also request that flow test on hydrants that he or she suspects may be substandard, such as those located in dead end areas or at higher elevations, be performed as well.

Evaluation:

(N) A Not Applicable rating should be given for this item if a water system does not provide fire protection.

(S) If a water system is flow testing each fire hydrant a minimum of once every three (3) years and maintaining current records, and if these records indicate that the system is producing adequate flows to protect the integrity of the water system, i.e., flows greater than 500 GPM, then this item should receive a Satisfactory rating.

(I) If a water system has adequate flows but has let flow tests lapse past the three year period for several fire hydrants, if the flow test records do not indicate the appropriate information, or if the water system does not color code their hydrants, then this item should receive a Needs Improvement rating.

(U) If a water system has inadequate flows or if a water system does not maintain flow test results, then this item should receive an Unsatisfactory rating. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

R.61-58.4 D (4) (b):(Design Criteria)

R.61-58.4 D (9) (a): (Design Criteria)

R.61-58.7 E (10): (Operation and Maintenance Criteria

15. Valve & Hydrant Maintenance

Purpose:

The purpose of this item is to ensure that a system's valves and hydrants are being maintained such that they may be located and operated as needed.

Inspection Guidelines:

Valve Maintenance

Properly operating valves are critical when a portion of the distribution system must be isolated, such as when a line break occurs. A valve maintenance program extends valve life and results in long term savings to the system. A water system must have a program for inspecting, exercising, and maintaining system valves. During the survey, the inspector should ask to see the written valve maintenance program. At a minimum the program should include the following components:

- An updated system map indicating the location and identification of all valves,
- Documentation of valve type, date of last exercise, number of turns to close, and a record of maintenance work for each valve,
- A schedule for regular exercise and routine maintenance,
- Documentation that valves are being exercised in accordance with the valve maintenance plan and that necessary maintenance is being performed.

An accurate and complete system map (Item 18 – System Map) is essential to both the valve and hydrant maintenance programs. This map should indicate all distribution lines, line sizes, valve locations, hydrant locations and corresponding valve and hydrant numbers. The map is critical if valves are to be located in a timely manner during an emergency. The program should include a schedule for exercising valves and performing maintenance. This may simply be a statement of how often and in what order valves are exercised. A review of valve records will indicate whether the program is being executed according to the plan. Records of the size, type, date of last exercise, number and direction of turns to close, and maintenance work for each valve must also be maintained.

Many small systems simply devote a single page for each valve that includes all pertinent information and a sketch of the valve location relative to intersection, hydrants, or property lines. The inspector should ask whether the records are updated as the system grows. Procedures for exercising valves and performing routine maintenance are also recommended to ensure consistency. These may include procedures for establishing traffic control, for notifying appropriate personnel if change-out is required, etc. Appendix E contains a worksheet for valve exercise and a typical valve card that may be helpful to systems working to establish a program.

Hydrant Maintenance

Properly operating hydrants are essential for fire protection and insurance purposes. In addition, a water system may be held liable if hydrants do not operate properly in emergency situations. A proper hydrant maintenance program will ensure that hydrants are operational, that adequate fire flow and pressure is available, and identify any necessary maintenance. At a minimum, a hydrant maintenance program must include the following components:

- An updated system map showing the location and number of all hydrants,
- A schedule for flow testing and performing routine maintenance,
- Documentation of hydrant type, date of installation, and a record of maintenance work performed for each hydrant,
- Documentation indicating that necessary maintenance is being performed.

Usually the same map is used for the valve and the hydrant maintenance programs. A schedule for the regular inspection and flow testing of fire hydrants is also required. The American Water Works Association (AWWA) recommends color-coding hydrant bonnets based on the available flow. The recommended color code is shown in the table below.

Bonnet Color	**Available Fire Flow**
Black or Bagged	Out of Service Hydrants
Orange	500-1000 gpm @ 20 psi
Green	1000 - 1500 gpm @ 20 psi
Light Blue	> 1500 gpm @ 20 psi

Some systems use a different color scheme that is set by the local fire department. This is an acceptable alternative as long as it is consistent. As with the valve maintenance program, certain documentation is required. There should be records of hydrant type, date of installation, maintenance work, and most recent flow test results. Procedures for performing hydrant maintenance and flow tests should also be available. Appendix E contains typical procedures for performing routine hydrant maintenance and flow testing which may be helpful to systems establishing a hydrant maintenance program.

Evaluation Criteria:

(N) A Not Applicable rating may given to very small water systems with a limited number of valves and no hydrants.

(S) A Satisfactory rating should be given to a system without fire protection if its valve maintenance program includes the essential components listed in the inspection guidelines.

If a system offers fire protection, a Satisfactory rating should be given if the system has an acceptable valve maintenance program and has a hydrant maintenance program that includes all of the essential components listed in the inspection guidelines.

(I) A Needs Improvement rating may be given if a system is committed and actively working to establish maintenance program(s), but is missing one or more components.

(U) An Unsatisfactory rating should be given if a system has no valve and/or hydrant maintenance program(s) or the documentation exists but the program is not being executed. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

R.61-58.7 E (9): (Operation and Maintenance criteria)

16. Flushing Program

Purpose:

The purpose of this item is to ensure that the system's routine flushing program is adequate to help prevent customer complaints and water quality problems associated with stagnant, discolored, and sediment-laden water. An added benefit of an active flushing program is that it helps to maintain a disinfectant residual throughout the distribution system.

Inspection Guidelines:

There are two distinct types of flushing programs recommended for public water systems: 1) A system wide flushing, where scouring velocities are maintained to clean the water line, and 2) The low velocity flushing used to maintain chlorine residuals in the distribution system. Both of these flushing methods are important for the water system and are required by the State Primary Drinking Water Regulations. In order to determine the flow required to achieve scouring velocities for different lines sizes, refer to the chart given in Appendix A.

The first item to review in any flushing program is the map of the distribution system. A second, and equally important item to review is the flushing records. These records should include the date, time, location, velocities, total flushing time, size and length of line, flow rate, time to clear, volume of water used, chlorine residuals, and other relevant information. The inspector's review of this data is very important in determining the effectiveness of the flushing program.

Another item that the water system should maintain and use with their flushing program is past water quality reports and complaint records. These two items are good indicators of whether or not an adequate flushing program is being conducted. However, a water system should not simply flush the system as a response to water quality complaints.

Restaurants and small businesses may not be required to implement a formal flushing program. The inspector will have to use his or her own judgment when determining the need for, and adequacy of, a flushing program for these types of systems. If a system is having water quality problems, such as iron, manganese, or sediment in their finished water, or if the system allows water to sit in the line for extended periods of time with little or no usage, then a flushing program may be warranted.

Evaluation Criteria:

(N) A Not Applicable rating should not be given for this item unless the inspector determines that a formal flushing program is not required.

(S) If the water system has a formal, written flushing program that includes a systematic plan for flushing the entire distribution system, and maintains records that address the adequacy of the program, then the system should be given a Satisfactory rating.

(I) If the system seems to have an adequate flushing program, but does not maintain a written plan or flushing records, then a Needs Improvement rating should be given.

(U) If the water system does not retain flushing records, only flushes when complaints are received, or does not maintain water quality, an Unsatisfactory rating should be given. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

R.61-58.7 E (13): (Operation and Maintenance Criteria)

17. Leak Detection & Repair

Purpose:

The purpose of this item is to ensure that the water system is actively searching for water line leaks and using sanitary practices to repair those leaks.

Inspection Guidelines:

The inspector should determine if the water system is carrying out a leak detection and repair program on a continuous basis. Depending on the size and complexity of the water system various components of this program could include the following:

Leak Detection

Water Audit: A water audit is a comparison of the amount of water produced with the amount of finished water sold plus the amount of water used for flushing procedures, fire fighting activities, etc. Some systems have staggered billing cycles and the consumption records may fluctuate from month to month. Therefore, an average loss should be calculated monthly over at least a one (1) year period. Keeping the average loss to no more than 10% is what water systems should strive for.

Visual Inspections: System personnel should report any leaks that are noticed during routine distribution maintenance. Low lying areas are good places for system personnel to focus their attention on because line breaks are more likely to occur in lower areas in the distribution system where the pressure is greatest.

Audible Inspections: Listening devices can be placed on fire hydrants, valves or directly on the ground over a water line to determine if there are leaks. These devices can be as simple as a metal or wooden rod or as sophisticated as a hydro-phonic probe equipped with an amplifier. Sometimes, water systems may have an agreement with a neighboring utility or private contractor so they may lease or share more expensive devices.

Leak Repair

Leak repair procedures must be fully documented, and various methods can be approved as long as adequate disinfection is achieved. The AWWA recommends that a repaired section of pipe should be filled with a solution containing a chlorine residual of 200 mg/L. This solution should be allowed to stand in the pipe for two (2) hours and then flushed out. For most water systems this method is not practical due to time constraints and system demands. An alternative method is to swab the inside of the pipe with the same chlorine solution.

The most common deficiency noted under this item is the lack of adequate record keeping. Systems will usually generate a work order for all line repairs, but the actual repair procedures are usually left off of the work order. The inspector should recommend that the leak repair form

include the date the repair was made, the location of the leak, the size of the line repaired, the disinfection method, the flushing procedures, and the resulting chlorine residual. If performed, a copy of the bacteriological monitoring results and the estimated amount of water lost due to the leak should also be included. In conjunction with this report form, the amount of water lost due to the leak and the amount of water due to flushing should be incorporated into the water audit.

Evaluation Criteria:

(N) A Not Applicable rating may be given to small water systems that generally experience few leaks and contract others to perform line repair.

(S) If a water system is using appropriate methods to identify and repair leaks, and if these procedures are well documented, then this item should be rated Satisfactory.

(I) If a water system is trying to identify leaks, but they do not have a written program for repairing leaks or adequate records documenting their repair procedures, then this item should receive a Needs Improvement rating. This item may also be rated Needs Improvement if the system has a good program but an unacceptably high percentage of unaccounted for water (i.e. > 15%).

(U) If a water system has an unusually high percent of water loss (greater than 25%), does not have an active leak detection program. This item may also be found to be a significant deficiency if there is no emphasis placed on practicing sanitary procedures when repairing leaks. The inspector will need to determine whether there is a public health risk in this instance. If the item is identified as a significant deficiency, the overall survey rating should be Unsatisfactory and referred to enforcement. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

R.61-58.7 E (11): (Operation and Maintenance Criteria)

R.61-58.7 E (12): (Operation and Maintenance Criteria)

R.61-58.7 B (2) (j): (Operation and Maintenance Criteria)

18. Water Audit

Purpose:

The purpose of this item is to ensure that the water system: (1) has a water audit program in place to properly account for the amount of water it distributes as being either consumed or lost, and (2) uses its audit program to control its water loss.

Inspection Guidelines:

The inspector should determine if the water system is implementing a well-documented water audit program on a routine basis, and if the system is using the program to control its water loss.

The preferred audit methodology is the Water Audit Methodology as developed by the International Water Association and the American Water Works Association. This methodology uses a water balance approach that is shown in the table below. All water systems should compare the volume of water they distribute (column 3) with the sum of customer consumption and losses (column 4). Losses are either apparent or real. Apparent losses (theft, meter & billing accuracies) are losses of revenue from water that reaches the customer. Real losses (leaks, overflows) are losses of water that do not reach the customer. Large systems should track all of the consumption and loss categories in column 5, and small systems should track all that apply. Some of these values will be known and some will have to be estimated.

Water Balance Table

<table>
<tr><td rowspan="13">Water from own sources (corrected for known errors)</td><td rowspan="14">System Input Volume</td><td>Water Exported</td><td rowspan="4">Authorized Consumption</td><td rowspan="3">Billed Authorized Consumption</td><td>Billed Water Exported</td><td rowspan="3">Revenue Water</td></tr>
<tr><td rowspan="13">Water Supplied</td><td>Billed Metered Consumption</td></tr>
<tr><td>Billed Unmetered Consumption</td></tr>
<tr><td rowspan="2">Unbilled Authorized Consumption</td><td>Unbilled Metered Consumption</td><td rowspan="9">Non-revenue Water</td></tr>
<tr><td>Unbilled Unmetered Consumption</td></tr>
<tr><td rowspan="9">Water Losses</td><td rowspan="3">Apparent Losses</td><td>Unauthorized Consumption</td></tr>
<tr><td>Customer Metering Inaccuracies</td></tr>
<tr><td>Systematic Data Handling Errors</td></tr>
<tr><td rowspan="4">Real Losses</td><td>Leakage on Transmission & Distribution Mains</td></tr>
<tr><td>Leakage & Overflows at Storage Tanks</td></tr>
<tr><td>Leakage on Service Connections up to Point of Customer Metering</td></tr>
<tr><td>Water Imported</td></tr>
</table>

American Water Works Association *Free Water Audit Software* ©

Water systems are encouraged to download and use the AWWA free water audit software to aid in completing and interpreting water audits. The free software can be found at: http://www.awwa.org . For guidance on using the free software and comprehensive auditing procedures, AWWA has published M36, *Water Audits & Loss Control Programs*.

Indicators of water system performance:
After a water system completes the water audit, the results should be used to determine system performance indicators. The AWWA water auditing software calculates several performance indicators that are system specific. Because each system is different, it is neither useful nor meaningful to compare performance indicators across different systems. Once a water system has begun the water auditing and loss control process, it is important for the system to seek to reduce its water losses (real and apparent) to the extent possible.

Evaluation Criteria:

(N) A Not Applicable rating may be given to State and non-community water systems. A Not Applicable rating may be given to a Community water system with less than 100 taps.

(S) This item should receive a Satisfactory rating if a water system is using appropriate methods to perform a well-documented water audit on a routine basis, and is continually seeking to reduce the amount of water loss in its system.

(I) This item should receive a Needs Improvement rating if a water system routinely performs a water audit, but has not been trying to reduce water loss. A Needs Improvement rating can also be given if the water system has an incomplete auditing program either in consumption and losses accounted for, or in documentation.

(U) This item should receive an Unsatisfactory rating if a water system does not periodically perform a water audit. An Unsatisfactory rating may also be given if no action has been taken to correct a Needs Improvement rating for this item from a previous survey.

References:

R.61-58.7 E (11): (Operation and Maintenance Criteria)

R.61-58.7 E (12): (Operation and Maintenance Criteria)

R.61-58.7 B (2) (j): (Operation and Maintenance Criteria)

19. System Map

Purpose:

Each system must have a current and accurate map of the distribution system to aid in the proper operation of the public water system and to be able to respond to emergency situations.

Inspection Guidelines:

The inspector should ask to review the distribution system maps to ensure that accurate and updated information is maintained. System maps should include the following:

- All sources and treatment plants,
- Distribution lines, with sizes, & storage tanks
- Pumping facilities,
- Valves, hydrants and blow-offs.

The complexity and level of detail required for the system map may vary depending on the size and type of water system. For the simplest types of systems, like a restaurant with a single service line, a sketch showing the location of service line and the shut-off valve is needed. For most community water systems, a detailed map that is drawn to scale is required. The inspector should use their best judgment to determine if the level of detail provided is adequate for the type and size of system being inspected.

Evaluation Criteria:

(N) The Not Applicable rating should not be given for this item.

(S) A Satisfactory rating should be given if the system map is drawn in adequate detail for the system and includes all of the applicable elements listed.

(I) If a system has a map of the distribution system, but it does not include the necessary components, or is not regularly updated, then a Needs Improvement rating should be given.

(U) If a system does not maintain an adequate system map, then an Unsatisfactory rating should be given. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

R.61-58.7 E (8): (Operation & Maintenance Criteria)

STORAGE

20. Protection from Contamination* Significant Deficiency Item

Purpose:

The purpose of this item is to ensure that all finished water storage tanks are properly protected against contamination.

Inspection Guidelines:

All openings that could potentially allow access to water contained in a finished water storage tank must be properly screened or sealed to prevent the entrance of insects, birds or other small animals. This item is especially important in ground water systems since there is usually no further treatment provided. Properly operated pressure tanks should always be under positive pressure so they are usually not susceptible to contamination from outside sources. Therefore, this item generally applies only to atmospheric tanks.

When inspecting atmospheric storage tanks, the inspector should locate the overflow discharge pipe and verify that a counter-weight flapper check or an insect screen protects it. If a screen is used to protect the discharge pipe, then it should be in good condition and be securely attached. When a flapper check is used, it should seat securely against the discharge pipe to form a reasonably tight seal when water is not being discharged. An overflow pipe should not discharge directly into a sanitary sewer or storm drain without a variance from the Department.

Climbing of elevated storage tanks by Department personnel is not practiced. Because of this, the inspector should ask for documentation that the roof vent screen(s) and access hatch have been checked to ensure that they are intact and locked respectively. Documentation may include photographs of these openings or a signed inspection report or invoice from a tank maintenance contractor. These inspections should be conducted annually. Another common area of concern is the point where the level indicator enters the storage tank.

For atmospheric ground storage tanks, the inspector should walk around the entire perimeter of the tank (if accessible) to make sure that all openings are properly sealed. The inspector should also inspect the vent screens and access hatches or ask for documentation that the water system personnel have inspected them.

Evaluation Criteria:

(N) A rating of Not Applicable rating should be given for this item if the water system is a purchased (master metered) system and does not provide storage. A Not Applicable rating can also be given to water systems that only have pressure storage tanks.

(S) If all storage tanks have proper overflow protection, maintain documentation of annual inspections of all access hatches and vents and have no other unprotected openings, then a rating of Satisfactory should be given.

(I) If all required sanitary protection measures are in place, but have not been properly maintained (i.e. screens are torn or have fallen off), then a Needs Improvement rating should be given. A Needs Improvement rating may also be given if system conducts annual inspections, but fails to maintain documentation.

(U) If the system fails to provide proper sanitary protection of its storage tanks and the lack of protection has the potential to contaminate the water system, then this item should be identified as a significant deficiency and an Unsatisfactory Rating should be given. Some examples include improper sizing (volume), clogged pressure relief valve, or inadequate internal cleaning or maintenance of storage tanks. If the item is determined to be a significant deficiency, the overall sanitary rating should be Unsatisfactory and an enforcement referral made. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

R.61-58.4 C (2) (c): (Design Criteria)

R.61-58.4 C (2) (g) (iii): (Design Criteria)

R.61-58.4 C (2) (K): (Design Criteria)

R.61-58.7 E (5): (Operation and Maintenance Criteria)

R.61-58.7 E (6): (Operation and Maintenance Criteria)

21. Capacity

Purpose:

The purpose of this item is to verify that adequate finished water storage capacity is available to ensure service during emergency situations and to provide an available reserve during hours of peak usage.

Inspection Guidelines:

For Elevated Storage

According to design regulations, "Where fire flows are provided, tanks shall be sized to provide two (2) hours of supply for a combined flow of peak hour domestic plus fire flow; or, the storage capacity (or equivalent capacity) shall be equal to one-half (½) the maximum daily consumption, whichever is greater. Either requirement may be reduced when the source and treatment facilities have sufficient capacity with auxiliary power to supplement peak demands of the system." Since there are no Operation and Maintenance criteria given in the State Primary Drinking Water Regulations, the inspector may want to conduct a preliminary analysis using the given design criteria. Where available, it is best to use actual flow data taken from meter readings. However, where these numbers are not available, they may be estimated using formulas given in Appendix A.

