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Water Use Forecasting
Sustainable Residential Development in California:
A Case Study

Matthew P. Zucca, P.E.
Erler & Kalinowski, Inc.

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Project Overview

- **Planned community in California**

- **More than 10,000 housing units**

- **High density (12 du/acre to 125 du/acre)**

- **Primarily residential, but includes CII uses**

Objectives

- **Create a flexible water needs planning tool**

- **Develop total project potable and non-potable water needs incorporating "CalGreen Code" requirements**

- **Evaluate potable water use reductions associated with wide use of reclaimed water**

- **Demonstrate to local land use authority the projected water needs for the project**

- **Support the development of a Water Supply Assessment as part of the EIR**

Water Use Differences for the Project

- **Developer-imposed requirement for only using Tier 3 high-efficiency clothes washers**

- **Use of reclaimed water for flushing toilets**

- **High density, but relatively high occupancy compared to typical MFR**

- **Community open space instead of individual residential landscaping**

- **Outdoor irrigation with reclaimed water**

Basis for Water Use Estimate

- **Recent studies provided significant new information regarding end uses for**
  - Existing homes in California
  - Standard Homes - Constructed after 2001
  - New, High-Efficiency Homes

- **Information provided a new basis upon which to estimate the water demands and conservation savings for a new development**

- **Utilize measured data from new, high-efficiency homes to develop reasonable estimate of Project water use**

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References

1. DeOreo, William B., 2011. *California Single Family Water Use Efficiency Study*, dated 20 April 2011

2. DeOreo, William B., 2011. *Water Efficiency Benchmarks for New Single-Family Homes - Final Report*, dated 24 March 2011.

3. Mayer, Peter and DeOreo, William, et al., 1999. *Residential End Uses of Water*. American Water Resources Association Research Foundation, 1999

4. UCCE/DWR, 2000. *A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California*, University of California Cooperative Extension and California Department of Water Resources. August 2000

Definitions

- **AWWARF Home:**
  - Homes whose water use was measured as part of the Residential End Uses of Water Study, AWWARF, 1999

- **Local Home:**
  - Based upon local end water use data within Project area

- **Existing Home:**
  - Homes within California regardless of the year of construction.
  - Study areas within California.

- **Standard Home:**
  - These homes were built after 1 January 2001
  - Study areas across United States

