# Sizing Up Your Water Footprint

## Overview

This exercise is designed to be completed in two phases. Steps 1-4 are to be completed by each student as a homework assignment. Step 5 is a small group exercise, to be completed by teams of students in class, after they have each completed the homework assignment independently.

## Learning Objectives

This exercise is designed to increase student awareness of:

- The myriad ways in which they depend upon fresh water in their daily lives
- How much water is needed to support their lifestyle and well-being
- The specific fresh water sources (rivers, lakes, or aquifers) that they depend upon
- How their water dependencies may be affecting those fresh water sources (rivers, lakes, or aquifers).

This exercise helps students to understand that their water dependency isn't limited to what comes out of their faucets or showers or goes down their toilet bowl. Those uses of water are referred to as "direct uses," and they usually account for only a small fraction of our total water dependency (also called our "water footprint"). Virtually everything that we consume or use in our daily lives – food, clothing, furniture, computers, or automobiles – requires water in its production. This is called "indirect" or "virtual" water use.

Through the homework exercise described below, students will learn just how big their water footprint really is – accounting for both the direct use part as well as the indirect or "virtual" part.



*This exercise has been developed by Sustainable Waters and students at the University of Virginia.*
Learn more at www.Sustainablewaters.org

## Step 1 – How Much Water Do You Use at Home?

1. Go to this website and follow these steps:

    a. Click on the green button labeled "Click HERE to start now!"

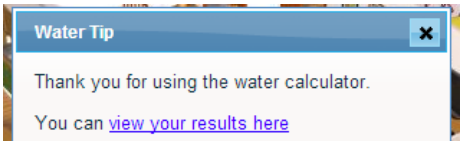

    b. Enter a US or Canadian zip code for the location of your home (see below).[1] You can use the location of your current residence, or you could use the location where you grew up if you are more familiar with the way that water was being used there. Just be sure to be consistent with your choice of location as you complete this exercise! This will affect pertinent information such as how many people live in your household, when it was built, and the landscaping in the surrounding area.


[1] Note: If you are not from the United States or Canada, pick a part of the United States with a climate similar to yours and use a zip code from that region for this exercise. You can use this website to select an appropriate zip code. Also note that if you are more familiar with liters to measure the volume of a liquid such as water, one gallon is equal to about 3.8 liters.

c. Answer the remaining questions pertaining to your water use at home. After answering the initial questions, click on the magnifying glasses in yellow dots (there are 4) that will take you to different places in the simulated household.

d. Click on the question marks that can be found in each room. Answer the questions accordingly. Also, be sure to take note of the blue dots labeled with an "i". These will give you important information about ways to reduce or minimize your water footprint. This information will be helpful for future assignments. If there is a remark about EnergySTAR appliances, just know that it is referring to an efficient appliance that reduces the water footprint.

e. After you have all green check marks on each room, press on the new yellow button with a foot to receive your final results from this exercise

.  →  → 

f. Fill in your results (gallons/year) in the Water Footprint Calculator spreadsheet (Excel file) provided for this exercise. To enter your information into the spreadsheet, click on the "Direct Water Footprint " tab, and enter your TOTAL household water use in GALLONS PER YEAR in column B, row 11 (this is the number you obtain from the Estimated Household Usage summary below).

Estimated Household Usage

| Category | gal. per year | gal. per day |
|---|---|---|
| Faucet | 10,921 | 29.9 |
| Toilet | 7,410 | 20.3 |
| Shower | 10,364 | 28.4 |
| Bathtub | 1,597 | 4.4 |
| Dishwasher | 1,277 | 3.5 |
| Clothes washer | 2,680 | 7.3 |
| Leaks | 7,153 | 19.6 |
| Other | 1,533 | 4.2 |
| Total indoor | 42,934 | 117.6 |
| Indoor hot | 12,795 | 35.1 |
| Outdoor | 0 | 0.0 |
| Total | 42,934 | 117.6 |

