

Analysis of Five Years of Municipal Water Use Data To Estimate Commercial and Institutional Per Capita Use

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Introduction

The following analysis was made to try to use the municipal water use data including total and residential per capita water use provided by [Texas Water Development Board (TWDB) staff] Kevin Kluge and Bill Billingsley and the non-revenue estimates provided by [TWDB staff] John Sutton. I also used Technical Note 12-01 (seasonal residential use), the SB 181 information for 2013, and the information gleaned from many commercial and institutional water efficiency audits. The purpose of the analysis was to break down municipal water use so that the commercial and institutional components could be separated out.

Assumptions and Methodology

SB 181 Information

The first analysis was of the Senate Bill 181 data reported in *Water Use of Texas Water Utilities: A biennial report to the Texas Legislature, January 1, 2015*¹.

The report shows that of the cities reporting, total per capita use including single and multi-family residential use, commercial, institutional, industrial, agricultural, and other users was 189 gallons per person per day (gpcd) of which 77 gpcd was for residential use for 2014 (Table A).

The report also breaks down use by type (Table B). This shows that 21% of the use is for commercial entities and 4% for institutional users. Based on the 189 gpcd, this equals **58.8 gpcd** for commercial and institutional users in 2014.

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www.twdb.texas.gov/publications/reports/special_legislative_reports/doc/2014_WaterUseOfTexasWaterUtilities.pdf

Table A. Average water use in gallons per capita daily, 2013

Description	Average total water use in gallons per capita daily	Average residential water use in gallons per capita daily
Medium Utilities (237)	141	79
Medium Significant ICI1 Utilities (27)	233	74
Medium-Large Utilities ³ (31)	163	90
Medium-Large Significant ICI Utilities (5)	252	88
Large Utilities (30)	167	85
Large Significant ICI Utilities (5)	251	76
Metropolitan Utilities	239	69
All Analyzed Utilities	189	77

Table B. Average categorical percentage of metered water use

Description	Total Residential	Single-Family Residential	Multi-Family Residential	Institutional	Commercial	Industrial	Agricultural	Other ¹
All Utilities (344)	58	48	10	4	21	15	<1	2
Significant ICI ² Utilities (34)	35	25	10	4	30	31	<1	1

Seasonal Use

Seasonal use for all residential users is more complex. TWDB Technical Note 12-01² shows that the average outdoor use by single family residential users is 31% of total use. However, the US Census data shows that only 66.5 percent of the population with the rest living in either multi-family or other types of housing. For this analysis, Table C summarizes the percent of outdoor use assumed. Based on these assumptions, residential users of all types average 29% for outdoor use and 71% for indoor use.

² www.twdb.texas.gov/publications/reports/technical_notes/doc/SeasonalWaterUseReport-final.pdf

Table C. 2010 Texas housing information and irrigation use assumptions

Type of Housing	Percent of Population	Outdoor Use %
Single family	63.4	31%
1 attached	3.1	31%
2 to 4	5.4	25%
5 or more	18.7	25%
Mobile homes	9	25%
Other	0.4	20%
Total (composite of above)	100	29%
Source: 2010 US Census for Texas and Technical Note 12-01. Assumptions in gray		

TWDB Data for 2009 - through 2013

The following data is taken from Texas Water Development Board files for the 78 cities in Texas that reported residential gpcd (gallons per person per day) separately from the total gpcd for the city. Table D shows actual annual use in acre-feet. The population served by this volume of water equals 54 percent of the total Texas population. The net use, based on TWDB methodology, includes leak loss, residential, commercial and institutional and miscellaneous uses. The TWDB reports that real leak loss ranges from 13.7% to 9.8%. Based on that, the average of 11.75% was assumed and applied to Net Use plus Industrial and Power sales to estimate total leak loss based on Table D. Outdoor residential use was as assumed to be 29% of total residential use. Based on these assumptions as applied to volumes of water use and population shown in Table D an estimate of per capita use by type was developed in Table E. It is important to note that the SB 181 information includes sales to industry and "other" and agricultural uses as described above. The SB 181 gpcd for 2014 was 189 gpcd. Based on Table E the equivalent gpcd would equal the net municipal gpcd plus the industrial and power gpcd which equals 184 gpcd for the five years.

As seen in Table E, the drought year 2011 was an anomaly. For this analysis, the other four years were analyzed separately for comparison. To do this analysis, net municipal use was first calculated by subtracting all sales to other utilities, power and industry from the total volumes. Figure 1 summarizes this process.

