Orange Water and Sewer Authority

Purity Sampling for New Water Lines
Frequently Asked Questions

1. Why is purity sampling required?

Before OWASA can accept new water lines into the public water system or approve them for service, it is necessary to disinfect them and perform bacteriological testing (purity sampling) to ensure that they are not a source of bacteria to our water distribution system and customers. This is required by the State[1] for all public water systems.

2. What are the samples tested for?

Each sample is tested for a group of bacteria called Total Coliform, as well as one subgroup of Total Coliform called *E. coli*. Total Coliforms are a group of bacteria commonly found in soil and surface waters and *E. coli* bacteria are most often found in fecal material (that is, from human or animal wastes). These *indicator bacteria* are used for purity testing, as opposed to other bacteria, because they are common in the environment and easy to test for. The presence of these bacteria in a water sample indicates contamination and therefore that pathogens (disease-causing organisms) may also be present. This is the same test OWASA runs on regulatory compliance samples collected all over the service area (95+ per month) and daily on our treated drinking water leaving the water treatment plant.

3. How can bacteria get into the new lines?

Coliform bacteria are abundant throughout in the environment. The way that materials are stored, handled, and installed all can introduce contamination: for example, from dirt and debris, construction material while stored or during construction activities, and/ or use of non-NSF 61-approved materials. This can also include the way that pipe and appurtenances are stored at the warehouse before delivery to the construction site. OWASA has prepared a separate guidance document on *Improving Purity Sampling Results for Water Lines* which discusses common and avoidable reasons for purity sampling failures. That 2019 guidance document is included as pages 7-10 of this pdf.

[1] 15A NCAC 18C .1003 DISINFECTION OF STORAGE TANKS AND DISTRIBUTION SYSTEMS

4. What's the difference between Day 1 and Day 2 sampling?

Day 1 samples are collected after the new water line has been super-chlorinated for 48 hours (and often 72 hours) and then flushed. The minimum chlorine level of 100 parts per million (ppm) for super-chlorinated water is 25 times the maximum allowable chlorine level for drinking water. It is a sign of a significant problem if a Day 1 sample fails because the new line has been in extended contact with super-chlorinated water, which should have killed/inactivated any bacteria present. Chlorine levels must still be greater than 20 ppm before flushing prior to Day 1 sample collection. OWASA procedure is to turn over the water in the new line two times and ensure chlorine levels have returned to normal before collecting samples. If turbidity levels are elevated, additional flushing may occur prior to collecting samples.

Day 2 samples are collected after the new line has sat undisturbed for 24 hours at standard distribution system chlorine levels and with no water usage after the collection of Day 1 samples. Bacteria can survive super-chlorination and grow in the lower system disinfectant levels after Day 1 flushing if the bacteria were shielded in a crevice; by particulates; or under a layer of oil, grease, or construction debris. Day 2 sampling is performed to see if this occurred. Only a maximum 5 minute flush is allowed on Day 2 to ensure water in the new line has reached the sampling location. If the new line were flushed for a long time, some of those bacteria might get flushed out and while the purity sample might pass, remaining bacteria would grow back up and pose a potential health hazard.

5. Why is OWASA's purity sampling procedure different from other utilities?

The State updated its minimum requirements for disinfection and testing of new water lines in 2019, and now references[1] the American Water Works Association[2] (AWWA) Standard C651, *Disinfecting Water Mains*, however that regulatory requirement is more recent than many utilities' established procedures. In addition, utilities have flexibility in how to approach the Standard's recommendations as well as the ability to be more stringent, and therefore variation between utilities may occur. Standard C651's Section 5.1 on *Bacteriological Testing* requires two days after the completion of disinfection with super-chlorinated water to flush the line and perform purity sampling. Option A (used by OWASA) requires two samples be collected from each sampling site and analyzed for indicator bacteria and residual disinfectant levels on both Day 1 and Day 2. Option B (not used by OWASA) requires flushing on Day 1 and both rounds of samples on Day 2. The duration of both Options is the same. OWASA also checks turbidity, as

