Current and Potential Future Supply and Demand in Santa Cruz

Water Supply Advisory Committee

June 26-27, 2014

Presentation Overview

* Introduction and Context
* A Representational View of How Sources are Deployed to Meet Demand
* Current Supply
* Current Demand
* Future Supply
* Future Demand
* Conclusions and Take Aways

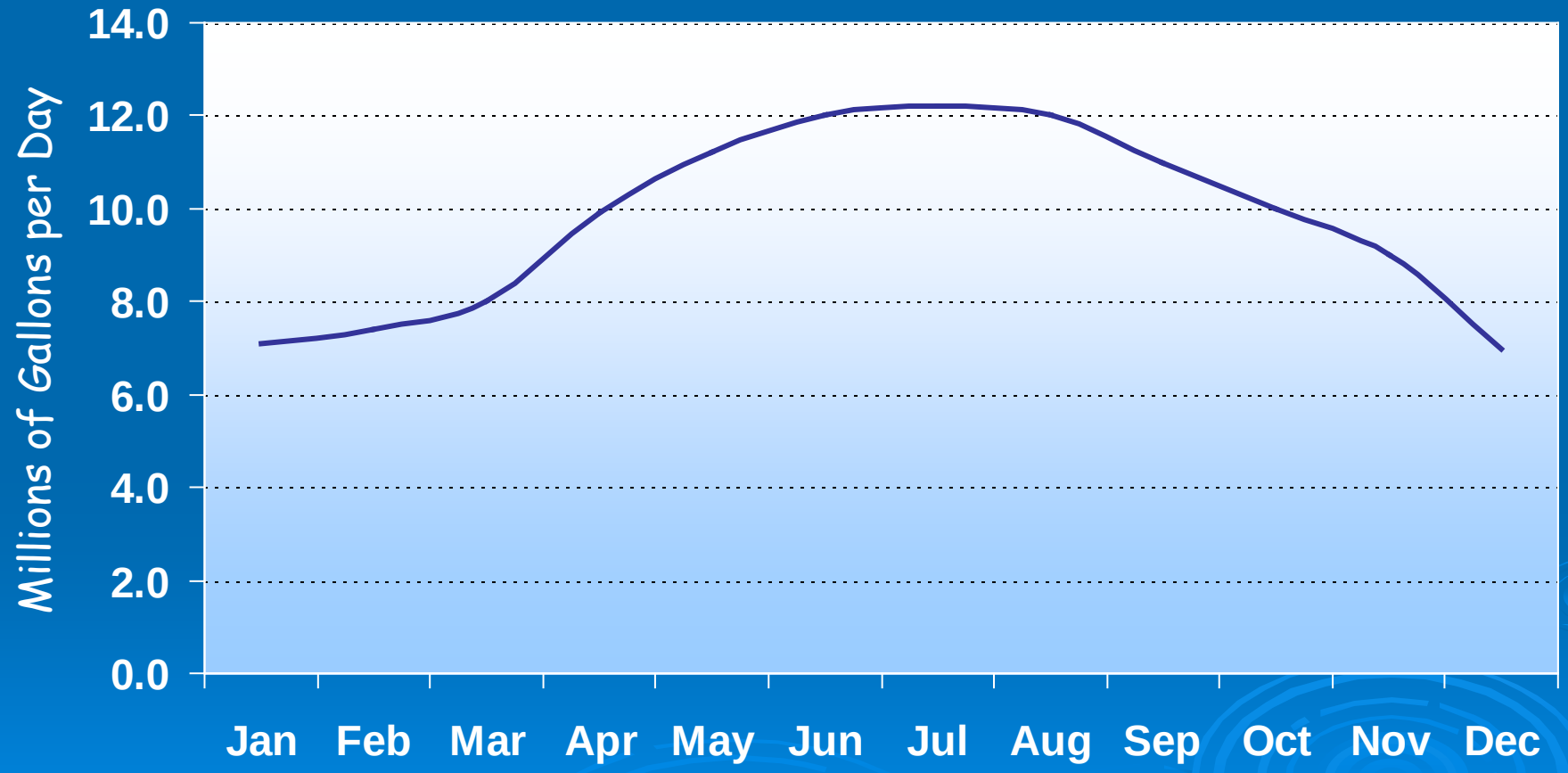
Introduction and Context

* The fundamental question the WSAC will have to grapple with in its work is the reliability of Santa Cruz's water supply.
* The fundamental measure for reliability is the degree to which available supply can meet existing and future demand under a range of foreseeable and unforeseeable but probable circumstances or conditions.

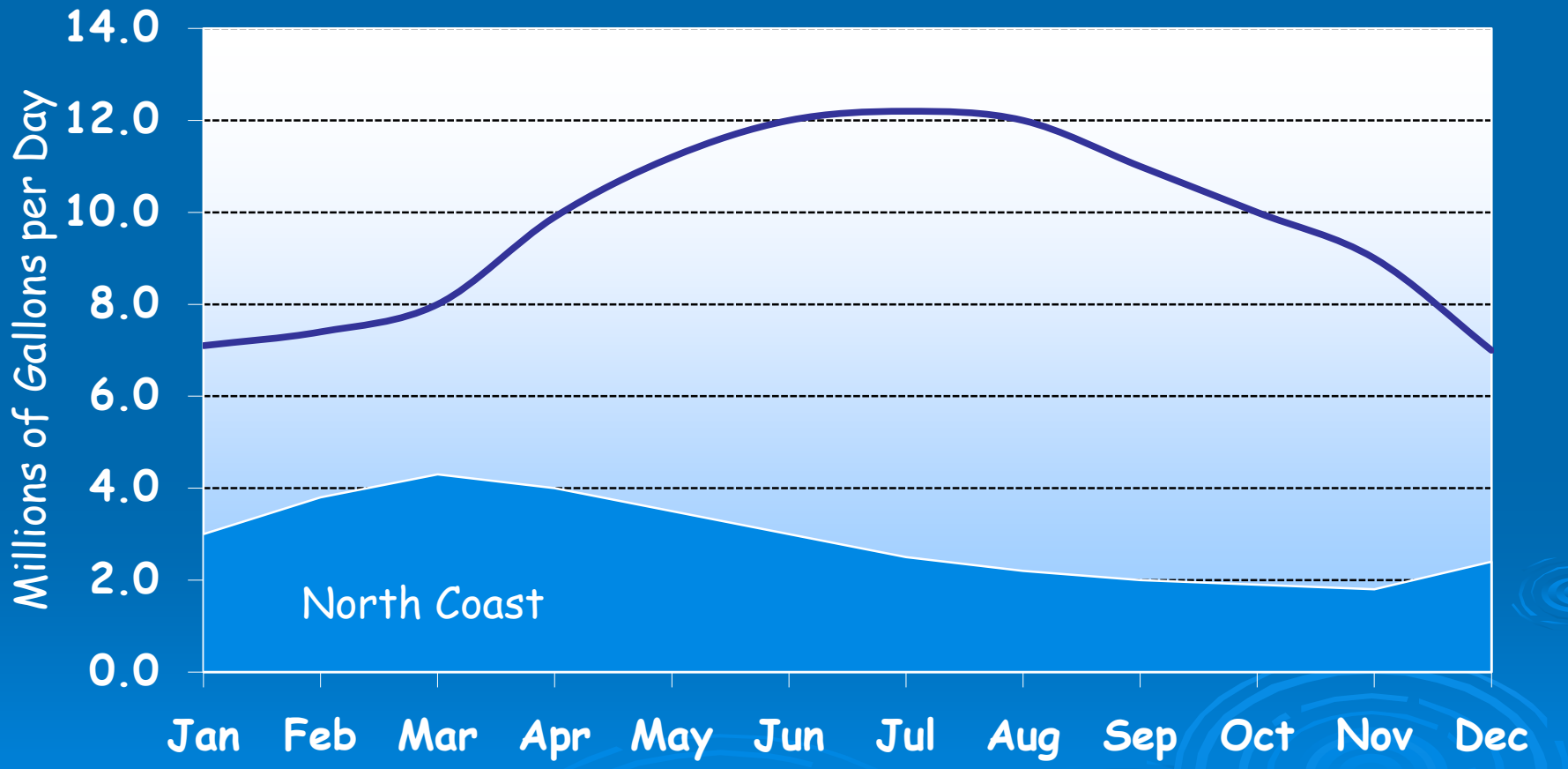
How Water Sources are Deployed to Meet Demand

A Representational View

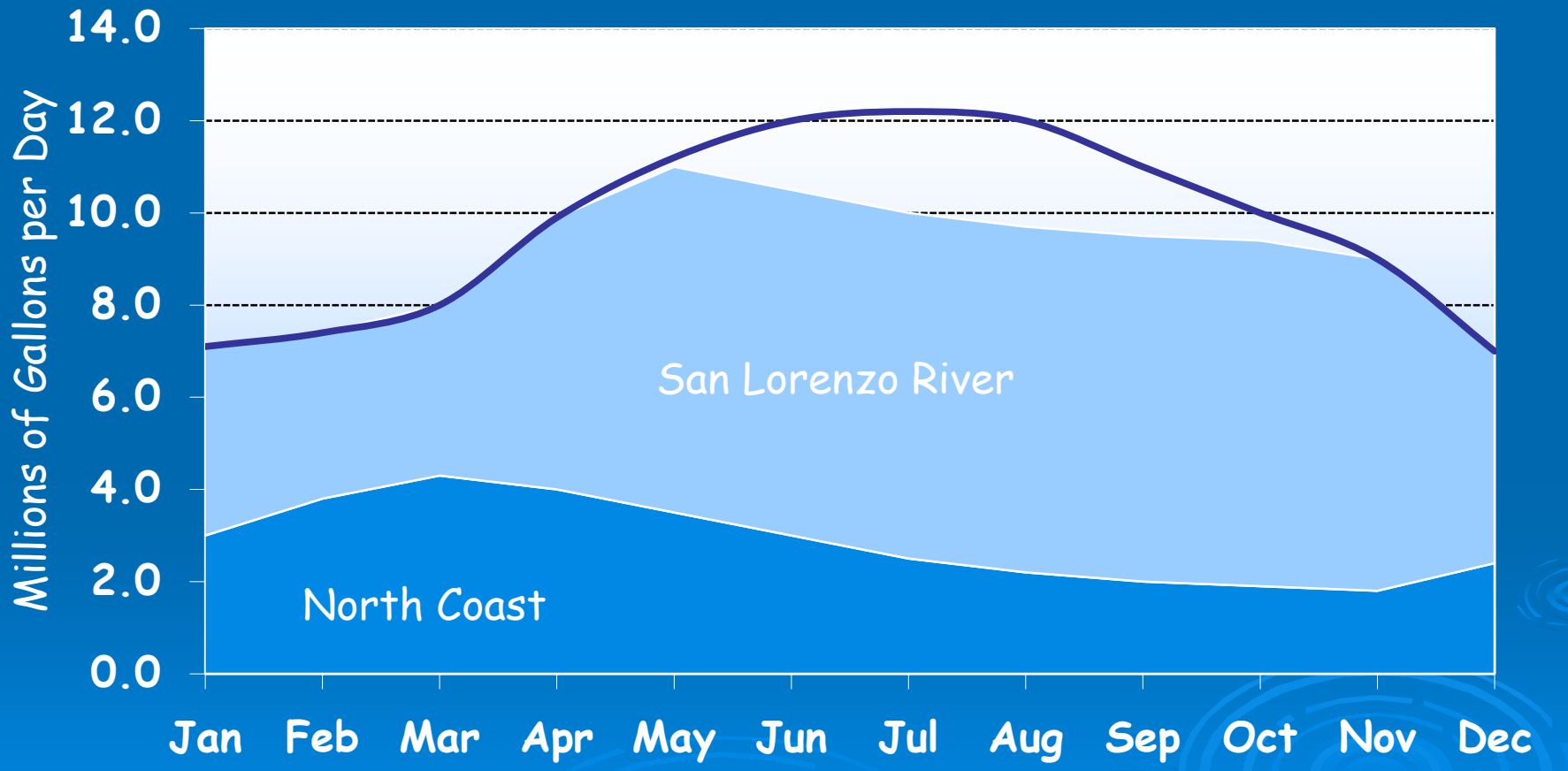
Average Monthly System Demand



Supply and Demand in Average Conditions



Supply and Demand in Average Conditions



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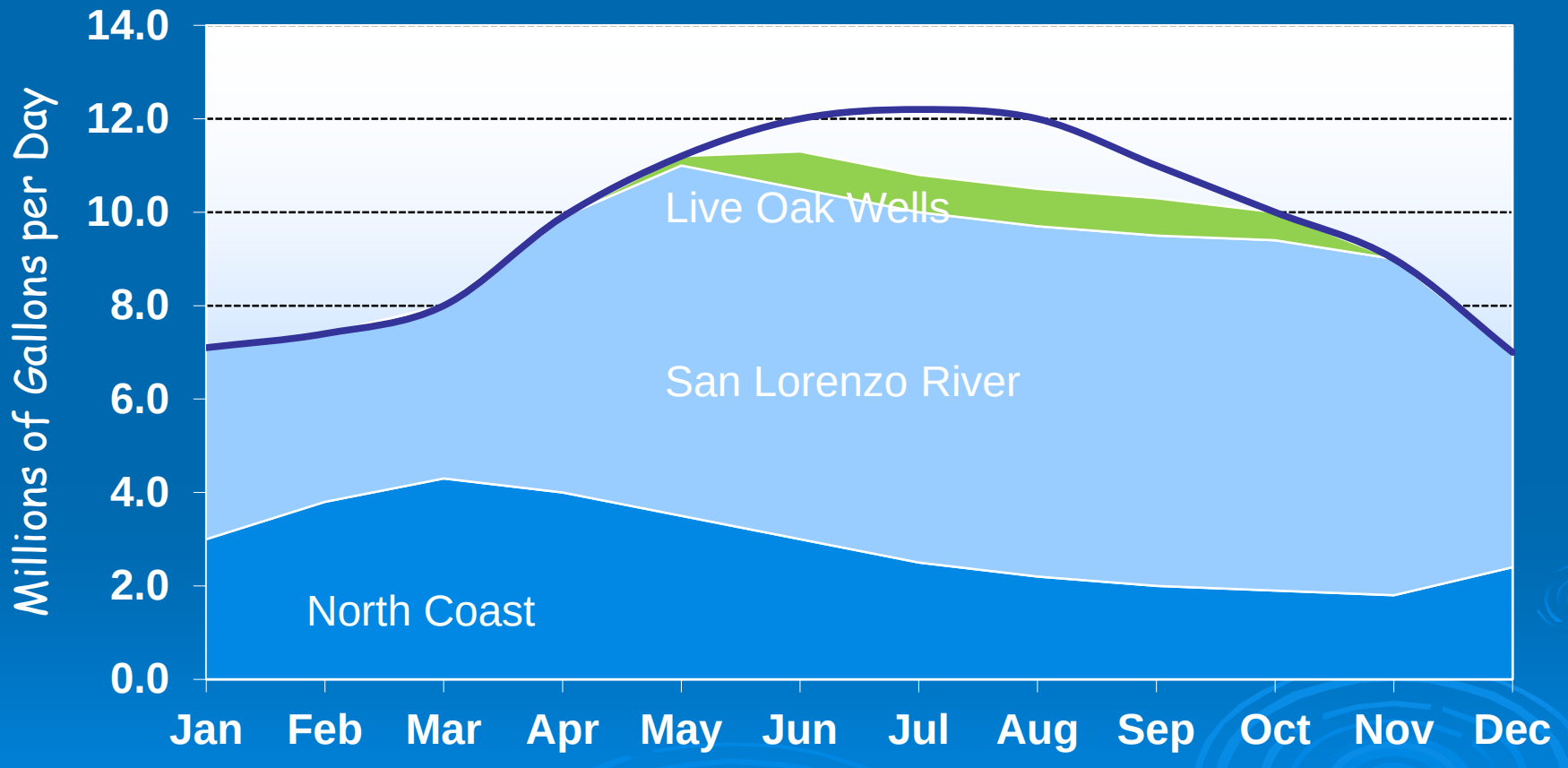
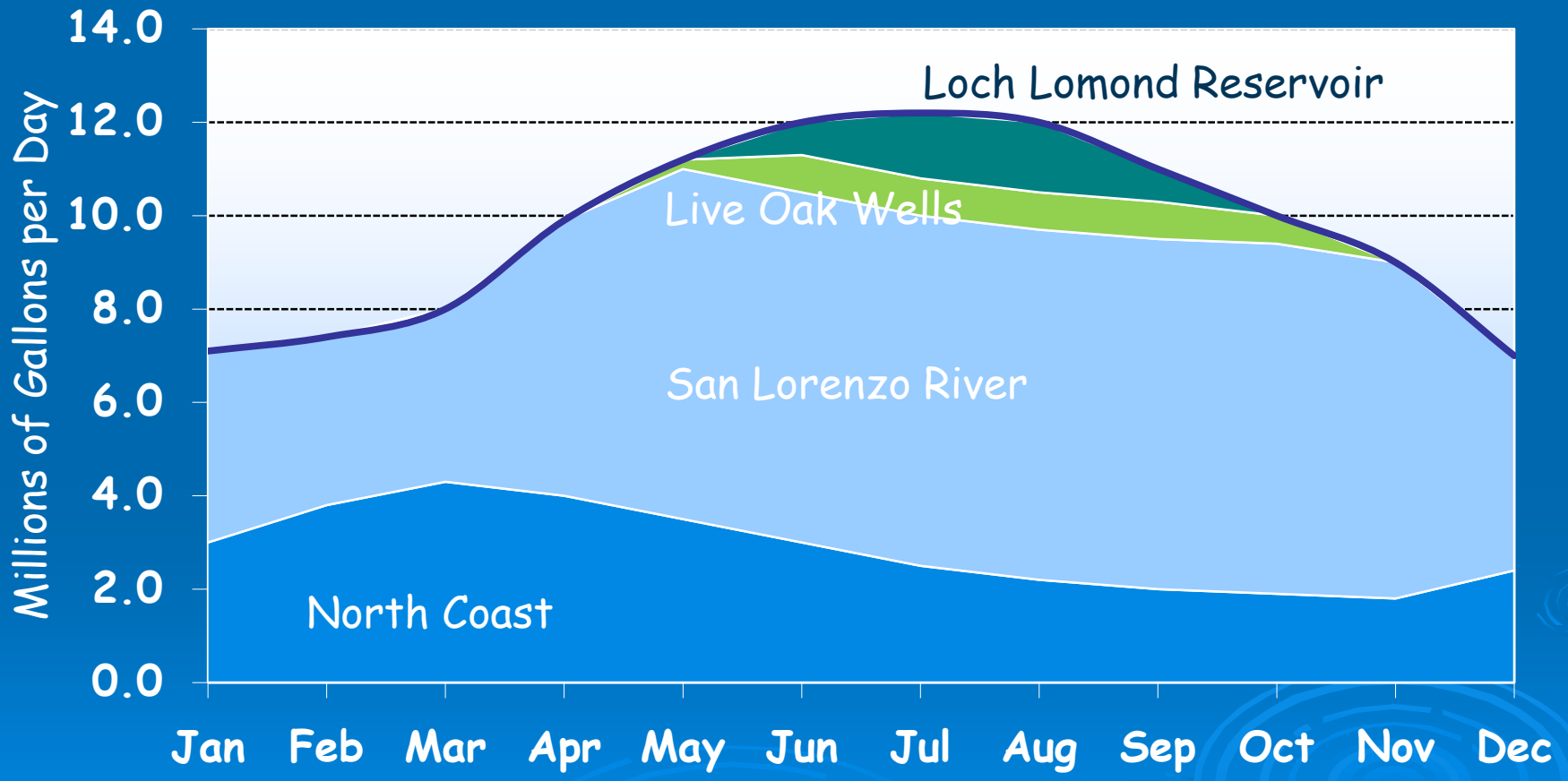
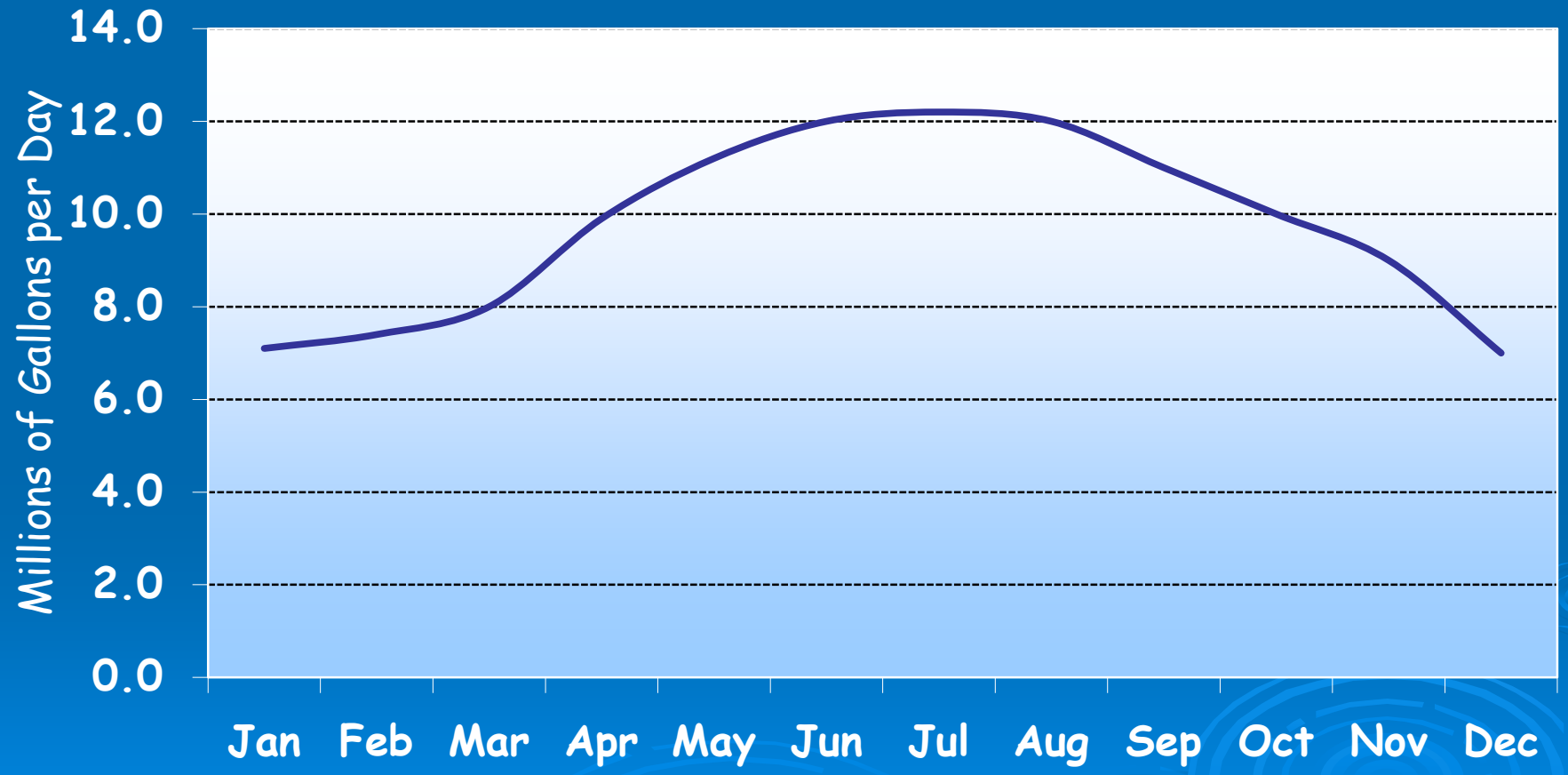


