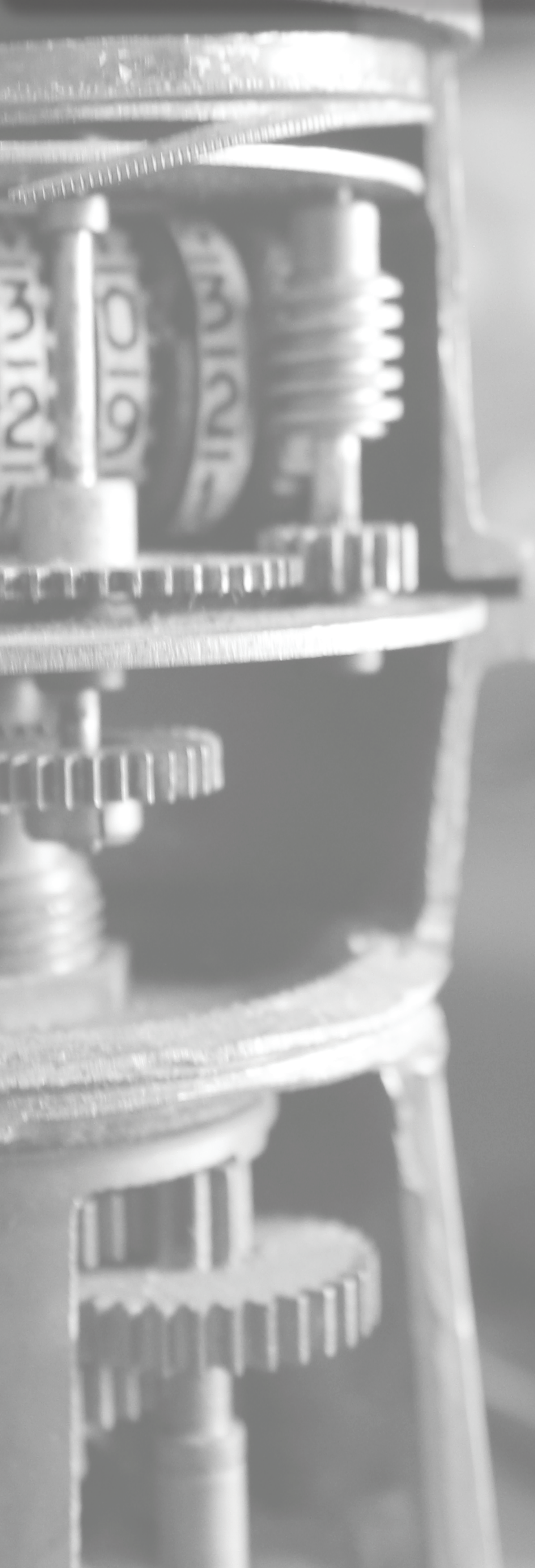
WATER AND PEOPLE
Unit 2: Water Conservation & Metering



Although there appears to be a plentiful water supply on our planet, great efforts still need to be made to conserve our water resources. Water is wasted every day; sometimes in small, almost invisible ways and other times in conspicuous ways - how many times have you seen a lawn being watered during a rainstorm?

A few simple steps can help save water - and money- around school and at home. Repairing leaks and using water conserving appliances can help minimize waste. Checking water meters can also help determine if there is a silent leak lurking out of sight.

Unit 2 Objectives

• Students will understand the basic and numerous ways water is wasted.

• Students will learn simple ways to reduce wasted water.

• Students will learn how to read a water meter.

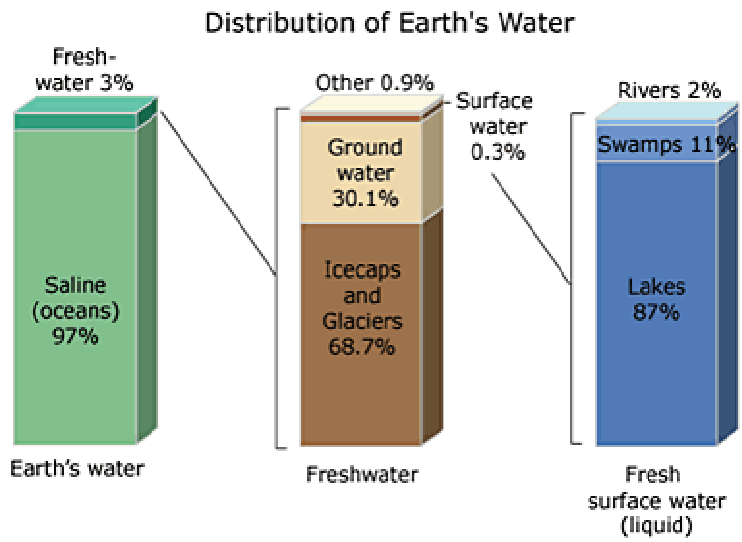
• Students will learn about different types of water meters used in the industry.

•Students will learn about different methods of meter reading.

Part One: Water Conservation

Although it appears groundwater and surface waters are in ample supply, all of it is not available for consumption or even irrigation. There are many ways where water is wasted; some of the ways are very obvious while others are subtle, sometimes seeming invisible. Understanding ways water is wasted is the first step in controlling the problem. There are plenty of ways everyone can stop wasting our greatest natural resource - water.

Lots of Water, Little to Drink



Source: United States Geological Survey Website

The amount of water on Earth is somewhere near 400 billion billion (yes, that is a double billion) gallons. That's a four followed by twenty zeros, or 400,000, 000,000,000,000,000. Although this seems like an almost-infinite amount, only a very small amount is available to drink.

