Water Reduction in Single-Family California Homes

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Many Californian families do not realize how much water they use per day. Since California frequently experiences periods of drought, it is important for the public to understand how they can reduce their water use. This research paper explains ways that Californian families can easily reduce water consumption within their homes. The paper explains how much water is used per fixture, and how much water can be saved making modifications of updates to existing fixtures.

Key Words: Residential Construction, Single-family homes, Water Consumption, Water Reduction

Introduction

Currently, in the year 2016, California is experiencing a time of severe drought. How do we affect this drought and are there ways we can help to minimize or mitigate it?

Growing up in Northern California, I spent much time in the spring and summer seasons on Folsom Lake. Last summer, I saw Folsom Lake dry up to less than 5% of its capacity. Not only is this unfortunate and saddening to see, but it is a wake-up call. I feel that as a Californian, I can help to find ways to minimize our water usage within the construction industry. By researching drought trends, construction trends, and water usage in California homes, I have pulled together information that we can use to quickly and simply reduce our water usage. By measuring the gallons of water wasted with the use of out-of-date fixtures to newer, more efficient fixtures, and comparing these to the water usage of an average Californian, I have calculated the amount of water a family of 4 could save per year, by updating their California homes. In addition, I have used the price of installation, along with the price of updated fixtures, to calculate the cost savings involved with the updates. The results show the amounts of water and money a family can save by updating their household fixtures.

General Background

It is evident that something must be done to reduce the amount of water used within single-family homes. In order to understand why an individual should update the fixtures in their home, one needs to understand the drought cycles in California and the history of Californian home construction.

History of Californian Drought

Currently, California is experiencing a time of water shortage. In these times, people tend to worry about the problem rather than to focus on a solution. It is human nature to blame water consumption for the drought, however, the problem is not so simply explained.

California, along with the rest of the world, sees varying levels of rainfall, depending on the climate conditions that exist in that geographical area over time. Regardless of how much water a specific area may receive, there is always the same amount of water on the planet Earth - it is just dispersed among different geographical areas (U.S. Drought Portal, 2016). If we look at a map of the United States, we will see that California is experiencing some of the worst drought in the nation. Why is this, and how can it be mitigated?
According to the U.S. Drought Monitor in Figure 1, California is currently experiencing extreme to exceptional drought. The U.S. Drought Monitor, taken from Drought.gov, measures drought based off of several categories: palmer severity index, soil moisture, weekly streamflow, precipitation index, and objective drought indicator blends.

The main reason that California experiences such extreme drought in times of low precipitation is because of its population density in relation to its usual climate, particularly in Eastern and Southern California.

Before colonists migrated eastward, the Eastern and Southern parts of California were already areas of high temperatures and low rainfall (PG&E, 2016). As people inhabited the area and began developing properties, the rainfall that was already negligible, slowly began to be consumed. Today, Southern Californian residents get most, if not all their water from aqueducts built from areas that experience more rainfall. As a result, in times of low precipitation, like the current period, drought does not only affect Southern Californian residents, it also negatively affects Northern Californian residents. Northern California, with its higher rainfall, now supplies Southern California with water.

Though we are currently experiencing a time of drought, it is not the worst in California history. To specifically understand how drought continuously affects California, we can look at the levels of rainfall over the last 100+ years.
If we look to Figure 2, we begin to understand how and when rainfall affects California. About every 20 years, California experiences a time of severe drought and a time of severe rain. One will also notice that the current drought is not as bad as seen in past years. It is important to understand that times of drought are inevitable, and that there are ways that California residents can minimize the extremity of drought when it occurs next.

**History of Californian Homes**

While the California drought cycles are important to understand, it is also important to understand the history of Californian home construction or homebuilding trends and why it might be necessary to update them.

In the last 5 years, new building codes have been put into place specifying low flow fixtures in housing developments. However, the majority of California homes were not built in the last 5 years, so we must look at when Californian homes were constructed, and the building codes that existed during these times.

*Figure 3: A history of Residential Construction in the USA.*
By looking at Figure 3, one can see that the majority of homes in California were built in the 1970s and 1980s. This is significant because of the building codes that existed at the time. A typical home built during this time period had faucets that ran about 5 gallons of water per minute (GPM), showers that ran 3 gallons of water per minute, clothes washers that ran 40 gallons of water per load, dish washers that ran 10 gallons of water per load, and toilets that used 5 gallons per flush. Today, the Federal Plumbing Standards require much lower-flow fixtures. Most of the homes people live in today use these old fixtures; replacing old fixtures with newer fixtures will reduce water consumption. The comparisons in usage and findings are listed below in Table 1.

