State of San Francisco Bay 2011
Appendix J

STEWARDSHIP – Urban Water Use
Technical Appendix

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Background and rationale

Urban or municipal water use by residential, commercial, industrial and institutional (schools, government) customers accounts for about 90 percent of the 1.1 million acre-feet total annual water use in the Bay Area.[1] About 85% of the urban use is supplied from watersheds outside of the Bay-draining watersheds, predominantly from the Delta watershed with smaller amounts from the watersheds of the Russian River and Tomales Bay. The local bay-draining watersheds provide both surface water and groundwater to urban users in the Santa Clara Valley, the Alameda Creek watershed and the North Bay. Groundwater supplies about 15% of the urban uses although some of the groundwater is derived from the imported supply that is used to recharge the local groundwater basins. Groundwater is also the primary supply for water used by agriculture in the Bay Area.

Good stewardship of our water in the Bay Area means using it more efficiently by reducing the amount of water needed for any goal while still accomplishing that goal. More efficient water use has many actual and potential benefits for the Bay Area including:

- Reduces dependence on ecologically harmful water diversions from rivers and streams;
- Reduces the financial and energy costs of water and wastewater treatment, pumping, transporting and storing water supplies
- Relieves competition for limited supplies and the need to develop new supplies;
- Reduces pollutant loads from irrigating lawns, gardens and crops;
- Reduces the vulnerability of our supplies to disruption by earthquakes, droughts, floods, rising sea level, and regulatory requirements to protect endangered species.
- Qualifies water agencies for State grant funding if water use efficiency targets are met

In short, more efficient water use can reduce the human "footprint" on the natural water balance.

This indicator assesses municipal water use in the Bay Area by determining if the region is using more or less water over time and by determining whether we are getting more or less efficient by calculating the per person (per capita) use of water. Both total municipal water use and the use by just the residential customers are evaluated. Residential use, which consists of what is used in single family and multi-family residences for indoor uses (waste elimination, washing clothes and dishes, bathing, drinking) and outdoor uses (irrigation and cleaning), is the factor most directly controlled by individuals and families, whose decisions to use water more efficiently in and around the home can collectively create large-scale benefits. Institutional (primarily schools and governments) and commercial users can have both an indoor and outdoor component, depending on the nature of the business while industrial users are primarily using water indoors for a manufacturing process including energy generation. The water use that is measured by this indicator is the direct consumption of the water used inside and outside of the homes, businesses, and factories in the Bay Area but it does not measure our total water footprint, which is the volume of water that is required to produce all the goods and services that we consume and is many times greater than our direct consumption.[2]

[1] The terms "urban" and "municipal" water use are used interchangeably and refers to the use by communities that are supplied by public water districts and private water companies in contrast to the rural areas that are primarily self-supplied with groundwater.

[2] The average yearly water footprint of an American is about 655,000 gallons per year or about 18 times greater than the 36500 gallons per year or the roughly 100 gallons per day the average Bay Area resident consumes through the water supply system. Water footprints of all nations for the period 1997 - 2001 have been first reported Chapagain, A.K. and Hoekstra, A.Y. "Water footprints of nations". *Value of Water Research Report Series No. 16* (UNESCO-IHE)

Residential per capita use can be used to compare water use within and across watershed boundaries or among water agencies.[3] Per capita use derived from the total municipal use measures, along with the residential use, different proportions of commercial, industrial, and institutional uses by the different municipalities and thus make the comparisons across boundaries and what we as individuals use less accurate. The total municipal per-capita use for the Bay Area is a reasonable indicator of how the region as a whole is managing its water supplies over time and is also the metric that is used to assess compliance with the recently passed State legislation that establishes urban water use targets.

Data sources

This indicator requires measurements of total municipal and residential water use and population[4]. Data on water use and population for the period 1986-2009 was compiled in order to evaluate how the Bay Area urban use is affected over time by climate, plumbing codes, conservation measures and economic conditions. 1986 is just prior to the 1987-92 drought, the longest drought experienced by Bay Area municipalities. Major plumbing code changes were also instituted in the early 1990's. More recently the Bay Area experienced a 3-year dry period and economic downturn that also affected water use. Data for 2010 had not been reported for many of the Bay Area agencies when this was compiled in the spring of 2011.