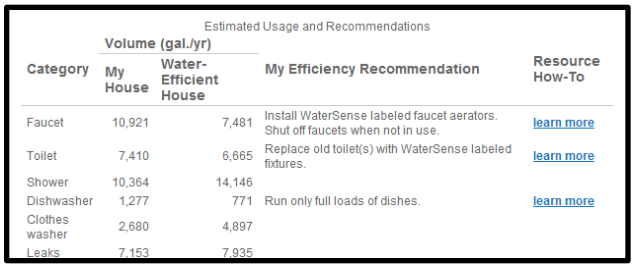
Then enter the values from each of the categories (e.g., faucet, toilet, etc) in Row 30, Columns C-K, in GALLONS PER YEAR.

g. Given your results, how does your household water use compare with other residences in the same geographic area? (see "Average House" column below). How do you compare with a "Water-Wise House"? List a few areas in which you or your neighbors might be able to become more conservative in your use of water.

Estimated Household Volume (gal./year)

| Category | My House | Average House | Water-Wise House |
|---|---|---|---|
| Faucet | 10,921 | 13,626 | 7,481 |
| Toilet | 7,410 | 23,011 | 6,665 |
| Shower | 10,364 | 15,702 | 14,146 |
| Bathtub | 1,597 | 1,624 | 2,947 |
| Dishwasher | 1,277 | 1,354 | 771 |
| Clothes washer | 2,680 | 19,943 | 4,897 |
| Leaks | 7,153 | 11,190 | 7,935 |
| Other | 1,533 | 3,790 | 544 |
| Total indoor | 42,934 | 90,240 | 45,340 |
| Indoor hot | 12,795 | 26,892 | 13,511 |
| Outdoor | 0 | 0 | 0 |
| Total | 42,934 | 90,240 | 45,340 |

h. Write down some of the efficiency recommendations you found the most useful and applicable in your home.



Estimated Usage and Recommendations

| Category | Volume (gal./yr) My House | Volume (gal./yr) Water-Efficient House | My Efficiency Recommendation | Resource How-To |
|---|---|---|---|---|
| Faucet | 10,921 | 7,481 | Install WaterSense labeled faucet aerators. Shut off faucets when not in use. | learn more |
| Toilet | 7,410 | 6,665 | Replace old toilet(s) with WaterSense labeled fixtures. | learn more |
| Shower | 10,364 | 14,146 | | |
| Dishwasher | 1,277 | 771 | Run only full loads of dishes. | learn more |
| Clothes washer | 2,680 | 4,897 | | |
| Leaks | 7,153 | 7,935 | | |

i. The volume of water being reported up to this point in the exercise relates to the total volume of water being used in or outside your residence each year. As you have likely noticed, the Water Footprint Calculator spreadsheet automatically converts this into gallons per day as well. Also in the spreadsheet, you will see that you will need to enter the number of people in your household in Column B, Row 18. The spreadsheet will then calculate how much water is being used per person, on average, in gallons per capita per day (GPCD).

You can now compare your direct water footprint in GPCD with people living in other parts of your country, or in other countries. Here are some websites to help you find information on the GPCD for comparison. How does your direct water footprint compare?

- Data360: Average water use per day (30 different countries)
- National Geographic: "The national average American household footprint is 100 gallons per capita per day (gpcd), or about 5 percent of an individual's total daily H20 use."
- Circle of Blue's Urban Water Pricing Survey (table): Look at the column labeled average daily per capita residential use (gallons) for a list of American Cities
- United States EPA: "The average American uses about 90 gallons/day of water in the American household (about 107,000 gallons/year). The average European uses 53 gallons. The average Sub-Saharan citizen uses 3-5 gallons."

Before closing Step 1, we need to talk about where the water used in your home goes after it you use it. In most countries, the water used indoors (in your shower, sinks, or toilet) goes down a drain after use, and is then routed to a wastewater treatment plant, where the water is cleaned up and then discharged back into a freshwater source, or into the ocean. This is referred to as RETURN FLOW, and in most cases becomes available for someone else's use. Virtually all of the water that you use inside the house is returned to a freshwater source, but a tiny fraction (typically less than 5%) is lost as evaporation, spillage, or digestion in your body. This lost water is referred to as "consumptive use."

