WaterSense® Specification for Homes, Version 2.0 Supporting Statement

1.0 Introduction

The U.S. Environmental Protection Agency's (EPA's) WaterSense program released the first version of its specification for labeled homes in 2009 with the *WaterSense Single-Family New Home Specification* and issued modifications in 2012 and 2014 to expand the scope to multifamily buildings and include minor revisions, respectively. The goal of the WaterSense Labeled Homes Program is to encourage the construction and purchase of water-efficient, high-performing homes that include water- and energy-efficient products and advanced design. The program aims to reduce indoor and outdoor water use in homes and encourage community infrastructure savings.

In February 2021, EPA released the *WaterSense Specification for Homes, Version 2.0* (hereafter referred to simply as the *WaterSense Specification for Homes,* unless the version number is necessary to include for clarity), which aims to further promote residential water efficiency and help enable market transformation in the building industry. The specification is applicable to single-family homes and multifamily buildings and can apply to new and existing homes.

EPA intends for the revised *WaterSense Specification for Homes* to:

- Provide flexibility in the technical requirements for homes constructed to the WaterSense specification without compromising overall water efficiency or performance.
- Ensure that WaterSense labeled homes are high-performing with regard to water efficiency and homeowner satisfaction.
- Provide quantifiable potential water and utility cost savings for individual homeowners.
- Improve regional applicability.
- Improve collaboration with existing green building certification programs.
- Use existing infrastructure for certification and verification purposes to ease requirements for home builders and verifiers who confirm home compliance with the specification.
- Use the WaterSense program's resources efficiently.

2.0 Current Status of Water Use in Residential Homes

New home construction is an optimal opportunity to encourage builders and homeowners to use water-efficient products and practices. To provide perspective, there were more than 1.25 million new single-family homes and multifamily units constructed in 2019,[1] representing significant cumulative water use. By encouraging water-efficient products, appliances, and design elements during construction, EPA intends to transform building practices to reduce lifetime water and energy use and utility costs.

Federal regulations have addressed water use and efficiency inside the home over the past quarter century. The Energy Policy Act of 1992 (EPAct 1992) established the maximum flush

[1] U.S. Census, 2020. *Monthly New Residential Construction, October 2020.* November 18, 2020. Table 5b. www.census.gov/construction/nrc/pdf/newresconst.pdf

volume for toilets at 1.6 gallons per flush (gpf), and the maximum flow rate for bathroom sink faucets, kitchen faucets, and showerheads at 2.5 gallons per minute (gpm). Subsequently, in 1998, the U.S. Department of Energy (DOE) adopted a maximum flow rate standard of 2.2 gpm for all faucets. In 2012 and 2016 respectively, the DOE issued new regulations mandating minimum water efficiency requirements for clothes washers and dishwashers.[2,3] The WaterSense and ENERGY STAR® programs promote water efficiency in plumbing fixtures and appliances that go beyond these national standards.

Two studies completed over the past 20 years best characterize water use in the residential sector. The American Water Works Association (AWWA) Research Foundation completed a 1999 study, *Residential End Uses of Water* (REUW1999),[4] that provided the first detailed analysis of residential water use patterns and efficiency levels in the United States. The Water Research Foundation (WRF) completed an updated study in 2016, *Residential End Uses of Water, Version 2* (REUW2016),[5] providing an expanded assessment and analysis of single-family water use across North America. REUW2016 also presents updated information about water use patterns, as compared to REUW1999. Table 2-1 summarizes the average daily per capita indoor water use for North American homes, as identified by both residential studies.

Table 2-1. Daily Indoor Per Capita Water Use

Type of Use	Daily Indoor Water Use (gallons per capita per day)	
	REUW1999	REUW2016
Toilets	18.5	14.2
Clothes washers	15.0	9.6
Showers	11.6	11.1
Faucets	10.9	11.1
Leaks	9.5	7.9
Other	1.6	2.5
Baths	1.2	1.5
Dishwashers	1.0	0.7
Total	**69.3**	**58.6**

Over the 15-year period between the two REUW studies, residential per capita indoor water use decreased 15.4 percent. While this reduction is significant, there are still opportunities for additional water savings. A 2011 study by William DeOreo found that new homes built with high-

[2] DOE, 2012. Energy Conservation Program: Energy Conservation Standards for Residential Clothes Washers. Direct Final Rule. May 31,2012. www.regulations.gov/document?D=EERE-2008-BT-STD-0019-0041
[3] DOE, 2016, Energy Conservation Program: Energy Conservation Standards for Residential Dishwashers; Final Rule. December 13, 2016. www.regulations.gov/document?D=EERE-2014-BT-STD-0021-0033
[4] Mayer, Peter W. et al., 1998. *Residential End Uses of Water.* Published by the AWWA Research Foundation and American Water Works Association.
[5] DeOreo, William B., Peter Mayer, Benedykt Dziegielewski, and Jack Kiefer, 2016. *Residential End Uses of Water, Version 2.* Published by the Water Research Foundation.

efficiency plumbing fixtures, appliances, and design practices (considered to be roughly equivalent to homes built to the *WaterSense Specification for New Homes, Version 1.0*) had an average indoor daily per capita water use of 36.7 gallons per day, which is 37 percent more water-efficient than North American homes surveyed for REUW2016.[6] EPA intends for the *WaterSense Specification for Homes, Version 2.0* to serve as a resource to help achieve additional household water savings.