All of the Bay Area municipal water agencies measure the water use of their customers in order to bill them based upon the volume of use but the reporting of that data is not always consistent and available since 1986. Municipal water use by retail water agencies is separated into different sectors or types of use, often distinguished by the size and type of water meter. Residential water use is accounted for separately from commercial, industrial, institutional and dedicated landscaping use. Residential customers are usually separated into single family and multi-family accounts and must be combined to derive the total residential use. Except for the residential water use compiled for the Santa Clara Valley Water District, a wholesaler of water in the South Bay, the residential water use is derived from the retail agency deliveries of water to their residential customers.[5]

Total municipal and residential water use and population data for the 1986-2009 period were compiled for Contra Costa Water District (CCWD), East Bay Municipal Utilities District (EBMUD), Alameda County Water District (ACWD), San Francisco Public Utilities District (SFPUC), Zone 7 Water Agency (Zone 7), Santa Clara Valley Water District (SCVWD), Bay Area Water Supply and Conservation Agencies (BAWSCA- an association of the water agencies that wholesale water from the SFPUC), Marin Municipal Water District (MMWD), and the City of Napa (Napa), which together serve about 93% of the 6.6 million people that reside in the municipalities in the local Bay-draining watersheds. Table 1 lists the agencies, the type of service provided (wholesale or retail or both), the geographic region served, population, and the sources of water.

Data was obtained either directly from the water agencies (either from data sent to me or obtained from their Urban Water Management Plans), or from a compilation done for the Bay Area Water Agencies Coalition (BAWAC- a coalition of the major Bay Area water agencies) or from the Department of

[3] This assumes that the agencies are defining the single family and multi-family residential customer class similarly, which is generally true although some agencies separate mobile home parks and dedicated landscaping meters at multi-family complexes.

[4] The volume of water use shown for this indicator is in acre-feet per year. An acre-foot is equal to 325,851 gallons. The data is reported by the water agencies in gallons or cubic feet or occasionally acre-feet.

[5] The data obtained from the Santa Clara Valley Water District assumes the residential water use in their retail districts is 52% of the total water use in every year.

Water Resources Public Water System Survey (DWR PWSS).[6] Municipalities and areas not included because data back to 1986 was not available include Novato, Petaluma, Sonoma Valley, Napa Valley not including City of Napa, Vallejo, American Canyon, Benicia, Fairfield, and Suisun City; these areas have about 450,000 people.

In addition to the DWR PWSS, the California Urban Water Conservation Council (CUWCC) also collects water use data from their member agencies, including most of the Bay Area retailers and wholesalers but their database was not functioning at the time of this compilation in the spring of 2011. The water use data the agencies report to the DWR PWSS and the CUWCC is not always consistent with the same data contained in agency reports including Urban Water Management Plans, thus where possible data was obtained by direct inquiry to the water agencies.

Methods and calculations

The average daily water use per person – gallons per capita per day (gpcd) – is calculated by converting the reported monthly, bi-monthly or annual residential water use data into gallons, dividing by the appropriate number of days to get a daily use and then dividing that result by the population using that water to get the gpcd. It is assumed for purposes of this calculation that only the population reported to reside within the service area of the district consumes the residential water and that visitors to the area are consuming water from non-residential accounts (i.e. commercial or institutional accounts).[7]

Goals, targets, and reference conditions

As noted above, in order to evaluate how the Bay Area urban use is affected over time by climate, plumbing codes, conservation measures and economic conditions, water use was assessed beginning in 1986. 1986 is just prior to the 1987-92 drought, the longest drought experienced by Bay Area municipalities and prior to major plumbing code changes instituted in the early 1990's and is used as a reference condition in this assessment from which to measure changes in total water use, population, and per-capita use.

The Water Conservation Act of 2009, Senate Billx7-7 (2009 Act) established a goal of reducing urban per-capita water use by 20% by 2020 with an interim goal of a 10% per-capita reduction by 2015. This first legislatively-proscribed urban water use target in California provides that targets can be calculated by one of four methods. Method 3 target is ninety-five percent of the applicable hydrologic region target derived from the State's April 30, 2009, draft 20x2020 Water Conservation Plan.[8] The calculated target for the San Francisco Bay region in 2020 is 124 gpcd (95% of 131 gpcd), which can be used to assess progress for the region, although this indicator is not meant to be used to determine 2009 Act compliance. A water agency can choose the method to establish its target, which is described in Methodologies for Calculating Baseline and Compliance Urban Per Capita Water Use, Feb 2011, available on the DWR web site http://www.water.ca.gov/wateruseefficiency/sb7/ established for tracking the implementation of the legislation.

