Water Usage

QUESTIONS 1-1 THROUGH 1-5

The GAP Farm Review checklist starts with water usage questions about all water used on crops in the field. This includes water used for irrigation, as part of cooling and frost-control, and in chemical applications (e.g., fertilizers).

Water can be a carrier of many microorganisms, including pathogens that cause illness. Under certain circumstances even small amounts of contaminated water that has come in contact with fresh produce can result in food-borne illness. The risk of water with some level of microbial contamination damaging your saleable product will depend in part on the following:

- The crop — Does it have a large surface area or a rough texture that naturally holds onto water? Does it sit on the ground or underground, or is it grown well above the ground where drip irrigation water may not come in contact with it?
- The method of water delivery — Overhead irrigation comes in direct contact with edible portions of your crop, whereas drip irrigation largely keeps water away from the product by delivering the water directly onto soil.
- The timing of the application — How close to harvest is the water applied?

Your water risk assessment will include water testing, analysis of the findings, and careful consideration of the crops, irrigation and other water uses, to determine what practices or changes to your system may be necessary to mitigate risk of microbial contamination.

Generally, water that will be in contact with the edible portion of the crop should be better quality than water that is used where there is minimal contact with the edible portion.

Water Testing

Your planning starts with an assessment of your water quality to determine the kind and frequency of water testing needed, whether your water source is appropriate for pre-harvest application, and how it will affect your water usage practices. The assessment will include reviews of water quality testing conducted by your local irrigation district or municipality, or farm-specific tests ordered on your wells or surface water.

Generic *E. coli* is the standard test for irrigation water. *E. coli* is a common bacteria that lives in the lower intestines of animals (including humans) and is generally not harmful. It is frequently used as a marker for water contamination. Soil and water tests will often show some level of the presence of generic *E. coli*. Thresholds of acceptable levels of *E. coli* will vary, depending on each farm's unique practices.

Testing regimes vary based the water source and the way it is used in your farm. The following are general rules for municipal water, well water and surface water testing regimes.

Water source	Risk	Test	Documentation
City water/municipal	Low	Not generally required. You may want to test at your outflow however, especially if your on-site system is old, recently modified or potentially compromised.	A copy of the water quality report from the supplying municipality is sufficient.
Well water and springs	Medium	Annual test for generic *E. coli* for irrigation. (For produce wash water, which must be potable and have no presence of fecal *E. coli*, you would need to test specifically for fecal *E. coli*.)	Annual test report from a recognized lab is required. The report must include a concentration measurement of the amount of generic *E. coli*, rather than simply presence/absence of the contaminant. A presence/absence reading will not be acceptable in audit.
Surface water (ponds, streams, rivers, lakes); this includes irrigation districts that are open ditches or do not conduct regular testing	High	Test for generic *E.coli* for irrigation water. Test 3x/year: • Start of season • Peak use • Prior to harvest If using an irrigation district water source, the district water test is acceptable. (Test for fecal *E. coli* if considering use of the water for produce wash water.)	All three test reports are required. The reports must include a concentration measurement of the amount of generic *E. coli*, rather than simply presence/absence of the contaminant. A presence/absence reading will not be acceptable in audit. If using an irrigation district report, a copy is required at time of audit.

How to Take a Water Sample

Before Sampling Your Water Supply

- Contact your selected laboratory prior to collecting the sample to confirm the following:
  - Sample delivery times.
  - Collecting instructions.
  - Pricing per sample.
  - Testing methods available.
- Collect samples in sterile containers provided by the testing laboratory.
- Do not rinse your sample bottles prior to taking samples.
- If more than one sample is to be tested, all samples should be collected within a continuous 18 hour period.
- Always take extra bottles and sample request forms from the testing lab.

One of the tests recommended is the Colilert® method (Generic *E. coli* and coliforms) with quantitative results (not presence/absence). If funds are low, a single sample at the point of use is recommended to account for the entire irrigation system. If funds are available or you plan on participating in a cost share program, one sample should be taken from the water source (wellhead, surface water, etc) and from the point of use (end point) for irrigation and wash water. Your results will be representative of the water quality throughout your system. You will be able to identify if your water is becoming contaminated through your system, either in irrigation lines or at the wash station. If you do find an unacceptable level of contamination, you can isolate it either to the water source (i.e. cracked well casing, inflow from above due to faulty well seal, contaminated runoff, wildlife contamination, etc.) or to the above-ground (i.e. irrigation or wash station) system.

