

## GLOSSARY

<b>ACCREDITATION</b>	A rigorous assessment conducted by an independent science-based organization to assure the overall capability and competency of a laboratory and its quality management systems.
<b>ACTIVE COMPOST</b>	Compost feedstock that is in the process of being rapidly decomposed and is unstable. Active compost is generating temperatures of at least 50 degrees Celsius (122 degrees Fahrenheit) during decomposition; or is releasing carbon dioxide at a rate of at least 15 milligrams per gram of compost per day, or the equivalent of oxygen uptake.
<b>ADEQUATE / ADEQUATELY</b>	That which is needed to accomplish the intended purpose in keeping with good public health practice.
<b>AERIAL APPLICATION</b>	Any application administered from above leafy greens; may be delivered via aircraft, sprayer, sprinkler, etc.
<b>AEROSOLIZED</b>	The dispersion or discharge of a substance under pressure that generates a suspension of fine particles in air or other gas.
<b>AGRICULTURAL / COMPOST TEA</b>	A water extract of biological materials (such as compost, manure, non-fecal animal byproducts, peat moss, pre-consumer vegetative waste, table waste, or yard trimmings), excluding any form of human waste, produced to transfer microbial biomass, fine particulate organic matter, and soluble chemical components into an aqueous phase. Agricultural / Compost teas are held for longer than one hour before application and are considered non-synthetic crop treatments for the purposes of this document.
<b>AGRICULTURAL TAILWATER</b>	Excess run off water which is generated and collected during the process of irrigation.
<b>AGRICULTURAL WATER</b>	Water used in activities covered in these guidelines where water is intended to, or is likely to, contact lettuce/leafy greens or food contact surfaces, including water used in growing activities (including all irrigation water and water used for preparing crop sprays) and in harvesting, packing, and holding activities (including water used for washing or cooling harvested lettuce/leafy greens and water used for preventing dehydration of lettuce/leafy greens).
<b>AGRICULTURAL (AG) WATER SYSTEM</b>	Any combination of water sources, storage, conveyances, ancillary equipment, etc. under the control of the grower and used within a leafy green production operation.
<b>ANCILLARY EQUIPMENT</b>	Temporary storage equipment for fertilizers such as third-party storage tanks, pony tanks, etc.
<b>ANIMAL BY-PRODUCT</b>	Most parts of an animal that do not include muscle meat including organ meat, nervous tissue, cartilage, bone, blood and excrement.
<b>ANIMAL HAZARD</b>	Feeding, skin, feathers, fecal matter or signs of animal presence in an area to be harvested in sufficient number and quantity to suggest to a reasonable person the crop may be contaminated.
<b>ADENOSINE TRI-PHOSPHATE (ATP)</b>	A high-energy phosphate molecule required to provide energy for cellular function.
<b>APPLICATION INTERVAL</b>	Means the time between application of an agricultural input (such as a soil amendment) to a growing area and harvest of leafy greens from the growing area where the agricultural input was applied.

<b>ATP TEST METHODS</b>	Exploits knowledge of the concentration of ATP as related to viable biomass or metabolic activity; provides an estimate of cleanliness.
<b>BIOFERTILIZERS</b>	Fertilizer materials/products that contain microorganisms such as bacteria, fungi, and cyanobacteria that shall promote soil biological activities.
<b>BIOSOLIDS</b>	Solid, semisolid, or liquid residues generated during primary, secondary, or advanced treatment of domestic sanitary sewage through one or more controlled processes.
<b>BLUE VALVE</b>	Pipes which are used as a closed conveyance system for moving agricultural surface water from water source to irrigation systems or reservoirs for agricultural use.
<b>BUILDINGS</b>	Any fully- or partially-enclosed building on the farm that is used for storing of food contact surfaces and packaging materials, including minimal structures that have a roof but no walls.
<b>CLOSED DELIVERY SYSTEM</b>	A water storage or conveyance system which is fully enclosed and protected such that water is not exposed to the environment from the water source to the point of use.
<b>COLONY FORMING UNITS (CFU)</b>	Viable microorganisms (bacteria, yeasts & mold) either consisting of single cells or groups of cells, capable of growth under the prescribed conditions (medium, atmosphere, time and temperature) to develop into visible colonies (colony forming units) which are counted.
<b>CONCENTRATED ANIMAL FEEDING OPERATION (CAFO)</b>	A lot or facility where animals have been, are or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period and crops, vegetation forage growth, or post-harvest residues are not sustained in the normal growing season over any portion of the lot or facility. In addition, there must be more than 1,000 'animal units' (as defined in 40 CFR 122.23) confined at the facility; or more than 300 animal units confined at the facility if either one of the following conditions are met: pollutants are discharged into navigable waters through a man-made ditch, flushing system or other similar man-made device; or pollutants are discharged directly into waters of the United States which originate outside of and pass over, across, or through the facility or otherwise come into direct contact with the animals confined in the operation.
<b>COLIFORMS</b>	Gram-negative, non-spore-forming, rod-shaped bacteria that ferment lactose to gas. They are frequently used as indicators of process control, but exist broadly in nature.
<b>CO-MANAGEMENT</b>	An approach to conserving soil, water, air, wildlife, and other natural resources while simultaneously minimizing microbiological hazards associated with food production.
<b>COMPOSTING</b>	Means a process to produce compost in which organic material is decomposed by the actions of microorganisms under thermophilic conditions for a designated period of time (for example, 3 days) at a designated temperature (for example, 131 °F (55 °C)), followed by a curing stage under cooler conditions.
<b>CROSS-CONTAMINATION</b>	The transfer of microorganisms, such as bacteria and viruses, from one place to another.
<b>CURING</b>	The final stage of composting, which is conducted after much of the readily metabolized biological material has been decomposed, at cooler temperatures than those in the thermophilic phase of composting, to further reduce pathogens, promote further decomposition of cellulose and lignin, and stabilize composition. Curing may or may not involve insulation, depending on environmental conditions.

<b>DEEP WELL</b>	An underground water source that is not hydrologically or physically connected to or influenced by surface water or vulnerable to contamination from the surface.
<b>DETECTION LIMIT</b>	For water testing purposes, methods that estimate bacterial populations in serial dilutions are limited to a minimum level of <2.2 MPN/100 mL and methods that count bacterial colonies growing on media are limited to a minimum level of <1.0 CFU/100 mL.
<b>DIRECT WATER APPLICATION</b>	Use of agricultural water in a manner whereby the water is intended to, or is likely to, contact leafy greens or food contact surfaces.
<b>ENTEROHEMORRHAGIC <i>E. COLI</i></b>	Shiga toxin-producing <i>E. coli</i> clinically associated with bloody diarrhea.
<b><i>ESCHERICHIA COLI</i> (<i>E. COLI</i>)</b>	Common bacteria that live in the lower intestines of animals (including humans) and are generally not harmful; frequently used as indicators of fecal contamination but can also be found in nature from non-fecal sources.
<b>FECAL COLIFORMS</b>	Coliform bacteria that grow at elevated temperatures and may or may not be of fecal origin. Useful to monitor effectiveness of composting processes. Also called “thermotolerant coliforms.”
<b>FIELD EQUIPMENT</b>	Equipment used to: prepare the production area and plant, cultivate, fertilize, treat or any other pre-harvest in-field activities.
<b>FLOODING</b>	The flowing or overflowing of a field with water outside a grower’s control that is reasonably likely to contain microorganisms of significant public health concern and is reasonably likely to cause adulteration of edible portions of fresh produce in that field.
<b>FOOD-CONTACT SURFACE</b>	Those surfaces that contact human food and those surfaces from which drainage, or other transfer, onto the food or surfaces that contact the food ordinarily occurs during the normal course of operations. “Food contact surfaces” includes food contact surfaces of equipment and tools used during harvest, packing and holding.
<b>FOOD SAFETY ASSESSMENT</b>	A standardized procedure that predicts the likelihood of harm resulting from exposure to chemical, microbial and physical agents in the diet.
<b>FOOD SAFETY PERSONNEL</b>	Person trained in basic food safety principals and/or working under the auspices of a food safety professional.
<b>FOOD SAFETY PROFESSIONAL</b>	Person entrusted with management level responsibility for conducting food safety assessments before food reaches consumers; requires documented training in scientific principles and a solid understanding of the principles of food safety as applied to agricultural production; in addition this individual must have successfully completed food safety training at least equivalent to that received under standardized curriculum recognized as adequate by the Food and Drug Administration See appendix B for more details.
<b>GEOMETRIC MEAN</b>	Mathematical def.: the $n^{\text{th}}$ root of the product of $n$ numbers, or: Geometric Mean = $n^{\text{th}}$ root of $(X_1)(X_2)...(X_n)$ , where $X_1, X_2$ , etc. represent the individual data points, and $n$ is the total number of data points used in the calculation. Practical def.: the average of the logarithmic values of a data set, converted back to a base 10 number.
<b>GREEN WASTE</b>	Any plant material that is separated at the point of generation contains no greater than 1.0 percent of physical contaminants by weight. Green material includes, but is not limited to, yard trimmings ("Yard Trimmings" means any wastes generated from the maintenance or alteration of public, commercial or residential landscapes