Also, a history of marked pressure drops during heavy usage periods may indicate that the system is not providing adequate storage to meet the system demands. Often this kind of evaluation requires the use of 24 hr pressure recorders and may not be within the scope of a routine survey. Previous system pressure evaluations and records of recurring low-pressure complaints may be the best way to evaluate this item in some instances.

For Hydro-pneumatic Storage

According to design regulations, "For ... ground water systems where the pump yield equals or exceeds the instantaneous demand, the tank shall be sized so the pump cycles a maximum of six (6) times per hour. Where the pump yield is less than the instantaneous demand, the tank shall be sized to provide the difference for a minimum twenty (20) minute demand period based on the actual usable volume of the tank." Again, since there are no Operation and Maintenance criteria given in the State Primary Drinking Water Regulations, it is necessary for the inspector to evaluate qualitative criteria to determine if the system has adequate storage capacity. An indication of insufficient storage capacity is the frequent cycling of the pumps. If the pumps are cycling often, and it is determined that all the equipment is operating properly, then there may be a greater demand on the system than the tanks can supply.

Evaluation Criteria:

(N) A rating of Not Applicable should be given for this item to a purchased (master metered) system that does not provide storage.

(S) A Satisfactory rating should be given if adequate storage is provided based on the criteria given.

(I) A Needs Improvement rating should not be given for this item.

(U) An Unsatisfactory rating should be given if the water system has had low pressures due to lack of storage or low water levels.

References:

R.61-58.4 C (1) (a): (Design Criteria)

R.61-58.4 C (3): (Design Criteria)

R.61-58.4 C (4): (Design Criteria)

R.61-58.4 C (5): (Design Criteria)

R.61-58.4 C (5) (b): (Design Criteria)

R.61-58.7 D (12) (Operation and Maintenance Criteria)

22. Security

Purpose:

The purpose of this item is to ensure that all finished water storage facilities are properly protected against contamination due to vandalism, tampering and/or sabotage.

Inspection Guidelines:

All storage tanks must be secured against entrance by unauthorized personnel. The introduction of a contaminant at this stage, either accidentally or purposefully, could prove devastating to the water system since subsequent treatment is usually not provided. All access to the area surrounding a finished water storage tank should be restricted to the highest degree possible. All hatches as well as the perimeter fence gate should be locked. All elevated tanks should be equipped with an anti-climb device or should have at least one ten (10) foot section of ladder removed.

If the storage tank is located in a well-populated area where someone tampering with the tank could be observed, the inspector may decide that a perimeter fence is not required. Where a perimeter fence is provided, a minimum six (6) foot chain link fence with barbed wire capping is preferred. If a perimeter fence is not provided, all tank controls, hatches, pits and valves (if not located in valve pits) must remained locked at all times and the access ladder must be equipped with an anti-climb device. The most obvious sign of inadequate security is the presence of recent graffiti or vandalism on or around the storage tank. The inspector should note any signs of recent graffiti or vandalism and should consider it a sign of inadequate security.

Evaluation Criteria:

(N) A rating of Not Applicable should be given for this item to a purchased (master metered) system that does not provide storage.

(S) If all storage tanks are properly protected against vandalism, tampering or sabotage, then a rating of Satisfactory should be given for this item.

(I) If all necessary security measures are in place, but are poorly maintained (i.e. locks not in locked position, fences in need of repair), then a rating of Needs Improvement should be given.

(U) If adequate security measures are not provided, or if the inspector observes recent or repeated vandalism, then this item should be rated Unsatisfactory. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

R.61-58.7 C (17): (Operation and Maintenance Criteria)

23. Appurtenances

Purpose:

The purpose of this item is to ensure that the equipment necessary for the proper operation of a storage tank is present and in working order.

Inspection Guidelines:

Storage tanks can be divided into two primary categories: 1) hydro-pneumatic storage vessels, that use compressed air to maintain water pressure and 2) atmospheric storage vessels that either use elevation to maintain water pressure or simply store water that is later pumped into the system. Refer to the typical drawings in Appendix B for further detail.

All Tanks

Isolation / Bypass
All storage structures must be constructed so that they can be isolated from the distribution system for maintenance and repair. Some tanks are connected to the system by a single pipe that serves as both the inlet and the outlet. The inspector should check to ensure that an isolation valve is installed in the inlet/outlet line and should verify with the system representative that it is operational. For tanks with separate inlet and outlet lines, the inspector should ensure that an isolation valve is installed in each line, and that a bypass is provided so the water flow can be diverted around the tank in the event that it must be taken out of service. Most elevated tanks and all bladder type hydro-pneumatic tanks have a single inlet/outlet pipe; while most ground storage reservoirs, standpipes, clearwells and standard hydro-pneumatic tanks will have a separate inlet and outlet line.

Drains
All tanks must have an adequately sized drain so that the tank can be emptied by means other than the outlet piping to the distribution system. For very small captive air tanks, an isolation valve and spigot may serve as the tank drain.

Sample Tap
A sample tap must be provided on the outlet of all tanks and must be located on the tank side of the isolation valve or on the tank itself. The purpose of the sample tap is to allow water inside the tank to be sampled prior to putting the tank back into service after maintenance or repair. The inspector should make sure that the sample tap is present and is located so that a sample can be readily collected in an ordinary sample bottle.

Atmospheric Storage (Clearwells, Elevated Tanks, Ground Storage and Standpipes)

Overflow
Atmospheric storage tanks must have an overflow to ensure that the water level cannot rise above the design level. The end of the pipe should be between twelve (12) and twenty-four (24)

inches above the ground surface and should discharge over a drainage structure or a splash pad such that it can be observed from outside the fence.

Special Note: If the end of the overflow is not at an elevation between twelve and twenty-four inches, then the inspector must decide whether or not the current design warrants modification during the next tank maintenance. If the current design is satisfactory in that it can be easily inspected and poses no maintenance or operational problems, then the inspector may decide that modification is not warranted.

Vents
Atmospheric storage tanks must be properly vented in order to keep the structure from imploding in the event of rapid discharge from the tank. The overflow cannot be considered an adequate vent.

Level Indicator/Control
The inspector should ensure that a water level indicator is present and functional. Either electronic telemetry or mechanical float type level indicators may be used.

The inspector should also ensure that the water level could be properly controlled through the use of electronic telemetry, altitude valves or equivalent controls, as necessary. The proper water level must be maintained in each tank without overflow or stagnation of the water under normal operating conditions.

Hydro-pneumatic Storage Tanks

Air make-up system
The inspector should look for an air make-up system on all standard hydro-pneumatic tanks. The system will consist of device to put air into the tank, as well as an air volume control valve to expel excess air. Captive air (bladder) tanks do not require an air make-up system. Their air charge is preset and does not come into contact with water inside the tank.

One way to charge a standard hydro-pneumatic tank with air is to install an automatic drain in a section of pipe that opens when the well pump shuts off. Upon pump startup, the automatic drain valve closes, and the air in this section of pipe is forced into the tank to replace air that has been dissolved or lost to leakage. This arrangement is called a snifter or marble valve arrangement.

The other common way to get air into a standard hydro-pneumatic tank is to use an air compressor connected to the tank. The air compressor is typically located within a control building near the tank. It is extremely important that a properly operating pressure relief valve is installed on a tank that utilizes an air compressor. Excess pressure can cause a hydro-pneumatic tank to rupture or explode with destructive force. An air compressor is required on hydro-pneumatic tanks 2000 gallons and larger in size.

Pressure gauge
A functional pressure gauge must be provided on all hydro-pneumatic storage tanks. The inspector should ensure that the gauge is operational and that its scale is suitable for normal system pressures, i.e. the gauge should not be at its maximum or minimum reading under normal conditions.

Pressure relief valve
The inspector should ensure that all tanks are protected from excess pressure by a pressure relief valve. The pressure relief valve can be located on the wellhead piping on a single pump system that does not have an air compressor. On tanks with an air compressor, the pressure relief valve must be located on the tank side of the isolation valve(s) or on the tank itself. The pressure relief valve must be capable of discharging water at least as quickly as the pump can fill the tank. If the pressure relief valve seems unusually small for the system (e.g.: a one inch pressure relief valve on a tank with a six inch inlet), then the inspector should ensure that the valve is adequately sized.

Pressure switch
If a pump is associated with a hydro-pneumatic tank, a pressure switch for automatically starting and stopping the pump will be found on the piping between the tank and the pump. The inspector should ask what the on/off pressures are and should check to see if the pressure gauge reading is within this range. If the pressure reading is not within the specified range, the pressure switch needs to be adjusted.

Evaluation Criteria:

(N) A rating of Not Applicable should be given for this item to a purchased (master metered) system that does not provide storage.

<u>All Tanks</u>

(S) If all of the items in this category are present, operational and in good condition, then a rating of Satisfactory should be given.

(I) If all of the items in this category are present and operational but one or more is not in satisfactory condition, then a rating of Needs Improvement should be given.

(U) If either the bypass, drain or sample tap is not present or is not operational due to lack of maintenance, then a rating of Unsatisfactory should be given.

<u>Atmospheric Storage</u>

(S) If all of the items in this category are present, operational and meet the above guidelines, then a rating of Satisfactory needs to be given.

(I) If all of the items in this category are present, but a flapper or screen is missing, then a rating of Needs Improvement should be given. A rating of Needs Improvement should also be

given if the overflow needs to be modified during the next tank maintenance, but is otherwise satisfactory.

(U) If any of the above items are not present or not operational then a rating of Unsatisfactory should be given. This item may be found to be a significant deficiency if the condition of the overflow or vent is in any way endangering the safety of the public water supply. If the item is found to be a significant deficiency, the overall sanitary survey should be rated Unsatisfactory and an enforcement referral should be made.

Hydro-pneumatic Storage

(S) If all of the items in this category are present, operational and in good condition, then a rating of Satisfactory should be given.

(I) If all of the items in this category are present and in good overall condition, but a minor problem exists with a pressure gauge or pressure switch, then a rating of Needs Improvement should be given. For example, if the pressure switch needs adjustment or the pressure gauge appears to have been broken recently, but the system is still operating acceptably, then this rating should be used.

(U) If one or more of the items in this category is not present, but is required due to the design of the tank, then a rating of Unsatisfactory should be given.

Overall Rating

The overall rating should reflect the lowest rating given for the categories listed above. If an Unsatisfactory rating is warranted for any element listed in the Inspection Guidelines, then the item should be given an overall rating of Unsatisfactory. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

R.61-58.4 C (1)(b): (Design Criteria) Isolation Valves

R.61-58.4 C (1)(c): (Design Criteria) Level Controls

R.61-58.4 C (2)(f): (Design Criteria) Overflow

R.61-58.4 C (5)(d): (Design Criteria) Hydro-pneumatic Tanks

R.61-58.7 E (3): (Design Criteria) Drain

R.61-58.4 C (5)(d): (Design Criteria) Isolation Valves

24. Maintenance

Purpose:

The purpose of this item is to ensure that the water system's storage tanks are properly maintained to guarantee their good working condition.

Inspection Guidelines

The physical appearance of the outside of the storage tank is a good first indicator of proper maintenance. All metal surfaces should be free of rust and should have a consistent and even coating. Rust will usually occur at the welded, or in some cases, riveted seams of the metal panels that form the tank. If the seams show progressive rust, then there is a high probability that the interior of the tank is severely corroded as well. If advanced corrosion of the exterior of the tank is noticed, then the inspector should ask to see the results of the most recent interior inspection. In the case of elevated tanks, the system will usually have an independent company perform all routine tank maintenance. If a tank inspection has been done recently, then the inspector should review the findings and recommendations presented in the inspection report and ask if the water system plans to follow up on those recommendations.

The water system should be reminded that all paint coatings which are applied to surfaces which come into contact with potable water must be certified as meeting the specifications of the American National Standard Institute/National Sanitation Foundation International (ANSI/NSF) Standard 61, Drinking Water System Components - Health Effects. The system must notify the Department, in writing, ten (10) days prior to painting a storage tank.

Where hydro-pneumatic storage tanks are used, the operation of the air make-up system is also of concern. Hydro-pneumatic tanks should have approximately two-thirds water to one-third air ratio if operated properly. The inspector can determine the water level in the tank by touching the side of the tank and noticing where the tank feels cold or shows signs of condensation. There should be a distinct line of separation along the entire length of the tank, which indicates the air-water interface. This line should be approximately two-thirds of the way up the tank.

If the air-water interface is obviously less than two-thirds of the way up the tank, then the air volume control valve is likely malfunctioning. If the interface is more than two-thirds of the way up the tank or is not distinguishable, then the tank is probably waterlogged. If a tank is waterlogged then the pressure will drop significantly when the well pump or booster pump stops. On bladder tanks, a waterlogged tank usually indicates that the bladder has failed and the tank must be replaced.

Evaluation Criteria:

(N) A rating of Not Applicable should be given for this item to a purchased (master metered) system that does not provide storage.

(S) If all tanks appear to be in good condition and all appurtenances are calibrated and maintained on a routine basis to ensure their proper operation, then this item should receive a Satisfactory rating.

(I) If it can be verified that all appurtenances are being calibrated and maintained and appear to be in proper working condition but some of the storage tanks show early signs of deterioration or if there is not a routine tank maintenance program, then this item should receive a Needs Improvement rating.

(U) If several appurtenances are not being calibrated and maintained and as a result are not working properly, if any tank is showing signs of serious deterioration, or if a tank maintenance program does not exist, then this item should receive an Unsatisfactory rating. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

R.61-58.7 B (2) (b): (Operation and Maintenance Criteria)

R.61-58.7 E (2): (Operation and Maintenance Criteria)

PUMPS, PUMP FACILITIES, & CONTROLS

25. Reliable Capacity* Significant Deficiency Item

Purpose:

The Purpose of this item is to ensure that the regulated capacity of a water system is adequate at all times to meet the various demands placed on the system.

Inspection Guidelines:

Determining the reliable capacity of a water system can sometimes be very complex. The reliable capacity assigned to a water system represents the maximum flow that the system can reliably treat or provide water.

- System Capacity - The reliable volume of water that can be supplied to the customers by the entire water system on a daily basis. This shall include, but not be limited to, the capacity of the raw water sources, treatment facilities, pumping facilities, and distribution facilities.

- Regulated Capacity of a Well - Maximum amount of water that may be pumped from the well (based on 16 hours/day at the design yield).

- Design Yield - The yield of a well based on a 24-hour pump test conducted during installation. This is the flow rate that the well is designed for. (For example 60 gpm at 210 feet of head.)

- Test Yield – The flow rate that the well was pumped during the most recent well performance test.

- Current Yield – the flow rate that the Regional inspector records during a sanitary survey.

The following scenarios show how the reliable capacity is determined for different system configurations:

Single well without a treatment plant - The reliable capacity of a well is determined by multiplying the Design Yield by 960 minutes per day (16 hours). In this case, the reliable capacity of the water system would be equal to the reliable capacity of the well.

Single well with a treatment plant (e.g. iron/manganese filtration, etc) - Same as above, but the capacity of the treatment plant must not exceed the capacity of any single treatment process. The reliable system capacity would be equal to the rated capacity of the well OR the treatment plant.

Multiple wells supplying a single treatment plant - The capacity of a multiple source groundwater treatment plant is limited to the lowest rated process in the treatment train, the

source wells (calculated as the sum of all contributing wells pumping 16 hours per day or all the contributing wells minus the largest well pumping for 24 hours a day, whichever is less), and any finished water pumps with the largest pump out of service.

Metered systems - The capacity of a metered system is based on the maximum amount of water that can be obtained per day, as specified by contract or other agreement.

Systems that purchase water, but also have their own plants and/or wells: The rated capacity for these water systems is the sum of the reliable capacities of the treatment plants plus the amount of water available as a result of a contract with the system offering master meter connection plus the reliable capacity of the wells.

**NOTE: Emergency & Stand-By wells are not included in overall system capacity calculations.

The rated capacity may not always be a firm upper limit. In situations where the system capacity is limited by pumping (by assuming the largest pump out of service), the water system may treat water at rates above the rated capacity.

If the capacity of the system is exceeded on a consistent basis during the peak water use months, the water system must submit an engineering report to the Department addressing any upgrades necessary to keep up with growth in demand on the system. The Department can also deny new water line construction permits until the reliable capacity of the system is increased.

Evaluation Criteria:

(N) A rating of Not Applicable should not be given for this item.

(S) If the water system is operating within their reliable capacity, then this item should receive a Satisfactory rating.

(I) If documentation or other information shows that the system is operating at rates higher than their reliable capacity, then this item should receive a Needs Improvement rating.

(U) This item would be considered a significant deficiency when there is inadequate pump capacity to adequately maintain system flows and pressures. Some examples include, but are not limited to: routinely pumping wells more than 16 hours a day, wells permanently out of service with no plans for adding capacity, unresolved problems with well pumping such that system reliability is affected, or pressure drops below 25 psi due to inadequate pumping or controls. If this item is determined to be a significant deficiency, the overall survey should be rated Unsatisfactory and an enforcement referral made. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

R.61-58.7.D (12) – (Operation and Maintenance Criteria)

26. Operation & Control

Purpose:

The purpose of this item is to ensure that the water system is operated in a manner that provides safe, reliable drinking water to the customer.

Inspection Guidelines:

The inspector should look for abnormal occurrences related to the operation of the system by reviewing Department files including customer complaints concerning varying pressure, water quality, etc. Although the water system may be operated in accordance with the specific requirements set forth by regulation, this in itself does not guarantee that the system is operated in a safe, reliable manner. For example, if the required 25 psi minimum (see Item 11. Adequate Pressure) is maintained, but system pressure at a given location often fluctuates over a wide range (say between 25 psi and 100 psi), then the system is probably not being operated in a reliable manner.

Some specific items that the inspector should look for include the following:

- Excessive pressure fluctuations,
- Frequent overflow of elevated tanks (may be indicated by severe erosion near discharge or by frequent complaints from adjacent residences or businesses),
- Elevated or hydro-pneumatic tanks that become stagnant due to low usage,
- Repeated line breaks at or near the same location that could indicate a pressure surge problem,
- Inadequate valves in the distribution system for isolating sections of line for leak repair and flushing.

Distribution problems may be caused by either poor operational habits or inadequate design. In instances where poor operational habits or procedures can be identified, the inspector should state the problem and discuss possible solutions with the appropriate system personnel. A quick response should be expected from the system. In instances where improper or outdated design seems to be the cause, a quick resolution of the problem may not be possible. If system demand has out-paced system improvement in a given area, then the owner(s) of the water system will need to make long term plans to correct the problem. The best solution will be to identify operational procedures that can be changed to ease the problem until more permanent improvements can be made. The inspector should consider the seriousness of the problem and the system's willingness and ability to take corrective action when rating this item.

Evaluation Criteria:

(N) A rating of Not Applicable should not be given for this item.

(S) If the system provides safe, reliable service to its customers and has no operational or design problems with its distribution system, then a rating of Satisfactory should be given.

(I) If the system has minor problems with the operation or design of its system and shows a willingness to correct the problem(s) in a timely manner, then a rating of Needs Improvement should be given.

(U) If the system has problems in the operation or design of its distribution system that can affect the safety or reliability of the public water supply, then a rating of Unsatisfactory should be given. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

R.61-58.7 (E): (Operation and Maintenance Criteria)

27. Pumps

Purpose:

The purpose of this item is to ensure that pumping devices are properly installed and maintained to provide safe, reliable operation and to protect the source from contamination.