The amount of water available to Earth never changes. There is the same amount of water here today as there was 3 billion years ago. The Earth is a closed system with all water and other substances confined within the Earth's atmosphere and gravitational pull. The water cycle is responsible for cleaning and recycling the water.

Most of the water on Earth, 97%, is salt water and is found in the oceans. That only leaves 3% fresh water for drinking, but not all of the fresh water is accessible for drinking.

More than two-thirds of the fresh water is locked away in ice caps, icebergs, or glaciers. Most of the ice is found at the pole of the Earth, such as Greenland and Antarctica. Not even all of the liquid freshwater is available, either. A good portion of the remaining fresh water is found in groundwater and not usable for drinking water.

All that is available to drink is the surface water that is not polluted, a very small percentage of the total water found on Earth.

A Drop in the Bucket

Using a few simple pieces of lab equipment, it is easy to demonstrate how limited our drinking water truly is. When this demonstration is completed, students will view the drip that might be leaking from the sink in the classroom much differently.

Materials

1000 mL graduated cylinder
100 mL graduated cylinder
10 mL graduated cylinder
eye dropper
water

Demonstration

Start with the 1000 mL cylinder filled with water. This represents all the water found on Earth.

Pour 30 mL of water from the 1000 mL graduated cylinder into the 100 mL graduated cylinder. This represents all the fresh water found on Earth. The remaining 970 mL of water represents all the salt water.

Pour 6 mL of water from the 100 mL graduated cylinder into the 10 mL graduated cylinder. The remaining 24 mL represents the frozen, fresh water found in ice caps and glaciers. The 6 mL of water represents the fresh, non-frozen water. Of this 6 mL, 1.5 mL is surface water and 4.5 mL is ground water.

Use an eye dropper and remove 1 drop of water from the 10 mL graduated cylinder. This one drop represents the clean, fresh water that is not polluted and is available to use, only about 0.003% of the total amount of Earth's water!

Interior Water Conservation

The easiest place to begin conserving water is inside your home. There are many places where small, almost invisible leaks can add up to a considerable amount of waste. Fixing leaks and conserving water in your home not only saves water, but it also saves money. Each drip of water is money going down the drain! If it is hot water that is dripping, it cost even more.

Faucet leaks are one of the largest source of wasted water in the home, and they are easy to detect. When a faucet is shut off but drips, or worse, keeps running, it needs to be fixed. There is no such thing as 'just a small leak', it all adds up. A leaky faucet, shower or toilet can dribble away thousands of gallons of water a year. Repairs are typically simple and affordable, usually a washer or seat has gone bad and needs to be replaced.

Leaks and Their Impacts

The size of the leak will determine how much water is wasted. Below are examples of how much water is wasted over the course of three months.

1/32" drip
18,500 gallons

1/16" trickle
74,000 gallons

1/8" stream
296.000. gallons

1/4" stream
1,181,000 gallons

There are many small changes that can be made to conserve water at home. The most important is fixing leaks as soon as they are detected. If a toilet is running all the time, determine if there is a leak by placing food coloring in the toilet tank and letting it sit. If the water in the bowl turns color, there is a leak.

Other ways to conserve involve replacing older appliances that are not as efficient. Replacing an old toilet that uses 5 gallons to flush with a 1.6 gallon per flush can permanently reduce water consumption by 25%. Low-flow shower heads and high-efficiency clothes and dish washers will also reduce water use.

One simple way for everyone in the family to save water is not allowing the faucet to run while brushing teeth, shaving or washing hands. Some of the best ways of conserving do not cost anything!

The Leaky Faucet

Small leaks add up to very large amounts of wasted water and wasted money, money right down the drain. Almost everyone encounters a drippy sink somewhere at home or at school and too often the leak is overlooked and not fixed. This activity demonstrates how a perceived small leak can waste a large amount of water over time. By measuring the amount of water wasted from a small drip, students can calculate how many gallons of water a day are going down the drain, unused.

Materials

1000 mL graduated cylinder
Large styraform cup with a small hole poked in the bottom
Two plastic cups (smaller than the styrafoam cup), one filled with water
Clock to track time.

Each small group of students will need a set of the supplies

Procedure

Give each group of students a set of materials.

Hold the styrafoam cup over the empty plastic cup.

Pour the water from the plastic cup into the sytrafoam cup and start timing for one minute. When one minute is up, remove the dripping styrafoam cup from the plastic cup and place it in the other (empty) plastic cup.

Pour the water that dripped into the plastic cup during the one minute into the graduated cylinder .

Use the formula below to calculate how many gallons of water are wasted during the course of a day.

How Much Down the Drain??

How many milliliters of water dripped in one minute: ________ mL

(________ mLx 1440) / 3840 = gallons per day.