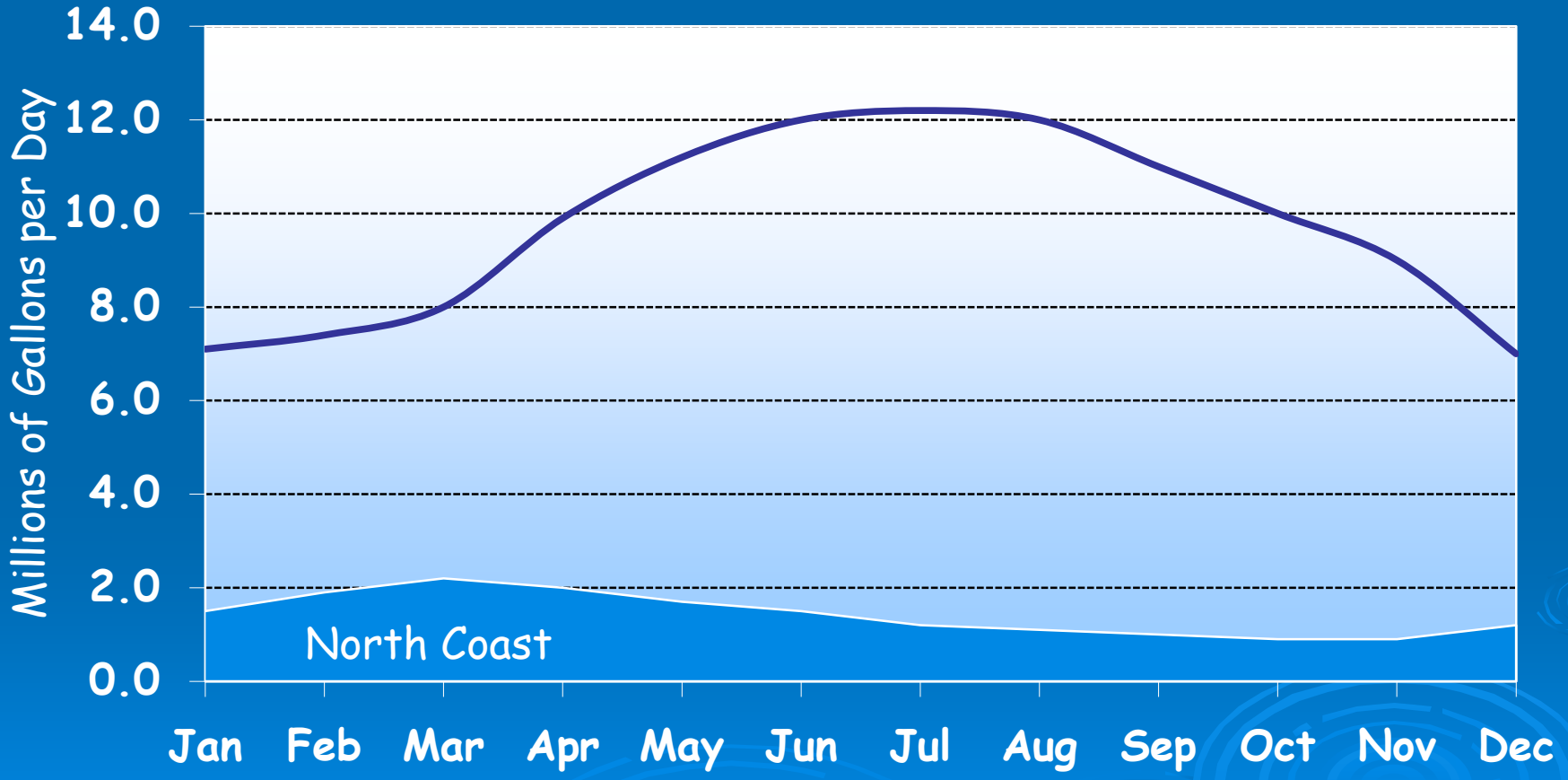
Supply and Demand in Average Conditions



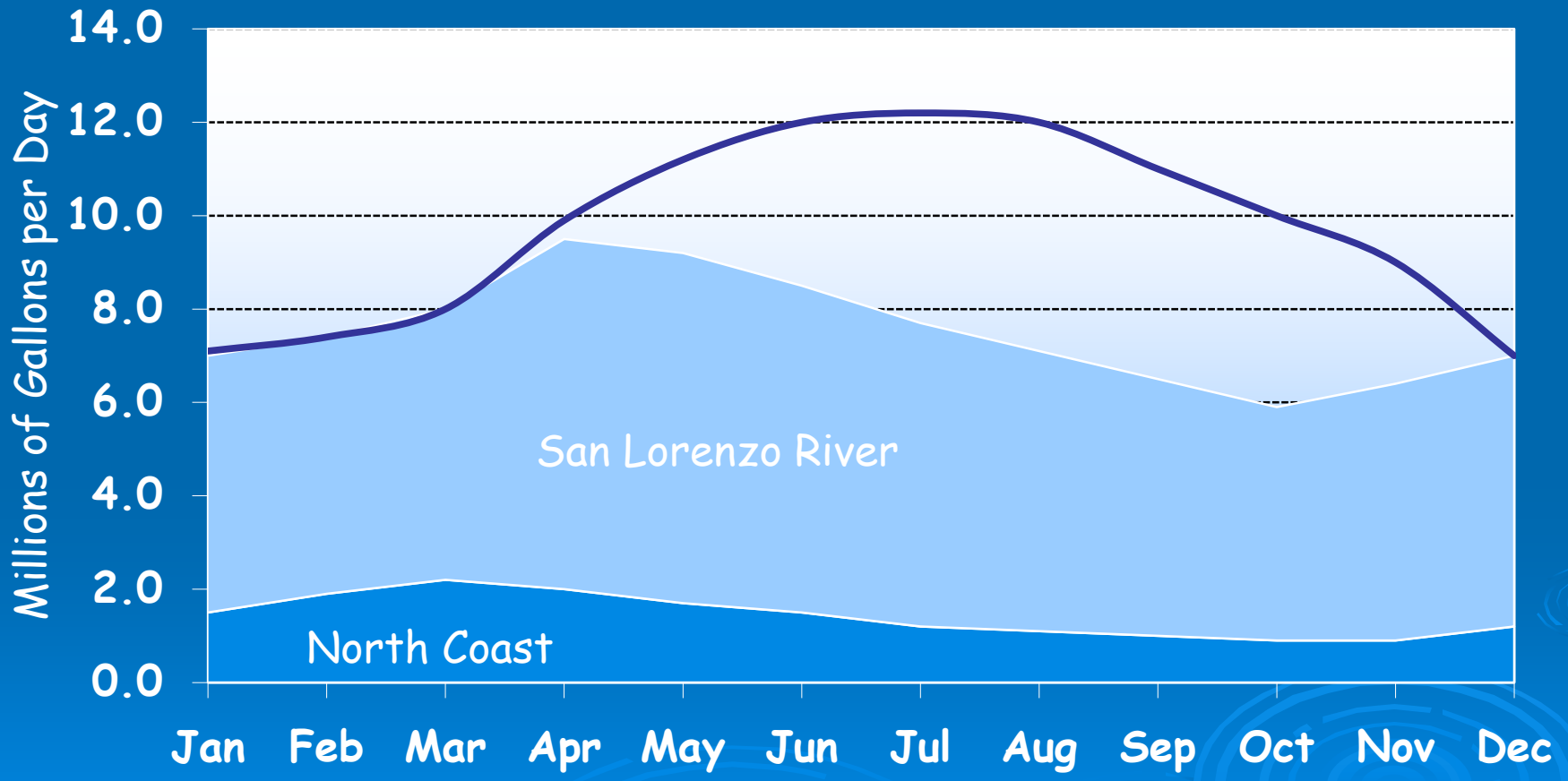
Supply and Demand in a Drought



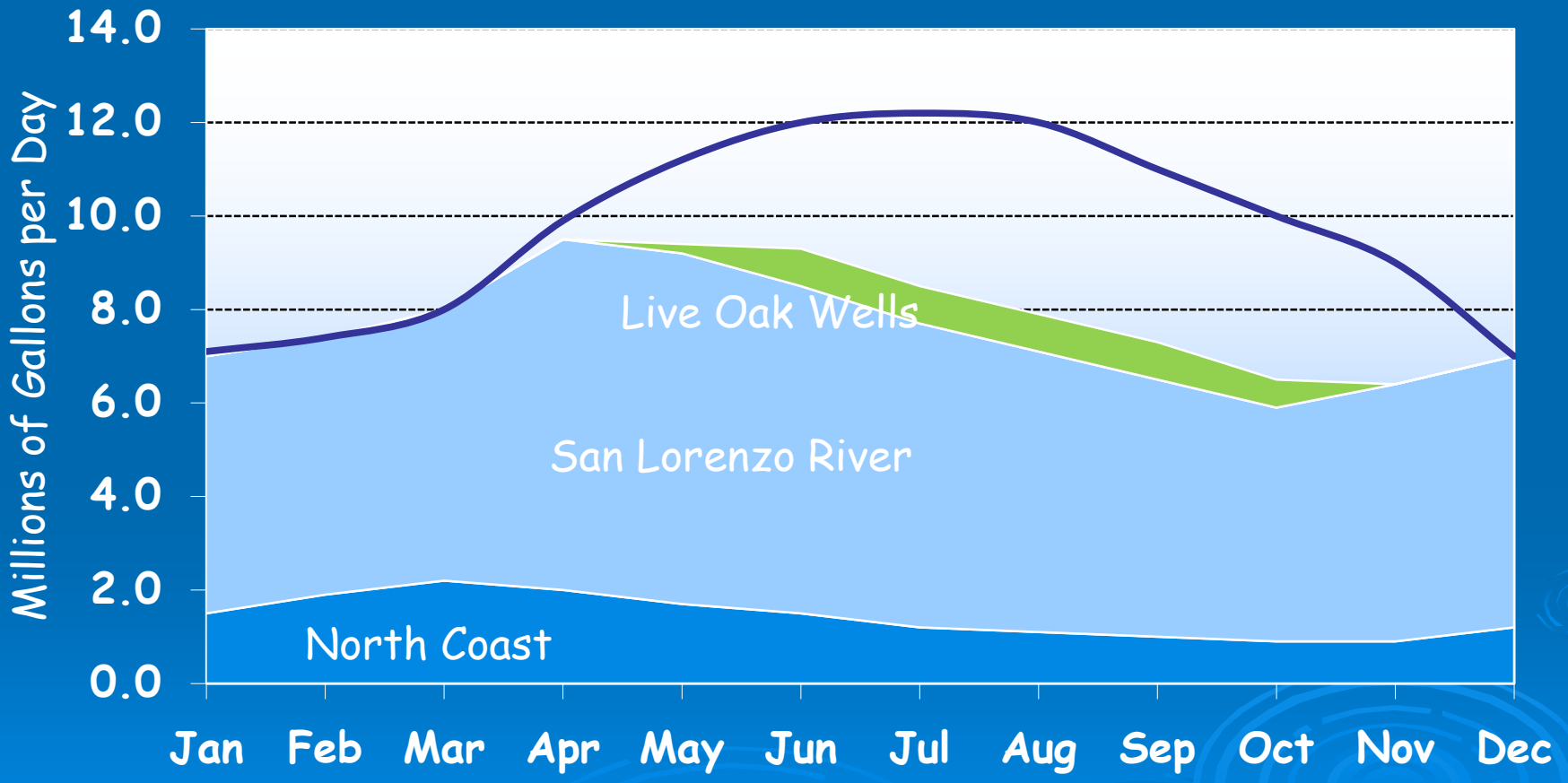
Supply and Demand in a Drought



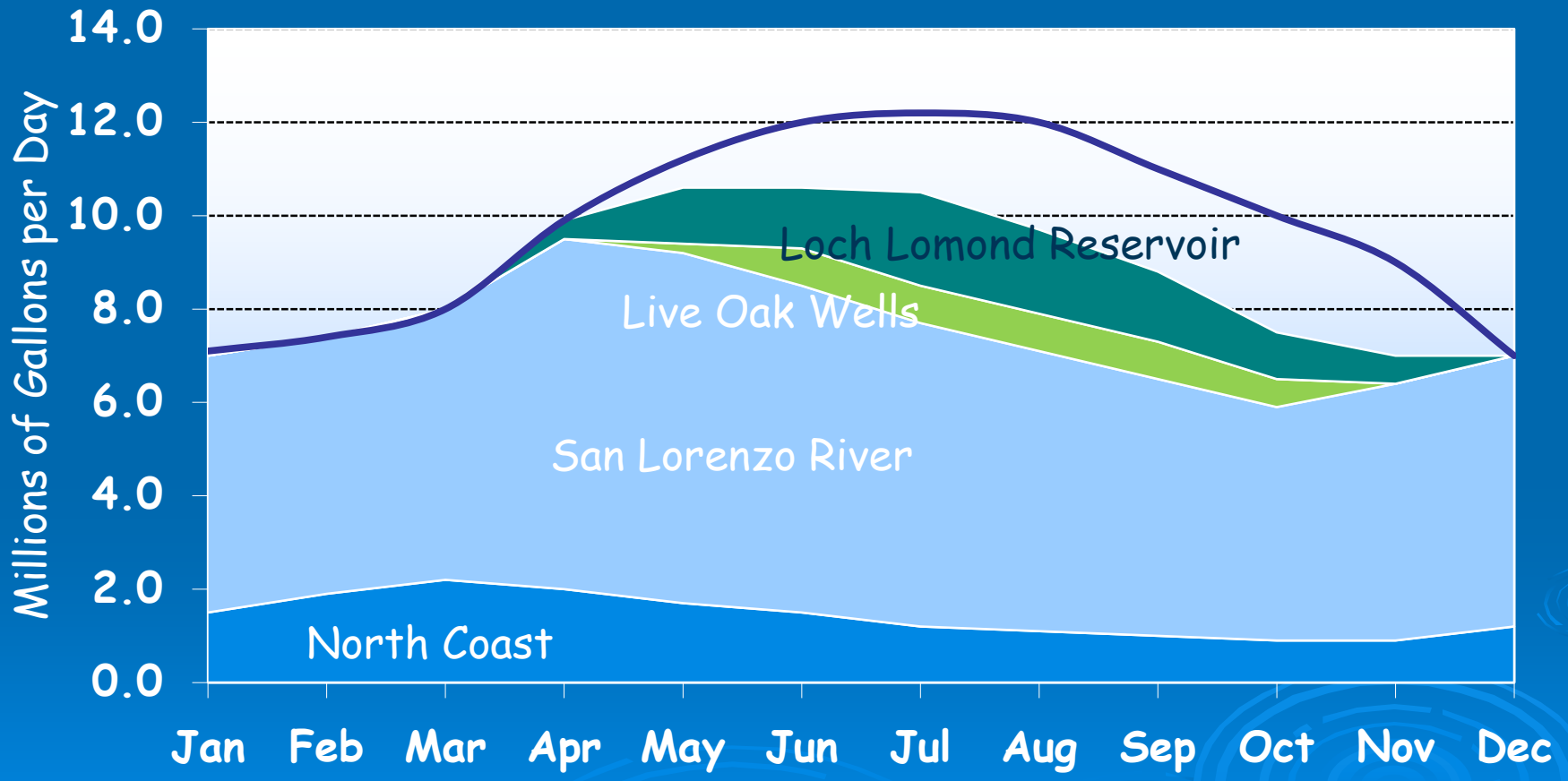
Supply and Demand in a Drought



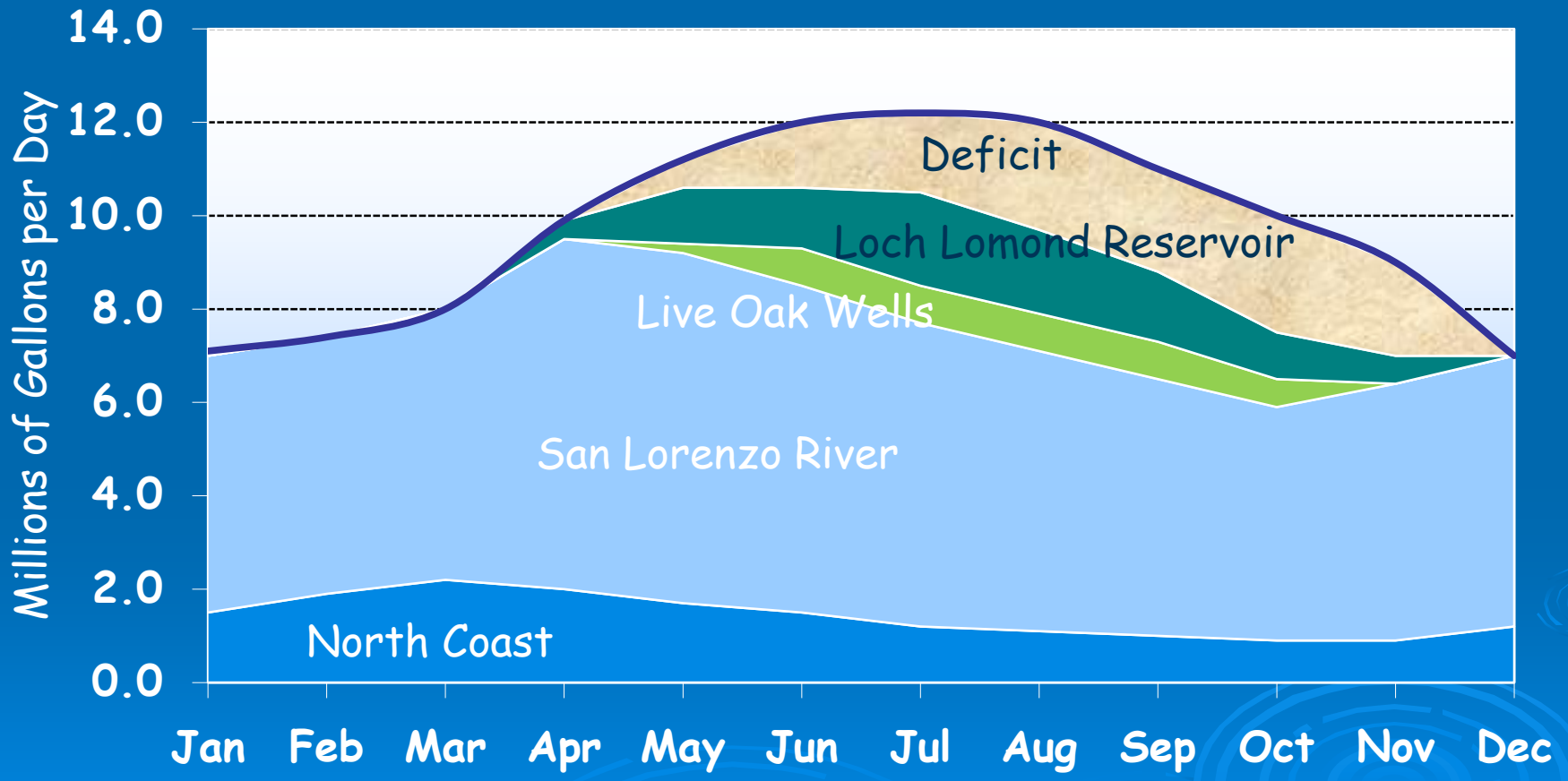
Supply and Demand in a Drought



Supply and Demand in a Drought



Supply and Demand in a Drought



The Role of Curtailment

Curtailment is a strategy used to respond to short term supply deficiencies

* The 2009 Water Shortage Contingency Plan, sets the following overarching goals:
  * To conserve the water supply of the City for the greatest public benefit;
  * To mitigate the effects of a water supply shortage on public health and safety, economic activity, and customers lifestyle; and
  * To budget water use so that supply will be available for the most essential purposes for the entire duration of the water shortage.