Table D. Acre-feet of Use from TWDB Data for 78 Cities That Broke Out Residential Use for the Period from 2009 through 2013 (equals 54% of Texas' population)

Year	Population	Intake Total	Total Sales	Sales to Utilities	Sales Ind. & Power	Sales Power	Net Use	Residential Volume
2009	13,658,767	3,194,979	850,498	504,500	336,227	9,684	2,344,489	1,237,461
2010	13,540,756	3,209,804	880,260	535,320	336,962	7,898	2,329,543	1,208,530
2011	13,801,414	3,734,520	982,155	608,741	350,212	23,119	2,752,363	1,334,069
2012	14,076,463	3,490,545	1,004,158	586,419	381,667	36,000	2,486,388	1,291,593
2013	14,339,154	3,394,715	1,020,617	644,543	351,854	24,015	2,374,098	1,177,617

Table E. Analysis of Municipal Use for 2009 through 2013

Year	Total intake gpcd	Total Sales gpcd	Sales to Other Utility gpcd	Ind. & Power sales gpcd	Net Mun. gpcd	Residential gpcd	Residential indoor gpcd	Residential Outdoor gpcd	Leak loss gpcd	Com./Inst. gpcd
2009	209	62	37	25	147	77	54	22	17	53
2010	211	63	38	25	148	76	54	22	20	51
2011	242	64	40	24	178	86	61	25	21	71
2012	221	64	38	26	158	82	58	24	19	56
2013	211	64	41	23	148	73	52	21	17	57
<i>Analysis with and without 2011</i>										
2011	242	64	40	24	178	86	61	25	21	71
All 5 Years	219	63	39	25	156	79	56	23	19	58
Four Years Without 2011	213	63	39	25	150	77	55	22	18	54

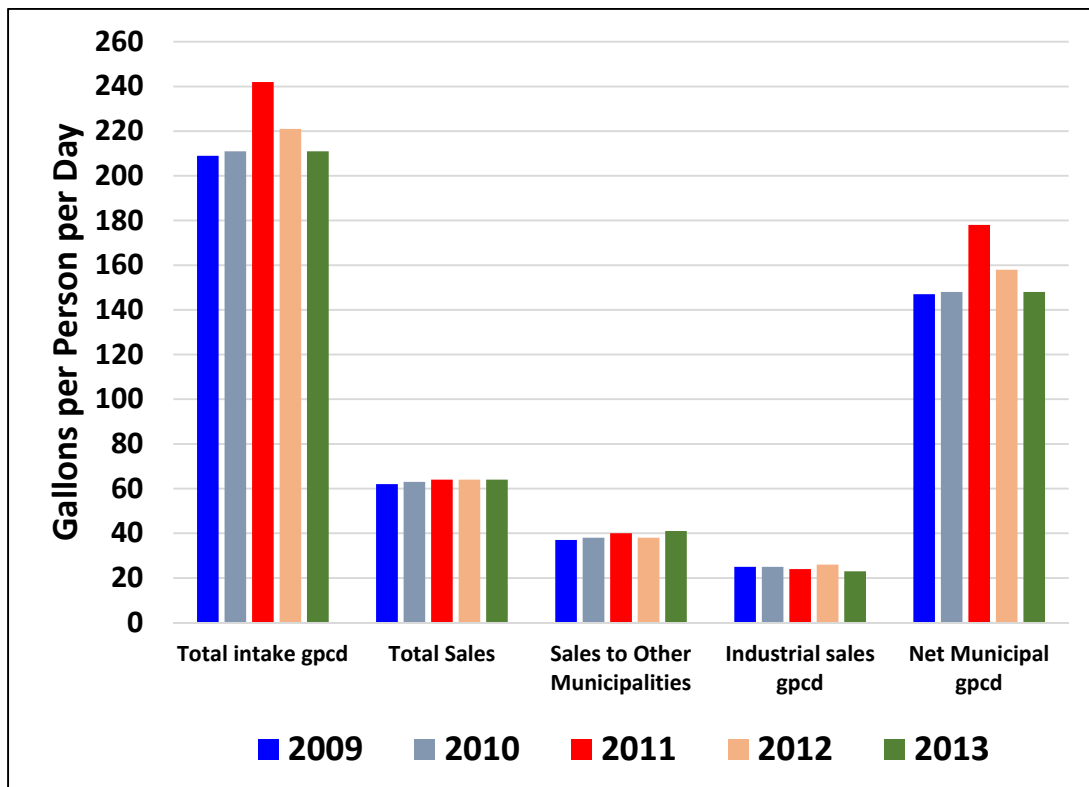


Figure 1. Total Intake and Use (gpcd). Source: TWDB

The next step was to breakdown the net gpcd and the residential gpcd into various categories. Figure 2. Shows the results of this analysis. I assumed that 29% of residential use was for outdoor purposes and that leak loss equals 11.75% of net use plus industrial and power sales. As both Table B. and Figure 2A. Show, commercial and institutional gpcd in this analysis equals a five year average of 58 gpcd as compared to the SB 181 average for 2014 of 58.8 gpcd. When 2011 was removed and only the four non-drought years considered, average commercial/institutional gpcd was 54 gpcd.