The WaterSense Labeled Homes Program is an initiative designed to actively promote the transformation of the mainstream homebuilding industry towards increased water efficiency. Through the revised specification and resulting program structure, EPA intends to collaborate directly with existing green home building programs to promote a national ethic of water efficiency. By affirming the technical efficacy of existing home certification programs with regard to water efficiency, WaterSense aims to raise the profile of water efficiency in the broader green building industry. Through recognition of homes that meet specific performance and efficiency criteria, WaterSense hopes to drive builder and consumer confidence during the home buying process.

3.0 Definitions

For definitions related to the revised WaterSense Labeled Home Program, refer to the *WaterSense Home Certification System* and *WaterSense Technical Evaluation Process for Approving Home Certification Methods.*

4.0 Overview of Program Changes in Version 2.0

Motivation for Revision

Based on feedback from stakeholders, years of program operation, and changes in the home building marketplace that have occurred over the last decade, EPA has decided to revise its specification and certification process for WaterSense labeled homes. Since the original specification was introduced in 2009, water-efficient products have become more accessible and effective, and consumer demand for water-efficient homes has increased. With Version 2.0, WaterSense aims to accommodate a broader network of water efficiency professionals interested in participating in the WaterSense Labeled Homes Program, which had been limited in the original program structure. The revision also allows WaterSense to acknowledge a growing number of regional home certification and/or labeling programs operating across the United States.

With this revision, EPA: 1) requires that homes meet a minimum set of quality performance criteria (via a mandatory checklist); and 2) requires that homes meet an efficiency requirement (set at 30 percent more water-efficient than a home with characteristics typical of new construction, based on national standards, and common design and landscape practices). This specification structure reduces the prescriptive requirements (with the exception of key WaterSense labeled plumbing products) and focuses on WaterSense's main objective of saving water, while allowing builder partners to choose the approach that best fits their market, and strategy. Under the revised specification and certification structure, EPA recognizes credible certification programs or standards that have valid approaches to demonstrate compliance with the water efficiency requirement for homes. EPA also allows the programs to offer the WaterSense label in ways conducive to their existing structures and the needs of their

[6] DeOreo, William B, 2011. *Analysis of Water Use in New Single-Family Homes.*

stakeholders. By encouraging other organizations to administer the program and issue the WaterSense label in conjunction with their existing certifications, the revised specification increases flexibility among, and access to, a larger network of home verifiers. Builder partners, in turn, are able to choose home certification programs that suit their needs and the needs of their customers. The flexibility inherent in the revision allows for the inclusion of regional or local programs that could better address regional climate variability and local water efficiency priorities.

By adding flexibility to the technical requirements, as well as to the program and certification structure, EPA seeks to increase the reach of the WaterSense Labeled Homes Program and make it possible for more homes to earn the WaterSense label, while maintaining an equal (or greater) level of water efficiency and performance.

Revised Program Structure

Home Certification Organizations (HCOs) are central to the revised program structure. HCOs are responsible for implementing a program for the verification, certification, and labeling of homes for WaterSense. They are responsible for submitting a Proposed Certification Method (PCM), which details the methodology and protocols the HCO intends to use to determine whether a home meets the water efficiency requirements included in the *WaterSense Specification for Homes*. Other than requiring that homes include specific WaterSense labeled plumbing products and be free of water leaks, WaterSense does not dictate the specific requirements that a PCM must contain or the structure under which certification is granted.

EPA evaluates and approves HCOs to ensure they have the capability, competence and proper controls to certify and label homes for WaterSense. EPA also evaluates and approves the HCO's PCM to ensure that: 1) the method was developed in a fair and transparent manner; and 2) homes certified in accordance with the PCM and meeting the efficiency level or requirements the HCO has specified for WaterSense, will consistently meet WaterSense's efficiency requirement. EPA has developed a technical evaluation process to test the PCM's technical effectiveness, which is discussed in more detail in Section 7.0. Upon evaluation and approval by EPA, the PCM becomes a WaterSense Approved Certification Method (WACM). Hereafter, EPA uses the term WACM to refer to the approved certification method with the threshold or specific requirements the HCO has designated to earn the WaterSense label. WaterSense will periodically review WACMs for efficacy and maintain oversight of the HCOs' implementation and use of the WaterSense label.

Home builders that partner with WaterSense can achieve certification through an HCO of their choosing. Candidate homes must be verified and certified in accordance with the *WaterSense Specification for Homes* and the HCO's WACM requirements to earn the WaterSense label. Trained WaterSense home verifiers (verifiers) are responsible for inspecting homes to determine whether they meet these requirements.

Documents Associated With the Revision

This supporting statement describes three documents associated with the specification revision: the *WaterSense Specification for Homes*; the *WaterSense Home Certification System*; and the *WaterSense Technical Evaluation Process for Approving Home Certification Methods*. These three documents used in concert comprise the revised WaterSense Labeled Homes Program structure. This supporting statement describes the purposes of the components in each document.