Water Sampling Procedures

Irrigation water	• Run the irrigation system for the amount of time needed to flush the 'hold up' volume of the system plus an additional 5-10 minutes. • Collect samples from the sprinkler/drip system (not the intake area).
Post harvest water	• When collecting samples from the distribution system tap make sure to remove any attachments, such as aerators. • Open the tap fully and allow the system to run for at least 10 minutes (or the time to flush out the 'hold up' volume) before the sample is taken. • Slowly fill the container to the line as indicated and tightly cap the container.
Transportation	• The sample should be delivered to the laboratory as soon as possible, and no longer than 24 hours after its collection. • Samples should be placed in a cooler with ice or gel packs during transportation. • Check with specific lab for any additional procedures.

Source: Good Agricultural Practices for Small Diversified Farms: Tips and Strategies to Reduce Risk and Pass an Audit, Ben Chapman, Ph.D., Audrey Kreske, Ph.D., and Roland McReynolds, Esq. Published by Carolina Farm Stewardship Association in partnership with North Carolina State University, www.carolinafarmstewards.org. Reprinted with permission.

This farm's pumping and pressurizing equipment is secured by fencing, and the area surrounding it is kept free of contaminants like trash and debris. The water source is an open canal, and thus exposed to airborne and other contaminants. The water is tested regularly, and is pressurized and delivered via drip tape exclusively, so the water does not touch edible portions of the food.

Making Decisions Based on Water Test Results

The USDA GAP standard does not include a set level of acceptable microbial contamination for irrigation water, but instead relies on farmer analysis and decision making based on the range of practices and situations on that farm.

Each farm will have different risk scenarios early, mid and late-season, especially if more than one source of water is used. The type of crop, as well as the water delivery method, will be key components in a risk assessment. Acceptable microbial contamination levels for irrigation water vary depending on the farm's risk profile: again, the type of crop, the way the crop is irrigated and how close to harvest the water is applied.

Water testing is not the only method of assessing water quality. You may find potential sources of contamination during a pre-harvest walk-through, or in the course of regular review of farm practices.

Surface water has the highest risk of contamination — risks include everything from airborne contaminants like dust and chicken feathers, to migratory birds and other wildlife. Consider and reduce the risk of contamination of surface waters by keeping the pumping equipment and filters in good repair, and monitoring the sources for accumulations of culls, trash or debris, and signs of pests or wildlife impact. Maintain effective barriers like fences and hedgerows so that wild and domestic animals do not have access to irrigation water sources directly. Be sure to consider potential runoff issues into the water source from adjacent land, especially livestock farms, composting activity or any septic or sewage systems.

Irrigation methods can contribute to or mitigate contamination from source water. If used in sprays or for overhead irrigation, depending on when in the life cycle of the plant it is applied, irrigation water can introduce pathogens to the edible portion of the plant. In addition to assuring that the farm's water quality is appropriate for the crop it's applied to, you may wish to consider drip irrigation or other methods that are designed to prevent water from having direct contact with the crop. Drip irrigation can decrease the risk of microbial contamination because the water is applied to the soil rather than onto the plant. However, using drip tape does not take the place of regular testing regimes as described in this manual and in other resources referenced.

In situations where well water is tested and meets potability standards, overhead irrigation is unlikely to transmit microbial contamination to the crops, even when it comes in contact with the edible portion of the plant.

FSMA Requirements for Production Water

§112.41 THROUGH §112.50

The Produce Safety Rule sets water quality requirements for all water that is likely or intended to touch produce during growing, harvesting, packing, or holding of any produce covered by the rule. In addition to water that may or does touch produce directly, water that touches food contact surfaces, such as water used for cleaning and sanitizing tools and equipment, is also included in these standards because those surfaces are a potential cross-contamination point.

The FSMA Produce Safety Rule and USDA GAP/GHP audit standards take a similar approach to water quality monitoring that is based on a risk assessment of your unique situation. The level of risk depends on several factors including the source of the water, how and when the water is used on the farm, whether the water comes in direct contact with the produce, and the quality of the water at the time of use.

Similar to other food safety programs, the FDA divides agricultural water quality standards into two categories based on their use: (1) production water and (2) harvest and post-harvest water. This section focuses on production water, which is any water used on covered produce prior to harvest. Examples of production water include water used for irrigation, fertigation, foliar sprays, and frost protection. (See the GAP/GHP Audit Part 3 chapter in this guide for more information on post-harvest water standards for both the GAP/GHP audit and FSMA Produce Safety Rule.)

§112.42

System Monitoring and Maintenance

The Produce Safety Rule requires active monitoring of agricultural water systems. You must inspect your water system — at least the parts of it under your control — at the beginning of the growing season, and as needed (at least once annually), to identify food safety hazards. You must inspect and maintain your water source and water distribution system (such as pumps, pipes, irrigation ditches, faucets, sprinklers, drip tape, etc.) as needed in order to prevent equipment malfunction, accumulation of animal and waste debris hazards, and contamination related to pooling water.

