Comments on WaterSense® Notice of Intent to Develop a Draft Specification for Spray Sprinkler Nozzles

April 26, 2023

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Commenter: Jay Guthy
Affiliation: Toro
Comment Date: December 7, 2022

Email Text:

Hello,

I read the note from EPA on Spray Sprinkler Nozzle Specification performance. Kudos to the EPA for considering such an action.

Recent specifications in many states now requiring PR in spray bodies is a step in the right direction. But it's a small step and often, a misguided one. Reducing pressure in a spray body with a high precipitation (precip) rate *does* reduce the application rate of water. HOWEVER, the mandate says nothing of requiring an efficient spray nozzle on a PR body, thus improving the EFFICIENCY of the overall device.

Having an inefficient (low-uniform, high precip nozzle) on a PR body has minimal positive impact. I would much prefer a highly uniform and efficient nozzle on a non-PR body vs. the opposite scenario just described.

The most efficient nozzle in the industry is Toro's Precision Spray Nozzle and it's not really close. The nozzle has a lower, 1.0 inch/hr. Precip rate and high uniformity. Uniformity in some cases over .8. All equally matched precip. You can NEVER have high efficiency with a low uniform (55% or less) nozzle. It's the theoretical high threshold of efficiency. The weak-link in the chain, if you will.

Toro's competitors may be unlikely to support such a Specification as none possess such a highly uniform nozzle. Hunter's MP Rotator has a low Precip rate but their uniformity is also low, requiring higher run times (SC) to account for the lack of uniformity.

So be prepared for a lack of response and support of such an action on your part. Toro's marketing department can be a resource for additional information you may seek. Thanks for pursuing such an action. It's long-overdue.

Kindly,
Jay GuthyP

P. Jay Guthy, CLIA, CIT
Regional Sales Manager, Toro, Irritrol & Unique Lighting
860-918-4567
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Commenter: Nicolle Miller
Affiliation: East Bay Municipal Utility District
Comment Date: December 14, 2022

Email Text:

Good morning,

I am interested in finding out more about the development of a WaterSense specification for spray sprinkler nozzles and would like to be added to the stakeholder list.

Best,

Nicolle Miller
Water Conservation Representative
East Bay Municipal Utility District
P: 510.986.7615 | C: 510.213.8606 | E: nicolle.miller@ebmud.com

Commenter: Paul Jeffrey Knopp
Affiliation: Behnke Landscape Architecture
Comment Date: December 19, 2022

Email Text:

See attached.

P. Jeff Knopp, ASLA | LEED AP
Principal

behnke
LANDSCAPE ARCHITECTURE

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Email Attachment:
See pages 4 through 5.

Template for Public Comment Submission on WaterSense Documents

Commenter Name: Paul Jeffrey Knopp

Commenter Affiliation: Irrigation Association Certified Irrigation Designer

Date of Comment Submission: 12/19/22

Topic: Definition of "spray sprinkler nozzle."

Comment: NOI Text says "There is no explicit definition for spray sprinkler nozzles within ASABE/ICC 802-2020, so for the purpose of this NOI, WaterSense developed the following definition based on related definitions included in the standard:

- Spray sprinkler nozzle: The discharge opening of a spray sprinkler used to control the volume of discharge, distribution pattern, and droplet size. These nozzles are attached to spray sprinkler bodies that do not contain components to drive the rotation of the nozzle during operation and lack an internal control valve.

Though the general product category of spray sprinkler nozzles is not defined, the ASABE/ICC 802-2020 standard defines one specific type of spray sprinkler nozzle:

- Multi-stream, multi-trajectory (MSMT) nozzles: Nozzles designed to distribute discharge water in a number of individual streams, of varying trajectories, which rotate across the distribution.

MSMT sprinkler nozzles are only available as rotating models. The rotation is driven by the nozzle, not the spray sprinkler."

Rationale: While the definition itself is fine, not sure why you confuse the issue by introducing the MSMT nozzle as a subset of spray sprinkler nozzles. If you are going to introduce MSMT nozzles as a subset, then you should also introduce Fixed Spray Sprinkler nozzles as a subset, or don't introduce MSMT's at all.

Suggested Change (or Language): Add to above:

- "Fixed Spray Sprinkler Nozzle: A nozzle intended to distribute a spray of discharge water without rotation across the distribution."

Topic: Text Under Figure 4

Comment: NOI Text says: "WaterSense is not aware of any versions of MSMT nozzles for rotor sprinklers."

Rationale: I believe that the The Stream Rotor 300 Series from Toro has an MSMT nozzle for rotors. Rainbird used to make one, but not sure that they do anymore.

Suggested Change (or Language): I would just take the sentence out of the text as it does not really apply to the standard.

Topic: Figure 4

Comment: The diagram uses the text “Standard spray sprinkler Nozzle”

Rationale: This is confusing text.

Suggested Change (or Language): Change to “Fixed Spray Sprinkler Nozzle”

Topic: General

Comment: Figure 4 is as far as I got. This was enough for me to determine that this NOI is poorly written.

Rationale: You really need someone (or multiple persons) who has/have been in the industry for many years to be paid by you to review the NOI. You cannot expect my boss (or anyone’s boss) to pay me (or anyone) to review your work.

Suggested Change (or Language): This NOI needs lots of editing.

Commenter: R. Troy Peters, P.E., Ph.D.
Affiliation: Washington State University
Comment Date: January 10, 2023

Email Text:

Quick introduction: I'm a professor of irrigation engineering and have been doing irrigation research and have been an extension irrigation specialist in the dry side of Washington state for over 20 years. I learned about this through ASABE where I have served as the chair of the sprinkler irrigation committee for a few years and am currently the chair of the irrigation parent committee NRES-24.

Below are some thoughts/suggestions on this draft specification.

Overall, I agree with this standard and that this specification should be developed. MSMT nozzles should be more widely used. The increased adoption of these is generally in the best interest of everyone, including irrigation contractors, homeowners, and the public at large.

The scale of water savings possible in agriculture dwarfs that of landscape irrigation. LEPA/LESA sprinklers on center pivots have proven to save 15-20% of the water in agricultural irrigation. These should be given the WaterSense designation as well.

Page 7: Those 4 attributes are specific to MSMT nozzles. If you want to expand this by defining HES nozzles, then these should be left out. I think it is OK to just avoid the whole "HES" designation and make this about MSMT nozzles in particular.

Equation 1 is for the gross application rate and does not account for wind drift and evaporation losses. Reducing these losses is the point of this new designation for HES spray nozzles. Net application rate (gross rate – losses before it hits the ground) is most relevant for irrigation management. This requires the inclusion of an application efficiency (Ea) term. i.e. Net application rate is that equation multiplied by application efficiency (Ea) as a % divided by 100, or as a decimal.

Page 8: Lower application rates ONLY result in higher efficiency if there would be runoff otherwise. If all else is the same, and the soil can take the water in at a higher application rate without runoff, then the *higher* application rate is more efficient because there is less time for water losses to wind drift and evaporation from the operating sprinkler and from water evaporation from a wet plant and soil surface. For example, what is better, a sprinkler that applies water extremely slowly, but runs all day with a constantly wet plant and soil surface and with water flying through the air non-stop, or one that can get all the water into the soil in a few minutes and leaves the irrigated surface dry and keeps water out of the air for the vast majority of the time? A caveat: In practice, this efficiency improvement due to reduced evaporation from a wet plant and soil surface because of reduced application time of non-MSMT nozzles may be small.

Matched precipitation rates are most useful for good irrigation system design. Without it, half-circles and corners would need smaller nozzles (1/2 and 1/4 of the flow rate of a full circle sprinkler respectively) to match precipitation rates of full-circle sprinklers within a

single zone in order to ensure good application uniformity. Designers don't always do this or can't do it practically. Thus, matched precipitation is often better. But not always. It is possible to get similar uniformities without matched precipitation sprinklers. For example, if all the half-circle sprinklers are in the same zone and that zone is run at 1/2 of the runtime of the full-circle sprinklers, the uniformity would be the same as matched precipitation. Or, if there is the same amount of overlap between application areas from 1/2 circle sprinklers with full sprinklers the uniformity may still be good even if they are on the same zone and have the same flow rate. These conditions are hard to set up, and a knowledgeable and experienced designer would have to do it, which isn't always the case. Thus, in general, better designs are achieved with matched precipitation sprinklers. They make good design and zone setup so much simpler.

Page 9: Using application rate as a water efficiency or performance criteria doesn't make sense. See above. Matched precipitation could be used, but not overall application rate.
Increased wetted radius means fewer sprinklers are required and lower application rates, both of which are good, and can increase efficiency if it would otherwise cause runoff, but runoff is uncommon in landscape irrigation systems. When present, runoff is usually managed by more frequent, but shorter run times. The reduced piping and trenching required by using sprinklers with larger wetted diameters can mean that the same results, if not better, can be accomplished with less pipe, sprinklers, and digging. This reduced input and installation costs should increase profit opportunity for contractors.

Page 12: Landscapes with lower DU don't *use* more water. They *lose* more water. There are more water losses to deep percolation in order to adequately irrigate all areas.

Higher DUs don't always result in increased water savings primarily because of human behavior. People don’t irrigate less to compensate for an improved system DU.

A threshold DU used in agriculture for chemigation is 0.8. That should be possible and is reasonable to expect in landscape irrigation.

The water stream pattern from MSMT nozzles allows the droplets to draft behind the droplets in front of them, allowing for greater wetted radii as well as reduced evaporation (because of reduced air resistance and air that is already saturated with water from the droplets in front) on the way to the soil (greater application efficiency). Larger droplets = less total surface area exposed to evaporation on the way to the soil surface = higher application efficiency. Larger droplets also have more momentum in comparison with the air resistance that is trying to slow them down and thus they fly further also contributing to a greater wetted radius. The slow rotation speed of the MSMT nozzle streams allocates the pressure force to increased droplet velocity instead of absorbing that force/energy to spin the sprinkler or losing that force/energy to breaking up the water surface tension into smaller droplets. Some rotation movement is necessary for improved uniformity. The pressure/energy from very high pressures (> 80 psi) goes to breaking up water droplets into smaller droplets (breaking the surface tension) and thus the benefits from large droplets (improved efficiency and larger wetted radius) diminishes.

Pressure regulation is not always needed or necessary and doesn't always result in improved overall irrigation efficiency. If the area if flat and if there are little pressure losses in the system (i.e. the nozzle pressures at the base of the sprinkler are constant and predictable) then spending resources on pressure regulators is wasteful. If there are significant pressure differences due to elevation differences or pressure losses in the system, then pressure regulators can greatly improve the performance (DU) of the system.

Page 9:
Overall irrigation efficiency (water flowing onto an area divided by the water that is used by the plants), which is a function of DU as well as the application efficiency (Ea) (water that can be collected in a catch can divided by the gross depth that should be caught from the application rate; Equation 1), is what we are after more than the wetted radius or application rate. A test method that measures DU can also measure application rate AND overall irrigation efficiency if the flow rates of the nozzles can be measured or accurately estimated. The irrigation system evaluation methods (Ea and DUlq) using catch cans are well known, taught, and practiced and the Irrigation Association teaches these classes and has certifications for them. To get to application efficiency (Ea), the gross application depths needs to be determined (net catch depth from the catch cans divided by the gross catch depth from Eq. 1). This can be measured from the flow rates of the nozzles and application area each nozzle is assigned to. This requires a bit more data collection, but is possible and not overly time consuming. Ea is then the mean catch can depth in the are divided by this calculated gross depth. A rough method of estimating overall irrigation efficiency (IE) is application efficiency (Ea) multiplied by the distribution uniformity of the low quarter (DUlq). IE = Ea * DUlq. Of course, both terms need to be as a decimal (%/100) instead of as a %. Multiplication by DUlq assumes that 75% of the area will be over-irrigated in order to adequately irrigate the low quarter. MSMT sprinkler heads should shine in both DUlq measurements as well as Ea. The Irrigation Training and Research Center in California (http://www.itrc.org/) might be a well-known, and respected third-party for testing DUlq and Ea for these different nozzles under standardized conditions. In reality this way of defining IE still doesn't perfectly capture the total irrigation efficiency according to many people's definitions since a perfectly functioning system can still be mismanaged by running it longer than necessary, however irrigation scheduling and changing human behavior around these systems is likely outside the scope of WaterSense.

People need to learn to adjust their application times for the lower application rates of MSMT sprinklers. They need to learn to adjust them in general! Even most installers don't know how to set run times properly. It is better if they can adjust the time between irrigations (irrigation frequency) rather than the run time or application depth of individual irrigation events. The suggested irrigation frequency for each zone and how these need to change throughout the season should be a required output of the irrigation system design. I'm aware that overcoming these problems is the goal of Smart Controllers.

Page 22:
The percent of water used outdoors is a gigantic function of the climatic region, the weather, and the time of year. These change drastically. I'm not sure it is relevant or important to what you are trying to accomplish here, however. The payback time estimate is a rough estimate based on a large number of hidden assumptions, but I think it's OK to leave it as it is as it generally shows that people will get their money

back. They more they need to irrigate, or the longer the required run times in a season, the shorter the payback time will be and thus the stronger the financial incentive for converting.

Your assumptions that people don't fix something that they don't perceive as broken is spot on. Whether broken heads get replaced with an appropriate or similar head is questionable. I don't have any answers or suggestions for this however, except improved education.

Application rate is not a good surrogate for irrigation efficiency.

Hope this is helpful and useful!
Troy

R. Troy Peters, P.E., Ph.D.
Professor and Extension Irrigation Engineer
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Irrigated Agriculture Research and Extension Center
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Commenter: Nathan Bowen
Affiliation: Irrigation Association
Comment Date: January 20, 2023

Email Text:

Attached, please find a request for an extension of the comment period for the Spray Sprinkler Nozzle NOI.

Regards,

Nathan Bowen
Advocacy Director
Irrigation Association
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Email Attachment:
See page 11.

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January 20, 2023

U.S. Environmental Protection Agency
WaterSense Program
1200 Pennsylvania Avenue NW
Washington, DC 20004

Re: Comment Period Extension Request for WaterSense Notice of Intent to Develop a Draft Specification for Spray Sprinkler Nozzles

To whom it may concern:

On behalf of the approximately 1,300 member companies of the Irrigation Association, I write to request a 60-day extension of the comment period with respect to the WaterSense Notice of Intent to Develop a Draft Specification for Spray Sprinkler Nozzles.

The Irrigation Association represents experts in all aspects of irrigation, including agriculture, landscape, turfgrass and golf. Irrigation manufacturers, distributors and contractors have proudly partnered with WaterSense since its inception to strengthen the marketplace for efficient water-use technologies and practices. Since it was launched in 2006, WaterSense has fostered successful collaboration between the industry, public and private water providers, and the federal government to expand the water-efficient product marketplace.

We appreciate the opportunity to review and comment on this Notice of Intent on behalf of the entire irrigation industry. In order to ensure the interests of all the impacted elements of the industry are taken into account, we respectfully request additional time to gather input and feedback on the proposal. Additional time would allow the opportunity for more robust and comprehensive feedback to the program.

Thank you for your consideration of this request. Please contact Nathan Bowen (nathanbowen@irrigation.org), Irrigation Association advocacy director, for additional information.

Sincerely,

Natasha L. Rankin

Natasha L Rankin, MBA, CAE
Chief Executive Officer

Commenter: Kevin Hartley
Affiliation: Town of Windsor, Colorado
Comment Date: January 26, 2023

Email Text:

Good morning;

I am writing to address the WaterSense Spray Nozzle NOI.

Although there are rotary nozzles that affix to spray bodies of which some should have the WaterSense label of approval, I have to strongly advise against giving ANY spray nozzle receiving such accommodations. Doing so would be a great disservice to American consumers, as there are no spray nozzles that work in an efficient manner anywhere near.70 distribution uniformity (DU). I have been an auditor for many years and assessed over 5000 residential, commercial and industrial systems, and the ONLY time I have measured a DU of.70 DU was when the pressure was too high, the zone was crowded (too many heads for the area), and there was a great deal of overspray. The best I have measured for Rain Bird MPRs on PRS 30/SAM heads was a.58 DU and a precipitation rate of 1.58" an hour. OF all spray nozzles on the market Rain Bird Matched Precipitation Rate (MPR) Nozzles have performed the best compared to other models and manufacturers, which is stating much, considering the poor performance provided by the MPRs. You can count the TORO Precision sprays in that statement as well, which one would think performed the best of all sprays, but real-world testing has proven quite the contrary.

Precipitation rate is the other issue with spray nozzles, they apply water far too quickly to prevent runoff from the landscape and require such a short cycle with a cycle and soak program to prevent runoff, the run times get too short to be effective when adjusting for seasonality, causing the owner to adjust run times up to compensate, thus overwatering.

In my professional opinion, granting WaterSense labeling to any spray nozzle only weakens your mission, and reliability and waters down (Pun Intended) the EPA's reputation.

As a water conservation specialist, I use your certification as a measure for eligibility for rebates of certain irrigation equipment, and certifying spray nozzles go against the water efficiency technologies we are trying to promote. We would have to drop the promotion of the WaterSense label in order to continue our mission if it comes to pass.

I hope you will take this into consideration as you move forward, and I can provide test data if you would like.

Thank you for your time and commitment,

Kevin Hartley
Water Conservation Technician
Town of Windsor, Colorado
Parks, Recreation & Culture | Open Space & Trails

922 15th St., Windsor, CO 80550
Office: 970-674-6687
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recreationliveshere.com

Commenter: Kelsey Jacquard
Affiliation: Hunter Industries
Comment Date: March 21, 2023

Email Text:

Hello,

Thank you for opening up the Spray Sprinkler Nozzle NOI to comments and suggestions. Please see the attached response from Hunter Industries.

Please let me know if you have any questions or would like to follow up on any comments.

Thank you.

KELSEY JACQUARD, *CID, CLIA*
Category Manager – Mechanical Irrigation Products

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Email Attachment:
See pages 15 through 21.

Template for Public Comment Submission on WaterSense Documents

Commenter Name: Kelsey Jacquard

Commenter Affiliation: Hunter Industries

Date of Comment Submission: March 21, 2023

Topic: Definition of spray sprinkler nozzle

Comment: Define MSMT nozzles separate from spray sprinkler nozzles.

Rationale: MSMT nozzles are established in the industry as a separate style nozzle from "fan" spray nozzles. MSMT nozzles use multiple rotating streams to target water distribution and to put water down slowly, more like a rotor.