5.0 WaterSense Specification for Homes

The revised specification establishes technical criteria that homes must meet to earn the WaterSense label. The specification contains two components: 1) the Mandatory Checklist; and 2) the water efficiency requirement.

Mandatory Checklist

In addition to an overall water efficiency requirement (discussed below), homes must meet all requirements included on the Mandatory Checklist for WaterSense Labeled Homes, listed in Appendix B of the *WaterSense Specification for Homes*. This includes WaterSense labeled plumbing fixtures (i.e., toilets, lavatory faucets and showerheads), which have been independently certified to perform as well or better than standard models, while also using less water. In addition, WaterSense labeled homes are also required to pass a pressure-loss test on all water supply lines, which indicates the absence of leaks. For a home to earn the label, there may not be visible leaks from specified elements of the plumbing system—including the plumbing fixtures identified above—or from other water-using systems and appliances installed in the home at the time of verification. Leaks can adversely impact a home's water use and result in added homeowner costs or even property damage.

The Mandatory Checklist is intended to ensure that all WaterSense labeled homes, regardless of the HCO or WACM under which they are certified, contain a minimum set of features that will meet homeowners' expectations for product performance. For the Mandatory Checklist, EPA selected items that are universally applicable to all homes and have minimal incremental cost.

Although the Mandatory Checklist does not include outdoor requirements (beyond requiring irrigation systems to be leak-free), outdoor components are still part of the revised WaterSense homes specification. Based on the structure of EPA's technical evaluation, discussed in Section 7.0, homes with the expectation of significant outdoor water use would not meet the water efficiency requirements without accounting for and reducing outdoor water use.

Table 5-1 presents the requirements of the Mandatory Checklist.

Table 5-1. Mandatory Checklist for WaterSense Labeled Homes

Item	Requirements	Confirmed
Leaks	Pressure-loss test on all water supplies detects no leaks	☐ Yes ☐ No
	Free of visible leaks from toilet(s), as determined through visual assessment and by conducting a dye tablet test in each toilet to ensure the flapper is not leaking	☐ Yes ☐ No
	Free of visible leaks from bathroom faucet(s)	☐ Yes ☐ No
	Free of visible leaks from showerhead(s)	☐ Yes ☐ No
	Free of visible leaks from bathroom tub faucet(s), i.e., tub spout(s), when showerhead(s) are activated, as determined through visual assessment after showerhead(s) have been activated for one minute	☐ Yes ☐ No
	Free of visible leaks from kitchen and other sink faucet(s)	☐ Yes ☐ No
	Free of visible leaks from other fixtures or appliances (e.g., water heaters, clothes washers, dishwashers, hose bibs, irrigation systems) at the point of use or point of connection to water distribution system	☐ Yes ☐ No
Toilets	WaterSense labeled[7]	☐ Yes ☐ No
Bathroom sink faucets	WaterSense labeled[7]	☐ Yes ☐ No
Showerheads	WaterSense labeled[7]	☐ Yes ☐ No

Efficiency Requirement

The specification stipulates that homes must be at least 30 percent more water-efficient than a home with characteristics typical of new construction. A home's water efficiency is determined through compliance with the HCO's WACM. WaterSense reviews and approves an HCO's program requirements to determine if homes certified in accordance with the WACM will use 30 percent less water than homes with characteristics typical of new construction. This process is explained in more detail in Section 7.0.

WaterSense set the water efficiency requirement at 30 percent based on analysis of typical attributes and features in homes, common efficiency measures, and potential impacts across different climates. WaterSense is using a percent reduction to provide flexibility while retaining the focus on the program's primary objective of saving water. The percent reduction gives builders flexibility to select technologies or practices best suited to their techniques, style, and market, as long as they cumulatively achieve 30 percent water savings. The percent reduction also scales with climate. Homes in more arid regions, for example, typically have higher annual water usage due to irrigation demands. These homes will need to take more substantial outdoor water efficiency measures to meet the efficiency requirement. The percent reduction can also be easily translated to water and cost savings.

WaterSense typically requires that products be at least 20 percent more water-efficient relative to standard products to be eligible for the WaterSense label. WaterSense has chosen to set a higher water savings target for homes to account for indoor and outdoor water savings potential,

[7] A listing of WaterSense labeled toilets, bathroom sink faucets, and showerheads can be found at www.epa.gov/watersense/product-search.

which cumulatively provides more opportunities for water savings. Additionally, the homebuilding community has transformed over the past decade and has adopted many water efficiency features as standard practice. EPA wants to encourage the market to become even more water-efficient by recognizing homes and builders that go above and beyond.

6.0 WaterSense Home Certification System

To facilitate continued stakeholder participation in the WaterSense Labeled Homes Program and enable a smoother transition to Version 2, EPA published a revised *WaterSense Home Certification System* (Version 1.3) in May 2020. Version 1.3 of the certification system helps bridge the gap between Version 1.2 and Version 2.0 and establishes the necessary certification infrastructure to operate Version 2 of the WaterSense Labeled Homes Program. More information can be found in the *Explanation of Revisions to the WaterSense Home Certification System.*[8]

EPA subsequently instituted a pilot program to evaluate the efficacy of the draft Version 2 program requirements and specification criteria. From the implementation of the pilot, EPA identified and made minor clarifications to the *WaterSense Home Certification System,* but otherwise confirmed its functionality in the home certification marketplace and effectiveness at meeting EPA's goals.

