

**Agricultural Water**

All agricultural water must be safe and of adequate sanitary quality for its intended use




**Pre-Harvest**  
**Post-Harvest**

**Produce is susceptible to water-borne microbial hazards before, during, and after harvest**

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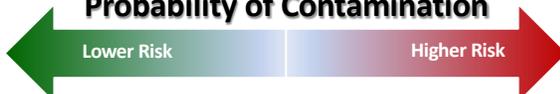
**Two Sets of “Microbial Quality Criteria”**

**Production Water**  
Water used in contact with produce during growth

**Postharvest Water**  
Water used during or after harvest

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**Probability of Contamination**

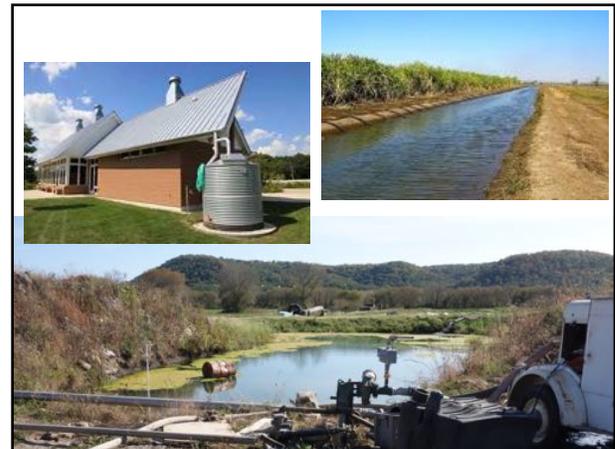


<b>Public Water Supply</b>	<b>Ground Water</b>	<b>Surface Water</b>
		
Treated		Open to Environment

**Prevent Contamination of Water**

*Keep the surrounding area free of debris, pesticides, petroleum products, fertilizer and manure, chemicals, animal enclosures*

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**When Is A Well Considered Surface Water?**



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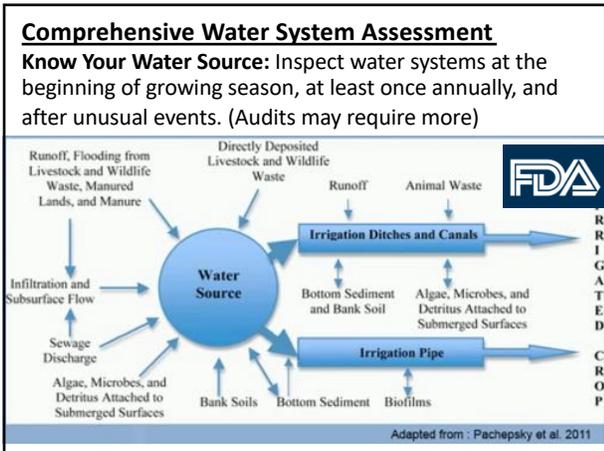
**Farm Name:** \_\_\_\_\_ **Effective Date:** \_\_\_\_\_  
**F-3, F-4 Water Systems Description and Risk Assessment** **Document #:** \_\_\_\_\_  
**Signature/date of Person writing plan:** \_\_\_\_\_ **Revision #:** \_\_\_\_\_  
**Signature/date of Supervisor review:** \_\_\_\_\_ **Revision Date:** \_\_\_\_\_

**Describe Your Water System**

- A Water System Map is in this section of my Food Safety Plan
- Water types and sources used for the activities on my farm are identified in this template.
- ID numbers of water sources provide location identification.

