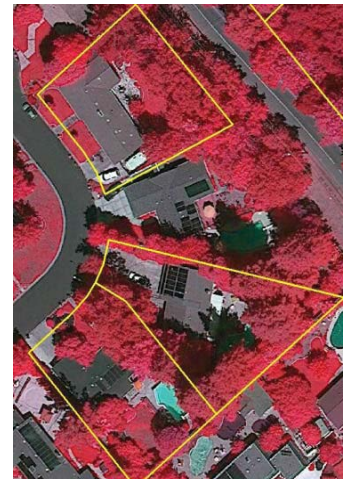


This presentation premiered at WaterSmart Innovations

watersmartinnovations.com



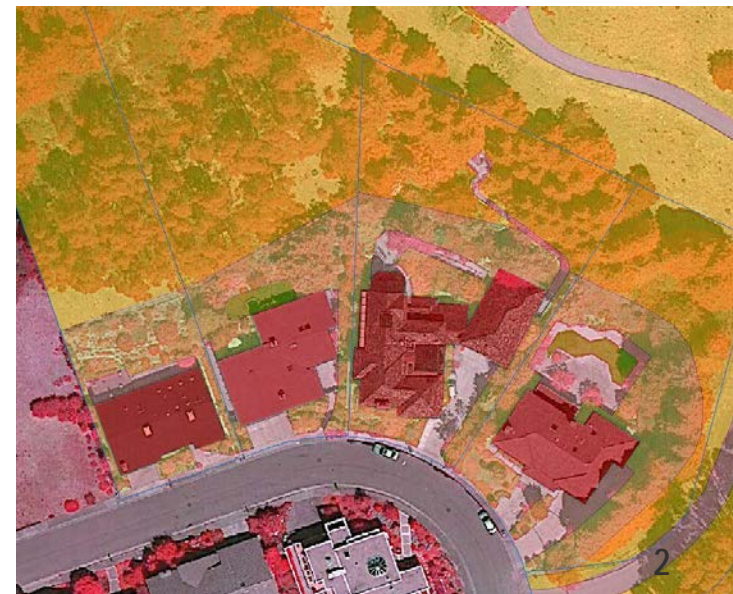
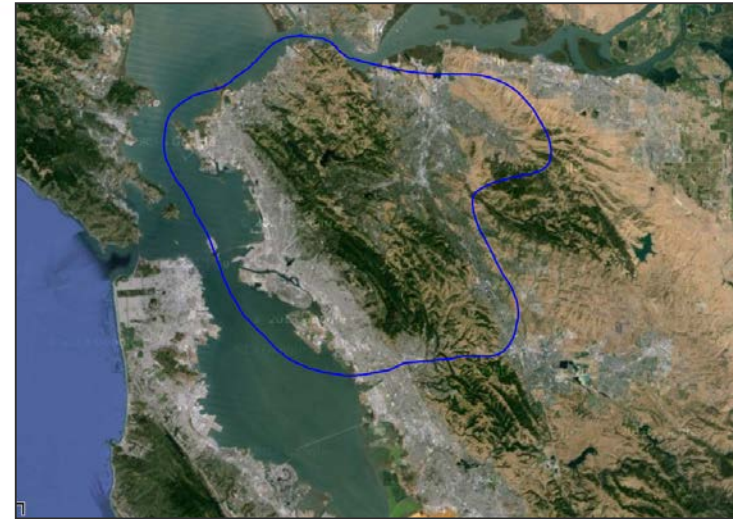
How Detailed Imagery, GIS & Software Enhance Landscape Water Budgets



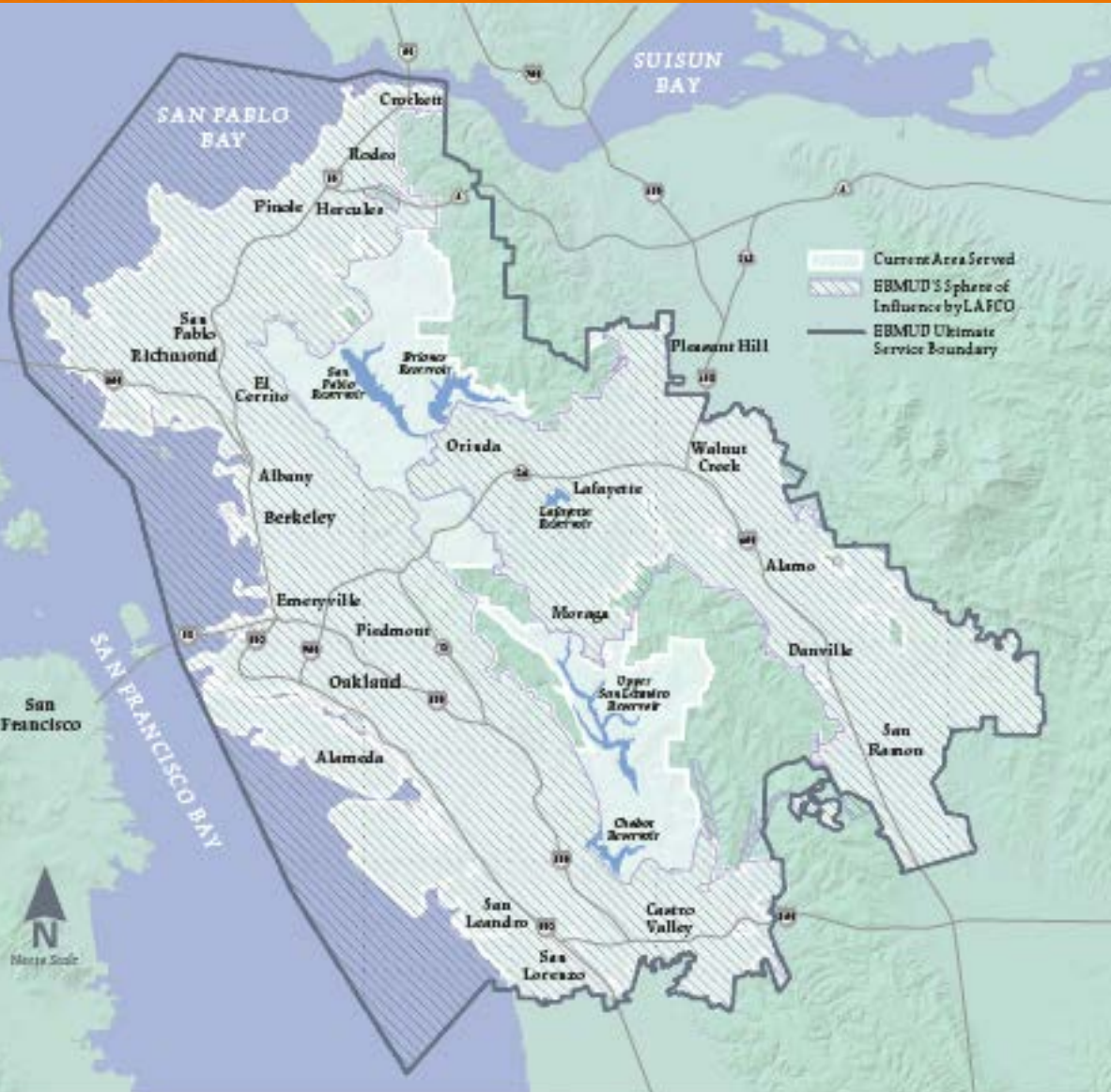
Presentation Overview



- EBMUD and customer demographic data
- Parcel-level landscape water budget classifications and new lessons
- Budget-based rate modeling uses/scenarios
- Outdoor efficiency related research, enhancements and regulations