However, any water that is applied to water outdoor landscape areas or leaks from water distribution pipes can reasonably be assumed to be fully used by plants, or evaporates into the atmosphere. This water is consumptively used, meaning that it is lost from the local area and not available for further use in your community.

A "Water Footprint" – as defined by the Water Footprint Network – includes only the water that is *consumptively used*. At the bottom of the Direct Water Footprint calculator (row 38) you will see the final estimate of your Direct Water Footprint.

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## Step 2 – Where Does Your Water Come From?

From the faucet, from the showerhead, from…rain maybe? True, but those answers don't quite capture the full story of where that water is extracted from a natural source (meaning: from a river, lake, or groundwater aquifer), and how it gets to your home for your use. Do you know the exact location(s) and name(s) of your water source(s)?

It's okay if you don't, according to a nationwide poll by The Nature Conservancy and Fairbank, Maslin, Maullin, Metz & Associates, 77% of Americans were unable to correctly identify the source of their household water. It's important for you to know where your water comes from, though, so that you can better understand what might be happening to your water source(s) and maybe you can even do something to help protect it. So let's figure out where the water that you use in your residence is coming from.

1. Search online to find your water source

    a. If you have no idea where your water comes from, you can start with a Google search, using search phrases such as: "drinking water source for [your city or town's name]" or "water supply for [your city or town's name] comes from", or "water utility for [your city or town's name]".

    b. If this doesn't reveal your water source, you can try to find your city or town's official website and look for their water services page. Who is responsible for the management and distribution of your local water supply? Do you receive a monthly water bill? If so, what is the name of the agency or company that is sending bills to you? *Search carefully, some providers are easy to find but some are trickier, with multiple services working within the same or very close areas.*

    c. Once you have found the name of your water provider, see if you can find its official website. Then you can search for information about the water source(s) that are being used by the company/agency.

    If all of the above fails, you can try to find your city on this website from The Nature Conservancy

d. Write down the name(s) of the water source(s) that you depend upon for your direct water footprint (your residential use). Is this water source a river, a lake, or an aquifer?

e. If you were able to find a website for your water provider, can you tell how much water is being used for your town or city in total, either by day or year?

f. Learn more about the water source that you depend upon for your residential water use. If you live in the United States, you can "Surf" your watershed by visiting the EPA's watershed database. Search by using either geographic unit (zip code, city name, etc.) in the search bar or by locating your state on the map, and then locate a more specific region on the succeeding state map.

   On your watershed page, under the section for "Assessments of Watershed Health," choose the "Impaired water for this watershed" link. Then click on the blue region of the following map and explore your watershed more closely in the EPA's "MyWATERS Mapper" interactive map.

   Look in the pop up box "Features at this location." How big is your watershed?

   You can minimize the feature pop up box and explore other aspects of the map. Explore potential water impairments by simply selecting "Rivers & Streams" from the pull down bar in the upper right hand corner of the map, then choose a category from the "Water Impairments" pull down bar on the opposite left hand side.

   What did you find? Any surprises?

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## Step 3 – How Big is My Indirect (Virtual) Water Footprint?

As mentioned in Step 1, it takes water to make virtually all of the food and other goods that you consume or use in your daily life. In fact, the volume of your indirect or "virtual" use of water will usually amount to a much greater volume than what you use at home. In this step, we'll find out just how much water you use indirectly.

2. Open the Water Footprint Calculator spreadsheet again, and let's get started on your indirect water footprint.

   a. You will see there are three different sheets pertaining to indirect water footprints:

      - Indirect Water Footprint - a table where you will enter your consumption of food, clothing, and transportation habits.
      - Indirect WF pie chart – this page will automatically generate a pie chart showing the proportions of your weekly indirect water footprint for food, clothing, and transportation; and
      - Indirect WF graph – this page will automatically generate a bar chart contrasting your indirect water footprint for different types of foods you consume each week.

