Facility Water Analysis
and
Water Efficiency Opportunities

for

Mr. Russ Koehler

AMGEN Pharmaceuticals
ATO Campus

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SECTION I – *Water Balance / Existing Conditions*

EXECUTIVE SUMMARY

Efficient water management for the Commercial, Industrial and Institutional market is analogous to energy conservation in the early 1970s. Water conservation is a relatively new topic and its effectiveness will increase as new applications of water conservation measures evolve. Well-planned water management is often accompanied by savings of energy, wastewater treatment, and toxic disposal. These long-term savings can reduce Amgen's expenses and sustain the viability of the ATO Campus. Managers with a thorough knowledge of their site's water use will be better able to lessen the impact of future water shortages on their operations. Increasing water costs and fees for wastewater discharge, more stringent wastewater pretreatment requirements, and water supply restrictions impose challenges on the Management team and the Facility Engineers. They are expected to continue production while improving the effectiveness of the facility. The safety and health of employees, customers, and residents must also be maintained.

On April 1st, 2015 Governor Jerry Brown renewed his emergency declaration and imposed a mandatory 25 percent statewide water reduction and prohibited certain water uses. This means that California needs to reduce its water use by 25 percent from the 2013 designated baseline. California American Water created and is implementing a 5 stage Water Shortage Contingency Plan. All districts except Ventura are currently in Stage 2**; Ventura entered Stage 3 Mandatory Conservation** Restrictions on Sept 15, 2015. They also increased the drought surcharge in the Ventura District from 21 cents to 41 cents per 100 gallons used in excess of 8,976 gallons. Other

Ventura County Stage 3 Water-Use Restrictions:

- No watering lawns or landscapes with potable water for 48 hours following or during rainfall
- No using water to wash hardscapes such as sidewalks or driveways
- No irrigation runoff or overspray onto streets, sidewalks or driveways
- No washing a vehicle without a positive shut-off nozzle at the end of the hose
- No using fountains or decorative water features that DO NOT recirculate water and filling of lakes, ponds, and new pools is limited
- All leaks must be fixed within 24 hours of notification
- No watering of ornamental grass on public medians
- Restaurants and other food service establishments can only serve water to customers upon request
- Hotels and motels must provide guests with the option of choosing not to have towels or linens laundered daily and prominently display notice of this option

Target reductions vary by location, as shown in the table below:

California American Water District	Proposed Target Reduction
Los Angeles County	28%
Monterey	8%
Sacramento	20%
San Diego County	8%
Ventura County	**32%**
Larkfield District	25%

With California in its fifth year of a serious drought and the aggressive Sustainability Goals set by Amgen Corporate, the Thousand Oaks facility is in a great position to rise to the challenge by reducing water consumption and realizing the revenue associated with those savings. The California Plumbing Code Standard (SB 407) now requires that commercial properties change existing commodes to water conserving plumbing fixtures, by January 1, 2019.

What this means:

SB 407 requires properties built before January 1, 1994 to upgrade all Non-compliant plumbing fixtures to water-conserving fixtures under the following schedule:

a) January 1, 2017: Single-family properties
b) January 1, 2019: Multi-family and **Commercial properties**

All of the existing plumbing fixtures on the Amgen Campus are already in compliance, with the majority of existing commodes designed to flush at 1.6 gallons per flush (gpf), and the balance of existing fixtures designed to flush at 1.28 gpf. While auditing the Campus, our team observed a large population of 1.6 gpf commodes that were flushing anywhere from 2.5 gpf to 4.0 gpf. This situation is detailed in the Domestic Water (restrooms) section of this report, along with the recommended actions to bring these fixtures back into compliance, while saving a substantial amount of water.

After performing an extensive two-week audit of the ATO facilities and grounds, with the help from some extremely helpful and knowledgeable Amgen employees (Russ Koehler / Allison Faris), we were able to account for over 95% of the water use on Campus, with less than 5% being labeled as 'unaccounted for' use. In addition, we identified Water Conservation Measures (WCM's) that will help Amgen achieve their Sustainability goals and show the local

community that they are doing their part to ensure the availability of clean water for future generations.

Some of the WCM's (Domestic) that we've identified have extremely low Paybacks, accurate pricing and are easily implemented; while other WCM's (Non-Domestic) are represented in *Range of Magnitude*. In order to provide design drawings and implementation plans for the Non-Domestic measures, we will have to schedule another few weeks of 'Investment Grade' on-site audits.

AMGEN - Thousand Oaks

Water Conservation Measures (WCM) - Range Of Magnitude

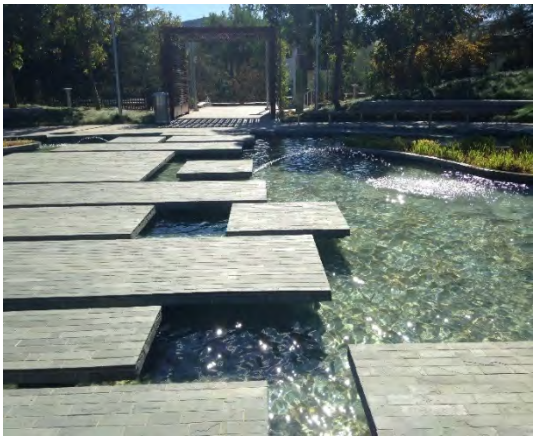
Executive Summary

WCM #	Domestic Measures	Quantity	Estimated Yearly Savings ($$$)	Yearly Water Savings (Gals)	Estimated Price - Installed ($'s)	Estimated Payback (yrs)
WCM - 1	Toilet Retrofits - Install Correct Flush Kits (1.6 gpf)	251	$ 9,108	1,459,579	$18,825	**2.1**
WCM - 2	Faucet Retrofits - Install .05 gpm flow restrictors	643	$ 87,303	13,990,832	$19,080	**0.22**
	O&M Savings		$ 11,295			
	Energy Savings - *Hot Water through Faucets*				-$22,407	
	Rebates - $10 per Flow Restrictor				-$6,430	
	Domestic Measures Subtotal		**$ 107,706**	**15,450,411**	**$9,068**	**0.08**

WCM #	Non-Domestic Measures		Estimated Yearly Savings ($$$)	Yearly Water Savings (Gals)	Estimated Payback - Range of Magnitude (yrs)
WCM - 3	B18N / B32 - Eliminate RO as Boiler Feedwater		$ 9,443,798	4,721,899	1 - 2 Years
WCM - 4	Vortex or WCTI --> Non-Chemical CT Treatment		**TBD**	**TBD**	2 - 3 Years
WCM - 5	B99 - Reuse RO Effluent as CT Make-Up		$ 6,967	1,139,650	5 - 7 years
WCM - 6	Repair all Faulty / Install New Solenoids on Quench Systems Steam Condensate Quench		**TBD**	**TBD**	2 - 3 Years
WCM - 7	Repair Condensate Return System - Bldg 38		**TBD**	**TBD**	1 - 2 Years
WCM - 8	Facility / Process Submetering				Soft Benefit - Operational Efficiency / Cost Avoidance
WCM - 9	Liquid Cover - Water Features				Not Feasible unless used on indoor Pools where Heat loss is used in Payback
	Non-Domestic Measures Subtotal		**$ 9,450,765**	**5,861,549**	
	WCM Totals		**$ 9,558,471**	**21,311,960**	

ATO - CAMPUS OVERVIEW

The 120 acre Amgen (HQ) Campus in Thousand Oaks California is a second home to over 5,000 full time employees, with an additional 1,800 people serving as interns and temporary staff. The campus is laid out so that all of the perking is on the exterior, allowing employees to walk between buildings while enjoying the incredible landscaping and peaceful surroundings. The unique Water Features are incorporated into the landscape and add to the 'calming' atmosphere, inviting many employees to hold meetings and schedule events outside of the offices. Some of the Water features are a functional part of the common areas, allowing pedestrians to walk across circular ponds using the 'stepping stones' that traverse across the center of the pond. As is typical of the progressive Amgen culture, some of the buildings have already achieved LEED Platinum, Gold and Silver certifications and there are additional properties that will be joining the ranks. LEED-certified buildings are resource efficient. They use less water and energy while reducing greenhouse gas emissions. And as an added bonus, they save money. When the State of California got around to mandating reduction of water consumption due to the drought, Amgen was already ahead of the game with their stated Sustainability goals. As a result of the progressive nature of a few individuals in the organization, *Water Efficiency Technologies* was invited to work in conjunction with **Russ Koehler** and his team, to perform a comprehensive water analyst of the campus, to identify all 'end uses' of the metered municipally supplied water. This exercise included the creation of a Water Balance, that will quickly highlight potential leaks, faulty meters, waste and other anomalies in the campus network of pipes.



The Scope of this analysis includes 97 water meters serving 38 buildings, campus water features, irrigation system, reverse osmosis and other process water systems, HVAC system components, domestic water use and other miscellaneous activities on campus. This report is the result of the hard work of a dedicated team and is the first step in identifying opportunities to make the ATO campus an Amgen standard for water conservation.

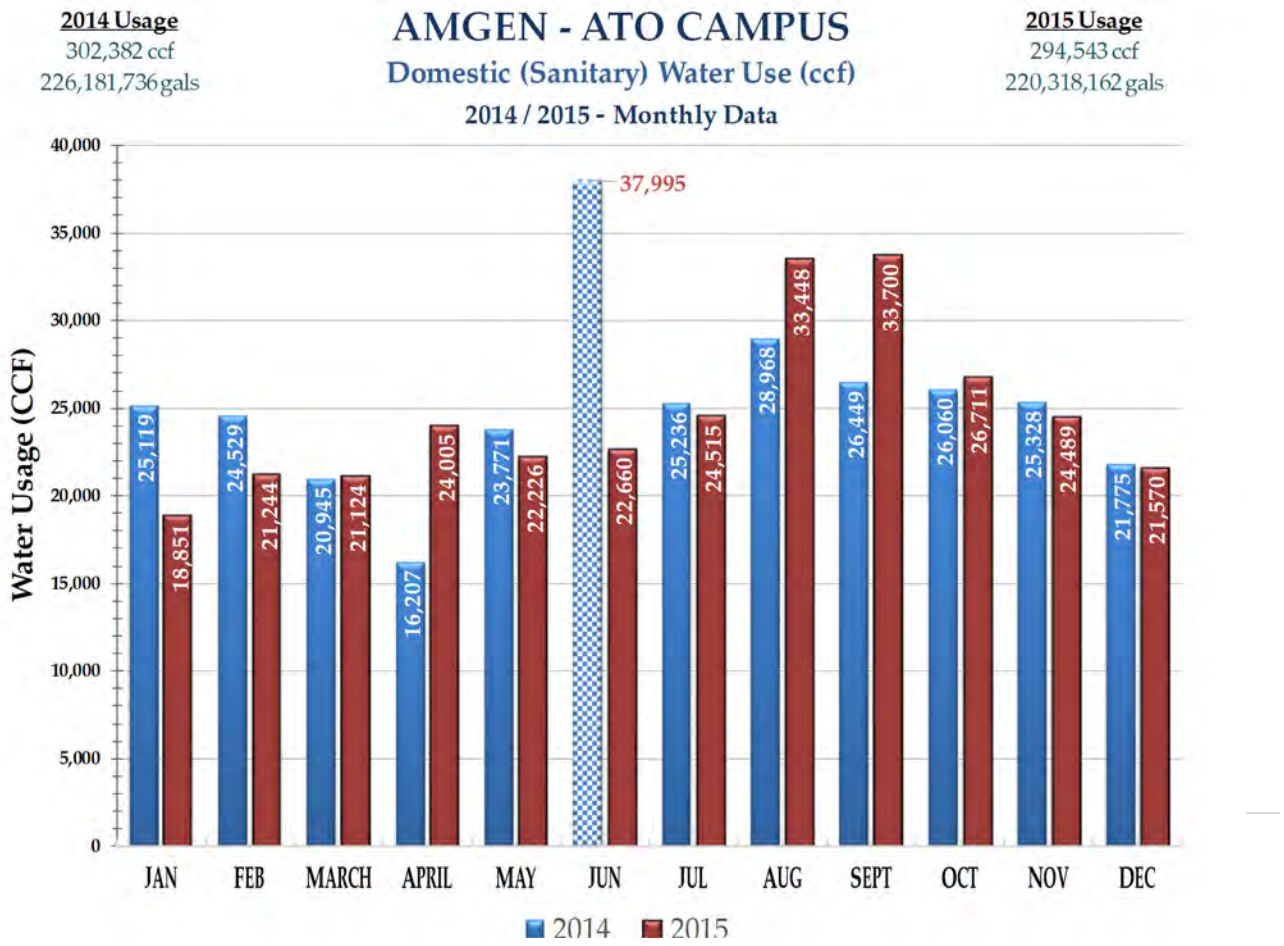
HISTORICAL WATER USE

The total 2014 and 2015 water consumption on the ATO Campus for the **39** Domestic, **21** Irrigation and **37** Fire Service Water Meters is shown in the table, below. The Domestic meters serving **Buildings 33 and 34** also supply water for Irrigation, but the usage is not broken out in these totals. The ***Water Balance*** section of this report will show further detailed use for each meter. The bills are issued every 30 days, on average, and the totals are provided below in numerical and graphical format.

Totals (Gals)	2014	2015	# Meters
Irrigation	39,752,460	34,214,268	21
Domestic Water	226,181,736	220,318,164	39
Fire Service	61,336	50,864	37
	265,995,532	**254,583,296**	**97**

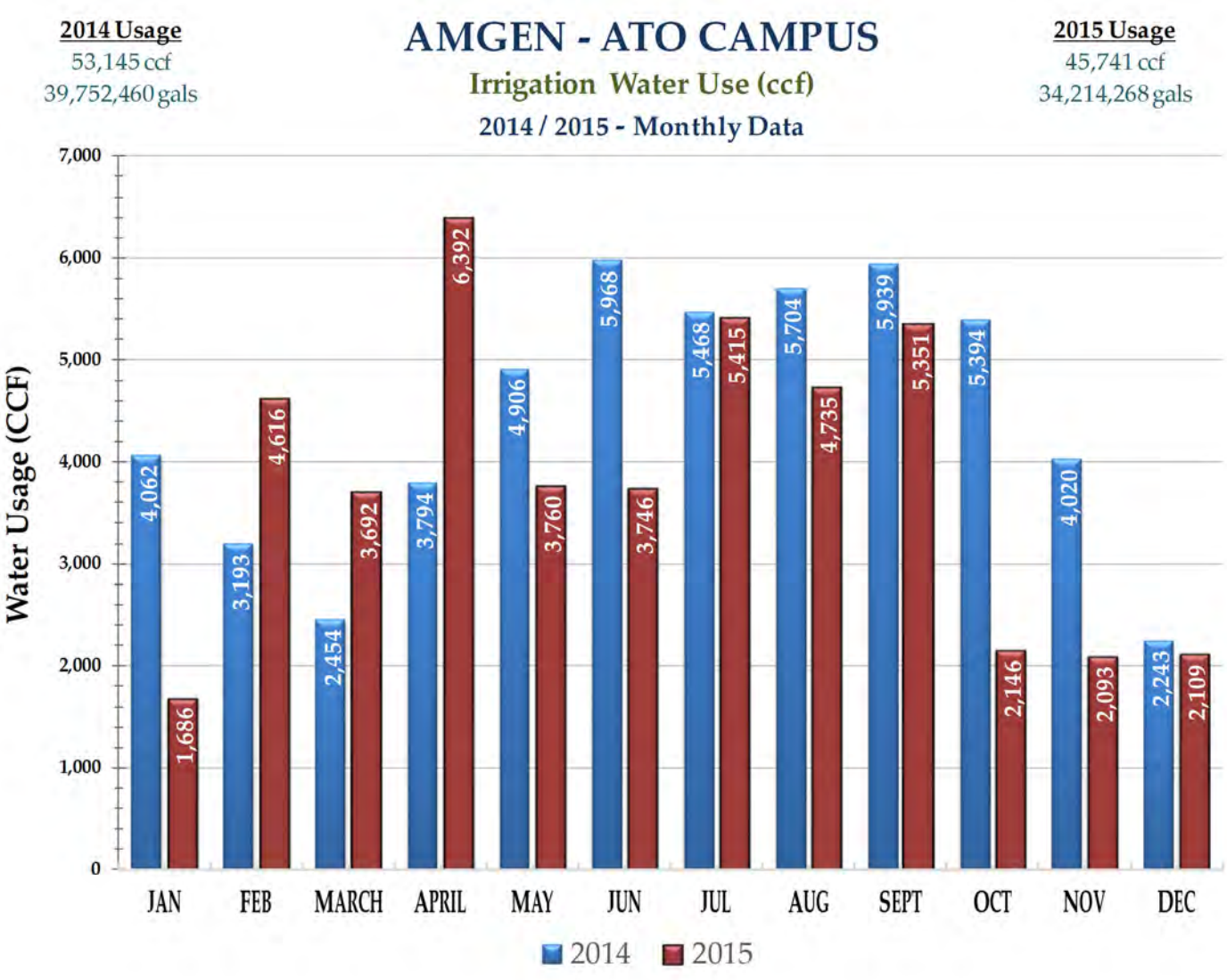
Domestic Water Use – Entire Campus / 2014 & 2015

Total water used by the Domestic water meters for the entire campus in 2015, was approximately **220 million gallons** (294,543 ccf).



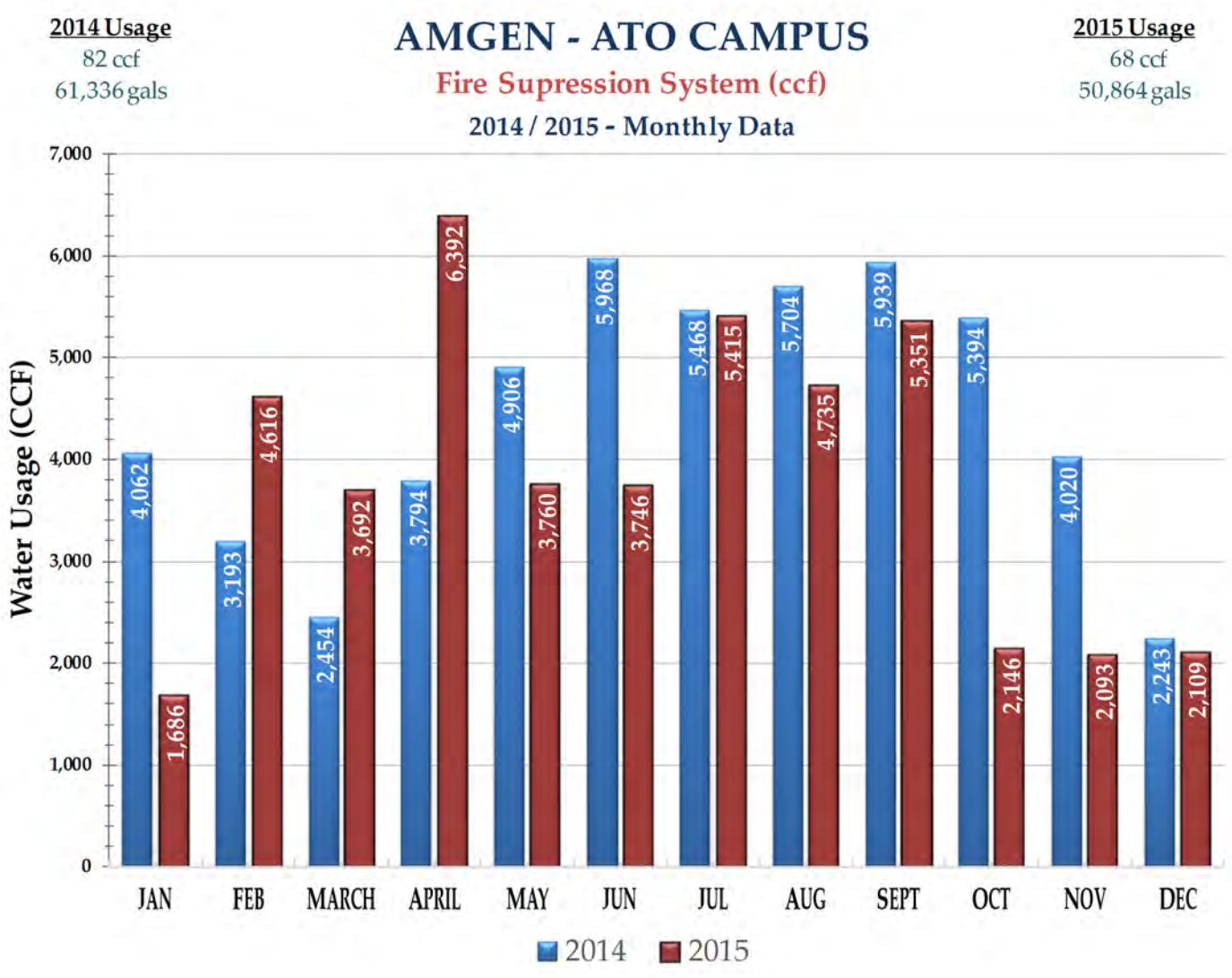
Irrigation Water Use – *Entire Campus / 2014 & 2015*

Total water used for Irrigation and Water Features, for the entire campus in 2015, was approximately **34 Million gallons** (45,741 ccf).



Fire System Water Use – *Entire Campus / 2014 & 2015*

Total water used for testing and maintenance of the **Fire Suppression System** for the entire campus in **2015**, was approximately **51 thousand gallons** (68 ccf)



WATER / SEWER RATES

Water Rates – California American

Amgen's water is provided by California American at the Commercial / Industrial rate and billed in Hundred-Gallon increments. All Irrigation, Domestic and Fire Service meters are on the **same** rate schedule. CalAm's meter program requires them to replace the 1 1/2 and 2" meters every 4 years.

2016 - California American Water and Sewer Rates		
Rate Type	**Units**	**Water**
Non-tiered (flat)	kGal (thousand gallons)	$6.24

Sewer Rates – City of Thousand Oaks

Sewer Service is provided by the City of Thousand Oaks and is based on the data provided by the Flow Meters at Bldg 34, Bldg 99 and PS6. Industrial waste discharge permits are requiring and water test are done by Amgen and the Thousand Oaks sewer department, on a regular schedule. Amgen falls into the 'Regulated Industrial Waste' category and is billed at $28.20 per Service Unit (SU).

Service Units are calculated as follows:

$$SU = \frac{\text{Daily Flow}}{285}\left[0.6 + \frac{\text{BOD}}{200} \times 0.20) + \frac{(SS)}{200} \times 0.20)\right]$$

Daily Flow = Wastewater Flow (gpd)
BOD = Biochemical Oxygen Demand (mg/l)
SS = Suspended Solids (mg/l)

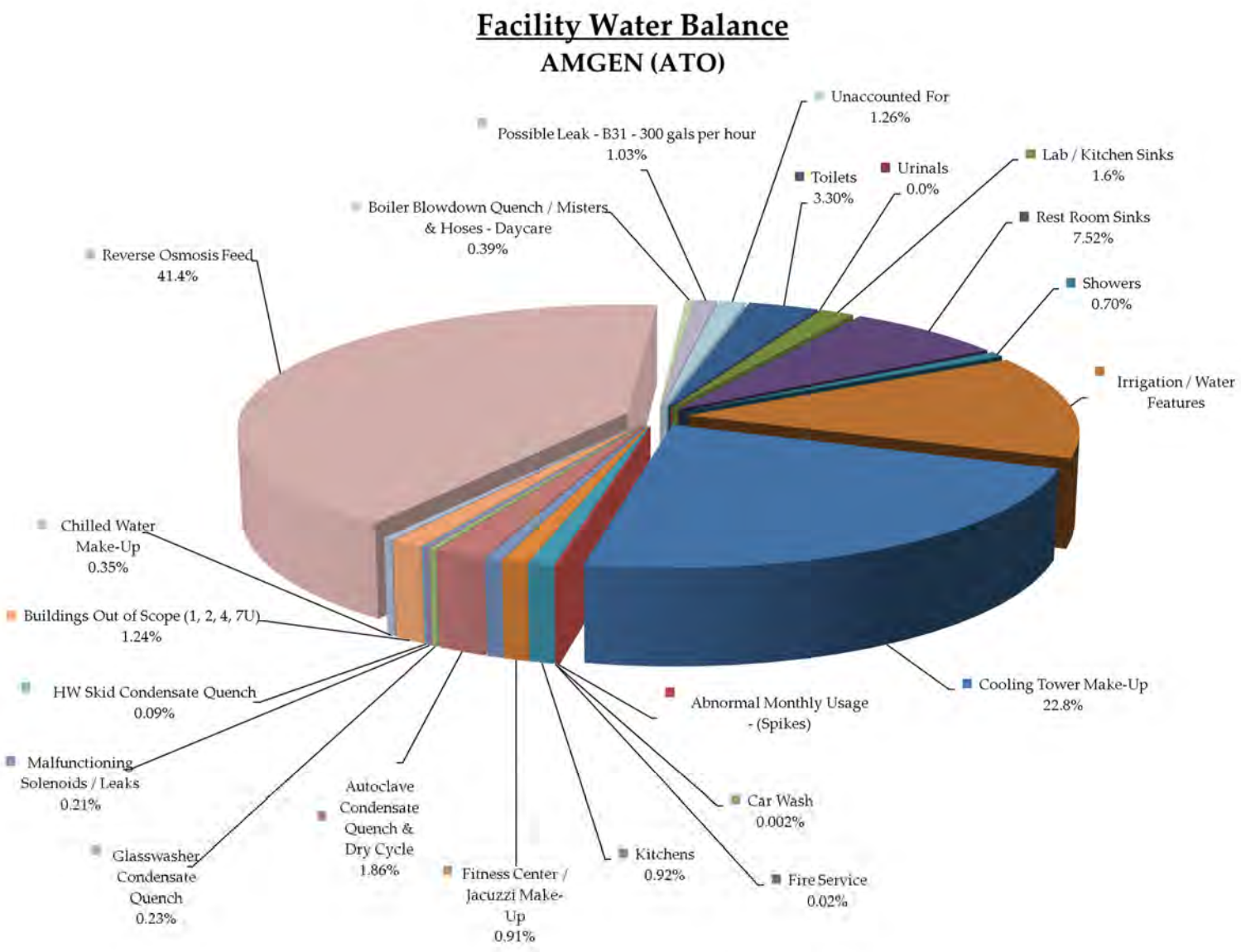
Proposed Monthly WW Rates per Service Unit ($ / SU[8])

	Current	5/2016[9]	1/1/2017
WW Service Unit Rate	$28.20	$28.49	$28.78
($) Impact		$0.29	$0.29
Percentage Impact		1%	1%

WATER BALANCE – AMGEN ATO CAMPUS

An integral part of any comprehensive water conservation program is the development of an accurate water balance. Without a water balance, which quantifies and illustrates where a facility's water is actually being used, it is much more difficult to prescribe potential solution sets for reducing water usage. Using the information collected during the audit, along with details gathered through interviews with site staff, we quantified and calculated the water use for the ATO Campus, for several different water end-use categories.

