



July 30<sup>th</sup>, 2024 Version 1 – FINAL REPORT

Topic Discussed in this report:

Water

Prepared by:

Western Growers

for the California Leafy Green Marketing Agreement

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#### Background

Since the inception of California's Leafy Green Handlers Marketing Agreement (CA LGMA), Western Growers (WG) has facilitated a systematic amendment process to update the CA LGMA-approved guidelines (also known as the LGMA metrics).

#### LGMA 2024 Amendment Process Summary

**Priority Setting:** starts with the CA LGMA confirming members of a priority-setting committee for the priority-setting process. The goal of the priority-setting process was to have a transparent selection of the topic(s) to be evaluated during the 2024 amendment process. A series of meetings were conducted for the priority-setting committee to build consensus on the priorities to be evaluated throughout the process.

**Working Group:** Following the priority-setting process, the CA LGMA confirms subject matter experts, and industry representatives to be part of working groups for each priority. The working group meets for a series of meetings to develop recommendations in the form of a draft of proposed changes to the CA LGMA.

**Open Comment Period:** Following the working group process, a 30-day comment period is opened for external parties to submit comments on the language proposed by the working group and/or propose changes to that language. These proposals and supporting documentation are made publicly available on the <u>www.leafygreenguideance.com</u> website.

**Webinar:** Approximately a week after the comment period closes, WG hosts a webinar. During the webinar, the process is reviewed, the LGMA presents the working group's proposed changes, and Western Growers shares comment(s) submitted during the comment period. An opportunity for additional remarks from those who submitted comments is also provided.

**Reporting:** Following the webinar, WG submits this report to the CA LGMA capturing the original proposal, public comments and revisions, and feedback during the webinar.

#### Selected Priorities from the Priority Setting Process

The following priorities were selected by the priority-setting committee to be considered for the 2024 CA LGMA amendment process.

- a. Ag Water Standards
  - 1. Review of Type B to A water standards
  - 2. Review variable water quality and sampling standards as they relate to generic *E. coli*.
- b. Harvesting Equipment Sanitation
  - 1. Harvest Equipment Sanitation propose key changes. (initial process as part of a long-term effort)

A full report and supplemental material for the priority-setting process are available on the <u>www.leafygreenguideance.com</u> website (<u>access the report</u>, access the <u>supplemental materials</u>)

#### Working Group Process - Water

#### Woking Group Members - Water

Three working groups were created to address the three priority areas identified above. The process started on April 5<sup>th,</sup> 2024, with a meeting that included all working group members to review logistics and timelines. Following the initial meetings, the three working groups met independently. For the two water-related topics, the working groups decided to merge because many topics covered during the initial two meetings were discussed in both working groups. The final composition of the working groups was as follows:

Table 1. Water Working Group Members

Water Working Group		
Working group member	Affiliation	
Amanda Brooks	Harrison Farms	
Trevor Suslow	UC Davis	
Channah Rock	University of Arizona	
Michelle Danyluk	University of Florida	
Matt Burke	Tanimura & Antle	
Vicki Scott	Scott Resources	
Lupe Camarena	Nature Fresh Farms	
Angie Ramirez	Triangle Farms	

In addition to the members in the working group, CA and AZ LGMA staff and Western Growers staff participated in the process. Table 2 below lists the participants from these organizations and their roles.

Table 2. Harvesting Equipment Working Group members (staff)

Harvesting Equipment Sanitation Working Group	
Working group member (Staff)	Affiliation and Role
Greg Komar	CA LGMA - CA LGMA staff
Connie Quinlan	CA LGMA - CA LGMA staff
Teressa Lopez	AZ LGMA – AZ LGMA staff
Kami Van Horn	AZ LGMA – AZ LGMA staff
Susan Leaman	iDecisionSciences, LLC – Drafting support
Gustavo Reyes	Western Growers – Drafting and facilitation

#### Process Summary – Water

Following the initial meeting, the water working group held 6 meetings on 4/6/2024, 4/17/2024, 4/24/2024, 4/30/2024, 5/13/2024 and 5/31/2024.

During the first four meetings, the working group reviewed Issue 6: Water. The working group discussed the scope, drafted the framework for updates, and discussed priorities. On the 4/30/2024 meeting, WG suggested an updated timeline for the water metrics revisions, as the scope of the proposed update would need more time to be correctly developed by the working group.

Following the release of the FSMA final rule for pre-harvest agricultural water, WG and the LGMA suggested putting forward a small language update. WG drafted initial revisions to the metrics, which the working group further modified during a May 30<sup>th</sup> meeting and submitted to the public for comment. The language in the water section (Issue 6) was revised to align with the language in the FSMA final rule for pre-harvest agricultural water. Revisions include language related to crop characteristics susceptibility to human pathogen adhesion and internalization, a written agricultural water assessment, and additional information on the degree of protection from possible sources of contamination.

For the broader issue 6 (water) review: The working group will start the review and amendment process towards the end of the 2024 summer. This review will address topics brought up during this comment period including additional considerations for well assessments, the number of samples and sample volume, and microbial criteria. After the working group completes its recommended revisions, a second comment period will be opened toward the end of 2024.

#### **Comment Period and Webinar**

#### Summary and Attendees.

On June 3rd, 2024, Western Growers opened a 30-day comment period regarding changes to the Water section (Issue 6) to align its language with the final FSMA Pre-Harvest Agricultural Water Rule and the Harvesting Equipment Sanitation section (Issue 8). Interested parties could submit their comment and proposed changes through the <u>www.leafygreenguidance.com</u> website.

Following the comment period, WG hosted a webinar on July 11<sup>th</sup>, 2024. The goals for the webinar were (i) for the CA LGMA to share a summary of the proposals submitted by the working groups, and (ii) to provide those who submitted comments an opportunity to share a summary of the comments submitted.

For the Harvesting Equipment Sanitation Proposal. Five sets of comments were received via the <u>www.leafygreenguidance.com</u> website.

The webinar was moderated by Gustavo Reyes from Western Growers. Those who submitted proposals/comments were allowed to give a summary and remarks about their submission within a maximum time limit of 7 minutes. The webinar had 50 attendees, who are listed in Table 3 below in alphabetical order. The attendees were allowed to participate by online voting on (i) whether they had issues with the submitted comments, followed by (ii) the option to submit comments via online polls.

Last Name	First Name	Affiliation
Alameda	Mary	Nunes Company Inc
Alencar	Fabia	Subway
Alfaro	Adriana	FM I- The Food Industry Association
Amaral	Matt	D'Arrigo Bros Co of California
Anderson	Aaron	Pacific International Marketing
Avila	Maggy	RAMCO Enterprises L P
Bermudez	Ernesto	GreenGate Fresh, LLP
Bourne-Lynch	Sherell	Schnucks
Burk	Tina	Heritage Farms LLC
Camarena	Lupe	Nature Fresh Farms
Dominguez	Cynthia	Duda Farms
Dorick	Jennifer	Darling Ingredients Inc
Eisenbeiser	Ashley	FMI - The Food Industry Association
Gibbons	Tom	
Gomez	Cristina	Nunes Company Inc
Gonzalez	Claudia	Legacy-Greens
Gumowski	Adrian	AZDA
Gutierrez	Martin	
Hsu	Bill	Yum Brands, Inc.
Kavanaugh	Megan	Bio S I Technology
Kelleher	Gillian	Kelleher Consultants LLC
Kohl	Larry	Ahold Delhaize USA company
Kunduru	Mahipal	Торсо
Lakey	Katie	Crowe Cayman Ltd
LaPlante	Lance	Yum Brands, Inc.
Licata	Alyssa	CALGMA
Longoria	Julia	Bonipak
Madison	Morgan	Florida Fruit and Vegetable Association
Mendoza	Cecilia	Taylor Farms
Munoz	Jorge	Taylor Farms
Nunes	Kristina	Nunes Company Inc
O'Donnell	Kathleen	Wegmans
Ortiz	jose	D'Arrigo Bros Co of California
Padilla	Samuel	Pasquinelli Produce Company
Quanquin	Bruno	Stevens Water Monitoring Systems

Table 3. Webinar Attendees (Does not include panelists)

Rock	Channah	University of Arizona Yavapai County Cooperative Extension
Ruelas	Paola	Rousseau Farming Company
Scott	Vicki	Scott Resources
Shakespeare	Mark	Walmart
Sierra	Valentin	Amigo Farms
Solorio	Marianna	Bonipak
Sughroue	Jay	BioSafe Systems LLC
Taylor	Michael	Stop Foodborne Illness
Unwer	Becky	Walmart
Valadez	Angela	Publix
Valadez	Angela	Publix Super Markets
Valdes	Francisco	Sabor Farms
Vargas	Erendira	RC Farms LLC
Voga	Brandon	Big Y
York	Tim	CA LGMA

#### Table 4. Webinar Panelists.

Last Name	First Name	Affiliation
Reyes	Gustavo	Western Growers
Salas	Sonia	Western Growers
Leaman	Sisan	iDecisionsSciences, LLC
Komar	Greg	CALGMA
Teressa	Lopez	AZ LGMA
Joe	Stout	Commercial Food Sanitation
Thesmar	Hilary	FMI- The Food Industry Association
Mudahar	Gurmail	Tanimura & Antle
Odello	Jake	Nunes Company Inc
Danyluk	Michelle	University of Florida
Chedwick	Megan	Church Brothers
Banegas	Tony	Bonduelle Fresh Americas
Shebl	Marcus	Taylor Farms
Kerr	Justin	Factor IV Solutions
Arboisiere	Felice	Dole Fresh Vegetables
Quinlan	Connie	CA LGMA

#### Webinar Description, concerns, and comments submitted.

The webinar began with background on the working groups' proposed changes presented by Greg Komar, CA LGMA Technical Director.

Hilary Thesmar presented the comment submitted by FMI.

- 5/25 (20.8%) of attendees reported having concerns with the submitted comments
- Comment submitted include
  - Participant comment: DEFU can't be used for routine monitoring. It exceeds drinking water standards, and we don't know the public health significance of it being sampling.

Teressa Lopez presented the comments submitted by the AZ LGMA Technical Subcommittee.

- 1/12 (8.3%) of attendees reported having concerns with the submitted comments
- The comments submitted include:
  - Participant comment: I concur with the AZ LGMA comments on water.

#### Webinar and Comments Takeaways

Comments received during the comment period reflect specific questions about the proposed changes and recommendations to update the broader Issue 6 (Water). These broader recommendations include well assessment, considerations for adjacent land use, and reviewing of sampling protocols. These broad changes to Issue 6 will be addressed in a second comment period after the working group fully reviews Issue 6. This is expected to take place in late summer and during the fall of 2024.

The AZ LGMA TSC submitted questions specific to the proposed changes. WG asked Dr. Channah Rock for an expert response to these two questions. A paraphrased version of the expert response is included in the next section.

#### Working Group Proposal and Comment Submissions

This report provides a summary of currently proposed amendments to assist the CA LGMA Technical Committee and the CA LGMA Board in finalizing their approval process. This document includes:

1. Highlights of the original proposal submitted by the working group and comments submitted by the AZ LGMA Technical Subcommittee and FMI.

The full version of the original proposed changes is attached at the end of this report as Appendix I. Appendix II contains the full proposals and comments submitted by the AZ LGMA Technical Committee and FMI

#### Summary of the original proposal submitted by the Water Working Group

Changes proposed by the working group are highlighted in red text. Comments by the AZ Technical subcommittee are in green and reference text is highlighted in green. Comments by FMI are in blue and reference text is highlighted in blue. Paraphrased expert opinion response in orange.

#### Changes proposed to the introductory paragraph

The safety of whole fresh and fresh-cut (e.g., bagged salad) leafy greens is a longstanding issue. Leafy greens are mostly consumed raw without cooking or processing steps to eliminate microbial hazards. Therefore, the way they are grown, harvested, packed, held, processed, and distributed is crucial to

ensuring that the risk of human pathogen contamination is minimized. LGMA recognizes that different crop characteristics may impact susceptibility to adhesion and internalization of hazards. These metrics are intended to prioritize risk by classifying agricultural water systems for specific uses within leafy greens operations. Remedial actions follow a "find and fix" structure to identify and correct both system nonconformities and more serious failures. These metrics should be considered the *minimum* controls necessary to assess agricultural water systems for fitness of use.

#### Changes proposed to the best practices under "General Agricultural Water Management"

- Agricultural water systems are a function of the source, storage, and conveyance. Each component of an agricultural water system that is within your control must be evaluated to ensure that the quality of agricultural water used in leafy green operations is known (i.e., the required parameters are measured and conform to the prescribed standards) and adequate for its intended use.
- It's prudent to evaluate and make a good faith effort to address the food safety hazards proximate to your agricultural water systems that may not be under your control.
- NEVER use water from any water system that has not been microbially characterized and assessed as described below.
- Prior to annual use of the water in agricultural operations perform a written agricultural water assessment, as described in Appendix A, prior to use of water in agricultural operations. An agricultural water system description shall be prepared. The water assessment must identify conditions that are reasonably likely to introduce known or reasonably foreseeable hazards into or onto the leafy greens. The assessment must address the following elements:

#### Comments:

AZLGMA Technical Subcommittee: Would like Appendix A reference to remain in place in this section. (refer to Appendix A) or as described in Appendix A.

FMI: Include health assessment of well: Conduct a well check valve assessment Risers, vents etc. Sample sprinklers at different locations: beginning of distribution system, middle, furthest point

 This A description (including the location and nature) of the agricultural water source and the type of distribution system shall be created. Information in the description shall include permanent fixtures such as wells, gates, reservoirs, valves, returns and other permanent above ground fixtures and could also include non-permanent features such as tanks, drip stations, gas power pumps, pipes, water treatment systems, etc. that make up a complete irrigation system. This could be achieved by using maps, photographs, drawings or other means to communicate the location of permanent fixtures and the flow of the water system (including any water captured for re-use or other natural or managed features which prevent environmental runoff from entering the water system).

#### Comments:

AZLGMA Technical Subcommittee: Would like clarification to ensure that the direction the water travels down furrow rows would not need to be described in the assessment.

Expert response: Expert opinion recommends identifying that the location of water

entering the field is appropriate. Getting away from the direction of flow in furrows, but, accounts for where the water enters the field.

AZLGMA Technical Subcommittee: This is new proposed language that is not tracked on the proposed document. AZLGMA Technical Subco: would like clarification on what tanks are being referred to here. Fertilizer tanks, and water treatment systems are often set up and removed throughout the growing season. Would the expectation be to update the description each time these are removed or added? Similarly, gas powered pumps are often replaced if maintenance is required, would re-assessment in changes in their placement be expected?

Expert response: It would be important to note non-permanent structures only if they played a role in water delivery and treatment. A new assessment may not need to be completed every time a tank moves, but they at least need to be addressed at the beginning of the season. Potentially introducing language for "significant change" warranting a new assessment.

 $\odot$  Water sources and the production blocks they may serve should be documented.

 The degree of protection from possible sources of contamination, including by other water users; animal impacts; and adjacent and nearby land uses related to animal activity (for example, grazing or commercial animal feeding operations of any size), application of biological soil amendment(s) of animal origin, or presence of untreated or improperly treated human waste.

#### Comments:

FMI: FMI recommends include additional considerations for adjacent and nearby land use to include other factors that could be a source of contamination.

- Documented agricultural water practices for each agricultural water system, including the application methods as described in Table 1, water sources and the production blocks they may serve.
- Manage and maintain all components of your agricultural water system that are within your control including the water source and the on-ranch (farm) distribution /conveyance system(s) must be managed and maintained in a manner that minimizes human pathogen contamination.
- Testing water at the end of the delivery system (e.g., the last sprinkler head) or the point-of-use is essential for ensuring water that contacts the crop is of adequate microbial quality.
- For surface water sources, consider the impact of storm events on irrigation practices. Bacterial loads in surface water are generally much higher after a storm than normal, and caution shall be exercised when using these waters for irrigation.

#### Comments:

FMI: For well water sources, consider the impact of storm events on irrigation practices. Test distribution system following flooding events where ranch risers and vents are under water. Verify that well water and distribution systems continue to meet the Type A water definition

• Water systems that convey untreated human or animal waste are never suitable for use in leafy greens operations in any manner and must be separated from conveyances utilized to deliver

agricultural water.

• Water records must be reviewed, dated, and signed, within a week after the records are made, by a supervisor or responsible party.

#### Additional text in the metrics that was not part of the proposal.

#### Changes proposed to: Best Practice for Managing Irrigation Water Treatment Systems

• Collect three (3)-100 mL samples from 3 different sprinkler heads with at least one sample from the farthest/last sprinkler head. Acceptance Criteria and Data Monitoring Criteria as outlined in Table 2D - Routine Monitoring of Microbial Water Quality must be met.

FMI: Increase the sample size in accordance with the method "Standard Operating Procedure for Dead-End Ultrafiltration Water Sampling in the Field for Bacterial Pathogens Issue Date: August 19, 2021, Revision 7"

Appendices

Proposal Submitted by the Water Working Group



# COMMODITY SPECIFIC FOOD SAFETY GUIDELINES

FOR THE PRODUCTION AND HARVEST OF LETTUCE AND LEAFY GREENS



SEPTEMBER 20, 2023 This document supersedes all previously published versions of the Commodity Specific Food Safety Guidelines for the Production and Harvest of Leafy Greens including those dated on or before March 30, 2023.

#### 2 6. ISSUE: WATER

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3 The safety of whole fresh and fresh-cut (e.g., bagged salad) leafy greens is a longstanding issue. Leafy greens are mostly 4 consumed raw without cooking or processing steps to eliminate microbial hazards. Therefore, the way they are grown, 5 harvested, packed, held, processed, and distributed is crucial to ensuring that the risk of human pathogen 6 contamination is minimized. LGMA recognizes that different crop characteristics may impact susceptibility to adhesion 7 and internalization of hazards. These metrics are intended to prioritize risk by classifying agricultural water systems for 8 specific uses within leafy greens operations. Remedial actions follow a "find and fix" structure to identify and correct 9 both system nonconformities and more serious failures. These metrics should be considered the minimum controls 10 necessary to assess agricultural water systems for fitness of use.

#### <sup>11</sup> General Agricultural Water Management - The Best Practices Are:

- Agricultural water systems are a function of the source, storage, and conveyance. Each component of an agricultural water system that is within your control must be evaluated to ensure that the quality of agricultural water used in leafy green operations is known (i.e., the required parameters are measured and conform to the prescribed standards) and adequate for its intended use.
- It's prudent to evaluate and make a good faith effort to address the food safety hazards proximate to your agricultural water systems that may not be under your control.
- NEVER use water from any water system that has not been microbially characterized and assessed as
   described below.
- Prior to annual use of the water in agricultural operations perform a written agricultural water assessment, as
   described in Appendix A, prior to use of water in agricultural operations. An agricultural water system
   description shall be prepared. The water assessment must identify conditions that are reasonably likely to
   introduce known or reasonably foreseeable hazards into or onto the leafy greens. The assessment must address
   the following elements:
- 25 • This A description (including the location and nature) of the agricultural water source and the type of 26 distribution system shall be created. Information in the description shall include permanent fixtures 27 such as wells, gates, reservoirs, valves, returns and other permanent above ground fixtures and could 28 also include non-permanent features such as tanks, drip stations, gas power pumps, pipes, water 29 treatment systems, etc. that make up a complete irrigation system. This could be achieved by using 30 maps, photographs, drawings or other means to communicate the location of permanent fixtures and the flow of the water system (including any water captured for re-use or other natural or managed 31 32 features which prevent environmental runoff from entering the water system).
  - OWater sources and the production blocks they may serve should be documented.
  - The degree of protection from possible sources of contamination, including by other water users; animal impacts; and adjacent and nearby land uses related to animal activity (for example, grazing or commercial animal feeding operations of any size), application of biological soil amendment(s) of animal origin, or presence of untreated or improperly treated human waste.
    - Documented agricultural water practices for each agricultural water system, including the application methods as described in Table 1, water sources and the production blocks they may serve.
- Manage and maintain all components of your agricultural water system that are within your control including
   the water source and the on-ranch (farm) distribution /conveyance system(s) must be managed and
   maintained in a manner that minimizes human pathogen contamination.
- Testing water at the end of the delivery system (e.g., the last sprinkler head) or the point-of-use is essential for
   ensuring water that contacts the crop is of adequate microbial quality.

- For surface water sources, consider the impact of storm events on irrigation practices. Bacterial loads in surface
   water are generally much higher after a storm than normal, and caution shall be exercised when using these
   waters for irrigation.
- Water systems that convey untreated human or animal waste are never suitable for use in leafy greens
   operations in any manner and must be separated from conveyances utilized to deliver agricultural water.
- Water records must be reviewed, dated, and signed, within a week after the records are made, by a
   supervisor or responsible party.

### 52 Hazard Analysis – Step 1: Assessment of Agricultural Water Systems

Evaluating food safety hazards from agricultural water applications in leafy green operations must take into account
the quality of the agricultural water system, how the agricultural water will be applied, and when it will be applied.
Prior to using water in any leafy green operation, conduct an agricultural water system assessment (including source,
storage, and conveyance as described in Appendix A) and determine the agricultural water system type.

- 57 There are two types of agricultural water systems used in leafy green operations:
- Type A: Agricultural water that is unlikely to contain indicators of fecal contamination either due to natural
   hydrogeologic filtration or through controlled USEPA and state regulated treatment regime as demonstrated
   by an agricultural water system assessment as outlined in Appendix A, microbial testing, and when applicable,
   treatment verification.
- **Type B:** All other agricultural water systems.

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- 63 1) Source: Evaluate each agricultural water source used in your leafy green operations and determine its
   64 type.
  - a) Some agricultural water sources are supplied by a third-party provider that certifies the water is of adequate microbial quality (i.e., unlikely to contain indicators of fecal contamination). Example of these sources are:
    - Public (e.g., municipal) or private providers that deliver certified potable water achieved through treatment or some other process
    - b) Some agricultural water sources deliver water of appropriate microbial quality due to natural physical, chemical, and biological processes that filter water as it passes through the soil. Examples of these sources for Type A agricultural water systems are:
      - Wells constructed in a manner such that contamination from outside sources (e.g., surface water or other surface chemical or biological influences / effects) is unlikely (e.g., well heads are protected, maintained, and monitored; see Appendix A for additional guidance), and water is tested to conform to standards.
  - Regulated recycled water (e.g., tertiary treated, purple pipe, etc.) providers that treat, test, and deliver water that is suitable for use in agricultural applications.<sup>1</sup>
- 79 c) Some agricultural water sources are part of a Type A system due to on-ranch treatment that, when

<sup>&</sup>lt;sup>1</sup> State regulations vary for recycled water. In some states recycled water for produce production allows a certain level of generic *E. coli*, total coliforms, and/or fecal coliforms.

80 81		operating under validated and verifiable parameters, turns Type B water into Type A. An example of a water source used in a Type B $\rightarrow$ A agricultural water system is:
82		Treated surface water (verified to conform to standards)
83 84 85 86	d)	Some agricultural water sources are considered part of a Type B system because they are vulnerable to contamination and have not been treated to achieve adequate microbial reduction and shall be used in a manner that minimizes contamination of the crop. Examples of water sources in a Type B agriculture water system are:
87 88		• Wells that may be vulnerable to contamination by outside sources including surface waters or by other surface chemical or biological influences / effects)
89		Untreated surface water
90 91 92 93 94 95 96	2) Storag An agri change proper mainte Agricul are det	e and conveyance: Agricultural water source is only one component of an agricultural water system. culture water system that starts out with water of appropriate microbial quality at the source may e quality as it progresses through the delivery system. Microbial water quality depends on the ties of the agricultural water system's components and how they are maintained (for more on system nance, see the section below on Best Practice for Managing Storage and Conveyance Systems). tural water systems are typically opened or closed. For the purposes of this document, these systems fined as follows:
97 98 99 100 101		• <u>Closed delivery systems</u> store or convey agricultural water in a manner that does not expose it to the outside environment and where water maintains the initial source type. Water from closed delivery systems must be tested at the end of the system to verify water quality is unchanged as it moves through the system. Additional details about testing requirements for a closed delivery system are provided in Tables 2B and 2C, and guidance is provided in Appendix A.
102 103 104 105 106 107 108		• <u>Open delivery systems</u> , at some point in the system, store or convey agricultural water in a manner that exposes it to the outside environment (i.e., a reservoir / pond, canal, lateral, uncovered water tank, etc.). Water in open delivery systems (e.g., reservoirs and ponds) may be used in overhead applications within 21 days to the scheduled harvest if it is treated (as described in Table 2D) at the time it is applied to crops. Additional details about testing requirements for an open delivery system are provided in Table 2F pertaining to Type B agricultural water systems, and guidance is provided in Appendix A.
109 110 111 112	3) System agricul confor depend	a: Each component of an agricultural water system must be evaluated to ensure that the quality of tural water used in leafy green operations is known (i.e., the required parameters are measured and m to the prescribed standards) and adequate for its intended use. Agricultural water use will vary ding on the type of system.
113 114		<ul> <li>When determining whether a system is Type A or B, each component (source, storage, conveyance, etc.) must be individually evaluated in typing an entire system.</li> </ul>
115		• When Type A and B waters are combined, categorize water as Type B.
116	Hazard Ana	ysis – Step 2: How Is Your Agricultural Water System Being Used?
117 118 119	Use/Applica production a agricultural v	tion method: Risk of leafy green contamination is closely related to how water is used in the nd harvest environment as well as in post-harvest applications (Rock et al., 2019). For this reason, vater requirements vary depending on how it is applied. In leafy green operations, agricultural water is 4

- typically used in aerial (e.g., sprayers, overhead sprinklers, aircraft), ground (e.g., furrow and drip irrigation), and
- 121 post-harvest applications. Agricultural water is also used for cleaning and, when appropriate, sanitizing equipment
- used during production, harvest, and post-harvest activities. Type A, Type B water that is treated to become Type A
- 123 (B $\rightarrow$ A), and Type B agricultural water systems are suitable for specific uses as described in Table 1.
- 124
- 125 Timing of use: Risk of leafy green contamination is closely related to when agricultural water is applied in the 126 production environment. For this reason, requirements for agriculture water that is aerially applied to leafy green 127 crops vary depending on when the water is applied (Fonseca et al., 2010; Gutierrez-Rodriquez et al., 2012, 2019; 128 Koike et al., 2009; 2010; Moyne et al., 2011; Suslow et al., 2010; Wood et al., 2010).
- A number of environmental factors, including location of the operation, and the climatic conditions of UV, relative humidity, precipitation, and temperature, may alter the appropriateness of these time-based requirements. Based on the most appropriate, currently available research addressing the risks related to the timing of aerial agricultural water application in leafy green operations, time-based requirements are generally divided as follows:
- Within (<) 21 days of the scheduled harvest date
- Greater than (>) 21 days until the scheduled harvest date
- Agricultural water from a Type A agricultural water system used in overhead irrigation within (<)21 days of</li>
   the scheduled harvest must meet the performance requirements for Type A agricultural water systems as
   outlined in Tables 2B and 2C.
- Untreated agricultural water that meets Type A requirements for irrigation water or Type B system that
   meets the performance requirements outlined in Table 2E may be used in aerial applications prior (>) 21 days
   before the scheduled harvest.
- To use agricultural water from a Type B agricultural water system in overhead irrigation within (<)21 days of</li>
   the scheduled harvest date, the water must be treated to become Type A water (B→A) and demonstrated to
   meet the performance requirements as outlined in Table 2D.

 TABLE 1. Agricultural Water System Uses by Application Method – See TABLE 2A—2G

Application	Agricultural water systems (possible sources)	Treatment methods for use in direct contact with crop	Microbial indicator
<ul> <li>Overhead irrigation and chemical application priorto (&gt;) 21 days before scheduled harvest date</li> <li>Germination</li> <li>Ground chemigation</li> <li>Drip irrigation</li> <li>Furrow irrigation</li> <li>Dust abatement</li> <li>Non-food-contact farm equipment cleaning</li> </ul>	Type A and B agricultural water systems	No treatment necessary if it can be demonstrated t o meet the microbial standards.	generic <i>E. coli</i>
<ul> <li>Overhead applications (including irrigation, pesticide spray, aerial chemigation) applied within (&lt;) 21 days of scheduled harvest date</li> </ul>	Type A agricultural water systems (closed systems including water from wells, municipalities, tertiary treated and disinfected recycled water e.g., purple valve)	No treatment necessary if it can be demonstrated to meet the microbial standards.	generic <i>E. coli</i>
	Treated Type B→A agricultural water systems with open components such as reservoirs, ponds, canals, laterals, ditches, etc.	Must be treated and tested to demonstrate treatment efficacy and compliance with microbial standards.	generic <i>E. coli</i> and total coliforms
Application			
<ul> <li>Food-contact (harvest) equipment cleaning &amp; sanitizing</li> <li>Hand wash water</li> </ul>	<ul> <li>Water that directly contacts of food-contact surfaces such as Maximum Contaminant Leve contain an approved antimic prevent cross-contamination performed, as appropriate to acceptance criteria have bee</li> </ul>	edible portions of harvested s equipment or utensils, mus I Goal for <i>E. coli</i> as specified robial treatment at a concen . Microbial or physical/chem o the specific operation, to de n met.	crop or is used on at meet the by U.S. EPA or tration sufficientto ical testing shall be emonstrate that

150	Irrigation Water Sampling Plans and Remedial Actions
151 152 153 154	Testing agricultural water systems is one method of gathering evidence that your system is of adequate quality for its intended use. Along with visual monitoring of agricultural water systems, a water quality testing program is a vital best practice for protecting leafy green crops from contamination. To be most effective as a food safety tool, water samples must reflect, to the extent possible, the water at the point of use.
155	<ul> <li>As irrigation system equipment may change locations throughout the season, but water sources are</li></ul>
156	generally at a fixed location, a robust overhead irrigation water quality testing program must include
157	assessments of both the irrigation water source and the irrigation system. Assessing water quality at the
158	end of the delivery system ensures source water quality does not degrade as it moves through the system.
159	<ul> <li>For the purposes of this document, sampling of agricultural water systems occurs for the following three</li></ul>
160	reasons and Tables 2B-2C follow this framework providing specific details for each assessment's
161	requirements:
162 163	<ul> <li>Baseline microbial assessments: To "type" your agriculture water <u>source</u> and establish its "known" quality.</li> </ul>
164	<ul> <li>Initial microbial water quality assessment: To test your agricultural water <u>system</u> prior to use to</li></ul>
165	ensure water is not degraded as it moves through the system.
166	<ul> <li>Routine system assessments: To monitor the microbial quality of your agricultural water system</li></ul>
167	throughout the season to ensure it continues to meet the microbial water quality standards.
168	<ul> <li>If you are applying water from a Type A agricultural water system greater than (&gt;) 21 days</li></ul>
169	to the scheduled harvest date, you may choose to sample and test your water according to
170	Type B criteria rather than according to Type A criteria; however, Type A baseline (when
171	required) and initial microbial water quality assessments must be conducted before the 21
172	days-before-harvest window closes and routine verification / monitoring begins (per
173	requirements outlined in Tables 2B and 2C).
174	<ul> <li>Routine sampling is a part of building a dataset useful for evaluating individual data points</li></ul>
175	and evaluating trends to gain a better understanding of your agricultural water system.
176	<ul> <li>Non-routine sampling when food safety risks are deemed higher due to specific</li></ul>
177	circumstances (i.e., weather, animal and human activities, discharge, etc.) should also be
178	part of a robust food safety program. In the event that additional risk factors that could
179	affect water quality are observed or measured such as weather, manure application in a
180	nearby field, or animal-related activity, consider conducting additional water testing.
181	<ul> <li>If you are irrigating with Type B→A agricultural water systems, collecting and analyzing</li></ul>
182	water system data is essential for understanding how the treatment functions in your
183	irrigation system and can optimize its effectiveness.
184 185	<ul> <li>All agricultural water systems used in overhead irrigation prior to (&gt;) 21 days before the scheduled harvest date must meet the water quality requirements outlined in Table 2E for Type B agricultural water systems.</li> </ul>
186	<ul> <li>If a Type A or B agricultural water system fails the respective acceptance criteria, follow remedial action</li></ul>
187	steps as outlined in Table 2F (also included in Figures 2B, 3A and 3C). Consider performing root cause
188	analysis to determine if additional preventive measures can be incorporated into the agricultural water

system operation.

Retain documentation of all test results and/or Certificates of Analysis/Quality Assurance for a period of at least two (2) years.

192	Best Pra	ctice for Managing Storage and Conveyance Systems
193 194	Develo each a	op a SOP for the maintenance of ancillary equipment and water storage and conveyance components of gricultural water system used in your operations. The SOP must address:
195 196 197	0	Regularly scheduled visual inspections, including ancillary equipment connected to your storage and conveyance system, to ensure it is in good working order and does not pose a contamination risk to your system.
198 199	0	Measures to maintain water quality by removing debris and controlling the presence of weeds, algae, tule, trash, and when appropriate, sediment within the grower's control.
200 201	0	Procedures to control pest access to the storage and conveyance systems (examples may include: avian deterrents, fencing, and rodent monitoring).
202 203	0	Corrective actions to ensure irrigation pipes and drip tape are microbiologically safe to use if a pest infestation does occur.
204 205	0	Berms, slopes and diversion ditches for prevention of run-off (i.e., from irrigation or rain) into water storage and conveyance systems.
206	0	Procedures to ensure standing and/or stagnant water does not pose a contamination risk.
207 208	0	Management of agricultural water system components used to prepare crop amendments to ensure these activities and equipment are not a contamination source.
209 210	0	Water used in aerial applications (e.g., pesticide and fertilizer, etc.) within the 21-days-to-harvest window must be from Type A or $B \rightarrow A$ agricultural water systems. Implement practices to ensure:
211 212		<ul> <li>Holding tanks and equipment-mounted application tanks, manifold and boom lines, and nozzles are to be properly maintained and cleaned.</li> </ul>
213 214		<ul> <li>Water treatment chemistry or approach is compatible with the agricultural chemicals being applied.</li> </ul>
215	0	Establish corrective action procedures for non-compliance scenarios, including:
216		<ul> <li>Contaminated source water</li> </ul>
217		<ul> <li>Animal intrusion</li> </ul>
218		<ul> <li>Contaminating run-off</li> </ul>
219		<ul> <li>Uncontrolled flooding [reference page, line and table]</li> </ul>
220	• Docum	nent all corrective measures, cleaning activities, and maintenance.
221	Best Pract	ice for Furrow Irrigation Systems Management
222 223	<ul> <li>Agricu manne</li> </ul>	Itural practices, such as irrigation methods, bed configuration, etc., should be implemented in a er to avoid water from breaching the top of the bed.
224 225	<ul> <li>Agricu headla</li> </ul>	ltural practices, such as equipment movement, irrigation practices, etc., should be monitored at and and tail ditch locations for damaged beds which may allow water to contact the edible portion

226 of the crop.

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Coordinate irrigation events with harvest, to the degree possible, to avoid saturation of the field soil to prevent excessive dirt and mud from getting on the edible portion of the crop, harvest tools (e.g., knives, gloves, etc.), and harvest equipment (e.g., machines, belts, trailers, etc.).

#### 230 Best Practice for Drip Tape Irrigation Systems Management

- Drip tape should be handled, stored, used, and re-used in a manner that prevents damage and contamination to the drip tape.
- While in use, repairs to drip tape should be completed in a timely manner to prevent water contact with
   the edible portion of the crop.

#### <sup>235</sup> Best Practice for Managing Irrigation Water Treatment Systems

- The minimum best practices for managing irrigation water treatment are outlined below and must be
   completed. For greater detail refer to Appendix A.
- Prior to 21 days-to-scheduled harvest conduct an initial irrigation water treatment assessment to establish treatment process parameters that will be monitored to ensure consistent treatment delivery and to demonstrate its effectiveness as described in Appendix A.
  - Repeat this assessment if a material change (e.g., change in equipment or type of water treatment) to your system occurs.
- Before using treated water to irrigate crops within the ≤ 21 days-to-scheduled harvest timeframe growers
   must first establish SOP's outlining irrigation treatment and process parameters for all irrigation treatment
   systems unless duplicated systems are in use.
- Confirm that water microbial quality is not being degraded as it passes through each of your water treatment systems (i.e., due to equipment conditions) by performing a microbial water quality assessment during an irrigation event before entering the ≤ 21 days-to-scheduled harvest timeframe.
- Collect three (3)-100 mL samples from 3 different sprinkler heads with at least one sample from the
   farthest/last sprinkler head. Acceptance Criteria and Data Monitoring Criteria as outlined in Table 2D Routine Monitoring of Microbial Water Quality must be met.

# Best Practice Water Used for Overheard Chemical Applications within 21 Days of Scheduled Harvest (This section does NOT apply to chemical applications made through the distribution system i.e., sprinkler)

Type B water used for overhead applications within 21 days of scheduled harvest must be treated. With the start-up of any new treatment process it is important to evaluate all conditions that may affect water treatment efficacy and performance. Examples of parameters that provide valuable information about treatment efficacy in relationship to water quality are: Turbidity, pH, antimicrobial dose, historical microbial monitoring data, etc. (See Appendix A for additional guidance).

- Develop a SOP for all of the parts of the ag water system used in overhead chemical application. The SOP
   must address:
- Water used in overhead applications (e.g., pesticide and fertilizer, etc.) within the 21-days-to-harvest
   window must meet Type A and/or B→A water quality requirements.

263 264 265	0	Holding tanks and equipment-mounted application tanks, manifold and boom lines, and nozzles MUST be regularly inspected and properly maintained and cleaned so they do not pose a contamination risk.
266 267	0	Water treatment chemistry or approach shall be compatible with the agricultural chemicals being applied.
268 269 270	0	Procedures to control pest access to the equipment during storage and staging (examples may include avian deterrents, fencing, and rodent monitoring) must be in place (validation can include: Pest control applicator (PCA) records, label requirements, letter of guarantee).
271	0	Establish corrective action procedures for non-compliance scenarios including:
272		<ul> <li>treatment failure</li> </ul>
273		<ul> <li>contaminated source water</li> </ul>
274		pest concerns
275		<ul> <li>chemical incompatibility</li> </ul>
276		<ul> <li>equipment sanitation concerns.</li> </ul>
277	0	Document all corrective measures, cleaning activities, and maintenance.
278 279 280 281 282 283	<ul> <li>Develor applic initial ensure mater treatm</li> </ul>	op a SOP for each unique application process to treat water that will be used in an overhead ation within 21 days of a scheduled harvest. Prior to the 21-days-to-scheduled-harvest conduct an water treatment assessment to establish treatment process parameters that will be monitored to a consistent treatment delivery and to demonstrate effectiveness. Repeat this assessment if a rial change to your system occurs and incorporate this assessment's findings into your water ment SOP. The SOP must address:
284	0	Step-by-step instructions to ensure the water treatment is correctly implemented.
285	0	Location of water sources
286	0	Name and suggested supplies needed.
287	0	Sanitizer used and quantity used.
288	0	Critical limits and operational limits
289	0	Water sampling location
290	0	Corrective actions if critical limits are not met.
291	0	Required records
292	Devel	op a baseline for water treatment:
293 294 295 296	0	Prior to the 21 days-to-scheduled harvest, a minimum of three (3)-100 mL samples must be taken for each overhead application process (distinct water quality source, different sanitizer, different size water holding tank, etc.). The three (3) samples must be taken from different treated water batches.
297	0	All three (3) samples must be non-detect for generic <i>E. coli.</i>
298	• Routir	ne testing:
299 300	0	A minimum of one (1) microbiological sample must be taken each month from a representative agricultural water system or at the next application event.
301	0	This 100 mL sample should have no detectable generic <i>E. coli</i> .

