

# Know Your Flow and Curb Water Waste



A WaterSense® Guide to Leak Detection and Flow Monitoring Devices



Household leaks can be a major source of water waste; they cause utility bills to be higher than necessary and sometimes even damage homes. A household can waste thousands of gallons of water each year from undetected water leaks. Leaks can be caused by a variety of factors, including old piping or plumbing fixtures, corrosion, cold temperatures, irregular water pressure, equipment malfunctions, and incorrect installation or application of water fixtures.

Fortunately, leak detection and flow monitoring devices are available to help you identify leaks or irregular water use throughout your home, and installing them can avoid or mitigate the water waste and damage caused by leaks. These devices rely on moisture detection, which alerts homeowners to unexpected dampness, or flow monitoring, which measures how much water is flowing and detects water consumption patterns that may indicate a leak or other irregularity. The U.S. Environmental Protection Agency's (EPA's) WaterSense program has developed this guide to help consumers understand the benefits of installing leak detection and flow monitoring devices, information about available technologies on the market, and tips for selecting a device and performing maintenance to reduce water waste at home. While this guide focuses on use of these devices in the home, they can also be used in multifamily, commercial, and institutional buildings, such as schools, hospitals, and hotels, to save water and reduce damage from leaks.

### Why Find and Fix Leaks?

Common household leaks include worn-out toilet flappers or malfunctioning fill valves, dripping faucets or showerheads, or a damaged irrigation system. If left unnoticed or unaddressed, a stuck fill valve in a toilet can waste 4,300 gallons of water per day and up to \$1,400 in water costs per month. A drip irrigation system malfunction that leaks at 1 gallon per minute can waste \$5,700 per year.

WaterSense partners celebrate Fix a Leak Week the third week of March each year to remind homeowners to find and fix leaks in plumbing fixtures and irrigation systems. Visit [www.epa.gov/watersense/fix-leak-week](http://www.epa.gov/watersense/fix-leak-week) for more information on proactively identifying and addressing household leaks.



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## Why Invest in Leak Detection or Flow Monitoring Devices?

Leak detection and flow monitoring devices can offer a variety of benefits, depending on the technology, features, and where they are installed:

- **Save water and money.** By locating and fixing leaks before they waste a lot of water, homeowners can reduce water, sewer, and—in the case of hot water—energy costs.
- **Prevent costly damage.** In the event of a catastrophic leak (e.g., a failed water heater, pipe burst, washing machine hose failure), devices that are equipped with automatic shut-off valves can stop the water supply to prevent large-scale water damage and associated costs.
- **Reduce insurance premiums.** Some insurers offer discounts for homes that have a leak detection or flow monitoring device installed.
- **Gain water use insight to inspire behavior change.** Flow monitoring devices can provide information about water use within the home and compare it to typical use patterns, which can promote behavioral changes to reduce water consumption.

### Get Credit for Getting Smart

Both residential and commercial green building rating systems recognize water conservation in new construction and remodeling. The following green building codes, standards, and certification programs require or award credit for leak detection and flow monitoring devices:

- Green Building Initiative's Green Globes Certification
- U.S. Green Building Council's LEED® Rating System
- NGBS Certification to the ICC 700 National Green Building Standard
- International Green Construction Code

Note that each program has its own requirements for which devices qualify.

Beyond consumer savings, the water savings associated with leak detection and repair can also help protect local water sources during times of drought and support water conservation efforts in communities where water supplies are scarce.

## How Do Leak Detection and Flow Monitoring Devices Work?

Leak detection and flow monitoring devices can be characterized as either **point-of-use** or **point-of-entry**, based on the placement of the device and how it is able to monitor.

### *Point-of-Use Devices*

Point-of-use devices are installed directly at a water fixture, which is helpful when targeting specific, leak-prone areas, but they may fail to detect leaks if they occur upstream of where the device is installed or in other fixtures without these devices.