EBMUD Water and Wastewater Service Areas

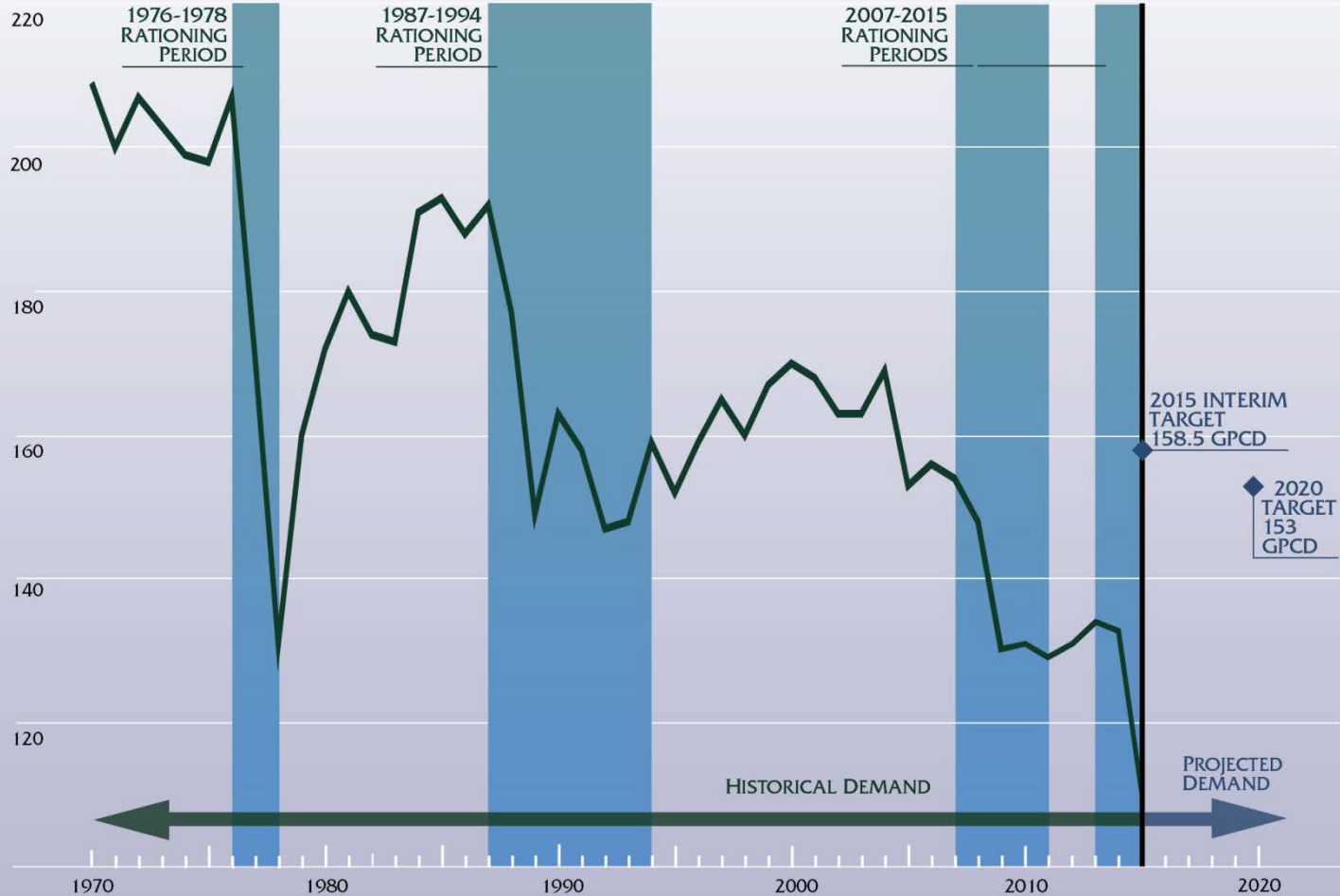


- 330 sq/mi service area
- 35 communities
- 1.4 million water customers
 - ~ 400,000 meters
 - ~ 382,000 accounts
 - ~ 85 % residential
- 650,000 wastewater customers
- Distinct microclimates
- >4,200 miles of pipe

EBMUD Gross Per Capita Water Use (Gallons/Day (1970-2015))



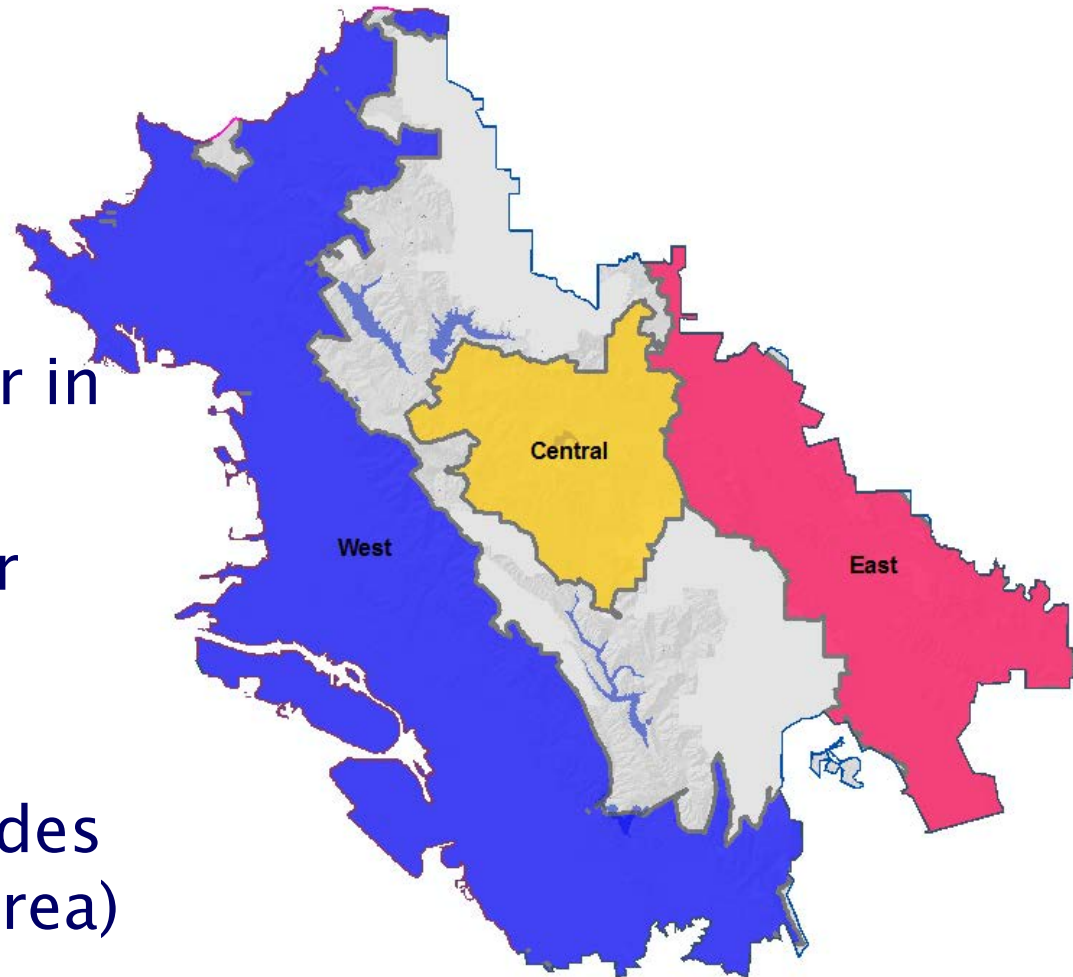
AVERAGE DAILY WATER DEMAND IN GALLONS PER CAPITA PER DAY (GPCD)



Outdoor Water Use



- Three climate zones
 - West ~36-38 in.
 - Central ~42-45 in.
 - East ~48-50 in.
- Irrigation is main driver in the summer months
- 4 weather stations over 330 s.q. miles
- Upgraded to spatial ET weather data by zip-codes (72 in EBMUD service area)