ASABE 802-2020 defines a rotor as "a sprinkler that applies water in a pattern by means of one or more rotating streams to a defined landscape area." The test method for rotors is also different from sprays based on one or more rotating streams.
ASABE 802-2020 defines a spray as "a sprinkler that continuously applies water in a pattern to a defined landscape area."
ISO 8026 section 3.6 defines an irrigation sprayer as a "device that discharges water in the form of fine jets or in a fan shape without rotational movement of its parts."

MSMT nozzles and spray nozzles are built very differently and priced differently to the consumer. MSMT nozzles can be made of up to 20 components while a spray nozzle is generally made up of 3-4 components. The cost to the manufacturer to produce and ultimately to the consumer to install is about 5 times more expensive than a spray nozzle.

Suggested Change (or Language):
Define spray nozzle as a "nozzle that discharges water in the form or fine jets or in a fan shape without rotational movement of its parts."
Define MSMT nozzle as a "nozzle that discharges water in multiple rotating streams."

Topic: Proposed application rate as a water-efficiency criterion

Comment: Disagree with proposal of using application rate as a water-efficiency criterion.

Rationale: The best application rate for the landscape depends on multiple factors. Soil type, plant type, weather, water window restrictions, and available nozzle sizes among other factors determine the best application rate for the landscape.

Sandy soils allow for high application rates from the nozzle while clay soils require low precipitation rate nozzles to prevent runoff.

Hot, dry climates can prefer higher precipitation rates to better saturate the soil to better fight evaporation where low precipitation rate nozzles would require significantly longer runtimes to properly irrigate the landscape.
Local water districts in drought regions oftentimes limit the cycle time for each zone, sometimes to 10 minutes for example, which is not enough time to properly irrigate with low precipitation rate nozzles.
Smaller nozzle radius options are limited in their precipitation rate offering, where a standard would limit the available irrigation options for certain spaces.
Low precipitation rates do prevent runoff, but irrigation efficiency comes from how effective the applied water is to the landscape. It is possible to space heads apart to achieve a low application rate.
CA researched the idea of using a precipitation rate requirement for the 2014 MWELO standard, and after research and stakeholder input, decided upon using DU as the requirement for nozzle installation except on slopes which was limited to 1.0 in/hr.

More research is needed before establishing a precipitation/application rate as a requirement or as a definition of high-efficiency irrigation. The study used measured flow rate over published radius instead of actual radius for a true application rate study. Ultimately, application rate can be altered based on head spacing, and DU would have to also be a requirement to maintain a healthy landscape.

Suggested Change (or Language): Eliminate criterion.

Topic: Proposed matched precipitation as a water-efficiency criterion

Comment: Disagree with proposal of using matched precipitation rate as a water-efficiency criterion.

Rationale: Most nozzles are already matched precipitation within their nozzle families, but they are not always matched across families or manufacturers. A WaterSense label for matched precipitation might be confusing and lead consumers to believe that all these nozzles can be mixed in a landscape irrigation zone. More research is needed before establishing matched precipitation rate as a requirement or as a definition of high-efficiency irrigation.

Suggested Change (or Language): Eliminate criterion

Topic: Distance of throw

Comment: It is stated in the proposal that “HES sprinkler nozzles tend to have larger distances of throw than standard sprinkler nozzles” which only applies to MSMT nozzles.

Rationale: Other “high-efficiency” spray nozzles have the same radius range as traditional sprays, and MSMT nozzles have a larger radius range due to the rotating streams.

Suggested Change (or Language): Either delete statement or correct it to "MSMT nozzles tend to have larger distances of throw than standard spray nozzles".

Topic: Distance of throw

Comment: Request for feedback on whether HES sprinklers reduce the cost of materials in practice would only apply to MSMT nozzles due to their longer radius range and low precipitation rates.

Rationale: New irrigation systems designed with MSMT nozzles can have fewer heads due to the longer radius range, and they can have more heads per zone due to the lower flow rates. This only applies to MSMT nozzles for the radius range. For maintenance, all nozzles on a zone would need to be replaced with HES or MSMT nozzles if the criterion is precipitation rate. Runtimes would also need to reevaluating to keep the landscape healthy.

Suggested Change (or Language): Eliminate this question as it does not affect water efficiency or water savings. Also, clarify "simply replace standard sprinkler nozzles with HES sprinkler nozzles on each zone and verify runtimes meet the needs of the landscape".

Topic: Distance of throw as a criterion to align with reported value

Comment: Agree with proposal. The tolerance range will need to be wide enough to reasonably accommodate variation in plastic components. A percent variation may need to scale with the nozzle radius or use a +/- 2ft tolerance as an example. More research is needed for an achievable tolerance.

Rationale: Variation in parts does lead to variation in radius which affects all brands of nozzles.

Suggested Change (or Language):

Topic: ASAE S398.1 as an acceptable test method for radius of throw.

Comment: This test standard only applies to sprinklers with uniform radii. How would the proposal apply to specialty nozzles with non-uniform radii or asymmetrical spray patterns?

Rationale: ASAE S38.1 specifies that it only applies to sprinklers with uniform radii. This covers testing of most Spray and MSMT nozzles using a single leg test, but it does not include non-uniform radii or asymmetrical patterns.

From ASAE S398.1
1 Purpose
1.1 This Standard has the following three purposes:
1.1.1 To define a common test procedure for the collection of sprinkler test data such as pressure, flow rate, and radius of throw, which may be used for

the purpose of publishing performance specifications for sprinklers whose areas of coverage have uniform radii.

The ASABE 802 standard shows the following test method which is not clear on how to determine the radius of throw for specialty nozzles.

TABLE 303.5.4.1
MAXIMUM COLLECTOR SPACING AND CATCHMENT ARRANGEMENT FOR REGULAR SPRAY PATTERNS

WATER DISTRIBUTION METHOD	MAXIMUM CENTER-TO-CENTER COLLECTOR SPACING (FEET)	CATCHMENT ARRANGEMENT
Spray pattern	1	Rectangular grid
Rotating stream(s)	2	Single leg

For SI:1 foot = 30.5 cm.

Suggested Change (or Language): Either clarify the test procedure for specialty nozzles with non-uniform radii or asymmetrical patterns or clarify the proposal to not include specialty nozzles in this standard. “This standard applies to HES and MSMT nozzles with uniform radii only.”

Topic: DU as a criterion

Comment: More research is needed considering the lack of evidence of high DU resulting in water savings. This is counterintuitive, and there may not be enough controlled studies. CA Title 23 settled on a DU requirement of 65% or greater after researching the idea of a precipitation rate requirement. A minimum DU threshold would be the preferred requirement with no required publishing of data. If the nozzle passes the minimum threshold, it complies.

Rationale: DU has been an established baseline for efficiency in the industry for a long time, but the limited studies available do not show significant water savings according to the proposal. It may be worthwhile to perform a more controlled study of DU considering it has been accepted as the requirement in new irrigation systems in CA.

Suggested Change (or Language): Perform more research on DU before establishing the requirement for high-efficiency nozzles. If it looks promising, establish a minimum DU requirement that must be reached to receive the WaterSense label. Same as the pressure-regulated sprinkler bodies standard, create a pass/fail criteria without publishing performance data.

Topic: DU collected as both ASABE and other test methods internally

Comment: We use both the ASABE 802-2020 test method and our own internal test methods to measure DU.

Rationale:

Suggested Change (or Language):

Topic: DU collection for specialty nozzles

Comment: The test method for DU is defined for traditional uniform radius nozzles. Is there a test method to model the uniformity of specialty non-uniform radii nozzles and asymmetrical pattern nozzles such as side strip and corner strip nozzles?

Rationale:

Suggested Change (or Language): Either clarify the test procedure for specialty nozzles with non-uniform radii or asymmetrical patterns, or clarify the proposal to not include specialty nozzles in this standard. “This standard applies to HES and MSMT nozzles with uniform radii only.”

Topic: Water droplet size

Comment: There are no established and accessible methods for testing water droplet size. However, as precipitation rate drops for fan spray sprinklers, water droplet sizes will decrease to apply water slowly, which makes them prone to wind drift. If there is a way to measure precipitation rate without wind and with a controlled wind speed, that may be an interesting way to test for water application. More research is needed before establishing a water droplet size or wind drift effect as a requirement or as a definition of high-efficiency irrigation.

Rationale: CIT has done research on water droplet sizes using laser optic technology. However, that test method is no longer accessible.

Suggested Change (or Language): Eliminate water droplet criteria but research potential test methods of uniformity and precipitation rate in wind as droplet size does influence wind drift and misting.

Topic: List of MSMT sprinkler nozzles

Comment: Toro Precision Spray Nozzles are not MSMT nozzles.

Rationale: In the footnote c under Table 1, it is stated that the nozzles appear to have a stream-like pattern due to oscillations in the pattern. The spray pattern does not use streams, but instead pulses from left to right to apply water more slowly. MSMT nozzles use multiple streams to direct water and apply water slowly to the landscape.

Suggested Change (or Language): Eliminate the Toro Precision Spray Nozzle from the list of MSMT nozzles.

Topic: Payback period for MSMT nozzles

Comment: Payback period should be a range depending on home size and how nozzles are replaced.

Rationale: It could cost more than $100 to convert standard spray nozzles to MSMT nozzles depending on whether homeowners do it themselves or hire a professional contractor, which would be the recommended approach, especially since MSMT nozzles adjust differently than spray nozzles.

Suggested Change (or Language): Verify the payback period if it is relevant to nozzle efficiency. Could be longer if homeowners hire a professional contractor.

Topic: Product marking, documentation, and marketing

Comment: Product performance data and specifications are available on product webpages and in product catalogs. Eliminate DU from this requirement.

Rationale: DU can be an evaluated pass/fail criterion for labeling but requiring publication of DU would be confusing. Products have variation, and if they meet the threshold required, that should be enough for the consumer.

Suggested Change (or Language): Eliminate published DU requirement for product documentation.

Topic: Communicating savings

Comment: It is stated throughout the proposal that homeowners are likely not going to change their runtimes when switching to a low precipitation rate nozzle. While some may not, it is best practice to reevaluate the runtime to keep the landscape healthy and maintain the same water application needed for the plant material.

Rationale: To maintain a healthy landscape, runtimes will have to be reevaluated or the landscape will suffer.

Suggested Change (or Language): Eliminate language justifying water savings from incorrect runtime scheduling or clarify that runtimes should be reevaluated with low precipitation rate nozzles.

Topic: Calling the specification “high-efficiency” spray nozzles

Comment: There is a comment in the proposal that “high-efficiency” is not used in marketing materials for existing products when it is already used in some product names and marketing materials in the industry.

Rationale: “High-efficiency” is used in product names and in marketing already in the industry.
https://www.krain.com/nozzles
https://www.rainbird.com/products/he-van-high-efficiency-variable-arc-nozzles
https://www.rainbird.com/products/u-series-high-efficiency-dual-orifice-nozzles
Including their own created MWELO label for marketing.

Suggested Change (or Language): Eliminate comment if it is not relevant or retitle nozzle standard with more detail, such as “high-uniformity nozzle”.

Commenter: Paul Lauenstein
Affiliation: General Public
Comment Date: March 21, 2023

Email Text:

Please ban lawn irrigation sprinklers. Lawn irrigation is a frivolous waste of our vital and finite water resources.

See attached water bill insert entitled “Secrets of a Waterless Lawn."

Paul Lauenstein
4 Gavins Pond Rd.
Sharon, MA 02067
781-784-2986

Email Attachment:
See pages 23 through 24.

Are you a heavy water user?

To find out how your water use compares to the suggested maximum of 65 gallons per person per day, see the handy lookup chart opposite.

If you use over 100,000 gallons per year, you should get a free water audit from Energy New England, courtesy of the Sharon Water Department. They will provide you with a customized analysis that will highlight the most cost-effective strategies for conserving water in your home. To schedule a free water audit for your home, call the Sharon Water Department at 781/784-1525.

Please do your part to help our community use water efficiently.

Sharon has a long and proud history of protecting and preserving our drinking water aquifers as well as the natural beauty of our town. Read about the sensible lawn care practices, and efficient toilets and clothes washers described in this pamphlet. Let's use our municipal well water efficiently. It will save money, improve our local ecosystem, and maintain our water independence.

Water Management Advisory Committee
Sharon Water Department
781/784 1525

Sharon Water Conservation Program

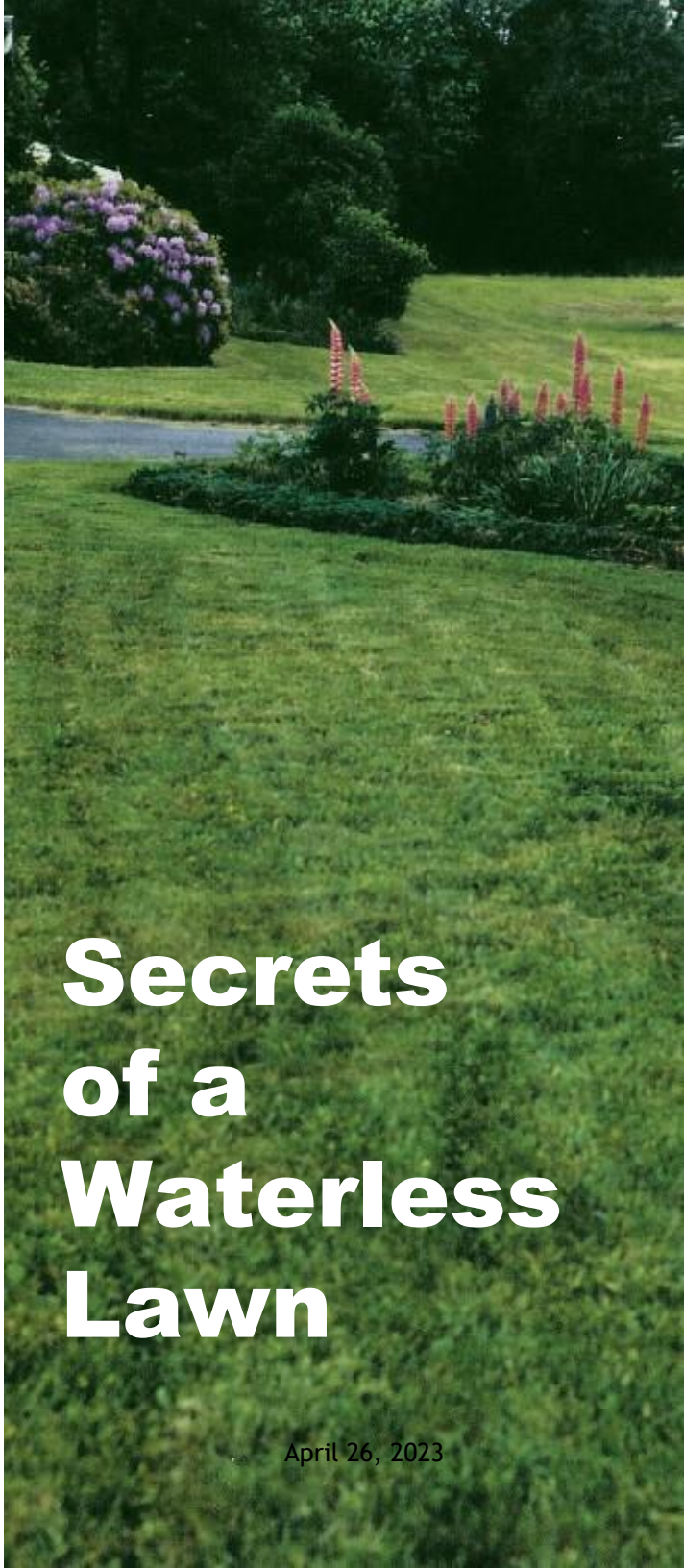
EPA WaterSense

Is your water use under 65 GPCD?

Gallons Per Capita Daily (GPCD)

Gallons used in 6 months (for annual gpcd, average your last 2 water bills)

	NO. OF HOUSEHOLD OCCUPANTS							
	1	2	3	4	5	6	7	8
4,000	22	11	7	5	4	4	3	3
6,000	33	16	11	8	7	5	5	4
8,000	44	22	15	11	9	7	6	5
10,000	55	27	18	14	11	9	8	7
12,000	66	33	22	16	13	11	9	8
14,000	77	38	26	19	15	13	11	10
16,000	88	44	29	22	18	15	13	11
18,000	99	49	33	25	20	16	14	12
20,000	110	55	37	27	22	18	16	14
22,000	121	60	40	30	24	20	17	15
24,000	132	66	44	33	26	22	18	16
26,000	142	71	47	36	28	24	20	18
28,000	153	77	51	38	31	26	22	19
30,000	164	82	55	41	33	27	23	21
32,000	175	88	58	44	35	29	25	22
34,000	186	93	62	47	37	31	27	23
36,000	197	99	66	49	39	33	28	25
38,000	208	104	69	52	42	35	30	26
40,000	219	110	73	55	44	37	31	27
42,000	230	115	77	58	46	38	33	29
44,000	241	121	80	60	48	40	34	30
46,000	252	126	84	63	50	42	36	32
48,000	263	132	88	66	53	44	38	33
50,000	274	137	91	68	55	46	39	34
52,000	285	142	95	71	57	47	41	36
54,000	296	148	99	74	59	49	42	37
56,000	307	153	102	77	61	51	44	38
58,000	318	159	106	79	64	53	45	40
60,000	329	164	110	82	66	55	47	41
62,000	340	170	113	85	68	57	49	42
64,000	351	175	117	88	70	58	50	44
66,000	362	181	121	90	72	60	52	45
68,000	373	186	124	93	75	62	53	47
70,000	384	192	128	96	77	64	55	48
72,000	395	197	132	99	79	66	56	49
75,000	411	205	137	103	82	68	59	51
80,000	438	219	146	110	88	73	63	55
85,000	466	233	155	116	93	78	67	58
90,000	493	247	164	123	99	82	70	62
95,000	521	260	174	130	104	87	74	65
100,000	548	274	183	137	110	91	78	68



Secrets of a Waterless Lawn

April 26, 2023

Reduce costly lawn irrigation and still have a nice lawn

Summertime demand for water surges almost 50% over indoor use in winter, depleting our groundwater when it is needed most to sustain ecosystems in local rivers, lakes and streams. Lawn watering is the main reason for this surge in water use.

Overwatering is expensive, and can even cause harmful fungus outbreaks. One inch of water per week is enough to keep a lawn green. That includes natural rain, which averages over 3" per month in summer.