	including, but not limited to, yard clippings, leaves, tree trimmings, prunings, brush, and weeds), untreated wood wastes, natural fiber products, and construction and demolition wood waste. Green material does not include food material, biosolids, mixed solid waste, material processed from commingled collection, wood containing lead-based paint or wood preservative, mixed construction or mixed demolition debris. "Separated At The Point of Generation" includes material separated from the solid waste stream by the generator of that material. It may also include material from a centralized facility as long as that material was kept separate from the waste stream prior to receipt by that facility and the material was not commingled with other materials during handling. <sup>1</sup>
<b>GROUND WATER</b>	The supply of fresh water found beneath the earth's surface, usually in aquifers, which supply wells and springs. Ground water does not include any water that meets the definition of surface water.
<b>HARVEST EQUIPMENT</b>	Any kind of equipment which is used during or to assist with the harvesting process including but not limited to harvesting machines, food contact tables, belts, knives, etc.
<b>HARVESTING</b>	Activities that are traditionally performed on farms for the purpose of removing leafy greens from the field and preparing them for use as food; does not include activities that transform a raw agricultural commodity into a processed food. Examples of harvesting include cutting (or otherwise separating) the edible portion of the leafy greens from the crop plant and removing or trimming parts, cooling, field coring, gathering, hulling, removing stems, trimming of outer leaves of, and washing.
<b>HAZARD</b>	Any biological, physical, or chemical agent that has the potential to cause illness or injury in the absence of its control.
<b>HOLDING</b>	Storage of leafy greens in warehouses, cold storage, etc. including activities performed incidental to storage (e.g., activities performed for safe or effective leafy green storage) as well as activities performed as a practical necessity for leafy green distribution (such as blending and breaking down pallets), but does not include activities that transform the raw commodity into a processed food.
<b>HYDROPONIC</b>	The growing of plants in nutrient solutions with or without an inert medium (as soil) to provide mechanical support.
<b>INDICATOR MICROORGANISMS</b>	An organism that when present suggests the possibility of contamination or under processing.
<b>KNOWN OR REASONABLY FORESEEABLE HAZARD</b>	Known or reasonably foreseeable hazard means a biological, chemical, and physical hazard that is known to be, or has the potential to be, associated with the farm or the food.
<b>LEAFY GREENS</b>	Iceberg lettuce, romaine lettuce, green leaf lettuce, red leaf lettuce, butter lettuce, baby leaf lettuce (i.e., immature lettuce or leafy greens), escarole, endive, spring mix, spinach, cabbage (green, red and savoy), kale, arugula and chard.
<b>MANURE</b>	Animal excreta, alone or in combination with litter (such as straw and feathers used for animal bedding) for use as a soil amendment.
<b>MICROORGANISMS</b>	Yeasts, molds, bacteria, viruses, protozoa, and microscopic parasites and includes species having public health significance and those subjecting leafy greens to decomposition or that otherwise may cause leafy greens to be adulterated.

<b>MONITOR</b>	To conduct a planned sequence of observations or measurements to assess whether a process, point or procedure is under control and, when required, to produce an accurate record of the observation or measurement.
<b>MONTHLY</b>	Because irrigation schedules and delivery of water is not always in a growers control “monthly” for purposes of water sampling means within 35 days of the previous sample.
<b>MOST PROBABLE NUMBER (MPN)</b>	Estimated values that are statistical in nature; a method for enumeration of microbes in a sample, particularly when present in small numbers.
<b>MUNICIPAL WATER</b>	Water that is processed and treated by a municipality to meet USEPA drinking water standards.
<b>NON-SYNTHETIC CROP TREATMENTS</b>	Any crop input that contains animal manure, an animal product, and/or an animal by-product that is reasonably likely to contain human pathogens. Includes agricultural or compost teas for the purposes of these guidelines.
<b>ON-GROUND HARVESTING</b>	When leafy green plants are cut and laid on top of the in-ground plant base before being placed in packing containers/packaging material.
<b>OPEN DELIVERY SYSTEM</b>	A water storage or conveyance system which is partially or fully open and unprotected such that water is exposed to the environment at any point from the water source to the point of use.
<b>OXIDATION REDUCTION POTENTIAL (ORP)</b>	An intrinsic property that indicates the tendency of a chemical species to acquire electrons and so be reduced; the more positive the ORP, the greater the species’ affinity for electrons.
<b>PACKING</b>	Placing leafy greens into a container other than packaging them and also includes activities performed incidental to packing (e.g., activities performed for the safe or effective packing of leafy greens (such as sorting, culling, grading, and weighing or conveying incidental to packing or repacking)).
<b>PARTS PER MILLION (PPM)</b>	Usually describes the concentration of something in water or soil; one particle of a given substance for every 999,999 other particles.
<b>PATHOGEN</b>	A disease-causing agent such as a virus, parasite, or bacteria.
<b>PEST</b>	Any objectionable animals or insects, including birds, rodents, flies, and larvae.
<b>POOLED WATER</b>	An accumulation of standing water; not free-flowing.
<b>POTABLE WATER</b>	Water that is safe to drink or to use for food preparation without risk of health problems.
<b>PRE-PLANT IRRIGATION</b>	The process by which water is used to prepare soil prior to planting.
<b>PROCESS AUTHORITY</b>	A regulatory body, person, or organization that has specific responsibility and knowledge regarding a particular process or method; these authorities publish standards, metrics, or guidance for these processes and/or methods.
<b>READY-TO-EAT (RTE) FOOD (EXCERPTED FROM USFDA 2005 MODEL FOOD CODE)</b>	(1) "Ready-to-eat food" means FOOD that: (a) Is in a form that is edible without additional preparation to achieve FOOD safety, as specified under one of the following: 3-401.11(A) or (B), § 3-401.12, or § 3-402.11, or as specified in 3-401.11(C); or (d) May receive additional preparation for palatability or aesthetic, epicurean, gastronomic, or culinary purposes. (2) "Ready-to-eat food" includes: (b) Raw fruits and vegetables that are washed as specified under § 3-302.15;