The Water Shortage Contingency Plan Uses a Priority-Based Allocation System

When a shortage occurs, available water supply is classified into **3 usage priorities**:

Priority	Type of Water Use
Highest	**Health and safety:** Indoor domestic use for personal care
Next highest	Business (protect jobs/economy)
Lowest	Landscape, yard, or garden irrigation and other outdoor uses

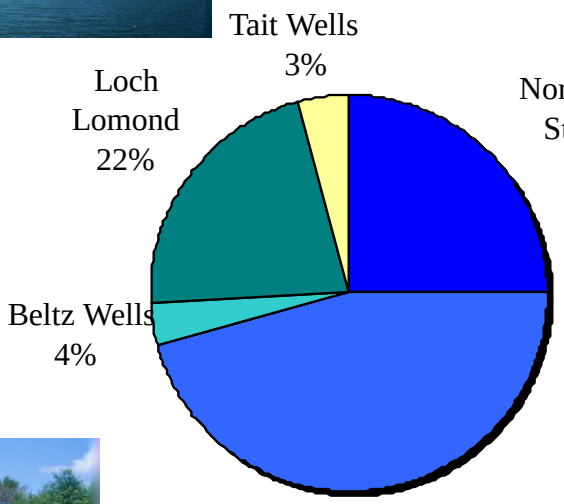
Table ES-3. Water Supply Allocation and Customer Reduction Goals

Normal Peak Season Demand = 2,473 mil gal	No Deficiency		Stage 2 15% Deficiency		Stage 3 25% Deficiency		Stage 4 35% Deficiency		Stage 5 50% Deficiency	
	Delivery		Delivery		Delivery		Delivery		Delivery	
	%	Volume (mil gal)	%	Volume (mil gal)	%	Volume (mil gal)	%	Volume (mil gal)	%	Volume (mil gal)
Single Family Residential	100	1,031	84%	864	73%	753	62%	639	48%	495
Multiple Residential	100	524	87%	454	78%	411	69%	361	55%	287
Business	100	438	95%	416	92%	402	87%	381	70%	307
UC Santa Cruz	100	132	85%	113	76%	100	66%	87	52%	68
Other Industrial	100	23	95%	22	90%	21	85%	20	67%	15
Municipal	100	48	76%	36	57%	27	41%	20	28%	14
Irrigation	100	110	64%	70	34%	37	12%	13	0%	0
Golf Course Irrigation	100	106	73%	78	51%	54	34%	36	20%	21
Coast Agriculture	100	59	95%	56	90%	53	85%	50	67%	40
Other	100	2	95%	2	90%	2	50%	1	50%	1
Total	**100**	**2,473**	**85%**	**2,111**	**75%**	**1,861**	**65%**	**1,607**	**50%**	**1,247**
Demand Reduction %, Million gallons	**0**	**0**	**15%**	**-362**	**25%**	**-612**	**35%**	**-866**	**50%**	**-1,226**

Current Supply

Water Sources

Loch Lomond Reservoir
(1960)



North Coast Streams
(1890)

Beltz Wells
(1964)

San Lorenzo River
(1924)

City of Santa Cruz Water Rights

Table 3-1. Summary of Water Rights Held by the City of Santa Cruz

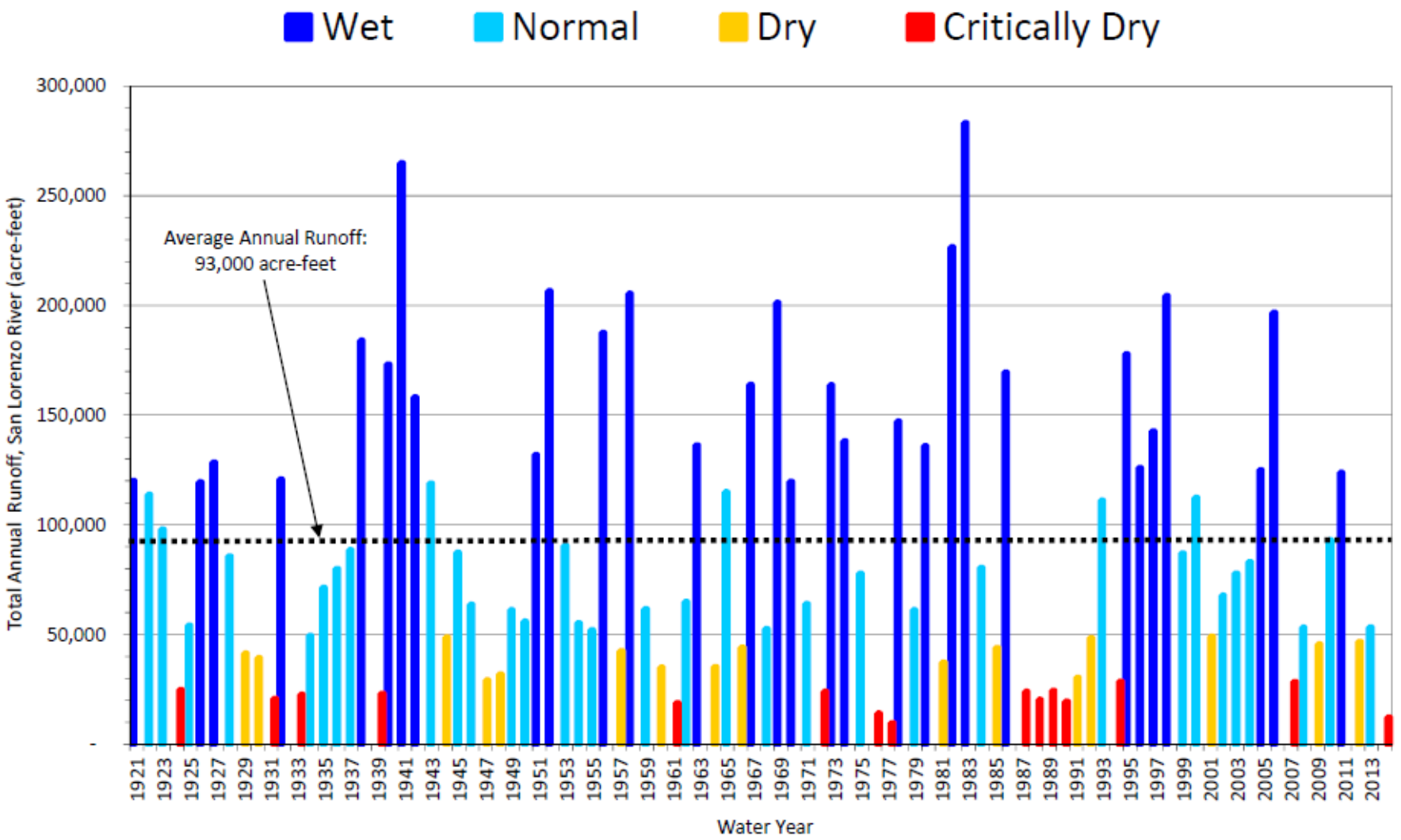
Source	License/ Permit Number	Period	Maximum Diversion Rate (cfs)	Fish Flow Requirement (cfs)	Annual Diversion Limit (mil gal)
North Coast	Pre-1914	Year round	No limit	None	None
San Lorenzo River:					
Tait Street Diversion and Wells	1553, 7200	Year-round	12.2	None	None
Felton Diversion to Loch Lomond Reservoir	16601, 16123	Sept	7.8	10	977
		Oct	20	25	
		Nov-May	20	20	
		Jun-Aug	0	--	
Newell Creek:	9847				
Collection to storage (max amount/year)		Sept-Jun	No limit	--	1,825
Withdrawal		--	--	1	1,042

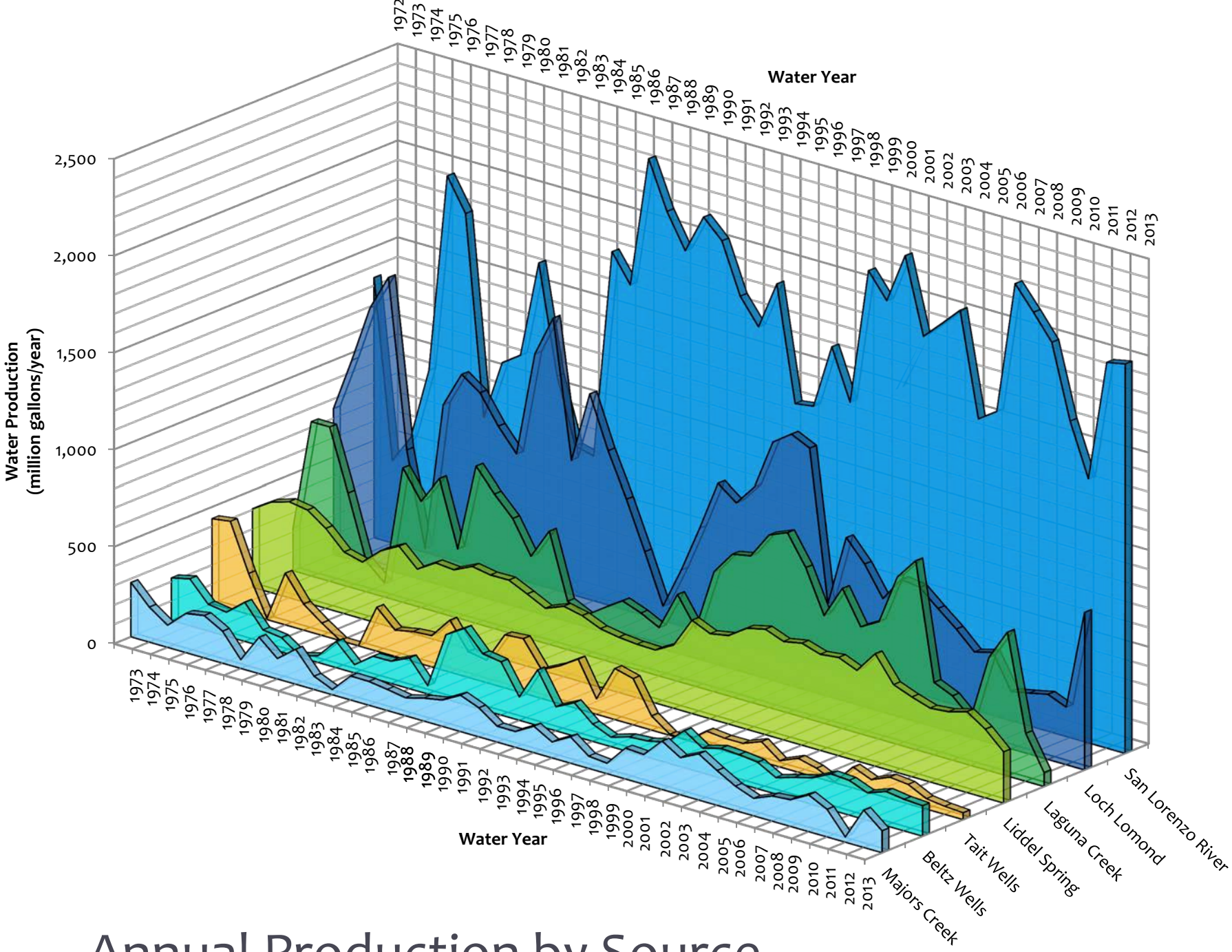
Gross Water Supply Sources for the City of Santa Cruz's Water Utility, 2009-2013

	Calendar Year All figures in million of gallons				
Source	2009	2010	2011	2012	2013
Coastal Sources	814	1,168	1,211	711	400
San Lorenzo River	2,038	1,468	1,465	1,959	2,110
Loch Lomond	195	411	228	462	807
Beltz Wells	165	145	163	163	160
Totals	3,212	3,192	3,067	3,295	3,477

Annual runoff from the San Lorenzo River is highly variable

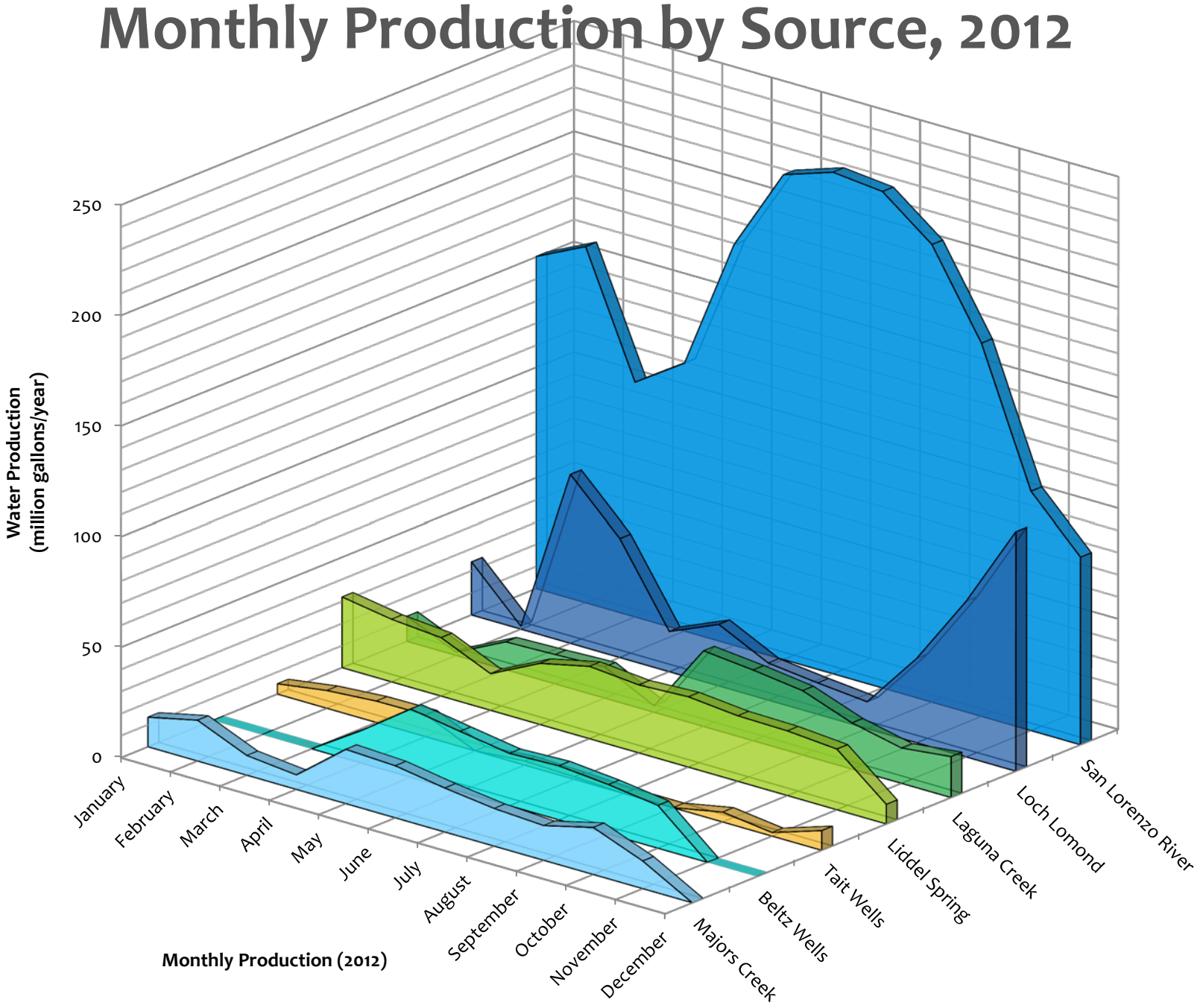
1 acre foot = 325,851.427 gallons



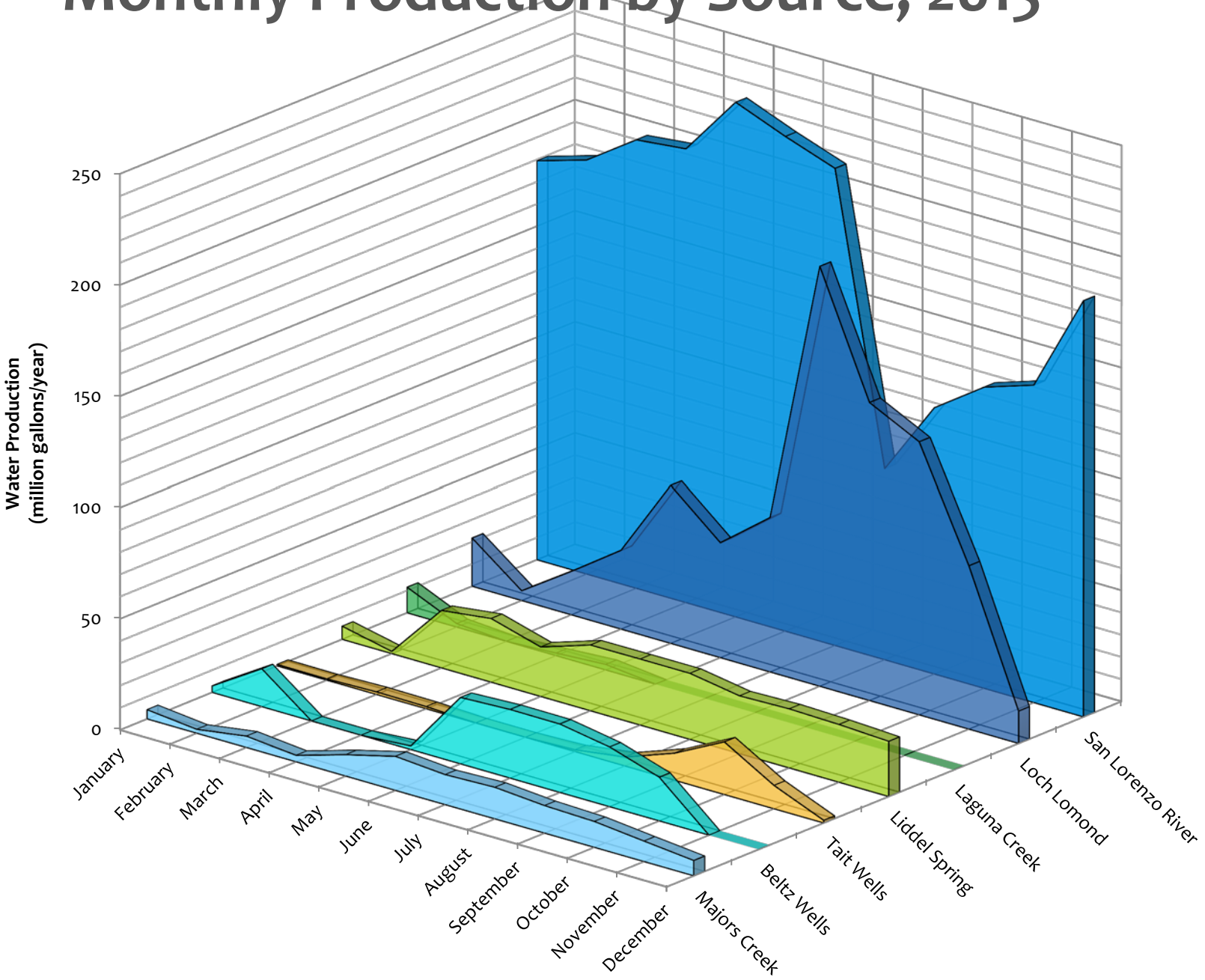


Annual Production by Source

Monthly Production by Source, 2012



Monthly Production by Source, 2013



Short Term Flow Agreements

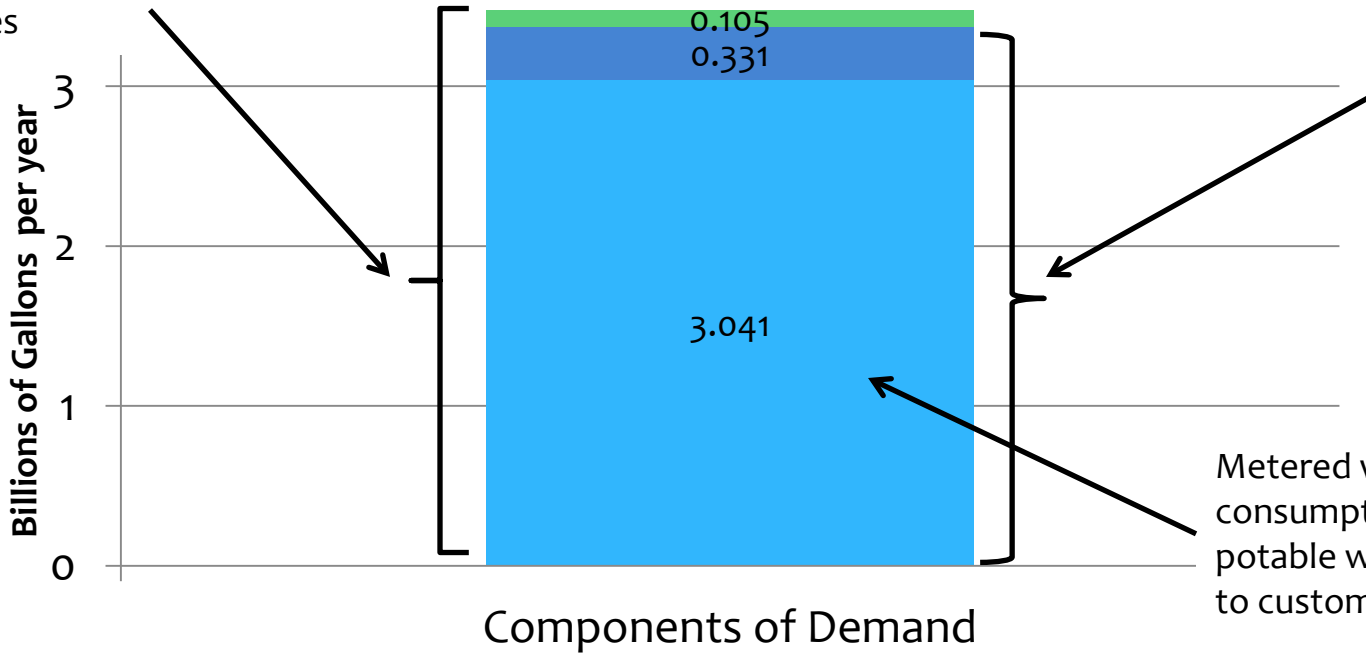
* For several years, the Water Department has negotiated short term (6 month window) flow agreements with the California Department of Fish and Wildlife and the NOAA National Marine Fisheries Service;
* The flows agreed to are designed to address the flow needs of the fish species and life stages that are relevant during that 6 month window; and
* The flow agreements are specifically agreed not to be precedent setting for either party.

