



Green Building & Sustainable Construction (TCM 5330)

Water Efficiency



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What are the impacts of water consumption on environment, economy, and community?

Environment:



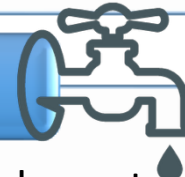
- The demand for water drives a slew of operations that have negative environmental impacts. In order to keep a supply of water, we build dams, dig wells, and make withdrawals from our natural water bodies. The built environment also makes it increasingly difficult for water to naturally recharge the system.

Economy:



- Talk about resources that aren't priced according to their true value—water has to be one of the most underpriced commodities. While the economics of saving water today might not be that impressive, as supply dwindles, the benefits become more apparent. Another cost-saving measure is that when you use less water, you also use less energy to heat that water.

Community:



- There is no doubt that water is different than any other commodity; it is fundamental to our existence. Ensuring safe, clean water for future generations is an imperative that can't be ignored.



Watch the video

ENVIRONMENTAL SUSTAINABILITY VIDEO: WATER CONSUMPTION

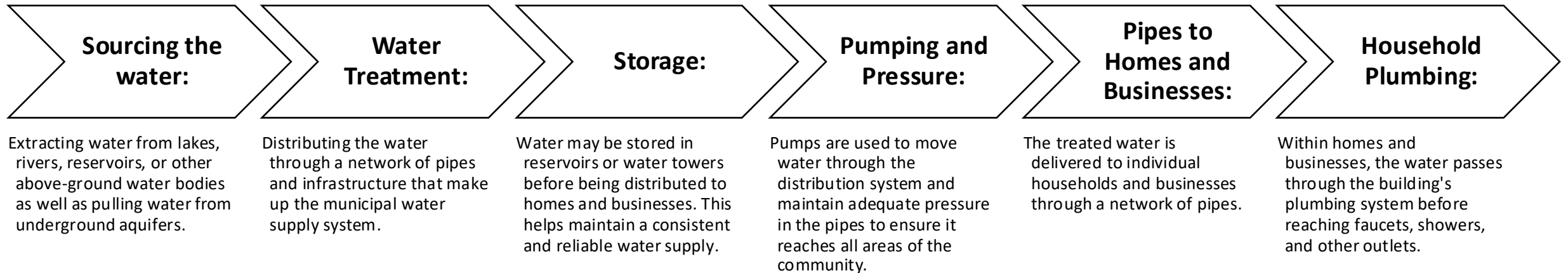
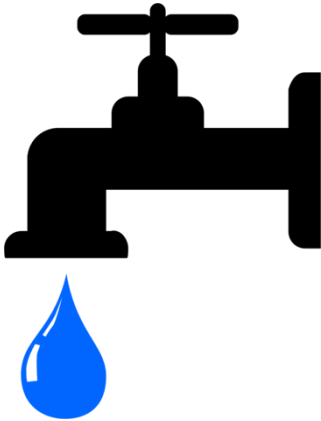
- Link: https://www.youtube.com/watch?v=MmPih842-rE&ab_channel=ForgeMonchieriSpA

(you may also click on the YouTube Logo below)



Where does drinking tap water come from?

- Drinking tap water typically comes from a municipal water supply system, and its source (surface water or groundwater) can vary depending on the location.
- The process generally involves the following steps:



Watch the video

How do we get clean drinking water?

- Link:

https://www.youtube.com/watch?v=PEKXB3N6g3I&ab_channel=InterestingEngineering

(you may also click on the YouTube Logo below)



What fixtures or appliances use the most water in the building?



Toilets:

Older toilets, especially those with higher flush volumes, can be major water consumers. Consider upgrading to low-flow or dual-flush toilets to reduce water usage.

Showers:

Long and frequent showers can contribute to high water consumption. Installing low-flow showerheads or using a timer can help conserve water.

Washing Machines:

Traditional top-loading washing machines tend to use more water than front-loading or high-efficiency models. Selecting an energy-efficient washing machine and adjusting load sizes can help save water.

