**The relationship between agriculture and the environment**

 **Pillar 1 B. specific water conservation and purification practices used by farmers**

(9th – 12th Grade)

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| --- |
| **Introduction**: The impact of water pollution can harm drinking water by impacting ground water and aquifers. Farmers implement specific water conservation and purification processes. **Website**: <http://sustainableagriculture.net/fsma/learn-about-the-issues/agricultural-water/> **Video**: <https://www.youtube.com/watch?v=AFtdTnyTUZ0>  **Hands On**:<https://www3.epa.gov/safewater/kids/flash/flash_aquifer.html> <http://www.agclassroom.org/teacher/matrix/lessonplan.cfm?lpid=584> (App: <http://ianr.unl.edu/irrigation-flow-meter-calculator-app>)  |

**Journey 2050 Lesson 3: Water**

Purpose

Students will discuss the limited amount of fresh water on earth, identify how best management practices can reduce water consumption, discuss the need for water conservation and protection related to population growth and agriculture, and compare and contrast methods of irrigation for water conservation.

Materials

* *Water* PowerPoint
* Interest Approach Supplies
	+ Option 1: Rain jacket, hat, 5-gallon (18L) bucket of water, tablespoon
	+ Option 2: One-gallon container, clear bowl, ½-cup measuring cup, eyedropper
* Map of local watershed (optional)
* [*Journey 2050: Water*](https://www.youtube.com/watch?v=zdrzktN0Q4c) video
* *Sustainability Farm Game:* Level 3 Water
	+ [Download App](http://www.journey2050.com/play-the-game/)
	+ *Optional:* [Create Free Teacher Account](http://journey2050.rnp.io/teachers/sign_up) to track student progress and print reports.
* Computer or tablet device for each student

Essential Files (maps, charts, pictures, or documents)

* [Water PowerPoint](http://naitc-api.usu.edu/media/uploads/2017/04/13/3-J2050_Lesson_3.pptx)

Vocabulary

**Conservation tillage:** leaving at least 30% of the soil\_s surface covered with crop residues left after harvesting the previous crop; this helps slow water movement, reducing the risk of erosion, and increases soil organic matter, improving the soil\_s ability to hold moisture and grow better crops

**Crop residue:** plant material remaining in a field after harvesting, including leaves, stalks, roots

**Irrigation:** artificial application of water to the land or soil to assist plant growth

**Riparian area:** A space between the land and the waterway ideally filled with native grass, bushes and trees

**Watershed:** the land area that drains into the same body of water (e.g. river, lake or wetland), including areas such as parks, fields, schoolyards and even parking lots; watersheds know no political borders, whether national or international

Did you know? (Ag Facts)

* Over 70% of Earth is covered in water but only a small amount is freshwater.
* Only 5% of all the water on Earth is freshwater
* Only a small drop (3%) of the freshwater on the earth is accessible because the rest is trapped in groundwater, the atmosphere, glaciers and ice caps.10
* Groundwater is the easiest to access, but that still leaves us with over 68% of our water supply that is salt water or un-accessible.

Background Agricultural Connections

Journey 2050 takes students on a virtual simulation that explores world food sustainability and answers the question, "How will we sustainably feed over 9 billion people by the year 2050?" The lesson plans and online simulation program allows students to make decisions on a virtual farm and witness their impact on society, the environment and the economy at a local and global scale. The lessons engage students with the important concepts regarding sustainable agriculture. The online simulation contextualizes these concepts as students experience the lives of three farm families in Kenya, India and Canada. As students interact with each family, they learn the role of best management practices in feeding the world, reducing environmental impacts and improving social performance through greater access to education, medical care and community infrastructure. These six lessons can be taught individually or as an entire unit. See the following links for the remaining lessons:

Interest Approach – Engagement

Use one of the following demonstrations to help students visualize the amount of freshwater available on earth:

 **Option 1:**

1. Prior to class, fill a five-gallon bucket with water.
2. Ask for one volunteer. Dress the volunteer in rain gear, including a rain hat, and have the student sit or stand in front of the class.
3. Once your volunteer student is in place, bring the bucket of water in front of the class as well. Explain that this bucket represents all the water on the entire earth.
	* Ask your class what portion of this water they think is usable. As they offer their ideas, help them understand that to be usable, the water cannot be salt water, it can’t be frozen (glaciers), and it can’t be so deep in the ground that we can’t access it.
4. Tell your class that you are going to show them the answer by dumping how much of our earth’s water is freshwater in a usable form on the student’s head. Pick up the bucket of water and pretend to dump…stop…set it down and grab a tablespoon. Proceed to drop three tablespoons of water on the student’s head.1

**Option 2:**

1. Fill a one-gallon container (such as a plastic ice cream bucket) with water. This represents all the water on Earth.
2. Pour one half-cup of water out of the one-gallon container and into a clear bowl. The water in the bowl represents all of the freshwater on Earth, which is less than three percent of the total water on Earth. Freshwater is found in lakes, rivers, groundwater, ice and living things. The 15 half-cups that are still in the one-gallon container represent salt water. We cannot use salt water without first removing the salt in a process known as desalination. Though research and technology are improving this process, it is still prohibitively expensive and often impractical.
3. With an eyedropper, place one drop of water from the half-cup onto a small plate. This one drop represents the freshwater that is available for our use. This water is found in rivers and lakes. Explain that the rest of the water in the half-cup is deep groundwater, water bound up as soil moisture, water in living things or water in the atmosphere.

**Following the demonstration:**

1. Share the statistics found in the *Did You Know?* section of the lesson.
2. Help students conclude from the demonstration that water is a limited natural resource. Ask, “How are water and agriculture related?” Use further guiding questions until students recognize that farmers must use a portion of our water supply to grow the crops and raise the livestock that provide our food supply. Ask students, “What practices can farmers use to conserve and protect freshwater?” Inform students that they will be learning about how water use in agriculture can be managed to provide food more sustainably for our growing population.

Procedures

**Preparation:** Prior to class, review the *Background* information, video clip, and PowerPoint slides (including the speaker notes) associated with the lesson. Read the [Teacher's Guide: Getting Started](http://naitc-api.usu.edu/media/uploads/2017/04/12/0-J2050_Getting_Started.pdf) document paying particular attention to page 2 where you will find the instructions for downloading the *Sustainability Farming Game*.

**Activity 1:**

1. Open the *Water* PowerPoint.
2. Slide 3: Play the [*Journey 2050: Water*](https://www.youtube.com/watch?v=zdrzktN0Q4c) video (5:07). Engage students with the video by asking them to discover three things: 1) How is water used in agriculture? 2) What methods do farmers use to irrigate their crops? 3) What best practices can be implemented to use water more efficiently in agriculture? (Background and discussion prompts are outlined in the steps below and in the PowerPoint notes).
3. **How is water used in agriculture?**
	* Slide 4: Ask students, “What do farmers need to grow a crop?” Use the click animations on the PowerPoint slide to display open space, fertile soil, sunshine, correct climate and seeds. Once these items have been discussed, explain that there is one more item. Without it, the crop will fail completely. Ask students what this could be. *(water)*
	* What methods do farmers use to irrigate their crops? Describe these common methods:1
		+ 
* Slide 6: Drip Irrigation—Using the picture, describe drip irrigation. Water is sent through plastic pipes that are laid along the crop rows. Tiny holes allow water to drip at the base of the plants. This method is most effective for fruit and vegetable crops.
	+ - Slide 7: Center-Pivot Irrigation—Using the picture, describe center-pivot irrigation. This is a large sprinkling system on wheels. A line of sprinklers pivots around a center point in a field. This method of irrigation is what creates green crop circles that can be seen from a plane.
		- Slide 9: Flood/Furrow Irrigation—Using the picture, describe flood or furrow irrigation. To utilize this method of irrigation, farmers dig furrows between their crop rows. Water is delivered to the top of each row using ditches or siphon hoses. The crop is irrigated as the water flows from the top to the bottom of each row.
		- Slide 10: Ask students, “Besides irrigation, what other ways do farmers use water?” Allow students to offer their answers. Guide the discussion, clarifying that irrigation accounts for the majority of water use in agriculture, but water is also needed to raise livestock and to clean and sterilize facilities such as milk barns or food processing plants in order to prevent food-borne illness. 
1. **What best practices can be implemented to use water most efficiently in agriculture?**
	* Help students recall the definition of *best practice*. Next, apply the principle to water conservation and ask for ideas of how farmers can conserve water as they grow our food and fiber.
	* Slide 12: Refer back to the video clip they viewed at the beginning of the lesson. It described a practice called *conservation tillage*. Explain that farmers will leave crop residue (materials such as stalks, stems and seeds) in their fields without plowing it under in the fall. In the spring, they use an air seeder (device that precisely plants the seeds at equal distances and proper depth in the soil and then covers them) to plant the next crop, eliminating the need to plow the soil. Conservation tillage improves water-use efficiency in crops.
	* Slide 13: Explain that a riparian area is a space between land and a waterway, ideally filled with native grasses, shrubs and trees. Landowners can improve water quality by preserving wetland and riparian areas, which have many benefits. These areas help filter nutrients that are collected as water runs over the land; help control water levels during floods; and provide habitat for animals. If possible, use a local riparian area as an example to help students understand.
	* Slide 14: Explain to students that some methods of irrigation are more efficient than others. Best practices in irrigation vary by farm and crop, but they will generally enable farmers to decrease water evaporation, deliver water more directly to plant roots (eliminating water loss to other locations or from runoff), and measure precise soil moisture for exact watering.
	* Slide 15: Ask students, “How can we protect and conserve water at home and in our schools and communities?” As students discuss answers, reinforce the concept that our actions affect our natural resources. Water conservation ideas include: turning off the water while brushing your teeth, using low flow toilets, using water bottles and refill stations, decreasing shower times, etc.