- **High-Efficiency Home:**
  - Are built using the USEPA WaterSense New Home specification or better.
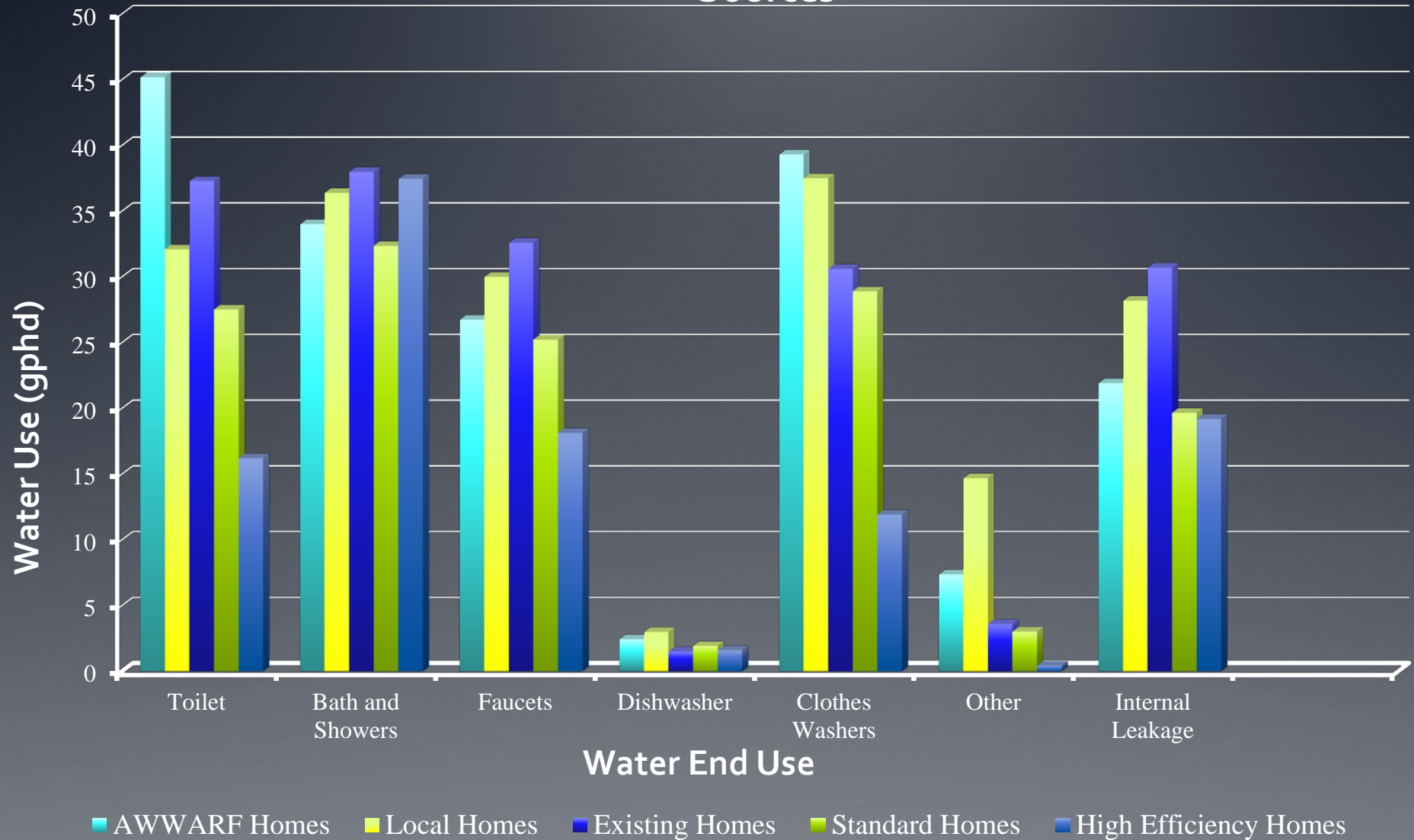 - Study areas in California and Oregon
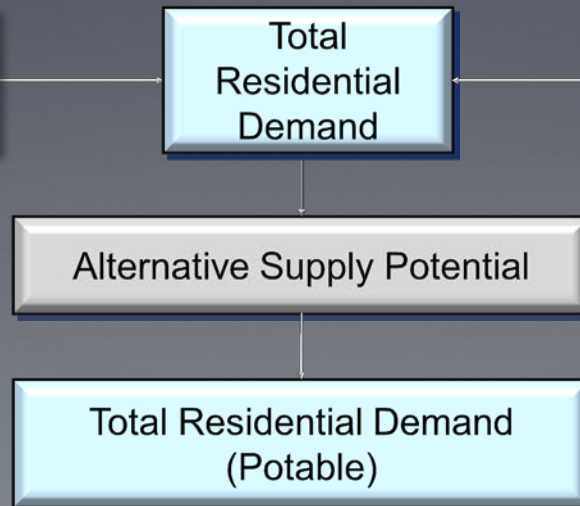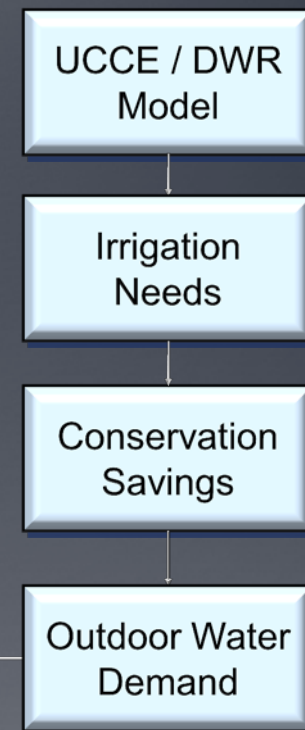
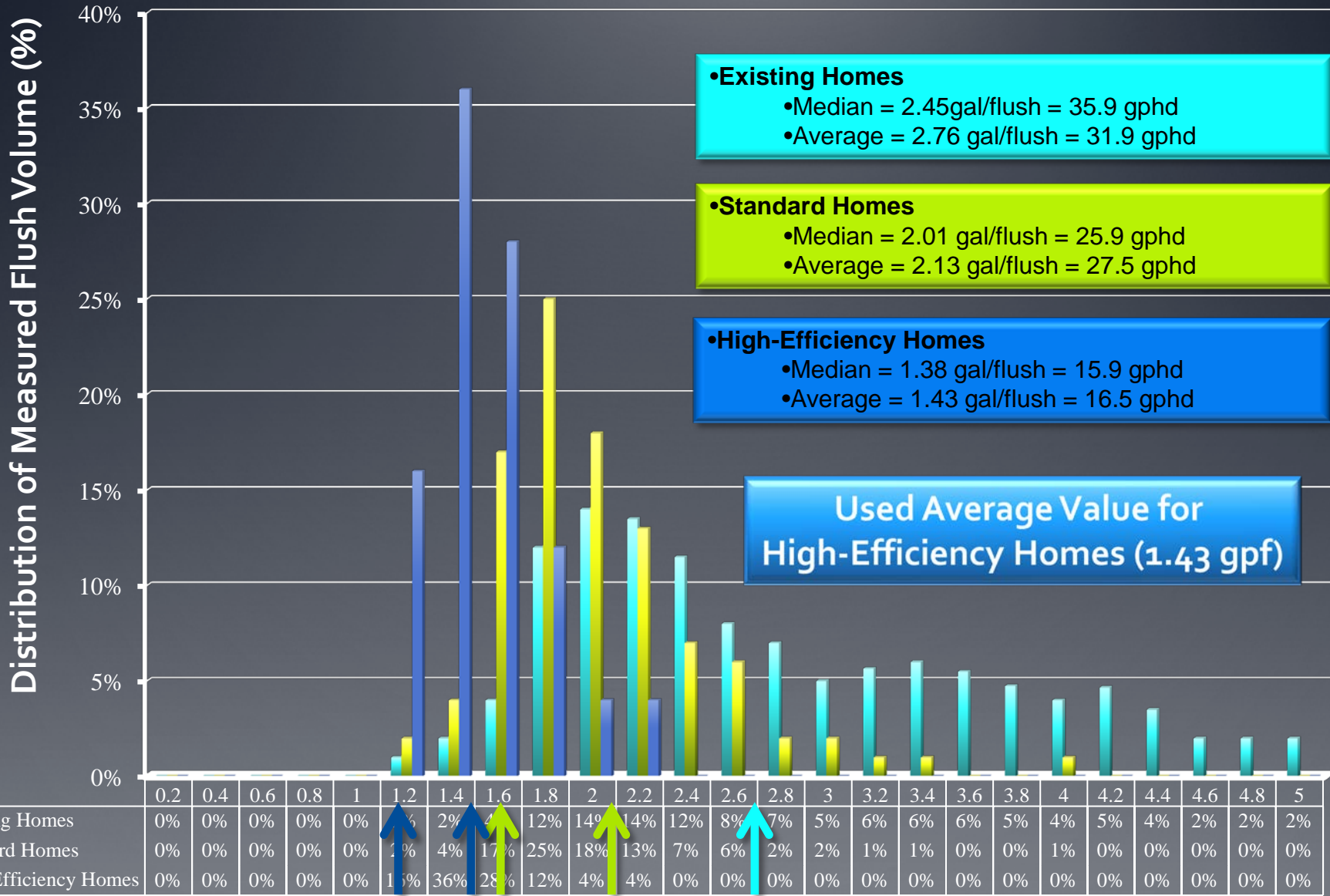Comparison of Average Daily Water Use from Various Data Sources