Current Demand

Why do we see so many different numbers for production and demand?

Gross production is all the water that is taken into the system, and includes raw water sales and raw water system losses

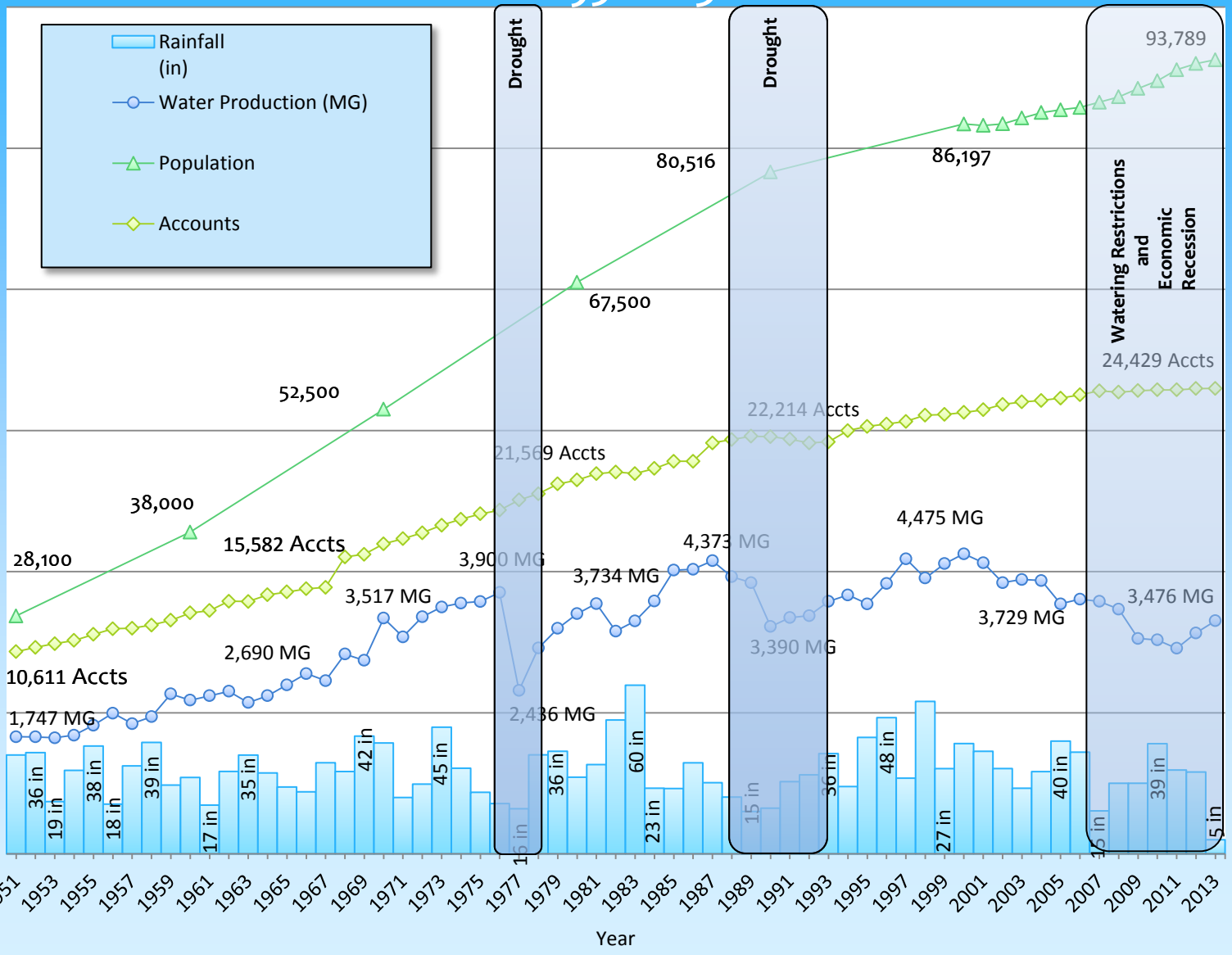
Net Production is all the water that goes through the GHWTP + Beltz Wells and includes system uses (e.g., flushing) and losses



Metered water consumption includes potable water sales billed to customers

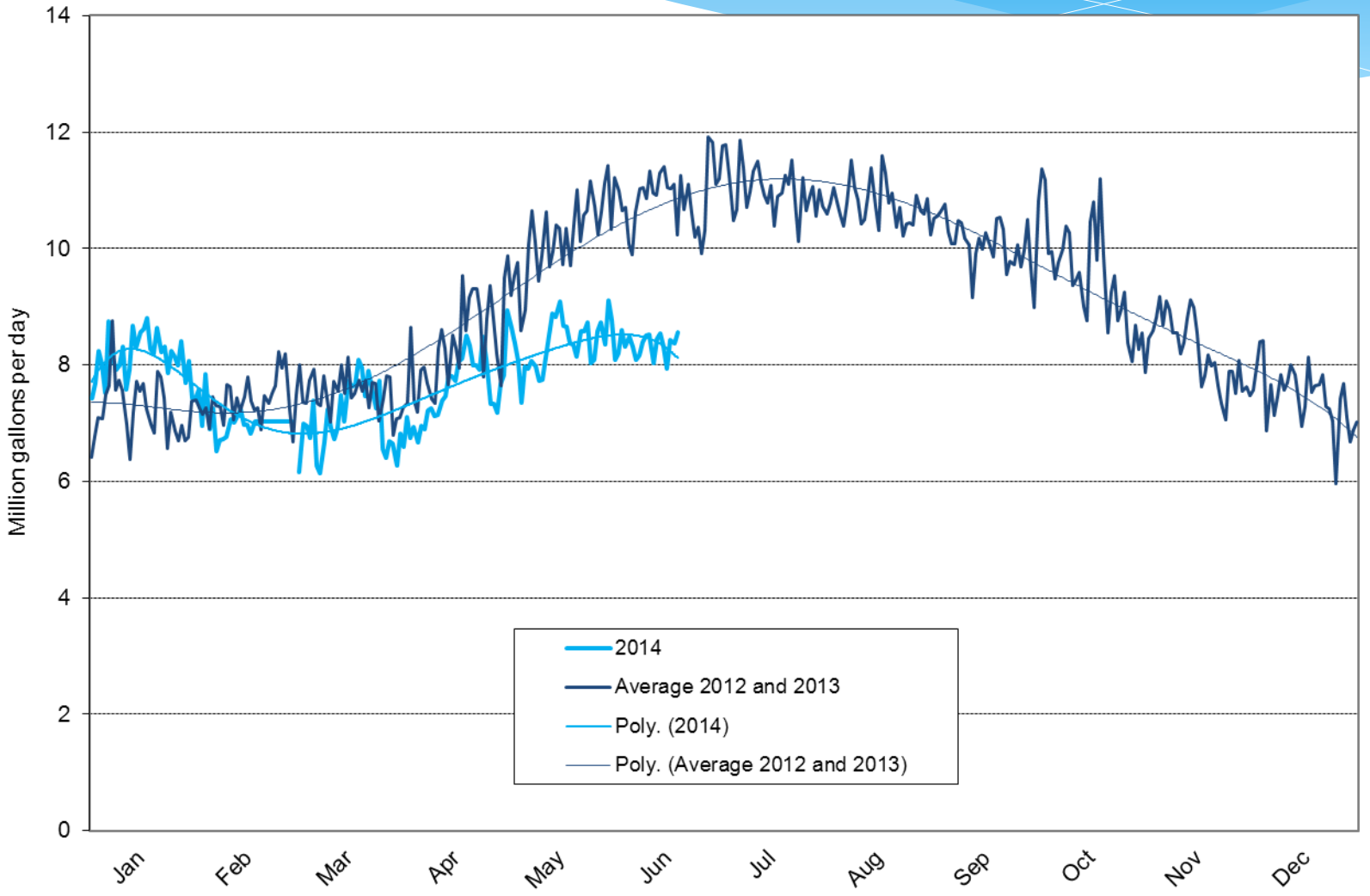
Calendar year 2013 data: gross production = 3.477 in billions of gallons