Water Balance Numeric Values – from Ultrasonic Meters & and Benchmarks



Total ATO Campus - Water Balance	AMGEN ATO	
	Percentage of Total	Consumption (gals)
Toilets	3.30%	8,408,943
Urinals	0.00%	0
Lab / Kitchen Sinks	1.61%	4,090,949
Rest Room Sinks	7.52%	19,156,780
Showers	0.70%	1,774,539
Irrigation / Water Features	13.44%	34,214,268
Cooling Tower Make-Up	22.80%	58,043,131
(Spikes)Abnormal Monthly Usage -	0.15%	377,300
Car Wash	0.00%	5,650
Fire Service	0.02%	50,864
Kitchens	0.92%	2,339,354
Fitness Center / Jacuzzi Make-Up	0.91%	2,304,000
Clean Steam - Condensate Quench	0.60%	1,522,386
Autoclave Condensate Quench & Dry Cycle	1.86%	4,740,372
Glasswasher Condensate Quench	0.23%	575,172
Malfunctioning Solenoids / Leaks	0.21%	525,600
HW Skid Condensate Quench	0.09%	228,939
Buildings Out of Scope (1, 2, 4, 7U)	1.24%	3,159,552
Chilled Water Make-Up	0.35%	900,000
Reverse Osmosis Feed	41.38%	105,338,275
Boiler Blowdown Quench / Misters & Hoses - Daycare	0.39%	984,152
Possible Leak - B31 - 300 gals per hour	1.03%	2,628,000
Unaccounted For	1.26%	3,215,071
TOTAL		**254,583,296**
Metered Consumption reported by CalAm (gals):		**254,583,296**

WATER BALANCE – BY BUILDING

In the following section of the report, each building's water use is analyzed and compared to actual metered consumption, which explains why the totals are often above, or below 100%. A 5% variance is considered a successful water balance of 'real' usage compared to 'modeled' usage that relies on years of benchmarking data. A comparison of the 2014 and 2015 water use is illustrated in a bar graph for each building, and the Water Balance is based on 2015 usage numbers.

Note: *There was an 11% increase in full time employees (FTE's) in 2015, compared to 2014.*

BUILDING 6 - LAB

Observations

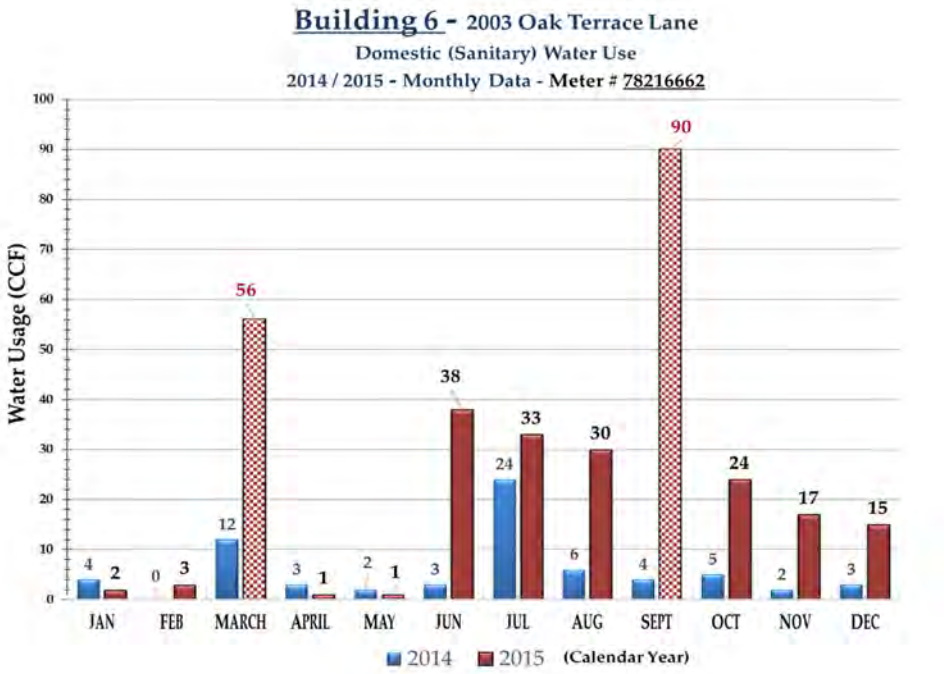
1. Building is on Campus Steam and CW Loop

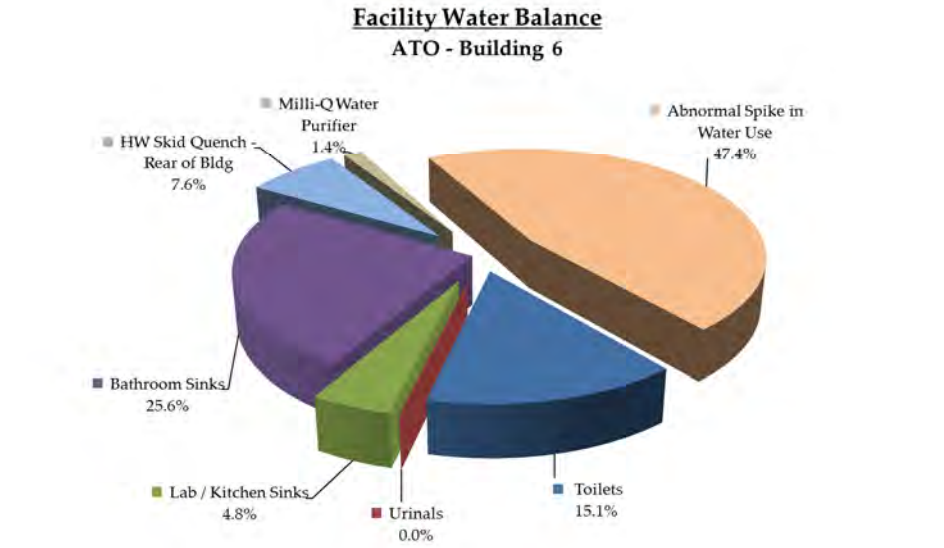
2. Abnormal water use is seen in March and September of 2015 - approximately **110,000 gallons.** That overage is equivalent to what the building should use in one year.

3. According to GFO Engineering the HW Skid in the rear of B6 is oversized and can handle the hot water loads of any future B6 buildout and all present and future B21 hot water requirements.

4. There is a solenoid that is failed (partially) open in the janitors closet on the first floor, that is controlling city water quench for a Heat Exchanger in the Interstitial space.

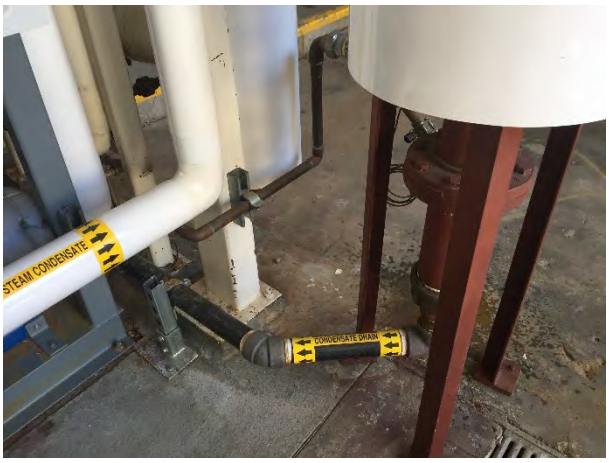
5. There are 2 Milli-Q® Pure Water systems that use city water.



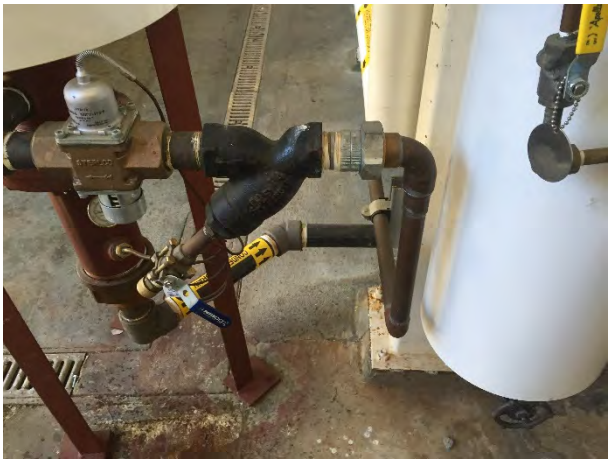


Facility Water Balance	Building 6 - LEED		
	Percentage of Total	Consumption (gals)	Consumption (ccf)
Toilets	15.1%	34,971	47
Urinals	0.0%	0	0
Lab / Kitchen Sinks	4.8%	11,050	15
Bathroom Sinks	25.6%	59,475	80
HW Skid Quench - Rear of Bldg	7.6%	17,520	23
Milli-Q Water Purifier	1.4%	3,328	4
Abnormal Spike in Water Use	47.4%	110,000	147
TOTAL	**101.9%**	**236,344**	**316**
		Gallons	Hundred Cubic Feet
Actual Metered Consumption		**231,880**	**310**

BUILDING 6 – PHOTO'S



1st Floor Janitor's Closet – Failed Solenoid on HEX Quench Line



HW Skid – rear of B6, with temperature probe and 'functioning' Solenoid Valve

BUILDING 8 - LAB

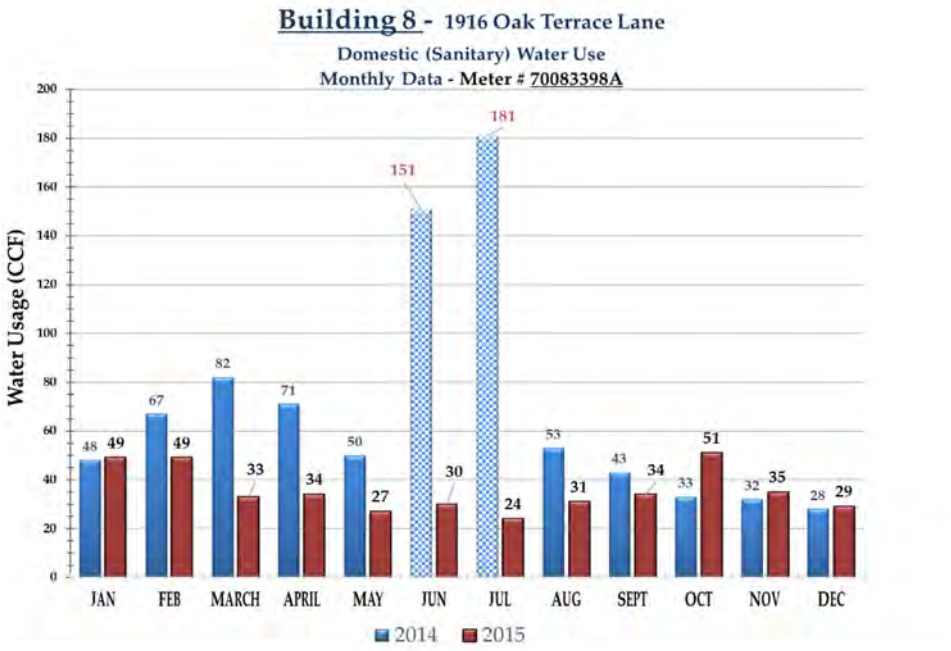
Observations

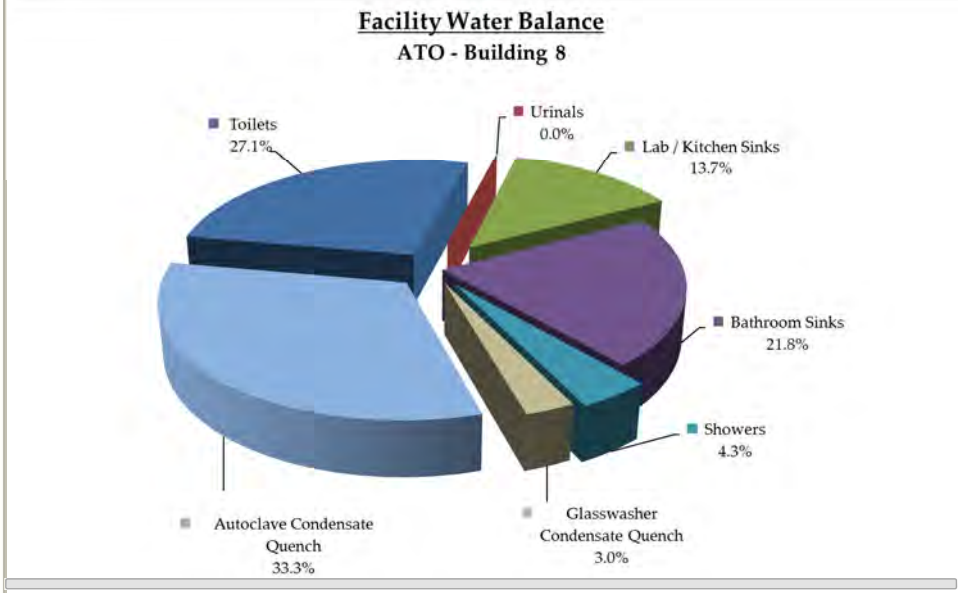
1. Building is on Campus Steam and CW Loop

2. Abnormal water use in Jun and July of **2014** – approximately **174,000 gallons.**

3. Autoclaves and Glassware Washers use city water to quench steam condensate, before it hits the drain (140 F ˚limit).

4. Air Handler on roof (AHU-1B) has a steam trap that is failed open.1 gpm to drain was observed – this is **heated and treated RO water, valued at approx $3 / gallon**. It is not reflected in the water balance, because it is coming from the Boilers in B32.



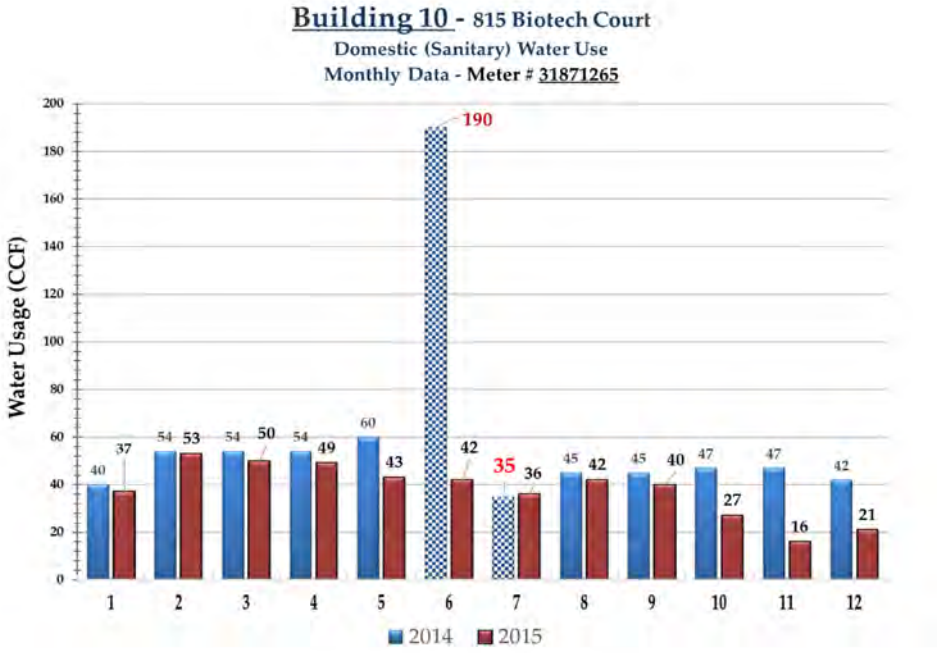


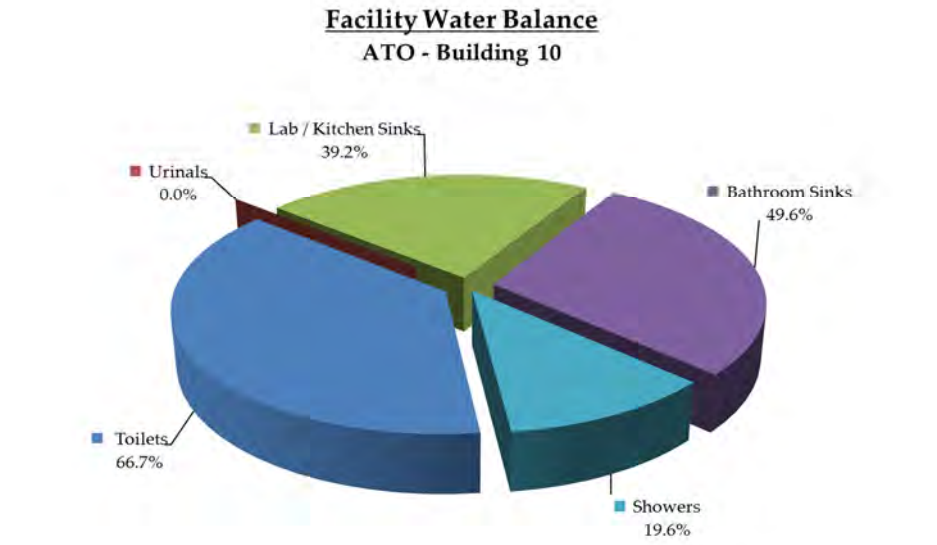
Facility Water Balance	Building 8		
	Percentage of Total	Consumption (gals)	Consumption (ccf)
Toilets	27.1%	86,275	115
Urinals	0.0%	0	0
Lab / Kitchen Sinks	13.7%	43,680	58
Bathroom Sinks	21.8%	69,542	93
Showers	4.3%	13,650	18
Glasswasher Condensate Quench	3.0%	9,408	13
Autoclave Condensate Quench	33.3%	106,097	142
TOTAL	**103.1%**	**328,652**	**439**
		Gallons	Hundred Cubic Feet
Actual Metered Consumption		**318,648**	**426**

BUILDING 10 - ADMIN

Observations

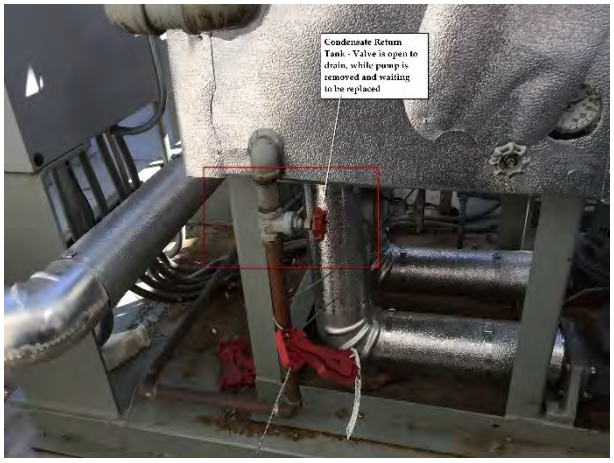
1. Building is on Campus Steam and CW Loop
2. Abnormal drop in water use during July of 2014; approximately 775,000-gallon reduction
3. Abnormal drop in water use during Jan of 2015; approximately 750,000-gallon reduction
4. The condensate pump in the utility yard was removed and 100% of the steam condensate was being sent to drain. It had been in that condition for the entire two months that we were performing the audit.





Facility Water Balance	Building 10		
	Percentage of Total	Consumption (gals)	Consumption (ccf)
Toilets	66.7%	227,501	304
Urinals	0.0%	0	0
Lab / Kitchen Sinks	39.2%	133,640	179
Bathroom Sinks	49.6%	169,272	226
Showers	19.6%	66,820	89
TOTAL	**175.1%**	**597,233**	**798**
		Gallons	Hundred Cubic Feet
Actual Metered Consumption		**341,088**	**456**

BUILDING 10 – PHOTO'S



Utility Yard – Condensate Pump removed and draining to sewer

Condensate Tank Valve – Open to Drain. Pump was removed for over a month.

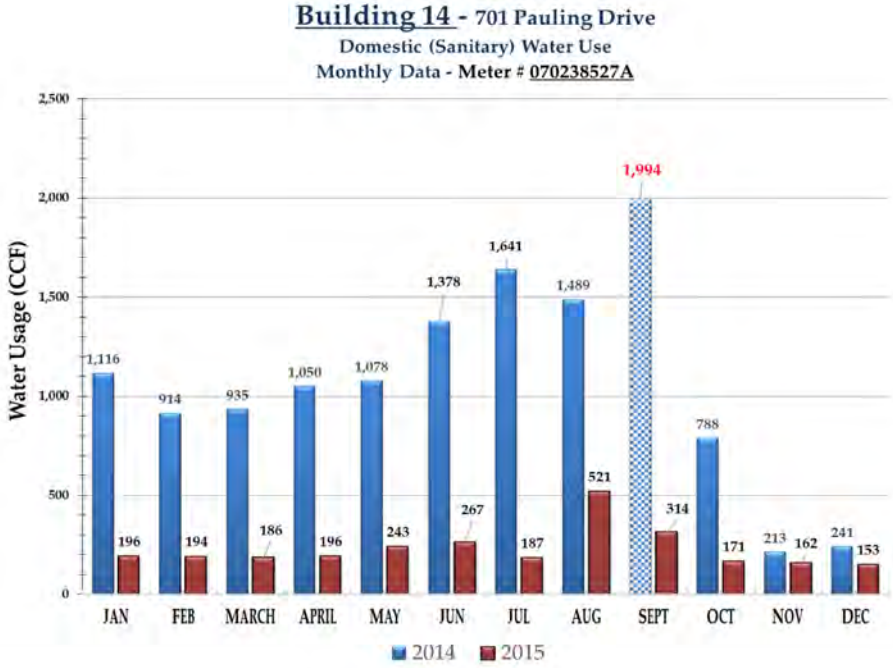
BUILDING 14 - LAB

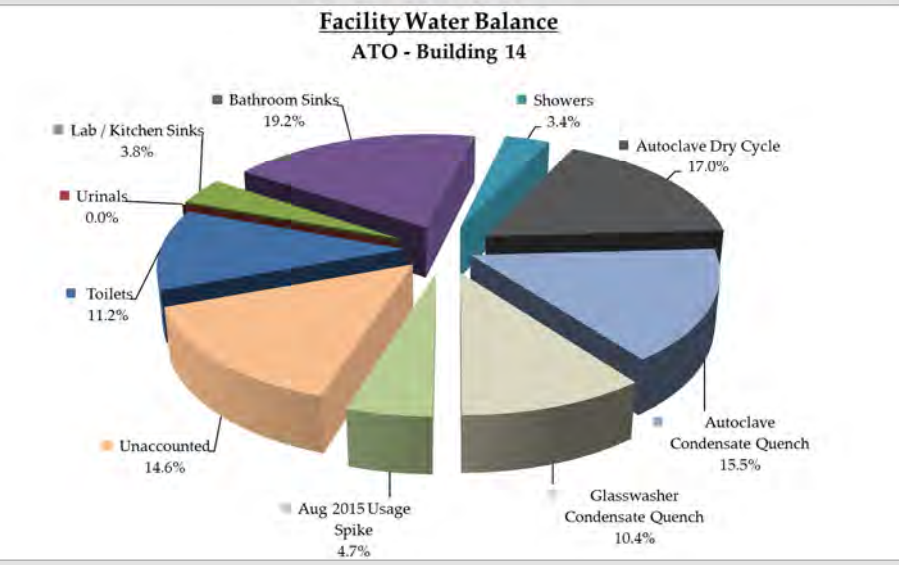
Observations

1. Building is on Campus Steam and CW Loop

2. Abnormal water use in August of **2015** – approximately 215,424 gallons over the average monthly usage of 174,284 gals.

3. Averaging the Aug spike with the July shortfall, the meter is over by almost 100,000 gallons, which is included in the Water Balance





Facility Water Balance	Building 14		
	Percentage of Total	Consumption (gals)	Consumption (ccf)
Toilets	11.2%	233,639	312
Urinals	0.0%	0	0
Lab / Kitchen Sinks	3.8%	78,936	106
Bathroom Sinks	19.2%	401,253	536
Showers	3.4%	71,760	96
Autoclave Dry Cycle	17.0%	355,800	476
Autoclave Condensate Quench	15.5%	324,420	434
Glasswasher Condensate Quench	10.4%	217,308	291
Aug 2015 Usage Spike	4.7%	99,000	132
Unaccounted	**14.6%**	**304,804**	**407**
TOTAL	**100.0%**	**2,086,920**	**2,790**
		Gallons	Hundred Cubic Feet
Actual Metered Consumption		**2,086,920**	**2,790**

BUILDING 15 - LAB

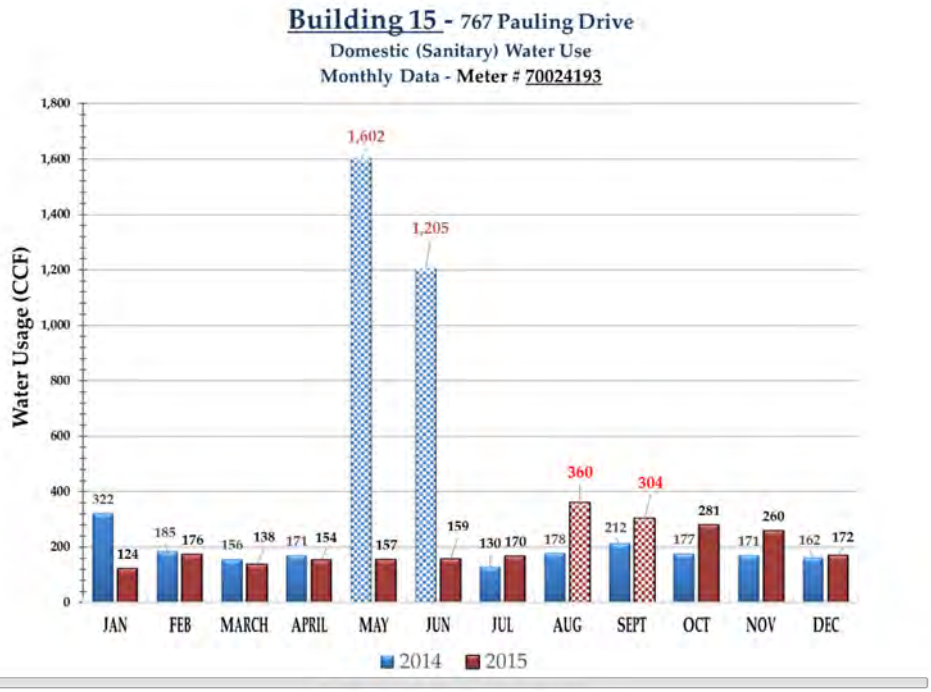
Observations

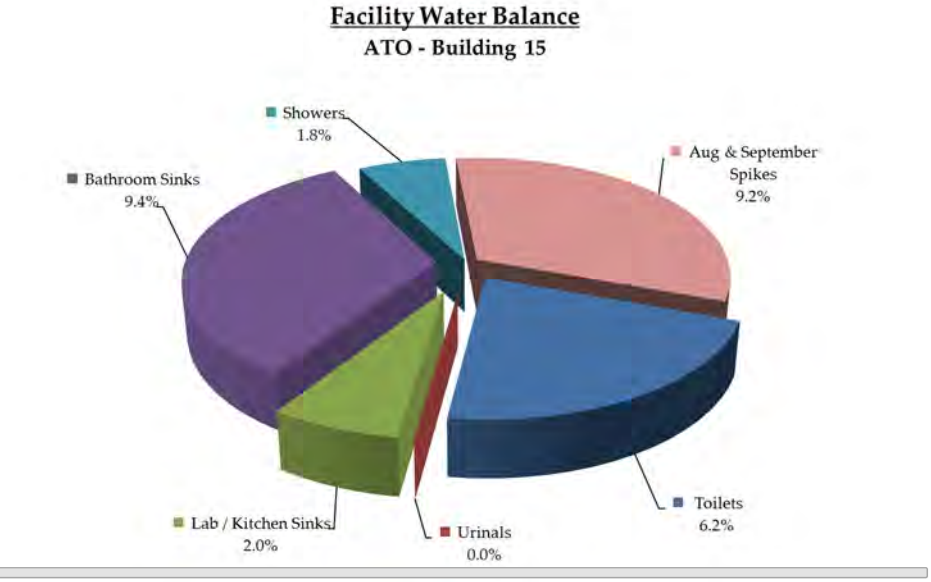
1. Building is on Campus Steam and CW Loop

2. Abnormal water use in August and October of **2015** – approximately 168,300 gallons over the average monthly usage of 149,600 gallons, which is reflected in the Water Balance

3. Strainers leaking at .25 gpm on basement steam line, after Heat Exchanger number HX-1-1. That equates to 250,000 gallons / yr of RO water @ $2 / gal.