Here is how the formula was derived:

$$\frac{?\ \text{mL}}{1\ \text{mi}} \times \frac{1440\ \text{minutes}}{1\ \text{day}} \times \frac{1\ \text{ounce}}{30\ \text{mLs}} \times \frac{1\ \text{gallon}}{128\ \text{oz}} = \_\_\_\_\_\ \text{gal/day}$$

Water Use Statistics

The daily indoor water use per capita in the United States is 69.3 gallons. Here is how it breaks down:

Use	Gallons per Capita	Percent of Total Daily Use
Showers	11.6	16.7%
Clothes Washers	15.0	21.6%
Dishwashers	1.0	1.4%
Toilets	18.5	26.7%
Baths	1.2	1.7%
Leaks	9.5	13.7%
Faucets	10.9	15.7%
Other Domestic Uses	1.6	2.3%

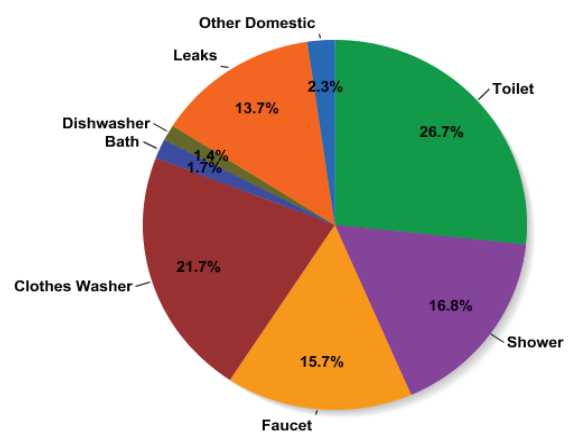
By installing more efficient water fixtures and regularly checking for leaks, households can reduce their daily per capita water demand to 45.2 gallons, a 32% reduction. The following chart is a breakdown for households using water conservation measures.

Use	Gallons per Capita	Percent of Total Daily Use
Showers	8.8	19.4%
Clothes Washers	10.0	22.1%
Dishwashers	0.7	1.5%
Toilets	8.2	18.1%
Baths	1.2	2.6%
Leaks	4.0	8.8%
Faucets	10.8	23.8%
Other Domestic Uses	1.6	2.3%

The average U.S. household uses 127,400 gallons of water a year, which is approximately 350 gallons per day. If all U.S. households installed water-saving features, water use could decrease by 30%, saving an estimated 5.4 billion gallons of water a day. This would result in $11.3 million per day, or more than $4 billion per year.

Handbook of Water Use and Conservation, Amy Vickers, Residential End Uses of Water (Denver, Co: AWWARF, 1999)

Typical Household Water Use



American Water Works Association, 1999

Exterior Water Conservation

There are many places inside where water can be conserved, but what about outside? Proper landscaping and outdoor water use will help conserve water outside.

Be careful when maintaining the grounds around your home because your activities may affect your communities water resources. Many people depend on nearby groundwater wells or surface water reservoirs for their water supply. Pollution of groundwater or surface water may affect the environment and the quality of the drinking water. Overuse of water may affect the amount of water available, especially during dry periods. You can help reduce pollution by following some simple guidelines.

Reduce Your Use!!

Fix leaking faucets as soon as possible.

Plant less grass; shrubs and ground cover require less water and maintenance.

Choose native shrubs adapted to your climate.

Water only when necessary.

Do not water the lawn or sidewalk!

Water Problems & Past Land Use Practices

There are plenty of past land use practices that did not take into consideration what the impacts on the water supply might be. When we only think of our current needs and disregard the associated environmental impacts, the consequences can be far-reaching and long-lasting.

Some of our past practices that have created problems are:

•Over-pumping of water from deep wells.
When water is removed faster than it can be recharged, it will deplete the aquifer over time, leaving inadequate water supply for the area.

•Draining swamps and marshes.
Swamps and marshes act like a natural sponge, absorbing excessive runoff from rain events and slowly releasing the water into the environment, reducing the flash flooding in the area.

•Cutting forests in hilly regions and the loss of topsoil.
The trees and vegetation play an important role in reducing erosion and protecting the nutrient-rich topsoil. When trees are indiscriminately cut from steep hillsides and vegetation is removed, there is nothing preventing erosion. Topsoil taken millennia to develop but can be lost during one storm event.

Protect Your Water Resources

Anyone can help keep their local waters safer by following some simple guidelines while working outside their house. A few minutes and a little planning can have a great impact on the environment. Having an awareness about your actions and how they affect the local water will benefit everyone.

Lawn & Garden Care

- Have the soil tested to check for possible nutrient deficiencies, only use fertilizer if the test show the need.
- Use slow release organic fertilizers and apply in the fall to promote healthy root development.
- Use alternatives to commercial chemicals such as pest-resistant plants and introduce beneficial species such as ladybugs, bees and bats.
- Apply environmentally friendly pesticides when possible.
- Apply pesticides during dry periods to prevent them from being washed away.
- Maintain a "no chemical" buffer zone around your vegetable garden.
- Properly dispose of unused chemicals at a household hazardous collection center.

Watering & Maintaining Your Landscaping

- Plant native and drought resistant plants to reduce watering needs.
- Only water when needed, usually once a week is sufficient - shrubs need even less!
- Compost leaves, clippings and veggie wastes to improve the soil of your garden.
- Apply mulch to reduce weeds and help the soil to maintain more moisture.
- Water in the morning to reduce water loss from excessive evaporation.
- Use a soaker hose and use a rain sensor/controller for your irrigation system.

Landscape Design

- Maintain vegetated buffer area around surface water and storm drains. Vegetation traps sediment and helps absorb nitrates from excess fertilizers and improperly functioning septic systems.
- Help reduce erosion by diverting runoff away from steep slopes; slopes should be well vegetated.
- Employ water-conserving landscaping practices, known as xeriscaping, to minimize water usage. Xeriscaping and use of native plants can reduce water consumption from 25% to 75%.

Automatic Irrigation Controllers - The Wise Way to Irrigate

This is a cooperative effort sponsored by members of both the water and landscape industry to promote efficient landscape water use. The purpose is to highlight the importance of irrigation controller features that allow for a proper irrigation schedule.

How does a controller work?