[2] The American Water Works Association is an international, nonprofit, scientific and educational society dedicated to providing total water solutions assuring the effective management of water. Founded in 1881, the Association is the largest organization of water supply professionals in the world. The American Water Works Association first published consensus documents in 1908. Today, the more than 180 AWWA Standards cover all areas of water treatment and supply. OWASA references many of their relevant standards as examples of industry best-practice.

recommended. OWASA's increased hold time and residual disinfectant level for the super-chlorinated water helps ensure adequate disinfection for sampling. A utility that doesn't follow the minimum procedures in AWWA Standard C651 risks missing the discovery of bacteria that signal risk to the consuming public.

6. What is the sample collection protocol?

Sterile 100 milliliter (mL) plastic bottles are used to collect the samples. A chlorine neutralizing agent is introduced into the bottle by the manufacture prior to sealing the bottle. The exterior of the capped bottle is not sterile. The key to not contaminating the sample is to make sure not to touch the sterile insides of the cap and bottle, or the bottle threads, once the bottle has been opened. Gloves are rarely used while collecting samples because gloves are just as likely to have total coliforms on them as bare skin, they can make it harder to feel what's being touched and notice if the sterile portions were touched, or a glove could bunch up and inadvertently touch the sterile areas without being noticed. No special precautions, such as sanitizing hands, are needed: the key is to carefully collect the sample and discard the bottle if it is even suspected a sterile area was touched. Before collecting purity samples, OWASA staff are trained on proper sample collection procedures by our laboratory staff.

Filled bottles are gathered in a cooler and delivered to the laboratory for processing the same day, and typically before 2:00 p.m. For the analytical method used, the time from sample collection to initiation of analysis should not exceed 30 hours and icing of samples during transit is not required.

7. How are the samples analyzed?

OWASA tests the samples using Colilert. This is a bacteriological analysis method to determine the presence or absence of the Total Coliform bacteria. The method is based on Standard Methods 20th Edition 9223 B. Enzyme Substrate Test pg. 9-69. Results are reported per 100 mL of sample. "Present" means that there were detectable bacteria per 100 mL of sample. "Absent" means that no bacteria were detected (i.e., that the level was below detectable limits).

8. What is the difference between the OWASA lab and the lab a contractor may use to analyze samples?

The OWASA lab is State certified. This requires completing and passing proficiency testing every 6 months as well as undergoing and passing inspections by the State Laboratory of Public Health every 2-3 years. Proficiency testing consists of analyzing unknown samples and reporting the results; results must match the true values to maintain certification. OWASA performs regulatory analyses that are reported to the

State every month. Purity samples for new water lines are analyzed at the same time and in the same way as OWASA's regulatory compliance samples.

Any private laboratory that is certified for drinking water regulatory analyses undergoes the same proficiency testing and inspections. Because new line purity samples are not regulatory compliance samples, some labs may forego adding the chlorine neutralizer, which can lead to a false passing sample.

9. Why can't we just run our own samples at a state-certified lab?

For new water lines that will become OWASA's to operate and maintain, OWASA relies on our own staff who are properly trained and prepared to collect and analyze samples to ensure the quality of the drinking water provided to our customers. Using contracted help would add additional variables to the results, which OWASA chooses to avoid. While a Contractor may elect to collect their own sample(s) for Total Coliform analysis, the result cannot substitute for analysis by the OWASA lab.

10. How is the location of the control sample chosen?

OWASA takes an additional sample from the distribution system as close to the new line sampling as possible. The objectives of taking a control sample are to ensure that a "present" result is not due to the way the samples were handled, problems with the sample bottles, or the water in the OWASA distribution system. If there is no suitable and accessible sampling location on the OWASA supplying the new line, a nearby home or business tap is used. A contractor who has concern about the control sample location selected by OWASA may request a sampling station be added by OWASA at contractor expense. OWASA will consider requests to add a sampling station if there is not a suitable sampling site close by and on the OWASA line supplying the new lines being tested.