In the SB 181 document, residential use was 77 gpcd for 2014 while the average for the five years (2009-2013) was 79 gpcd and the average for the four non-drought years was 77 gpcd.

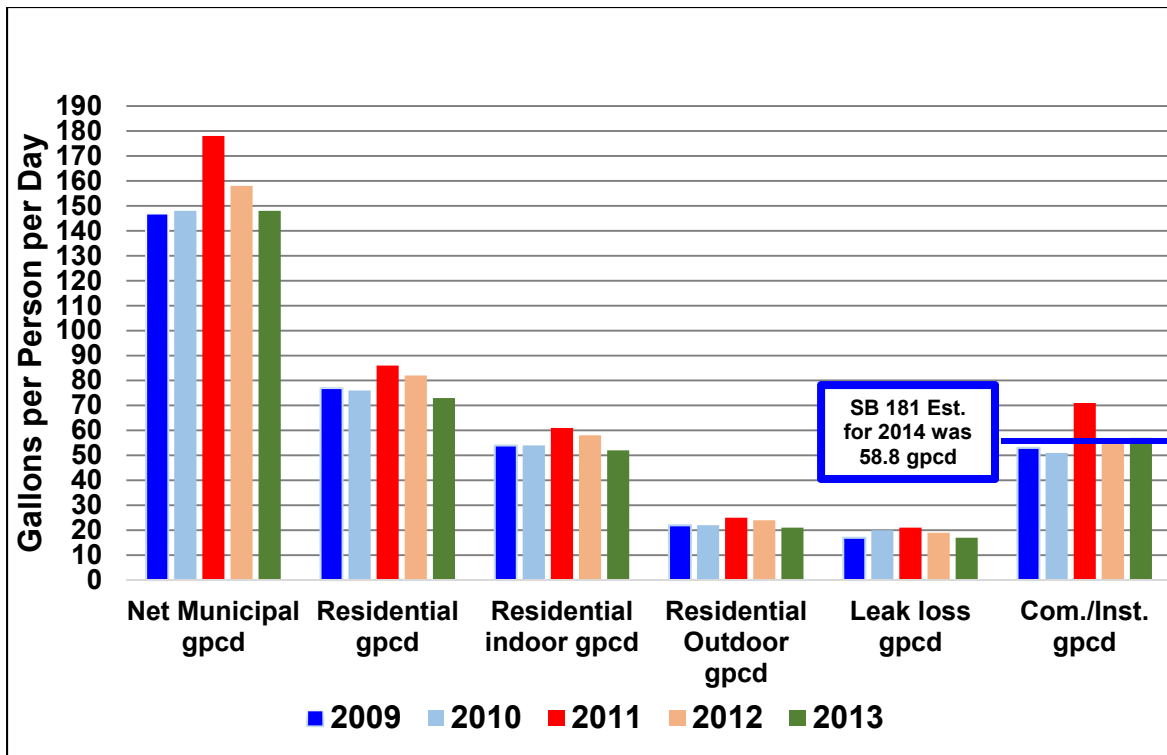


Figure 2A. Breakdown of Net Municipal Use (gpcd). Source: TWDB

Additional analysis of the 2009-2013 data shows that municipal use exclusive of industrial sales breaks down as shown in Figure 3.