<table>
<thead>
<tr>
<th>Fixture</th>
<th>Outdated Fixture Usage</th>
<th>Updated Fixture Usage</th>
<th>Gallon Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faucets</td>
<td>5 GPM</td>
<td>2.2 GPM</td>
<td>2.8 GPM</td>
</tr>
<tr>
<td>Showers</td>
<td>3 GPM</td>
<td>1.5 GPM</td>
<td>1.5 GPM</td>
</tr>
<tr>
<td>Washers</td>
<td>40 GPL</td>
<td>22 GPL</td>
<td>18 GPL</td>
</tr>
<tr>
<td>Dishwasher</td>
<td>10 GPL</td>
<td>5 GPL</td>
<td>5 GPL</td>
</tr>
<tr>
<td>Toilets</td>
<td>5 GPF</td>
<td>1.28 GPF</td>
<td>3.72 GPF</td>
</tr>
</tbody>
</table>

Table 1.

**Research**

Updating fixtures in a home is not only simple, but it can save thousands of gallons of water per year, along with some cost savings over time. Data and research has been collected and shown below comparing outdated fixture’s water flow to updated fixture’s water flow, the time each fixture is used for an average person, the cost to purchase each fixture, and the steps to install each one.

**Toilets**

Toilets are the biggest water wasters of all household fixtures. They account for about 31% of overall household water consumption.

The average person flushes a toilet about 5 times per day, and old toilets use anywhere from 3.5-7 gallons per flush. This means that the average person uses about 25 gallons of water per day.

Newer high-efficiency toilets use 1.28 gallons of water per flush, reducing the amount of water per flush by nearly 3.7 gallons. A 1.28 gallon toilet can be purchased for about $90 at Home Depot.

By installing a 1.28 GPF toilet, water consumption is reduced by 18.6 gallons per day or 6,789 gallons per year. The recommended amount of water to consume per day is a half-gallon (Authority Nutrition, 2016). So, this finding equates to 13,578 days of the healthy drinking amount.

**Faucets**

Faucets include any sink fixture used in the kitchen or bathroom. They account for 15%-18% of daily water consumption inside a typical household. Old faucets use 5 or more gallons of water per minute. An average person runs their sinks for about 1.5 minutes per day. This would mean that an average person uses about 7.5 gallons of water by running their kitchen and bathroom sinks in a day. The amount of water consumed by old faucets, per day, is equal to approximately 15 days of the healthy drinking amount.

The new Federal Plumbing Standards require faucets to use less than 2.5 gallons per minute for new construction (Conserve H2O, 2009). This alone cuts the amount of water produced by a faucet in half. The easiest way to reduce water on your old fixtures is to install a WaterSense Aerator. Most of these use only 2.2 gallons of water per minute. At Home Depot, a person can buy a 2.2 gpm aerator for $2.43. The plus of implementing aerators into a home is that they are easily self-installed. It takes less than 5 minutes to put these onto the existing faucets, and the kit comes with all the needed parts.
If aerators are installed on a kitchen faucet, and on a bathroom sink faucet it would cost about $5.00, and it would save 4.2 gallons of water per day or 1,533 gallons per year. This equates to 3,066 days of the recommended daily water intake amount.

**Showers**

Showers are the third biggest water waster in residential usage. An average American showers for approximately 8.9 minutes with an old shower head that uses 3 gallons per minute. The amount of water used per person per day comes out to about 26.64 gallons of water or about 53 days of the healthy drinking amount.

When looking for a water-friendly shower head, a person should look for one that uses less than 2.5 gallons per minute. Most WaterSense shower heads use 2 gallons per minute and can be purchased at Home Depot for $12.72.

Like aerators, water heads can also be self-installed. The steps are simple:

1. Remove old shower head by simple unscrewing it off of the pipe. If it is tight loosen it by means of a wrench.
2. Turn on the water briefly to rinse out the pipe.
3. Screw on the new showerhead and tighten it by hand.
4. Turn on the water to be sure that it is not leaking. If it is leaking, make it tighter by using a wrench or Teflon tape.