4. Pump seals that were recently replaced were leaking. During second site visit, they had all been repaired and all leaks fixed.





Facility Water Balance	Building 15		
	Percentage of Total	Consumption (gals)	Consumption (ccf)
Toilets	6.2%	113,959	152
Urinals	0.0%	0	0
Lab / Kitchen Sinks	2.0%	37,180	50
Bathroom Sinks	9.4%	173,190	232
Showers	1.8%	33,800	45
Aug & September Spikes	9.2%	168,300	225
,Autoclave Cond Quench, Dry Cycle Tunnel Washer Quench, Cage Washer Quench	73.3%	1,346,521	1,800
TOTAL	**102.0%**	**1,872,950**	**2,504**
		Gallons	Hundred Cubic Feet
Actual Metered Consumption		**1,836,340**	**2,455**

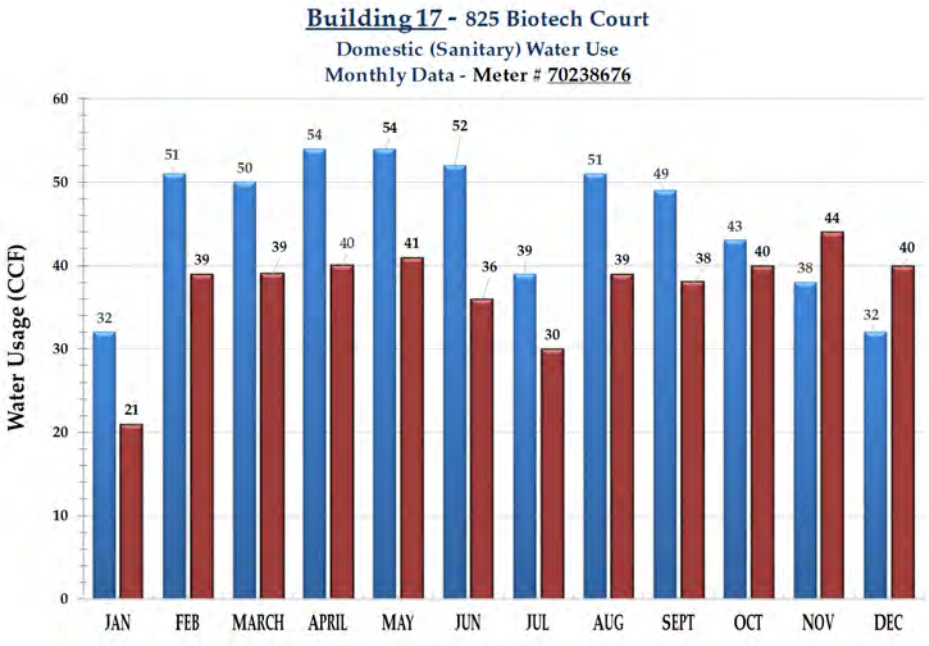
BUILDING 15 – PHOTO'S

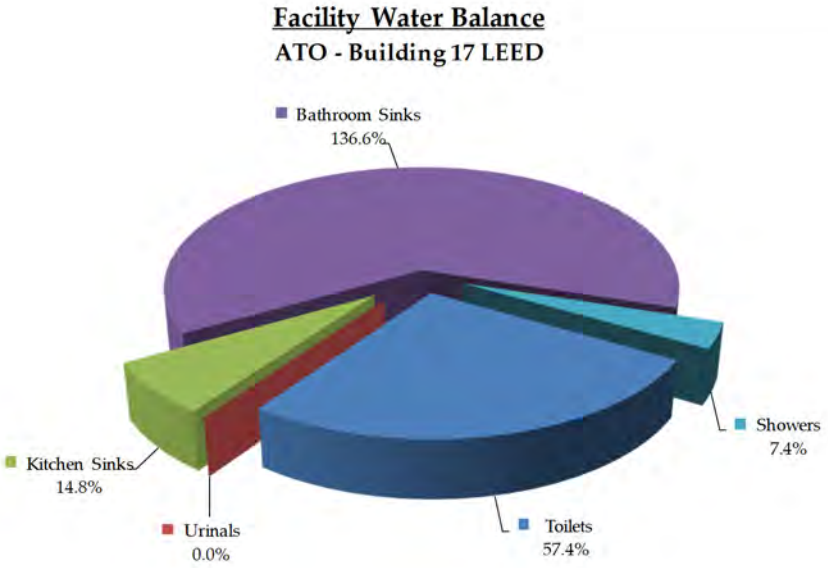
Basement – Strainer valves before steam traps are not holding - .25 gpm of condensate to drain (HX – 1 – 1)

BUILDING 17 - ADMIN

Observations

1. Building is on Campus Steam and CW Loop
2. Municipal water meter reads 334,356 gallons for 2015, and the Domestic (rest rooms) water use Benchmarks at 722,837 gallons.
3. The demographics (185 FTE's) or the water meter are incorrect.



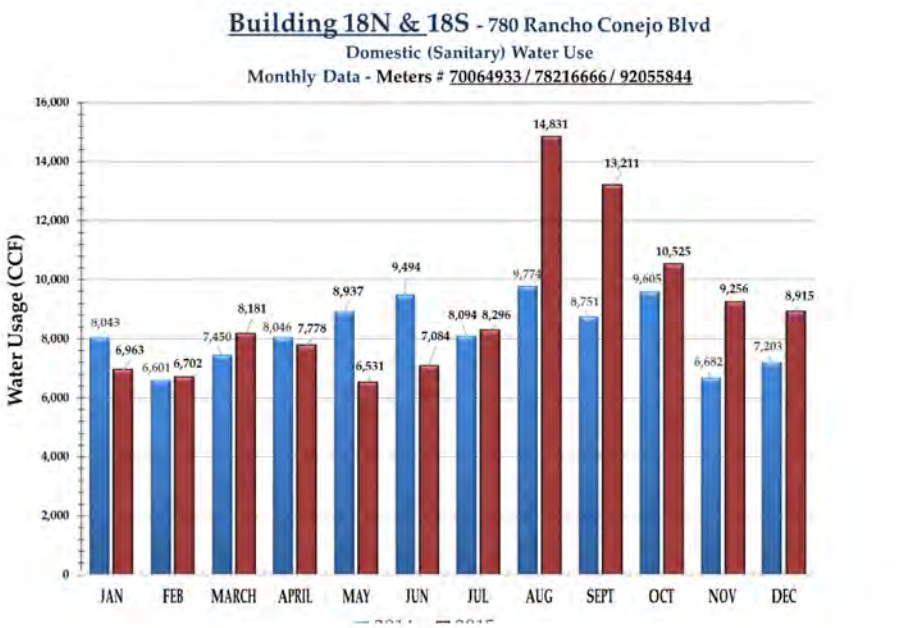


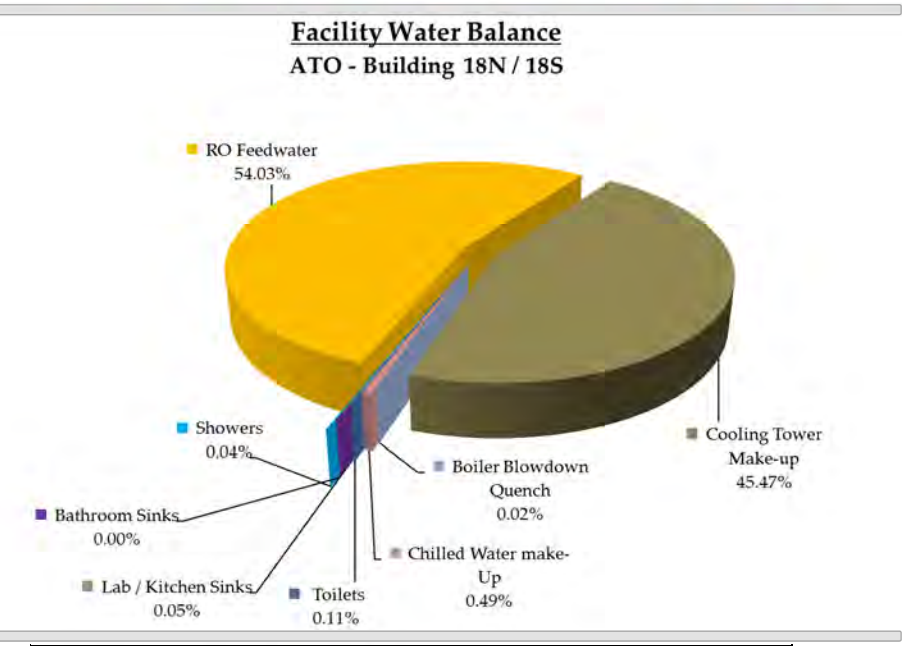
Facility Water Balance	Building 17		
	Percentage of Total	Consumption (gals)	Consumption (ccf)
Toilets	57.4%	191,845	256
Urinals	0.0%	0	0
Kitchen Sinks	14.8%	49,478	66
Bathroom Sinks	136.6%	456,774	611
Showers	7.4%	24,739	33
TOTAL	**216.2%**	**722,837**	966
		Gallons	Hundred Cubic Feet
Actual Metered Consumption		**334,356**	**447**

BUILDING 18N / 18S - CUP

Observations

1. Building is the main source of Campus Steam, CW and RO Water
2. Boilers are fed 100% RO as make-up
3. Three main meters feed both buildings and are tied together.
4. RO effluent is substantial and conductivity is 1,500 µS which is good for almost two COC on the Cooling Towers
5. Main water meter marked as 18S Domestic water is actually split into three lines marked for both buildings (see photos – next page)
6. Aug and September (2015) usage spikes attributed to CT evaporation.





Facility Water Balance	Building 18N / 18S		
	Percentage of	Consumption	Consumption (ccf)
Toilets	0.11%	87,961	118
Bathroom Sinks	0.00%	0	0
Lab / Kitchen Sinks	0.05%	39,468	53
Showers	0.04%	35,880	48
RO Feedwater	54.03%	**43,756,813**	58,498
Cooling Tower Make-up	45.47%	36,824,840	49,231
Boiler Blowdown Quench	0.02%	15,120	20
Chilled Water make-Up	0.49%	400,000	535
TOTAL	**100.2%**	**81,160,082**	**108,503**
		Gallons	Hundred Cubic Feet
Actual Metered Consumption (gal)		**80,988,204**	**108,273**

BUILDING 18N/18S – PHOTO'S

Data loggers / Ultrasonic flowmeters on boiler feed-water pumps – 100% RO water feed.

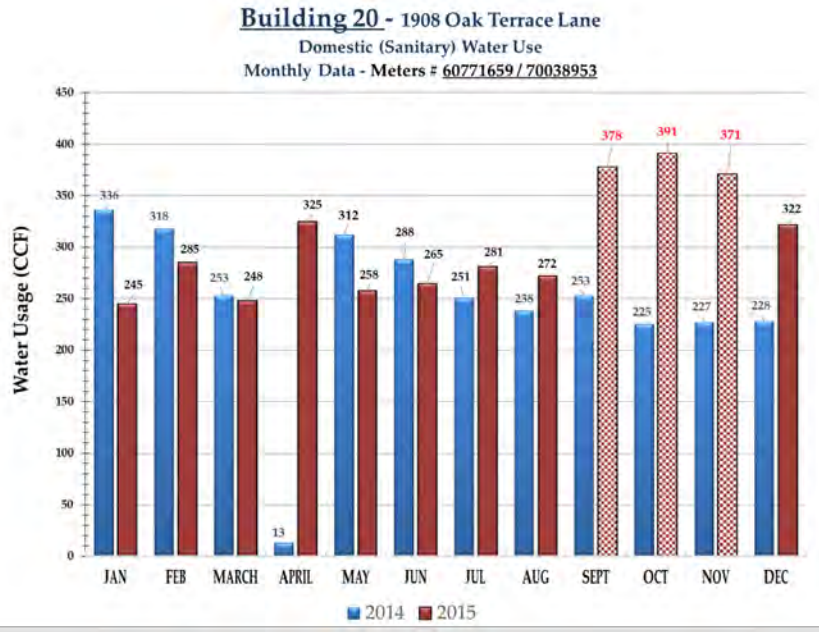
Main meter for B18S, is actually split into three (3) separate lines marked as 18N Industrial, 18S Domestic and 18N Domestic

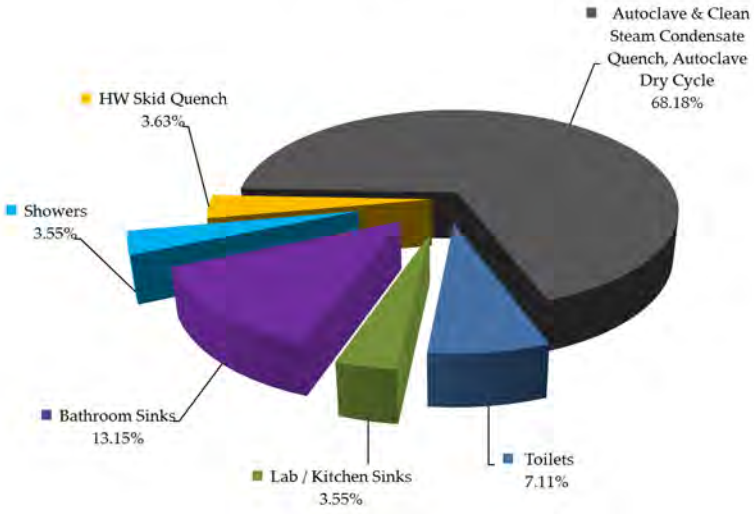
Stainless 'In-Line' flowmeter installed to measure boiler feed-water was inoperable for the three months we were onsite.

BUILDING 20 - MANUFACT

Observations

1. Building is on Campus Steam and CW Loop
2. Estimated WFI use in Center Core is 1.4 Million Gallons / yr
3. September through November 2015 saw usage spikes with no apparent explanation.



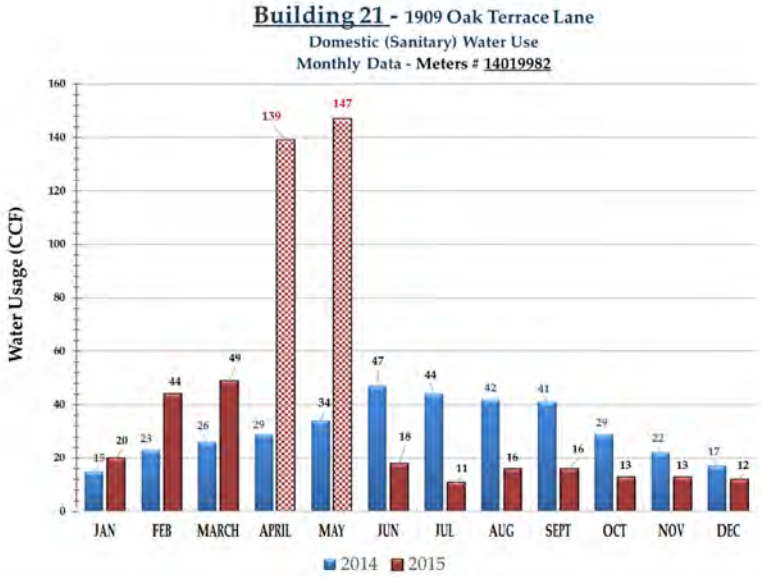


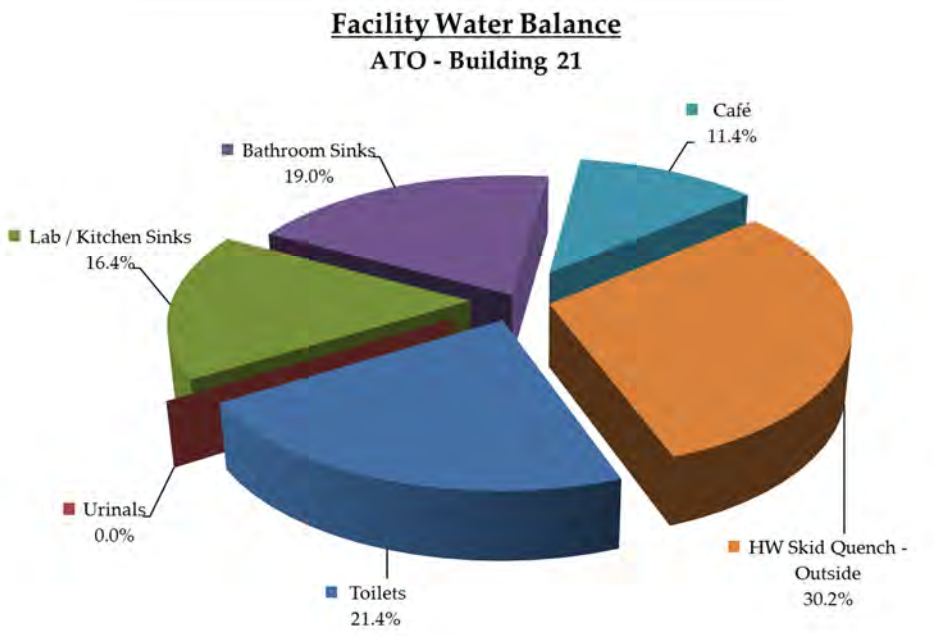
Facility Water Balance	Building 20		
	Percentage of Total	Consumption (gals)	Consumption (ccf)
Toilets	7.1%	193,727	259
Lab / Kitchen Sinks	3.5%	96,668	129
Bathroom Sinks	13.1%	358,109	479
Showers	3.5%	96,668	129
HW Skid Quench	3.6%	98,765	132
Autoclave & Clean Steam	68.2%	1,856,790	2,482
TOTAL	**99.2%**	**2,700,726**	**3,611**
		Gallons	Hundred Cubic Feet
Actual Metered Consumption		**2,723,468**	**3,641**

BUILDING 21 - ADMIN

Observations

1. Building is on Campus Steam and CW Loop
2. Heating Hot Water is provided by an independent HW skid, outside of building. The pump seals were leaking hot condensate in the sanitary sewer, as of our last visit in March of 2016
3. April and May of 2015 saw large usage spikes with no apparent explanation.





Facility Water Balance	Building 21		
	Percentage of Total	Consumption (gals)	Consumption (ccf)
Toilets	21.4%	79,810	107
Urinals	0.0%	0	0
Lab / Kitchen Sinks	16.4%	61,204	82
Bathroom Sinks	19.0%	70,854	95
Café	11.4%	42,354	57
HW Skid Quench - Outside	30.2%	112,654	151
TOTAL	**98.5%**	**366,877**	**490**
		Gallons	Hundred Cubic Feet
Actual Metered Consumption (gal)		**372,504**	**498**

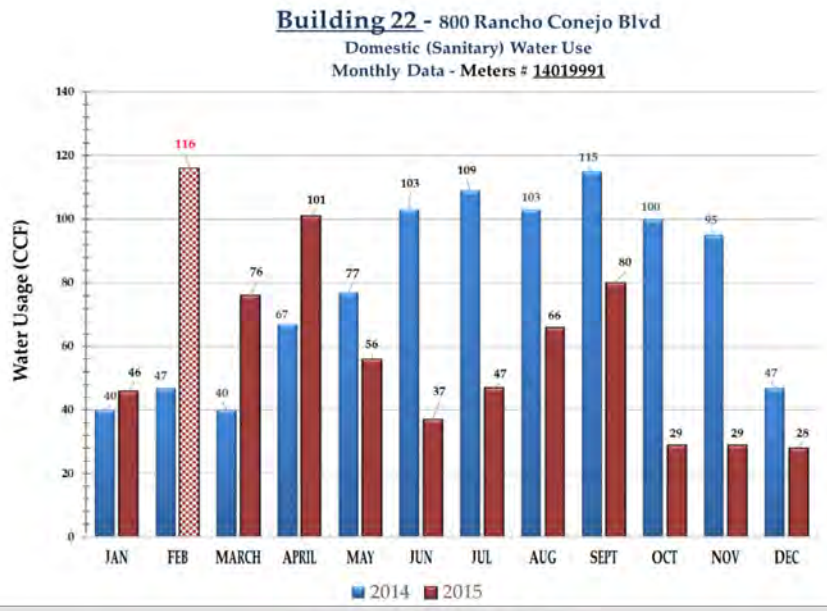
BUILDING 21 – PHOTO'S

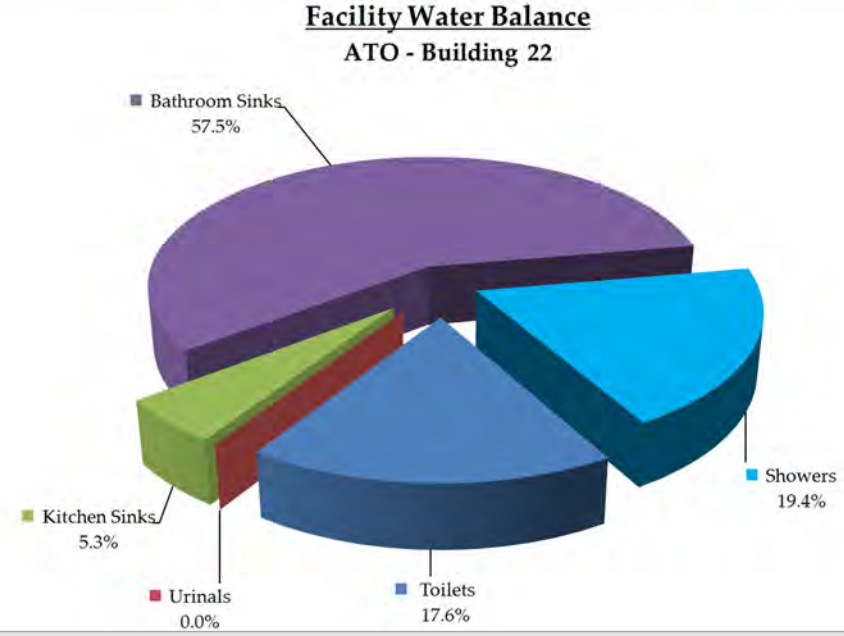
Hot Water Skid Leaking from the Pump Seals and Housings. Hot condensate with Boiler chemicals is flowing to the Sanitary Sewer

BUILDING 22 - ADMIN

Observations

1. Building is on Campus Steam and CW Loop, attached to 18N
2. Facility Maintenance is located in this building.
3. Majority of the water use is Domestic, and quite erratic.
4. There was a 10% increase in FTE's assigned to this building, from 2014 to 2015



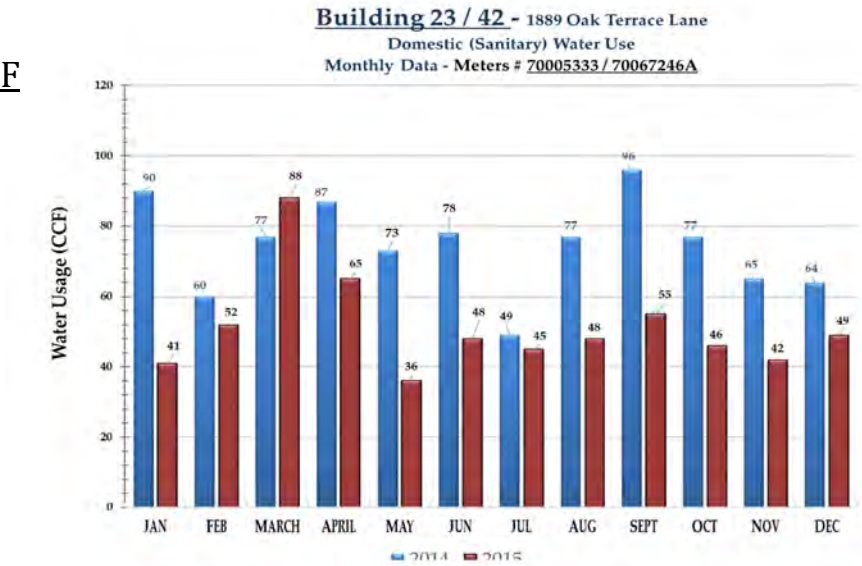


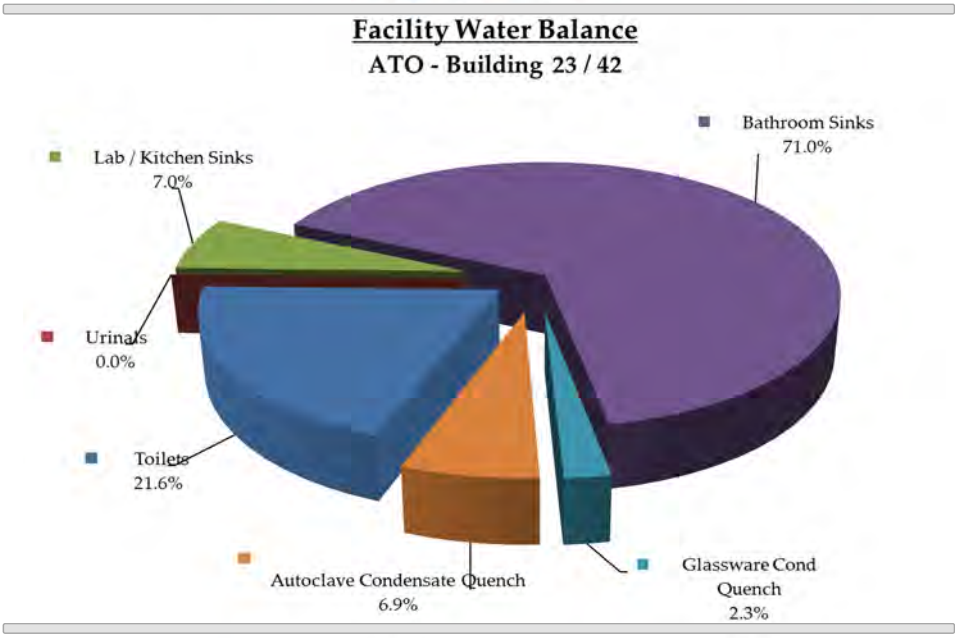
Facility Water Balance	Building 22		
	Percentage of Total	Consumption (gals)	Consumption (ccf)
Toilets	17.6%	93,475	125
Urinals	0.0%	0	0
Kitchen Sinks	5.3%	28,314	38
Bathroom Sinks	57.5%	306,020	409
Showers	19.4%	102,960	138
TOTAL	**99.8%**	**530,769**	**710**
		Gallons	Hundred Cubic Feet
Actual Metered Consumption		**531,828**	**711**

BUILDING(S) 23/42 - MANUF

Observations

1. Buildings are on Campus Steam and CW Loop, and share two water mains
2. Estimated WFI use is approximately 4.7 Million Gallons / yr
3. PH Neutralization Tanks on lower level