**Activity 2: *Sustainability Farm Game* Level 3 Water**

1. Slide 16: Open Level 3 of the *Sustainability Farm Game* on each student’s computer or device. Explain that in this level of the game they will be farming in all three countries (Kenya, India and Canada). Prepare students for the game by informing them of the following:
	* In this level of the game you will primarily be managing water use. There will be a water meter on the left side of the screen that you will need to pay close attention to.
	* The game is simulated for the year 2030.
	* Stop when you finish farming in Canada
	* Total game time is 15 minutes (5 minutes in each country)
2. Slides 17–18: Once students have completed the game, use the following questions to help synthesize what they have learned:
	* What were your limiting factors?
	* Did you find it difficult to have enough water for your crops? Why is freshwater conservation and preservation important? How did the weather impact your crops?
	* What ripple effects did you notice from your investments?

**Wrap-Up:**

Summarize the following key points (slide 19):

* Water is a natural resource critical to agriculture.
* Although the majority of Earth is made up of water, only a small fraction is actually usable.
* Farmers improve their water efficiency by using water conservation practices and technologies such as irrigation (with moisture sensors), conservation tillage and riparian areas.
* Some regions of the world face greater threats to their water supply than others.

Essential Links

* [Journey 2050 Teacher Registration](http://journey2050.rnp.io/teachers/sign_in)

Enriching Activities

* Using slide 22 of the attached PowerPoint, break students into small groups. Have each group brainstorm ways we can conserve and protect water. Assign each group one of the specific areas below:
	+ Home – Outside (manage lawn and landscape sprinklers)
	+ Home – Inside (5-minute showers, don’t dump medicine in toilets as treatment plants might not be able to filter them, turn off water while brushing teeth)
	+ School (rain gardens, sensor bathroom taps, water fountains vs water bottles, low flow toilets]
	+ Community [Provide garbage bins and hang posters on impact of dog feces running into river, native tree planting day to stabilize river bank and collect runoff)
	+ Optional – Local Industry such as Oil & Gas, Forestry, Manufacturing (re-use water in processing, clean water used before returning it to the rivers)
	+ Optional – Farm (wetlands, drip irrigation, cell phones that turn irrigation on and off depending on weather)
* Display a map of your local watershed so students can see where water flows from and to in your area. Every action you take impacts our community and our neighbors downstream. Point out to students that in some countries they can’t drink water from the tap because it is contaminated. Every day we must protect and conserve water.
* Using slide 21 of the attached PowerPoint, consider using the following supplementary videos:
	+ [What Is a Watershed?](https://www.youtube.com/watch?v=QOrVotzBNto) (1:17 min)
	+ [Why Should You Care About Our Watersheds?](https://www.youtube.com/watch?v=1fB2N7chZlU) (2:04 min)
	+ [Agrium Watershed Contest](https://www.youtube.com/watch?v=rd-Bk2VHNlE) (2:02 min)
* Using slide 23 of the attached PowerPoint, display a map of the world and ask students, “Which countries have the least available freshwater?” Allow students to offer their guesses and proceed to ask, “Which countries have the most available freshwater?” Discuss reasons why. Through class discussion, help students more fully recognize that across the globe not everyone has access to a reliable freshwater source. Discuss factors that impact water availability and daily water use per person (estimate liters or gallons by country). Access data from [Data 360](http://www.data360.org/dsg.aspx?Data_Set_Group_Id=757) website.