The *WaterSense Home Certification System* documents the process for certifying and labeling homes in compliance with the *WaterSense Specification for Homes.* It also defines the roles and responsibilities of parties associated with home certification and labeling, namely HCOs, verifiers, builder partners, and EPA.

HCO Organizational Requirements

WaterSense has identified six components of certification to ensure that an HCO has a structure in place to effectively certify homes, as well as issue and maintain the integrity of the WaterSense label. The following section describes the purpose of each certification component in the context of the certification system. The *WaterSense Home Certification System* contains more details on the requirements associated with each component.

As part of the home certification system, HCOs are required to establish procedures to address each of the following components:

1. **Independent oversight** ensures that the administration of the WACM and certification and labeling of homes for WaterSense are governed in a fair and impartial manner.
2. **Quality assurance** ensures that home verifications and certifications are conducted in a consistent, accurate, and appropriate manner. Quality assurance helps maintain the integrity of the WaterSense label and ensures that anticipated water savings and home performance are realized. Quality assurance also provides a mechanism for resolving complaints regarding home verification and/or certification.
3. **Verifier training and authorization** is intended to prepare verifiers to conduct accurate and consistent verifications, complete necessary paperwork, and comply

[8] EPA, 2020. *Explanation of Revisions to the WaterSense Home Certification System.* May 14, 2020. www.epa.gov/sites/production/files/2020-05/documents/ws-homes-explanation_of_revisions_to_ws_home_certification_system.pdf

with quality assurance standards. Following training and authorization, WaterSense home verifiers should be prepared to verify a home in accordance with the *WaterSense Specification for Homes* and the HCO's WACM under which they are authorized.

4. **Home verification protocols** establish requirements by which the HCO and its verifiers verify and certify homes for the WaterSense label. These protocols serve an important function for consumers, since accurate verifications identify homes that meet the expected water savings and performance.
5. **Impartiality** ensures that conflicts of interest (COI) related to the verification and certification of homes do not exist or have been resolved. When HCOs ensure impartiality, verifiers and designee(s) can fulfill their responsibilities in a manner that does not compromise the integrity of the HCO's certification program or the issuance of the WaterSense label.
6. **Messaging and reporting** create a link between WaterSense and HCOs. Through clear channels of communication, WaterSense can relay program information to stakeholders and track key program outputs.

By addressing each certification component, HCOs maintain the integrity of the WaterSense label and ensure that homes that are certified to the *WaterSense Specification for Homes* demonstrate expected water savings and performance.

Once approved, HCOs are responsible for verifying and certifying homes to the *WaterSense Specification for Homes*. The HCO is permitted to delegate most responsibilities to a "designee," such as a provider of hired or contracted verifiers or other organization that supports adherence to the certification requirements. However, the HCO is required to oversee all delegated activities and retains ultimate responsibility for the verification and certification of each home. Since controlling the use of the label is essential to certification programs such as WaterSense, it is important that responsibility for controlling label use remains centralized with the HCO, rather than dispersed among designees.

Some responsibilities cannot be delegated to a designee and must be executed by the HCO. The HCO holds ultimate responsibility for issuing the WaterSense label to homes. The HCO is also responsible for reporting information on authorized verifiers and new certified homes to WaterSense. Section 5.0 of the *WaterSense Home Certification System* summarizes key responsibilities for approved HCOs and provides logistical details to help HCOs implement each responsibility.

HCO Certification Method Development Process

The certification system indicates acceptable approaches for HCOs to follow as they develop or adopt a PCM. These approaches are identified to help ensure HCOs are meeting the needs of a broad set of stakeholders. An HCO can use one of three options to demonstrate its PCM was developed following an open and transparent process. The requirements also help EPA conform to the National Technology Transfer and Advancement Act, which stipulates that federal agencies rely on technical standards developed and adopted by voluntary consensus standards bodies, as opposed to using government-unique standards. Following are three optional approaches for HCOs to meet these requirements:

1. Utilize an American National Standards Institute (ANSI) approved standard or standard developed through an equivalent consensus-based standard development process.
2. For public agencies, demonstrate compliance with the administrative and transparency requirements associated with standards and policy development of the jurisdiction having authority over the program.
3. Provide written documentation demonstrating that the certification method was developed in accordance with a set of criteria, based on the ANSI Essential Requirements,[9] as presented in the *WaterSense Home Certification System.*

The three options ensure maximum flexibility for HCOs in the development of their PCMs, while generally providing for the same level of openness and transparency.

HCO Application and Approval

Prospective HCOs apply to EPA to oversee the certification and labeling of homes for WaterSense in accordance with the *WaterSense Specification for Homes*. As part of their application, prospective HCOs provide supplemental documentation that indicates how the HCO meets each certification component.