302	Corrective action:
303	<ul> <li>If microbiological testing shows that the water did not meet generic <i>E. coli</i> acceptance criteria</li></ul>
304	within 21 days of a scheduled harvest, perform a root cause analysis and correct the concern.
305	Notify the grower/producer.
306	<ul> <li>The product must be tested for pathogens before harvest if this water was used in overhead</li></ul>
307	application. Follow the product testing requirements outlined in Table 2F.
308	Ongoing monitoring:
309	<ul> <li>Between microbiological routine testing events, records must be kept that verify that each</li></ul>
310	application event is conducted following the parameters established during the initial setup.
311	<ul> <li>If monitoring shows that the water treatment parameters are not being met, do not use the</li></ul>
312	water.
313 314	<ul> <li>Perform a corrective action to assure the water treatment is effective before using the water.</li> </ul>
315	<ul> <li>Take a microbiological sample to verify that the treatment was effective and have that</li></ul>
316	result as part of the corrective action documentation.
317	<ul> <li>If the verification microbiological sample does not meet acceptance criteria, perform a root</li></ul>
318	cause analysis and correct the treatment process. Product must be tested for pathogens
319	before harvesting. Follow Table 2F for product testing requirements.
320	<ul> <li>Maintain records that demonstrate the water used for chemical applications meets Type A source water</li></ul>
321	requirements. See Tables 2B and 2C for historical and/or baseline water quality requirements for source
322	water that will be used for overhead applications.
323	Other Considerations for Water
324 325	• Treat water only with antimicrobial treatments approved by the USEPA for use in agricultural applications in accordance with label specifications, guidelines for use, and consideration of environmental impacts.
326	<ul> <li>Antimicrobial treatments must be used and managed in a manner that meets all federal, state, and local</li></ul>
327	regulations.
328	<ul> <li>Do not store raw manure or any type of compost near irrigation water sources or conveyance systems (see</li></ul>
329	Table 0).
330	Best Practice for Irrigation Water from Type B Agricultural Water
331	The following table (2A) outlines the metrics for agricultural water conveyance systems whereby edible portions of the

crop are not likely to be contacted (e.g., germination, ground chemigation, furrow, drip irrigation, dust abatement 332 333 water); if water is used in the vicinity of produce, then testing is necessary. For any of these uses, the agricultural water 334 system must be assessed and monitored to demonstrate that the water meets the microbial standards for water that 335 is likely to contain indicators of fecal contamination. Routine monitoring of microbial quality is required for all water 336 types and remedial actions are required if water testing shows a conveyance system has failed to deliver water that meets the microbial standard. Efforts should always be made, when using Type B water, to avoid contact with the 337 338 edible portion of the crop within 21 days of a scheduled harvest. When performing remedial actions, it is the intent 339 that all remedial steps outlined in the tables below are followed and that they are followed in the order of sequence 340 as written.

#### 341TABLE 2A. Irrigation Water from Type B Agricultural Water – See FIGURE 1

Metric	Rationale /Remedial Actions	
<ul> <li>Examples of water from Type B agricultural water systems:</li> <li>Ground chemigation</li> <li>Drip irrigation</li> <li>Furrow irrigation</li> <li>Dust abatement</li> </ul>	Water for Type B use throughout the production of the crop shall meet or exceed microbial standards based on a rolling geometric mean of the five most recent samples. However, a rolling geometric mean of five samples is not necessarily required prior to irrigation or harvest. If less than five samples are collected prior to irrigation, the acceptance criteria depend on the number of samples taken. If only one sample has been taken, it must be below 126 MPN/100 mL. Once two samples are taken, a geometric mean can be calculated, and the normal acceptance criteria apply. If the acceptance criteria are exceeded during this time-period, additional samples may be collected to reach a 5-sample rolling geometric mean (as long as the water has not been used for irrigation). The rolling geometric mean calculation starts after 5 samples have been collected. If the water source has not been tested in the past 60 days, the first water sample shall be tested prior to use, to avoid using a contaminated water source. After the first sample is shown to be within acceptance criteria, subsequent samples shall be collected no less frequently than monthly (or at the next irrigation event if longer than monthly) at points of use within the distribution system. Ideally, irrigation water should not contain generic <i>E. coli</i> , but low levels do not necessarily indicate that the water is unsafe. Investigation and/or remedial action SHOULD be taken when test results are higher than normal	
	or indicate an upward trend. Investigation and remedial action SHALL be taken when acceptance criteria are exceeded.	
Target Organisms: Generic E. coli		
Sampling Procedure: 100 mL sample collected aseptically as close as practical to the point of use. Sampling Frequency: One sample per agricultural water source shall be collected and tested prior to use if >60 days since last test of the water source. Additional samples shall be collected no less than 18 hours apart and at least monthly (or at the next irrigation event ifgreater than monthly) during use from points within the delivery system.	<ul> <li>If the rolling geometric mean (n=5) or any one sample exceeds the acceptance criteria, then the water shall not be used until remedial actions have been completed and generic <i>E. coli</i> levels are within acceptancecriteria:</li> <li>Conduct an agricultural water assessment (Appendix A) of water source and conveyance system to determine if a contamination source is evident and can be eliminated. Eliminate identified contamination sources.</li> <li>Retest the agricultural water after taking remedial actions to determine if it meets the outlined microbial water quality acceptance criteria for this use. This sample should represent the conditions of the original water system, if feasible this test should be as close as practical to the original sampling point. A more aggressive sampling program (i.e., sampling once per week instead of once per month) shall be instituted if an explanation for the exceedance is not readily apparent. This type of sampling program should also be instituted if an upward trend is noted in normal sampling results.</li> <li>If follow-up agricultural water testing indicates that a crop has been directly contacted with water exceeding accentance criteria product</li> </ul>	

Metric	Rationale /Remedial Actions
Acceptance Criteria: ≤ 126 MPN/100 mL (rolling geometric mean n=5) and ≤ 576 MPN/100 mL for any single sample	shall be sampled and tested for STEC (including <i>E. coli</i> O157:H7) and <i>Salmonella</i> as described in Appendix C, prior to harvest. If crop testing indicates the presence of either pathogen, the crop shall NOT be harvested for the fresh market.
Test Method: Any FDA-allowed method <sup>2</sup>	
<b>Records:</b> Each water sample and analysis shall record the type of water source, date, time, and location of the	

sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the producer/shipper who is the responsible party for a period of two years.

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<sup>&</sup>lt;sup>2</sup> Equivalent testing methodology for agricultural water https://www.fda.gov/food/foodscienceresearch/laboratorymethods/ucm575251.htm

#### 344 FIGURE 1. Irrigation Water from Type B Agricultural Water – See TABLE 2A

#### For any given water source (municipal, well, reclaimed water, reservoir or other surface water):

**Sampling Frequency: For Type B water,** one sample per water source shall be collected and tested prior to use if >60 days since last test of the water source. Additional samples shall be collected during use no less than 18 hours apart andat least monthly (or at the next irrigation event if greater than monthly) during use.

- Sample sources as close to the point-of-use as practical using sampling methods as prescribed in Table 2A.
- Analyze samples for generic *E. coli* using a MPN methodology. Other EPA-, FDA- or AOAC International accredited method may be used.
- Geometric means, including rolling geometric means shall be calculated using the five most recent samples.

#### **ACCEPTANCE CRITERIA**

345

≤ 126 MPN/100ml (Geometric mean of 5 samples) <u>AND</u>

<576 MPN/100ml (all single samples)</p>

No further action necessary. Water maybe used in leafy green operations as outlinedin Table 2A.

#### ACTION LEVEL

>126 MPN/100ml (geometric mean over five samples)

OR

>576 MPN/100ml (any single sample)

#### **REMEDIAL ACTIONS:**

- Discontinue any agricultural production use until it returns to compliance.
- Examine the water source and distribution system to determine if a contaminationsource is evident and can be eliminated.
- After remedial actions have been taken, retest the water at the same sampling point.
- Continue testing daily for five days at the point closest to use.
- If any of the next five samples is >576 MPN/100mL, repeat sanitary survey and/orremedial action.
- Do not use this water system until the water can meet the outlined acceptance criteriafor this use.

#### **CROP TESTING:**

- If water exceeding the acceptance criteria has been used for crop production, sample and test product for STEC (including *E. coli* O157:H7) and *Salmonella* as described in Appendix C, prior to harvest.
- If crop testing indicates the presence of either pathogen, do NOT harvest for human consumption.

#### <sup>346</sup> Best Practice for Irrigation Water from Type A Agricultural Water

The following tables (2B - 2F) refer to agricultural water distribution systems and not to specific ranches, lots, fields, 347 348 etc. The tables outline the metrics for overhead applications of agricultural water sourced from public/private supplies 349 (2B), regulated recycled water and private wells (2C), treated water supplies (2D), and untreated water that is likely to 350 contain indicators of fecal contamination (2E). Each type of agricultural water system must be assessed to demonstrate 351 that the water from the source and the distribution system meet the microbial standards. Treated water must be 352 assessed and monitored to demonstrate that the water treatment is working as intended and that the treated water 353 meets the microbial standard. Routine monitoring of microbial quality is required for all water system types, and remedial actions are required if water testing shows a system has failed to deliver water that meets the microbial 354 355 standard. When performing remedial actions, it is the intent that all remedial steps outlined in the tables below are 356 followed and that they are followed in the order of sequence as written.

#### 358 TABLE 2B. Irrigation Water from Type A Agricultural Water Systems Sourced from Public or Private Providers –

#### 359 See FIGURE 2A-2B

Metric	Rationale /Remedial Actions
Examples of these types of Type A	Irrigation water from Type A agricultural water systems sourced from
agricultural water systems: Water	regulated public or private providers would not be expected to contain
maycome from public and private	generic <i>E. coli</i> due to treatment or some other filtering-type process.
providersand are stored and	Water sourced from a public/private Type A agricultural water
conveyed in closed delivery	provider must be stored and conveyed in well-
systems.	maintained, closed systems and tested for generic <i>E. coli</i> .

#### **B1. Baseline Microbial Assessment**

A baseline microbial assessment of the water source is not necessary for a Type A system using source water from a public/private provider. In lieu of a baseline microbial assessment, acquire and maintain the supplier's most current COA on file.

**Records:** Records of the analysis of source water may be provided by municipalities, irrigation districts, or other water providers and must be available for verification from the grower/handler who is the responsible party for a period of two years

#### **B2. Initial Microbial Water Quality Assessment**

#### Target Organisms: Generic E. coli

Initial Assessme	ent Sampling
Procedure:	

Aseptically collect at least three (3)-100mL samples during one irrigation eventwith at least one sample at the end of the delivery system (e.g., last sprinkler head).

#### Initial Assessment Sampling Frequency:

This is a one-time seasonal sampling event for each system with samples collected during one irrigation event occurring before the 21-days-to-scheduled-harvest period begins. (Also conduct this assessment after any material modifications to Type A overhead irrigation systems.)

## Initial Assessment Acceptance Criterion:

Non-detectable in two (2) of three (3)-100 mL samples and 10 MPN as the single sample maximum for

The purpose of this assessment is to confirm that the water's microbial quality is not being degraded as it passes through your system (i.e., due to equipment conditions). The assessment is performed to verify that your irrigation water delivery system is able to maintain and deliver water of the same microbial quality (e.g., Type A) as the source water. Unless there is a material change to your system (e.g., change in equipment or type of watertreatment), this is a one-time assessment for each irrigation system, and it is not necessary to repeat system evaluations for each irrigation event.

To test your water delivery systems, sample and test irrigation water during an irrigation event. All discrete systems are to be tested before entering the 21-days-to-scheduled-harvest time frame. To assess the water delivery system, water samples are taken throughout the system with at least one sample at the endof the line where water contacts the crop.

#### Initial Assessment Testing

If at least two (2) in three (3) samples do not have detectable levels of generic *E. coli*, and the level in the one remaining sample is no greater than ( $\leq$ ) 10 MPN, then the water system maintains its Type A status.

If water samples do not meet the acceptance criteria (i.e., if two (2)or more of the samples have detectable levels of generic *E. coli* <u>or</u> the level in at least one sample is greater than (>) 10 MPN), then conduct the following follow-up testing:

Metric	Rationale /Remedial Actions	
one (1) sample.	Follow-up Testing	
Follow-up Testing Acceptance Criterion: Non-detectable in four (4) of five (5)-100 mL samples and 10 MPN as the single sample maximum for one (1) sample. Note: For the purposes of water testing, MPN and CFU are considered equivalent.	Prior to the next irrigation event perform a root cause analysisand an agricultural water system assessment as described in Appendix A to identify and correct the failure.	
	After assessing the system, retest the system for generic <i>E. coli</i> in five (5)-100 mL samples collected during the next irrigation event using the sampling procedure and frequency (described in the left column). Water samples can be pulled from the endof any system nodes/branches in the irrigation system of concern. Of the five (5) follow-up samples, four (4) must have no detectable generic <i>E. coli</i> and the one (1) remaining samplemust have levels no greater than ( $\leq$ ) 10 MPN generic <i>E. coli</i> / 100mL.	
		If test results meet the acceptance criterion for generic <i>E. coli</i> , the water system can be used as a Type A system.
	<u>Testing Failure</u> : When one sample has more than (>) 10 MPN generic <i>E.</i> <i>coli</i> / 100 mL or more than one sample have detectable generic <i>E. coli</i> , the agricultural water system is disqualified for TypeA usage. Perform a root cause analysis to identify and correct the failure (see Appendix A for mitigation measures). In the interim, the water can be used as a Type B agricultural water system.	
	Test Method: Any FDA-allowed metho	d <sup>2</sup>
<b>Records:</b> Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for a period of two years.		
B3. Routine Verification of Microbial Water Quality		
Routine Verification SamplingProcedure: Aseptically collect at least three (3)- 100mL samples during one irrigation eventwith at least one sample taken at the end of the delivery system (e.g., last sprinkler head).	To verify irrigation water continues to meet the acceptance criterion throughout the season, design your sampling plan so eachdistinct irrigation system that is in use is sampled and tested at least once	
	during the season. If two (2) or more of the samples have detectable levels of generic <i>E.</i> <i>coli</i> <u>or</u> the level in at least one sample is greater than (>) 10MPN, prior to the next irrigation event perform a <b>Level 1 Assessment</b> as outlined in <u>Table 2F</u> .	

#### Routine Verification SamplingFrequency:

Sample and test each distinct irrigationsystem for generic *E. coli* at least once during the season.

#### Routine Verification AcceptanceCriterion:

Non-detectable generic *E. coli* in 100

Metric	Rationale /Remedial Actions
mLwater samples and <u>&lt;</u> 10 MPN as the single sample maximum for one (1) in three (3) samples	
<b>Note</b> : For the purposes of water testing, MPN and CFU are considered equivalent.	
Test Method: Any FDA-allowed method <sup>2</sup>	
<b>Records:</b> Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for a	

period of two years.

#### 362 FIGURE 2A. Irrigation Water from Type A Agricultural Water Systems Sourced from Public / Private

#### **Providers – See TABLE 2B**



## FIGURE 2B. Irrigation Water from Type A Agricultural Water Systems Sourced from Public / Private Providers – See TABLE 2B

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#### **ROUTINE MONITORING of MICROBIAL WATER QUALITY**

- For Type A agricultural water from public/private sources for overhead applications when used within (<) 21 days of thescheduled harvest date. (When using Type A agricultural water from these sources for overhead applications up to (>) 21days of the scheduled harvest date follow water metrics in Table 2E/Figure 5 for Type B agricultural water systems.)
- Aseptically collect three (3) samples during one irrigation event with at least one sample taken at the end of the deliverysystem (e.g., last sprinkler head); each distinct irrigation system must be tested at least once during the season.
- Test for generic *E. coli* using a FDA-allowed method and assess microbial quality using the three (3) collected samples.

#### ACCEPTANCE CRITERIA

No detectable generic *E. coli* in at least 2 of 3 consecutive samples and < 10 MPN in one remaining sample

No further action necessary. Water may be used in leafy green operationsas outlined in Table 2B.

#### ACTION LEVEL

Generic E. coli detected in > 2 samples or one samplehas levels above (>) 10 MPN / 100 mL

#### CONDUCT A LEVEL 1 ASSESSMENT:

- If generic *E. coli* levels in your water exceed the acceptance criterion, prior to the next irrigation event conduct an agricultural water system assessment as described in Appendix A and retest water (as described in step #2 below) until it is shown to be back in compliance with the acceptance criterion.
- During the next irrigation event, collect 5 100 mL samples from the irrigation system and test for generic *E. coli*. Water can be pulled from the end of any system nodes/branches in the irrigation system of concern. If these water samples also fail to meet the acceptance criterion, discontinue use of this water for overhead applications while continuing to evaluate your water system to identify and correct any failures and continuing to testas described in this step until the water is back in compliance (see AppendixA for guidance on troubleshooting irrigation system failures).
- If this water (i.e., the water from the initial sampling to the last of the follow-up sampling) has been applied to leafy greens, either consider the crop unsuitable for the fresh market or test the crop from all affected lots (i.e., lots that have been irrigated with this water within the <21 days-to- scheduled-harvest window) for STEC (including *E. coli* O157:H7) and *Salmonella*. Product needs to be tested prior to harvesting and after your last irrigation event. Sample crop per the protocol described in Appendix C.If any individual sample tests positive for any of these human pathogens, the crop within that lot shall NOT be harvested for the fresh market and human consumption.

# TABLE 2C. Irrigation Water from Type A Agricultural Water Systems Sourced from Private Wells or Regulated Tertiary Treated Recycled Water Supplies – See FIGURE 3A-3C

Metric	Rationale /Remedial Actions
<ul> <li>Examples of water from Type A agricultural water systems:</li> <li>Regulated recycled wastewater</li> <li>Water sourced from a well – well water is conveyed to the field in a closed delivery system and applied to the crop via overhead sprinklers.</li> </ul>	Irrigation water from Type A agricultural water systems with well source water would not be expected to contain generic <i>E.</i> <i>coli</i> due to natural filtration as the water passes through the soil. Water from regulated tertiary treated recycled water supplies may have low levels of generic <i>E. coli</i> due to regulatory allowable limits. Type A agricultural water systems must be stored and conveyed in well-maintained, closed systems and tested for generic <i>E. coli</i> . Remedial actions vary depending on when the water is being used in relation to harvest.
C1. Baseline Microbial Assessment	
Target Organisms: Generic E. coli	
<ul> <li>Baseline Assessment Sampling Procedure: If historical water test data is not available, aseptically collect at least three (3)-100 mL sample at the source.</li> <li>Baseline Assessment Sampling Frequency: Sample and test the water two times (with sampling events separated by no less than 7 days) before using the water within the 21-days-to-scheduled-harvest-window.</li> <li>Baseline Assessment Acceptance Criteria: Non-detectable generic <i>E. coli</i> in five (5) of six (6) 100 mL samples and ≤ 10 MPN as the single sample maximum for one (1) sample.</li> </ul>	The purpose of a baseline assessment is to ensure your water source (e.g., a well or regulated tertiary treated recycled water) meets the microbial standards for generic <i>E. coli</i> . This baseline microbial assessment must be conducted before these Type A water sources can be used for overhead irrigation within 21-days to-scheduled-harvest. For agricultural water systems with multiple wells, each well must be tested prior to use in order to validate the integrity of the agricultural water system. <u>Self-certification with historical water test data:</u> If at least four (4) of the last five (5) consecutive historical water tests (80%) have no detectable generic <i>E. coli</i> , the remaining one (1) sample does not exceed ( $\leq$ ) 10 MPN in 100 mL, and one (1) of those tests was taken within the last 6 months, then the well/regulated tertiary treated recycled water supply is self- certified as a Type A agricultural water source.
<b>Note</b> : For the purposes of water testing, MPN and CFU are considered equivalent.	Self-certification process when no historical data is available: If historical data is unavailable, test each well or regulated recycled water twice (separated by no less than seven days) prior to use as the source water for a Type A agricultural water system. If at least five (5) of the six (6) total samples have no detectable generic <i>E. coli</i> and the remaining sample has $\leq$ 10 MPN in 100 mL, then the water/well is self-certified as a Type A agricultural water source. <u>Testing Failure</u> : If test results do not meet the acceptance criteria, then the water/well cannot be considered a Type A agricultural water source. Perform a root cause analysis and an agricultural water system assessment as described in Appendix A to identify and correct the failure. In the interim, the water can be treated or used as a source for a Type B agricultural water

Metric	Rationale /Remedial Actions			
	system.			
Test Method: Any FDA-allowed method <sup>2</sup>				
<b>Records:</b> Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for aperiod of two years.				
C2. Initial Microbial Water Quality Assessment				
Target Organism: Generic E. coli				
Initial Assessment Sampling Procedure: Aseptically collect at least three (3)-100 mL during one irrigation event at the end of thedelivery system (e.g., last sprinkler head).	The purpose of this assessment is to confirm that the water's microbial quality is not being degraded as it passes through your system (i.e., due to equipment conditions). The assessment is performed to verify that your irrigation water delivery system is able to maintain and deliver water of the			
Initial Assessment Sampling Frequency: This is a one-time seasonal sampling event for each system with samples collected during one irrigation event occurring beforethe 21-day-to-scheduled- harvest-period begins. (Also conduct this assessment after any material modifications to Type A overhead irrigation systems.)	same microbial quality (e.g., Type A) as the water source. Unless there is a material change to your system (e.g., changein equipment or type of water treatment), this is a one-time assessment for each irrigation system, and it is not necessary to repeat system evaluations for each irrigation event. To test your water delivery systems, sample and test irrigation water during an irrigation event. All discrete systems are to be tested before entering the 21-days-to-scheduled-harvest timeframe. To assess the water delivery system, water samples are taken at the end of the line where water contactsthe crop.			
Initial Assessment Acceptance Criteria: Non-detectable generic <i>E. coli</i> in two (2) ofthree (3)-100 mL samples and ≤ 10 MPN asthe single sample maximum for one (1) sample.	Initial Assessment Testing If at least two (2) in three (3) samples do not have detectable levels of generic <i>E. coli</i> , and the level in the one remaining sample is no greater than ( $\leq$ ) 10 MPN, then the water system maintains its Type A status.			
Follow-up Testing Acceptance Criteria: Non-detectable in four (4) of five (5)-100 mLsamples and $\leq$ 10 MPN as the single sample maximum for one (1) sample.	If water samples do not meet the acceptance criteria (i.e., iftwo (2) or more of the samples have detectable levels of generic <i>E. coli</i> <u>or</u> the level in at least one sample is greater than (>) 10 MPN), then conduct the following follow-up testing:			
<b>Note</b> : For the purposes of water testing, MPNand CFU are considered equivalent.	<ol> <li>Follow-up Testing         <ol> <li>Prior to the next irrigation event perform a root cause analysis and an agricultural water system assessment as described in Appendix A to identify and correct the failure.</li> <li>After assessing the system, retest the system for generic <i>E. coli</i> in five (5)-100 mL samples collected during the next irrigation event using the sampling procedure and frequency (described in the left column). Water samples can be pulled from the end of any system nodes/branches</li> </ol> </li> </ol>			
Metric	Rationale /Remedial Actions			
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	<ul> <li>in the irrigation system of concern. Of the five (5) follow-up samples, four (4) must have no detectable generic <i>E. coli</i> and the one (1) remaining sample must have levels no greater than (&lt;) 10 MPN / 100 mL.</li> <li>3) If test results meet the acceptance criterion for generic <i>E. coli</i>, the water system can be used as a Type A system.</li> <li><u>Testing Failure</u>: When one sample has more than (&gt;) 10 MPN / 100 mL or more than one sample have detectable generic <i>E. coli</i>, the agricultural water system is disqualified for Type A usage. Perform a root cause analysis to identify and correct the failure (see Appendix A for mitigation measures). In the interim, the water can be used as a Type B agricultural water system.</li> </ul>			
Test Method: Any FDA-allowed method <sup>2</sup>				
<b>Records:</b> Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for a period of two years.				
C3. Routine Verification of Microbial Water Quality				
Target Organisms: Generic E. coli				
Sampling Procedure Three (3)-100 mL samples aseptically collected at the end of the delivery system (e.g., the last sprinkler head).	To verify irrigation water continues to meet the acceptance criterion throughout the season, design your sampling plan so each distinct irrigation system that is in use is sampled and tested at least once during the season.			
Sampling Frequency Sample and test each distinct irrigation system for generic <i>E. coli</i> at least once during the season.	If two (2) or more of the samples have detectable levels of generic <i>E. coli</i> <u>or</u> the level in at least one sample is greater than (>) 10 MPN, prior to the next irrigation event perform a <b>Level 1</b> Assessment as outlined in Table 2F.			
Acceptance Criterion				
Non-detectable generic <i>E. coli</i> in 100 mL water samples and $\leq$ 10 MPN as the single sample maximum for one (1) in three (3) samples				
<b>Note</b> : For the purposes of water testing, MPN and CFU are considered equivalent.				
Test Method: Any FDA-allowed method <sup>2</sup>				
<b>Records:</b> Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for a period of two years.				

- 370 FIGURE 3A. Irrigation Water from Type A Agricultural Water Systems Sourced from Private Wells or
- 371 Regulated Tertiary Treated Recycled Water Supplies See TABLE 2C
- 372 **BASELINE MICROBIAL ASSESSMENT** Self-certification with historical water If historical data is unavailable: test data: To self-certify, take three (3)-100 mLsamples Assessment conducted using historical at the water source on two sampling occasions water test records consisting of 5 separated by  $\geq$  7 days. consecutive water test results - one of which occurred in the last 6 months. ACTION LEVEL Generic *E. coli* detected in > 2 samples **ACCEPTANCE CRITERIA** or one sample has levels above (>) 10 MPN /100 mL No detectable generic *E. coli* in all but one sample and no greater than 10 MPN in that one sample Water source cannot be considered part of a Type A agricultural water system. Water source is self-certified; no further action necessary until the initial microbial water quality assessment. **REMEDIAL ACTION** • Perform a root cause analysis and an agricultural water system assessment as described in Appendix A to identify and correct the failure. • In the interim, the water can be treated or used as a source for a Type B agricultural water system. If you choose to treat the water, follow Type  $B \rightarrow A$  water system requirements. • See Appendix A for guidance on mitigation measures such as shock treatment for

contaminated wells.

# 373 FIGURE 3B. Irrigation Water from Type A Agricultural Water Systems Sourced from Private Wells or

- 374 Regulated Tertiary Treated Recycled Water Supplies See TABLE 2C
- 375



# 376 FIGURE 3C. Irrigation Water from Type A Agricultural Water Systems Sourced from Private Wells or

- 377 Regulated Tertiary Treated Recycled Water Supplies See TABLE 2C
- 378

### **ROUTINE MONITORING of MICROBIAL WATER QUALITY**

- For Type A agricultural water from regulated recycle water / private well sources for overhead applications when used within (≤) 21 days of the scheduled harvest date. (When using Type A agricultural water from these sources for overhead applications up to (>) 21 days of the scheduled harvest date follow water metrics in Table 2E/Figure 5 for Type B agricultural water systems.)
- Collect three (3) samples at the end of the delivery system (e.g., last sprinkler head); test each distinctirrigation system in use at least once during the season.
- Test for generic *E. coli* using a FDA-allowed method.
- Assess microbial quality using the three (3) collected samples.

#### **ACCEPTANCE CRITERIA**

No detectable generic *E. coli* in at least 2 of 3 consecutive samples and  $\leq$  10 MPN in one remaining sample

No further action necessary. Water may be used in leafy green operationsas outlined in Table 2C.

#### ACTION LEVEL

Generic *E. coli* detected in  $\ge 2$ samples or one samplehas levels above (>) 10 MPN / 100 mL

#### CONDUCT A LEVEL 1 ASSESSMENT:

- If generic *E. coli* levels in your water exceed the acceptance criterion, prior to the next irrigation event, conduct an agricultural water systemassessment as described in Appendix A.
- Retest the water for generic *E. coli* during the next irrigation event in five (5) 100 mL samples. Water can
  be pulled from the end of any system nodes/branches in the irrigation system of concern. If these water
  samples also fail to meet the acceptance criterion, discontinue use of this water for overhead applications
  while continuing to evaluate your water system to identify and correct any failures and continuing to test
  as described in this step until the water is back in compliance (see Appendix A for guidance on
  troubleshooting irrigationsystem failures).
- If this water (the water from the initial sampling to the last of the follow-up sampling) has been applied to leafy greens, either consider the crop unsuitable for the fresh market or test the crop from all affected lots (i.e., lots that have been irrigated with this water within the <21 days-to-scheduled-harvest window) for STEC (including *E. coli*O157:H7) and *Salmonella*. Product needs to be tested prior to harvesting and after your last irrigation event. Sample crop per the protocol described in Appendix C. If any individual sample tests positive for any of these human pathogens, the crop within that lot shall NOT be harvested for the fresh market and human consumption.

# 379 **TABLE 2D:** Irrigation Water from Treated Type B → A Agricultural Water Systems – See FIGURE 4.

Metric	Rationale /Remedial Actions
Example of treated water from a Type B→A agricultural water system: Water may arrive at the production area in an irrigation district canal or lateral from which it is pumped and treated before being used in overhead sprinkler irrigation.	When water from a Type B agricultural water system is used in an overhead application within ( $\leq$ ) 21 days to thescheduled harvest date, it must be treated to move it from a Type B agricultural water system to a Type A system (B $\rightarrow$ A) by a scientifically valid antimicrobial watertreatment - i.e., contain an approved antimicrobial watertreatment at sufficient concentration to prevent potential contamination risk during overhead applications.
	Microbial and/or physical/chemical testing of the source and system must be performed, as appropriate to the specific operation, to demonstrate that performance criteria have been met before use within ( $\leq$ ) 21 days to the scheduled harvest date and continues to be met throughout its use.
	Water in open delivery systems (e.g., reservoirs and ponds) may be used in overhead applications within 21 days to the scheduled harvest if it is treated at the sametime it is applied to crops.

#### D1. Routine Verification of Microbial Water Quality

#### **Target Organisms:**

- Total coliforms (TC)
- Generic E. coli

#### Routine Verification Sampling Procedure:

Aseptically collect at least three (3)-100 mL samples during one irrigation event with at least one sample at the end of the delivery system (e.g., last sprinkler head).

#### **Routine Verification Sampling Frequency:**

Sampling is conducted monthly.

If the irrigation treatment system is being used prior to the 21-days-to-harvest-window, sample and test each distinct irrigation treatment system on at least one occasion.

If the irrigation treatment system is being used within the 21-days-to-harvest-window, sample each distinct irrigation treatment system on at least two occasions separated by at least three (3) days. Routine water sampling is performed to verify irrigation water continues to meet the microbial quality acceptance criteria throughout the season. Routine verification of treated irrigation water systems is focusedon the function of the system. Sampling needs to occur at a frequency that allows operators to verify they have control of their treatment system. An essential component of this verification process is building a dataset so microbial quality can be analyzed to best inform you how to effectively run your water treatment system.

Sample and test the system for total coliforms and generic *E. coli* in three (3)-100 mL samples. To maintainits Type A status, water samples must have:

 no detectable generic *E. coli* in at least two (2) of thethree (3) samples with a maximum level no greater than (<) 10 MPN in the remaining sample, and

Metric	Rationale /Remedial Actions	
<ul> <li>Routine Verification Acceptance Criteria:</li> <li><u>Generic E. coli</u>: No detection in two (2) of the last three (3) water samples with a maximum level of (≤) 10 MPN allowed in one (1) sample [consecutive values]</li> <li>Routine Verification Data Monitoring Criteria:</li> <li><u>Total coliforms</u>: A maximum level of ≤ 99 MPN in 100 mL in all water samples or an adequate log reduction based on the untreated water's baseline total coliforms levels*</li> <li>Note: For the purposes of water testing, MPN and CFU are considered equivalent.</li> </ul>	<ul> <li>data monitoring for total coliforms at a level nogreater than (≤) 99 MPN in 100 mL *</li> <li>* As an alternative to the threshold approach for total coliforms (≤ 99 MPN / 100 mL), operators can verify their irrigation treatment system by conducting paired pre- and post-treatment microbial testing of water distribution system (see Appendix A for additional guidance on conducting a log reduction assessment).</li> <li>If two (2) or more of the three (3)-100 mL samples do not meet the acceptance criteria for generic <i>E. coli</i> and at least one sample is greater than (&gt;) 10 MPN and one (1) or more of the total coliforms results do not meet the monitoring criteria, prior to the next irrigation event perform a Level1 Assessment as outlined in Table 2F.</li> </ul>	
Test Method: Any FDA-allowed method <sup>2</sup>		
<b>Records</b> : Each water sample and analysis shall record the type of water source, date, time, and location of the		

sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for a period of two years.

#### D2. Routine Water Treatment Monitoring

Antimicrobial water treatments - USEPA-approved for use in agricultural water.

**Target variable:** Antimicrobial irrigation water treatment or manufacturer's operational specifications (e.g., per manufacturer's recommendations, chemical concentration, etc.).

can be shown to have a low degree of variation.
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Test Method: Per label instructions

#### Metric

#### **Rationale / Remedial Actions**

**Records**: During every irrigation event, treatment-related parameter values such as residual antimicrobial levels, pH, dose settings, UVT, etc. must be documented to demonstrate the system is working as intended. Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for a period of two years.

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#### 382 FIGURE 4. Irrigation Water from Type B→A (Treated) Agricultural Water Systems – See TABLE 2D

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#### **ROUTINE MONITORING of MICROBIAL WATER QUALITY**

- Collect three (3) 100 mL samples during one irrigation event with at least one sample taken at the end of the distribution irrigation system (e.g., last sprinkler head).
- Sample monthly during use and test for generic *E. coli* and total coliforms using a FDA-allowed method.
- If the irrigation system is being used up until 21 days to scheduled harvest, sample each distinct irrigation system on one occasion and follow microbial standards in Table 2E / Figure 5 for Type B agricultural water systems.
- If the irrigation system is being used within the 21-days-to-harvest-window, sample each distinct irrigation system on two occasions separated by at least three (3) days.

# ACTION LEVEL

Generic *E. coli* detected in  $\geq$  2 samples or level above (>) 10 MPN / 100 mL in a single sample

#### **ACCEPTANCE CRITERIA**

No detectable generic *E. coli* in at least 2 of 3 samples and  $\leq$  10 MPN in one sample

#### **DATA MONITORING CRITERIA**

<u>
 99 MPN in 100 mL or an</u>
 adequate log reduction based on
 the untreated water's baseline
 total coliform levels
 }

#### No further action necessary.

Water may be used in leafy green operations as outlined in Table 2D.

#### CONDUCT A LEVEL 1 ASSESSMENT:

When using Type  $B \rightarrow A$  agricultural water for overhead applications within (<) 21 days of the scheduled harvest date:

- If generic *E. coli* or total coliform levels in your water exceed the acceptance and/or monitoring criteria, pause irrigation and conduct an agricultural water system assessment as described in Appendix A to determine why the treatment was not effective.
- Retest the water for generic *E. coli* and total coliforms during the next irrigation event in five (5) - 100 mL samples. Water can be pulled from any point in the distribution systems in the irrigation treatment system of concern with at least one coming from the last sprinkler head. If these water samples also fail to meet the acceptance and/or monitoring criteria, discontinue use of this water for overhead applications while continuing to evaluate your water system to identify and correct any failures and continuing to test as described in this step until the water is back in compliance (see Appendix A for guidance on troubleshooting irrigation system failures).
- If this water (the water from the initial sampling applied to the crop within 21 days to harvest to the first and last of the follow-up sampling) with generic *E. coli* above the acceptance criteria has been applied to leafy greens, either consider the crop unsuitable for the fresh market or test the crop from all affected lots (i.e., lots that havebeen irrigated with this water within the <21 days-to-scheduled-harvest window) for STEC (including *E. coli* O157:H7) and *Salmonella*. Product needs to be tested prior to harvesting and after your last irrigation event. Sample crop per the protocol described in Appendix C. If any individual sample tests positive for any of these human pathogens, the crop within that lot shall NOT be harvested for the fresh market and human consumption.

# 385 TABLE 2E. Irrigation Water from Type B Agricultural Water Systems Intended for Overhead Irrigation

# 386 prior to 21 days – See FIGURE 5

Metric R	Rationale /Remedial Actions
Example of water from a Type BWagricultural water system - waterthmay arrive at the field in an irrigationqudistrict canal from which itis thenscused to overhead irrigate crop priorovto 21 days to the scheduled harvesthatdate.Altefc	Water from Type B agricultural water systems is untreated and exposed to the environment (e.g., open sources and/or delivery systems) so that its quality may be inadequate for overhead irrigation within ( $\leq$ ) 21 days to the scheduled harvest date. Water from these systems is restricted to use in overhead irrigation when applied prior to (>) 21 days to the scheduled harvest date. Also, water from Type A agricultural water systems can be sampled and essted under Type B agricultural water system requirements when it is used for overhead irrigation prior to 21 days before the scheduled harvest date.

## E1. Routine Verification of Microbial Water Quality

# Target Organisms: Generic E. coli

#### Routine Verification Sampling Procedure:

100 mL sample collected aseptically at the point-of-use, i.e., one sprinkler head per water source for irrigation, water tap for pesticides, etc. preseason irrigation water may be tested and utilized.

# Routine Verification Sampling Frequency:

One sample per water source shall be collected and tested prior to use if > 60 days since last test of the water source. Additional samples shall be collected no less than 18 hours apart and at least monthly (or at the next irrigation event if greater than monthly) during use from points within the water distribution system.

# Routine Verification Acceptance Criterion:

< **126 MPN / 100 mL** (geometric mean) and <u>< 235 MPN/100mL</u> for any single sample. **Note**: For the purposes of water testing, MPN and CFU are considered equivalent. When using water from Type B agricultural water distribution systems for overhead applications **prior to (>) 21 days** of the scheduled harvest date, samples for microbial testing shall be taken as close as practicable to the point-of-use (i.e., to be determined by the sampler, to ensure the integrity of the sample, using sampling methods as prescribed in Table 2D) so as to test both the water source and the water distribution system. In a closed water distribution system (meaning no connection to the outside) water samples may be collected from any point within the system but are still preferred at the point-of-use. No less than one (1) sample per month (or at the next irrigation event) per water distribution system is required under these metrics. If there are multiple potential point-of-use sampling points ina water distribution system, then samples shall be taken from different point-of-use locations each subsequent sampling event (randomize or rotate sample locations).

Water for pre-harvest, direct edible portion contact prior to (>)21 days before scheduled harvest shall meet or exceed antimicrobial standards for recreational water, based on a rolling geometric mean of the five (5) most recent samples. However, a rolling geometric mean of five samples is not necessarily required prior to irrigation or harvest. If less than five (5) samples are collected prior to irrigation, the acceptance criteria depend on the number of samples taken. For example:

- If only one (1) sample has been taken, it must be below (<)126 MPN / 100 mL.
- Once two (2) samples are taken, a geometric mean can be calculated, and the normal acceptance criteria apply.

If the acceptance criteria are exceeded during this time period, additional samples may be collected to reach a five (5)-sample rolling geometric mean. The *rolling* geometric mean calculation starts after five (5) samples have

Metric	Rationale /Remedial Actions
	been collected. If the water source has not been tested in the past 60 days, the first water sample shall be tested prior to use, to avoid using a contaminated water source. After the first sample is shown to be within acceptance criteria, subsequent samples shall be collected no less frequently than monthly at points-of-use within the water distribution system.
	Ideally, pre-harvest water used prior to 21 days before harvest for overheadapplications should not contain generic <i>E. coli</i> , but low levels do not necessarily indicate that the water is unsafe. Investigation and/or remedial action SHOULD be taken when test results are higher than normal or indicate an upward trend. Investigation and remedial action SHALL be takenwhen acceptance criteria are exceeded.
	<b>Remedial Actions:</b> If the rolling geometric mean (n=5) or any one sample exceeds the acceptance criteria, then the water shall not be used whereby edible portions of the crop are contacted by water until remedial actions have been completed and generic <i>E. coli</i> levels are within acceptance criteria:
	<ul> <li>Conduct an agricultural water system assessment of water source and water distribution system to determine if a contamination source is evident and can be eliminated. Eliminate identified contamination source(s).</li> </ul>
	<ul> <li>For wells, perform an agricultural water system assessment and/or treatas described in Appendix A.</li> </ul>
	<ul> <li>Or begin water treatment</li> </ul>
	Retest the water after conducting the agricultural water system assessment and/or taking remedial actions to determine if it meets the outlined microbial acceptance criteria for this use. Retest the water daily, take three samples, no less than 18 hours apart at the point closest to use. This sample should represent the conditions of the original water system, if feasible this test should be at the original sampling point. A more aggressive sampling program (i.e., sampling once per week instead of once per month) or water treatment shall be instituted if an explanation for the exceedance is not readily apparent. This type of sampling program should also be instituted if
	an upward trend is noted in normal sampling results.

Test Method: Any FDA-allowed method<sup>2</sup>

**Records**: Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for a period of two years.

# FIGURE 5. Irrigation Water from Type B Agricultural Water Systems intended for Overhead Irrigation – See TABLE 2E



#### **ROUTINE MONITORING of MICROBIAL WATER QUALITY**

- If using > 21 days prior to the scheduled harvest date, collect one (1) 100 mL samples per irrigation water system at the point of use monthly.
- Analyze samples for generic *E. coli* using a FDA-allowable method.
- Calculate geometric means using the five most recent samples.

## ACCEPTANCE CRITERIA

< 126 MPN / 100mL
(geometric mean)</pre>

AND

<u>< 235 MPN / 100 mL in a</u> single sample

#### No further action necessary.

Water from this source may be used for any use such as crop foliar applications and/or irrigation up until 21 days to scheduled harvest. However, when test results are higher than normal or indicate an upwardtrend, investigation and/or remedial action **SHOULD** be taken.