Dishwashers:

Dishwashers can be water-intensive, particularly if they are not energy-efficient models. Run the dishwasher with full loads and choose shorter wash cycles to conserve water.

Garden Irrigation Systems:

Automatic sprinkler systems or frequent watering of lawns and gardens can contribute significantly to water consumption. Consider using rain sensors, drip irrigation, or watering during cooler parts of the day.

Leaky Fixtures:

Undetected leaks in faucets, toilets, or pipes can lead to substantial water wastage over time. Regularly check for and promptly repair any leaks.

Water Heaters:

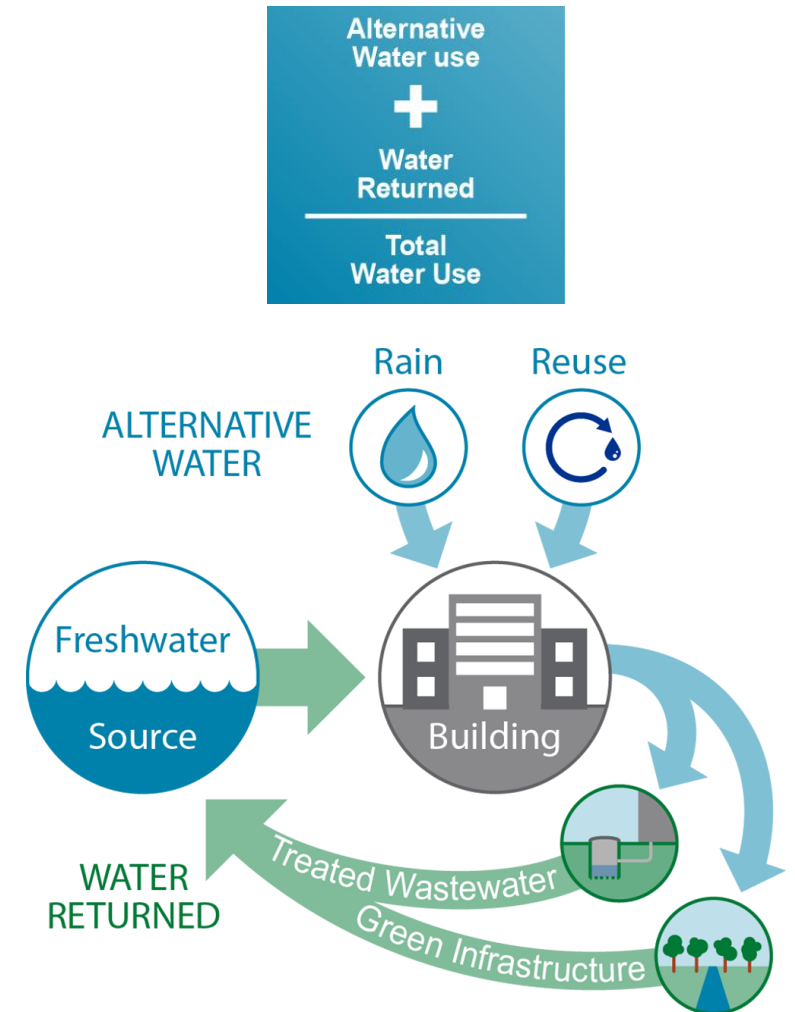
While water heaters don't consume water directly, inefficient or older water heaters may lead to longer wait times for hot water, resulting in more water wasted while waiting for it to heat up.

Faucets:

Running faucets, especially if left on while performing other tasks, can contribute to water waste. Install aerators on faucets to reduce flow rates.

Can we have a “zero net water” building? If not, how close can we come?

- Achieving a "zero net water" building, where the total water used within the building is balanced by an equivalent amount of water savings or on-site water generation, is challenging but not impossible.
- The concept of a "zero net water" or "water-neutral" building aims to minimize water consumption, enhance water efficiency, and offset any remaining water use through sustainable practices.



Watch the video

Net Zero Water - developing an integrated water management plan - Arup

- Link:

https://www.youtube.com/watch?v=0goqqP6RS6A&t=1s&ab_channel=Arup

(you may also click on the YouTube Logo below)



What are some strategies to achieve a “zero net water” building?