In its response to a prospective HCO's application, EPA may provisionally approve an HCO for select elements of the organizational requirements if an HCO requires modifications to fully adhere to EPA's organizational and certification method development process requirements. Provisional approval allows EPA to approve HCOs that may not initially meet all organizational requirements outlined in the *WaterSense Home Certification System*, provided that the HCO agrees to meet the outstanding requirements within a certain timeframe. Provisional approval applies to elements of the organization structure and certification method development that might not be necessary to begin operating as an HCO but are needed to ensure proper long-term organizational function and ability to issue the WaterSense label. EPA will not issue provisional approval for PCMs that are unable to consistently differentiate homes that meet the water efficiency requirement of the *WaterSense Specification for Homes.*

The *Application for Home Certification Organization (HCO) and Proposed Certification Method (PCM) Approval*, provided on the WaterSense website, contains more details on requirements that may be considered for provisional approval. If an HCO is provisionally approved for any organizational requirement, EPA will work with the HCO to develop a plan that outlines the conditions and timeline for full compliance.

HCOs that satisfactorily meet EPA's criteria are eligible to sign a licensing agreement. The licensing agreement is the legal document between EPA and the HCO that controls the use and distribution of the WaterSense label and formally identifies the HCO as the entity ultimately responsible for the label. As part of this responsibility, the HCO helps maintain the integrity of the WaterSense label. The licensing agreement also signals the HCO's and EPA's commitment to cooperate in the administration of the WaterSense Labeled Homes Program in accordance with the *WaterSense Specification for Homes,* the HCO's WACM, and the *WaterSense Home Certification System.*

[9] ANSI Essential Requirements: Due process requirements for American National Standards. Edition: January 2020. www.ansi.org/essentialrequirements/

7.0 WaterSense Technical Evaluation Process for Approving Home Certification Methods

Under the *WaterSense Specification for Homes*, EPA requires homes that earn the WaterSense label to be at least 30 percent more water-efficient than a comparable home with characteristics typical of new construction, based on national standards and common design and landscape practices. The specific requirements and/or the features a home must have to meet the water efficiency criteria are dictated by an HCO's WACM. To that end, EPA has established a technical evaluation process to assess water savings that can be achieved through the criteria and performance thresholds established within a PCM. EPA approves PCMs that meet the water efficiency criteria, as demonstrated through the technical evaluation. This technical evaluation provides assurance that the homes that ultimately earn the WaterSense label can deliver the anticipated water efficiency.

This supporting statement generally describes the technical evaluation process and the rationale behind EPA's approach. The *WaterSense Technical Evaluation Process for Approving Home Certification Methods* provides full details on the approach and assumptions for assessing potential water savings and approving PCMs.

Defining Reference Homes

Because home design and attributes, such as number of bedrooms (which relates to occupancy) and lot size (which relates to landscape area), can significantly influence a home's water use, EPA assesses a PCM's water use and savings across a series of "reference homes" and "reference buildings." These reference homes/buildings are intended to represent a range of physical attributes that are realistic in single-family and multifamily home construction. Water use in each reference home and/or reference building is compared between a baseline configuration with water use characteristics typical of new construction and a water-efficient configuration with the "least efficient" home and landscape design expected to achieve certification under the PCM. The intent is to assess the PCM's ability to differentiate homes that can meet the water efficiency requirement across a broad potential range of home designs and physical attributes. The *WaterSense Technical Evaluation Process for Approving Home Certification Methods* provides more details on the features and attributes of each reference home and reference building.

EPA identified features to include in its reference homes from the U.S. Department of Housing and Urban Development (HUD) 2017 Survey of Construction, and reviewed U.S. Census data to identify typical design attributes, such as number of bedrooms, bathrooms, and lot size. EPA used this data to estimate the prevalence of the water-using design features in single-family and multifamily construction, including number of plumbing fixtures (toilets, lavatory faucets, kitchen faucets), appliances (clothes washers, dishwashers), and landscaped area.

For each reference home, EPA also estimates a theoretical irrigation requirement based on the geographic scope of the specific PCM. The requirement takes into account the local modified net evapotranspiration ($NetET_o$) which incorporates reference evapotranspiration, rainfall, and specific watering months. For larger regional or national-scale programs, the reference home uses the applicable range of modified $NetET_o$ and rainfall values. This enables EPA to more accurately evaluate and assess savings associated with the outdoor water use and the balance between indoor and outdoor use based on the potential geographic area where the PCM may be applied.

Determining the "Least Efficient" Home and Landscape Design

EPA reviews the requirements of the PCM and defines and evaluates water savings for one or more home and landscape designs based on the minimum requirements a home needs to meet to achieve the PCM's proposed designation for WaterSense. These home and landscape designs represent the criteria that potentially result in the "least efficient" homes that can earn the WaterSense label. The features of the "least efficient" home designs are incorporated into the assumptions and form the basis for the water-efficient configurations. This conservative approach provides assurance that homes with a variety of configurations certified under the PCM are able to meet or exceed the 30 percent water efficiency requirement established in the *WaterSense Specification for Homes*.

Assessing Water Savings Over a Baseline Configuration

For each reference home, EPA evaluates indoor and outdoor water use associated with a baseline configuration that includes characteristics typical of new construction (based on national standards and common design and landscape practices) and compares it to a water-efficient configuration that has the characteristics represented in the "least efficient" home design(s) for the PCM.