- If crop has been directly contacted with water exceeding acceptance criteria, sample and test product for STEC (including *E. coli* O157:H7) and *Salmonella* as described in Appendix C, prior to harvest.
- If crop testing indicates the presence of either pathogen, do NOT harvest for fresh market and human consumption.

#### ACTION LEVEL

> 126 MPN / 100mL (geometric mean)

<u>OR</u>

235 MPN / 100 mL in a single sample

#### **REMEDIAL ACTIONS:**

- Discontinue use for foliar and direct contact with the edible portion of the plant applications until it returnsto compliance.
- Examine the water source and distribution system to determine if a contamination source is evident and can be eliminated.
- For wells, perform an agricultural water system assessment and/or treat as described in Appendix A.
- After performing an agricultural water system assessment and/or remedial actions, retest the water atthe same sampling point.
- Take three samples, no less than 18 hours apart at the point closest to use. If any of these samples is >126 MPN/ 100mL, repeat agricultural water system assessment and/or remedial action.
- Do not use water from that water system, in a manner that directly contact edible portions of the crop, until the water can meet the outlined acceptance criteria forthis use or treat water to meet the acceptance criteria.

# TABLE 2F. Level 1 Assessment - Remedial Actions for Type A and B→A Agricultural Water Systems – See FIGURE 4

Metric	Rationale/Remedial Actions	
Target Organisms: Generic E. coli and total coliforms		
Target Organisms: Generic E. coli and to         Remedial Actions Sampling         Procedure:         Aseptically collect five (5)-100 mL         sample from any point in the         delivery system with a minimum of         one from the last sprinkler head, i.e.,         at the last point of contact with the         crop - last sprinkler head.         Remedial Actions Sampling         Frequency:         Sample water during the next         consecutive irrigation event after a         sample fails the acceptance criterion         or monitoring criterion.         Remedial Actions Acceptance         Criterion for Generic E. coli:         80% non-detectable generic E. coli in         100 mL and ≤ 10 MPN as the single	<ul> <li>Datal coliforms</li> <li>When using agricultural water systems for overhead applications up to (&gt;) 21 days of the scheduled harvest date: <ul> <li>Follow water metrics in Table 2D for Type B agricultural water systems.</li> <li>When using water from Type A and/or B→A agricultural water systems for overhead applications within (&lt;) 21 days of the scheduled harvest date:</li> </ul> </li> <li>Generic <i>E. coli</i> <ul> <li>If generic <i>E. coli</i> levels in your water exceed the acceptance criterion, prior to the next irrigation event conduct an agriculturalwater system assessment as described in Appendix A. During the next irrigation event, collect five (5)-100 mL samples from the irrigation system and test for generic <i>E. coli</i>. Water can be pulled from any point in the delivery systems in the irrigation treatment system of concern with at least one coming from the last sprinklerhead. If these water samples also fail to meet the acceptance criterion, discontinue use of this water for overhead applications while continuing to evaluate your irrigation</li> </ul></li></ul>	
sample maximum for one (1) sample Remedial Actions Monitoring Criterion for Total Coliform Monitoring Level Failure: 5/5 samples with a maximum level of 99 MPN in 100 mL in all water samples or an adequate log reduction based on the untreated water's baseline total coliform levels (refer to Appendix A for log reduction guidance)	<ul> <li>continuing to test as described in this step until the water is back in compliance (see Appendix A for guidance on troubleshooting irrigation treatment system failures).</li> <li>2) If this water (the water from the initial sampling to the last round of sampling) has been applied to leafy greens, test the crop from all affected lots (i.e., lots that have been irrigated with this water within the &lt;21 days-to-scheduled-harvest window) for STEC (including <i>E. coli</i> O157:H7) and <i>Salmonella</i>. Product needs to be tested prior to harvesting and after your last irrigation event. The crop within that lot shall NOT be harvested for the fresh market if either pathogen is present. Sample crop per the protocol described in Appendix C. If any individual sample tests positive for any of these human pathogens, the crop within that lot shall NOT be harvested for human consumption.</li> <li>1) If these water samples fail to meet the monitoring criterion perform a root cause analysis and continue to evaluate your irrigation treatment system to identify and correct any failures</li> </ul>	

	back in compliance (see Appendix A for guidance on troubleshooting irrigation treatment system failures).	
	<ol> <li>Water can still be used as a Type A system and no pre-harvest pathogen testing is required as long as the generic <i>E. coli</i> acceptance criterion is met.</li> </ol>	
Test Method: Any FDA-allowed method <sup>2</sup>		
<b>Records</b> : Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for a period of two years.		

# 395 TABLE 2G. Harvest Direct Product Contact, Harvest Food-Contact Surfaces, and Hand Wash Water (On

# 396 Farm Practices Only) - See FIGURE 6

Metric	Rationale /Remedial Actions
<ul> <li>Water Type:</li> <li>Municipal</li> <li>Well (Type A)</li> <li>Reverse Osmosis</li> </ul>	Water used during harvest operations that directly contacts edible portions of harvested crop, water used forhand washing, or is used on food-contact surfaces such asequipment or utensils, shall be sourced from municipal, well (Type A) or reverse osmosis water sources.
Microbial Water Quality Testing	
Target Organism: Generic E. coli	
<ul> <li>Sampling Procedure:</li> <li>Prior to use in harvest equipment, a 100 mL sample collected aseptically at the water source.</li> <li>Sampling Frequency:</li> <li>One sample per water source shall be collected and tested prior to use if &gt;60 days since last test of the water source. Additional samples shall be collected at intervals of no less than 18 hours and at least monthly during use.</li> <li>For wells and municipal water sources, if generic <i>E. coli</i> are below detection limits for five consecutive samples, the requirements for 60 days and monthly sampling are waived, and the sampling frequency may be decreased to no less than once every 180 days. This exemption is void if there is a significant water source or distribution system change.</li> <li><u>Reverse Osmosis Systems</u>: No less than one (1) sample per month per system is required.</li> <li>Test Method:</li> <li>Any FDA allowed method<sup>2</sup></li> <li>Acceptance Criteria:</li> <li>Negative or below DL for all samples</li> </ul>	<ul> <li>Testing must be conducted to demonstrate that this water meets the Maximum Contaminant Level Goal for generic <i>E. coli</i> as specified by U.S. EPA or contain an approved disinfection method at sufficient concentration or of sufficient wavelength to prevent cross-contamination.</li> <li>Microbial or physical/chemical testing shall be performed, as appropriate to the specific operation, to demonstrate that acceptance criteria have been met.</li> <li>Single-Pass vs. Multiple-Pass Systems</li> <li>Single-pass use – Water must have non-detectable levels of generic <i>E. coli</i> or breakpoint disinfectant present at point of entry.</li> <li>Multi-pass use – Water must have non-detectable levels of generic <i>E. coli</i> and/or sufficient disinfectant toensure multi-pass water has no detectable generic <i>E. coli</i>.</li> <li>Remedial Actions:</li> <li>Develop an SOP that determines what corrective actions will be required when harvest water does not meet acceptance criteria. If any single sample exceeds the acceptance criteria, then DO NOT USE THE WATER until remedial actions have been completed and generic <i>E. coli</i> or disinfectant levels arewithin acceptance criteria:</li> <li>Conduct an agricultural water system assessment of water source and distribution system to determine if</li> </ul>

Metric	Rationale /Remedial Actions	
Metric         Physical/Chemical Testing         Target Variable:         Water disinfectant (e.g., UV transmittance, chlorine or other disinfectant compound).         Multi-Pass Water Acceptance Criteria:         Chlorine         ≥ 1 ppm free chlorine after application and pH 5.5 – 7.5         Other approved treatments per product EPA label for human pathogen reduction in water.         Testing Procedure:         • Chemical reaction-based colorimetric test, or         • Ion-specific probe, or         • UV transmittance         • Other as recommended by disinfectant supplier.         Testing Frequency:         • Prior to first use on day of harvest.         • During harvest, samples shall be taken at routine intervals (i.e., hourly, breaks, lunch, etc.) as determine by historical data showingtypical	<ul> <li>Rationale /Remedial Actions</li> <li>a contamination source is evident and can be eliminated.Eliminate identified contamination source(s) and/or treat with appropriate disinfectants.</li> <li>For wells, perform an agricultural water system assessment and/or treat as described in Appendix A.</li> <li>Retest the water at the same sampling point after conducting the agricultural water assessment for waterused for harvest and/or taking remedial actions to determine if it meets the outlined microbial acceptancecriteria for this use.</li> <li>For example, if the water intended for use on food- contact surfaces has detectable generic <i>E. coli</i>, DO NOT USE THE WATER.</li> <li>Examine the distribution line and source inlet as described in Appendix A and retest from the same point of use.</li> <li>After corrective actions have been implemented and verifiedthe water may be used for harvest operations and hand wash water.</li> </ul>	
degree of variation. <b>Records</b> : All test results and remedial actions shall be of the ware	documented and available for verification from the user of	
thewater for a period of two years.		

# FIGURE 6. Harvest Direct Product Contact, Harvest Food-Contact Surfaces, and Hand Wash Water (On Farm Practices Only) – See TABLE 2G

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#### Water Type: Municipal, Wells (Type A), and Reverse Osmosis:

Water that directly contacts edible portions of harvested crop shall meet microbial standards set forth in U.S. EPA National Drinking Water Regulations and/or contain an approved disinfectant at sufficient concentration to prevent cross-contamination.

#### SAMPLING FREQUENCY:

One sample per water source shall be collected and tested prior to use if > 60 days since last test of the water source. Additional samples shall be collected no less than 18 hours apart and a least monthly during use.

- Sample sources using sampling methods as prescribed in Table 2G.
- Analyze samples for generic *E. coli* using any FDA allowed method.

#### **ACCEPTANCE CRITERIA**

Negative or below DL /100 mL generic *E. coli* 

OR

#### MULTI-PASS WATER ACCEPTANCE CRITERIA

Chlorine ≥1 ppm free chlorine (pH 5.5 - 7.5) OR

Sufficient disinfectant; physical treatment - sufficient wavelength to prevent cross- contamination. Other approved treatments per product EPA label for human pathogen reduction in water.

No further action necessary. Water from this source may be used for anypurpose.

#### ACTION LEVEL

Positive generic E. coli

#### **REMEDIAL ACTIONS:**

- DO NOT USE THE WATER.
- Follow your SOP for corrective action to bring water backinto compliance with the acceptance criteria.
- For wells, perform an agricultural water system assessment and/or treat as described in Appendix A.
- After agricultural water system assessment on water usedfor harvest and/or remedial actions have been taken, retest the water at the same sampling point.
- After corrective actions have been implemented and verified the water may be used for harvest operations.
- If water exceeding the acceptance criteria has been used during harvest, it is NOT appropriate microbial quality for this use. Sample and test product for STEC including *E. coli* O157:H7 and *Salmonella* as described in Appendix C.

# 2024 CA LGMA Amendment Process Report - Water Revisions

Proposal Submitted by the Water Working Group No Markup (clean)



# COMMODITY SPECIFIC FOOD SAFETY GUIDELINES

FOR THE PRODUCTION AND HARVEST OF LETTUCE AND LEAFY GREENS



SEPTEMBER 20, 2023 This document supersedes all previously published versions of the Commodity Specific Food Safety Guidelines for the Production and Harvest of Leafy Greens including those dated on or before March 30, 2023.

> Adopted by the California Leafy Green Products Handler Marketing Agreement Advisory Board Document managed by Western Growers - learn more at www.leafygreenguidance.com

# 1 6. ISSUE: WATER

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2 The safety of whole fresh and fresh-cut (e.g., bagged salad) leafy greens is a longstanding issue. Leafy greens are mostly 3 consumed raw without cooking or processing steps to eliminate microbial hazards. Therefore, the way they are grown, 4 harvested, packed, held, processed, and distributed is crucial to ensuring that the risk of human pathogen 5 contamination is minimized. LGMA recognizes that different crop characteristics may impact susceptibility to adhesion 6 and internalization of hazards. These metrics are intended to prioritize risk by classifying agricultural water systems for 7 specific uses within leafy greens operations. Remedial actions follow a "find and fix" structure to identify and correct 8 both system nonconformities and more serious failures. These metrics should be considered the minimum controls 9 necessary to assess agricultural water systems for fitness of use.

# <sup>10</sup> General Agricultural Water Management - The Best Practices Are:

- Agricultural water systems are a function of the source, storage, and conveyance. Each component of an agricultural water system that is within your control must be evaluated to ensure that the quality of agricultural water used in leafy green operations is known (i.e., the required parameters are measured and conform to the prescribed standards) and adequate for its intended use.
- It's prudent to evaluate and make a good faith effort to address the food safety hazards proximate to your agricultural water systems that may not be under your control.
- NEVER use water from any water system that has not been microbially characterized and assessed as
   described below.
- Prior to annual use of the water in agricultural operations a written agricultural water assessment shall be
   prepared. The water assessment must identify conditions that are reasonably likely to introduce known or
   reasonably foreseeable hazards into or onto the leafy greens. The assessment must address the following
   elements:
- 23 A description (including the location and nature) of the agricultural water source and the type of 0 24 distribution system shall be created. Information in the description shall include permanent fixtures 25 such as wells, gates, reservoirs, valves, returns and other permanent above ground fixtures and could 26 also include non-permanent features such as tanks, drip stations, gas power pumps, pipes, water 27 treatment systems, etc. that make up a complete irrigation system. This could be achieved by using 28 maps, photographs, drawings or other means to communicate the location of permanent fixtures and 29 the flow of the water system (including any water captured for re-use or other natural or managed 30 features which prevent environmental runoff from entering the water system).
  - The degree of protection from possible sources of contamination, including by other water users; animal impacts; and adjacent and nearby land uses related to animal activity (for example, grazing or commercial animal feeding operations of any size), application of biological soil amendment(s) of animal origin, or presence of untreated or improperly treated human waste.
- 35 o Documented agricultural water practices for each agricultural water system, including the application
   36 methods as described in Table 1, water sources and the production blocks they may serve.
- Manage and maintain all components of your agricultural water system that are within your control including
   the water source and the on-ranch (farm) distribution /conveyance system(s) in a manner that minimizes
   human pathogen contamination.
- Testing water at the end of the delivery system (e.g., the last sprinkler head) or the point-of-use is essential for
   ensuring water that contacts the crop is of adequate microbial quality.
- For surface water sources, consider the impact of storm events on irrigation practices. Bacterial loads in surface
   water are generally much higher after a storm than normal, and caution shall be exercised when using these

44 waters for irrigation.

- Water systems that convey untreated human or animal waste are never suitable for use in leafy greens
   operations in any manner and must be separated from conveyances utilized to deliver agricultural water.
  - Water records must be reviewed, dated, and signed, within a week after the records are made, by a supervisor or responsible party.
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#### Hazard Analysis – Step 1: Assessment of Agricultural Water Systems

Evaluating food safety hazards from agricultural water applications in leafy green operations must take into account
the quality of the agricultural water system, how the agricultural water will be applied, and when it will be applied.
Prior to using water in any leafy green operation, conduct an agricultural water system assessment (including source,
storage, and conveyance as described in Appendix A) and determine the agricultural water system type.

- 54 There are two types of agricultural water systems used in leafy green operations:
- Type A: Agricultural water that is unlikely to contain indicators of fecal contamination either due to natural
   hydrogeologic filtration or through controlled USEPA and state regulated treatment regime as demonstrated
   by an agricultural water system assessment as outlined in Appendix A, microbial testing, and when applicable,
   treatment verification.
- **Type B:** All other agricultural water systems.
- Source: Evaluate each agricultural water source used in your leafy green operations and determine its
   type.
  - Some agricultural water sources are supplied by a third-party provider that certifies the water is of adequate microbial quality (i.e., unlikely to contain indicators of fecal contamination). Example of these sources are:
  - Public (e.g., municipal) or private providers that deliver certified potable water achieved through treatment or some other process
  - b) Some agricultural water sources deliver water of appropriate microbial quality due to natural physical, chemical, and biological processes that filter water as it passes through the soil. Examples of these sources for Type A agricultural water systems are:
    - Wells constructed in a manner such that contamination from outside sources (e.g., surface water or other surface chemical or biological influences / effects) is unlikely (e.g., well heads are protected, maintained, and monitored; see Appendix A for additional guidance), and water is tested to conform to standards.
  - Regulated recycled water (e.g., tertiary treated, purple pipe, etc.) providers that treat, test, and deliver water that is suitable for use in agricultural applications.<sup>1</sup>
- Some agricultural water sources are part of a Type A system due to on-ranch treatment that, when
   operating under validated and verifiable parameters, turns Type B water into Type A. An example of a
   water source used in a Type B → A agricultural water system is:

<sup>&</sup>lt;sup>1</sup> State regulations vary for recycled water. In some states recycled water for produce production allows a certain level of generic *E. coli*, total coliforms, and/or fecal coliforms.

79	<ul> <li>Treated surface water (verified to conform to standards)</li> </ul>
80 81 82 83	d) Some agricultural water sources are considered part of a Type B system because they are vulnerable to contamination and have not been treated to achieve adequate microbial reduction and shall be used in a manner that minimizes contamination of the crop. Examples of water sources in a Type B agriculture water system are:
84 85	<ul> <li>Wells that may be vulnerable to contamination by outside sources including surface waters or by other surface chemical or biological influences / effects)</li> </ul>
86	Untreated surface water
87 88 90 91 92 93	2) <b>Storage and conveyance</b> : Agricultural water source is only one component of an agricultural water system. An agriculture water system that starts out with water of appropriate microbial quality at the source may change quality as it progresses through the delivery system. Microbial water quality depends on the properties of the agricultural water system's components and how they are maintained (for more on system maintenance, see the section below on Best Practice for Managing Storage and Conveyance Systems). Agricultural water systems are typically opened or closed. For the purposes of this document, these systems are defined as follows:
94 95 96 97 98	<ul> <li><u>Closed delivery systems</u> store or convey agricultural water in a manner that does not expose it to the outside environment and where water maintains the initial source type. Water from closed delivery systems must be tested at the end of the system to verify water quality is unchanged as it moves through the system. Additional details about testing requirements for a closed delivery system are provided in Tables 2B and 2C, and guidance is provided in Appendix A.</li> </ul>
99 100 101 102 103 104 105	<ul> <li><u>Open delivery systems</u>, at some point in the system, store or convey agricultural water in a manner that exposes it to the outside environment (i.e., a reservoir / pond, canal, lateral, uncovered water tank, etc.). Water in open delivery systems (e.g., reservoirs and ponds) may be used in overhead applications within 21 days to the scheduled harvest if it is treated (as described in Table 2D) at the time it is applied to crops. Additional details about testing requirements for an open delivery system are provided in Table 2F pertaining to Type B agricultural water systems, and guidance is provided in Appendix A.</li> </ul>
106 107 108 109	3) System: Each component of an agricultural water system must be evaluated to ensure that the quality of agricultural water used in leafy green operations is known (i.e., the required parameters are measured and conform to the prescribed standards) and adequate for its intended use. Agricultural water use will vary depending on the type of system.
110 111	<ul> <li>When determining whether a system is Type A or B, each component (source, storage, conveyance, etc.) must be individually evaluated in typing an entire system.</li> </ul>
112	• When Type A and B waters are combined, categorize water as Type B.
113	Hazard Analysis – Step 2: How Is Your Agricultural Water System Being Used?
114 115 116 117	<b>Use/Application method</b> : Risk of leafy green contamination is closely related to how water is used in the production and harvest environment as well as in post-harvest applications (Rock et al., 2019). For this reason, agricultural water requirements vary depending on how it is applied. In leafy green operations, agricultural water is typically used in aerial (e.g., sprayers, overhead sprinklers, aircraft), ground (e.g., furrow and drip irrigation), and

post-harvest applications. Agricultural water is also used for cleaning and, when appropriate, sanitizing equipment

- used during production, harvest, and post-harvest activities. Type A, Type B water that is treated to become Type A ( $B \rightarrow A$ ), and Type B agricultural water systems are suitable for specific uses as described in Table 1.
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122 Timing of use: Risk of leafy green contamination is closely related to when agricultural water is applied in the 123 production environment. For this reason, requirements for agriculture water that is aerially applied to leafy green 124 crops vary depending on when the water is applied (Fonseca et al., 2010; Gutierrez-Rodriquez et al., 2012, 2019; 125 Koike et al., 2009; 2010; Moyne et al., 2011; Suslow et al., 2010; Wood et al., 2010).

A number of environmental factors, including location of the operation, and the climatic conditions of UV, relative humidity, precipitation, and temperature, may alter the appropriateness of these time-based requirements. Based on the most appropriate, currently available research addressing the risks related to the timing of aerial agricultural water application in leafy green operations, time-based requirements are generally divided as follows:

- Within (<) 21 days of the scheduled harvest date
- Greater than (>) 21 days until the scheduled harvest date
- Agricultural water from a Type A agricultural water system used in overhead irrigation within (<)21 days of</li>
   the scheduled harvest must meet the performance requirements for Type A agricultural water systems as
   outlined in Tables 2B and 2C.
- Untreated agricultural water that meets Type A requirements for irrigation water or Type B system that
   meets the performance requirements outlined in Table 2E may be used in aerial applications prior (>) 21 days
   before the scheduled harvest.
- To use agricultural water from a Type B agricultural water system in overhead irrigation within (<)21 days of</li>
   the scheduled harvest date, the water must be treated to become Type A water (B→A) and demonstrated to
   meet the performance requirements as outlined in Table 2D.

 TABLE 1. Agricultural Water System Uses by Application Method – See TABLE 2A—2G

Application	Agricultural water systems (possible sources)	Treatment methods for use in direct contact with crop	Microbial indicator
<ul> <li>Overhead irrigation and chemical application priorto (&gt;) 21 days before scheduled harvest date</li> <li>Germination</li> <li>Ground chemigation</li> <li>Drip irrigation</li> <li>Furrow irrigation</li> <li>Dust abatement</li> <li>Non-food-contact farm equipment cleaning</li> </ul>	Type A and B agricultural water systems	No treatment necessary if it can be demonstrated t o meet the microbial standards.	generic <i>E. coli</i>
<ul> <li>Overhead applications (including irrigation, pesticide spray, aerial chemigation) applied within (&lt;) 21 days of scheduled harvest date</li> </ul>	Type A agricultural water systems (closed systems including water from wells, municipalities, tertiary treated and disinfected recycled water e.g., purple valve)	No treatment necessary if it can be demonstrated to meet the microbial standards.	generic <i>E. coli</i>
	Treated Type B→A agricultural water systems with open components such as reservoirs, ponds, canals, laterals, ditches, etc.	Must be treated and tested to demonstrate treatment efficacy and compliance with microbial standards.	generic <i>E. coli</i> and total coliforms
Application			
<ul> <li>Food-contact (harvest) equipment cleaning &amp; sanitizing</li> <li>Hand wash water</li> </ul>	• Water that directly contacts edible portions of harvested crop or is used on food-contact surfaces such as equipment or utensils, must meet the Maximum Contaminant Level Goal for <i>E. coli</i> as specified by U.S. EPA or contain an approved antimicrobial treatment at a concentration sufficientto prevent cross-contamination. Microbial or physical/chemical testing shall be performed, as appropriate to the specific operation, to demonstrate that acceptance criteria have been met.		

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147	Irrigation Water Sampling Plans and Remedial Actions
148 149 150 151	Testing agricultural water systems is one method of gathering evidence that your system is of adequate quality for its intended use. Along with visual monitoring of agricultural water systems, a water quality testing program is a vital best practice for protecting leafy green crops from contamination. To be most effective as a food safety tool, water samples must reflect, to the extent possible, the water at the point of use.
152	<ul> <li>As irrigation system equipment may change locations throughout the season, but water sources are</li></ul>
153	generally at a fixed location, a robust overhead irrigation water quality testing program must include
154	assessments of both the irrigation water source and the irrigation system. Assessing water quality at the
155	end of the delivery system ensures source water quality does not degrade as it moves through the system.
156	<ul> <li>For the purposes of this document, sampling of agricultural water systems occurs for the following three</li></ul>
157	reasons and Tables 2B-2C follow this framework providing specific details for each assessment's
158	requirements:
159 160	<ul> <li>Baseline microbial assessments: To "type" your agriculture water <u>source</u> and establish its "known" quality.</li> </ul>
161	<ul> <li>Initial microbial water quality assessment: To test your agricultural water <u>system</u> prior to use to</li></ul>
162	ensure water is not degraded as it moves through the system.
163	<ul> <li>Routine system assessments: To monitor the microbial quality of your agricultural water system</li></ul>
164	throughout the season to ensure it continues to meet the microbial water quality standards.
165	<ul> <li>If you are applying water from a Type A agricultural water system greater than (&gt;) 21 days</li></ul>
166	to the scheduled harvest date, you may choose to sample and test your water according to
167	Type B criteria rather than according to Type A criteria; however, Type A baseline (when
168	required) and initial microbial water quality assessments must be conducted before the 21
169	days-before-harvest window closes and routine verification / monitoring begins (per
170	requirements outlined in Tables 2B and 2C).
171	<ul> <li>Routine sampling is a part of building a dataset useful for evaluating individual data points</li></ul>
172	and evaluating trends to gain a better understanding of your agricultural water system.
173	<ul> <li>Non-routine sampling when food safety risks are deemed higher due to specific</li></ul>
174	circumstances (i.e., weather, animal and human activities, discharge, etc.) should also be
175	part of a robust food safety program. In the event that additional risk factors that could
176	affect water quality are observed or measured such as weather, manure application in a
177	nearby field, or animal-related activity, consider conducting additional water testing.
178	<ul> <li>If you are irrigating with Type B→A agricultural water systems, collecting and analyzing</li></ul>
179	water system data is essential for understanding how the treatment functions in your
180	irrigation system and can optimize its effectiveness.
181 182	• All agricultural water systems used in overhead irrigation prior to (>) 21 days before the scheduled harvest date must meet the water quality requirements outlined in Table 2E for Type B agricultural water systems.
183	<ul> <li>If a Type A or B agricultural water system fails the respective acceptance criteria, follow remedial action</li></ul>
184	steps as outlined in Table 2F (also included in Figures 2B, 3A and 3C). Consider performing root cause
185	analysis to determine if additional preventive measures can be incorporated into the agricultural water
186	system operation.

Retain documentation of all test results and/or Certificates of Analysis/Quality Assurance for a period of at
 least two (2) years.

189	Best Practio	ce for Managing Storage and Conveyance Systems
190 191	• Develop a each agric	SOP for the maintenance of ancillary equipment and water storage and conveyance components of cultural water system used in your operations. The SOP must address:
192 193 194	⊙ R( cc y(	egularly scheduled visual inspections, including ancillary equipment connected to your storage and onveyance system, to ensure it is in good working order and does not pose a contamination risk to our system.
195 196	ο N tι	leasures to maintain water quality by removing debris and controlling the presence of weeds, algae, Ile, trash, and when appropriate, sediment within the grower's control.
197 198	o Pi av	rocedures to control pest access to the storage and conveyance systems (examples may include: vian deterrents, fencing, and rodent monitoring).
199 200	o Co in	orrective actions to ensure irrigation pipes and drip tape are microbiologically safe to use if a pest ifestation does occur.
201 202	⊙ Be st	erms, slopes and diversion ditches for prevention of run-off (i.e., from irrigation or rain) into water corage and conveyance systems.
203	0 <b>P</b> I	rocedures to ensure standing and/or stagnant water does not pose a contamination risk.
204 205	o N th	lanagement of agricultural water system components used to prepare crop amendments to ensure nese activities and equipment are not a contamination source.
206 207	o W W	/ater used in aerial applications (e.g., pesticide and fertilizer, etc.) within the 21-days-to-harvest indow must be from Type A or B→A agricultural water systems. Implement practices to ensure:
208 209		<ul> <li>Holding tanks and equipment-mounted application tanks, manifold and boom lines, and nozzles are to be properly maintained and cleaned.</li> </ul>
210 211		<ul> <li>Water treatment chemistry or approach is compatible with the agricultural chemicals being applied.</li> </ul>
212	0 Es	stablish corrective action procedures for non-compliance scenarios, including:
213		<ul> <li>Contaminated source water</li> </ul>
214		<ul> <li>Animal intrusion</li> </ul>
215		<ul> <li>Contaminating run-off</li> </ul>
216		<ul> <li>Uncontrolled flooding [reference page, line and table]</li> </ul>
217	Document	t all corrective measures, cleaning activities, and maintenance.
218	Best Practice	for Furrow Irrigation Systems Management
219 220	<ul> <li>Agricultur manner to</li> </ul>	al practices, such as irrigation methods, bed configuration, etc., should be implemented in a o avoid water from breaching the top of the bed.
221 222	• Agricultur headland	al practices, such as equipment movement, irrigation practices, etc., should be monitored at and tail ditch locations for damaged beds which may allow water to contact the edible portion

223 of the crop.

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Coordinate irrigation events with harvest, to the degree possible, to avoid saturation of the field soil to prevent excessive dirt and mud from getting on the edible portion of the crop, harvest tools (e.g., knives, gloves, etc.), and harvest equipment (e.g., machines, belts, trailers, etc.).

#### 227 Best Practice for Drip Tape Irrigation Systems Management

- Drip tape should be handled, stored, used, and re-used in a manner that prevents damage and contamination to the drip tape.
- While in use, repairs to drip tape should be completed in a timely manner to prevent water contact with
   the edible portion of the crop.

# <sup>232</sup> Best Practice for Managing Irrigation Water Treatment Systems

- The minimum best practices for managing irrigation water treatment are outlined below and must be
   completed. For greater detail refer to Appendix A.
- Prior to 21 days-to-scheduled harvest conduct an initial irrigation water treatment assessment to establish treatment process parameters that will be monitored to ensure consistent treatment delivery and to demonstrate its effectiveness as described in Appendix A.
  - Repeat this assessment if a material change (e.g., change in equipment or type of water treatment) to your system occurs.
- Before using treated water to irrigate crops within the ≤ 21 days-to-scheduled harvest timeframe growers
   must first establish SOP's outlining irrigation treatment and process parameters for all irrigation treatment
   systems unless duplicated systems are in use.
- Confirm that water microbial quality is not being degraded as it passes through each of your water treatment systems (i.e., due to equipment conditions) by performing a microbial water quality assessment during an irrigation event before entering the ≤ 21 days-to-scheduled harvest timeframe.
- Collect three (3)-100 mL samples from 3 different sprinkler heads with at least one sample from the
   farthest/last sprinkler head. Acceptance Criteria and Data Monitoring Criteria as outlined in Table 2D Routine Monitoring of Microbial Water Quality must be met.

# Best Practice Water Used for Overheard Chemical Applications within 21 Days of Scheduled Harvest (This section does NOT apply to chemical applications made through the distribution system i.e., sprinkler)

Type B water used for overhead applications within 21 days of scheduled harvest must be treated. With the start-up of any new treatment process it is important to evaluate all conditions that may affect water treatment efficacy and performance. Examples of parameters that provide valuable information about treatment efficacy in relationship to water quality are: Turbidity, pH, antimicrobial dose, historical microbial monitoring data, etc. (See Appendix A for additional guidance).

- Develop a SOP for all of the parts of the ag water system used in overhead chemical application. The SOP
   must address:
- Water used in overhead applications (e.g., pesticide and fertilizer, etc.) within the 21-days-to-harvest
   window must meet Type A and/or B→A water quality requirements.

260 261 262	0	Holding tanks and equipment-mounted application tanks, manifold and boom lines, and nozzles MUST be regularly inspected and properly maintained and cleaned so they do not pose a contamination risk.
263 264	0	Water treatment chemistry or approach shall be compatible with the agricultural chemicals being applied.
265 266 267	0	Procedures to control pest access to the equipment during storage and staging (examples may include avian deterrents, fencing, and rodent monitoring) must be in place (validation can include: Pest control applicator (PCA) records, label requirements, letter of guarantee).
268	0	Establish corrective action procedures for non-compliance scenarios including:
269		<ul> <li>treatment failure</li> </ul>
270		<ul> <li>contaminated source water</li> </ul>
271		pest concerns
272		<ul> <li>chemical incompatibility</li> </ul>
273		<ul> <li>equipment sanitation concerns.</li> </ul>
274	0	Document all corrective measures, cleaning activities, and maintenance.
275 276 277 278 279 280	<ul> <li>Develor applic initial ensure mater treatm</li> </ul>	op a SOP for each unique application process to treat water that will be used in an overhead ation within 21 days of a scheduled harvest. Prior to the 21-days-to-scheduled-harvest conduct an water treatment assessment to establish treatment process parameters that will be monitored to a consistent treatment delivery and to demonstrate effectiveness. Repeat this assessment if a rial change to your system occurs and incorporate this assessment's findings into your water ment SOP. The SOP must address:
281	0	Step-by-step instructions to ensure the water treatment is correctly implemented.
282	0	Location of water sources
283	0	Name and suggested supplies needed.
284	0	Sanitizer used and quantity used.
285	0	Critical limits and operational limits
286	0	Water sampling location
287	0	Corrective actions if critical limits are not met.
288	0	Required records
289	Devel	op a baseline for water treatment:
290 291 292 293	0	Prior to the 21 days-to-scheduled harvest, a minimum of three (3)-100 mL samples must be taken for each overhead application process (distinct water quality source, different sanitizer, different size water holding tank, etc.). The three (3) samples must be taken from different treated water batches.
294	0	All three (3) samples must be non-detect for generic <i>E. coli.</i>
295	• Routir	ne testing:
296 297	0	A minimum of one (1) microbiological sample must be taken each month from a representative agricultural water system or at the next application event.
298	0	This 100 mL sample should have no detectable generic <i>E. coli</i> .

299	Corrective action:
300	<ul> <li>If microbiological testing shows that the water did not meet generic <i>E. coli</i> acceptance criteria</li></ul>
301	within 21 days of a scheduled harvest, perform a root cause analysis and correct the concern.
302	Notify the grower/producer.
303	<ul> <li>The product must be tested for pathogens before harvest if this water was used in overhead</li></ul>
304	application. Follow the product testing requirements outlined in Table 2F.
305	Ongoing monitoring:
306	<ul> <li>Between microbiological routine testing events, records must be kept that verify that each</li></ul>
307	application event is conducted following the parameters established during the initial setup.
308	<ul> <li>If monitoring shows that the water treatment parameters are not being met, do not use the</li></ul>
309	water.
310	<ul> <li>Perform a corrective action to assure the water treatment is effective before using the</li></ul>
311	water.
312	<ul> <li>Take a microbiological sample to verify that the treatment was effective and have that</li></ul>
313	result as part of the corrective action documentation.
314	<ul> <li>If the verification microbiological sample does not meet acceptance criteria, perform a root</li></ul>
315	cause analysis and correct the treatment process. Product must be tested for pathogens
316	before harvesting. Follow Table 2F for product testing requirements.
317	<ul> <li>Maintain records that demonstrate the water used for chemical applications meets Type A source water</li></ul>
318	requirements. See Tables 2B and 2C for historical and/or baseline water quality requirements for source
319	water that will be used for overhead applications.
320	Other Considerations for Water
321 322	• Treat water only with antimicrobial treatments approved by the USEPA for use in agricultural applications in accordance with label specifications, guidelines for use, and consideration of environmental impacts.
323	<ul> <li>Antimicrobial treatments must be used and managed in a manner that meets all federal, state, and local</li></ul>
324	regulations.
325	<ul> <li>Do not store raw manure or any type of compost near irrigation water sources or conveyance systems (see</li></ul>
326	Table 0).
327	Best Practice for Irrigation Water from Type B Agricultural Water
328	The following table (2A) outlines the metrics for agricultural water conveyance systems whereby edible portions of the

crop are not likely to be contacted (e.g., germination, ground chemigation, furrow, drip irrigation, dust abatement 329 330 water); if water is used in the vicinity of produce, then testing is necessary. For any of these uses, the agricultural water 331 system must be assessed and monitored to demonstrate that the water meets the microbial standards for water that 332 is likely to contain indicators of fecal contamination. Routine monitoring of microbial quality is required for all water 333 types and remedial actions are required if water testing shows a conveyance system has failed to deliver water that meets the microbial standard. Efforts should always be made, when using Type B water, to avoid contact with the 334 335 edible portion of the crop within 21 days of a scheduled harvest. When performing remedial actions, it is the intent that all remedial steps outlined in the tables below are followed and that they are followed in the order of sequence 336 337 as written.

# 338TABLE 2A. Irrigation Water from Type B Agricultural Water – See FIGURE 1

Metric	Rationale /Remedial Actions
<ul> <li>Examples of water from Type B agricultural water systems:</li> <li>Ground chemigation</li> <li>Drip irrigation</li> <li>Furrow irrigation</li> <li>Dust abatement</li> </ul>	Water for Type B use throughout the production of the crop shall meet or exceed microbial standards based on a rolling geometric mean of the five most recent samples. However, a rolling geometric mean of five samples is not necessarily required prior to irrigation or harvest. If less than five samples are collected prior to irrigation, the acceptance criteria depend on the number of samples taken. If only one sample has been taken, it must be below 126 MPN/100 mL. Once two samples are taken, a geometric mean can be calculated, and the normal acceptance criteria apply. If the acceptance criteria are exceeded during this time-period, additional samples may be collected to reach a 5-sample rolling geometric mean (as long as the water has not been used for irrigation). The rolling geometric mean calculation starts after 5 samples have been collected. If the water source has not been tested in the past 60 days, the first water sample shall be tested prior to use, to avoid using a contaminated water source. After the first sample is shown to be within acceptance criteria, subsequent samples shall be collected no less frequently than monthly (or at the next irrigation event if longer than monthly) at points of use within the distribution system. Ideally, irrigation water should not contain generic <i>E. coli</i> , but low levels do not necessarily indicate that the water is unsafe. Investigation and/or remedial action SHOULD be taken when test results are higher than normal or indicate an upward trend. Investigation and remedial action SHALL be
Target Organisms: Generic E. coli	taken when acceptance criteria are exceeded.
Sampling Procedure: 100 mL sample collected aseptically as close as practical to the point of use. Sampling Frequency: One sample per agricultural water source shall be collected and tested prior to use if >60 days since last test of the water source. Additional samples shall be collected no less than 18 hours apart and at least monthly (or at the next irrigation event ifgreater than monthly) during use from points within the delivery system.	<ul> <li>If the rolling geometric mean (n=5) or any one sample exceeds the acceptance criteria, then the water shall not be used until remedial actions have been completed and generic <i>E. coli</i> levels are within acceptancecriteria:</li> <li>Conduct an agricultural water assessment (Appendix A) of water source and conveyance system to determine if a contamination source is evident and can be eliminated. Eliminate identified contamination sources.</li> <li>Retest the agricultural water after taking remedial actions to determine if it meets the outlined microbial water quality acceptance criteria for this use. This sample should represent the conditions of the original water system, if feasible this test should be as close as practical to the original sampling point. A more aggressive sampling program (i.e., sampling once per week instead of once per month) shall be instituted if an explanation for the exceedance is not readily apparent. This type of sampling program should also be instituted if an upward trend is noted in normal sampling results.</li> <li>If follow-up agricultural water testing indicates that a crop has been directly contacted with water orcoording accentance criteria product</li> </ul>

Metric	Rationale /Remedial Actions	
Acceptance Criteria: ≤ 126 MPN/100 mL (rolling geometric mean n=5) and ≤ 576 MPN/100 mL for any single sample	shall be sampled and tested for STEC (including <i>E. coli</i> O157:H7) and <i>Salmonella</i> as described in Appendix C, prior to harvest. If crop testing indicates the presence of either pathogen, the crop shall NOT be harvested for the fresh market.	
Test Method: Any FDA-allowed method <sup>2</sup>		
Records: Each water sample and analysis shall record the type of water source, date, time, and location of the		

sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the producer/shipper who is the responsible party for a period of two years.

339

<sup>&</sup>lt;sup>2</sup> Equivalent testing methodology for agricultural water https://www.fda.gov/food/foodscienceresearch/laboratorymethods/ucm575251.htm

#### 341 FIGURE 1. Irrigation Water from Type B Agricultural Water – See TABLE 2A

#### For any given water source (municipal, well, reclaimed water, reservoir or other surface water):

**Sampling Frequency: For Type B water,** one sample per water source shall be collected and tested prior to use if >60 days since last test of the water source. Additional samples shall be collected during use no less than 18 hours apart andat least monthly (or at the next irrigation event if greater than monthly) during use.

- Sample sources as close to the point-of-use as practical using sampling methods as prescribed in Table 2A.
- Analyze samples for generic *E. coli* using a MPN methodology. Other EPA-, FDA- or AOAC International accredited method may be used.
- Geometric means, including rolling geometric means shall be calculated using the five most recent samples.