A large part of our household water use goes to watering our landscape. The most efficient way to accomplish this is through the use of an automatic irrigation system. The most important component of the system is the irrigation controller, also called the timer or the clock. The controller is responsible for turning the system on and off.

An automatic irrigation system is a collection of pipes, tubing, valves, sprinkler heads, and circuitry. Automatic valves, which control the flow of the water to the different parts of the landscape, open and shut upon a signal from the controller. Once programmed, the controller determines when, how often, and how long each valve is opened. The more programming capability your system has, the more efficiently water can be applied to the landscape.

Some controllers have optional features that add to their efficiency. Controllers that have a "pause time" feature allows for more uniform pressure by closing one valve completely before opening another. This is a very important feature for those who are on a well, allowing the well to recover before the next irrigation cycle. If the controller has a "soak cycle", it will allow for short, multiple waterings. This feature is beneficial to reduce runoff or to break the soil surface tension and wet the soil.

Knowing your landscape's watering needs

Having an efficient watering system is only one aspect of exterior water conservation. Knowing when your plants need water is equally important.

Efficiently designing your landscape through the use of plant material, soil preparation, and proper horticultural practices. Extensive use of plants suited for the climate and the region should be maximized.

Plants should be grouped, as much as practical, according to their watering needs. Proper maintenance that include regular pruning, weeding, lawn aerating and de-thatching, and the use of mulches and fertilizers should be followed.

Know how much water your landscape *really* needs. Plants require the most water during the summer and little to no water in the winter. After July, plants need less and less water each month, and by November, little or no irrigation is required until March or April. As spring approaches, watering will need to increase each month through July. By the end of September, your landscape will need only about half the water it needed in July.

Part Two: Water Metering

A water meter is a device used to measure the volume of water usage and is a mainstay of revenue for any water utility. Water meters are used at each residential and commercial building in a public water supply system. Water meters can also be used at the water source, such as a well, or throughout a water system to determine flow through that portion of the system. A display on a water meter is typically in cubic feet (ft^3), cubic meters (m^3) or U.S. gallons on a mechanical or electronic register. Some electronic meter registers can display rate-of-flow as well as totalization.

Meter reading technology has evolved through many stages throughout the years and there are many different versions at utilities throughout the U.S. There are several types of water meters in common use. The selection of the meter is based on accuracy requirements, required flow rates, flow measurement methods and the type of end user. There are manufacturing standards for all water meters; the standards for North America are determined by the American Water Works Association.

This section covers the different types of meter and how they function. The following types of meters will be covered in greater depth as the section progresses.

Common Types of Water Meters

- Multi-jet meter
- Single-jet meter
- Positive displacement meter
- Turbine meter
- Compound meter
- Fire meter
- Fire hydrant meter
- Electromagnetic meter
- Ultrasonic meter
- Nutating Disk
- Propeller

There are two major methods of measuring flow; displacement and velocity. Each type has is most useful application.

Displacement metering relies on water to physically displace the moving measurement element in direct relation to the amount of water that passes through the meter. The piston or disk moves a magnet that drives the register. They are typically used in residential, or lower flow applications.

A velocity meter measures the velocity of the flow of water through a meter of a known internal capacity. The speed of the flow can then be converted into the volume of flow for usage. Most of this type of meter have an adjustment vane for the calibration of the meter to the required accuracy standards.

Water meters are typically owned, read, and maintained by a public water provider such as a city, rural water association, or private water company. In some cases, an owner of a mobile home park, apartment complex, or commercial building may be billed by a utility on one meter and may want to share the cost of the bill among its tenants. In this case, private meters may be purchased to separately track usage of each unit.

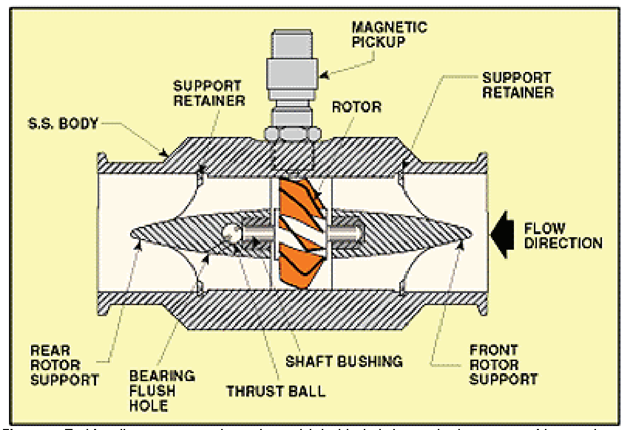
Types of Water Meters

Velocity Water Meters

A velocity type meter measures the velocity of glow through a meter of a known internal capacity. The speed of the glow can be then converted into volume of flow for usage. There are several types of meters that measure water flow velocity to determine totalized usage. They include single and multi-jet meters, turbine meters, propeller meters and electromagnetic meters. Most velocity meters have an adjustment can for calibration of the meter to required accuracy standards

Turbine Meters

Turbine meters are less accurate than displacement meters and jet meters at low flow rates, but the measuring element does not occupy or severely restrict the entire path of flow. The flow direction is generally straight through the meter of, allowing for higher flow rates and less pressure loss than displacement-type meters. They are the meter of choice for large commercial users, fire protection, and as master meters for the water distribution system. Strainers are generally required to be installed in the front of the meter to protect the measuring element from gravel of other debris that could enter the water distribution system.



http://water.me.vccs.edu/exam_prep/flow1.htm

Turbine meters are generally available for 1 1/2" to 12" or greater pipe sizes. The meter bodies are typically made of bronze, cast iron or ductile iron. Internal turbine elements can be plastic of non-corrosive metal alloys.