This technical evaluation assesses water use and savings for specific features for which EPA has identified studies, research, or other data that suggest quantifiable savings can be achieved from implementation of that feature. Wherever possible, EPA utilized industry-recognized studies, such as the Water Research Foundation's REUW2016 (cited above), to identify water use, water savings, or water use patterns of different fixtures, appliances, or systems. EPA otherwise based savings estimates on the best available data.

Table 7-1 lists the features for which EPA currently assesses savings in the technical evaluation. The specific calculations and assumptions for assessing water use in the baseline and water-efficient configurations are detailed in the *WaterSense Technical Evaluation Process for Approving Home Certification Methods*.

Table 7-1. Features Impacting Water Use in Baseline and/or Efficient Configurations Under Technical Evaluation

Indoor	Outdoor
• Toilets • Showerheads • Lavatory faucets • Kitchen faucets • Clothes washers • Dishwashers • Bathtubs • Hot water delivery/recirculation system • Thermostatic shutoff valves in showers • Leaks and leak detection systems • Other (if applicable)	• Plant type(s) (i.e., turf, shrubs/ornamentals, xeriscape) • Irrigation type (s) (i.e., spray or microirrigation) • WaterSense labeled spray sprinkler bodies (with integral pressure regulation) or pressure-regulating valve • Irrigation scheduling technologies, including: o WaterSense labeled weather-based irrigation controller o Soil moisture-based irrigation controller (soil moisture sensor)[10] o Rain shutoff device (rain sensor) • Efficient irrigation design or professional irrigation audit • Residential Irrigation Capacity Index (RICI) score[11]

8.0 Specification Transition

The *WaterSense Specification for Homes, Version 2.0* and the *WaterSense Home Certification System, Version 2.0* are effective as of February 2021. Prospective HCOs can apply to oversee the certification and labeling of homes for WaterSense by submitting a completed *Application for Home Certification Organization (HCO) and Proposed Certification Method (PCM) Approval* to EPA.

Concurrent with the release of materials related to Version 2 of the WaterSense Labeled Homes Program, EPA published a document to summarize the transition. As discussed in the *WaterSense Labeled Homes Program Transition to Version 2,* HCOs previously approved by EPA under Version 1.3 of the *WaterSense Home Certification System* and the Version 2 pilot program will have their approval extended under Version 2 of the program. Therefore, as of February 2021, builder partners can coordinate with approved HCOs and/or their approved verifiers to certify and label homes in accordance with the *WaterSense Specification for Homes, Version 2.0.*

[10] EPA recently published the *WaterSense Specification for Soil Moisture-Based Irrigation Controllers*. Once sufficient labeled products become available on the market, as part of future minor revisions to the *WaterSense Technical Evaluation Process for Approving Home Certification Methods,* EPA intends to require these products be WaterSense labeled to be credited for their water efficiency.

[11] The RICI score is a ratio based on the sum of flow rates for each irrigation valve and the irrigated area. In the most basic terms, the higher the RICI score, the higher the anticipated irrigation water use. More information is presented in the *WaterSense Technical Evaluation Process for Approving Home Certification Methods*.

Details of EPA's continued support of the *WaterSense New Home Specification, Version 1.2,* and the transition period to Version 2 of the WaterSense Labeled Homes Program are described in greater detail in the *WaterSense Labeled Homes Program Transition to Version 2.*

9.0 Potential Water, Energy, and Cost Savings

The structure of the *WaterSense Specification for Homes* assures EPA that homes that earn the WaterSense label have demonstrated they will be at least 30 percent more water-efficient than homes with characteristics typical of new construction. However, because indoor water use is largely dependent on occupancy, and outdoor water use can vary greatly depending on local climate and landscape size, it can be challenging to pinpoint the average water use typical of new construction.

Water Savings

To quantify household water savings for a WaterSense labeled home, EPA uses its technical evaluation process and tool (described in more detail in Section 7.0). However, in place of the reference homes, EPA assumes a national average household occupancy of 2.61 occupants per household[12] and an average landscape size of 5,826 square feet.[13]

Depending on local climate, EPA estimates annual water use for an average home of typical new construction could be between 102,200 gallons of water per year (approximately 42,700 gallons indoor and 59,500 gallons outdoor) and 256,900 gallons of water per year (approximately 42,700 gallons indoor and 214,200 gallons outdoor). EPA estimates that homes built to the water efficiency requirement (i.e., at least 30 percent more water-efficient compared to homes with characteristics typical of new construction) could therefore save between 30,600 gallons and 77,100 gallons of water annually.

For the purposes of estimating potential national water savings, EPA assumes average household water savings of 53,850 gallons of water per year. Extrapolated to the national level, if 10 percent of newly constructed single-family homes in the United States earned the WaterSense label,[14] potential estimated annual water savings across the program could be up to 4.9 billion gallons of water (see Calculation 1).