#### **ACCEPTANCE CRITERIA**

342

≤ 126 MPN/100ml (Geometric mean of 5 samples) <u>AND</u>

<576 MPN/100ml (all single samples)</p>

No further action necessary. Water maybe used in leafy green operations as outlinedin Table 2A.

#### ACTION LEVEL

>126 MPN/100ml (geometric mean over five samples)

OR

>576 MPN/100ml (any single sample)

#### **REMEDIAL ACTIONS:**

- Discontinue any agricultural production use until it returns to compliance.
- Examine the water source and distribution system to determine if a contaminationsource is evident and can be eliminated.
- After remedial actions have been taken, retest the water at the same sampling point.
- Continue testing daily for five days at the point closest to use.
- If any of the next five samples is >576 MPN/100mL, repeat sanitary survey and/orremedial action.
- Do not use this water system until the water can meet the outlined acceptance criteriafor this use.

#### **CROP TESTING:**

- If water exceeding the acceptance criteria has been used for crop production, sample and test product for STEC (including *E. coli* O157:H7) and *Salmonella* as described in Appendix C, prior to harvest.
- If crop testing indicates the presence of either pathogen, do NOT harvest for human consumption.

# <sup>343</sup> Best Practice for Irrigation Water from Type A Agricultural Water

344 The following tables (2B - 2F) refer to agricultural water distribution systems and not to specific ranches, lots, fields, 345 etc. The tables outline the metrics for overhead applications of agricultural water sourced from public/private supplies 346 (2B), regulated recycled water and private wells (2C), treated water supplies (2D), and untreated water that is likely to 347 contain indicators of fecal contamination (2E). Each type of agricultural water system must be assessed to demonstrate that the water from the source and the distribution system meet the microbial standards. Treated water must be 348 349 assessed and monitored to demonstrate that the water treatment is working as intended and that the treated water 350 meets the microbial standard. Routine monitoring of microbial quality is required for all water system types, and remedial actions are required if water testing shows a system has failed to deliver water that meets the microbial 351 352 standard. When performing remedial actions, it is the intent that all remedial steps outlined in the tables below are 353 followed and that they are followed in the order of sequence as written.

# 355 TABLE 2B. Irrigation Water from Type A Agricultural Water Systems Sourced from Public or Private Providers –

# 356 See FIGURE 2A-2B

Metric	Rationale /Remedial Actions
Examples of these types of Type A	Irrigation water from Type A agricultural water systems sourced from
agricultural water systems: Water	regulated public or private providers would not be expected to contain
maycome from public and private	generic <i>E. coli</i> due to treatment or some other filtering-type process.
providersand are stored and	Water sourced from a public/private Type A agricultural water
conveyed in closed delivery	provider must be stored and conveyed in well-
systems.	maintained, closed systems and tested for generic <i>E. coli</i> .

## **B1. Baseline Microbial Assessment**

A baseline microbial assessment of the water source is not necessary for a Type A system using source water from a public/private provider. In lieu of a baseline microbial assessment, acquire and maintain the supplier's most current COA on file.

**Records:** Records of the analysis of source water may be provided by municipalities, irrigation districts, or other water providers and must be available for verification from the grower/handler who is the responsible party for a period of two years

# **B2. Initial Microbial Water Quality Assessment**

# Target Organisms: Generic E. coli

#### Initial Assessment Sampling Procedure:

Aseptically collect at least three (3)-100mL samples during one irrigation eventwith at least one sample at the end of the delivery system (e.g., last sprinkler head).

## Initial Assessment Sampling Frequency:

This is a one-time seasonal sampling event for each system with samples collected during one irrigation event occurring before the 21-days-to-scheduled-harvest period begins. (Also conduct this assessment after any material modifications to Type A overhead irrigation systems.)

# Initial Assessment Acceptance Criterion:

Non-detectable in two (2) of three (3)-100 mL samples and 10 MPN as the single sample maximum for

The purpose of this assessment is to confirm that the water's microbial quality is not being degraded as it passes through your system (i.e., due to equipment conditions). The assessment is performed to verify that your irrigation water delivery system is able to maintain and deliver water of the same microbial quality (e.g., Type A) as the source water. Unless there is a material change to your system (e.g., change in equipment or type of watertreatment), this is a one-time assessment for each irrigation system, and it is not necessary to repeat system evaluations for each irrigation event.

To test your water delivery systems, sample and test irrigation water during an irrigation event. All discrete systems are to be tested before entering the 21-days-to-scheduled-harvest time frame. To assess the water delivery system, water samples are taken throughout the system with at least one sample at the endof the line where water contacts the crop.

# Initial Assessment Testing

If at least two (2) in three (3) samples do not have detectable levels of generic *E. coli*, and the level in the one remaining sample is no greater than ( $\leq$ ) 10 MPN, then the water system maintains its Type A status.

If water samples do not meet the acceptance criteria (i.e., if two (2)or more of the samples have detectable levels of generic *E. coli* <u>or</u> the level in at least one sample is greater than (>) 10 MPN), then conduct the following follow-up testing:

low-up Testing or to the next irrigation event perform a root cause analysisand an icultural water system assessment as described in Appendix A to ntify and correct the failure. er assessing the system, retest the system for generic <i>E. coli</i> in five -100 mL samples collected during the next irrigation event using the npling procedure and frequency (described in the left column). ter samples can be pulled from the endof any system des/branches in the irrigation system of concern. Of the five (5) ow-up samples, four (4) must have no detectable generic <i>E. coli</i> and one (1) remaining samplemust have levels no greater than (≤) 10 <sup>IN</sup> generic <i>E. coli</i> / 100mL. est results meet the acceptance criterion for generic <i>E. coli</i> ,the			
by to the next irrigation event perform a root cause analysisand an icultural water system assessment as described in Appendix A to ntify and correct the failure. The er assessing the system, retest the system for generic <i>E. coli</i> in five 100 mL samples collected during the next irrigation event using the npling procedure and frequency (described in the left column). The ter samples can be pulled from the endof any system des/branches in the irrigation system of concern. Of the five (5) ow-up samples, four (4) must have no detectable generic <i>E. coli</i> and to one (1) remaining samplemust have levels no greater than ( $\leq$ ) 10 mL generic <i>E. coli</i> / 100mL.			
er assessing the system, retest the system for generic <i>E. coli</i> in five 100 mL samples collected during the next irrigation event using the npling procedure and frequency (described in the left column). ter samples can be pulled from the endof any system des/branches in the irrigation system of concern. Of the five (5) ow-up samples, four (4) must have no detectable generic <i>E. coli</i> and o ne (1) remaining samplemust have levels no greater than ( $\leq$ ) 10 N generic <i>E. coli</i> / 100mL. est results meet the acceptance criterion for generic <i>E. coli</i> , the			
ter samples can be pulled from the endof any system des/branches in the irrigation system of concern. Of the five (5) ow-up samples, four (4) must have no detectable generic <i>E. coli</i> and one (1) remaining samplemust have levels no greater than ( $\leq$ ) 10 N generic <i>E. coli</i> / 100mL. est results meet the acceptance criterion for generic <i>E. coli</i> , the			
est results meet the acceptance criterion for generic <i>E. coli</i> , the			
ter system can be used as a Type A system.			
ting Failure: When one sample has more than (>) 10 MPN generic <i>E.</i> ( / 100 mL or more than one sample have detectable generic <i>E. coli</i> , agricultural water system is disqualified for TypeA usage. Perform a ot cause analysis to identify and correct the failure (see Appendix A mitigation measures). In the interim, the water can be used as a be B agricultural water system.			
Test Method: Any FDA-allowed method <sup>2</sup>			
<b>Records:</b> Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for a period of two years.			
B3. Routine Verification of Microbial Water Quality			
verify irrigation water continues to meet the acceptance criterion oughout the season, design your sampling plan so eachdistinct gation system that is in use is sampled and tested at least once ring the season. wo (2) or more of the samples have detectable levels of generic <i>E.</i>			

# Routine Verification SamplingFrequency:

Sample and test each distinct irrigationsystem for generic *E. coli* at least once during the season.

#### Routine Verification AcceptanceCriterion:

Non-detectable generic *E. coli* in 100

Metric	Rationale /Remedial Actions	
mLwater samples and <u>&lt;</u> 10 MPN as the single sample maximum for one (1) in three (3) samples		
<b>Note</b> : For the purposes of water testing, MPN and CFU are considered equivalent.		
Test Method: Any FDA-allowed method <sup>2</sup>		
<b>Records:</b> Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for a		

period of two years.
# 359 FIGURE 2A. Irrigation Water from Type A Agricultural Water Systems Sourced from Public / Private

# **Providers – See TABLE 2B**



# FIGURE 2B. Irrigation Water from Type A Agricultural Water Systems Sourced from Public / Private Providers – See TABLE 2B

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### **ROUTINE MONITORING of MICROBIAL WATER QUALITY**

- For Type A agricultural water from public/private sources for overhead applications when used within (<) 21 days of thescheduled harvest date. (When using Type A agricultural water from these sources for overhead applications up to (>) 21days of the scheduled harvest date follow water metrics in Table 2E/Figure 5 for Type B agricultural water systems.)
- Aseptically collect three (3) samples during one irrigation event with at least one sample taken at the end of the deliverysystem (e.g., last sprinkler head); each distinct irrigation system must be tested at least once during the season.
- Test for generic *E. coli* using a FDA-allowed method and assess microbial quality using the three (3) collected samples.

### ACCEPTANCE CRITERIA

No detectable generic *E. coli* in at least 2 of 3 consecutive samples and < 10 MPN in one remaining sample

No further action necessary. Water may be used in leafy green operationsas outlined in Table 2B.

### ACTION LEVEL

Generic E. coli detected in > 2 samples or one samplehas levels above (>) 10 MPN / 100 mL

### CONDUCT A LEVEL 1 ASSESSMENT:

- If generic *E. coli* levels in your water exceed the acceptance criterion, prior to the next irrigation event conduct an agricultural water system assessment as described in Appendix A and retest water (as described in step #2 below) until it is shown to be back in compliance with the acceptance criterion.
- During the next irrigation event, collect 5 100 mL samples from the irrigation system and test for generic *E. coli*. Water can be pulled from the end of any system nodes/branches in the irrigation system of concern. If these water samples also fail to meet the acceptance criterion, discontinue use of this water for overhead applications while continuing to evaluate your water system to identify and correct any failures and continuing to testas described in this step until the water is back in compliance (see AppendixA for guidance on troubleshooting irrigation system failures).
- If this water (i.e., the water from the initial sampling to the last of the follow-up sampling) has been applied to leafy greens, either consider the crop unsuitable for the fresh market or test the crop from all affected lots (i.e., lots that have been irrigated with this water within the <21 days-to- scheduled-harvest window) for STEC (including *E. coli* O157:H7) and *Salmonella*. Product needs to be tested prior to harvesting and after your last irrigation event. Sample crop per the protocol described in Appendix C.If any individual sample tests positive for any of these human pathogens, the crop within that lot shall NOT be harvested for the fresh market and human consumption.

# TABLE 2C. Irrigation Water from Type A Agricultural Water Systems Sourced from Private Wells or Regulated Tertiary Treated Recycled Water Supplies – See FIGURE 3A-3C

Metric	Rationale /Remedial Actions
<ul> <li>Examples of water from Type A agricultural water systems:</li> <li>Regulated recycled wastewater</li> <li>Water sourced from a well – well water is conveyed to the field in a closed delivery system and applied to the crop via overhead sprinklers.</li> </ul>	Irrigation water from Type A agricultural water systems with well source water would not be expected to contain generic <i>E.</i> <i>coli</i> due to natural filtration as the water passes through the soil. Water from regulated tertiary treated recycled water supplies may have low levels of generic <i>E. coli</i> due to regulatory allowable limits. Type A agricultural water systems must be stored and conveyed in well-maintained, closed systems and tested for generic <i>E. coli</i> . Remedial actions vary depending on when the water is being used in relation to harvest.
C1. Baseline Microbial Assessment	
Target Organisms: Generic E. coli	
Baseline Assessment Sampling Procedure:If historical water test data is notavailable, aseptically collect at least three(3)-100 mL sample at the source.Baseline Assessment Sampling Frequency:Sample and test the water two times (withsample and test the water two times (withsample and test the water two times (withsample genetic separated by no less than7 days) before using the water within the21-days-to-scheduled-harvest-window.Baseline Assessment Acceptance Criteria:Non-detectable generic <i>E. coli</i> in five (5) ofsix (6) 100 mL samples and < 10 MPN as	The purpose of a baseline assessment is to ensure your water source (e.g., a well or regulated tertiary treated recycled water) meets the microbial standards for generic <i>E. coli</i> . This baseline microbial assessment must be conducted before these Type A water sources can be used for overhead irrigation within 21-days to-scheduled-harvest. For agricultural water systems with multiple wells, each well must be tested prior to use in order to validate the integrity of the agricultural water system. <u>Self-certification with historical water test data:</u> If at least four (4) of the last five (5) consecutive historical water tests (80%) have no detectable generic <i>E. coli</i> , the remaining one (1) sample does not exceed ( $\leq$ ) 10 MPN in 100 mL, and one (1) of those tests was taken within the last 6 months, then the well/regulated tertiary treated recycled water supply is self- certified as a Type A agricultural water source.
<b>Note</b> : For the purposes of water testing, MPN and CFU are considered equivalent.	Self-certification process when no historical data is available: If historical data is unavailable, test each well or regulated recycled water twice (separated by no less than seven days) prior to use as the source water for a Type A agricultural water system. If at least five (5) of the six (6) total samples have no detectable generic <i>E. coli</i> and the remaining sample has $\leq$ 10 MPN in 100 mL, then the water/well is self-certified as a Type A agricultural water source. <u>Testing Failure</u> : If test results do not meet the acceptance criteria, then the water/well cannot be considered a Type A agricultural water source. Perform a root cause analysis and an agricultural water system assessment as described in Appendix A to identify and correct the failure. In the interim, the water can be treated or used as a source for a Type B agricultural water

Metric	Rationale /Remedial Actions	
	system.	
Test Method: Any FDA-allowed method <sup>2</sup>		
<b>Records:</b> Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for aperiod of two years.		
C2. Initial Microbial Water Quality Assessmer	nt	
Target Organism: Generic E. coli		
Initial Assessment Sampling Procedure: Aseptically collect at least three (3)-100 mL during one irrigation event at the end of thedelivery system (e.g., last sprinkler head).	The purpose of this assessment is to confirm that the water's microbial quality is not being degraded as it passes through your system (i.e., due to equipment conditions). The assessment is performed to verify that your irrigation water delivery system is able to maintain and deliver water of the	
Initial Assessment Sampling Frequency: This is a one-time seasonal sampling event for each system with samples collected during one irrigation event occurring beforethe 21-day-to-scheduled- harvest-period begins. (Also conduct this assessment after any material modifications to Type A overhead irrigation systems.)	Same microbial quality (e.g., Type A) as the water source. Unless there is a material change to your system (e.g., changein equipment or type of water treatment), this is a one-time assessment for each irrigation system, and it is not necessary to repeat system evaluations for each irrigation event. To test your water delivery systems, sample and test irrigation water during an irrigation event. All discrete systems are to be tested before entering the 21-days-to-scheduled-harvest timeframe. To assess the water delivery system, water samples are taken at the end of the line where water contactsthe crop.	
Initial Assessment Acceptance Criteria: Non-detectable generic <i>E. coli</i> in two (2) ofthree (3)-100 mL samples and ≤ 10 MPN asthe single sample maximum for one (1) sample.	Initial Assessment Testing If at least two (2) in three (3) samples do not have detectable levels of generic <i>E. coli</i> , and the level in the one remaining sample is no greater than ( $\leq$ ) 10 MPN, then the water system maintains its Type A status.	
Follow-up Testing Acceptance Criteria: Non-detectable in four (4) of five (5)-100 mLsamples and $\leq$ 10 MPN as the single sample maximum for one (1) sample.	If water samples do not meet the acceptance criteria (i.e., iftwo (2) or more of the samples have detectable levels of generic <i>E. coli</i> <u>or</u> the level in at least one sample is greater than (>) 10 MPN), then conduct the following follow-up testing:	
<b>Note</b> : For the purposes of water testing, MPNand CFU are considered equivalent.	<ol> <li>Follow-up Testing</li> <li>Prior to the next irrigation event perform a root cause analysis and an agricultural water system assessment as described in Appendix A to identify and correct the failure.</li> <li>After assessing the system, retest the system for generic <i>E. coli</i> in five (5)-100 mL samples collected during the next irrigation event using the sampling procedure and frequency (described in the left column). Water samples can be pulled from the end of any system nodes/branches</li> </ol>	

Metric	Rationale /Remedial Actions
	<ul> <li>in the irrigation system of concern. Of the five (5) follow-up samples, four (4) must have no detectable generic <i>E. coli</i> and the one (1) remaining sample must have levels no greater than (&lt;) 10 MPN / 100 mL.</li> <li>3) If test results meet the acceptance criterion for generic <i>E. coli</i>, the water system can be used as a Type A system.</li> <li><u>Testing Failure</u>: When one sample has more than (&gt;) 10 MPN / 100 mL or more than one sample have detectable generic <i>E. coli</i>, the agricultural water system is disqualified for Type A usage. Perform a root cause analysis to identify and correct the failure (see Appendix A for mitigation measures). In the interim, the water can be used as a Type B agricultural water system.</li> </ul>
<b>Test Method:</b> Any FDA-allowed method <sup>2</sup>	
<b>Records:</b> Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for a period of two years.	
C3. Routine Verification of Microbial Water Quality	
Target Organisms: Generic E. coli	
Sampling Procedure Three (3)-100 mL samples aseptically collected at the end of the delivery system (e.g., the last sprinkler head).	To verify irrigation water continues to meet the acceptance criterion throughout the season, design your sampling plan so each distinct irrigation system that is in use is sampled and tested at least once during the season.
Sampling Frequency Sample and test each distinct irrigation system for generic <i>E. coli</i> at least once during the season.	If two (2) or more of the samples have detectable levels of generic <i>E. coli</i> <u>or</u> the level in at least one sample is greater than (>) 10 MPN, prior to the next irrigation event perform a <b>Level 1</b> <b>Assessment</b> as outlined in Table 2F.
Acceptance Criterion	
Non-detectable generic <i>E. coli</i> in 100 mL water samples and <u>&lt;</u> 10 MPN as the single sample maximum for one (1) in three (3) samples	
<b>Note</b> : For the purposes of water testing, MPN andCFU are considered equivalent.	
Test Method: Any FDA-allowed method <sup>2</sup>	
<b>Records:</b> Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for a period of two years.	

FIGURE 3A. Irrigation Water from Type A Agricultural Water Systems Sourced from Private Wells or
 Regulated Tertiary Treated Recycled Water Supplies – See TABLE 2C

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# **BASELINE MICROBIAL ASSESSMENT** Self-certification with historical water If historical data is unavailable: test data: To self-certify, take three (3)-100 mLsamples Assessment conducted using historical at the water source on two sampling occasions water test records consisting of 5 separated by $\geq$ 7 days. consecutive water test results - one of which occurred in the last 6 months. ACTION LEVEL Generic *E. coli* detected in > 2 samples **ACCEPTANCE CRITERIA** or one sample has levels above (>) 10 MPN /100 mL No detectable generic *E. coli* in all but one sample and no greater than 10 MPN in that one sample Water source cannot be considered part of a Type A agricultural water system. Water source is self-certified; no further action necessary until the initial microbial water quality assessment. **REMEDIAL ACTION** • Perform a root cause analysis and an agricultural water system assessment as described in Appendix A to identify and correct the failure. • In the interim, the water can be treated or used as a source for a Type B agricultural water system. If you choose to treat the water, follow Type $B \rightarrow A$ water system requirements. • See Appendix A for guidance on mitigation measures such as shock treatment for contaminated wells.

# 370 FIGURE 3B. Irrigation Water from Type A Agricultural Water Systems Sourced from Private Wells or

371 Regulated Tertiary Treated Recycled Water Supplies – See TABLE 2C



# 373 FIGURE 3C. Irrigation Water from Type A Agricultural Water Systems Sourced from Private Wells or

- 374 Regulated Tertiary Treated Recycled Water Supplies See TABLE 2C
- 375

# **ROUTINE MONITORING of MICROBIAL WATER QUALITY**

- For Type A agricultural water from regulated recycle water / private well sources for overhead applications when used within (<) 21 days of the scheduled harvest date. (When using Type A agricultural water from these sources for overhead applications up to (>) 21 days of the scheduled harvest date follow water metrics in Table 2E/Figure 5 for Type B agricultural water systems.)
- Collect three (3) samples at the end of the delivery system (e.g., last sprinkler head); test each distinctirrigation system in use at least once during the season.
- Test for generic *E. coli* using a FDA-allowed method.
- Assess microbial quality using the three (3) collected samples.

### **ACCEPTANCE CRITERIA**

No detectable generic *E. coli* in at least 2 of 3 consecutive samples and  $\leq$  10 MPN in one remaining sample

No further action necessary. Water may be used in leafy green operationsas outlined in Table 2C.

### ACTION LEVEL

Generic *E. coli* detected in  $\ge 2$ samples or one samplehas levels above (>) 10 MPN / 100 mL

### CONDUCT A LEVEL 1 ASSESSMENT:

- If generic *E. coli* levels in your water exceed the acceptance criterion, prior to the next irrigation event, conduct an agricultural water systemassessment as described in Appendix A.
- Retest the water for generic *E. coli* during the next irrigation event in five (5) 100 mL samples. Water can
  be pulled from the end of any system nodes/branches in the irrigation system of concern. If these water
  samples also fail to meet the acceptance criterion, discontinue use of this water for overhead applications
  while continuing to evaluate your water system to identify and correct any failures and continuing to test
  as described in this step until the water is back in compliance (see Appendix A for guidance on
  troubleshooting irrigationsystem failures).
- If this water (the water from the initial sampling to the last of the follow-up sampling) has been applied to leafy greens, either consider the crop unsuitable for the fresh market or test the crop from all affected lots (i.e., lots that have been irrigated with this water within the <21 days-to-scheduled-harvest window) for STEC (including *E. coli*O157:H7) and *Salmonella*. Product needs to be tested prior to harvesting and after your last irrigation event. Sample crop per the protocol described in Appendix C. If any individual sample tests positive for any of these human pathogens, the crop within that lot shall NOT be harvested for the fresh market and human consumption.

# 376 **TABLE 2D:** Irrigation Water from Treated Type B → A Agricultural Water Systems – See FIGURE 4.

Metric	Rationale /Remedial Actions
Example of treated water from a Type B→A agricultural water system: Water may arrive at the production area in an irrigation district canal or lateral from which it is pumped and treated before being used in overhead sprinkler irrigation.	When water from a Type B agricultural water system is used in an overhead application within ( $\leq$ ) 21 days to thescheduled harvest date, it must be treated to move it from a Type B agricultural water system to a Type A system (B $\rightarrow$ A) by a scientifically valid antimicrobial watertreatment - i.e., contain an approved antimicrobial watertreatment at sufficient concentration to prevent potential contamination risk during overhead applications.
	Microbial and/or physical/chemical testing of the source and system must be performed, as appropriate to the specific operation, to demonstrate that performance criteria have been met before use within ( $\leq$ ) 21 days to the scheduled harvest date and continues to be met throughout its use.
	Water in open delivery systems (e.g., reservoirs and ponds) may be used in overhead applications within 21 days to the scheduled harvest if it is treated at the sametime it is applied to crops.

# D1. Routine Verification of Microbial Water Quality

# **Target Organisms:**

- Total coliforms (TC)
- Generic E. coli

# Routine Verification Sampling Procedure:

Aseptically collect at least three (3)-100 mL samples during one irrigation event with at least one sample at the end of the delivery system (e.g., last sprinkler head).

# **Routine Verification Sampling Frequency:**

Sampling is conducted monthly.

If the irrigation treatment system is being used prior to the 21-days-to-harvest-window, sample and test each distinct irrigation treatment system on at least one occasion.

If the irrigation treatment system is being used within the 21-days-to-harvest-window, sample each distinct irrigation treatment system on at least two occasions separated by at least three (3) days. Routine water sampling is performed to verify irrigation water continues to meet the microbial quality acceptance criteria throughout the season. Routine verification of treated irrigation water systems is focusedon the function of the system. Sampling needs to occur at a frequency that allows operators to verify they have control of their treatment system. An essential component of this verification process is building a dataset so microbial quality can be analyzed to best inform you how to effectively run your water treatment system.

Sample and test the system for total coliforms and generic *E. coli* in three (3)-100 mL samples. To maintainits Type A status, water samples must have:

 no detectable generic *E. coli* in at least two (2) of thethree (3) samples with a maximum level no greater than (<) 10 MPN in the remaining sample, and

Metric	Rationale /Remedial Actions	
<ul> <li>Routine Verification Acceptance Criteria:</li> <li><u>Generic E. coli</u>: No detection in two (2) of the last three (3) water samples with a maximum level of (≤) 10 MPN allowed in one (1) sample [consecutive values]</li> <li>Routine Verification Data Monitoring Criteria:</li> <li><u>Total coliforms</u>: A maximum level of ≤ 99 MPN in 100 mL in all water samples or an adequate log reduction based on the untreated water's baseline total coliforms levels*</li> <li>Note: For the purposes of water testing, MPN and CFU are considered equivalent.</li> </ul>	<ul> <li>data monitoring for total coliforms at a level nogreater than (≤) 99 MPN in 100 mL *</li> <li>* As an alternative to the threshold approach for total coliforms (≤ 99 MPN / 100 mL), operators can verify their irrigation treatment system by conducting paired pre- and post-treatment microbial testing of water distribution system (see Appendix A for additional guidance on conducting a log reduction assessment).</li> <li>If two (2) or more of the three (3)-100 mL samples do not meet the acceptance criteria for generic <i>E. coli</i> and at least one sample is greater than (&gt;) 10 MPN and one (1) or more of the total coliforms results do not meet the monitoring criteria, prior to the next irrigation event perform a Level1 Assessment as outlined in Table 2F.</li> </ul>	
Test Method: Any FDA-allowed method <sup>2</sup>		
<b>Records</b> : Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions		

sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for a period of two years.

### **D2.** Routine Water Treatment Monitoring

Antimicrobial water treatments - USEPA-approved for use in agricultural water.

**Target variable:** Antimicrobial irrigation water treatment or manufacturer's operational specifications (e.g., per manufacturer's recommendations, chemical concentration, etc.).

can be shown to have a low degree of variation.
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Test Method: Per label instructions

# Metric

### **Rationale / Remedial Actions**

**Records**: During every irrigation event, treatment-related parameter values such as residual antimicrobial levels, pH, dose settings, UVT, etc. must be documented to demonstrate the system is working as intended. Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for a period of two years.

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### 379 FIGURE 4. Irrigation Water from Type B→A (Treated) Agricultural Water Systems – See TABLE 2D

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381

### **ROUTINE MONITORING of MICROBIAL WATER QUALITY**

- Collect three (3) 100 mL samples during one irrigation event with at least one sample taken at the end of the distribution irrigation system (e.g., last sprinkler head).
- Sample monthly during use and test for generic *E. coli* and total coliforms using a FDA-allowed method.
- If the irrigation system is being used up until 21 days to scheduled harvest, sample each distinct irrigation system on one occasion and follow microbial standards in Table 2E / Figure 5 for Type B agricultural water systems.
- If the irrigation system is being used within the 21-days-to-harvest-window, sample each distinct irrigation system on two occasions separated by at least three (3) days.

Generic *E. coli* detected in  $\geq$  2 samples or level above (>) 10 MPN / 100 mL in a single sample

**ACTION LEVEL** 

### **ACCEPTANCE CRITERIA**

No detectable generic *E. coli* in at least 2 of 3 samples and  $\leq$  10 MPN in one sample

### **DATA MONITORING CRITERIA**

<u>< 99 MPN in 100 mL or an</u>
adequate log reduction based on
the untreated water's baseline
total coliform levels

### No further action necessary.

Water may be used in leafy green operations as outlined in Table 2D.

### CONDUCT A LEVEL 1 ASSESSMENT:

When using Type  $B \rightarrow A$  agricultural water for overhead applications within (<) 21 days of the scheduled harvest date:

- If generic *E. coli* or total coliform levels in your water exceed the acceptance and/or monitoring criteria, pause irrigation and conduct an agricultural water system assessment as described in Appendix A to determine why the treatment was not effective.
- Retest the water for generic *E. coli* and total coliforms during the next irrigation event in five (5) - 100 mL samples. Water can be pulled from any point in the distribution systems in the irrigation treatment system of concern with at least one coming from the last sprinkler head. If these water samples also fail to meet the acceptance and/or monitoring criteria, discontinue use of this water for overhead applications while continuing to evaluate your water system to identify and correct any failures and continuing to test as described in this step until the water is back in compliance (see Appendix A for guidance on troubleshooting irrigation system failures).
- If this water (the water from the initial sampling applied to the crop within 21 days to harvest to the first and last of the follow-up sampling) with generic *E. coli* above the acceptance criteria has been applied to leafy greens, either consider the crop unsuitable for the fresh market or test the crop from all affected lots (i.e., lots that havebeen irrigated with this water within the <21 days-to-scheduled-harvest window) for STEC (including *E. coli* O157:H7) and *Salmonella*. Product needs to be tested prior to harvesting and after your last irrigation event. Sample crop per the protocol described in Appendix C. If any individual sample tests positive for any of these human pathogens, the crop within that lot shall NOT be harvested for the fresh market and human consumption.

# 382 TABLE 2E. Irrigation Water from Type B Agricultural Water Systems Intended for Overhead Irrigation

# 383 prior to 21 days – See FIGURE 5

Metric	Rationale /Remedial Actions
<b>Example of water from a Type B</b> <b>agricultural water system</b> - water may arrive at the field in an irrigation district canal from which itis then used to overhead irrigate crop prior to 21 days to the scheduled harvest date.	Water from Type B agricultural water systems is untreated and exposed to the environment (e.g., open sources and/or delivery systems) so that its quality may be inadequate for overhead irrigation within (≤) 21 days to the scheduled harvest date. Water from these systems is restricted to use in overhead irrigation when applied prior to (>) 21 days to the scheduled harvest date. Also, water from Type A agricultural water systems can be sampled and tested under Type B agricultural water system requirements when it is used for overhead irrigation prior to 21 days before the scheduled harvest date.

# E1. Routine Verification of Microbial Water Quality

# Target Organisms: Generic E. coli

### Routine Verification Sampling Procedure:

100 mL sample collected aseptically at the point-of-use, i.e., one sprinkler head per water source for irrigation, water tap for pesticides, etc. preseason irrigation water may be tested and utilized.

# Routine Verification Sampling Frequency:

One sample per water source shall be collected and tested prior to use if > 60 days since last test of the water source. Additional samples shall be collected no less than 18 hours apart and at least monthly (or at the next irrigation event if greater than monthly) during use from points within the water distribution system.

# Routine Verification Acceptance Criterion:

< **126 MPN / 100 mL** (geometric mean) and <u>< 235 MPN/100mL</u> for any single sample. **Note**: For the purposes of water testing, MPN and CFU are considered equivalent. When using water from Type B agricultural water distribution systems for overhead applications **prior to (>) 21 days** of the scheduled harvest date, samples for microbial testing shall be taken as close as practicable to the point-of-use (i.e., to be determined by the sampler, to ensure the integrity of the sample, using sampling methods as prescribed in Table 2D) so as to test both the water source and the water distribution system. In a closed water distribution system (meaning no connection to the outside) water samples may be collected from any point within the system but are still preferred at the point-of-use. No less than one (1) sample per month (or at the next irrigation event) per water distribution system is required under these metrics. If there are multiple potential point-of-use sampling points ina water distribution system, then samples shall be taken from different point-of-use locations each subsequent sampling event (randomize or rotate sample locations).

Water for pre-harvest, direct edible portion contact prior to (>)21 days before scheduled harvest shall meet or exceed antimicrobial standards for recreational water, based on a rolling geometric mean of the five (5) most recent samples. However, a rolling geometric mean of five samples is not necessarily required prior to irrigation or harvest. If less than five (5) samples are collected prior to irrigation, the acceptance criteria depend on the number of samples taken. For example:

- If only one (1) sample has been taken, it must be below (<)126 MPN / 100 mL.
- Once two (2) samples are taken, a geometric mean can be calculated, and the normal acceptance criteria apply.

If the acceptance criteria are exceeded during this time period, additional samples may be collected to reach a five (5)-sample rolling geometric mean. The *rolling* geometric mean calculation starts after five (5) samples have

Metric	Rationale /Remedial Actions
	been collected. If the water source has not been tested in the past 60 days, the first water sample shall be tested prior to use, to avoid using a contaminated water source. After the first sample is shown to be within acceptance criteria, subsequent samples shall be collected no less frequently than monthly at points-of-use within the water distribution system.
	Ideally, pre-harvest water used prior to 21 days before harvest for overheadapplications should not contain generic <i>E. coli</i> , but low levels do not necessarily indicate that the water is unsafe. Investigation and/or remedial action SHOULD be taken when test results are higher than normal or indicate an upward trend. Investigation and remedial action SHALL be takenwhen acceptance criteria are exceeded.
	<b>Remedial Actions:</b> If the rolling geometric mean (n=5) or any one sample exceeds the acceptance criteria, then the water shall not be used whereby edible portions of the crop are contacted by water until remedial actions have been completed and generic <i>E. coli</i> levels are within acceptance criteria:
	<ul> <li>Conduct an agricultural water system assessment of water source and water distribution system to determine if a contamination source is evident and can be eliminated. Eliminate identified contamination source(s).</li> </ul>
<ul> <li>For wells, perform an agricultural water system assessment and/o treatas described in Appendix A.</li> </ul>	<ul> <li>For wells, perform an agricultural water system assessment and/or treatas described in Appendix A.</li> </ul>
	<ul> <li>Or begin water treatment</li> </ul>
	Retest the water after conducting the agricultural water system assessment and/or taking remedial actions to determine if it meets the outlined microbial acceptance criteria for this use. Retest the water daily, take three samples, no less than 18 hours apart at the point closest to use. This sample should represent the conditions of the original water system, if feasible this test should be at the original sampling point. A more aggressive sampling program (i.e., sampling once per week instead of once per month) or water treatment shall be instituted if an explanation for the exceedance is not readily apparent. This type of sampling program should also be instituted if
	an upward trend is noted in normal sampling results.

Test Method: Any FDA-allowed method<sup>2</sup>

**Records**: Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for a period of two years.

# FIGURE 5. Irrigation Water from Type B Agricultural Water Systems intended for Overhead Irrigation – See TABLE 2E



### **ROUTINE MONITORING of MICROBIAL WATER QUALITY**

- If using > 21 days prior to the scheduled harvest date, collect one (1) 100 mL samples per irrigation water system at the point of use monthly.
- Analyze samples for generic *E. coli* using a FDA-allowable method.
- Calculate geometric means using the five most recent samples.

# ACCEPTANCE CRITERIA

< 126 MPN / 100mL
(geometric mean)</pre>

AND

<u>< 235 MPN / 100 mL in a</u> single sample

### No further action necessary.

Water from this source may be used for any use such as crop foliar applications and/or irrigation up until 21 days to scheduled harvest. However, when test results are higher than normal or indicate an upwardtrend, investigation and/or remedial action **SHOULD** be taken.



- If crop has been directly contacted with water exceeding acceptance criteria, sample and test product for STEC (including *E. coli* O157:H7) and *Salmonella* as described in Appendix C, prior to harvest.
- If crop testing indicates the presence of either pathogen, do NOT harvest for fresh market and human consumption.

### ACTION LEVEL

> 126 MPN / 100mL (geometric mean)

<u>OR</u>

235 MPN / 100 mL in a single sample

### **REMEDIAL ACTIONS:**

- Discontinue use for foliar and direct contact with the edible portion of the plant applications until it returnsto compliance.
- Examine the water source and distribution system to determine if a contamination source is evident and can be eliminated.
- For wells, perform an agricultural water system assessment and/or treat as described in Appendix A.
- After performing an agricultural water system assessment and/or remedial actions, retest the water at the same sampling point.
- Take three samples, no less than 18 hours apart at the point closest to use. If any of these samples is >126 MPN/ 100mL, repeat agricultural water system assessment and/or remedial action.
- Do not use water from that water system, in a manner that directly contact edible portions of the crop, until the water can meet the outlined acceptance criteria forthis use or treat water to meet the acceptance criteria.

# TABLE 2F. Level 1 Assessment - Remedial Actions for Type A and B→A Agricultural Water Systems – See FIGURE 4

Metric	Rationale/Remedial Actions
Target Organisms: Generic E. coli and to	otal coliforms
Remedial Actions Sampling Procedure:	When using agricultural water systems for overhead applications <b>up</b> to (>) 21 days of the scheduled harvest date:
Aseptically collect five (5)-100 mL sample from any point in the delivery system with a minimum of one from the last sprinkler head, i.e., at the last point of contact with the crop - last sprinkler head.	<ul> <li>Follow water metrics in Table 2D for Type B agricultural water systems.</li> <li>When using water from Type A and/or B→A agricultural water systems for overhead applications within (&lt;) 21 days of the scheduled harvest date:</li> <li>Generic E. coli</li> </ul>
<ul> <li>Remedial Actions Sampling Frequency:</li> <li>Sample water during the next consecutive irrigation event after a sample fails the acceptance criterion or monitoring criterion.</li> <li>Remedial Actions Acceptance Criterion for Generic <i>E. coli</i>:</li> <li>80% non-detectable generic <i>E. coli</i> in 100 mL and ≤ 10 MPN as the single sample maximum for one (1) sample</li> <li>Remedial Actions Monitoring Criterion for Total Coliform Monitoring Level Failure:</li> <li>5/5 samples with a maximum level of 99 MPN in 100 mL in all water samples or an adequate log reduction based on the untreated water's baseline total coliform levels (refer to Appendix A for log reduction guidance)</li> </ul>	<ul> <li>1) If generic <i>E. coli</i> levels in your water exceed the acceptance criterion, prior to the next irrigation event conduct an agriculturalwater system assessment as described in Appendix A. During the next irrigation event, collect five (5)-100 mL samples from the irrigation system and test for generic <i>E. coli</i>. Water can be pulled from any point in the delivery systems in the irrigation treatment system of concern with at least one coming from the last sprinklerhead. If these water samples also fail to meet the acceptance criterion, discontinue use of this water for overhead applications while continuing to evaluate your irrigation treatment system to identify and correct any failures and continuing to test as described in this step until the water is back in compliance (see Appendix A for guidance on troubleshooting irrigation treatment system failures).</li> <li>2) If this water (the water from the initial sampling to the last round of sampling) has been applied to leafy greens, test the crop from all affected lots (i.e., lots that have been irrigated with this water within the &lt;21 days-to-scheduled-harvest window) for STEC (including <i>E. coli</i> O157:H7) and <i>Salmonella</i>. Product needs to be tested prior to harvesting and after your last irrigation event. The crop within that lot shall NOT be harvested for the fresh market if either pathogen is present. Sample crop per the protocol described in Appendix C. If any individual sample tests positive for any of these human pathogens, the crop within that lot shall NOT be harvested for human consumption.</li> </ul>
	Total coliforms
	<ol> <li>If these water samples fail to meet the monitoring criterion perform a root cause analysis and continue to evaluate your irrigation treatment system to identify and correct any failures and continuing to test as described in this step until the water is</li> </ol>

	back in compliance (see Appendix A for guidance on troubleshooting irrigation treatment system failures).	
<ol> <li>Water can still be used as a Type A system and no pre-harve pathogen testing is required as long as the generic <i>E. coli</i> acceptance criterion is met.</li> </ol>		
<b>Test Method:</b> Any FDA-allowed method <sup>2</sup>		
<b>Records</b> : Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for a period of two years.		