If you can tolerate a period of dormancy in late summer, you can have a healthy, beautiful lawn without any irrigation at all. The quality and thickness of the topsoil is key. A layer of rich, organic loam 6" to 8" thick retains moisture, encourages deep roots, and harbors earthworms that aerate and enrich the soil with their castings.

Topsoil can be supplemented by leaving grass clippings and leaves shredded by your mower to decompose on your lawn. This builds a rich organic layer that holds moisture and recycles the costly nutrients you paid for when you fertilized your lawn. It also makes lawn mowing easier! To build topsoil faster, apply a thin layer of rich loam or compost once or twice a year.

Applying weak organic fertilizer in spring and fall aids moisture retention and adds micronutrients. Mix it with equal parts of 10-10-10 for root development, and lime to counteract acid rain. Using white powdered lime helps you see where you have already fertilized. Apply this mix at a rate of about 20 lbs. per 1,000 sq. ft.

More tips for a healthy lawn:

• Cut it long. Set your mower to its highest setting. Taller grass provides shade to slow evaporation from the soil.

• Mow it regularly. You should be removing less than 1/3 of the grass when you mow.

• Sharpen your mower blade. A dull blade shreds grass instead of slicing it.

• Tolerate clover in your lawn. Clover is a legume and adds nitrogen to the soil.

• Avoid pesticides. They kill beneficial earthworms. If grubs become a problem, apply milky spore. Once established in the soil, milky spore can protect against grubs for years!

• Overseed with drought-hardy perennial grass seed in early September to crowd out weeds. Apply compost, dehydrated manure or peat moss on newly seeded areas, especially bare spots, to hold moisture and help establish new grass.

• Compost your own "black gold" for use on the lawn and in your garden. Add leaves, weeds, melon rinds, carrot peels, tea bags, apple cores, banana peels, and other vegetable wastes. Crushed egg shells are good too. Avoid meat and high-fat items like peanut butter that smell and attract pests.

• For additional information, visit: www.nsrwa.org/greenscapes/guidebook/

Tips and rebates for saving water indoors:

• Get a $150 rebate for a High Efficiency Toilet (HET) that averages under 1.28 gallons per flush (gpf). A HET saves about 8,000 gallons per year compared to an older 3.5 gpf model. Be sure the dual-flush or pressure assist model you choose is MaP rated to flush at least 500 to 1,000 grams. See: http://www.bewaterwise.com/HET.pdf

• Front-load clothes washers use less water than a typical top-load washer. They also save energy, reduce drying time, use less detergent, cause less fabric wear, and extend the life of your septic system. The Water Department offers a $200 rebate for models with an Energy Star water factor of under 6.0 and at least 3 cu. ft. capacity ($150 for smaller models). To look up the water factor, see http://www.energystar.gov/index.cfm?c=clotheswash.pr_clothes_washers

Before you buy, call the Water Dept. at 784-1525 to confirm which toilets and clothes washers qualify for rebates.

• Check for leaks. Put food coloring in your toilet tank for 15 minutes. If you see color in the bowl, it's leaking. Also, if your water meter advances while no one is home, there's probably a leak.

• For more information, call the water efficiency hotline: **1-888-772-4242**.

Commenter: Ron Wolfarth
Affiliation: Rain Bird
Comment Date: March 21, 2023

Email Text:

N/A

Email Attachment:
See pages 26 through 47.

March 21, 2023

US Environmental Protection Agency – WaterSense Program

Via Email – watersense-products@erg.com

RE: WaterSense Notice of Intent to develop a Draft Specification for Spray Sprinkler Nozzles

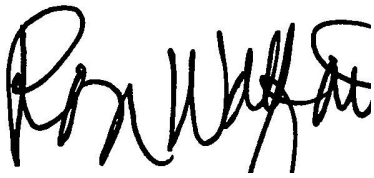
WaterSense Team,

Rain Bird Corporation (Rain Bird) is a leading global manufacturer and provider of irrigation products and services headquartered in Azusa, California. The privately held company has roots going back to 1933 during California's agricultural boom. Since the beginning, Rain Bird has produced and offered the industry's broadest range of irrigation products for farms, golf courses, sports arenas, commercial developments, and homes in more than 130 countries around the world.

Over the past nine decades, Rain Bird has been awarded more than 450 patents worldwide, including the first in 1935 for the original horizontal action impact drive sprinkler (U.S. Patent #1,997,901), which revolutionized the food production industry and ushered in a new era in irrigation. In fact, the original impact sprinkler was designated a historic landmark in 1990 by the American Society of Agricultural Engineers.

Thank you for the opportunity to comment on the WaterSense Notice of Intent to develop a specification for spray sprinkler nozzles. Rain Bird looks forward to again working collaboratively with US Environmental Protection Agency WaterSense and other stakeholders in advancing the WaterSense program. It fits well with Rain Bird's philosophy of efficiency we call the Intelligent Use of Water™. Spray sprinklers are a significant user of urban residential water. Improving their efficiency is something that Rain Bird not only supports but something in which Rain Bird has invested heavily over its history.

Sincerely,



Ron Wolfarth
Project Manager

(520) 907-0682
rwolfarth@rainbird.com

Rain Bird Corporation – Landscape Irrigation Division
6991 E. Southpoint Road, Tucson, AZ 85756 • Phone (520) 741-6100 • Fax (520) 741-6146

Rain Bird Draft Response to US Environmental Protection Agency WaterSense Notice of Intent for Spray Sprinkler Nozzles

Commenter Name: Ron Wolfarth, Project Manager
Commenter Affiliation: Rain Bird Corporation - Tucson, Arizona
Date of Comment Submission: March 21, 2023

Rain Bird offers a summary of its conclusions and recommendations here. These are discussed in detail in the following response in the context of the Notice of Intent.

A. Rain Bird Conclusions

1. Appendix A savings studies do not adequately isolate the contribution made by the spray sprinkler nozzles used in rebate programs for use in justifying the development of a draft specification for spray sprinkler nozzles.
2. "Earlier research" (prior to the publication of the WaterSense specification for spray sprinkler bodies) is not refuted by research subsequently published. In other words, "earlier research" is still valid and the finding that multi-stream, multi-trajectory (MSMT) nozzles save little to no water still stands.
3. The Wascher report should not be relied upon to cost justify the prescription of MSMT spray sprinkler nozzles.

B. Rain Bird Recommendations

1. WaterSense should define spray sprinkler nozzle efficiency as how well a spray sprinkler nozzle beneficially delivers water to the target landscape. Elements influencing spray sprinkler nozzle efficiency performance, in priority order, are:
    a. Manufacturer recommended operating pressure.
        i. WaterSense should require WaterSense labeled spray sprinkler nozzles be installed in combination with a WaterSense labeled spray sprinkler body with pressure regulation set to the recommended operating pressure of the spray sprinkler nozzle. This would completely address operating pressure elements of spray sprinkler nozzle efficiency.
        ii. WaterSense should abandon the notion that MSMT spray sprinkler nozzles are more efficient because when operated well above the manufacturer recommended operating pressure their flow increases proportionally less than fan spray sprinkler nozzles which are also operated well above the manufacturer recommended operating pressure.
    b. Water droplet size
        i. WaterSense should consider water droplet size distribution of spray sprinkler nozzles as an element of spray sprinkler nozzle efficiency. A water droplet size distribution biased toward larger sized droplets potentially has the following potential beneficial effects.
            1. Less wind drift losses.
            2. Less evaporation losses.
            3. Longer radius of throw.
    a. Distribution Uniformity
        i. WaterSense should require that spray sprinkler nozzles have distribution uniformity of 65% or higher.

ii. This 65% value matches the value set in California's Model Water Efficient Landscape Ordinance.
iii. Research performed by Dr. Michael Dukes shows that investments in achieving distribution uniformity higher than 50% contribute diminishing improvements to soil moisture uniformity.

b. Matched precipitation rate
i. WaterSense should require labeled spray sprinkler nozzles to have matched precipitation rate among all members of a product family that a user would normally combine on a single zone of an irrigation system.
ii. WaterSense should use theoretical precipitation rate and allow a maximum of 20% variability between any two members of a product family that would normally be combined on the same zone valve to determine whether a set of nozzles is matched precipitation rate.
iii. All patterns and radius sets of a spray sprinkler nozzle product family should be required to be matched precipitation rate for the product family to qualify for the label.
iv. Precipitation rate should vary no more than 20% between any two members of the same product family which users would normally combine on the same zone valve.

2. WaterSense should not categorize spray sprinkler nozzles as HES and Standard in the draft specification.
   a. The assignment of certain products to the categories of HES and Standard should not be done before the definition of spray sprinkler nozzle efficiency and a testing protocol is agreed upon and testing of spray sprinkler nozzles is complete. Only then will it be known which products belong to each category.
3. WaterSense should not use application rate as a criterion for the WaterSense draft specification for spray sprinkler nozzles.
   a. The application rate of spray sprinkler nozzles is not relevant to the efficiency of nozzles. Proponents of using application rate in this context cite runoff as the problem that is addressed. Runoff is a management issue that should be addressed by the proper management of irrigation schedules aided by WaterSense labeled weather-based controllers.
4. WaterSense should not use the flow rate of spray sprinkler nozzles as an efficiency criterion.
5. WaterSense should abandon the notion that MSMT spray sprinkler nozzles have a pressure regulating effect because they have lower flow rates when operated much higher than the manufacturer recommended operating pressure.
6. WaterSense should not set a radius "exceedance" threshold.
   a. "Exceedance" is not defined or included in the ASABE S398.1 standard for determining sprinkler radius and no other known standard includes this term or concept.
   b. There is no practical technology available to more tightly control the distance a nozzle throws water beyond its S398.1 defined radius.
   c. The amount of water that is sprayed beyond the S398.1 defined radius is not material in zero wind conditions.
7. Stakeholders should endeavor to develop an American National Standards Institute (ANSI) standard that defines spray sprinkler nozzle efficiency and a spray sprinkler nozzle testing protocol.
   a. Consensus agreement on the definition of spray sprinkler nozzle efficiency and a testing protocol that quantifies performance in those areas is needed to clearly distinguish efficient products from inefficient products.
8. Stakeholders should endeavor to develop a coefficient which describes the relationship between water loss due to wind drift and evaporation under different operating pressures and wind speeds and water droplet size distribution of spray sprinkler nozzles.

a. A coefficient of this sort would allow indoor testing of spray sprinkler nozzles to determine wind drift and evaporation efficiency of those nozzles.

9. WaterSense should not rely on Appendix A studies to determine if the use of MSMT spray sprinkler nozzle result in water savings.
   a. While the studies do show that programs which rebate the retrofit of spray sprinkler nozzles can result in lower water use, they do not adequately isolate the contribution that the spray sprinkler nozzle made to the savings.
10. WaterSense should suspend its development of the draft specification for spray sprinkler nozzles until such time as the proposed standards are published.
11. Once the proposed standard and coefficient exist and testing of spray sprinkler nozzles is complete, WaterSense should resume development of the draft specification for spray sprinkler nozzles.
    a. Test results will reveal spray sprinkler nozzle efficiency performance.
    b. WaterSense should use these test results to set performance thresholds to qualify for the WaterSense label.

Responses to Questions in and Comments on the WaterSense Notice of Intent

C. Technical Background Section (Starting on page 2)

1. **Topic: *"WaterSense would like stakeholder input on its product category definition of "spray sprinkler nozzle"."*** (From the Technical Background section on page 5)

Response: Rain Bird supports this definition.

Rationale: No further comment.

D. Scope Section (Starting on page5)

1. **Topic: *"WaterSense would like stakeholder feedback on the intended scope of the specification."***
   (From the Scope section on page 7)

Response: If product categories must be assigned in the draft specification, they should be called "Fan Spray Sprinkler Nozzle" and "Multi-Stream, Multi-Trajectory (MSMT) Spray Sprinkler Nozzle".

Rationale: WaterSense should not categorize spray sprinkler nozzles in the draft specification. Certainly, WaterSense should not categorize the products in a prescriptive way according to product features like application rate or multiple streams and multiple trajectories. If consensus was reached on the definition of spray sprinkler nozzle efficiency and a testing protocol which revealed each spray sprinkler nozzle's performance against that standard, WaterSense could then set an efficiency performance threshold for WaterSense label qualification. Spray sprinkler nozzles would be categorized as WaterSense labeled (HES) and non-WaterSense labeled (Standard) spray sprinkler nozzles.

Comment: The use of the category name "Standard" in the Notice of Intent implies that those are the inefficient spray sprinkler nozzles when compared to the MSMT, or High Efficiency Spray Sprinkler (HES) nozzles. Rain Bird does not believe this to be a uniformly true characterization of fan spray sprinkler nozzles. Some fan spray sprinkler nozzles are highly efficient. Including these high efficiency fan spray sprinkler nozzles in a category called "Standard" when Standard is then used to describe everything other than high efficiency products (implying low efficiency products) is not accurate.
If WaterSense must categorize spray sprinkler nozzles in some way and desires to use the word "Standard" to refer to products that are not high efficiency compared to other products which are high efficiency, then it should categorize and name the products as:

- High Efficiency Fan Spray Sprinkler Nozzles
- Standard Fan Spray Sprinkler Nozzles
- High Efficiency MSMT Spray Sprinkler Nozzles
- Standard MSMT Spray Sprinkler Nozzles

Perhaps there are no members of the High Efficiency Fan Spray Sprinkler Nozzles and Standard MSMT Spray Sprinkler Nozzles categories. However, that will not be known until consensus is reached on the definition of Spray Sprinkler Nozzle Efficiency, a Testing protocol is defined, and testing is completed.

E. Water Efficiency and Performance Section (Starting on page 7)

1. **Topic:** "*As described in Section VII Estimated Water Savings, WaterSense has estimated that some types of spray sprinkler nozzles use approximately 10 percent less water than standard spray sprinkler nozzles. WaterSense has found that spray sprinkler nozzles marketed as "high-efficiency" are MSMT nozzles that emit multiple streams of water at multiple trajectories. Based on WaterSense's research, water utilities with rebate programs for spray sprinkler nozzles often require MSMT nozzles. Furthermore, although the authors used a variety of terms for the product, MSMT nozzles were considered a more water-efficient option in the water savings studies documented in Appendix A.*" (From the first paragraph of the Water Efficiency and Performance section on page 7)
   Comment:
   a. The conclusion that "some types" of spray sprinkler nozzles (presumably MSMT) use approximately 10 percent less water than "Standard" spray sprinkler nozzles (presumably everything else) is based on the savings studies in Appendix A which was not yet published in 2017 when the WaterSense Spray Sprinkler Body Specification was published. WaterSense excluded Spray Sprinkler Nozzles from its 2017 Spray Sprinkler Body Specification because it concluded that there was no research which supported any spray sprinkler nozzle as more efficient than other spray sprinkler nozzles. In fact, that research showed MSMT spray sprinkler nozzles were not more efficient than other spray sprinkler nozzles. MSMT spray sprinkler nozzles showed little or no savings.
      It appears that since Appendix A savings studies primarily studied MSMT spray sprinkler nozzles and savings were claimed, WaterSense has chosen to exclude all other spray sprinkler nozzles on the market, even those that are marketed as high efficiency spray sprinkler nozzles. Rain Bird believes this to be a wrong conclusion for several reasons.
      ii. It is not clear that Appendix A savings studies considered other high efficiency fan spray sprinkler nozzles. Two examples are the Rain Bird HE-VAN (High Efficiency Variable Arc Nozzle) and the Rain Bird U-Series (Undercut) spray sprinkler nozzles. Both products are more efficient than others on the market. Rain Bird competitors also offer spray sprinkler nozzles marketed as being high efficiency.
      iii. It is not practical to give a detailed analysis of each of the Appendix A savings studies in these comments. However, Rain Bird finds, in general, that the WaterSense conclusion that MSMT spray sprinkler nozzles use 10% less water is not warranted.
         1. At least some of the savings studies were initiated after the conservation programs were complete. Therefore, there was no opportunity for those conducting the studies to control or know many relevant variables.
         2. Valid assessments in those cases were reached that the implementation of the conservation program resulted in less water being used by the conservation program participants, because water use records exist before and after the retrofits were conducted. Rain Bird accepts the conclusion that less water was used after the retrofit compared to the period before the retrofit.
         3. However, many elements may have contributed to those savings. Because those other elements were not able to be controlled by those conducting the study, the degree to

which MSMT spray sprinkler nozzles contributed to water use reduction cannot be determined. It may have been a positive or negative contribution or no contribution at all as was determined in some of the earlier research.

4. As an example, Rain Bird believes that proper irrigation scheduling plays a very important role in efficient irrigation. If users were told that the nozzles they were given are more efficient because they have lower application rates, some, maybe most, users would be triggered to adjust their irrigation schedule. Perhaps they were encouraged to adjust their irrigation schedules by program sponsors. It is very possible that the schedule on the controller prior to the retrofit was very inefficient. The correction of the irrigation schedule could account for all the savings caused by the replacement program even if the nozzles had not been retrofitted.

iv. Many of the Appendix A studies raise questions that cause Rain Bird to be cautious in drawing conclusions regarding reduced water use directly attributable to MSMT spray sprinkler nozzles.

a. Many stakeholders assume all fan spray sprinkler nozzles are inefficient because most have higher application rates compared to MSMT spray sprinkler nozzles. Runoff is widely and appropriately viewed as waste and something to be avoided. Rain Bird agrees. Runoff is caused by poor management of the irrigation system. It is not an inherent characteristic of spray sprinkler nozzles. Application/precipitation rate should not be a criterion for defining spray sprinkler nozzle efficiency or for WaterSense labeling.

v. Consider hypothetically if a spray sprinkler nozzle A were to be developed with an application rate typical of fan spray sprinkler nozzles and was shown to apply 90% of total irrigation water to the target landscape area in a normal wind condition. Consider also spray sprinkler nozzle B that had application rates typical of MSMT spray sprinkler nozzles and were shown to apply only 80% of total irrigation water to the target landscape area in the same wind condition. Spray sprinkler nozzle A and B have similar distribution uniformity. (The lower amount of water reaching the target area of spray sprinkler nozzle B could be due to losses from wind drift and evaporation.)