Inspection Guidelines:

General

Refer to Appendix B for typical drawings of each type of pump installation.

The inspector should ensure that no cross connection is made by tracing all lines that are connected to the pump or its appurtenances. If the end of the line cannot be located, then the inspector should ask questions regarding its purpose and possible cross connections. For example, if the line is supplying high-pressure water to a shaft seal, then the inspector should ensure that the water source is suitable for this purpose. If the line is a drain line connected to an air release valve or other appurtenance, then the inspector should ensure that the end of the line is protected by an adequate air gap and screen.

The inspector should look for short cycling of the pump. A properly designed and operated pump or pump station will not cycle more than once every five minutes or so. If the pump seems to be short cycling, then the inspector should ask the operator for an explanation. Inadequate storage tank capacity, a waterlogged hydro-pneumatic tank or a faulty pressure switch could all cause the pump to short cycle.

The inspector should ask how the pump or pump station is controlled and if it can be operated manually during emergency situations. Manual operation of a system designed to run by a pressure switch or level control is only acceptable as a temporary measure in the event of equipment failure. Manual operation is also acceptable if the system was designed and permitted to operate in this manner.

Vertical Turbine Pumps

Vertical turbine pumps consist of an above ground motor and a pumping unit located inside the well, below water level. Vertical turbine pumps can be installed outdoors or inside of a building. A typical well installation would have the pump located outdoors and the wellhead piping and chemical feed equipment located within an adjacent building.

The inspector should examine the connection between the pump discharge head and the well casing to ensure that a flanged connection or suitable sanitary seal is used to prevent contamination from entering the well at this point. The inspector should also ensure that an air relief valve is installed in the discharge piping prior to the check valve. Refer to Item 4, Wellhead Piping for further detail.

The inspector should notice if water sprays from around the pump shaft when the pump is in operation. Either a packing gland or a mechanical seal will seal the point where the shaft enters the discharge head. A packing gland will be easily recognized by the two adjustment nuts located on opposite sides of the pump shaft. If an excessive amount of water is spraying from the packing gland, then the inspector should state that it needs to be adjusted or repaired. A small amount of leakage from the packing gland is normal and is necessary to keep the packing and shaft cool. On mechanical seal equipped pumps, the seal must be replaced when leakage becomes excessive. No adjustment can be made to a mechanical seal.

Submersible pumps

Submersible pumps are similar in design to vertical turbines, but have a submersible electric motor mounted directly beneath the pumping unit below the draw down water level. The wellhead may be located under a protective enclosure outdoors or inside of a building.

The inspector should ensure that the top of the well casing is effectively sealed against the entry of water under all conditions. There are no mechanical parts that can be visually inspected on a submersible pump.

Centrifugal and Jet Pumps

Centrifugal or jet pumps are mounted completely above ground and depend upon atmospheric or system pressure to force water into the suction side of the pump. A centrifugal or jet pump will usually be located inside of a building or pump house because the electric motors used on these pumps are typically not designed to be exposed to the elements.

The point where the pump motor's shaft enters to the pump casing will be equipped with a packing gland or mechanical seal similar to a vertical turbine pump. Refer to the preceding section on vertical turbine pumps for further detail.

Evaluation Criteria:

(N) A rating of Not Applicable should be given for a purchased (master meter) system that does not own or operate pumps.

(S) If the system's pump(s) are installed and operated according to the Inspection Guidelines and are well maintained, then this item should be given a rating of Satisfactory.

(I) If the system's pump(s) are installed and operated according to the Inspection Guidelines, with only minor exceptions, then this item should be given a rating of Needs Improvement. This rating should also be given if a system's pump(s) are installed and operated correctly, but are not very well maintained.

(U) If any pump is not installed according to the above guidelines, or if a problem that may threaten the adequacy or safety of the public water supply exists, then this category should be

given a rating of Unsatisfactory. An Unsatisfactory rating can also be given if the inspector feels that no action has been taken to correct previous ratings of Needs Improvement or if the condition of the pump(s) indicates a severe lack of maintenance.

References:

R.61-58.2 B (16) (a) (v): (Design Criteria)

R.61-58.2 B (16) (a) (vii): (Design Criteria)

R.61-58.2 B (16) (a) (x): (Design Criteria)

R.61-58.2 B (16) (a) (xi): (Design Criteria)

R.61-58.2 B (16) (b): (Design Criteria)

R.61-58.2 B (16)(c): (Design Criteria)

R.61-58.2 B (16) (e): (Design Criteria)

R.61-58.2 B (16) (f): (Design Criteria)

28. Flow Measuring Device

Purpose:

The purpose of this item is to ensure that each public water supply well is equipped with an acceptable means of measuring flow. Each water system needs to accurately account for all water that is produced from each water source.

Inspection Guidelines:

The inspector should first determine whether a mechanical flow-measuring device (i.e. flow meter) is required for each well. If any treatment is added a flow meter is required for each of these wells. If treatment is not added, then the inspector must determine if there is another acceptable method for accurately measuring flow from the well. A five gallon bucket and a stop watch used in conjunction with the well's blow off pipe, while simplistic, may be an acceptable method of flow measurement for low production wells (i.e. less than 25 gpm).

There are some instances where the inspector may decide that an existing well producing greater than 25 gpm is not required to install a flow meter. While some method of measuring flow is recommended for all wells, closed systems that have an adequate quantity of water, do not add treatment, and are not subject to rapid population growth may be given exemption from this requirement at the discretion of the inspector. The most common example of this type of system would be a small trailer park which is not subject to major expansion, but that happens to have a well that can produce greater than 25 gpm. Any expansion of the system, upgrade to the well or increase in customer complaints should trigger a reevaluation of this item.

Evaluation Criteria:

(N) If the inspector determines that a flow-measuring device in not needed for the well(s), then a Not Applicable may be given. This rating should be reevaluated during each subsequent inspection.

(S) If each well is equipped with a flow measuring device and it is in proper working order, then a rating of Satisfactory should be given.

(I) If only some of the system's wells are equipped with flow measuring devices, while others are not, then a Needs Improvement should be given. However, the inspector may determine that all wells that need a flow-measuring device have them, and a Needs Improvement rating may not be warranted.

(U) If the system's well(s) does not have a required flow-measuring device, then a rating of Unsatisfactory should be given.

References:

R.61-58.2 B (16) (a) (vi): (Design Criteria)

R.61-58.2 B (16) (a) (viii): (Design Criteria)

R.61-58.7 B (20): (Operation and Maintenance Criteria)

R.61-58.7 D (7): (Operation and Maintenance Criteria)

MONITORING, REPORTING, & DATA VERIFICATION

29. Monitoring & Recordkeeping* Significant Deficiency Item

Purpose:

The purpose of this item is to ensure that the water system is monitoring their treatment process and maintaining records that verify that they are checking equipment operation and drinking water quality on a routine basis.

Inspection Guidelines:

Water systems must keep all appropriate records and make them available for inspection by the Department and the public upon request. Copies of any written reports, summaries, or communications relating to sanitary surveys or operational inspections of the water system must be kept for a minimum of ten (10) years. Records involving a variance or exemption granted to the water system must be kept for a minimum of five (5) years from the expiration date of the variance or exemption. Records of actions taken by the water system to correct any violation of the State Primary Drinking Water Regulations must be kept for a minimum of three (3) years after the last corrective action. Records of all chemical measurements and corresponding chemical feed rate calculations must be kept for a minimum of three (3) years. Records of all flow meter and chemical feed pump calibrations must be kept on file for a minimum of three (3) years. Records for all water quality monitoring must be kept for a minimum of three (3) years.

Where treatment is added, the inspector should verify that the water from each treatment process is being sampled and analyzed at least once a day or as often as needed by a certified operator to ensure that the treatment process is functioning properly. If a combined phosphate or poly-phosphate chemical is used, total phosphate residual monitoring may be conducted once every two (2) weeks in lieu of daily monitoring. All monitoring conducted for the purpose of process control must be performed using equipment and methodology acceptable to the Department. A certified laboratory must perform all samples analyses that are reported to the Department for compliance purposes.

Evaluation Criteria:

(N) A Not Applicable rating should not be given for this item. However, systems that do not provide treatment only have to comply with the record keeping requirements.

(S) If a water system is monitoring equipment operation on a regular basis, sampling in enough locations to adequately judge the effectiveness of the treatment process, and keeping sufficient documentation of these inspections, then this item should receive a Satisfactory rating.

(I) If a water system is attempting to monitor their treatment process, but the number of inspection locations or the frequency of inspections should be increased, or if a water system's

records lack detail and do not allow an outside inspector to properly evaluate the treatment process, then this item should receive an Needs Improvement rating.

(U) If a water system does not monitor their treatment process for quality control, or does not maintain records, then this item should be found as a significant deficiency and receive an Unsatisfactory rating. Some examples can include: not monitoring according to the Department-approved monitoring plan or site sampling plan, or not keeping adequate process control records. Data falsification is another serious issue that would constitute a significant deficiency. If the item is found to be a significant deficiency, the overall survey should be rated Unsatisfactory and an enforcement referral made. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

R.61-58.5 CC: (Inorganics and Organics Monitoring Criteria)

R.61-58.7 B (3): (Operation and Maintenance Criteria)

R.61-58.7 B (4): (Operation and Maintenance Criteria)

R.61-58.7 B (5): (Operation and Maintenance Criteria) - Phosphate

R.61-58.7 D (13): (Operation and Maintenance Criteria) - General

R.61-58.7 E (1): (Operation and Maintenance Criteria)

R.61-58.7 D (6): (Operation and Maintenance Criteria)

R.61-58.6 D: (Operation and Maintenance Criteria) - Record Keeping

30. Testing Equipment

Purpose:

The purpose of this item is to ensure that a water system has adequate instrumentation for testing the parameters necessary to monitor water quality and ensure proper operation.

Inspection Guidelines:

The inspector must determine whether or not a system has the proper test equipment to accurately monitor their system. This will include both bench-top and continuous monitors. If a system is adding chlorine, a method for measuring chlorine residual must be in place or if a system is making a pH adjustment, then a pH meter must be used, etc. All monitoring equipment necessary for process control must be in good condition and give accurate and reliable results. The equipment should be maintained in good physical condition. Fluoride and pH probes should not have chemical residues on them; chlorine test kits should not have stained glassware, etc. Some of the items the inspector should look for would include, proper sample handling, clean glassware, appropriate reagents, calibration records and charts.

Systems treating groundwater using iron removal and/or ion exchange softening are required to have, at a minimum, the capability to monitor free chlorine residual and pH. On a daily basis, the operator of a groundwater treatment plant is required to sample and analyze the finished water from each treatment plant to ensure the treatment plant is functioning properly. Where fluoride is added to the water, tests to determine the fluoride content of the finished water shall be made at least daily by a certified laboratory and recorded on the Monthly Operating Report Form.

Evaluation Criteria:

(N) A Not Applicable rating may be given for this item if no monitoring or testing equipment is required.

(S) A Satisfactory rating should be given if the water system conducts the appropriate water quality monitoring and testing using approved standard methods and equipment.

(I) A Needs Improvement rating should be given if the system conducts the appropriate water quality monitoring and testing using approved standard methods and equipment, but the documentation for equipment calibrations, maintenance, and a standard operating procedure is not complete and the appropriate records are not maintained.

(U) An Unsatisfactory rating should be given if the system does not conduct the appropriate water quality monitoring and testing. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

R.61-58.7 B (4): (Operation and Maintenance Criteria)

31. Sample Siting Plan

Purpose:

The purpose of this item is to evaluate the system's sample siting plan to determine if it is adequate to ensure that there is no place in the distribution system where microbiological contamination could persist indefinitely with little chance of detection.

Inspection Guidelines:

All Public Water Systems must collect coliform samples according to a written sample siting plan. This plan ensures that samples are collected at locations representative of the entire distribution system. The sample plan identifies both sample collection sites and a collection schedule. There are two parts to a satisfactory plan, a written description of the procedures, site locations and descriptions, and how the plan is carried out (SOP) and a system map that shows the sources, distribution piping, storage tanks and sample locations. Sample siting plans are required to be kept updated and should be reviewed during each sanitary survey. The inspector should review the plan to determine if the plan is representative of water throughout the distribution system and that the plan is adequately written to allow someone with limited knowledge of the system to carry out the plan.

The plan must contain routine and repeat sampling locations representative of the distribution system, as well as the sample collection schedule. The sample sites in the plan should be located in accessible locations at a customer's premises, dedicated sampling station, or other designated sampling site.

The plan must include a map of the distribution system and a detailed description of how the sampling plan will be carried out. The distribution map must show the locations of all distribution water lines, water sources, storage tanks and sampling points.

The sample siting plan should be designed such that system coverage is accomplished with each month's samples. Water systems must collect samples at regular time intervals throughout the month except for ground water systems that serve less than 5,000 people. Ground water systems that serve less than 5,000 people may collect all required samples on the same day if the samples are collected from different sample sites. All major portions of the distribution system must be covered by the sampling plan. Each routine sample point in the plan must be sampled at least every three (3) months. The sample plan should avoid sampling points that are served by major transmission mains, and should target areas served by smaller pipes or dead end lines.

The inspector must review the plan for adequacy. The plan must be representative of the entire distribution system. The plan must include all routine, repeat, and Ground Water Rule triggered source monitoring (for ground water systems) sites. The inspector must also determine if the system is taking the correct number of samples for the system's population. It is appropriate for the inspector to remind systems to review the plan annually for adequacy and to contact either the local Regional office, or the Drinking Water Protection Division in Columbia for questions

or when making revisions. Sample plans are subject to Department review and revision if needed.

Routine Monitoring requirements:

Non-community systems that serve 1,000 or fewer people and use only ground water must collect one sample per **quarter**.

During *each* sanitary survey, inspectors must determine whether or not the water system is being appropriately monitored (number & frequency of samples). The system will increase to monthly monitoring if: They trigger a level 2 assessment, 2 level 1 assessments, has an E. coli MCL violation, has a coliform treatment technique violation, or has two RTCR monitoring violations or one RTCR monitoring violation and a Level 1 trigger in a rolling 12-month period.

*Note – there are provisions for a non-community system to increase their monitoring and criteria to return to quarterly monitoring. While not in the sample siting plan, each inspector should review the appropriate portions of the regulations (R.61-58.17) to ensure that the system is on the correct monitoring schedule.

Community water systems serving 1,000 or fewer people and use only ground water must collect and have analyzed one sample per **month**.

Surface Water systems serving 1,000 or fewer people must collect one sample per **month.**

All water systems serving more than 1,000 people must collect the number of samples according to their service population each **month.**

Minimum Population Served	Minimum Number of Samples per Month	Minimum Population Served	Minimum Number of Samples per Month
1,001 to 2,500	2	70,001 to 83,000	80
2,501 to 3,300	3	83,001 to 96,000	90
3,301 to 4,100	4	96,001 to 130,000	100
4,101 to 4,900	5	130,001 to 220,000	120
4,901 to 5,800	6	220,001 to 320,000	150
5,801 to 6,700	7	320,001 to 450,000	180
6,701 to 7,600	8	450,001 to 600,000	210
7,601 to 8,500	9	600,001 to 780,000	240
8,501 to 12,900	10	780,001 to 970,000	270
12,901 to 17,200	15	970,001 to 1,230,000	300
17,201 to 21,500	20	1,230,001 to 1,520,000	330
21,501 to 25,000	25	1,520,001 to 1,850,000	360
25,001 to 33,000	30	1,850,001 to 2,270,000	390
33,001 to 41,000	40	2,270,001 to 3,020,000	420
41,001 to 50,000	50	3,020,001 to 3,960,000	450
50,001 to 59,000	60	3,960,001 or more	480
59,001 to 70,000	70		

Special monitoring evaluations for non-community water systems serving less than 1,000 people using only ground water.
During each sanitary survey, the inspector must evaluate whether or not the water system is on the correct monitoring schedule. When performing a survey on these types of systems (non-community less than 1,000 people using only groundwater), the inspector will want to discuss with the Drinking Water Protection Division to get input on the correct schedule. It is important to determine if the system should be on routine, reduced, or increased monitoring. There are several criteria in the regulations (R.61-58.17) that will need to be met and have a bearing on what schedule the system is on and can remain on. The system's water quality, compliance history, and barriers to contamination all play a role in determining the appropriate schedule.

Evaluation Criteria:

(N) A Not Applicable rating should be given for this item to State systems.

(S) If the sample siting plan includes a detailed description of how the plan is carried out as well as an adequate map (if required) that identifies the required system components (i.e. tanks, valves, etc.) and all sampling points, then a Satisfactory rating should be given for this item.

(I) If all of the elements for a proper plan are in place, but there are some elements of the plan that are missing or should be changed (i.e. no written procedure, sampling points on major transmission lines, lack of full system coverage, etc.) then a Needs Improvement rating should be given, and the system should be asked to revise the plan.

(U) If the system does not seem to have a documentable sampling procedure, a rating of Unsatisfactory should be given. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

If changes to the sample siting plans are required based on Department review, it will be the water system's responsibility to make those changes and show to the Department's satisfaction that the changes have been implemented.

References:

R.61-58.7 B (2)(f): (Operation and Maintenance Criteria)

R.61-58.17 (Revised Total Coliform Rule)

SYSTEM MANAGEMENT & OPERATION

32. Corrections From Previous Survey* Significant Deficiency Item

Purpose:

The purpose of this item is to make sure that water systems return to compliance after deficiencies have been documented on previous sanitary surveys.

Inspection Guidelines:

Water system management is a major factor that affects the performance of a water system. Management provides the direction, funding, and support that is needed for the system to continually provide safe drinking water.

Whether or not water systems fix deficiencies noted on previous surveys reflects back on the water system management. If the system has issues from previous surveys and does not make necessary corrections, there may be more of a risk to public health. Some water systems have the same deficiencies noted on their surveys year after year. By not correcting identified problems, the water system management shows that they are not committed to keeping their water system in compliance with the regulations.

Not all deficiencies are major and have a public health impact. However, minor deficiencies that remain uncorrected can reveal the system's lack of commitment to protect public health.

Evaluation Criteria:

(N) A Not Applicable rating should not be given for this item system.

(S) If the water system did not have any unresolved issues from a previous survey or other site visit, then a Satisfactory rating should be given for this item.

(I) If there are minor deficiencies documented from a previous survey that have not been corrected, but do not have the potential to cause risks to public health, then a Needs Improvement rating should be given for this item. Several examples could be issues related to distribution system programs, paperwork issues, etc.

(U) If the system has not corrected any item(s) from a previous survey and the uncorrected items pose an increased public health risk, then the item should be rated as a significant deficiency and an Unsatisfactory rating should be given. Some examples can include inoperable equipment, cracked well pad, potential for contamination from storage, using improper disinfection after repairs, or other corrections, major or minor, that if not corrected could introduce contamination into the system. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

33. Emergency Plan

Purpose:

The purpose of this item is to ensure that the public water system has an up-to-date Emergency Preparedness Plan that addresses who to contact and any arrangements that would be necessary in the event that there is an emergency involving the treatment facility, the treatment process, or the distribution system.