# 392 TABLE 2G. Harvest Direct Product Contact, Harvest Food-Contact Surfaces, and Hand Wash Water (On

# 393 Farm Practices Only) - See FIGURE 6

Metric	Rationale /Remedial Actions
Water Type: • Municipal • Well (Type A) • Reverse Osmosis Microbial Water Quality Testing	Water used during harvest operations that directly contacts edible portions of harvested crop, water used forhand washing, or is used on food-contact surfaces such asequipment or utensils, shall be sourced from municipal, well (Type A) or reverse osmosis water sources.
Target Organism: Generic E. coli	
<ul> <li>Sampling Procedure:</li> <li>Prior to use in harvest equipment, a 100 mL sample collected aseptically at the water source.</li> <li>Sampling Frequency:</li> <li>One sample per water source shall be collected and tested prior to use if &gt;60 days since last test of the water source. Additional samples shall be collected at intervals of no less than 18 hours and at least monthly during use.</li> <li>For wells and municipal water sources, if generic <i>E. coli</i> are below detection limits for five consecutive samples, the requirements for 60 days and monthly sampling are waived, and the sampling frequency may be decreased to no less than once every 180 days. This exemption is void if there is a significant water source or distribution system change.</li> <li>Reverse Osmosis Systems: No less than one (1) sample per month per system is required.</li> <li>Test Method:</li> <li>Any FDA allowed method<sup>2</sup></li> <li>Acceptance Criteria:</li> <li>Negative or below DL for all samples</li> </ul>	<ul> <li>Testing must be conducted to demonstrate that this water meets the Maximum Contaminant Level Goal for generic <i>E. coli</i> as specified by U.S. EPA or contain an approved disinfection method at sufficient concentration or of sufficient wavelength to prevent cross-contamination.</li> <li>Microbial or physical/chemical testing shall be performed, as appropriate to the specific operation, to demonstrate that acceptance criteria have been met.</li> <li>Single-Pass vs. Multiple-Pass Systems</li> <li>Single-pass use – Water must have non-detectable levels of generic <i>E. coli</i> or breakpoint disinfectant present at point of entry.</li> <li>Multi-pass use – Water must have non-detectable levels of generic <i>E. coli</i> and/or sufficient disinfectant toensure multi-pass water has no detectable generic <i>E. coli</i>.</li> <li>Remedial Actions:</li> <li>Develop an SOP that determines what corrective actions will be required when harvest water does not meet acceptance criteria, then DO NOT USE THE WATER until remedial actions have been completed and generic <i>E. coli</i> or disinfectant levels arewithin acceptance criteria;</li> <li>Conduct an agricultural water system assessment of water source and distribution system to determine if</li> </ul>

Metric	Rationale /Remedial Actions
<ul> <li>Physical/Chemical Testing</li> <li>Target Variable:</li> <li>Water disinfectant (e.g., UV transmittance, chlorine or other disinfectant compound).</li> <li>Multi-Pass Water Acceptance Criteria:</li> <li>Chlorine <ul> <li>1 ppm free chlorine after application and pH 5.5 – 7.5</li> <li>Other approved treatments per product EPA label for human pathogen reduction in water.</li> </ul> </li> <li>Testing Procedure: <ul> <li>Chemical reaction-based colorimetric test, or</li> <li>Ion-specific probe, or</li> <li>UV transmittance</li> <li>Other as recommended by disinfectant supplier.</li> </ul> </li> <li>Testing Frequency: <ul> <li>Prior to first use on day of harvest.</li> <li>During harvest, samples shall be taken at routine intervals (i.e., hourly, breaks, lunch, etc.) as determine by historical data showingtypical degree of variation.</li> </ul> </li> </ul>	<ul> <li>a contamination source is evident and can be eliminated.Eliminate identified contamination source(s) and/or treat with appropriate disinfectants.</li> <li>For wells, perform an agricultural water system assessment and/or treat as described in Appendix A.</li> <li>Retest the water at the same sampling point after conducting the agricultural water assessment for waterused for harvest and/or taking remedial actions to determine if it meets the outlined microbial acceptancecriteria for this use.</li> <li>For example, if the water intended for use on food- contact surfaces has detectable generic <i>E. coli</i>, DO NOT USE THE WATER.</li> <li>Examine the distribution line and source inlet as described in Appendix A and retest from the same point of use.</li> <li>After corrective actions have been implemented and verifiedthe water may be used for harvest operations and hand wash water.</li> </ul>
<b>Records</b> : All test results and remedial actions shall be documented and available for verification from the user of the	

# 396 FIGURE 6. Harvest Direct Product Contact, Harvest Food-Contact Surfaces, and Hand Wash Water (On-

397 Farm Practices Only) – See TABLE 2G

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### Water Type: Municipal, Wells (Type A), and Reverse Osmosis:

Water that directly contacts edible portions of harvested crop shall meet microbial standards set forth in U.S. EPA National Drinking Water Regulations and/or contain an approved disinfectant at sufficient concentration to prevent cross-contamination.

### SAMPLING FREQUENCY:

One sample per water source shall be collected and tested prior to use if > 60 days since last test of the water source. Additional samples shall be collected no less than 18 hours apart and a least monthly during use.

- Sample sources using sampling methods as prescribed in Table 2G.
- Analyze samples for generic *E. coli* using any FDA allowed method.

### ACCEPTANCE CRITERIA

Negative or below DL /100 mL generic *E. coli* 

OR

### MULTI-PASS WATER ACCEPTANCE CRITERIA

Chlorine ≥1 ppm free chlorine (pH 5.5 - 7.5) OR

Sufficient disinfectant; physical treatment - sufficient wavelength to prevent cross- contamination. Other approved treatments per product EPA label for human pathogen reduction in water.

No further action necessary. Water from this source may be used for anypurpose.

### ACTION LEVEL

Positive generic E. coli

### **REMEDIAL ACTIONS:**

- DO NOT USE THE WATER.
- Follow your SOP for corrective action to bring water backinto compliance with the acceptance criteria.
- For wells, perform an agricultural water system assessment and/or treat as described in Appendix A.
- After agricultural water system assessment on water usedfor harvest and/or remedial actions have been taken, retest the water at the same sampling point.
- After corrective actions have been implemented and verified the water may be used for harvest operations.
- If water exceeding the acceptance criteria has been used during harvest, it is NOT appropriate microbial quality for this use. Sample and test product for STEC including *E. coli* O157:H7 and *Salmonella* as described in Appendix C.

# 2024 CA LGMA Amendment Process Report - Water Revisions

Proposal Submitted by the AZ LGMA



# COMMODITY SPECIFIC FOOD SAFETY GUIDELINES

FOR THE PRODUCTION AND HARVEST OF LETTUCE AND LEAFY GREENS



SEPTEMBER 20, 2023 This document supersedes all previously published versions of the Commodity Specific Food Safety Guidelines for the Production and Harvest of Leafy Greens including those dated on or before March 30, 2023.

> Adopted by the California Leafy Green Products Handler Marketing Agreement Advisory Board Document managed by Western Growers - learn more at www.leafygreenguidance.com

#### 2 6. ISSUE: WATER

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3 The safety of whole fresh and fresh-cut (e.g., bagged salad) leafy greens is a longstanding issue. Leafy greens are mostly consumed raw without cooking or processing steps to eliminate microbial hazards. Therefore, the way they are grown, 4 5 harvested, packed, held, processed, and distributed is crucial to ensuring that the risk of human pathogen 6 contamination is minimized. LGMA recognizes that different crop characteristics may impact susceptibility to adhesion and internalization of hazards. These metrics are intended to prioritize risk by classifying agricultural water systems for 7 8 specific uses within leafy greens operations. Remedial actions follow a "find and fix" structure to identify and correct 9 both system nonconformities and more serious failures. These metrics should be considered the minimum controls necessary to assess agricultural water systems for fitness of use. 10

### <sup>11</sup> General Agricultural Water Management - The Best Practices Are:

- Agricultural water systems are a function of the source, storage, and conveyance. Each component of an agricultural water system that is within your control must be evaluated to ensure that the quality of agricultural water used in leafy green operations is known (i.e., the required parameters are measured and conform to the prescribed standards) and adequate for its intended use.
- It's prudent to evaluate and make a good faith effort to address the food safety hazards proximate to your agricultural water systems that may not be under your control.
- NEVER use water from any water system that has not been microbially characterized and assessed as
   described below.
- Prior to annual use of the water in agricultural operations perform a written agricultural water assessment, as
   described in Appendix A prior to use of water in agricultural operations. An agricultural water system
   description shall be prepared. The water assessment must identify conditions that are reasonably likely to
   introduce known or reasonably foreseeable hazards into or onto the leafy greens. The assessment must address
   the following elements:
  - This A description (including the location and nature) of the agricultural water source and the type of distribution system shall be created. Information in the description shall include permanent fixtures such as wells, gates, reservoirs, valves, returns and other permanent above ground fixtures and could also include non-permanent features such as tanks, drip stations, gas power pumps, pipes, water treatment systems, etc. that make up a complete irrigation system. This could be achieved by using maps, photographs, drawings or other means to communicate the location of permanent fixtures and the flow of the water system (including any water captured for re-use or other natural or managed features which prevent environmental runoff from entering the water system).
  - O Water sources and the production blocks they may serve should be documented.
    - The degree of protection from possible sources of contamination, including by other water users; animal impacts; and adjacent and nearby land uses related to animal activity (for example, grazing or commercial animal feeding operations of any size), application of biological soil amendment(s) of animal origin, or presence of untreated or improperly treated human waste.
  - Documented agricultural water practices for each agricultural water system, including the application methods as described in Table 1, water sources and the production blocks they may serve.
- Manage and maintain all components of your agricultural water system that are within your control including
   the water source and the on-ranch (farm) distribution /conveyance system(s) must be managed and
   maintained in a manner that minimizes human pathogen contamination.
- Testing water at the end of the delivery system (e.g., the last sprinkler head) or the point-of-use is essential for
   ensuring water that contacts the crop is of adequate microbial quality.

**Commented [KVH1]:** AZLGMA Technical Subco: Would like Appendix A reference to remain in place in this section. (refer to Appendix A) or as described in Appendix A.

**Commented [KVH2]:** AZLGMA Technical Subco: Would like clarification to ensure that the direction the water travels down furrow rows would not need to be described in the assessment.

**Commented [KVH3]:** This is new proposed language that is not tracked on the proposed document. AZLGMA Technical Subco: would like clarification on what tanks are being referred to here. Fertilizer tanks, and water treatment systems are often set up and removed throughout the growing season. Would the expectation be to update the description each time these are removed or added? Similarly, gas powered pumps are often replaced if maintenance is required, would re-assessment in changes in their placement be expected?

- For surface water sources, consider the impact of storm events on irrigation practices. Bacterial loads in surface
   water are generally much higher after a storm than normal, and caution shall be exercised when using these
   waters for irrigation.
- Water systems that convey untreated human or animal waste are never suitable for use in leafy greens
   operations in any manner and must be separated from conveyances utilized to deliver agricultural water.
- Water records must be reviewed, dated, and signed, within a week after the records are made, by a
   supervisor or responsible party.

#### Hazard Analysis – Step 1: Assessment of Agricultural Water Systems

Evaluating food safety hazards from agricultural water applications in leafy green operations must take into account
 the quality of the agricultural water system, how the agricultural water will be applied, and when it will be applied.
 Prior to using water in any leafy green operation, conduct an agricultural water system assessment (including source,
 storage, and conveyance as described in Appendix A) and determine the agricultural water system type.

- 57 There are two types of agricultural water systems used in leafy green operations:
- Type A: Agricultural water that is unlikely to contain indicators of fecal contamination either due to natural
   hydrogeologic filtration or through controlled USEPA and state regulated treatment regime as demonstrated
   by an agricultural water system assessment as outlined in Appendix A, microbial testing, and when applicable,
   treatment verification.
- **Type B:** All other agricultural water systems.

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- Source: Evaluate each agricultural water source used in your leafy green operations and determine its type.
  - a) Some agricultural water sources are supplied by a third-party provider that certifies the water is of adequate microbial quality (i.e., unlikely to contain indicators of fecal contamination). Example of these sources are:
    - Public (e.g., municipal) or private providers that deliver certified potable water achieved through treatment or some other process
- b) Some agricultural water sources deliver water of appropriate microbial quality due to natural physical, chemical, and biological processes that filter water as it passes through the soil. Examples of these sources for Type A agricultural water systems are:
  - Wells constructed in a manner such that contamination from outside sources (e.g., surface water
    or other surface chemical or biological influences / effects) is unlikely (e.g., well heads are
    protected, maintained, and monitored; see Appendix A for additional guidance), and water is
    tested to conform to standards.
  - Regulated recycled water (e.g., tertiary treated, purple pipe, etc.) providers that treat, test, and deliver water that is suitable for use in agricultural applications.<sup>1</sup>
  - c) Some agricultural water sources are part of a Type A system due to on-ranch treatment that, when

<sup>&</sup>lt;sup>1</sup> State regulations vary for recycled water. In some states recycled water for produce production allows a certain level of generic *E. coli*, total coliforms, and/or fecal coliforms.

<sup>3</sup> 

80 81	operating under validated and verifiable parameters, turns Type B water into Type A. An example of a water source used in a Type B $\rightarrow$ A agricultural water system is:
82	Treated surface water (verified to conform to standards)
83 84 85 86	d) Some agricultural water sources are considered part of a Type B system because they are vulnerable to contamination and have not been treated to achieve adequate microbial reduction and shall be used in a manner that minimizes contamination of the crop. Examples of water sources in a Type B agriculture water system are:
87 88	<ul> <li>Wells that may be vulnerable to contamination by outside sources including surface waters or by other surface chemical or biological influences / effects)</li> </ul>
89	Untreated surface water
90 91 92 93 94 95 96	2) Storage and conveyance: Agricultural water source is only one component of an agricultural water system. An agriculture water system that starts out with water of appropriate microbial quality at the source may change quality as it progresses through the delivery system. Microbial water quality depends on the properties of the agricultural water system's components and how they are maintained (for more on system maintenance, see the section below on Best Practice for Managing Storage and Conveyance Systems). Agricultural water systems are typically opened or closed. For the purposes of this document, these systems are defined as follows:
97 98 99 100 101	<ul> <li><u>Closed delivery systems</u> store or convey agricultural water in a manner that does not expose it to the outside environment and where water maintains the initial source type. Water from closed delivery systems must be tested at the end of the system to verify water quality is unchanged as it moves through the system. Additional details about testing requirements for a closed delivery system are provided in Tables 2B and 2C, and guidance is provided in Appendix A.</li> </ul>
102 103 104 105 106 107 108	<ul> <li><u>Open delivery systems</u>, at some point in the system, store or convey agricultural water in a manner that exposes it to the outside environment (i.e., a reservoir / pond, canal, lateral, uncovered water tank, etc.). Water in open delivery systems (e.g., reservoirs and ponds) may be used in overhead applications within 21 days to the scheduled harvest if it is treated (as described in Table 2D) at the time it is applied to crops. Additional details about testing requirements for an open delivery system are provided in Table 2F pertaining to Type B agricultural water systems, and guidance is provided in Appendix A.</li> </ul>
109 110 111 112	3) System: Each component of an agricultural water system must be evaluated to ensure that the quality of agricultural water used in leafy green operations is known (i.e., the required parameters are measured and conform to the prescribed standards) and adequate for its intended use. Agricultural water use will vary depending on the type of system.
113 114	<ul> <li>When determining whether a system is Type A or B, each component (source, storage, conveyance, etc.) must be individually evaluated in typing an entire system.</li> </ul>
115	• When Type A and B waters are combined, categorize water as Type B.
116	Hazard Analysis – Step 2: How Is Your Agricultural Water System Being Used?
117 118 119	<b>Use/Application method</b> : Risk of leafy green contamination is closely related to how water is used in the production and harvest environment as well as in post-harvest applications (Rock et al., 2019). For this reason, agricultural water requirements vary depending on how it is applied. In leafy green operations, agricultural water is 4

Hazard Analysis – Step 3: When Is Your Agricultural Water System Being Used?

- typically used in aerial (e.g., sprayers, overhead sprinklers, aircraft), ground (e.g., furrow and drip irrigation), and
   post-harvest applications. Agricultural water is also used for cleaning and, when appropriate, sanitizing equipment
   used during production, harvest, and post-harvest activities. Type A, Type B water that is treated to become Type A
- 123 (B→A), and Type B agricultural water systems are suitable for specific uses as described in Table 1.
- 124
- Timing of use: Risk of leafy green contamination is closely related to when agricultural water is applied in the
   production environment. For this reason, requirements for agriculture water that is aerially applied to leafy green
   crops vary depending on when the water is applied (Fonseca et al., 2010; Gutierrez-Rodriquez et al., 2012, 2019;
   Koike et al., 2009; 2010; Moyne et al., 2011; Suslow et al., 2010; Wood et al., 2010).
- A number of environmental factors, including location of the operation, and the climatic conditions of UV, relative
   humidity, precipitation, and temperature, may alter the appropriateness of these time-based requirements. Based
   on the most appropriate, currently available research addressing the risks related to the timing of aerial agricultural
   water application in leafy green operations, time-based requirements are generally divided as follows:
- Within (<) 21 days of the scheduled harvest date
- Greater than (>) 21 days until the scheduled harvest date
- Agricultural water from a Type A agricultural water system used in overhead irrigation within (<)21 days of</li>
   the scheduled harvest must meet the performance requirements for Type A agricultural water systems as
   outlined in Tables 2B and 2C.
- Untreated agricultural water that meets Type A requirements for irrigation water or Type B system that
   meets the performance requirements outlined in Table 2E may be used in aerial applications prior (>) 21 days
   before the scheduled harvest.
- To use agricultural water from a Type B agricultural water system in overhead irrigation within (<)21 days of</li>
   the scheduled harvest date, the water must be treated to become Type A water (B→A) and demonstrated to
   meet the performance requirements as outlined in Table 2D.
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# TABLE 1. Agricultural Water System Uses by Application Method – See TABLE 2A—2G

Application	Agricultural water systems (possible sources)	Treatment methods for use in direct contact with crop	Microbial indicator
<ul> <li>Overhead irrigation and chemical application priorto (&gt;) 21 days before scheduled harvest date</li> <li>Germination</li> <li>Ground chemigation</li> <li>Drip irrigation</li> <li>Furrow irrigation</li> <li>Dust abatement</li> <li>Non-food-contact farm equipment cleaning</li> </ul>	Type A and B agricultural water systems	No treatment necessary if it can be demonstrated t o meet the microbial standards.	generic <i>E. coli</i>
<ul> <li>Overhead applications (including irrigation, pesticide spray, aerial chemigation) applied within (≤) 21 days of scheduled harvest date</li> </ul>	Type A agricultural water systems (closed systems including water from wells, municipalities, tertiary treated and disinfected recycled water e.g., purple valve)	No treatment necessary if it can be demonstrated to meet the microbial standards.	generic <i>E. coli</i>
	Treated Type B→A agricultural water systems with open components such as reservoirs, ponds, canals, laterals, ditches, etc.	Must be treated and tested to demonstrate treatment efficacy and compliance with microbial standards.	generic <i>E. coli</i> and total coliforms
Application			
<ul> <li>Food-contact (harvest) equipment cleaning &amp; sanitizing</li> <li>Hand wash water</li> </ul>	<ul> <li>Water that directly contacts food-contact surfaces such a Maximum Contaminant Leve contain an approved antimic prevent cross-contamination performed, as appropriate to acceptance criteria have bee</li> </ul>	edible portions of harvested s equipment or utensils, mus I Goal for <i>E. coli</i> as specified robial treatment at a concen . Microbial or physical/chem o the specific operation, to de n met.	crop or is used on t meet the by U.S. EPA or tration sufficientto ical testing shall be emonstrate that

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150	Irrigation Water Sampling Plans and Remedial Actions
151 152 153 154	Testing agricultural water systems is one method of gathering evidence that your system is of adequate quality for its intended use. Along with visual monitoring of agricultural water systems, a water quality testing program is a vital best practice for protecting leafy green crops from contamination. To be most effective as a food safety tool, water samples must reflect, to the extent possible, the water at the point of use.
155 156 157 158	<ul> <li>As irrigation system equipment may change locations throughout the season, but water sources are generally at a fixed location, a robust overhead irrigation water quality testing program must include assessments of both the irrigation water source and the irrigation system. Assessing water quality at the end of the delivery system ensures source water quality does not degrade as it moves through the system.</li> </ul>
159	<ul> <li>For the purposes of this document, sampling of agricultural water systems occurs for the following three</li></ul>
160	reasons and Tables 2B-2C follow this framework providing specific details for each assessment's
161	requirements:
162	<ul> <li>Baseline microbial assessments: To "type" your agriculture water <u>source</u> and establish its "known"</li></ul>
163	quality.
164 165	<ul> <li>Initial microbial water quality assessment: To test your agricultural water <u>system</u> prior to use to ensure water is not degraded as it moves through the system.</li> </ul>
166	<ul> <li>Routine system assessments: To monitor the microbial quality of your agricultural water system</li></ul>
167	throughout the season to ensure it continues to meet the microbial water quality standards.
168	<ul> <li>If you are applying water from a Type A agricultural water system greater than (&gt;) 21 days</li></ul>
169	to the scheduled harvest date, you may choose to sample and test your water according to
170	Type B criteria rather than according to Type A criteria; however, Type A baseline (when
171	required) and initial microbial water quality assessments must be conducted before the 21
172	days-before-harvest window closes and routine verification / monitoring begins (per
173	requirements outlined in Tables 2B and 2C).
174	<ul> <li>Routine sampling is a part of building a dataset useful for evaluating individual data points</li></ul>
175	and evaluating trends to gain a better understanding of your agricultural water system.
176	<ul> <li>Non-routine sampling when food safety risks are deemed higher due to specific</li></ul>
177	circumstances (i.e., weather, animal and human activities, discharge, etc.) should also be
178	part of a robust food safety program. In the event that additional risk factors that could
179	affect water quality are observed or measured such as weather, manure application in a
180	nearby field, or animal-related activity, consider conducting additional water testing.
181	<ul> <li>If you are irrigating with Type B→A agricultural water systems, collecting and analyzing</li></ul>
182	water system data is essential for understanding how the treatment functions in your
183	irrigation system and can optimize its effectiveness.
184 185	<ul> <li>All agricultural water systems used in overhead irrigation prior to (&gt;) 21 days before the scheduled harvest date must meet the water quality requirements outlined in Table 2E for Type B agricultural water systems.</li> </ul>
186	<ul> <li>If a Type A or B agricultural water system fails the respective acceptance criteria, follow remedial action</li></ul>
187	steps as outlined in Table 2F (also included in Figures 2B, 3A and 3C). Consider performing root cause
188	analysis to determine if additional preventive measures can be incorporated into the agricultural water
189	system operation.

190 191	• Retain documentation of all test results and/or Certificates of Analysis/Quality Assurance for a period of at least two (2) years.		
192	Best Practice for Managing Storage and Conveyance Systems		
193 194	• Develop a SOP for the maintenance of ancillary equipment and water storage and conveyance components of each agricultural water system used in your operations. The SOP must address:		
195 196 197	<ul> <li>Regularly scheduled visual inspections, including ancillary equipment connected to your storage and conveyance system, to ensure it is in good working order and does not pose a contamination risk to your system.</li> </ul>		
198 199	<ul> <li>Measures to maintain water quality by removing debris and controlling the presence of weeds, algae, tule, trash, and when appropriate, sediment within the grower's control.</li> </ul>		
200 201	<ul> <li>Procedures to control pest access to the storage and conveyance systems (examples may include: avian deterrents, fencing, and rodent monitoring).</li> </ul>		
202 203	<ul> <li>Corrective actions to ensure irrigation pipes and drip tape are microbiologically safe to use if a pest infestation does occur.</li> </ul>		
204 205	<ul> <li>Berms, slopes and diversion ditches for prevention of run-off (i.e., from irrigation or rain) into water storage and conveyance systems.</li> </ul>		
206	<ul> <li>Procedures to ensure standing and/or stagnant water does not pose a contamination risk.</li> </ul>		
207 208	<ul> <li>Management of agricultural water system components used to prepare crop amendments to ensure these activities and equipment are not a contamination source.</li> </ul>		
209 210	<ul> <li>Water used in aerial applications (e.g., pesticide and fertilizer, etc.) within the 21-days-to-harvest window must be from Type A or B→A agricultural water systems. Implement practices to ensure:</li> </ul>		
211 212	<ul> <li>Holding tanks and equipment-mounted application tanks, manifold and boom lines, and nozzles are to be properly maintained and cleaned.</li> </ul>		
213 214	<ul> <li>Water treatment chemistry or approach is compatible with the agricultural chemicals being applied.</li> </ul>		
215	<ul> <li>Establish corrective action procedures for non-compliance scenarios, including:</li> </ul>		
216	<ul> <li>Contaminated source water</li> </ul>		
217	<ul> <li>Animal intrusion</li> </ul>		
218	Contaminating run-off		
219	<ul> <li>Uncontrolled flooding [reference page, line and table]</li> </ul>		
220	Document all corrective measures, cleaning activities, and maintenance.		
221	Best Practice for Furrow Irrigation Systems Management		
222 223	<ul> <li>Agricultural practices, such as irrigation methods, bed configuration, etc., should be implemented in a manner to avoid water from breaching the top of the bed.</li> </ul>		

Agricultural practices, such as equipment movement, irrigation practices, etc., should be monitored at
 headland and tail ditch locations for damaged beds which may allow water to contact the edible portion

226	of the crop
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227	•	Coordinate irrigation events with harvest, to the degree possible, to avoid saturation of the field soil to
228		prevent excessive dirt and mud from getting on the edible portion of the crop, harvest tools (e.g., knives,
229		gloves, etc.), and harvest equipment (e.g., machines, belts, trailers, etc.).

#### 230 Best Practice for Drip Tape Irrigation Systems Management

- Drip tape should be handled, stored, used, and re-used in a manner that prevents damage and contamination to the drip tape.
- While in use, repairs to drip tape should be completed in a timely manner to prevent water contact with
   the edible portion of the crop.

### 235 Best Practice for Managing Irrigation Water Treatment Systems

- The minimum best practices for managing irrigation water treatment are outlined below and must be
   completed. For greater detail refer to Appendix A.
- Prior to 21 days-to-scheduled harvest conduct an initial irrigation water treatment assessment to establish treatment process parameters that will be monitored to ensure consistent treatment delivery and to demonstrate its effectiveness as described in Appendix A.
  - Repeat this assessment if a material change (e.g., change in equipment or type of water treatment) to your system occurs.
- Before using treated water to irrigate crops within the ≤ 21 days-to-scheduled harvest timeframe growers
   must first establish SOP's outlining irrigation treatment and process parameters for all irrigation treatment
   systems unless duplicated systems are in use.
- Confirm that water microbial quality is not being degraded as it passes through each of your water treatment systems (i.e., due to equipment conditions) by performing a microbial water quality assessment during an irrigation event before entering the ≤ 21 days-to-scheduled harvest timeframe.
- Collect three (3)-100 mL samples from 3 different sprinkler heads with at least one sample from the farthest/last sprinkler head. Acceptance Criteria and Data Monitoring Criteria as outlined in Table 2D -Routine Monitoring of Microbial Water Quality must be met.
- Best Practice Water Used for Overheard Chemical Applications within 21 Days of Scheduled Harvest
   (This section does NOT apply to chemical applications made through the distribution system i.e., sprinkler)

Type B water used for overhead applications within 21 days of scheduled harvest must be treated. With the start-up of any new treatment process it is important to evaluate all conditions that may affect water treatment efficacy and performance. Examples of parameters that provide valuable information about treatment efficacy in relationship to water quality are: Turbidity, pH, antimicrobial dose, historical microbial monitoring data, etc. (See Appendix A for additional guidance).

- Develop a SOP for all of the parts of the ag water system used in overhead chemical application. The SOP must address:
  - O Water used in overhead applications (e.g., pesticide and fertilizer, etc.) within the 21-days-to-harvest window must meet Type A and/or B→A water quality requirements.

263 264 265	<ul> <li>Holding tanks and equipment-mounted application tanks, manifold and boom lines, and nozzles MUST be regularly inspected and properly maintained and cleaned so they do not pose a contamination risk.</li> </ul>
266 267	<ul> <li>Water treatment chemistry or approach shall be compatible with the agricultural chemicals being applied.</li> </ul>
268 269 270	<ul> <li>Procedures to control pest access to the equipment during storage and staging (examples may include avian deterrents, fencing, and rodent monitoring) must be in place (validation can include: Pest control applicator (PCA) records, label requirements, letter of guarantee).</li> </ul>
271 272 273 274	<ul> <li>Establish corrective action procedures for non-compliance scenarios including:</li> <li>treatment failure</li> <li>contaminated source water</li> <li>pest concerns</li> </ul>
275 276	<ul><li>chemical incompatibility</li><li>equipment sanitation concerns.</li></ul>
277	<ul> <li>Document all corrective measures, cleaning activities, and maintenance.</li> </ul>
278 279 280 281 282 283	• Develop a SOP for each unique application process to treat water that will be used in an overhead application within 21 days of a scheduled harvest. Prior to the 21-days-to-scheduled-harvest conduct an initial water treatment assessment to establish treatment process parameters that will be monitored to ensure consistent treatment delivery and to demonstrate effectiveness. Repeat this assessment if a material change to your system occurs and incorporate this assessment's findings into your water treatment SOP. The SOP must address:
284	• Step-by-step instructions to ensure the water treatment is correctly implemented.
285	<ul> <li>Location of water sources</li> </ul>
286	<ul> <li>Name and suggested supplies needed.</li> </ul>
287	<ul> <li>Sanitizer used and quantity used.</li> </ul>
288	Critical limits and operational limits
289	• Water sampling location
290	Corrective actions if critical limits are not met.     Populated records
291	Develop a baseline for water treatment:
202	<ul> <li>Develop a baseline for watch a calification.</li> <li>Develop a baseline for watch a calification.</li> </ul>
293 294 295 296	a prior to the 21 days-to-scheduled harvest, a minimum of three (3)-100 mL samples must be taken for each overhead application process (distinct water quality source, different sanitizer, different size water holding tank, etc.). The three (3) samples must be taken from different treated water batches.
297	• All three (3) samples must be non-detect for generic <i>E. coli</i> .
298	Routine testing:
299 300	<ul> <li>A minimum of one (1) microbiological sample must be taken each month from a representative agricultural water system or at the next application event.</li> </ul>

301 • This 100 mL sample should have no detectable generic *E. coli*.

302	Corrective action:	
303	<ul> <li>If microbiological testing shows that the water did not meet generic <i>E. coli</i> acceptance criteria</li></ul>	
304	within 21 days of a scheduled harvest, perform a root cause analysis and correct the concern.	
305	Notify the grower/producer.	
306	<ul> <li>The product must be tested for pathogens before harvest if this water was used in overhead</li></ul>	
307	application. Follow the product testing requirements outlined in Table 2F.	
308	Ongoing monitoring:	
309	<ul> <li>Between microbiological routine testing events, records must be kept that verify that each</li></ul>	
310	application event is conducted following the parameters established during the initial setup.	
311 312	<ul> <li>If monitoring shows that the water treatment parameters are not being met, <i>do not use the water</i>.</li> </ul>	
313	<ul> <li>Perform a corrective action to assure the water treatment is effective before using the</li></ul>	
314	water.	
315	<ul> <li>Take a microbiological sample to verify that the treatment was effective and have that</li></ul>	
316	result as part of the corrective action documentation.	
317	<ul> <li>If the verification microbiological sample does not meet acceptance criteria, perform a root</li></ul>	
318	cause analysis and correct the treatment process. Product must be tested for pathogens	
319	before harvesting. Follow Table 2F for product testing requirements.	
320	<ul> <li>Maintain records that demonstrate the water used for chemical applications meets Type A source water</li></ul>	
321	requirements. See Tables 2B and 2C for historical and/or baseline water quality requirements for source	
322	water that will be used for overhead applications.	
323	Other Considerations for Water	
324 325	<ul> <li>Treat water only with antimicrobial treatments approved by the USEPA for use in agricultural applications in accordance with label specifications, guidelines for use, and consideration of environmental impacts.</li> </ul>	
326	<ul> <li>Antimicrobial treatments must be used and managed in a manner that meets all federal, state, and local</li></ul>	
327	regulations.	
328	<ul> <li>Do not store raw manure or any type of compost near irrigation water sources or conveyance systems (see</li></ul>	
329	Table 0).	
330	Best Practice for Irrigation Water from Type B Agricultural Water	
331 332 333 334 335 336 337 338	The following table (2A) outlines the metrics for agricultural water conveyance systems whereby edible portions of the crop are not likely to be contacted (e.g., germination, ground chemigation, furrow, drip irrigation, dust abatement water); if water is used in the vicinity of produce, then testing is necessary. For any of these uses, the agricultural water system must be assessed and monitored to demonstrate that the water meets the microbial standards for water that is likely to contain indicators of fecal contamination. Routine monitoring of microbial quality is required for all water types and remedial actions are required if water testing shows a conveyance system has failed to deliver water that meets the microbial standard. Efforts should always be made, when using Type B water, to avoid contact with the edible portion of the crop within 21 days of a scheduled harvest. When performing remedial actions, it is the intent	

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that all remedial steps outlined in the tables below are followed and that they are followed in the order of sequence

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as written.

### 341 TABLE 2A. Irrigation Water from Type B Agricultural Water – See FIGURE 1

Metric	Rationale /Remedial Actions
<ul> <li>Examples of water from Type B agricultural water systems:</li> <li>Ground chemigation</li> <li>Drip irrigation</li> <li>Furrow irrigation</li> <li>Dust abatement</li> </ul>	Water for Type B use throughout the production of the crop shall meet or exceed microbial standards based on a rolling geometric mean of the five most recent samples. However, a rolling geometric mean of five samples is not necessarily required prior to irrigation or harvest. If less than five samples are collected prior to irrigation, the acceptance criteria depend on the number of samples taken. If only one sample has been taken, it must be below 126 MPN/100 mL. Once two samples are taken, a geometric mean can be calculated, and the normal acceptance criteria apply. If the acceptance criteria are exceeded during this time-period, additional samples may be collected to reach a 5-sample rolling geometric mean (as long as the water has not been used for irrigation). The rolling geometric mean calculation starts after 5 samples have been collected. If the water source has not been tested in the past 60 days, the first water sample shall be tested prior to use, to avoid using a contaminated water source. After the first sample is shown to be within acceptance criteria, subsequent samples shall be collected no less frequently than monthly (or at the next irrigation event if longer than monthly) at points of use within the distribution system.
	not necessarily indicate that the Water is unsafe. Investigation and/or remedial action SHOULD be taken when test results are higher than normal or indicate an upward trend. Investigation and remedial action SHALL be taken when acceptance criteria are exceeded.
Target Organisms: Generic E. coli	
Sampling Procedure: 100 mL sample collected aseptically as close as practical to the point of use. Sampling Frequency: One sample per agricultural water source shall be collected and tested prior to use if >60 days since last test of the water source. Additional samples shall be collected no less than 18 hours apart and at least monthly (or at the next irrigation event ifgreater than monthly) during use from points within the delivery system.	<ul> <li>If the rolling geometric mean (n=5) or any one sample exceeds the acceptance criteria, then the water shall not be used until remedial actions have been completed and generic <i>E. coli</i> levels are within acceptancecriteria:</li> <li>Conduct an agricultural water assessment (Appendix A) of water source and conveyance system to determine if a contamination source is evident and can be eliminated. Eliminate identified contamination sources.</li> <li>Retest the agricultural water after taking remedial actions to determine if it meets the outlined microbial water quality acceptance criteria for this use. This sample should represent the conditions of the original water system, if feasible this test should be as close as practical to the original sampling point. A more aggressive sampling program (i.e., sampling once per week instead of once per month) shall be instituted if an explanation for the exceedance is not readily apparent. This type of sampling program should also be instituted if an upward trend is noted in normal sampling results.</li> <li>If follow-up agricultural water testing indicates that a crop has been directly contacted with water exceeding accentance criteria product</li> </ul>

wetric	Rationale / Remedial Actions	
Acceptance Criteria: ≤ 126 MPN/100 mL (rolling geometric mean n=5) and ≤ 576 MPN/100 mL for any single sample	shall be sampled and tested for STEC (including <i>E. coli</i> O157:H7) and <i>Salmonella</i> as described in Appendix C, prior to harvest. If crop testing indicates the presence of either pathogen, the crop shall NOT be harvested for the fresh market.	
Test Method: Any FDA-allowed method <sup>2</sup>		
<b>Records:</b> Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the producer/shipper who is the responsible party for a period of two years.		

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<sup>&</sup>lt;sup>2</sup> Equivalent testing methodology for agricultural water <u>https://www.fda.gov/food/foodscienceresearch/laboratorymethods/ucm575251.htm</u>



#### 344 FIGURE 1. Irrigation Water from Type B Agricultural Water – See TABLE 2A

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#### For any given water source (municipal, well, reclaimed water, reservoir or other surface water):

Sampling Frequency: For Type B water, one sample per water source shall be collected and tested prior to use if >60 days since last test of the water source. Additional samples shall be collected during use no less than 18 hours apart andat least monthly (or at the next irrigation event if greater than monthly) during use.

- Sample sources as close to the point-of-use as practical using sampling methods as prescribed in Table 2A.
- Analyze samples for generic *E. coli* using a MPN methodology. Other EPA-, FDA- or AOAC International accredited method may be used.
- Geometric means, including rolling geometric means shall be calculated using the five most recent samples.

ACCEPTANCE CRITERIA ≤ 126 MPN/100ml (Geometric mean of 5 samples) AND	<u>ACTION LEVEL</u> >126 MPN/100ml (geometric mean over five samples) <u>OR</u> >576 MPN/100ml (any single sample)
<u>&lt;576 MPN/100ml (all single</u> samples)	REMEDIAL ACTIONS:
No further action necessary. Water maybe used in leafy green operations as outlinedin Table 2A.	<ul> <li>Discontinue any agricultural production use until it returns to compliance.</li> <li>Examine the water source and distribution system to determine if a contaminationsource is evident and can be eliminated.</li> <li>After remedial actions have been taken, retest the water at the same sampling point.</li> <li>Continue testing daily for five days at the point closest to use.</li> <li>If any of the next five samples is &gt;576 MPN/100mL, repeat sanitary survey and/orremedial action.</li> <li>Do not use this water system until the water can meet the outlined acceptance criteriafor this use.</li> <li>CROP TESTING:</li> <li>If water exceeding the acceptance criteria has been used for crop production.</li> </ul>
	sample and test product for STEC (including <i>E. coli</i> O157:H7) and <i>Salmonella</i> as described in Appendix C, prior to harvest.
	<ul> <li>If crop testing indicates the presence of either pathogen, do NOT harvest for human consumption.</li> </ul>
# <sup>346</sup> Best Practice for Irrigation Water from Type A Agricultural Water

347 The following tables (2B - 2F) refer to agricultural water distribution systems and not to specific ranches, lots, fields, 348 etc. The tables outline the metrics for overhead applications of agricultural water sourced from public/private supplies 349 (2B), regulated recycled water and private wells (2C), treated water supplies (2D), and untreated water that is likely to 350 contain indicators of fecal contamination (2E). Each type of agricultural water system must be assessed to demonstrate 351 that the water from the source and the distribution system meet the microbial standards. Treated water must be 352 assessed and monitored to demonstrate that the water treatment is working as intended and that the treated water 353 meets the microbial standard. Routine monitoring of microbial quality is required for all water system types, and 354 remedial actions are required if water testing shows a system has failed to deliver water that meets the microbial 355 standard. When performing remedial actions, it is the intent that all remedial steps outlined in the tables below are followed and that they are followed in the order of sequence as written. 356

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# TABLE 2B. Irrigation Water from Type A Agricultural Water Systems Sourced from Public or Private Providers – See FIGURE 2A-2B

B d a hui a	Detionals (Demodial Astigue	
Wetric	Rationale / Remedial Actions	
examples of these types of Type A agricultural water systems: Water maycome from public and private providersand are stored and conveyed in closed delivery systems.	Irrigation water from Type A agricultural water systems sourced from regulated public or private providers would not be expected to contain generic <i>E. coli</i> due to treatment or some other filtering-type process. Water sourced from a public/private Type A agricultural water provider must be stored and conveyed in well- maintained, closed systems and tested for generic <i>E. coli</i> .	
B1. Baseline Microbial Assessment		
A baseline microbial assessment of the water source is not necessary for a Type A system using source water from a public/private provider. In lieu of a baseline microbial assessment, acquire and maintain the supplier's most current COA on file.		
<b>Records:</b> Records of the analysis of source water may be provided by municipalities, irrigation districts, or other water providers and must be available for verification from the grower/handler who is the responsible party for a period of two years		
B2. Initial Microbial Water Quality As	sessment	
Target Organisms: Generic E. coli		
Initial Assessment Sampling Procedure: Aseptically collect at least three (3)- 100mL samples during one irrigation eventwith at least one sample at the end of the delivery system (e.g., last sprinkler head). Initial Assessment Sampling Frequency: This is a one-time seasonal sampling event for each system with samples collected during one irrigation event occurring before the 21-days-to-scheduled-harvest period begins. (Also conduct this assessment after any material modifications to Type A overhead	The purpose of this assessment is to confirm that the water's microbial quality is not being degraded as it passes through your system (i.e., due to equipment conditions). The assessment is performed to verify that your irrigation water delivery system is able to maintain and deliver water of the same microbial quality (e.g., Type A) as the source water. Unless there is a material change to your system (e.g., change in equipment or type of watertreatment), this is a one-time assessment for each irrigation system, and it is not necessary to repeat system evaluations for each irrigation event. To test your water delivery systems, sample and test irrigation water during an irrigation event. All discrete systems are to be tested before entering the 21-days-to-scheduled-harvest time frame. To assess the water delivery system, water samples are taken throughout the system with at least one sample at the endof the line where water contacts the crop. Initial Assessment Testing If at least two (2) in three (3) samples do not have detectable levels of	
irrigation systems.) Initial Assessment Acceptance Criterion: Non-detectable in two (2) of three (3)-100 mL samples and 10 MPN as the single sample maximum for	than ( $\leq$ ) 10 MPN, then the water system maintains its Type A status. If water samples do not meet the acceptance criteria (i.e., if two (2) or more of the samples have detectable levels of generic <i>E. coli</i> <u>or</u> the level in at least one sample is greater than (>) 10 MPN), then conduct the following follow-up testing:	



Metric	Rationale /Remedial Actions
one (1) sample. Follow-up Testing Acceptance Criterion:	Follow-up Testing Prior to the next irrigation event perform a root cause analysisand an
Non-detectable in four (4) of five (5)-100 mL samples and 10 MPN	agricultural water system assessment as described in Appendix A to identify and correct the failure. After assessing the system, retest the system for generic $E$ , colün five
as the single sample maximum for one (1) sample.	(5)-100 mL samples collected during the next irrigation event using the sampling procedure and frequency (described in the left column).
testing, MPN and CFU are considered equivalent.	Water samples can be pulled from the endof any system nodes/branches in the irrigation system of concern. Of the five (5) follow-up samples, four (4) must have no detectable generic <i>E. coli</i> and the one (1) remaining samplemust have levels no greater than ( $\leq$ ) 10 MPN generic <i>E. coli</i> / 100mL.
	If test results meet the acceptance criterion for generic <i>E. coli</i> , the water system can be used as a Type A system.
	Testing Failure: When one sample has more than (>) 10 MPN generic <i>E.</i> <i>coli</i> / 100 mL or more than one sample have detectable generic <i>E. coli</i> , the agricultural water system is disqualified for TypeA usage. Perform a root cause analysis to identify and correct the failure (see Appendix A for mitigation measures). In the interim, the water can be used as a
	Type B agricultural water system.

