

Water Savings Models for Annual Irrigation Audits

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Water saving by lowering single family GPCD with reduction in irrigation demand.

A new single family gallons per capita per day (SF GPCD) was created based on estimating the reduced irrigation demand for single family homes if annual irrigation audits for single family homes were enforced by the utility. This was considered to be the utility's current SF GPCD's minus the fraction of outdoor water demand that would be reduced due to the savings from the irrigation audits multiplied by a participation factor.

Using data from the City of Cedar Park TX, it was found that homes used an average of 30% less water after conducting an irrigation audit with the city. These water savings came from reducing over watering, reducing run off, and fixing leaks in irrigation systems. The study looked at 38 different homes from 2017 to 2019 and found a mean savings of 35%, Median savings of 31.7% and a mode savings of 30%. From this we expect to see a 30% reduced SF GPCD from homes that complete an irrigation audit with the utility.

See Equation 1 below for reduced SF GPCD calculation:

$$SF_{GPCD_{reduced}} = SF_{GPCD_{avg}} - \left[F_{reduction} \times (SF_{GPCD_{avg}} - GPCD_{indoor}) \right] \quad (\text{Eq.1})$$

Terms

$SF_{GPCD_{avg}}$ = *Average Single Family GPCD for the utility.*

Data obtained from Texas Water Development Board

$F_{reduction}$ = *Fraction of reduced water use after irrigation audit is complete, = 1/3*

$GPCD_{indoor}$ = *48.5 gallons per person per day (DeOreo 2016)*

Projected Savings:

To estimate projected water savings, water demand forecasts can be created for years 2020, 2030, 2040, 2050 and 2060 based on each water user groups' average SF GPCD, and population projections for those years available on the TWDB website. The first forecast is based on a base case water demand with no enforced irrigation audits. The second forecast is created based on the reduced SF GPCD if 5% of single family homes completed irrigation audits. The forecasted water savings are considered to be the difference between these two water demand scenarios. The total forecasted base case demand, reduced demand and water savings are the sum of forecasts for all water user groups.

Equation 2 below shows the calculation for forecasted demand base case for the utility with their current SF gpcd:

$$SF_{WU_basecase_i} \left(\frac{af}{yr} \right) = SF_{GPCD_{avg}} \times P_i \times \frac{365 \text{ days}}{\text{year}} \times \frac{1 \text{ af}}{325,851 \text{ gallons}}, \text{ for ith year} \quad (\text{Eq. 2})$$

Equation 3 below shows the calculation for forecasted reduced demand the utility with irrigation audits:

$$SF_{WU_reduced_i} \left(\frac{af}{yr} \right) = \left[SF_{WU_basecase_i} \times (1 - P_f) \right] + \left[SF_{GPCD_{reduced}} \times P_f \times P_i \times \frac{365 \text{ days}}{\text{year}} \times \frac{1 \text{ af}}{325,851 \text{ gallons}} \right], \text{ for ith year} \quad (\text{Eq. 3})$$

Equation 4 below shows the projected water savings for the utility with irrigation audits:

$$\text{Water Savings}_i \left(\frac{af}{yr} \right) = SF_{WU_basecase_i} - SF_{WU_reduced_i}, \text{ for ith year} \quad (\text{Eq.4})$$

Terms

$SF_{GPCD_{avg}}$ = Avereage Single Family GPCD for the utility.

P_i
= Population of utility for ith year, availble on the Texas Water Development Board website

P_f =
Participation Factor, Percent of Single Famiy Connections who participate in irrigation audits annually set to 5%

The total forecasted demand is considered to be the sum of the forecasted base case demands, reduced demands, and water savings for all utilities. Equations 5, 6, and 7 below show this calculation.

$$\text{Total Base Case Demand}_i \left(\frac{af}{yr} \right) = \sum_1^n WUGs [SF_{WU_basecase_i}], \text{ for ith year} \quad (\text{Eq. 5})$$

$$\text{Total Reduced Demand}_i \left(\frac{af}{yr} \right) = \sum_1^n WUGs [SF_{WU_reduced_i}], \text{ for ith year} \quad (\text{Eq. 6})$$

$$\text{Total Water Savings}_i \left(\frac{af}{yr} \right) = \sum_1^n WUGs [SF_{WU_basecase_i} - SF_{WU_reduced_i}], \text{ for ith year} \quad (\text{Eq. 7})$$

Notes:

It should be noted that just because an irrigation audit is performed on a residence doesn't mean there are guaranteed water savings. This is considered in the 5% overall participation rate, where there may be more participating households with less than 30% water savings.

For utility's whose SF GPCD was less than 60 gallons per person per day it should be assumed that no water savings would be obtained from irrigation audits as the customers in these utilities are likely not irrigating.

For customers not listed in the TWDB database, a flat population growth rate of 2% was applied to their 2017 population based on results of the 2019 Texas Demographic Center report.

Resources

DeOreo, William (2016). *Residential End Uses of Water*. Water Research Foundation.

Available at: <http://www.waterrf.org/Pages/Projects.aspx?PID=4309>

Texas Demographic Center (2019). *Texas Population Projections 2010 to 2050*.

Available at:

https://demographics.texas.gov/Resources/publications/2019/20190128_PopProjectionsBrief.pdf

Texas Water Development Board (2019). *Population and Water Demand Projections*.

<http://www.twdb.texas.gov/waterplanning/data/projections/index.asp>

Texas Water Development Board (2019). *Regional Water Planning Data*.

<https://www.twdb.texas.gov/waterplanning/data/rwp-database/index.asp>