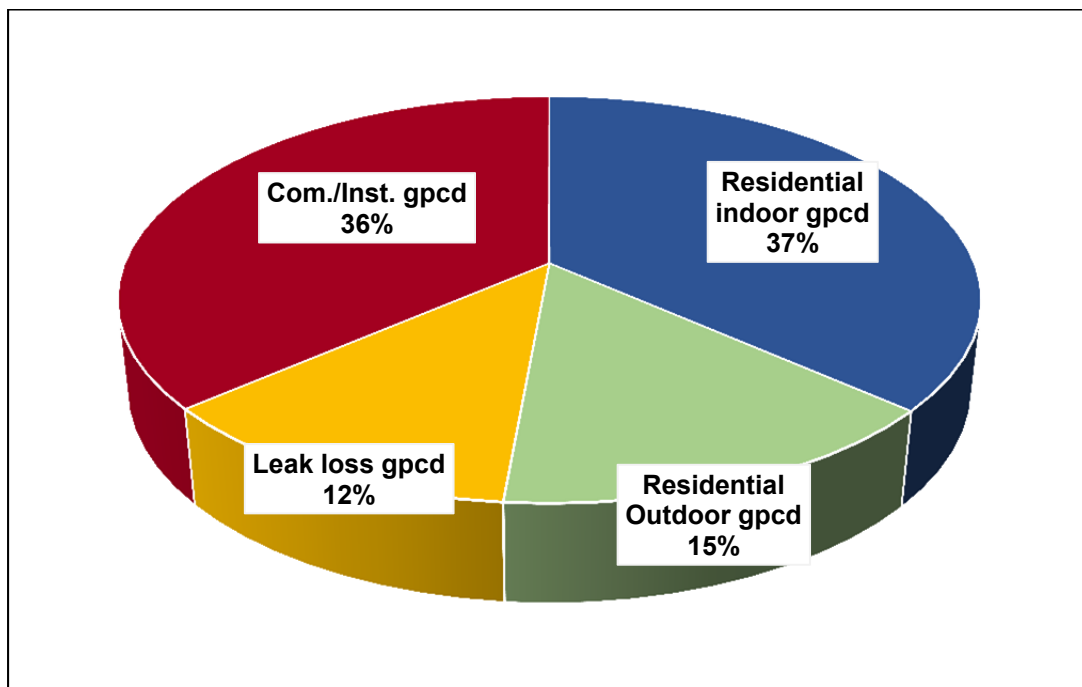


Figure 3. Municipal Water Use Based on 2009, 2010, 2012 & 2013 Data for Cities Reporting Residential Use Exclusive of Industrial Use

When municipal sales to industry are included with the commercial and institutional sales, they approximately equal residential use as seen in

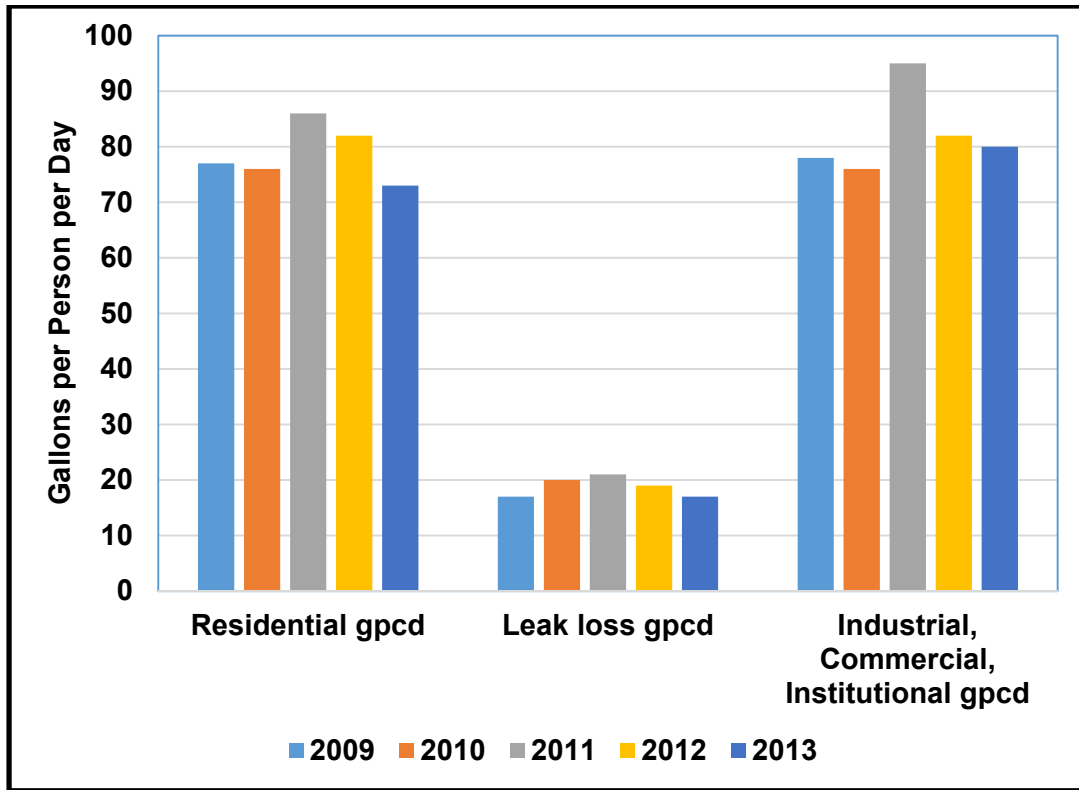


Figure 2B. Per Capita Municipal Use by Major User Class Including Industrial Sales

Comparison of **Commercial and Institutional** Use – SB 181 and Five Year Analysis and four year non-drought gpcd use were as follows:

SB 181 58.8 gpcd

Five Yr. avg. 58 gpcd

Four Yr. avg. 54 gpcd

Based on the 2014 analysis for SB 181, the majority of commercial and institutional use was for commercial users. As Figure 4 Shows, all methods yield similar results.