Suggested Companion Resources

* [Journey 2050 Program Summary](http://www.agclassroom.org/teacher/matrix/resources.cfm?rid=765) (Activity)
* [Agronomy - Grow with It!](http://www.agclassroom.org/teacher/matrix/resources.cfm?rid=771) (Book)
* [How Reducing Food Waste Could Ease Climate Change](http://www.agclassroom.org/teacher/matrix/resources.cfm?rid=775) (Multimedia)
* [Revolutionizing the Way We Grow Food](http://www.agclassroom.org/teacher/matrix/resources.cfm?rid=601) (Multimedia)
* [The Story of Bottled Water video](http://www.agclassroom.org/teacher/matrix/resources.cfm?rid=531) (Multimedia)
* [World Population History](http://www.agclassroom.org/teacher/matrix/resources.cfm?rid=777) (Multimedia)
* [Irrigation Museum](http://www.agclassroom.org/teacher/matrix/resources.cfm?rid=745) (Website)
* [Project WET](http://www.agclassroom.org/teacher/matrix/resources.cfm?rid=733) (Website)
* [Responsible Acre](http://www.agclassroom.org/teacher/matrix/resources.cfm?rid=766) (Website)
* [The USGS Water Science School](http://www.agclassroom.org/teacher/matrix/resources.cfm?rid=734) (Website)
* [Using Technology to Save Water](http://www.agclassroom.org/teacher/matrix/resources.cfm?rid=607) (Website)

Sources/Credits

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**Sources:**

1. <https://water.usgs.gov/edu/pdf/earthwherewater.pdf>
2. <http://www.fao.org/news/story/en/item/130033/icode/>
3. <http://www.unep.org/dewa/vitalwater/article141.html>
4. <http://www.fao.org/news/story/en/item/130033/icode/>
5. <http://www.nationalgeographic.com/kidsnetwork/water/session_01.html>
6. <https://blog.epa.gov/blog/2010/06/my-jeans-are-very-thirsty/> from <http://ngm.nationalgeographic.com/2010/04/table-of-contents>
7. <http://www.borgenmagazine.com/impact-drip-irrigation-crop-per-drop/>
8. <http://www.fao.org/docrep/t1696e/t1696e09.htm>
9. <https://water.usgs.gov/edu/earthwherewater.html>
10. <https://water.usgs.gov/edu/pdf/earthwherewater.pdf>
11. <http://www.miseagrant.umich.edu/flow/pdf/U2/FLOW-U2-L3-MICHU-08-402.pdf>
12. <http://www.ers.usda.gov/topics/farm-practices-management/irrigation-water-use.aspx>

Next Activity:

AGRICULTURAL WATER

**NOTE: This text has been updated to reflect changes in the proposed FSMA rules as of October 2014.**

**Background**

Farmers use water throughout their operations, for everything from irrigating crops and preventing frost damage to washing and cooling produce.  In the proposed Produce Rule, FDA has developed standards for agricultural water use on farms.

The Food Safety Modernization Act (FSMA) requires the Food and Drug Administration (FDA) to develop regulations aimed at improving the safety of produce.  Water used in agricultural operations has been identified as a potential source of pathogens that may contaminate produce, and Congress required FDA to include standards for water when developing new regulations for produce safety.