Distribution of Measured Toilet Flush Volumes (3 per/du)
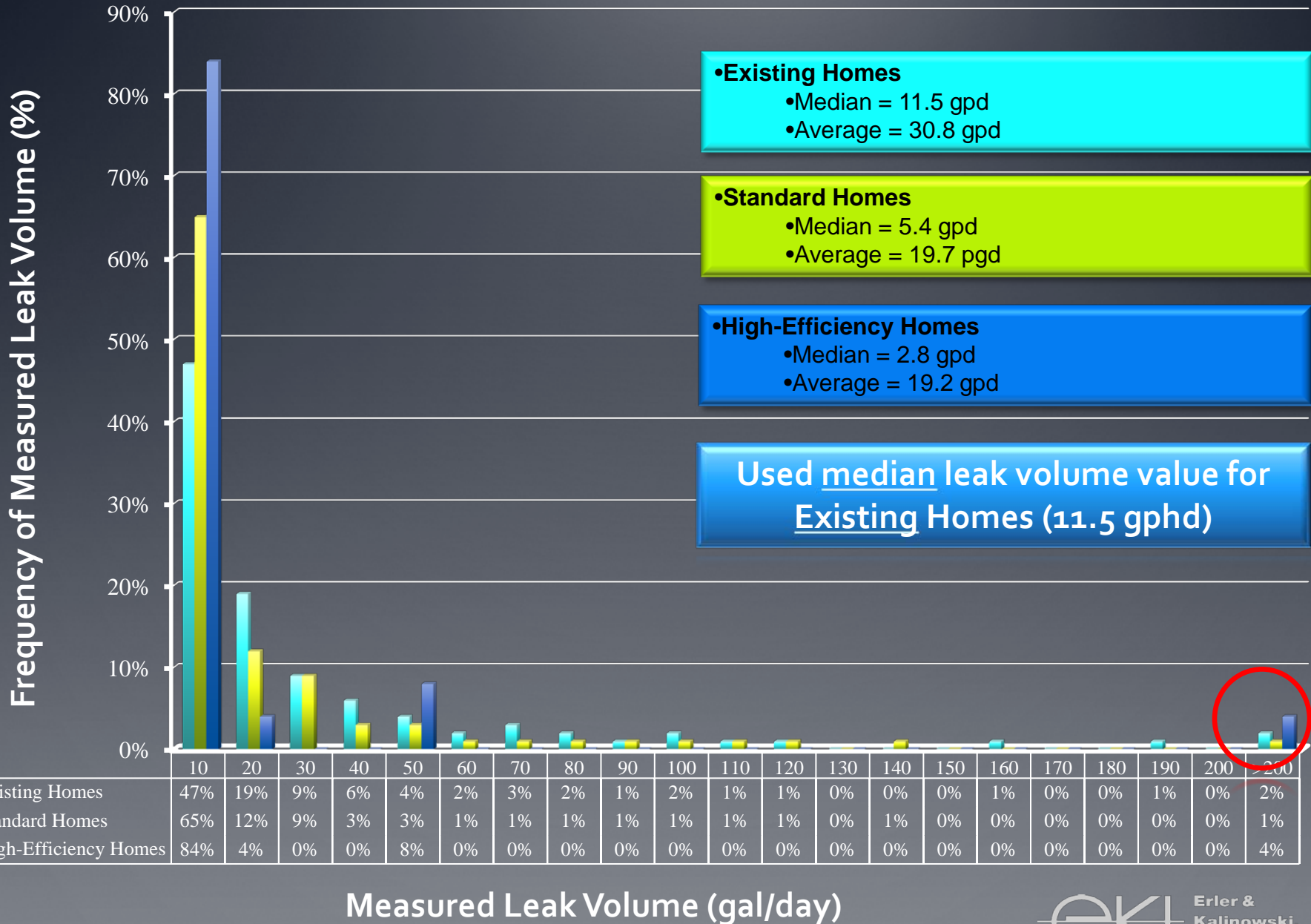

Distribution of Measured Flush Volume (%) (y-axis)

Measured Toilet Flush Volume (gal/flush) (x-axis)

- **Existing Homes**
  - Median = 2.45gal/flush = 35.9 gphd
  - Average = 2.76 gal/flush = 31.9 gphd

- **Standard Homes**
  - Median = 2.01 gal/flush = 25.9 gphd
  - Average = 2.13 gal/flush = 27.5 gphd

- **High-Efficiency Homes**
  - Median = 1.38 gal/flush = 15.9 gphd
  - Average = 1.43 gal/flush = 16.5 gphd

Used Average Value for High-Efficiency Homes (1.43 gpf)

	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	5
Existing Homes	0%	0%	0%	0%	0%	1%	2%	4%	12%	14%	14%	12%	8%	7%	5%	6%	6%	6%	5%	4%	5%	4%	2%	2%	2%
Standard Homes	0%	0%	0%	0%	0%	2%	4%	17%	25%	18%	13%	7%	6%	2%	2%	1%	1%	0%	0%	1%	0%	0%	0%	0%	0%
High-Efficiency Homes	0%	0%	0%	0%	0%	16%	36%	28%	12%	4%	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

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Distribution of Measured Laundry Load Volumes (3 per/du)

Existing Homes
- Median = 36 gal/load   0.96 loads/day
- Average = 37 gal/load

Standard Homes
- Median = 34 gal/load   0.9 loads/day
- Average = 36 gal/load

High-Efficiency Homes
- Median = 14.8 gal/load   0.8 loads/day
- Average = 15.1 gal/load

Used Average Value for High-Efficiency Homes (15.1 gal/load)

Distribution of Measured Laundry Load Volumes (y-axis)

Measured Laundry Load Volume (gal/load) (x-axis)

	5	10	15	20	25	30	35	40	45	50	55	60	65	70
Existing Homes	0%	0%	3%	8%	9%	10%	14%	18%	18%	11%	4%	3%	2%	1%
Standard Homes	0%	5%	14%	11%	10%	10%	21%	16%	6%	3%	2%	2%	0%	0%
High-Efficiency Homes	12%	48%	36%	0%	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%

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Distribution of Measured Daily Leak Volumes (3 per/du)

Existing Homes
- Median = 11.5 gpd
- Average = 30.8 gpd

Standard Homes
- Median = 5.4 gpd
- Average = 19.7 pgd

High-Efficiency Homes
- Median = 2.8 gpd
- Average = 19.2 gpd

Used <u>median</u> leak volume value for Existing Homes (11.5 gphd)

Frequency of Measured Leak Volume (%)

Measured Leak Volume (gal/day)