Water-Efficient Fixtures and Appliances:	Install low-flow toilets, water-saving faucets, and energy-efficient appliances to minimize water use within the building.
Rainwater Harvesting:	Implement rainwater harvesting systems to collect and store rainwater for non-potable uses such as landscape irrigation, flushing toilets, or cooling systems.
Greywater Recycling:	Treat and reuse greywater (water from showers, sinks, and washing machines) for non-potable purposes, reducing the demand on fresh water sources.
On-Site Water Treatment:	Explore on-site water treatment systems to purify and recycle water within the building, allowing for multiple uses and reducing reliance on external water sources.
Native Landscaping and Xeriscaping:	Design landscaping with native, drought-resistant plants that require minimal irrigation. Xeriscaping principles aim to create water-efficient and sustainable landscapes.
Efficient Irrigation Systems:	Use smart irrigation systems that adjust watering schedules based on weather conditions and soil moisture levels to optimize water use in outdoor spaces.
Water-Conserving Design:	Consider the building's design and layout to minimize water use. For example, placing plumbing fixtures in close proximity can reduce the length of water distribution pipes.
Educational Programs:	Implement educational programs for building occupants to promote water-saving habits and raise awareness about the importance of water conservation.

Watch the video

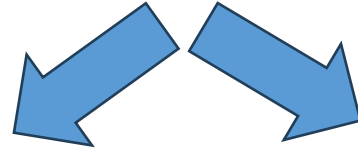
LEED v4.1 for Existing Buildings: Water Efficiency

- Link: https://www.youtube.com/watch?v=RpRG-xkGvcE&ab_channel=USGBC%28U.S.GreenBuildingCouncil%29
(you may also click on the YouTube Logo below)



Low-performing Vs. High-performing building

Water Efficiency Measures



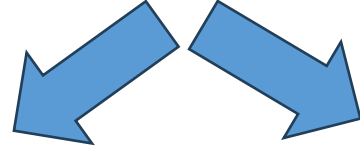
Low-Performing Building:

- Often characterized by conventional, water-intensive fixtures and appliances, such as older toilets and inefficient irrigation systems.
- Lack of water-efficient technologies and practices, leading to higher water consumption.

High-Performing Building:

- Incorporates advanced water-efficient fixtures and appliances, such as low-flow toilets, water-saving faucets, and energy-efficient washing machines.
- Implements smart irrigation systems, rainwater harvesting, and greywater recycling to optimize water use.

Low-performing Vs. High-performing building Landscaping Practices



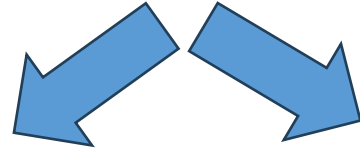
Low-Performing Building:

- May have extensive lawns or landscaping that requires frequent watering, contributing to high outdoor water consumption.

High-Performing Building:

- Adopts water-conserving landscaping practices, including the use of native plants, xeriscaping principles, and efficient irrigation systems.

Low-performing Vs. High-performing building Rainwater Management



Low-Performing Building:

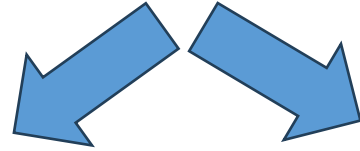
- Relies solely on traditional gutters and downspouts, potentially leading to uncontrolled runoff.

High-Performing Building:

- Utilizes advanced rainwater management strategies such as green roofs, permeable surfaces, and rainwater harvesting systems to reduce runoff and promote on-site water retention.