ID Water Source	Uses	Check if used and add ID of water sources		
		Municipal	Private Well	Untreated Surface water
	Drinking	<input type="checkbox"/>	<input type="checkbox"/>	Not permitted
	Hand Washing	<input type="checkbox"/>	<input type="checkbox"/>	Not permitted from harvest on
	Cleaning food contact surfaces	<input type="checkbox"/>	<input type="checkbox"/>	Not permitted
	Harvest and post-harvest water that contacts produce	<input type="checkbox"/>	<input type="checkbox"/>	Not permitted
	Ice that contacts produce and contact surfaces	<input type="checkbox"/>	<input type="checkbox"/>	Not permitted
	Irrigation: <input type="checkbox"/> None <input type="checkbox"/> Overhead sprinkler <input type="checkbox"/> Drip <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Furrow <input type="checkbox"/> Flood	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Fertilizer application	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Pesticide / Fungicide application	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Compost tea and foliar applications	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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**ANNUAL WATER RISK ASSESSMENT**

**Farm Name:** \_\_\_\_\_ **Effective Date:** \_\_\_\_\_  
**F-4.1 Water System Risk Assessment Log** **Document #:** \_\_\_\_\_  
**Signature/date of Person writing plan:** \_\_\_\_\_ **Revision #:** \_\_\_\_\_  
**Signature/date of Supervisor review:** \_\_\_\_\_ **Revision Date:** \_\_\_\_\_

**Water System Risk Assessment. We perform a Water Systems Risk Assessment**

- Seasonally
- And any time there is a change made to the system or a situation occurs that could introduce an opportunity to contaminate the system

The risk assessment addresses potential physical, chemical, and biological hazards and hazard control procedures for the water distribution system.

If your answer to a question indicates a risk of a food safety hazard, then further understanding, conducting a risk assessment and/or Preventive or Corrective Action(s) are needed to minimize possible contamination.

Area of Potential Risk with Water System and Use	Yes	No	NA	What is the potential risk identified?	Likelihood (Circle One)	What Preventive/Corrective Action(s) will you use to minimize the risk?	Date/Initials
Is the source of water used for irrigation clearly identified?					Low Medium High		
Is the potable water source clearly identified?					Low		

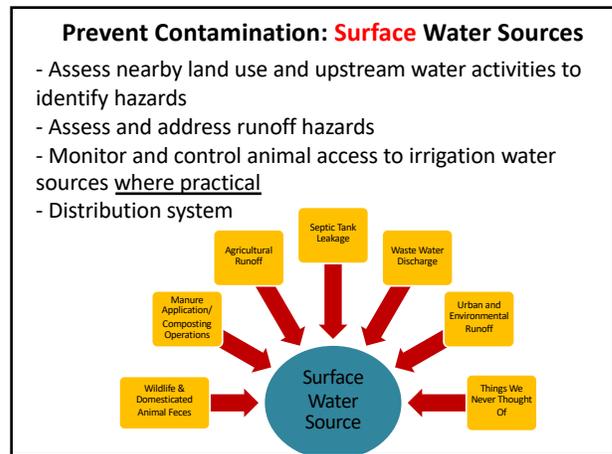
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**MAP IT: Water Sources and Distribution Systems on Your Farm.**

*Water can be contaminated at the **source**, or it can become contaminated in the **distribution system***

- Identify the water sources that are available to your farm: wells, irrigation hydrants, streams, ponds. **(ID CODE FOR RECORDS)**
- With arrows show water flow and wind direction.
- Identify any potential contamination hazards that may exist for these sources.
- Describe or diagram how water is used for irrigation on your farm.

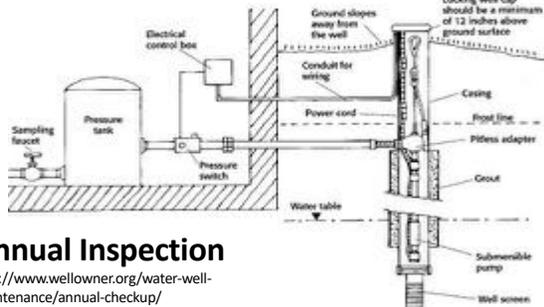
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**Prevent Contamination: Ground Water Sources**

- Be sure land slopes away from wellhead
- Inspect wellhead -- properly capped and elevated
- Inspect well to ensure it is in good condition