- **Moisture detection sensors** are common point-of-use devices that use prongs with electrodes to sense conductivity changes when water is present. Consumers can place these devices in leak-prone or hard-to-see areas, such as behind a clothes washer or near a water heater. They can also be used to detect water in locations where a point-of-entry flow monitoring device could not identify a leak, such as near an air conditioning unit that could leak condensate or under a sink's drain pipe. Moisture detection devices specifically designed for under-sink water filtration systems are a common method to detect water leaking onto floorboards. When selecting a moisture detection device, look for a version that allows you to adjust sensitivity, so it will not trigger an alert in the event of high humidity in the air.
- **In-line flow monitoring devices** are installed for a specific end use where leaks are common, such as toilets, since about 20 percent of toilets leak. These monitoring devices can be placed between the toilet water supply and the fill valve. An alert is triggered if water is flowing continuously through the fill valve, which indicates a leaky flapper or other malfunction. In-line flow monitoring technology can also be employed as a point-of-entry device, as discussed in the next section.

### Toilet Leak Detection and Water Savings in Action

Over 1,000 in-line flow monitoring devices were installed at toilets in a low-income senior housing community. The community was able to reduce water use by 25 percent after identifying and fixing toilet leaks, collectively saving over 1 million gallons of water and an estimated \$10,000 in water bills.<sup>1</sup>



Smart leak detector placed next to a water heater. Photo courtesy of Moen, Inc.

### Point-of-Entry Devices

Point-of-entry leak detection and flow monitoring devices are usually installed on the main water line, either at a building's utility water meter or where the water enters the building, which allows them to track the water use of an entire home or building. Compared to point-of-use devices, point-of-entry devices are better equipped to detect leaks because they monitor

<sup>1</sup> Pacific Institute. June 2022. "Pacific Institute-Led Water Efficiency Project Featuring Remote Toilet Leak Detection in Low-Income Housing Wins Los Angeles Better Buildings Challenge Award." <https://pacinst.org/announcement/pacific-institute-led-water-efficiency-project-featuring-remote-toilet-leak-detection-in-low-income-housing-wins-los-angeles-better-buildings-challenge-award/>.

water consumption anywhere downstream from where the device is installed. Many point-of-entry devices can also monitor temperature and alert consumers to the possibility of frozen pipes. As a result, these devices are often used to monitor both indoor and outdoor water use. However, because they monitor water consumption versus the presence of water, they are not capable of identifying water leaks that are not associated with water use, such as condensate leaking from an air conditioning unit, a roof leak, or water pooling under a sink from a drain pipe leak.

- **In-line devices** may require installation by a plumber at the point of entry and usually include an integral water shut-off valve. In-line flow monitoring devices commonly have a mechanical flow monitor that measures velocity or water displacement volumes to determine the gallons of water moving through the system over a given time. They can also monitor pressure changes, which is helpful for finding very small leaks that could otherwise go unnoticed. According to one company's data, 60 percent of homeowners who installed an in-line flow monitoring device with water shutoff capability discovered previously undetected leaks.<sup>2</sup> Consumers can often program these types of devices to trigger an alert if water is flowing continuously for a predetermined amount of time, or if a certain volume has passed through the flow monitor over a certain period of time, both of which can indicate a leak.
- **External flow monitors** are point-of-entry devices that can be a do-it-yourself installation at your home's water meter or on the main water line; they rely on a few different technologies. An ultrasonic wave sensor, for example, calculates



Installation of in-line flow monitoring device with shut-off capabilities. Photo courtesy of Moen, Inc.



Smart water leak detection system. Photo courtesy of Kohler Co.

<sup>2</sup> Moen. January 2023. "Moen provides knowledge and products to help people conserve water effortlessly." <https://www.moen.com/press-room/press-releases/us-20230131-moen-water-perceptions>.

flow rates by sending waves upstream and downstream from its placement on the water line. A magnetic flow monitor, meanwhile, calculates flow rates based on the speed of a spinning magnet within the water meter as water flows past it. Like other point-of-entry devices, consumers are alerted of leaks when irregularities in flow rate are detected, such as continuous flow at a low rate. One study found that homes that installed external flow monitoring devices reduced indoor water use by 15 percent compared to average use and maintained savings over time.<sup>3</sup> In Goodyear, Arizona, homes that used these devices saved an average of 38 gallons per household per day compared to their water use prior to installation of the device.<sup>4</sup>



External flow monitoring device and smart phone app. Photo courtesy of Hydrific - Part of LIXIL.

### Hybrid Systems

Different types of leak detection technologies or points of installation can sometimes be integrated with each other to create a hybrid system. A point-of-use device designed to detect moisture can be paired with an in-line automatic shut-off valve on the water main, so that dampness detected in one area of the home can signal a cut-off to the entire home's water supply and mitigate water damage. Similarly, an in-line flow monitoring device can work with a moisture detection device to create a more complete picture of a home's water use patterns and leak status. Note that when integrating multiple devices, it helps if they are manufactured by the same company so they can be managed within the same app or system.