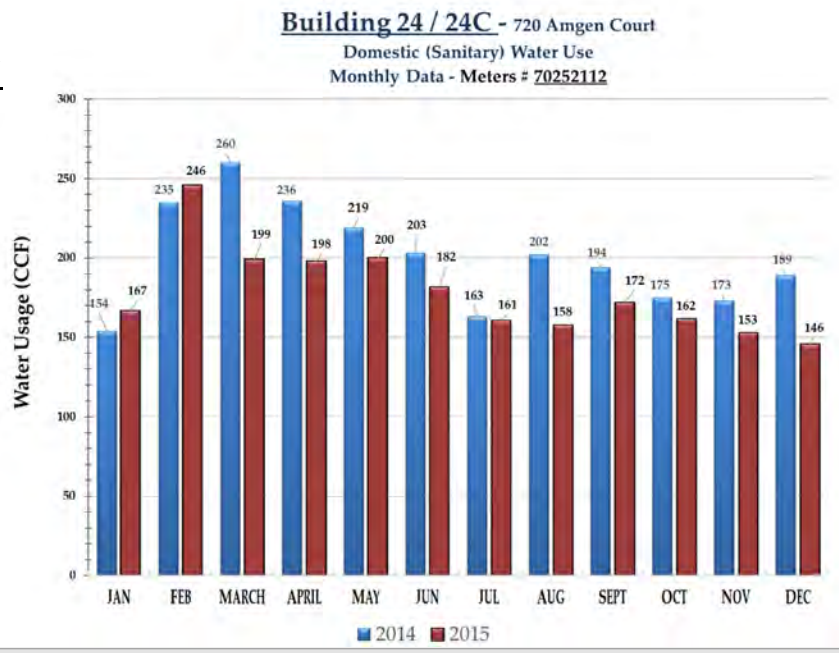


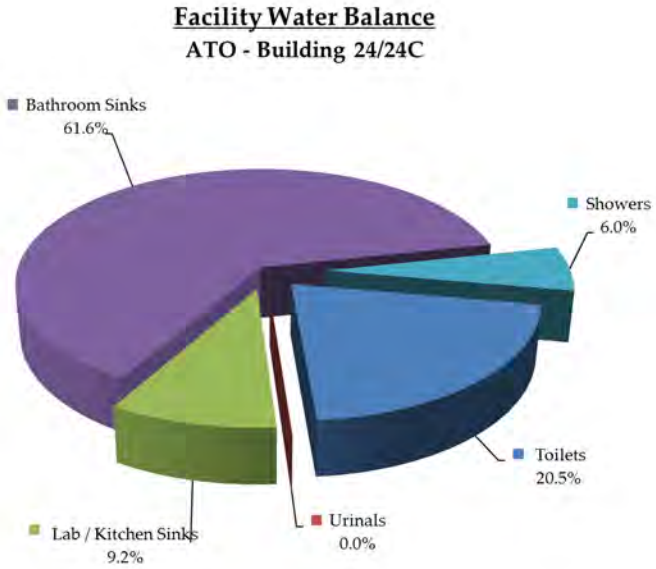
Facility Water Balance	Building 23 / 42		
	Percentage of Total	Consumption (gals)	Consumption (ccf)
Toilets	21.6%	99,274	133
Urinals	0.0%	0	0
Lab / Kitchen Sinks	7.0%	32,240	43
Bathroom Sinks	71.0%	326,560	437
Glassware Cond Quench	2.3%	10,752	14
Autoclave Condensate Quench	6.9%	31,680	42
TOTAL	**108.8%**	**500,506**	**669**
		Gallons	Hundred Cubic Feet
Actual Metered Consumption		**460,020**	**615**

BUILDING(S) 24/24C- ADMIN

Observations

1. Buildings are on Campus Steam and CW Loop.



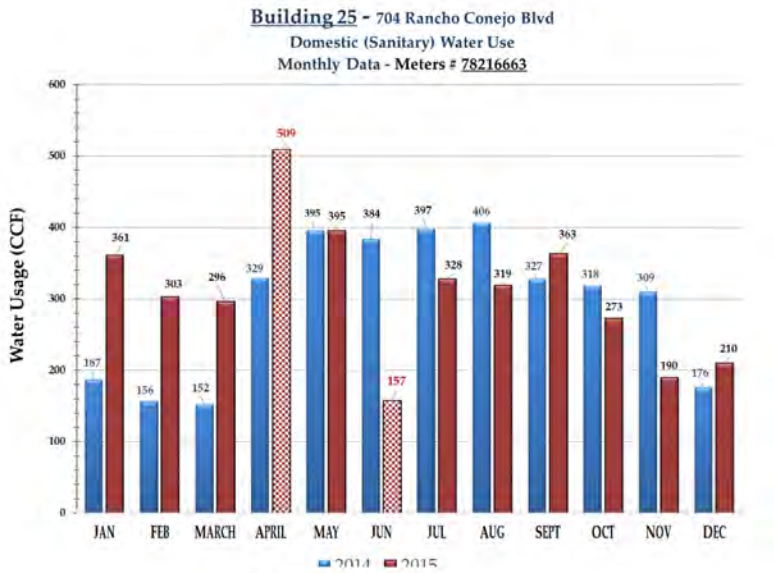


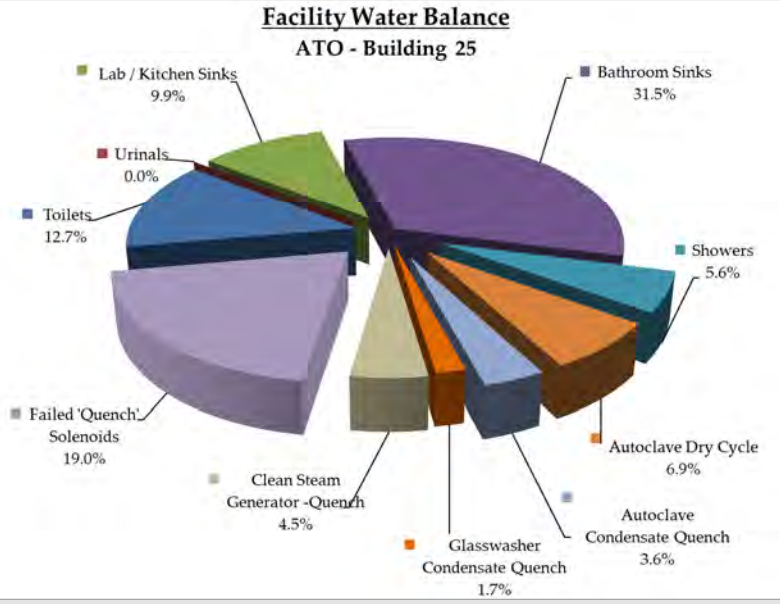
Facility Water Balance	Building 24 / 24C		
	Percentage of Total	Consumption (gals)	Consumption (ccf)
Toilets	20.5%	328,256	439
Urinals	0.0%	707	1
Lab / Kitchen Sinks	9.2%	148,148	198
Bathroom Sinks	61.6%	988,474	1,321
Showers	6.0%	96,200	129
TOTAL	**97.4%**	**1,561,785**	**2,088**
		Gallons	Hundred Cubic Feet
Actual Metered Consumption		**1,603,712**	**2,144**

BUILDING 25 - LAB

Observations

1. Buildings are on Campus Steam and CW Loop
2. Autoclaves, Clean Steam Generators, Glassware Washers and faulty quench solenoids consume almost 36% of the water in this building.
3. April of 2015 shows an abnormally high use followed by low usage in June.





Facility Water Balance	Building 25		
	Percentage of Total	Consumption (gals)	Consumption (ccf)
Toilets	12.7%	352,294	471
Urinals	0.0%	0	0
Lab / Kitchen Sinks	9.9%	273,910	366
Bathroom Sinks	31.5%	871,819	1,166
Showers	5.6%	156,520	209
Autoclave Dry Cycle	6.9%	190,080	254
Autoclave Condensate Quench	3.6%	98,496	132
Glasswasher Condensate Quench	1.7%	47,856	64
Clean Steam Generator -Quench	4.5%	123,543	165
Failed 'Quench' Solenoids	19.0%	525,600	703
TOTAL	**95.3%**	**2,640,119**	**3,530**
		Gallons	Hundred Cubic Feet
Actual Metered Consumption (gal)		**2,770,592**	**2,771**

BUILDING 27/PS6 – ADMIN/GAR

Observations

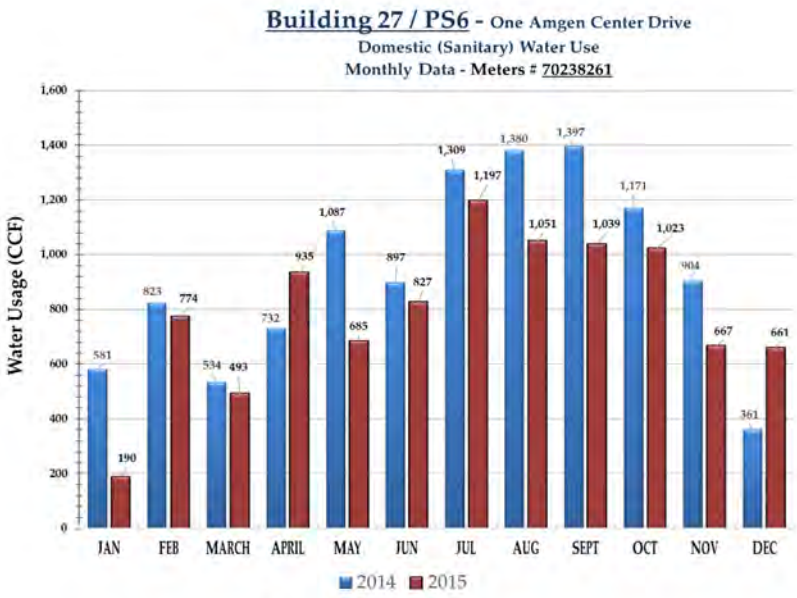
1. Building is on CW Loop but has Boilers for Hot Water and Building Heat

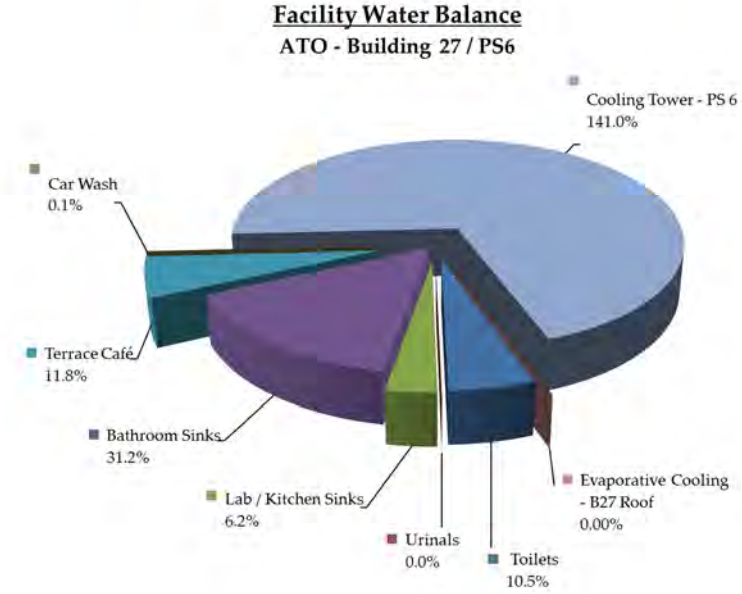
2. Car Wash in Garage (PS6) but is extremely efficient and only uses 1.5 gallons per car; the system recycles most of what it consumes.

3. Terrace Cafeteria serves about 1,300 meals per day with 60% dine-in and 40% take-out. Deli-37 dishes are also washed in this kitchen.

4. Two 44-ton rooftop cooling towers (BAC F1742-K) serve multiple Liebert units that cool computer rooms, kitchen refrigerator's and telephone rooms.

5. Total Cooling Capacity of all Liebert Units is 62 Tons, if they are all in operation at max capacity





Facility Water Balance	27 / PS6		
	Percentage of Total	Consumption (gals)	Consumption (ccf)
Toilets	10.5%	747,368	999
Urinals	0.0%	0	0
Lab / Kitchen Sinks	6.2%	440,440	589
Bathroom Sinks	31.2%	2,224,308	2,974
Terrace Café	11.8%	845,000	1,130
Car Wash	0.1%	5,650	8
Cooling Tower - PS 6	141.0%	10,064,000	13,455
Evaporative Cooling - B27 Roof	0.0%	**0**	0
TOTAL	**200.7%**	**14,326,766**	**19,153**
		Gallons	Hundred Cubic Feet
Actual Metered Consumption (gal)		**7,137,416**	**9,542**

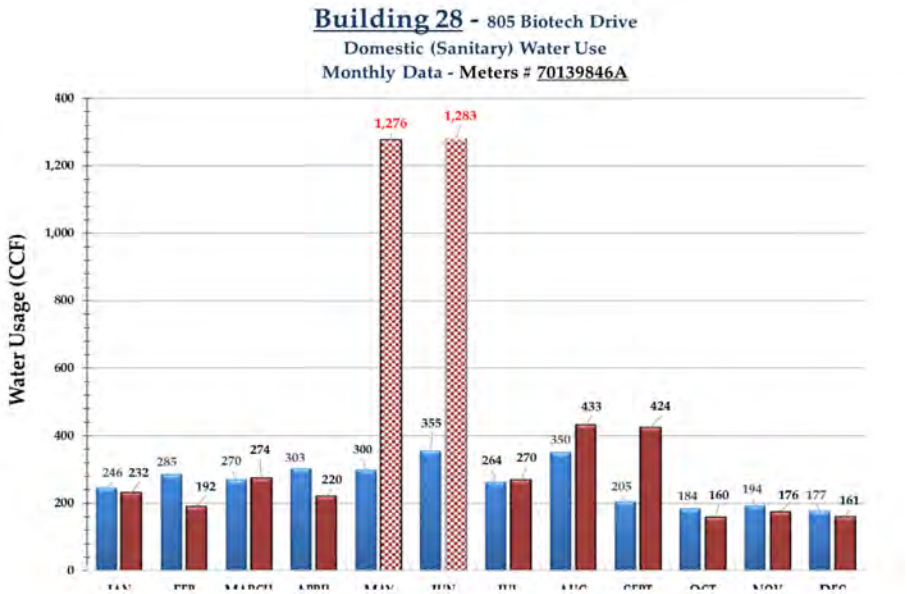
BUILDING 27 – PHOTO'S

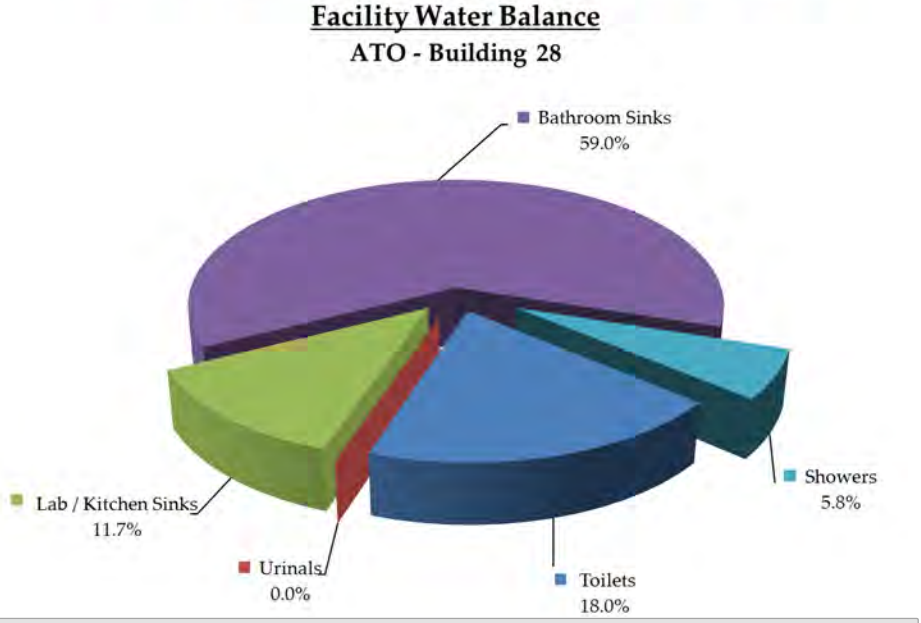
Leaking Steam Trap (Humidification) – leaking condensate on roof

BUILDING 28 -ADMIN

Observations

1. Building is on Campus Steam and CW Loop



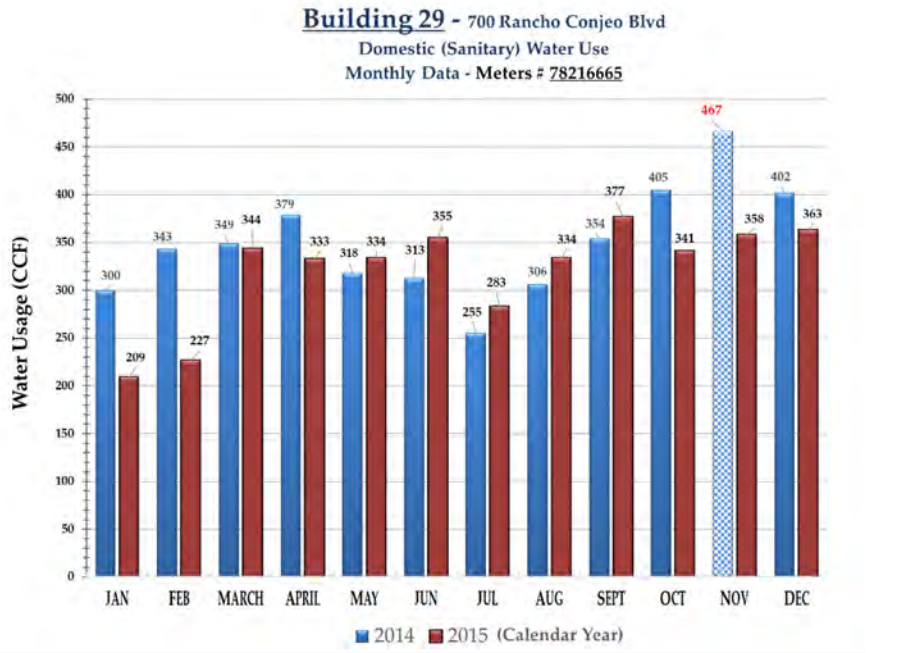


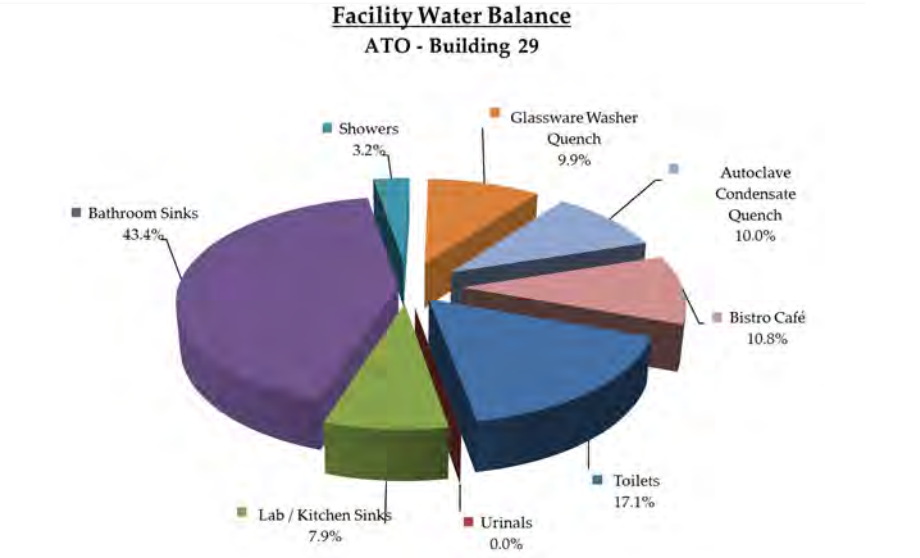
Facility Water Balance	Building 28		
	Percentage of Total	Consumption (gals)	Consumption (ccf)
Toilets	18.0%	688,016	920
Urinals	0.0%	0	0
Lab / Kitchen Sinks	11.7%	445,588	596
Bathroom Sinks	59.0%	2,252,434	3,011
Showers	5.8%	222,794	298
TOTAL	**94.6%**	**3,608,833**	**4,825**
		Gallons	Hundred Cubic Feet
Actual Metered Consumption (gal)		**3,815,548**	**5,101**

BUILDING 29 - LAB

Observations

1. Building is on Campus Steam and CW Loop
2. Bistro Café serves about 800 meals per day with 60% dine-in and 40% take-out. Beakers Café dishes are also washed in this kitchen
3. Glassware Washers and Autoclave Quench consumes about 20% of the water in this building.



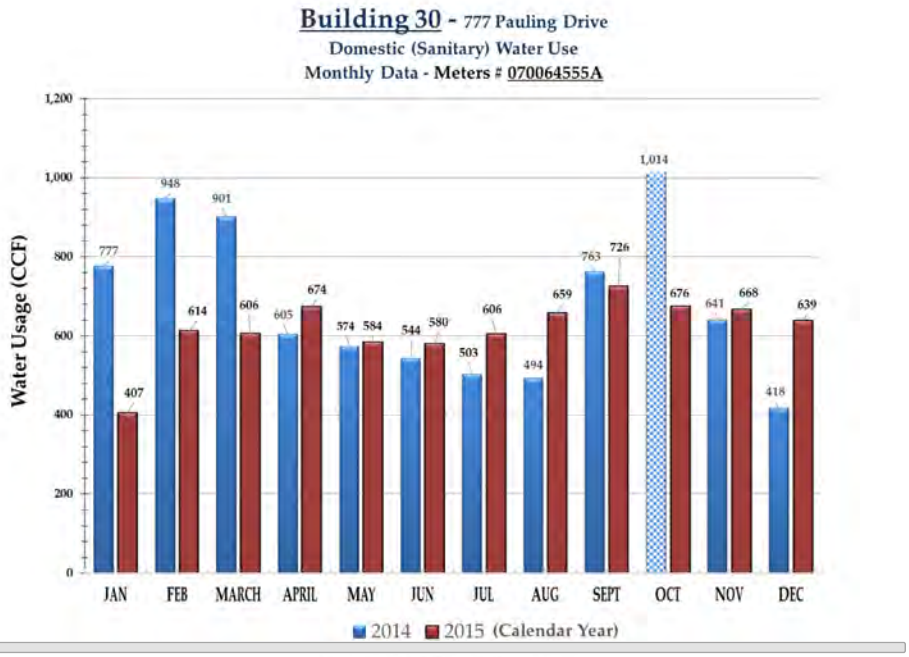


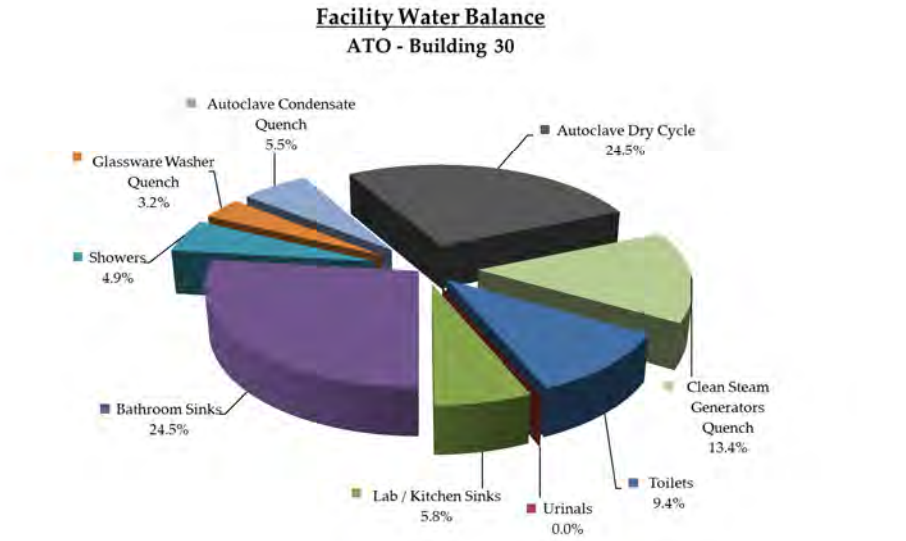
Facility Water Balance	Building 29		
	Percentage of Total	Consumption (gals)	Consumption (ccf)
Toilets	17.1%	493,566	660
Urinals	0.0%	0	0
Lab / Kitchen Sinks	7.9%	227,760	304
Bathroom Sinks	43.4%	1,251,543	1,673
Showers	3.2%	91,104	122
Glassware Washer Quench	9.9%	286,464	383
Autoclave Condensate Quench	10.0%	289,872	388
Bistro Café	10.8%	312,000	417
TOTAL	**102.3%**	**2,952,309**	**3,947**
		Gallons	Hundred Cubic Feet
Actual Metered Consumption (gal)		**2,885,784**	**3,858**

BUILDING 30 - LAB

Observations

1. Building is on Campus Steam and CW Loop
2. PH Neutralization Tanks on lower level
3. Autoclaves, Clean Steam Generators, Glassware Washers consume almost 47% of the water in this building.