	<p>(c) Fruits and vegetables that are cooked for hot holding, as specified under § 3-401.13;</p> <p>(e) Plant FOOD for which further washing, cooking, or other processing is not required for FOOD safety, and from which rinds, peels, husks, or shells, if naturally present are removed.</p>
<b>RECLAIMED WATER</b>	Subject to State regulation tertiary treated (recycled and disinfected) water (suitable for irrigation and industrial use) conveyed through (purple) pipes which are designated solely for this use. (e.g. purple pipe).
<b>RISK MITIGATION</b>	Actions to reduce the severity/impact of a risk.
<b>SANITARY FACILITY</b>	Includes both toilet and hand-washing stations.
<b>SANITIZE</b>	To adequately treat cleaned surfaces by a process that is effective in destroying vegetative cells of microorganisms of public health significance, and in substantially reducing numbers of other undesirable microorganisms, but without adversely affecting the product or its safety for the consumer.
<b>SHALLOW WELL</b>	An underground water source that may be influenced by or connected to surface water resulting in vulnerability to contamination from the surface.
<b>SHIPPING UNIT/ EQUIPMENT</b>	Any cargo area used to transport leafy greens on the farm or from the farm to cooling, packing, or processing facilities.
<b>SOIL AMENDMENT</b>	Elements added to the soil, such as compost, peat moss, or fertilizer, to improve its capacity to support plant life.
<b>SURFACE WATER</b>	Water either stored or conveyed on the surface and open to the environment. (e.g. rivers, lakes, streams, reservoirs, etc.)
<b>SYNTHETIC CROP TREATMENTS (CHEMICAL FERTILIZERS)</b>	Any crop inputs that may be refined, and/or chemically synthesized and/or transformed through a chemical process (e.g. gypsum, lime, sulfur, potash, ammonium sulfate etc.).
<b>TRANSPORTER</b>	The entity responsible for transporting product from the field; LGMA guidelines apply only to handlers and cover production through harvesting.
<b>ULTRAVIOLET INDEX (UV INDEX)</b>	A measure of the solar ultraviolet intensity at the Earth's surface; indicates the day's exposure to ultraviolet rays. The UV index is measured around noon for a one-hour period and rated on a scale of 0-15.
<b>VALIDATED PROCESS</b>	A process that has been demonstrated to be effective through a statistically based study, literature, or regulatory guidance.
<b>VALIDATION</b>	Obtaining scientific evidence that a control measure or combination of control measures in a given process, if properly implemented, is capable of controlling the hazard to a specified or acceptable level.
<b>VERIFICATION</b>	Confirmation measures collected to determine whether a control or measure is or has been operating as intended.
<b>VISITOR</b>	Any person (other than personnel) who enters your field/operations with your permission.
<b>WATER DISTRIBUTION SYSTEM</b>	Distribution systems -- consisting of pipes, pumps, valves, storage tanks, reservoirs, meters, fittings, and other hydraulic appurtenances - to carry water from its primary source to a lettuce and leafy green crop

<b>WATER SOURCE</b>	The location from which water originates; water sources can be municipal, well or surface water such as rivers, lakes or streams.
<b>WATER TREATMENT</b>	Any process that improves the quality (safety) of the water to make it more acceptable for a specific end-use.
<b>WATER USE</b>	The method by which water is being used in the agricultural process.

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## 1. ISSUE: WATER

The safety of whole fresh and fresh-cut (e.g., bagged salad) leafy greens is a longstanding issue. As far back as 2004, FDA has issued letters to the leafy greens industry to express concerns about outbreaks associated with this commodity. 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. The California and Arizona LGMA water metrics were first established in 2007 and have been continuously amended and updated to reflect supporting scientific research and improved industry practices.

But challenges continue. Between 2009 and 2017, FDA and their partners at the Centers for Disease Control and Prevention identified 28 foodborne illness outbreaks of Shiga-toxin producing *E. coli* (STEC) in the United States with a confirmed or suspected link to leafy greens -- an average of more than three outbreaks per year. Indeed, this period followed implementation of the initial LGMA measures by the leafy greens industry to address food safety concerns after the 2006 *E. coli* O157:H7 spinach outbreak. Then in 2018 as the industry prepared for FSMA compliance and inspections, additional *E. coli* O157:H7 outbreaks occurred in the Arizona and California's desert growing region and on California's Central Coast. During FDA's environmental assessment conducted in response to the early 2018 outbreak associated with desert-grown romaine, three samples of irrigation canal water were found to contain an *E. coli* O157:H7 strain with the same rare molecular fingerprint (using whole genome sequencing) as the strain that produced human illnesses (the outbreak strain). These samples were collected from an approximate 3.5-mile stretch of an irrigation canal in the Wellton area of Yuma County that delivers water to several of the farms identified as potential shippers of contaminated product in the traceback investigation. Of note is other pathogens of public health significance were also detected in these canal water samples.

(<https://www.fda.gov/ucm/groups/fdagov-public/@fdagov-afda-orgs/documents/document/ucm624633.pdf>)

Later in 2018, another foodborne illness outbreak triggered FDA to conduct environmental sampling on California's Central Coast where an irrigation reservoir was found to contain *E. coli* O157:H7 with the same molecular fingerprint as the strain that caused the cases of human illness. It is well understood that water, if it contains fecal material and contacts edible portions of the crop, may contaminate leafy greens during production and harvest operations. Contamination may also occur by means of water-to-soil followed by soil-to-leafy greens contact. Irrigation methods may have varying potential to introduce human pathogens and/or promote human pathogen growth on lettuce and leafy greens (Stine *et al.*, 2005; Williams *et al.*, 2013). Water used in other production operations including, but not limited to, the use as a pesticide and fertilizer diluent and in dust abatement programs may have varying potential to introduce human pathogens or promote human pathogen growth on leafy greens (Guan *et al.*, 2005; Lopez-Velasco *et al.*, 2013; Mahovic *et al.*, 2013; Staley *et al.*, 2011; Staley *et al.*, 2012; Verhaelen *et al.*, 2013).

In its November 2018 letter to industry, FDA requested that industry assess the need for updating and developing additional commodity-specific procedures, policies, and best practices to enhance leafy green safety, including, at a minimum, how leafy greens growers can assure that the agricultural water (ag water is defined as water that directly contacts the harvestable portion of the crop) they use is safe and adequate for its intended use. Recent outbreaks have demonstrated inadequacies in currently used ag water quality management strategies. First, generic *E. coli* is inconsistent, and therefore ineffective when used as the sole indicator for the presence of pathogens, such as *E. coli* O157:H7, in ag water sources. In addition, not all ag water from all sources and systems are of equivalent food safety risk and monitoring and use need to better address those risk differentials.

The metrics applied in this edition of the commodity-specific guidance are intended to prioritize risk by classifying ag water systems for specific uses within leafy greens operations. These revised metrics should be considered the minimum controls necessary to assess ag water systems for fitness of use. It is the responsibility of industry members to continuously evaluate and implement practices to maintain or improve the quality of water used in their specific leafy green operations.

### General Ag water management - the Best Practices Are:

- Ag water systems are a function of the source, storage, and conveyances. Each component of an ag water system that is within your control must be evaluated to ensure that the quality of ag water used in leafy green operations is known and adequate for its intended use.