See Table 1 on the following page for a summary of different types of leak detection and flow monitoring devices and potential advantages and disadvantages of implementing each type in a home.

<sup>3</sup> Flume Utility & Business Solutions. "Revolutionizing Water Management in Your Community." <https://flumewater.com/utilities/>.

<sup>4</sup> Flume Utility & Business Solutions. "City of Goodyear: Empowering Residents with Flume to Reduce Residential Water Use by 14%." <https://flumewater.com/resources-flume-utility-and-business-solutions/>.

**Table 1. Summary of Available Technologies of Leak Detection and Flow Monitoring Devices**

Type of Device	Installation Location	Type of Alarm Response and Power Source	Advantages	Disadvantages
<b>Point-of-Use Devices</b>				
Moisture detection devices	Leak-prone or hard-to-see areas (e.g., behind a clothes washer, near a water heater). Areas where a point-of-entry flow monitoring device could not identify a leak (e.g., near an air conditioning unit, under a sink drain).	Audible alarm or a mobile/email alert, depending on the model. Not equipped with shut-off capabilities, but can be integrated with devices that do so. Typically are battery-powered.	Can be installed by the consumer without a plumber. Location of the leak is easily identifiable once the alert response is triggered.	Can only detect leaks at the end use, cannot detect any leak upstream of the device. Can be triggered by high humidity if sensitivity is not adjusted.
In-line flow monitoring devices	Leak-prone end uses, such as toilets (the device is placed between the toilet water supply and fill valve).	Audible alarm or mobile/email alert, depending on the model. Can include a remote or automatic shut-off valve. Typically are battery-powered.	Location of the leak is easily identifiable once the alert is triggered.	Can only detect leaks at the end use, cannot detect any leak upstream of the device.
<b>Point-of-Entry Devices</b>				
In-line flow monitoring devices	At the water meter or on the main water line.	Usually include a remote or automatic shut-off valve. Connect to WiFi and can provide mobile or email alerts. Typically require external power source but may have battery back-up.	Pressure monitoring is helpful for finding very small leaks that could otherwise go unnoticed. Capable of identifying any leaks associated with water use after the water meter (or point of installation).	Usually require a plumber for installation. Location of the leak is not immediately known once the alert is triggered. Cannot identify leaks that are not associated with water-using fixtures.
External flow monitoring devices	At the water meter or on the main water line.	Connect to WiFi and can provide mobile or email alerts. Battery-powered or external power source.	Can often be installed by the consumer without a plumber. Capable of identifying any leaks associated with water use beyond the water meter (or point of installation).	Location of the leak is not immediately known once an alert is triggered. Cannot identify leaks that are not associated with water-using fixtures. May not be able to identify extremely small leaks.

## Selecting a Leak Detection or Flow Monitoring Device

While there are various technologies and types of devices to consider, it's important to understand a home's leak detection needs and compare the different features, capabilities, and specifications when selecting a device. Following are some factors to take into account:

- **Your water monitoring goal.**
  - If you want to identify leaks at a certain water fixture or in a specific leak-prone location, a point-of-use device may be a good choice.
  - If you also want to monitor outdoor water use, a point-of-entry leak detection and flow monitoring device can encompass both indoor and outdoor water use.
  - If you're looking for more granular information on water use in your home, an integrated system of multiple sensors or devices may be helpful.
- **Notifications and connectivity.** Consider how you want to be alerted in the event of a leak, as different devices may offer audible alarms, text alerts, or in-app notifications. Different types of alerts may be more appropriate, depending on the lifestyle of the residents or location of the sensor. If the leak detection device is located outdoors or in a basement, for example, a mobile alert may be more effective than an audible alarm.
- **Water shut-off capabilities.** Decide whether you want the device to be equipped with an automatic shut-off valve or remote shut-off capabilities to stop the water supply to a fixture or the entire home if a leak is detected. This feature may be helpful for a vacation home that does not have regular occupancy. If you select a shut-off device, consider the pipe size supported by the device compared to the pipe size in your home to ensure it will function as expected.
- **User control and programmability.** Consider whether the sensitivity on your device can be programmed or adjusted according to your needs, so that alarms and alerts are triggered at a threshold that makes sense for the device's application. Some devices can offer programmability to account for irrigation scheduling, changes in seasons, planned vacancies in the home, or other deviations from your typical water use.
- **Installation requirements.** Installing in-line, point-of-entry devices will likely require hiring a plumber. If the device relies on electricity, a nearby power source is also needed. Determine the best location to install the device and how it will fit with the layout of the room.