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[6] Because the Santa Clara Valley Water District did not compute residential water use data for 2008 and 2009, additional data for those years had to be compiled for water agencies in Santa Clara Valley that do not receive SFPUC water and thus whose data was unavailable from BAWSCA. These agencies include the San Jose Water Company, Great Oaks Water Company, California Water Service Agency- Los Altos, and San Jose Municipal Water Company- Evergreen.

[7] It is possible that some of the visitors using the water in the municipalities are using residential water (e.g. bed and breakfasts) but that there is no way of determining that for this project. If visitors are using residential water in significant quantities then the gpcd will be somewhat higher.

[8] The 20 by 2020 Water Conservation Plan follows from the 2008 governor's executive order requiring state agencies to develop a plan to reduce statewide per capita urban water use by 20 percent by the year 2020.

The Bay Institute's 2003 Ecological Scorecard (TBI 2003) concluded that residential use – particularly indoor use -- lends itself to establishing per-capita benchmarks and for comparative evaluation within the region since per-capita indoor use should be roughly the same throughout the region while outdoor use varies primarily due to lot size and climate. Differences in total urban use are a function of the mix of residential and non-residential uses and the different types of commercial and industrial uses and thus is harder to establish comparative targets for efficient use. Based upon a review of several end-use studies, TBI (2003) uses an indoor use target of 40 gpcd in its scoring of residential water use.

Results

Table 2 and Figures 1 and 2 document the fluctuation and eventual overall decline in total water use and per-capita use in the San Francisco Bay region in the 1986-2009 period. Total urban water use in the Bay Area is 20 percent less today than it was 25 years ago, a remarkable achievement given that the population has increased by 20 percent. This is primarily a result of greater efficiency of use, combined more recently with a dampening of water demand due to the economic downturn. The increased efficiency has been achieved through mandates for more efficient water-using appliances, and by Bay Area residents and businesses reducing their use in response to requests for conservation during the recent 2007 to 2009 dry period. Residential use did not decline as much - only 10% in the 1986-2009 period- reflecting the fact that residential growth in the region has been greater in the hotter inland areas with greater per-capita use. Commercial and industrial water use has also declined proportionally more due to the shrinkage of manufacturing and industry as well as economic incentives to decrease potable water use, including the greater use of recycled water.

Although data for the entire Bay Area is only available through 2009, data from selected suppliers for 2010 and 2011 indicates that usage is continuing its downward trend as cooler and wetter springtime weather in those years reduced demand. The outdoor water use, which can represent up to half of the total annual use, is sensitive to the variations in precipitation and temperature, particularly in the spring and fall.

The total per capita use of 132 gpcd in 2009 shows that the Bay region has already made significant progress toward meeting the 2020 regional urban water use target of 124 gpcd with many of the individual agencies well below the regional target. Although a rebounding economy and years with less precipitation are factors that will likely increase urban water use at some point in the future, if recent per-capita usage can be maintained or improved, the mandate for a 20 percent reduction should be easily achieved by 2020.

The change in water use and per-capita use for the individual agencies is shown in Table 3.
This table shows the considerable geographic variation in the water use and the trends over time around the region. The variation in water use is largely explained by the climatic differences between the cooler Bay-side versus the warmer inland areas and residential lot size differences between the smaller lots in the older cities and larger lots in the newer suburbs; SFPUC and Zone 7 Alameda County represent the two extremes with a greater than two-fold difference in the total and per-capita water use. Variations in water use is also reflective of the relative proportion of the different types of uses- residential versus non-residential uses and variations within the commercial and industrial sectors- in the region (e.g. Santa Clara and Contra Costa Counties have more water-using industry than Marin or Napa Counties). The water use trends over time also reflect the relative growth patterns in the region in the past quarter century. Residential growth has been proportionally much greater in the warmer inland areas of Eastern Alameda and Contra Costa Counties than in the inner Bay Area and is

reflected in the increase of residential water use in the water districts serving those areas. The per-capita total and residential use, however, has decreased in all areas.

The decrease in the regional urban water use has reduced the demand on imported supplies, but it has not translated into greater inflows to the Bay from the Delta (see flow indicator). Competition for the limited supplies from the Delta and it tributary watersheds means that other urban and agricultural users will divert any additional water from the reduced demand. If demand stays at these reduced levels due to continued conservation, reduced economic activity or wetter conditions, the water agencies will continue to experience declining revenues and thus water rates will have to be increased to balance revenues with costs. The challenge for the agencies is how to structure rates so that users are not penalized for using less. The potential for greater efficiency of use in the region- upwards of 15% or more, particularly in outdoor water use, is still high and therefore it is possible to accommodate population increases over the next decade without significant increases in total demand.