Multi-Jet Meters

Multi-jet meters are very accurate in small sizes and are commonly used in 5/8" to 2" sizes for residential and smaller commercial uses. Multi-jet meters use multiple ports surrounding an internal chamber, to create a jet of water against an impeller. The impeller rotation speed is in relation to the velocity of water flow. Although multi-jet meters are very accurate at low flow rates, they are not used in larger sizes because they do not have the straight flow-through path needed for the high flow rates of high diameter pipes. Multi-jet meters generally have an internal strainer element that can protect the jet ports from becoming clogged. The meters normally have a bronze alloy body or outer casing, the internal measuring parts are made from modern thermoplastics and stainless steel.

Compound Meters

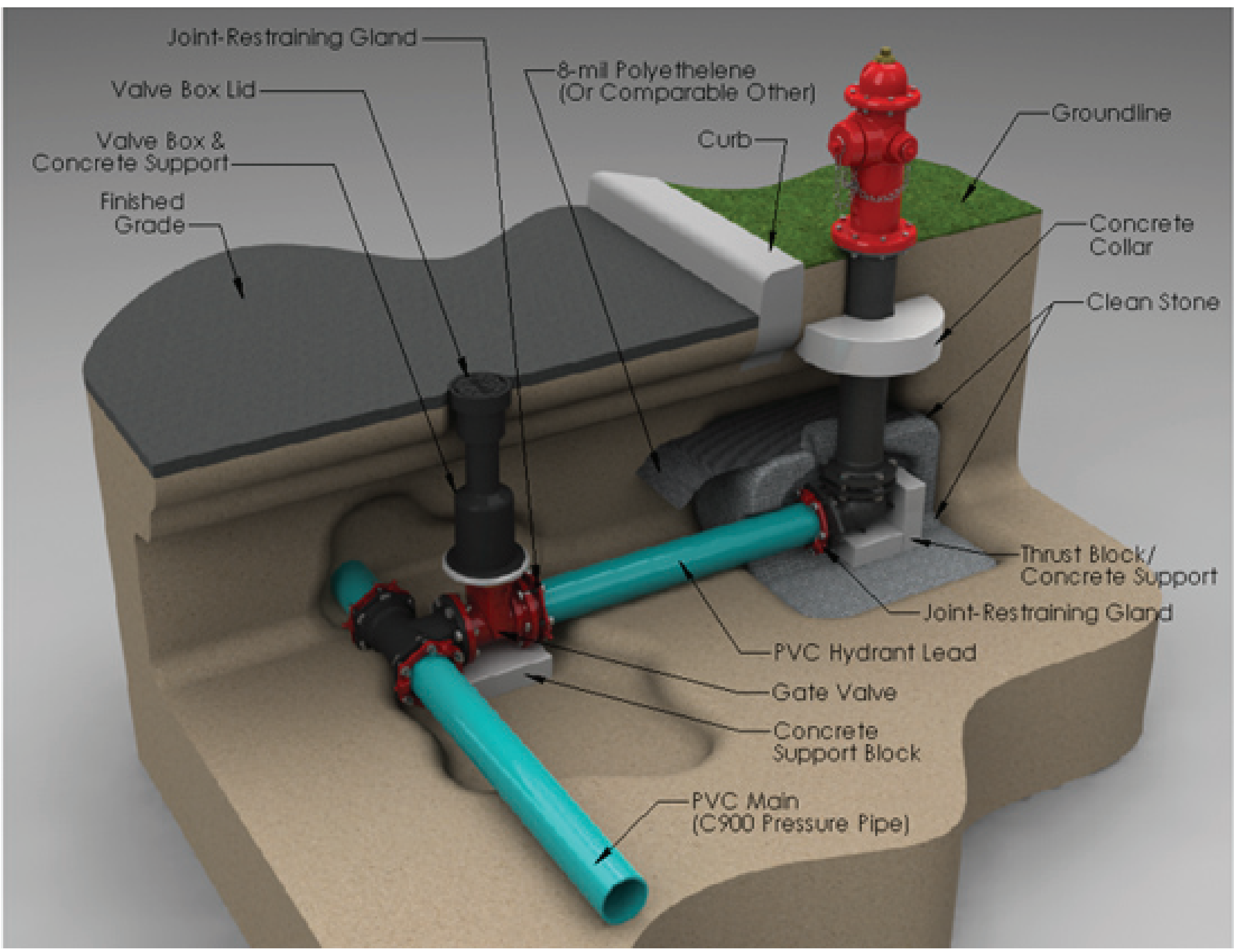
A compound meter is used where high flow rates are necessary, but , at times, there are smaller rates of flow that still need to be accurately measured. Compound meters have two measuring elements and a check valve to regulate flow between them. At high flow rates, water is normally diverted primarily or completely to the turbine part of the water meter. When the flow rates drop too low for it to be accurately measured, a check value closes to divert water to a smaller meter that can accurately measure the reduced flow. The low flow portion of the meter is typically a multi-jet or positive displacement meter. By adding the registration of the high and low flow meter, the utility can obtain the total consumption of the meter.

Fire Hydrant Meters

Fire hydrants are a specialized type of portable turbine meter with approvals from Underwriters Laboratory (UL) or Factory Mutual (FM) for the high flow rates required for fire protection.

The meters are normally made of aluminum to be light weight and are typically 3" capacity. Utilities often require them for measurement of water used in construction, poll filling or where a permanent meter is not yet installed.