1. Spray sprinkler nozzle A should not be excluded from receiving a WaterSense label due to its higher application rate when a much higher portion of water delivered through the irrigation system is made beneficially available to the crop. Spray sprinkler nozzle A is more efficient.
2. The only reason spray sprinkler nozzle A might not deliver more beneficial water to the crop than spray sprinkler nozzle B in this hypothetical case would be due to misuse causing runoff. Mismanagement of the irrigation schedule is the true cause of the waste in this hypothetical case, not the spray sprinkler nozzle.
3. Application/precipitation rate should not be a criterion for a WaterSense label.

vi. A common user response to observing runoff or its effects is to adjust the irrigation schedule. (Many users either do not observe the runoff or ignore this waste signal.)

vii. If spray sprinkler nozzle application rates were somehow able to be matched to the infiltration rate of the soil, all runoff would be eliminated and no waste signal would be visible to the user, the community or a policing authority. However, if the scheduling of the irrigation system is still set to over-irrigate, the excess irrigation would percolate beyond the root zone and be wasted. It would also be invisible. Those users may conclude that since there is no runoff, there is no waste and this is the cost of maintaining an attractive landscape. They would have no reason to be embarrassed by their irrigation habits.

2. **Topic:** *"It is possible that manufacturers could develop other types of high-efficiency spray sprinkler nozzles in the future. To be inclusive of future developments in the market, WaterSense uses the phrase 'high-efficiency spray (HES) sprinkler nozzle' (which includes MSMT nozzles) in this NOI to differentiate the products that WaterSense is considering labeling.*" (From the second paragraph of the Water Efficiency and Performance section on page 7)

   Comment:

   a. Rain Bird does not support this.
   b. The quoted phrase in parenthesis, "(*which includes MSMT nozzles),"* currently seems to exclude everything else currently on the market and only leaves open the possibility of "other types of high-efficiency spray sprinkler nozzles in the future". The exclusion of other existing products from Rain Bird and its competitors that are marketed as high efficiency from the HES category is inappropriate without data that supports that decision.
   c. Rain Bird believes that WaterSense should pause its development of a draft specification for spray sprinkler nozzles until an ANSI standard definition of Spray Sprinkler Nozzle Efficiency and a standard Testing Protocol is developed and published. WaterSense should resume development of the draft specification when efficiency testing of spray sprinkler nozzles according to the new standard is complete.

F. Application Rate Section (Starting on page 8)

1. **Topic:** *"Pressure regulation can also directly and independently affect application rate. Pressure regulating spray sprinkler bodies create a constant flow rate to the sprinkler nozzle regardless of supply pressure. Without pressure regulation, spray sprinkler bodies may apply water at higher rates than the sprinkler nozzle's specified application rate*". (From the end of the last paragraph on page 8)

   Comment:

   a. RE: *"Pressure regulating sprinkler bodies create a constant flow rate to the sprinkler nozzle regardless of supply pressure."*

      This is not an accurate statement. Pressure regulators provide a relatively constant downstream pressure when upstream pressure and flow rate fluctuates within a range. Spray sprinkler nozzles of different nominal flow rates can be installed on the same pressure regulated spray sprinkler body and the pressure supplied to the nozzle remains about the same while the nozzles will flow at different rates.
   b. Given the recognized importance of spray sprinkler body pressure regulation (indicated by the WaterSense Spray Sprinkler Body label specification), the spray sprinkler nozzle label specification should require the combination of WaterSense label sprinkler spray bodies and spray sprinkler nozzles. The WaterSense Irrigation Controller specification requires the combination of multiple products in order qualify for the label. This will ensure proper operating pressure and will improve irrigation efficiency.

2. **Topic:** "*…preliminary research results suggest that HES sprinkler spray nozzles provide a similar effect as pressure regulation, though likely not to the same extent as pressure-regulating sprinkler bodies.*" (From paragraph 1 on page 9)

   Comment:

   a. Pressure regulators provide a relatively constant downstream pressure when upstream pressure and flow rate fluctuates within a range. Suggesting that MSMT nozzles have a similar effect as pressure regulation is misleading to the uninformed reader by suggesting that this is a positive characteristic of MSMT nozzles.

b. It is accurate to say that as pressure increases above the recommended operating pressure of MSMT nozzles, flow rate rises less than fan spray nozzles rise under those conditions. However, it is very instructive to also say that water droplet size is reduced as pressure rises. The higher the water pressure applied to the nozzle orifice, the greater proportion of small water droplets that are generated. A nozzle with a small orifice will generate more smaller water droplets compared a larger nozzle operated at the same high pressure. (This is how misting systems used for cooling in outdoor, desert environments work. Nozzles with very small orifices at very high pressure atomize the water which very quickly evaporates absorbing the heat energy which cools the air.)
c. As operating pressures rise, water droplets become smaller and more subject to wind drift and evaporation causing irrigation water losses. This informs the reader regarding the potentially negative aspects of operating spray sprinkler nozzles with smaller orifices at high operating pressures. The degree to which this is true for MSMT or fan spray sprinkler nozzles can only be determined by testing.

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3. **Topic:** "*WaterSense is not aware of a Test Method for evaluating matched precipitation rate or pressure regulation provided by spray sprinkler nozzles"*. (From paragraph 2 under 'Testing Methods and Associated Data' on page 9)

   Comment:

   a. Theoretical application rate evaluation does not require testing. WaterSense should use theoretical application rate to evaluate matched precipitation rate.
   b. Theoretical precipitation rate can be calculated for each nozzle of different arcs and radii based on published data from the manufacturer. When nozzles are combined on a zone of an irrigation system with spacing and arrangement that results in the same precipitation rate, it is considered "matched". If a test plot of unmatched precipitation rate nozzles were operated and catch cans collected the water, it would theoretically have poorer uniformity than a test plot of matched precipitation rate nozzles. What is not known is how much of the water that leaves the spray sprinkler nozzle hits the ground instead of evaporating or blowing away.
   c. Net application rate is determined using a grid of catch cans. It uses the average amount of water captured in catch cans in a formula to determine the depth of water that reaches the surface of the ground over a given period. It accounts for some losses, primarily wind drift and evaporation especially if it is conducted outdoors. Using net application rate would require a large amount of testing. This testing provides little value to the evaluation of matched precipitation rate. It may have value in the overall efficiency evaluation of a nozzle because it takes wind drift and evaporation into account if the testing is conducted outdoors under wind controlled and/or measured conditions.
   d. There is currently no test method for evaluating pressure regulation of spray sprinkler nozzles because no spray sprinkler nozzles currently have pressure regulation features. Perhaps this feature will be offered in the marketplace in the future. Pressure regulation of spray sprinklers is currently only available in the spray sprinkler body.
   e. A benefit of pressure regulation devices integral to the spray sprinkler bodies is that downstream operating pressure is the same regardless of the flow of the spray sprinkler nozzle. Spray sprinkler nozzles of differing flow rates can be installed on the same sprinkler spray body and operating water pressure at the spray sprinkler nozzle remains about the same.
   f. Water droplet size distribution of a nozzle is determined by several factors. Some of these factors are:
      i. Nozzle orifice size,
      ii. Nozzle shape,

iii. Pressure at the nozzle,
iv. Turbulence in the flow path of water to the nozzle, and
v. Coefficient of friction in the water path to the nozzle.

A combination of these, and other, factors determine the water droplet size distribution of a nozzle. There exists a wide range of variability in water droplet size distribution results. This wide range of results significantly impact how much irrigation water is made beneficially available to the crop.

g. Smaller water droplets weigh less than the larger water droplets. At some point of higher operating pressure, more of the water droplets become small and light and they do not travel as far (in addition to being blown away in a breeze and/or evaporating before reaching the ground). This causes poor irrigation coverage, poor performance of the crop, and is the definition of inefficient irrigation. Spray sprinkler nozzles should never be operated beyond the manufacturer's recommended operating pressure. WaterSense should require the use of WaterSense labeled spray sprinkler bodies in combination with qualifying spray sprinkler nozzles to qualify for the WaterSense label.
h. WaterSense should not consider one type of spray sprinkler nozzle more efficient than another because when one is operated beyond the manufacturer's recommended operating range, it results in less flow than another type of spray sprinkler nozzle also operating beyond the recommended operating range.

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4. **Topic:** "*As discussed in Section V Existing Performance Data, Dr. Michael Dukes of the University of Florida conducted research to evaluate whether spray sprinkler nozzles could be differentiated based on flow rate. Dr. Dukes developed a test method that aligns with ASABE/ICC 802-2020. His results indicate that flow rate is substantially lower in HES sprinkler nozzles compared to their standard counterparts. Based on these findings, ASABE/ICC 802-2020 could be used to differentiate spray sprinkler nozzles. The application rate can be calculated from flow rate by measuring irrigated area and using Equation 3-1 in ASABE/ICC 802-2020, which aligns with Equation 1 above."* (From paragraph 3 under 'Testing Methods and Associated Data' on page 9)

   Comment:
   a. A review of published manufacturer literature reveals the same finding that MSMT spray sprinkler nozzles have lower flow rates than most fan spray sprinkler nozzles.
   b. Nozzle flow rate is not an element of irrigation efficiency and should not be used as such.

   Topic: "*flow rate is substantially lower in HES sprinkler nozzles compared to their standard counterparts…"* (From paragraph 3 under 'Testing Methods and Associated Data' on page 9)
   Comment:
   a. Nozzle flow rate is not an element of irrigation efficiency and should not be used as such.
   b. The use of the category name "Standard" in the Notice of Intent implies that those are the inefficient spray sprinkler nozzles when compared to the MSMT, or High Efficiency Spray Sprinkler (HES) nozzles. Rain Bird does not believe this to be a uniformly true characterization of fan spray sprinkler nozzles. Some fan spray sprinkler nozzles are high efficiency. Including these high efficiency fan spray sprinkler nozzles in a category called "Standard" when Standard is then used to describe everything other than high efficiency products (implying low efficiency products) is not accurate.
   c. If WaterSense desires to use the word Standard to refer to products that are not high efficiency compared to other products which are high efficiency, then it should categorize the products as:
      - High Efficiency Fan Spray Sprinkler Nozzles
      - Standard Fan Spray Sprinkler Nozzles
      - High Efficiency MSMT Spray Sprinkler Nozzles

- Standard MSMT Spray Sprinkler Nozzles

Perhaps there are no members of the High Efficiency Fan Spray Sprinkler Nozzles and Standard MSMT Spray Sprinkler Nozzles categories. However, that will not be known by WaterSense until consensus is reached on the definition of Spray Sprinkler Nozzle Efficiency and a Testing protocol is defined and testing is completed.

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5. **Topic:** *"WaterSense is considering using application rate as a water efficiency criterion to identify HES sprinkler nozzles. For a spray sprinkler nozzle to earn the WaterSense label, WaterSense would propose two thresholds for application rates: one at the manufacturer's recommended operating pressure and one at high pressure. WaterSense would set the thresholds based on Dr. Dukes' data and reference the test method in ASABE/ICC 802-2020.*
For the purposes of this NOI, WaterSense is proposing that each radius in a model's product family be tested (for example, 12- and 15-feet radii versions of a model) at the full circle pattern only. If the nozzle has an adjustable radius, WaterSense is considering requiring it to be tested at the maximum radius.

For the purposes of this NOI, WaterSense is proposing that each radius in a model's product family be tested (for example, 12- and 15-feet radii versions of a model) at the full circle pattern only. If the nozzle has an adjustable radius, WaterSense is considering requiring it to be tested at the maximum radius.

WaterSense is seeking stakeholder feedback on its proposal to use application rate (at recommended operating pressure and high pressure) as a water efficiency criterion for spray sprinkler nozzles. WaterSense is also interested in whether any manufacturers currently use the ASABE/ICC 802-2020 test method for application rate and, if so, would be willing to share masked data with WaterSense.

Additionally, WaterSense requests stakeholder opinions on using the following parameters to evaluate spray sprinkler nozzles:
Test each radius in a model's product family at the full circle pattern only; and
Test models with an adjustable radius at the maximum radius." (From the Application Rate as Water Efficiency or Performance Criteria section starting on in the middle of page 9 and ending on page 10)

Response: RE: ***"****WaterSense is considering using application rate as a water efficiency criterion to identify HES sprinkler nozzles."*

Application/precipitation rate should not be a criterion for a WaterSense label.

Rationale: Lowering application/precipitation rates of sprinklers is an attempt to reduce runoff. Runoff is a failure of irrigation scheduling and is neither an inherent characteristic of spray sprinkler nozzles nor an element of irrigation efficiency.

Response: RE: *"(at recommended operating pressure and high pressure)".*

Rain Bird is concerned that the publication (by Rain Bird or by its release to WaterSense) of product performance data outside of the recommended operating pressure will confuse and mislead customers. Rain Bird is very hesitant to participate in the sharing of data which constitutes misuse of the product.

Rationale: Users should never operate spray sprinkler nozzles at pressures beyond the manufacturer's recommended operating pressure. WaterSense would confuse some users if it were to say that one spray sprinkler nozzle is better than another because it uses less water than another when it also is

operated at 'high' pressure. Some users may conclude that WaterSense believes that it is acceptable to operate the HES at those high pressures, but not the 'Standard' spray sprinkler nozzles.

Rationale: Rain Bird's decades-long, customary practice when presenting Rain Bird landscape irrigation product performance data in printed form has been to only provide to customers that data collected under conditions at which Rain Bird recommends the use of the product. Customers have become accustomed to that practice. When they see printed Rain Bird landscape irrigation performance data, they know that Rain Bird recommends the product's use under those conditions. There is no other indication in Rain Bird landscape irrigation product literature of recommended use conditions.

Response: RE: *"application rate as a water efficiency criterion."*

Application/precipitation rate is not an element of spray sprinkler nozzle efficiency and should not be a criterion for a WaterSense label.

Rationale: Rain Bird does not support application rate as a water efficiency criterion for the several reasons.

a. A lower application/precipitation rate can reduce and/or delay the start of runoff. However, runoff can only occur when the irrigation schedule is mismanaged. It has been said, "If a perfectly designed, installed and maintained irrigation system is mismanaged, then water will simply be wasted more efficiently than ever before". Irrigation schedule management is the cause of the runoff problem. That problem is best addressed by WaterSense labeled irrigation controllers and user education.
b. Runoff is a waste signal and may trigger some users to address that waste by addressing the poor irrigation schedule management.
c. If an irrigation schedule set to over-irrigate is not addressed and runoff is otherwise eliminated, water will percolate past the reach of the crop's roots (commonly called 'deep percolation') and be wasted the same as if it were to runoff.

Comment: There exists a point of view that lower application/precipitation rates can lead to lower irrigation efficiency, especially in a residential application.

a. Lower application/precipitation rates will extend the time needed to irrigate properly. This could possibly expose the sprinklers to less favorable wind conditions and increase the time water is suspended in the air subjecting it to more wind drift and evaporation and increase those losses.
b. Lower application/precipitation rate zones require less flow to cover the same area of landscape. The size in area (square feet) of many residential landscape hydrozones are driven by the different plant water needs. These water needs differ due to plant type, sun/shade exposure, drainage patterns, and soil type variations. Residential contractors are subject to cost competition. Respecting these hydrozone requirements requires more zones so they can be scheduled differently in run time and irrigation interval. More hydrozones require more zone valves. Cost driven contractors are tempted to ignore these hydrozone requirements in favor of a lower installation cost so that they will have a lower sale price to the homeowner compared to their efficiency-driven contractor competitor.
c. This cost difference driver is demonstrated in the John Wascher (Hunter Industries) report cited in Appendix A of the Notice of Intent. For Wascher to show a lower installation cost in his MSMT spray sprinkler nozzle design compared to the fan spray sprinkler nozzle design, Wascher had to assume:
    i. The landscape was 100% turf.
    ii. Sun/shade patterns ("micro-climate differences"?) were not relevant.

iii. The site was entirely flat.
iv. Some of the landscape did not have to be irrigated.
v. Overspray onto neighboring property was acceptable.
vi. The poor uniformity of a single row of sprinklers was acceptable.
vii. A single row of sprinklers on the same zone as sprinklers spaced head-to-head resulting in very different application rates was acceptable.

These are neither the conditions of the "typical" residential landscape, nor are these tradeoffs that enhance irrigation efficiency. These are bad design choices driven by a desire for a lower installation cost.

d. The lower the precipitation rate of the spray sprinkler in a residential setting, the higher the temptation to compromise good, efficient irrigation design principles due to the potential cost savings of those tradeoffs.
e. One reason the higher flow rate of fan spray sprinkler nozzles result in more zone valves is because they more quickly exceed the capacity of the residential water supply source. This tends to negate the temptation to make poor irrigation system design tradeoffs that entice the cost driven contractor. It also makes a more even cost playing field for the efficiency driven contractor who installs more zone valves.
f. Application/precipitation rate is not an element of spray sprinkler nozzle efficiency and should not be a criterion for a WaterSense label.

Response: RE: Use of ASABE/ICC 802-2020 for the calculation of Application Rate and the sharing of masked data.

Rain Bird uses equation 3-1 in ASABE/ICC 802-2020 to calculate Application/Precipitation Rate and publishes those results in its literature.

Rationale: No further comment.

Response: RE: Testing of spray sprinkler nozzles of differing radii at full circle only.

Rain Bird supports the testing of spray sprinkler nozzles of differing radii at full circle only if testing must be done.

Comment: Application/precipitation rate is not an element of spray sprinkler nozzle efficiency and should not be a criterion for a WaterSense label.

Response: RE: Test models with an adjustable radius at the maximum radius.

Rain Bird supports the testing of models with an adjustable radius at the maximum radius .

Rationale: No further comment.

Response: If WaterSense tests spray sprinkler nozzles which have an adjustable arc, they should be tested at full radius and full arc.

Rationale: No further comment.

6. **Topic:** *"Although spray sprinkler nozzles are not necessarily pressure-regulating by design, Dr. Dukes' results provide some evidence that MSMT nozzles may provide a similar effect as pressure regulation. (See Section V Existing Performance Data for more details.) As a result, WaterSense would not need to include a separate test method for pressure regulation but would incorporate it*

into the evaluation of application rate." (From the Application Rate as Water Efficiency or Performance Criteria section second full paragraph of page 10)

Comment:

While Dr. Duke's results are interesting, WaterSense should not use this information to prescriptively require MSMT spray sprinkler nozzles to qualify for a WaterSense label.

a. WaterSense should require the use of WaterSense labeled spray sprinkler bodies regulated at the manufacturer's recommended operating pressure in combination with qualifying spray sprinkler nozzles to qualify for the WaterSense label. No study or testing would then be required.
b. WaterSense labeled Irrigation Controllers require several products which are sold separately to be combined to qualify for the WaterSense label.

