NCEP Network of Conservation Educators & Practitioners

Developing capacity to sustain the Earth's diversity

NPS/Mike Quinn

Water Conservation Unit

Water conservation means reducing the amount of water we use through either technical or social means. It is seen by many as the most cost-effective and environmentally sound way to reduce our demand for water. Water conservation makes sense everywhere, but it is especially important with the Colorado River since every drop of water is used up by the time it gets to the ocean. Taking shorter showers (social) or installing drip irrigation (technical) will reduce the amount of water we use, therefore making more water available for other uses. In this lesson we'll explore where the Colorado River's water is used and where there is the best potential for conservation. After that, we'll finish the unit with the Water Conservation Calculator!

Low flow shower heads use much less water

Unit Outline:

1. Types of Water Use
    - Municipal
    - Agricultural
2. Potential for Conservation
    - Municipal
    - Agricultural
3. Interactive Simulation - Water Conservation Calculator

Point application irrigation is much more efficient than flood irrigation!

Types of Water Use

Water use is often divided into two categories: municipal and agricultural. Municipal use typically includes use in cities, industry, and residential settings, while agricultural use is water that is specifically used for crops or livestock. It is important to differentiate between these two types of use since they account for different amounts of water use and have different potentials for conservation.

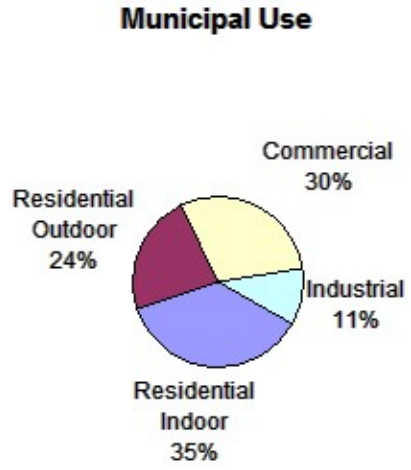
Municipal Use consists of the following categories:

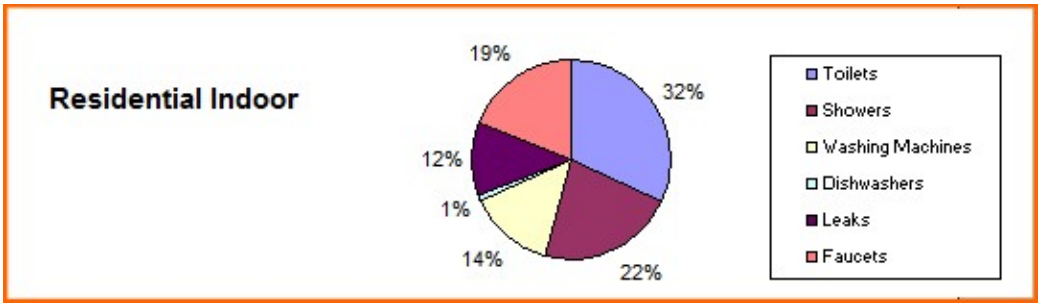
Industrial: Every manufactured product, whether it is steel, paper, lumber, chemicals, gasoline, or oil, must use water in some capacity during its creation. Even though industrial water use only comprises about ten percent of total public use, it is vital to the many businesses that utilize it.

Commercial: While the industrial use of water is associated with manufacturing a product, commercial use is associated with selling products or services. For example, some leading commercial uses of water are in hotels, restaurants, retail, laundries, golf courses, and offices.

Residential Outdoor: Watering lawns and gardens is the primary use of residential outdoor water. This use peaks in the summer when available "extra" water is usually at a minimum.

Residential Indoor: This is the water that is used by families inside their homes. See the plot below for how the average family uses this water!