	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	200
Existing Homes	47%	19%	9%	6%	4%	2%	3%	2%	1%	2%	1%	1%	0%	0%	0%	1%	0%	0%	1%	0%	2%
Standard Homes	65%	12%	9%	3%	3%	1%	1%	1%	1%	1%	1%	1%	0%	1%	0%	0%	0%	0%	0%	0%	1%
High-Efficiency Homes	84%	4%	0%	0%	8%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	4%
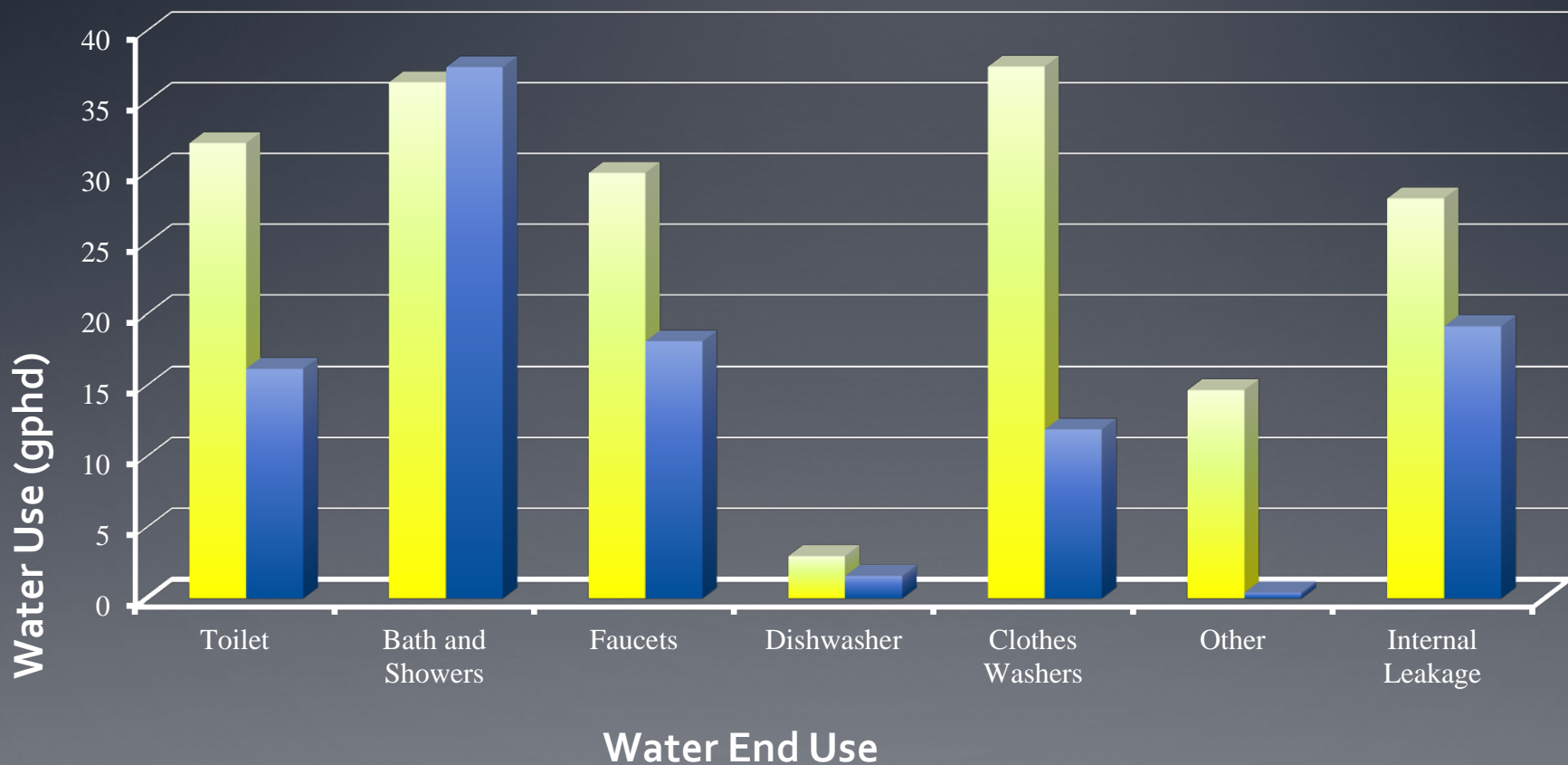
Comparison of Local Homes to High Efficiency Homes