**Annual Inspection**

<http://www.wellowner.org/water-well-maintenance/annual-checkup/>

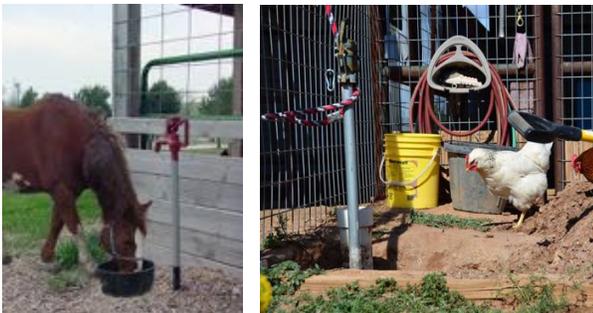
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Corroded or broken caps and conduits on well heads are common and an easy, inexpensive repair.

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Are animals by a hydrant a contamination problem?



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**System Includes Conveyance**

- Contamination can occur at the source**
- biological: livestock or wildlife
  - chemical: running into water source

- Within the conveyance and at the point of emission**
- microbes can enter or grow inside irrigation systems
  - chemigation improperly cleaned after



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**The water in a dunk tank is a contact surface**

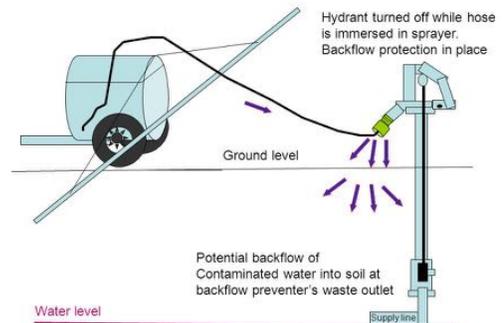
**Prevent Contamination of Water Systems**



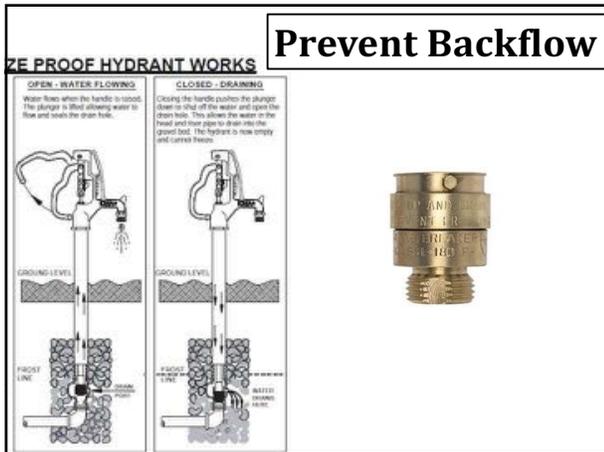
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**DO YOU NEED DESIGNATED HOSES FOR POSTHARVEST?**

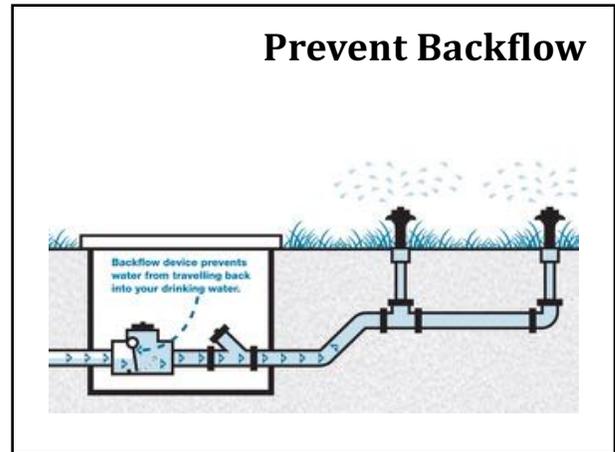
What Risk do Frost Free Hydrants Pose?