Population, Accounts, Water Production, and Rainfall 1951-2013

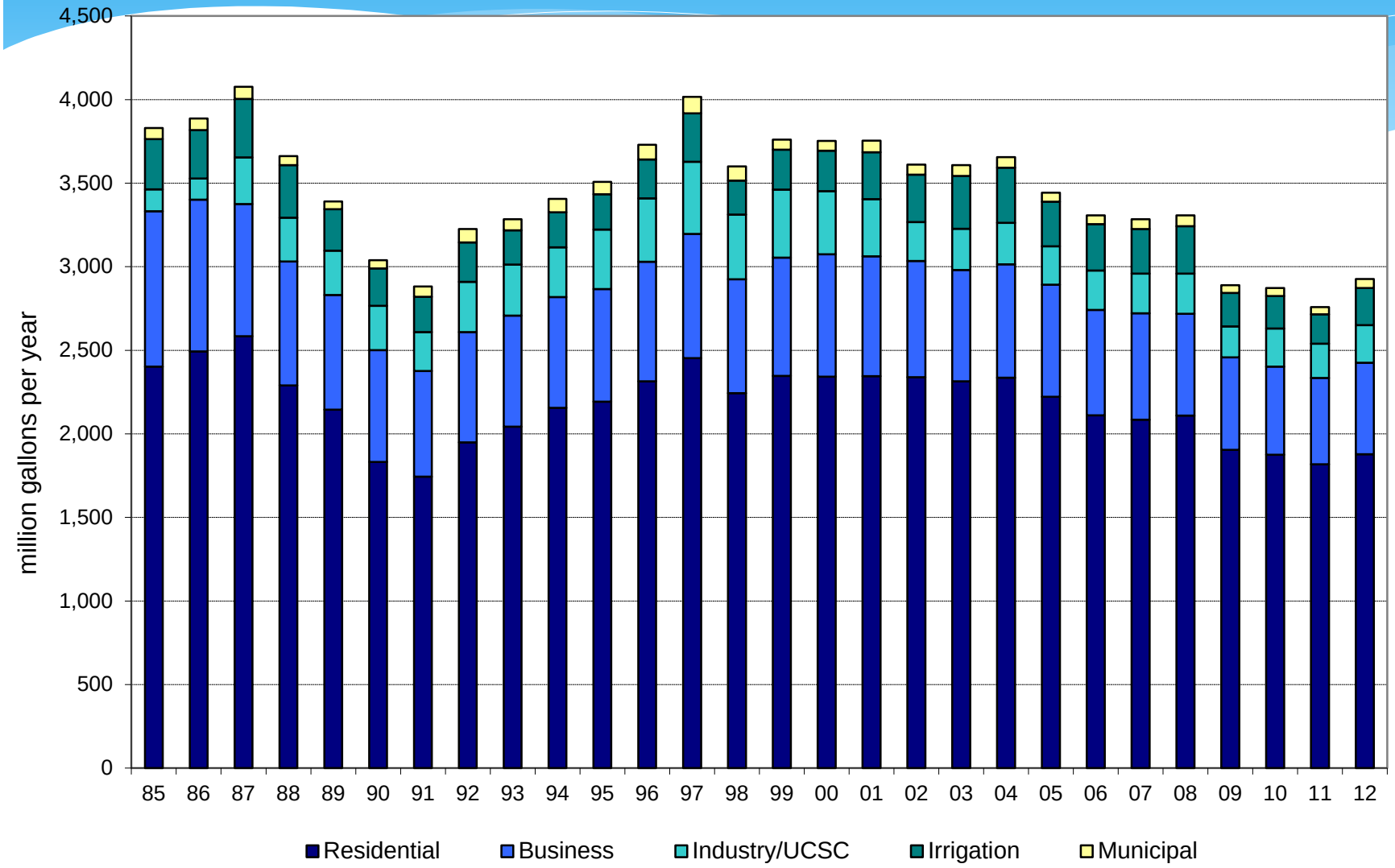


Gross Daily Water Consumption

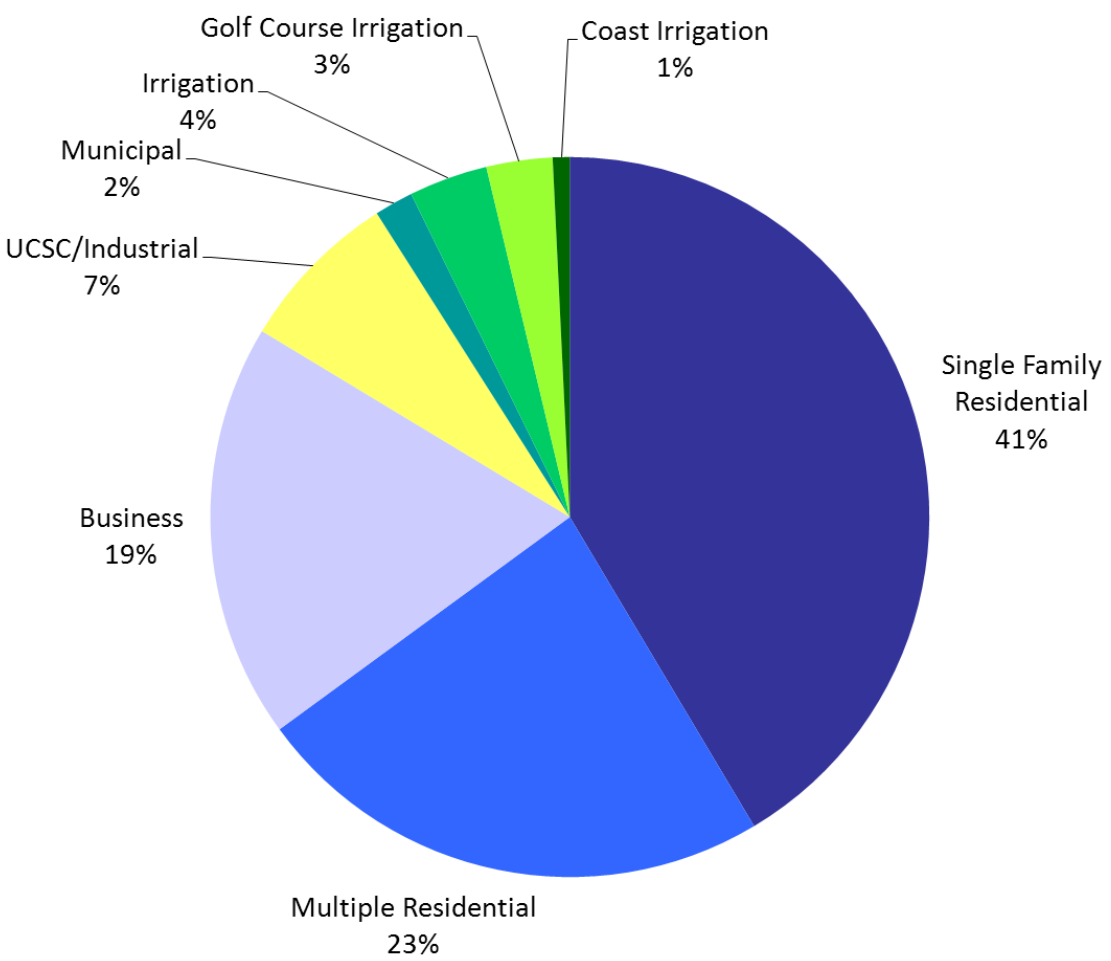
through June 18, 2014



Annual Metered Water Consumption

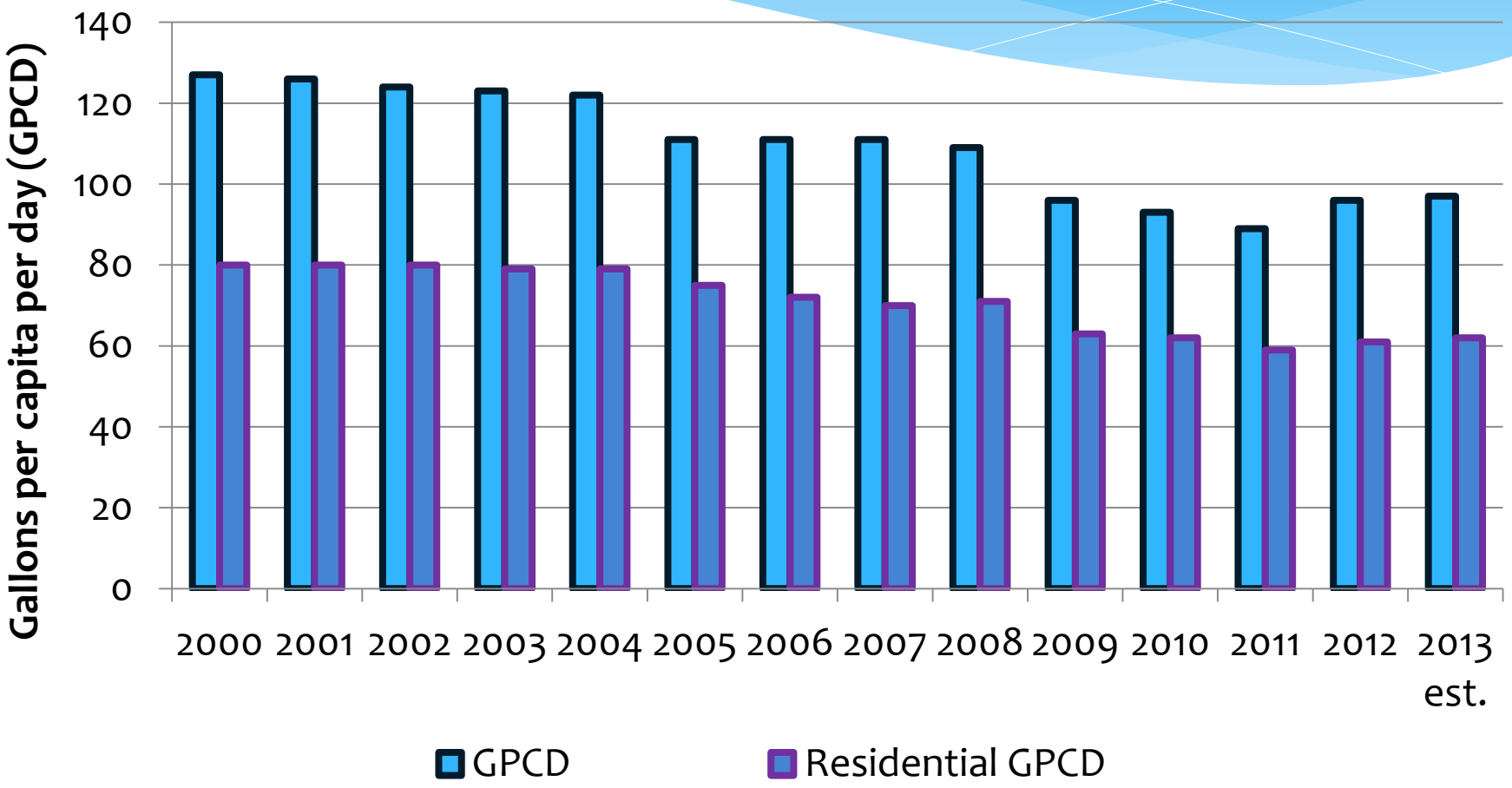


Metered Water Use by Customer Category

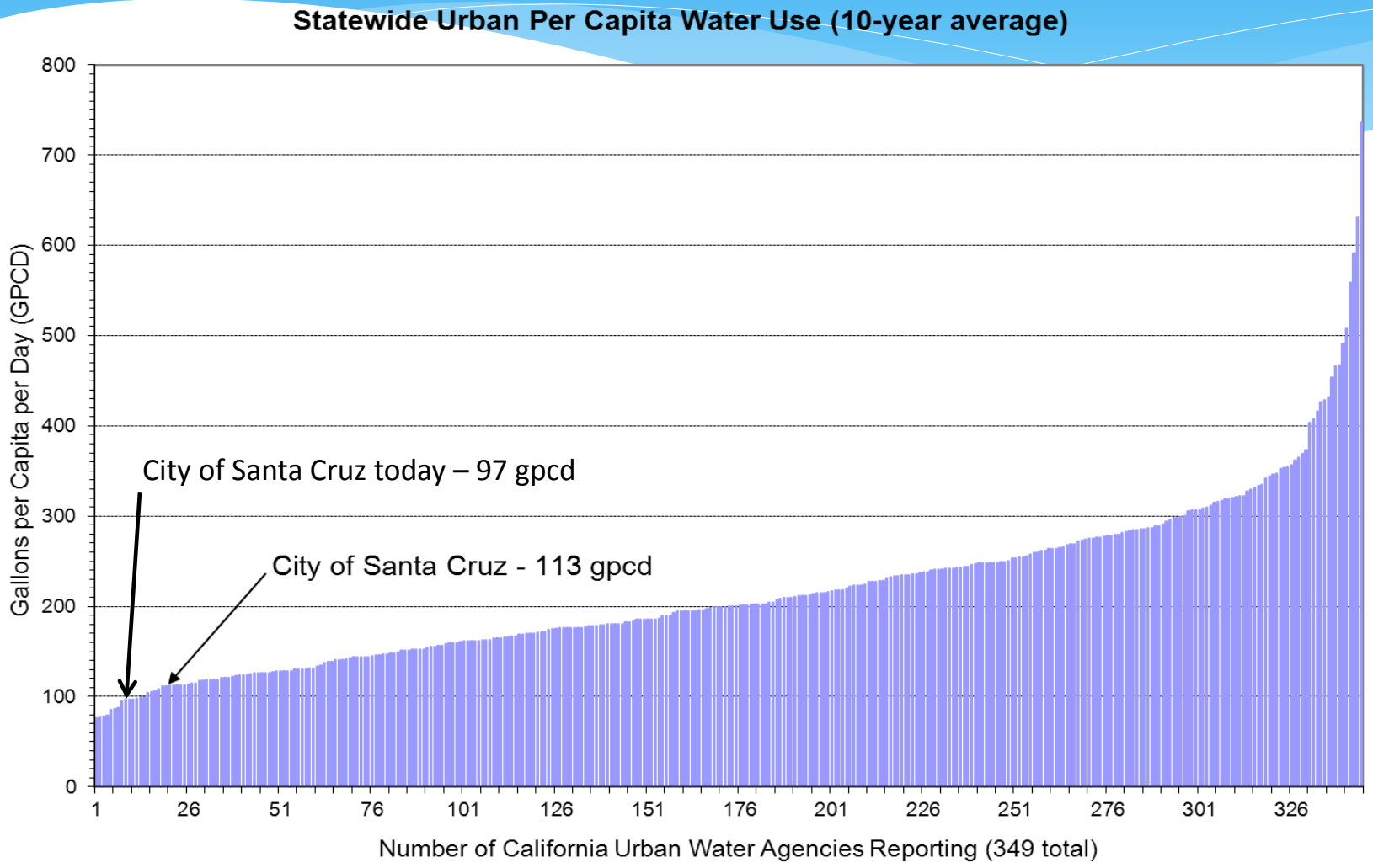


Gallons per capita per day

2010 Urban Water Management Plan Figure 4-5 as augmented by additional data



Average Per Capita Water Use 2001-2010



Customer Characteristics

Customer Accounts Broken Down by Type and Geographic Area

Calendar Year 2013					
Customer Class	Inside City	Capitola	North Coast	Outside City	Total
Single family	12,212	134	22	6,590	18,958
Multi-family	1,788	5	8	930	2,731
Irrigation residence	127	3	-	70	200
Irrigation business	118	18	-	116	252
Bulk/Hydrant meters	31	-	-	1	32
North Coast Irrigation	-	-	28	-	28
Irrigation golf	1	-	-	5	6
Construction	64	-	1	3	68
Business general	1,077	72	10	542	1,701
Business restaurant	102	2	-	2	106
Hotel/motel	79	2	-	4	85
Industrial	31	-	-	7	38
UC Santa Cruz	11	-	-	-	11
City of Santa Cruz	210	-	3	5	218
Total	**15,851**	**236**	**72**	**8,275**	**24,434**

Water Consumption by Customer Class and Geographic Location

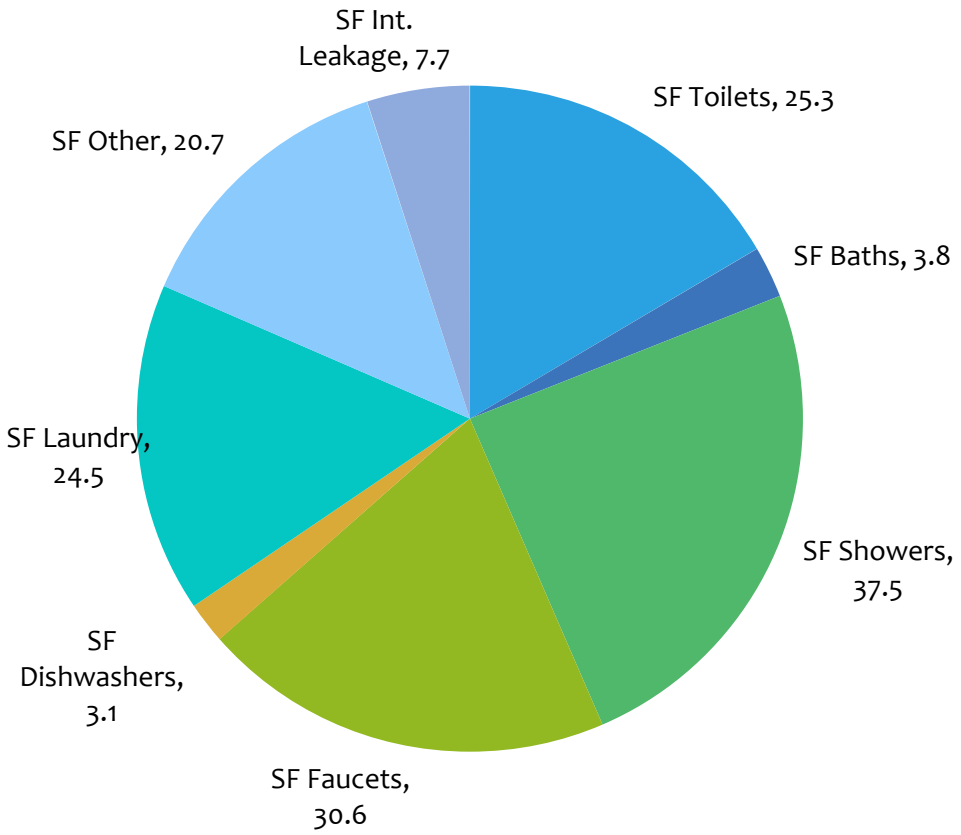
Calendar Year 2013 Figures are in millions of gallons					
Customer Class	Inside City	Capitola	North Coast	Outside City	Total
Single family	764	9	2	451	1,266
Multi-family	366	4	2	319	690
Irrigation residence	28	<1	-	15	44
Irrigation business	38	4	-	33	75
Bulk/Hydrant meters	2	-	-	-	2
North Coast Irrigation	-	-	24	-	24
Irrigation golf	45	-	-	63	108
Construction	1	-	-	-	1
Business general	249	30	4	169	452
Business restaurant	38	1	-	1	40
Hotel/motel	70	8	-	2	80
Industrial	55	-	-	1	56
UC Santa Cruz	182	-	-	-	182
City of Santa Cruz	61	-	<1	1	62
Total	**1,899**	**56**	**32**	**1,055**	**3,043**

Indoor/Outdoor Breakdown (%)

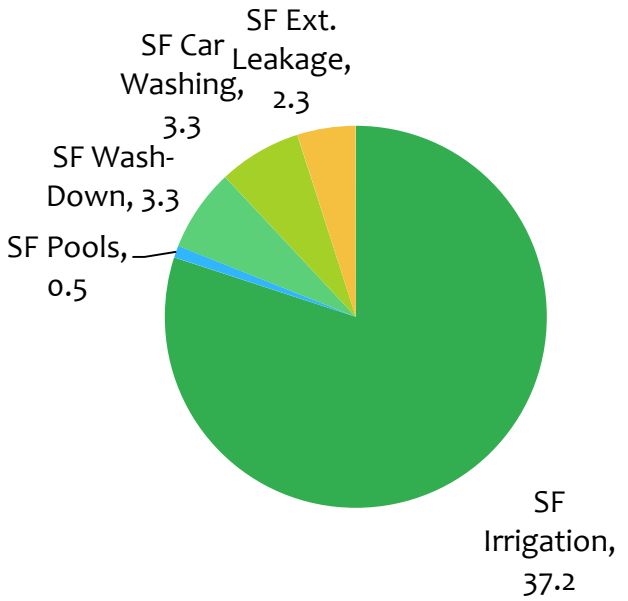
Category	Indoor	Outdoor
Single Family	77	23
Multi-family	88	12
Business	79	21
UCSC	77	23
Municipal	32	68
Irrigation	0	100
Golf	0	100

End Use Breakdown
Typical Single Family Account

Internal End Uses
153 gallons/household/day



External End Uses
47 gallons/household/day



Baseline Conservation Survey: Summary of Key Findings for Single Family Residential Accounts

Item	Standard	No. surveyed	Average per household	Percent water efficient
Faucets	2.2 gpm	352	3.5	83%
Showerheads	2.5 gpm	176	1.8	92%
Toilets	1.6 gpf	208	2.1	90%
Clothes Washers	Type	96	0.96	62%
Dishwashers	Age	81	0.81	65%

Baseline Conservation Survey: Summary of Key Findings for Multi-Family Residential Accounts

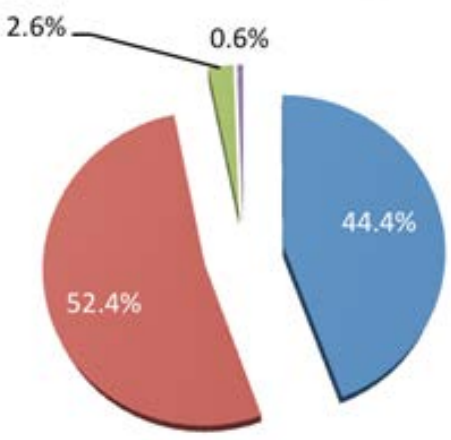
Item	Standard	No. surveyed	Average per household	Percent water efficient
Faucets	2.2 gpm	322	2.4	87%
Showerheads	2.5 gpm	152	1.2	95%
Toilets	1.6 gpf	181	1.3	89%
Clothes Washers	Type	44/109	0.4/0.08	58/46%
Dishwashers	Age	49	0.4	45%

Lot Characteristics

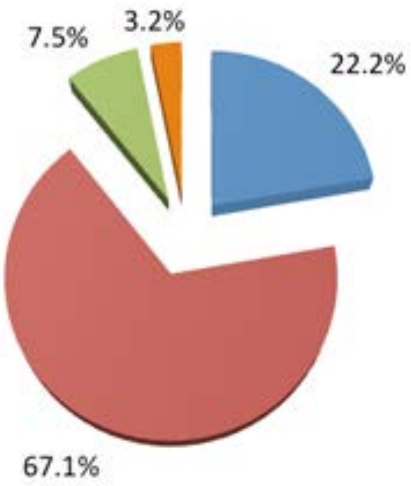
	Single Family	Multi-Family	Commercial (includes Schools)
Mean Lot Size (sq. ft.)	8,574	~50,000	~104,450
Median Lot Size (sq. ft.)	6,316	9,600	14,810
Sites with Landscaping	98%	73%	54%
Average Lot Area in Landscaping sq. ft. (%)	1,884 (22%)	5,800 (12%)	4,835 (5%)
Sites with Turf	48%	51%	15%
Average Turf Area (sq. ft.)	542	2,744	3,005

Irrigation Characteristics
Types of Irrigation Equipment

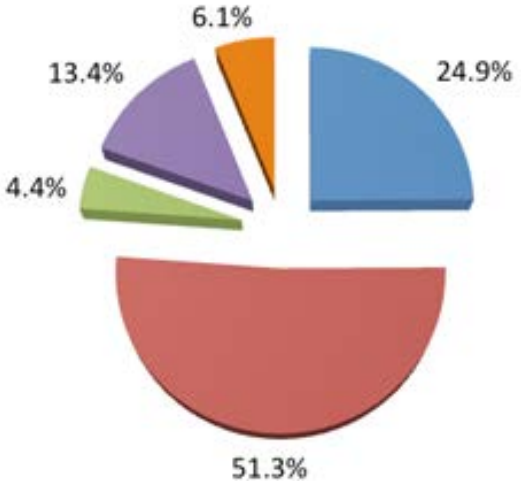
Single Family



Multi-Family



Commercial



Drip
Spray
Rotor
Hose End
Not Available

Turf and Irrigation Characteristics

Watering Turf with In-Ground Irrigation System

Single Family	Multi-Family	Commercial
62.5%	71.2%	74.4%

Future Supply

Supply Modeling

* Confluence Model Inputs
  * Hydrology
  * Operating rule curves for various sources
  * System demand – by customer class
  * Water rights constraints
* Models aren't static, as you learn more about the system and how the model forecasts it, questions and issues are identified that are researched and result in refining the model. This continuous "calibration" process is always a part of developing and using a supply model.

Summary of Santa Cruz Confluence Assumption Changes over Time				
Modeling Parameter	**For IWP**	**Interim Assumption Adjustment (2010)**	**HCP (outdated)**	**Current/HCP**
Annual Demand (mg)	4,600 - 5,300	3,500 - 4,500	3,500	3,500 - 4,000
Demand Shape (Percent of annual demand in peak season)	57%	64%	64%	57%
Loch Lomond Rule Curves	Calibrated to 1977	Calibrated to 1977	Calibrated to 1977; then to 1990	Calibrated to 1990
Loch Lomond Water Right	1.043 billion gallon annual withdrawal limit	1.043 billion gallon annual withdrawal limit	1.043 billion gallon annual withdrawal limit	No Limit
N. Coast Annual Ad Demand (mg)	30.8	30.8	81.4	22.5
Tait St. Diversion Capacity (cfs)	11.52	11.52	11.52	Peak: 12.2 Off-Peak: 11.52

Forces Affecting Future Supply

Fish Flow Releases

* Sources of and rationale for selecting flow sets for use in Recon:
  * Modeling changes are underway and are expected to be finalized by the fall;
  * DEIR fish flow release flow sets have been presented to the public previously, so maintaining consistency with these flow sets seems to make sense, especially for use in Recon.

Fish Flow Tiers – what do they mean?

Tier 1, 2 and 3

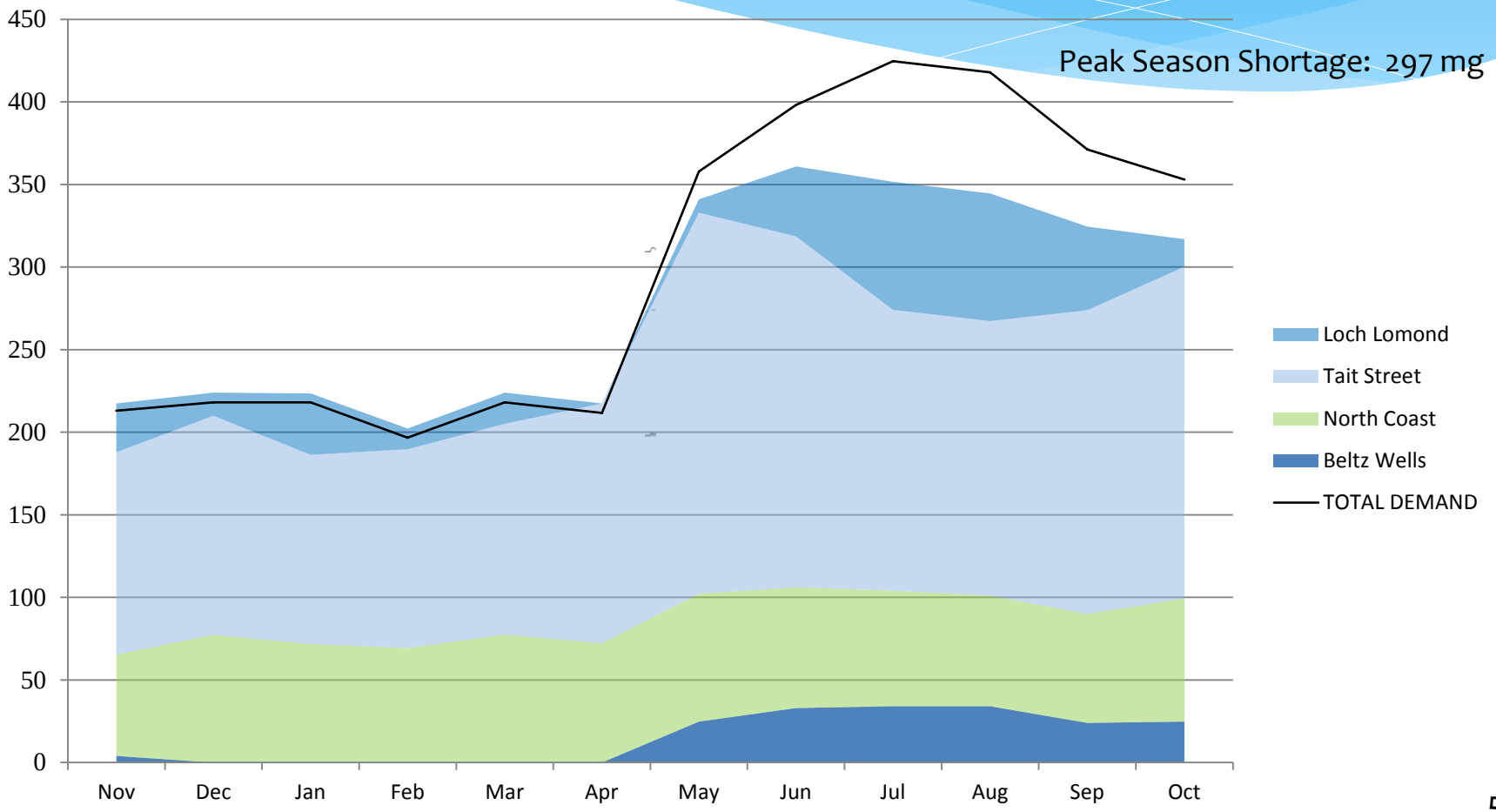
* Tier 1 refers to the (then) current voluntary flow releases initiated by the City in 2007 to maintain current habitat levels.
* Tier 2 would limit City diversions & thereby increase baseflows in priority streams (Laguna Creek and the San Lorenzo River below Tait Street), as well as increase winter flows for adult migration and spawning in these streams.
* Tier 3 would further limit City diversions to further increase baseflows in North Coast streams and the San Lorenzo River, providing 80 percent of optimum flows for fish habitat. Tier 3 leaves the most water in the streams for fish habitat, and results in the least amount of flowing water available for City diversion.

Fish Flow Tiers – what do they mean?