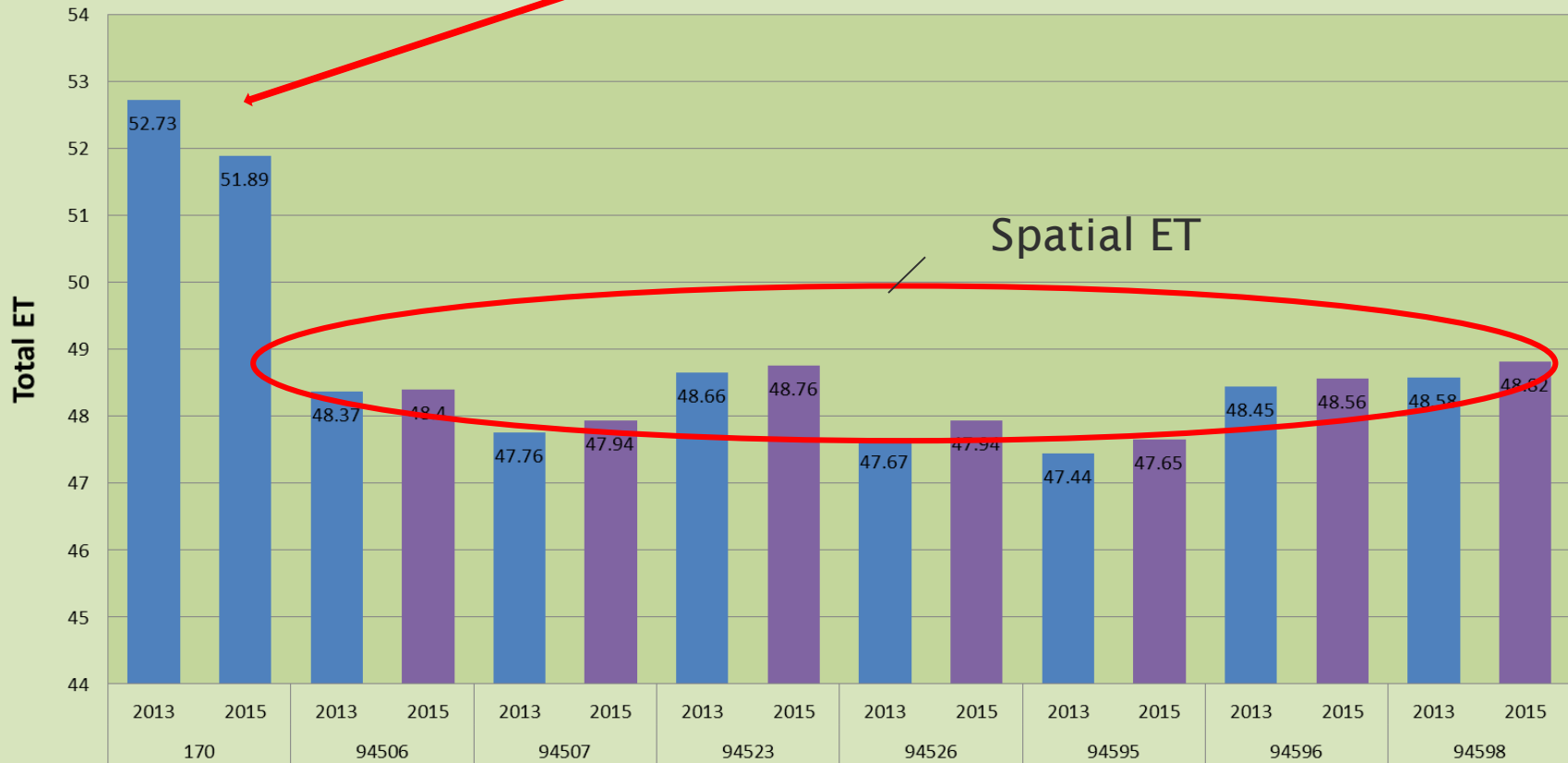


Climate Zone ET Factor Variation

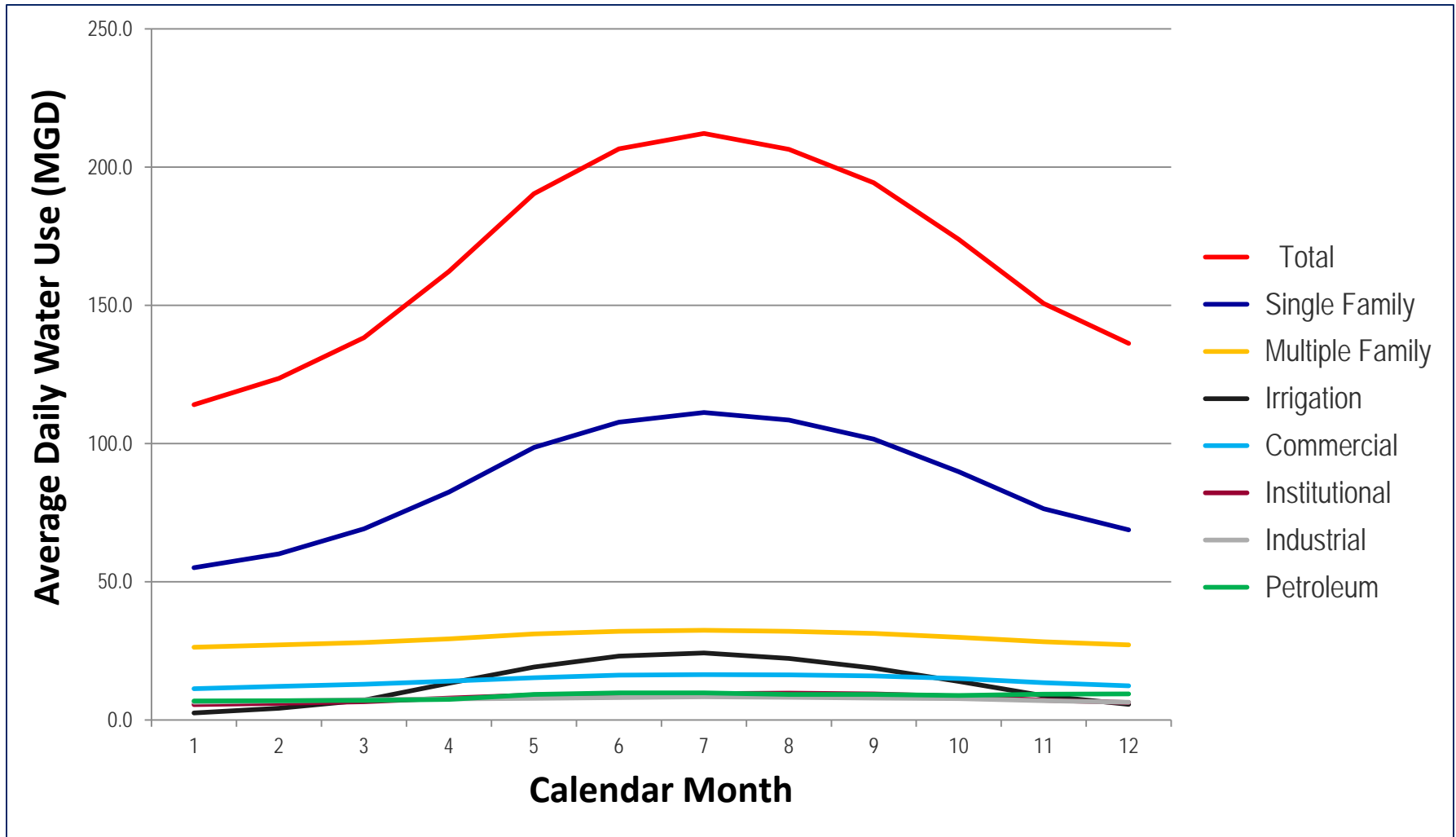


Concord Station

Spatial ET



2013 Seasonal Water Use by Customer Category



Landscape Water Budget Program (Established 1999)



- Obtained digital infrared image of 330 sq. mi. service area
- 9 classifications: (grass, shrubs, trees, natural, buildings, and more...)
- GIS-billing system integration developed in-house:
 - calculates irrigated area of each polygon
 - captures daily weather station data



2009 State Water Conservation Legislation



20x2020 Water Conservation Plan



February 2010

- Water utilities are provided four methodologies to reduce per capita water use
- EBMUD elected Target Method 2
 - A water budget approach
 - Updated evaluation in 2015

Single Family Water Budgets



- Email reports up to 4 recipients
- Customer usage from billing system
- Reports sent on bi-monthly billing cycle
- Shows 2-years of water budget history

EAST BAY MUNICIPAL UTILITY DISTRICT



Home Water Use Calculator

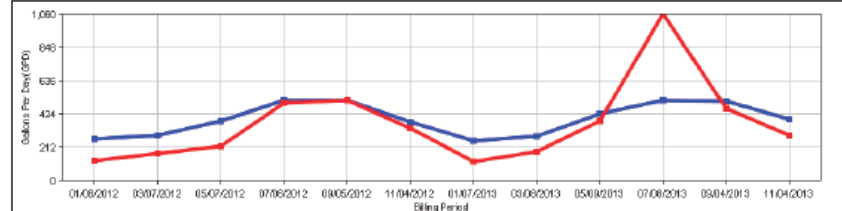
Thank you for participating in our Single Family Water Budget Program. The following is your customized water usage profiles for the last two years. The graphical description compares your measured water usage versus your budgeted water usage for each billing period. The purpose of the budget report is to show customers how efficiently water is being used inside and outside the home.

Customer Name: Charles Bohlig
 Service Address: 47 Bates Bl
 City: Orinda
 Account #: 13050400001
 Meter #: 92841187
 Est. Irrigated Area(sq. ft): 3105
 Household occupants: 4
 Base Household use: 200



Irrigated Area at 47 Bates Bl

Water Budget Summary	Used	Budgeted
Gallons used last 12 months	150,348	142,803
Gallons used previous year	114,444	143,306
Percent of budget last 12 months		105%
Percent of budget for previous year		80%
2 years estimated savings in gallons:		21,317



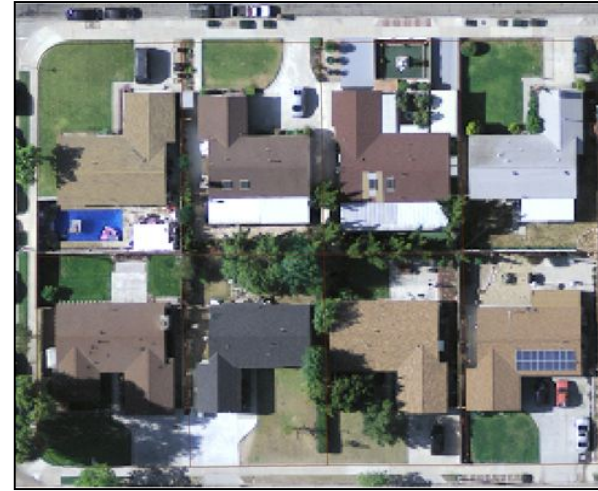
Billing Period	01/08/12	03/07/12	05/07/12	07/06/12	09/05/12	11/04/12	01/07/13	03/08/13	05/09/13	07/08/13	09/04/13	11/04/13
Budget(GPD)	267	291	381	516	510	378	256	285	428	513	508	391
Consumption(GPD)	132	177	221	499	515	337	129	187	380	1060	464	294
Evapotranspiration(ET)	2.93	3.45	7.15	12.26	12.21	6.89	2.2	3.29	8.67	12.13	11.52	7.53

EBMUD estimates the average indoor water use per person with high efficiency fixtures at 50 gpd (gallons per day). Evapotranspiration (ET) represents the estimated water need of cool season grass (in inches) for each billing period. The Water Budget Calculation does not use rain, typically irrigation systems can be turned off for the winter months of November, December, January, and February. The Maximum Allowable Water Budget for landscaping, effective January 2010, is calculated using 80% of ET_o for the irrigated area of landscaping. If you feel the irrigated area is not accurate or would like more information on this program, contact EBMUD at (510) 287-1900.



20x2020 System Wide Computing Tools

- Approx. 360,000 parcels
- Reduce manual processing time & costs
- Methodology
 - Two vendors
 - Computer & manual process
 - Software optimization tool
 - High-resolution 4-band imagery (Google Candid & Air Bus)
 - 6-inch resolution
 - 6 microclimate zones



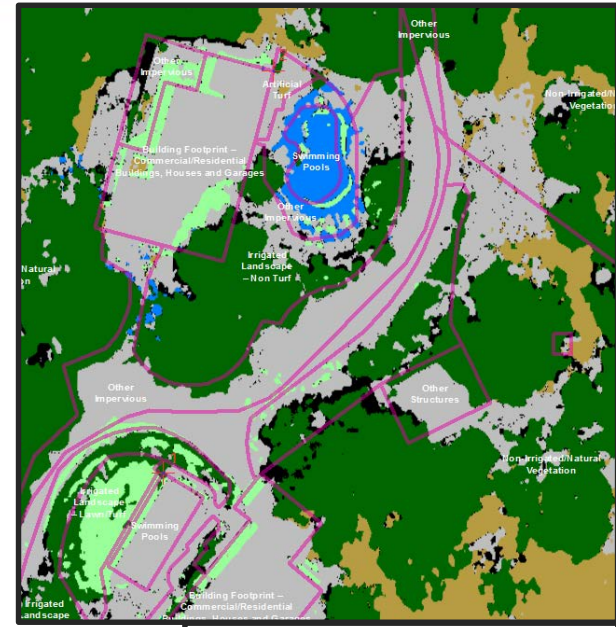
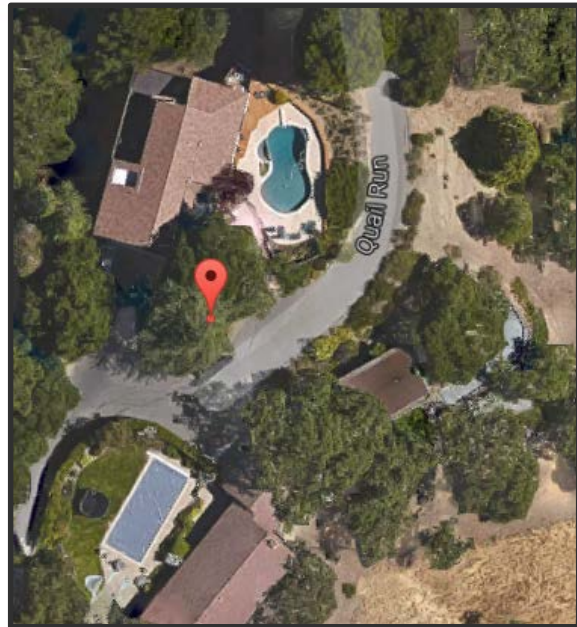
EBMUD Parcel Data