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agricultural tea that touches plants must use water free of generic e-coli



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## PRODUCTION WATER RISK VARIABLES

Table 7. Relative Likelihood of Produce Becoming Contaminated with Pathogens of Public Health Concern from Agricultural Water

Source	Least <span style="color: green;">←</span> <span style="color: yellow;">→</span> <span style="color: red;">→</span> Most			
	Public Drinking Water	Ground water	Surface water protected from runoff	Surface water unprotected from runoff
And where contamination is known to exist, the likelihood of contamination is a function of the following factors:				
Contact with commodity	Indirect contact		Direct contact	
Commodity effects	Unlikely infiltration		Susceptible to infiltration	
Application timing	Surface not conducive to adhesion		Surface conducive to adhesion	
	Early in crop growth	Late in crop growth	During harvest	Postharvest

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## Water Microbial Quality Profile

- Microbial water testing is the only way to quantitatively assess the microbial quality of the water
- A water quality profile can help you:
  - Understand the quality of your water source
  - Understand seasonal and event impact on your water quality
  - Determine appropriate uses for each source
  - Decide if corrective measures are needed when microbial water quality profile exceeds criteria in the FSMA Produce Safety Rule

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## Water Testing Frequency For **Production Water**

### PRODUCE RULE WATER TEST REQUIREMENTS

Public Water Treated	Copy of test results or current certificate of compliance
Ground Water Untreated	1 <sup>st</sup> : 4 times within a year Then: 1 or more per year – rolling profile
Surface Water Untreated	1 <sup>st</sup> : 20 or more in 2 to 4 years. Then: 5 annual samples – rolling profile

Additional testing may be needed for unusual events

**THE POINT IS TO UNDERSTAND YOUR WATER SOURCE.**

Profile samples must be:

- representative of use
- collected as close in time as practicable to, but before, harvest



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**WATER QUALITY:** The criteria are based on two values, the geometric mean (GM) and the statistical threshold (STV):

- **126 or less** colony forming units (CFU) generic *E. coli* per 100 mL water geometric mean (GM)

**AND**

- **410 or less** CFU generic *E. coli* per 100 mL water statistical threshold value (STV)

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## Geometric Means and Statistical Threshold Values

- The geometric mean (GM) is a log-scale average, the “typical” value
- The statistical threshold value (STV) is a measure of variability, the estimated “high range” value

- Online Calculator

<http://agwater.arizona.edu/onlinecalc/>

<http://wafs.ucdavis.edu/>

Lab Result (CFU or MPN *E. coli*/100 ml)

Note

Add

Table 1. Your Microbial Water Quality Profile (MWQP)

Sample Date	Sample Location/ID	Sample Number	<i>E. coli</i> CFU or MPN/100 ml	Log <i>E. coli</i> CFU or MPN/100 ml	Sample Stage	Action	Note
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### Where To Go for Water Tests

- Lab should be certified by state and local environmental agencies, or third-party accreditors
- Can the lab provide the test you need?
- Be sure the lab provides sampling instructions
  - Labs should provide instructions for acceptable sampling containers, hold times, storing, and transport expectations



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### How To Collect Samples

- Follow all sample submission instructions from the laboratory
- A sterile bottle must be used to collect samples
- Do not rinse bottle before sampling
- In a distribution system, allow the water to run before sampling in order to collect a representative sample



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### FDA released proposed revisions to Subpart E – Agricultural Water on December 2, 2021

- Docket FDA-2021-N-0471
- <https://www.regulations.gov/document/FDA-2021-N-0471-0001>
- Proposed revisions move from testing as the primary metric for decision making to an **Agricultural Water Assessment (AgWA)** that looks at the whole water system
- The expectation is that each grower will set their standards and understand why these standards are appropriate for their farm

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### Agricultural Water Assessment