11. How can some samples pass and some samples fail?

OWASA collects two samples per day at each sampling point to increase the size of the dataset and thereby the sampling power. Bacteria are not evenly distributed in the water column: each sample is just a snapshot of the water coming out of the new line at that precise moment. The more samples collected, the better the information about the quality of the water coming out of the new line. As an example, imagine you were grabbing handfuls of M&Ms out of a large, covered box without knowing the colors present. The box contains almost all brown M&Ms and a few red ones, but you don't know that. The first handful might just be brown M&Ms and you might conclude that the whole box contained only brown. The more handfuls you took, however, the more likely you would be to get a handful that has a red M&M. For this reason, it is not

uncommon for some samples to pass and others to fail, even from the same sample location.

12. What is the impact of the March system-wide conversion to free chlorine on purity sampling?

OWASA water meets all State and Federal disinfection requirements year-round. While OWASA maintains strong levels of chloramines, a combination of chlorine and ammonia, in the distribution system, because chloramines are a weaker disinfectant than free chlorine, the State requires that public water systems using chloramines annually change over to free chlorine. In March, the 24-hour wait between Day 1 and Day 2 sampling is with the more potent free chlorine in the new line, and with additional disinfection power, the sample is more likely to test "Absent." Chloramines are commonly used in North Carolina due to their superior ability to hold a disinfectant residual in the distribution system compared to free chlorine and their decreased formation of disinfection by-products. Neighbors including Raleigh, Cary, Apex, Durham, Chatham County, Hillsborough, Burlington, and Greensboro all use chloramines to maintain disinfectant residual in the distribution system.

13. Why can't purity sampling happen later in the week?

Purity sampling is an involved, multi-day process that includes scour flushing, super-chlorinating the new line, and letting the water sit in contact with the new line for a minimum of 24 hours (longer is beneficial) before the Day 1 and Day 2 sampling can begin. Samples require 24 hours to complete the actual analysis and read the results. Flushing and loading the new line with chlorine on Thursday or Friday of one week, letting the new line disinfect over the weekend, and then sampling Day 1 on Monday and Day 2 on Tuesday means final sample results will not be ready from the OWASA lab until late Wednesday afternoon. Wednesday is typically used as a back-up sampling date for inclement weather or other problem, and those results are not available until Thursday afternoon. OWASA laboratory staff work business hours and are not available to read sample results during the weekend.

14. I am concerned that the blowoff sized for my project or other OWASA limitation will not allow adequate flushing scour velocity to be reached. What can I do?

Obtaining scour flushing velocity is important to help cleaning the new line before disinfection. Consistent with AWWA Standard C651, the OWASA *Manual of Specifications, Standards, and Design* requires a minimum scour velocity of 3.0 feet per second. Determining whether scour velocities are reached can be a more complicated exercise. Some dechlorination devices are equipped to hold a pitot tube for measuring flow velocity.

In some instances, the system hydraulics at the sample location make it difficult to maintain a high flushing rate without draining elevated storage or dropping system pressure to unacceptable levels. Extra flushing beyond what is required may be difficult to accommodate. Pigging with lower velocity flow rate is recognized by AWWA as an alternate means for cleaning new lines where reaching scour velocity is challenging.

It is important to remember, as noted in AWWA Standard C651: "Flushing is no substitute for preventative measures during construction. Certain contaminants, such as caked deposits, resist flushing at any feasible velocity, and pigging of the main, or other suitable method acceptable to the purchaser, may be required."

15. How do I know that water from the OWASA line or required materials is not causing failing purity samples? Could an interaction with some particular component required for new water line construction at OWASA that is not required by other utilities and the water in the new line be contributing to failing purity samples?