- 49 • It's prudent to evaluate the food safety hazards proximate to your ag water systems that may not be under your  
50 control.
- 51 • NEVER use water from any water system that has not been microbially characterized.
- 52 • A water system description shall be prepared. This description can use maps, photographs, drawings or other means  
53 to communicate the location of permanent fixtures and the flow of the water system (including any water captured  
54 for re-use or other natural or managed features which prevent environmental runoff from entering the water  
55 system.). Document permanent fixtures that are directly under your control include wells, gates, reservoirs, valves,  
56 returns and other above ground features that make up a complete irrigation system in such a manner as to enable  
57 location in the field. In addition, list ancillary equipment, moveable fixtures, and equipment and document water  
58 sources and the production blocks they may serve.
- 59 • All components of your ag water system that are within your control including the water source and the on-ranch  
60 (farm) distribution /conveyance system(s) must be managed and maintained in a manner that prevents human  
61 pathogen contamination. Testing water as close to the end of the delivery system (e.g., the last sprinkler head) or  
62 the point-of-use as practical is essential for ensuring water that contacts the crop is of adequate microbial quality.
- 63 • Water systems that convey untreated human or animal waste are never suitable for use in leafy greens operations  
64 in any manner and must be separated from conveyances utilized to deliver irrigation water.
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### 66 Step 1: Hazard Analysis: Assess Your Ag Water Systems

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

- 71 1) **System:** Each component of an ag water system must be evaluated to ensure that the quality of ag water used  
72 in leafy green operations is known and adequate for its intended use. Prior to using ag water in any leafy green  
73 operation, conduct an ag water system assessment (including source, storage, and conveyance as described in  
74 Appendix A). Ag water use will vary depending on system quality as follows:
  - 75 • There are two types of agricultural water systems used in leafy green operations:
    - 76 Type A: Ag water that is free from fecal contamination as demonstrated by an ag water system  
77 assessment as outlined in Appendix A, microbial testing, and when applicable, treatment verification.
    - 78 Type B: All other ag water systems.
  - 79 • When determining whether a system is Type A or B, each component (source, storage, conveyance, etc.)  
80 must be individually evaluated in typing an entire system.
  - 81 • When Type A and B waters are combined, categorize water as Type B.
- 82 2) **Source:** Evaluate each ag water source used in your leafy green operations and determine its type.
  - 83 a) Some ag water sources are inherently free from fecal contamination and these sources would be consider  
84 Type A. Example of these Type A sources are:
    - 85 • Public (e.g., municipal) or private provider is treated, tested, and delivered as potable water
    - 86 • Regulated recycled waste water (e.g., tertiary treated, purple pipe, etc.) is treated, tested, and delivered  
87 as suitable for use in agricultural applications.
    - 88 • Deep well ground water where microorganisms are filtered via physical, chemical, and biological  
89 processes as water passes through the soil, well construction is such that contamination from the  
90 outside is unlikely, and water is tested to conform to standards.

- 91 b) Some ag water sources are Type A due to on-ranch treatment that, when operating under validated and  
92 verifiable parameters, turns Type B water into Type A. An example of this Type B → A ag water source is:
- 93 • Treated surface water (verified to conform to standards)
- 94 c) Some ag water sources are considered Type B because they come from a source that may be contaminated  
95 with feces and have not been treated to ensure no human pathogens are present. Examples of Type B ag  
96 water sources are:
- 97 • Shallow wells
- 98 • Untreated surface water

99 3) **Storage and conveyance:** Water source is only one component of an ag water system. A water system that starts  
100 out with one water type at the source may change type as it progresses through the delivery system depending on  
101 the properties of the system's components and how they are maintained (for more on system maintenance, see the  
102 section below on *Best Practice for Managing Storage and Conveyance System*). Ag water systems are typically  
103 opened or closed. For the purposes of this document, these systems are defined as follows:

- 104 • All closed delivery systems store or convey ag water in a manner that does not expose it to the outside  
105 environment and where water maintains the initial source type. Water from closed delivery systems must  
106 be tested as close to the end of the delivery system as practical to verify water quality is unchanged as it  
107 moves through the system. For additional details and guidance on testing a closed delivery system, see  
108 Tables 2A and 2B and Appendix A, respectively.
- 109 • All open delivery systems that, at some point in the system, store or convey ag water in a manner that  
110 exposes it to the outside environment (i.e., a reservoir, canal, lateral, uncovered water tank, etc.), and  
111 where water is not treated before being applied to crops, is a Type B ag water system. For additional details  
112 and guidance on testing an open delivery system, see Table 2D and Appendix A, respectively.

## 113 Step 2: How Is Your Ag Water System Being Used?

114 **Use/Application method:** Risk of leafy green contamination is closely related to *how* water is used in the production  
115 and harvest environment as well as in post-harvest applications. For this reason, ag water requirements vary  
116 depending on *how* it is applied. In leafy green operations, ag water is typically used in aerial (e.g., sprayers, overhead  
117 sprinklers, aircraft), ground (e.g., furrow and drip irrigation), and post-harvest applications. Water is also used for  
118 cleaning and, when appropriate, sanitizing equipment used during production, harvest, and post-harvest activities.  
119 Type A, Type B water that is treated to become Type A (B→A), and Type B ag water systems are suitable for specific  
120 uses as described in Table 1: Ag Water System Uses by Application Method.

## 121 Step 3: When Is Your Ag Water System Being Used?

122 **Timing of use:** Risk of leafy green contamination is closely related to *when* ag water is applied in the production  
123 environment. For this reason, requirements for ag water that is aerially applied to leafy green crops vary depending  
124 on *when* the water is applied (Fonseca *et al.*, 2010; Koike *et al.*, 2009; 2010; Suslow *et al.*, 2010; Wood *et al.*, 2010).

125 To address the risks related to the timing of aerial application of ag water in leafy green operations, time-based  
126 requirements are divided as follows:

- 127 ○ Within ( $\leq$ ) 21 days of the scheduled harvest date
- 128 ○ Greater than ( $>$ ) 21 days until the scheduled harvest date
- 129 • All ag water systems used within ( $\leq$ ) 21 days of harvest in overhead irrigation that will directly contact the edible  
130 portion of the crop must be demonstrated to be free of microorganisms indicative of fecal contamination.
- 131 • Untreated ag water from a Type B system may be used in aerial applications up until ( $>$ ) 21 days before harvest.

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- To use ag water from a Type B system in overhead irrigation within ( $\leq$ ) 21 days of the scheduled harvest date, water from these systems must be treated to become Type A (B $\rightarrow$ A) water and demonstrated to meet the performance requirements for Treated Water from Type A Ag Water Systems as outlined in Table 2C.
- If ag water from a Type A system is used in overhead irrigation within ( $\leq$ ) 21 days of harvest, water is not required to be treated if it can be demonstrated to meet the performance requirements for water from Type A ag water systems as outlined in Tables 2A and 2B.

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TABLE 1: Ag Water System Uses by Application Method

Application	Ag water systems (possible sources)	Treatment methods for use in direct contact with crop	Microbial standard
<ul style="list-style-type: none"> <li>• Overhead irrigation within (<math>\leq</math>) 21 days of scheduled harvest date</li> <li>• Pesticide spray</li> <li>• Aerial chemigation</li> <li>• Root zone transplanting</li> </ul>	<p>Type A ag water systems (closed systems including water from deep wells, municipalities, tertiary treated and disinfected recycled water e.g., purple valve)</p>	<p>No treatment necessary if it can be demonstrated to meet the microbial standards.</p>	<p>Generic <i>E. coli</i>: Nondetectable in 100 mL volume</p>
	<p>Treated Type A ag water systems (B→A systems with open components such as reservoirs, ponds, canals, laterals, ditches, etc.)</p>	<p>Must be treated and tested to demonstrate compliance with microbial standards.</p>	<p>Generic <i>E. coli</i> &amp; total coliforms: Nondetectable in 100 mL volume</p>
<ul style="list-style-type: none"> <li>• Overhead irrigation up to (&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>	<p>Closed or open water system</p>	<p>Generic <i>E. coli</i></p>	<p>Generic <i>E. coli</i>: <math>\leq 126</math> MPN/100 mL</p>
<ul style="list-style-type: none"> <li>• Food-contact (harvest) equipment cleaning &amp; sanitizing</li> <li>• Hydrovac cooling</li> <li>• Product rehydration</li> <li>• Hydrocooling</li> <li>• Packing ice</li> </ul>	<p>Water that directly contacts edible portions of harvested crop or is used on food-contact surfaces such as equipment or utensils, shall meet the Maximum Contaminant Level Goal for <i>E. coli</i> as specified by U.S. EPA or contain an approved disinfectant at a concentration sufficient to 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.</p>		

## Irrigation Water Sampling Plans and Remedial Actions

- Testing ag water systems is one method of gathering evidence that your system is of adequate quality for its intended use. Along with visual monitoring of ag water systems, a water testing program is a vital best practice for protecting leafy green crops from contamination. To be most effective as a food safety tool, water sampling must reflect, as much as possible, the water that is contacting the crop.
- Routine sampling is a part of building a dataset useful for evaluating individual data points and evaluating trends, but non-routine sampling when food safety risks are deemed higher due to specific circumstances (i.e., weather, animal and human activities, discharge, etc.) should also be part of a robust food safety program.