Inspection Guidelines:

It is very important that water systems have an up-to-date copy of the Emergency Preparedness Plan at a location that is readily accessible. The Emergency Preparedness Plan should address the critical parts of the water system (e.g., raw water source, treatment, storage, power source, and crucial areas such as hospitals or dialysis centers) and at a minimum, contain the following elements:

- The telephone number for the Department's Regional office, the Department's Bureau of Water office and the Department' twenty-four (24) hour telephone number;
- The names and telephone numbers for all current chemical suppliers;
- The names and telephone numbers for the electric power, natural gas, telephone and cable companies;
- The names and telephone numbers for the potential sources of spare parts, pipe sections and pipe repair parts;
- The names and telephone numbers for contractors to call for making any repairs beyond the capability of the system personnel;
- The names and numbers for well drillers;
- Arrangements for obtaining emergency power;
- Arrangements for obtaining potable water;
- An up-to-date distribution map showing line sizes, the location of larger valves, fire hydrants, blow-offs, and pumping, storage and treatment facilities;
- Procedures for notifying the public and media including a sample Boil Water Notice and a sample Boil Water Advisory (see appendix F for guidance); and,
- Emergency disinfection procedures for wells, water lines and storage tanks.

In addition to the above list, Emergency Preparedness Plans for community water systems must also include the following:

- The name and telephone numbers for the County Emergency Preparedness representative, the local law enforcement and highway patrol offices, and the local fire department(s) and Emergency Medical Service (EMS);

- The telephone number for the State Emergency Operations Center, State Warning Point;

- The names and telephone numbers for water system personnel who should be notified in the event of an emergency;

- The locations and telephone numbers for primary and secondary command posts that may be utilized in the event of an emergency;

- The names, addresses and telephone numbers for equipment suppliers and contacts for equipment repair, i.e., pump motors, pump shafts, etc.; and,

- A list of any mutual aid agreements among water systems, such as emergency connections, personnel, equipment supplies and chemical supplies.

If a water system is located in a coastal area, it should also include specific emergency procedures to handle hurricanes.

Evaluation Criteria:

(N) A Not Applicable rating should not be given for this item.

(S) If a water system has an up-to-date and readily accessible Emergency Preparedness Plan that contains all the pertinent emergency information listed here, then this item should receive a Satisfactory rating.

(I) If a water system has an Emergency Preparedness Plan that contains all pertinent emergency information but some of the information is out of date or if a water system has unintentionally left out critical information that is not listed here but that the inspector feels is necessary, then this item should receive a Needs Improvement rating.

(U) If a water system does not have an Emergency Preparedness Plan, if the plan is not readily accessible, if the plan does not include all the items listed here, or it appears that all the operators are not well-informed of what actions to take during an emergency situation, then this item should receive an Unsatisfactory rating. An Unsatisfactory rating may also be given if there has been no effort to correct a previous Needs Improvement rating.

References:

R.61-58.8

34. Plant Security

Purpose:

The purpose of this item is to ensure that proper security precautions are taken at water treatment plants to prevent intentional or accidental contamination or disruption of the public water supply.

(Security is also evaluated under Item #3 Source, and Item #21 Storage.)

Inspection Guidelines:

Facility Design
The inspector should look for perimeter fencing, lockable doors, and lockable equipment enclosures when evaluating the adequacy of plant security measures. If a facility does not have one or more of the above items, then the inspector should evaluate the need for modifications. For example, a facility with lockable enclosures protecting all of its outdoor equipment would probably not need to install a perimeter fence as quickly as a facility with exposed pumps and chemical feed equipment. However, the need for adequate security measures should be stressed to all systems.

Security Procedures
The presence of fencing and locks does not, in itself, make a facility adequately secure. The facility's staff must be in the habit of keeping doors and gates locked. The inspector should make note of employee practices while conducting the survey and should ask questions regarding standard security practices.

Another factor to consider when evaluating plant security is the history of incidents at the plant. If a facility does not provide security that meets design standards but has never experienced a problem with plant security, then the inspector may take this into consideration when rating this item. Conversely, if a facility has all of the required items but continues to have security problems, then the inspector should probably recommend that further measures be taken to discourage entrance.

Evaluation Criteria:

(N) A rating of Not applicable should be given to a system that does not provide treatment or whose treatment facilities are located within the secured wellhead area.

(S) If the facility has fencing, locks and protective enclosures in place, and takes adequate precautions to keep doors and gates locked, then a rating of Satisfactory should be given.

(I) If the facility takes adequate precautions but needs minor improvement in its security procedures or needs to install perimeter fencing, then a rating of Needs Improvement should be given.

(U) If the facility does not have adequate fencing, locks or protective enclosures in place, or does not take necessary precautions in locking doors and gates, then a rating of Unsatisfactory should be given. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

R.61-58.7 (B) (18): (Operation and Maintenance Criteria)

35. Facility Maintenance

Purpose:

The purpose of this item is to evaluate the overall facility maintenance practices of the water system including all treatment facilities, storage and treatment buildings, and the grounds around those facilities.

Inspection Guidelines:

The water system needs to employ good housekeeping and grounds keeping practices to ensure that all elements of the treatment process are readily accessible for inspection during the sanitary survey. Access to all treatment and storage buildings should not be restricted by overgrown vegetation or the accumulation of non-essential items. The floors of all treatment and storage buildings should be free from clutter and have open pathways to allow access to all areas. The areas around the treatment units should also be free of trip hazards and standing water or other liquids.

The outside areas around the system's facilities, including wells, treatment plants, and storage tanks should be maintained such that access is readily available to all areas around these facilities. Grass should be kept mowed and there should be no cluttering of the area with non-essential items. Not only will good maintenance practices inspire confidence in the overall operation of the system, it will allow the operator to more readily inspect the entire facility and identify potential problem areas before they develop into more serious problems.

Evaluation Criteria:

(N) A Not Applicable rating should not be used for this item.

(S) If the system regularly provides good housekeeping and grounds keeping at their well sites, treatment facilities and storage tanks, then a Satisfactory rating should be given for this item.

(I) If the system facilities and grounds need more regular attention, but are not altogether neglected, then a rating of Needs Improvement may be given.

(U) If the system's storage or treatment buildings are neglected or if the grounds around these facilities or the system's storage tanks are not maintained in a neat or orderly manner, then a rating of Unsatisfactory rating should be given. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

R.61-58.7 B (1): (Operation and Maintenance Criteria)

R.61-58.7 B (7):(Operation and Maintenance Criteria)

R.61-58.7 B (8):(Operation and Maintenance Criteria)

R.61-58.7 B (9):(Operation and Maintenance Criteria)

R.61-58.7 B (10):(Operation and Maintenance Criteria)

R.61-58.7 B (12):(Operation and Maintenance Criteria)

R.61-58.7 B (14):(Operation and Maintenance Criteria)

R.61-58.7 B (17):(Operation and Maintenance Criteria)

R.61-58.7 B (18):(Operation and Maintenance Criteria)

36. Supplies & Spare Parts Inventory

Purpose:

The purpose of this item is to ensure that the public water supply is not disrupted due to an inadequate stock of spare parts and supplies.

Inspection Guidelines:

The term spare parts refers to equipment-specific parts kept on hand for pumps, chemical feeders, analyzers or any other mechanical device that is required for the production of drinking water in compliance with the State Primary Drinking Water Regulations. The term supplies refers to more general items such as pipe, fittings, glue or other items necessary for the general repair and maintenance of the water system and treatment plant.

Each water system should have the capability of making minor repairs in-house in order to prevent a minor problem from becoming a major disruption of service. For smaller water systems, a few PVC pipe fittings and PVC solvent may be adequate for repairing minor emergencies. For larger water systems, it may be necessary to have a complete stock of pump parts, chemical feeder parts and/or backup units in addition to an assortment of pipe, fittings and other supplies on hand in order to provide an adequate safety factor.

It will be difficult for an inspector to judge the adequacy of spare parts and supplies by simply conducting an inspection of the storeroom. The inspector should research Department files in order to determine if inadequate spare parts and supplies have been a problem in the past. The inspector will also need to ask questions regarding any equipment that is in need of repair at the time of the survey. If the need for parts can reasonably be predicted and system personnel can make the repairs, then the parts should probably be kept on hand.

Chemical feed systems, such as chlorine used for primary disinfection, require backup units to be kept in stock by the water system. For further detail, please refer to the Water Treatment section of this manual.

Some water systems choose not to perform their own routine maintenance. If the water system has a service contract in place with a maintenance contractor, it is reasonable that their own stock of spare parts and supplies will be reduced accordingly. The inspector must decide if the system's spare parts and supplies are adequate based upon the size of the system, the type of treatment provided and any unique factor that applies to a particular system.

Evaluation Criteria:

(N) A Not Applicable rating may be given for this item for small systems that do not add treatment and do not perform their own repairs.

(S) If the water system appears to have adequate spare parts and supplies in stock to make minor repairs to pumps, chemical feed systems and distribution lines, then a rating of Satisfactory should be given.

(I) If the water system has a reasonable amount of spare parts and supplies on hand, but needs to improve on a few specific areas, then a rating of Needs Improvement should be given.

(U) If the water system keeps no appreciable amount of spare parts and supplies on hand or has a history of service outages due to the lack of parts and supplies needed to make reasonably predictable repairs, then a rating of Unsatisfactory should be given. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

R.61-58.7 B (7): (Operation and Maintenance Criteria)

R.61-58.7 B (9) (k): (Operation and Maintenance Criteria)

37. Waste Disposal

Purpose:

The purpose of this item is to confirm that waste handling and disposal practices meet all applicable rules and regulations of the Department. Provisions must be made for proper disposal of water treatment plant waste. In locating waste disposal facilities, due consideration shall be given to preventing potential contamination of the water supply.

Inspection Guidelines:

The inspector must determine what, if any, waste handling and/or waste disposal a facility has. Any discharge to a stream or water of the State requires a NPDES permit. The inspector should check with the regional wastewater evaluator to see what records pertain to the facility in question.

The inspector should also determine if the sanitary waste from water treatment plants, pumping station, etc., is receiving proper treatment. Waste from these facilities must be discharged directly to a sanitary sewer system, when feasible, or to an adequate on-site waste treatment facility or septic tank.

The waste from reverse osmosis, ion exchange plants, demineralization plants, etc., may be disposed of by controlled discharge if a NPDES permit has been issued by the Department to the plant. Except when discharging to large waterways, a holding tank of sufficient size shall be provided to allow the brine to be discharged over a twenty-four hour period. Where discharging to a sanitary sewer, a holding tank may be required to prevent the overloading of the sewer and/or interference with the waste treatment process.

Waste filter wash water from iron and manganese removal plants can be disposed of by using sand filters, lagoons, or by discharging to a sanitary sewer. Sand filters and lagoons must have a NPDES permit for any effluent discharges or a proper No Discharge (ND) permit for land applications. Discharge to a community sanitary sewer is acceptable. Approval of this method will depend on obtaining approval from the owner of the sewage system as well as from the Department before final designs are made. A holding tank must be provided to prevent overloading the sewers.

Evaluation Criteria:

(N) If no waste handling facilities required, then a Not Applicable rating should be given.

(S) A Satisfactory rating should be given if all the waste from a water plant is handled in an appropriate manner and the waste handling facilities are operating within any necessary Departmental permits.

(I) A Needs Improvement rating should be given if proper waste handling facilities are in place but are not being properly operated or maintained.

(U) An Unsatisfactory rating should be given if the waste is not handled properly and/or the necessary permits have not been obtained or if the permits are being violated. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

R.61-58.2 (F):

38. Procedures Manual

Purpose:

The purpose of this item is to ensure that a water system maintains written procedures for the operation and maintenance of its system.

Evaluation Criteria:

The list below includes all of the information that may be required in a procedures manual:

- Detailed instructions on starting and stopping any treatment plant;
- Preventative maintenance procedures and schedules for equipment;
- Water quality monitoring records;
- Reporting and public notification requirements;
- Sampling and analytical procedures for monitoring water quality;
- Sample siting plan;
- Valve and hydrant maintenance procedures;
- Distribution system flushing program;
- Disinfection requirements for the repair of wells, tanks, and water lines;
- Cross-connection control program;
- Leak detection and repair program;
- Safety procedures;

The information that must be included in the procedures manual varies depending on the system type. The inspector must review the above list and judge which items are applicable based on the complexity and size of the system. It may be helpful to review past sanitary survey reports and look for any problem areas that may point to the need for standard procedures. For example, a small community water system that does not add treatment may need to include only preventative maintenance procedures and schedules for pumps and tanks, reporting and public notification requirements, water quality monitoring records, a sample siting plan, and disinfection procedures. A community system that adds treatment will need to include additional

procedures for starting and stopping treatment, sampling and monitoring water quality and for preparing chemical feed solutions. A large public ground water system that adds treatment may require all of the procedures above. The inspector must judge which procedures are applicable to the system being inspected.

Evaluation Criteria:

(N) This item may be rated Not Applicable for very small water systems that do not add treatment and have a limited distribution system.

(S) A Satisfactory rating should be given if all applicable procedures are included in the manual.

(I) An Needs Improvement rating may be given to a system that has a procedures manual that is missing one or more elements.

(U) An Unsatisfactory rating should be given if the system has no procedures for operating and maintaining the system. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

R.61-58.7 B (2): (Operation and Maintenance Criteria)

39. Stand-by Power

Purpose:

The purpose of this item is to ensure that the water system has emergency operational capability during electrical power outages.

Inspection Guidelines:

Auxiliary power is strongly recommended for all water systems, but is only required when gravity storage for water systems with 300 or more service connections is less than one-half of the maximum daily demand. The inspector should review Department files and determine if the water system has adequate auxiliary power to support sufficient pumping and treatment capacity or to supplement the existing gravity storage to meet one-half of the maximum daily demand. This auxiliary power requirement may be waived if two (2) or more independent sources from the serving electrical utility are available or if an alternate water source is available via connections with other systems.

Evaluation:

(N) A Not Applicable rating should be given for this item to a water system that has less than 300 service connections. A Not Applicable rating may also be given to a system that has more than 300 service connections if the equivalent elevated storage is equal to or greater than one-half of the system's maximum daily demand.

(S) If a water system provides adequate auxiliary power where required, then this item should receive a Satisfactory rating.

(I) A Needs Improvement rating should not be given for this item.

(U) If a water system does not provide adequate auxiliary power where needed, then this item should receive an Unsatisfactory rating.

References:

R. 61-58.4 B (1)(I): (Design Criteria)

R.61-58.7 B (14): (Operation and Maintenance Criteria)

40. Is System Presently Under Enforcement Order?

Purpose:

The purpose of this item is to verify whether or not a water system has an open enforcement order against them and if the system is in compliance with the order.

Inspection Guidelines:

This item is used by the enforcement section in the Central Office and can have important impacts. If the water system has an enforcement order that contains a stipulated penalty (fix the problems and don't pay a fine) and the system is not in compliance with the order, the penalty is no longer stipulated and the fine is reinstated. This item is also important under the ground water rule when corrective actions have been ordered from the Department. If the system is not complying with a corrective action(s) they must issue public notice.

The item is also used by enforcement staff when closing out an order after all deficiencies have been corrected. If the system is complying with the order, or all deficiencies have been fixed or corrective actions completed, the order can be closed.

Evaluation Criteria:

This is a Yes or No item on the survey. Either the system is under an enforcement order, or they are not.

If the system is under an order, are they complying with the order, yes or no.

References:

R.61-58.16.F (1) (e): (Ground Water Rule, corrective action compliance)

OPERATOR CERTIFICATION

41. Certified Operator* Significant Deficiency Item

Purpose:

The purpose of this item is to ensure that all water systems employ the proper grade operator as mandated by the State Safe Drinking Water Act, and to ensure that an adequate staff is employed to properly operate and maintain the system.

Inspection Guidelines:

Certified Operator

Water systems are grouped, by DHEC, into water treatment groups based on the system type, number of taps served, and treatment technology. The South Carolina Environmental Certification Board (part of the Dept. of Labor, Licensing, and Regulation or LLR) designates the appropriate grade operator for each group of water systems. The inspector must first determine the appropriate system grouping, and then determine the corresponding operator grade. The table below summarizes water system groupings and required operator grades. The inspector should verify that an operator with the appropriate grade inspects the system daily.

Water Treatment Operator

Treatment Plant Group	System Description	Operator Grade Needed
1	A facility that provides disinfection treatment using a sodium hypochlorite or calcium hypochlorite solution as the disinfectant.	E
2	A facility that provides disinfection treatment using gaseous chlorine or chloramine disinfection or includes sequestering, fluoridation, or corrosion control treatment.	D
3	A facility treating a groundwater source that is not under the direct influence of surface water, utilizing aeration, coagulation, sedimentation, lime softening, filtration, chlorine dioxide, ozone, ultra-violet light disinfection, powdered activated carbon addition, granular activated carbon filtration or ion exchange, or membrane technology or that includes sludge storage or a sludge dewatering process.	C
4	A facility treating a surface water source or a groundwater source that is under the direct influence of surface water, utilizing aeration, coagulation, clarification with a minimum detention time of two hours in the clarification unit, lime softening, rapid rate gravity filtration (up to four gallons per minute per square foot), slow sand filtration, chlorine dioxide, powdered activated carbon	C

	addition, or granular activated carbon filtration or ion exchange or that includes sludge storage or a sludge dewatering process.	
5	A facility treating a surface water source or a groundwater source that is under the direct influence of surface water, utilizing high rate gravity filtration (greater than four gallons per minute per square foot), clarification with a detention time of less than two hours in the clarification unit, diatomaceous earth filtration, or ultraviolet light disinfection.	B
6	A facility treating a surface water source or a groundwater source that is under the direct influence of surface water, utilizing direct filtration, membrane technology, or ozone.	A
7	Drinking water dispensing stations and vending machines that utilize water from an approved public water system or bottled water plants that treat water from the distribution system of a public water system or from a groundwater source that is not under the direct influence of surface water.	Vending Machine License

Distribution system groupings and associated operator requirements ensure that people making decisions concerning the operation of distribution system, that could affect public health, meet minimum standards for distribution system operator certification.

Distribution System Operator

Distribution System Group	**System Description**	**Operator Grade Needed**
1	Distribution systems associated with state and transient noncommunity water systems.	None
2	Distribution systems associated with community and nontransient noncommunity public water systems that have a reliable production capacity not greater than six hundred thousand gallons a day and that do not provide fire protection.	D
3	Distribution systems associated with community and nontransient noncommunity water systems that have a reliable production capacity greater than six hundred thousand gallons a day but not greater than six million gallons a day (MGD) or have a reliable production capacity not greater than six hundred thousand gallons a day and provide fire protection.	C
4	Distribution systems associated with community and nontransient noncommunity water systems that have a reliable production capacity than six MGD, but not greater than twenty MGD.	B
5	Distribution systems associated with community and nontransient noncommunity water systems that have a reliable production capacity greater than twenty MGD.	A

Additionally, there are two other operator classes that the inspector may find. The first is the trainee-grade (T) operator. This operator has started the certification process with the LLR, but either has not passed the exam yet or does not have enough time in service yet. Trainees are not allowed to operate plants or distribution systems without direct supervision from an operator of appropriate grade for either the treatment plant or distribution system.