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7. **Topic:** *"To evaluate matched precipitation, WaterSense is proposing that licensed certifying bodies evaluate application rates across an entire family of models. WaterSense is not aware of an industry standard variance in application rates that constitutes matched precipitation for spray sprinkler nozzles. WaterSense would need to identify an acceptable variance for the purposes of the specification.*

   WaterSense seeks input on whether it should require spray sprinkler nozzles to have matched precipitation to be eligible for the WaterSense label. What would be an acceptable variance in application rates to ensure matched precipitation? If WaterSense requires matched precipitation, how should EPA verify the data?" (From the Application Rate as Water Efficiency or Performance Criteria section third full paragraph of page 10)

Response: RE: MPR requirement for eligibility for WaterSense label.

Yes, theoretical MPR should be required for a WaterSense label.

Rationale: Theoretical matched precipitation rate (MPR) is a critical aspect of spray sprinkler nozzles in providing uniform application of water in a properly designed, installed, maintained and managed irrigation system. The MPR requirement should include not only MPR between all arcs (quarter, half, full circle, as examples) of a nozzle family, but also between the different radii offered within that nozzle family. WaterSense should not allow an exception to models of the same nozzle family. If one radius model of the family does not conform to the MPR criteria, the entire family should not be eligible for labeling. Rain Bird believes that allowing such exceptions would be too confusing and misleading to the consumer. It may result in models of the family with mis-matched precipitation rates combined on the same zone. That would result in poor uniformity across that zone of the irrigation system and waste water.

Response: RE: Acceptable variance in MPR for WaterSense label eligibility.

Rain Bird recommends no greater than 20% variability in theoretical MPR between arcs of nozzles and radius sets of nozzles to be eligible for a WaterSense label.

Rationale: Rain Bird strives for perfection in this area, but there are limits to what can be accomplished in the design and manufacturing processes. A requirement of variability less than 20% may not be able to be achieved.

Response: RE: EPA verification of data.

WaterSense could consult published data which the manufacturer would self-certify.

Rationale: Spot checks of published manufacturer self-certified data is adequate to confirm conformance.

G. Distance of Throw Section (Starting on page 10)

1. **Topic:** ***"WaterSense is interested in feedback from irrigation contractors about whether they are likely to incorporate HES sprinkler nozzles in bids for new irrigation systems, any factors that might influence their decision (i.e., new installation vs. retrofit), and whether HES sprinklers reduce the cost of materials in practice."*** (From the Distance of Throw section on pages 10 and 11)

Response: Contractors currently incorporate MSMT nozzles in new and retrofit applications. MSMT nozzles may reduce the cost of materials (and labor) in practice in some situations.

Rationale: An element missing from the NOI discussion of sprinkler spray nozzle radius of throw is that of performance and adherence to efficient irrigation design practices.

There are irrigation design cost tradeoffs that harm irrigation efficiency and there is insufficient information given in the Waschler report (John Waschler, Hunter Industries). Some missing data and questionable efficient design tradeoffs are:

a. The study assumes 100% turf (which reduces the need for hydrozoning for different plant water requirements and allows fewer valves, larger radius sprinklers to be used and reduces the need for small radius spray sprinkler nozzles which reduced the cost of the MSMT design. The report then claims it is a typical landscape which is, at best, a questionable claim),
b. Microzones and climate are not considered (which reduces the need for more valves due to exposure (sun/shade) differences and the subsequent radius reduction necessary),
c. No irrigation legend (to determine the radius of the nozzle which then allows determination of the existence of over/underspray),
d. Questionable layout of zone valves in the fan spray sprinkler nozzle design (For example, in the fan spray sprinkler design, the zone on the left side of the house is supplied by a zone valve on the right side of the house. The zone valve could be located directly adjacent to the zone it serves. About 100 feet of lateral line is wasted.)
e. Overspray onto adjacent property is tolerated on the MSMT design which reduces expense and may violate building codes in some jurisdictions.
f. Single row irrigation is tolerated which reduces expense for the MSMT design more than for the fan spray design and significantly degrades distribution uniformity.
g. A single row of sprinklers on the same zone as sprinklers spaced head-to-head resulting in precipitation rates which are not matched is acceptable.
h. Grading plan to determine slope vs flat areas and drainage patterns and the potential need for more hydrozones.
i. Some of the landscape area is not irrigated. The tree near the front door does not seem to be irrigated which would add another zone valve to the MSMT design and likely not add a zone valve on the fan spray design.

The conclusion that MSMT nozzles lower installation cost on this site is not warranted unless efficient irrigation design principles are ignored.

Rain Bird believes that there is potential for MSMT nozzles to reduce installation cost and to not compromise design integrity in certain circumstances. This will often not be the case. A more

comprehensive study of a diversity of landscapes is needed to cost justify the WaterSense prescription of MSMT spray sprinkler nozzles.

There are many applications where there would be no cost savings with MSMT nozzles. Given the higher unit cost of MSMT nozzles compared to fan spray sprinkler nozzles, MSMT nozzles may increase the installation cost on sites that would require the same number of fan spray sprinklers as MSMT spray sprinkler nozzles due to the design elements discussed above.

Some states have enacted legislation requiring that only spray sprinkler bodies that are WaterSense labeled be sold and/or installed in that state. Rain Bird expects a similar legislative response to WaterSense labeled spray sprinkler nozzles. This would require MSMT spray sprinkler nozzles in all circumstances where a spray sprinkler nozzle is the best choice and would severely limit irrigation designers.

Landscapes which have small-sized irrigation hydrozones due to lot size and/or diverse hydrozone requirements are highly likely to require the same number of spray sprinkler bodies regardless of which style (fan or MSMT) nozzle is chosen. In those cases, the use of MSMT nozzles could increase the installation expense.

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2. **Topic:** ***"WaterSense seeks stakeholder feedback on whether ASAE/ASABE S398.1 is an appropriate test method for distance of throw.***

   Do stakeholders believe it is reasonable for WaterSense to require the tested distance of throw to align with the value reported by the manufacturer? WaterSense is also interested in stakeholder input on the appropriate percent exceedance (e.g., percentage greater than the rated distance of throw) to prevent water waste due to overspray." (From the Distance of Throw as Water Efficiency or Performance Criteria section on page 12)

Response: RE: Appropriateness of ASAE/ASABE S398.1.

Yes, ASAE/ASABE S398.1 is appropriate to use to determine distance of throw.

Rationale: S398.1 is one of few existing standards in the irrigation industry which has been accepted and adhered to by the major manufacturers for many years (30+).

Response: RE: WaterSense testing of distance of throw to align with value reported by the manufacturer.

Yes.

Rationale: It is reasonable for WaterSense to require this. There are details that must be addressed like acceptable variation, minimum/maximum/average radius of throw, and adjustment of radius of variable arc nozzles during the test because the mechanics of changing arc impacts radius performance (which is commonly understood by the user). There are also practical limits present when small plastic injection-molded nozzles are used. Variation in the manufacturing process is unavoidable and presents real barriers to performance improvement beyond a certain point.

Response: RE: Appropriate percent exceedance/overspray.

ASAE S398.1 is used to measure radius. ASAE S398.1 does not define "exceedance" of radius. Until this is defined and tests performed against that criterion, Rain Bird does not support this as a criterion for the WaterSense draft specification.

Rationale: Rain Bird does not believe this requirement is useful.

a. Rain Bird knows of no useful technology to control or reduce the degree of "exceedance" of radius.
b. The amount of water that falls beyond the ASABE S398.1 radius is not material. The minimum amount of water captured in a catch can during an ASABE S398.1 radius test 0.01 inches. One foot is added to the distance of the farthest catch can with that minimum amount of water to determine radius. That means that less than 0.01 inches of water falls to the ground at the stated radius defined by ASABE S398.1.
c. Much of the "exceedance" or overspray observed in the landscape is caused by windblown spray. Wind blowing in the same direction as the direction of spray will carry the water farther than if there is no wind. Some amount of overspray is unavoidable.
d. Requiring a maximum amount of spray radius beyond the ASABE S398.1 defined radius requires a non-existent level of control of how water behaves once it leaves the nozzle.

H. Distribution Uniformity Section (Starting on page 12)

1. **Topic:** *"Early studies on water savings associated with MSMT sprinkler nozzles focused on DU as the likely mechanism for anticipated water savings. Researchers and utilities suggested that MSMT sprinkler nozzles might use less water and result in healthier landscapes because they distribute water more evenly. Since DU quantifies this metric, stakeholders suggested that DU might be an appropriate way to measure water efficiency, and some researchers attempted to quantify the range of DU that would result in water savings. Many of these studies included irrigation audits conducted in a controlled environment, such as a field or concrete surface.[27, 28, 29, 30, 31, 32] While many of these studies reported higher DUs for MSMT sprinkler nozzles, <u>the researchers did not observe the expected water savings</u>."* (underline added) (From the Distribution Uniformity as Water Efficiency or Performance Criteria section on pages 13 & 14)

Comment: Given this statement, WaterSense should not conclude that MSMT spray sprinkler nozzles are high efficiency.

a. The "early" research that showed no savings with MSMT spray sprinkler nozzles has not been refuted.
b. WaterSense says the reason that MSMT spray sprinkler nozzles are more efficient is the savings studies cited in Appendix A. Those studies were conducted in a way that cannot isolate the MSMT spray sprinkler nozzles as a source of the water savings.
c. The Sovocool (2014) study (one of the 'early studies" that showed no savings) that compared water use of fan spray sprinkler nozzles to MSMT spray sprinkler nozzles was a study which tightly controlled conditions and did a superior job of isolating water use to the nozzle type. It showed no savings after a short initial period of some savings. This study is very relevant when considering if MSMT spray sprinkler nozzles are directly responsible for lower irrigation water use.
d. Appendix A savings studies show that if homeowners are motivated to pay attention to their irrigation system, they take actions that result in lower water use compared to those who take no action and continue the same practices as in the past. They also show that rebating spray sprinkler nozzles that are promoted as 'high efficiency' spray sprinkler nozzles adequately motivates some homeowners to make changes that result in about 10% (according to WaterSense) water savings. They do not isolate which user actions caused the water savings or to what degree each element of change caused the water use reduction.

2. **Topic:** ***"WaterSense invites manufacturers to submit laboratory data on DU for HES and standard spray sprinkler nozzles. WaterSense also invites manufacturers to indicate whether they collect DU***

data in accordance with ASABE/ICC 802-2020 or through another method." (From the Distribution Uniformity as Water Efficiency or Performance Criteria section on page 14)

Response: RE: Submission of laboratory data.

Rain Bird is open to discussing this possibility.

Rationale: Rain Bird would entertain a specific request for information.

Response: RE: Collection method of DU data.

Rain Bird performs catch can testing of nozzles using ASAE/ASABE S398.1 which is required by ASABE/ICC 802-2020. The result of this testing is used to determine sprinkler radius and is used to generate a distribution rate curve. Rain Bird uses those data to determine Distribution Uniformity.

Rationale: No further comment.

3. **Topic:** ***"WaterSense would like stakeholder input on whether DU should be used in a specification to establish a minimum level of performance or used to differentiate HES and standard spray sprinkler nozzles."*** (From the Distribution Uniformity as Water Efficiency or Performance Criteria section on page 15)

Response: Distribution Uniformity should be used in the WaterSense label specification for spray sprinkler nozzles. It should be set as a threshold level of 65% or higher.

Rationale: California's Model Water Efficiency Ordinance (MWELO) requires DU of 65%. Dukes (2006) research suggests that once 50% DU is reached, improvement in DU beyond this level provides diminishing returns. Dr. Dukes has stated in conversation with Rain Bird that this study has some noise in the data, so Rain Bird supports using 65% DU to define HES nozzles to conform with MWELO. Rain Bird does not support a requirement higher than 65%.

4. **Topic:** ***"WaterSense invites stakeholders to submit data pertaining to the relationship between DU and water savings and/or performance (e.g., landscape health)."*** (From the Distribution Uniformity as Water Efficiency or Performance Criteria section on page 15)

Response: Rain Bird has nothing to contribute on this subject.

Rationale: No further comments.

I. Water Droplet Size and Spray Pattern Section (Starting on page 15)

1. **Topic:** *"As noted in Table 2, standard sprinkler nozzles produce fine droplets (resembling mist) that can be blown by the wind and diverted from their intended destination. MSMT sprinkler nozzles have a spray pattern that creates larger droplets and reduces misting.[33] The spray pattern allows MSMT sprinkler nozzles to distribute water more evenly across the landscape despite their lower flow rate. The larger droplet size could also prevent water from being applied to undesirable areas, such as hardscapes, potentially decreasing the total water applied for irrigation."* (Page 15)

Comment: Given the substantial consequences of water droplet size in this context, Rain Bird would like to see the data which supports the claim that MSMT spray sprinkler nozzles have larger droplets and

reduce mist. Table 2 also claims that MSMT spray sprinkler nozzles also have larger water droplets at "high" pressure.

2. **Topic:** *"In contrast, MSMT sprinkler nozzles produce larger droplets that may be more resistant to wind, meaning that more of the water emitted is likely to travel to and be used by the plants for which it was intended, reducing the likelihood of brown spots."* (From Droplet size or spray pattern as Water Efficiency or Performance Criteria – Bottom of page 15)

Comment: Given the substantial consequences of water droplet size in this context, Rain Bird would like to see the data which supports the claim that MSMT spray sprinkler nozzles have larger droplets and have more wind resistance than other nozzles.

3. Topic: ***"WaterSense invites stakeholders to share data on droplet size and water efficiency, especially collected in accordance with ISO Standard 15886-2:2021. WaterSense welcomes feedback on whether stakeholders think droplet size should be included as a criterion in a WaterSense specification."*** (From Droplet size or spray pattern as Water Efficiency or Performance Criteria – top of page 16)

Response: Rain Bird believes that water droplet size distribution should be included as an element of the definition and testing protocol of spray sprinkler nozzle efficiency.

Rationale: An ANSI standard should be developed that defines spray sprinkler nozzle efficiency and specifies a testing protocol for measuring water droplet size. Research should be conducted to develop a water droplet size distribution coefficient to wind drift and evaporation losses in the field. Spray sprinkler nozzles could then be tested indoors to determine their water droplet size distribution performance and the losses due to wind drift and evaporation could be estimated using the coefficient. WaterSense (and others) could use results of this testing to set label performance specifications.

J. Possible Additional Criteria From Existing Standards Section (Starting on page 18)

1. **Topic:** ***"WaterSense welcomes stakeholder feedback on whether to require these sections of ASABE/ICC 802-2020 in a potential specification."*** (From Possible Additional Criteria From Existing Standards section on page 19)

Response: Rain Bird supports requirements of these sections of ASABE/ICC 802-2020.

Rationale: No further comment.

K. Existing Performance Data Section (Starting on page 19)

1. Topic: ***"WaterSense invites stakeholders to share any additional performance data on HES sprinkler nozzles."*** (From the Existing Performance Data section on page 20)

Response: Rain Bird has no data to share.

Rationale: No further comment.

L. Product Marking, Documentation, and Marketing Section (Starting on page 20)

1. Topic: ***"WaterSense invites stakeholder feedback on these proposed product marking and documentation requirements."*** (From the Product Marking, Documentation, and Marketing section on page 21)

Response: Rain Bird supports these requirements and recommends that WaterSense require spray sprinkler nozzles be installed on WaterSense labeled spray sprinkler bodies with the appropriate pressure regulator setting and with markings on the packaging indicating that the combination of products is required to satisfy the label requirements.

Rationale: No further comment.

M. Estimated Water Savings Section (Starting on page 21)

1. **Topic:** ***"WaterSense is interested in feedback from stakeholders on whether the estimated percentage of outdoor water used for spray irrigation is accurate, or whether spray irrigation typically accounts for more than 50 percent of outdoor water use in residential properties."*** (From the Estimated Water Savings section on page 22.)

Response: Rain Bird has no definitive data on this subject.

Rationale: The context of this question is not clear. Is WaterSense asking if spray irrigation from products that would be included in this draft specification represent 50% of all outdoor water use, all residential outdoor water use, all residential water use of irrigated homes, all residential water use of homes irrigated with underground irrigation systems or something else?

Regardless, it is Rain Bird's opinion based on the sales of spray sprinklers compared to all other forms of irrigation that the WaterSense estimate that 50% of outdoor water use is attributable to spray irrigation is very high when each device type's area of coverage is applied and totaled. This remains the case even when the context of the question is water use of residential underground irrigation systems, not all residential outdoor water use.
In addition, it should also be considered that fewer than 50% of homes in the US have underground irrigation systems. Many homes are irrigated with sprinklers attached to garden hoses which are dragged from place to place. Sprinklers on garden hoses are more likely to be something other than sprays. Many homes have no irrigation and are not irrigated by any means.

2. **Topic:** ***"WaterSense is interested in stakeholder feedback on spray sprinkler nozzle replacement behaviors. For example, do stakeholders typically replace nozzles after a designated period of time, or do they wait until they need to fix malfunctioning spray sprinkler nozzles in the event of a problem? Specifically, are there data indicating how long spray sprinkler nozzles are installed in the field before being replaced, and/or how long spray sprinkler nozzles typically last in residential settings?"*** (From the Estimated Water Savings section on page 22.)

Response: Rain Bird has only anecdotal evidence of how long Rain Bird products last in service or when users choose to replace nozzles. Rain Bird residential products are designed and tested to last about 7 years in the most extreme conditions expected.

Rationale: Product warranties are not a good indicator of product life. Warranties are marketing programs. For example, some products offer lifetime warranties. Those products are not expected to last 75+ years. Long duration warranties are many times meant to increase consumer confidence in the product's reliability. Rain Bird warranties are not equal to Rain Bird's opinion of expected life.

3. **Topic: "WaterSense is interested in feedback from water utilities on promoting WaterSense labeled HES sprinkler nozzles. In particular, WaterSense is curious whether water utilities have concerns about whether consumers with HES sprinkler nozzles could meet their irrigation needs with watering windows in place."** (From the Communicating Savings Section on page 23.)

Response: Lower application/precipitation rates increase the exposure time of water suspended in the air and subject to wind drift and evaporation losses. The ideal irrigation conditions water window is much smaller than most water windows imposed by water utilities.