Low-performing Vs. High-performing building

Water Monitoring and Management



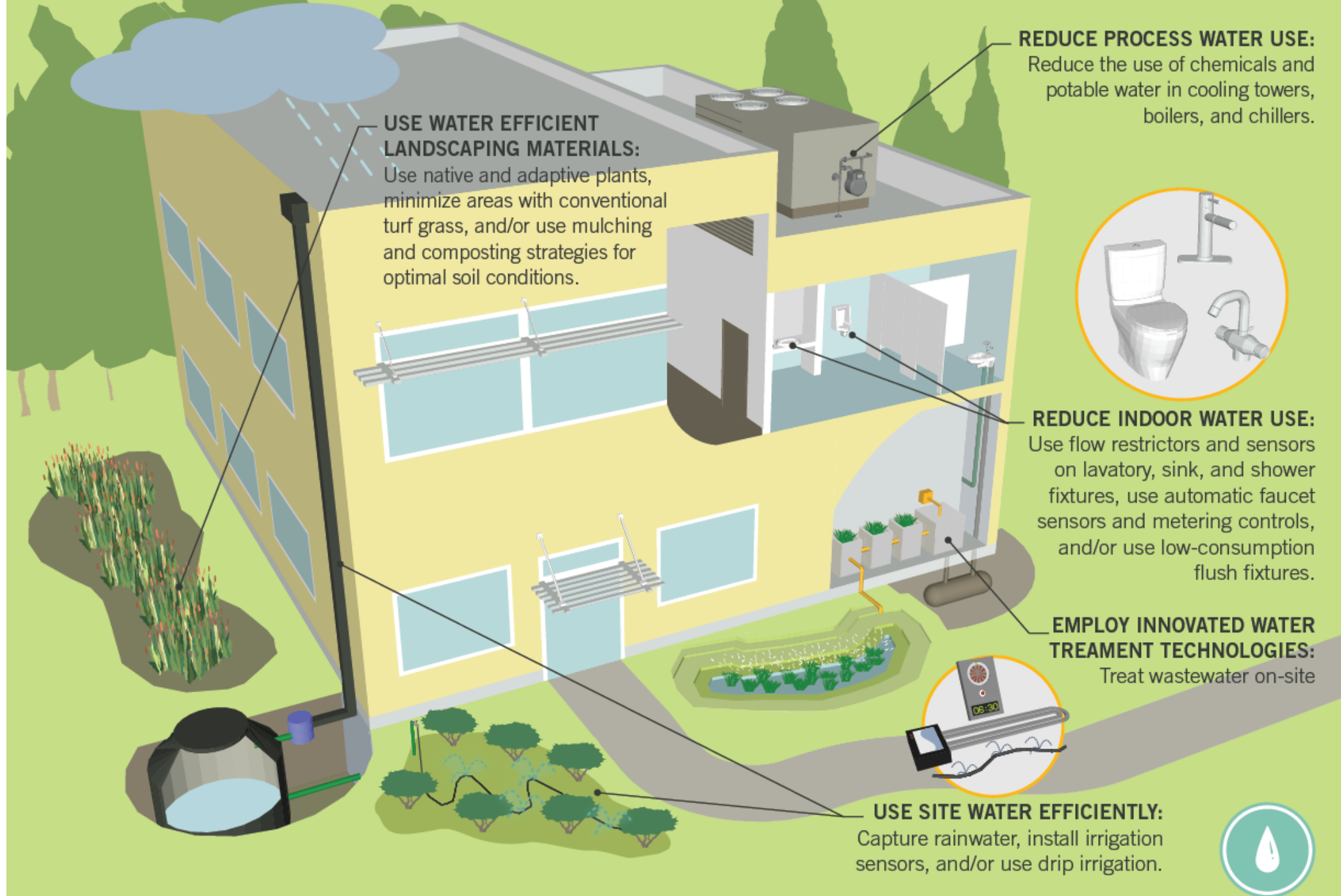
Low-Performing Building:

- Limited or no monitoring of water usage, making it challenging to identify and address inefficiencies.