Calculation 1: National Water Savings Potential

$$53{,}850 \text{ gallons savings per year per home}^{15} \times 90{,}300 \text{ homes}^{16} = 4.9 \text{ billion gallons of water}$$

Energy Savings

The energy savings of a WaterSense labeled home varies depending on the water-efficient design and features of the WACM. The energy savings in a WaterSense labeled home are a

[12] U.S. Census Bureau. 2019 American Community Survey 1-Year Estimates.
[13] DeOreo, William B., Peter Mayer, Benedykt Dziegielewski, and Jack Kiefer, 2016. *Residential End Uses of Water, Version 2.* Published by the Water Research Foundation. Table 6.31.
[14] This is representative of the approximate market share of the ENERGY STAR Certified Homes Program. www.energystar.gov/newhomes/energy_star_certified_new_homes_market_share
[15] Assumed average savings based the range of estimated water savings achievable by improving water efficiency by 30 percent.
[16] Based on U.S. Census Bureau, Characteristics of New Single-Family Houses Completed, 2019. In 2019, 903,000 single-family homes were completed.

result of the decrease in the overall hot water use from more efficient distribution, fixtures, and appliances. Therefore, energy savings would primarily be associated with indoor efficiency measures, specifically hot water savings from installation of water-efficient showerheads, lavatory and kitchen faucets, dishwashers, clothes washers, and reduction in structural and/or behavioral waste from hot water delivery.

To estimate potential energy savings, EPA assumes that a home achieves a 30 percent reduction in total indoor water use (see Calculation 2), and that 33.2 percent of this water is hot (based on the breakdown of hot and cold water use identified in REUW2016,[17] see Calculation 3).

Calculation 2: Estimated Indoor Water Savings per Household

$$42{,}700 \text{ gallons of indoor water use per year} \times 30 \text{ percent water savings} = 12{,}800 \text{ gallons of indoor water savings per year}$$

Calculation 3: Estimated Hot Water Savings per Household

$$12{,}800 \text{ gallons of indoor water savings per year} \times 33.2 \text{ percent hot water} = 4{,}250 \text{ gallons of hot water saved per year}$$

This expected hot water savings results in 718 kilowatt-hours (kWh) of electricity savings or 3.67 thousand cubic feet (Mcf) of natural gas savings each year (see Calculation 4 and Calculation 6).

Calculation 4: Electricity Savings per Household From Hot Water Savings

$$4{,}250 \text{ gallons of hot water saved per year} \times 0.169 \frac{\text{kWh}}{\text{gallon}} = 718 \text{ kWh of electricity savings per year}$$

Water heating consumes 0.169 kWh of electricity per gallon of water heated (see Calculation 5), assuming:

- Specific heat of water = 1.0 British thermal units per pound (Btu/lb) ·°F
- 1 gallons of water = 8.34 lbs
- 1 kWh = 3,412 Btus
- Incoming water temperature is raised 64.5°F[18]
- Water heating process is 93.1 percent efficient electric hot water heating[19]

[17] DeOreo, William B., Peter Mayer, Benedykt Dziegielewski, and Jack Kiefer, 2016. *Residential End Uses of Water, Version 2.* Published by the Water Research Foundation. Table 6.25.
[18] Chen, Y., H. Fuches, J. Schein, V. Franco, H. Stratton, and C. Dunham, 2020. Calculating Average Hot Water Mixes of Residential Plumbing Fixtures. Lawrence Berkeley National Laboratory, Energy Analysis and Environmental Impacts Division. Table 3, Page 8.
[19] EPA, 2020. Data and Information Used by WaterSense. www.epa.gov/watersense/data-and-information-used-watersense#Savings%20from%20Avoided%20Water%20Heating. Based on data from the Air Conditioning, Heating, & Refrigeration Institute (AHRI).

Calculation 5: kWh of Electricity per Gallon of Water Heated

$$\frac{\left(1 \text{ gallon} * 1.0 \frac{\text{Btu}}{\text{lbs} \cdot °\text{F}}\right) \times \left(\frac{1 \text{ kWh}}{3{,}412 \text{ Btus}}\right) \times \left(\frac{8.34 \text{ lbs}}{1 \text{ gallon}}\right) \times 64.5°\text{F}}{93.1 \text{ percent efficiency}} = 0.169 \text{ kWh/gallon}$$

Calculation 6: Natural Gas Savings per Household From Hot Water Savings

$$4{,}250 \text{ gallons of hot water saved per year} \times 8.63 \times 10^{-4} \frac{\text{Mcf}}{\text{gallon}} = 3.67 \text{ Mcf of natural gas per year}$$

Water heating consumes 8.63 x 10^{-4} Mcf of natural gas per gallon of water heated (see Calculation 7 and Calculation 8), assuming:

- Specific heat of water = 1.0 Btu/lb ·°F
- 1 gallons of water = 8.34 lbs
- 1 therm = 99,976 Btus
- 1 Mcf = 10.307 therms
- Incoming water temperature is raised 64.5°F[20]
- Water heating process is 60.5 percent efficient natural gas hot water heating[21]

Calculation 7: Therms of Natural Gas per Gallon of Water Heated

$$\frac{\left(1 \text{ gallon} * 1.0 \frac{\text{Btu}}{\text{lbs} \cdot °\text{F}}\right) \times \left(\frac{1 \text{ therm}}{99{,}976 \text{ Btus}}\right) \times \left(\frac{8.34 \text{ lbs}}{1 \text{ gallon}}\right) \times 64.5°\text{F}}{60.5 \text{ percent efficiency}} = 0.00889 \text{ therms/gallon}$$