   Click on the spreadsheet tab for "Indirect Water Footprint." Look at the first four columns on the left of this sheet in order to get a sense for how this table works. Column A shows the names of foods, clothing, and transportation estimates we are going to include when calculating your indirect water footprint. Note that this list includes only a sampling of foods and other goods. You may find water footprint information about other consumer goods if you search online, such as by going to the Water Footprint Network's "Product Gallery." Column B tells you the "per serving" or "per unit" volumes and weights assumed for each item in Column A. Column C gives you the virtual water content in one unit of a certain type of product, for example, each medium-sized apple contains 18.47 gallons of virtual (indirect) water. Column D provides the source of the information that we used to estimate the item's water footprint.

b. Type in the numbers/units of food items you consume EACH WEEK in Column E ("*Your Weekly Consumption")*. Note your inputs should be whole numbers greater than or equal to 0.

c. Type in the numbers/units of clothing items you consume EACH YEAR in Column E ("*Your Annual Consumption*").

d. Finally, type in the number of transportation-related items you use EACH WEEK ("*Your Weekly Consumption*").

e. The computer then calculates the average amount of foods and other goods you consume EACH DAY by dividing your weekly amount by 7 or your annual amounts by 365 (see Column G), and further calculates your indirect water footprint for each day (Column H). Note that – consistent with the way that your direct water footprint was calculated in Step 1 – all of these indirect water volumes represent *consumptive uses* of water.

f. Finally, you will see your total INDIRECT WATER FOOTPRINT at the bottom of the page, in row 41, in gallons per day. You can compare your total indirect water footprint with averages for people living in other countries by clicking on the spreadsheet tab labeled "Comparisons w Other Countries" (see far right column for total indirect water footprints).

g. After you finish the above tasks to calculate your indirect water footprint, please click on the spreadsheet tab for "Indirect WF Pie Chart." You will see the computer has made for you a pie chart with the values extracted from your answers. This pie chart shows you which category of goods you eat or use in your daily life - food, clothing, or transportation – consume the most indirect water. The result varies for each person – for example, an international businessman's indirect water footprint associated with transportation (airplane travel) each week may account for a much bigger transportation footprint than yours!

h. Now click on the spreadsheet tab for "Indirect WF Graph." You will see the spreadsheet has made for you a bar chart with the values extracted from your answers. This bar chart portrays which foods in your diet have the largest indirect water footprints.

i. Finally, compare your total daily indirect water footprint with your direct daily water footprint. Which is bigger? Are you surprised?!

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## Step 4 – Where Does All of That Virtual Water Come From?

In this final step of your homework assignment, we are going to connect you with some far distant places in the world where your indirect water footprint is landing.

3. Pick a food or beverage item that you consume regularly from the list in the Indirect Water Footprint spreadsheet.

    a. Use the indirect water footprint calculator to determine how much water goes into one serving of the food or beverage item you selected. Calculate how much virtual water you consume per week while consuming this item.

    b. Do you know where all of that water came from? Where was this food grown, or where were the ingredients used to produce this food or beverage grown? You might be able to determine this by checking the product label carefully. If there are multiple ingredients in your food or beverage item, pick one ingredient and see if you can tell where it was grown. If you cannot easily determine the origin, you can use the "Water Footprint Assessment Tool" developed by the Water Footprint Network to search for regions in the world that produce this crop or ingredient:

    Click "Start Geographic Assessment"

and “Select Crop.”


After you select the crop of interest, click the (X) to close the menu, and view the map to see where irrigation is used to grow that crop.

c. Do some research on one or more of the watersheds where this crop is being grown. Are there any regular problems with water scarcity or pollution during part or all of the year? If not, have there been any drought years that have resulted in water shortages? What are some environmental and social effects of water use in this region? (Hint: you can try to do a Google search by entering the watershed name followed by “water problems” or “water scarcity.”) Make notes of your findings.