Comparison of Local Homes to High Efficiency Homes
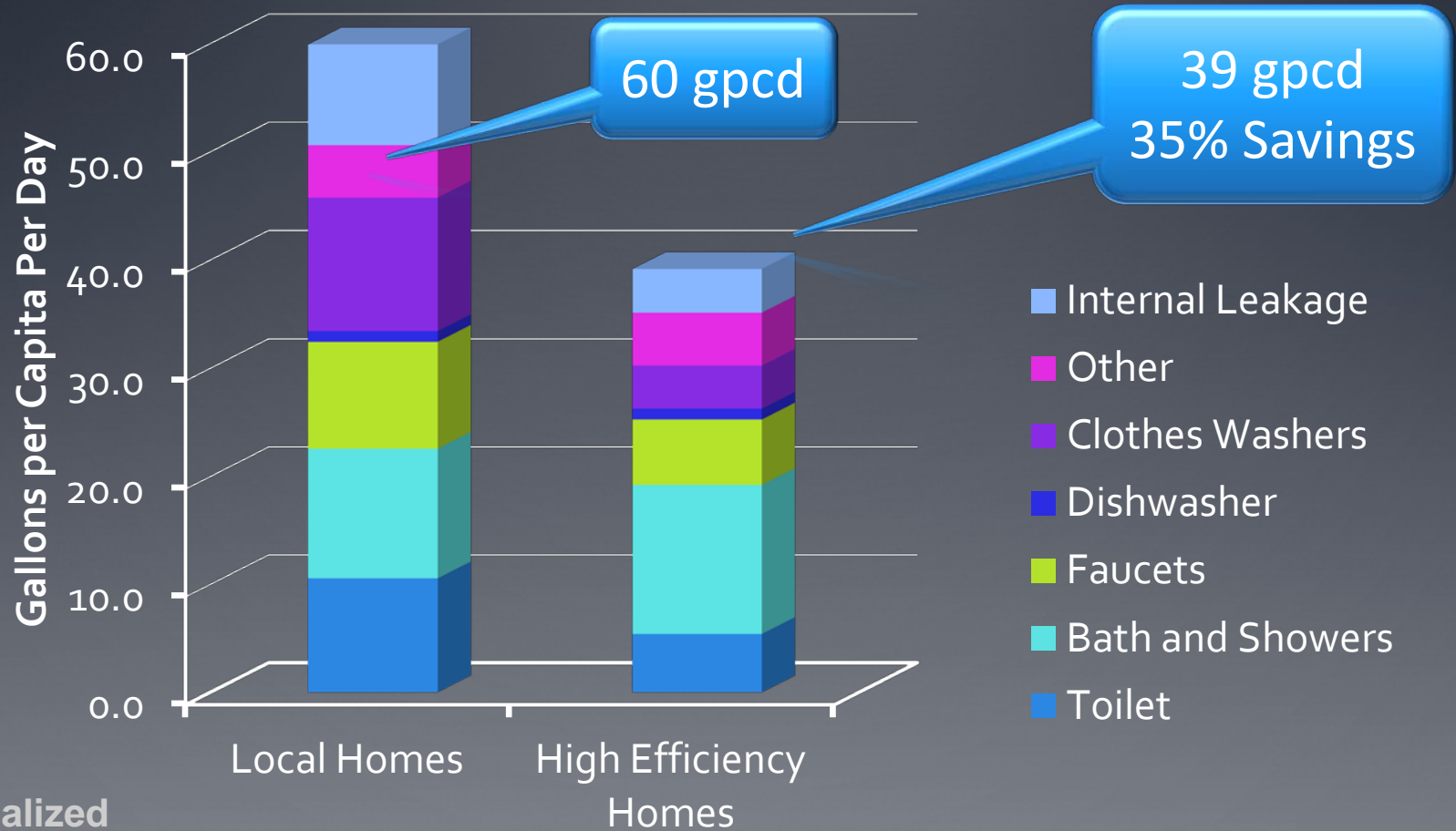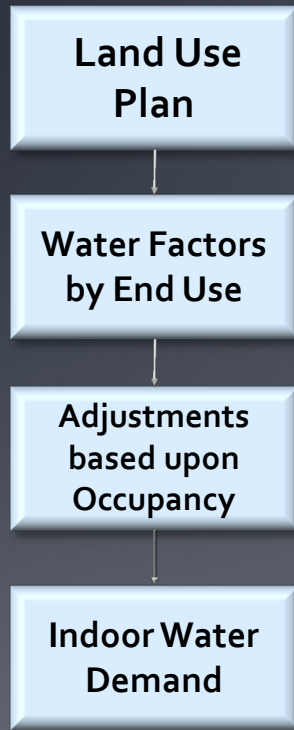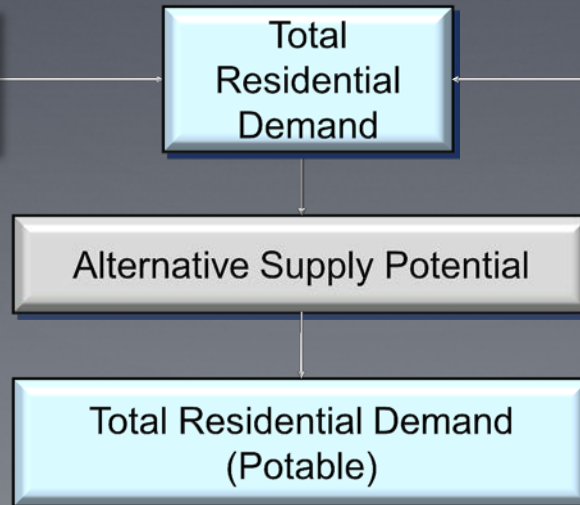
Outdoor Demand

- **UCCE / DWR, "A guide to Estimating irrigation Water Needs of Landscape Plantings in California, The Landscape Coefficient Method and WUCOLS III" (2000)**

- **Landscape Coefficient Method and WUCOLS**
  - Climate Factors – ET, Rainfall
  - Landscape Factors – Plant varietals, density
  - Project Specific Factors – Landscape area, types of plantings

ET and Precipitation
California Irrigation Management Information System

Landscape Coefficients
Based on UCCE / DWR Studies

Category of Planting	Example Plantings	Water Use Coefficient
High Water Use	Turf	0.8
Low Water Use	Drought Tolerant	0.4