The other operator is the Grandfathered (G) operator. This certification only exists for distribution system operators. The grandfathered operator is only allowed to work on a specific distribution system (they've been there a long time and know the system inside and out, but can't get certified). Grandfathered operators can be considered the operator of record for their specific system, but are not allowed to be the operator of record for any other distribution system.

There are several systems that have been given permission (in writing) to use a lower than required grade operator to make some daily visits or visits on the weekends and holidays. This only applies to the water treatment and not the distribution system. These systems should be able to produce a letter from the Central Office stating the requirements that must be maintained. The letters specifically spell out what the lower grade operator is and is not allowed to do. Also, there are a few water systems that have comprehensive computer controls and monitoring and they have also been given a wavier from the daily site visit requirement. These water systems should also be able to produce the written wavier granted to them.

Evaluation Criteria:

(N) A Not Applicable rating should not be given on this item.

(S) If the water system employs an operator of the appropriate grade and is adequately staffed, then a Satisfactory rating should be given.

(I) A Needs Improvement rating may be given to a system that employs the appropriate grade operator(s), but needs to be better staffed. The water system should make a commitment to improve staffing in order to be given a Needs Improvement rating.

(U) If a system does not employ an operator of the appropriate grade, an Unsatisfactory rating should be given and this item should be rated as a significant deficiency. Immediate action should be taken to correct this problem. Other examples of this item warranting a significant deficiency include: operators failing to make daily facility visits where required, improper grade operators operating a system, or a person operating without a license. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

R.68-58.7 (D) (2): (Operation and Maintenance)

R.68-58.7 (E) (1): (Operation and Maintenance)

42. Staffing

Purpose:

The purpose of this item is to ensure that all water systems employ the proper grade operator as mandated by the State Safe Drinking Water Act, and to ensure that an adequate staff is employed to properly operate and maintain the system.

Inspection Guidelines:

The inspector must judge whether the staffing level is adequate to properly monitor, operate, and maintain the water system. This may be determined by evaluating the complexity and overall condition of the system and system records. A review of operator logs will indicate the frequency of visits. The inspector should verify that a system adding chemical treatment has daily operator visits. Systems that do not add chemical treatment require weekly inspections of the wellhead piping. A log of these inspections must be maintained and should be reviewed by the inspector. A review of customer complaints may also be helpful. If problems such as line breaks require an unreasonable amount of time to correct, inadequate staffing may be the problem. It is important that a water system be adequately staffed to perform daily operational and preventative maintenance duties, and react in emergency situations.

Evaluation Criteria:

(N) A Not Applicable rating should not be given on this item.

(S) If the water system employs an operator of the appropriate grade and is adequately staffed, then a Satisfactory rating should be given.

(I) A Needs Improvement rating may be given to a system that employs the appropriate grade operator(s), but needs to be better staffed. The water system should make a commitment to improve staffing in order to be given a Needs Improvement rating.

(U) If a system does not employ an operator of the appropriate grade, an Unsatisfactory rating should be given and immediate action should be taken to correct this problem. If the system is so severely understaffed that water quality is at risk, then an Unsatisfactory rating should be given and the inspector should determine if this justifies a significant deficiency rating. An Unsatisfactory rating may also be given if no action has been taken to correct a rating of Needs Improvement given in a previous survey.

References:

R.68-58.7 (D) (2): (Operation and Maintenance)

R.68-58.7 (E) (1): (Operation and Maintenance)

43. Treatment System Group

This item should be filled out with the appropriate water treatment system grouping. The plant groupings can be found in Item number 41, certified operator.

44. Treatment System Operator Grade

The number of certified water treatment operators employed by the water system should be entered in the spaces provided.

45. Distribution System Group

This item should be filled out with the appropriate distribution system grouping. The distribution system groupings can be found in Item number 41, certified operator.

46. Distribution Operator Grade

The number of certified distribution system operators employed by the water system should be entered in the spaces provided.

OTHER REQUIREMENTS

47. Drought Response Plan

Drought response plans are required by the SC Dept. of Natural Resources, DNR. All systems were required to submit to DNR their plans for approval. If the system has a plan, indicate yes, and if they don't, indicate no.

48. Source Water Protection Plan

The purpose of this item is to determine whether or not a water system has and is following a source water protection plan. The complexity of the plans will vary with system size and experience. If no plan exists, the inspector should leave an informational brochure with the water system management. Indicate yes or no in the box if the system does or does not have a source water protection plan.

49. Are All Services Metered

Does the water system have water meters on all customers taps? If not, enter an estimate of the percent of the system that is metered.

50. Field Tests

If the inspector collected any of the field tests, sample results should be entered in the appropriate spaces.

51. Samples Taken

If the inspector collected any lab samples during the sanitary survey and the results are available, the results should be entered in the spaces provided. If results are pending, that may be noted on the survey form and followed up in the report.

52. Follow-Up Scheduled

If the inspector has scheduled a follow up inspection, mark yes in the box provided and enter the follow up inspection date in the box below. Keep in mind that any water system that has an overall unsatisfactory survey MUST have a follow up survey within six (6) months.

Appendix A: Sample Calculations

Flow, MGD

$$\frac{\text{(Flow, gpm) * (60 min/hr) * (24 hr/day)}}{\text{1,000,000/M}}$$

Flow, gpm

$$\frac{\text{(Flow, MGD) * (1,000,000)}}{\text{(60 min/hr) * (24 hr/day)}}$$

Dry Chemical Feed, lbs/day

$$\frac{\text{Chemical Applied, lbs}}{\text{Length of Application, day}}$$

Liquid Chemical Feed, lbs/day (Flow, MGD) * (Dose, mg/L) * (8.34 lbs/gal)

Chemical Feed, lbs/day

$$\frac{\text{(Chemical concentration, mg/L) * (Volume Pumped, mL) * (60 min/hr) * (24 hr/day)}}{\text{(Time pumped, min) * (1000 mL/L) * (1000 mg/g) * (454 g/lb)}}$$

Chlorine, lbs (Volume, MG) * (Dose, mg/L) * (8.34 lbs/gal)

Actual Dose, mg/L

$$\frac{\text{Chlorine, lbs}}{\text{(Volume of water, MG) * (8.34 lbs/gal)}}$$

Chlorine Feed, lbs/day (Flow, MGD) * (Dose, mg/L) * (8.34 lbs/gal)

Chlorine Demand, mg/L (Chlorine Dose, mg/L) – (Chlorine Residual, mg/L)

Hypochlorite Strength, %

$$\frac{\text{Chlorine Required, lbs/day) * (100\%)}}{\text{(Hypochlorinator Flow, gal/day) * (8.34 lbs/gal)}}$$

Water Added into Hypochlorite Solution, gal

$$\frac{\text{(Hypo, gal) * (Hypo Strength, \%) – (Hypo, gal) * (Desired Hypo strength \%)}}{\text{(Desired Hypo, \%)}}$$

Fire Hydrant Flushing

Diameter of Pipe (in)	Gallons/Foot	Orifice Diameter (in)	Minimum Flow (gpm)
2	0.163	¾	25
2 ½	0.255	1	40
3	0.367	1 ¼	60
4	0.652	1 ½	100
6	1.47	2	220
8	2.61	2 ½	400
10	4.08	FH	612
12	5.87	FH	882
14	8.00	SB	1200
16	10.44	SB	1570

Flushing Times:

$$\text{Number of Minutes} = \frac{(\text{Length of line, ft}) * (\text{Gallons/Foot of Line})}{(\text{Flushing Flow, gpm})}$$

Flowrates from Hydrants / Blowoffs:

$$\text{Flow Rate, gpm} = \frac{(2.83) * (\text{Diameter of orifice, in})^2 * (\text{Length of Discharge, in})}{(\text{Height to Center of Orifice, in})^{0.5}}$$

$$\text{Flow Rate, gpm} = (26.8) * (\text{Diameter of Orifice, in})^2 * (\text{Pitot Gauge Pressure, psi})^{0.5}$$

Amount of Water Used:

$$\text{Gallons Needed} = (\text{Flushing Time, min}) * (\text{Flushing Flow, gpm})$$

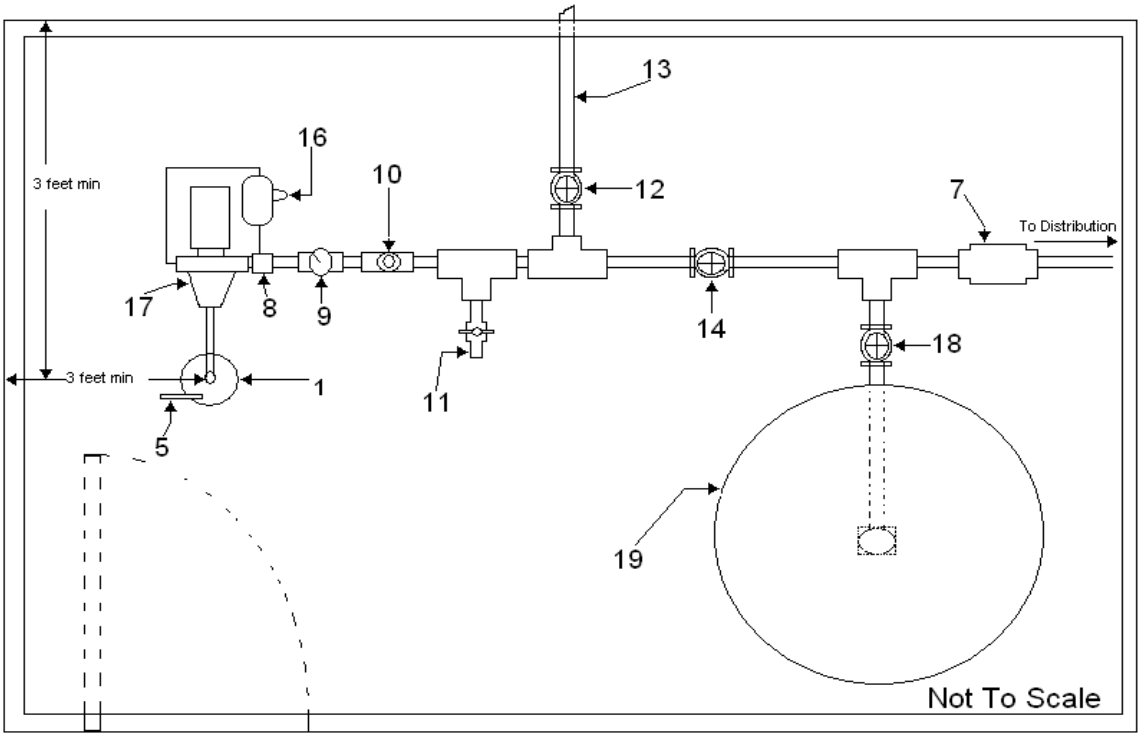
Volume of Cylinders:

$$\text{Volume, gal} = (\text{Area, sq ft}) * (\text{Depth, ft}) * (7.48 \text{ gal/cu ft})$$

$$\text{Volume, gal/ft} = (0.785) * (\text{Diameter, ft})^2 * (7.48 \text{ gal/cu ft})$$

Appendix B: Typical Diagrams

Diagram 1: Jet Pump Well Head Diagram



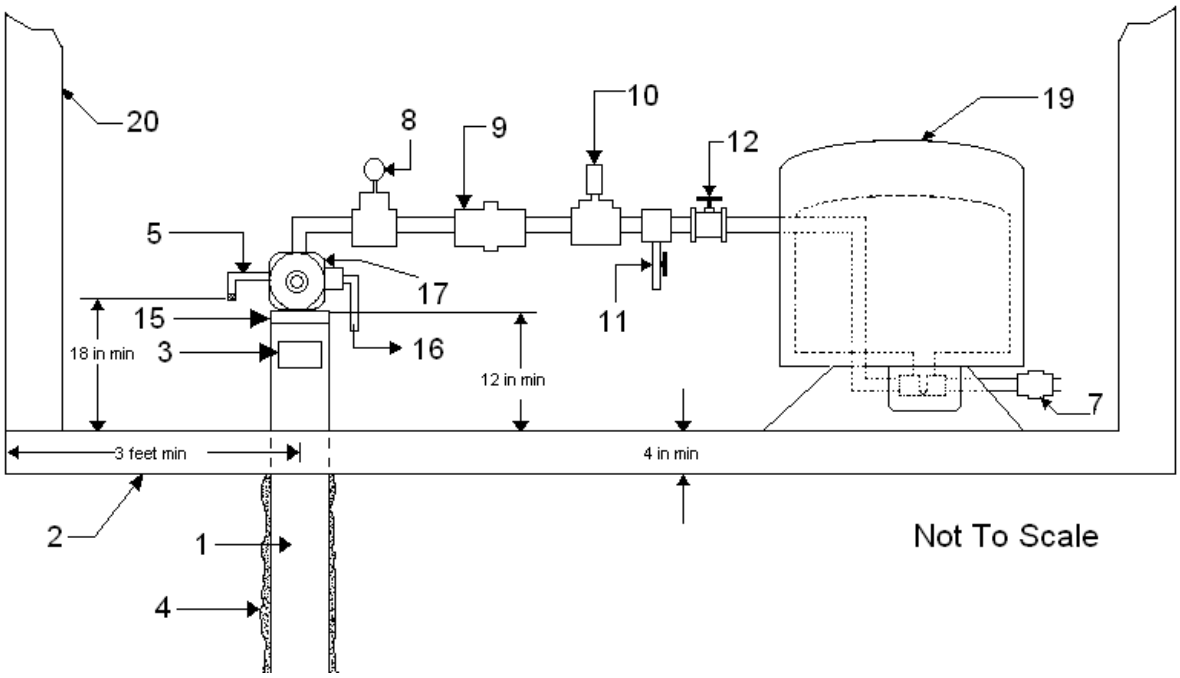


Diagram Key for Jet Pump and Submersible Pump Systems
Diagrams 1 & 2

1. Well Casing: The top of the well casing shall extend at least twelve (12) inches above the concrete pad or pump house floor.

2. Concrete Pad: A minimum radius of three (3) feet from the center of the well casing and a minimum thickness of four (4) inches.

3. Well Identification Plate: Must be permanently installed immediately after completion of drilling.

4. Grout: Well must be grouted in accordance with the construction specifications of the permit

5. Screened Vent: Must face downward with the opening located a minimum of eighteen (18) inches above the concrete pad or well house floor. Screen must have an effective opening of 0.024 inches or smaller. (This item is not required on packer-type jet pumps.)

6. Air or Vacuum Valve (optional): System design may require this valve. This item is not needed on a jet pump system.

7. Check Valve

8. Pressure Gauge

9. Flow Meter: Must be located down stream of the check valve and before the blow-off. This item is required on any public water supply well where the yield of the well cannot be easily measured from the blow-off using a bucket and stopwatch or by other means acceptable to the Department. The flow meter must be capable of measuring both instantaneous and totalized flow.

10. Pressure Relief Valve (optional): May be installed anywhere along the well head piping prior to the gate valve (#14) and must be sized to discharge the total flow of the pump at a pressure less than or equal to the working pressure of the storage tank. This item is required whenever the pump is capable of operating at a pressure greater than the working pressure of the storage tank.

11. Sample Tap: Must be located down stream of the check valve and before the gate valve isolating the well from the system (#14).

12. Gate Valve: For blow-off.

13. Blow-off: Must be located down stream of the meter (#9) and before the gate valve (#14) for isolating the well from the system.

14. Gate Valve: For isolating the well from the system.

15. Sanitary Well Seal: All openings other than the screened vent (#5) shall be effectively sealed against the entrance of the water under all conditions.

16. Electric Cable: Must be enclosed in conduit and meet the requirements of the National Electric Code (NEC).

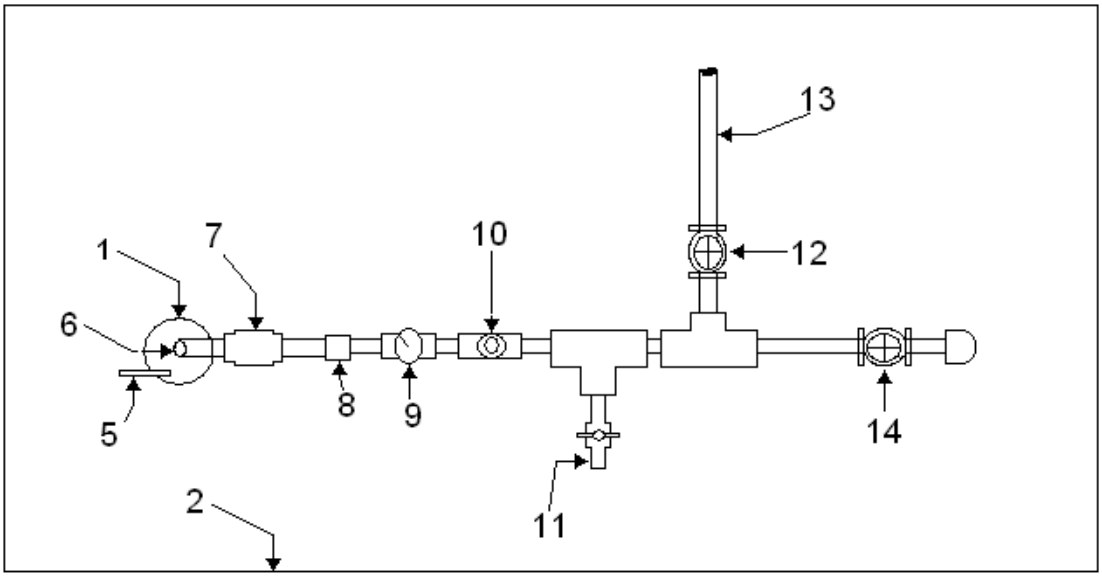
17. Jet Pump and Motor: Shown with pressure switch mounted on motor housing.

18. Gate Valve: For isolating the tank from the distribution system.

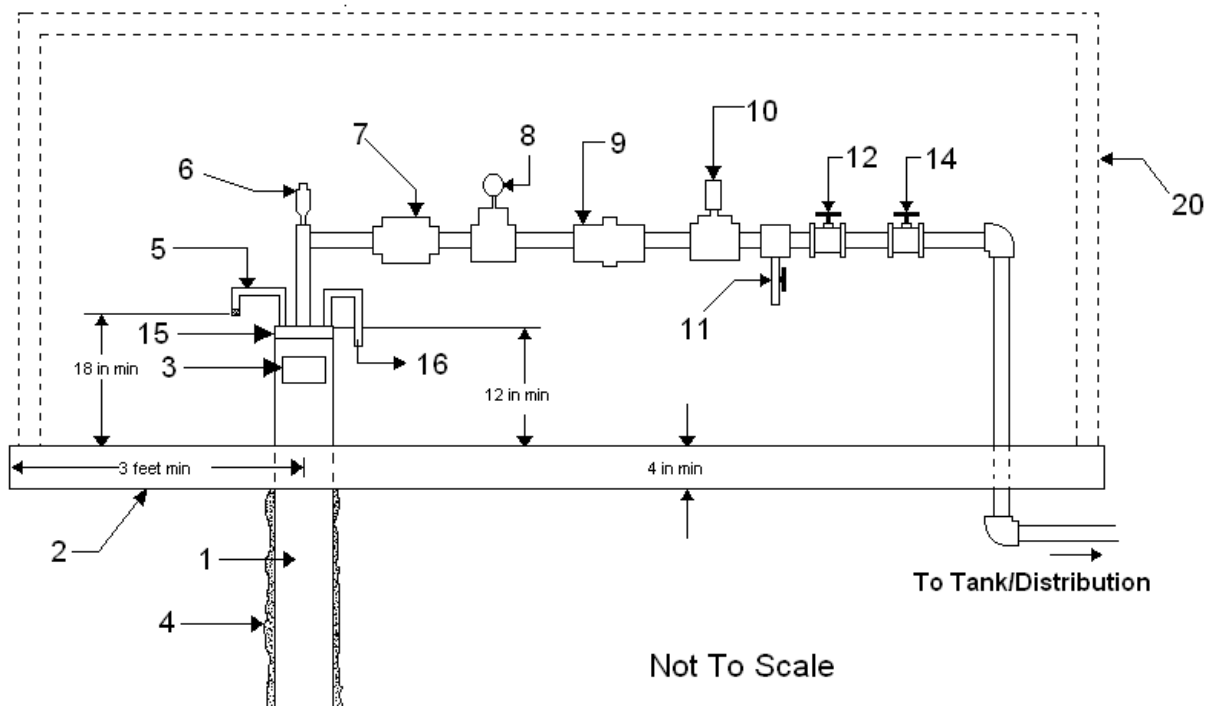
19. Bladder Tank: This type of tank may be used on either jet pump or submersible pump systems, although it is not shown on the Submersible Pump Well Head Diagram.