TABLE G-5 PARCEL STRATA DISTRIBUTION

PARCEL SIZE (SQFT)	SINGLE FAMILY PARCELS	MULTI-FAMILY PARCELS	IRRIGATION PARCELS	TOTAL # PARCELS FOR STRATA
<4,000	73,213	6,413	2,672	82,298
4,001-8000	152,661	15,380	3,113	171,154
8,001-12,000	40,625	3,393	1,428	45,446
12,001-16,000	16,729	1,493	755	18,977
16,001-20,000	9,201	761	491	10,453
20,001-24,000	8,046	544	390	8,980
>24,000	15,173	3,651	4,396	23,220
TOTAL	315,648	31,635	13,245	360,528

Parcel Classification Methodologies



Legend

Class	
[Red Box]	Building Footprint
[Dark Red Box]	Other Structures
[Pink Box]	Other Impervious
[Light Green Box]	Irrigated Landscape – Non Turf
[Bright Green Box]	Irrigated Landscape – Lawn/Turf
[Purple Box]	Potentially Irrigated
[Yellow Box]	Non-Irrigated/Natural Vegetation
[Dark Purple Box]	Special Landscape Areas
[Black Box]	Artificial Turf
[Blue Box]	Swimming Pools
[Light Blue Box]	Open Water

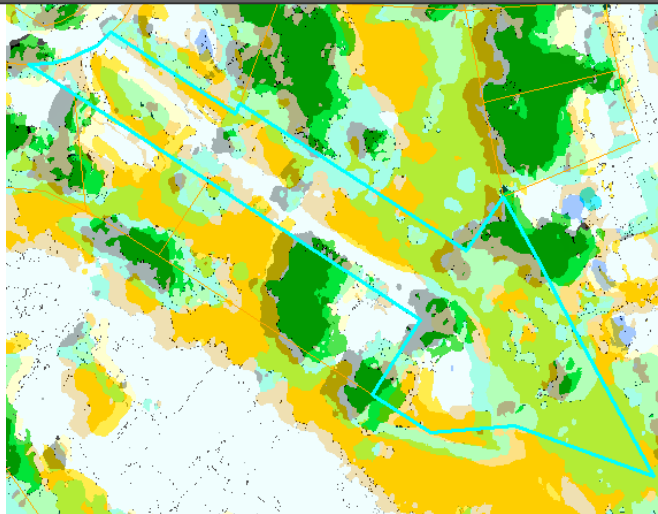
- 1) Irrigated turf
- 2) Shrubs/trees
- 3) Manmade objects
- 4) Pools
- 5) Non-irrigated surfaces

Observations

Manual Turf Measurement = 0



V4 Turf: 23,811 FT²

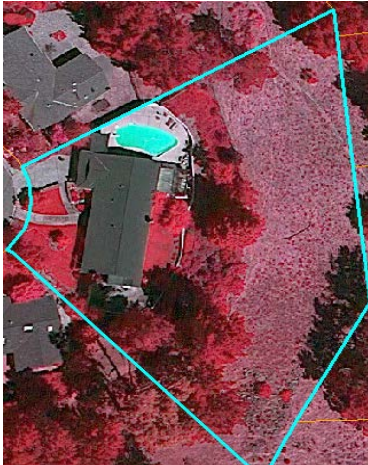


V5 Turf: 63,862 FT²



Observations

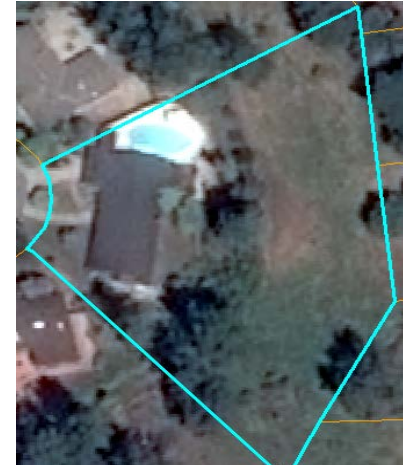
Manual Turf Measurement: 2,023



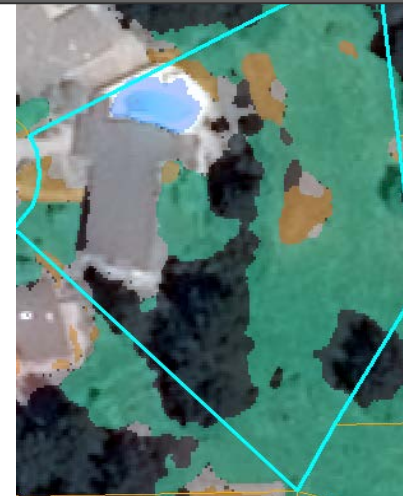
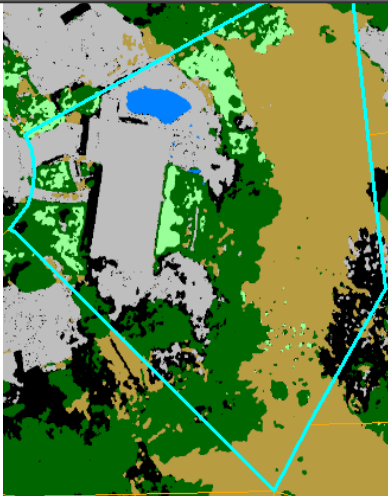
V3 Turf: 2,121