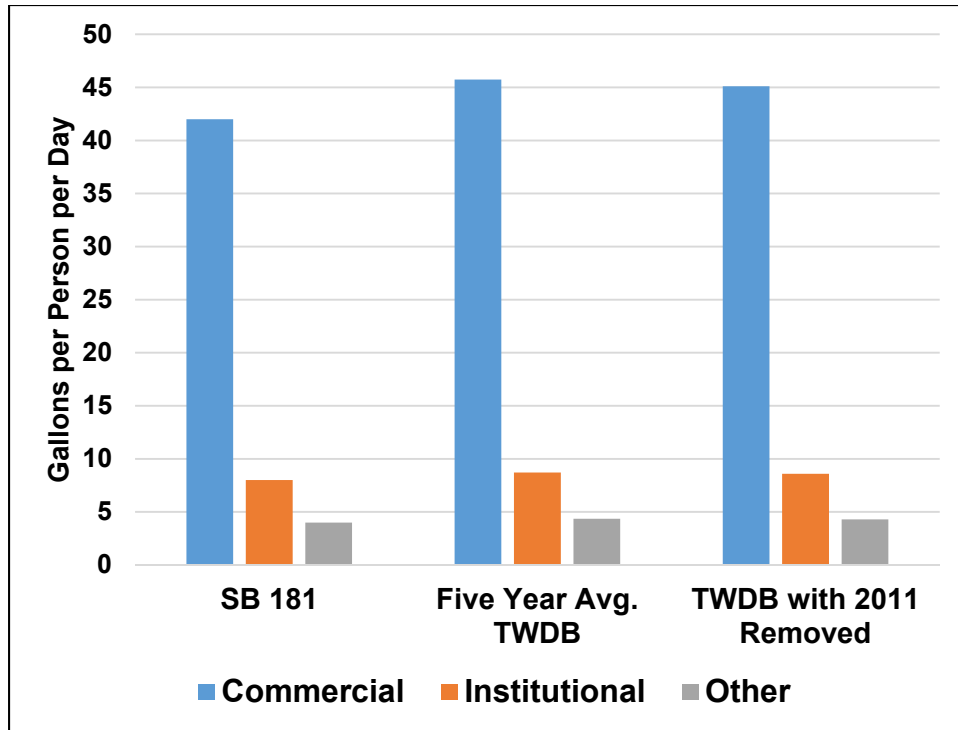


Figure 4. Comparison of GPCD Estimations

Comparison to National Data

Long term trend analysis data does not exist, but the US Geological Survey's water use reports have national estimated of municipal (Domestic and Public) use data from 1950 through 2010 and the TWDB has similar information starting in 1974. Figure 5. Compares these total municipal use gpcd's and then takes information gathered from both this document and from two American Water Works Association studies, one in 1999 and the other in 2016 to estimate indoor residential use. Table F. shows the assumptions for indoor residential per capita use used in Figure 5. The difference, the bars in Figure 5. contains outdoor use, commercial and institutional uses, leak losses, etc. The non-indoor use estimates have remained fairly constant over time. Unfortunately, there is no way to separate these uses any further other than to note that currently commercial and institutional use is about 55 to 59 gpcd. It is interesting to note that indoor residential per capita use and commercial and institutional per capita use are both in the range of 50 to 60 gpcd.

Table F. Assumed Indoor Residential Use

Year	Gallons per Person Per Day
1970	75
1980	75
1990	75
1995	73
2000	69
2005	60
2010	55