Also important to the water standards, Congress required FDA to take into consideration conservation practices and environmental standards such as those by USDA’s Natural Resources Conservation Service (NRCS) and the Environmental Protection Agency (EPA). Congress also specified that FDA could not propose requirements that conflict with or duplicate the requirements for certified organic production.

FDA’s initial proposed water standard caused great concern among produce farmers because the microbial standard, treatment requirements, and testing frequencies were overly prescriptive, inflexible, and insufficiently risk- and science-based.  In response to comments received on this issue, FDA has significantly revised its approach to agricultural water standards, as explained in more detail below.

**Proposed Agricultural Water Standards**

The [proposed standards for agricultural water](https://www.federalregister.gov/articles/2013/01/16/2013-00123/standards-for-the-growing-harvesting-packing-and-holding-of-produce-for-human-consumption#sec-112-41) include:

* General water quality requirements;
* Water system inspection requirements;
* Water treatment requirements;
* Water testing requirements;
* Requirements for water used in harvesting, packing, and holding of produce; and
* Recordkeeping requirements.

The requirements apply to “[agricultural water](https://www.federalregister.gov/articles/2013/01/16/2013-00123/standards-for-the-growing-harvesting-packing-and-holding-of-produce-for-human-consumption#p-1365)” – i.e., water that is used in the growing, harvesting, packing, or holding of “covered” produce ([click here for the list of produce subject to the requirements of the Produce Rule](https://www.federalregister.gov/articles/2013/01/16/2013-00123/standards-for-the-growing-harvesting-packing-and-holding-of-produce-for-human-consumption#sec-112-1)).  FDA considers water to be “agricultural water” if it is intended to or likely to contact covered produce or food-contact surfaces.  Examples of agricultural water include irrigation water that is directly applied to the harvestable portion of a crop, water used for preparing crop sprays, and water used for washing or cooling harvested produce.

Broadly, the proposed agricultural water standards are aimed at minimizing the likelihood of produce being contaminated by pathogens in water used in the growing, harvesting, packing, and holding of produce.  Because the methods for detecting microbial pathogens in water are so limited, FDA is basing its proposed standards on monitoring for hazards and testing water for fecal contamination – specifically for generic *E. coli*, which FDA claims is a satisfactory indicator for determining fecal contamination.

*What the Proposed — and Re-Proposed — Standards Require*

**General Water Quality Requirements**

Generally, the proposed agricultural water standards require farmers to ensure that agricultural water is “safe” and “of adequate sanitary quality for its intended use.”  That means that water should not contain pathogens or contaminants and that it should be suitable for use.  This general requirement underpins the entire water standard.

If, through any of the scenarios discussed below, a farmer has determined or has reason to believe that the agricultural water is not safe or of adequate sanitary quality, generally the standards require the farmer to immediately discontinue use of that water on the farm.  The farmer must then take action to address the water quality problem in one of two ways:

1. *Inspect the on-farm agricultural water system components that are under the farm’s control, identify any conditions that could be causing the problem, make any necessary changes to fix the problem, and retest the water to ensure the changes were effective; OR*
2. *Treat the water (see the water treatment section below).*

**Water System Inspection Requirements**

The proposed standards require a farmer to inspect his/her agricultural water system at the beginning of a growing season.  In that inspection, a farmer must identify conditions that may result in hazards contaminating produce through water, and take into consideration:

* The nature of each agricultural water source (e.g., ground water or surface water);
* The extent of the farmer’s control over each source;
* The degree of protection of each source;
* Use of adjacent or nearby land; and
* The likelihood of hazards being introduced in the water by a farm upstream.

The standards require a farmer to adequately maintain all agricultural water sources under that farmer’s control and keep those sources free of possible sources of contamination such as debris, trash, or domesticated animals.  Farmers must also inspect and maintain equipment used in the agricultural water system, and minimize the amount of pooling water.