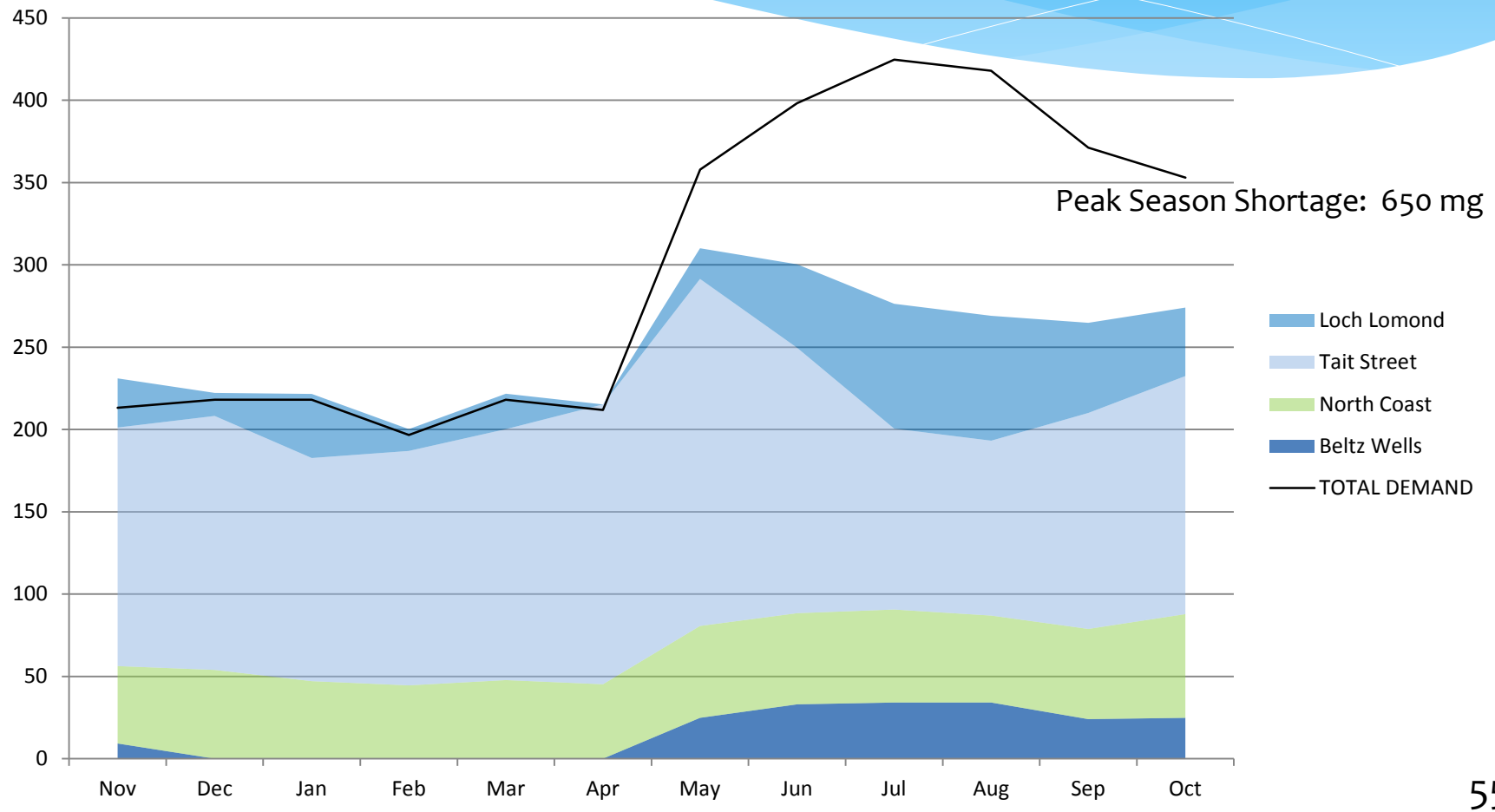
Tier 3/2

* Tier 3/2 is a combination of tiers three and two. It is designed to maintain flows to maintain all life history stages of steelhead and coho and includes:
  * Minimum in-stream flows to maintain all life history stages for coho salmon and steelhead;
  * Bypass flows in wet and normal years to achieve habitat values for all life stages of steelhead and coho that are approximately 80 percent of the habitat value that would occur in the absence of the City diversions; and
  * In dry and critically dry years, bypass flows are targeted to provide approximately 80 percent of habitat values that would occur in the absence of City diversion in Laguna and San Lorenzo River below Tait Street, while providing habitat values in the other streams that are improvements over existing operations, but do not fully achieve 80 percent of the habitat value.

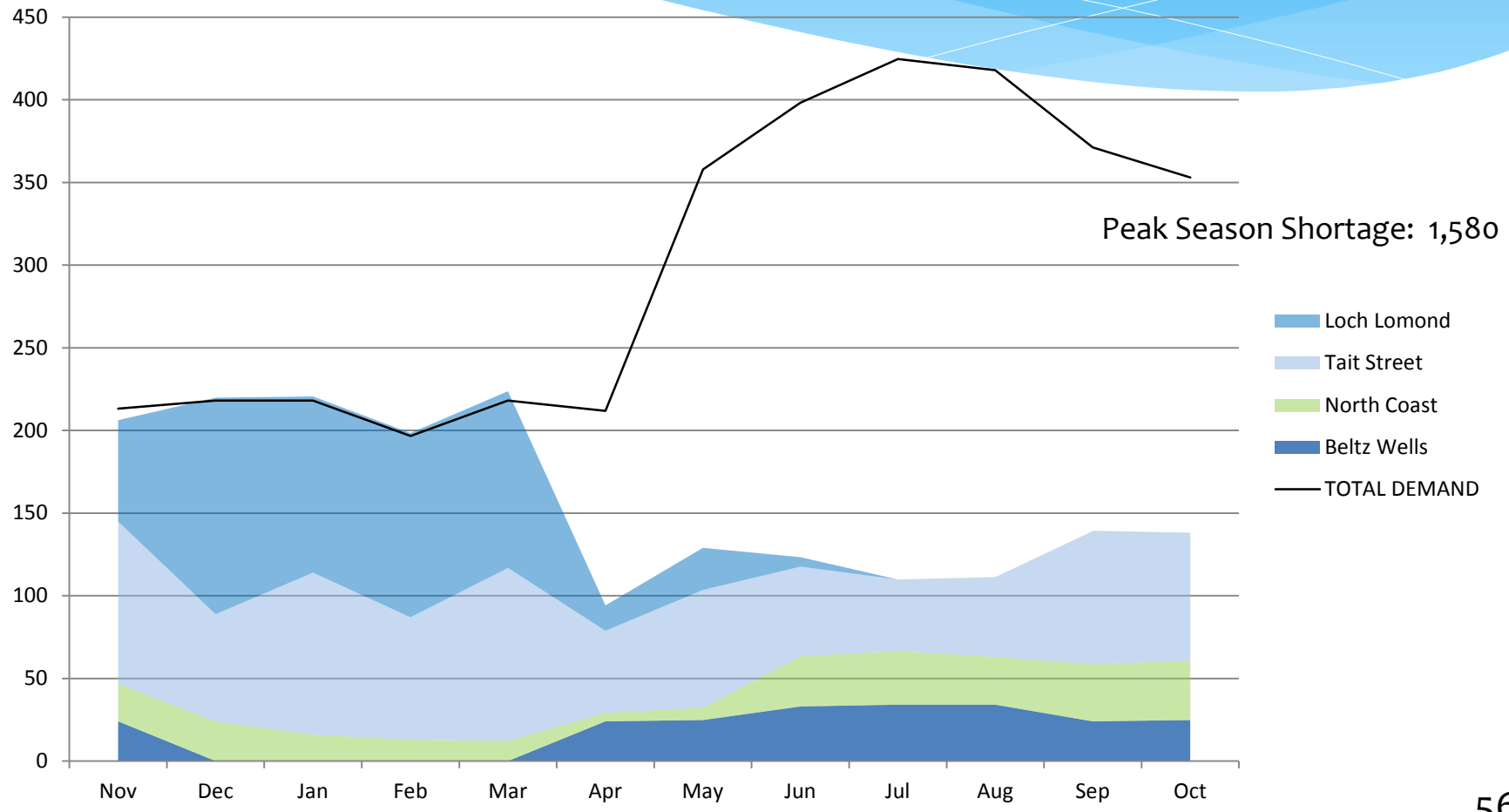
Monthly Source Production Under 1977 Hydrologic Conditions – Natural Flows (millions of gallons per month)



Monthly Source Production Under 1977 Hydrologic Conditions – Tier 3/2 Flows (millions of gallons per month)



Monthly Source Production Under 1977 Hydrologic Conditions – Tier 3 Flows (millions of gallons per month)



Fish Flow Tiers – what do they mean?

DFG 5

* DFG 5: is the CDFWs counter proposal to Tier 3/2 which includes a number of infrastructure improvements such as a second pipe between Felton diversion and Newell Creek Dam

Tier 3:

As submitted to the resource agencies in August 2011 as part of a broader draft conservation strategy (which also included much lower flow goals known as Tiers 1 and 2), this flow strategy for North Coast and Tait St. sources includes:

* Diversions would be limited to achieve approximately 80% of the habitat value in North Coast streams and the San Lorenzo River that would exist in the absence of City diversions.

Tier 3/2:

Upon receiving feedback that the August 2011 City proposal needed to be more responsive to several issues including dry year rearing flows and smolt outmigration, a hybrid Tier 3/2 flow proposal was developed and submitted to the resource agencies in July 2012. This includes the following flow goals for the North Coast and Tait St. sources:

* Under this hybrid scenario, Laguna Creek and the San Lorenzo River would receive Tier 3 flows in normal and wet years and Tier 2 flows in drier years with a small number of "exception" years where a minimal flow (aka "Tier 1") would be provided in extreme drought conditions. Tier 2 flows generally include lower flows for smolt outmigration and rearing than does Tier 3, while Tier I flows have minimal flows to support only rearing in all streams.

DFG 5:

In response to the City's July 2012 proposal, the Department of Fish and Wildlife (then DFG) submitted a counterproposal in September 2012. This proposal included the following modifications of the City's July 2012 proposal for North Coast and Tait St. sources:

* Criteria for determining "exception years" (and subsequently reduced flow goals) based on reservoir storage levels.
* Lower adult migration flow triggers
* Increased smolt outmigration flows
* Generally higher rearing flows
* Reduced adult migration, spawning and incubation flows in Liddell and Majors Creeks in dry years

Climate Change

PROJECTED CLIMATE CHANGES FOR THE SANTA CRUZ REGION

Changes are summarized for selected climate variables that were quantified by a recent USGS study (Flint et al., 2012) unless otherwise indicated. Key seasonal changes are bolded.

Climate variable	Projected changes by 2100	Confidence ranking	Supporting evidence	Seasonal and spatial patterns
Average maximum air temperatures (30 yr intervals)	↑ Expected to increase 3-4°C above the historic reference period of 1971-2000	high	Climate model agreement. Projections are consistent with statewide projections (Cayan et al., 2009).	High spatial variability with the largest changes expected in the Santa Cruz mountains. **Warmer temperatures are projected to extend further into fall months** compared to the historic reference period of 1971-2000.
Air temperature variability (30 yr intervals)	↑ Expected 20-30% larger standard deviation than the historic reference period of 1971-2000	high	Climate model agreement. Projections are consistent with statewide projections made in other studies (Cayan et al., 2009).	Increased variability but reduced range of extreme temperatures. Largest changes expected in the Santa Cruz mountains with a high degree of spatial variability across the region.
Sea levels	↑ Expected 1-1.4m rise above 2010 elevations	high	Standardized projections with general model agreement (Knowles, 2010), data available at www.caladapt.org.	Coastal low lying areas and areas adjacent to streams most vulnerable when coupled with high tides during a high runoff event.
Annual precipitation totals (30 yr intervals)	↔ Direction of change undetermined	low	Climate models disagree on the direction of change, but both show the most pronounced changes during winter months. Climate models disagree on which months are responsible for annual precipitation changes.	Total annual precipitation changes cannot be determined, but **projections indicate less precipitation in the fall and spring with the timing of peak annual precipitation shifting from January to February.** Summers are projected to be longer and drier.
Precipitation variability (30 yr intervals)	↔ Expected < 10% larger standard deviation than the historic reference period of 1971-2000	low	Very small changes (<10%) are detected which may be smaller than the uncertainty associated with the model outputs.	Largest increases in precipitation variability projected in the Santa Cruz mountains.

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Potential Implications of Climate Change for Santa Cruz's Water Supply

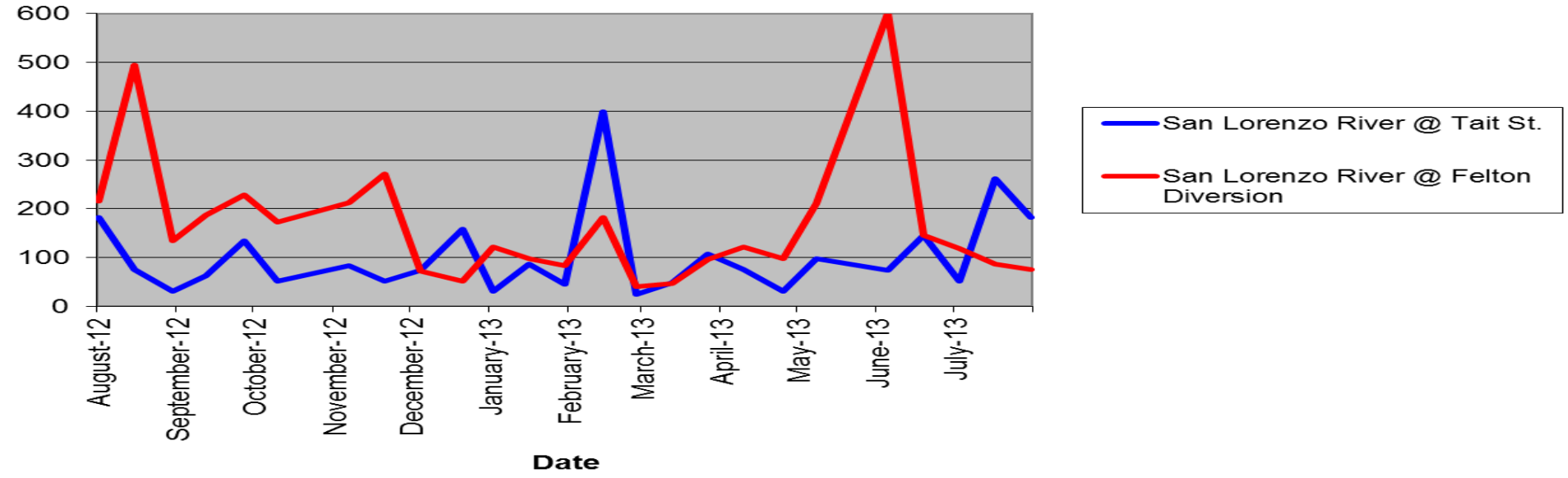
* Probable increased variability overall,
* Probable increased frequency of drought, and
* Probable changes in precipitation patterns

Implications of Potential Source of Supply Changes on Source Characteristics

Watershed Impacts on Water Quality:

- Coliform/Bacteria
- TOC ➡ TTHM
- Sludge Processing
- Sand Removal

E. Coli @ San Lorenzo River



Total Coliform Bacteria @ San Lorenzo River

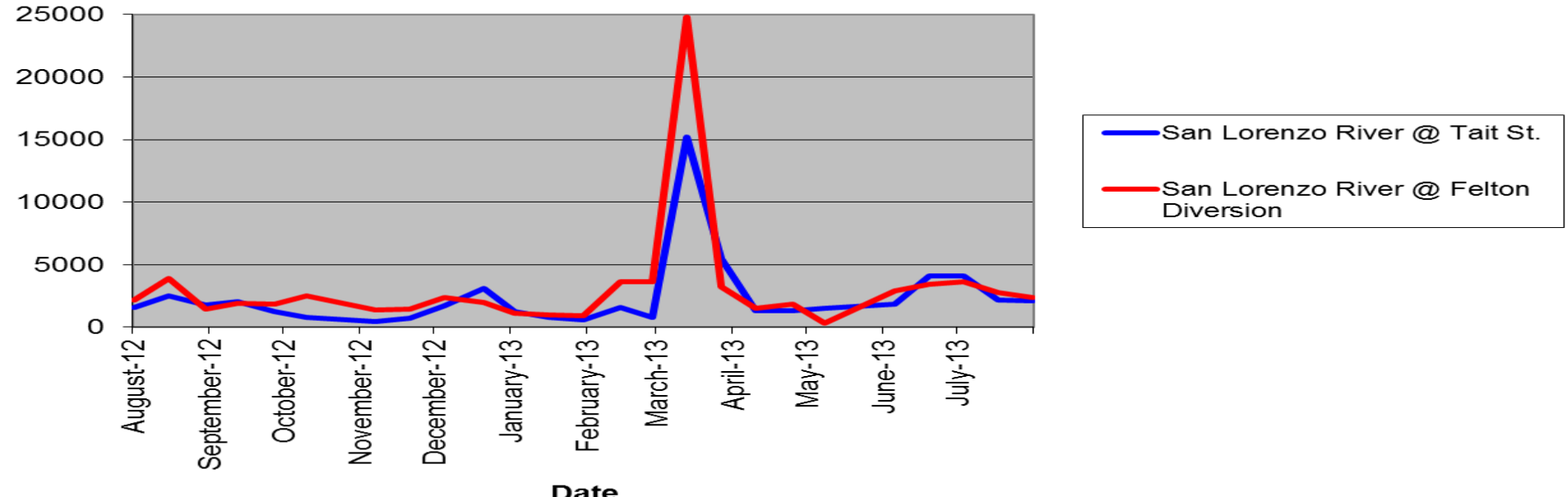
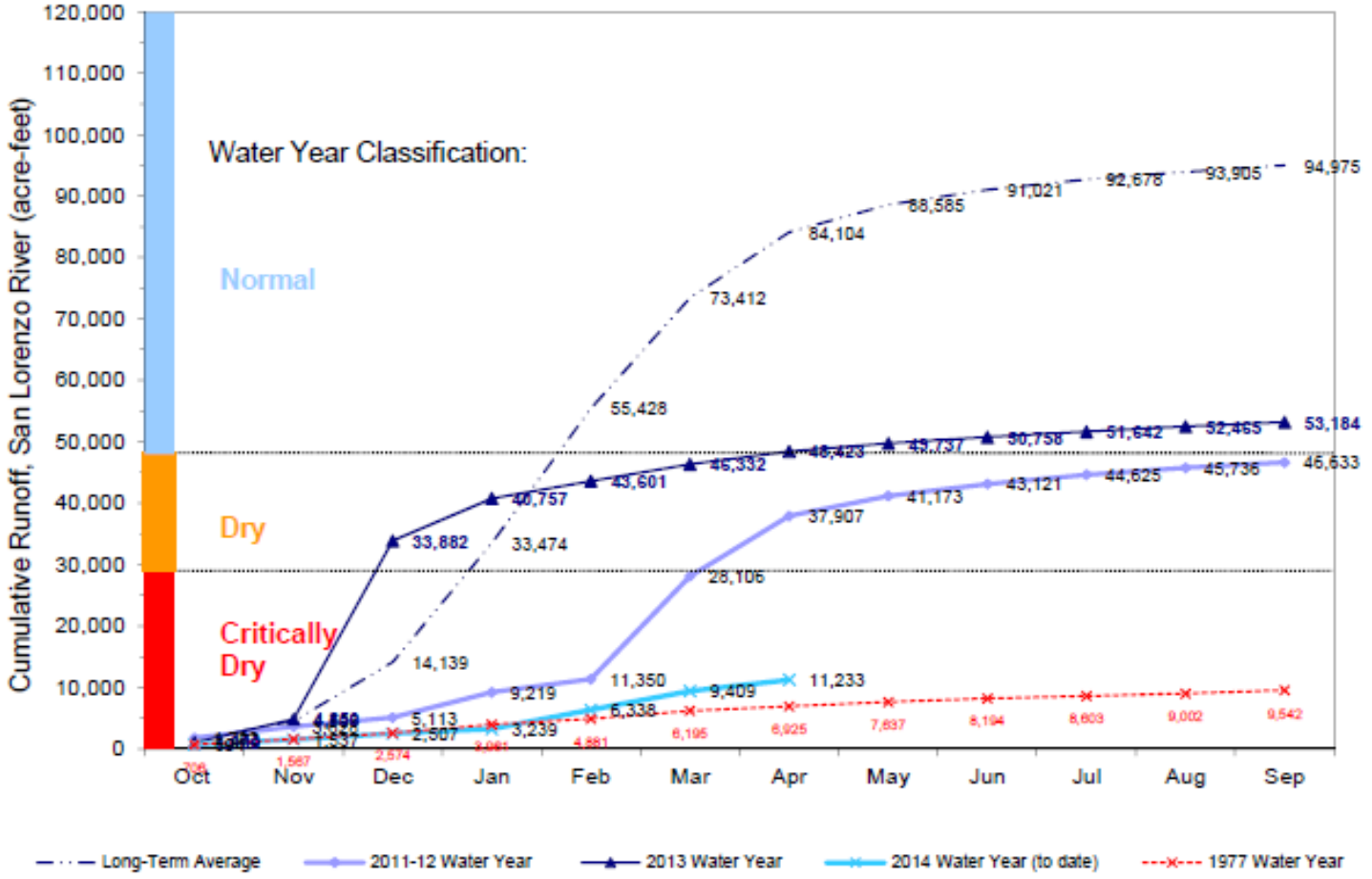


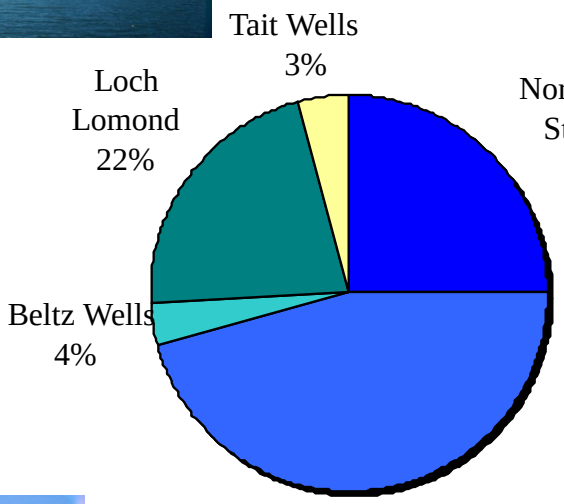
Figure 3. Cumulative Runoff and Water Year Classification, 5/01/14 (acre-feet)



Water Sources

Loch Lomond Reservoir
(1960)

TOC: 4-6 mg/L



North Coast Streams
(1890)

TOC: <1mg/L

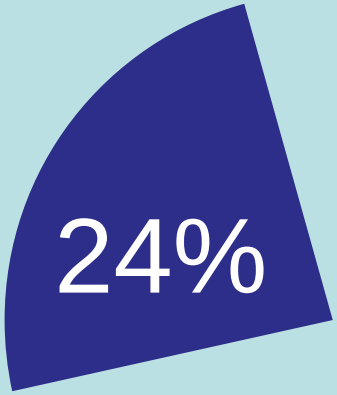
Beltz Wells
(1964)

TOC: 0 mg/L

San Lorenzo River
(1924)

TOC: 2-4 mg/L
(>10 During High Flows)

THM Source Formation Potentials

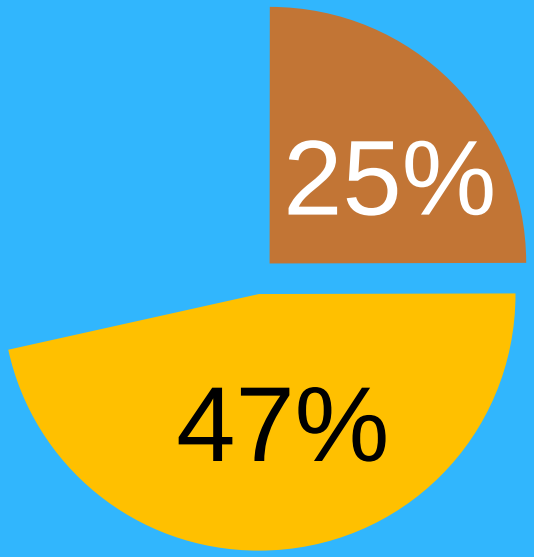


Reservoir

TTHM's
140 ppb

EPA

MCL
80 ppb



River/Stream

TTHM's
70 ppb


GHWTP
sludge
discharge to
the sanitary
sewer

Future Demand

How We Estimate Demand

Major Inputs, Methodologies, and Source Reference

* Major inputs:
  * Population forecasts (AMBAG)
  * Growth in number of accounts for each class of customers (calculated based on population)
  * Water use in future development (developed based on recent actual experience)
* Selected methodology comes from the AWWA M50 Manual: Water Resources Planning
* Price hasn't been formally factored into projections but obviously has an impact and needs to be considered.