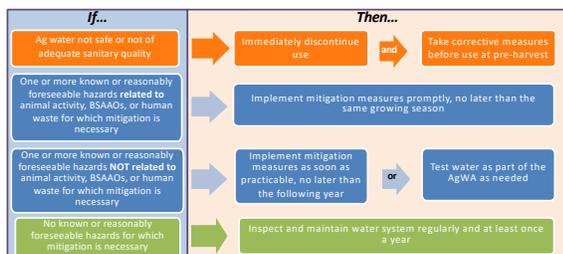
- Growers would be required to evaluate these factors to identify conditions reasonably likely to introduce known or reasonably foreseeable hazards onto produce or food contact surfaces

Ag Water system	<ul style="list-style-type: none"> <li>• Source and location (surface, ground, municipal)</li> <li>• Water distribution system (open or closed)</li> <li>• Degree of protection from possible contamination including other users, animal impacts, and adjacent land uses</li> </ul>
Ag Water practices	<ul style="list-style-type: none"> <li>• Type of application method (overhead, drip, furrow, flood)</li> <li>• Time interval between last direct application and harvest</li> </ul>
Crop characteristics	<ul style="list-style-type: none"> <li>• Susceptibility to surface adhesion or internalization</li> </ul>
Environmental Conditions	<ul style="list-style-type: none"> <li>• Frequency of rain or extreme weather that might impact the agricultural water system or might damage produce</li> <li>• Air temperatures</li> <li>• Sun (UV) exposure</li> </ul>
Other factors	<ul style="list-style-type: none"> <li>• Includes results of testing</li> </ul>

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### Agricultural Water Assessment

- Outcomes: Farms would use the outcomes of the AgWA to determine corrective or mitigation measures



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### Agricultural Water Assessment

Corrective measures	<ul style="list-style-type: none"> <li>• Re-inspecting the entire affected agricultural water system under the farm's control and, among other steps, making necessary changes OR</li> <li>• Treating the water in accordance with the standards in FSMA PSR</li> </ul>
Mitigation measures	<ul style="list-style-type: none"> <li>• Making necessary changes such as repairs</li> <li>• Increasing time interval: minimum 4 days between last direct application → harvest (microbial die-off)</li> <li>• Increasing time interval for harvest → storage (microbial die-off)</li> <li>• Other activities such as: Commercial washing</li> <li>• Changing water application method</li> <li>• Treating water (PSR standards)</li> <li>• Taking alternative mitigation measures supported by scientific information</li> </ul>

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### Access & Reassess

**Conduct** each year, AND, Anytime there is a significant change in:

- The agricultural water system(s)
- Agricultural water practices
- Crop characteristics
- Environmental conditions
- Other things likely to introduce a hazard

**Evaluate:** Impact of the changes, new hazards

**Record:** Written determination of whether corrective or mitigation measures needed

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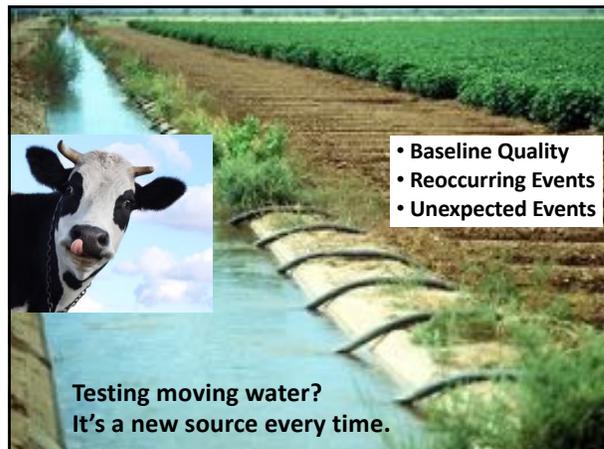
### More frequent monitoring, testing or irrigation changes may be required when conditions change

- Changes in land use, development, road construction
- Natural disruptions such as fires and floods
- Migrating wildlife
- Rain Quantity and Intensity
- High Wind
- Algae & Sediment
- High Turbidity
- Signs of fecal matter
- Dead animals
- Drought
- Canal maintenance
- High temperatures



*It is important to understand the variables of your water source.*

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### WHAT CAN BE DONE WHEN SOURCE WATER CHRONICALLY FAILS TO MEET STANDARDS?