Anatomy of a Fire Hydrant



http://www.unitedwaterproducts.com/images/graphics/fire-flo-awwa-hydrant.png

Electromagnetic Flow Meters

Electromagnetic flow meters, commonly referred to as "mag meters", are technically a velocity-type water meter, except that they use electromagnetic properties to determine water flow velocity rather than mechanical means like the jet and turbine meters. Mag meters use the physics principle of Faraday's Law of Induction for measurement and require AC or DC electricity from line of battery to operate the electromagnetism. Since mag meters have no mechanical measuring element, they normally have the advantage of being able to measure flow in either direction, and use electronics for measuring and totalizing the flow.

Mag meters can also be useful for measuring untreated water, raw water, and waste water since there is no mechanical measuring element to get clogged or damaged by debris flowing through the meter. With the lack of mechanical measuring element, strainers are not required. Stray electrical energy flowing through the flow tube can cause inaccurate readings; therefore most mag meters need to be installed with either grounding rings or grounding electrodes to divert stray electricity away from the electrodes used to measure the flow inside the flow tube.

Ultrasonic Meters

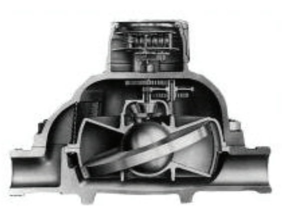
Ultrasonic water meters use an ultrasonic transducer to send ultrasonic sound waves through the fluid to determine the velocity. The velocity is then translated into a measurement of the volume of water. Ultrasonic flow meters are ideal for metering wastewater or any dirty liquid which is conductive or water based. Ultrasonics flow meters will generally not work with distilled water or drinking water. Ultrasonic meters are also ideal where there might be low pressure drops, they are also low maintenance.

Displacement Water Meters

Displacement meters are typically referred to as positive displacement or "PD" meters. Displacement meters are generally very accurate at low to moderate flow rates typical of residential and small commercial users. They are common in sizes from 5/8" to 2". This type of meter is not practical in large commercial applications because this technology relies on water being pushed through the measuring element and they do not do well with high flow rates or pressure drops. Displacement meters normally have a built-in strainer to protect the measuring element. They are normally constructed with bronze, brass, or plastic bodies with internal measuring chambers made from molded plastics and stainless steel.

Two common methods of positive displacement measuring are oscillating piston meter and nutating disk meters. Both methods rely on water to physically displace the moving measuring element in direct relation to the amount of water that passes through the meter. The pin or disk moves a magnet that drives the register.

Nutating Disk Chamber



http://www.ferret.com.au/c/AMS-Instrumentation-and-Calibration/images/Niagara-nutating-disc-flowmeters-178128-255x255.jpg

Displacement Water Meter

http://www.jerman.com/C700.jpg

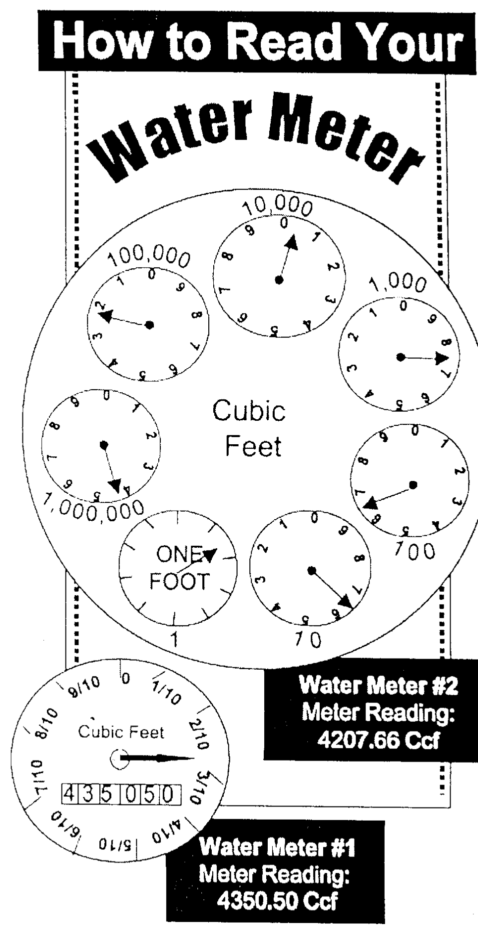
Reading a Water Meter

Learning to read your water meter can help you discover water leaks, monitor usage and double check your utility bill. All three of these activities may end up saving money in the long run. Water meters are typically located in the basement, in a concrete box along the front curb, or along an outside wall of the house.

The meters record water usage in units of hundreds of cubic feet (Ccf) or gallons. There are two types of water meters in use today.

Water Meter #1

This type resembles a mileage indicator on an automobile and is read in the same manner. The last two digits to the right can be disregarded as they measure extremely small units. If zero appears as the last digit to the right, this number never changes. It represents tens of gallons or cubic feet (Ccf) which are recorded by the small pointer hand.
To determine usage on a monthly basis, write down the meter reading now and then take another reading exactly one month from now. Subtract the old reading from the new reading and you will have the number of water units the household consumed in one month. The water usage can also be checked by the day using the same process, but this time include the last two digits as the usage number will be much smaller for one day.

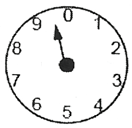


Water Meter #2

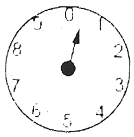
This type looks like a series of small clocks that alternate turning clockwise and counter clockwise. The dials can be read by starting with the highest numbered dial (usually 100,000 or 1,000,000) and ending with the dial marked 1,000. The shaded dials labeled 100, 10, and one foot can be disregarded for now because they measure small amounts of water.