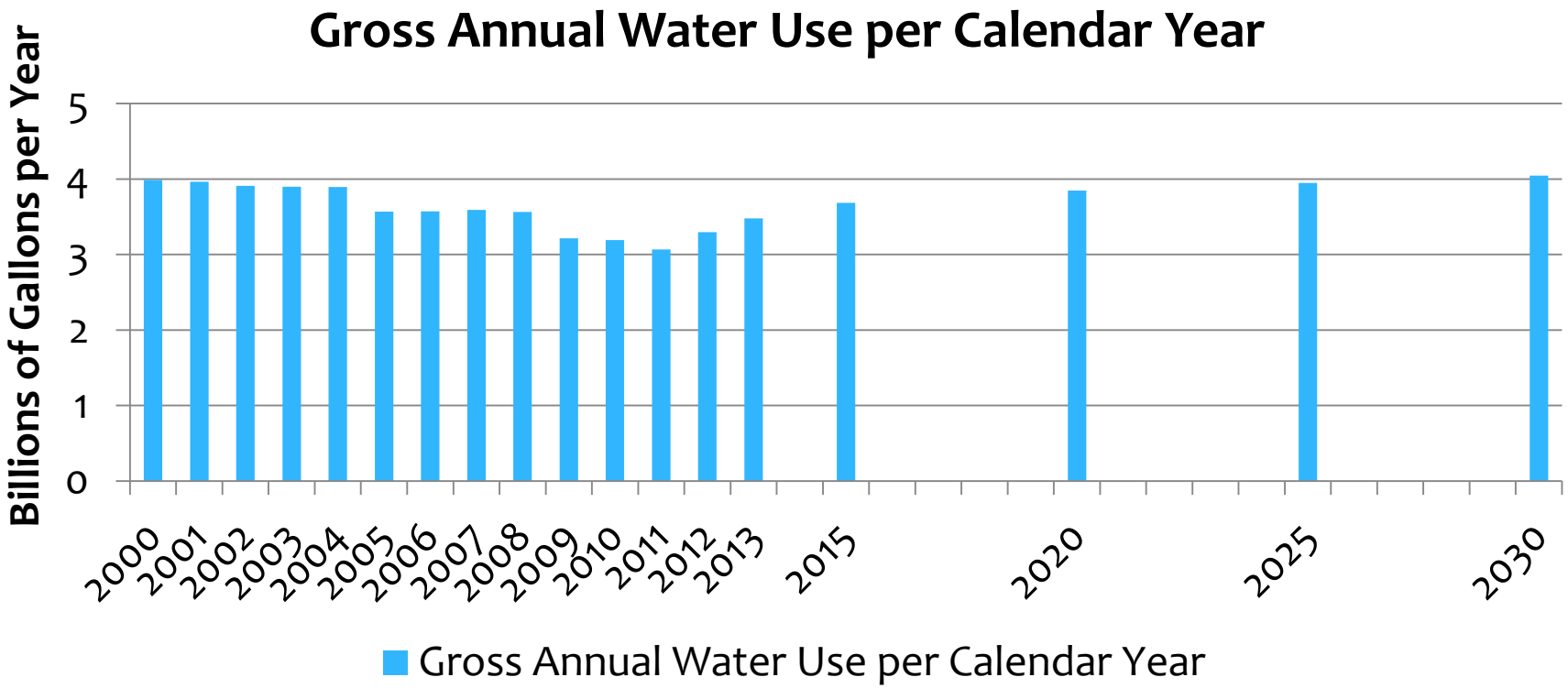
2010 Urban Water Management Plan Demand Forecasts*

* Used population forecasts created by the Association of Monterey Bay Area Governments
* Were created using one method for customers inside Santa Cruz and another for those living outside Santa Cruz
* The inside Santa Cruz forecast was developed to align with the Santa Cruz 2030 General Plan
* Included 2 scenarios – Scenario 1 based on higher per account water use levels during 1999 to 2004, and Scenario 2 based on the lower per account water use levels occurring during 2007 and 2008

* For a more detailed description of the methodology, please see http://www.cityofsantacruz.com/Modules/ShowDocument.aspx?documentid=24687

Demand Projection from the 2010 Urban Water Management Plan

Water Demand Forecast Scenario 2, Table 4-11



2010 Urban Water Management Plan Table 4-11: Water Demand Forecast, Scenario 2 (a)

Location:	Customer Class	2010	2015	2020	2025	2030
City of Santa Cruz	Single Residential	839	854	869	884	899
	Multiple Residential	408	424	440	456	472
	Business/Industry	425	454	483	511	540
	Municipal	54	54	55	55	56
	Irrigation/Golf	115	118	120	122	125
	UC Santa Cruz	212	276	339	344	349
Inside City Subtotal (millions of gallons)		**2,055**	**2,180**	**2,306**	**2,373**	**2,441**
Outside City: County, Capitola, & North Coast Irrigation	Single Residential	502	513	523	533	543
	Multiple Residential	336	343	350	357	364
	Business/Industry	231	236	240	245	250
	Municipal	-	-	-	-	-
	Irrigation/Golf	130	133	135	138	141
Outside City Subtotal (millions of gallons)		**1,199**	**1,224**	**1,248**	**1,273**	**1,297**
Other miscellaneous uses including water losses		268	280	292	300	307
Total System Water Demand (millions of gallons)		**3,522**	**3,684**	**3,847**	**3,946**	**4,046**

Notes:

(a) Assumes existing (2010) water demands recover to 2007-08 levels

Price Elasticity of Demand*

* Measures the responsiveness of the quantity of water demanded to a change in price;
* For example, a 15% rate increase with a -0.3 elasticity would result in a 4.5% reduction in demand;
* Measured price elasticities of demand between 0 and -1 are referred to as "relatively" inelastic because the percentage change in quantity is less than the percentage change in price.

* From Forecasting Urban Water Demand, R. Bruce Billings and Clive V. Jones; Second Edition, AWWA 2008

Price Elasticity of Water Demand – Elasticity Factors		
	Marginal Price in Rate Structure	
	Uniform Rates	Increasing Block Rates
Base case elasticity	-0.4	-0.5
Additions or Subtractions		
• Marginal price on bills	-0.1	-0.15
• Wet/cold climate	+0.1	+0.1
• Arid West	-0.1	-0.1
• Winter (low irrigation season)	+0.15	+0.15
• Summer (high irrigation season)	-0.15	-0.15
• Bills > 1.5% of average income	-0.1	-0.1
• Bills < 0.5% of average income	+0.2	+0.2
• Effective Long Term Conservation	+0.1	+0.1

Adapted from Table 9-5, Second Edition, Forecasting Urban Water Demand, R. Bruce Billings and Clive V. Jones, AWWA 2008

Santa Cruz's Current Water Rates: Fixed Water Rate Charges Based on Meter Size and Volume Rates for SFR and Duplex Customers

Meter Size	Inside City (Monthly)	Outside City (Monthly)
5/8" and 3/4"	$17.41	$22.20
1"	43.52	55.50
1-1/2"	87.05	110.98
2"	139.27	177.57
3"	261.14	332.95
4"	435.23	554.92
6"	870.46	1,109.83
8"	2,002.05	2,553.34
10"	2,472.09	3,151.92

Note: All other customers pay a uniform rate of $4 per ccf inside the city or $5.10 per ccf outside the city

Single-Family and Duplex Residential Customers		
Units per billing period	Inside-City	Outside-City
1-4 ccf	$1.57	$2.00
5-9 ccf	4	5.1
10-14 ccf	5.14	6.55
15-18 ccf	7.05	8.98
Over 18 ccf	8.79	11.21

Price Elasticity for Santa Cruz

* Using the elasticity factors from the elasticity table, **single family/duplex residential** elasticity would be:
  * Summer elasticity (with long term conservation): -0.55
  * Winter elasticity (with long term conservation): -0.25
* Using the elasticity factors from the previous slide, elasticity for **all other customers** would be:
  * Summer elasticity (with long term conservation): -0.45
  * Winter elasticity (with long term conservation): -0.15

If price were the only factor… what does history tell us about the potential elasticity of demand in Santa Cruz?

* Between 2004 and 2008, demand, as measured by gross production, fell by 9%;
* Between 2004 and the end of 2008 a series of rate increase totaling 82.5% was implemented (June 2004: 25%, January 2005 through 2008 20%, 15%, 12.5% and 10% respectively);
* Actual rates for this period more than doubled (113.5%) due to compounding;
* If no other variables, such as weather, influenced demand, and demand changed only due to price, the elasticity of demand for this period would be -0.11 for an 82.5% rate increase or -0.08% for the 113.5% rate increase

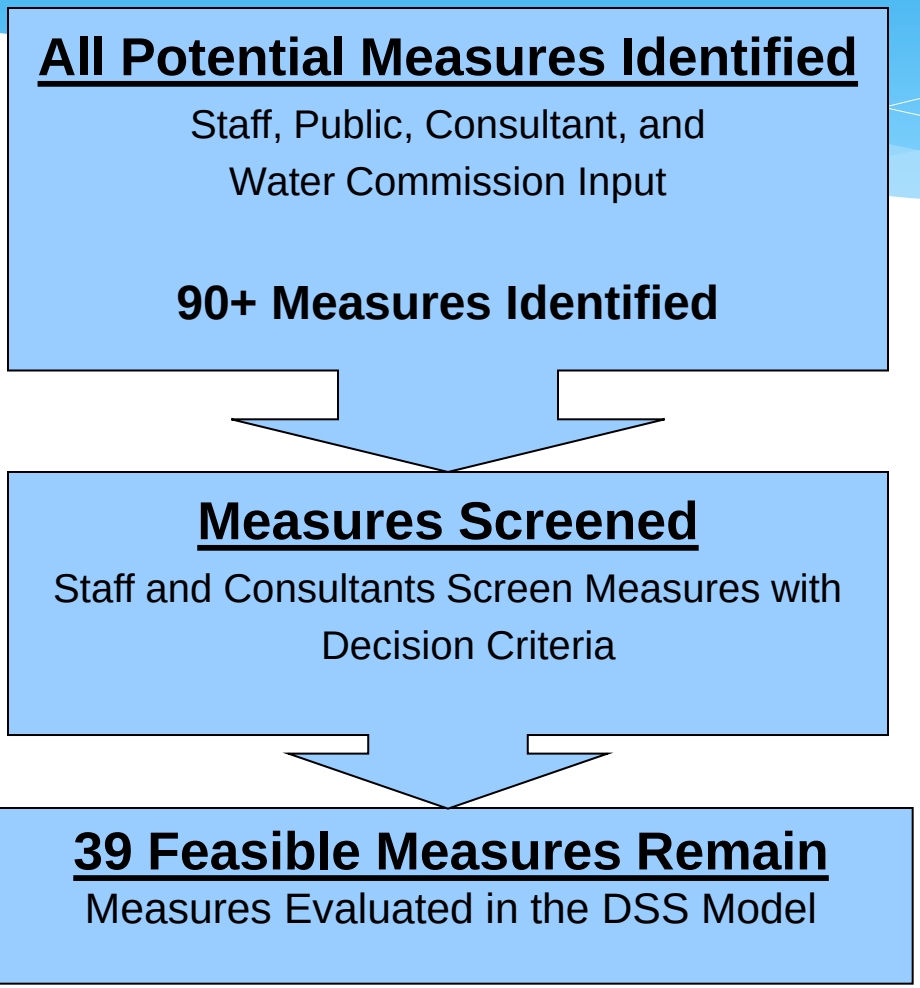
Long Term Water Conservation Master Plan

Note: The Long Term Conservation Master Plan described in this presentation is a work in progress. Several slides in this part of the presentation show analytical results that are based on certain assumptions that may change over time. The purpose of including these slides is to demonstrate the analytical approaches that can be used in considering additional conservation measures rather than present final analyses and/or recommendations.

How efficient are fixtures in the residential, commercial, and landscape sectors?

Preliminary Results Water Use Baseline Survey		
	SFR	MFR
Toilets	90%	91%
Showerheads	92%	98%
Bathroom Faucets	90%	82%
Kitchen Faucets	71%	82%
Clothes Washers	63%	46%

Conservation Measure Screening



Potential Water Conservation Measures

Measure	Customer	Type of Program
Water System		
1. Water Loss Control Program	Water Dept/System	Operations
2. Advanced Metering Infrastructure	Irrigation, All	Operations
3. Water Budget-Based Billing	Irrigation, All	Pricing
4A. General Public Information Program	All	Education
4B. Customer Water Use (Billing) Reports & Service	SFR	Education
Residential		
5. Leak Repair and Plumbing Emergency Assistance	SFR*, MFR*	Technical Assistance
6. Single Family Water Surveys - Indoor / Outdoor	SFR	Technical Assistance
7. Pressure Reduction	All	Financial Incentive
8. High Efficiency Faucet Aerator / Showerhead Giveaway	All	Device Distribution
9A. Residential High Efficiency Toilets (HET) Rebates	SFR, MFR	Financial Incentive
9B. Residential Ultra High Efficiency Toilets (UHET) Rebates	SFR, MFR	Financial Incentive
10. Install Ultra High Efficiency Toilets, Showerheads, and Faucet Aerators	SFR, MFR	Direct Install
11A. Residential Clothes Washer Rebate	SFR, MFR	Financial Incentive
11B. Residential Clothes Washer Rebate - Expanded*	SFR, MFR	Financial Incentive
12. Require High Efficiency Clothes Washers in New Development	New Development	Regulation
13. Provide a Rebate for Hot Water on Demand Pump Systems Retrofit	SFR	Financial Incentive
14. Require Hot Water on Demand / Structured Plumbing in New Developments	New Development	Regulation
15. Toilet Retrofit At Time of Sale	All	Regulation
Commercial		
16. High Efficiency Washer Rebate	CII*/MFR	Financial incentive
17. Customized Top Users Incentive Program	CII	Financial Incentive
18. Promote Restaurant Spray Nozzles	CII	Direct Install
19. CII Surveys Targeting Top Water Users Program	CII	Technical Assistance
20. High Efficiency Urinal Rebates	CII	Financial Incentive
21. Install Sensor-Activated Low Flow Faucets	CII	Direct Install
22. School Building Retrofit	Schools	Financial Incentive

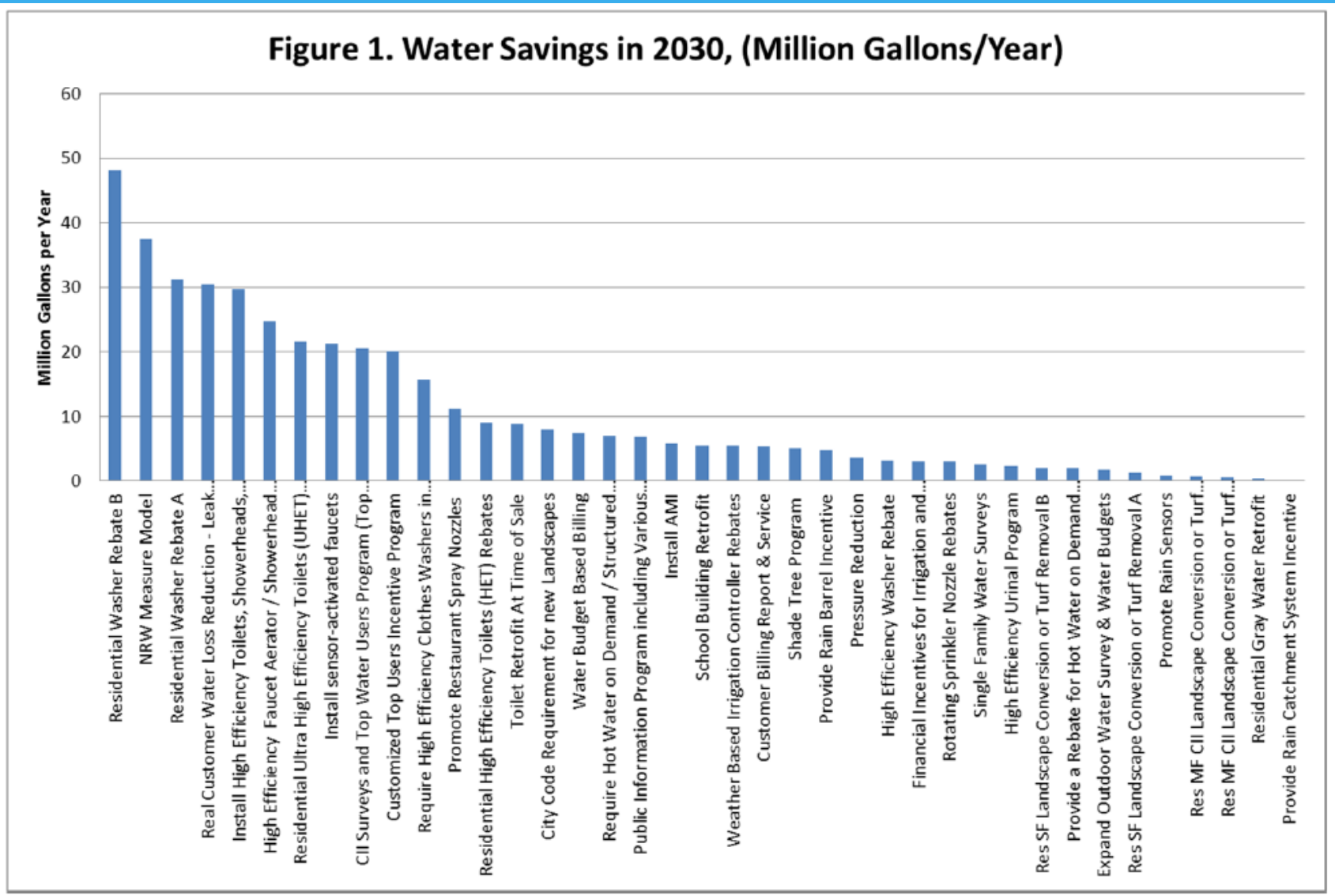
(continued)

Landscape

23. Water Efficient Landscape Ordinance	All	Regulation
24A. Landscape Conversion or Turf Removal	SFR	Financial Incentive
24B. Landscape Conversion or Turf Removal -Expanded*	SFR	Financial Incentive
25A. Landscape Conversion or Turf Removal	MFR, CII	Financial Incentive
25B. Landscape Conversion or Turf Removal -Expanded*	MFR, CII	Financial Incentive
26. Outdoor Water Audit	MFR, CII, Irr*	Technical Assistance
27. Financial Incentives for Irrigation and Landscape Upgrades	All	Financial Incentive
28. Weather Based Irrigation Controller Rebates	All	Financial Incentive
29. Rotating Sprinkler Nozzle Rebates	All	Financial Incentive
30. Residential Gray Water Retrofit	SFR	Financial Incentive
31. Shade Tree Program	All	Distribution
32. Promote Rain Sensors	All	Financial Incentive
33. Provide Rain Barrel Incentive	SFR	Financial Incentive
34. Provide Large Rain Catchment System Incentive	All	Financial Incentive

* SFR = Single Family Residential
* MFR = Multi-Family Residential
* CII = Commercial, Industrial, Institutional
* Irr = Irrigation
* Expanded programs may included fewer restrictions and/or increased incentives or other measures to increase participation levels.