Table 1: Water Agencies in the San Francisco Bay Region

Agency	Type	County / region served	Population in 2009	Primary sources of water
Alameda County Water District (*ACWD*)	Retail	South Alameda	332,000	SWP, SFPUC, and ground water
Bay Area Water Supply and Conservation Agencies (*BAWSCA*)[9]	Association	San Mateo, north Santa Clara, south Alameda	1,719,028 (869,164)[10]	SFPUC, SWP, CVP, local surface and ground water
Contra Costa Water District (*CCWD*) (includes treated and wholesale service areas)	Retail and Wholesale	North, central, and east Contra Costa	457,544	CVP, and direct diversion from the Delta
East Bay Municipal Utility District (*EBMUD*)	Retail	North Alameda, north and central Contra Costa	1,400,000	Mokelumne River and local surface water
Marin Municipal Water District (*MMWD*)	Retail	South and central Marin	190,600	Lagunitas Creek, and Russian River surface water
San Francisco Public Utilities District (*SFPUC*)	Retail and Wholesale	San Francisco	848,601	Tuolumne River and local runoff in Alameda and San Mateo County
Santa Clara Valley Water District (*SCVWD*)	Wholesale	Santa Clara	1,822,000[11]	SFPUC, SWP, CVP, local surface and ground water
Zone 7 of the Alameda County Flood Control and Water Conservation District (*Zone 7*)	Wholesale	East Alameda	216,000	SWP, local surface and ground water
City of Napa	Retail	Napa	85,814	SWP, local surface water

[9] BAWSCA does not deliver water but is an association from the 29 cities, water districts and other agencies that purchase all or a portion of their water from the City and County of San Francisco (SFPUC) Hetch Hetchy water system.
[10] BAWSCA includes ACWD and agencies that are part of SCVWD. The bracketed number represents the population *excluding* those entities.
[11] 2010 population

Table 2- Total and Residential Water Use for the San Francisco Bay Region

Category	Year	Population served		Total Use (AF)		Residential Use (AF)	
			Population Served	Gallons per capita day (GPCD)	Total Water Use (AF)	Gallons per capita day (GPCD)	Residential Water Use (AF)
	1986		4,899,583	200	1,095,075	107	588,575
Drought Period	1987		4,960,101	201	1,115,781	106	588,479
	1988		5,026,287	187	1,054,355	97	545,169
	1989		5,100,478	166	947,070	90	514,009
	1990		5,165,134	170	981,503	89	514,094
	1991		5,195,112	148	859,548	77	449,694
	1992		5,246,028	149	876,048	82	482,040
	1993		5,313,206	153	908,995	86	513,663
	1994		5,354,939	160	957,448	89	531,421
	1995		5,382,104	160	961,710	90	541,861
	1996		5,436,714	167	1,016,822	94	572,703
	1997		5,507,039	173	1,068,384	97	600,421
	1998		5,581,163	162	1,011,697	90	562,702
	1999		5,650,259	168	1,065,797	94	594,227
	2000		5,730,602	171	1,096,438	95	610,171
	2001		5,799,308	169	1,101,009	96	625,916
	2002		5,854,638	167	1,097,317	95	623,551
	2003		5,890,232	162	1,068,050	93	615,995
	2004		5,961,281	163	1,091,353	93	617,870
	2005		5,995,794	155	1,043,993	88	589,487
	2006		6,047,734	155	1,047,702	88	593,850
Dry Period	2007		6,116,940	158	1,081,633	89	607,079
	2008		6,114,426	145	993,462	86	587,141
	2009		6,146,286	132	909,842	78	534,279
Percent Change (%)			**20%**	**51%**	**-20%**	**38%**	**-10%**
Annual Change (%)			**0.8%**	**-2.1%**	**-0.8%**	**-1.6%**	**-0.4%**

Table 3: Total and Residential Water Use for Individual Agencies in the San Francisco Bay Area