High-Performing Building:

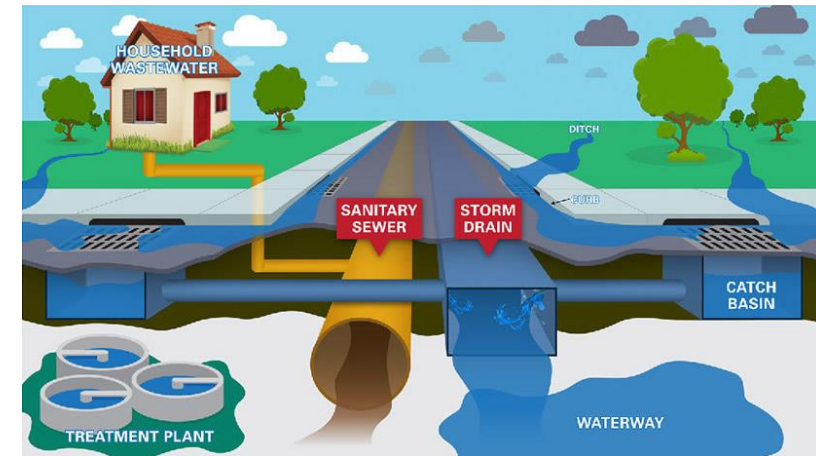
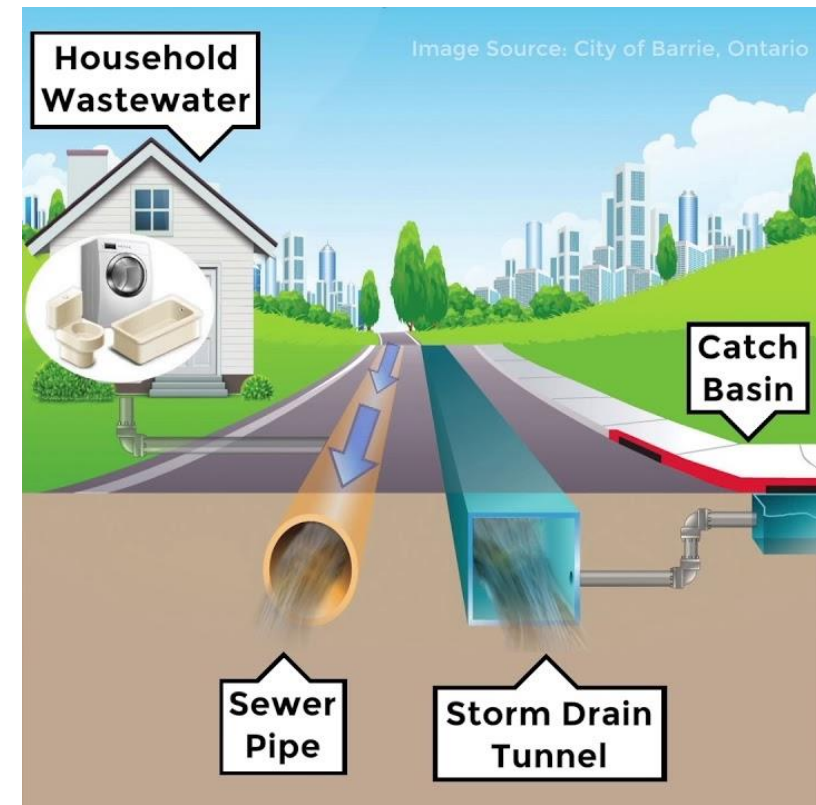
- Implements water monitoring systems to track usage patterns, identify leaks, and optimize water management strategies.

Sample of a high-performing building in water efficiency



What is the difference between a storm drain and a sewer?

- Storm drains handle uncontaminated stormwater runoff and discharge it directly into natural water bodies, while sewers manage wastewater from various sources, including homes and industries, treating it before discharge to ensure environmental safety.
- It's crucial to keep sewer systems separate to prevent contamination of natural water bodies and promote effective water management.



What are the three areas of water use in a project?

Indoor water

- water that is used inside the building for toilet flushing, handwashing, and drinking.

Outdoor (Irrigation) water

- water that is used outside the building to maintain landscaping.