Look at the pointer on the highest numbered dial. If it is between two numbers, write down the lower number. In the example above, this would be "4" on the dial labeled 1,000,000. IF the pointer seems to be one a number, check the pointer on the next lower dial. If the hand is located on the "1" side of the zero, read the figure indicated; if not, read the lower figure.

Determining the number may seem tricky when the pointer is between the zero and the nine. In that case, the zero is actually a ten, so nine would be the lower number to choose. If the pointer is between the zero and the one, the chosen number would be zero because zero is less than one.



This meter dial would read "9" because nine is less than 10. Zero represents 10 in this case because of the location of the arrow between the nine and the ten.



Likewise, this meter dial would read "0" because it is less than one.

Locating Leaks

Now that you know how to read your meter, use this knowledge to locate money-wasting leaks in your home.

How to find a leak:
Turn off all water inside and outside the home.

Read the meter. Mark where there pointer hand or one foot hand is on the meter.

Wait 15 to 20 minutes and then check the hand again.

If the hand has moved, there is a leak in the house.

Monitoring Household Appliances

Use the following procedure to find out how much water, and money, is required to run your dishwasher, shower, or washing machine.

How much water for an appliance:
Turn off all the water in the house.

Take a water meter reading.

Turn on the appliance to monitor. When the appliance has completed its cycle, turn it off.

Take another water meter reading.

Subtract the old reading from the new reading to determine how much water was used.

Converting Ccf to Gallons

748 gallons = 1 Ccf

Multiply the number of Ccf by 748 gallons to determine the number of gallons used.

Example:
12 Ccf x 748 gallons = 8,976 gallons

Water Meter Reading

Water Meter Registers

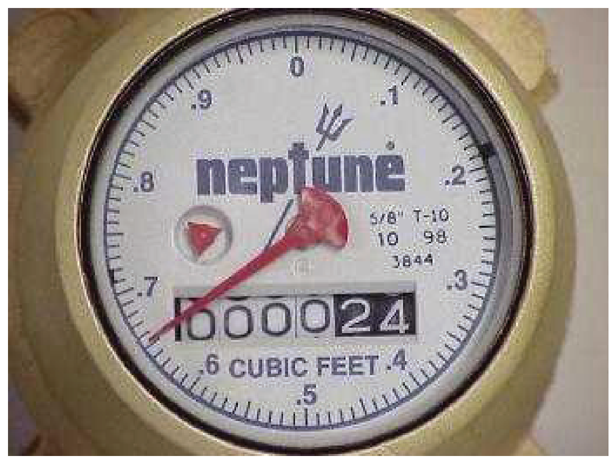
There are several types of registers on water meters. A standard register normally has a dial similar to a clock with gradations around the perimeter to indicate water usage measured by the meter as well as a set of odometer wheels similar to those in a car. Modern registers are driven by a magnetic coupling between a magnet in the measuring chamber attached to the measuring element and another attached to the bottom of the register. Gears in the register convert the motion of the measuring element to the proper usage increment for display on the sweep hand and the odometer. Many registers also have a leak detector. This is a small visible disk or hand that is geared closer to the rotation speed of the drive magnet, so that very small flows that would be visually undetectable on the regular sweep hand can be seen.

Different size meters may display a reading in different resolutions. One rotation of the sweep hand my be 10 gallons or 1000 gallons. if one rotation of the hand represents 10 gallons, the meter has a 10 gallon sweep. Most utilities bill to the nearest 100 or 1000 gallons (10 to 100 ft^2, 1 to 10 m^3).

Standard Register

http://images1.hellotrade.com/data2/MD/OW/HTVENDOR-2044077/meter-singlemag-g-250x250.jpg

Modern Register



http://www.ci.bellevue.wa.us/images/Utilities/meter.jpg

Water Reading Technology

Water meters were typically read by a water meter who would walk from house to house recording the meter reading in a log, this is a very time consuming and labor intensive process. It also introduces room for human error and incorrect meter readings. As technology progresses there are more efficient and accurate ways to get meter readings.

Automatic meter reading (AMR) comes in many different forms. Meters can be read automatically using touch technology, radio frequency network, handheld reading, mobile, or fixed network. The following section will discuss the new methods of meter reading.

Automatic Meter Reading (AMR)

Automatic meter reading manufacturers have developed pulse or encoder registers to produce electronic output for radio transmitters, reading storage devices, and data logging devices. Pulse meters dens a digital or analog electronic pulse to a recording device. Encoder registers have an electronic means for an external deice to interrogate the register for either the position or the odometer wheels or a stored electronic reading. Frequent transmissions of consumption can be used to give smart meter functionality.

Radio Frequency (RF) Network

Radio frequency-based AMT can take many forms. The more common ones are handheld, mobile and fixed network. Each one of these methods will be covered in greater detail. There are two-way RF systems and one-way RF systems in use that utilize either licensed or unlicensed RF bands.

In a two-way or ”wake up” RF network, a radio transceiver sends a signal to a particular transmitter serial number. This wakes the system from its resting state and tells it to transmit its data. The meter attached transceiver and the reading transceiver both send and receive radio signals and data.

In a one-way or "bubble-up" RF network, the transmitter broadcasts readings continuously every few seconds. This means the reading device can only be a receiver and the AMR device can only be a transmitter. Data travels one way, from the AMR device (transmitter) to the meter reading receiver.

There are also hybrid systems that combine one-way and two-way technologies using one-way communication fore reading and two-way communication for programming functions.