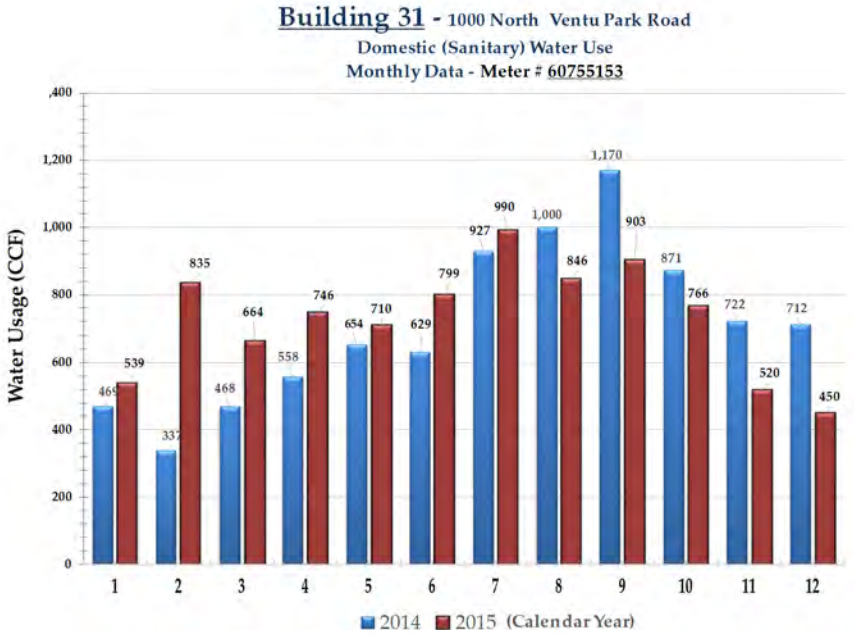


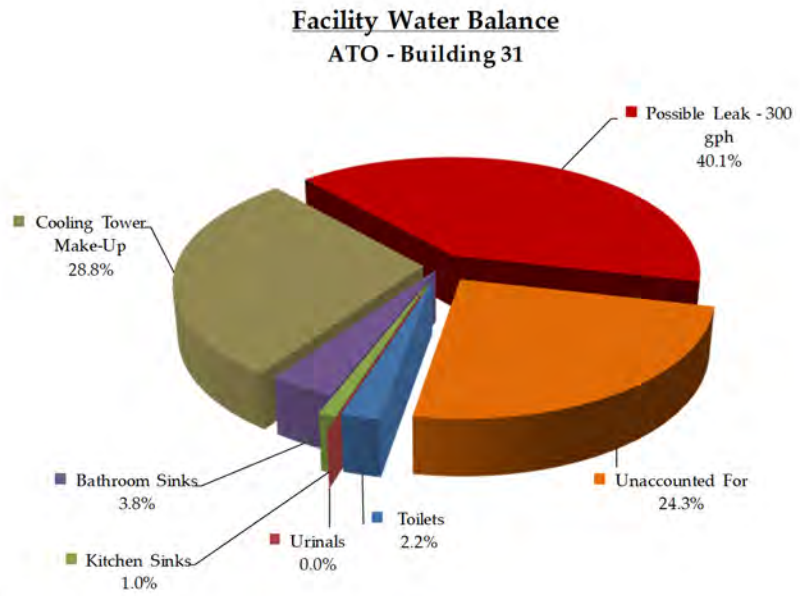
Facility Water Balance	Building 30		
	Percentage of Total	Consumption (gals)	Consumption (ccf)
Toilets	9.4%	521,474	697
Urinals	0.0%	0	0
Lab / Kitchen Sinks	5.8%	321,157	429
Bathroom Sinks	24.5%	1,364,696	1,824
Showers	4.9%	269,880	361
Glassware Washer Quench	3.2%	180,024	241
Autoclave Condensate Quench	5.5%	305,460	408
Autoclave Dry Cycle	24.5%	1,363,500	1,823
Clean Steam Generators Quench	13.4%	743,987	995
TOTAL	**91.1%**	**5,070,178**	**6,778**
		Gallons	Hundred Cubic Feet
Actual Metered Consumption (gal)		**5,564,372**	**7,439**

BUILDING 31 - WAREHOUSE

Observations

1. Building is **not** on Campus Steam and CW Loop.
2. The two (2) 300-ton Chillers provide cooling for this building.
3. Two Marley cooling towers remove the heat load from the building.
4. Hot Water for Heating and Domestic use is provided by two onsite Boilers.
5. Water meter data obtained by CalAm suggests that there is a steady flow of 300 gallons per hour, through the meter. We have not identified if this is a leak or actual use for some unidentified process.





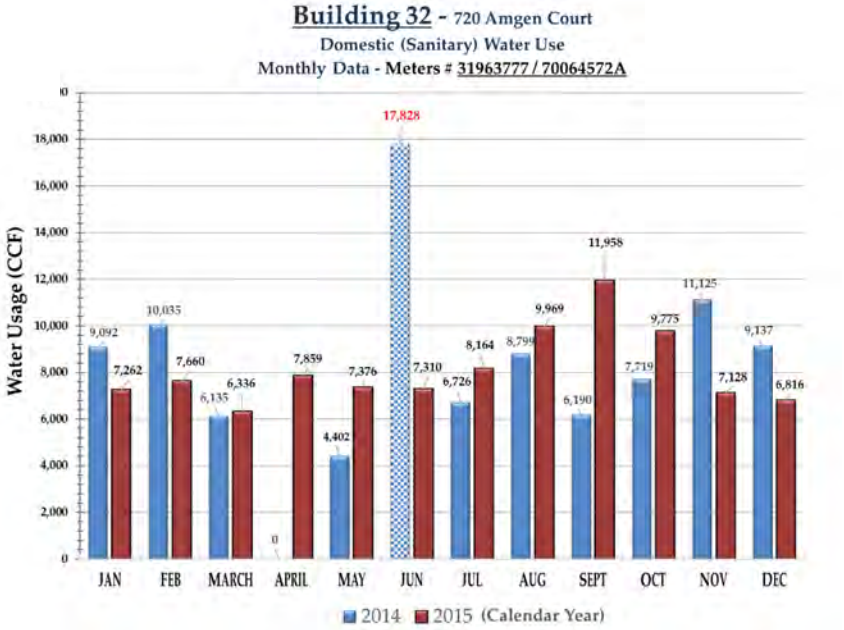
Facility Water Balance	Building 31		
	Percentage of Total	Consumption (gals)	Consumption (ccf)
Toilets	2.2%	142,532	191
Urinals	0.0%	0	0
Kitchen Sinks	1.0%	62,920	84
Bathroom Sinks	3.8%	247,521	331
Cooling Tower Make-Up	28.8%	1,887,050	2,523
Possible Leak - 300 gph	**40.1%**	**2,628,000**	**3,513**
Unaccounted For	**24.3%**	**1,590,441**	**2,126**
TOTAL	**100.0%**	**6,558,464**	**8,768**
		Gallons	Hundred Cubic Feet
Actual Metered Consumption (gal)		**6,558,464**	**8,768**

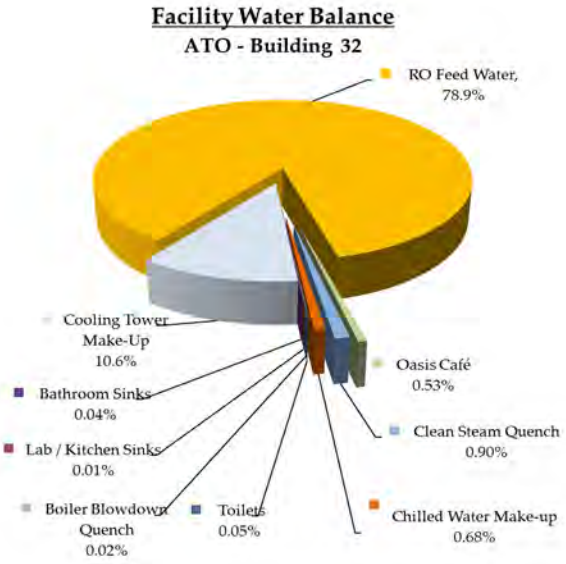
BUILDING 32 - CUP

Observations

1. Building is the secondary source of Campus Steam, CW and RO Water.
2. Boilers are fed 100% RO as make-up
3. Three main meters feed both buildings and are tied together
4. RO effluent is substantial and conductivity is 1,500 µS which is good for almost two COC on the Cooling Towers
5. Oasis Café serves about 600 meals per day with 60% dine-in and 40% take-out. Beakers Café dishes are also washed in this kitchen

B32 Main City Water that Feeds 4 RO Trains



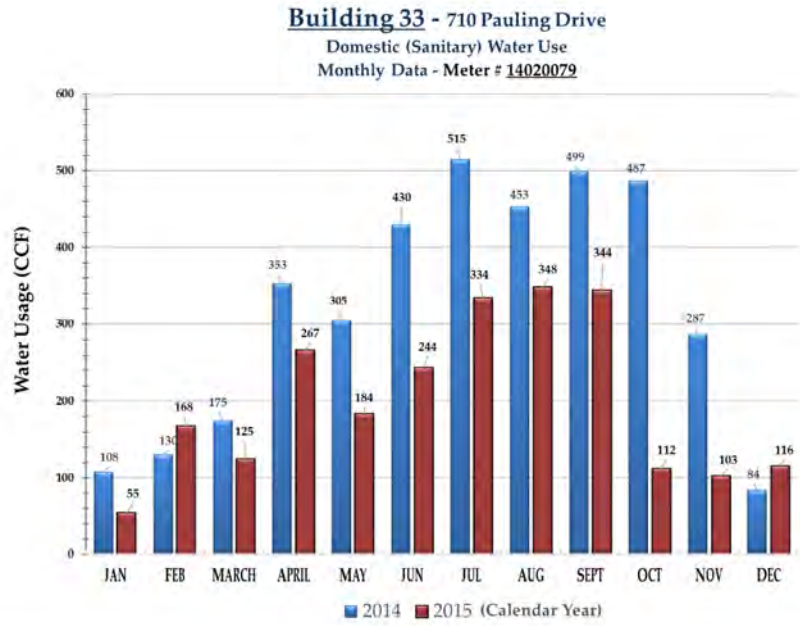


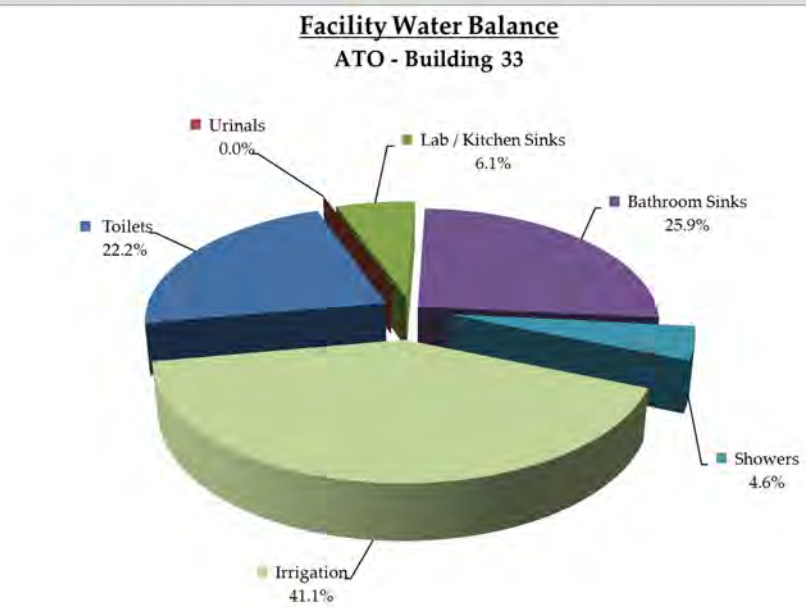
Facility Water Balance	Building 32		
	Percentage of Total	Consumption (gals)	Consumption (ccf)
Toilets	0.05%	33,060	44
Lab / Kitchen Sinks	0.01%	9,152	12
Bathroom Sinks	0.04%	28,113	38
Cooling Tower Make-Up	10.61%	7,748,470	10,359
RO Feed Water	78.94%	57,639,462	77,058
Oasis Café	0.53%	390,000	521
Clean Steam Quench	0.90%	654,856	875
Chilled Water Make-up	0.68%	500,000	668
Boiler Blowdown Quench	0.02%	15,120	20
TOTAL	**91.8%**	**67,018,232**	**89,597**
		Gallons	Hundred Cubic Feet
Actual Metered Consumption (gal)		**73,014,524**	**97,613**

BUILDING 33 - ADMIN

Observations

1. Building is on Campus Steam and CW Loop
2. Irrigation included in Domestic meter



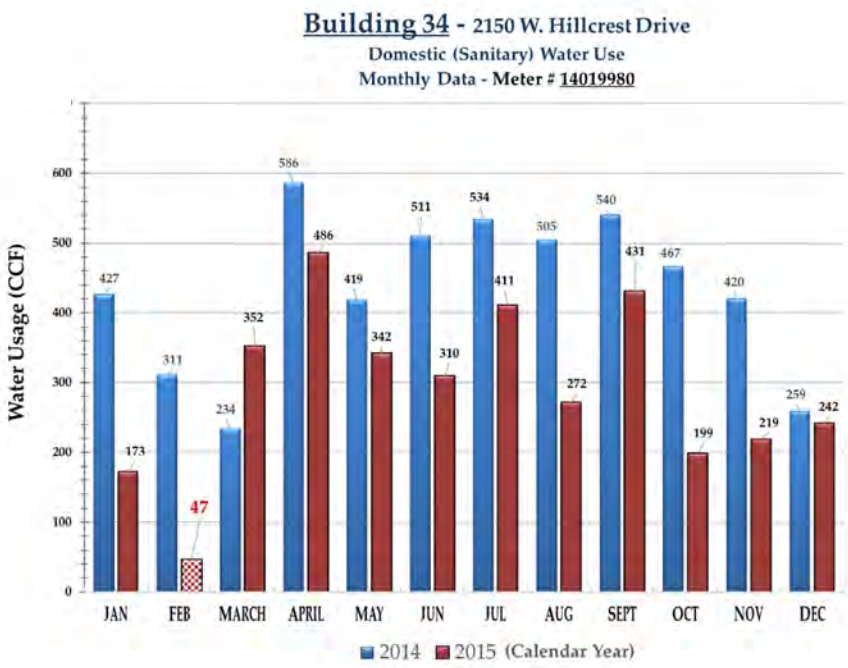


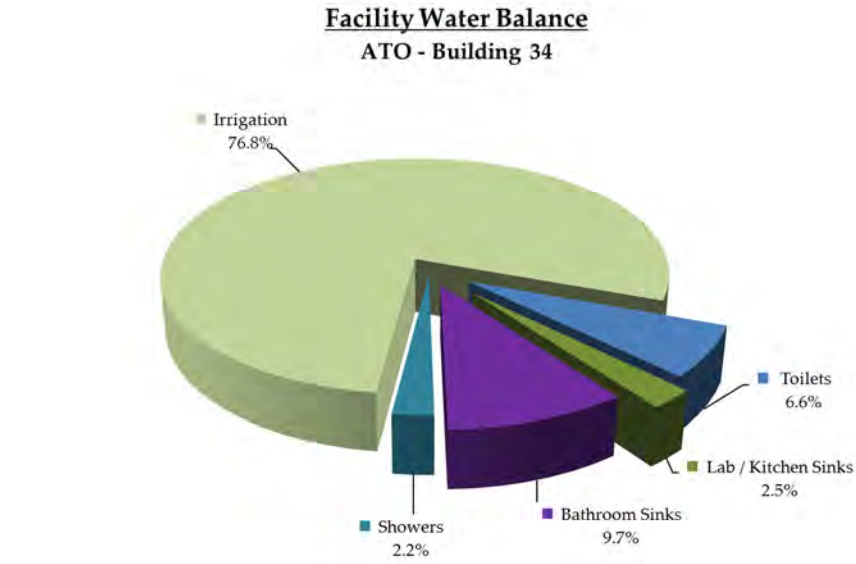
Facility Water Balance	Building 33		
	Percentage of Total	Consumption (gals)	Consumption (ccf)
Toilets	22.2%	399,276	534
Urinals	0.0%	0	0
Lab / Kitchen Sinks	6.1%	110,240	147
Bathroom Sinks	25.9%	464,765	621
Showers	4.6%	83,200	111
Irrigation	41.1%	737,819	986
TOTAL	**100.0%**	**1,057,481**	**1,414**
		Gallons	Hundred Cubic Feet
Actual Metered Consumption (gal)		**1,795,200**	**2,400**

BUILDING 34 - ADMIN

Observations

1. Building is **not** on Campus Steam and CW Loop.
2. Irrigation included in Domestic meter
3. Outfall is in rear of parking lot
4. Air Cooled DX Unit on Roof
5. Natural Gas Boiler for Building Heat and Electric for Domestic HW



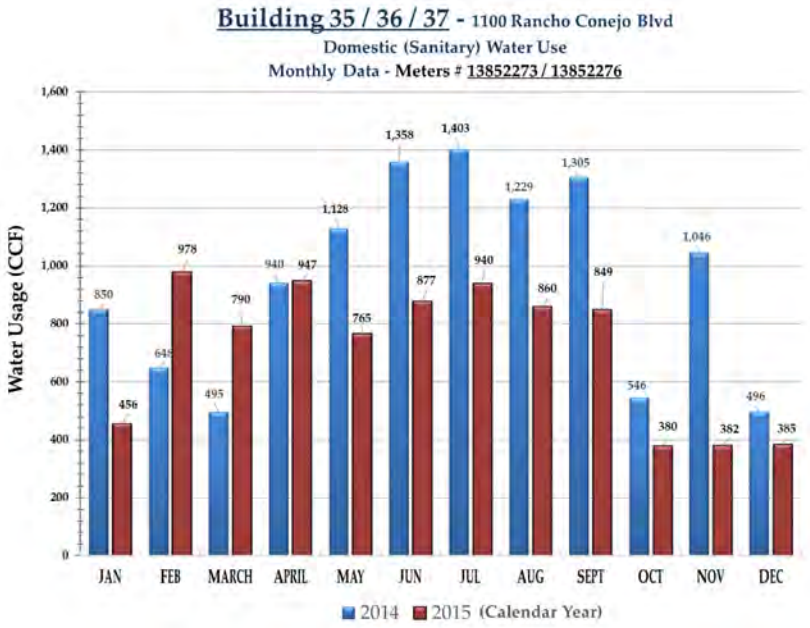


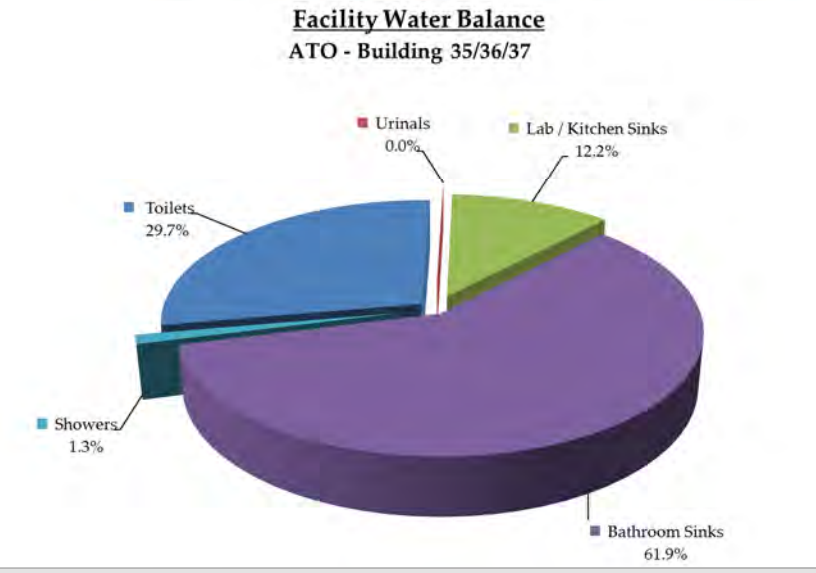
Facility Water Balance	Building 34		
	Percentage of Total	Consumption (gals)	Consumption (ccf)
Toilets	6.6%	171,288	229
Lab / Kitchen Sinks	2.5%	64,064	86
Bathroom Sinks	9.7%	252,382	337
Showers	2.2%	58,240	78
Irrigation	76.8%	2,000,453	2,674
TOTAL	**97.7%**	**2,546,427**	**3,404**
		Gallons	Hundred Cubic Feet
Actual Metered Consumption (gal)		**2,606,032**	**3,484**

BUILDINGS 35/36/37 - ADMIN

Observations

1. Buildings are **not** on Campus Steam and CW Loop.
2. Boilers for Building Heat on roof and Electric for Domestic HW
3. All Three Buildings fed by 2 Domestic Water Meters
4. Meter Data and Demographics for all Three Buildings Combined in Water Balance



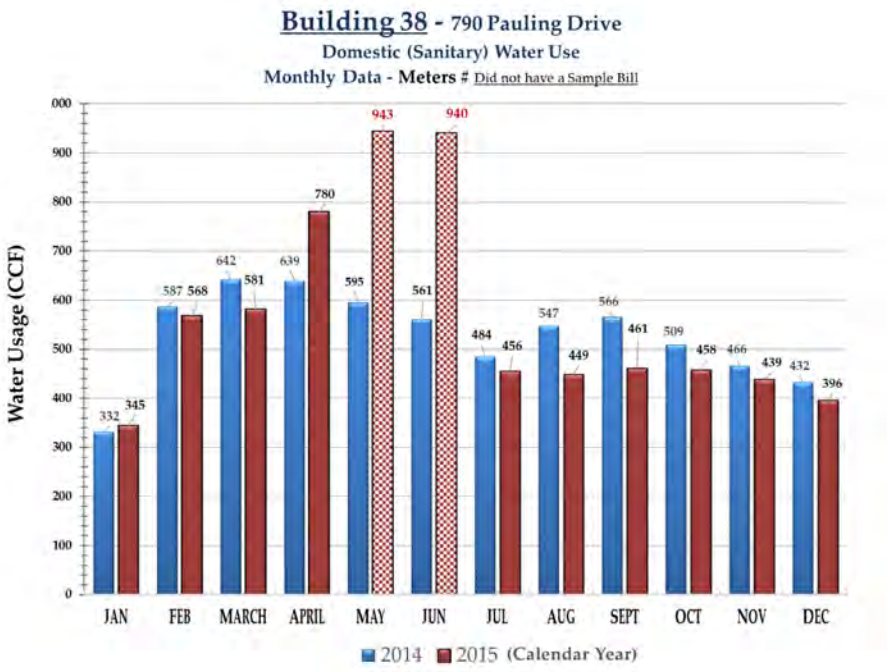


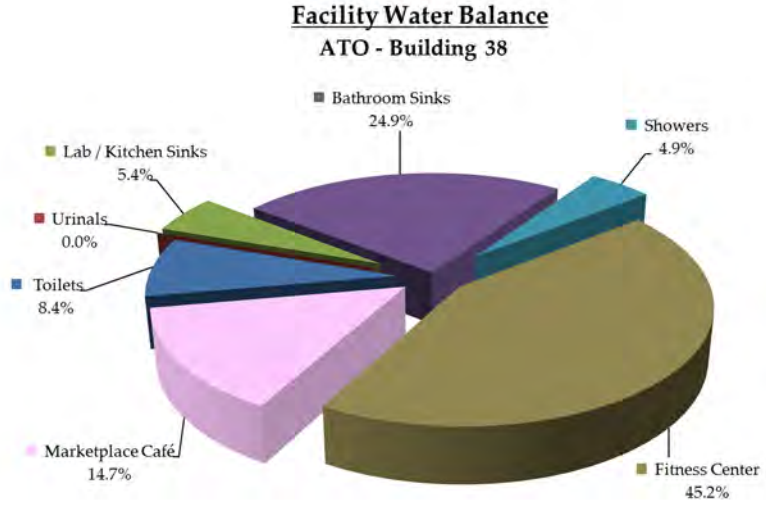
Facility Water Balance	Building 35/36/37		
	Percentage of Total	Consumption (gals)	Consumption (ccf)
Toilets	29.7%	1,912,140	2,556
Urinals	0.0%	0	0
Lab / Kitchen Sinks	12.2%	788,736	1,054
Bathroom Sinks	61.9%	3,983,876	5,326
Showers	1.3%	80,860	108
TOTAL	**105.1%**	**6,765,612**	**9,045**
		Gallons	Hundred Cubic Feet
Actual Metered Consumption (gal)		**6,439,532**	**8,609**

BUILDINGS 38 - ADMIN

Observations

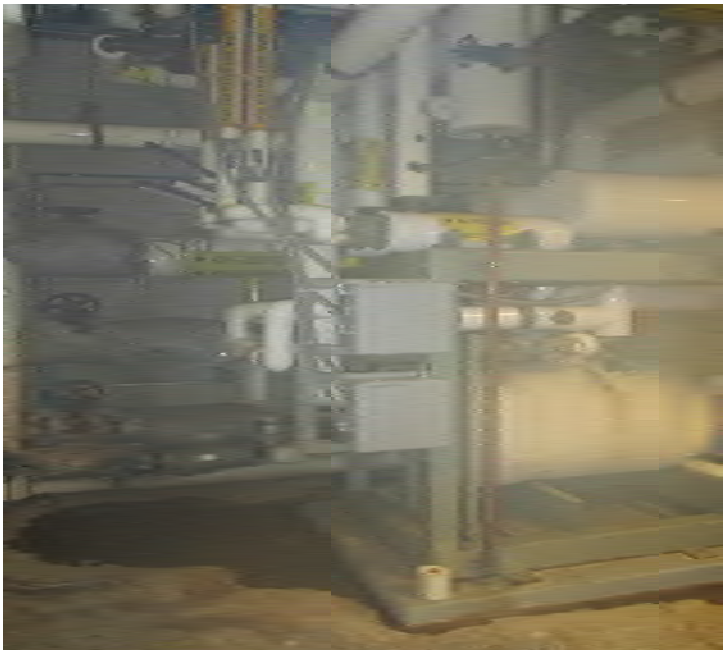
1. Building is on Campus Steam and CW Loop
2. Meter Data and Demographics for all Three Buildings Combined in Water Balance
3. Condensate return was open to drain, and not being sent back to 18N. Engineering claims that buried pipe is corroded and leaking.





Facility Water Balance	Building 38		
	Percentage of Total	Consumption (gals)	Consumption (ccf)
Toilets	8.4%	426,792	571
Urinals	0.0%	0	0
Lab / Kitchen Sinks	5.4%	276,276	369
Bathroom Sinks	24.9%	1,270,215	1,698
Showers	4.9%	251,160	336
Fitness Center	45.2%	2,304,000	3,080
Marketplace Café	14.7%	750,000	1,003
TOTAL	**103.5%**	**5,278,443**	**7,057**
		Gallons	Hundred Cubic Feet
Actual Metered Consumption (gal)		**5,098,368**	**6,816**

BUILDING 38 – PHOTO'S

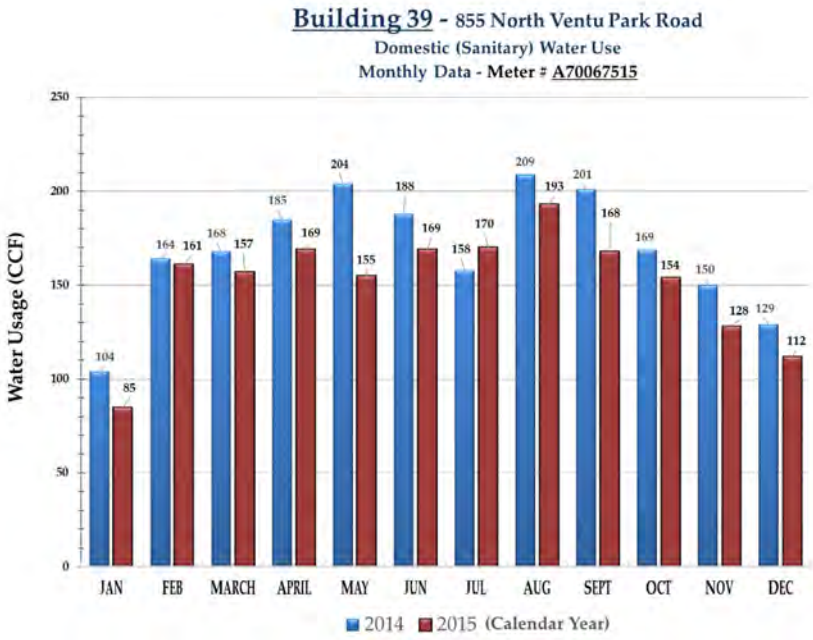


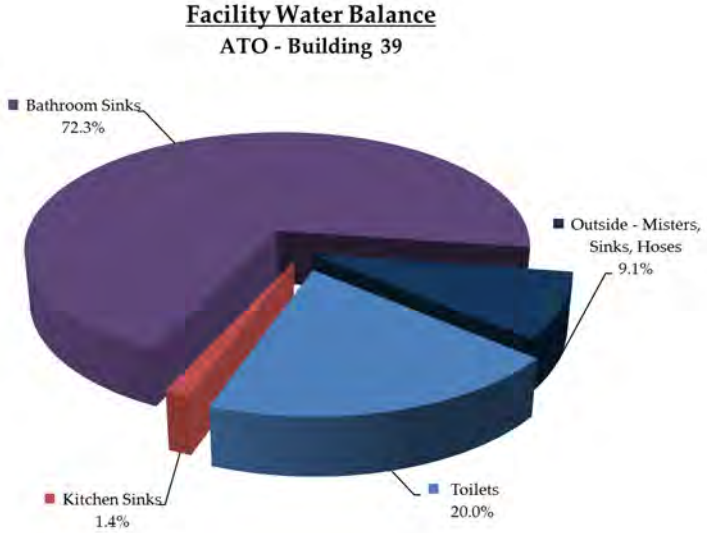
Condensate return was open to drain, and not being sent back to 18N, due to failure of a buried condensate return line

BUILDINGS 39 - ADMIN

Observations

1. Building is **not** on Campus Steam and CW Loop
2. Daycare / Childcare Center.
3. Air Cooled DX Units outside – Ground Level
4. Dual Boilers for Building Heat and 6 '75 gal' Water Heaters for Domestic HW
5. Outside water use – hoses, misting nozzles, sinks.