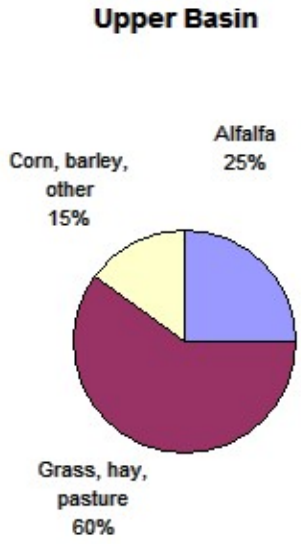


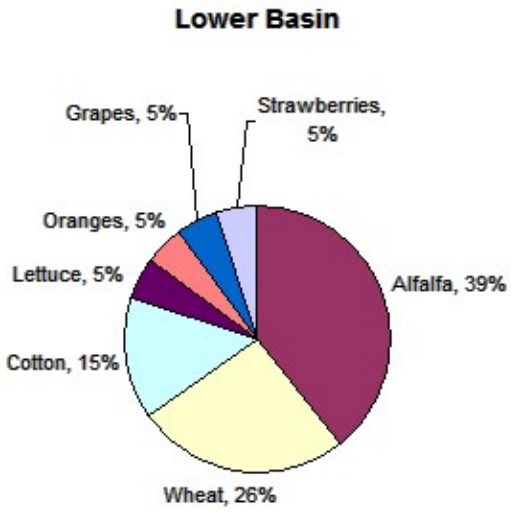


Types of Water Use

Agricultural

Because there is a different climate in the Upper and Lower Basin, the types of crops grown and use of agricultural water is also different. In the two figures below we can see that the Upper Basin uses agricultural water mostly on grass, hay, pasture, and alfalfa. The Lower Basin grows these crops along with fruits and vegetables. The primary fruits and vegetables grown with Colorado River water are lettuce, beets, carrots, broccoli, apples, oranges, grapes, and strawberries.





Potential for Conservation – Municipal Use

Now that we know where and how water is used in the Colorado River Basin, let's see where there is the potential to conserve some of this water. A recent study by the Pacific Institute identified where the potentials for conservation are in municipal water use. The study focused on California, but since it is municipal use, it's largely applicable to the rest of the Colorado River Basin as well.

Commercial and Industrial: Reducing the amount of water we use in commercial and industrial settings can be achieved by improving water efficiency and substituting reclaimed water. Improving water efficiency includes behavioral improvements, such as adjusting a watering schedule, and technological improvements like ultra-low-flow-toilets or auto-shut-off valves that reduce the amount of water used to accomplish a certain task. On-site reuse of water includes reusing water in the original process, such as recycling water in cooling towers, or recovering process water for use in alternative applications, such as irrigation. The Pacific Institute study indicated that the commercial and industrial sector could reduce their use of water by up to 38% through these means.

Residential Outdoor: The Pacific Institute study estimated that residential outdoor water use could be reduced by 25-40% through various means. Primary among these is switching from water intensive landscaping like turf to more drought tolerant plants. Using sprinkler systems with auto rain shutoffs (i.e. they do not turn on when it's raining) and soil moisture sensors, along with rain water reuse, helps achieve the rest of the savings.

Residential Indoor: We saw above how we use our indoor water. Most of this water is used in appliances and fixtures that have seen a lot of technological improvements in water efficiency over the past 20 years. For example, most toilets sold these days are 1.6 gallon/flush low flow toilets, where they used to be 6 gallons/flush. The same types of reductions in water use have been achieved in dishwashers, clothes washers, and showers. The table to the right shows how much it is estimated that we can save in each of the areas of indoor use. This represents up to a 40% reduction in water usage.

Potential Indoor Water Savings	
Toilets	57%
Showers	24%
Washer	33%
Dishwashi	46%
Leaks	80%
Faucets	0%

Potential for Conservation – Agricultural Use

As the demand for water in the Colorado River Basin increases as a result of the Basin's population growth, irrigation districts and farmers will need to implement water management and water conservation programs. The irrigation districts will work to increase the efficiency with which they deliver water to the farmers while the farmers will implement actions that increase the amount of crops they can produce for a given amount of water. Many improvements in efficiency have already occurred in the basin, but there still remains a significant potential for improvement.

Irrigation Districts

The United States Bureau of Reclamation and the local irrigation districts that are responsible for delivering water to farmers lose hundreds of thousands of acre-feet of water every year to evaporation, seepage to groundwater, and other operational inefficiencies. Most of the agencies responsible for these water deliveries have started over the past decade to improve the efficiency with which they delivery water. This efficiency means to convey and deliver the water to the farmers while losing as little as possible in the process. The mechanisms with which the efficiency programs have been implemented are largely canal lining, building regulating reservoirs, implemented canal seepage recovery programs, and building interceptor canals. The United States Department of Agriculture has done studies on potential efficiency gains and estimated that improvements can be made on the order of 10 – 20%.

Canal lining: Older canals that consisted of dirt ditches allowed some of the water to seep into the ground, meaning more needed to be diverted from the river to meet the farmers' demand. Newer canals lined with concrete allow very little water to infiltrate into the ground.