Process water

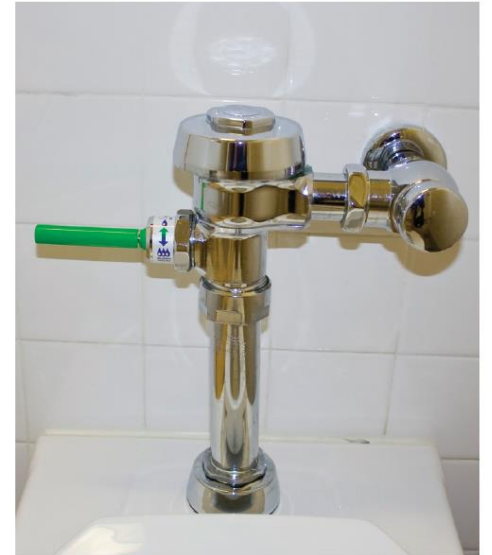
- water that is used in building systems to heat and cool air to maintain building temperatures. This also includes water used for dishwashing or washing machines.

Indoor water

- Indoor water consumption refers to the amount of water used within a building for various domestic and commercial activities.
- It includes water used for drinking, cooking, cleaning, personal hygiene, and other indoor purposes.
- Monitoring and managing indoor water consumption are essential for promoting water conservation and sustainability.



Waterless Urinal



Dual Flush Toilet

Indoor water saving strategies

Use efficient fixtures.

- Nowadays, it is pretty easy to obtain quality fixtures that use significantly less water than their predecessors. Low-flow toilets, faucets, and showerheads all provide the same service and use far less water.

20%

less water can be used by installing water-efficient fixtures and appliances

New Circle Mechanical



Indoor water saving strategies

Use non-potable water.

- Collecting or harvesting rainwater for use in toilets can take the strain off municipal potable water supplies.
- Using non-potable water for toilets can help reduce the demand for fresh, drinkable water and conserve water resources.
- Local regulations and building codes may dictate specific requirements for using non-potable water in toilets, so it's essential to check with local authorities before implementing such systems.



Indoor water saving strategies

Install meters.

- It's hard to fix a problem if you don't know what the problem is. Meters identify where water is being used so you can tell if you have a leak or some other issue.



Outdoor (irrigation) water

- Irrigation account for more than a quarter of all water consumption.
- This water is typically applied to the green space through various irrigation methods to supplement natural rainfall and ensure proper plant growth.
- Improved landscape design and maintenance can greatly reduce or even eliminate the need for potable water outdoors.



Outdoor water saving strategies Choose locally adapted plants.

- Plants that thrive naturally in an area do so for a reason — they have adapted to the soil and climate and therefore require little maintenance.



Outdoor water saving strategies

Use xeriscaping.

- Xeriscaping is another term for landscaping design that focuses on using plants that are native to an area and therefore require little water.
- In addition, xeriscaping emphasizes soil improvements, mulching, and efficient irrigation to maximize any water that is used.



Outdoor water saving strategies

Select efficient irrigation technologies.

- Sprinklers are great for running through on a hot summer day, but they are certainly not the most efficient way to water plants.
- Plants drink from their roots, therefore, supplying water directly to their roots means the plants get the bulk of the water instead of it evaporating into the air.



Outdoor water saving strategies

Use non-potable water.

- Non-potable water refers to water that isn't fit for humans to drink but is safe for watering plants. Municipally supplied reclaimed water is considered non-potable water.
- Capturing rainwater from the roof and using it as water for irrigation is one option for using the water that falls on the site.



Outdoor water saving strategies

Install submeters.

- It's hard to fix a problem when you can't find it. Submeters help identify leaks and let you know where your water is going.





What do we mean by irrigation efficiency?

- The percentage of water delivered by irrigation equipment that is actually used for irrigation and does not evaporate, blow away, or fall on hardscape.
- For example, overhead spray sprinklers have lower irrigation efficiencies (65%) than drip systems (90%).

Process Water

- Process Water includes the water used in dishwashers, clothes washers, and ice machines.
- It also refers to water used for industrial purposes and in building systems such as boilers and chillers.
- At the building management level, there are numerous opportunities to reduce the amount of water being used for operational and industrial purposes.
- Process water is reduced when a project uses reclaimed water in its cooling towers.