## Example:

Beer: Old World Dark Night Porter – Old World Brewery

***I chose to analyze the water footprint of the barley in this beer.***

a. Porters contain more barley than the average beer, so after some Google searching, I determined that one bottle of the Dark Night Porter might have about .07 kg of barley per gallon of beer produced. If I have 7 of these beers every week, I consume about 84 oz of beer or .66 gallons of beer every week. This translates to about .0462 kg of barley every week for beer. Using the indirect water footprint calculator, I see that .0462 kg of barley requires about .65 cubic meters of water to produce (172 gallons).

b. Checking the label of the beer, I see that it is brewed in Arizona, USA. I’ve determined this from a Google search about the company. Using the “Water Footprint Assessment Tool”, I look around and see that barley is grown in the Klamath River of Oregon. ***(I chose this watershed for barley production because of its proximity to Arizona. You can use your judgment to guess where the product or ingredient might have been grown, if there is no explicit information listed on the product label)***

c. The Klamath River is located in Oregon. Like many other rivers in the western USA, it is dammed for irrigation water supply and to generate hydroelectric power. The

US government encouraged farming in the Klamath River Basin by constructing water storage projects. However, many environmental groups are fighting for the removal of these dams on the Klamath River because they are blocking important salmon migrations and impacting spawning patterns. This has in turn affected fishing yields for commercial fishermen in the area. In 2001, especially, a drought prompted commercial fishermen to fight to reduce water diversions to farms so that the fish could have a chance of spawning. The Bureau of Reclamation denied this request, prioritizing farm productivity over the health of the fish species. While 2001 was an unusually dry year, the Klamath River is also regularly depleted by people who divert water from the Upper Klamath Lake, which feeds the Klamath River. In addition, many migratory birds relied on wetlands that were fed by the river but are now dried up.

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## Step 5 – How Can We Best Reduce our Water Footprints?

In-Class Discussion (1-1/2 hours):

**Overview for Professors**

The purpose of this step is to provide students with the opportunity to share what they learned from their homework assignment, and to do some creative thinking with their peers about the best ways to reduce their water footprints.

Students should be split up into groups of 2-4 to discuss their completed homework assignments. You should allow a full hour-and-a-half for this in-class exercise. At the beginning of the exercise (task 1 below), the students will read three short articles. If they bring their laptops to class, they can read the three articles online; otherwise, you will need to print out copies of these articles for all students to read. Similarly, in task 3 below they will review a couple of (long!) lists of possible ways to conserve water or reduce their water footprints, which can be read either online or as hard copies distributed in class.

**Directions for Students**

1. Spend 10-15 minutes reading "The Hidden Water in Everyday Products," "The Water Footprint of Food," and "The Water Footprint of Energy"

2. Share with your group your largest direct and indirect items in your water footprints, based on the results of your homework assignment.

(i.e., "My largest direct was taking long showers and my largest indirect source was driving my car.")

3. You should then review the following two lists to identify possible ways to reduce your water footprints, with a focus on the ideas that are most directly connected to the largest items in your direct or indirect water footprints:

100+ Ways to Conserve

110 Ways to Save Water

4. Discuss with your group some of the ideas that made most sense for addressing your personal water footprint.

(i.e., "I could take shorter showers and install water-efficient shower heads. I will try to ride my bike or walk more often rather than drive my car.")

5. Share with your group the food or item that you researched in Step 4 of your homework exercise, and the conditions that exist in the watershed(s) where that food or product is produced or grown. Discuss a few ways you can reduce your indirect water footprint when using this product.

(i.e., "I researched the cotton used in making my clothing. It looks like most of the places where cotton is being grown are being mismanaged with respect to water. I'm going to think twice before buying clothing I don't really need, and I'll also look for second-hand clothing from thrift stores. I will recycle my own clothing as well.")

6. Determine the largest direct and indirect sources of your group's footprint.

7. Come up with the top 5 ways (either most effectively or creatively) to reduce your water footprint as a group and present this to the class.

(example: "Our Top 5 list includes: (1) Take shorter showers (2) Use the dishwasher (when full) rather than washing by hand. (3) Eat less meat, drink less coffee, and buy more food from local farms where I can be assured that it is being produced sustainably (4) Buy recycled clothes and recycle our own clothes; (5) Bike and walk more")