Calculation 8: Mcf of Natural Gas per Gallon of Water Heated

$$0.00889 \frac{\text{therms}}{\text{gallon}} \times \left(\frac{1 \text{ Mcf}}{10.307 \text{ therms}}\right) = 8.63 \times 10^{-4} \text{ Mcf/gallon}$$

In addition to the energy savings from the home itself, WaterSense estimates that an additional 113 kWh of electricity is saved by not supplying the average 53,850 gallons of total water saved annually per home (see Calculation 9) and an additional 32 kWh of electricity is saved by not treating the average 12,800 gallons of wastewater (from indoor water use) saved annually per

[20] Chen, Y., H. Fuches, J. Schein, V. Franco, H. Stratton, and C. Dunham, 2020. Calculating Average Hot Water Mixes of Residential Plumbing Fixtures. Lawrence Berkeley National Laboratory, Energy Analysis and Environmental Impacts Division. Table 3, Page 8.
[21] EPA, 2020. Data and Information Used by WaterSense. www.epa.gov/watersense/data-and-information-used-watersense#Savings%20from%20Avoided%20Water%20Heating. Based on data from AHRI.

home[22] (see Calculation 10). If 10 percent of newly constructed single-family homes in the United States earned the WaterSense label, national energy savings could exceed 42 million kWh and 176 million cubic feet (MMcf) of natural gas each year (see Calculation and Calculation 12).

These calculations are based on the following assumptions:

- Approximately 47 percent of new homes in the United States heat their water using electricity, and 53 percent heat their water using natural gas.[23]
- Approximately 89 percent of households in the United States are connected to a public water supply.[24]
- Approximately 83 percent of households in the United States are connected to a public sewage system.[25]
- Total electricity required to supply water (including pumping raw water, filtration/treatment, and distribution) is 0.0021 kWh per gallon.[26]
- Total electricity required to treat wastewater is 0.0025 kWh per gallon,[27] and only water savings from indoor uses would have been treated.

Calculation 9: Electricity Savings From Not Supplying Saved Water to the Home

$$53{,}850 \text{ gallons of total water savings per year} \times 0.0021 \frac{\text{kWh}}{\text{gallons}} =$$
$$113 \text{ kWh of electricity saved per year}$$

Calculation 10: Electricity Savings From Not Treating Saved Wastewater from the Home

$$12{,}800 \text{ gallons of indoor water savings per year} \times 0.0025 \frac{\text{kWh}}{\text{gallons}} =$$
$$32 \text{ kWh of electricity saved per year}$$

Calculation 11: National Electricity Savings Potential

$$(718 \text{ kWh saved per home per year} \times 0.47 \times 90{,}300 \text{ homes})$$
$$+ (113 \text{ kWh per home per year} \times 0.89 \times 90{,}300 \text{ homes})$$
$$+ (32 \text{ kWh per home per year} \times 0.83 \times 90{,}300 \text{ homes})$$
$$= 42.0 \text{ million kWh of electricity savings per year}$$

[22] Water used for irrigation would not have been treated at a wastewater treatment facility.
[23] U.S. Census Bureau. American Housing Survey. 2019. 63,808,000 homes use natural gas to heat water, and 56,125,000 homes use electricity to heat water.
[24] U.S. Census Bureau. American Housing Survey. 2019.
[25] Ibid.
[26] Electric Power Research Institute (EPRI), 2013. *Electricity Use and Management in the Municipal Water Supply and Wastewater Industries*, EPRI, Palo Alto, California, November 2013 Report 3002001433.
[27] Ibid.

Calculation 12: National Natural Gas Savings Potential

$$(3.67 \text{ Mcf saved per home per year} \times 0.53 \times 90{,}300 \text{ homes}) = 176{,}000 \text{ Mcf of natural gas savings per year}$$

Cost Savings

National average water and wastewater costs for residential customers are $11.48 per 1,000 gallons.[28] It is possible, although uncommon, that a homeowner could be billed separately for these utility service connections and would therefore only incur the water supply costs for water used for irrigation.

Based on the water savings presented above, EPA estimates that WaterSense labeled homes could save between $350 and $885 annually in water supply and wastewater costs.

Factoring in potential energy savings, the average household with electric water heating may save an additional $93 annually.[29] The average household with natural gas water heating could save an additional $38 annually.[30]

In total, a WaterSense labeled home could save between $388 and $978 annually on utility bills compared to typical new construction.

[28] WaterSense Estimate for 2019 based on Raftelis Financial Consulting. Water and Wastewater Rate Survey. American Water Works Association, 2016. WaterSense adjusted rate data using the Gross Domestic Product (GDP) deflator for water from the U.S. Department of Commerce Bureau of Economic Analysis.
[29] Based on a national residential average of $0.1301/kWh for 2019. U.S. Energy Information Administration. *Short Term Energy Outlook.* Price Summary Table. Accessed December 1, 2020.
[30] Based on a national residential average of $10.46/Mcf for 2019. U.S. Energy Information Administration. *Short Term Energy Outlook*. Price Summary Table. Accessed December 1, 2020.