Outdoor Demand
UCCE / DWR Model Parameters

Irrigation Efficiency	→	80%	→	Assumes plants don't get all water
Area of Landscaping	→	20%	→	Based upon land use planning estimates
Types of Plantings	→	Mix	→	50/50 split between HWU and LWU plants
Recycled Water Use	→	125%	→	Periodic excess application for salts
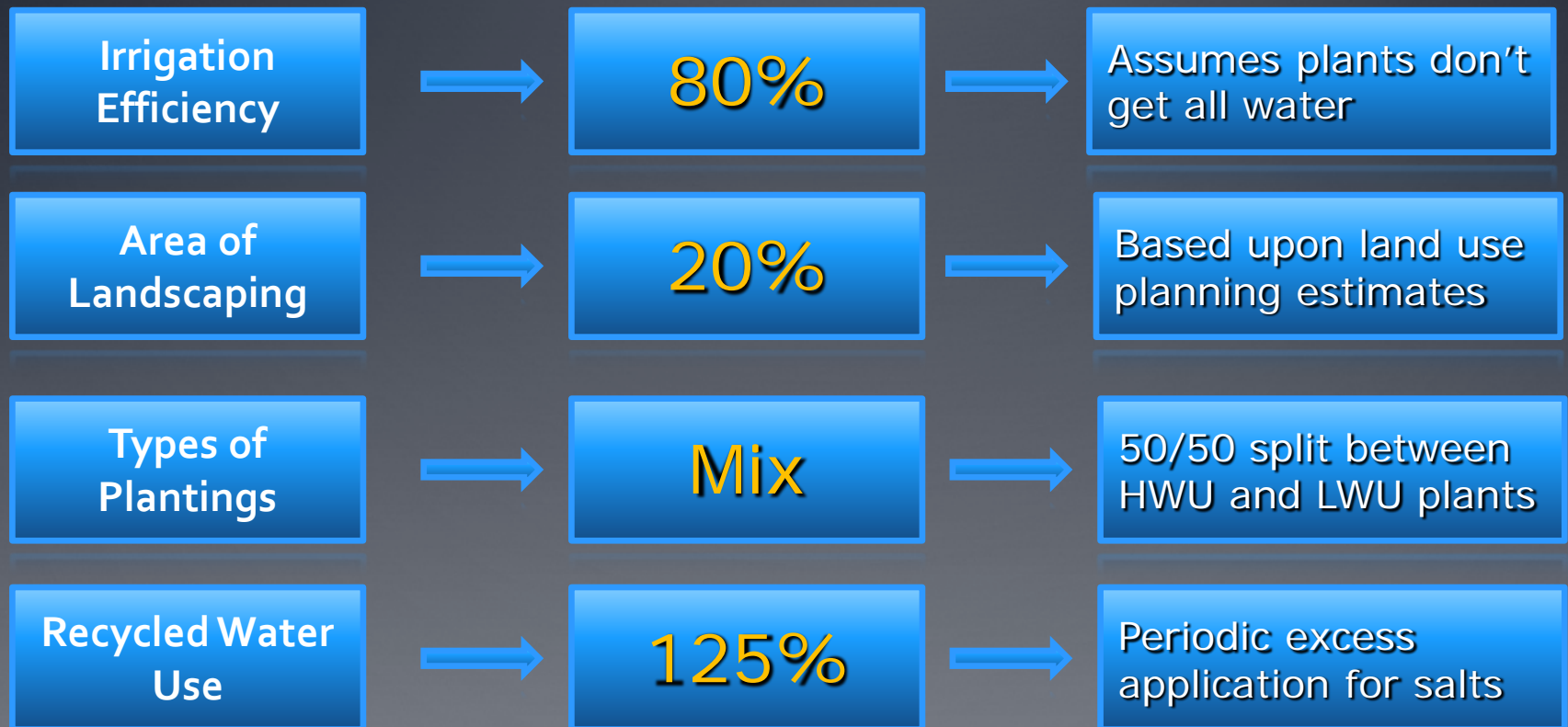
Outdoor Demand Calculations
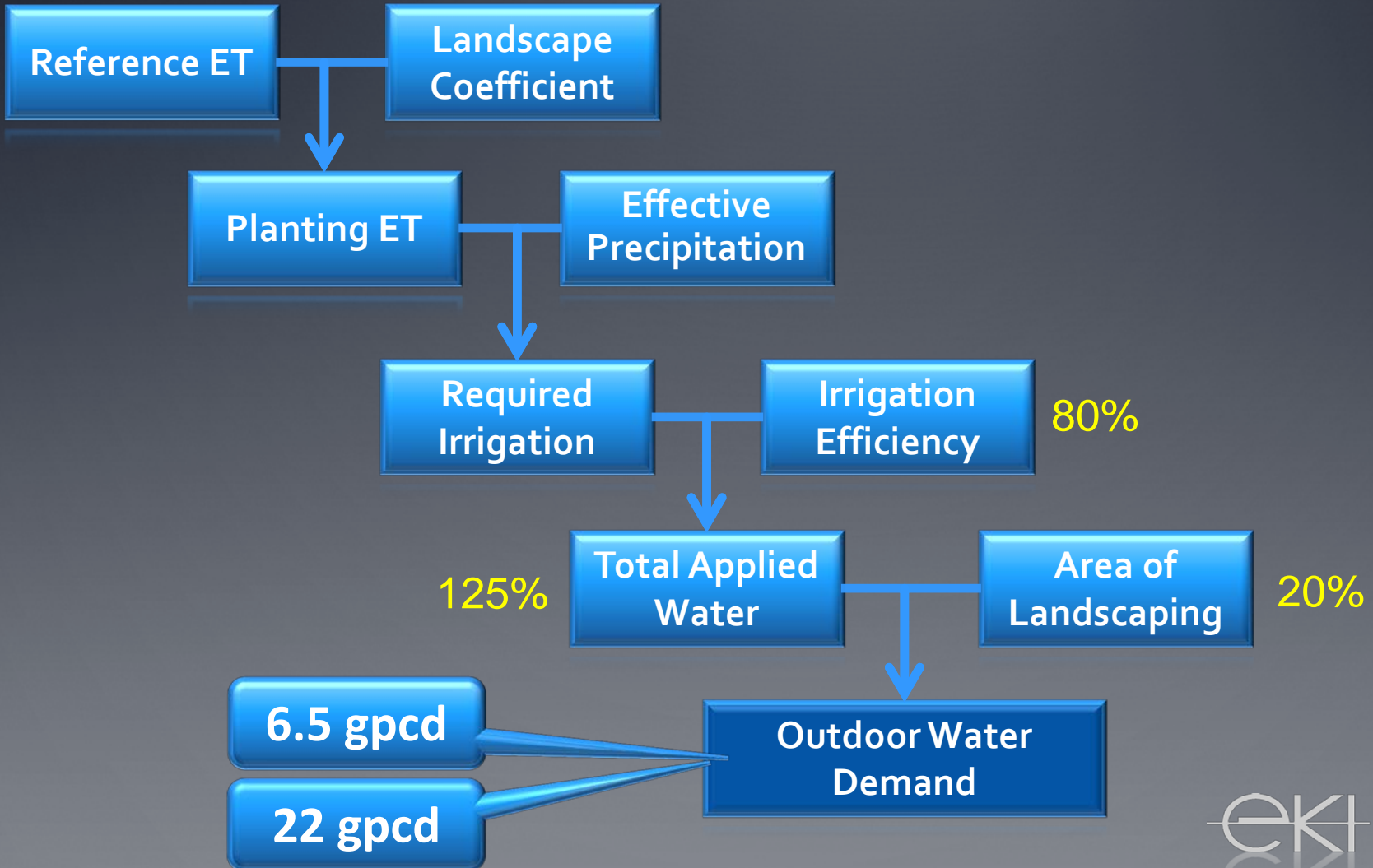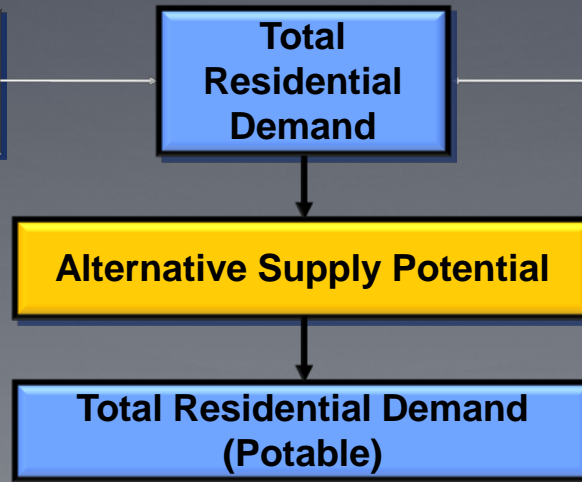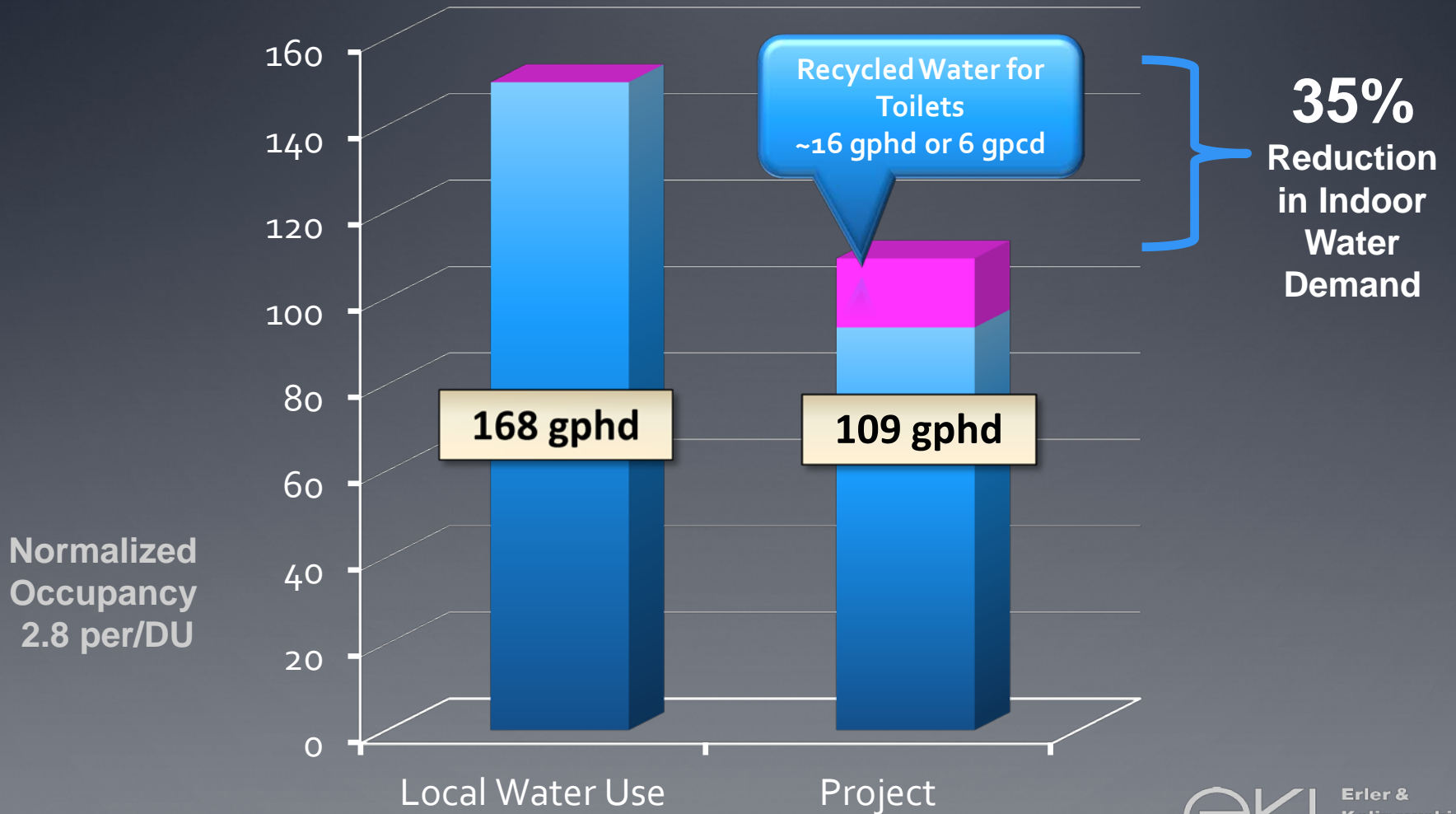
Comparison of Indoor <u>Potable</u> Water Demands
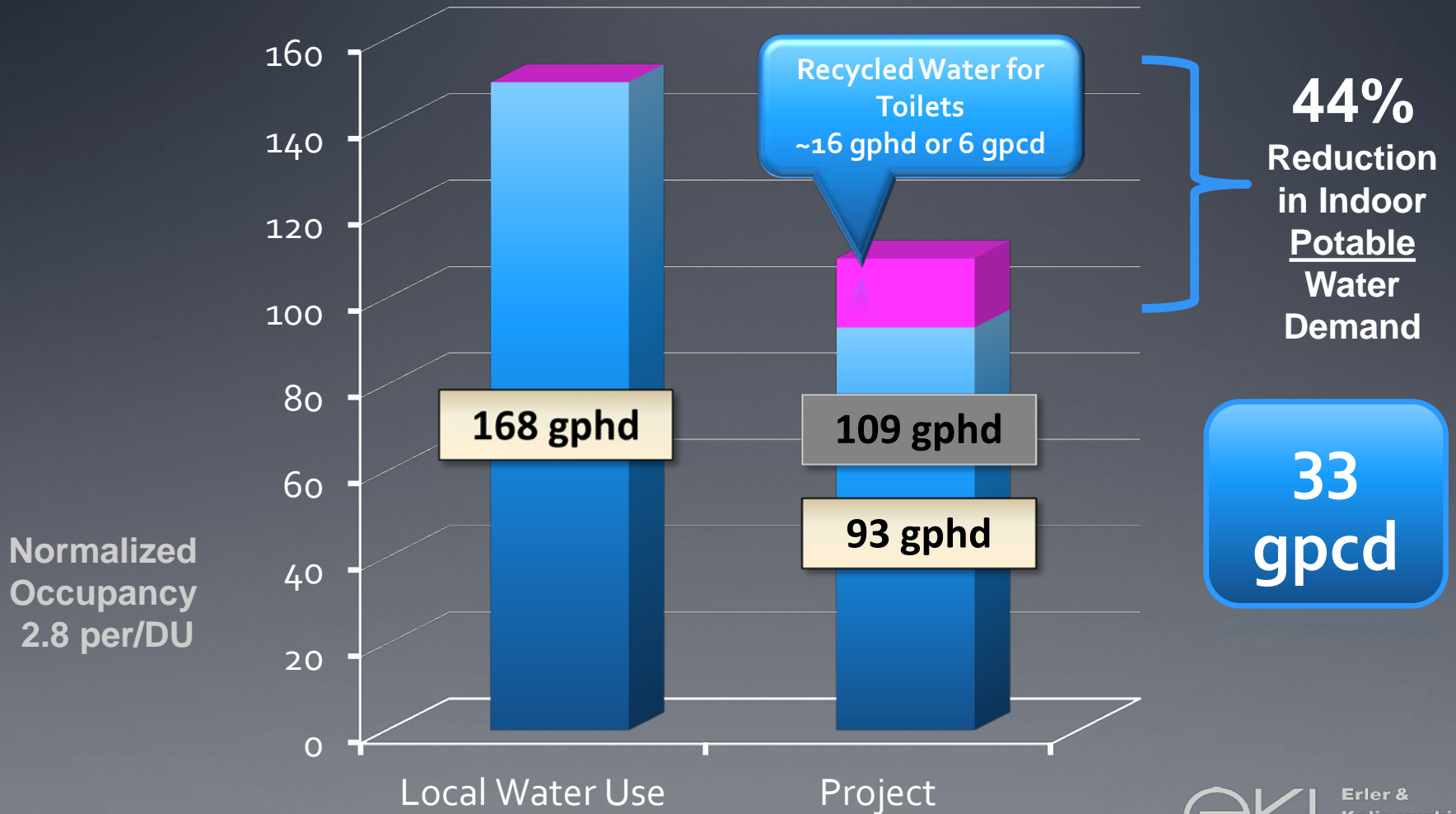
Total Average Per Capita Residential Water Use