V4 Turf: 6,320



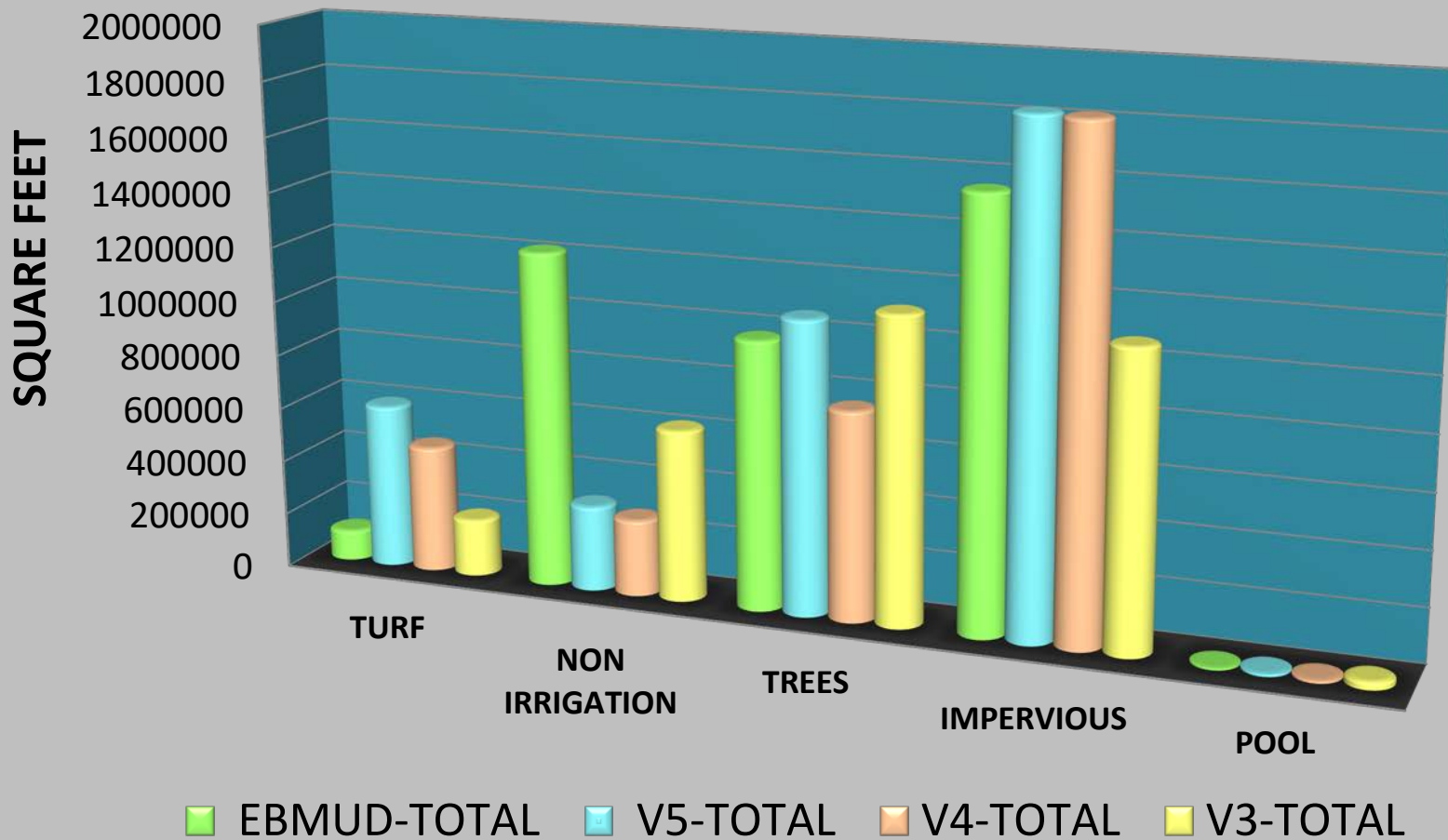
V5 Turf: 24,049



Observations



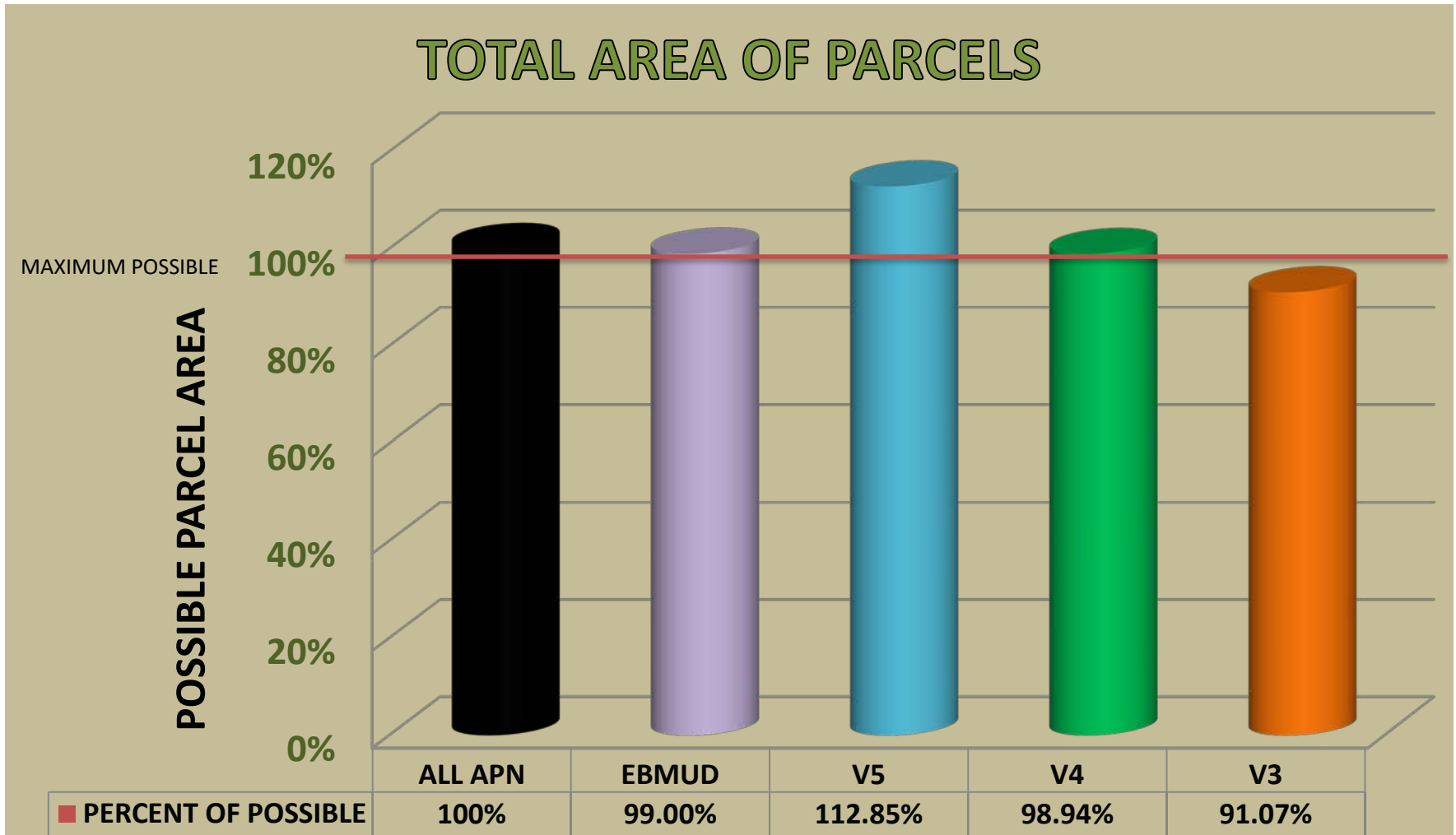
Software vs Manual Analysis



Observations



Software Applications Improving, Manual Checks Still Needed



2015 Update Summary - Two Methodologies/Analysis



Element	Methodology A	Methodology B
Parcel sample	29,910	301,000
Landscape classes	11	9
Classification process	Automated processing, manual editing and statistical extrapolation	Supervised, automated software classification + optimization

Observations and Recommendations



- Parcel size does not always correlate well to irrigated area (parcels can be totally impervious or vegetated within a size class)
- An increase in variance of the avg. parcels (bins) reduces the precision of the estimate.
- “Irrigated area” needed for current property owner water budget/MAWA
- “Irrigable area” needed for parcel water budget w/changing ownership.

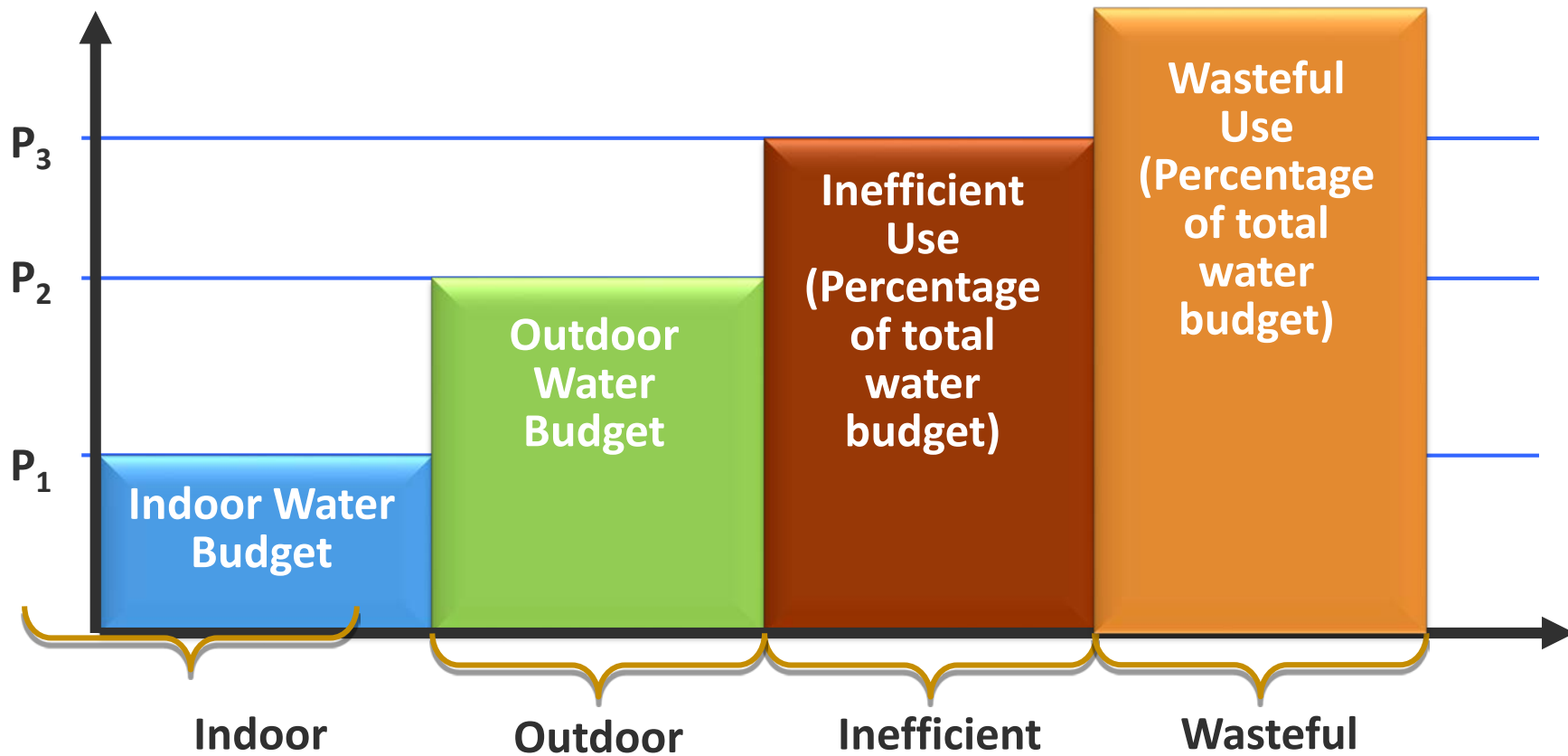
What Is A Water Budget Rate?



“Water budget rate is an increasing block rate structure in which the block definition is different for each customer based on an efficient level of water use by that customer.”

Source: American Water Works Association Journal, May 2008, Volume 100, Number 5

Water Budget Tiered Rate



EBMUD SFR Inclining Tiered Rate Structure



- Tier 1

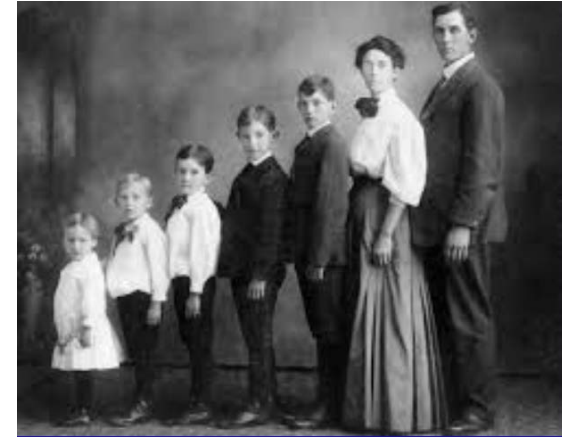
- 0 to 7 CCF per month
- Provides 172 gpd of indoor water for three-person household (@ 57 gpd)

- Tier 2

- 8 to 16 CCF per month
- Provides irrigation for 3,300 sq.ft. at average weather

- Tier 3

- 16 + CCF per month
- Considered high outdoor water use



Water Budget Rates Are Based On Indoor/Outdoor Budgets



- Indoor budgets are based on efficient water use on a per capita basis
- Outdoor budgets are based on efficient irrigation of landscape area and weather data
- Setting the (efficient use) indoor and outdoor water budget for each customer is the challenge
 - Many options and choices
 - May include variances for indoor and outdoor use
- Customer use above the indoor and outdoor water budget is considered inefficient

Water Budget Analysis For Single Family Customers



- INDOOR BUDGET ONLY
 - Only calculate water budget for indoor use
 - Keep existing inclining tiers for outdoor use
- SIMPLIFIED OUTDOOR BUDGET (+ indoor)
 - Uses algorithm to assign percent landscaped area to a parcel based on available parcel data
- INDIVIDUALIZED OUTDOOR BUDGET (+ indoor)
 - Uses analysis of aerial imagery to determine the landscape area for each parcel