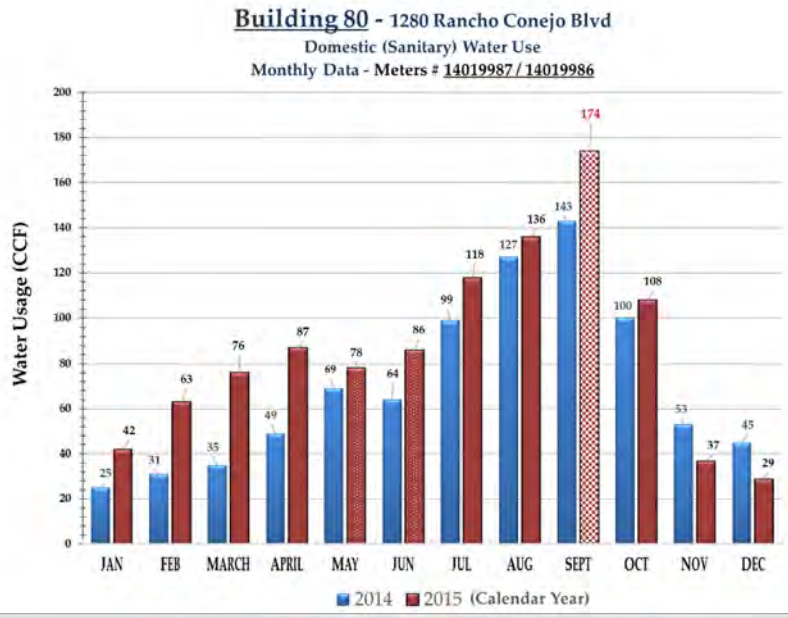


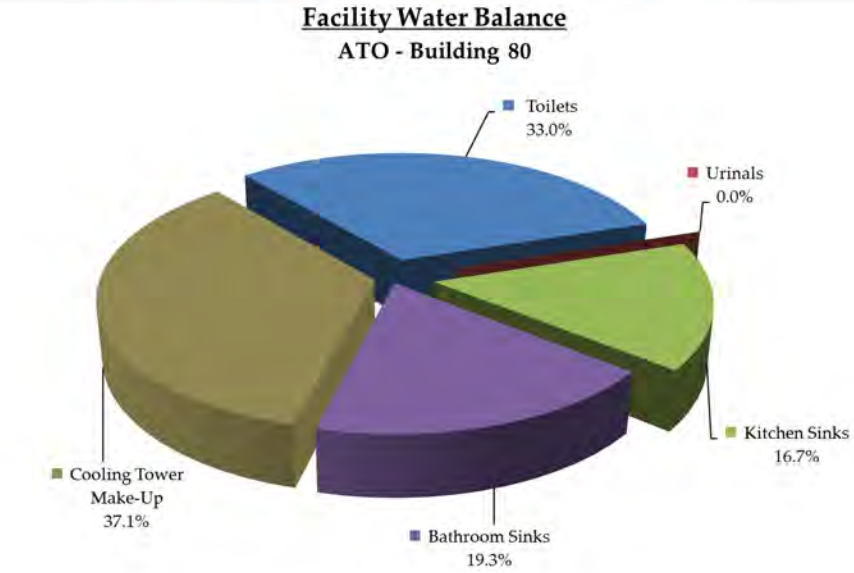
Facility Water Balance	Building 39		
	Percentage of Total	Consumption (gals)	Consumption (ccf)
Toilets	20.0%	272,227	364
Kitchen Sinks	1.4%	18,590	25
Bathroom Sinks	72.3%	984,163	1,316
Outside - Misters, Sinks, Hoses	9.1%	123,655	165
TOTAL	**102.7%**	**1,398,635**	**1,870**
		Gallons	Hundred Cubic Feet
Actual Metered Consumption (gal)		**1,362,108**	**1,362**

BUILDINGS 80 - ADMIN

Observations

1. Building is **not** on Campus Steam and CW Loop
2. Electric HW Heaters for Domestic Use
3. Gas Boiler for Building Heat
4. Water Source Heat Pump, a Split System
5. BAC Closed Loop Cooling Towers
6. Building has two Main Water Lines
7. September spike does not look out of line; the Aug bill may have been estimated and then September was an actual 'read'.



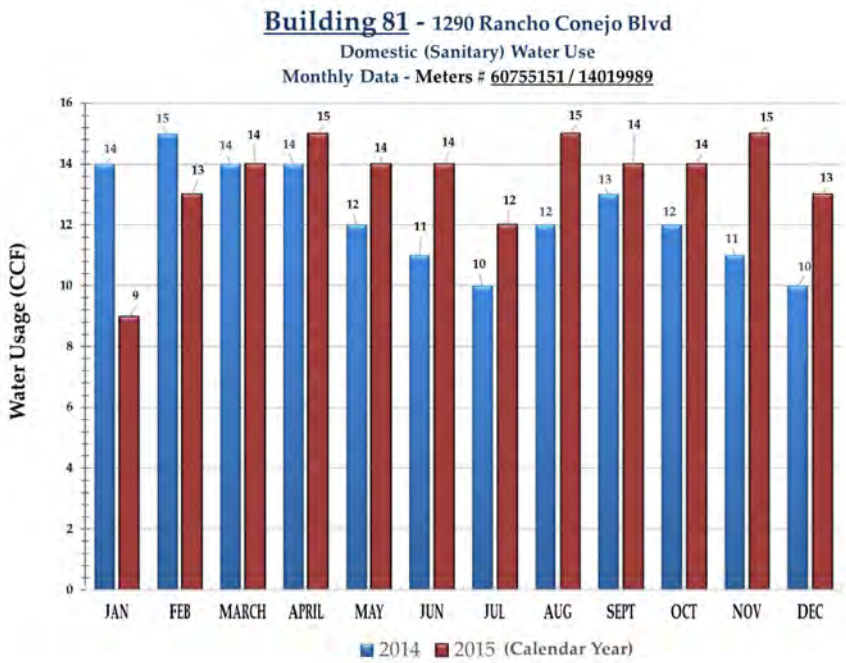


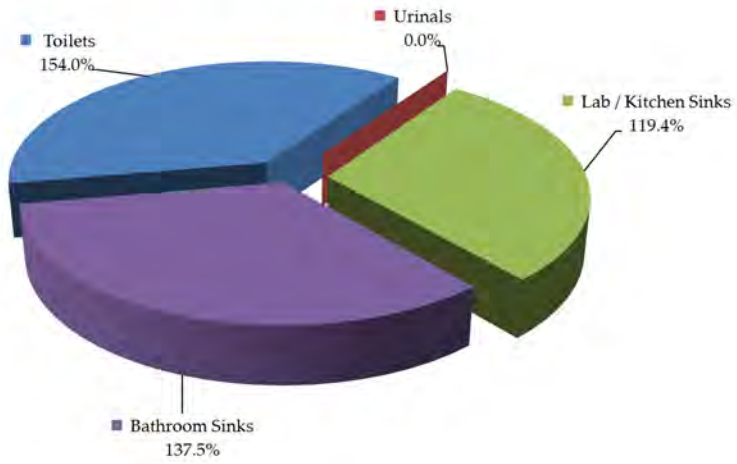
Facility Water Balance	Building 80		
	Percentage of Total	Consumption (gals)	Consumption (ccf)
Toilets	33.0%	255,341	341
Urinals	0.0%	0	0
Kitchen Sinks	16.7%	129,272	173
Bathroom Sinks	19.3%	149,275	200
Cooling Tower Make-Up	37.1%	286,571	714
TOTAL	**106.1%**	**820,459**	**1,428**
		Gallons	Hundred Cubic Feet
Actual Metered Consumption (gal)		**773,432**	**1,034**

BUILDINGS 81 - ADMIN

Observations

1. Building is **not** on Campus Steam and CW Loop
2. Electric HW Heater for Domestic Use
3. Split Systems and Electric A/C Units
4. High Ratio – Men to Woman
5. Building has two Main Water Lines



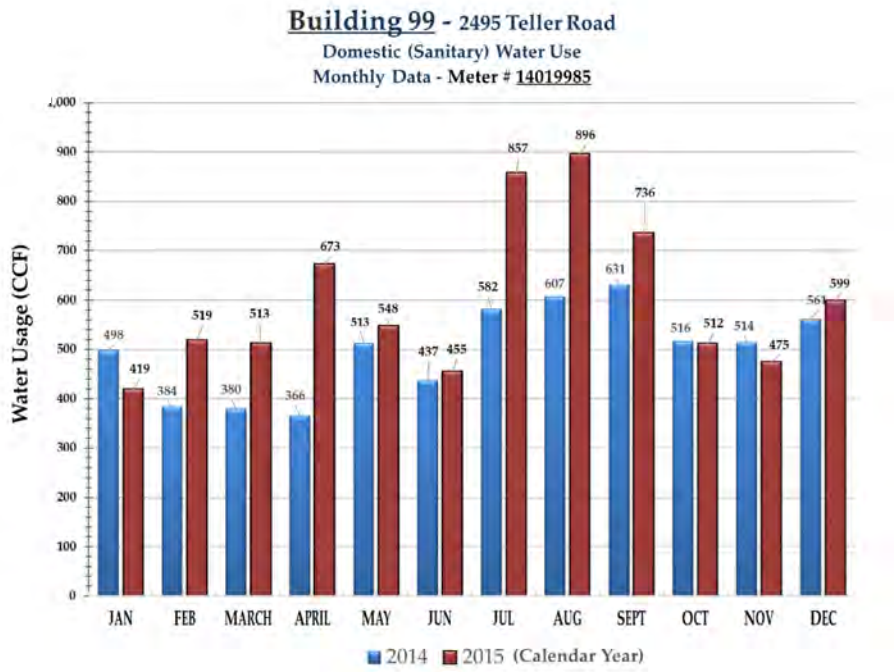


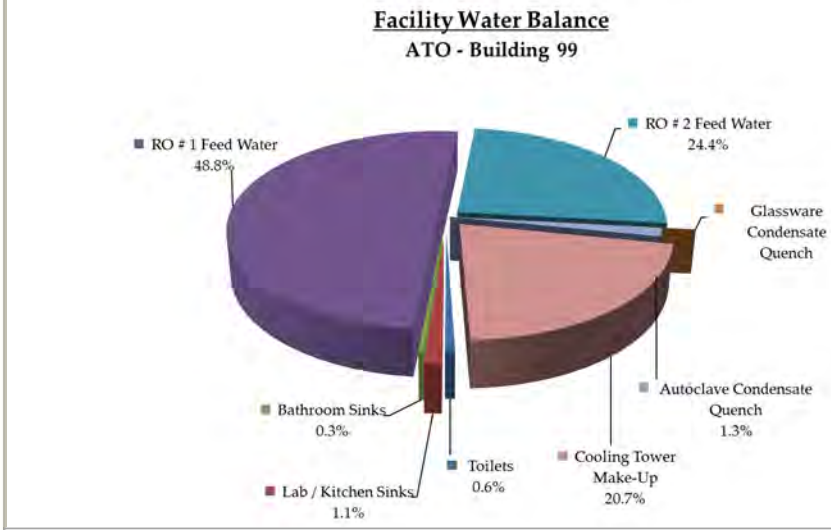
Facility Water Balance	Building 81		
	Percentage of Total	Consumption (gals)	Consumption (ccf)
Toilets	154.0%	186,645	250
Urinals	0.0%	0	0
Lab / Kitchen Sinks	119.4%	144,716	193
Bathroom Sinks	137.5%	166,647	223
TOTAL	**411.0%**	**498,008**	**666**
		Gallons	Hundred Cubic Feet
Actual Metered Consumption (gal)		**121,176**	**121**

BUILDINGS 99 - LAB

Observations

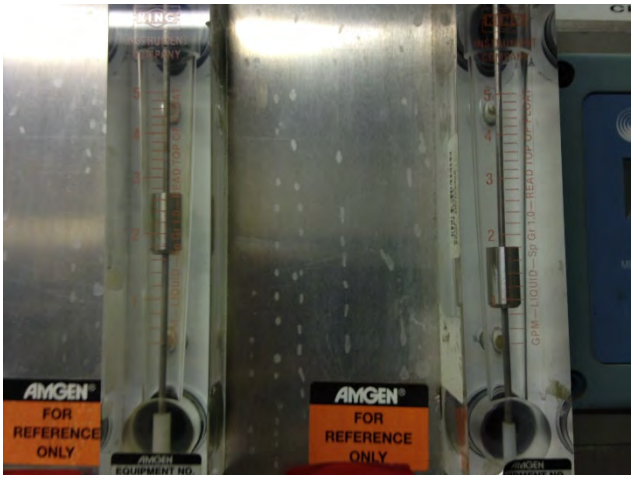
1. Building is **not** on Campus Steam and CW Loop
2. There are two RO systems; #1 one serves the boiler (make-up water) and #2 serves the labs and is the source for DI water.
3. The Cooling Towers are located next to the mechanical room which houses the RO units, creating a possibility for using RO reject used as CT make-up.





Facility Water Balance	Building 99		
	Percentage of Total	Consumption (gals)	Consumption (ccf)
Toilets	0.6%	33,935	45
Lab / Kitchen Sinks	1.1%	59,496	80
Bathroom Sinks	0.3%	16,120	22
RO # 1 Feed Water	48.8%	2,628,000	3,513
RO # 2 Feed Water	24.4%	1,314,000	1,757
Glassware Condensate Quench	0.1%	3,384	5
Autoclave Condensate Quench	1.3%	70,308	94
Cooling Tower Make-Up	20.7%	1,116,500	1,493
TOTAL	**97.3%**	**5,241,743**	**7,008**
		Gallons	Hundred Cubic Feet
Actual Metered Consumption (gal)		**5,387,096**	**7,202**

BUILDING 99 – PHOTO'S



One of the 2 – RO Systems supplying Building 99 with Pure Water. We installed an inline flowmeter and tested the water for use as Cooling Tower Make-up.

DOMESTIC WATER SYSTEM

Domestic water is often defined as 'water used for indoor and outdoor purposes' - all the things you do at work or home: drinking, preparing food, bathing, washing clothes and dishes, brushing your teeth, irrigating the yard and garden, and washing the dog. For the purposes of this section of the report, we are limiting the definition of Domestic water to ***'water used in the restrooms, fitness centers and showers'***. In actuality, Domestic municipal water mains serve most areas on campus, excluding Irrigation & Fire Suppression.

This section summarizes **existing** conditions and is followed by a section outlining our recommended actions.

Toilets – Existing Conditions

While performing our audit of the toilet fixtures that use domestic water, we were pleased to see that all of them have been replace with 'low-flow' models, **designed to operate between 1.28 – 1.6 gallons per flush (gpf).** As part of our audit procedure, we flush the fixtures to determine if they are functioning as specified; a commissioning process. During this exercise we began to notice that a large population of the low flow fixtures were flushing at double the design volume. After further inspection, we discovered that the facility maintenance staff has installed over 250 high flow (3.5 gpf) flush kits in the 1.6 and 1.28 gpf toilet fixtures. While the toilets will 'typically' perform with this excessive volume of water, it is not necessary and is detrimental to achieving water reduction goals and mandates. The 2015 usage for all of the toilets included in this report is almost **8.5 Million gallons** per year.

Urinals – Existing Conditions

About 95% of the Urinals on the ATO campus are waterless, or water free. There are 16 wall hung urinals in Building 24C and 9 wall hung urinals in B95 (not in scope), all of which are flushing at 1.0 gpm. There are no recommended actions for Urinals, in Section II.

Rest Room Faucets – Existing Conditions

The **2015 usage** for the rest room faucets included in this report is just over **19 Million gallons** per year. The current California plumbing code mandates the use of 0.5 gpm flow restrictors for restrooms, highlighted below in yellow.

Of the **764 restroom faucets** included in the scope of this report, flow rates are as follows:

Restroom Faucet Flow Rates	
Qty	**Flow Rate (gpm)**
104	**0.5**
68	**1.5**
342	**2.0**
246	**2.2**

Kitchen and Lab Faucets – Existing Conditions

The **2015 usage** for all of the kitchen/lab faucets included in this report is almost **4.1 Million gallons** per year. The current California plumbing code mandates the use of 1.8 gpm flow restrictors on kitchen or lab faucets, highlighted in yellow.

Of the **190 kitchen and lab faucets** included in the scope of this report, flow rates are as follows:

Kitchen/LabFaucet Flow Rates	
Qty	**Flow Rate (gpm)**
2	**1.8**
177	**2.2**
11	**3.5 - 4.0**

IRRIGATION AND WATER FEATURES

Irrigation

There is an extensive irrigation system on the ATO Campus designed using drip irrigation and water efficient nozzles. The system is run using Weathermatic® Irrigation Controllers that utilize Evapotranspiration data and soil moisture monitoring systems, to operate a peak efficiency. Due to ongoing drought in California, watering restrictions dictate that the system can only run each zone for 15 min, which forces these controllers to essentially 'ignore' all of the weather and soil moisture related intelligence.

There are **21 dedicated irrigation water mains, and 2 domestic water mains** (Bldgs. 33 and 34) that also feed the irrigation system as well as the water features. Although the 2 domestic water mains serving buildings **33 & 34** do not have irrigation sub-meters installed, the modeled water use indicates that **approximately 2.7 million gallons, of the total 34.2 million gallons** use for ATO Irrigation, is provided by these Domestic water mains.

Water Features

The Amgen campus is a beautiful and unique sustainable space designed by Fletcher Studio, out of San Francisco. The water features are embedded into the overall design and building architecture, and almost seem that they are natural formations functioning as part of the walking paths between buildings. There are a total of **15 water features** on the Amgen campus, being fed by some of the 21 dedicated irrigation meters. The water is cleaned in various filtration shacks on campus, containing standard pool filtration equipment, but the make-up water is not sub-metered.

CAFETERIAS / KITCHENS

The dining and catering services on the Amgen campus are run by Eurest (Compass Group) and provide food for the full time employees, visitors, special events and the Day Care center. The kitchens that support this large operation have done an outstanding job in addressing waste by installing efficient dishwashers, trough collectors, garbage disposals, pot washers, pre-rinse spray nozzles and tray wash stations that recycle a large content of the water. The water use is not sub-metered, but is estimated to be close to **2.3 million gallons each year**. Approximately sixty percent of the guests remain in the cafeterias for lunch while forty percent take their food 'to-go', which cuts down on water used to wash dishes and utensils. Because of the focus on sustainability, the food service operation is able to keep the water used per customer to just under 2 gallons per serving. That beats the typical benchmark of **3 -5 gallons per customer** by 50%.

The typical number of meals that are prepared each day, is summarized below:

Name / Function	# of customers / daily	Location
Terrace Café	1,300	B27
Marketplace Café	1,200	B38
Bisto	800	B29
Oasis	600	B32
Deli-37	120	B37
Child Day Care	200	B39
Catering	700	Various
	4,920	

Any additional savings in the kitchens will come from changes in human behavior, which is tough to control. Educating the kitchen staff to employ 'Best Practices' is always beneficial.

Some examples of Best Practices include:

- Educate and instruct staff about the importance of water efficiency.
- Instruct staff to quickly report leaks.
- Never defrost food under running water.
- Instruct staff to be attentive to turning water faucets completely off.
- Instruct staff to never leave running faucets unattended.
- Only run dish machines with full racks.
- Turn off dish machines and disposals when not in use.

CENTRAL UTILITY PLANTS - CUP

Cooling Towers

The main cooling towers are located in the Central Utility Plants (Bldgs 18N and Bldg 32), as the majority of the chillers are located in these buildings, providing chilled water to the campus buildings. The other towers are located in Bldgs 31, 80, 99 and PS-6, and the total city make-up water supplied to all towers in 2015, was approximately 58 million gallons; almost 28% of the total water usage on campus.

The water that is lost from the tower, and must be replaced by make-up water, is stored in the simple equation, below.

Make-Up = Evaporation + Blowdown + Drift

A key parameter used to evaluate cooling tower operation is *"cycles of concentration"* (sometimes referred to as cycles or concentration ratio). This is determined by calculating the ratio of the concentration of dissolved solids in the blowdown water compared to the make-up water. Because dissolved solids enter the system in the make-up water and exit the system in the blowdown water, the cycles of concentration are also approximately equal to the ratio of volume of make-up to blowdown water.

From a water efficiency standpoint, you want to maximize cycles of concentration. This will minimize blowdown water quantity and reduce make-up water demand. However, this can only be done within the constraints of your make-up water and cooling tower water chemistry. Dissolved solids increase as cycles of concentration increase, which can cause scale and corrosion problems unless carefully controlled.

Based on the data provided by the sub-meters that are installed on the tower make-up and blowdown (bleed) line, the cycles of concentration for the towers is shown below. Many systems operate between 3 and 5 COC's, across the United States.

CAMPUS COOLING TOWERS / CYCLES OF CONCENTRATION (COC)

Cooling Towers - Cycles of Concentration (COC)	
Tower Location	**COC**
18-1	2.8
18-2	3.2
31	1.3
32	6.5
80-1	No Blowdown Info
80-2	
99-1	1.4
99-2	3.5
PS6	1.6

Buildings 18N / 32

The primary central utility plant is housed in building 18N where steam, chilled water and RO water is produce for campus distribution. If we look back in this report at each building's water balance page, it is easy to see that the majority of the cooling is handled in 18N as represented by the level of evaporation and make-up water. Following the same process, it is evident that building 32 provides the majority of the RO water based on volume of feed water.

BOILERS / R.O. SYSTEMS

The steam boilers (all combined) are capable of producing over 150,000 pph and the boiler make-up source is 100% Reverse Osmosis water, which is extremely expensive and not the preferred method of recovering water losses. The condensate return system plays a big role in reducing the amount of RO water needed to replenish losses, but the system is in need of repair. We observed various traps that were failed and blowing steam as well as condensate pumps that were disconnected, sending the hot (R.O.) condensate directly to drain.

We installed ultrasonic flow-meters and Hobo data loggers to measure the amount of **R.O. water that is feeding the boilers** in both plants, because the inline meters in both buildings are not functioning.

Using that data, we have suggested multiple WCM's that are outline in *Section II.*

Building 99

Building 99 is located outside of the main campus and is not reliant on the Chilled water or Steam loop from the CUPs. The Boilers, Chillers, Cooling Towers and RO Systems function independently from the main campus.

RO Systems/Cooling Towers

There are two RO systems in the mechanical room, located on the side of the building by the cooling towers. We were able to install an inline flowmeter on the effluent (reject) line of the main system, that confirmed the accuracy of the flow indicators on the machine. The ratio of Permeate (product) to Concentrate (effluent) is 60/40. The unit consumes 5 gpm, sending 2 gpm directly to drain.

Flowmeter installed by Team and 'real-time' flowmeters on the

At current water rates, the value of this water (yearly) is shown in the table below:

Building Number	Gallons of RO Effluent / year	Value of Effluent @ $6.24 / kGal
99	1,733,968	$10,820

SECTION II – *Water Conservation Opportunities*

DOMESTIC OPPORTUNITIES

The recommended Water Conservation Measures for the Domestic Plumbing system are discussed below; we are addressing the toilet fixtures and the restroom sinks. Most of the lab and kitchen sinks are flowing at 2.2 gpm and adding flow restrictors to these faucets could impede on productivity. Because of this concern, we have not included any recommended actions for the kitchen or lab faucets.

Commercial Toilets

Our team identified **eight hundred and sixty-eight (868)** commercial wall and floor mounted toilets that were observed during our audit. Out of that population, **two hundred and fifty-one (251)** are operating above the design flush rate.

The quantities and types are shown in the table below.

Commercial Toilet Inventory		
Qty	**Flow Rate (gpm)**	**Actual Flush**
17	1.28	1.28
582	1.6	1.6
150	1.6	**2.4**
101	1.6	**3.5**

RECOMMENDED ACTIONS

Replace all existing 2.4 and 3.5 gpf flush kits **(Qty 251)** with new Silicone 1.6 gpf flush kits, and adjust controls stop for optimal performance.

Potential Savings realized by implementing this WCM are 1,462,200 gallons each year. At current water rates, that equates to $9,124 each year

Restroom Faucets

The **2015 usage** for the rest room faucets included in this report is just over **19 Million gallons** per year. The current California plumbing code mandates that restroom faucets may not flow at a rate higher than 0.5 gpm for restrooms. There are seven hundred and sixty-four (764) restroom sinks on campus and range from 0.5 gallons per minute (gpm) to over 3.5 gpm. A total of six hundred and forty-three faucets (643) are prime candidates for water savings and the details are on the next page.

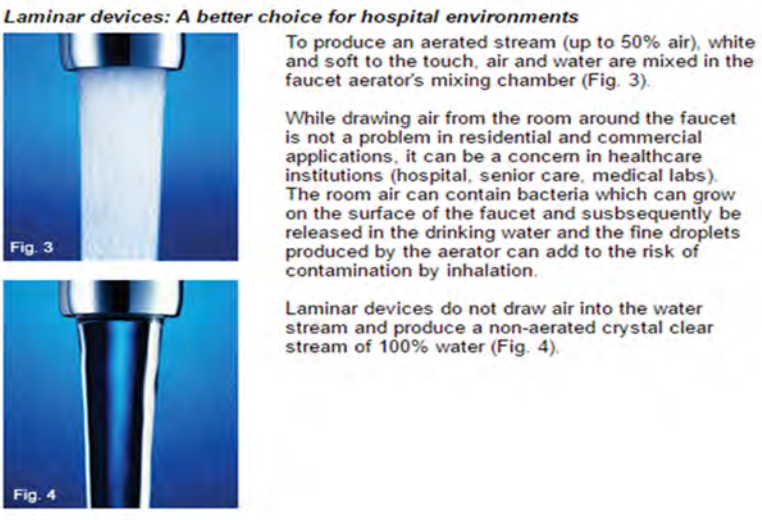
Restroom Faucet Flow Rates	
Qty	**Flow Rate (gpm)**
104	**0.5**
68	**1.5**
329	**2.0**
246	**2.2**

Recommended Actions

Replace all **six hundred and forty-three (643)** high flow faucet restrictors with Neoperl 0.5 gpm Laminar flow restrictors.