## Test Method: Any FDA-allowed method<sup>2</sup>

**Records:** Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for a period of two years.

### **B3.** Routine Verification of Microbial Water Quality

Routine Verification SamplingProcedure:	To verify irrigation water continues to meet the acceptance criterion throughout the season, design your sampling plan so eachdistinct
Aseptically collect at least three (3)- 100mL samples during one irrigation eventwith at least one sample taken at the end of the delivery system (e.g., last sprinkler head). Routine Verification	irrigation system that is in use is sampled and tested at least once during the season. If two (2) or more of the samples have detectable levels of generic <i>E.</i> <i>coli</i> <u>or</u> the level in at least one sample is greater than (>) 10MPN, prior to the next irrigation event perform a <b>Level 1</b> Assessment as outlined in <u>Table 2F</u> .
Sample and test each distinct irrigationsystem for generic <i>E. coli</i> at least once during the season.	
Routine Verification AcceptanceCriterion:	
Non-detectable generic E. coli in 100	

Metric	Rationale /Remedial Actions
mLwater samples and $\leq$ 10 MPN as the single sample maximum for one (1) in three (3) samples	
Note: For the purposes of water testing, MPN and CFU are considered equivalent.	
Test Method: Any FDA-allowed metho	d <sup>2</sup>
<b>Records:</b> Each water sample and analysis shall record the type of water source, date, time, and location of the	

**Records:** Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for a period of two years.

## 362 FIGURE 2A. Irrigation Water from Type A Agricultural Water Systems Sourced from Public / Private

## 363 Providers – See TABLE 2B



### 365 FIGURE 2B. Irrigation Water from Type A Agricultural Water Systems Sourced from Public / Private

### 366 Providers – See TABLE 2B

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- During the next irrigation event, collect 5 100 mL samples from the irrigation system and test for generic *E*. coli. Water can be pulled from the end of any system nodes/branches in the irrigation system of concern. If these water samples also fail to meet the acceptance criterion, discontinue use of this water for overhead applications while continuing to evaluate your water system to identify and correct any failures and continuing to testas described in this step until the water is back in compliance (see AppendixA for guidance on troubleshooting irrigation system failures).
- If this water (i.e., the water from the initial sampling to the last of the follow-up sampling) has been applied to leafy greens, either consider the crop unsuitable for the fresh market or test the crop from all affected lots (i.e., lots that have been irrigated with this water within the <21 days -to- scheduled-harvest window) for STEC (including *E. coli* O157:H7) and *Salmonella*. Product needs to be tested prior to harvesting and after your last irrigation event. Sample crop per the protocol described in Appendix C.If any individual sample tests positive for any of these human pathogens, the crop within that lot shall NOT be harvested for the fresh market and human consumption.

# 368TABLE 2C. Irrigation Water from Type A Agricultural Water Systems Sourced from Private Wells or369Regulated Tertiary Treated Recycled Water Supplies – See FIGURE 3A-3C

Metric	Rationale /Remedial Actions
<ul> <li>Examples of water from Type A agricultural water systems:</li> <li>Regulated recycled wastewater</li> <li>Water sourced from a well – well water is conveyed to the field in a closed delivery system and applied to the crop via overhead sprinklers.</li> </ul>	Irrigation water from Type A agricultural water systems with well source water would not be expected to contain generic <i>E.</i> <i>coli</i> due to natural filtration as the water passes through the soil. Water from regulated tertiary treated recycled water supplies may have low levels of generic <i>E. coli</i> due to regulatory allowable limits. Type A agricultural water systems must be stored and conveyed in well-maintained, closed systems and tested for generic <i>E. coli</i> . Remedial actions vary depending on when the water is being used in relation to harvest.
C1. Baseline Microbial Assessment	
Target Organisms: Generic E. coli	
<ul> <li>Baseline Assessment Sampling Procedure: If historical water test data is not available, aseptically collect at least three (3)-100 mL sample at the source.</li> <li>Baseline Assessment Sampling Frequency: Sample and test the water two times (with sampling events separated by no less than 7 days) before using the water within the 21-days-to-scheduled-harvest-window.</li> <li>Baseline Assessment Acceptance Criteria: Non-detectable generic <i>E. coli</i> in five (5) of six (6) 100 mL samples and ≤ 10 MPN as the single sample maximum for one (1) sample.</li> </ul>	The purpose of a baseline assessment is to ensure your water source (e.g., a well or regulated tertiary treated recycled water) meets the microbial standards for generic <i>E. coli</i> . This baseline microbial assessment must be conducted before these Type A water sources can be used for overhead irrigation within 21-days to-scheduled-harvest. For agricultural water systems with multiple wells, each well must be tested prior to use in order to validate the integrity of the agricultural water system. Self-certification with historical water test data: If at least four (4) of the last five (5) consecutive historical water tests (80%) have no detectable generic <i>E. coli</i> , the remaining one (1) sample does not exceed ( $\leq$ ) 10 MPN in 100 mL, and one (1) of those tests was taken within the last 6 months, then the well/regulated tertiary treated recycled water source.
<b>Note</b> : For the purposes of water testing, MPN and CFU are considered equivalent.	<u>Self-certification process when no historical data is available:</u> If historical data is unavailable, test each well or regulated recycled water twice (separated by no less than seven days) prior to use as the source water for a Type A agricultural water system. If at least five (5) of the six (6) total samples have no detectable generic <i>E. coli</i> and the remaining sample has $\leq$ 10 MPN in 100 mL, then the water/well is self-certified as a Type A agricultural water source. <u>Testing Failure</u> : If test results do not meet the acceptance criteria, then the water/well cannot be considered a Type A agricultural water source. Perform a root cause analysis and an agricultural water system assessment as described in Appendix A to identify and correct the failure. In the interim, the water can be treated or used as a source for a Type B agricultural water

Metric	Rationale /Remedial Actions
	system.

Test Method: Any FDA-allowed method<sup>2</sup>

**Records:** Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for aperiod of two years.

### **C2.** Initial Microbial Water Quality Assessment

Target Organism: Generic E. coli

### Initial Assessment Sampling Procedure:

Aseptically collect at least three (3)-100 mL during one irrigation event at the end of thedelivery system (e.g., last sprinkler head).

### Initial Assessment Sampling Frequency:

This is a one-time seasonal sampling event for each system with samples collected during one irrigation event occurring beforethe 21-day-to-scheduledharvest-period begins. (Also conduct this assessment after any material modifications to Type A overhead irrigation systems.)

### Initial Assessment Acceptance Criteria:

Non-detectable generic *E. coli* in two (2) of three (3)-100 mL samples and  $\leq$  10 MPN as the single sample maximum for one (1) sample.

### Follow-up Testing Acceptance Criteria:

Non-detectable in four (4) of five (5)-100 mLsamples and  $\leq$  10 MPN as the single sample maximum for one (1) sample.

**Note**: For the purposes of water testing, MPNand CFU are considered equivalent.

The purpose of this assessment is to confirm that the water's microbial quality is not being degraded as it passes through your system (i.e., due to equipment conditions). The assessment is performed to verify that your irrigation water delivery system is able to maintain and deliver water of the same microbial quality (e.g., Type A) as the water source. Unless there is a material change to your system (e.g., changein equipment or type of water treatment), this is a one-time assessment for each irrigation system, and it is not necessary to repeat system evaluations for each irrigation event. To test your water delivery systems, sample and test irrigation water during an irrigation event. All discrete systems are to be tested before entering the 21-days-to-scheduled-harvest timeframe. To assess the water delivery system, water samples are taken at the end of the line where water contactsthe crop.

### Initial Assessment Testing

If at least two (2) in three (3) samples do not have detectable levels of generic *E. coli*, and the level in the one remaining sample is no greater than ( $\leq$ ) 10 MPN, then the water system maintains its Type A status.

If water samples do not meet the acceptance criteria (i.e., iftwo (2) or more of the samples have detectable levels of generic *E. coli* <u>or</u> the level in at least one sample is greater than (>) 10 MPN), then conduct the following follow-up testing:

### Follow-up Testing

- Prior to the next irrigation event perform a root cause analysis and an agricultural water system assessment as described in Appendix A to identify and correct the failure.
- 2) After assessing the system, retest the system for generic *E. coli* in five (5)-100 mL samples collected during the next irrigation event using the sampling procedure and frequency (described in the left column). Water samples can be pulled from the end of any system nodes/branches



Metric	Rationale /Remedial Actions
	in the irrigation system of concern. Of the five (5) follow- up samples, four (4) must have no detectable generic <i>E.</i> <i>coli</i> and the one (1) remaining sample must have levels no greater than ( <u>&lt;)</u> 10 MPN / 100 mL.
	3) If test results meet the acceptance criterion for generic <i>E. coli</i> , the water system can be used as a Type A system.
	<u>Testing Failure</u> : When one sample has more than (>) 10 MPN / 100 mL or more than one sample have detectable generic <i>E.coli</i> , the agricultural water system is disqualified for Type A usage. Perform a root cause analysis to identify and correct the failure (see Appendix A for mitigation measures). In the interim, the water can be used as a Type B agricultural water system.
Test Method: Any FDA-allowed method <sup>2</sup>	
<b>Records:</b> Each water sample and analysis shall sample, the method of analysis, and, if quantit shall be documented and available for verifica period of two years.	record the type of water source, date, time, and location of the tative, the detection limit. All test results and remedial actions tion from the grower/handler who is the responsible party for a
C3. Routine Verification of Microbial Water Q	luality
Target Organisms: Generic E. coli	
Sampling Procedure Three (3)-100 mL samples aseptically collected at the end of the delivery system (e.g., the last sprinkler head).	To verify irrigation water continues to meet the acceptance criterion throughout the season, design your sampling plan so each distinct irrigation system that is in use is sampled and tested at least once during the season.
Sampling Frequency	If two (2) or more of the samples have detectable levels of
Sample and test each distinct irrigation system for generic <i>E. coli</i> at least once during the season.	<ul> <li>(&gt;) 10 MPN, prior to the next irrigation event perform a Level</li> <li>Assessment as outlined in Table 2F.</li> </ul>
Acceptance Criterion	
Non-detectable generic <i>E. coli</i> in 100 mL water samples and $\leq$ 10 MPN as the single sample maximum for one (1) in three (3) samples	
<b>Note</b> : For the purposes of water testing, MPN andCFU are considered equivalent.	
Test Method: Any FDA-allowed method <sup>2</sup>	
<b>Records:</b> Each water sample and analysis shall sample, the method of analysis, and, if quantit shall be documented and available for verifica	record the type of water source, date, time, and location of the tative, the detection limit. All test results and remedial actions tion from the grower/handler who is the responsible party for a

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period of two years.

# FIGURE 3A. Irrigation Water from Type A Agricultural Water Systems Sourced from Private Wells or Regulated Tertiary Treated Recycled Water Supplies – See TABLE 2C



# 373 FIGURE 3B. Irrigation Water from Type A Agricultural Water Systems Sourced from Private Wells or

374 Regulated Tertiary Treated Recycled Water Supplies – See TABLE 2C

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# FIGURE 3C. Irrigation Water from Type A Agricultural Water Systems Sourced from Private Wells or Regulated Tertiary Treated Recycled Water Supplies – See TABLE 2C

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## **ROUTINE MONITORING of MICROBIAL WATER QUALITY** For Type A agricultural water from regulated recycle water / private well sources for overhead applications when used within (<) 21 days of the scheduled harvest date. (When using Type A agricultural water from these sources for overhead applications up to (>) 21 days of the scheduledharvest date follow water metrics in Table 2E/Figure 5 for Type B agricultural water systems.) • Collect three (3) samples at the end of the delivery system (e.g., last sprinkler head); test each distinct irrigation system in use at least once during the season. • Test for generic E. coli using a FDA-allowed method. • Assess microbial quality using the three (3) collected samples. **ACCEPTANCE CRITERIA** No detectable generic *E. coli* in at ACTION LEVEL least 2 of 3 consecutive samples and < 10 MPN in one remaining Generic *E. coli* detected in $\geq 2$ sample samples or one samplehas levels above (>) 10 MPN / 100 mL No further action necessary. Water may be used in leafy green operationsas outlined in Table 2C. CONDUCT A LEVEL 1 ASSESSMENT: If generic E. coli levels in your water exceed the acceptance criterion, prior to the next irrigation event, conduct an agricultural water systemassessment as described in Appendix A. • Retest the water for generic E. coli during the next irrigation event in five (5) - 100 mL samples. Water can be pulled from the end of any system nodes/branches in the irrigation system of concern. If these water samples also fail to meet the acceptance criterion, discontinue use of this water for overhead applications while continuing to evaluate your water system to identify and correct any failures and continuing to test as described in this step until the water is back in compliance (see Appendix A for guidance on troubleshooting irrigationsystem failures). • If this water (the water from the initial sampling to the last of the follow-up sampling) has been applied to leafy greens, either consider the crop unsuitable for the fresh market or test the crop from all affected lots (i.e., lots that have been irrigated with this water within the <21 days-to-scheduled-harvest window) for

leafy greens, either consider the crop unsuitable for the fresh market or test the crop from all affected lots (i.e., lots that have been irrigated with this water within the <21 days-to-scheduled-harvest window) for STEC (including *E. coli*O157:H7) and *Salmonella*. Product needs to be tested prior to harvesting and after your last irrigation event. Sample crop per the protocol described in Appendix C. If any individual sample tests positive for any of these human pathogens, the crop within that lot shall NOT be harvested for the fresh market and human consumption.

# 379 TABLE 2D: Irrigation Water from Treated Type B $\rightarrow$ A Agricultural Water Systems – See FIGURE 4.

Rationale /Remedial Actions
When water from a Type B agricultural water system is used in an overhead application within ( $\leq$ ) 21 days to thescheduled harvest date, it must be treated to move it from a Type B agricultural water system to a Type A system (B $\rightarrow$ A) by a scientifically valid antimicrobial watertreatment - i.e., contain an approved antimicrobial watertreatment at sufficient concentration to prevent potential contamination risk during overhead applications. Microbial and/or physical/chemical testing of the source and system must be performed, as appropriate to the specific operation, to demonstrate that performance criteria have been met before use within ( $\leq$ ) 21 days to the scheduled harvest date and continues to be met throughout its use. Water in open delivery systems (e.g., reservoirs and ponds) may be used in overhead applications within 21 days to the scheduled harvest if it is treated at the sametime it is applied to crops.
-
Routine water sampling is performed to verify irrigation water continues to meet the microbial quality acceptance criteria throughout the season. Routine verification of treated irrigation water systems is focusedon the function of the system. Sampling needs to occur at a frequency that allows operators to verify they have control of their treatment system. An essential component of this verification process is building a dataset so microbial quality can be analyzed to best inform you how to effectively run your water treatment system. Sample and test the system for total coliforms and generic <i>E. coli</i> in three (3)-100 mL samples. To maintainits Type A status, water samples must have: • no detectable generic <i>E. coli</i> in at least two (2) of thethree (3) samples with a maximum level no

<ul> <li>Routine Verification Acceptance Criteria:</li> <li><u>Generic E. coli</u>: No detection in two (2) of the last three (3) water samples with a maximum level of (≤) 10 MPN allowed in one (1) sample</li> <li>data monitoring for total coliforms at a leve nogreater than (≤) 99 MPN in 100 mL *</li> <li>* As an alternative to the threshold approach for coliforms (≤ 99 MPN / 100 mL), operators can vertice transition transmut surface there invited to the threshold approach for coliforms (≤ 99 MPN / 100 mL), operators can vertice transmut surface to the operator transmut surface to the tr</li></ul>		
[consecutive values]       Inter Imgation deather system by conducting pre- and post-treatment microbial testing of wa distribution system (see Appendix A for addition guidance on conducting a log reduction assessm guidance on conducting a log reduction assessm guidance on conducting a log reduction assessm for addition guidance on conducting a log reduction assessm for addition guidance on conducting a log reduction assessm for addition guidance on conducting a log reduction assessm for addition guidance on conducting a log reduction assessm for addition guidance on conducting a log reduction assessm for addition guidance on conducting a log reduction assessm for addition guidance on conducting a log reduction assessm for addition guidance on conducting a log reduction assessm for addition guidance on conducting a log reduction assessm for addition guidance on conducting a log reduction assessm for addition guidance on conducting a log reduction assessm for addition guidance on conducting a log reduction assessm for addition guidance on conducting a log reduction assessm for addition guidance on conducting a log reduction assessm for addition guidance on conducting a log reduction assessm for addition guidance on conducting a log reduction assessm for addition guidance on conducting a log reduction assessm for addition guidance on conducting a log reduction assessment as outlined in Table and the monitoring criteria, prior to the next irrigation perform a Level1 Assessment as outlined in Table	<ul> <li>data monitoring for total coliforms at a level nogreater than (&lt;) 99 MPN in 100 mL *</li> <li>* As an alternative to the threshold approach for total coliforms (&lt; 99 MPN / 100 mL), operators can verify their irrigation treatment system by conducting paired pre- and post-treatment microbial testing of water distribution system (see Appendix A for additional guidance on conducting a log reduction assessment).</li> <li>If two (2) or more of the three (3)-100 mL samples do not meet the acceptance criteria for generic <i>E. coli</i> and at least one sample is greater than (&gt;) 10 MPN and one (1) or more of the total coliforms results do not meet the monitoring criteria, prior to the next irrigation event perform a Level1 Assessment as outlined in Table 2F.</li> </ul>	
Records: Each water sample and analysis shall record the type of water source, date, time, and location	n of the	
sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial a shall be documented and available for verification from the grower/handler who is the responsible par period of two years.	ctions rty for a	
D2. Routine Water Treatment Monitoring		
Antimicrobial water treatments - USEPA-approved for use in agricultural water.		
<b>Target variable:</b> Antimicrobial irrigation water treatment or manufacturer's operational specifications manufacturer's recommendations, chemical concentration, etc.).	(e.g., per	
Testing Procedure:Monitor the efficacy of the water treatment method manufacturer's label or operational instructions.• Chemical reaction-based colorimetric test, or • Ion-specific probe, or • Other as recommended by antimicrobial watertreatment supplier or manufacturer's specifications.Monitor the efficacy of the water treatment method manufacturer's label or operational instructions. To demonstrate the irrigation system is performing intended during each water treatment irrigation ex document: • Flow rates	od perthe g as <u>vent</u> ,	
Treatment-related parameters such as residual     aptimisrabial layole pH does settings LIV/T atc	 oring	
Monitoring must be conducted whenever the irrigation treatment system is in use. Continuousmonitoring with periodic verification by titration <b>OR</b> routine monitoring if the system can be shown to have a low degree of variation.	D1.	

## Metric

### Rationale /Remedial Actions

**Records**: During every irrigation event, treatment-related parameter values such as residual antimicrobial levels, pH, dose settings, UVT, etc. must be documented to demonstrate the system is working as intended. Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for a period of two years.

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### 382 FIGURE 4. Irrigation Water from Type B→A (Treated) Agricultural Water Systems – See TABLE 2D

## 383 384

### **ROUTINE MONITORING of MICROBIAL WATER QUALITY**

- Collect three (3) 100 mL samples during one irrigation event with at least one sample taken at the end of the distribution irrigation system (e.g., last sprinkler head).
- Sample monthly during use and test for generic *E. coli* and total coliforms using a FDA-allowed method.
- If the irrigation system is being used up until 21 days to scheduled harvest, sample each distinct irrigation system on one occasion and follow microbial standards in Table 2E / Figure 5 for Type B agricultural water systems.
- If the irrigation system is being used within the 21-days-to-harvest-window, sample each distinct irrigation system on two occasions separated by at least three (3) days.

### ACTION LEVEL

Generic *E. coli* detected in  $\ge$  2 samples or level above (>) 10 MPN / 100 mL in a single sample

#### least 2 of 3 samples and $\leq$ 10 MPN in one sample

**ACCEPTANCE CRITERIA** 

No detectable generic *E. coli* in at

### DATA MONITORING CRITERIA

≤ 99 MPN in 100 mL or an adequate log reduction based on the untreated water's baseline total coliform levels

#### No further action necessary.

Water may be used in leafy green operations as outlined in Table 2D.

# CONDUCT A LEVEL 1 ASSESSMENT:

When using Type B $\rightarrow$ A agricultural water for overhead applications within ( $\leq$ ) 21 days of the scheduled harvest date:

- If generic *E. coli* or total coliform levels in your water exceed the acceptance and/or monitoring criteria, pause irrigation and conduct an agricultural water system assessment as described in Appendix A to determine why the treatment was not effective.
- Retest the water for generic *E. coli* and total coliforms during the next irrigation event in five (5) - 100 mL samples. Water can be pulled from any point in the distribution systems in the irrigation treatment system of concern with at least one coming from the last sprinkler head. If these water samples also fail to meet the acceptance and/or monitoring criteria, discontinue use of this water for overhead applications while continuing to evaluate your water system to identify and correct any failures and continuing to test as described in this step until the water is back in compliance (see Appendix A for guidance on troubleshooting irrigation system failures).
- If this water (the water from the initial sampling applied to the crop within 21 days to harvest to the first and last of the follow-up sampling) with generic *E. coli* above the acceptance criteria has been applied to leafy greens, either consider the crop unsuitable for the fresh market or test the crop from all affected lots (i.e., lots that havebeen irrigated with this water within the <21 days-to-scheduled-harvest window) for STEC (including *E. coli* O157:H7) and *Salmonella*. Product needs to be tested prior to harvesting and after your last irrigation event. Sample crop per the protocol described in Appendix C. If any individual sample tests positive for any of these human pathogens, the crop within that lot shall NOT be harvested for the fresh market and human consumption.



#### 385 TABLE 2E. Irrigation Water from Type B Agricultural Water Systems Intended for Overhead Irrigation 386

prior to 21 days - See FIGURE 5

Metric	Rationale /Remedial Actions
Example of water from a Type B agricultural water system - water may arrive at the field in an irrigation district canal from which itis then used to overhead irrigate crop prior to 21 days to the scheduled harvest date.	Water from Type B agricultural water systems is untreated and exposed to the environment (e.g., open sources and/or delivery systems) so that its quality may be inadequate for overhead irrigation within ( $\leq$ ) 21 days to the scheduled harvest date. Water from these systems is restricted to use in overhead irrigation when applied prior to (>) 21 days to the scheduled harvest date.
	Also, water from Type A agricultural water systems can be sampled and tested under Type B agricultural water system requirements when it is used for overhead irrigation prior to 21 days before the scheduled harvest date.

### E1. Routine Verification of Microbial Water Quality

#### Target Organisms: Generic E. coli

### **Routine Verification Sampling** Procedure:

100 mL sample collected aseptically at the point-of-use, i.e., one sprinkler head per water source for irrigation, water tap for pesticides, etc. preseason irrigation water may be tested and utilized.

### **Routine Verification Sampling** Frequency:

One sample per water source shall be collected and tested prior to use if > 60 days since last test of the water source. Additional samples shall be collected no less than 18 hours apart and at least monthly (or at the next irrigation event if greater than monthly) during use from points within the water distribution system.

**Routine Verification Acceptance** Criterion:

< 126 MPN / 100 mL (geometric mean) and < 235 MPN/100mL for any single sample. Note: For the purposes of water testing, MPN and CFU are considered equivalent.

When using water from Type B agricultural water distribution systems for overhead applications prior to (>) 21 days of the scheduled harvest date, samples for microbial testing shall be taken as close as practicable to the point-of-use (i.e., to be determined by the sampler, to ensure the integrity of the sample, using sampling methods as prescribed in Table 2D) so as to test both the water source and the water distribution system. In a closed water distribution system (meaning no connection to the outside) water samples may be collected from any point within the system but are still preferred at the point-of-use. No less than one (1) sample per month (or at the next irrigation event) per water distribution system is required under these metrics. If there are multiple potential point-of-use sampling points ina water distribution system, then samples shall be taken from different point-of-use locations each subsequent sampling event (randomize or rotate sample locations).

Water for pre-harvest, direct edible portion contact prior to (>)21 days before scheduled harvest shall meet or exceed antimicrobial standards for recreational water, based on a rolling geometric mean of the five (5) most recent samples. However, a rolling geometric mean of five samples is not necessarily required prior to irrigation or harvest. If less than five (5) samples are collected prior to irrigation, the acceptance criteria depend on the number of samples taken. For example:

- If only one (1) sample has been taken, it must be below (<)126 MPN /</p> 100 mL.
- Once two (2) samples are taken, a geometric mean can be calculated, and the normal acceptance criteria apply.

If the acceptance criteria are exceeded during this time period, additional samples may be collected to reach a five (5)-sample rolling geometric mean. The rolling geometric mean calculation starts after five (5) samples have



Metric	Rationale /Remedial Actions
	<ul> <li>been collected. If the water source has not been tested in the past 60 days, the first water sample shall be tested prior to use, to avoid using a contaminated water source. After the first sample is shown to be within acceptance criteria, subsequent samples shall be collected no less frequently than monthly at points-of-use within the water distribution system.</li> <li>Ideally, pre-harvest water used prior to 21 days before harvest for overheadapplications should not contain generic <i>E. coli</i>, but low levels do not necessarily indicate that the water is unsafe. Investigation and/or remedial action SHOULD be taken when test results are higher than normal or indicate an upward trend. Investigation and remedial action SHALL be takenwhen acceptance criteria are exceeded.</li> </ul>
	<b>Remedial Actions:</b> If the rolling geometric mean (n=5) or any one sample exceeds the acceptance criteria, then the water shall not be used whereby edible portions of the crop are contacted by water until remedial actions have been completed and generic <i>E. coli</i> levels are within acceptance criteria:
	<ul> <li>Conduct an agricultural water system assessment of water source and water distribution system to determine if a contamination source is evident and can be eliminated. Eliminate identified contamination source(s).</li> </ul>
	<ul> <li>For wells, perform an agricultural water system assessment and/or treatas described in Appendix A.</li> </ul>
	Or begin water treatment
	Retest the water after conducting the agricultural water system assessment and/or taking remedial actions to determine if it meets the outlined microbial acceptance criteria for this use. Retest the water daily, take three samples, no less than 18 hours apart at the point closest to use. This sample should represent the conditions of the original water system, if feasible this test should be at the original sampling point. A more aggressive sampling program (i.e., sampling once per week instead of once per month) or water
	treatment shall be instituted if an explanation for the exceedance is not readily apparent. This type of sampling program should also be instituted if

**Records**: Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for a period of two years.

# FIGURE 5. Irrigation Water from Type B Agricultural Water Systems intended for Overhead Irrigation – See TABLE 2E



**ROUTINE MONITORING of MICROBIAL WATER QUALITY** • If using > 21 days prior to the scheduled harvest date, collect one (1) – 100 mL samples per irrigation water system at the point of use monthly. • Analyze samples for generic *E. coli* using a FDA-allowable method. • Calculate geometric means using the five most recent samples. ACTION LEVEL **ACCEPTANCE CRITERIA** > 126 MPN / 100mL (geometric mean) <u>OR</u> < 235 MPN / 100 mL in a</p> 235 MPN / 100 mL in a single single sample sample **REMEDIAL ACTIONS:** • Discontinue use for foliar and direct contact with the No further action necessary. edible portion of the plant applications until it returnsto compliance. Water from this source may be used for any use such as crop foliar applications Examine the water source and distribution system to and/or irrigation up until 21 days to determine if a contamination source is evident and can be scheduled harvest. However, when test eliminated. results are higher than normal or indicate • For wells, perform an agricultural water system an upwardtrend, investigation and/or assessment and/or treat as described in Appendix A. remedial action SHOULD be taken. • After performing an agricultural water system assessment and/or remedial actions, retest the water at he same sampling point. Take three samples, no less than 18 hours apart at the CROP TESTING: point closest to use. If any of these samples is >126 MPN/ 100mL, repeat agricultural water system assessment • If crop has been directly contacted with and/or remedial action. water exceeding acceptance criteria, Do not use water from that water system, in a manner sample and test product for STEC that directly contact edible portions of the crop, until the (including E. coli O157:H7) and Salmonella as described in Appendix C, water can meet the outlined acceptance criteria forthis use or treat water to meet the acceptance criteria. prior to harvest. If crop testing indicates the presence of either pathogen, do NOT harvest for fresh market and human consumption.

# 391 TABLE 2F. Level 1 Assessment - Remedial Actions for Type A and B→A Agricultural Water Systems – See

392 FIGURE 4

Metric	Rationale/Remedial Actions
Target Organisms: Generic E. coli and t	otal coliforms
Remedial Actions Sampling Procedure:	When using agricultural water systems for overhead applications <b>up</b> to (>) 21 days of the scheduled harvest date:
Aseptically collect five (5)-100 mL sample from any point in the delivery system with a minimum of one from the last sprinkler head, i.e., at the last point of contact with the crop - last sprinkler head.	<ul> <li>Follow water metrics in Table 2D for Type B agricultural water systems.</li> <li>When using water from Type A and/or B→A agricultural water systems for overhead applications within (≤) 21 days of the scheduled harvest date:</li> <li>Generic E. coli</li> </ul>
Remedial Actions Sampling Frequency: Sample water during the next consecutive irrigation event after a sample fails the acceptance criterion or monitoring criterion. Remedial Actions Acceptance Criterion for Generic <i>E. coli</i> : 80% non-detectable generic <i>E. coli</i> in 100 mL and ≤ 10 MPN as the single sample maximum for one (1) sample Remedial Actions Monitoring Criterion for Total Coliform Monitoring Level Failure: 5/5 samples with a maximum level of 99 MPN in 100 mL in all water samples or an adequate log reduction based on the untreated water's baseline total coliform levels (refer to Appendix A for log reduction guidance)	<ul> <li>Ceneric E. coli</li> <li>1) If generic E. coli levels in your water exceed the acceptance criterion, prior to the next irrigation event conduct an agriculturalwater system assessment as described in Appendix A. During the next irrigation event, collect five (5)-100 mL samples from the irrigation system and test for generic E. coli. Water can be pulled from any point in the delivery systems in the irrigation treatment system of concern with at least one coming from the last sprinklerhead. If these water samples also fail to meet the acceptance criterion, discontinue use of this water for overhead applications while continuing to evaluate your irrigation treatment system to identify and correct any failures and continuing to test as described in this step until the water is back in compliance (see Appendix A for guidance on troubleshooting irrigation treatment system failures).</li> <li>2) If this water (the water from the initial sampling to the last round of sampling) has been applied to leafy greens, test the crop from all affected lots (i.e., lots that have been irrigated with this water within the &lt;21 days-to-scheduled-harvest window) for STEC (including <i>E. coli</i> O157:H7) and <i>Salmonella</i>. Product needs to be tested prior to harvesting and after your last irrigation event. The crop within that lot shall NOT be harvested for the fresh market if either pathogen is present. Sample crop per the protocol described in Appendix C. If any individual sample tests positive for any of these human pathogens, the crop within that lot shall NOT be harvested for human consumption.</li> </ul>
	Total coliforms
	<ol> <li>If these water samples fail to meet the monitoring criterion perform a root cause analysis and continue to evaluate your irrigation treatment system to identify and correct any failures and continuing to test as described in this step until the water is</li> </ol>

	back in compliance (see Appendix A for guidance on troubleshooting irrigation treatment system failures).
	<ol> <li>Water can still be used as a Type A system and no pre-harvest pathogen testing is required as long as the generic <i>E. coli</i> acceptance criterion is met.</li> </ol>
Test Method: Any FDA-allowed method	22
<b>Records</b> : Each water sample and analysis sample, the method of analysis, and, if	is shall record the type of water source, date, time, and location of the quantitative, the detection limit. All test results and remedial actions

sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for a period of two years.

# TABLE 2G. Harvest Direct Product Contact, Harvest Food-Contact Surfaces, and Hand Wash Water (On Farm Practices Only) - See FIGURE 6

Metric	Rationale /Remedial Actions
Water Type: • Municipal • Well (Type A) • Reverse Osmosis Microbial Water Quality Testing	Water used during harvest operations that directly contacts edible portions of harvested crop, water used forhand washing, or is used on food-contact surfaces such asequipment or utensils, shall be sourced from municipal, well (Type A) or reverse osmosis water sources.
Target Organism: Generic E. coli	
<ul> <li>Sampling Procedure: Prior to use in harvest equipment, a 100 mL sample collected aseptically at the water source.</li> <li>Sampling Frequency: One sample per water source shall be collected and tested prior to use if &gt;60 days since last test of the water source. Additional samples shall be collected at intervals of no less than 18 hours and at least monthly during use. For wells and municipal water sources, if generic <i>E. coli</i> are below detection limits for five consecutive samples, the requirements for 60 days and monthly sampling are waived, and the sampling frequency may be decreased to no less than once every 180 days. This exemption is void if there is a significant water source or distribution system change. Reverse Osmosis Systems: No less than one (1) sample per month per system is required.</li> <li>Test Method: Any FDA allowed method<sup>2</sup></li> <li>Acceptance Criteria: Negative or below DL for all samples</li> </ul>	<ul> <li>Testing must be conducted to demonstrate that this water meets the Maximum Contaminant Level Goal for generic <i>E.coli</i> as specified by U.S. EPA or contain an approved disinfection method at sufficient concentration or of sufficient wavelength to prevent cross-contamination.</li> <li>Microbial or physical/chemical testing shall be performed, as appropriate to the specific operation, to demonstrate that acceptance criteria have been met.</li> <li>Single-Pass vs. Multiple-Pass Systems</li> <li>Single-pass use – Water must have non-detectable levels of generic <i>E. coli</i> or breakpoint disinfectant present at point of entry.</li> <li>Multi-pass use – Water must have non-detectable levels of generic <i>E. coli</i> and/or sufficient disinfectant toensure multi-pass water has no detectable generic <i>E. coli</i>.</li> <li>Remedial Actions:</li> <li>Develop an SOP that determines what corrective actions will be required when harvest water does not meet acceptance criteria, then DO NOT USE THE WATER until remedial actions have been completed and generic <i>E. coli</i> or disinfectant levels arewithin acceptance criteria.</li> </ul>
	Conduct an agricultural water system assessment of water source and distribution system to determine if



Metric	Rationale /Remedial Actions
Physical/Chemical Testing         Target Variable:         Water disinfectant (e.g., UV transmittance, chlorine or other disinfectant compound).         Multi-Pass Water Acceptance Criteria:         Chlorine         ≥ 1 ppm free chlorine after application and pH 5.5 – 7.5         Other approved treatments per product EPA label for human pathogen reduction in water.         Testing Procedure:         • Chemical reaction-based colorimetric test, or         • Ion-specific probe, or         • UV transmittance         • Other as recommended by disinfectant supplier.         Testing Frequency:         • Prior to first use on day of harvest.         • During harvest, samples shall be taken at routine intervals (i.e., hourly, breaks, lunch, etc.) as determine by historical data showingtypical	<ul> <li>a contamination source is evident and can be eliminated.Eliminate identified contamination source(s) and/or treat with appropriate disinfectants.</li> <li>For wells, perform an agricultural water system assessment and/or treat as described in Appendix A.</li> <li>Retest the water at the same sampling point after conducting the agricultural water assessment for waterused for harvest and/or taking remedial actions to determine if it meets the outlined microbial acceptancecriteria for this use.</li> <li>For example, if the water intended for use on food-contact surfaces has detectable generic <i>E. coli</i>, DO NOT USE THE WATER.</li> <li>Examine the distribution line and source inlet as described in Appendix A and retest from the same point of use.</li> <li>After corrective actions have been implemented and verifiedthe water may be used for harvest operations and hand wash water.</li> </ul>
degree of variation. <b>Records</b> : All test results and remedial actions shall be d thewater for a period of two years.	ocumented and available for verification from the user of

# FIGURE 6. Harvest Direct Product Contact, Harvest Food-Contact Surfaces, and Hand Wash Water (On Farm Practices Only) – See TABLE 2G

#### Water Type: Municipal, Wells (Type A), and Reverse Osmosis:

Water that directly contacts edible portions of harvested crop shall meet microbial standards set forth in U.S. EPA National Drinking Water Regulations and/or contain an approved disinfectant at sufficient concentration to prevent cross-contamination.

#### SAMPLING FREQUENCY:

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One sample per water source shall be collected and tested prior to use if > 60 days since last test of the water source. Additional samples shall be collected no less than 18 hours apart and a least monthly during use.

- Sample sources using sampling methods as prescribed in Table 2G.
- Analyze samples for generic E. coli using any FDA allowed method.

### ACCEPTANCE CRITERIA Negative or below DL /100 mL generic *E. coli* OR <u>MULTI-PASS WATER ACCEPTANCE</u>

**CRITERIA** 

≥1 ppm free chlorine

OR

Sufficient disinfectant; physical treatment - sufficient wavelength to prevent cross- contamination. Other

approved treatments per product EPA

No further action necessary.

Water from this source may be used

for anypurpose.

#### ACTION LEVEL

Positive generic E. coli

### REMEDIAL ACTIONS:

- DO NOT USE THE WATER.
- Follow your SOP for corrective action to bring water backinto compliance with the acceptance criteria.
- For wells, perform an agricultural water system assessment and/or treat as described in Appendix A.
- After agricultural water system assessment on water usedfor harvest and/or remedial actions have been taken, retest the water at the same sampling point.
- After corrective actions have been implemented and verified the water may be used for harvest operations.
- If water exceeding the acceptance criteria has been used during harvest, it is NOT appropriate microbial quality for this use. Sample and test product for STEC including *E. coli* O157:H7 and *Salmonella* as described in Appendix C.



# Analyze samples for g

# 2024 CA LGMA Amendment Process Report - Water Revisions

Proposal Submitted by FMI



# COMMODITY SPECIFIC FOOD SAFETY GUIDELINES

FOR THE PRODUCTION AND HARVEST OF LETTUCE AND LEAFY GREENS



SEPTEMBER 20, 2023 This document supersedes all previously published versions of the Commodity Specific Food Safety Guidelines for the Production and Harvest of Leafy Greens including those dated on or before March 30, 2023.