Process water saving strategies

Use efficient fixtures.

- Water-efficient appliances are easy to come by and are cost competitive, thanks to increased consumer demand.



Process water saving strategies

Use non-potable water.



- Using non-potable water for process water in buildings is a sustainable practice that involves the use of water that is not safe for drinking but is suitable for other purposes. Process water refers to water used for industrial processes and building systems, such as cooling towers, boilers, and irrigation.
- Well-designed building systems don't need to use excessive amounts of potable water.
- Closed-loop systems keep water clean in a contaminant-free closed loop that stretches the use of the water.

Process water saving strategies

Install submeters.

- Process water systems can have leaks and maintenance issues.
- Metering helps quickly identify problem areas.



Water Saving Systems

Waterless urinals

- The baseline water use for water closets, commonly known as toilets, is 1.6 gallons per flush (GPF).
- Waterless urinals are a type of urinal designed to operate without the need for flushing water. They function by using alternative methods to traditional flush urinals to convey urine away from the bowl.



Water Saving Systems

Dual-flush toilets

- Dual-flush toilets are designed to save water by offering two different flushing options: one for liquid waste and another for solid waste.



Water Saving Systems

Low-flow showerheads and faucets

- The U.S. federal standard for low-flow showerheads is a flow rate of no more than 2.5 gallons per minute (gpm) at a standardized pressure of 80 pounds per square inch (psi).
- Low-flow showerheads now come in even more efficient forms, using as little as 1.5 gpm or less.
- They achieve this by restricting the volume of water that flows through the showerhead, incorporating air to maintain pressure, or through pulsating streams that require less water to provide effective rinsing.



Water Saving Systems

Drip irrigation systems

- Drip irrigation systems are a type of micro-irrigation system that has the potential to save water and nutrients by allowing water to drip slowly to the roots of plants, either from above the soil surface or buried below the surface.
- The goal is to place water directly into the root zone and minimize evaporation.
- Drip irrigation systems distribute water through a network of valves, pipes, tubing, and emitters.



Water Saving Systems

Submeters

- Water submeters are devices used to measure water consumption in individual units within a larger property, such as apartments in a multi-unit building, individual businesses in a shopping center, or separate departments within an industrial facility.
- Unlike the main water meter that utility companies install to measure the total consumption for the entire property, submeters allow property owners and managers to track water usage in finer detail.



Water Saving Systems

Rainwater-harvesting system

- Rainwater harvesting systems are a method of collecting, storing, and conserving rainwater for later use. This approach is an environmentally friendly practice that helps to reduce reliance on municipal water supplies, mitigate flooding, and provide water for various purposes



The primary standard used to establish the baseline case for indoor water use

- The primary standard used to establish the baseline case for indoor water use is: ASHRAE Standard 90.1
- ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Standard 90.1 is a widely recognized energy standard that includes provisions for water efficiency in buildings. While it primarily focuses on energy efficiency, it also addresses water use, particularly in the context of plumbing fixtures and systems within buildings. Therefore, ASHRAE Standard 90.1 is often referenced as a baseline for indoor water use in building design and construction.



Using Nonpotable water

- Municipally supplied reclaimed water is considered nonpotable water.
- Nonpotable water is often used for toilet flushing and irrigation to conserve fresh water resources. It can also be used for industrial processes, firefighting, and certain types of cleaning.
- However, it is not suitable for ice making, drinking, or showers, as these activities require water that meets potable (drinkable) water standards to ensure safety and health.



What is graywater?

- Domestic wastewater composed of wash water from kitchen, bathroom, and laundry sinks, tubs, and washers. (EPA)

What is wastewater?

- The spent or used water from a home, community, farm, or industry that contains dissolved or suspended matter.

What is blackwater?

- Wastewater from toilets and urinals is commonly known as blackwater.

Watch the video Greywater and Blackwater

- Link:

https://www.youtube.com/watch?v=3KZus_D9zkQ&ab_channel=Greywatertreatment

(you may also click on the YouTube Logo below)