RF-based meter reading usually eliminates the need for the meter reader to enter the property or the home, or to locate and open an underground meter pit. The utility saves money by increased speeds of meter reading, decreases liability from entering private property, and has less chance of missing reads because of being locked out from meter access.

Radio Frequency Limitations

The technology based on RF is not readily accepted everywhere. In several Asian countries, the technology faces a barrier of regulations in place pertaining to the use of the radio frequency of any radiated power. For example, in India the radio frequency which is generally in ISM (Industrial, Scientific, and Mechanical) is not free to use, even for low power radio of 10mW.

The frequency band of 2.4 GHz can now be used in India for outdoor as as well as indoor applications, but few manufacturers produce products in this frequency band. Initiatives in radio frequency AMR in such countries are being taken up with regulators wherever the cost of licensing outweighs the benefits of AMR.

Touch Technology

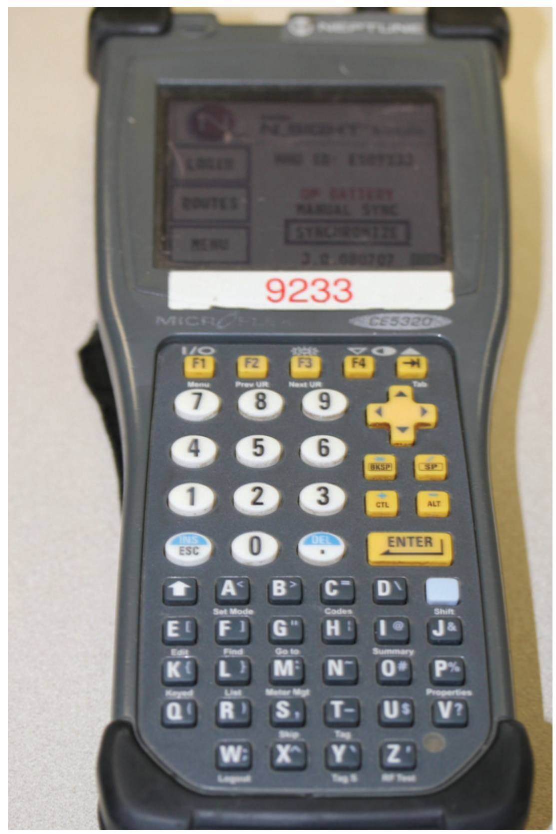
With touch based AMR, a meter reader carries a handheld computer or data collection device with a wand or a probe. The device automatically collects the readings from a meter by touching or placing the read probe in close proximity to a reading coil enclosed in a touch pad. When a button is pressed, the probe sends a signal to the touch module to collect the meter reading. The software in the device matched the serial number of the meter to one in the route database, saves the meter reading for a later download to a billing or data collection computer. Since the meter reader still had to go to the site of the meter, this meter is sometimes referred to as "on-site" AMR.

Mobile

Mobile, or "drive-by", meter reading is where a reading device is installed in a vehicle. The meter reader drives the vehicle while the reading device automatically collect the meter readings. The mobile meter reading equipment often includes navigational and mapping features provided by GPS and other mapping software. With mobile meter reading, the reader does not normally have to read the meters in any particular order, but just drives the service area until all the meters are read. Components usually consist of a laptop or proprietary computer, software, radio frequency (RF) receiver/transceiver, and external vehicle antennas.

Handheld

In handheld AMR, a meter reader carries a handheld computer with a built in or attached receiver/transceiver (radio frequency or touch) to collect meter reading from an AMR capable meter or an outside remote odometer. This is sometimes referred to as a "walk-by" meter reading since the meter reader walks by the locations where meters are installed as they go through their meter reading route. Handheld computers may also be used to manually enter readings without the use of AMR technology as an alternate, but this will not support exhaustive data, which can be accurately read using the meter reading electronically.



Handheld Metering Device

Fixed Network

Fixed network AMR is a method where a network is permanently installed to capture meter readings. This method can consist of a series of antennas, towers, collectors, repeaters or other permanently installed infrastructure to collect transmissions of meter readings from AMR-capable meters which send the data to a central computer without a person in the field to collect it.

There are several types of network technologies used to transmit data back to a central computer. A star network, which is the most common, requires a meter to transmit its data to a central collector or repeater. Some systems use only collectors which receive and store data for processing. Other systems use a repeater to send readings from a more remote area back to a main collector without actually storing the data. A repeater may be forwarded by RF signal or sometimes is converted to a wired network such as a telephone or IP network to send the data back to a collector.

Some manufacturers are developing mesh networks where meters themselves act as repeaters passing the data to nearby meters until it makes it to a main collector. A mesh network may save the infrastructure of many collection points, but is more data intensive on the meters. One issue with mesh networks is the increased demand for power. Battery operated meters will also need increased power to support the increased frequency of transmitting. It also requires that the meter devices be receivers as well as transmitters, potentially making individual transceiver costs higher. However, the additional cost may be outweighed by the savings of multiple collectors and repeater antennas and finding places to mount them.

AMR System

Some fixed network systems are also capable of being installed as a hybrid AMR system where fixed and mobile networks are intermixed by design. In a hybrid system, part of the system is read by fixed network, and parts may be read by mobile technology.

Utilities with low density, rural areas may not be able to justify the cost of a fixed network infrastructure for parts of their service area, using it only for its higher density zones or commercial accounts.

Some hybrid networks allow reading of a meter by both methods concurrently as a source of redundancy. In the event of a failure of the network due to a natural disaster, power failure, or other network interruption, the mobile reading system is available as part of their disaster recovery plan as an alternative means of data collection while the fixed network system is being repaired.