For the purposes of this document, sampling of ag water systems occurs for the following three reasons:

- To “type” your ag water *source* and establish its “known” quality (baseline assessments).
- To test your ag water *system* prior to use to ensure water is not degraded as it moves through the system (during the first irrigation event).
- To monitor the quality of your ag water *system* throughout the season to ensure it continues to meet the microbial water quality standards (routine assessments). If there are multiple potential sampling points in your ag water system, then take samples from randomized or rotating locations each subsequent sampling event.

If you use a Type A irrigation water system sourced from a **public (e.g., municipality) and private provider** that is treating water to ensure compliance with USEPA microbial standards for drinking water:

- No baseline assessment of your water source is required; however, you must keep the most current certificate of quality assurance on file for each source.
- During the first irrigation event, test your system to verify water quality is not being degraded as it passes through your system.
- Routinely monitor your ag water system throughout the season to ensure it is maintaining the intended quality.

If you use a Type A irrigation water system sourced from a **regulated tertiary treated recycled waste water** (e.g., purple pipe) that is treated to ensure compliance with state regulations for irrigation and industrial use:

- No baseline assessment of your water source is required; however, you must keep the most current certificate of quality assurance on file for each source.
- During the first irrigation event, test your system to verify water quality is not being degraded as it passes through your system.
- Routinely monitor your ag water system throughout the season to ensure it is maintaining the intended quality.

If you use a Type A irrigation water system sourced from a **deep well** that is naturally filtered:

- A baseline assessment of the source water is required to demonstrate the water is not contaminated with fecal material.
- During the first irrigation event, test your system to verify water quality is not being degraded as it passes through your system.
- Routinely monitor your ag water system throughout the season to ensure it is maintaining the intended quality.

If you use a Type A irrigation water system from an **on-ranch treated source**:

- A baseline assessment is required to establish the treatment method parameters needed to meet the microbial water quality standards.
- During the first irrigation event, test your system to verify established treatment parameters are being met/maintained so water quality is not degraded as it passes through your system.

- 185           ▪ Routinely monitor treatment parameters and/or microbial quality to ensure treatment is operating  
186           within established parameters.
- 187 • In the event that additional risk factors are observed or measured such as weather, manure application in a  
188     nearby field, or animal related activity consider conducting additional testing.
- 189 • Type B ag water systems used in overhead irrigation up to (>) 21 days before the scheduled harvest date will  
190     follow current water metrics for foliar applications.
- 191 • If a Type A or B ag water system fails the respective acceptance criteria, follow remedial action steps as outlined  
192     in Table 2A, 2B, 2C, and 2D and Figures XA, XB, and XC.
- 193 • Retain documentation of all test results and/or Certificates of Analysis/Quality Assurance for a period of at least  
194     two (2) years.

195 **Best Practices for Managing Storage and Conveyance System:**

- 196 • Develop a SOP for the maintenance of ancillary equipment and water storage and conveyance components of  
197     each ag water system used in your operations. The SOP must address:
  - 198     ○ Regularly scheduled visual inspections including ancillary equipment connected to your storage and  
199     conveyance system to ensure it is in good working order and does not pose a contamination risk to your  
200     system.
  - 201     ○ Measures to maintain water quality by removing debris and controlling the presence of weeds, algae,  
202     tule, trash, or debris.
  - 203     ○ Periodic scheduled cleaning and maintenance to eliminate or reduce the presence of algae, which can  
204     be conducive to the growth of harmful bacteria.
  - 205     ○ Procedures to control unwanted pest access to the storage and conveyance systems (examples include:  
206     avian deterrents, fencing, rodent monitoring).
  - 207     ○ Microbiologically safe use of irrigation pipes and drip tape if a pest infestation does occur.
  - 208     ○ Berms, slopes and diversion ditches for prevention of rain or irrigation run-off into water storage and  
209     conveyance systems.
  - 210     ○ Procedures to ensure standing and/or stagnant water does not pose a contamination risk.
  - 211     ○ Management of ag water system components used to prepare crop amendments to ensure these  
212     activities and equipment are not a contamination source.
  - 213     ○ Establish corrective action procedures for non-compliance scenarios, including:
    - 214         ▪ Contaminated source water
    - 215         ▪ Animal intrusion
    - 216         ▪ Contaminating run-off
  - 217     ○ Document all corrective measures, cleaning activities, and maintenance.
- 218 • Establish and implement a SOP for cleaning irrigation equipment prior to first seasonal use and during the  
219     season as deemed appropriate based on food safety risks.
- 220 • When preparing a field for furrow irrigation system:
  - 221     ○ Laser-level ranch as necessary to level field prior to planting.
  - 222     ○ Raise beds high enough to minimize irrigation water's direct contact with product.
- 223 • Develop irrigation schedules to minimize cross-contamination through mud and water during harvest activities.

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**Other considerations for water:**

- Chemically treat water only with sanitizers approved by the USEPA for use in agricultural applications in accordance with label specifications, guidelines for use, and consideration of environmental impacts.
- Do not store raw manure or any type of compost near irrigation water sources or conveyance systems (see Table 6).



**TABLE 2A. IRRIGATION WATER FROM TYPE A AG WATER SYSTEMS SOURCED FROM PUBLIC, PRIVATE, OR TERTIARY TREATED SUPPLIES**

Metric	Rationale /Remedial Actions
<p><b>Examples of these types of Type A ag water systems</b> - water may come from:</p> <ul style="list-style-type: none"> <li>• Public and private providers</li> <li>• Regulated recycled waste water</li> </ul> <p>And are stored and conveyed in closed delivery systems.</p>	<p>Irrigation water from Type A ag water systems sourced from regulated public, private, or tertiary treated water supplies would not be expected to contain total coliforms due to treatment. Type A ag water systems must be stored and conveyed in well-maintained, closed systems and tested for generic <i>E. coli</i> as close to the end of the delivery system as practical.</p>
<p><b>A1. Baseline Microbial Assessment</b></p>	
<p>A baseline microbial assessment is not necessary for a Type A system using water from a regulated source. In lieu of a baseline microbial assessment, acquire and maintain the supplier’s most current COA on file.</p>	
<p><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</p>	
<p><b>A2. First Irrigation Event Microbial Assessment</b></p>	
<p><b>Target Organisms:</b> Generic <i>E. coli</i></p>	
<p><b>Sampling Procedure:</b> Collect at least one (1)-100 mL sample during the irrigation event. Sample must be taken as close to the end of the delivery system as practical (e.g., last sprinkler head).</p> <p><b>Sampling Frequency:</b> During initial irrigation event or after any material modifications to Type A ag water systems</p> <p><b>Primary Acceptance Criterion:</b> No detectable generic <i>E. coli</i> in a 100 mL sample for any single sample</p>	<p>If test results exceed the primary acceptance criterion, then repeat this testing regiment of one (1)-100 mL sample the next three times the system (including other segments or branches) is used to irrigate.</p> <p>Failure of any additional sample disqualifies this ag water system for Type A usage; however, water can be used as a Type B ag water system. Perform a root cause analysis and an ag water system assessment as described in Appendix A to identify and correct the failure.</p>
<p><b>Test Method:</b> Any FDA-approved method<sup>1</sup></p>	
<p><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.</p>	
<p><b>A3. Routine Monitoring of Microbial Water Quality</b></p>	
<p><b>Target Organisms:</b> Generic <i>E. coli</i></p>	
<p><b>Sampling Procedure:</b> 100 mL sample aseptically collected as close to the end of the delivery system as practical,</p>	<p>If, during routine monitoring of your overhead irrigation system, generic <i>E. coli</i> levels exceed the primary acceptance criterion, then a <b>Level 1 Assessment</b> (refer to section A4. of this table) must be undertaken for that system.</p>