*FDA’s revised or “supplemental” proposed Produce Rule does not change the general water quality requirements or the water system inspection requirements.*

**Water Treatment Requirements**

The original proposed agricultural water standard presented chemical treatment of agricultural water as the only option if the agricultural water was not safe and of adequate sanitary use and the problem was not within the farmer’s control.  FDA has provide some clarity and flexibility on this issue by allowing farmers to modify their practices and continue using surface water for irrigation without treating it, as explained below in the Water Testing Requirements section.

For non-irrigation purposes, however, treatment is likely the only option for farmers with water that exceeds the applicable microbial standard.  If a farmer must treat the water, then FDA suggests treating water with an antimicrobial compound.  FDA notes, however, that any chemical used to treat water would need to be registered with the Environmental Protection Agency and that, presently, there is no such registration for chemical treatment of irrigation water.  FDA assumes that this issue will be addressed and a new registered product created before farmers must comply with the water standards (see compliance information below).

For water that is treated, FDA requires a farmer to make sure that the treated water is consistently safe and of adequate sanitary use, and to monitor treatment at an adequate, but unspecified frequency.

**Water Testing Requirements**

FDA is proposing to require testing of agricultural water when that water:

* Directly contacts the harvestable portion of a crop prior to, during, or after harvest;
* Directly contacts food-contact surfaces;
* Is used for hand washing during and after harvest;
* Is used to make agricultural teas; or
* Is used to irrigate sprouts.

A farmer would not be required to test his/her agricultural water if he/she:

* Uses water from public water systems and has public water system results or certificates of compliance;
* Uses an irrigation method that does not directly contact the harvestable portion covered produce (e.g. drip or furrow irrigation); or
* Treats the water according to the water treatment requirements (see above).

For farmers that have to test water, FDA is proposing three numerical standards for testing:

1. **No detectible***E. coli***present per 100 ml of water**:  This standard would apply to water used for an activity during and after harvest, water used to make agricultural teas, and water used in sprout irrigation.
2. **A geometric mean of no more than 126 CFU per 100 ml:**This standard would apply to untreated groundwater used to irrigate in a manner that directly contacts the harvestable portion of the crop.
3. **A statistical threshold value of 410 colony forming units (CFUs) generic***E. coli***per 100 ml for a single water sample, and a geometric mean of no more than 126 CFU per 100 ml**:  This standard would apply to untreated surface water used for growing activities (except for sprouts) that directly contact the harvestable portion of the crop.  If your water testing shows that you exceed these values, you can still use your water, as long as you apply an appropriate time interval between the end of irrigation and harvest (see the “Calculating Microbial Die-off” section below).

**This is a significant change from FDA’s original approach**, which set a limit of 235 CFU per 100 mL and prohibited the use of water that exceeded this limit.

***FDA’s New Approach to Testing and Using Untreated Surface Water***

FDA has proposed a new tiered approach to testing and using untreated surface water that is directly applied to the harvestable portion of the crop:

1. **Conduct a baseline survey to initially develop the water quality profile of each of your water sources:**FDA is proposing that you develop your water quality profile by calculating the geometric mean (GM) and the statistical threshold value (STV) of generic E. coli (in CFU per 100 mL) using at least 20 samples over at least two years.  You should sample the water as it’s used (e.g. at the end of the sprinkler), and collect the samples during a time period as close as practical to harvest.
	* If your water quality profile is above the STV and GM thresholds, then you are not required to stop using that water source.  Instead, you can still use the water in conformance with the microbial die-off provision (see “Calculating Microbial Die-Off” below).
2. **Verify your water quality profile through annual sampling:** Each year, you must take at least 5 new samples to verify the accuracy of your water quality profile.  If your annual survey is sufficiently different from your existing water quality profile, then you would have to update your water quality profile and make adjustments to your practices.
3. **Re-establish your baseline:**FDA is proposing that you re-establish your baseline survey every ten years, or sooner if your annual survey samples do not support your water quality profile, and then adjust your practices accordingly (e.g. wait another day or two before harvesting, based on the microbial die-off rate).

To develop a new water quality profile, you can use your 5 samples from the current year’s annual survey combined with past year’s samples (e.g. 15 samples from the last 3 years).  You can also use your 5 current samples and take 15 new samples to meet the 20 sample minimum.  However, if you know or have reason to believe that your water quality profile no longer represents the quality of your water due to significant changes in neighboring land use or other impacts outside of your control that could adversely affect the quality of your water source, then you must re-establish your baseline with at least 15 new samples, and modify your practices accordingly.