Methodology



- Compared water budget structure with current tier structure for each SFR customer using 2013 water consumption
 - Compared customers in existing Tier 1, 2, 3 to customers who are within and exceed water budget
 - Compared use in existing Tier 1, 2, 3 to use in water budget indoor efficient, outdoor efficient, and inefficient
- Did not project changes to customer behaviors in response to water budget rates structure

Simplified Outdoor Budget Alternative



Landscape Area = Assign Landscape Area by Lot Size Bins

- Group the parcel sizes into bins and then determine the appropriate landscape area for each bin
- Assigns landscaped area for each bin based on the average of observed landscape area for parcels within each bin
- Use ET zone and assigned landscape area to calculate outdoor water budget

Simplified Outdoor Budget Structure



Indoor Efficient/Tier 1

- 6 ccf/month
- 3 people per household
- 50 gallons/person/day

Outdoor Efficient/Tier 2

Five lot size bins

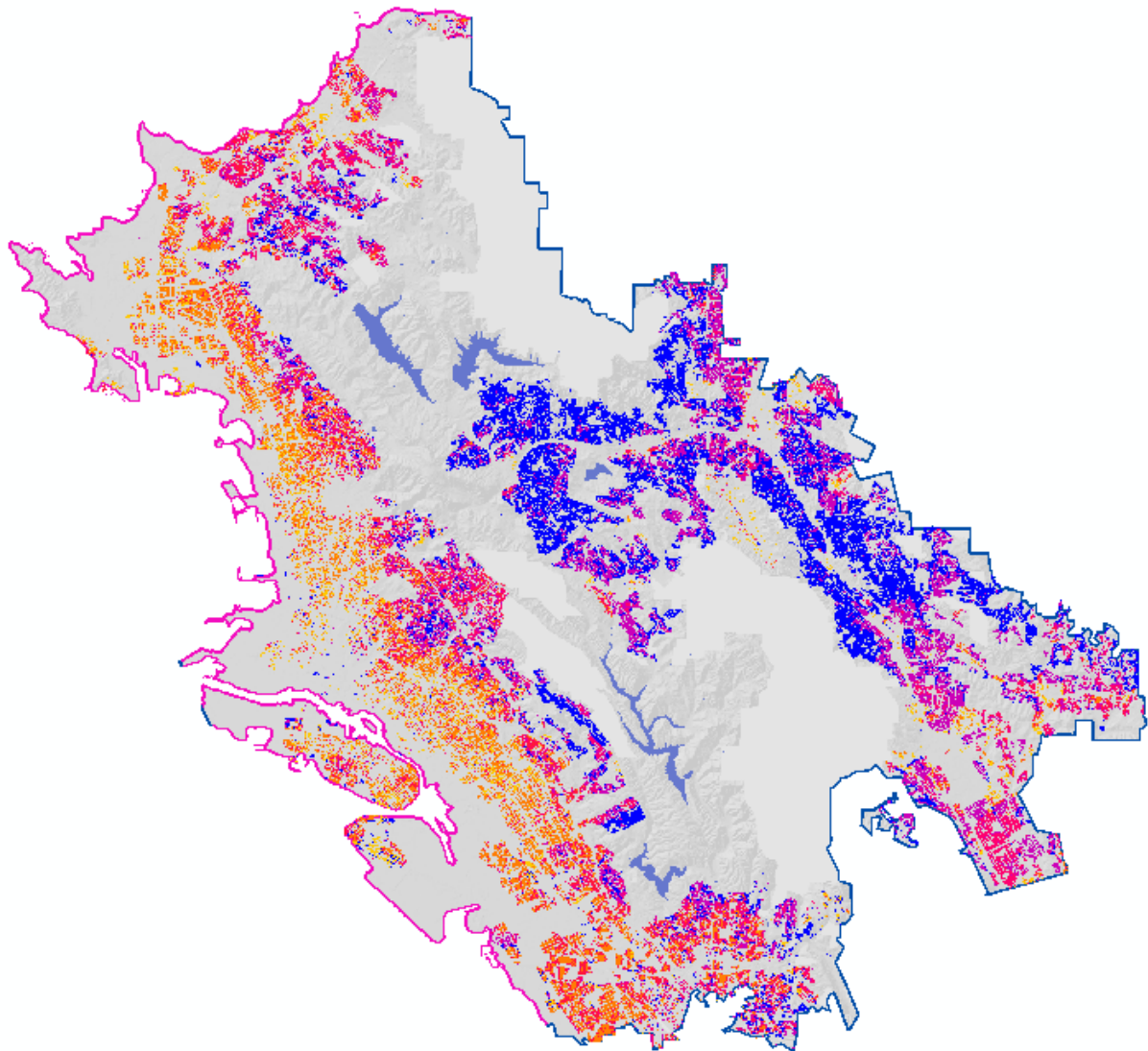
Four weather stations

Inefficient/Tier 3

Use above Indoor and
Outdoor Efficient Budgets



Single Family Residential Parcel Size Distribution



Lot size (sq. ft.)

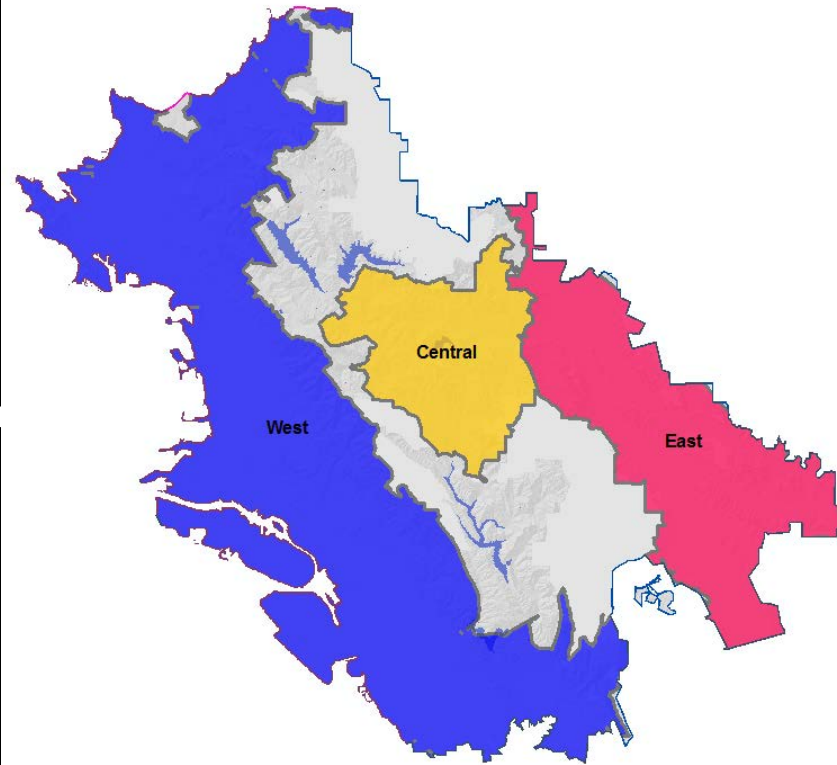
- 0 - 3,750
- 3,751 - 5,500
- 5,501 - 6,750
- 6,751 - 9,500
- 9,501 - 19,250
- 19,251+