<sup>1</sup> Equivalent testing methodology for agricultural water  
<https://www.fda.gov/food/foodscienceresearch/laboratorymethods/ucm575251.htm>

<p>such as at the last point of contact with the crop (e.g., last sprinkler head).</p> <p>Sampling plan must ensure that each distinct segment or branch in the system is tested at least once during the season.</p> <p><b>Sampling Frequency:</b></p> <p>Each irrigation water system must be tested at least monthly.</p> <p><b>Primary Acceptance Criterion:</b></p> <p>No detectable generic <i>E. coli</i> in a 100 mL sample for any single sample.</p>	
<p><b>Test Method:</b> Any FDA-approved method<sup>1</sup></p>	
<p><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 shall be documented and available for verification from the grower/handler who is the responsible party for a period of two years.</p>	
<p><b>A4. Level 1 Assessment – Remedial Action</b></p>	
<p><b>Target Organisms:</b> Generic <i>E. coli</i></p>	
<p><b>Sampling Procedure:</b></p> <p>Aseptically collect 100 mL sample as close to the end of the delivery system as practical, i.e., at the last point of contact with the crop - last sprinkler head.</p> <p><b>Sampling Frequency:</b></p> <p>Sample water during the next 3 consecutive irrigation events after a sample fails the primary acceptance criterion.</p> <p><b>Primary Acceptance Criterion:</b></p> <p>No detectable generic <i>E. coli</i> in a 100 mL sample for any single sample.</p> <p><b>Conditional acceptance criterion: *TBD</b></p> <p>*Derived from water experts' feedback and/or analysis of industry data; final number pending additional data</p>	<p>When using Type A ag water from public/private/tertiary treated sources for overhead applications <b>within (&lt;) 21 days</b> of the scheduled harvest date:</p> <ul style="list-style-type: none"> <li>▪ If generic <i>E. coli</i> levels in your water exceed the primary acceptance criterion, pause irrigation and conduct an ag water system assessment as described in Appendix A and retest water until it is shown to be back in compliance with the acceptance criterion based on the test results of one-100 mL sample collected the next three (3) times this ag water system is used to irrigate.</li> <li>▪ If any of these 2<sup>nd</sup> round samples fail - i.e., exceed the primary acceptance criterion (non-detectable generic <i>E. coli</i> levels in 100 mL), discontinue use of this water for overhead applications until it is shown to be back in compliance.</li> <li>▪ If this water has been applied to leafy greens, test all product that has been irrigated with this water within the &lt;21 days-to-scheduled-harvest window for <i>E. coli</i> O157:H7, STEC/EHEC, and <i>Salmonella</i> as described in Appendix C. If any individual sample tests positive for any of these three human pathogens, the crop within that lot shall NOT be harvested for human consumption.</li> </ul> <p>When using Type A ag water from public/private/tertiary treated sources for overhead applications <b>up to (&gt;) 21 days</b> of the scheduled harvest date:</p> <ul style="list-style-type: none"> <li>▪ If generic <i>E. coli</i> levels in your water exceed the conditional acceptance criterion, conduct an ag water system assessment as described in Appendix A and retest water until it is shown to be back in compliance with the acceptance criterion based on the test results of one (1)-100 mL sample collected the next three (3) times this ag water system is used to irrigate.</li> </ul>
<p><b>Test Method:</b> Any FDA-approved method<sup>1</sup></p>	

**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.

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**TABLE 2B. IRRIGATION WATER FROM TYPE A AG WATER SYSTEMS SOURCED FROM DEEP WELLS**

Metric	Rationale /Remedial Actions
<p><b>Examples of water from Type A ag water systems sourced from a deep well</b> - water from deep wells is conveyed to the field in closed delivery systems and applied to the crop via overhead sprinklers.</p>	<p>Irrigation water from Type A ag water systems with deep well source water would not be expected to contain total coliforms due to natural filtration as the passes through the soil. Type A ag 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.</p>
<p><b>B1. Baseline Microbial Assessment</b></p>	
<p><b>Target Organisms:</b> Generic <i>E. coli</i></p>	
<p><b>Sampling Procedure:</b> For each source, aseptically collect one (1)-100 mL sample at the source.</p> <p><b>Sampling Frequency:</b> Before use at the start of each season or no less frequent than every 6 months.</p> <p><b>Acceptance criterion:</b> No detectable generic <i>E. coli</i> in a 100 mL sample for any single sample.</p>	<p>If you have six (6) consecutive historical water tests that meet the acceptance criterion, and one of those tests was taken within the last 6 months, then the well is self-certified as a Type A ag water source.</p> <p>If historical data is unavailable to self-certify, test the well monthly for six months. If all samples meet the acceptance criterion then the well is self-certified as a Type A ag water source.</p> <p>If a test result exceeds the acceptance criterion, then the well cannot be considered a Type A ag water source. Perform a root cause analysis and an ag 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 ag water system.</p>
<p><b>Test Method:</b> Any FDA-approved method<sup>1</sup></p>	
<p><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.</p>	
<p><b>B2. First Irrigation Event Microbial Assessment</b></p>	
<p><b>Target Organisms:</b> Generic <i>E. coli</i></p>	

<p><b>Sampling Procedure:</b> Collect at least one (1)-100 mL sample as close to the end of the delivery system as practical (e.g., last sprinkler head).</p> <p><b>Sampling Frequency:</b> During the season’s initial irrigation event or after any material modifications to Type A ag water systems</p> <p><b>Primary Acceptance Criterion:</b> No detectable generic <i>E. coli</i> in a 100 mL sample for any single sample</p>	<p>If test results exceed the primary acceptance criterion, then repeat this testing regiment of one (1)-100 mL sample the next three times the system (including other segments or branches) is used to irrigate.</p> <p>Failure of any additional samples disqualifies this ag water system for Type A usage; however, water can be used as a Type B ag water system. Perform a root cause analysis and an ag water system assessment as described in Appendix A to identify and correct the failure.</p>
<p><b>Test Method:</b> Any FDA-approved method<sup>1</sup></p>	
<p><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.</p>	
<p><b>B3. Routine Monitoring of Microbial Water Quality</b></p>	
<p><b>Target Organisms:</b> Generic <i>E. coli</i></p>	
<p><b>Sampling Procedure:</b> 100 mL sample aseptically collected as close to the end of the delivery system as practical, such as at the last point of contact with the crop (e.g., last sprinkler head).  Sampling plan must ensure that each distinct segment in the system is tested at least once during the season.</p> <p><b>Sampling Frequency:</b> Each irrigation water system must be tested at least monthly.</p> <p><b>Primary Acceptance Criterion:</b> No detectable generic <i>E. coli</i> in a 100 mL sample for any single sample</p>	<p>If, during routine microbial monitoring, generic <i>E. coli</i> levels exceed the primary acceptance criterion, then a <b>Level 1 Assessment</b> (refer to section B4. of this table) must be undertaken for that system.</p>
<p><b>Test Method:</b> Any FDA-approved method<sup>1</sup></p>	
<p><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.</p>	
<p><b>B4. Level 1 Assessment – Remedial Action</b></p>	
<p><b>Target Organisms:</b> Generic <i>E. coli</i></p>	
<p><b>Sampling Procedure:</b> Aseptically collect one (1)-100 mL sample as close to the end of the delivery system as</p>	<p>When using Type A ag water from deep well sources for overhead applications <b><u>within (&lt;) 21 days</u></b> of the scheduled harvest date:</p>