If you are using untreated surface water for other purposes, like post-harvest, to irrigate sprouts or make agricultural teas, for hand washing, or in direct contact with food-contact surfaces, then you must test the quality of each source of the water “with an adequate frequency to provide reasonable assurances that the water meets the required standard” (no detectable generic E. coli per 100 mL).  You must have adequate scientific data or information to support your testing frequency.

*Calculating Microbial Die-Off*

If you are using untreated surface water to irrigate in a way that directly contacts the harvestable portion of the crop, and your water quality exceeds the proposed STV and GM thresholds, you can still use that water as long as you wait enough time to account for the natural reduction in generic E. coli (“microbial die-off”) that would bring you below within the threshold.  If this confuses you, you aren’t alone.  This is a relatively complicated concept, and FDA recognizes that they will need to provide guidance and education to help farmers calculate the appropriate number of days that they need to wait between the end of irrigation and harvest.

FDA has proposed a die-off rate of 0.5 log per day that would apply to determine the number of days you must wait between irrigation and harvest.  This rate means that every day after you irrigate, you can assume a roughly 67% reduction in generic E.coli on the surface of the crop due to natural causes like sunlight, moisture, temperature, pH, etc.  [FDA provides some examples](https://www.federalregister.gov/articles/2014/09/29/2014-22447/standards-for-the-growing-harvesting-packing-and-holding-of-produce-for-human-consumption#p-110) of how applying the 0.5 log die-off rate allows you to use water that would otherwise exceed the standard.

You can also use an alternative die-off rate for the time between irrigation and harvest, and/or apply a die-off rate between harvest and end of storage.  In both instances, you are expected to provide documentation showing that the alternative method is supported by adequate scientific data indicating that the alternative would provide the same level of public health protection and would not result in adulterated produce.  This alternatives option is not applicable to water used during and after harvest, water used to make agricultural teas, and water used in sprout irrigation.

***FDA’s New Approach to Testing and Using Untreated Groundwater***

If you are using untreated groundwater, FDA has proposed a tiered testing approach like that for untreated surface water:

1. **Conduct a baseline survey to develop a water quality profile:** FDA is proposing to require at least four tests during the growing season or over the period of one year, using at least four samples collected as close as practical to harvest.
	* If the groundwater is for post harvest use, handwashing, sprouts, agricultural teas, or it contacts food-contact surface, the standard is no detectable generic E. coli per 100 mL
	* If you are using the water for irrigation and it will directly contact the harvestable portion of the crop, the standard is a geometric mean of generic E. coli of 126 CFU or less per 100 mL
2. **Annual Verification:** If you meet the applicable standard in your baseline survey, then you only need to test once annually.  But, you must resume testing at least four times per year (or growing season) if any annual test fails to meet the standard.

**Sharing Water Testing Data**

FDA has proposed new provisions that address the issue of whether and how farmers can use test results obtained by third parties.  You can use:

* Test results that you obtain, or by someone else or another entity acting on your behalf; or
* Data collected by a third party or parties, provided the water source(s) sampled adequately represent your water source(s), as long as the requirements above regarding testing are met.

**Requirements for Water used in Harvesting, Packing, and Holding of Produce**

For water used during harvesting, packing, and holding activities, FDA is requiring farmers to manage the water to maintain adequate sanitary quality and minimize the potential for contamination.  Farmers must visually monitor the quality of water for build-up of organic material, and must maintain and monitor water temperature to minimize the potential for infiltration of microorganisms into covered produce.

**Recordkeeping Requirements**

FDA is proposing that farmers keep the following records with respect to agricultural water:

* The findings of the inspection of the agricultural water system;
* Documentation of results of any analytical tests conducted to determine whether agricultural water is safe and of adequate sanitary quality;
* Scientific data or information to support the adequacy of a water treatment method used;
* Documentation of results of water treatment monitoring;
* Documentation of the results of water testing;
* Scientific data used to support the use of an alternative for agricultural water used during growing activities;
* Scientific data used to support the use of an alternative microbial die-off rate; and
* Annual documentation of the results or certificates of compliance from a public water system, if applicable.