> Adopted by the California Leafy Green Products Handler Marketing Agreement Advisory Board Document managed by Western Growers - learn more at www.leafygreenguidance.com

## 2 6. ISSUE: WATER

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3 The safety of whole fresh and fresh-cut (e.g., bagged salad) leafy greens is a longstanding issue. Leafy greens are mostly consumed raw without cooking or processing steps to eliminate microbial hazards. Therefore, the way they are grown, 4 5 harvested, packed, held, processed, and distributed is crucial to ensuring that the risk of human pathogen 6 contamination is minimized. LGMA recognizes that different crop characteristics may impact susceptibility to adhesion and internalization of hazards. These metrics are intended to prioritize risk by classifying agricultural water systems for 7 8 specific uses within leafy greens operations. Remedial actions follow a "find and fix" structure to identify and correct 9 both system nonconformities and more serious failures. These metrics should be considered the minimum controls necessary to assess agricultural water systems for fitness of use. 10

# <sup>11</sup> General Agricultural Water Management - The Best Practices Are:

- Agricultural water systems are a function of the source, storage, and conveyance. Each component of an agricultural water system that is within your control must be evaluated to ensure that the quality of agricultural water used in leafy green operations is known (i.e., the required parameters are measured and conform to the prescribed standards) and adequate for its intended use.
- It's prudent to evaluate and make a good faith effort to address the food safety hazards proximate to your agricultural water systems that may not be under your control.
- NEVER use water from any water system that has not been microbially characterized and assessed as
   described below.
- Prior to annual use of the water in agricultural operations perform a written agricultural water assessment, as described in Appendix A, prior to use of water in agricultural operations. An agricultural water system description shall be prepared. The water assessment must identify conditions that are reasonably likely to introduce known or reasonably foreseeable hazards into or onto the leafy greens. The assessment must address the following elements:
  - This A description (including the location and nature) of the agricultural water source and the type of distribution system shall be created. Information in the description shall include permanent fixtures such as wells, gates, reservoirs, valves, returns and other permanent above ground fixtures and could also include non-permanent features such as tanks, drip stations, gas power pumps, pipes, water treatment systems, etc. that make up a complete irrigation system. This could be achieved by using maps, photographs, drawings or other means to communicate the location of permanent fixtures and the flow of the water system (including any water captured for re-use or other natural or managed features which prevent environmental runoff from entering the water system).
  - O Water sources and the production blocks they may serve should be documented.
    - The degree of protection from possible sources of contamination, including by other water users; animal impacts; and adjacent and nearby land uses related to animal activity (for example, grazing or commercial animal feeding operations of any size), application of biological soil amendment(s) of animal origin, or presence of untreated or improperly treated human waste.
  - Documented agricultural water practices for each agricultural water system, including the application methods as described in Table 1, water sources and the production blocks they may serve.
- Manage and maintain all components of your agricultural water system that are within your control including
   the water source and the on-ranch (farm) distribution /conveyance system(s) must be managed and
   maintained in a manner that minimizes human pathogen contamination.
- Testing water at the end of the delivery system (e.g., the last sprinkler head) or the point-of-use is essential for
   ensuring water that contacts the crop is of adequate microbial quality.

Commented [A1]: Include health assessment of well: Conduct a well check valve assessment Risers, vents etc. Sample sprinklers at different locations: beginning of distribution system, middle, furthest point

**Commented [A2]:** FMI recommends include additional considerations for adjacent and nearby land use to include other factors that could be a source of contamination.

- For surface water sources, consider the impact of storm events on irrigation practices. Bacterial loads in surface
   water are generally much higher after a storm than normal, and caution shall be exercised when using these
   waters for irrigation.
- Water systems that convey untreated human or animal waste are never suitable for use in leafy greens
   operations in any manner and must be separated from conveyances utilized to deliver agricultural water.
- Water records must be reviewed, dated, and signed, within a week after the records are made, by a
   supervisor or responsible party.

### Hazard Analysis – Step 1: Assessment of Agricultural Water Systems

Evaluating food safety hazards from agricultural water applications in leafy green operations must take into account
 the quality of the agricultural water system, how the agricultural water will be applied, and when it will be applied.
 Prior to using water in any leafy green operation, conduct an agricultural water system assessment (including source,
 storage, and conveyance as described in Appendix A) and determine the agricultural water system type.

- 57 There are two types of agricultural water systems used in leafy green operations:
- Type A: Agricultural water that is unlikely to contain indicators of fecal contamination either due to natural
   hydrogeologic filtration or through controlled USEPA and state regulated treatment regime as demonstrated
   by an agricultural water system assessment as outlined in Appendix A, microbial testing, and when applicable,
   treatment verification.
- **Type B:** All other agricultural water systems.

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- Source: Evaluate each agricultural water source used in your leafy green operations and determine its type.
  - a) Some agricultural water sources are supplied by a third-party provider that certifies the water is of adequate microbial quality (i.e., unlikely to contain indicators of fecal contamination). Example of these sources are:
    - Public (e.g., municipal) or private providers that deliver certified potable water achieved through
      treatment or some other process
- b) Some agricultural water sources deliver water of appropriate microbial quality due to natural physical, chemical, and biological processes that filter water as it passes through the soil. Examples of these sources for Type A agricultural water systems are:
  - Wells constructed in a manner such that contamination from outside sources (e.g., surface water
    or other surface chemical or biological influences / effects) is unlikely (e.g., well heads are
    protected, maintained, and monitored; see Appendix A for additional guidance), and water is
    tested to conform to standards.
  - Regulated recycled water (e.g., tertiary treated, purple pipe, etc.) providers that treat, test, and deliver water that is suitable for use in agricultural applications.<sup>1</sup>
  - c) Some agricultural water sources are part of a Type A system due to on-ranch treatment that, when

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**Commented [A3]:** For well water sources, consider the impact of storm events on irrigation practices. Test distribution system following flooding events where ranch risers and vents are under water. Verify that well water and distribution systems continue to meet the Type A water definition

<sup>&</sup>lt;sup>1</sup> State regulations vary for recycled water. In some states recycled water for produce production allows a certain level of generic *E. coli*, total coliforms, and/or fecal coliforms.

80 81	operating under validated and verifiable parameters, turns Type B water into Type A. An example of a water source used in a Type B $\rightarrow$ A agricultural water system is:
82	Treated surface water (verified to conform to standards)
83 84 85 86	d) Some agricultural water sources are considered part of a Type B system because they are vulnerable to contamination and have not been treated to achieve adequate microbial reduction and shall be used in a manner that minimizes contamination of the crop. Examples of water sources in a Type B agriculture water system are:
87 88	<ul> <li>Wells that may be vulnerable to contamination by outside sources including surface waters or by other surface chemical or biological influences / effects)</li> </ul>
89	Untreated surface water
90 91 92 93 94 95 96	2) Storage and conveyance: Agricultural water source is only one component of an agricultural water system. An agriculture water system that starts out with water of appropriate microbial quality at the source may change quality as it progresses through the delivery system. Microbial water quality depends on the properties of the agricultural water system's components and how they are maintained (for more on system maintenance, see the section below on Best Practice for Managing Storage and Conveyance Systems). Agricultural water systems are typically opened or closed. For the purposes of this document, these systems are defined as follows:
97 98 99 100 101	<ul> <li><u>Closed delivery systems</u> store or convey agricultural water in a manner that does not expose it to the outside environment and where water maintains the initial source type. Water from closed delivery systems must be tested at the end of the system to verify water quality is unchanged as it moves through the system. Additional details about testing requirements for a closed delivery system are provided in Tables 2B and 2C, and guidance is provided in Appendix A.</li> </ul>
102 103 104 105 106 107 108	<ul> <li><u>Open delivery systems</u>, at some point in the system, store or convey agricultural water in a manner that exposes it to the outside environment (i.e., a reservoir / pond, canal, lateral, uncovered water tank, etc.). Water in open delivery systems (e.g., reservoirs and ponds) may be used in overhead applications within 21 days to the scheduled harvest if it is treated (as described in Table 2D) at the time it is applied to crops. Additional details about testing requirements for an open delivery system are provided in Table 2F pertaining to Type B agricultural water systems, and guidance is provided in Appendix A.</li> </ul>
109 110 111 112	3) System: Each component of an agricultural water system must be evaluated to ensure that the quality of agricultural water used in leafy green operations is known (i.e., the required parameters are measured and conform to the prescribed standards) and adequate for its intended use. Agricultural water use will vary depending on the type of system.
113 114	<ul> <li>When determining whether a system is Type A or B, each component (source, storage, conveyance, etc.) must be individually evaluated in typing an entire system.</li> </ul>
115	• When Type A and B waters are combined, categorize water as Type B.
116	Hazard Analysis – Step 2: How Is Your Agricultural Water System Being Used?
117 118 119	Use/Application method: Risk of leafy green contamination is closely related to how water is used in the production and harvest environment as well as in post-harvest applications (Rock et al., 2019). For this reason, agricultural water requirements vary depending on how it is applied. In leafy green operations, agricultural water is 4

Hazard Analysis – Step 3: When Is Your Agricultural Water System Being Used?

- typically used in aerial (e.g., sprayers, overhead sprinklers, aircraft), ground (e.g., furrow and drip irrigation), and
   post-harvest applications. Agricultural water is also used for cleaning and, when appropriate, sanitizing equipment
   used during production, harvest, and post-harvest activities. Type A, Type B water that is treated to become Type A
- 123 (B→A), and Type B agricultural water systems are suitable for specific uses as described in Table 1.
- 124
- Timing of use: Risk of leafy green contamination is closely related to when agricultural water is applied in the
   production environment. For this reason, requirements for agriculture water that is aerially applied to leafy green
   crops vary depending on when the water is applied (Fonseca et al., 2010; Gutierrez-Rodriquez et al., 2012, 2019;
   Koike et al., 2009; 2010; Moyne et al., 2011; Suslow et al., 2010; Wood et al., 2010).
- A number of environmental factors, including location of the operation, and the climatic conditions of UV, relative
   humidity, precipitation, and temperature, may alter the appropriateness of these time-based requirements. Based
   on the most appropriate, currently available research addressing the risks related to the timing of aerial agricultural
   water application in leafy green operations, time-based requirements are generally divided as follows:
- Within (<) 21 days of the scheduled harvest date
- Greater than (>) 21 days until the scheduled harvest date
- Agricultural water from a Type A agricultural water system used in overhead irrigation within (<)21 days of</li>
   the scheduled harvest must meet the performance requirements for Type A agricultural water systems as
   outlined in Tables 2B and 2C.
- Untreated agricultural water that meets Type A requirements for irrigation water or Type B system that
   meets the performance requirements outlined in Table 2E may be used in aerial applications prior (>) 21 days
   before the scheduled harvest.
- To use agricultural water from a Type B agricultural water system in overhead irrigation within (<)21 days of</li>
   the scheduled harvest date, the water must be treated to become Type A water (B→A) and demonstrated to
   meet the performance requirements as outlined in Table 2D.
- 144

# TABLE 1. Agricultural Water System Uses by Application Method – See TABLE 2A—2G

Application	Agricultural water systems (possible sources)	Treatment methods for use in direct contact with crop	Microbial indicator
<ul> <li>Overhead irrigation and chemical application priorto (&gt;) 21 days before scheduled harvest date</li> <li>Germination</li> <li>Ground chemigation</li> <li>Drip irrigation</li> <li>Furrow irrigation</li> <li>Dust abatement</li> <li>Non-food-contact farm equipment cleaning</li> </ul>	Type A and B agricultural water systems	No treatment necessary if it can be demonstrated t o meet the microbial standards.	generic <i>E. coli</i>
<ul> <li>Overhead applications (including irrigation, pesticide spray, aerial chemigation) applied within (≤) 21 days of scheduled harvest date</li> </ul>	Type A agricultural water systems (closed systems including water from wells, municipalities, tertiary treated and disinfected recycled water e.g., purple valve)	No treatment necessary if it can be demonstrated to meet the microbial standards.	generic <i>E. coli</i>
	Treated Type B→A agricultural water systems with open components such as reservoirs, ponds, canals, laterals, ditches, etc.	Must be treated and tested to demonstrate treatment efficacy and compliance with microbial standards.	generic <i>E. coli</i> and total coliforms
Application			
<ul> <li>Food-contact (harvest) equipment cleaning &amp; sanitizing</li> <li>Hand wash water</li> </ul>	• Water that directly contacts edible portions of harvested crop or is used on food-contact surfaces such as equipment or utensils, must meet the Maximum Contaminant Level Goal for <i>E. coli</i> as specified by U.S. EPA or contain an approved antimicrobial treatment at a concentration sufficientto prevent cross-contamination. Microbial or physical/chemical testing shall be performed, as appropriate to the specific operation, to demonstrate that acceptance criteria have been met.		

149	
150	Irrigation Water Sampling Plans and Remedial Actions
151 152 153 154	Testing agricultural water systems is one method of gathering evidence that your system is of adequate quality for its intended use. Along with visual monitoring of agricultural water systems, a water quality testing program is a vital best practice for protecting leafy green crops from contamination. To be most effective as a food safety tool, water samples must reflect, to the extent possible, the water at the point of use.
155 156 157 158	<ul> <li>As irrigation system equipment may change locations throughout the season, but water sources are generally at a fixed location, a robust overhead irrigation water quality testing program must include assessments of both the irrigation water source and the irrigation system. Assessing water quality at the end of the delivery system ensures source water quality does not degrade as it moves through the system.</li> </ul>
159	<ul> <li>For the purposes of this document, sampling of agricultural water systems occurs for the following three</li></ul>
160	reasons and Tables 2B-2C follow this framework providing specific details for each assessment's
161	requirements:
162	<ul> <li>Baseline microbial assessments: To "type" your agriculture water <u>source</u> and establish its "known"</li></ul>
163	quality.
164 165	<ul> <li>Initial microbial water quality assessment: To test your agricultural water <u>system</u> prior to use to ensure water is not degraded as it moves through the system.</li> </ul>
166	<ul> <li>Routine system assessments: To monitor the microbial quality of your agricultural water system</li></ul>
167	throughout the season to ensure it continues to meet the microbial water quality standards.
168	<ul> <li>If you are applying water from a Type A agricultural water system greater than (&gt;) 21 days</li></ul>
169	to the scheduled harvest date, you may choose to sample and test your water according to
170	Type B criteria rather than according to Type A criteria; however, Type A baseline (when
171	required) and initial microbial water quality assessments must be conducted before the 21
172	days-before-harvest window closes and routine verification / monitoring begins (per
173	requirements outlined in Tables 2B and 2C).
174	<ul> <li>Routine sampling is a part of building a dataset useful for evaluating individual data points</li></ul>
175	and evaluating trends to gain a better understanding of your agricultural water system.
176	<ul> <li>Non-routine sampling when food safety risks are deemed higher due to specific</li></ul>
177	circumstances (i.e., weather, animal and human activities, discharge, etc.) should also be
178	part of a robust food safety program. In the event that additional risk factors that could
179	affect water quality are observed or measured such as weather, manure application in a
180	nearby field, or animal-related activity, consider conducting additional water testing.
181	<ul> <li>If you are irrigating with Type B→A agricultural water systems, collecting and analyzing</li></ul>
182	water system data is essential for understanding how the treatment functions in your
183	irrigation system and can optimize its effectiveness.
184 185	<ul> <li>All agricultural water systems used in overhead irrigation prior to (&gt;) 21 days before the scheduled harvest date must meet the water quality requirements outlined in Table 2E for Type B agricultural water systems.</li> </ul>
186	<ul> <li>If a Type A or B agricultural water system fails the respective acceptance criteria, follow remedial action</li></ul>
187	steps as outlined in Table 2F (also included in Figures 2B, 3A and 3C). Consider performing root cause
188	analysis to determine if additional preventive measures can be incorporated into the agricultural water
189	system operation.

190 191	• Retain documentation of all test results and/or Certificates of Analysis/Quality Assurance for a period of at least two (2) years.
192	Best Practice for Managing Storage and Conveyance Systems
193 194	• Develop a SOP for the maintenance of ancillary equipment and water storage and conveyance components of each agricultural water system used in your operations. The SOP must address:
195 196 197	<ul> <li>Regularly scheduled visual inspections, including ancillary equipment connected to your storage and conveyance system, to ensure it is in good working order and does not pose a contamination risk to your system.</li> </ul>
198 199	<ul> <li>Measures to maintain water quality by removing debris and controlling the presence of weeds, algae, tule, trash, and when appropriate, sediment within the grower's control.</li> </ul>
200 201	<ul> <li>Procedures to control pest access to the storage and conveyance systems (examples may include: avian deterrents, fencing, and rodent monitoring).</li> </ul>
202 203	<ul> <li>Corrective actions to ensure irrigation pipes and drip tape are microbiologically safe to use if a pest infestation does occur.</li> </ul>
204 205	<ul> <li>Berms, slopes and diversion ditches for prevention of run-off (i.e., from irrigation or rain) into water storage and conveyance systems.</li> </ul>
206	• Procedures to ensure standing and/or stagnant water does not pose a contamination risk.
207 208	<ul> <li>Management of agricultural water system components used to prepare crop amendments to ensure these activities and equipment are not a contamination source.</li> </ul>
209 210	<ul> <li>Water used in aerial applications (e.g., pesticide and fertilizer, etc.) within the 21-days-to-harvest window must be from Type A or B→A agricultural water systems. Implement practices to ensure:</li> </ul>
211 212	<ul> <li>Holding tanks and equipment-mounted application tanks, manifold and boom lines, and nozzles are to be properly maintained and cleaned.</li> </ul>
213 214	<ul> <li>Water treatment chemistry or approach is compatible with the agricultural chemicals being applied.</li> </ul>
15	<ul> <li>Establish corrective action procedures for non-compliance scenarios, including:</li> </ul>
16	<ul> <li>Contaminated source water</li> </ul>
17	Animal intrusion
18	<ul> <li>Contaminating run-off</li> </ul>
19	<ul> <li>Uncontrolled flooding [reference page, line and table]</li> </ul>
20	Document all corrective measures, cleaning activities, and maintenance.
21	Best Practice for Furrow Irrigation Systems Management
222 223	• Agricultural practices, such as irrigation methods, bed configuration, etc., should be implemented in a manner to avoid water from breaching the top of the bed.

Agricultural practices, such as equipment movement, irrigation practices, etc., should be monitored at
 headland and tail ditch locations for damaged beds which may allow water to contact the edible portion

226	of the crop
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227	•	Coordinate irrigation events with harvest, to the degree possible, to avoid saturation of the field soil to	
228		prevent excessive dirt and mud from getting on the edible portion of the crop, harvest tools (e.g., knives,	
gloves, etc.), and harvest equipment (e.g., machines, belts, trailers, etc.).		gloves, etc.), and harvest equipment (e.g., machines, belts, trailers, etc.).	

### 230 Best Practice for Drip Tape Irrigation Systems Management

- Drip tape should be handled, stored, used, and re-used in a manner that prevents damage and contamination to the drip tape.
- While in use, repairs to drip tape should be completed in a timely manner to prevent water contact with
   the edible portion of the crop.

# 235 Best Practice for Managing Irrigation Water Treatment Systems

- The minimum best practices for managing irrigation water treatment are outlined below and must be
   completed. For greater detail refer to Appendix A.
- Prior to 21 days-to-scheduled harvest conduct an initial irrigation water treatment assessment to establish treatment process parameters that will be monitored to ensure consistent treatment delivery and to demonstrate its effectiveness as described in Appendix A.
  - Repeat this assessment if a material change (e.g., change in equipment or type of water treatment) to your system occurs.
- Before using treated water to irrigate crops within the ≤ 21 days-to-scheduled harvest timeframe growers
   must first establish SOP's outlining irrigation treatment and process parameters for all irrigation treatment
   systems unless duplicated systems are in use.
- Confirm that water microbial quality is not being degraded as it passes through each of your water treatment systems (i.e., due to equipment conditions) by performing a microbial water quality assessment during an irrigation event before entering the ≤ 21 days-to-scheduled harvest timeframe.
- Collect three (3)-100 mL samples from 3 different sprinkler heads with at least one sample from the farthest/last sprinkler head. Acceptance Criteria and Data Monitoring Criteria as outlined in Table 2D -Routine Monitoring of Microbial Water Quality must be met.
- Best Practice Water Used for Overheard Chemical Applications within 21 Days of Scheduled Harvest
   (This section does NOT apply to chemical applications made through the distribution system i.e., sprinkler)

Type B water used for overhead applications within 21 days of scheduled harvest must be treated. With the start-up of any new treatment process it is important to evaluate all conditions that may affect water treatment efficacy and performance. Examples of parameters that provide valuable information about treatment efficacy in relationship to water quality are: Turbidity, pH, antimicrobial dose, historical microbial monitoring data, etc. (See Appendix A for additional guidance).

- Develop a SOP for all of the parts of the ag water system used in overhead chemical application. The SOP must address:
  - Water used in overhead applications (e.g., pesticide and fertilizer, etc.) within the 21-days-to-harvest window must meet Type A and/or B→A water quality requirements.

**Commented [A4]:** Increase the sample size in accordance with the method "Standard Operating Procedure for Dead-End Ultrafiltration Water Sampling in the Field for Bacterial Pathogens Issue Date: August 19, 2021, Revision 7"

263 264 265	<ul> <li>Holding tanks and equipment-mounted application tanks, manifold and boom lines, and nozzles MUST be regularly inspected and properly maintained and cleaned so they do not pose a contamination risk.</li> </ul>
266 267	<ul> <li>Water treatment chemistry or approach shall be compatible with the agricultural chemicals being applied.</li> </ul>
268 269 270	<ul> <li>Procedures to control pest access to the equipment during storage and staging (examples may include avian deterrents, fencing, and rodent monitoring) must be in place (validation can include: Pest control applicator (PCA) records, label requirements, letter of guarantee).</li> </ul>
271 272 273 274	<ul> <li>Establish corrective action procedures for non-compliance scenarios including:</li> <li>treatment failure</li> <li>contaminated source water</li> <li>pest concerns</li> </ul>
275 276	<ul><li>chemical incompatibility</li><li>equipment sanitation concerns.</li></ul>
277	<ul> <li>Document all corrective measures, cleaning activities, and maintenance.</li> </ul>
278 279 280 281 282 283	• Develop a SOP for each unique application process to treat water that will be used in an overhead application within 21 days of a scheduled harvest. Prior to the 21-days-to-scheduled-harvest conduct an initial water treatment assessment to establish treatment process parameters that will be monitored to ensure consistent treatment delivery and to demonstrate effectiveness. Repeat this assessment if a material change to your system occurs and incorporate this assessment's findings into your water treatment SOP. The SOP must address:
284	• Step-by-step instructions to ensure the water treatment is correctly implemented.
285	<ul> <li>Location of water sources</li> </ul>
286	<ul> <li>Name and suggested supplies needed.</li> </ul>
287	<ul> <li>Sanitizer used and quantity used.</li> </ul>
288	Critical limits and operational limits
289	• Water sampling location
290	Corrective actions if critical limits are not met.     Populated records
291	Develop a baseline for water treatment:
202	<ul> <li>Develop a baseline for watch a calification.</li> <li>Develop a baseline for watch a calification.</li> </ul>
293 294 295 296	a prior to the 21 days-to-scheduled harvest, a minimum of three (3)-100 mL samples must be taken for each overhead application process (distinct water quality source, different sanitizer, different size water holding tank, etc.). The three (3) samples must be taken from different treated water batches.
297	• All three (3) samples must be non-detect for generic <i>E. coli</i> .
298	Routine testing:
299 300	<ul> <li>A minimum of one (1) microbiological sample must be taken each month from a representative agricultural water system or at the next application event.</li> </ul>

301 • This 100 mL sample should have no detectable generic *E. coli*.
302	Corrective action:		
303	<ul> <li>If microbiological testing shows that the water did not meet generic <i>E. coli</i> acceptance criteria</li></ul>		
304	within 21 days of a scheduled harvest, perform a root cause analysis and correct the concern.		
305	Notify the grower/producer.		
306	<ul> <li>The product must be tested for pathogens before harvest if this water was used in overhead</li></ul>		
307	application. Follow the product testing requirements outlined in Table 2F.		
308	Ongoing monitoring:		
309	<ul> <li>Between microbiological routine testing events, records must be kept that verify that each</li></ul>		
310	application event is conducted following the parameters established during the initial setup.		
311 312	<ul> <li>If monitoring shows that the water treatment parameters are not being met, <i>do not use the water</i>.</li> </ul>		
313	<ul> <li>Perform a corrective action to assure the water treatment is effective before using the</li></ul>		
314	water.		
315	<ul> <li>Take a microbiological sample to verify that the treatment was effective and have that</li></ul>		
316	result as part of the corrective action documentation.		
317	<ul> <li>If the verification microbiological sample does not meet acceptance criteria, perform a root</li></ul>		
318	cause analysis and correct the treatment process. Product must be tested for pathogens		
319	before harvesting. Follow Table 2F for product testing requirements.		
320	<ul> <li>Maintain records that demonstrate the water used for chemical applications meets Type A source water</li></ul>		
321	requirements. See Tables 2B and 2C for historical and/or baseline water quality requirements for source		
322	water that will be used for overhead applications.		
323	Other Considerations for Water		
324 325	<ul> <li>Treat water only with antimicrobial treatments approved by the USEPA for use in agricultural applications in accordance with label specifications, guidelines for use, and consideration of environmental impacts.</li> </ul>		
326	<ul> <li>Antimicrobial treatments must be used and managed in a manner that meets all federal, state, and local</li></ul>		
327	regulations.		
328 329	• Do not store raw manure or any type of compost near irrigation water sources or conveyance systems (see Table 0).		
330	Best Practice for Irrigation Water from Type B Agricultural Water		
331 332 333 334 335 336 337 338	The following table (2A) outlines the metrics for agricultural water conveyance systems whereby edible portions of the crop are not likely to be contacted (e.g., germination, ground chemigation, furrow, drip irrigation, dust abatement water); if water is used in the vicinity of produce, then testing is necessary. For any of these uses, the agricultural water system must be assessed and monitored to demonstrate that the water meets the microbial standards for water that is likely to contain indicators of fecal contamination. Routine monitoring of microbial quality is required for all water types and remedial actions are required if water testing shows a conveyance system has failed to deliver water that meets the microbial standard. Efforts should always be made, when using Type B water, to avoid contact with the edible portion of the crop within 21 days of a scheduled harvest. When performing remedial actions, it is the intent		

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that all remedial steps outlined in the tables below are followed and that they are followed in the order of sequence

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as written.

# 341 TABLE 2A. Irrigation Water from Type B Agricultural Water – See FIGURE 1

Metric	Rationale /Remedial Actions
<ul> <li>Examples of water from Type B agricultural water systems:</li> <li>Ground chemigation</li> <li>Drip irrigation</li> <li>Furrow irrigation</li> <li>Dust abatement</li> </ul>	Water for Type B use throughout the production of the crop shall meet or exceed microbial standards based on a rolling geometric mean of the five most recent samples. However, a rolling geometric mean of five samples is not necessarily required prior to irrigation or harvest. If less than five samples are collected prior to irrigation, the acceptance criteria depend on the number of samples taken. If only one sample has been taken, it must be below 126 MPN/100 mL. Once two samples are taken, a geometric mean can be calculated, and the normal acceptance criteria apply. If the acceptance criteria are exceeded during this time-period, additional samples may be collected to reach a 5-sample rolling geometric mean (as long as the water has not been used for irrigation). The rolling geometric mean calculation starts after 5 samples have been collected. If the water source has not been tested in the past 60 days, the first water sample shall be tested prior to use, to avoid using a contaminated water source. After the first sample is shown to be within acceptance criteria, subsequent samples shall be collected no less frequently than monthly (or at the next irrigation event if longer than monthly) at points of use within the distribution system.
	not necessarily indicate that the water is unsafe. Investigation and/or remedial action SHOULD be taken when test results are higher than normal or indicate an upward trend. Investigation and remedial action SHALL be taken when acceptance criteria are exceeded.
Target Organisms: Generic E. coli	Γ
Sampling Procedure: 100 mL sample collected aseptically as close as practical to the point of use. Sampling Frequency: One sample per agricultural water source shall be collected and tested prior to use if >60 days since last test of the water source. Additional samples shall be collected no less than 18 hours apart and at least monthly (or at the next irrigation event ifgreater than monthly) during use from points within the delivery system.	<ul> <li>If the rolling geometric mean (n=5) or any one sample exceeds the acceptance criteria, then the water shall not be used until remedial actions have been completed and generic <i>E. coli</i> levels are within acceptancecriteria:</li> <li>Conduct an agricultural water assessment (Appendix A) of water source and conveyance system to determine if a contamination source is evident and can be eliminated. Eliminate identified contamination sources.</li> <li>Retest the agricultural water after taking remedial actions to determine if it meets the outlined microbial water quality acceptance criteria for this use. This sample should represent the conditions of the original water system, if feasible this test should be as close as practical to the original sampling point. A more aggressive sampling program (i.e., sampling once per week instead of once per month) shall be instituted if an explanation for the exceedance is not readily apparent. This type of sampling program should also be instituted if an upward trend is noted in normal sampling results.</li> <li>If follow-up agricultural water testing indicates that a crop has been directly contacted with water exceeding accentance criteria product</li> </ul>

Metric	Rationale / Remedial Actions
Acceptance Criteria: ≤ 126 MPN/100 mL (rolling geometric mean n=5) and ≤ 576 MPN/100 mL for any single sample	shall be sampled and tested for STEC (including <i>E. coli</i> O157:H7) and <i>Salmonella</i> as described in Appendix C, prior to harvest. If crop testing indicates the presence of either pathogen, the crop shall NOT be harvested for the fresh market.
Test Method: Any FDA-allowed method <sup>2</sup>	
<b>Records:</b> Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the producer/shipper who is the responsible party for period of two years.	

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<sup>&</sup>lt;sup>2</sup> Equivalent testing methodology for agricultural water <u>https://www.fda.gov/food/foodscienceresearch/laboratorymethods/ucm575251.htm</u>



### 344 FIGURE 1. Irrigation Water from Type B Agricultural Water – See TABLE 2A

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#### For any given water source (municipal, well, reclaimed water, reservoir or other surface water):

Sampling Frequency: For Type B water, one sample per water source shall be collected and tested prior to use if >60 days since last test of the water source. Additional samples shall be collected during use no less than 18 hours apart andat least monthly (or at the next irrigation event if greater than monthly) during use.

- Sample sources as close to the point-of-use as practical using sampling methods as prescribed in Table 2A.
- Analyze samples for generic *E. coli* using a MPN methodology. Other EPA-, FDA- or AOAC International accredited method may be used.
- Geometric means, including rolling geometric means shall be calculated using the five most recent samples.

ACCEPTANCE CRITERIA ≤ 126 MPN/100ml (Geometric mean of 5 samples) AND	<u>ACTION LEVEL</u> >126 MPN/100ml (geometric mean over five samples) <u>OR</u> >576 MPN/100ml (any single sample)
<576 MPN/100ml (all single samples)	REMEDIAL ACTIONS:
No further action necessary. Water maybe used in leafy green operations as outlinedin Table 2A.	<ul> <li>Discontinue any agricultural production use until it returns to compliance.</li> <li>Examine the water source and distribution system to determine if a contaminationsource is evident and can be eliminated.</li> <li>After remedial actions have been taken, retest the water at the same sampling point.</li> <li>Continue testing daily for five days at the point closest to use.</li> <li>If any of the next five samples is &gt;576 MPN/100mL, repeat sanitary survey and/orremedial action.</li> <li>Do not use this water system until the water can meet the outlined acceptance criteriafor this use.</li> <li>CROP TESTING:</li> <li>If water exceeding the acceptance criteria has been used for crop production</li> </ul>
	sample and test product for STEC (including <i>E. coli</i> O157:H7) and <i>Salmonella</i> as described in Appendix C. prior to bayyest
	<ul> <li>If crop testing indicates the presence of either pathogen, do NOT harvest for human consumption.</li> </ul>

# <sup>346</sup> Best Practice for Irrigation Water from Type A Agricultural Water

347 The following tables (2B - 2F) refer to agricultural water distribution systems and not to specific ranches, lots, fields, 348 etc. The tables outline the metrics for overhead applications of agricultural water sourced from public/private supplies 349 (2B), regulated recycled water and private wells (2C), treated water supplies (2D), and untreated water that is likely to 350 contain indicators of fecal contamination (2E). Each type of agricultural water system must be assessed to demonstrate 351 that the water from the source and the distribution system meet the microbial standards. Treated water must be 352 assessed and monitored to demonstrate that the water treatment is working as intended and that the treated water 353 meets the microbial standard. Routine monitoring of microbial quality is required for all water system types, and 354 remedial actions are required if water testing shows a system has failed to deliver water that meets the microbial 355 standard. When performing remedial actions, it is the intent that all remedial steps outlined in the tables below are followed and that they are followed in the order of sequence as written. 356

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# TABLE 2B. Irrigation Water from Type A Agricultural Water Systems Sourced from Public or Private Providers – See FIGURE 2A-2B

Metric Rationale /Remedial Actions		
Examples of these types of Type A agricultural water systems: Water maycome from public and private providersand are stored and conveyed in closed delivery systems.	Irrigation water from Type A agricultural water systems sourced from regulated public or private providers would not be expected to contain generic <i>E. coli</i> due to treatment or some other filtering-type process. Water sourced from a public/private Type A agricultural water provider must be stored and conveyed in well-maintained, closed systems and tested for generic <i>E. coli</i> .	
B1. Baseline Microbial Assessment		
A baseline microbial assessment of the water source is not necessary for a Type A system using source water from a public/private provider. In lieu of a baseline microbial assessment, acquire and maintain the supplier's most current COA on file.		
<b>Records:</b> Records of the analysis of source water may be provided by municipalities, irrigation districts, or other water providers and must be available for verification from the grower/handler who is the responsible party for a period of two years		
B2. Initial Microbial Water Quality Ass	essment	
Target Organisms: Generic E. coli		
Initial Assessment Sampling Procedure: Aseptically collect at least three (3)- 100mL samples during one irrigation eventwith at least one sample at the end of the delivery system (e.g., last sprinkler head). Initial Assessment Sampling Frequency: This is a one-time seasonal sampling event for each system with samples collected during one irrigation event occurring before the 21-days-to-scheduled-harvest period begins. (Also conduct this assessment after any material modifications to Type A overhead irrigation systems.)	The purpose of this assessment is to confirm that the water's microbial quality is not being degraded as it passes through your system (i.e., due to equipment conditions). The assessment is performed to verify that your irrigation water delivery system is able to maintain and deliver water of the same microbial quality (e.g., Type A) as the source water. Unless there is a material change to your system (e.g., change in equipment or type of watertreatment), this is a one-time assessment for each irrigation system, and it is not necessary to repeat system evaluations for each irrigation event. To test your water delivery systems, sample and test irrigation water during an irrigation event. All discrete systems are to be tested before entering the 21-days-to-scheduled-harvest time frame. To assess the water delivery system, water samples are taken throughout the system with at least one sample at the endof the line where water contacts the crop. Initial Assessment Testing If at least two (2) in three (3) samples do not have detectable levels of generic <i>E. coli</i> , and the level in the one remaining sample is no greater	
Initial Assessment Acceptance Criterion: Non-detectable in two (2) of three (3)-100 mL samples and 10 MPN as the single sample maximum for	than $(\leq)$ 10 MPN, then the water system maintains its Type A status. If water samples do not meet the acceptance criteria (i.e., if two (2) or more of the samples have detectable levels of generic <i>E. coli</i> <u>or</u> the level in at least one sample is greater than (>) 10 MPN), then conduct the following follow-up testing:	

Metric	Rationale /Remedial Actions
one (1) sample. Follow-up Testing Acceptance	<u>Follow-up Testing</u> Prior to the next irrigation event perform a root cause analysisand an
Non-detectable in four (4) of five (5)-100 mL samples and 10 MPN	agricultural water system assessment as described in Appendix A to identify and correct the failure.
as the single sample maximum for one (1) sample.	After assessing the system, retest the system for generic <i>E. coll</i> in five (5)-100 mL samples collected during the next irrigation event using the sampling procedure and frequency (described in the left column).
<b>Note</b> : For the purposes of water testing, MPN and CFU are considered equivalent.	Water samples can be pulled from the endof any system nodes/branches in the irrigation system of concern. Of the five (5) follow-up samples, four (4) must have no detectable generic <i>E. coli</i> and the one (1) remaining samplemust have levels no greater than ( $\leq$ ) 10 MPN generic <i>E. coli</i> / 100mL.
	If test results meet the acceptance criterion for generic <i>E. coli</i> , the water system can be used as a Type A system.
	<u>Testing Failure</u> : When one sample has more than (>) 10 MPN generic <i>E. coli</i> / 100 mL or more than one sample have detectable generic <i>E. coli</i> , the agricultural water system is disqualified for TypeA usage. Perform a root cause analysis to identify and correct the failure (see Appendix A
	Tor mitigation measures). In the interim, the water can be used as a Type B agricultural water system.

## Test Method: Any FDA-allowed method<sup>2</sup>

**Records:** Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for a period of two years.

#### **B3.** Routine Verification of Microbial Water Quality

Routine Verification SamplingProcedure:	To verify irrigation water continues to meet the acceptance criterion throughout the season, design your sampling plan so eachdistinct
Aseptically collect at least three (3)- 100mL samples during one irrigation eventwith at least one sample taken at the end of the delivery system (e.g., last sprinkler head). Routine Verification SamplingFrequency:	irrigation system that is in use is sampled and tested at least once during the season. If two (2) or more of the samples have detectable levels of generic <i>E</i> . <i>coli</i> <u>or</u> the level in at least one sample is greater than (>) 10MPN, prior to the next irrigation event perform a <b>Level 1 Assessment</b> as outlined in <u>Table 2F</u> .
Sample and test each distinct irrigationsystem for generic <i>E. coli</i> at least once during the season.	
Routine Verification AcceptanceCriterion:	
Non-detectable generic E. coli in 100	

Metric	Rationale /Remedial Actions
mLwater samples and $\leq$ 10 MPN as the single sample maximum for one (1) in three (3) samples	
Note: For the purposes of water testing, MPN and CFU are considered equivalent.	
Test Method: Any FDA-allowed method <sup>2</sup>	
<b>Records:</b> Each water sample and analysis shall record the type of water source, date, time, and location of the	

**Records:** Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for a period of two years.

### 362 FIGURE 2A. Irrigation Water from Type A Agricultural Water Systems Sourced from Public / Private

### 363 Providers – See TABLE 2B



#### 365 FIGURE 2B. Irrigation Water from Type A Agricultural Water Systems Sourced from Public / Private

#### 366 Providers – See TABLE 2B

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- During the next irrigation event, collect 5 100 mL samples from the irrigation system and test for generic *E*. *coli*. Water can be pulled from the end of any system nodes/branches in the irrigation system of concern. If these water samples also fail to meet the acceptance criterion, discontinue use of this water for overhead applications while continuing to evaluate your water system to identify and correct any failures and continuing to testas described in this step until the water is back in compliance (see AppendixA for guidance on troubleshooting irrigation system failures).
- If this water (i.e., the water from the initial sampling to the last of the follow-up sampling) has been applied to leafy greens, either consider the crop unsuitable for the fresh market or test the crop from all affected lots (i.e., lots that have been irrigated with this water within the <21 days -to- scheduled-harvest window) for STEC (including *E. coli* O157:H7) and *Salmonella*. Product needs to be tested prior to harvesting and after your last irrigation event. Sample crop per the protocol described in Appendix C.If any individual sample tests positive for any of these human pathogens, the crop within that lot shall NOT be harvested for the fresh market and human consumption.

# 368TABLE 2C. Irrigation Water from Type A Agricultural Water Systems Sourced from Private Wells or369Regulated Tertiary Treated Recycled Water Supplies – See FIGURE 3A-3C

Metric	Rationale /Remedial Actions
<ul> <li>Examples of water from Type A agricultural water systems:</li> <li>Regulated recycled wastewater</li> <li>Water sourced from a well – well water is conveyed to the field in a closed delivery system and applied to the crop via overhead sprinklers.</li> </ul>	Irrigation water from Type A agricultural water systems with well source water would not be expected to contain generic <i>E.</i> <i>coli</i> due to natural filtration as the water passes through the soil. Water from regulated tertiary treated recycled water supplies may have low levels of generic <i>E. coli</i> due to regulatory allowable limits. Type A agricultural water systems must be stored and conveyed in well-maintained, closed systems and tested for generic <i>E. coli</i> . Remedial actions vary depending on when the water is being used in relation to harvest.
C1. Baseline Microbial Assessment	
Target Organisms: Generic E. coli	
<ul> <li>Baseline Assessment Sampling Procedure: If historical water test data is not available, aseptically collect at least three (3)-100 mL sample at the source.</li> <li>Baseline Assessment Sampling Frequency: Sample and test the water two times (with sampling events separated by no less than 7 days) before using the water within the 21-days-to-scheduled-harvest-window.</li> <li>Baseline Assessment Acceptance Criteria: Non-detectable generic <i>E. coli</i> in five (5) of six (6) 100 mL samples and ≤ 10 MPN as the single sample maximum for one (1) sample.</li> </ul>	The purpose of a baseline assessment is to ensure your water source (e.g., a well or regulated tertiary treated recycled water) meets the microbial standards for generic <i>E. coli</i> . This baseline microbial assessment must be conducted before these Type A water sources can be used for overhead irrigation within 21-days to-scheduled-harvest. For agricultural water systems with multiple wells, each well must be tested prior to use in order to validate the integrity of the agricultural water system. Self-certification with historical water test data: If at least four (4) of the last five (5) consecutive historical water tests (80%) have no detectable generic <i>E. coli</i> , the remaining one (1) sample does not exceed ( $\leq$ ) 10 MPN in 100 mL, and one (1) of those tests was taken within the last 6 months, then the well/regulated tertiary treated recycled water source.
<b>Note</b> : For the purposes of water testing, MPN and CFU are considered equivalent.	<u>Self-certification process when no historical data is available:</u> If historical data is unavailable, test each well or regulated recycled water twice (separated by no less than seven days) prior to use as the source water for a Type A agricultural water system. If at least five (5) of the six (6) total samples have no detectable generic <i>E. coli</i> and the remaining sample has $\leq$ 10 MPN in 100 mL, then the water/well is self-certified as a Type A agricultural water source. <u>Testing Failure</u> : If test results do not meet the acceptance criteria, then the water/well cannot be considered a Type A agricultural water source. Perform a root cause analysis and an agricultural water system assessment as described in Appendix A to identify and correct the failure. In the interim, the water can be treated or used as a source for a Type B agricultural water

Metric	Rationale /Remedial Actions
	system.