324,955 Single-family parcels

Outdoor Use Scenarios

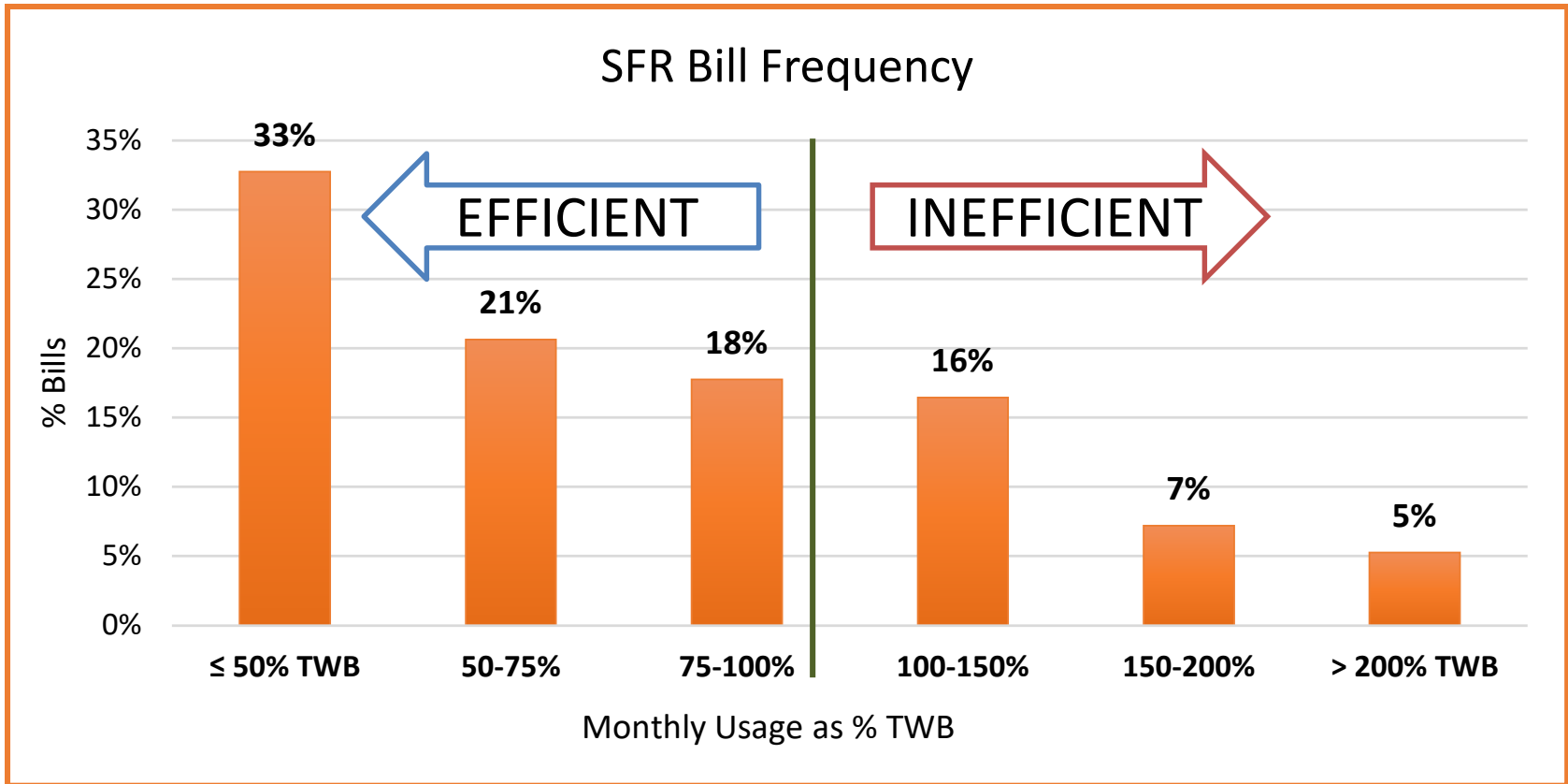


Monthly Water Use (CCF)	Avg. Daily Equivalent (GPD)	Irrigable Turf Area by SCC Region (sq.ft. in July)		
		West	Central	East
30	750	3,900	3,600	3,400
35	875	4,800	4,500	4,100
40	1,000	5,700	5,300	4,900
45	1,125	6,600	6,100	5,700
50	1,250	7,500	6,900	6,400
55	1,375	8,400	7,800	7,200
60	1,500	9,300	8,600	8,000



Daily Irrigated Area (Sq. Ft.)	Monthly Water Use Required to Support Irrigated Area (July)		
	West	Central	East
3,375	27	28	30
4,140	31	33	35
4,910	36	38	40
5,675	40	42	45
6,440	44	47	50
7,210	48	52	55
7,975	53	56	60

Simplified Outdoor Budget Results* 2013



33% of customers use only 50% of their total water budget (TWB)

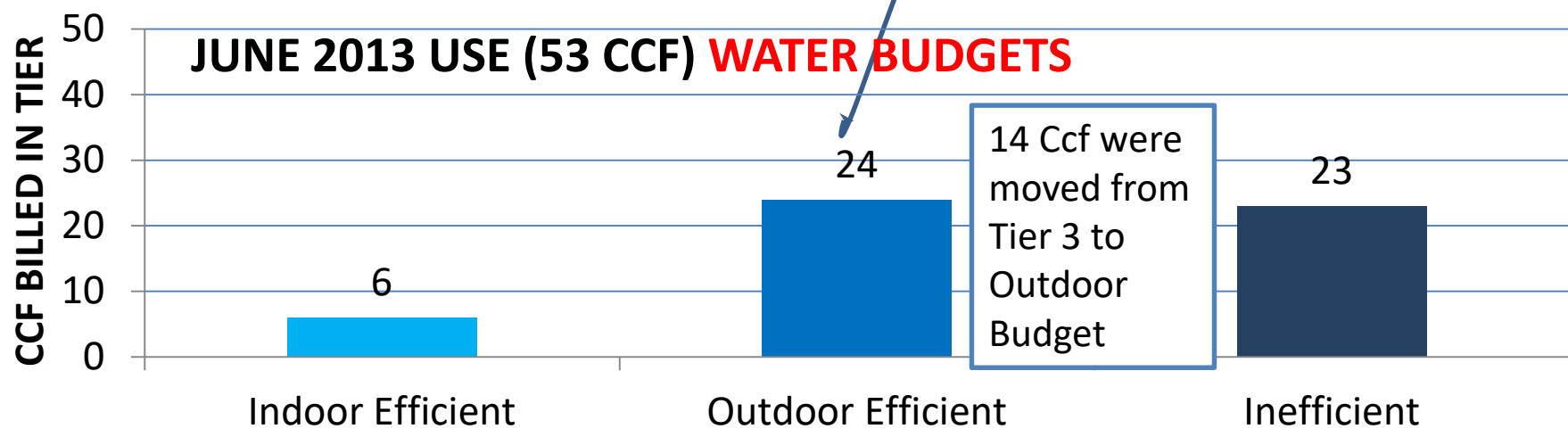
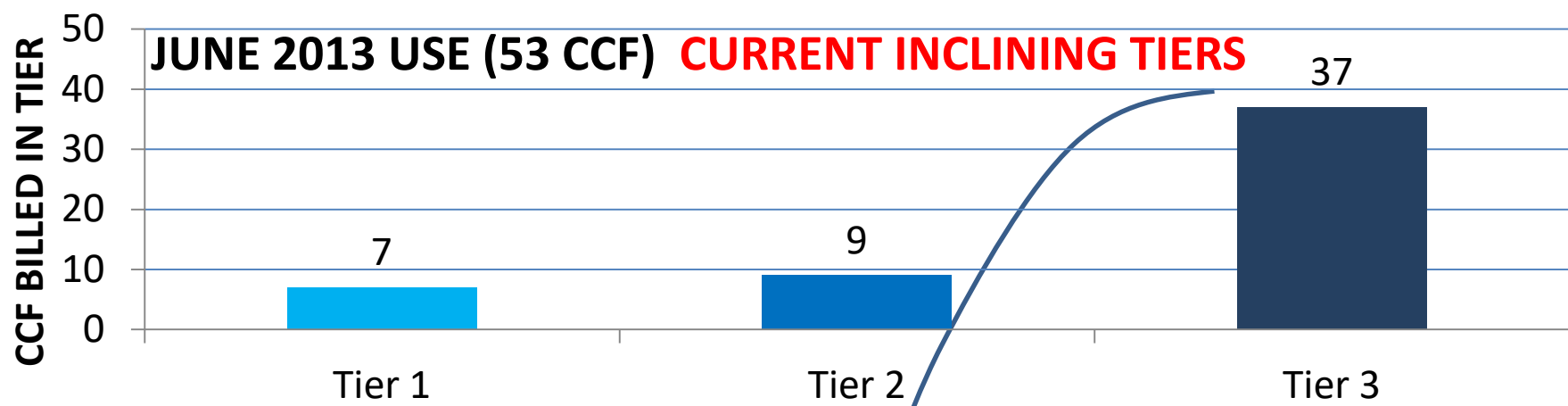
72% of customers are within Total Water Budget

28% (16+7+5) of customers exceed their total water budget (TWB)

*Analysis without considering customer response to water budget rates

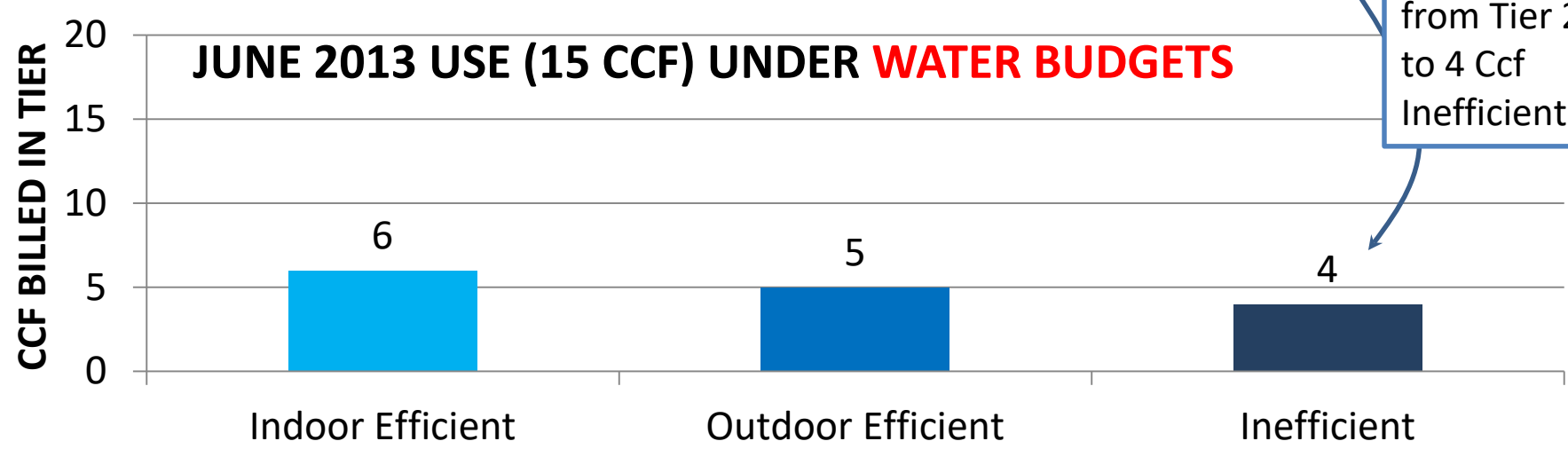
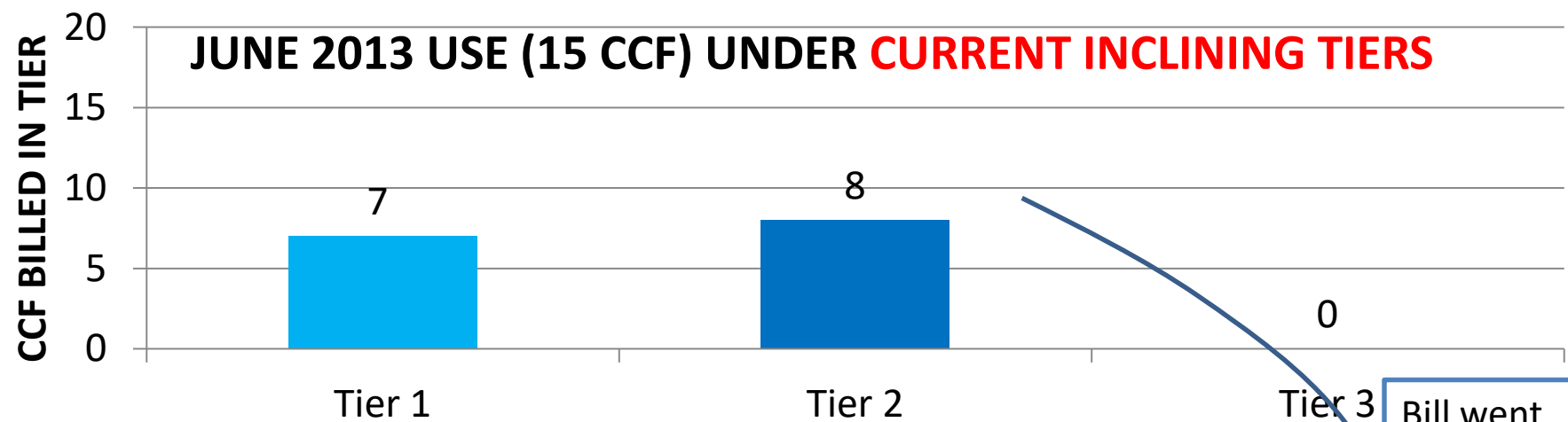
Analysis Example: Customer A