**1<sup>st</sup>: Inspect the water system to identify problems.**

**Best solution is to find and remediate the source of contamination.**



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Start with the obvious

- Leaky pipes
- Animals in water
- Manure directly draining into water
- Waste water drainage
- Talk with your watershed neighbors.

Identify the sources in your watershed.

However, there may be times that you can't identify the sources without extensive testing help.

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**Corrective Measure:  
Eliminate Contact**



Reducing contact is the most effective control

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**Relative risk of GI illness in lettuce based on irrigation practice\***

Irrigation Practice	Relative Risk
Subsurface Irrigation	9 in 100,000,000
Furrow Irrigation	1.1 in 100,000
Sprinkler Irrigation	1.1 in 1,000

\* Assumes 126 E.coli per 100 ml of irrigation water.

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**Corrective Measure: Die-Off Time Interval  
Between Irrigation and harvest**  
*Apply a 4-day minimum time interval to allow die-off.*

- 68.38% die off over one day (31.62% remains),
- 90.00% over two days (10% remains),
- 96.84% over three days (3.16% remains), and
- 99.00% over four days (1% remains).

**Challenge:** Bacteria dies off rapidly. However many viruses do not. Hepatitis A can last 2 weeks on a cantaloupe.

1. <http://agwater.arizona.edu/>  
2. Download: [PSA-Geometric Means, Statistical Threshold Values, and Microbial Die-Off Rates](#)

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**Pathogens on Produce May Or May Not Die Off Over Time**

- Environmental conditions can influence die-off rates including
  - Desiccation (drying out)
  - Sunlight (ultraviolet irradiation)
  - Temperature and humidity
  - Starvation and competition
- Some pathogens may be 'protected' on the plant and survive for extended periods of time
- Under some conditions, pathogens can even regrow on a plant so avoiding contamination is best

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**When Die Off And Reducing Contact Isn't Enough  
Corrective Measure: Treating Production Water**

- Treating water is generally a short term solution
  - **Expensive**
  - May reduce yields and plant health
  - May produce harmful by-products – environmental issues
- **Chemical** – organic matter, ph, pathogen load can affect
  - Peroxyacetic Acid (PAA)
  - Chlorine / Chlorine Dioxide /eWater
  - Sodium or Calcium Hypochlorite
  - Copper / Silver Ionization
  - Ozone
  - Bromine

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**Physical**

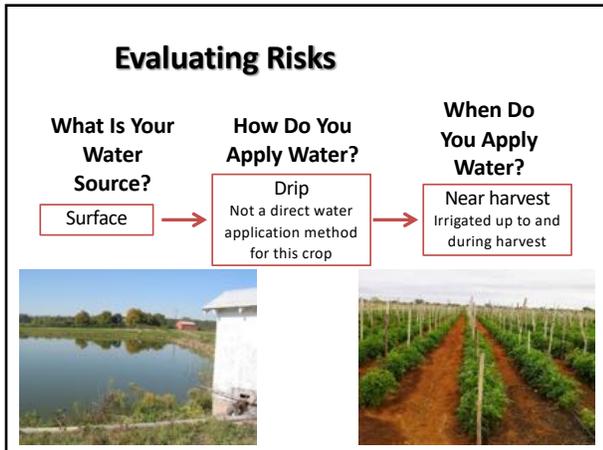
- Heat Sterilization
- Ultra Violet Light (UV)
- Filtration (Membrane, or other media)
- Ozone Unit