Rationale: An irrigation zone with a lower application rate will take more time to apply the necessary amount of irrigation water compared to an irrigation zone with a higher application rate.

a. The time water is exposed to wind drift and evaporation is increased by a zone with a lower application rate. In other words, the same volume of water is suspended in the air twice as long in an irrigation zone with an application rate that is half that of another irrigation zone. Until more is known about the losses associated with wind drift and evaporation, the significance of this effect cannot be known. Rain Bird believes it is very significant.
b. Many areas of the country experience the least amount of wind in the early morning hours. Ideally, all irrigation would occur during this short time. Some low precipitation rate systems would more likely be operated for some portion of its total run time during less ideal wind conditions resulting in more losses.

G. Communicating Savings Section (Starting on page 22)

1. **Topic:** ***"WaterSense is interested in stakeholder feedback on suspected reasoning behind potential water savings, including any information on whether stakeholders change irrigation schedules after a retrofit. WaterSense invites stakeholder opinions on irrigation runtimes, including preferences for duration of irrigation."*** (From Communicating Savings section on page 23)

Response: The most likely source of potential water savings is appropriate management/operation of the irrigation system.

Rationale: A professional golfer was once quoted as having said that if you give him only a croquet mallet, he will beat any amateur using the best set of golf clubs ever made.
A similar statement could be made for irrigation. A knowledgeable irrigation manager will use less water and have better landscape performance on a mediocre irrigation system than the average user making irrigation scheduling decisions on a perfectly designed, installed, and maintained system. This is why the WaterSense decision to label weather-based irrigation controllers early in the program life was wise. Weather-based irrigation controllers reduce the need for a knowledgeable end-user through automation.

Response: RE: Preferences for duration of irrigation.
Rain Bird has only anecdotal information on user preferences of duration of irrigation.

Rationale: In Rain Bird's anecdotal experience, irrigation controller settings are highly variable.

Response: Rain Bird looks to the WaterSense program for product efficiency design criteria.

Rationale: It may be attractive to some to impose product restrictions (application rate) which cause the user to unknowingly use the product in a way that uses less water or cause conditions that many users or the community would find undesirable. However, this prescriptive approach (limiting application rate) does not promote efficient irrigation design or management practices. Manufacturers may be compelled by this proposed WaterSense prescriptive approach to ignore other elements of waste (wind drift and evaporation, deep percolation) to meet the WaterSense label specification. This prescriptive approach may stifle water efficiency innovation by de-emphasizing investment in the development of important criteria that would result in more efficient irrigation. Innovation and solutions that result in less water use would tend to have lower priority in product design investment decisions.

WaterSense should set a spray sprinkler nozzle efficiency performance threshold for the labeling of spray sprinkler nozzles rather than prescribe a product feature or application rate which is not an element of spray sprinkler nozzle efficiency.
The definition of spray sprinkler nozzle efficiency is not currently agreed upon in the landscape irrigation industry or among other stakeholders nor is there an agreed upon testing protocol for spray sprinkler nozzle efficiency. These should be in place before WaterSense finalizes this label specification.

Response: Other irrigation efficiency information should not be ignored.

Rationale: Information regarding the water droplet size performance of spray sprinkler nozzles has not been developed.

a. The correlation between water droplet size distribution of a nozzle and the resulting water loss due to wind drift and evaporation has not been developed.
b. If the application/precipitation rate of sprinklers were to be reduced to not exceed the infiltration rate of soils, runoff as a waste signal to the user, community and policing authorities would be eliminated. The irrigation systems scheduled to apply too much water would still result in waste. The waste would simply be undetectable due to deep percolation. Perhaps this deep percolation waste would be less than is the current amount of runoff waste. This is not known. However, deep percolation waste is much more difficult for the user, community, and policing authority to detect.
   It is also possible that waste would increase because those users who now respond to the runoff waste signal and adjust their irrigation schedule would no longer have a trigger.

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2. **Topic:** "Unfortunately, none of the savings studies discussed in Appendix A examined irrigation schedules before and after retrofits, so WaterSense cannot determine if water savings are due to lower flow rate alone, or if factors such as irrigation scheduling or other system adjustments impacted the results." (From the end of paragraph 3 on page 23)

Rationale: Rain Bird agrees that it is unfortunate that these studies did not tightly control several factors like irrigation schedules.

a. If the savings ARE due to the other factors cited in the quote, those savings may not be persistent. If the landscape begins to suffer due to the water losses cited above, users are likely to increase irrigation schedules. Users will tend to only change irrigation when the landscape suffers. This would result in users adding time to the irrigation schedule and tending not to reduce it when irrigation demand drops.
b. If the savings shown in Appendix A research are a result of the other factors, MSMT spray sprinkler nozzles should not be singled out as efficient while other efficient nozzles are excluded.
c. Perhaps if those other 'high efficiency' nozzles were the subject of rebates, they also would cause the same behaviors that resulted in lower water use.
d. Perhaps these "other factors" explain the results of the Sovocool (2014) study in which fan spray sprinkler nozzles were retrofitted with MSMT spray sprinkler nozzles under highly controlled conditions. The initial results showed the savings that were expected. However, a short time later, water use in the irrigation system increased back to the pre-study levels.
   i. Rain Bird had a conversation with Kent Sovocool shortly after this follow-up study was final.
   ii. It was confirmed that Mr. Sovocool had high faith that no errors were made in conditions and controls of the study. He was bewildered that initial savings were not persistent and water use reverted to pre-study levels.
   iii. It was suggested that other losses like wind drift and evaporation (which were not considered in the irrigation schedule development) resulted in inadequate landscape

irrigation. Perhaps users noticed the landscape suffering. Perhaps they increased the irrigation schedules until the landscape performance improved.

iv. Mr. Sovocool acknowledged that this could explain the results. We did NOT conclude that this IS what happened. We agreed that we DO NOT KNOW.

e. The source of savings reported in Appendix A research is not known and WaterSense should not base its WaterSense label specification on this research until more is known if the source of the savings is the MSMT spray sprinkler nozzle. WaterSense should not require low precipitation rate of nozzles to qualify for a WaterSense label before more is known about spray sprinkler nozzle efficiency and the drivers of water savings in some field applications. There is significant risk that WaterSense may be harming the overall efficiency of the product category if it continues its current path.

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3. **Topic: "WaterSense is interested in feedback from water utilities on promoting WaterSense labeled HES sprinkler nozzles. In particular, WaterSense is curious whether water utilities have concerns about whether consumers with HES sprinkler nozzles could meet their irrigation needs with watering windows in place."** (From the Communicating Savings Section on page 23.)

Response: Lower application/precipitation rates increase the exposure time of water suspended in the air and subject to wind drift and evaporation losses.

Rationale: An irrigation zone with a lower application rate will take more time to apply the necessary amount of irrigation water compared to an irrigation zone with a higher application rate.

a. The time water is exposed to wind drift and evaporation is increased by a zone with a lower application rate. In other words, the same volume of water is suspended in the air twice as long in an irrigation zone with an application rate that is half that of another irrigation zone. Until more is known about the losses associated with wind drift and evaporation, the significance of this effect cannot be known. Rain Bird believes it is very significant.

b. Many areas of the country experience the least amount of wind in the early morning hours. Ideally, all irrigation would occur during this short time. Some low precipitation rate systems would more likely be operated for some portion of its total run time during less ideal wind conditions resulting in more losses.

Rain Bird appreciates the opportunity to comment on the WaterSense Notice of Intent and looks forward to working collaboratively with US Environmental Protection Agency WaterSense Program and all other like-minded stakeholders in the development of the WaterSense Draft Specification for Spray Sprinkler Nozzles.

Commenter: Andrew Morris
Affiliation: Alliance for Water Efficiency
Comment Date: March 22, 2023

Email Text:

Dear WaterSense Staff,

Please find AWE's comments attached.

Thank you,

Andrew D. Morris| **Senior Manager of Policy and Programs**
Alliance for Water Efficiency
e: andrew@a4we.org
p: 770-906-1888
w: www.allianceforwaterefficiency.org
Join us for the AWE Symposium in Chicago! Aug 1-3, 2023.

Email Attachment:
See pages 49 through 50.

AWE Public Comment for Spray Sprinkler Nozzle NOI

Commenter Name: Ron Burke, President and CEO

Commenter Affiliation: Alliance for Water Efficiency (AWE)

Date of Comment Submission: March 22, 2023

Topic: General

Comment: AWE is supportive of WaterSense labeling for high-efficiency spray sprinkler nozzles.

Rationale: Given its recognition in the marketplace, a WaterSense label could indeed be an important distinguishing factor in creating utility incentive programs, designing landscape irrigation systems, and informing purchasing decisions.

Topic: Intended Scope of the Specification

Comment: AWE members had questions about whether the differences between standard spray sprinkler nozzles and multi-stream, multi-trajectory (MSMT) nozzles should be grouped together under a single specification or separated into two specifications.

Rationale: Separate definitions (or separate specifications) are needed because spray nozzles and MSMTs differ in terms of components, materials, price point, etc.

Topic: Whether water utilities have concerns about whether consumers with HES sprinkler nozzles could meet their irrigation needs with watering windows in place.

Comment: AWE's utility members do not generally anticipate issues with their customers being able to meet their irrigation needs during watering windows, whether in general or during drought. Utilities that understand the benefit of low-precipitation spray nozzles can adjust water window policies, if necessary. A malleable policy issue like watering windows shouldn't be a barrier to efficient irrigation technology nationally.

Rationale: In January 2020 AWE released a research report titled *Use and Effectiveness of Municipal Irrigation Restrictions During Drought*, and all the watering windows reviewed as part of this project focused on limiting landscape irrigation to certain specified day or days of the week. This reflects the general practice among utilities and states, which focus on day and time restrictions that still provide an adequate number of hours on designated watering day(s) for landscape irrigation. Common examples include limits like – before 9 a.m. or after 4 p.m., before 10 a.m. or after 7 p.m., etc. There are a few rare exceptions where utilities have limited run times to much narrower windows or even limited the run times for each zone of an irrigation system. These much narrower limits are not a best practice, and even some utilities imposing them seemed to recognize this by granting exceptions for landscape irrigation systems that could not function as designed under narrow limits.

Topic: Irrigation Runtimes and Duration of Irrigation

Comment: The specification should make it clear that run times should be evaluated when replacing traditional nozzles with HE or MSMT nozzles.

Rationale: Depending on the specifics of the landscape irrigation system and the landscapes being irrigated, evaluation is necessary to determine whether water savings can be achieved by replacing traditional nozzles with HE or MSMT nozzles or whether it will merely increase runtimes. Water savings can be more predictably achieved when designing new landscape irrigation systems with HE or MSMT nozzles from the start.

Commenter: Ryan Moore
Affiliation: New York State Energy Research and Development Authority (NYSERDA)
Comment Date: March 23, 2023

Email Text:

To whom it may concern,
Please find attached NYSERDA comments on Watersense's Notice of Intent (NOI) to develop a Draft Specification for Spray Sprinkler Nozzles. Thank you for the opportunity to weigh-in on this NOI. Any questions or concerns, please email or call me at the number below.
Thanks again,
Ryan

Ryan Moore
Project Manager
Codes, Products, and Standards

NYSERDA
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nyserda.ny.gov
follow : friend : connect with NYSERDA

Email Attachment:
See page 52.

Commenter Name: Chris Corcoran

Commenter Affiliation: New York State Energy Research and Development Authority (NYSERDA)

Date of Comment Submission: March 23, 2023

Topic: General Support

Comment: NYSERDA appreciates the opportunity to submit comments to WaterSense on the Spray Sprinkler Nozzle Notice of Intent to develop a Draft Specification. NYSERDA's mission is to advance clean energy innovation and investments to combat climate change, improving the health, resiliency, and prosperity of New Yorkers and delivering benefits equitably to all. NYSERDA is strongly supportive of WaterSense developing a new specification for this product category. New York has recently established appliance standards that include Spray Sprinkler Bodies referencing the WaterSense specification; NYSERDA looks to the WaterSense program to help establish meaningful opportunities for water savings. A specification for Spray Sprinkler Nozzles is expected to lead to water and associated bill savings for New Yorkers. Please do not hesitate to reach out with any questions. Thank you.

Rationale: N/A

Suggested Change (or Language): N/A

Commenter: Tres Wangsgaard
Affiliation: Orbit Irrigation, LLC / Hydro-Rain
Comment Date: March 23, 2023

Email Text:

Hi WaterSense,

Please find attached our comments on the NOI to Develop a draft standard for Spray Sprinkler Nozzles.

Thanks,
Tres Wangsgaard (CLIA, CIC, CWCM-L)
Global Director of Product Development Engineering
Orbit Irrigation Products / Hydro-Rain

Elven Webb (CLIA, CIC, CIT)
Product Line Manager – Heads
Orbit Irrigation Products / Hydro-Rain

Email Attachment:
See pages 54 through 58.

Commenter Names: Elven Webb(CLIA, CIC, CIT), Tres Wangsgaard (CLIA, CIC, CWCM-L)
Commenter Affiliation: Orbit Irrigation, LLC / Hydro-Rain
Date of Comment Submission: 3/23/2023

Topic: NOI for Spray Sprinkler Nozzles
Comment: We applaud the 2017 specification for Landscape Irrigation Sprinklers, ensuring that spray sprinklers are operating at their optimum pressure range results in real water savings. Over-pressurized sprinkler systems with the new compliant pressure regulating heads will no longer waste water as it blows away as mist in the wind. That said, we have several concerns about the new proposed standard for nozzle efficiency. If nozzles are not used at the optimum pressure range, OR not used in a sprinkler system with proper spacing for a particular nozzle, we are going to be advertising an efficiency that will not be realized in application. This would be particularly true in nozzle retro-fit situations where moving individual heads to be optimally spaced will likely neither be apparent to or understood by the end user. How will that be communicated effectively so as not to mislead the end user? (That pressure range and system design are as important or more important than "nozzle efficiency"?).
Rationale: DU is a measure of **system efficiency**, **not nozzle efficiency**. As we read this proposed draft specification, we fully understand the intent and agree that in an ideal world where everyone is a certified irrigation contractor, it could work. But as written, it will be likely be misused to oversimplify efficiency, and the end goal of water savings will not be realized. Car mileage efficiency makes sense as a comparative expectation of gas mileage between vehicle models. If you are driving uphill or against a headwind, you are not going to achieve the mileage efficiency advertised, but every vehicle should have a proportional decrease in efficiency to those outside factors, but note that a car is a complete system. The draft standard is proposing to assign blanket efficiency ratings to a single component of a system. When the water savings will require that the whole system be run at optimal conditions.
The auto industry does not advertise a miles per gallon ratings for car tires. The petroleum industry does not advertise a miles per gallon rating for gasoline.
Irrigation system efficiency (DU) depends at least as much upon the optimum system design and operating conditons as it does any idealized individual component efficiency. We feel that putting an efficiency number (DU) rating on a component is going to mislead the end user that they are saving water. This standard would also result in water districts into offering incentives and legislative bodies creating legislation for water savings that a nozzle alone cannot deliver.
Suggested Change: WaterSense approved nozzles should require at a minimum labeling the head prominently with the radius of spray range (for head to head spacing) and optimum recommended pressure range for which the nozzle meets the distribution uniformity requirements for WaterSense efficiency "compliance"… something like that. Given that this draft standard is targeting a 10% reduction in water usage across sprays, and sprays are assumed to be 50% of sprinkler system distribution, isn't this a lot of effort to save, at 100% implementation, a 5% savings in residential irrigation water. We think that the expansion of smart timer conversion incentives and pressure regulated spray body incentives would result in much greater net water savings than a nozzle efficiency standard.

Topic: MSMT nozzle patents
Comment: Multiple utility patents appear to limit manufacturers from making MSMT nozzles. Developing a specification for spray sprinkler nozzles would likely result in legislation that would benefit a few companies and effectively lock others out of the spray nozzle market.
Rationale: There are a number of patents on MSMT and other HES nozzles.
Suggested Change: Do not offer WaterSense certification to strip nozzles (square or rectangular pattern MSMT nozzles that have essentially locked everyone but Hunter out of the strip nozzle market). So as not to create a monopoly in states that turn this standard into legislation.

Topic: Precipitation Rates and water conservation efforts
Comment: MSMT and HES **s**pray nozzles don't work well with non-potable water. This will require manufacturers to effectively communicate their recommendations for where it is best to use MSMT and HES nozzles and installation instructions.
Rationale: MSMT and HES nozzles require filtering on a finer scale. With non-potable water, more filtration than the nozzle alone can supply. Or frequent filter cleaning.
Suggested Change: manufacturers should be required to communicate best practices in their instructions and product information so that the communicated savings are accurate.

Topic: Matched Precipitation Rates (MPR)
Comment: Communicating savings will be problematic from one family of nozzles to another.
Rationale: The MPR of nozzles exists within families of nozzles (Families: adjustable, fixed, MSMT, and HES) but not across manufacturers' whole product lines. When defining MPR, is it possible to say to the consumer that the adjustable nozzles all have a similar precipitation rate, fixed spray nozzles all have a separate precipitation rate, and MSMT/HES nozzles have a different precipitation rate, without mixing families and still get an efficiently watered lawn with good plant health?
Suggested Change: Manufacturers must clearly state which nozzles they recommend grouping together for MPR.

Topic: Matched precipitation rate.
Comment: MPR is not possible across the whole adjustable nozzle family.
Rationale: Every manufacturer has outliers in their nozzle families that cannot get matched precipitation rate. The consumer may feel that they need to get a four-foot, or eighteen-foot adjustable nozzle to fit their landscape's needs. The apertures in those nozzles are impossible to match with other distances in the family.
Suggested Change: manufacturers cannot claim MPR across the adjustable (not MSMT) family.

Topic: Distance of Throw and Precipitation rates.
Comment: We agree that the distance of the throw needs to meet a standard that the whole industry can agree on. ASAE S398.1 sets a reasonable standard. Interpolation of that data may produce some interesting results.
Rationale: All manufacturers have published performance charts of their nozzles. The interpolation of current data has resulted in performance charts that look more mathematically precise than the real-world results, i.e., the quarter pattern nozzle has one-fourth of the GPM and PR of the 360-degree nozzle at the same distance and pressure. That belies the actual data. The pattern that water sprays out of fixed nozzles does not allow for such mathematically precise results. Will manufacturers agree to publish the real numbers? Will "Interpolation of data" allow them to continue the current trend? Does that enable proper communication of savings if the performance data is not precise?
Suggested Change: Proper interpolation of data must be defined. Also precipitation rates probably shouldn't be a requirement of HES nozzles when breaking the watering cycle into cycle and soak intervals, done automatically on smart timers when the correct data is supplied to the timer, can be used as an alternative method to ultra-low precipitation rates.