June 2013 Use 53 Ccf, 5000 Sqft Landscape



Analysis Example: Customer B

June 2013 Use 15 Ccf, 1400 Sqft Landscape

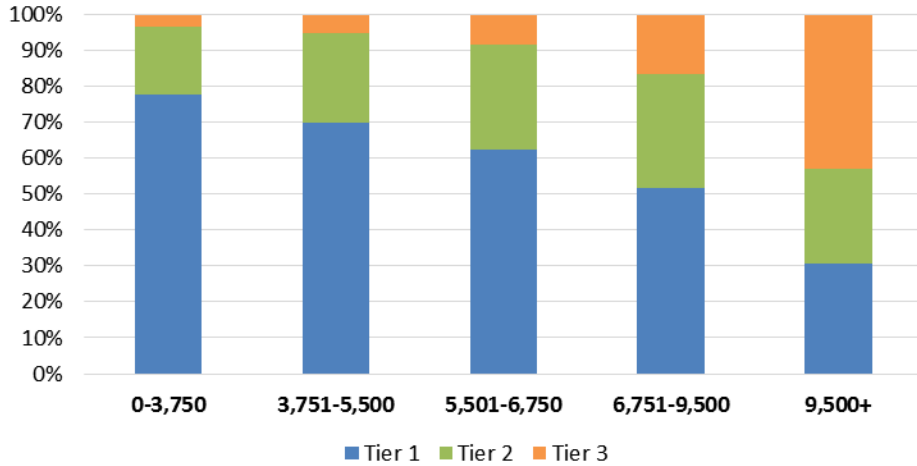


Bill went from Tier 2 to 4 Ccf Inefficient

Parcel Size Comparison



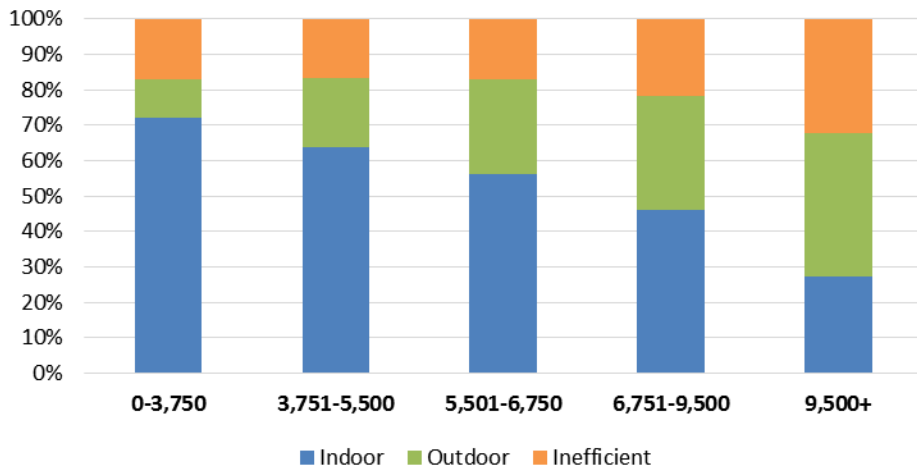
Total Service Area - 2013 Current



Current rate structure

~3% of the smallest lots (<3,750 sqft) usage and ~43% of the larger lots (9,500+ sqft) usage are in Tier 3

Total Service Area - 2013 Simplified WB



Simplified water budget structure

~17% of the smallest lots usage and ~32% of the larger lots usage are considered inefficient

Current And Simplified Outdoor Budget Comparison



- Total water use by tiers are similar for current and water budget
- Bill distribution by tiers are different
 - ~35% of current Tier 2 customers are considered inefficient
 - ~20% of current Tier 3 customers are efficient
 - Impact on customers varies primarily on bin (parcel) size
- Analysis did not include customer response to rate structure

Looking Forward: Land use change management

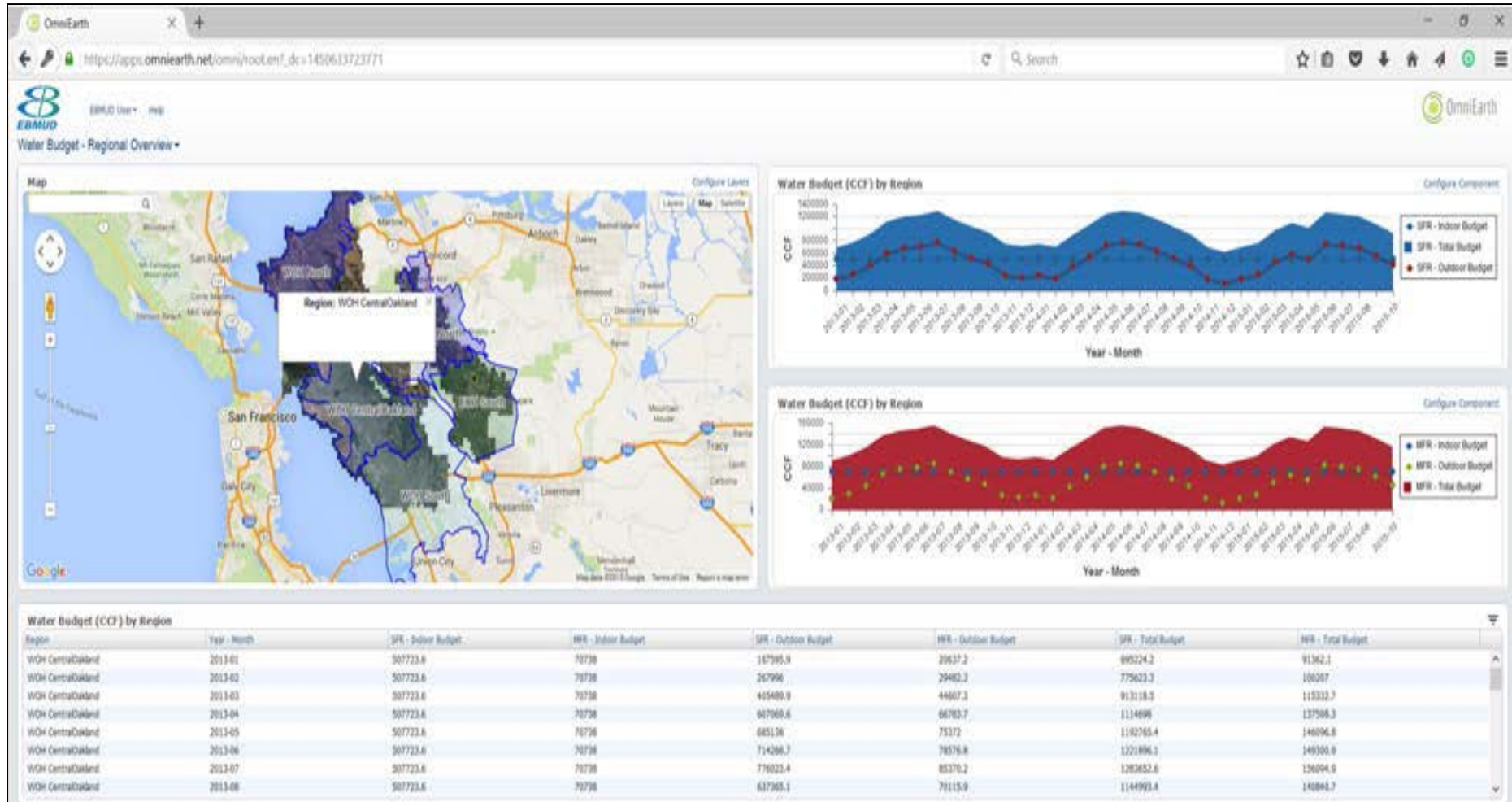


Where do future outdoor water savings come from?

- a) Engaging customers that have not participated in conservation programs
- b) Locking in achieved savings from drought response (lessen rebound effect)



Looking Forward: Water Budget Dashboards



Governor's Executive Order Calls For Outdoor Water Efficiency Standards/Regulations



State Agency Preliminary Approach:

- Conduct pilot study with 30 agencies to determine landscape area and average irrigation rates
- 2017- measure (irrigable) landscape area statewide
- 2018-based on landscape area measurement programs establish initial (2021) and formal 2025 standards
- Public draft document in January 2017

NEXT STEPS



- EBMUD
 - Refine individual parcel budget data and accuracy
 - Advanced Metering Infrastructure (AMI) projects
 - Home Water Reports
 - Landscape Water Budget Reports
 - Billing Presentment Changes
- **Continue to review and plan for water budgets as these programs are implemented in the coming years**

Questions ... Hardscape or Xeriscape?



Charles Bohlig
Supervisor of Water Conservation
East Bay Municipal Utility District
charles.bohlig@ebmud.com
510-287-0491

Richard Harris
Manager of Water Conservation
East Bay Municipal Utility District
richard.harris@ebmud.com
510-287-1675