Test Method: Any FDA-allowed method<sup>2</sup>

**Records:** Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for aperiod of two years.

#### **C2.** Initial Microbial Water Quality Assessment

Target Organism: Generic E. coli

#### Initial Assessment Sampling Procedure:

Aseptically collect at least three (3)-100 mL during one irrigation event at the end of thedelivery system (e.g., last sprinkler head).

### Initial Assessment Sampling Frequency:

This is a one-time seasonal sampling event for each system with samples collected during one irrigation event occurring beforethe 21-day-to-scheduledharvest-period begins. (Also conduct this assessment after any material modifications to Type A overhead irrigation systems.)

#### Initial Assessment Acceptance Criteria:

Non-detectable generic *E. coli* in two (2) of three (3)-100 mL samples and  $\leq$  10 MPN as the single sample maximum for one (1) sample.

#### Follow-up Testing Acceptance Criteria:

Non-detectable in four (4) of five (5)-100 mLsamples and  $\leq$  10 MPN as the single sample maximum for one (1) sample.

**Note**: For the purposes of water testing, MPNand CFU are considered equivalent.

The purpose of this assessment is to confirm that the water's microbial quality is not being degraded as it passes through your system (i.e., due to equipment conditions). The assessment is performed to verify that your irrigation water delivery system is able to maintain and deliver water of the same microbial quality (e.g., Type A) as the water source. Unless there is a material change to your system (e.g., changein equipment or type of water treatment), this is a one-time assessment for each irrigation system, and it is not necessary to repeat system evaluations for each irrigation event. To test your water delivery systems, sample and test irrigation water during an irrigation event. All discrete systems are to be tested before entering the 21-days-to-scheduled-harvest timeframe. To assess the water delivery system, water samples are taken at the end of the line where water contactsthe crop.

#### Initial Assessment Testing

If at least two (2) in three (3) samples do not have detectable levels of generic *E. coli*, and the level in the one remaining sample is no greater than ( $\leq$ ) 10 MPN, then the water system maintains its Type A status.

If water samples do not meet the acceptance criteria (i.e., iftwo (2) or more of the samples have detectable levels of generic *E. coli* <u>or</u> the level in at least one sample is greater than (>) 10 MPN), then conduct the following follow-up testing:

#### Follow-up Testing

- Prior to the next irrigation event perform a root cause analysis and an agricultural water system assessment as described in Appendix A to identify and correct the failure.
- 2) After assessing the system, retest the system for generic *E. coli* in five (5)-100 mL samples collected during the next irrigation event using the sampling procedure and frequency (described in the left column). Water samples can be pulled from the end of any system nodes/branches



Metric	Rationale /Remedial Actions
	in the irrigation system of concern. Of the five (5) follow- up samples, four (4) must have no detectable generic <i>E.</i> <i>coli</i> and the one (1) remaining sample must have levels no greater than ( <u>&lt;)</u> 10 MPN / 100 mL.
	3) If test results meet the acceptance criterion for generic <i>E. coli</i> , the water system can be used as a Type A system.
	<u>Testing Failure</u> : When one sample has more than (>) 10 MPN / 100 mL or more than one sample have detectable generic <i>E.coli</i> , the agricultural water system is disqualified for Type A usage. Perform a root cause analysis to identify and correct the failure (see Appendix A for mitigation measures). In the interim, the water can be used as a Type B agricultural water system.
Test Method: Any FDA-allowed method <sup>2</sup>	
<b>Records:</b> Each water sample and analysis shall sample, the method of analysis, and, if quantit shall be documented and available for verifica period of two years.	record the type of water source, date, time, and location of the tative, the detection limit. All test results and remedial actions tion from the grower/handler who is the responsible party for a
C3. Routine Verification of Microbial Water Q	luality
Target Organisms: Generic E. coli	
Sampling Procedure Three (3)-100 mL samples aseptically collected at the end of the delivery system (e.g., the last sprinkler head).	To verify irrigation water continues to meet the acceptance criterion throughout the season, design your sampling plan so each distinct irrigation system that is in use is sampled and tested at least once during the season.
Sampling Frequency	If two (2) or more of the samples have detectable levels of
Sample and test each distinct irrigation system for generic <i>E. coli</i> at least once during the season.	<ul> <li>(&gt;) 10 MPN, prior to the next irrigation event perform a Level :</li> <li>Assessment as outlined in Table 2F.</li> </ul>
Acceptance Criterion	
Non-detectable generic <i>E. coli</i> in 100 mL water samples and $\leq$ 10 MPN as the single sample maximum for one (1) in three (3) samples	
<b>Note</b> : For the purposes of water testing, MPN andCFU are considered equivalent.	
Test Method: Any FDA-allowed method <sup>2</sup>	
<b>Records:</b> Each water sample and analysis shall sample, the method of analysis, and, if quantit shall be documented and available for verifica	record the type of water source, date, time, and location of the tative, the detection limit. All test results and remedial actions tion from the grower/handler who is the responsible party for a

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period of two years.

# FIGURE 3A. Irrigation Water from Type A Agricultural Water Systems Sourced from Private Wells or Regulated Tertiary Treated Recycled Water Supplies – See TABLE 2C



#### FIGURE 3B. Irrigation Water from Type A Agricultural Water Systems Sourced from Private Wells or Regulated Tertiary Treated Recycled Water Supplies – See TABLE 2C



# FIGURE 3C. Irrigation Water from Type A Agricultural Water Systems Sourced from Private Wells or Regulated Tertiary Treated Recycled Water Supplies – See TABLE 2C

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### **ROUTINE MONITORING of MICROBIAL WATER QUALITY** For Type A agricultural water from regulated recycle water / private well sources for overhead applications when used within (<) 21 days of the scheduled harvest date. (When using Type A agricultural water from these sources for overhead applications up to (>) 21 days of the scheduledharvest date follow water metrics in Table 2E/Figure 5 for Type B agricultural water systems.) • Collect three (3) samples at the end of the delivery system (e.g., last sprinkler head); test each distinct irrigation system in use at least once during the season. • Test for generic E. coli using a FDA-allowed method. • Assess microbial quality using the three (3) collected samples. **ACCEPTANCE CRITERIA** No detectable generic *E. coli* in at ACTION LEVEL least 2 of 3 consecutive samples and < 10 MPN in one remaining Generic *E. coli* detected in $\geq 2$ sample samples or one samplehas levels above (>) 10 MPN / 100 mL No further action necessary. Water may be used in leafy green operationsas outlined in Table 2C. CONDUCT A LEVEL 1 ASSESSMENT: If generic E. coli levels in your water exceed the acceptance criterion, prior to the next irrigation event, conduct an agricultural water systemassessment as described in Appendix A. • Retest the water for generic E. coli during the next irrigation event in five (5) - 100 mL samples. Water can be pulled from the end of any system nodes/branches in the irrigation system of concern. If these water samples also fail to meet the acceptance criterion, discontinue use of this water for overhead applications while continuing to evaluate your water system to identify and correct any failures and continuing to test as described in this step until the water is back in compliance (see Appendix A for guidance on troubleshooting irrigationsystem failures). • If this water (the water from the initial sampling to the last of the follow-up sampling) has been applied to leafy greens, either consider the crop unsuitable for the fresh market or test the crop from all affected lots (i.e., lots that have been irrigated with this water within the <21 days-to-scheduled-harvest window) for

leafy greens, either consider the crop unsuitable for the fresh market or test the crop from all affected lots (i.e., lots that have been irrigated with this water within the <21 days-to-scheduled-harvest window) for STEC (including *E. coli*O157:H7) and *Salmonella*. Product needs to be tested prior to harvesting and after your last irrigation event. Sample crop per the protocol described in Appendix C. If any individual sample tests positive for any of these human pathogens, the crop within that lot shall NOT be harvested for the fresh market and human consumption.

# 379 TABLE 2D: Irrigation Water from Treated Type B $\rightarrow$ A Agricultural Water Systems – See FIGURE 4.

Rationale /Remedial Actions
When water from a Type B agricultural water system is used in an overhead application within ( $\leq$ ) 21 days to thescheduled harvest date, it must be treated to move it from a Type B agricultural water system to a Type A system (B $\rightarrow$ A) by a scientifically valid antimicrobial watertreatment - i.e., contain an approved antimicrobial watertreatment at sufficient concentration to prevent potential contamination risk during overhead applications. Microbial and/or physical/chemical testing of the source and system must be performed, as appropriate to the specific operation, to demonstrate that performance criteria have been met before use within ( $\leq$ ) 21 days to the scheduled harvest date and continues to be met throughout its use. Water in open delivery systems (e.g., reservoirs and ponds) may be used in overhead applications within 21 days to the scheduled harvest if it is treated at the sametime it is applied to crops.
-
Routine water sampling is performed to verify irrigation water continues to meet the microbial quality acceptance criteria throughout the season. Routine verification of treated irrigation water systems is focusedon the function of the system. Sampling needs to occur at a frequency that allows operators to verify they have control of their treatment system. An essential component of this verification process is building a dataset so microbial quality can be analyzed to best inform you how to effectively run your water treatment system. Sample and test the system for total coliforms and generic <i>E. coli</i> in three (3)-100 mL samples. To maintainits Type A status, water samples must have: • no detectable generic <i>E. coli</i> in at least two (2) of thethree (3) samples with a maximum level no

<ul> <li>data monitoring for total colliforms at a level nogreater than (≤) 99 MPN in 100 mL *</li> <li>data monitoring for total colliforms at a level nogreater than (≤) 99 MPN in 100 mL *</li> <li>As an alternative to the threshold approach for total colliforms (≤) 10 MPN allowed in one (1) sample [consecutive values]</li> <li>there (3) water samples with a maximum level of ≤ 99 MPN in 100 mL in all water samples or an adequate log reduction based on the untreated water's baseline total colliforms levels*</li> <li>If two (2) or more of the three (3)-100 mL samples do not meet the acceptance criteria for generic <i>E. coli</i> and at least one sample is greater than (&gt;) 100 MPN and one (1) or more of the total colliforms results do not meet the acceptance riteria for generic <i>E. coli</i> and at least one sample is greater than (&gt;) 100 MPN and one (1) or more of the total colliforms results do not meet the monitoring criteria, prior to the next irrigation event perform a Level1 Assessment as outlined in Table 2F.</li> <li>Test Method: Any FDA-allowed method<sup>2</sup></li> <li>Routime Water Treatment Monitoring unatitative, the detection limit. All test results and remedial actions hall be documented and available for verification from the grower/handler who is the responsible party for a beeriod of two years.</li> <li>Routine Water Treatment Monitoring unatitative, the detection limit. All test results and remedial actions hall be documented and available for verification from the grower/handler who is the responsible party for a beeriod of two years.</li> <li>Routine Water Treatment Monitoring Monitoring for use in agricultural water.</li> <li>'arget variable: Antimicrobial irrigation water treatment or manufacturer's operational specifications (e.g., per nanufacturer's recommendations, chemical concentration, etc.).</li> <li>''esting Procedure:         <ul> <li>Chemical reaction-based colorimetric test, or</li> </ul> </li> <li>Monitor the efficacy</li></ul>
Arecords: Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions hall be documented and available for verification from the grower/handler who is the responsible party for a beriod of two years.  22. Routine Water Treatment Monitoring  Antimicrobial water treatments - USEPA-approved for use in agricultural water.  arget variable: Antimicrobial irrigation water treatment or manufacturer's operational specifications (e.g., per nanufacturer's recommendations, chemical concentration, etc.).  (arget reation-based colorimetric test, or the efficacy of the water treatment method perthe manufacturer's label or operational instructions.  To demonstrate the irrigation system is performing or the manufacturer's label or operational instructions.
<ul> <li>Ample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for a period of two years.</li> <li>Antimicrobial water Treatment Monitoring</li> <li>Antimicrobial water treatments - USEPA-approved for use in agricultural water.</li> <li>'arget variable: Antimicrobial irrigation water treatment or manufacturer's operational specifications (e.g., per nanufacturer's recommendations, chemical concentration, etc.).</li> <li>'esting Procedure:         <ul> <li>Chemical reaction-based colorimetric test, or</li> <li>Monitor the efficacy of the water treatment method perthe manufacturer's label or operational instructions.</li> <li>To demonstrate the irrigation system is performing actions.</li> </ul> </li> </ul>
D2. Routine Water Treatment Monitoring         Antimicrobial water treatments - USEPA-approved for use in agricultural water.         'arget variable: Antimicrobial irrigation water treatment or manufacturer's operational specifications (e.g., per nanufacturer's recommendations, chemical concentration, etc.).         'esting Procedure:       Monitor the efficacy of the water treatment method perthe manufacturer's label or operational instructions.         • Chemical reaction-based colorimetric test, or       To demonstrate the irrigation system is performing as
Antimicrobial water treatments - USEPA-approved for use in agricultural water.  arget variable: Antimicrobial irrigation water treatment or manufacturer's operational specifications (e.g., per nanufacturer's recommendations, chemical concentration, etc.).  breating Procedure:  Chemical reaction-based colorimetric test, or  Monitor the efficacy of the water treatment method perthe manufacturer's label or operational instructions.  To demonstrate the irrigation system is performing as
Farget variable: Antimicrobial irrigation water treatment or manufacturer's operational specifications (e.g., per nanufacturer's recommendations, chemical concentration, etc.).         Festing Procedure:       Monitor the efficacy of the water treatment method perthe manufacturer's label or operational instructions.         • Chemical reaction-based colorimetric test, or       To demonstrate the irrigation system is performing as
• Chemical reaction-based colorimetric test, or Chemical reaction-based colorimetric test, or To demonstrate the irritation system is performing as
<ul> <li>Ion-specific probe, or</li> <li>Other as recommended by antimicrobial watertreatment supplier or manufacturer's specifications.</li> <li>Flow rates</li> </ul>
<ul> <li>Treatment-related parameters such as residual antimicrobial levels, pH, dose settings, UVT, etc.</li> <li>If water quality falls outside the acceptable monitoring parameters, conduct microbial testing per section D1. Routine Verification of Microbial Water Quality.</li> </ul>

## Metric

#### Rationale /Remedial Actions

**Records**: During every irrigation event, treatment-related parameter values such as residual antimicrobial levels, pH, dose settings, UVT, etc. must be documented to demonstrate the system is working as intended. Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for a period of two years.

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#### 382 FIGURE 4. Irrigation Water from Type B→A (Treated) Agricultural Water Systems – See TABLE 2D

## 383 384

#### **ROUTINE MONITORING of MICROBIAL WATER QUALITY**

- Collect three (3) 100 mL samples during one irrigation event with at least one sample taken at the end of the distribution irrigation system (e.g., last sprinkler head).
- Sample monthly during use and test for generic *E. coli* and total coliforms using a FDA-allowed method.
- If the irrigation system is being used up until 21 days to scheduled harvest, sample each distinct irrigation system on one occasion and follow microbial standards in Table 2E / Figure 5 for Type B agricultural water systems.
- If the irrigation system is being used within the 21-days-to-harvest-window, sample each distinct irrigation system on two occasions separated by at least three (3) days.

#### ACTION LEVEL

Generic *E. coli* detected in  $\geq$  2 samples or level above (>) 10 MPN / 100 mL in a single sample

#### least 2 of 3 samples and $\leq$ 10 MPN in one sample

**ACCEPTANCE CRITERIA** 

No detectable generic *E. coli* in at

#### DATA MONITORING CRITERIA

≤ 99 MPN in 100 mL or an adequate log reduction based on the untreated water's baseline total coliform levels

#### No further action necessary.

Water may be used in leafy green operations as outlined in Table 2D.

# CONDUCT A LEVEL 1 ASSESSMENT:

When using Type B $\rightarrow$ A agricultural water for overhead applications within ( $\leq$ ) 21 days of the scheduled harvest date:

- If generic *E. coli* or total coliform levels in your water exceed the acceptance and/or monitoring criteria, pause irrigation and conduct an agricultural water system assessment as described in Appendix A to determine why the treatment was not effective.
- Retest the water for generic *E. coli* and total coliforms during the next irrigation event in five (5) - 100 mL samples. Water can be pulled from any point in the distribution systems in the irrigation treatment system of concern with at least one coming from the last sprinkler head. If these water samples also fail to meet the acceptance and/or monitoring criteria, discontinue use of this water for overhead applications while continuing to evaluate your water system to identify and correct any failures and continuing to test as described in this step until the water is back in compliance (see Appendix A for guidance on troubleshooting irrigation system failures).
- If this water (the water from the initial sampling applied to the crop within 21 days to harvest to the first and last of the follow-up sampling) with generic *E. coli* above the acceptance criteria has been applied to leafy greens, either consider the crop unsuitable for the fresh market or test the crop from all affected lots (i.e., lots that havebeen irrigated with this water within the <21 days-to-scheduled-harvest window) for STEC (including *E. coli* O157:H7) and *Salmonella*. Product needs to be tested prior to harvesting and after your last irrigation event. Sample crop per the protocol described in Appendix C. If any individual sample tests positive for any of these human pathogens, the crop within that lot shall NOT be harvested for the fresh market and human consumption.



#### 385 TABLE 2E. Irrigation Water from Type B Agricultural Water Systems Intended for Overhead Irrigation 386

prior to 21 days - See FIGURE 5

Metric	Rationale /Remedial Actions
Example of water from a Type B agricultural water system - water may arrive at the field in an irrigation district canal from which itis then used to overhead irrigate crop prior to 21 days to the scheduled harvest	Water from Type B agricultural water systems is untreated and exposed to the environment (e.g., open sources and/or delivery systems) so that its quality may be inadequate for overhead irrigation within ( $\leq$ ) 21 days to the scheduled harvest date. Water from these systems is restricted to use in overhead irrigation when applied prior to (>) 21 days to the scheduled harvest date.
date.	Also, water from Type A agricultural water systems can be sampled and tested under Type B agricultural water system requirements when it is used for overhead irrigation prior to 21 days before the scheduled harvest date.

#### E1. Routine Verification of Microbial Water Quality

#### Target Organisms: Generic E. coli

#### **Routine Verification Sampling** Procedure:

100 mL sample collected aseptically at the point-of-use, i.e., one sprinkler head per water source for irrigation, water tap for pesticides, etc. preseason irrigation water may be tested and utilized.

#### **Routine Verification Sampling** Frequency:

One sample per water source shall be collected and tested prior to use if > 60 days since last test of the water source. Additional samples shall be collected no less than 18 hours apart and at least monthly (or at the next irrigation event if greater than monthly) during use from points within the water distribution system.

**Routine Verification Acceptance** Criterion:

< 126 MPN / 100 mL (geometric mean) and < 235 MPN/100mL for any single sample. Note: For the purposes of water testing, MPN and CFU are considered equivalent.

When using water from Type B agricultural water distribution systems for overhead applications prior to (>) 21 days of the scheduled harvest date, samples for microbial testing shall be taken as close as practicable to the point-of-use (i.e., to be determined by the sampler, to ensure the integrity of the sample, using sampling methods as prescribed in Table 2D) so as to test both the water source and the water distribution system. In a closed water distribution system (meaning no connection to the outside) water samples may be collected from any point within the system but are still preferred at the point-of-use. No less than one (1) sample per month (or at the next irrigation event) per water distribution system is required under these metrics. If there are multiple potential point-of-use sampling points ina water distribution system, then samples shall be taken from different point-of-use locations each subsequent sampling event (randomize or rotate sample locations).

Water for pre-harvest, direct edible portion contact prior to (>)21 days before scheduled harvest shall meet or exceed antimicrobial standards for recreational water, based on a rolling geometric mean of the five (5) most recent samples. However, a rolling geometric mean of five samples is not necessarily required prior to irrigation or harvest. If less than five (5) samples are collected prior to irrigation, the acceptance criteria depend on the number of samples taken. For example:

- If only one (1) sample has been taken, it must be below (<)126 MPN /</p> 100 mL.
- Once two (2) samples are taken, a geometric mean can be calculated, and the normal acceptance criteria apply.

If the acceptance criteria are exceeded during this time period, additional samples may be collected to reach a five (5)-sample rolling geometric mean. The rolling geometric mean calculation starts after five (5) samples have



Metric	Rationale /Remedial Actions
	<ul> <li>been collected. If the water source has not been tested in the past 60 days, the first water sample shall be tested prior to use, to avoid using a contaminated water source. After the first sample is shown to be within acceptance criteria, subsequent samples shall be collected no less frequently than monthly at points-of-use within the water distribution system.</li> <li>Ideally, pre-harvest water used prior to 21 days before harvest for overheadapplications should not contain generic <i>E. coli</i>, but low levels do not necessarily indicate that the water is unsafe. Investigation and/or remedial action SHOULD be taken when test results are higher than normal or indicate an upward trend. Investigation and remedial action SHALL be takenwhen acceptance criteria are exceeded.</li> </ul>
	<b>Remedial Actions:</b> If the rolling geometric mean (n=5) or any one sample exceeds the acceptance criteria, then the water shall not be used whereby edible portions of the crop are contacted by water until remedial actions have been completed and generic <i>E. coli</i> levels are within acceptance criteria:
	<ul> <li>Conduct an agricultural water system assessment of water source and water distribution system to determine if a contamination source is evident and can be eliminated. Eliminate identified contamination source(s).</li> </ul>
	<ul> <li>For wells, perform an agricultural water system assessment and/or treatas described in Appendix A.</li> </ul>
	Or begin water treatment
	Retest the water after conducting the agricultural water system assessment and/or taking remedial actions to determine if it meets the outlined microbial acceptance criteria for this use. Retest the water daily, take three samples, no less than 18 hours apart at the point closest to use. This sample should represent the conditions of the original water system, if feasible this test should be at the original sampling point. A more aggressive sampling program (i.e. sampling once per week instead of once per month) or water
	treatment shall be instituted if an explanation for the exceedance is not readily apparent. This type of sampling program should also be instituted if

**Records**: Each water sample and analysis shall record the type of water source, date, time, and location of the sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for a period of two years.

# FIGURE 5. Irrigation Water from Type B Agricultural Water Systems intended for Overhead Irrigation – See TABLE 2E



**ROUTINE MONITORING of MICROBIAL WATER QUALITY** • If using > 21 days prior to the scheduled harvest date, collect one (1) – 100 mL samples per irrigation water system at the point of use monthly. • Analyze samples for generic *E. coli* using a FDA-allowable method. • Calculate geometric means using the five most recent samples. ACTION LEVEL **ACCEPTANCE CRITERIA** > 126 MPN / 100mL (geometric mean) <u>OR</u> < 235 MPN / 100 mL in a</p> 235 MPN / 100 mL in a single single sample sample **REMEDIAL ACTIONS:** • Discontinue use for foliar and direct contact with the No further action necessary. edible portion of the plant applications until it returnsto compliance. Water from this source may be used for any use such as crop foliar applications Examine the water source and distribution system to and/or irrigation up until 21 days to determine if a contamination source is evident and can be scheduled harvest. However, when test eliminated. results are higher than normal or indicate • For wells, perform an agricultural water system an upwardtrend, investigation and/or assessment and/or treat as described in Appendix A. remedial action SHOULD be taken. • After performing an agricultural water system assessment and/or remedial actions, retest the water at he same sampling point. Take three samples, no less than 18 hours apart at the CROP TESTING: point closest to use. If any of these samples is >126 MPN/ 100mL, repeat agricultural water system assessment • If crop has been directly contacted with and/or remedial action. water exceeding acceptance criteria, Do not use water from that water system, in a manner sample and test product for STEC that directly contact edible portions of the crop, until the (including E. coli O157:H7) and Salmonella as described in Appendix C, water can meet the outlined acceptance criteria forthis use or treat water to meet the acceptance criteria. prior to harvest. If crop testing indicates the presence of either pathogen, do NOT harvest for fresh market and human consumption.

# 391 TABLE 2F. Level 1 Assessment - Remedial Actions for Type A and B→A Agricultural Water Systems – See

392 FIGURE 4

Metric	Rationale/Remedial Actions
Target Organisms: Generic E. coli and t	otal coliforms
Remedial Actions Sampling Procedure:	When using agricultural water systems for overhead applications <b>up</b> to (>) 21 days of the scheduled harvest date:
Aseptically collect five (5)-100 mL sample from any point in the delivery system with a minimum of one from the last sprinkler head, i.e., at the last point of contact with the crop - last sprinkler head.	<ul> <li>Follow water metrics in Table 2D for Type B agricultural water systems.</li> <li>When using water from Type A and/or B→A agricultural water systems for overhead applications within (≤) 21 days of the scheduled harvest date:</li> <li>Generic E. coli</li> </ul>
<ul> <li>Remedial Actions Sampling</li> <li>Frequency:</li> <li>Sample water during the next consecutive irrigation event after a sample fails the acceptance criterion or monitoring criterion.</li> <li>Remedial Actions Acceptance</li> <li>Criterion for Generic <i>E. coli</i>:</li> <li>80% non-detectable generic <i>E. coli</i> in 100 mL and ≤ 10 MPN as the single sample maximum for one (1) sample</li> <li>Remedial Actions Monitoring</li> <li>Criterion for Total Coliform</li> <li>Monitoring Level Failure:</li> <li>5/5 samples with a maximum level of 99 MPN in 100 mL in all water samples or an adequate log reduction based on the untreated water's baseline total coliform levels (refer to Appendix A for log reduction guidance)</li> </ul>	<ul> <li>Ceneric E. coli</li> <li>1) If generic E. coli levels in your water exceed the acceptance criterion, prior to the next irrigation event conduct an agriculturalwater system assessment as described in Appendix A. During the next irrigation event, collect five (5)-100 mL samples from the irrigation system and test for generic E. coli. Water can be pulled from any point in the delivery systems in the irrigation treatment system of concern with at least one coming from the last sprinklerhead. If these water samples also fail to meet the acceptance criterion, discontinue use of this water for overhead applications while continuing to evaluate your irrigation treatment system to identify and correct any failures and continuing to test as described in this step until the water is back in compliance (see Appendix A for guidance on troubleshooting irrigation treatment system failures).</li> <li>2) If this water (the water from the initial sampling to the last round of sampling) has been applied to leafy greens, test the crop from all affected lots (i.e., lots that have been irrigated with this water within the &lt;21 days-to-scheduled-harvest window) for STEC (including <i>E. coli</i> O157:H7) and <i>Salmonella</i>. Product needs to be tested prior to harvesting and after your last irrigation event. The crop within that lot shall NOT be harvested for the fresh market if either pathogen is present. Sample crop per the protocol described in Appendix C. If any individual sample tests positive for any of these human pathogens, the crop within that lot shall NOT be harvested for human consumption.</li> </ul>
	Total coliforms
	<ol> <li>If these water samples fail to meet the monitoring criterion perform a root cause analysis and continue to evaluate your irrigation treatment system to identify and correct any failures and continuing to test as described in this step until the water is</li> </ol>

	back in compliance (see Appendix A for guidance on troubleshooting irrigation treatment system failures).
	<ol> <li>Water can still be used as a Type A system and no pre-harvest pathogen testing is required as long as the generic <i>E. coli</i> acceptance criterion is met.</li> </ol>
Test Method: Any FDA-allowed method	22
<b>Records</b> : Each water sample and analysis sample, the method of analysis, and, if	is shall record the type of water source, date, time, and location of the quantitative, the detection limit. All test results and remedial actions

sample, the method of analysis, and, if quantitative, the detection limit. All test results and remedial actions shall be documented and available for verification from the grower/handler who is the responsible party for a period of two years.

# TABLE 2G. Harvest Direct Product Contact, Harvest Food-Contact Surfaces, and Hand Wash Water (On Farm Practices Only) - See FIGURE 6

Metric	Rationale /Remedial Actions
Water Type: • Municipal • Well (Type A) • Reverse Osmosis Microbial Water Quality Testing	Water used during harvest operations that directly contacts edible portions of harvested crop, water used forhand washing, or is used on food-contact surfaces such asequipment or utensils, shall be sourced from municipal, well (Type A) or reverse osmosis water sources.
Target Organism: Generic E. coli	
<ul> <li>Sampling Procedure: Prior to use in harvest equipment, a 100 mL sample collected aseptically at the water source.</li> <li>Sampling Frequency: One sample per water source shall be collected and tested prior to use if &gt;60 days since last test of the water source. Additional samples shall be collected at intervals of no less than 18 hours and at least monthly during use. For wells and municipal water sources, if generic <i>E. coli</i> are below detection limits for five consecutive samples, the requirements for 60 days and monthly sampling are waived, and the sampling frequency may be decreased to no less than once every 180 days. This exemption is void if there is a significant water source or distribution system change. Reverse Osmosis Systems: No less than one (1) sample per month per system is required.</li> <li>Test Method: Any FDA allowed method<sup>2</sup></li> <li>Acceptance Criteria: Negative or below DL for all samples</li> </ul>	<ul> <li>Testing must be conducted to demonstrate that this water meets the Maximum Contaminant Level Goal for generic <i>E.coli</i> as specified by U.S. EPA or contain an approved disinfection method at sufficient concentration or of sufficient wavelength to prevent cross-contamination.</li> <li>Microbial or physical/chemical testing shall be performed, as appropriate to the specific operation, to demonstrate that acceptance criteria have been met.</li> <li>Single-Pass vs. Multiple-Pass Systems</li> <li>Single-pass use – Water must have non-detectable levels of generic <i>E. coli</i> or breakpoint disinfectant present at point of entry.</li> <li>Multi-pass use – Water must have non-detectable levels of generic <i>E. coli</i> and/or sufficient disinfectant toensure multi-pass water has no detectable generic <i>E. coli</i>.</li> <li>Remedial Actions:</li> <li>Develop an SOP that determines what corrective actions will be required when harvest water does not meet acceptance criteria, then DO NOT USE THE WATER until remedial actions have been completed and generic <i>E. coli</i> or disinfectant levels arewithin acceptance criteria.</li> </ul>
	Conduct an agricultural water system assessment of water source and distribution system to determine if



Metric	Rationale /Remedial Actions
Physical/Chemical Testing         Target Variable:         Water disinfectant (e.g., UV transmittance, chlorine or other disinfectant compound).         Multi-Pass Water Acceptance Criteria:         Chlorine         ≥ 1 ppm free chlorine after application and pH 5.5 – 7.5         Other approved treatments per product EPA label for human pathogen reduction in water.         Testing Procedure:         • Chemical reaction-based colorimetric test, or         • Ion-specific probe, or         • UV transmittance         • Other as recommended by disinfectant supplier.         Testing Frequency:         • Prior to first use on day of harvest.         • During harvest, samples shall be taken at routine intervals (i.e., hourly, breaks, lunch, etc.) as determine by historical data showingtypical	<ul> <li>a contamination source is evident and can be eliminated.Eliminate identified contamination source(s) and/or treat with appropriate disinfectants.</li> <li>For wells, perform an agricultural water system assessment and/or treat as described in Appendix A.</li> <li>Retest the water at the same sampling point after conducting the agricultural water assessment for waterused for harvest and/or taking remedial actions to determine if it meets the outlined microbial acceptancecriteria for this use.</li> <li>For example, if the water intended for use on food-contact surfaces has detectable generic <i>E. coli</i>, DO NOT USE THE WATER.</li> <li>Examine the distribution line and source inlet as described in Appendix A and retest from the same point of use.</li> <li>After corrective actions have been implemented and verifiedthe water may be used for harvest operations and hand wash water.</li> </ul>
degree of variation. <b>Records</b> : All test results and remedial actions shall be d thewater for a period of two years.	ocumented and available for verification from the user of

# FIGURE 6. Harvest Direct Product Contact, Harvest Food-Contact Surfaces, and Hand Wash Water (On Farm Practices Only) – See TABLE 2G

#### Water Type: Municipal, Wells (Type A), and Reverse Osmosis:

Water that directly contacts edible portions of harvested crop shall meet microbial standards set forth in U.S. EPA National Drinking Water Regulations and/or contain an approved disinfectant at sufficient concentration to prevent cross-contamination.

#### SAMPLING FREQUENCY:

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One sample per water source shall be collected and tested prior to use if > 60 days since last test of the water source. Additional samples shall be collected no less than 18 hours apart and a least monthly during use.

- Sample sources using sampling methods as prescribed in Table 2G.
- Analyze samples for generic E. coli using any FDA allowed method.

#### ACCEPTANCE CRITERIA Negative or below DL /100 mL generic *E. coli* OR <u>MULTI-PASS WATER ACCEPTANCE</u>

**CRITERIA** 

≥1 ppm free chlorine

OR

Sufficient disinfectant; physical treatment - sufficient wavelength to prevent cross- contamination. Other

approved treatments per product EPA

No further action necessary.

Water from this source may be used

for anypurpose.

#### ACTION LEVEL

Positive generic E. coli

#### REMEDIAL ACTIONS:

- DO NOT USE THE WATER.
- Follow your SOP for corrective action to bring water backinto compliance with the acceptance criteria.
- For wells, perform an agricultural water system assessment and/or treat as described in Appendix A.
- After agricultural water system assessment on water usedfor harvest and/or remedial actions have been taken, retest the water at the same sampling point.
- After corrective actions have been implemented and verified the water may be used for harvest operations.
- If water exceeding the acceptance criteria has been used during harvest, it is NOT appropriate microbial quality for this use. Sample and test product for STEC including *E. coli* O157:H7 and *Salmonella* as described in Appendix C.



# Analyze samples for ge

# AZ LGMA Final Metric Changes

These are the final changes that were adopted by the AZ Technical Committee to go into the AZ LGMA metrics. This process is different from the CA LGMA, however, the CA LGMA Technical Committee will be presented with this proposal as an option for adoption.



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# 6. ISSUE: WATER

320 The safety of whole fresh and fresh-cut (e.g., bagged salad) leafy greens is a longstanding issue. Leafy greens are mostly consumed raw without cooking or processing steps to eliminate microbial hazards. Therefore, the way they 321 are grown, harvested, packed, held, processed, and distributed is crucial to ensuring that the risk of human 322 pathogen contamination is minimized. LGMA recognizes that different crop characteristics may impact 323 susceptibility to adhesion and internalization of hazards. These metrics are intended to prioritize risk by classifying 324 agricultural water systems for specific uses within leafy greens operations. Remedial actions follow a "find and fix" 325 structure to identify and correct both system nonconformities and more serious failures. These metrics should be 326 327 considered the minimum controls necessary to assess agricultural water systems for fitness of use.

328	
329	GENERAL AGRICULTURAL WATER MANAGEMENT - THE BEST PRACTICES ARE:
330 331 332 333	<ul> <li>Agricultural water systems are a function of the source, storage, and conveyance. Each component of an agricultural water system that is within your control must be evaluated to ensure that the quality of agricultural water used in leafy green operations is known (i.e., the required parameters are measured and conform to the prescribed standards) and adequate for its intended use.</li> </ul>
334 335	<ul> <li>It's prudent to evaluate and make a good faith effort to address the food safety hazards proximate to your agricultural water systems that may not be under your control.</li> </ul>
336 337	<ul> <li>NEVER use water from any water source that has not been microbially characterized <u>and assessed as</u> <u>described below</u>.</li> </ul>
338 339 340 341 342	<ul> <li>Prior to annual use of the water in agricultural operations a written Perform an Agricultural Water         Assessment, as described in Appendix A, prior to use of water in agricultural operations. An agricultural             water system description shall be prepared. The water assessment must identify conditions that are             reasonably likely to introduce known or reasonably foreseeable hazards into or onto leafy greens. The             assessment must address the following elements:         </li> </ul>
343 344 345 346 347 348 349 350	<ul> <li><u>This A description (including the location and nature) of the agricultural water source (for example, whether it is ground water or surface water) and the type of distribution system shall be created. Information in the description shall include permanent fixtures such as wells, gates, reservoirs, valves, returns and other permanent above ground fixtures that make up a complete agricultural water system. This could be achieved by using maps, photographs, drawings, or other means to communicate the location of permanent fixtures and the flow of the water system (including any water captured for re-use or other natural or managed features which prevent environmental runoff from entering the water system).</u></li> </ul>
351 352 353 354 355 356 357 358 359	<ul> <li>The description could also include non-permanent features such as tanks, drip stations, gas powered pumps, pipes, water treatment systems, etc. that make up a complete agricultural water systemcan use maps, photographs, drawings or other means to communicate the location of permanent fixtures and the flow of the water system (including any water captured for re-use or other natural or managed features which prevent environmental runoff from entering the water system). Permanent fixtures include wells, gates, reservoirs, valves, returns and other permanent above ground fixtures that make up a complete irrigation system should be documented in such a manner as to enable location in the field. Water sources and the production blocks they</li> </ul>
360	may serve should be documented. • The degree of protection from possible sources of contamination (refer to Table 0), including:

• other water users of the water system;



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363	<ul> <li>animal impacts (for example, animal intrusion, grazing or commercial animal feeding</li></ul>
364	operations of any size);
365	<ul> <li>adjacent and nearby land uses related to animal activity, application of biological soil</li></ul>
366	amendment(s) of animal origin (BSAAOs), or presence of untreated or improperly
367	treated human waste.
368 369 370 371 372 373 374 375 376 377 378 379 380	<ul> <li><u>Manage and maintain Aal</u>l components of your agricultural water system that are within your control including the water source and the on-ranch (farm) distribution /conveyance system(s) must be managed and maintained in a manner that minimizes human pathogen contamination.</li> <li>Testing water at the end of the delivery system (e.g., the last sprinkler head) or the point-of-use is essential for ensuring water that contacts the crop is of adequate microbial quality.</li> <li>For surface water sources, consider the impact of storm events on irrigation practices. Bacterial loads in surface water are generally much higher after a storm than normal, and caution shall be exercised when using these waters for irrigation.</li> <li>Water systems that convey untreated human or animal waste are never suitable for use in leafy greens operations in any manner and must be separated from conveyances utilized to deliver agricultural water.</li> <li>Water records must be reviewed, dated, and signed, within a week after the records are made, by a supervisor or responsible party.</li> </ul>
381	HAZARD ANALYSIS - STEP 1: ASSESSMENT OF AGRICULTURAL WATER SYSTEMS
382 383 384 385 386 387 388	Evaluating food safety hazards from agricultural water applications in leafy green operations must take into account the quality of the agricultural water system, how the agricultural water will be applied, and when it will be applied. Prior to using water in any leafy green operation, conduct an agricultural water system assessment (including source, storage, and conveyance as described in Appendix A) and determine the agricultural water system system type.
389	There are two types of agricultural water systems used in leafy green operations:
390 391 392 393 394	<ul> <li>Type A: Agricultural water that is unlikely to contain indicators of fecal contamination either due to natural hydrogeologic filtration or through controlled USEPA and state regulated treatment regime as demonstrated by an agricultural water system assessment as outlined in Appendix A, microbial testing, and when applicable, treatment verification.</li> <li>Type B: All other agricultural water systems.</li> </ul>
395	<ol> <li>Source: Evaluate each agricultural water source used in your leafy green operations and determine its</li></ol>
396	type.
397	<ul> <li>Some agricultural water sources are supplied by a third-party provider that certifies the water is of</li></ul>
398	adequate microbial quality (i.e., unlikely to contain indicators of fecal contamination). Example of
399	these sources are:
400	<ul> <li>Public (e.g., municipal) or private providers that deliver certified potable water achieved through</li></ul>
401	treatment or some other process
402	b) Some agricultural water sources deliver water of appropriate microbial quality due to natural physical,
403	chemical, and biological processes that filter water as it passes through the soil. Examples of these
404	sources for Type A agricultural water systems are:
405	<ul> <li>Wells constructed in a manner such that contamination from outside sources (e.g., surface water</li></ul>
406	or other surface chemical or biological influences / effects) is unlikely (e.g., well heads are

# 2024 CA LGMA Amendment Process Report - Water Revisions



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