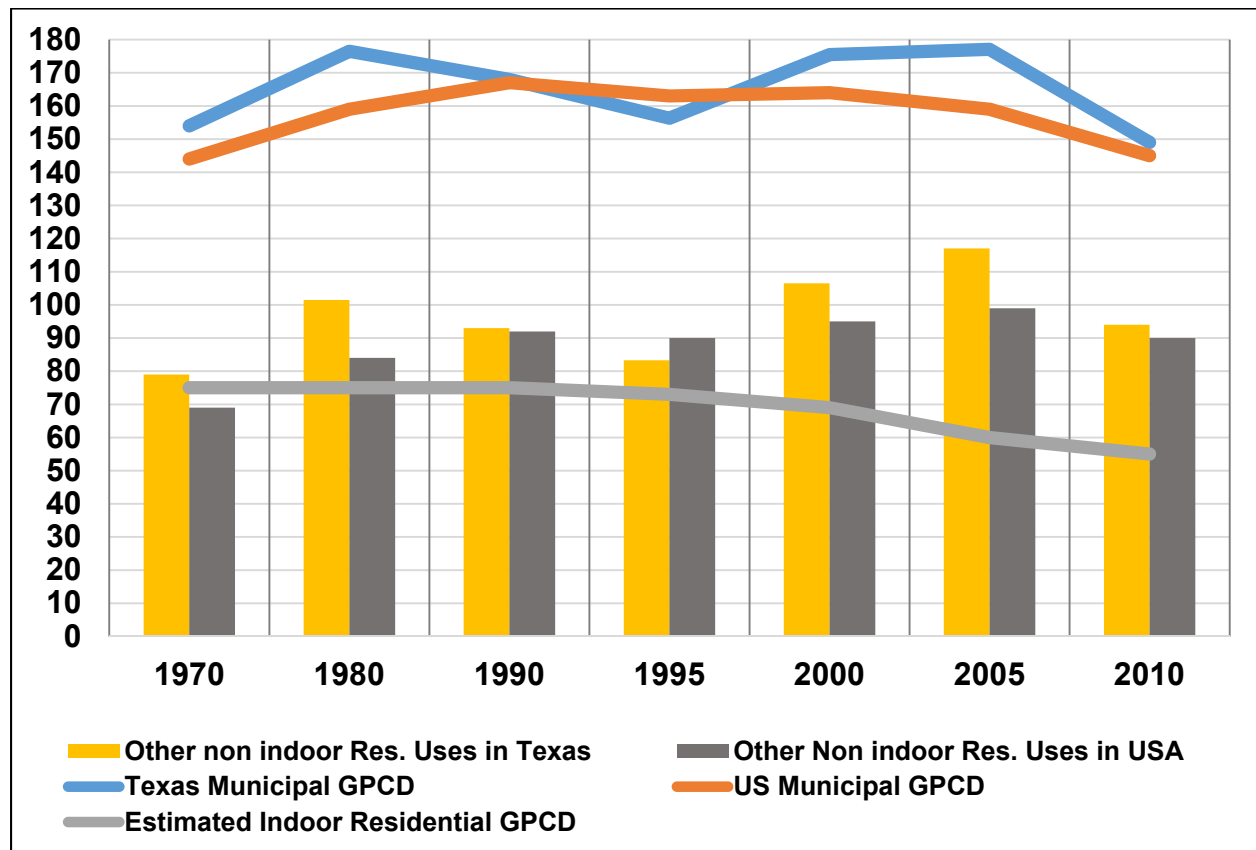


Figure 5. Municipal GPCD Comparison for Nation and Texas to Assumed Indoor Residential Use