<p>practical, i.e., at the last point of contact with the crop - last sprinkler head.</p> <p><b>Sampling Frequency:</b> Sample water during the next 3 consecutive irrigation events after a sample fails the primary acceptance criterion.</p> <p><b>Primary Acceptance Criterion:</b> No detectable generic <i>E. coli</i> in a 100 mL sample for any single sample</p> <p><b>Conditional acceptance criterion: *TBD</b> *Derived from water experts' feedback and/or analysis of industry data; final number pending additional feedback/data</p>	<ul style="list-style-type: none"> <li>▪ If generic <i>E. coli</i> levels in your water exceed the primary acceptance criterion, pause irrigation and conduct an ag water system assessment as described in Appendix A and retest water until it is shown to be back in compliance with the acceptance criterion based on the test results of one-100 mL sample collected the next three (3) times this ag water system is used to irrigate.</li> <li>▪ If any of these 2<sup>nd</sup> round samples fail - i.e., exceed the primary acceptance criterion (non-detectable generic <i>E. coli</i> levels in 100 mL), discontinue use of this water for overhead applications until it is shown to be back in compliance.</li> <li>▪ If this water has been applied to leafy greens, test all product that has been irrigated with this water within the &lt;21 days-to-scheduled-harvest window for <i>E. coli</i> O157:H7, STEC/EHEC, and <i>Salmonella</i> as described in Appendix C. If any individual sample tests positive for any of these three human pathogens, the crop within that lot shall NOT be harvested for human consumption.</li> </ul> <p>When using Type A water from deep well sources for overhead applications <b>up to (&gt;) 21 days</b> of the scheduled harvest date:</p> <p>If generic <i>E. coli</i> levels in your water exceed the conditional acceptance criterion, conduct an ag water system assessment as described in Appendix A and retest water until it is shown to be back in compliance with the acceptance criterion based on the test results of one-100 mL sample collected the next three (3) times this ag water system is used to irrigate.</p>
<p><b>Test Method:</b> Any FDA-approved method<sup>1</sup></p>	
<p><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.</p>	

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**TABLE 2C. IRRIGATION WATER FROM TREATED TYPE A AG WATER SYSTEMS (B→A SYSTEMS)**

Metric	Rationale /Remedial Actions
<p><b>Example of treated water from a Type A ag water system (B→A systems):</b> Water may arrive at the production area in an irrigation district canal that is then pumped into a reservoir where it is treated and delivered to the field via an overhead sprinkler system.</p>	<p>When water is treated to move it from a Type B source to a Type A ag water system (B→A), it must be treated by a validated antimicrobial treatment process i.e., contain an approved disinfectant at sufficient concentration to prevent cross-contamination during overhead applications.</p> <p>Water treated with a validated physical treatment process (i.e., filtration), must meet USEPA microbial (total coliform rule) standards per the primary acceptance criteria.</p> <p>Physical/chemical testing of the source and system must be performed, as appropriate to the specific operation, to demonstrate that acceptance criteria have been and can continuously be met.</p> <p>When applying treated water from a Type A ag water system to leafy green crops, a baseline treatment and microbial assessment of the source water must be completed prior to use to establish treatment parameters necessary to achieve the acceptance criteria. During the first irrigation event water quality must again be assessed to ensure the ag water system is delivering sufficiently treated water to the crop. Routine assessments throughout the season ensure the system continues to deliver sufficient levels of disinfectant to prevent cross-contamination of the crop.</p>
<p><b>C1. Baseline Treatment Assessment</b></p>	

<p><b>Target Variable:</b> Water disinfectant (e.g., chlorine or other disinfectant concentration, ORP, other per manufacturer’s recommendations).</p>	
<p><b>Chemical treatments:</b> USEPA-approved for use in agricultural water.</p> <p><b>Sampling Procedure:</b> After system has stabilized, collect three (3)-100 mL samples as close to the beginning of the delivery system as practical (e.g., first sprinkler head).</p> <p><b>Sampling Frequency:</b> Prior to the first seasonal use, collect three (3)-100 mL samples 1.5 hours apart (example: wait 0.5 hours and then take your first sample; take second sample after 2 hours of irrigation and the third sample after 3.5 hours).</p> <p><b>Acceptance Criteria:</b> Per label instructions on parameters indicating treatment (e.g., sanitizer effectiveness (e.g., chemical break point).</p>	<p>Prior to first seasonal use, growers must establish an SOP outlining the system parameters, such as water flow rate, distance from the treatment to the first sprinkler, and the pipe diameter.</p> <p>During the first irrigation event, growers must establish treatment process parameters such as antimicrobial dosing unit settings, pH, residual antimicrobial level at discharge point (first sprinkler), and any other parameter as needed, to ensure consistent treatment and demonstrate its effectiveness in meeting the microbial requirements.</p>
<p><b>C2. Baseline Microbial Assessment</b></p>	
<p><b>Target Organisms:</b></p> <ul style="list-style-type: none"> <li>• Initial test - Total coliforms (TC)</li> <li>• Follow-up test - Generic <i>E. coli</i></li> </ul>	
<p><b>Sampling Procedure:</b> After system has stabilized, collect three (3)-100 mL samples as close to the beginning of the delivery system as practical (e.g., first sprinkler head).</p> <p><b>Sampling Frequency:</b> Prior to the first seasonal use, collect three (3)-100 mL samples 1.5 hours apart (example: wait 0.5 hours and then take your first sample; take second sample after 2 hours of irrigation and the third sample after 3.5 hours).</p> <p><b>Primary Acceptance Criteria:</b> <u>Initial test:</u> No detectable total coliform in a 100 mL water sample <u>Follow-up test:</u> No detectable generic <i>E. coli</i> in a 100 mL water sample</p> <p><b>Note:</b> For the purposes of water testing, MPN and CFU shall be considered equivalent.</p>	<p>If using multiple, identical treated ag water systems to overhead irrigate, sample and test one representative system prior to first seasonal use.</p> <p>Before the season begins, test for the following in 100 mL volume:</p> <ul style="list-style-type: none"> <li>• <u>Initial test</u> - Each water sample must meet primary acceptance criterion for total coliform (non-detectable in 100 mL).</li> <li>• <u>Follow-up test</u> - If a routine test result exceeds the limit / is positive for TC, test the water sample for generic <i>E. coli</i>.</li> </ul> <p>If generic <i>E. coli</i> is <u>not</u> detected in the follow-up test, conduct a root cause analysis and ag water assessment per Appendix A.</p> <p>If routine test results exceed the primary acceptance criteria / is positive for TC and generic <i>E. coli</i>, then the system is not considered an acceptable source for a treated Type A ag water system. Perform a root cause analysis to identify why the treatment was not effective and correct the failure. In the interim, the water can be used as a source for a Type B ag water system.</p>
<p><b>Test Method:</b> Any FDA-approved method<sup>1</sup></p>	