Agency	Population change since 1986	Water Use			Change in total water use 1986-2009		*Per capita* water use		Change in *per capita* water use 1986-2009	
		Total (AF[12])	**Residential (AF)**	Resid. as % of total[13]	**Overall total % change**	**Residential total % change**	**Total** (GPCD)	**Residen -tial** (GPCD)	**Total GPCD % change**	**Residential GPCD % change**
Alameda County Water District (*ACWD*)	**+28**%	47,000	29,100	62%	**+4**%	**-4**%	126	78	**-34**%	**-44**%
Bay Area Water Supply and Conservation Agencies (*BAWSCA*)[14]	**+13**%	127,821	81,793	64%	**+2**%	**0**%	133	85	**-13**%	**-15**%
Contra Costa Water District (*CCWD*)	**+ 32**%	105,600	53,900	51%	**-26**%	**+11**%	206	105	**-87**%	**-32**%
East Bay Municipal Utility District (*EBMUD*)	**+21**%	208,325	118,744	57%	**-16**%	**-14**%	127	76	**-47**%	**-44**%
Marin Municipal Water District (*MMWD*)	**+12**%	25,982	16,905	65%	**-24**%	**-16**%	122	79	**-42**%	**-32**%
San Francisco Public Utilities District (*SFPUC*)	**+13**%	81,128	48,184	59%	**-39**%	**-16**%	86	51	**-60**%	**-33**%
Santa Clara Valley Water District (*SCVWD*)	**+22**%	352,000	175,500	52%	**-7**%	**-9**%	187	86	**-37**%	**-39**%
Zone 7 Alameda County (*Zone 7)*	**+48**%	46,785	29,753	64%	**+43**%	**+40**%	193	123	**-11**%	**-17**%
City of Napa	**+23**%	14,865	9,118	61%	**+13**%	**+12**%	155	95	**-13**%	**-15**%

[12] Note on units: AF = acre-feet (325,831 US Gal., or 1233.48 m^3); GPCD = gallons per person per day
[13] Residential water use as % of total water use not including any recycled water
[14] BAWSCA values exclude ACWD and agencies that are part of SCVWD

Figure 1. San Francisco Bay Area Population and Water Use

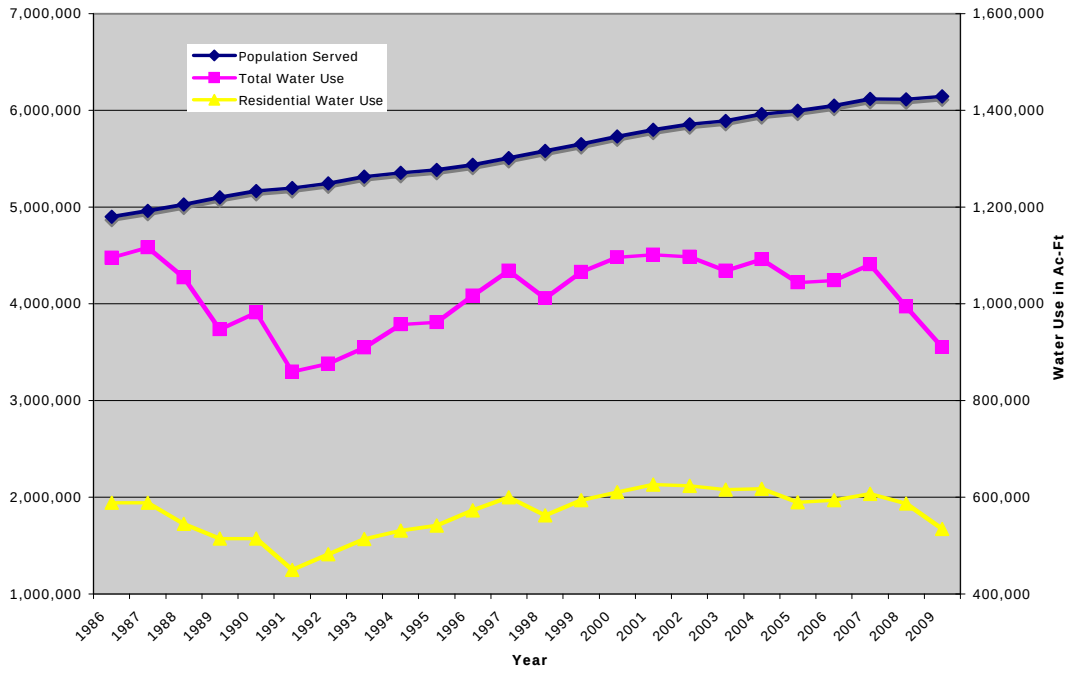

Figure 2. San Francisco Bay Area Per- Capita Water Use