OWASA has considered this question and has not identified any distinction in allowable materials which would lead to a greater number of failing samples than neighboring utilities. In addition, OWASA installs water lines and has not had difficulty passing samples, as would be true if there were something fundamental with materials or OWASA water. OWASA's new line installation tends to be at smaller sites, and pipe is both stored (at the warehouse until day of installation) and installed with extreme attention to cleanliness.

As noted earlier, OWASA performs extensive and ongoing Total Coliform testing in the distribution system, including at Maximum Residence Time sites, which show no detectable Total Coliform contamination. Sampling at the nearest control points provides additional assurance that OWASA water meets all drinking water standards.

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ORANGE WATER AND SEWER AUTHORITY

GUIDANCE DOCUMENT

IMPROVING PURITY SAMPLING RESULTS FOR WATER LINES

The types of bacteria that can lead to positive total coliform results during purity sampling are common in the environment. Dirt and debris at the construction site, staging areas, or warehouses/storage yards, contain bacteria that once inside the pipes can lead to positive bacterial samples. Such material can provide places for bacteria to hide, protected from the chlorine disinfection. OWASA is providing this Guidance Document to help educate engineers, developers, and contractors about some of the most common practices that lead to the failure of new pipes to pass purity testing, along with some best practices and related OWASA Specifications.

Theme 1: Contamination of pipes and/or fittings during installation.

Problem Practice: Placing pipes or fittings in direct contact with the ground, including stringing pipe along the path for ease of installation

Best Practice: Where possible, leave pipes on the racks until installation or use another material or method to prevent direct contact between the pipes and the soil. Do not put out more pipe than you can lay in one day, and cap the ends of whatever pipes stays out overnight. This recommendation applies equally to pipe in storage and pipes at the construction site.

Related Specification: "The Contractor shall open only as much ditch as he can completely install pipe, backfill, compact, and cleanup within the working day. The Contractor shall string out the pipe that can be installed in one day, and no more than 300 feet of trench shall be open in advance of the completed work in any section." [02275-3.2(C)(1)(c)] "Protect stored pipe from entry of water or dirt into pipe. Store pipe on shoulders and not in ditch lines. String out no more pipe than can be installed in a day. Also, protect bells and flanges of special fittings from entry of moisture and dirt. If pipe is provided with end protectors, do not remove protectors until ready for installation or for inspection. Once inspected, replace protectors. [02510-1.7(E)]

Problem Practice: Leaving open ends of pipes exposed instead of capping, plugging, or wrapping and taping overnight

Best Practice: Either wrap and tape or install plugs or caps on the exposed ends of pipes overnight. Trenches can flood and wash dirt and debris into pipes. This recommendation applies equally to pipe in storage and pipes at the construction site. The last installed pipe segment of the day shall be tightly plugged or capped.

Related Specifications: "No pipe shall be constructed in water and water shall not be allowed to drain though the pipe. The open end of the pipe shall be kept closed with a tight fitting plug to prevent washing of any foreign matter into the line." [02275-3.1(G)(2)] "At the conclusion of

the workday, or any other time when pipe laying is not in progress, a watertight plug shall be placed in the bell of the last joint of pipe laid." [02275-3.2(G)(3)] Pipe shall be kept clean at all times, and no pipe shall be used in the work that does not conform to the appropriate ASTM specifications." [02510-1.7(A)(1)]

Problem Practice: Failing to inspect each segment of pipe before the next segment is added

Best Practice: Shine a bright light and visually inspect the interior and exterior of each pipe segment before adding the next segment, looking for signs of dirt, debris, or damage. This is particularly true for segments already installed, which are especially susceptible to dirt and debris washing or flooding into the pipe from the trench. Remove any pipe that is dirty or damaged, as it is extremely difficult to clean very dirty pipe adequately.

Problem Practice: Storing pipes with elbows and appurtenances able to catch water

Best Practice: The openings of all pipes and fittings should be downward to keep from capturing water, as well as airborne dust and debris. This recommendation applies equally to pipe in storage and pipes at the construction site.