20. Well Head Protection: The wellhead must be protected from freezing and from vandalism by a lockable protective cover or pump house.

Diagram 2: Submersible Pump Well Head Diagram

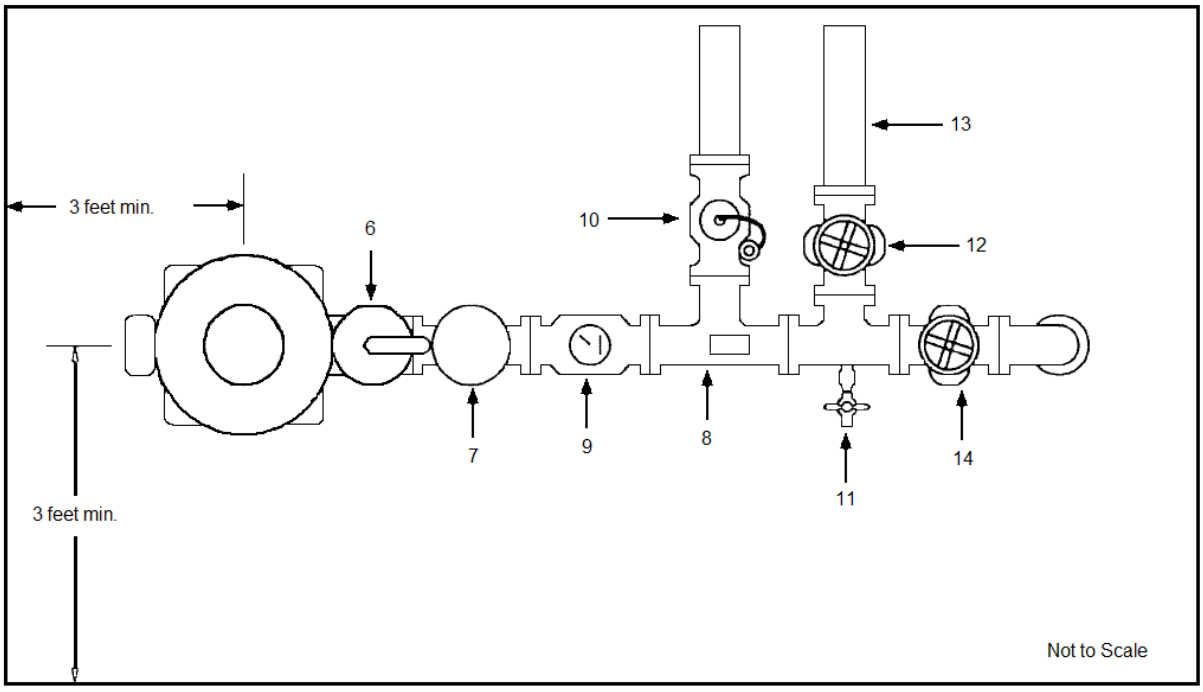


Not To Scale



Not To Scale

Diagram 3: Vertical Turbine Well Head Diagram



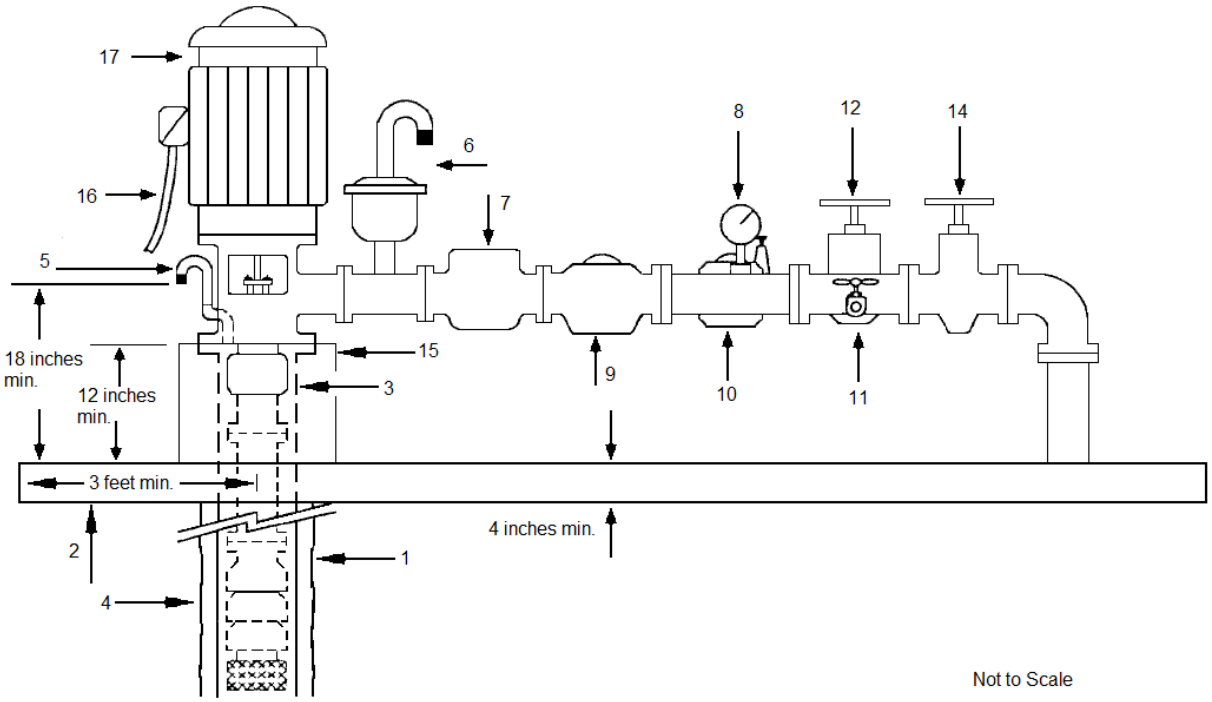


Diagram Key for Vertical Turbine Pump Systems

Diagram 3

1. Well Casing: The top of the well casing shall extend at least twelve (12) inches above the concrete pad or pump house floor.

2. Concrete Pad: A minimum radius of three (3) feet from the center of the well casing and a minimum thickness of four (4) inches.

3. Well Identification Plate: Must be permanently installed immediately after completion of drilling.

4. Grout: Well must be grouted in accordance with the construction specifications of the permit.

5. Screened Vent: Must face downward with the opening located a minimum of eighteen (18) inches above the concrete pad or well house floor. Screen must have an effective opening of 0.024 inches or smaller.

6. Air / Vacuum Valve: Required on a turbine pump in order to expel air from the pump column each time the pump starts.

7. Check Valve

8. Pressure Gauge

9. Flow Meter: Must be located down stream of the check valve and before the blow off. This item is required on any public water supply well where the yield of the well cannot be easily measured from the blow off using a bucket and stopwatch or by other means acceptable to the Department. The flow meter must be capable of measuring both instantaneous and totalized flow.

10. Pressure Relief Valve (optional): May be installed anywhere along the well head piping prior to the gate valve (#14) and must be sized to discharge the total flow of the pump at a pressure less than or equal to the working pressure of the storage tank. This item is required whenever the pump is capable of operating at a pressure greater than the working pressure of the storage tank.

11. Sample Tap: Must be located down stream of the check valve and before the gate valve isolating the well from the system (#14).

12. Gate Valve: For blow off.

13. Blow off: Must be located down stream of the meter (#9) and before the gate valve (#14) for isolating the well from the system.

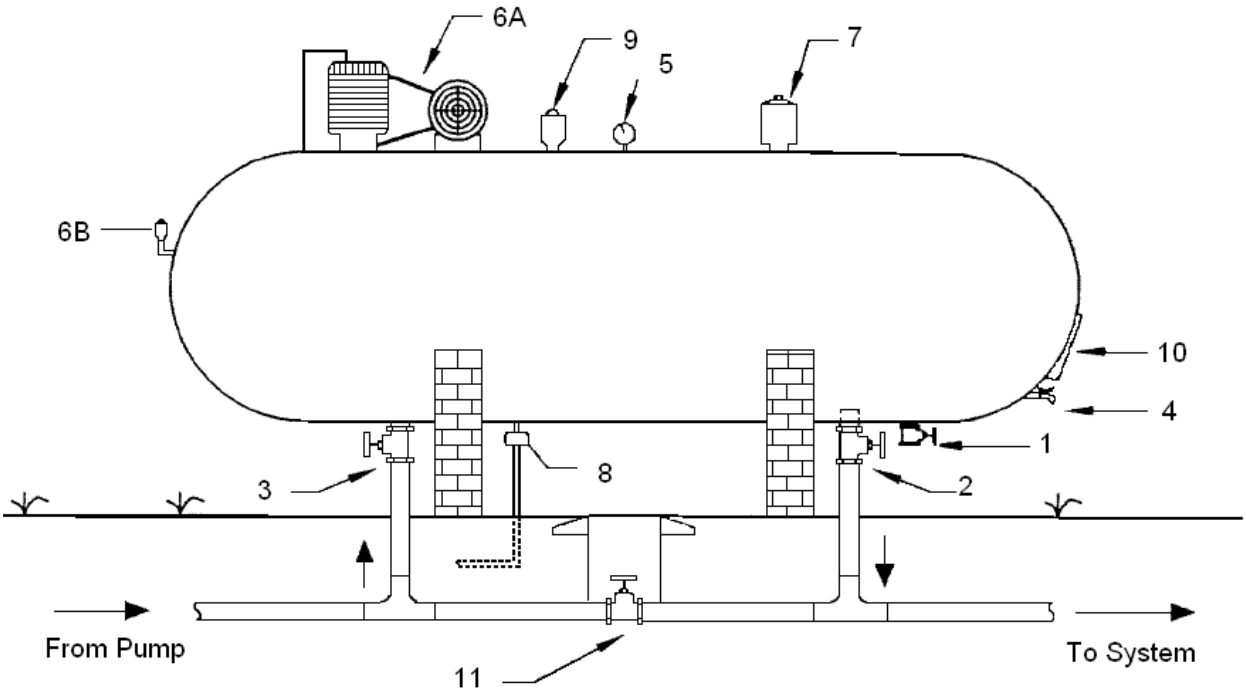
14. Gate Valve: For isolating the well from the system.

15. Sanitary Well Seal: All openings other than the screened vent (#5) shall be effectively sealed against the entrance of water under all conditions.

16. Electric Cable: Must be enclosed in conduit and meet the requirements of the National Electric Code.

17. Vertical "Hollow Shaft" Motor: Shown with pressure switch mounted on motor housing.

Diagram 4: Typical Piping for Standard Hydro-pneumatic Tank



Key

1. Drain valve: required on all standard (non-bladder) tanks. The drain must be a minimum of two (2) inches in diameter on tanks 500 gallons and larger.

2. Outlet with isolation valve: a flow-through arrangement is required on all standard (non-bladder) tanks. The outlet must be located on the opposite end of the tank from the inlet. An isolation valve is required on the outlet. Notice that the outlet piping extends slightly above the bottom of the tank to prevent sediment from entering the distribution system.

3. Inlet with isolation valve: a flow-through arrangement is required on all standard (non-bladder) tanks. The inlet must be located on the opposite end of the tank from the outlet. An isolation valve is required on the inlet.

4. Sample tap: required on all storage tanks.

5. Pressure gauge: required on all storage tanks. Can be located in the inlet or outlet piping on the tanks side of the isolation valve.

6. Air makeup system: required on all standard (non-bladder tanks. The system shown is an air compressor (6a) and air volume control valve (6b). This type of system is

required on tanks 2,000 gallons and larger. A snifter valve (dry pipe) arrangement may be used on smaller tanks.

7. Pressure relief valve: required on any tank that has an air compressor. This valve must be adjusted to fully open at or below the maximum working pressure of the tank.

8. Pressure switch: may be located on the inlet piping or on the tank itself. If located in the inlet piping, it must be close enough to the tank so that the pump will not short-cycle due to friction loss.

9. Vacuum relief valve: required on tanks 500 gallons and larger.

10. Access manhole: required on tanks 500 gallons and larger

11. Bypass piping: required on tanks 500 gallons and larger. The purpose of this arrangement is to allow the tank to be repaired without removing the associated well or booster pump from service.

Diagram 5: Bladder Tank Configuration

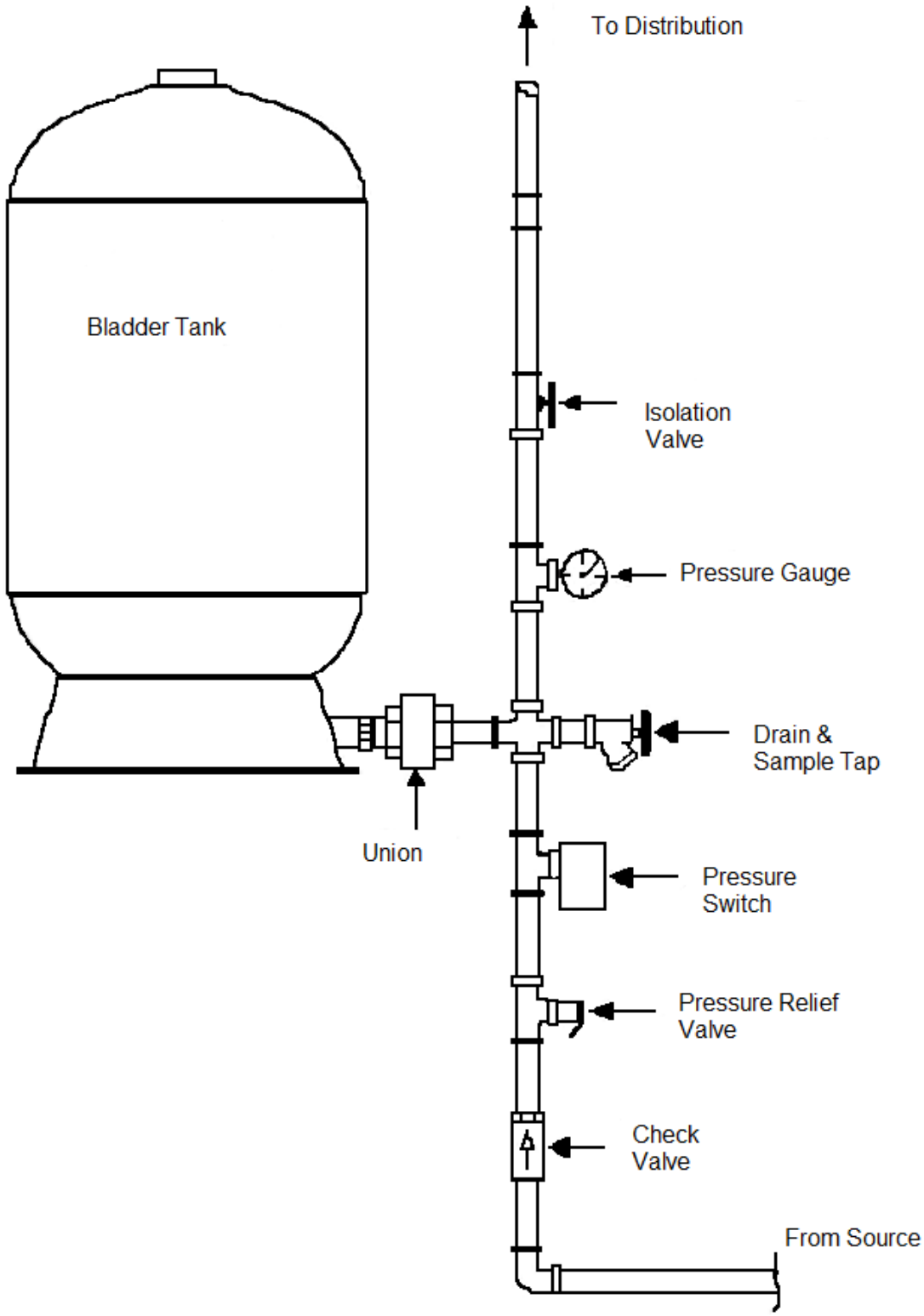
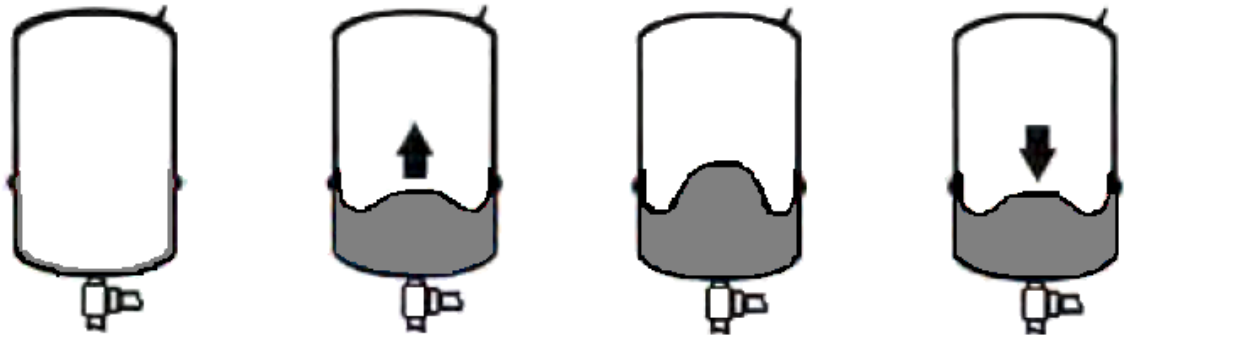


Diagram 6: Bladder Tank Operation



Start Up Cycle:
Diaphragm lies flat against the bottom of the chamber

Fill Cycle:
Water is pumped into the bottom, forcing the diaphragm up into the air chamber

Hold Cycle:
Pump cut-off pressure is reached. Diaphragm is at maximum hieght. Reservoir is filled to its rated capacity

Delivery Cycle:
Air pressure in top chamber forces diaphragm downward, delivering water to system. Pump remains shut off