By replacing the showerhead in a home, there will be savings up to 8.8 gallons of water per day or 3,212 gallons per year. This equates to 6,424 days of the recommended daily intake of water.

**Clothes Washers**

Clothes washers come in various sizes and capacities but outdated clothes washers use anywhere from 40-45 gallons of water per load. Energy Star originated 20 years ago, and even they have taken huge steps in reducing water in clothes washers. Energy Star has reduced their clothes washers’ water consumption by over 75%. Even with an Energy Star washer, it is important to know how many gallons per load your clothes washer uses, and if that could be greatly reduced.

An average person does about 2 loads of laundry per week. At 40 gallons per load, this is 80 gallons of water per week, or about 11.4 gallons of water per day. This equates to almost 23 days of the recommended amount of daily water intake.

The newest Energy Star washers use about 20 gallons per load and can be purchased for $500. By replacing an old washer with a newer model, there could be a savings of about 40 gallons of water per week or 2,085.7 gallons of water per year. This equates to 4,171 days of the recommended amount of daily water intake.

**Dishwashers**

Dishwashers only account for about 2% of the daily water use for an average person. Though the percentage seems small, a great deal of water can still be saved by updating an old dishwasher. An old dishwasher uses about 12 gallons of water per load, and the average person runs a dishwasher about once per week. This equals about 1.7 gallons of water per day, or 3 days of the recommended amount of daily water intake.

Like clothes washers, Energy Star has greatly improved the water efficiency of dishwashers. These new dishwashers use less than 5.5 gallons of water per load and can be purchased at Home Depot for $375. By replacing an old dishwasher, a household would be saving 6.5 gallons of water per week or 338.9 gallons of water per year. This equates to 678 days of the recommended amount of daily water intake.

**Data Findings**
By using the above research, the data has been consolidated into 3 simplified tables.

### Outdated Fixture Single-Person Water Consumption

<table>
<thead>
<tr>
<th>Fixture</th>
<th>Gallons per unit</th>
<th>Use per day</th>
<th>Unit</th>
<th>User Per Year</th>
<th>Gallons per year</th>
<th>CCFs</th>
<th>Cost per CCF</th>
<th>Cost Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faucets</td>
<td>5</td>
<td>1.5</td>
<td>Minutes</td>
<td>547.50</td>
<td>2737.50</td>
<td>3.659759</td>
<td>$2.64</td>
<td>$9.65</td>
</tr>
<tr>
<td>Showers</td>
<td>3</td>
<td>8.88</td>
<td>Minutes</td>
<td>3241.20</td>
<td>9723.60</td>
<td>12.999465</td>
<td>$2.64</td>
<td>$34.28</td>
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<tr>
<td>Washers</td>
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<td>N/A</td>
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<td>4000.00</td>
<td>5.347594</td>
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<td>N/A</td>
<td>48.00</td>
<td>480.00</td>
<td>0.641711</td>
<td>$2.64</td>
<td>$1.69</td>
</tr>
<tr>
<td>Toilets</td>
<td>5</td>
<td>5</td>
<td>flushes</td>
<td>1825.00</td>
<td>9125.00</td>
<td>12.199198</td>
<td>$2.64</td>
<td>$32.17</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>26,066.10</td>
<td></td>
<td></td>
<td>$91.88</td>
</tr>
</tbody>
</table>

Table 2.

All of the above data is based on the use of a single person in a home. The units measured per fixture are as follows: Faucets and Showers are measured in gallons per minute, Clothes and dishwashers are measured in gallons per load, and toilets are measured in gallons per flush.

The cost of water usage is determined by the amount of CCFs used in a month. A CCF is one hundred cubic feet of water. One CCF is equal to 748 gallons of water.

By observing the data, one will see that a single person uses about 26,066.10 gallons of water per year, at a cost of about $91.88.