Potential Savings realized by implementing this WCM are **14,004,482 gallons each year.** At current water rates, that equates to **$87,388** each year and will put all faucets in compliance with current plumbing codes. There is also fuel savings associated with the hot water reduction through the sinks

We recommend non-aerating **(Laminar) flow restrictors** because they do not introduce air into the water stream, reducing the possible spread of airborne pathogens, such as **Legionella**. A product specification sheet is included in the Appendix. airborne pathogens, such as **Legionella**. *A product specification sheet is included in the Appendix.*



NON-DOMESTIC OPPORTUNITIES

As indicated earlier, non-domestic water use is defined as any water use outside of the restrooms and locker rooms. It includes all water that supports or cools a process in an industrial or commercial environment, and does not have to be potable.

Reverse Osmosis Systems

Since the R.O. units at Amgen operate at high pressure, the reject water is discharged somewhere between 50-100 psig. If the logistics are right, we can simply pipe the R.O. reject water to its reuse location under its own pressure, without the need for tanks and pumps; this is the most cost effective option. This approach works well if it can be piped directly into a cooling tower basin. If this option is not feasible, the R.O. reject water can be piped to a new storage tank where it is pumped to its reuse location.

Using R.O. Effluent for CT Make-Up (Bldgs. 99)

As mentioned earlier, we installed an inline flow meter on the effluent (reject) line of the largest RO system in the Mechanical room of building 99. The unit consumes **5 gpm** of city water and sends **3 gpm** of effluent (reject) directly to drain, while producing **2 gpm** of product

RECOMMENDED ACTIONS

Just outside of the mechanical room that houses the two RO systems in building 99 are a pair of Marley Cooling Towers. According to the make-up meters, these towers use **1.1 million gallons of water each year**. The cost of the cooling tower make-up water at current rates is: **1,116,500 / 1000 * 6.24 = $6,966 /year**

We tested two RO reject water samples for various markers;
the results are included in the Appendix.

RO is running at 60% Reject / 40% Product (3 gpm reject / 2 gpm Product)				
Building 99 - Reverse Osmosis Reject *(effluent)*				
Date & Time	Totalized RO 'Effluent' produced (gallons)	Number of Days Between Readings	Volume Between Readings	Average Gallons Per Day
11/20/2015 6:52	***Installed***			
12/7/2015 15:05	75,212	17	75,212	4,424
1/14/2016 9:36	255,524	38	180,312	4,745
1/22/2016 8:05	296,184	8	40,660	5,083
	296,184	**63**	**296,184**	**4,751**
5 gpm City Water Feed=	**2,628,000**			
Yearly RO Effluent Available for Reuse (gallons):			**1,733,968**	
The conductivity (from our lab tests) is showing about **1,000 µS** which means we can get 2 cycles of concentration in the Cooling Towers, if we reuse this as make-up.				

At current water rates, the value of this water (yearly) is shown in the table below:

Building Number	Gallons of RO Effluent / year	Value of Effluent @ $6.24 / kGal
99	1,733,968	$10,820

The conductivity of the reject water is illustrated in the table, below:

RO Reject Conductivity (µS)		Microsiemens
Bldg 32	1592	
Bldg 18N	1465	
Bldg 99	1019	

Since the **C**onductivity is low (**1,019 µS**) and CT blowdown was recently raised to approximately **2,700 µS**, we can provide at least **2 Cycles** of Concentration if we send this effluent to the Marley Tower(s).

Potential Savings realized by implementing this WCM are 1,116,500 gallons each year. At current water rates, that equates to almost $7,000 each year

R.O. Water as Boiler make-up

As mentioned earlier in this report, our team installed ultrasonic flow-meters and Hobo data loggers to measure the amount of **R.O. water that is feeding the boilers** in both plants, because the existing inline meters (in both buildings) are not functioning.

The yearly use (gallons) of RO water as Boiler feed water is shown below:

Buildging Number	Gallons / year	Cost / year @ $2 gal
18N	3,202,875	$6,405,750
32	1,519,024	$3,038,048

RECOMMENDED ACTIONS

The water quality supplied by the Thousand Oaks City meets all of the ASME recommendations for Boiler Feed water quality, except total harness (Calcium & Magnesium Salts). *A 2015 Amgen city water quality report is included in the Appendix.*

Total Hardness	**1 PPM Maximum**
Total Alkalinity	**600 PPM Maximum**
Total Silica	**150 PPM Maximum**
Iron Content	**0.1 PPM Maximum**
pH	**8.5 – 10.5**
Total Dissolved Solids	**2,200 to 2,500 PPM**
Oxygen Content	**0 PPM**
Carbon Dioxide	**0 PPM**

(Source: Cleaver-Brooks, Inc.)

Installation of an Industrial Water Softening system will remove the necessary calcium, magnesium, iron and manganese to meet the ASME Boiler Feed water guidelines. Water softeners use a process called *ion exchange* to remove calcium and magnesium from the water. The hardness minerals are replaced with a highly soluble sodium or potassium ion that will not cause scale buildup, helping a boiler maintain efficiency throughout its life. By preventing scale buildup, a water softener also reduces a boiler's fuel consumption.

A 1/16" thick layer of hardness scale can reduce heat transfer by about 12 percent, which is directly proportional to the increased amount of fuel required to compensate for the loss.

The recommended hardness of boiler feed water is less than 1 ppm, so while a water softener is required for nearly all boilers, using R.O. water is extremely costly and not necessary. Any 'clean steam' requirements are supplied by freestanding clean steam generators that use pure water, and the campus steam is not introduced into this steam supply. It is only used in a HEX to transfer the heat needed to produce steam from the pure water in the clean steam generator.

Potential Savings realized by implementing this WCM are 4,721,899 gallons of Reverse Osmosis water, each year. At current RO production rates of $2 per gallon, that equates to almost $9.5 million, each year.

Note: One of the major considerations of using a softening system is the **backwash** of the softeners during **the regeneration cycle**. The City of Thousand Oaks Sewer Authority has limits on what can be sent through the Outfall and into the treatment plant. Since the resin beds are regenerated using a brine solution, the final flushing of the softeners will send water with a high salt concentration through the sewers. If this presents an issue, there is an exchange program where 'recharged' resin tanks are delivered and exchanged for the existing *spent* tanks. We actually did witness the use of these in building 7U, while conducting our audit.

In order to calculate accurate ROI for this WCM, further investigation needs to take place.

Liquid Pool Covers on Water Features

Liquid pool covers are essentially a biodegradable layer of oil which will significantly reduce evaporation without damaging equipment like pumps and filters. The oil itself has a half-life of approximately 24 hours and newer technologies last for roughly one week. During periods of activity caused by fountains, the oil simply mixes in with the water. When the fountains are turned off, or in areas of the water features where the water is calm, the oil will float to the top and create a barrier that reduces evaporation and heat loss. Obviously heat loss is not a concern for the outdoor features but would apply to indoor pools and spas.

How much water is lost every year to evaporation? The Los Angeles Airport experiences an estimated 65.5 inches per year of "pan" evaporation – the amount of water that evaporates from a standard measuring device used by hydrologists – a four-foot diameter Class A evaporation pan. The City of Thousand Oaks experiences and estimated 55 inches per year of 'pan' evaporation which is less than the rate that we would see in the ATO Water Features, because of the fountains which atomize and disturb the water, causing an increase in evaporation.

According to the table below, the ATO campus see approximately 14.5" of rain each year, so we can subtract that from the local evaporation rate, and use 40" per year in our calculations.

VENTURA, CALIFORNIA (049285)

Period of Record Monthly Climate Summary

Period of Record : 01/01/1900 to 08/31/2013

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	66.9	65.3	68.2	68.0	67.7	70.9	73.0	74.3	74.3	73.7	71.2	69.9	70.3
Average Min. Temperature (F)	45.0	43.2	45.8	47.0	48.7	53.0	55.1	54.3	52.8	51.6	48.1	45.1	49.1
Average Total Precipitation (in.)	3.05	3.26	2.55	0.98	0.23	0.04	0.01	0.02	0.22	0.49	1.46	2.37	14.67
Average Total SnowFall (in.)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average Snow Depth (in.)	0	0	0	0	0	0	0	0	0	0	0	0	0

Percent of possible observations for period of record.
Max. Temp.: 0.1% Min. Temp.: 0.1% Precipitation: 87.1% Snowfall: 87% Snow Depth: 86.8%
Check Station Metadata or Metadata graphics for more detail about data completeness.

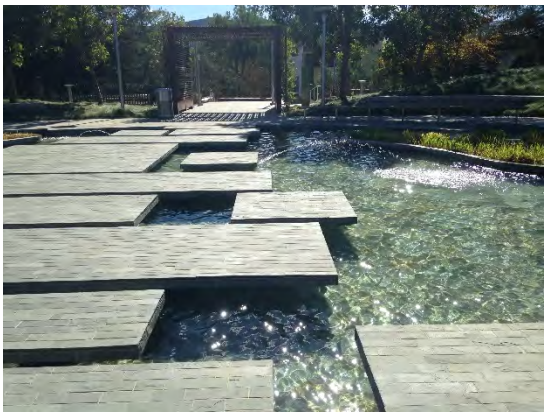
Western Regional Climate Center, wrcc@dri.edu

See Appendix on California Evapotranspiration Zones

RECOMMENDED ACTIONS

After running the calculations, it is obvious that without the Heat Savings associated with this WCM, it is clearly not financially feasible to implement this WCM.

We can illustrate the savings using **Water Feature 'E'** as an example, which is a shallow circular pond with stepping stones, decorative fountains, and a diameter of 30 feet. Using the adjusted evaporation rate of 40" per year, we can estimate the total evaporation using the area of the pond: $\boldsymbol{A = \pi r^2}$



Area = (3.14) x $(15)^2$ = 706.5 ft^2

*(40" = **3.33 ft**)*

3.33 ft / year x 706.5 ft^2 = 2,353 ft^3 or **17,602 gals/year**

If the fountains run 50% of each day, then the evaporation is only effective for the hours that the water is not agitated, which is 12 hours.

At the current water rates of $6.24 kgal and calm water, savings are only $110 each year and therefore is not a recommended WCM

The technology is called: Evaporation suppressing monolayers – (click here)

Repair Quench Pots and Solenoids on Sterilizers

An autoclave consumes water for three purposes: steam generation, effluent cooling, and vacuum generation. When the sterilizer is powered on, but in its idle state, steam enters the jacket and pre-heats the sterilizer to prepare it for operation. Whether the sterilizer is in its idle state or mid-sterilization, **steam is continuously condensing** within the autoclave and this condensate is discharged to a floor drain. In order to comply with building codes, all condensate and waste steam (commonly referred to as effluent) must be cooled down to below **140°F** prior to discharge. Cooling down waste steam and hot condensate is primarily achieved by mixing **raw cold water** with the sterilizer waste stream and then immediately discharging the entire mixture to drain.

Diagram of Steam Sterilizer with Vacuum System

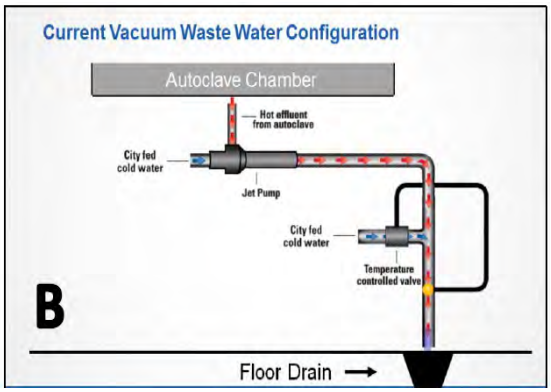


Diagram of Effluent Flow from Steam Sterilizer with Vacuum System

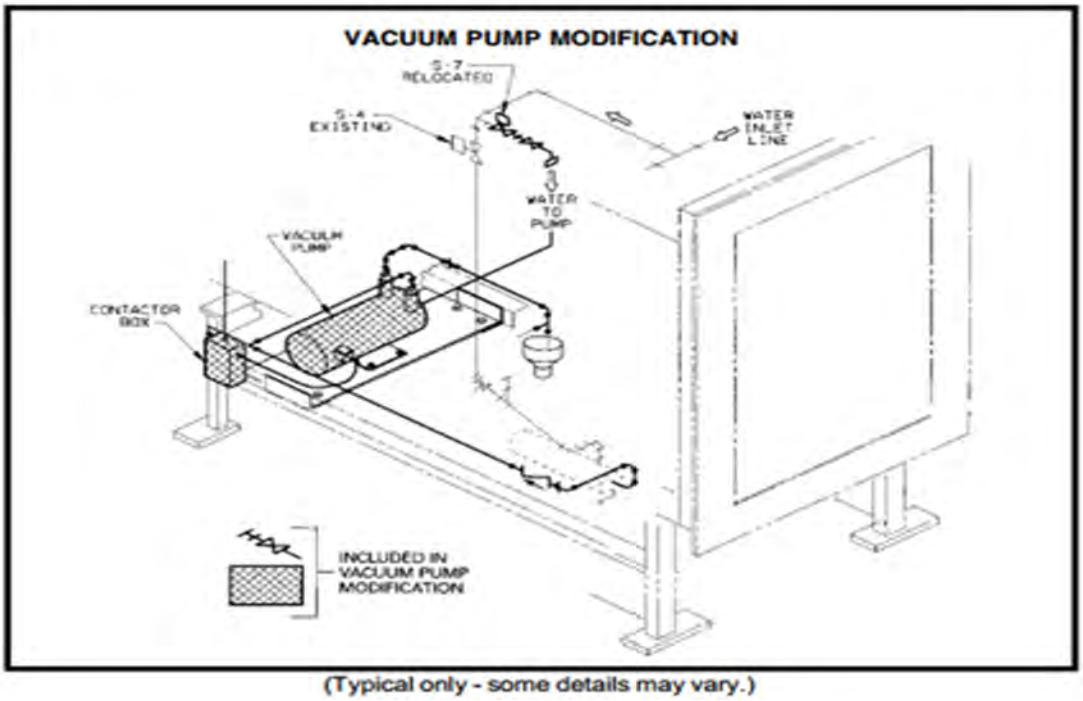
Many older sterilizers in the field employ a "constant-bleed" of cold water to cool the effluent. In this design, cold water flows through the sterilizer toward the drain 24/7, even if the sterilizer is off. These units typically consumed between 1,500-2,500 gallons of raw water per day in cooling water, resulting in an annual water consumption of almost 1 million gallons per year. Fortunately, this design is no longer used on new equipment. Newer sterilizers improve the constant-bleed cooling process by throttling the cold water on and off only when hot effluent (>140°F) is present. This "throttled-flow" configuration results in an average 90% reduction of the cooling water.

In addition to using city water to quench the condensate, vacuum sterilizers utilize once-through water to draw a vacuum for the unit. This water is flowing to drain at and an average 5 to 6 gpm, during a chamber dry cycle.

RECOMMENDED ACTIONS

Vacuum Pump Modification

Substantial water savings will be achieved on the Vacuum Sterilizers, by installing a water saving retrofit kit. The kit eliminates the water ejector (venturi) and replaces it with a vacuum pump as illustrated below.



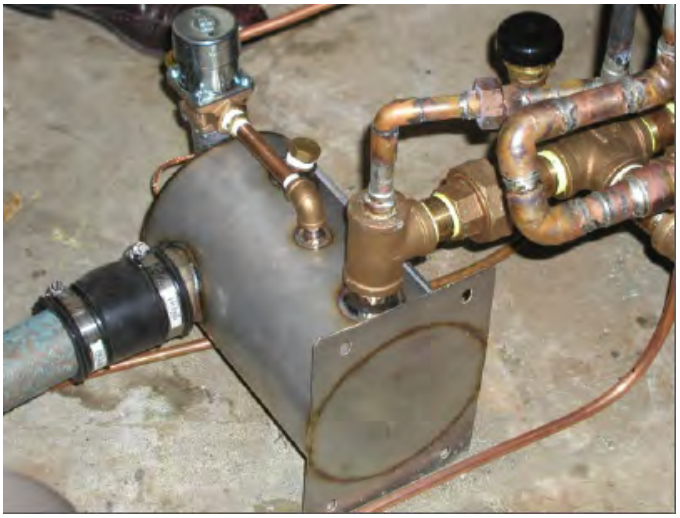
(Typical only - some details may vary.)

In order to calculate accurate ROI for this WCM, further investigation needs to take place, but will fall into the 2 – 3 year, payback range.

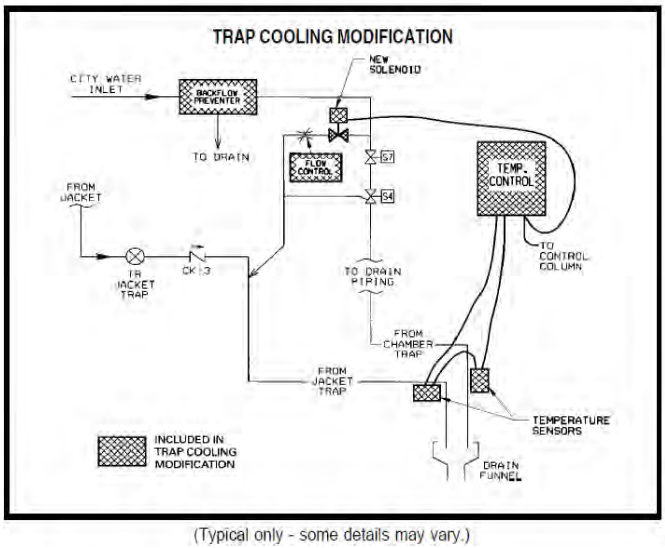
Condensate Cooling

Both the Gravity and Vacuum sterilizers use city water to quench the effluent to meet the city code of 140-degree discharge. Substantial water savings will be achieved by replacing the existing cold water quench with a retrofit kit designed to monitor the effluent discharge temperature, and quench with cold city water only when necessary. Amgen has several of these installed, but a large number of the solenoids are not functioning correctly, or are failed 'open'

Solenoid on Amgen's city water 'quench' line that is failed



Example of a 'custom made' quench pot that is functioning correctly



(Typical only - some details may vary.)

In order to calculate accurate ROI for this WCM, further investigation needs to take place, but will fall into the 2 – 3 year, payback range.

Repair Condensate Return System

There are many instances where condensate return lines are 'direct buried' and corrosion is a problem due to moisture, improper backfill and expansion/contraction, causing these pipes to fail before the end of their useful life. During our audit of **building 38**, we came across a large condensate return skid that was not in operation because the 'direct buried' return line was corroded. Since the is condensate is (approx) 180 °F RO water, this is an extreme waste that should be corrected immediately.

RECOMMENDED ACTIONS

Replace existing 'buried' condensate lines with pipe made from insulated Stainless Steel, like the Perma-Pipe 500. The cost of RO water at approximately $2 /gal plus the heat and chemical costs, will provide an **ROI of under 2 years.**

PERMA-PIPE 500

In order to calculate accurate ROI for this WCM, further investigation needs to take place, but will fall into the 1 – 2 year, payback range.

Vortex Technology (Chemical Free) - Cooling Tower Treatment

Historically, facility operators used chemicals to control conditions in the cooling towers caused by dissolved solids, dissolved gasses, organic compounds, suspended solids and microorganisms in the water. A properly managed chemical treatment program needs to be adjusted, monitored and controlled. In practice, this has been challenging to accomplish since a properly managed chemical program requires constant adjustments due to changes in the system water and make-up water

Most cooling tower treatment in the U.S. is still accomplished with biocidal, dispersant, and scale-inhibiting chemicals. While chemical treatment is effective, there are considerations beyond the cooling tower. Regulations are increasingly stringent for chemical storage, handling,

and disposal. Reducing or eliminating chemical usage in the treatment of cooling-tower water is the ultimate objective.

To resolve many of the issues associated with chemical treatment, technologies using non-chemical treatment have been evolving. Non-chemical devices (NCDs) use many different technologies to achieve biological and corrosion control. Over 30 suppliers are known to provide commercially available products that can be grouped into four basic classes or methodologies:

1. Magnetic devices
2. Induced electric field devices
3. Ultrasonic devices
4. Mechanical energy devices.

One *very* promising technology that falls under category 4 (above) is based on a process called Controlled Hydrodynamic Cavitation (CHC). These systems rely on kinetic energy in addition to chemical equilibrium to control scale, corrosion, and bio-fouling without the hazards of chemical treatment. CHC also minimizes corrosion and microbiological growth, reduces system operating costs, and conserves water and energy. Cavitation is the dynamic process in a fluid where micro-sized bubbles form, grow, and collapse. When pressure falls below a critical value, cavities are formed in the liquid. When pressure increases, the cavities cannot sustain the surrounding pressure, and consequently, collapse, creating localized points of extreme high pressure and temperature. While the technology is not new, usage (Vortex / VRTX) has been limited to Cooling Towers outside of the United States. In the past 8 years, there have been many systems installed in the United States, and case studies are available on the internet. And because CHC is a chemical-free system, the tower blow-down may be reused for other purposes, like irrigation!

Recommended Actions

Russ Koehler has already been working with CEC and Southern California Edison, to secure grants that will assist in funding a pilot test of this system, on one of the PS6 Cooling Towers.

Zero Blowdown System for Cooling Towers

There are many approaches to remove scale forming ions (dissolved Ca, Mg and Fe) in Recirculating Cooling Tower (RCW) systems. The most popular approach uses electricity / magnetic fields or chemicals to force precipitation of these scale forming species out of solution and incorporating a ½ micron side-stream filter to remove the suspended solids. The problem with this approach is that the precipitation that occurs outside the basin or after the side-stream filter (post-precipitation) will foul /scale up heat exchangers, condensers and the fill of the cooling tower. This approach is also limited in cycles by silica, to a maximum of 120 to 150 ppm which limits the water conservation focus of our program.

Although softening feed water prior to using it as Tower make-up is not new, a company in California (WCTI) has improved upon this concept and is achieving 50 to 100 cycles of concentration, while increasing the concentration of specific ions resulting in a reduction of corrosion rates and a huge gain in water conservation. Over Two Hundred (200) WCTI systems have been installed for a multitude of different CII customers such as Boeing, Intel, State of California Universities, Microsoft, Apple, U.S. Navy Shipyard Bremerton, Honda, many hospitals and office buildings in the US and Philippines.

How it Operates:

The Cooling Tower makeup goes through an extensive water softening step using the tried and proven 'ion exchange' process, which has been known since the 1950's. With the scale forming ions removed, there is little to no scale buildup on the surfaces of the RCW. Concentrated Silica becomes the scale free metal protectant and supplemental Silica, as high as 100 ppm, are used at Intel with no issues; "more silica is better". Regenerated with normal salt (NaCl), the softener removes Ca, Mg and Fe by the ion exchange method and there is no dangerous lye (NaOH or KOH) or **acids** used in the process; just water softener salt.

As cycles increase, Alkalinity builds to give a **pH of 9.5 to 10.2** which is a natural mild steel corrosion protector. At this pH, the water is in a natural biostatic condition, which **inhibits bacterial growth**.

A side stream filter is optional but recommended (sand, DE) on this system with surrounding dirt, sand or debris in the air. There is a large amount of independent data, NACE reports and laboratory analysis that is available for review.

Recommended Actions

Water Efficiency Technologies suggests that Amgen considers investigating the feasibility of implementing a WCTI 'Zero Blowdown' system. Once the system is operating in a balanced state, **the system will not require blow down**. The company is California based, and will make a site visit at your request.

Sub-Metering – Process Water / Water Features / Kitchens

Implementing a sub-metering program can help identify leaks, monitor consumption, and identify abnormal usage on a building-by-building basis. By sub-metering several of the larger, high water-use process equipment, kitchens, outdoor water features, fitness center spa, a facility can better understand usage patterns and react to increases in water consumption. This data can also be incorporated into most of the BAS systems and dashboards, for visible and audible monitoring.

Automated Meter Reading systems (AMR's) are extremely effective and accurate and depending on the scalability of Amgen's current BAS system, HBS may be able to utilize that platform to tie in the water metering infrastructure, either by hard wiring meters or using wireless transmitters; providing real time water consumption information.

Improving the existing sub-meter infrastructure that monitors Amgen's irrigation and cooling tower make-up, should be a priority to ensure sustainability of the WCM's that are being considered. The meter data we received for the CT make-up and blowdown, was extremely inconsistent and difficult to rely on as 'accurate data'.

Note: Amgen's sewer charges are based on flowmeters located at B34, B99 and PS6, so the City of Thousand Oaks is not assessing sewer charges for water that is evaporated (Irrigation / Cooling Towers)

Recommended Actions

- Install sub meters on all main water lines serving each RO system, as well as on the product and concentrate (effluent) lines, at the end of the process train.
- Install sub-meters on Spa/Pool in Fitness center to monitor for leaks or abnormal evaporation
- Install sub meters on all make-up water lines for outdoor water features, located in all pump/filter sheds.
- Install sub meters on all Main Kitchens and track usage versus number of transactions
- Test all sub-meters annually to ensure that they are still operating properly.
- Incorporate sub-meters in Building Automation System .

Using RO Reject to Flush Toilets in Building 24

At first glance, this appeared to be a logical WCM but the building only uses about 330,000 gal/yr to flush toilets. At the current water rate of $6.24 / kGal, this would only provide savings of just over $2,000 a year**.** The scope of mechanical changes that need to be made to the existing plumbing system in Building 24, in order to meet current plumbing codes related to **water reuse in toilets, is cost prohibitive.**

REBATES

Ventura County Rebate Information

- In light of the Governor's Executive Order and overall drought awareness, our California American Water customers have been actively participating in the SoCal WaterSmart rebate incentive program. Public interest in conservation rebates has been overwhelming and program funding has been committed. Approval of applications is on a first-come first-serve basis and subject to availability of funds.

California American Water customers are eligible for several in-house water conservation rebates. The Metropolitan Water District of Southern California also offers additional water conservation rebates. Rebates are offered for both our customers with residential and commercial properties. Refer to the appropriate sections below for more information. **Please note that only California American Water customers are eligible to apply for in-house rebates.**

All rebate amounts and rebate program availability are subject to change. Please call (805) 498-1266, ext. 2809 to determine current eligibility.

PLEASE NOTE: *Customers must not have already received a rebate for the same product at the same address. If a customer has already received a rebate from their water agency or MWD for a qualifying measure or device, they may not apply for that same measure or device a second time.*

Turf Removal Rebate Program

California American Water is suspending our turf rebate program in Ventura County at this time. We hope to identify additional funding sources and resume offering turf removal rebates in the future. Customers who have submitted their application to Metropolitan Water District's SoCal Watersmart program before the program was suspended on July 9, 2015 will still be eligible to receive their rebate. Customers can also submit their rebate application to SoCal Watersmart's waiting list to be eligible should further funding become available later this year through SoCal Watersmart. If you would like to be notified if additional funding becomes available through CA American Water's turf rebate program please leave a message with your name, address and telephone number on our local conservation hotline 805 498-1266 X 2819.

SoCAL Water$mart Rebates

Effective May 1, 2015, High Efficiency Toilet rebates are being offered starting at $100.00 per toilet (1.6 gpf and under) for commercial properties.

- Increased incentive for commercial flushometer toilets – base rebate is now $100
- Increased incentive for rotating nozzles – base rebate is now $4 per nozzle
- Laminar flow restrictors – rebate is $10 per restrictor

Program details can be found here:

http://socalwatersmart.com/index.php/home-cii

Our team can assist in making the reservation via the online reservation system for the qualified device(s). We must purchase and install the qualified devices within 60 days of making reservation and complete an online application, print, sign and mail the application packet to the Water$mart program for processing including:

- A copy of the water bill for the property at which device was installed.
- Invoice for device(s) purchased showing manufacturer and model numbers.