Appendix C: Common Drinking Water Treatment Chemicals

Chemical	Storage	Use
Gas		
Chlorine	150 lb or 1-ton cylinders	Disinfectant, taste & odor control, mineral oxidation
Dry Chemicals		
Calcium Hypochlorite (HTH)	5 lb cans, tablets	Disinfectant
Sodium Chlorite	50 lb drums	Disinfectant
Aluminum Sulfate (alum)	100 lb bags (or bulk liquid)	Coagulation & sedimentation
Potassium Permanganate	50 lb bags	Taste & odor control, mineral oxidation
Calcium Carbonate	50 lb bags	pH adjustment
Sodium Fluoride	50 lb bags	Fluoridation
Sodium Silicofluoride	50 lb bags	Fluoridation
Calcium Hydroxide (lime)	50 lb bags	pH adjustment, corrosion control
Sodium Carbonate (soda ash)	50 lb bags	Corrosion control
Sodium Hexametaphosphate	100 lb bags	Corrosion control
Sodium Bi-carbonate	50 lb bags	Corrosion control
Bi-metallic Phosphate	50 lb bags	Corrosion control
Orthophosphate	50 lb bags	Corrosion control
Activated carbon	50 lb bags, or bulk	Taste & odor control
Liquid Chemicals		
Sodium Hypochlorite (bleach)	1-gallon container	Disinfectant
Hydrochloric acid	50 lb drums	pH adjustment
Sodium Hydroxide (caustic)	50 lb drums	pH adjustment
Potassium Permanganate	50 lb drums	Taste & odor control, mineral oxidation
Hydrofluosilicic acid	50 lb drums	Fluoridation

Appendix D: Primary and Secondary MCLs

Mircoorganisms

Contaminant	MCLG[1] (mg/L)[2]	MCL or TT[1] (mg/L)[2]	Potential Health Effects from Long-Term Exposure Above MCL (unless specified as short-term)	Sources of Contaminant in Drinking Water
Cryptosporidium	Zero	TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste
Giardia lamblia		TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste
Heterotrophic plate count	n/a		HPC has no health effects; it is an analytic method used to measure the variety of bacteria that are common in water. The lower the concentration of bacteria in drinking water, the better maintained the water system is.	HPC measures a range of bacteria that are naturally present in the environment
Legionella	Zero	TT[3]	Legionnaire's Disease, a type of pneumonia	Found naturally in water; multiplies in heating systems
Total Coliforms (including fecal coliform and E. coli)	Zero	5.0%[4]	Not a health threat in itself; it is used to indicate whether other potentially harmful bacteria may be present[5]	Coliforms are naturally present in the environment; as well as feces; fecal coliforms and E. coli only come from human and animal fecal waste.
Turbidity	n/a	TT[3]	Turbidity is a measure of the cloudiness of water. It is used to indicate water quality and filtration effectiveness (e.g., whether disease-causing organisms are present). Higher turbidity levels are often associated with higher levels of disease-causing microorganisms such as viruses, parasites and some bacteria. These organisms can cause symptoms such as nausea, cramps, diarrhea, and associated headaches.	Soil Runoff
Viruses (enteric)	Zero	TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste

Disinfection Byproducts

Contaminant	**MCLG[1] (mg/L)[2]**	**MCL or TT[1] (mg/L)[2]**	**Potential Health Effects from Long-Term Exposure Above MCL (unless specified as short-term)**	**Sources of Contaminant in Drinking Water**
Bromate	Zero	0.010	Increased risk of cancer	Byproduct of drinking water disinfection
Chlorite	0.8	1.0	Anemia; infants & young children: nervous system effects	Byproduct of drinking water disinfection
Haloacetic acids (HAA5)	n/a[6]	0.060	Increased risk of cancer	Byproduct of drinking water disinfection
Total Trihalomethanes (TTHMs)	n/a[6]	0.080	Liver, kidney or central nervous system problems; increased risk of cancer	Byproduct of drinking water disinfection

Disinfectants

Contaminant	**MCLG[1] (mg/L)[2]**	**MCL or TT[1] (mg/L)[2]**	**Potential Health Effects from Long-Term Exposure Above MCL (unless specified as short-term)**	**Sources of Contaminant in Drinking Water**
Chloramines (as Cl2)	MRDLG 4	MRDL 4.0	Eye/nose irritation; stomach discomfort, anemia	Water additive used to control microbes
Chlorine (as Cl2)	MRDLG 4	MRDL 4.0	Eye/nose irritation; stomach discomfort	Water additive used to control microbes
Chlorine dioxide (as Cl2)	MRDLG 0.8	MRDL 0.8	Anemia; infants & young children: nervous system effects	Water additive used to control microbes

Inorganic Chemicals

Contaminant	MCLG[1] (mg/L)[2]	MCL or TT[1] (mg/L)[2]	Potential Health Effects from Long-Term Exposure Above MCL (unless specified as short-term)	Sources of Contaminant in Drinking Water
Antimony	0.006	0.006	Increase in blood cholesterol; decrease in blood sugar	Discharge from petroleum refineries; fire retardants; ceramics; electronics; solder
Arsenic	0	0.010 as of 01/23/06	Skin damage or problems with circulatory systems, and may have increased risk of getting cancer	Erosion of natural deposits; runoff from orchards, runoff from glass & electronics production wastes
Asbestos (fiber >10 micrometers)	7 million fibers per liter	7 MFL	Increased risk of developing benign intestinal polyps	Decay of asbestos cement in water mains; erosion of natural deposits
Barium	2	2	Increase in blood pressure	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits
Beryllium	0.004	0.004	Intestinal lesions	Discharge from metal refineries and coal-burning factories; discharge from electrical, aerospace, and defense industries
Cadmium	0.005	0.005	Kidney damage	Corrosion of galvanized pipes; erosion of natural deposits; discharge from metal refineries; runoff from waste batteries and paints
Chromium (total)	0.1	0.1	Allergic dermatitis	Discharge from steel and pulp mills; erosion of natural deposits
Copper	1.3	TT[7] Action Level 1.3	Short term exposure: Gastrointestinal distress Long term exposure: Liver or kidney damage People with Wilson's Disease should consult their personal doctor if the amount of copper in their water exceeds the action level	Corrosion of household plumbing systems; erosion of natural deposits

Cyanide (as free cyanide)	0.2	0.2	Nerve damage or thyroid problems	Discharge from steel/metal factories; discharge from plastic and fertilizer factories
Fluoride	4.0	4.0	Bone disease (pain and tenderness of the bones); Children may get mottled teeth	Water additive which promotes strong teeth; erosion of natural deposits; discharge from fertilizer and aluminum factories
Lead	zero	TT[7] Action Level 0.015	Infants and children: Delays in physical or mental development; children could show slight deficits in attention span and learning abilities Adults: Kidney problems; high blood pressure	Corrosion of household plumbing systems; erosion of natural deposits
Mercury (inorganic)	0.002	0.002	Kidney damage	Erosion of natural deposits; discharge from refineries and factories; runoff from landfills and croplands
Nitrate (measured as Nitrogen)	10	10	Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits
Nitrite (measured as Nitrogen)	1	1	Infants below the age of six months who drink water-containing nitrite in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits
Selenium	0.05	0.05	Hair or fingernail loss; numbness in fingers or toes; circulatory problems	Discharge from petroleum refineries; erosion of natural deposits; discharge from mines
Thallium	0.0005	0.002	Hair loss; changes in blood; kidney, intestine, or liver problems	Leaching from ore-processing sites; discharge from electronics, glass, and drug factories

Organic Chemicals

Contaminant	MCLG[1] (mg/L)[2]	MCL or TT[1] (mg/L)[2]	Potential Health Effects from Long-Term Exposure Above MCL (unless specified as short-term)	Sources of Contaminant in Drinking Water
Acrylamide	Zero	TT[8]	Nervous system or blood problems; increased risk of cancer	Added to water during sewage/wastewater treatment
Alachlor	Zero	0.002	Eye, liver, kidney or spleen problems; anemia; increased risk of cancer	Runoff from herbicide used on row crops
Atrazine	0.003	0.003	Cardiovascular system or reproductive problems	Runoff from herbicide used on row crops
Benzene	Zero	0.005	Anemia; decrease in blood platelets; increased risk of cancer	Discharge from factories; leaching from gas storage tanks and landfills
Benzo(a)pyrene (PAHs)	Zero	0.0002	Reproductive difficulties; increased risk of cancer	Leaching from linings of water storage tanks and distribution lines
Carbofuran	0.04	0.04	Problems with blood, nervous system, or reproductive system	Leaching of soil fumigant used on rice and alfalfa
Carbon tetrachloride	Zero	0.005	Liver problems; increased risk of cancer	Discharge from chemical plants and other industrial activities
Chlordane	Zero	0.002	Liver or nervous system problems; increased risk of cancer	Residue of banned termiticide
Chlorobenzene	0.1	0.1	Liver or kidney problems	Discharge from chemical and agricultural chemical factories
2,4-D	0.07	0.07	Kidney, liver, or adrenal gland problems	Runoff from herbicide used on row crops
Dalapon	0.2	0.2	Minor kidney changes	Runoff from herbicide used on rights of way
1,2-Dibromo-3-chloropropane (DBCP)	Zero	0.0002	Reproductive difficulties; increased risk of cancer	Runoff/leaching from soil fumigant used on soybeans, cotton, pineapples, and orchards
o-Dichlorobenzene	0.6	0.6	Liver, kidney, or circulatory system problems	Discharge from industrial chemical factories

p-dichlorobenzene	0.075	0.075	Anemia; liver, kidney or spleen damage; changes in blood	Discharge from industrial chemical factories
1,2-Dichloroethane	zero	0.005	Increased risk of cancer	Discharge from industrial chemical factories
1,1-Dichloroethylene	0.007	0.007	Liver problems	Discharge from industrial chemical factories
cis-1,2-Dichloroethylene	0.07	0.07	Liver problems	Discharge from industrial chemical factories
trans-1,2-Dichloroethylene	0.1	0.1	Liver problems	Discharge from industrial chemical factories
Dichloromethane	Zero	0.005	Liver problems; increased risk of cancer	Discharge from drug and chemical factories
1,2-Dichloropropane	Zero	0.005	Increased risk of cancer	Discharge from industrial chemical factories
Di(2-ethylhexyl) adipate	0.4	0.4	Weight loss, liver problems, or possible reproductive difficulties.	Discharge from chemical factories
Di(2-ethylhexyl) phthalate	Zero	0.006	Reproductive difficulties; liver problems; increased risk of cancer	Discharge from rubber and chemical factories
Dinoseb	0.007	0.007	Reproductive difficulties	Runoff from herbicide used on soybeans and vegetables
Dioxin (2,3,7,8-TCDD)	Zero	0.00000003	Reproductive difficulties; increased risk of cancer	Emissions from waste incineration and other combustion; discharge from chemical factories
Diquat	0.02	0.02	Cataracts	Runoff from herbicide use
Endothall	0.1	0.1	Stomach and intestinal problems	Runoff from herbicide use
Endrin	0.002	0.002	Liver problems	Residue of banned insecticide
Epichlorohydrin	Zero	TT[8]	Increased cancer risk, and over a long period of time, stomach problems	Discharge from industrial chemical factories; an impurity of some water treatment chemicals
Ethylbenzene	0.7	0.7	Liver or kidneys problems	Discharge from petroleum refineries
Ethylene dibromide	zero	0.00005	Problems with liver, stomach, reproductive system, or kidneys; increased risk of cancer	Discharge from petroleum refineries
Glyphosate	0.7	0.7	Kidney problems; reproductive difficulties	Runoff from herbicide use

Heptachlor	Zero	0.0004	Liver damage; increased risk of cancer	Residue of banned termiticide
Heptachlor epoxide	Zero	0.0002	Liver damage; increased risk of cancer	Breakdown of heptachlor
Hexachlorobenzene	zero	0.001	Liver or kidney problems; reproductive difficulties; increased risk of cancer	Discharge from metal refineries and agricultural chemical factories
Hexachlorocyclopentdadine	0.05	0.05	Kidney or stomach problems	Discharge from chemical factories
Lindane	0.0002	0.0002	Liver or kidney problems	Runoff/leaching from insecticide used on cattle, lumber, gardens
Methoxychlor	0.04	0.04	Reproductive difficulties	Runoff/leaching from insecticide used on fruits, vegetables, alfalfa, livestock
Oxamyl (Vydate)	0.2	0.2	Slight nervous system effects	Runoff/leaching from insecticide used on apples, potatoes, and tomatoes
Polychlorinated biphenyls (PCBs)	Zero	0.0005	Skin changes; thymus gland problems; immune deficiencies; reproductive or nervous system difficulties; increased risk of cancer	Runoff from landfills; discharge of waste chemicals
Pentachlorophenol	Zero	0.001	Liver or kidney problems; increased cancer risk	Discharge from wood preserving factories
Picloram	0.5	0.5	Liver problems	Herbicide runoff
Simazine	0.004	0.004	Problems with blood	Herbicide runoff
Styrene	0.1	0.1	Liver, kidney, or circulatory system problems	Discharge from rubber and plastic factories; leaching from landfills
Tetrachloroethylene	Zero	0.005	Liver problems; increased risk of cancer	Discharge from factories and dry cleaners
Toluene	1	1	Nervous system, kidney, or liver problems	Discharge from petroleum factories
Toxaphene	Zero	0.003	Kidney, liver, or thyroid problems; increased risk of cancer	Runoff/leaching from insecticide used on cotton and cattle
2,4,5-TP (Silvex)	0.05	0.05	Liver problems	Residue of banned herbicide
1,2,4-Trichlorobenzene	0.07	0.07	Changes in adrenal glands	Discharge from textile finishing factories
1,1,1-Trichloroethane	0.20	0.2	Liver, nervous system, or circulatory problems	Discharge from metal degreasing sites and other factories

1,1,2-Trichloroethane	0.003	0.005	Liver, kidney, or immune system problems	Discharge from industrial chemical factories
Trichloroethylene	Zero	0.005	Liver problems; increased risk of cancer	Discharge from metal degreasing sites and other factories
Vinyl chloride	Zero	0.002	Increased risk of cancer	Leaching from PVC pipes; discharge from plastic factories
Xylenes (total)	10	10	Nervous system damage	Discharge from petroleum factories; discharge from chemical factories

Radionuclides

Contaminant	**MCLG[1] (mg/L)[2]**	**MCL or TT[1] (mg/L)[2]**	**Potential Health Effects from Long-Term Exposure Above MCL (unless specified as short-term)**	**Sources of Contaminant in Drinking Water**
Alpha particles	None Zero	15 picocuries per Liter (pCi/L)	Increased risk of cancer	Erosion of natural deposits of certain minerals that are radioactive and may emit a form of radiation known as alpha radiation
Beta particles and photon emitters	None ---------- zero	4 millirems per year	Increased risk of cancer	Decay of natural and man-made deposits of certain minerals that are radioactive and may emit forms of radiation known as photons and beta radiation
Radium 226 and Radium 228 (combined)	None ---------- zero	5 pCi/L	Increased risk of cancer	Erosion of natural deposits
Uranium	zero	30 ug/L as of 12/08/03	Increased risk of cancer, kidney toxicity	Erosion of natural deposits

[1]Definitions:
Maximum Contaminant Level Goal (MCLG) - The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.

Maximum Contaminant Level (MCL) - The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. MCLs are enforceable standards.

Maximum Residual Disinfectant Level Goal (MRDLG) - The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.

Treatment Technique - A required process intended to reduce the level of a contaminant in drinking water.

Maximum Residual Disinfectant Level (MRDL) - The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.

[2]Units are in milligrams per liter (mg/L) unless otherwise noted. Milligrams per liter are equivalent to parts per million.

[3]EPA's surface water treatment rules require systems using surface water or ground water under the direct influence of surface water to (1) disinfect their water, and (2) filter their water or meet criteria for avoiding filtration so that the following contaminants are controlled at the following levels:

- Cryptosporidium: Unfiltered systems are required to include Cryptosporidium in their existing watershed control provisions.
- Giardia lamblia: 99.9% removal/inactivation
- Viruses: 99.99% removal/inactivation
- Legionella: No limit, but EPA believes that if Giardia and viruses are removed/inactivated, according to the treatment techniques in the Surface Water Treatment Rule, Legionella will also be controlled.
- Turbidity: For systems that use conventional or direct filtration, at not time can turbidity (cloudiness of water) go higher than 1 nephelolometric turbidity unit NTU), and samples for turbidity must be less than or equal to 0.3 NTU in

at least 95 percent of the samples in any month. Systems that use filtration other than the conventional or direct filtration must follow state limits, which must include turbidity at no time exceeding 5 NTU.

- HPC: No more than 500 bacterial colonies per milliliter.

- Long Term 1 Enhanced Surface Water Treatment: Surface water systems or (GWUDI) systems serving fewer than 10,000 people must comply with the applicable Long Term 1 Enhanced Surface Water Treatment Rule provisions (e.g. turbidity standards, individual filter monitoring, Cryptosporidium removal requirements, updated watershed control requirements for unfiltered systems).

- Long Term 2 Enhanced Surface Water Treatment Rule This rule applies to all surface water systems or ground water systems under the direct influence of surface water. The rule targets additional Cryptosporidium treatment requirements for higher risk systems and includes provisions to reduce risks from uncovered finished water storage facilities and to ensure that the systems maintain microbial protection as they take steps to reduce the formation of disinfection byproducts.

- Filter Backwash Recycling; The Filter Backwash Recycling Rule requires systems that recycle to return specific recycle flows through all processes of the system's existing conventional or direct filtration system or at an alternate location approved by the state.

[4] No more than 5.0% samples total coliform-positive in a month. (For water systems that collect fewer than 40 routine samples per month, no more than one sample can be total coliform-positive per month.) Every sample that has total coliform must be analyzed for either fecal coliforms or E. coli if two consecutive TC-positive samples, and one is also positive for E.coli fecal coliforms, system has an acute MCL violation.

[5] Fecal coliform and E. coli are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Disease-causing microbes (pathogens) in these wastes can cause diarrhea, cramps, nausea, headaches, or other symptoms. These pathogens may pose a special health risk for infants, young children, and people with severely compromised immune systems.

[6] Although there is no collective MCLG for this contaminant group, there are individual MCLGs for some of the individual contaminants:

- Trihalomethanes: bromodichloromethane (zero); bromoform (zero); dibromochloromethane (0.06 mg/L): chloroform (0.07mg/L).

- Haloacetic acids: dichloroacetic acid (zero); trichloroacetic acid (0.02 mg/L); monochloroacetic acid (0.07 mg/L). Bromoacetic acid and dibromoacetic acid are regulated with this group but have no MCLGs.

[7] Lead and copper are regulated by a Treatment Technique that requires systems to control the corrosiveness of their water. If more than 10% percent of tap water samples exceed the action level, water systems must take additional steps. For copper, the action level is 1.3 mg/L, and for lead it is 0.015 mg/L.

[8] Each water system must certify, in writing, to the state (using third-party or manufacturer's certification) that when it uses acrylamide and epichlorohydrin are used to treat water, the combination (or product) of dose and monomer level does not exceed the levels specified, as follows:

- Acrylamide = 0.05% dosed at 1 mg/L (or equivalent)

- Epichlorohydrin = 0.01% dosed at 20 mg/L (or equivalent)

National Secondary Drinking Water Regulations

National Secondary Drinking Water Regulations (NSDWRs or secondary standards) are non-enforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends secondary standards to water systems but does not require systems to comply.