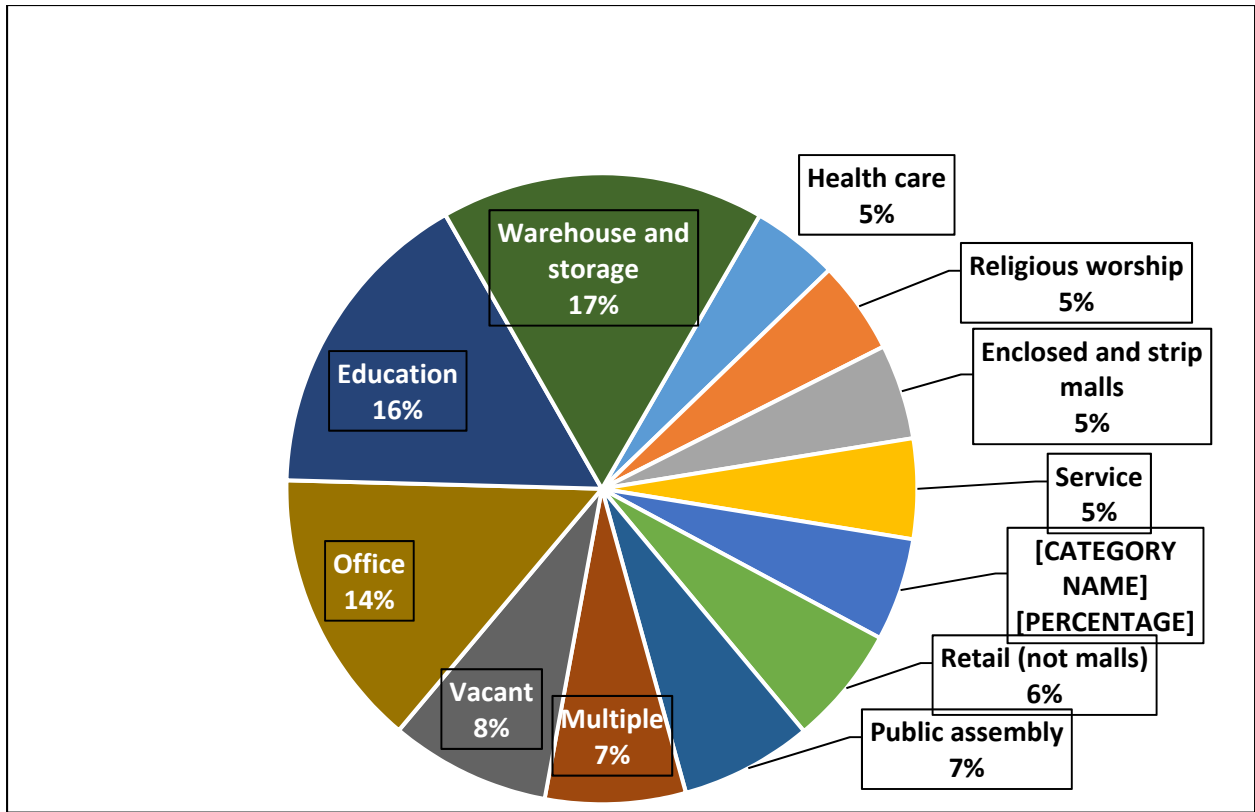
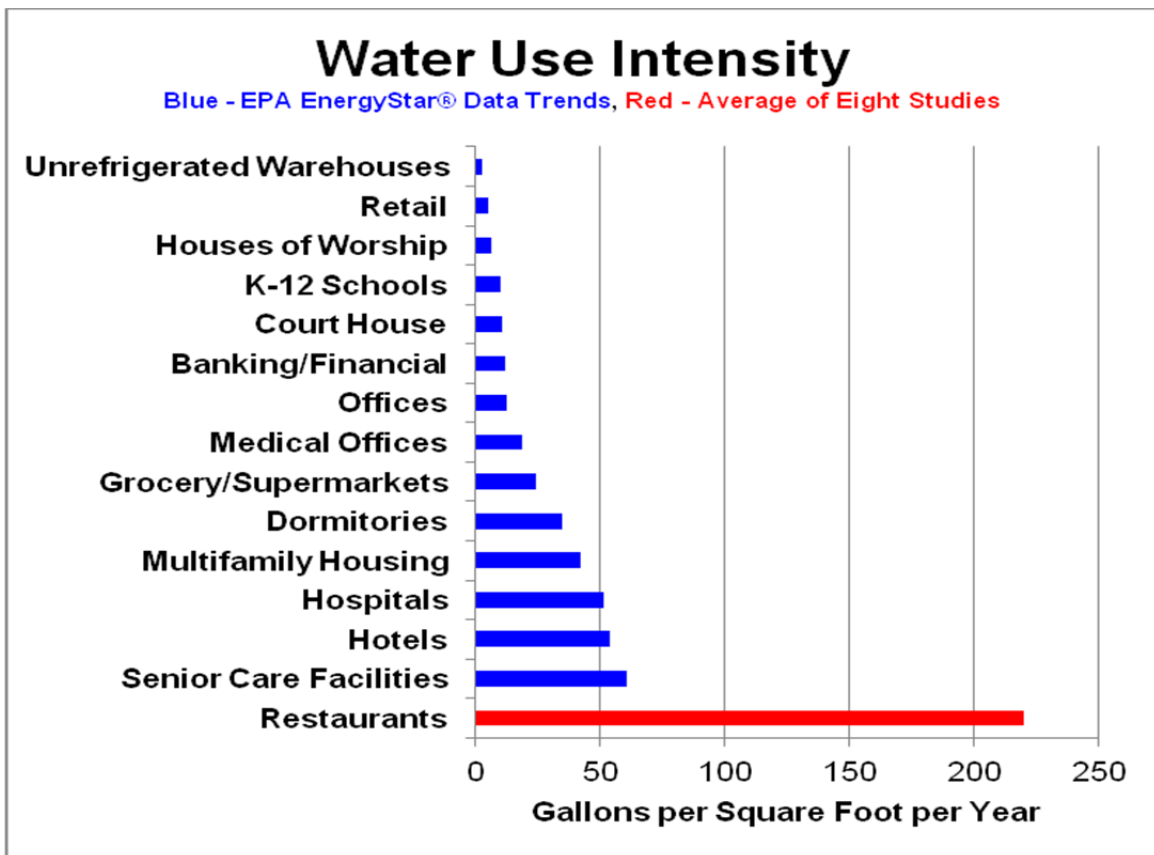
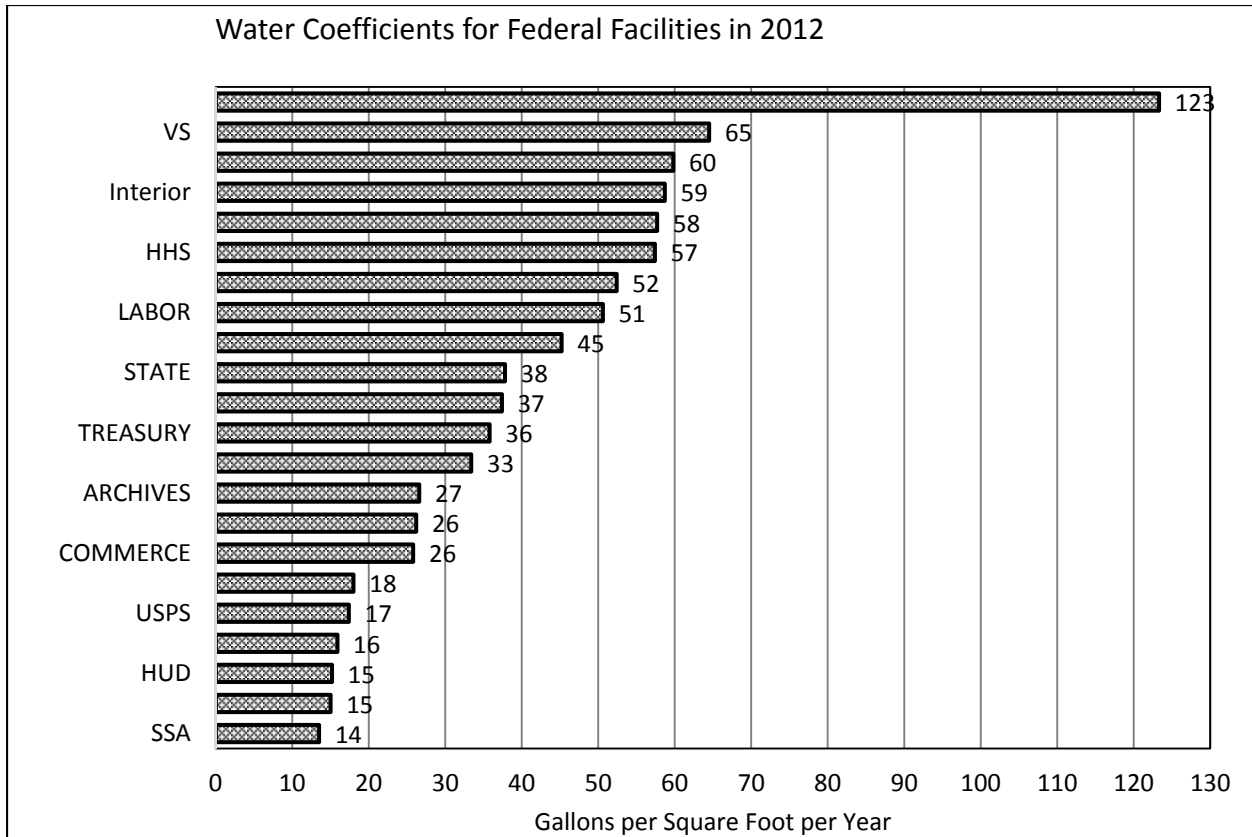