<p><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.</p>	
<p><b>C3. First Irrigation Event Microbial Assessment</b></p>	
<p><b>Target Organisms:</b> Generic <i>E. coli</i></p>	
<p><b>Sampling Procedure:</b>                  For any delivery system assessed in the baseline assessment, aseptically collect one (1)-100 mL sample as close to the beginning of the delivery system (e.g., first sprinkler head) as practical                  All other systems must be sampled as follows: Collect two samples – one at the beginning and one at the end of the delivery system.</p> <p><b>Sampling Frequency:</b>                  During the initial irrigation event or after any material modifications to Type A ag water systems.</p> <p><b>Primary Acceptance Criteria:</b>                  No detectable generic <i>E. coli</i> in a 100 mL water sample</p>	<p>If, during the first irrigation event, generic <i>E. coli</i> exceed the primary acceptance criteria (non-detectable in 100 mL), then repeat this testing regiment per the sampling procedure and frequency the next three (3) times the system is used to irrigate.</p> <p>Failure of any additional samples in this round of testing, disqualifies this ag water system for Type A usage; however, water can be used as a Type B ag water system. Perform a root cause analysis and an ag water system assessment as described in Appendix A to identify and correct the failure.</p>
<p><b>Test Method:</b> Any FDA-approved method<sup>1</sup></p>	
<p><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.</p>	
<p><b>C4. Routine Monitoring of Microbial Water Quality</b></p>	
<p><b>Target Organisms:</b></p> <ul style="list-style-type: none"> <li>• Initial test - Total coliforms (TC)</li> <li>• Follow-up test - Generic <i>E. coli</i></li> </ul>	
<p><b>Sampling Procedure:</b>                  One (1)-100 mL sample aseptically collected at a point in the irrigation water system as close to the end of the delivery system (e.g., last sprinkler head) as practical.</p> <p><b>Sampling Frequency:</b>                  Each ag water system must be tested for total coliform at least monthly.</p> <p><b>Primary Acceptance Criteria:</b>  <u>Initial test:</u> No detectable total coliform in a 100 mL water sample  <u>Follow-up test:</u> No detectable generic <i>E. coli</i> in a 100 mL water sample</p>	<p>During your monthly routine microbial water quality monitoring, test for the following in 100 mL:</p> <ul style="list-style-type: none"> <li>• <u>Initial test</u> - Each water sample must meet primary acceptance criterion for total coliform (non-detectable in 100 mL).</li> <li>• <u>Follow-up test</u> - If a routine test result exceeds the limit / is positive for TC, test the water sample for generic <i>E. coli</i>.</li> </ul> <p>If generic <i>E. coli</i> is <u>not</u> detected in the follow-up test, conduct a root cause analysis and ag water assessment per Appendix A.</p> <p>If routine test results exceed the primary acceptance criteria / is positive for TC and generic <i>E. coli</i> or if more than two consecutive samples per season for any individual ag water system fail the primary initial test (TC) acceptance criterion than a <b>Level 1 Assessment</b> (refer to section C6 in this table) must be undertaken for that system.</p>

<p><b>Test Method:</b> Any FDA-approved method<sup>1</sup></p>	
<p><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.</p>	
<p><b>C5. Routine Treatment Monitoring</b></p>	
<p><b>Chemical treatments</b> USEPA-approved for use in agricultural water.</p> <p><b>Target Variable:</b> Water disinfectant (e.g., chlorine or other disinfectant compound concentration, ORP).</p>	
<p><b>Testing Procedure:</b></p> <ul style="list-style-type: none"> <li>• Chemical reaction-based colorimetric test, or</li> <li>• Ion-specific probe, or</li> <li>• ORP, or</li> <li>• Other as recommended by disinfectant supplier.</li> </ul> <p><b>Testing Frequency:</b> Continuous monitoring (preferred) with periodic verification by titration <b>OR</b> routine monitoring if the system can be shown to have a low degree of variation.</p>	<p>Monitor the efficacy of the water treatment method per the manufacturer’s (label) instructions.</p> <p>If water falls outside the acceptable parameters, conduct a microbial test per the routine microbial assessment requirements per section C4 above.</p>
<p><b>Test Method:</b> Per label instructions</p>	
<p><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.</p>	
<p><b>C6. Level 1 Assessment – Remedial Action</b></p>	
<p><b>Target Organisms:</b> Generic <i>E. coli</i></p>	
<p><b>Sampling Procedure:</b> One (1)-100 mL sample aseptically collected as close to the end of the delivery system (e.g., last sprinkler head) as practical.</p> <p><b>Sampling Frequency:</b> For each sampling event, a sample shall be collected during three (3) consecutive irrigation events.</p> <p><b>Primary Acceptance Criterion:</b> No detectable generic <i>E. coli</i> in a 100 mL water sample</p>	<p>When using treated water from Type A ag water systems for overhead applications <b><u>within (&lt;) 21 days</u></b> of the scheduled harvest date:</p> <ul style="list-style-type: none"> <li>▪ If generic <i>E. coli</i> levels in your water exceed the primary acceptance criterion, pause irrigation and conduct an ag water system assessment as described in Appendix A and retest water until it is shown to be back in compliance with the acceptance criterion based on the test results of one-100 mL sample collected the next three (3) times this ag water system is used to irrigate.</li> <li>▪ If any of these 2<sup>nd</sup> round samples fail - i.e., exceed the primary acceptance criterion (non-detectable generic <i>E. coli</i> levels in 100 mL), discontinue use of this water for overhead applications until it is shown to be back in compliance.</li> <li>▪ If this water has been applied to leafy greens, test all product that has been irrigated with this water within the &lt;21 days-to-scheduled-harvest window for <i>E. coli</i> O157:H7, STEC/EHEC, and <i>Salmonella</i> as described in Appendix C. If any individual sample tests positive for any of these three human</li> </ul>

	<p>pathogens, the crop within that lot shall NOT be harvested for human consumption.</p> <p>When using treated water from Type A ag water systems for overhead applications <b>up to (&gt;) 21 days</b> of the scheduled harvest date:</p> <ul style="list-style-type: none"><li>▪ Follow existing water metrics for foliar applications</li></ul>
<p><b>Test Method:</b> Any FDA-approved method<sup>1</sup></p>	
<p><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.</p>	

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**TABLE 2D. IRRIGATION WATER FROM TYPE B AG WATER SYSTEMS**

Metric	Rationale /Remedial Actions
<p><b>Example of water from a Type B ag water system</b> - water may arrive at the field in an irrigation district canal from which it is then used to overhead irrigate crop up until 21 days to the scheduled harvest date.</p>	<p>Water from Type B ag water systems is untreated and exposed to the environment (e.g., open sources and/or delivery systems) so that its quality cannot be expected to be free of fecal contamination. Water from these systems is restricted to use in overhead irrigation when applied up to (&gt;) 21 days to the scheduled harvest date. Exercise caution when using Type B water to ensure it does not incidentally contaminate leafy greens during production and harvest activities.</p>
<p><b>D1. Routine Microbial Assessment</b></p>	
<p><b>Target Organisms:</b> Generic <i>E. coli</i></p>	
<p><b>Sampling Procedure:</b> 100 mL sample collected aseptically at the point-of-use; i.e., one sprinkler head per water source for irrigation</p> <p><b>Sampling Frequency:</b> One sample per water source shall be collected and tested prior to use if &gt; 60 days since last test of the water source. For each sampling event, a sample shall be collected during three (3) consecutive irrigation events.</p> <p><b>Primary Acceptance Criterion:</b> ≤126 MPN (or CFU*)/ 100 mL (geometric mean) and ≤235 MPN/100mL for any single sample.</p>	<p>When using water from Type B ag water systems for overhead applications <b>up to (&gt;) 21 days</b> of the scheduled harvest date:</p> <ul style="list-style-type: none"> <li>▪ Follow existing water metrics for foliar applications</li> </ul>
<p><b>Test Method:</b> Any FDA-approved method<sup>1</sup></p>	
<p><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.</p>	

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