Water Quality Testing

Like the USDA GAP/GHP audit, the FSMA Produce Safety Rule requires farms to test their agricultural water quality and is more prescriptive about the requirements for that testing. The Produce Safety Rule requires testing for generic *E. coli*, as an indicator organism for fecal contamination of the water. For production water, the Produce Safety Rule requires a quantitative testing method to count the number of pathogens (rather than a presence/absence test), which is measured in Colony Forming Units (CFU) or Most Probable Number (MPN).

The FDA created a list of water testing methodologies allowed under the Produce Safety Rule; you can review these in the Equivalent Testing Methodologies for Agricultural Water fact sheet in the Templates and Resources section of this guide. (Note: The first page of the fact sheet pertains to production water; the second page pertains only to post-harvest water.) The Washington State Department of Ecology maintains a searchable database of accredited environmental labs at https://fortress.wa.gov/ecy/laboratorysearch/; or go to ecology.wa.gov and search for "laboratory." The WSU Food and

Produce Safety Extension team also maintains a map of labs at foodsafety.wsu.edu. You can search for labs by location and desired testing method(s). Check with your local lab about what tests they offer and make sure that they accept public samples.

Testing frequency

§112.46

The Produce Safety Rule requires initial water testing to establish a baseline Microbial Water Quality Profile (MWQP), and then an annual testing protocol thereafter for on-going water quality monitoring. The Produce Safety Rule requires a higher frequency of initial tests than the USDA GAP/GHP audit. Produce Safety Rule testing frequencies are outlined below based on type of water source.

Microbial Water Quality Profile Standard

§112.44(b)

Unlike the USDA GAP/GHP audit, the Produce Safety Rule sets a specific, numerical water quality standard, and requires farms to establish a MWQP. A MWQP is a long-term water quality management strategy tool based on a set of calculations using figures from water testing results. As new water quality tests are done, the results are analyzed to provide a running measure of water quality. If at any point the calculation results are outside of the standards listed below, the farmer knows there is a water quality concern that needs to be looked into and corrective actions need to be taken to address the issue.

Agricultural production water must meet both of the following standards:

- **Geometric Mean (GM):** ≤ 126 colony forming units (CFU) or most probable number (MPN) in generic *E.coli* per 100 mL of water
- **Standard Threshold Value (STV):** ≤ 410 colony forming units (CFU) or most probable number (MPN) in generic *E. coli* per 100 mL of water

There are many resources available online to help you develop your water quality profile and compute the GM and STV. The University of Arizona Fresh Produce Safety website provides a list of online tools at cals.arizona.edu/fps/node/57/ and the Produce Safety Alliance has online calculators and a longhand calculation worksheet on their website at producesafetyalliance.cornell.edu/resources/general-resource-listing/.

Water source	Initial baseline survey	Annual testing requirement
Surface	20 or more samples over a period of 2 to 4 years	5 or more samples rolled into profile every year after initial survey, if results continue to meet the microbial quality criteria
Ground	4 or more samples during the growing season or over the period of a year	1 or more samples rolled into profile every year after initial survey, if results continue to meet the microbial quality criteria
Public	No testing required, if farmer can document public water system results or a current water supply certificate of compliance	

Corrective Actions for Production Water

§112.45(b)

In the event that water used for agricultural production does not meet the required microbial standards given above, the Produce Safety Rule lists three corrective actions that farmers can take, which must be followed as soon as practicable, and no later than the following year from when non-compliance is detected:

1. Apply a time interval between (1) last irrigation and harvest; or (2) harvest and the end of storage and/or activities such as commercial washing. Microbial die-off occurs over time due to factors including desiccation (drying out), sunlight (UV radiation), temperature, humidity, and crop type. An effective time interval is one in which these factors will have enough time to lower the microbial level to within the standards. A log reduction calculation can be used to assess if a time interval will be an effective corrective measure. For produce, a microbial die-off rate of 0.5 log per day, or another scientifically-validated rate, can be compared to agricultural water testing results to determine if a time interval is feasible means to reduce your water quality to an acceptable level. There are tools online to help you calculate microbial die-off rates. The University of Arizona Fresh Produce Safety website provides a list of online tools at cals.arizona.edu/fps/node/57/, and the Produce Safety Alliance has online calculators and a longhand calculation worksheet on their website at producesafetyalliance.cornell.edu/resources/general-resource-listing/.
2. Re-inspect the entire affected agricultural water system, identify and correct the likely hazard(s), and take adequate measures to ensure the changes were effective and that the water quality is acceptable before using that source again.
3. Treat your agricultural water with a physical treatment device or an antimicrobial pesticide product that is registered by the U.S. Environmental Protection Agency (EPA).