Projected Water Savings



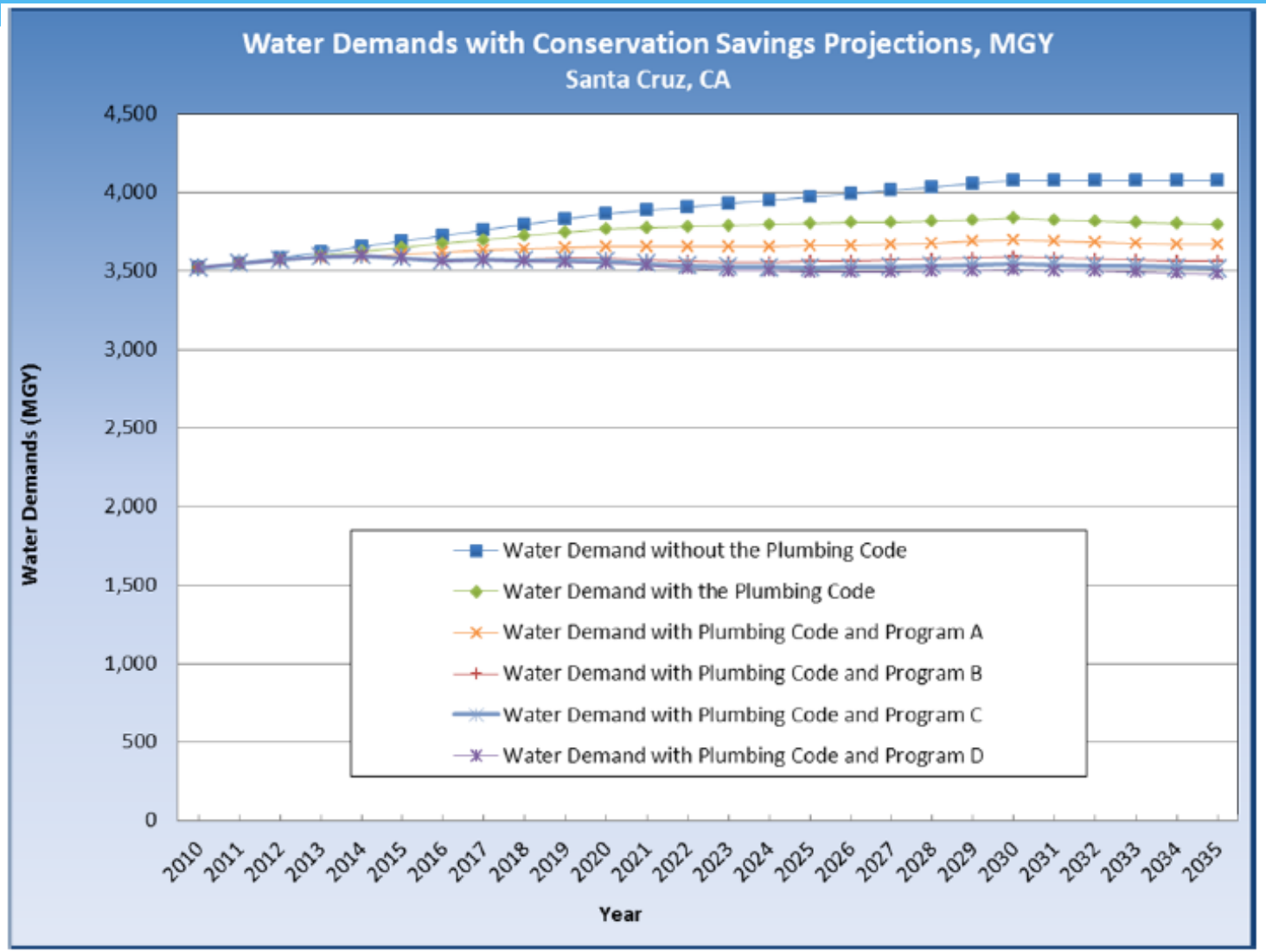
To assist in program evaluation, four conservation program plans were developed

* Education and Mandates will be included in the Plan
* Focusing on what levels of additional conservation measures are worth investing in for the next 10-20 years?
  * Program A – "Current Program"
  * Program B – "Customer Service & Cost Effective"
  * Program C – "Optimized to Maximize Savings"
  * Program D – "All Measures" (without exceeding saturation)

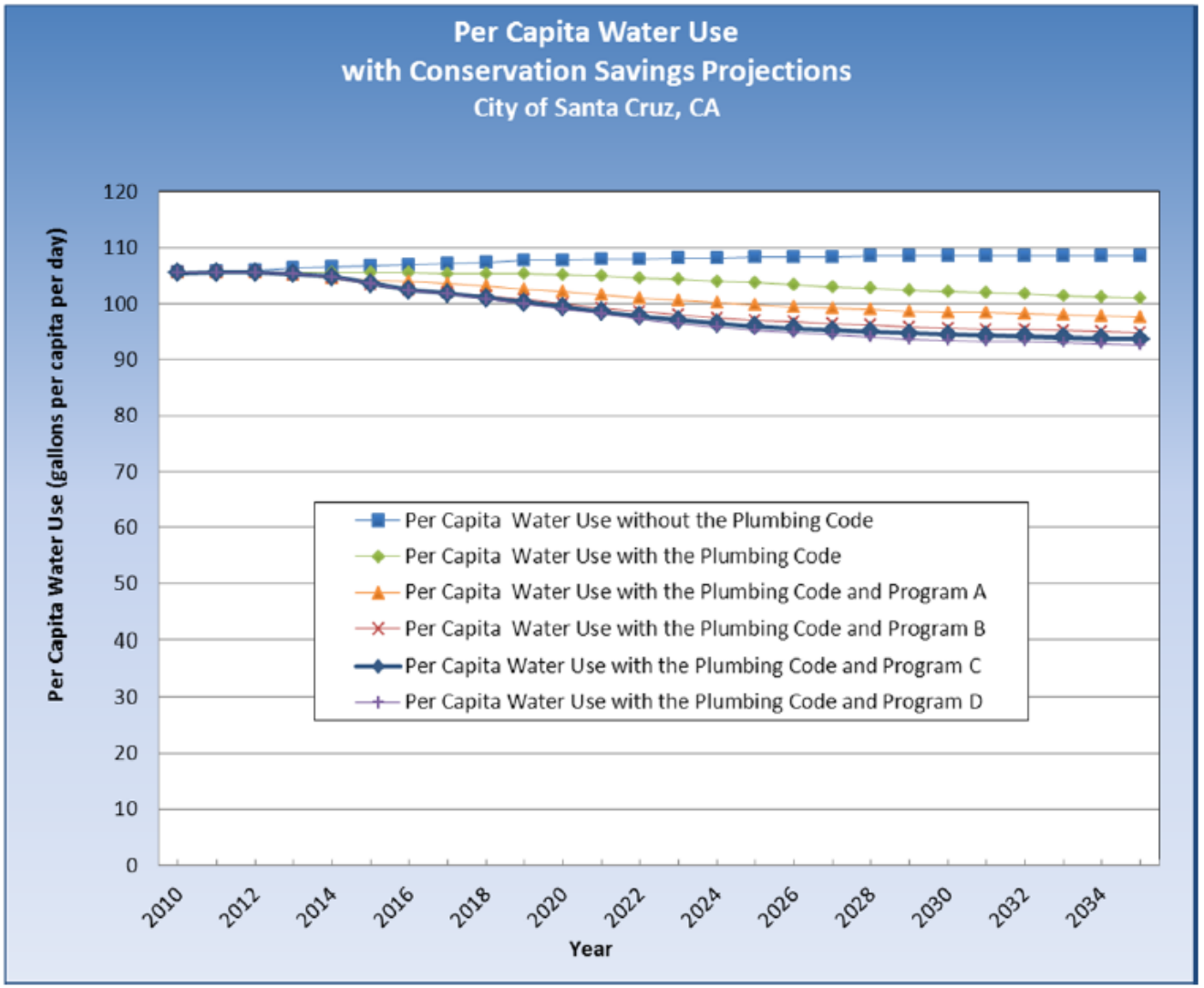
Conservation Programs and Measures
Santa Cruz, California

Measure Name	Program A	Program B	Program C	Program D	Water Savings MGY 2030	Benefit/Cost Ratio	Cost of Water Saved $/MG
NRW Measure Model		X	X	X	38	0.73	$2,344
Install AMI		X	X	X	6	0.33	$4,967
Water Budget Based Billing		X	X	X	7	9.52	$178
Public Information Program including Various Outreach & Education Approaches	X	X	X	X	7	0.29	$6,679
Customer Billing Report & Service				X	5	0.42	$4,445
Real Customer Water Loss Reduction - Leak Repair and Plumbing Emergency Assistance		X	X	X	30	1.29	$1,313
Single Family Water Surveys	X	X	X	X	3	0.14	$12,615
Pressure Reduction				X	4	0.20	$8,039
High Efficiency Faucet Aerator / Showerhead Giveaway	X	X	X	X	25	9.55	$182
Residential High Efficiency Toilets (HET) Rebates	X	X			9	0.86	$2,079
Residential Ultra High Efficiency Toilets (UHET) Rebates			X	X	22	0.38	$4,294
Install High Efficiency Toilets, Showerheads, and Faucet Aerators in Residential Buildings					30	0.63	$2,570
Residential Washer Rebate A	X	X			31	1.74	$993
Residential Washer Rebate B			X	X	48	0.82	$2,097
Require High Efficiency Clothes Washers in New Development		X	X	X	16	2.03	$812
Provide a Rebate for Hot Water on Demand Pump Systems				X	2	0.07	$24,031
Require Hot Water on Demand / Structured Plumbing in New Developments			X	X	7	0.66	$2,407
Toilet Retrofit At Time of Sale	X	X	X	X	9	1.64	$1,076
High Efficiency Washer Rebate			X	X	3	0.54	$3,128
Customized Top Users Incentive Program	X	X	X	X	20	5.35	$306
Promote Restaurant Spray Nozzles		X	X	X	11	7.13	$245
CII Surveys and Top Water Users Program (Top customers from each customer category)	X	X	X	X	21	0.69	$2,394
High Efficiency Urinal Program	X		X	X	2	0.28	$5,968
Install sensor-activated faucets				X	21	0.31	$5,203
School Building Retrofit		X	X	X	5	2.73	$581
City Code Requirement for new Landscapes	X	X	X	X	8	4.24	$382
Res SF Landscape Conversion or Turf Removal A	X		X		1	0.09	$17,920
Res SF Landscape Conversion or Turf Removal B				X	2	0.05	$35,839
Res MF CII Landscape Conversion or Turf Removal A	X		X		0.5	0.07	$24,534
Res MF CII Landscape Conversion or Turf Removal B				X	1	0.03	$49,069
Expand Outdoor Water Survey & Water Budgets			X	X	2	0.15	$11,157
Financial Incentives for Irrigation and Landscape Upgrades				X	3	0.09	$17,578
Weather Based Irrigation Controller Rebates				X	5	0.20	$7,568
Rotating Sprinkler Nozzle Rebates			X	X	3	0.50	$3,051
Residential Gray Water Retrofit				X	0.4	0.19	$8,206
Shade Tree Program				X	5	0.29	$5,619
Promote Rain Sensors				X	1	0.33	$4,752
Provide Rain Barrel Incentive	X	X	X	X	5	0.58	$2,857
Provide Rain Catchment System Incentive				X	0.006	0.04	$42,988
	Program_A	Program_B	Program_C	Program_D			

Water Demands with Conservation Savings Projections

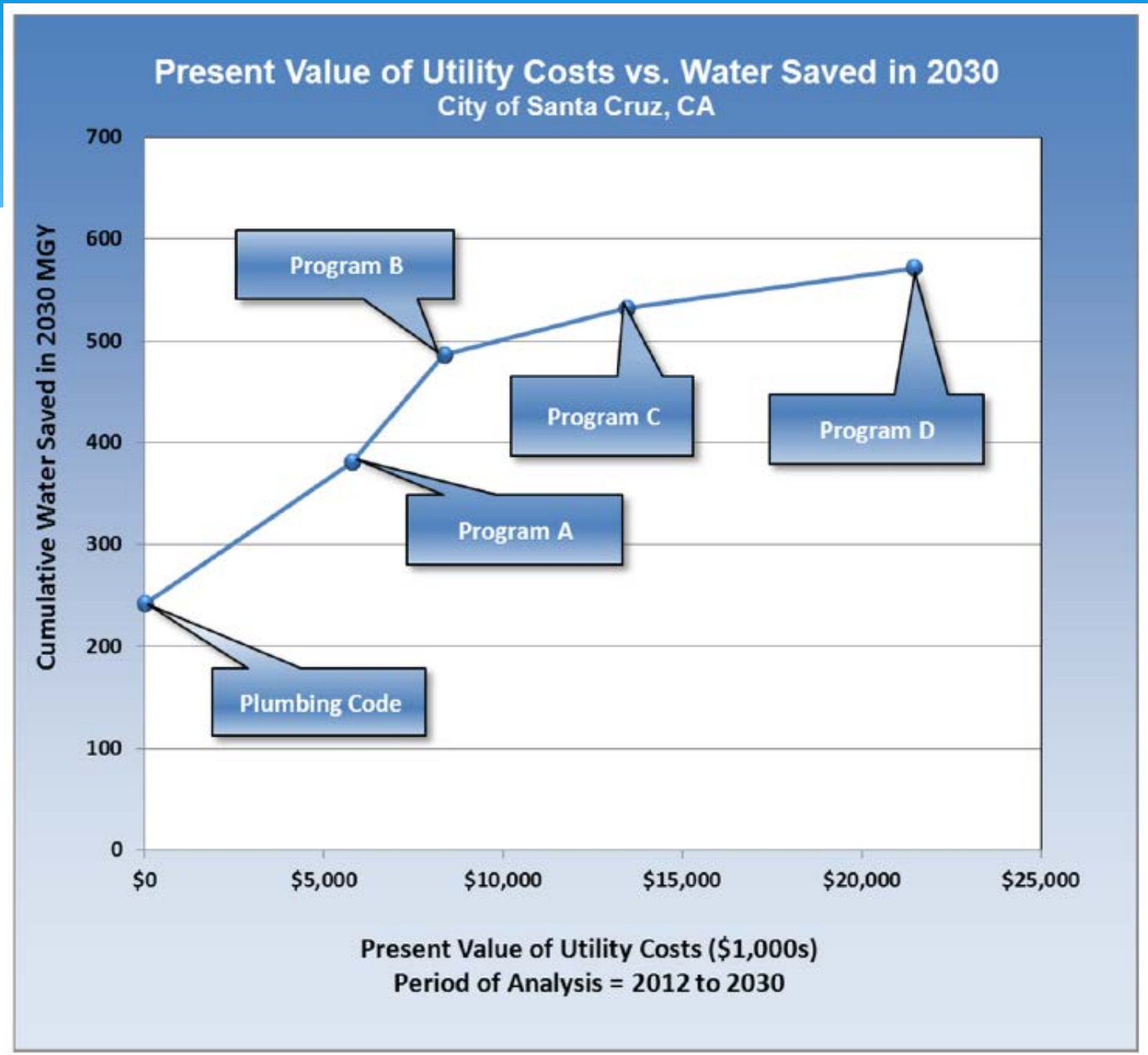


Per Capita Water Use with Conservation Savings Projections



Comparison of Programs

Santa Cruz, California		
Conservation Program	Present Value of Costs ($1,000)	2030 Water Saved (MGY)
Plumbing Code	$0	242
Program A	$5,768	381
Program B	$8,346	487
Program C	$13,425	532
Program D	$21,448	572

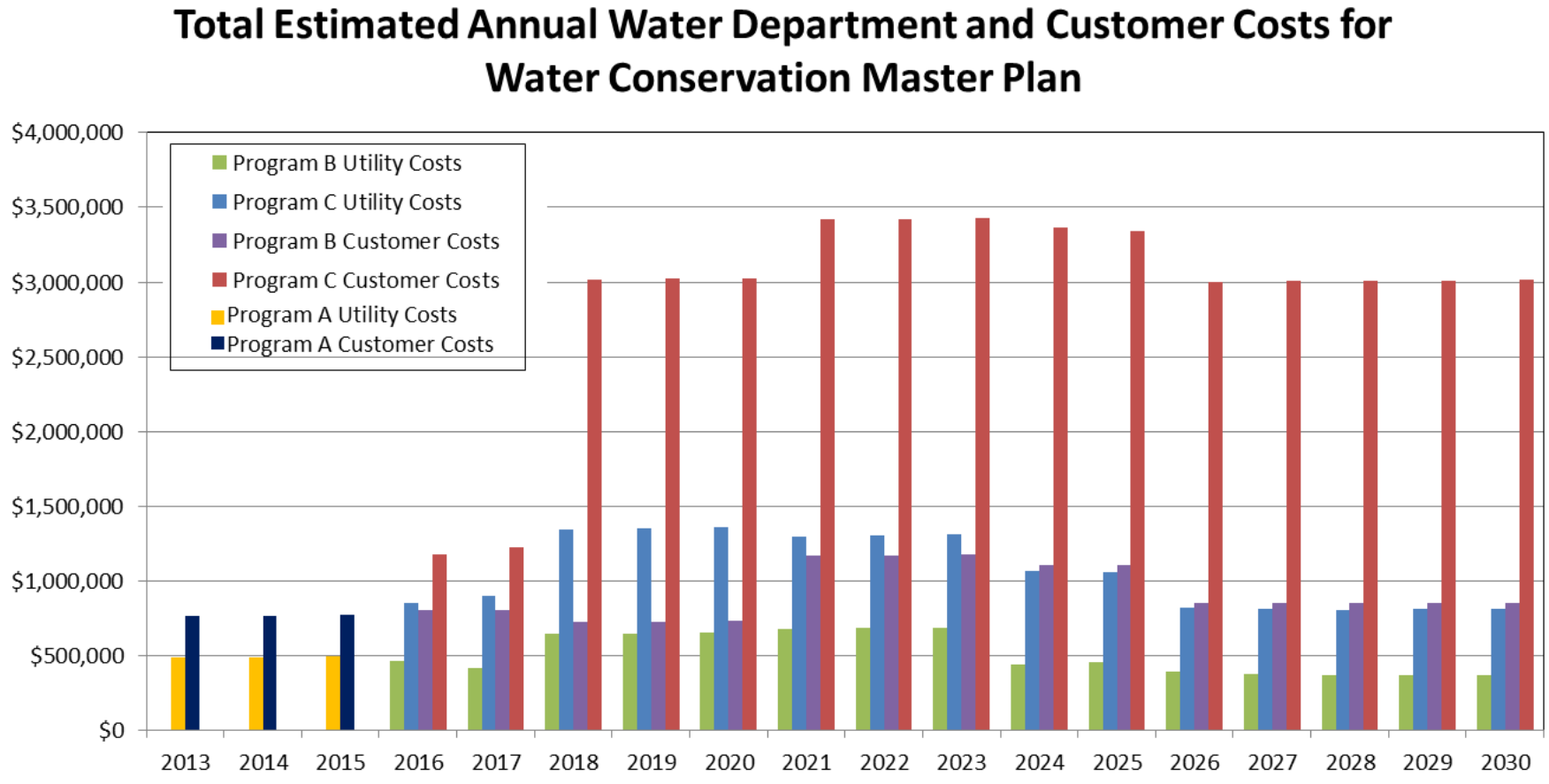

Present Value of Utility Costs vs. Water Saved in 2030
City of Santa Cruz, CA
Cumulative Water Saved in 2030 MGY
700
600
500
400
300
200
100
0
Program B
Program C
Program D
Program A
Plumbing Code
$0
$5,000
$10,000
$15,000
$20,000
$25,000
Present Value of Utility Costs ($1,000s)
Period of Analysis = 2012 to 2030

Long Term Conservation Program Water Savings Santa Cruz, California						
Water Savings (MGY)	2015	2020	2025	2030	Water Utility Benefit to Cost Ratio	Community Benefit to Cost Ratio
Program A	47	110	143	139	0.93	0.91
Program B	73	186	243	245	1.11	1.02
Program C	68	206	282	291	0.79	0.52
Program D	68	220	310	330	0.55	0.45

Table 4.

Marginal Cost Between Programs			
Conservation Program	Incremental Cost 30-year Present Value (PV) ($1000)	Incremental Savings, MGY	PV/MGY, $
Plumbing Code	$0	Baseline	$0
Program A	$5,768	138.87	$41,533
Program B	$2,578	105.90	$24,343
Program C	$5,080	45.76	$111,008
Program D	$8,022	39.80	$201,551

Program B vs. C
Program Implementation Costs



Note: Years 2013-2015 utility costs are based on the current conservation Program A . Estimated utility labor and material costs from 2016-2030 are based on Conservation Program C and B as revised at Water Commission Meeting on April 7, 2014.

Conclusion and Take Aways

Conclusion and Take Aways

* Lots of opportunity to discuss and disagree about what are the right assumptions about future demand, but there is no guaranteed right answer;
* Climate change introduces irreducible uncertainty into our process – ultimately we'll have to figure out how to take this uncertainty into account in our planning, but we aren't likely to find ways to resolve it; and
* Scenario planning is a useful way to learn about and get a better handle on how the various factors we're dealing with in our planning could affect our future.

The End

(Thank Heavens!)