Topic: Existing Performance Data
Comment: We have a concern about the Existing Performance data and Dr. Duke's research.
Rationale: The math used to get to the results of the graph on page nineteen in the NOI needs to be reexamined. Dr. Duke shows a chart suggesting that HES nozzles have a more consistent flow rate across a pressure range than non-HES nozzles. However, to illustrate his point he increases the pressure range and therefore the variability of the non-HES nozzles (testing from 30psi to 85psi) across a 55psi range, while the HES nozzles are tested across a 40psi pressure range (45psi to 85psi). While I think that we can all agree that slower precipitation rates on slopes or high clay content soils can reduce runoff in higher clay content soil types, here are other methods to accomplish the same effect with smart timers that will automatically break zone run times into several cycle and soak watering periods, without requiring ultra low precipitation rates.
Suggested Change: The math used in this justification of "consistency" is flawed on several fronts. You can't draw conclusions on "flow rate consistency" from a study where HES nozzle test pressures were increased by 89% and the non-HES test samples were tested at pressures which varied 183% (pressure variation on the non HES group was over double the increase of the HES sample group). I've heard the excuse that suggested operating pressure of 30psi for standard spray nozzles and 45 psi for MSMT nozzles was the rationale, but show me where anyone has suggested that 85psi is suggested operating pressure for non-HES nozzles. Also it was suggested that this flow rate consistency data demonstrated a pseudo-pressure regulation that isn't there, and it's clearly not. It's mathematical smoke and mirrors.

Topic: Existing Performance Data : Water Savings Potential Even Higher for Retrofits
Comment: Not likely. Head to head watering is generally how spray nozzles are designed to water most efficiently. There is absolutely zero data or even plausible rationale offered in this draft for suggesting that substituting MSMT nozzles (with an effective watering radius of 1.5x or 2x that of a standard nozzle) into an existing sprinkler system will result in more water savings.
Rationale: MSMT nozzles are designed to be most efficient when operated at head to head coverage for the rated radius of throw and suggested pressure range. Placing MSMT nozzles into an existing system designed with nozzles with a shorter radius of throw is not optimal nor is there any reason to think that it would result in larger water savings. If head to head spacing is optimal by design, less than head to head spacing is going to result in a lower DU and most likely overspray onto surfaces that you do not want watered.
Suggested Change: As recommended earlier it needs to be made very clear that the efficiencies advertised will not be realized unless system layout is taken into account. We pointed out earlier in this response that there is a huge potential for people to misinterpret a component efficiency rating to be a system efficiency rating and this draft standard is implying if not directly stating this fallacy in the last paragraph of Section V. Existing Performance Data. These nozzles are manufactured to have a lower DU, but that uniformity requires the nozzles to be placed in a sprinkler system with the spacing for which they were designed.

Topic: Product Marking, Documentation, and Marketing
Comment: We don't agree with a published DU or DULQ. Any testing or manufacturing is subject to error, variation, manipulation, embellishment, etc…
Rationale: The nozzle data published currently by two of the largest manufacturer's is highly massaged, admittedly so in one case, and verified by testing in both cases. So why will this be any different.
Suggested Change: Establish a minimum to meet the efficiency standard and eliminate the marketing eventuality to embellish the advertised DU numbers. We agree with the recommendation that WaterSense recommends using the sprinkler spray nozzles on a watersense compliant pressure regulated spray body. It makes sense to ensure the nozzle is operating at its prescribed pressure range.

Topic: Estimated Water Savings
Comment: Targeting 10% water savings with the assumption that sprays constitute 50% of residential watering… so (upon 100% conversion to HES nozzles) we're only saving 5% of residential watering? Again it seems like effort and money would be better spent incentivizing PR bodies and Smart Timers over this proposed standard. Also we again take issue with the statement that greater savings would be realized from installing HES nozzles in retrofit systems, based on what data? Assumptions? etc.??
Rationale: Smart timers have the capability to adjust watering schedules to more closely match local evapotranspiration conditions and only apply the water needed by the landscape. Pressure regulated heads can ensure nozzles are watering with less misting and more water makes it to the intended surface. WaterSense and the EPA should spend their time and money on efforts that will best preserve our water resources, and this standard would seem to be a lot of effort for very little increased water savings. The smart rain delay feature alone on smart timers will save far more water than nozzle efficiency, not to mention cycle & soak, as well as matching watering cycles with local evapotranspiration data.
Suggested Change: Pour more resources into smart timer conversions where the most savings can be realized with the least effort. Changing out a timer is way easier than spray bodies or nozzles, and saves more water. Once smart timers are the norm, then it makes more sense to start chasing the lesser methods of water savings. Also nobody is checking expiration dates on their nozzles, they replace them when they stop working (on MSMT nozzles the grease speed governor) stops working and the nozzle radius decreases significantly.

Topic: Communicating Savings
Comment: We think paragraph 5 of Section VIII is a pretty good summation of why this standard should be studied further before continuing forward.
Rationale: More study is needed in order to suggest run time reduction with regard to precipitation rate, runtime changes due to reduced runoff/ better absorption into the soil. Study the real water savings of systems installed in ideal conditions, Study the alleged "increased savings" in retrofit applications, study the relationships between soil intake rates and HES applications rates to determine how critical application rate actually is. We have heard several people say that they gave up on MSMT nozzles because they feel like they have to water too long so they didn't feel like they saved any water.
Suggested Change: Fund additional research into the actual water savings to be realized by HES/MSMT nozzles. This draft standard mentions several places that studies have not shown the nozzles to save water…why move forward with a standard before you have data to show it will make a difference? We would hate to see water districts spend their limited incentive money on replacing nozzles when the money would be better spent on the two previous better studied water saving products (Smart timers / Pressure Regulating Spray bodies)

Commenter: Nathan Bowen
Affiliation: Irrigation Association
Comment Date: April 5, 2023

Email Text:

Attached please find comments submitted on behalf of the Irrigation Association in response to the EPA WaterSense NOI for Spray Sprinkler Nozzles.

Regards,

Nathan Bowen
Advocacy Director
Irrigation Association
8280 Willow Oaks Corporate Drive, Suite 630 | Fairfax, VA 22031
C: 202-209-9091 | F: 703.536.7019
nathanbowen@irrigation.org | www.irrigation.org

Email Attachment:
See pages 60 through 61.

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www.irrigation.org

April 5, 2023

U.S. Environmental Protection Agency
WaterSense Program
1200 Pennsylvania Avenue NW
Washington, DC 20004

Re: WaterSense Notice of Intent to Develop a Draft Specification for Spray Sprinkler Nozzles

To whom it may concern:

On behalf of the Irrigation Association, we appreciate the opportunity to provide the following comments in response to the Environmental Protection Agency WaterSense program's *Notice of Intent (NOI) to Develop a Draft Specification for Spray Sprinkler Nozzles.*

The IA represents over 1,200 member companies including irrigation equipment and system manufacturers, dealers, distributors, designers, consultants, contractors and end users. We are committed to transforming humanity's stewardship and use of water, enabling the long-term sustainability of the planet's water and natural resources, and improving the quality of life through a reliable global food supply and vital green spaces.

We support the goals and objectives of the WaterSense program, and we are committed to working with EPA and WaterSense to ensure workable specifications for the industry, communities, utilities and ultimately consumers. As many utilities are already rebating a variety of "high efficiency" nozzle products, we understand the value of and need for a WaterSense specification, and we stand ready to assist in the development of such a specification.

We also note that additional work is needed to build consensus on the scope of such a specification. **Because of this, we recommend — and are committed to initiating — the development of a voluntary, consensus-based American National Standards Institute standard that defines spray nozzles efficiency that could then be used as a basis for a WaterSense specification.** The standard development process would forge consensus and help resolve issues IA members have raised in their individual comments on this NOI.

To this end, we are prepared to engage with an organization such as the American Society of Agricultural and Biological Engineers to facilitate the development of such a standard. Further, we

recognize this recommendation requires a commitment of time and resources on the part of the IA, and we are prepared to bring such a process to a successful conclusion.

Finally, we note that it will be critical, either through the standard-setting process or subsequent specification development, to address how a specification for spray sprinkler nozzles interfaces with other WaterSense specifications (i.e., irrigation controllers and spray sprinkler bodies).

We appreciate the opportunity to provide this input and look forward to continuing to engage with WaterSense throughout this process. Please contact IA Advocacy Director Nathan Bowen (nathanbowen@irrigation.org) with any questions.

Sincerely,

Natasha L Rankin, MBA, CAE
Chief Executive Officer

Commenter: Eric S. Neustrup
Affiliation: City of Bozeman's Water Conservation Division
Comment Date: April 5, 2023

Email Text:

These comments on the proposed standards were prepared by Eric Neustrup on behalf of the City of Bozeman's Water Conservation Division. If any explanation of clarification if necessary please reach out for further comment.

Eric S Neustrup | Water Conservation Specialist
City of Bozeman | 7 E Beall St. Suite 100 | Bozeman MT
P: 4065777400
Nothing in the world is more flexible and yielding than water. Yet when it attacks the firm and the strong none can withstand it, because they have no way to change it. So the flexible overcome the adamant, the yielding overcome the forceful. Lao Tzu

Email Attachment:
See pages 63 through 67.

- ***WaterSense would like stakeholder input on its product category definition of "spray." sprinkler nozzle.***

The two-part definition making the nozzle a distinct component from the body is very useful since the two components accomplish different tasks in most cases. The sprinkler body is typically responsible for the pressure regulation aspect of efficient irrigation, while the nozzle dictates the throw and overall area to be watered.

- ***WaterSense would like stakeholder feedback on the intended scope of the specification.***

The currently intended scope of the specification is useful in that it creates standards where there previously were not any. I would suggest expanding the scope of WaterSense labeling to include all products noted within the flow chart explaining the current scope (Figure 4). Having similar standards for rotor sprinklers and valves in head sprinklers would be highly beneficial in the future, as many of these products are useful when irrigating larger areas such as sports fields. I would emphasize the need to create similar standards around pressure regulating valves in head sprinklers in particular because many of these products represent so-called digital sprinklers that have the potential to drastically reduce water use in residential irrigation systems, which represent some of the largest shares of nonfunctional turf grass in the country.

- ***WaterSense is seeking stakeholder feedback on its proposal to use application rates (at recommended operating pressure and high pressure) as a water efficiency criterion for spray sprinkler nozzles. WaterSense is also interested in whether any manufacturers currently use the ASABE/ICC 802-2020 test method for application rate it and, if so, would be willing to share masked data with WaterSense.***

The use of application rate as an indicator of a component's ability to conserve water is a very good starting point. The NOI document lays out several reasons for this, all of which I agree with. There is an additional reason for considering a lower application rate to be more water conservative, though, and that is the ability to be more specific with the amount of water that is applied. With many existing spray nozzles, it is hard to put down a smaller amount of water due to the high precipitation rates; having spray nozzles with a lower application rate makes it easier for homeowners and water managers to tailor the water needs of specific areas.

- ***Additionally, WaterSense requests stakeholder opinions on using the following parameters to evaluate spray sprinkler nozzles:***

o Test each radius in a model's product family at the full circle pattern only; and

o Test models with an adjustable radius at the maximum radius.

Testing only the full circle pattern is a good starting point. It would probably require too much effort on the part of manufacturers to test every pattern in every radius, so limiting testing to just the full circle is a good way of making sure there is data available on a large

number of products. I would, however, say it is more important to test both the minimum and maximum radius for products that have an adjustable radius. I would also recommend including a standard that specifies a maximum deviation between the application rates for the minimum and maximum radius.

- ***WaterSense seeks input on whether it should require spray sprinkler nozzles to have matched precipitation to be eligible for the WaterSense label. What would be an acceptable variance in application rates to ensure matched precipitation? If WaterSense requires matched precipitation, how should EPA verify the data?***

Matched precipitation is a key component of making sure an irrigation system is able to conserve water. Making sure that the coverage over a given area is as even as possible allows for less wasted water while ensuring that the areas with the least amount of coverage receive the proper amount of water. By evening out the coverage, less water will be applied to the areas with the most overlaid coverage, while making sure that areas with less overlaid coverage receive what they need.

- ***WaterSense is interested in feedback from irrigation contractors about whether they are likely to incorporate HES sprinkler nozzles in bids for new irrigation systems, any factors that might influence their decision (i.e., new installation vs. retrofit), and whether HES sprinklers reduce the cost of materials in practice.***

Many irrigation contractors will not look at using less materials as a natural benefit, as materials are a significant source of profit on most projects. Overall, it is a benefit to use less plastic that is buried in the ground and unlikely to ever be removed. Retrofitting systems to include new HES nozzles does pose issues in terms of matching the spray patterns between the HES and traditional spray nozzles because traditional spray nozzles can have throw distances as short as 4’. In this situation, capping heads off can help make the system more efficient, but it is not likely to make the retrofitted system as efficient as a system that has been installed correctly from the beginning.

- ***WaterSense seeks stakeholder feedback on whether ASAE/ASABE S398.1 is an appropriate test method for distance of throw.***

Testing the throw radius under minimum, suggested, and maximum operating pressures would be the most useful way of accomplishing this. Most of these nozzles are likely to be installed on sprinkler bodies that are outfitted with a pressure-regulating component, meaning it is not necessary to make sure that the differences in performance at different pressures are minimal. Testing at different pressures is mostly meant to help inform decisions when an existing system is being retrofitted. In those situations, it could influence a contractor to select the nozzle that is most likely to perform properly in a given situation.

- ***Do stakeholders believe it is reasonable for WaterSense to require the tested distance of throw to align with the value reported by the manufacturer? WaterSense is also interested in stakeholder input on the appropriate percent exceedance (e.g., percentage greater than the rated distance of throw) to prevent water waste due to overspray.***

Manufacturer-reported specifications should be required to align with the third-party testing of the sprinkler components in general. Making sure that the information displayed to homeowners is correct will ensure that in the majority of situations (when homeowners work on their own systems), head-to-head coverage is more easily attained.

- ***WaterSense would like stakeholder input on whether DU should be used in a specification to establish a minimum level of performance or used to differentiate HES and standard spray sprinkler nozzles.***

DU is similar to matched precipitation in that both together create even coverage of a given area. DU is arguably more important than matched precipitation because it represents real-world data about how effective a given group of sprinklers is. I would suggest incorporating DU as part of the WaterSense standard.

- ***WaterSense invites stakeholders to share data on droplet size and water efficiency, especially that collected in accordance with ISO Standard 15886-2:2021. WaterSense welcomes feedback on whether stakeholders think droplet size should be included as a criterion in a WaterSense specification.***

Of all the components of the proposed standard, this seems like the one that is least effective in ensuring that a sprinkler system is not using excessive water. In situations with high winds, I would suggest that it is more important to have a controller that can suspend watering during high wind events. While increasing droplet size can help achieve efficiency in low wind situations, my experience in the field shows that it has little effect in high wind situations.

- ***WaterSense welcomes stakeholder feedback on whether to require the listed sections of ASABE/ICC 802-2020 in a potential specification.***

I would suggest including the following parts of ASABE/ICC 802-2020 as part of the proposed standard: 302.1, 302.2, 302.4, 302.5, 304.1.1, 304.1.2, 304.1.4, 304.1.5, 304.1.6, 304.2 These standards would have the most impact in real-world landscape situations. Making sure that sprinkler components are properly labeled, standardized, and easy to work on helps ensure that the inevitable breaks that do occur can be dealt with in a more efficient manner.

- ***WaterSense invites stakeholder feedback on the proposed product marking and documentation requirements.***

The clear marking and documentation of sprinkler components in the field will have significant impacts in terms of simplifying the repair process. Being able to easily identify the components that need to be replaced will make getting systems back in working order much simpler than it currently is.

- ***WaterSense is interested in feedback from stakeholders on whether the estimated percentage of outdoor water used for spray irrigation is accurate or whether spray irrigation typically accounts for more than 50 percent of outdoor water use in residential properties.***

The water savings from MSMT nozzles outlined on page 21 of the NOI document (10% water savings) is likely accurate. However, combining HES nozzles with other components like smart controllers should allow for water savings that are greater than what each individual component allows for. Being able to effectively make use of nozzles that apply water in a more efficient manner will work best when managed by a controller that can take the local weather conditions and site conditions into account.

- ***WaterSense is interested in stakeholder feedback on spray sprinkler nozzles and replacement behaviors. For example, do stakeholders typically replace nozzles after a designated period of time, or do they wait until they need to fix malfunctioning spray sprinkler nozzles in the event of a problem? Specifically, are there data indicating how long spray sprinkler nozzles are installed in the field before being replaced and/or how long spray sprinkler nozzles typically last in residential settings?***

I am not aware of any data examining how long spray sprinkler nozzles typically operate for or last in real-world situations. From my experience, MSMT nozzles have a shorter lifespan than traditional spray nozzles because they have more moving parts and smaller channels that the water moves through. This means there are more parts to break, and it is easier for MSMT nozzles to get clogged. Typically, nozzles are only replaced when they are broken. I have never come across a situation where all nozzles were replaced on a regular schedule. Most systems will include areas that are subject to more wear and tear on certain components than others. Boulevard strips are a great example of this. Boulevard strips are subject to lots of wear and tear from both people, vehicles, and (in colder climates) snow plowing and storage. As such, sprinklers in those areas will break more often than ones in the middle of a lawn area. Replacing components as they break prevents wasting components that may still have significant life left in them.

- ***WaterSense is interested in stakeholder feedback on the suspected reasoning behind potential water savings, including any information on whether stakeholders change irrigation schedules after a retrofit. WaterSense invites stakeholder opinions on irrigation runtimes, including preferences for irrigation duration.***

Most individuals are aware that MSMT nozzles are fundamentally different from traditional spray nozzles and adjust their run time to compensate for the new components. The water savings from MSMT nozzles are likely a side effect of the nozzles making the homeowners more aware of their irrigation system and water usage. When a system is retrofitted, it encourages homeowners to think more about their irrigation system, which is often an out-of-sight, out-of-mind component of a home. When homeowners invest their time and money in efficiency upgrades to their system and see it in action, they are more interested in managing it in an efficient manner.