Related Specification: "Store fire hydrants and valves in such a way as to prevent entry of water and dirt into openings. Support on skids or pallets off the ground or pavement. If fire hydrants or valves are provided with end protectors, do not remove protectors until ready for installation or for inspection. Once inspected, replace protectors. Protect valves against damage to threaded ends or flanges." [02510-1.7(H)]

Problem Practice: Failing to pig the lines before filling for service

Best Practice: Construction and pipe laying is dirty work that makes it difficult to ensure the clean interior of the pipe even when good precautions are exercised. Pipes are significantly easier to pig during construction. The pig can be installed at the first junction and flushed through before the next valve is installed. OWASA has seen better testing results when pigging is conducted prior to disinfection. This is particularly true if there has been any sign of dirt in the pipes. If OWASA inspectors observe dirt in the pipes, the absence of recommended practices being observed, or violations of OWASA Specifications, pigging may be mandated before acceptance testing begins.

Problem Practice: Use of non-food grade grease to ease pipe couplings

Best Practice: Petroleum products can cause contamination of the pipes and the grease is a strong attractant for dirt and bacteria. If used where the grease may contact drinking water, only products approved for use in drinking water may be used. State regulations require any products that may come into contact with the water to be ANSI/NSF certified.

Related Requirements: "Hydrants, upon installation and prior to acceptance of the project, shall be painted and greased, the caps are to be greased with a food grade anti-seize lubricant after

installation, and individually operated in front of an OWASA representative to verify the hydrant is greased and in working condition." [Page 02510-3.2(F)(2)]

15A NCAC 18C .1537 DRINKING WATER ADDITIVES (a) The standards set forth in American National Standards Institute/NSF International, codified at ANSI/NSF Standard 60 and ANSI/NSF Standard 61, are hereby incorporated by reference including any subsequent amendments and editions. (b) A water supply product used in a public water system shall meet the standards incorporated by reference in Paragraph (a) of this Rule. A product certified by an organization having a third-party certification program accredited by the American National Standards Institute to test and certify such products is acceptable for use in a public water system.

Problem Practice: Using a cap on a blow off where the pipe size is reduced, which can catch dirt in the corners, leading to positive samples

Best Practice: Install a graduated reducer to minimize the ability of dirt to settle and bacteria to grow.

Problem Practice: Failing to adequately disinfect pipe ends and fittings

Best Practice: Spray or swab all pipes and fittings with a minimum 1% hypochlorite solution before installation or just prior to making connections.

Related specifications: "The Contractor shall clean the valves before installation and check for satisfactory operation." [Page 02510-3.2(B)(1)]

Theme 2: Problems with testing and sampling

Problem Practice: Using a used or dirty pipe for the sample tap

Best Practice: Always use new, clean pipe for the sample tap and install into the new section of pipe.

Problem Practice: Providing inadequate chlorine contact time for the situation

Best Practice: OWASA Standard Specifications require 48 hours of hold time with super-chlorinated water. At times, additional hold time may help reduce the number of positive coliform samples. For example, there are greater numbers of positive bacteria test results in warmer weather when bacterial growth is more prolific. The benefits of longer chlorine hold times must be weighed against the possibility of losing too much chlorine residual in the lines before final measurement.

Problem Practice: Failing to use non-threaded bibs

Best Practice: As the threads at the end of a bib are known to hold dirt and debris which can harbor bacteria, ensure that sampling bibs used are non-threaded.

Problem Practice: Removing and reassembling sample points

Best Practice: Each instance of moving a sample point is an opportunity to contaminate the water line. Select locations carefully, and if a location needs to be moved, use clean pipe following proper disinfection procedures.

Note: "Related Specifications" citations refer to OWASA's Standard Specifications for Water Distribution and Wastewater Collection Systems, April 2015, as amended.