Regulating reservoirs, automated delivery, and interceptor canals: These mechanisms work to increase the flexibility and the accounting of water delivered to farms. Many delivery schedules are set up months ahead of time and occasionally a farmer's water demand decreases. Interceptor canals and regulating reservoirs mean this water can be stored or diverted to a different farmer that does need it, as opposed to over-irrigating the original farmer's crops.

Potential for Conservation – Agricultural Use continued

Farms

Irrigation efficiency on farms can be divided into two components: water losses and uniformity of application. If either the water losses are large, or application uniformity is poor, efficiency will be low. Although both components of efficiency are influenced by system design and management, losses are predominantly affected by management, while uniformity is predominantly affected by system design.

Water Losses

Over-watering is probably the most significant cause of water loss in any irrigation system. No matter how well the system is designed, if more water is applied than can be beneficially used by the crop, efficiency will suffer. Thus, proper irrigation scheduling is important if high efficiencies are to be achieved. Aside from over-watering, the major losses associated with surface irrigation systems are direct evaporation from the wet soil surface and wind drift. It should be noted, however, that some of the water lost to wind drift and evaporation from the sprinkler spray is not actually lost, since it substitutes for crop transpiration. Well maintained sprinkler systems should have leak and drainage losses below 1%, but poorly managed systems have shown losses of 10%. Two major technological improvements have occurred over the last decades that have helped minimize these losses. They are automated irrigation timing systems and point application irrigation systems.

Automated irrigation systems: These use information about soil moisture, temperature, and recent precipitation to influence the delivery schedule.

Low energy drip irrigation systems: These systems apply water directly to the crop and minimize delivery to the surrounding soil and atmosphere.

Irrigation Uniformity

Ideally, an irrigation system would apply water in a completely uniform manner, so that each part of the irrigated area receives the same amount of water. Whenever water is applied with less than perfect uniformity, some parts of the crop will receive more water than others. If the irrigation system is operated so that the part of the crop receiving the least water has its requirement met, then the remainder of the crop will be over-irrigated. Thus, a non-uniform irrigation unavoidably results in some degree of over watering. Many farmers laser till their fields to improve their uniformity of water delivery.

Potential for Conservation – Agricultural Use continued

Improvements in water delivery by irrigation districts combined with better on farm watering practices can lead to a range of potential efficiency gains. Because the Upper and Lower Basin have different climate and different crop types, these potential gains are also different.

Upper Basin

Wheat, alfalfa, and pasture land are the predominant users of agricultural water in the Upper Basin. A number of studies conducted by different organizations have estimated that a 5-10% gain in water use efficiency can easily be achieved, while an up to 20% increase in efficiency can be achieved through extensive changes in water management and delivery technology.

Lower Basin

The hot and dry climate of the Lower Basin means that most crops require a significant amount of irrigation water to grow. This also means, however, that there is a lot of room for potential efficiency gains. Alfalfa, cotton, and wheat are very water intensive crops, and together they use over half of the Lower Basin's agricultural water. Studies have found that efficiency gains up to 5% can easily be achieved with these crops, while further gains up to 15% can be achieved through significant investment. Fruit and vegetable production in the Lower Basin provides a higher economic return so many farmers growing these crops have already implemented water conservation measures. Studies by the U.S. Department of Agriculture and others have found that gains in efficiency of up to 5% can readily be achieved, while further gains up to 15% can be achieved through extensive retrofitting of existing delivery systems.

1. How much water do old toilets use? [redacted]

2. How much water do new high efficiency toilets use? [redacted]

3. Which municipal use accounts for the largest amount of water consumption? [redacted]

4. What has the best potential for overall water savings, municipal or agricultural? [redacted]

5. What type of municipal conservation is especially important in the summer? [redacted]

6. What is NOT a mechanism through which irrigation districts can conserver water? [redacted]

7. Automated irrigation systems use information about _____ to determine water delivery schedules? [redacted]

8. Reducing water for which two Lower Basin crops will save the most water overall? [redacted]

Water Conservation Calculator

Download the Excel-based interactive and jump to the end of the Unit to explore the Water Conservation Calculator

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Slide 5

- US Bureau of Reclamation, City of Tempe AZ. **http://www.usbr.gov/pn/programs/wat/canal.html**
- US Bureau of Reclamation. **http://www.usbr.gov/gp/water/wc_demonstration.cfm**

Slide 6

- US Department of Agriculture. **http://www.ers.usda.gov/Briefing/WaterUse/glossary.htm**