Figure 6. CBECS 2012 Estimate Distribution of Commercial/Institutional Floor Space in Texas (approximately 7.6 billion square feet)



Summary of Six United States Studies Reporting Water Use by Gallons per Square Foot of Heated Space per Year						
Type of Facility	EPA Portfolio Manager¹	University of Florida²	Santa Fe, New Mexico³	Colorado Water Wise - Brendle Group.⁴	AWWA End Use Study 2000⁵	Austin 2013⁶
<i>Gallons per Square Foot of Heated Space per Year</i>						
Restaurants		221		173 to 211	130 to 330	215
Senior Care Facilities	61	106		62 to 101		
Hotels	54	85		79 to 165	60 to 115	72
Hospitals	52	31				58
Grocery/Supermarkets	24	95	36		52 to 64	
Medical Offices	19	34	49			
Offices	13	20	26		9 to 15	
Banking/Financial	12	89				
Court House	11					
K-12 Schools	10	20		12 to 19	8 to 16	
Houses of Worship	7	15				
Retail/Shopping Centers	5	32	20			
Unrefrigerated Warehouses	3	8				
<p>U. S Environmental Protection Agency, Portfolio Manager, Data Trends, Water Use Tracking http://www.energystar.gov/buildings/tools-and-resources/water-use-tracking</p> <p>M. A. Morales and J. P. Heaney, Estimating Non-Residential Water Use with Publicly Available Databases, Conserve Florida Water Clearinghouse, Department of Environmental Engineering Sciences, University of Florida, P.O. Box 116450, Gainesville, FL 32611;</p> <p>M. A. Morales, J. P. Heaney, K.R. Freidman, J.M. Martin, Estimating Commercial, Industrial, and Commercial Water Use on the Basis of Heated Building Area, AWWA Journal, June 2011</p> <p>Planning Division, City of Santa Fe, New Mexico, Water Use in Santa Fe, 2001</p> <p>The Brendle Group, Inc. Benchmarking Task Force - Collaboration for Industrial, Commercial & Institutional Water Conservation, 226 S. Remington St. #3 Fort Collins, CO 80524</p> <p>American Water Works Association Research Foundation, Commercial and Institutional End Uses of Water, 2001, 6666 Quincy Avenue, Denver Colorado, http://ufdc.ufl.edu/WC13511002/00001/5j</p> <p>M Jordan, B Hoffman, S Riesenber, Benchmarking Commercial and Institutional Water Use in Austin, Texas, Austin Water Utility, Austin, Texas 2013</p>						