Gallons per Capita per Day

300
250
200
150
100
50
0

33 + **6** + **22** = **61**

Colorado River · Tulare · South Lahontan · Sacramento River · San Joaquin River · South Coast · North Coast · Central Coast · San Francisco · Project

California Hydrologic Region

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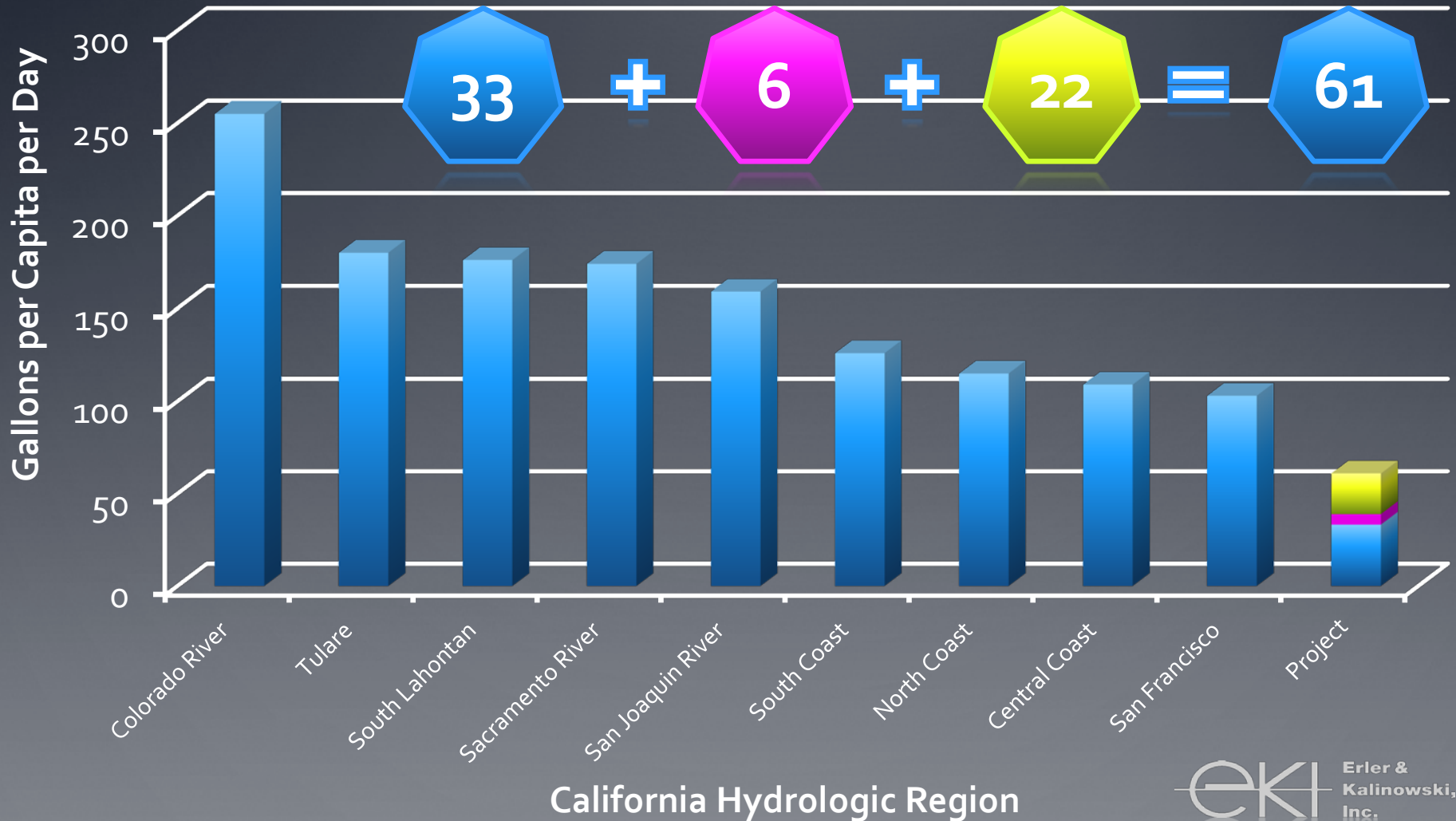
Summary

- **How Did We Get There?**
  - Very high density development with community open space
  - All new, high-efficiency fixtures
  - Requirements for high-efficiency clothes washers
  - Use of recycled water for flushing toilets and irrigation
  - Conservative in assumptions regarding "Other" demands (15 gphd)
- **What does it mean for this community?**
  - 1,400 AFY or 1.7 MGD of total residential water use
  - 1,200 AFY or 1.3 MGD of total <u>potable</u> residential water use
  - Compared to a "typical" SFR residential water use estimate of 0.3 AFY/DU, which would result in 3,600 AFY or 3.1 MGD water use

But is it Real

- AMI installation and remote monitoring
- Better technologies – Unmeasured flow reducers, 0.8 gpf toilets
- Pre-construction and pre-sale documents and agreements
- Point-of-sale inspections
- Water audits and surveys

Thank you
Any Questions?

mzucca@ekiconsult.com
(650) 292-9100