Recordkeeping

§112.50

There are several recordkeeping requirements related to agricultural water in the Produce Safety Rule, including:

- The findings of your water system inspections;
- Results of water quality testing from an accredited lab (or documentation from a public water authority if using public/municipal water);
- Results of your water treatment monitoring, if treatment is conducted; and
- Documentation of corrective actions taken if tested water does not meet the numerical quality standard, if applicable

Additional documentation may be required in certain circumstances, for example if you opt to use alternative testing methodologies, die-off rate calculations, or sampling frequencies. For more information on the recordkeeping requirements for agricultural water and sample templates, see the Records Required by the FSMA Produce Safety Rule document in the Templates and Resources section of this guide.

Testing Compliance Timeline

The compliance dates for agricultural water standards differ from the general Produce Safety Rule compliance timeline. In 2017, the FDA issued a proposed extension to provide farms an additional two years to meet the water requirements; this means compliance dates are expected to be 2022, 2023, or 2024, depending on your farm's size (larger farms have earlier compliance dates). If finalized, farms must begin their initial survey by the proposed water compliance dates. See the Overview of the FSMA Produce Safety Rule chapter in this guide for more information on compliance timelines. (Please remember that sprouts have many different requirements under FSMA, including different compliance dates, which are not addressed in this publication. Washington sprouts growers should contact the WSDA Produce Safety Program directly for guidance.)

The FDA also announced in 2017 that they are considering simplifying the agricultural water standards, due to stakeholder concerns that the agricultural water requirements, as written, are too complex to understand, interpret, and implement. The FDA is currently working on guidance, collecting more data, and coordinating with stakeholders on how to proceed. While the agricultural water standards are being assessed by the FDA, farms are advised to continue with your existing water quality and monitoring practices, until more is known about the potential changes to the regulatory requirements. This is particularly true for farms with requirements from buyers or a voluntary audit program. Farms that have never tested their water before should consider conducting some initial samples. This applies to farms who are likely to be covered by the Produce Safety Rule, but it is also a recommended best practice for farms that are not covered.

What if my farm floods?

Flooding caused by storms or other natural disaster can have significant food safety impacts on crops. There are two types of flooding, which pose different risks. Flooding caused by heavy rain that saturates the ground and causes pooling may damage or kill plants, but generally does not cause contamination of the crop. More severe flooding, caused by surface water runoff overflowing into production fields, can spread unknown chemical and/or biological hazards onto your produce. Under the U.S. Federal Food, Drug and Cosmetic Act, if any of the edible portion of a crop is exposed to contaminated flood waters, the produce is considered adulterated and should not enter the human food supply. There is no practical method to recondition the contaminated produce to provide a reasonable assurance of food safety.

Each flooding event should be considered on a case-by-case basis. To assess whether your crop is safe or not, you must evaluate the type of flooding that occurred, and whether the edible portion of the crop came into contact with the flood waters. Even if the flood waters did not entirely cover your entire crop, you must still assess whether any splashing may have occurred, and what a suitable buffer zone might be for harvesting adjacent crops that were not under water.

Before cleaning up or destroying any product, you should work with your local crop insurance program, university extension program, state department of agriculture, and your local FDA office to consider all possible types and routes of contaminations before determining whether a particular crop is adulterated.

For more information, see the Food Safety for Flooded Farms sheet in the Templates and Resources section of this guide.

Your farm's SOPs should specify the steps to be taken should your water test results indicate levels of unacceptably high levels of microbial contamination (interpreted on the basis of the crop grown, or the way the water is being delivered and applied) or if you identify other sources of contamination. Those steps must be documented, and the results recorded. For example:

- Stop using that water source.
- Investigate the source of the problem. Your farm map and initial risk assessment will help determine the potential sources of contamination.
  - Is this a systemic problem such as upstream contamination or seasonal changes in the water quality?
  - Is this a one-time contamination event? You should inspect for: cracks in the well structures including the well head, casing and seal; signs of animal contamination; possible contaminated run-off from heavy rainfall or flooding; contamination from an on-site or adjacent property septic or compost storage system.
- Implement mitigation strategies based on your SOPs.
  - If systemic or out of your control, consider adjusting irrigation methods, chemically treating your water, or changing the source of your water.
  - If a one-time contamination event, consider adjusting equipment or otherwise removing the source of contamination. Make sure to record the steps taken in your written log.
- Re-test the water prior to resuming usage. You will need to show the auditor the results of tests after the contamination event, or concerning water test results, with evidence that the mitigation strategy was effective and the water is microbially safe for the crop, delivery method and usage.

If I have a pond that serves as a watering hole for my livestock, can I use that water for irrigation?

No, you cannot use the same source of water as both watering hole for livestock and irrigation for food crops. Irrigation water must be protected from contact with livestock.

If necessary, irrigation water can go through a filter step to make it microbially safe for its intended use. In some systems, there is also the option to add an antimicrobial solution to the irrigation water before it is used on crops. The antimicrobial solution must be identified for use on fruit and vegetables and the amount used must be documented and monitored to show it meets label directions.