Contaminant	**Secondary Standard**
Aluminum	0.05 to 0.2 mg/L
Chloride	250 mg/L
Color	15 (color units)
Copper	1.0 mg/L
Corrosivity	noncorrosive
Fluoride	2.0 mg/L
Foaming Agents	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Odor	3 threshold odor number
pH	6.5-8.5
Silver	0.10 mg/L
Sulfate	250 mg/L
Total Dissolved Solids	500 mg/L
Zinc	5 mg/L

Appendix E: Valve and Hydrant Maintenance

Hydrant Flow Testing

1. Install traffic control and make provisions for adequate drainage.

2. At residual hydrant:

    a. Flush residual hydrant to eliminate sediment.

    b. Install outlet-nozzle cap equipped with pressure gauge on outlet nozzle.

    c. Open main valve slowly until air is vented. Close vent and open main valve fully.

    d. Read the gauge. This is the static pressure.

3. At flow hydrant:

    a. Measure and record the inside diameter of the outlet nozzle from the flow nozzle that the water will flow from.

    b. Determine the outlet nozzle coefficient based on the shoulder entrance. For a rounded shoulder, the coefficient is 0.9. For a square shoulder the coefficient is 0.8. For a nozzle that protrudes into the hydrant barrel, the coefficient is 0.7.

4. Conduct the flow test:

    a. Station one observer at the residual hydrant and one observer at the flow hydrant.

    b. Open the flow hydrant slowly until fully opened.

    c. When the pressure at the residual hydrant has stabilized, the observer signals the person stationed at the flow hydrant to take the readings. The readings for residual pressure and Pitot tube readings should be taken simultaneously.

    d. Record the residual and Pitot-gauge reading. Then slowly close the hydrant.

Hydrant Inspection and Maintenance

1. Clean up and evaluate the hydrant

    - Remove any obstructions around the hydrant.
    - See if paint is needed.
    - See if the hydrant needs to be raised because of a change in ground surface grade.

2. Look for main valve leaks

    - Use a listening device and check for main valve leakage.
    - Remove outlet-nozzle cap. Check for water or ice in the hydrant barrel.
    - Replace cap and leave it loose enough for some air to escape.
    - Check breakaway device for damage before operating the hydrant.

3. Look for stem thread buildup and any additional leaks

    - Open the hydrant slowly and allow air to vent from the loosened cap.
    - Tighten the outlet nozzle cap and open the hydrant all of the way.
    - Open and close the hydrant a few times to remove any hard water buildup on the stem threads. Check the lubrication before going on with the inspection.
    - Use a listening device to check for leaks in the upper barrel.
    - Check for leakage at the flanges, around the outlet muzzles, at the packing or seal around the operating stem. Repair any leaks as needed.
    - Close the hydrant slowly and completely. Back off of the operating nut enough to take pressure off of the thrust bearing or packing.
    - Remove an outlet nozzle cap and get ready to flush the hydrant.

4. Flush and clean the hydrant

    - While the hydrant is flowing, locate and test the isolation valve. If the water flow cannot be stopped, schedule repair of the isolation valve.

HYDRANT MAINTENANCE WORKSHEET

Date:_____ Crew:_____

Hydrant #	# of Turns	Static (psi)	Residual (psi)	Flow (gpm)	Remarks/Maintenance Performed

VALVE OPERATION WORKSHEET

Date:_____ Crew:_____

Valve #	Size	Direction of Turns	Remarks/Maintenance Performed

VALVE DEFICIENCY REPORT

Date:_____ Crew:_____

Valve #	Size	Location	Deficiency

Appendix F: Emergency Operations

EMERGENCY PROCEDURES FOR SMALL COMMUNITY WATER SYSTEMS

I. NAMES, ADDRESSES, AND PHONE NUMBERS OF STATE, LOCAL, & OTHER OFFICIALS

1. LOCAL DHEC ENVIRONMENTAL QUALITY CONTROL OFFICE

Name:
Address:

Telephone:

2. BUREAU OF WATER
SC Dept. of Health & Environmental Control
2600 Bull Street
Columbia, SC 29201
TELEPHONE: (803) 898-4300

3. DHEC 24-HOUR EMERGENCY RESPONSE TELEPHONE NUMBER

TELEPHONE: (803) 253-6488

4. COUNTY EMERGENCY PREPAREDNESS OFFICE
Address:

Telephone:

5. STATE EMERGENCY PREPAREDNESS OFFICE

SC Emergency Management Division
2779 Fish Hatchery Road
West Columbia, SC 29172
TELEPHONE: (803) 737-8500

6. WATER SYSTEM PERSONNEL
(Add additional information if more than one person)
Name:
Address:
Telephone:

7. PRIMARY AND SECONDARY EMERGENCY PREPAREDNESS COMMAND POSTS

Name:
Address:

Telephone:

Name:
Address:

Telephone:

8. CONTACT FOR OBTAINING ANY CHEMICALS NEEDED

Name:
Address:

Telephone:

List of chemicals used:

9. ELECTRIC POWER COMPANY
Name:
Telephone:

10. CONTACTS FOR OBTAINING EMERGENCY WATER SUPPLY

Contact the County Emergency Preparedness Office (refer to item 4 above)

11. EQUIPMENT SUPPLIER
Name:
Address:
Telephone:

12. LIST OF CONTRACTORS FOR MAJOR REPAIRS OR CLEANUPS

Name:
Address:

Telephone:

Name:
Address:

Telephone

II. PROCEDURES TO FOLLOW FOR VARIOUS TYPES OF EMERGENCIES

1. BREAK IN SERVICE DUE TO WELL PUMP OUT OF SERVICE, POWER OUTAGE, OR LINE BREAK

(A) Notify EQC Regional office by phone. If this office cannot be contacted, call the Bureau of Water or the DHEC 24-hour telephone number. (Always notify if system pressure falls below 10 psi).
(B) Notify appropriate water system operators
(C) Contact electric power company, if power outage
(D) Issue boil water notice
(E) Contact contractor to make repairs (furnish specifications)
(F) Disinfect water system and flush
(G) Sample for BACTERIOLOGICAL CONTAMINATION (must have at least two (2) samples free of contamination collected on consecutive days before the system is placed in service)

2. CONTAMINATION FROM PETROLEUM PRODUCTS AND OTHER CHEMICALS

(A) Notify DHEC Regional EQC Office. If this office cannot be contacted, call the Bureau of Water or the DHEC 24-hour telephone number.
(B) Notify appropriate water system personnel.

3. DISASTER FROM HURRICANE, EARTHQUAKE, ETC. WITH LINE BREAKS, FLOODING, AND/OR LOSS OF POWER

(A) Notify the DHEC Regional EQC Office by the fastest means available. If this is not possible, try to contact the Bureau of Water or the DHEC 24-hour telephone number
(B) Notify appropriate water system personnel
(C) Notify county and state emergency preparedness centers of your systems condition
(D) Issue boil water notice to be in effect until the system is cleared of problems
(E) Notify customers by explaining the situation and estimate the time of return to service
(F) Contact contractor(s) to make repairs (furnish specification)
(G) Flush and disinfect the water system
(H) Sample for bacteriological contamination (must have at least two (2) samples free of contamination collected on consecutive days before the boil water notice is lifted)
(I) If necessary, do a complete water quality analysis

NOTE: *These emergency procedures are to be part of the operation and maintenance manual of the water system. Equipment specifications, instructions for disinfecting the various parts of the water system, and sample boil water notice must be included in this manual*

BOIL WATER NOTICES AND ADVISORIES

INTRODUCTION

Customers of public water systems trust and depend on their providers and state officials to ensure that their drinking water is safe and to notify them when there is a problem concerning the safety of the water. The purpose of this document is to provide guidance on how to notify the customers of a public water system when there is a problem with their drinking water supply.

The words "Boil Water" used in the title of this document represent the action to be taken by a customer in the case of microbial contamination. This is the most common type of contamination problem that public water systems experience.

Although microbial contamination is the most common type of contamination problem, it is not the only one. Occasionally public water systems experience chemical contamination of the water supply as a result of a cross connection or a chemical or petroleum spill. During such events, the basic guidelines for notifying the customers are the same; however, the action to be taken will be different. The action to be taken during such events is often for the customer not to use the water for drinking or cooking, and in some cases bathing.

In the past, the South Carolina Department of Health and Environmental Control (Department) and other industry professionals have suggested the use of chlorine bleach as a means of disinfecting small quantities of water for drinking or cooking. However, since such treatment will not kill all parasitic organisms, the Department is no longer endorsing the use of such treatment in lieu of boiling the water.

DEFINITIONS

The difference between a "Boil Water Notice" and a "Boil Water Advisory" depends on the degree of certainty that a water system has been contaminated. The definition for each is as follows:

"Boil Water Notice" means a notice, whether written or verbal (i.e., media), issued by the Department, or the owner or operator of a public water system, notifying the users of the water system that the water is contaminated and to boil the water (vigorous rolling boil for at least one minute) prior to using it for drinking or cooking. The notice shall give the reason for its issuance and corrective actions being taken.

"Boil Water Advisory" means an advisory, whether written or verbal (i.e., media), issued by the Department, or the owner or operator of a public water system, notifying the users of the water system that the water may be contaminated and to boil the water (vigorous rolling boil for at least one minute) prior to using it for drinking or cooking. The advisory shall give the reason for its issuance and corrective actions being taken.

WHEN TO ISSUE A BOIL WATER NOTICE OR ADVISORY

A "Boil Water Notice" should be issued when sampling indicates that there is a threat to public health. The Department has identified some situations when such a notice is warranted. These situations are as follows:

Any fecal positive routine sample followed by a fecal positive repeat sample. The sampling in this situation has confirmed that pathogenic organisms are in the drinking water.

If the Department and/or the owner repeatedly collects total and/or fecal coliform positive samples from a well after shock disinfection and the well does not have continuous disinfection treatment. This is an indication that the well may be under the direct influence of surface water.

A "Boil Water Advisory" should be issued when an event has occurred which could have possibly contaminated the drinking water. The following are some situations where a boil water advisory may be warranted:

- Loss of pretreatment at a surface water treatment plant (i.e., no floc) and the untreated water reaches the distribution system. The finished water turbidities in this case may, or may not, be greater than 5 NTU. In this situation, it is likely that microbial contamination has reached the distribution system; however, it will be at least 24 hours before contamination can be confirmed through testing. Therefore, an advisory should be issued immediately.

- Loss of pressure in the entire distribution system or a significant portion of a distribution system.

- A line break where dirt and debris have entered the distribution piping.

- Prior to a hurricane making landfall.

- The use of emergency groundwater sources that have not been sampled or flushed on a regular basis.

Please note that the above situations are not the only times that a boil water notice/advisory should be issued. The Drinking Water and Recreational Water Compliance Section of the Bureau of Water can assist anyone in making a decision to issue a boil water notice/advisory, as well as assist in determining what actions should be taken to correct the problem and when to repeal the alert.

CONTENT AND FORMAT OF A BOIL WATER NOTICE OR ADVISORY

It is very important that a "Boil Water Notice or "Boil Water Advisory" include the following information:

- Title of the notice/advisory - The title must include the words "Boil Water Notice" or "Boil Water Advisory", to whom the notice/advisory is being issued and the date issued.

- A statement of who is issuing the notice/advisory - This would be either the Department or the name of the water system. As a general rule, the owner of the water system should issue the notice/advisory, even if it is being issued as a result of sampling conducted by the Department. However, if a notice/advisory is deemed necessary for the protection of public health, and the owner of the water system is unavailable or unwilling to issue the

notice/advisory, the Department will take the initiative of issuing the alert. Notices/advisories issued by the Department should only be issued by EQC Regional Directors or the Director of the Drinking Water and Recreational Water Compliance Section or their designee. In the case of a hurricane or flood, the Department will take the initiative to issue a "Boil Water Advisory" to the affected areas. Such an advisory will also be addressed to private well owners.

- A statement of what area of the water system the notice/advisory affects - For example, the entire system, north west portion, southern portion, customers along a specific road, etc.

- A statement that the residents should vigorously boil their water for at least one full minute prior to drinking or cooking. In the past, there have been several values used for the length of time that water should be vigorously boiled prior to use. However, the latest information from the Center for Disease Control (CDC) indicates that vigorously boiling water for one full minute is more than adequate to kill any pathogens and make the water safe to drink.

- An explanation of why the notice/advisory is being given - This is where the difference in a "Boil Water Notice" and a "Boil Water Advisory" comes into play. In the case of a "Boil Water Notice", the notice is issued because bacteriological sampling indicates that the drinking water has become contaminated, or there has been a waterborne disease outbreak. In the case of a "Boil Water Advisory", the advisory is given because there has been an event which could have contaminated the water system, such as a line break, loss of pressure, high turbidity in the finished water, etc.

- A statement reiterating that the water should be vigorously boiled for at least one full minute prior to drinking or cooking and that any ice made from water that has not been boiled should not be use for drinking purposes.

- A statement of what actions are being taken to correct the problem, and by whom.

- A statement that customers will be notified when the problem has been resolved and there is no longer a need to boil the water.

- Give the name of the office or person and phone number to contact for questions.

- Signature of responsible party at the bottom of the notice.

An example of a notice and advisory is attached for reference.

DISTRIBUTION OF THE NOTICE OR ADVISORY

There are several ways that the notice or advisory can be distributed. If the water system or affected area of a water system is relatively small, a written notice/advisory may be hand delivered to the door of each residence. In addition to the door-to-door delivery a copy of the

notice/advisory should be posted in places normally frequented by the residents, such as post offices, convenience stores, gas stations, etc.

The notice/advisory must never be placed in mailboxes because many of the residents may have already checked their mailbox for the day and thus may not receive the alert until the next day. Also, placing non-mailed items in a mailbox is a federal offense.

If the affected area is large, electronic media such as local radio and television stations should make the notice/advisory. In severe cases, such as waterborne disease outbreaks, the local Emergency Preparedness Division should be contacted to aid in getting the message to consumers through the emergency broadcast system.

COMMUNICATION WITH THE DEPARTMENT

The State Primary Drinking Water Regulations require that if a public water system issues a boil water notice or advisory, the Department must be notified immediately. The regulations further require that a copy of the notice/advisory be forwarded to the Department as soon as possible after is issued.

The regulations also require that a system notify the Department when the boil water notice/advisory is repealed and a copy of the repeal notice forwarded to the Department as soon as possible after it is issued.

Generally, public water systems should coordinate with the Department's District Environmental Quality Control (EQC) Regional offices. EQC Regional personnel will, in turn, coordinate activities with the Drinking Water and Recreational Water Compliance Section of the Bureau of Water. If the EQC Regional Office cannot be reached, the system should then call the Department's 24-hour number.

SUGGESTED ACTIONS TO BE TAKEN FOLLOWING THE ISSUANCE OF A NOTICE/ADVISORY

In the event of a pressure loss to all, or a portion, of the distribution system, intense flushing should begin as soon as pressure is restored. After flushing the affected area, several coliform samples must be taken throughout the affected area to determine if the distribution system is free of any bacteriological contamination. If applicable, chlorine residual measurements should be taken to ensure that there is an adequate disinfectant residual. If possible, chorine dosages should be increased by 1 to 2 parts per million during this period as a corrective and preventive measure. If the sampling indicates the absence of coliform bacteria, the advisory should be repealed. However, if the sampling indicates the presence of coliform bacteria, additional flushing should be conducted in the area where the positive coliform samples were collected and a second round of coliform samples collected from that area.

If a notice is issued as a result of positive bacteriological sample results, intense flushing and re-sampling (at least two sets of samples taken at least 24 hours apart) of the area should be conducted. Also, if possible, chlorine dosages should be increased as mentioned above. When at least two sets of samples, taken at least 24 hours apart, indicate the absence of coliform bacteria, the notice should be repealed.

The Department will issue a boil water advisory to the potentially affected area prior to any hurricane. Immediately following the hurricane, the public water systems and the Department will evaluate the systems for damage. If a system did not lose pressure and the water quality being pumped to the system was maintained (i.e., low turbidities, adequate chlorine residual) during and after the storm, the advisory should be repealed. However, if the system lost pressure, the same action specified above should be taken.

REPEAL OF A BOIL WATER NOTICE OR ADVISORY

The repeal of any boil water notice or advisory should be distributed in the same manner as it was issued. The repeal of a notice or advisory should include the following information:

- Title of the notice/advisory - The title must include the words "Repeal of Boil Water Notice" or "Repeal of Boil Water Advisory", to whom the repeal is being issued and the date issued.

- A statement of who is issuing the repeal - This would be the same as who issued the notice or advisory.

- A statement of what area of the water system the repeal affects – Generally this will be the same as mentioned in the notice or advisory; however, in certain cases the repeal may only apply to a portion of the area.

- A statement that the residents no longer need to vigorously boil their water prior to drinking or cooking.

- An explanation of why the notice/advisory is being lifted - Explain what actions have been taken to correct the problem to ensure that the water is safe to drink without boiling.

- Give the name of the office or person and phone number to contact for questions.

- Signature of responsible party at the bottom of the repeal.

BOIL WATER NOTICE
TO
THE RESIDENTS OF _____

(Date)

The (Utilities/Water System Name) advises the residents of the (Area Location), located in County, to vigorously boil their water for at least one (1) full minute prior to drinking or cooking.

Analyses of recent bacteriological samples collected by the (Utilities/Water System Name) from the drinking water system serving the (Area Location) indicate that the water system has become contaminated. Residents should continue to vigorously boil their water for at least one (1) full minute prior to drinking or cooking until otherwise notified by the (Utilities/Water System Name). Also, any ice made from water that has not been boiled should not be used for drinking purposes.

The (Utilities/Water System Name) is presently working to correct the problem.

If you should have any questions concerning this Notice, you may call the (Utilities/Water System Name) at (Telephone Number).

_____
Owner/System Representative Name
cc: SC DHEC (Local Office)

BOIL WATER ADVISORY
TO
THE RESIDENTS OF _____

(Date)

The (Utilities/Water System Name) advises the residents of the (Area Location), located in County, to vigorously boil their water for at least one (1) full minute prior to drinking or cooking.

A major line break in the (Utilities/Water System Name) system has resulted in a loss of pressure and service to many of the customers of the system. There has been no confirmed contamination of the system. However, because of the loss of pressure, customers are advised to vigorously boil their water for at least one (1) full minute prior to drinking or cooking until otherwise notified by the (Utilities/Water System Name). Also, any ice made from water that has not been boiled should not be used for drinking purposes.

The (Utilities/Water System Name) is presently working to correct the problem.

If you should have any questions concerning this Notice, you may call the (Utilities/Water System Name) at (Telephone Number).

_____
Owner/System Representative Name
cc: SC DHEC (Local Office)

Repeal of The BOIL WATER NOTICE
TO
THE RESIDENTS OF

(Date)

The (Utilities/Water System Name) advises the residents of the (Area Location), located in County, that they no longer need to boil their water prior to drinking or cooking.

Following an intense flushing of the distribution system, bacteriological samples where collected and analyzed by the (Utilities/Water System Name). The results of this sampling indicate that the system is now safe to use for drinking and cooking purposes.

If you should have any questions concerning this repeal of the Boil Notice, you may call the (Utilities/Water System Name) at (Telephone Number).

_____

Owner/System Representative Name
cc: SC DHEC (Local Office)