- ***WaterSense is interested in feedback from water utilities on promoting WaterSense-labeled HES sprinkler nozzles. In particular, WaterSense is curious whether water utility companies have concerns about whether consumers with HES sprinkler nozzles could meet their irrigation needs with watering windows in place.***

Due to the size of most residential yards, it is unlikely that switching to MSMT nozzles will cause issues with watering their landscape within a limited time period. Most watering windows enforced by water utilities cover the entire night and range from eight to fourteen hours, depending on several factors. In a situation in which the presence of MSMT nozzles results in a longer run time for a large system that exceeds the allowable watering window set in place by the utility, the utility may allow for exemptions or relaxations to the established watering window. This can be done by allowing the system manger/owner to water one more day per week, while staying within the allowed watering window, or in some cases, by exceeding the window itself. In order to ensure that the system is not over-watering the landscape, the system manager/owner may be required to provide a watering schedule to the utility demonstrating that the proposed watering schedule is appropriate for the landscape. From a water conservation standpoint, many utilities would prefer to make these exceptions and accommodate those with large systems, than encourage the installation of less efficient nozzles with higher precipitation rates.

Commenter: Chris Davey
Affiliation: The Toro Company
Comment Date: April 7, 2023

Email Text:

Hi Joanna:

Please find attached – Toro WaterSense SSN-NOI Official Comments.

Chris Davey
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See page 69.

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RIVERSIDE, CA (April 3, 2023) – Official Comments to the WaterSense® Notice of Intent (NOI) to Develop a Draft Specification for Spray Sprinkler Nozzles.

The Toro Company is a leading manufacturer and supplier of irrigation products and services and we are dedicated to being responsible stewards of water. We appreciate the opportunity to comment herein and support the EPA WaterSense Program, its objectives and goals, and are committed to work together with WaterSense and industry colleagues in developing a Draft Specification for Spray Sprinkler Nozzles.

As it relates to the NOI's Scope – Existing spray sprinkler nozzles available today vary widely in performance, and for good reason, so defining a measurement metric for 'high efficiency' nozzles that delineates them from other nozzles should be determined first. This metric could include common performance measures defined by Distribution Uniformity (DU), Precipitation Rate and other metrics. To that end, we have considered the very broad application of Spray Sprinkler Nozzles installed in North America and firmly believe the Irrigation industry must first work together on the development of an industry-led, consensus-based standard that defines spray sprinkler nozzle efficiency.

A Spray Sprinkler Nozzle specification is more complex than former standards like Pressure Regulated Spray Bodies, Soil Moisture Sensors, Controllers and others (ICC 802) and adding a spray sprinkler nozzle specification could affect these existing specs. The Irrigation Association (IA) has already expressed its willingness to represent the Industry and collaborate with an organization such as American Society of Agricultural and Biological Engineers (ASABE) or other agency to facilitate the development of such a standard that could then be used as a basis for a WaterSense 'Efficient Spray Sprinkler Nozzle' specification. Toro will participate in developing a standard along with other irrigation industry constituents (manufacturers).

Toro fully realizes that an effort to develop such a standard will take time, but would like to note there is little existing data defining 'irrigation efficiency'. Some current data exists around AB1881 and the Model Water Efficient Landscape Ordinance (MWELO) as well as some metrics developed by the Center for Irrigation Technology (CIT). This existing data is useful, but is insufficient in defining many of the elements in the NOI Scope. Toro has already provided detailed reports, data and studies to ERG on this along with other supporting information. Toro stands ready to continue our involvement in supporting a Draft Specification for Spray Sprinkler Nozzles and looks forward to further engagement with our industry partners, WaterSense, ERG, the Irrigation Association and others. Thank You!

Commenter: Kris Loomis
Affiliation: Sonoma County Water Agency
Comment Date: April 7, 2023

Email Text:

Thank you for the opportunity to provide feedback for the WaterSense Draft Specification for Spray Sprinkler Nozzles. We appreciate your continued commitment to the efficient use of water indoors and in the landscape. We are proud partners and appreciate the opportunity to collaborate on this project. Please find our comments attached.

Sincerely,

Kris Loomis || Sonoma Water
QWEL/CLIA/CID
Water Use Efficiency
Senior Programs Specialist
~~P: (707) 524-1165~~
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Mon - Thurs 7am - 5:30pm

Email Attachment:
See pages 71 through 76.

Sonoma Water

April 6, 2023

RE: Comments from Sonoma County Water Agency Regarding WaterSense® Notice of Intent to Develop a Draft Specification for Spray Sprinkler Nozzles

Commenter Name: Kris Loomis CID, CLIA, QWEL
Commenter Affiliation: Sonoma County Water Agency
Date of Comment Submission: 4/6/2023

Topic: Section II Technical Background
Sprinkler definition missing shrub adapter option

Comment: NOI pages 3-5 Definitions
In the document, there is no definition to include or exclude spray nozzle shrub adapters from the various types of sprinklers or sprinkler bodies. Shrub adapters can be used in place of a standard sprinkler body to attach a spray sprinkler standard nozzle, high-efficiency spray (HES) sprinkler nozzle, or multi stream-multi trajectory nozzle (MSMT). The use of shrub adapters should be a consideration during this process. Shrub head adapters are available in various thread patterns to accommodate different brand nozzles. There are options for integrated pressure regulation as well as models that do not have a pressure regulation feature.

Rationale: Eliminating or excluding shrub head adapters from the specification for spray sprinklers may have unintended consequences.

Suggested Change (or Language): Include the definition of a shrub adapter in the language of the document so it is clear whether the use of a shrub adapter in lieu of a standard sprinkler spray body is included or excluded from the specification when using the term “spray sprinkler body”.

Topic: Section IV Water Efficiency and Performance
Page 8 refers to “Nozzles with lower application rates are considered more efficient, as they allow more water to percolate into the soil rather than flow offsite as runoff”. In the context the statement is being used, it implies that nozzles with lower application rates in general are considered more efficient, however the reference used (17 Baum-Haley. 2014. *Op. cit*.) refers specifically to MSMT and Precision nozzles.

Comment: It should be restated that the context is specific to MSMT and Precision nozzles and not all low flow/low precipitation rate (PR) nozzles.
Rationale: Nozzles that are low flow/low PR but produce small droplets are likely to have a much lower efficiency than those with a larger droplet size.

Suggested Change (or Language): Rephrase the paragraph for clarity

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Topic: Section IV Water Efficiency and Performance
Pages 9-10 Feedback on proposal to use application rate (at recommended operating pressure and high pressure) as a water efficiency criterion for spray sprinkler nozzles.

Comment: It would be interesting to see the variation in performance data between pressure regulated and non-pressure regulated MSMTs at full radius ***and*** reduced radius. There is value to see the application rate variance between regulated and unregulated nozzle performance but it's also important to consider the consequence of pressure when adjustments to the radius are needed.

Rationale: It can be difficult to adjust the radius of MSMTs when the dynamic psi is higher than the manufacturer's recommended psi. When adjusting the radius with a pressure regulated sprinkler body, the radius is more likely to reduce than if using a sprinkler body that is unregulated and the psi is greater than the recommended psi. If the radius of an unregulated sprinkler body is unable to be reduced as needed, it may result in overspray and subsequent runoff due to the inability to reduce the radius as needed.

An additional consideration is due to the likely low PR of the MSMT, run times are typically longer which means when an MSMT has overspray, it is likely happening for an extended period of time.

Suggested Change (or Language): Consider testing MSMT nozzles regulated and unregulated at full radius *and* with a reduced radius. Industry standard calls for radius reduction of no greater than 25% so it is reasonable to test using this criteria.
You may want to ask Dr. Duke if there is any data available on the performance of MSMTs under unregulated psi, and reduced radius nozzles.

Topic: Section IV Water Efficiency and Performance
Page 10, Input on requiring spray sprinkler nozzles to have matched precipitation to be eligible for the WaterSense label.

Comment: Matched precipitation across nozzle series (same radius) within a hydrozone is key to having an efficient DU.

Further, in California, new development landscapes must comply with the Model Water Efficient Landscape Ordinance (MWELO) which states:
492.7 (M) *All irrigation emission devices must meet the requirements set in the American National Standards Institute (ANSI) standard, American Society of Agricultural and Biological Engineers'/International Code Council's (ASABE/ICC) 802-2014 "Landscape Irrigation Sprinkler and Emitter Standard, All sprinkler heads installed in the landscape must document a distribution uniformity low quarter of 0.65 or higher using the protocol defined in ASABE/ICC 802-2014*The ordinance also specifies that*:*
492.7 (P) Sprinkler heads and other emission devices shall have matched precipitation rates, unless otherwise directed by the manufacturer's recommendations.

Rationale: Without matched precipitation, areas that share the same hydrozone will have varying precipitation rates which will result in a lower DU and longer irrigation run times. The end result is high water use to maintain the appearance of the landscape.
By requiring matched precipitation for Spray Sprinkler Specification, it helps designers, installers and utilities by providing clear, specific guidance towards qualified equipment.

Further, the California State Water Board is developing a new regulatory framework to phase in outdoor residential standards for urban water utilities that will require all residential and commercial, industrial,

and institutional (CII) outdoor water use to be limited to 80% of ETo through 2030. This will be reduced to 63% from 2030 through 2035. Beyond 2035 standards are proposed to be 55% for residential and 45% for CII. The 2035 reductions match the current standards for new landscapes under MWELO.

While reducing outdoor landscape water use cannot be achieved by irrigation efficiency alone, having products that perform at a higher efficiency will provide a step in the right direction. In addition to new landscapes, existing landscapes will eventually need to be transformed to maintain compliance. Climate appropriate plant choices combined with the use of efficient irrigation equipment and proper water management will be essential in the process.

Suggested Change (or Language): It should be required for sprinkler nozzles within the same series to have matched precipitation to be eligible for the WaterSense label. Acknowledging the difficulty to achieve 100% matched precipitation across a series of nozzles, it is reasonable to allow a small variance within the series. It should be considered to have no variance greater than 0.05 PR within a series to be considered for the WaterSense label. Verifying this data should be done through a third party that has experience in evaluating irrigation equipment. The Center for Irrigation Technology may already have this information. If data is already available from prior testing, that could be used as a resource if it meets the desired testing criteria.

Topic: Section IV Water Efficiency and Performance
Pages 10-11 Distance of throw, and figure 5, Wascher's report and hydrozone considerations

Comment: It is advantageous to have a system similar to the illustration in figure 5 that irrigates with fewer sprinklers and fewer valves. However, something that should be considered in the design or retrofit process is the consequence of operating various microclimates on the same valve.

Rationale: As you can see in figure 5 on page 11, the system using fewer sprinklers has sprinklers on 2 and 3 sides of the residence on the same valve. There is no indication on the diagram where northern and southern exposures are located on the plan, however, it is clear that having more sprinklers per zone can create an unintended consequence of a mixed microclimate hydrozone. The result is overwatering the areas with a lower microclimate factor to meet the needs of the higher microclimate areas on the same valve. The other system shown in figure 5 with more sprinklers and more valves is zoned in a way that the sun exposure is likely to be consistent across the hydrozone.

Suggested Change (or Language): Perhaps the illustration used to demonstrate the ability to operate more sprinklers with fewer valves could be zoned in a way that explains the principal of hydrozoning by microclimate. It would also be helpful if this is mentioned somewhere to draw attention to it to those who may not be aware of it.

Topic: Section IV Water Efficiency and Performance
Pages 11-12 comment on HES sprinklers reducing the cost of materials in practice.

Comment: The cost for HES (MSMT) nozzles are significantly higher than standard fixed spray nozzles, however there are more factors to consider.

Rationale: If the use of lower flow HES (MSMTs) reduces the *overall* number of sprinklers, valves, controller size, and labor, it can be a way to cut down the overall cost of an installation. Smaller areas that only require a minimal number of sprinklers will have a higher per-nozzle cost if MSMTs are used and may actually result in a higher overall cost. If the area is larger, more sprinklers per valve can be used, or larger radius MSMTs can be used in lieu of shorter radius fixed spray nozzles, it may be a way to reduce cost. The overall number of sprinklers and valves will be reduced and the system will be less expensive overall for combined materials and labor.

Suggested Change (or Language): Acknowledge that not all systems using HES (MSMT) are less expensive. Designs should be evaluated to see if using MSMTs would be a materials and labor cost saving approach. Overall water reduction due to improved efficiency can help save money on your water bill and speed up the return on investment for the cost of a system using HES (MSMT).

Topic: Section IV Water Efficiency and Performance
Page 12 Do stakeholders believe it is reasonable for WaterSense to require the tested distance of throw to align with the value reported by the manufacturer?

Comment: This information should be verifiable.

Rationale: There should be data that supports the manufacturers performance chart for sprinkler nozzles.

Suggested Change (or Language): This data may be available and collected at the same time as verifying the PR of the sprinkler nozzle.

Topic: Section IV Water Efficiency and Performance
Page 15, Should DU be used in a specification to establish a minimum level of performance or used to differentiate HES and standard spray sprinkler nozzles.

Comment: Yes, using DU data should be included in meeting the criteria for WaterSense eligibility.

Rationale: Although WaterSense does not have the data to support connecting DU to water savings, there is data to support that MSMT sprinkler nozzles typically have a higher DU than standard fixed spray nozzles. If a system is designed and installed to produce a high DU, it would be the responsibility and burden of the water manager to calculate an irrigation schedule that is adequate but not excessive. This can be accomplished through educating water managers to become familiar with scheduling techniques that calibrate run times to make up for system inefficiencies. This calculation requires identifying the ETo, plant factor and estimated or actual DUlq to calculate the minimum and maximum run time range for combined efficiency and landscape health. By using a runtime multiplier (RTM) or DUlq to determine the range a reasonable schedule can be programmed and monitored.

Further, as mention in a previous comment, in California, new development landscapes must comply with the Model Water Efficient Landscape Ordinance (MWELO) which states:
492.7 (M) *All irrigation emission devices must meet the requirements set in the American National Standards Institute (ANSI) standard, American Society of Agricultural and Biological Engineers'/International Code Council's (ASABE/ICC) 802-2014 "Landscape Irrigation Sprinkler and Emitter Standard, All sprinkler heads installed in the landscape must document a distribution uniformity low quarter of 0.65 or higher using the protocol defined in ASABE/ICC 802-2014.*

The ordinance also specifies:
492.7 (P) Sprinkler heads and other emission devices shall have matched precipitation rates, unless otherwise directed by the manufacturer's recommendations.

The specification of Spray Sprinkler Nozzles that have a high DU will make it easier to design, install, and maintain systems to meet this criteria.

Suggested Change (or Language): Installers, designers, and water managers should consider taking a course and becoming certified in water management, and or irrigation auditing to become familiar with scheduling concepts.

Topic: Section IV Water Efficiency and Performance
Page 16, determining whether droplet size should be included as a criterion in a WaterSense specification.

Comment: Droplet size is an important factor to consider, especially in high pressure or windy operating conditions. The effect that droplet size has on the efficiency of the system is likely be noticeable by calculating the PR and DU.

Rationale: Sprinkler nozzles that have a low PR and small droplet size combined are more susceptible to wind drift and lower DU than sprinkler nozzles that have a low PR and larger droplet size.

Suggested Change (or Language): It is likely that establishing a minimum DU to meet WaterSense specifications will rule out sprinklers with low PR and small droplet size. It may not be necessary to establish a minimum droplet size. If droplet size does become a specification consideration, WaterSense should also consider nozzle trajectory as an additional evaluation criteria. If a small droplet size nozzle is combined with a high trajectory, it may be even more susceptible to wind drift and lower DU.

Topic: Section V Existing Performance Data
Page 22 Feedback from stakeholders on whether the estimated percentage of outdoor water used for spray irrigation is accurate, or whether spray irrigation typically accounts for more than 50 percent of outdoor water use in residential properties.

Comment: It is likely that systems that have spray sprinklers will use more water in general than systems that primarily use drip irrigation to apply water.

Rationale: Typically systems using overhead sprinklers to apply water are irrigating higher water use plant materials, such as turf. Turf has a high landscape plant coefficient and requires more water than most other types of plant materials. Systems typically irrigated by drip irrigation are irrigating plant materials or covering areas that need less water than turf. It is a safe assumption that more than 50 percent of outdoor water use in residential properties is spray if the property is irrigating turf.

Suggested Change (or Language): No change needed for the 50 percent assumption, however on page 21, it mentions the savings estimate of 2,400 gallons of water annually by replacing standard sprinkler nozzles, and on page 22, it mentions a monetary savings of $32 annually per landscape if HES sprinkler nozzles are installed. It would be useful to see the metrics used on calculating the savings. I am not sure how it is saving $32 annually if the only cost is the cost of 2,400 gallons of water saved each year.

Topic: Section VIII Communicating Savings
Page 23 opinions on irrigation runtimes, including duration of irrigation.

Comment: Lower PR sprinklers provide the unintended consequence of duration anxiety by consumers.

Rationale: For many years consumers were accustomed to irrigating at a frequency and duration that was familiar and comfortable. Now with PRs that are close to 25% of what they are replacing, it is a tough cognitive transition for people. The consequence can result in unintended deficit irrigation due to the discomfort of irrigating to meet the needs of the landscape.

Suggested Change (or Language): This can be accomplished through educating water managers to become familiar with scheduling techniques that calibrate run times to make up for system inefficiencies. This calculation requires identifying the ETo, plant factor, estimated or actual DUlq to calculate the minimum and maximum run time range for combined efficiency and landscape health. By using a runtime multiplier (RTM) or DUlq to determine the range a reasonable schedule can be programmed and monitored. This may or may not help with the duration anxiety, however, it should improve the quality of the landscape.

Topic: Section VIII Communicating Savings
Pages 23-24 Comments related to whether consumers with HES sprinkler nozzles could meet their irrigation needs with watering windows in place.

Comment: With unprecedented drought conditions, it has forced utilities to enforce water windows which can be difficult to comply with if the customer has a large landscape and or a landscape that has low PR sprinklers that require extended run time durations.

Rationale: It is possible to run out of time in a day and week to irrigate large landscapes and low PR systems when complying with water window restrictions.

Suggested Change (or Language): It is recommended that customers limit of the size of their turf areas and other high ETo landscape areas that use MSMT spray nozzles or other overhead low PR emission devices. In addition, customers should look for a WaterSense labeled controller that allows for concurrent programming to allow multiple valves to operate simultaneously to shorten the overall watering schedule to help stay within the watering window day and hours. While this option may create other concerns, if the hydraulic calculations and scheduling is done with some assistance or done by a trained water manager, it is more likely to be successful.