### Updated Fixture Single-Person Water Consumption

<table>
<thead>
<tr>
<th>Fixture</th>
<th>Gallons per unit</th>
<th>Use per day</th>
<th>Unit</th>
<th>User Per Year</th>
<th>Gallons per year</th>
<th>CCFs</th>
<th>Cost per CCF</th>
<th>Cost Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faucets</td>
<td>2.2</td>
<td>1.5</td>
<td>Minutes</td>
<td>547.50</td>
<td>1204.50</td>
<td>1.6102941</td>
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<td>$4.25</td>
</tr>
<tr>
<td>Showers</td>
<td>1.5</td>
<td>8.88</td>
<td>Minutes</td>
<td>3241.20</td>
<td>4861.80</td>
<td>6.4997326</td>
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<tr>
<td>Washers</td>
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<td>N/A</td>
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<td>2.9411765</td>
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<tr>
<td>Dishwasher</td>
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<td>N/A</td>
<td>N/A</td>
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<td>240.00</td>
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<tr>
<td>Toilets</td>
<td>1.28</td>
<td>5</td>
<td>flushes</td>
<td>1825.00</td>
<td>2336.00</td>
<td>3.1229947</td>
<td>$2.64</td>
<td>$8.23</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10,842.30</td>
<td></td>
<td></td>
<td>$38.22</td>
</tr>
</tbody>
</table>

Table 3.

The table above shows the amount of water consumed per updated fixture. Updating all the fixtures in a household, a single person would only use 10,842.30 gallons of water per year at a cost of $38.22.

If a single person replaced every fixture in their home with an EPA rated WaterSense fixture, they would see a savings of 15,223.8 gallons of water per year and about $50.00.

### Cost Savings
**Average Savings for Four-Person Single-Family Home**

<table>
<thead>
<tr>
<th></th>
<th>Gallons Used Per Year</th>
<th>Cost Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before Updates</td>
<td>104,264.40</td>
<td>$367.53</td>
</tr>
<tr>
<td>After Updates</td>
<td>43,369.20</td>
<td>$152.88</td>
</tr>
<tr>
<td><strong>Savings</strong></td>
<td><strong>60,895.20</strong></td>
<td><strong>$214.66</strong></td>
</tr>
</tbody>
</table>

Table 4.

In California, the average household consists of 4 people using that much water (Home Water Works, 2011). This data was achieved by multiplying the above numbers by a household of 4. If the average family in California replaced all of their fixtures with a WaterSense fixture they would see a savings of 60,895.2 gallons of water per year. This amount is equal to the recommended daily water intake of 121,790.4 days or 333.7 years. That is more than enough water for 3 people to drink for their entire lifespan.

The average family of 4 in California has a 3 bedroom, 2 bathroom house. Adding up the cost of purchasing each new fixture (2 shower heads, 3 faucets, 1 clothes dryer, 1 dishwasher, and 2 toilets), we come to a total of $1,090.44. This money would be made back in water cost savings in 5 years, and over the 5 years after that time, you would save approximately $1,056.16. Replacing outdated fixtures not only saves water, but it saves money as well.

**Marketing**

Homeowners may not understand the amount of water they are using each day and the impact this can have on those around them. They also may not understand how easy it can be to update the fixtures in their home and the amount of water they can save by doing so. I have put together a flyer that consolidates the information in this research paper to make it simple for anyone to understand. This flyer has the ability to make it easy for homeowners to understand how much water they use and how they can help reduce their water usage. See Appendix.

**Conclusion**

By looking at the drought trends, the history of California home construction, and the water usage per family, it is clear that action must be taken to reduce water consumption. It is simple for anyone to replace their old fixtures with new and the savings are worth it. If a family of four replaced the fixtures in their homes, they would save 608,952 gallons of water in 10 years with a cost savings of $2,146.60. Though the cost savings is not huge, the water savings is 608,952 gallons of water is enough water for 3,336 people to consume water for an entire year – and this is just the savings of one family. In this case of household water consumption, one person, or one family, can make a drastic difference. Knowing you can make a difference, will you?

The change starts with you. Take the time to update the outdated fixtures in your home and help minimize the water shortage problem that we currently have in California, and are sure to see again.

**References**


Appendix A
Public Use Flyer

Saving Water in your Household

OUTDATED FIXTURES
5 Gallons Per Flush
3 Gallons Per Minute
5 Gallons Per Minute
40 Gallons Per Load
10 Gallons Per Load

UPDATED FIXTURES
1.28 Gallons Per Flush
1.5 Gallons Per Minute
2.2 Gallons Per Minute
22 Gallons Per Load
5 Gallons Per Load

Updating all the fixtures in your home could save you up to 60,895 gallons of water per year. This is enough water for 3 people to drink water for their entire life span!!!