### Look for Certified Products

Leak detection and flow monitoring devices are not eligible to earn the WaterSense label. However, products certified to the ANSI/CAN/IAPMO Standard Z1349, *Devices for Detection, Monitoring or Control of Plumbing Systems*, have been tested for quality and performance of available features such as alarm response and automatic shut-off capabilities.

- **Maintain fire safety.** When deciding where to install the device, make sure it won't interfere with or potentially stop water supply to home fire protection sprinkler systems.
- **Battery requirements.** Some households experience leaks due to weather-related events, which may also trigger power outages. If you need the device to operate in a power outage, make sure it is battery-powered or has a battery back-up.
- **Rebates and incentives.** Check with your local water utility or home insurance provider to see if there are any financial incentives for installing leak detection and flow monitoring devices. Different organizations have different incentive structures, so make sure the device you select and install meets program requirements.

### Utility-Provided Advanced Metering Infrastructure

Some water utilities have implemented advanced metering infrastructure (AMI) systems, capable of regularly collecting water use data from the water meter and communicating water use insights or possible leaks to consumers on their bill or through an online portal. AMI systems provide benefits for both consumers and utilities, including:

- Increased frequency of data collection for more detailed analysis of water use patterns.
- Greater transparency surrounding water consumption and utility costs between the consumer and the utility.
- Increased communication between the utility and their customers, through access to an online portal that displays water data or alerts that customers receive in the case of a possible leak.
- Reduced water loss when customers use AMI data to diagnose flow irregularities that are detected.

If available, you can sign up for your utility's high water use notification system. While a utility's AMI system can offer similar leak detection benefits as a leak detection and flow monitoring device installed by the consumer, alerts from AMI systems can still lag for days and may allow more water to be wasted compared to in-home leak detection or flow monitoring devices.

### Maintenance Tips

Performing routine maintenance can extend the life of the leak detection or flow monitoring device and maintain a high level of performance and accuracy. Check your device's manual for any model-specific maintenance procedures, and consider implementing the following practices to ensure your device is functioning properly:

- If a device is powered by batteries, replace them as needed based on expected battery lifespan or low-battery alerts.
- For end-use or moisture detection devices, make sure the sensors are clean and the device is placed correctly at the fixture. Dust, dirt, and grime can build up over time, and the devices can be accidentally moved during normal household activities or tampered with by kids and pets.
- Test the functionality of your device according to the user manual. Periodically calibrating flow monitoring devices will ensure flow accuracy, which promotes accurate leak detection.
- If your device is connected to the internet, make sure it remains connected after power outages or changes to a WiFi password or internet provider.



Flow monitoring device. Photo courtesy of Moen, Inc.

### Detecting Real Water Savings

While expected water and cost savings are difficult to quantify due to variations in consumer behavior and the unpredictability of leaks, there are ways to maximize savings from your device. If you address leaks quickly, use your device to increase awareness of water consumption, and reduce water waste once identified, your leak detection device may pay for its initial cost more quickly with savings on water and sewer bills. While purchasing a device with automatic shut-off capability is usually more expensive, the ability to prevent major water damage can pay for itself in the event of just one avoided catastrophic leak. For example, from 2019 to 2023, 1.5 percent of homeowners submitted an insurance claim related to water damage or freezing with an average cost of \$15,400 per claim,<sup>5</sup> well above the going price to purchase and install a leak detection or flow monitoring device with an automatic shut-off valve.

Installing a leak detection or flow monitoring device is a great way to reduce water waste and prevent damage to your home. Committing to monitoring your home's water use, addressing detected leaks promptly, and maintaining leak detection devices will ensure the benefits of these devices. For more information on how to reduce your household water use, explore the WaterSense program website ([www.epa.gov/watersense](http://www.epa.gov/watersense)).

<sup>5</sup> Insurance Information Institute. "Facts + Statistics: Homeowners and renters insurance." <https://www.iii.org/fact-statistic/facts-statistics-homeowners-and-renters-insurance>.