**Biological**

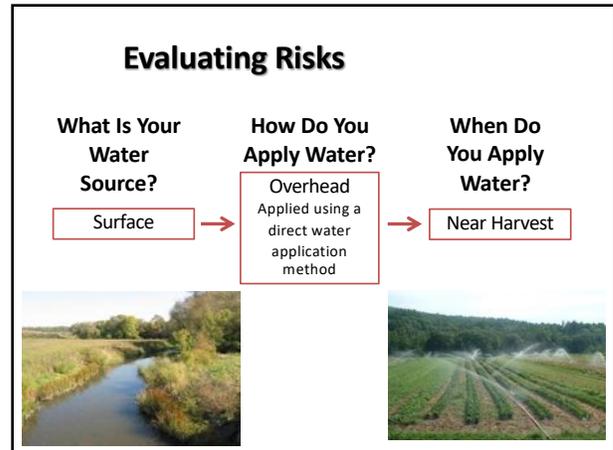
- Sand Filtration (biofilms)
- Constructed Wetlands

**All water treatments require on-site monitoring**

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### Agricultural Water Example

Water Source	Crop	Application Purpose	Application Method	Is this Agricultural Water?
Pond	Squash	Irrigation	Overhead	Yes, if summer squash (no for winter squash since it is not covered produce)

**Step 1: Is this crop covered produce?**  
**Answer:** For Summer Squash, yes and for Winter Squash, no

**Step 2: Is a direct application method used?**  
**Answer:** Yes, because the water is intended to, or likely to, contact covered produce

**Step 3: Is this Agricultural Water?**  
**Answer:** Yes, for summer squash  
 No, for winter squash

**PSA SUPPLEMENTAL MATERIAL**

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### Risk Assessment/Reduction Strategies



**Citrus**



**Drip irrigation**

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### Risk Assessment/Reduction Strategies



**Lettuce**



**Overhead irrigation**

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### Risk Assessment/Reduction Strategies



**Apples**



**Foliar application**

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**Risk Assessment/Reduction Strategies**



**Strawberries**



**Trickle**

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**Risk Assessment/Reduction Strategies**



**Potatoes**



**Overhead Irrigation**

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**Risk Assessment/Reduction Strategies**



**Carrots**



**Drip irrigation**

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**Corrective Actions Needed?  
Unintentional Water Contact**

- Broken Emitters and Other Water Application Issues
  - What is known about the quality of the water? How close is harvest?
- Human Mistakes
  - Spray applications accidentally mixed with untreated surface water
  - Forgetting to turn off irrigation pumps, may result in in-field flooding
- Flood Events
  - If the produce has come in contact with flood water from overflowing streams or open bodies of water, it is considered adulterated by the FDA and cannot be used for food
  - Contact with flood water that is not part of a natural disaster may be subject to provisions of the FSMA Produce Safety Rule



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**Proposed WATER Compliance Dates**

For **pre-harvest (production) agricultural water** requirements for covered produce other than sprouts

Business Size	Proposed Water Related Compliance Dates
All other businesses (>\$500K)	9 months after the effective date
Small businesses (>\$250K-500K)	1 year, 9 months after the effective date
Very small businesses (>\$25K-250K)	2 years, 9 months after the effective date

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**What NOW!**

1. Perform water system risk assessments and develop water management strategies to identify and reduce risks
2. Follow Good Agricultural Practices (GAPs) to protect water quality
3. Growers currently testing their water are encouraged to continue to do so
4. If not testing, growers might consider starting to test to better understand their water quality

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### WATER USE MANAGEMENT PLAN

Agricultural Water Quality Testing And Use Action Plan

Lab Information (name, address, phone) \_\_\_\_\_

Lab Information (name, address, phone) \_\_\_\_\_

Area of FS Action	Source and ID	How often is this source tested?	Who is responsible	Where	Record	Use	Check-in	
							Done	Will by
Water Quality Testing	Ground, surface, or municipal and identifying number		Who collects the samples, records the results, and oversees corrective actions.	Lab name	What records are kept for this action? Where?	What agricultural activities is this water is used for?		
Water Quality Testing								

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