All of these recordkeeping requirements are subject to the [overarching recordkeeping requirements of the proposed Produce Rule, available here.](http://sustainableagriculture.net/fsma/learn-about-the-issues/recordkeeping/)

**Compliance Dates**

Because the agricultural water standard is based on limited scientific evidence, because there are huge research gaps in agricultural water issues, and because the proposed standards are untenable at this time, FDA is proposing extended compliance dates for the agricultural water standards.

For the water testing, monitoring, and associated recordkeeping requirements, FDA is proposing the following compliance dates from the time that the final Produce Rule goes into effect:

* Six years for very small businesses,
* Five years for small businesses, and
* Four years for all other farms.

Small and very small farms may find the costs of annual testing, and establishing the baseline survey in particular, to be quite burdensome.  As a way to spread out the costs of compliance, small and very small farms have more time to come into compliance with the requirement.  Spreading out the 20 samples required for a baseline across 4-6 years makes achieving the baseline less onerous.  Allowing farmers to rely upon past year’s data in establishing a new baseline will also help spread the costs of compliance.  However, FDA is requesting comments on how long past year’s test results should be viable to use in calculating the baseline.  This means that they could decide that test results older than 3 years (for example) cannot be used.

**FDA Needs to Hear from YOU About Agricultural Water:**

If you use agricultural water, FDA needs to hear from you about how these proposed rules might impact your farm operation.  FDA is requesting comment on the proposed standards, on additional specific issues, and on information to include in additional guidance documents.

Here are some questions to guide your comments on this part of the re-proposed Produce Rule:

* Do you use water in your farming operation?  If yes, how do you use water and how will these standards impact you?
* Do you test your water?  If yes, what do you test for, how often do you test, what method do you use to test, and what does testing cost you?  If no, what do you do to monitor the quality of your water?
* How far away are you from the nearest lab?  Is it difficult for you to get samples to labs?  If so, why?
* Should annual verification be based on more than 5 samples?  Should highly variable water sources, like rivers, be tested more frequently or less frequently?
* How long should you be able to rely past year’s test results?
* Are there circumstances where you should have to get all new samples to re-establish your baseline, rather than relying on past year’s samples?
* Do you think FDA should establish a water quality standard that has a maximum limit, above which you shouldn’t be able to use the water?
* If you think the microbial die-off rate is a good idea, and provides you with flexibility to work with the microbial standard, be sure to say so!

FDA is also requesting comment on specific issues, including:

* The new tiered approach to untreated surface and ground water testing;
* The log die-off rates;
* The proposed numerical standards, and the absence of a maximum threshold above which you couldn’t use the water;
* How frequently untreated surface water is used for other purposes, besides crop irrigation;
* Circumstances under which FDA should require that a new baseline be established with all new test results; and
* Scenarios under which FDA should require immediate changes to current practices.

*How do I submit a comment to FDA?*

[Our step-by-step instructions show you how.](http://sustainableagriculture.net/fsma/speak-out-today/)

**Additional Resources**

* **Re-proposed Standards Directed to Agriculture Water**: <https://www.federalregister.gov/articles/2014/09/29/2014-22447/standards-for-the-growing-harvesting-packing-and-holding-of-produce-for-human-consumption#p-346>
* **Preamble discussion of Re-proposed Standards**: <https://www.federalregister.gov/articles/2014/09/29/2014-22447/standards-for-the-growing-harvesting-packing-and-holding-of-produce-for-human-consumption#h-21>
* **Original Proposed Standards Directed to Agricultural Water:**<https://www.federalregister.gov/articles/2013/01/16/2013-00123/standards-for-the-growing-harvesting-packing-and-holding-of-produce-for-human-consumption#sec-112-41>
* **Original Preamble discussion of Proposed Standards Directed to Agricultural Water:**<https://www.federalregister.gov/articles/2013/01/16/2013-00123/standards-for-the-growing-harvesting-packing-and-holding-of-produce-for-human-consumption#h-108>

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