ASHRAE 188 – PEVENTION OF LEGIONELLOSIS

ASHRAE, founded in 1894, is a global society advancing human well-being through sustainable technology for the built environment. The Society and its members focus on building systems, energy efficiency, indoor air quality, refrigeration and sustainability within the industry. Through research, standards writing, publishing and continuing education, ASHRAE shapes tomorrow's built environment today. Their standards are used on a global basis and are usually incorporated in **building code,** and ASHRAE 188 will probably follow that trend. This standard defines what types of buildings should have a **water management program**, and the minimum components of the program. It defines the aerosol-generating devices that need to be controlled in order to prevent legionellosis transmission. It also defines **who should develop the program** and how often it should be reassessed. It also includes an Annex developed specifically for **healthcare facilities** that adds clinical surveillance to the program. By creating a framework for proactively managing building water systems and reducing the potential for Legionella colonization of these systems, this should prevent many but not all cases of legionellosis.

This standard applies to human-occupied commercial, institutional, multi-unit-residential and industrial buildings, excluding single-family residential buildings. Only where specifically noted in this standard, shall certain building water systems or parts of building water systems be exempt.

ASHRAE 188 does not technically require water sampling though it is highly recommended. Water Efficiency Technologies' professional recommendation would be to sample any cooling towers, showers or water (lobby fountains) features. Potable sources (two every other floor) are most regularly inspected/sampled in buildings over 10 stories.

Certain labs are certified to run these types of samples and the specific certification for this is held under the CDC Elite program.

http://www.cdc.gov/legionella/elite.html

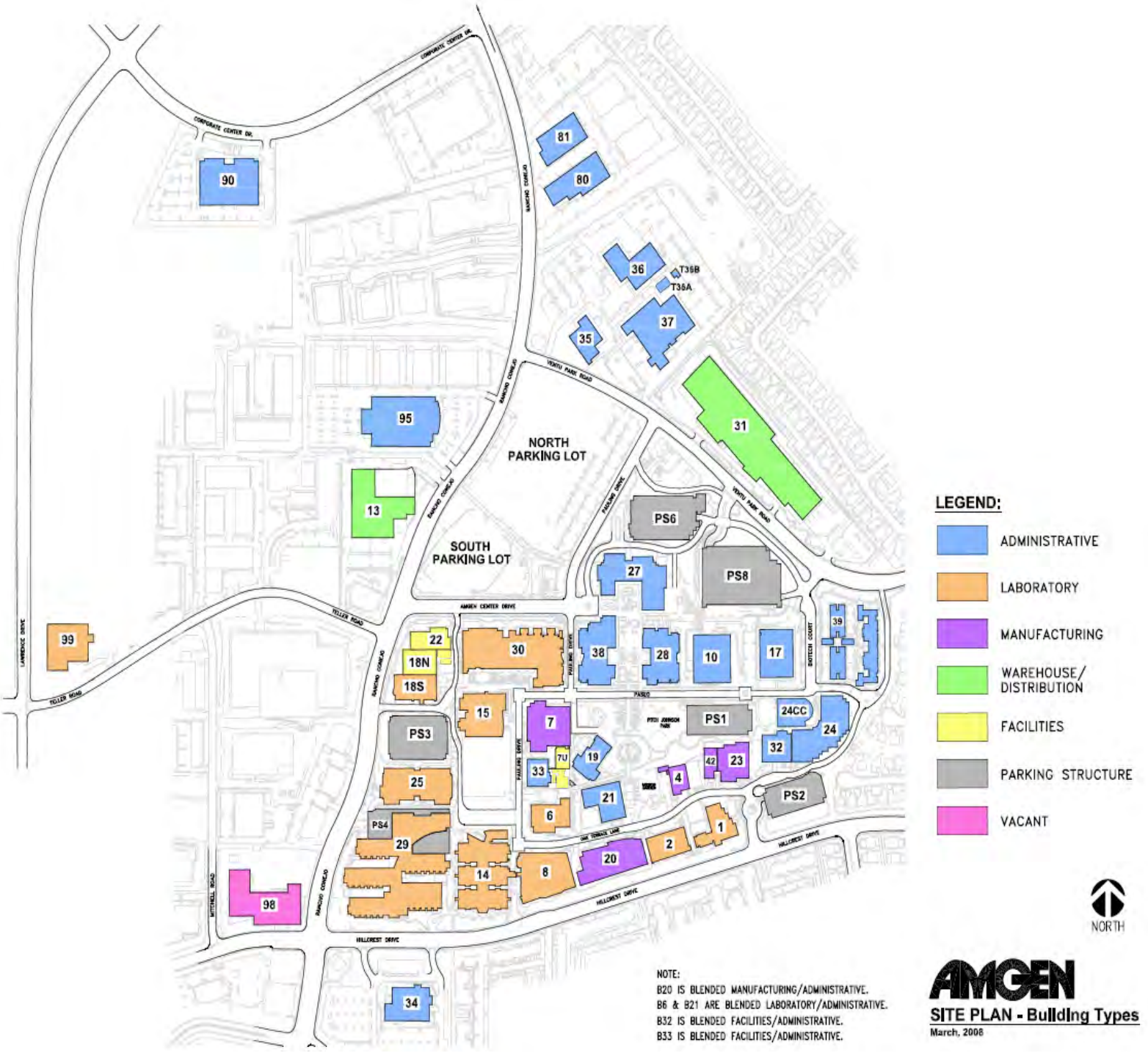
The following list are the typical categories that will need **full schematics**, hazard analysis summaries, procedures, and other strategies to comply with this new (soon to be) requirement.

- Building Use
- Number of stories
- Inpatient healthcare facility – Yes/No
- Primary occupant age and immune risk
- Total residual oxidant concentration of incoming potable water as Chlorine
- Presence of cooling towers and/or evaporative condensers that provide cooling and/or refrigeration to the HVAC system
- Presence of whirlpools and/or spas
- Presence of water-based devices that, by design, release aerosols

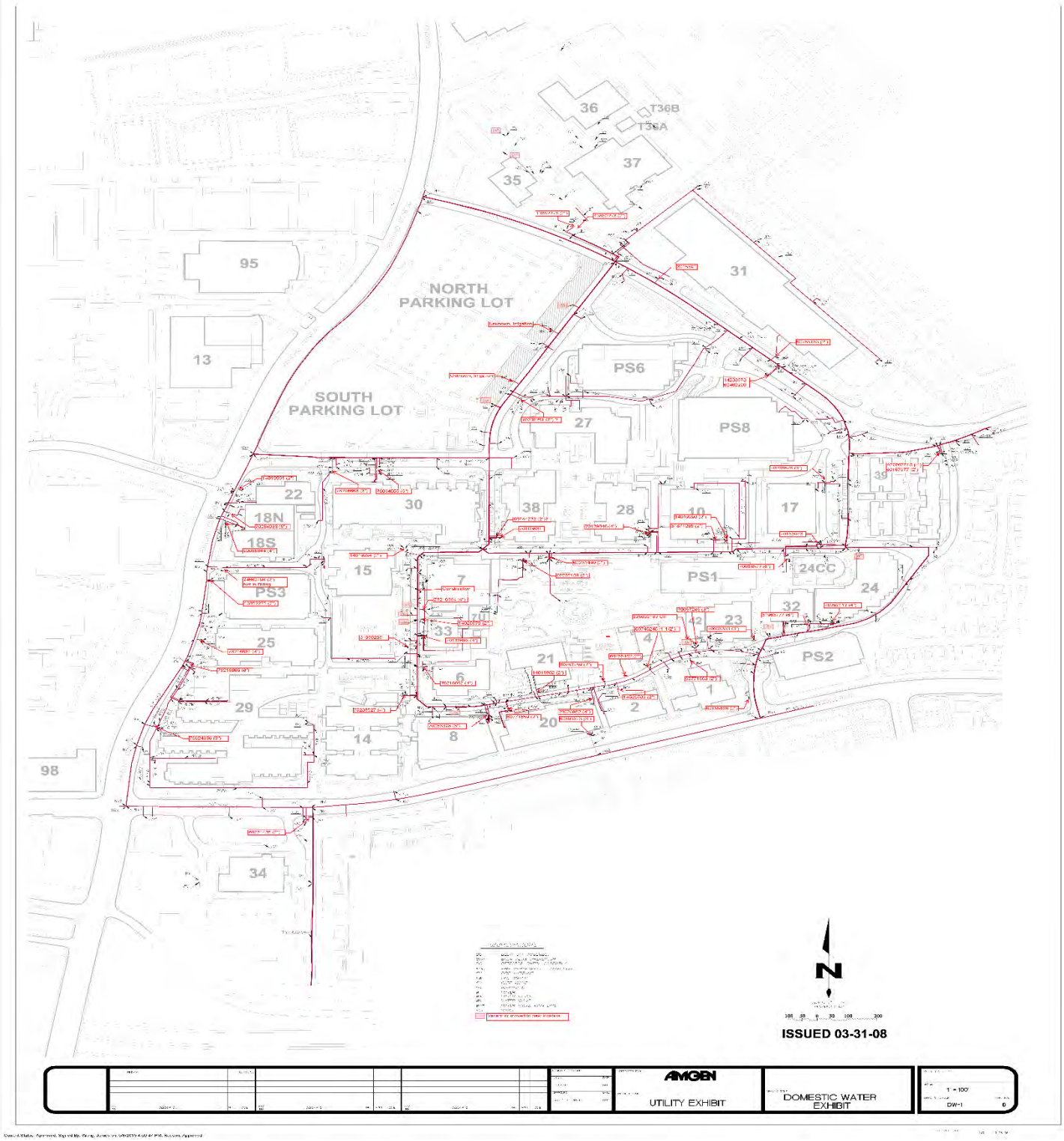
APPENDIX

- Campus Map – Buildings
- Campus Map – Water Meters
- List of Buildings included in Report
- Domestic Water Savings Calculations – *Sample Bldg*
- Domestic **Hot** Water Savings Calculations – *Sample Bldg*
- Water Meter Inventory
- Amgen City Water Quality - 2015
- Water Test Report – R.O Reject (Building 99)
- Water Savings Calculations – Domestic Water Example
- Energy Savings Calculations – Domestic **Hot** Water Example
- 'Vortex' - Hydrodynamic Cavitation - *Schematic*
- 'Zero Blowdown - *Schematic*
- Neoperl 0.5 Faucet Flow Restrictor – *Specification Sheet*
- California Evapotranspiration Zones

CAMPUS MAP - Buildings



CAMPUS MAP – Water Meters



List of Buildings Included in Report

Name	Use	Status	Own/Lease	External (sq. ft.)	Internal (sq. ft.)	Status	Address	Flrs	
Building 1	LAB		OWNED	20,961	20,476	**ABANDONED**	1892 Oak Terrace Lane	1	Not In Scope
Building 2	LAB		OWNED	23,862	23,379	**ABANDONED**	1900 Oak Terrace Lane	2	
Building 4	MFG		OWNED	9,833	9,450	**ABANDONED**	1897 Oak Terrace Lane	2	
Building 6	LAB	Active	OWNED	37,261	36,458	IN_USE	2003 Oak Terrace Lane	2	
Building 7	MFG	Active	OWNED	81,467	79,043	IN_USE	770 Pauling Drive	3	
Building 7U	Other	Active	OWNED	13,032	12,475	IN_USE	720 Pauling Drive	2	
Building 8	LAB	Active	OWNED	72,955	70,068	IN_USE	1916 Oak Terrace Lane	2	
Building 10	ADMIN	Active	OWNED	74,254	73,188	IN_USE	815 Biotech Court	2	
Building 13	Other	Active	LEASED	55,451	54,884	IN_USE	999 Rancho Conejo Blvd	1	
Building 14	LAB	Active	OWNED	190,318	178,378	IN_USE	701 Pauling Drive	3	
Building 15	LAB	Active	OWNED	125,707	122,298	IN_USE	767 Pauling Drive	3	
Building 17	ADMIN	Active	OWNED	79,934	78,477	IN_USE	825 Biotech Court	3	
Building 18N	Other	Active	OWNED	18,149	17,848	IN_USE	780 Rancho Conejo Blvd	1	
Building 18S	LAB	Active	OWNED	42,855	42,112	IN_USE	780 Rancho Conejo Blvd	2	
Building 20	MFG	Active	OWNED	83,022	81,724	IN_USE	1908 Oak Terrace Lane	2	
Building 21	ADMIN	Active	OWNED	49,788	48,937	IN_USE	1909 Oak Terrace Lane	2	
Building 22	Other	Active	OWNED	21,385	20,641	IN_USE	800 Rancho Conejo Blvd	2	
Building 23	MFG	Active	OWNED	45,329	44,172	IN_USE	1889 Oak Terrace Lane	2	
Buildings 24 / 24C	ADMIN	Active	OWNED	154,211	151,374	IN_USE	720 Amgen Court	4	
	Other	Active	OWNED	39,047	37,942	IN_USE	720 Amgen Court	2	
Building 25	LAB	Active	OWNED	141,995	138,627	IN_USE	704 Rancho Conejo Blvd	4	
Building 27 / PS6	ADMIN	Active	OWNED	263,205	258,509	IN_USE	One Amgen Center Drive	5	
Building 28	ADMIN	Active	OWNED	228,952	222,110	IN_USE	805 Biotech Drive	6	
Building 29	LAB	Active	OWNED	462,124	434,356	IN_USE	700 Rancho Conjeo Blvd	6	
Building 30	LAB	Active	OWNED	351,411	340,081	IN_USE	777 Pauling Drive	4	
Building 31	MFG	Active	OWNED	179,635	177,751	IN_USE	1000 North Ventu Park Road	2	
Building 32	Other	Active	OWNED	40,974	40,013	IN_USE	720 Amgen Court	3	
Building 33	ADMIN	Active	OWNED	41,995	39,831	IN_USE	710 Pauling Drive	3	
Building 34	ADMIN	Active	OWNED	56,093	54,592	IN_USE	2150 W. Hillcrest Drive	2	
Building 35	ADMIN	Active	OWNED	24,034	23,761	IN_USE	1100 Rancho Conejo Blvd	2	
Building 36	ADMIN	Active	OWNED	64,273	63,333	IN_USE	1100 Rancho Conejo Blvd	2	
Building 37	ADMIN	Active	OWNED	81,715	80,381	IN_USE	1100 Rancho Conejo Blvd	2	
Building 38	ADMIN	Active	OWNED	258,772	252,730	IN_USE	790 Pauling Drive	6	
Building 39	Other	Active	OWNED	44,838	43,488	IN_USE	855 North Ventu Park Road	1	
Building 42	MFG	Active	OWNED	22,732	21,613	IN_USE	1889 Oak Terrace Lane	3	
Building 71 (Arbors - Bldg. D)	ADMIN	Active	LEASED	71,250	71,250	**ABANDONED_SUB**	2560 Teller Road (Bldg "D" - (Abandoned)	2	
Building 80	ADMIN	Active	LEASED	32,789	32,194	IN_USE	1280 Rancho Conejo Blvd	1	
Building 81	ADMIN	Active	LEASED	26,856	26,351	IN_USE	1290 Rancho Conejo Blvd	1	
Building 94	Other	Active	LEASED	49,130	48,365	IN_USE	1535 Rancho Conejo Blvd, Building 'B'	1	
Building 98 (Semtech Bldg.)	Other	Active	OWNED	55,608	55,608	**ABANDONED**	652 Mitchell Drive (Abandoned)	1	
Building 99	MFG	Active	OWNED	44,763	44,003	IN_USE	2495 Teller Road	2	

Building 28 -- 805 Biotech Drive

Domestic Water Use - 12 Months (2015)

# of Tenants / FTE's =	779	# of Toilets =	100
# of Facility Support Employees =	1	# of Urinals =	24
# Tenant Days	202,540	# of Showers =	1
# Facility Support Employee Days* =	260	# of Kitchen Sinks =	19
# of Visitors/Day =	24	# of Bathroom Sinks =	50
# of Visitors Using Restrooms =	30%	# of FTE Days =	260
Percent Male Occupants =	45%	# of Facility Days =	260
Fuel Rate per MMBtu =	$4.80	W/S Rate per 1,000 gallons =	$6.24
% of Total Water used for Domestic:	94.6%	Total Metered Facility Gallons =	3,815,548
		Cooling Tower Makeup Gallons =	N/A

TODAY'S CONSUMPTION

TOILETS

1.60	# gallons per flush
3.0	# flushes per day women
1.0	# flushes per day men
204,701	# Tenant/Employee/Visitor days
147,385	# of Gallons used (Men)
540,411	# of Gallons used (Women)
687,796	# of Gallons used

URINALS

0.00	# gallons per flush
0.0	# flushes per day
92,115	# Tenant/Employee/Visitor days
0	# of Gallons used

SHOWERS

2.20	# gallons per minute
5.0	# minutes per shower
20,254	# Tenant days (10%)
222,794	# of Gallons used

LAB / KITCHEN SINKS

2.20	# gallons per minute
5.0	# minutes used per day
40,508	# Tenant days (20%)
445,588	# of Gallons used

BATHROOM SINKS

2.20	# gallons per minute
5.00	# minutes used per day
204,701	# Tenant/Employee/Visitor days
2,251,712	# of Gallons used

Total Domestic Gallons Pre-Retrofit =	3,607,890

CONSUMPTION AFTER RETROFIT

TOILETS

1.60	# gallons per flush
3.0	# flushes per day women
1.0	# flushes per day men
204,701	# Tenant/Employee/Visitor days
147,385	# of Gallons used (Men)
540,411	# of Gallons used (Women)
687,796	# of Gallons used

URINALS

0.00	# gallons per flush
0.0	# flushes per day
92,115	# Tenant/Employee/Visitor days
0	# of Gallons used
0	**# Gallons Reduced**

SHOWERS

2.00	# gallons per minute
0.0	# minutes per shower
20,254	# Tenant days (10%)
0	# of Gallons used
222,794	**# Gallons Reduced**

LAB / KITCHEN SINKS

1.80	# gallons per minute
5.0	# minutes used per day
40,508	# Tenant days (20%)
364,572	# of Gallons used
81,016	**# Gallons Reduced**

BATHROOM SINKS

0.50	# gallons per minute
5.00	# minutes used per day
204,701	# Tenant/Employee/Visitor days
511,753	# of Gallons used
1,739,959	**# Gallons Reduced**

Domestic Gallons Post-Retrofit =	1,564,120
Total Domestic Gallons Saved =	2,043,769

Total Facility Gallons =	3,815,548	Total Domestic Gallons Saved (%) =	56.6%
Gallons Water Saved =	2,043,769	Annual Water Savings =	$12,753
Gallons Heated Water Saved =	2,043,769	Annual Fuel Savings =	$2,995

* employee days estimates **260** days per year for each employee. Use 250 days if including Holidays

Domestic Hot Water Savings – *Sample Calculation*

Building 6 -- 2003 Oak Terrace Lane

Energy Savings / Domestic Hot Water

Total Gallons of Water Saved				**66,661**
Gallons of Heated Water Saved *(Showers, Kitchen and Bathroom Sinks)*				50,674
Lbs of Heated Water Saved *(Gallons Saved x 8.34 lb/gal)*	50,674	x	8.34	422,621
Temperature Increase	100	-	72	28
Average Ground Water Temp. - (City Water)	Water temp varies from 52°F to 76°F			
Btu / Lb. *(1 btu per 1 degree Temperature Increase)*				28
Total Btu Saved *(Lbs of Heated Water Saved x Btu/Lb)*	422,621	x	28	11,833,392
Total MMBtu Saved *(Standard Unit for Energy Purchase)*	11,833,392	/	1,000,000	11.83
Adjusted MMBtu Saved *(MMBtu Saved / Boiler Efficiency)*	11.83	/	85.0%	13.92
Transfer Efficiency *(Efficiency of the Heat Transfer System)*				85.0%
Adjusted MMBtu Saved *(MMBtu Saved / Heat Transfer Efficiency)*	13.92	/	85.0%	16.38
Fuel Rate / MMBtu *(Market Value)*				**$4.80**
Total Savings/yr (MMBtu Saved x Cost)	**16.38**	x	**$4.80**	**$79**

Water Quality Lab Reports – RO Reject (B99)

HBI Laboratories
3926 Pender Drive, Suite 120
Fairfax, VA 22030

Phone: 703-323-4400
Fax: 703-323-4440
Email: lab@healthybuildings.com

Client: Healthy Buildings International, Inc.
Lab ID: 37852

Job #1510001W

Laboratory Report – Amgen Building 99

Waterscreen Results

Analysis By: Mercy Nesiho

Analyzed on: 11/20/2015 3:09:48 PM

Analysis performed	Level detected (mg/l)	MCL (mg/l)	EPA Standard	Detection level (mg/l)
Microbiological				
Total coliform (P/A)	**N/A**	P	P	P
E. coli (P/A)	**N/A**	P	P	P
Heterotrophic Plate Count (MPN/ml)	**<2**	500*	P	2
*The MCL for heterotrophic plate count is a Treatment Technique. Under U.S. EPA's Surface Water Treatment Rule, systems using surface water or groundwater under the direct influence of surface water must achieve a heterotrophic plate count (HPC) no greater than 500 bacterial colonies per milliliter				
Inorganic Analytes – Metals				
Arsenic	**<0.005**	0.01	P	0.005
Cadmium	**<0.002**	0.005	P	0.002
Chromium	**<0.01**	0.1	P	0.01
Copper	**<0.1**	1.3	P	0.1
Iron	**0.04**	0.3	S	0.02
Lead	**<0.004**	0.015	P	0.004
Physical factors				
Alkalinity (Total as CaCO3)	**123**	N/A	N/A	20
Chloride	**111**	250	S	5
Hardness	**243**	N/A	N/A	10
Nitrate/Nitrite as N	**1.04**	10	P	0.5
Ortho Phosphate	**<1**	N/A	N/A	1
Conductivity	**1019 µS**			
pH (Standard Units)		6.5-8.5	S	-
Temperature		-	N/A	-
Total Dissolved Solids		500	S	20
Turbidity (Turbidity Units)		1.0	P	0.1
Free Chlorine		N/A	N/A	0.01

ATO – City Water Quality - 2015

AMGEN
ATO
One Amgen Center Dr., Thousand Oaks, CA, 91320
(805) 447-1000

Recorded By: **Kevin Horner**
(310) 628-1543
kevinh@enviroaqua.com
On-site: **05:30 to 11:00 PST**

MISCELLANEOUS - CITY WATER ANALYSIS				
Test	CITY WATER			
Conductivity (as mmhos)	857			
Limits	0 min			
pH	8.15			
Limits	0 min			
Hardness, total (ppm as $CaCO_3$)	110			
Limits	0 min			
Hardness, calcium (ppm as $CaCO_3$)	100			
Limits	0 min			
Alkalinity, total (ppm as $CaCO_3$)	80			
Limits	0 min			
Chloride ppm as Cl	70			
Limits	0 min			
Iron (ppm as Fe)	0.01			
Limits	0 min			
Copper (ppm)	0.03			
Limits	0 min			
Manganese	0			
Limits	0 min			
Silica (ppm as SiO_2)	12			
Limits	0 min			
Sulfate	228			
Limits	0 min			
Suspended Solids	0			
Limits	0 min			
Chlorine, free (ppm as Cl_2)	0.08			
Limits	0 min			
Chlorine, total (ppm as Cl_2)	1.5			
Limits	0 min			
Total Dissolved Solids	592			
Limits	0 min			
Turbidity (Fau)	0			
Limits	0 min			

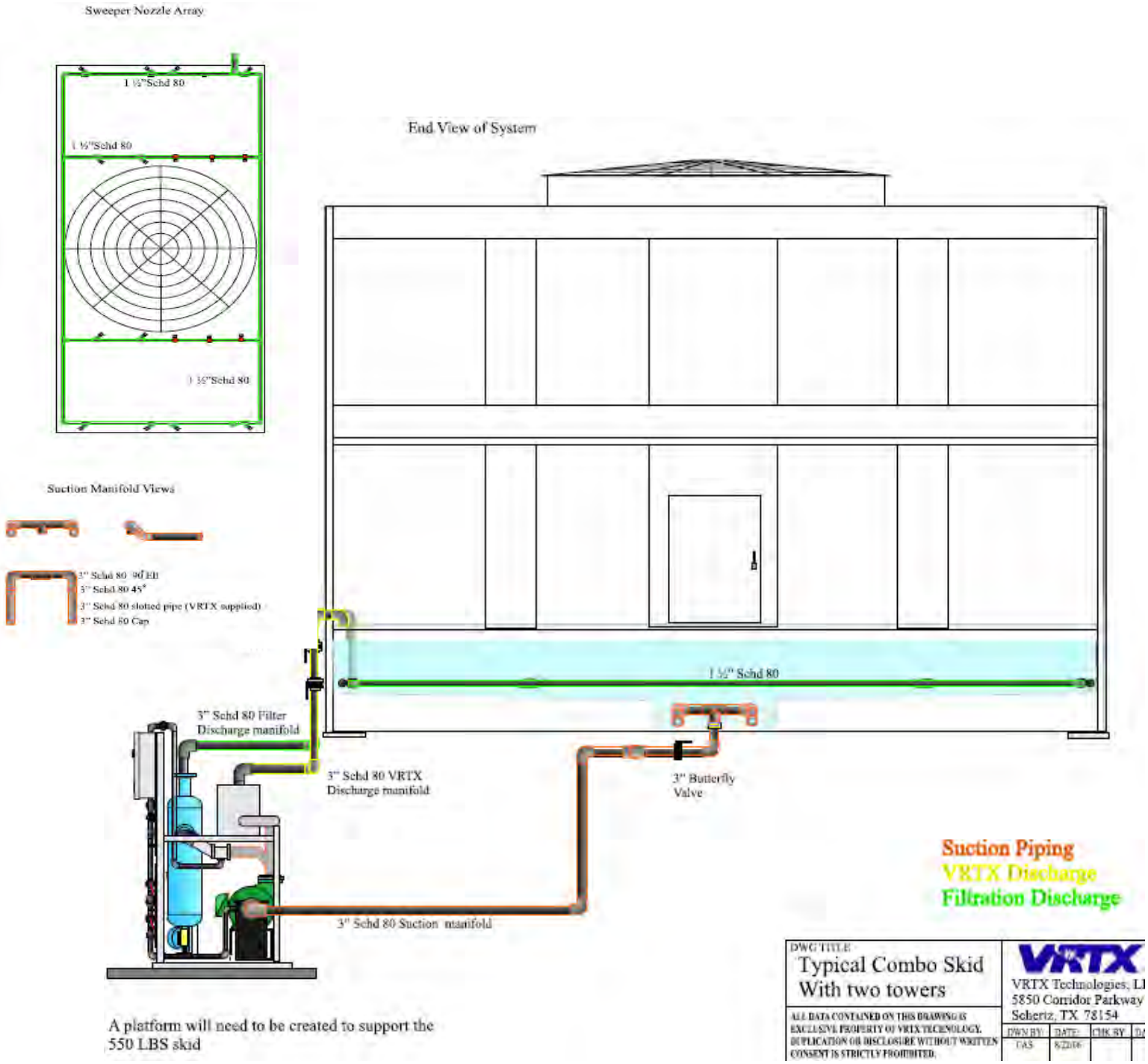
Opening Comments

Above are the tests normally run on a city water sample. I have included manganese at your request.

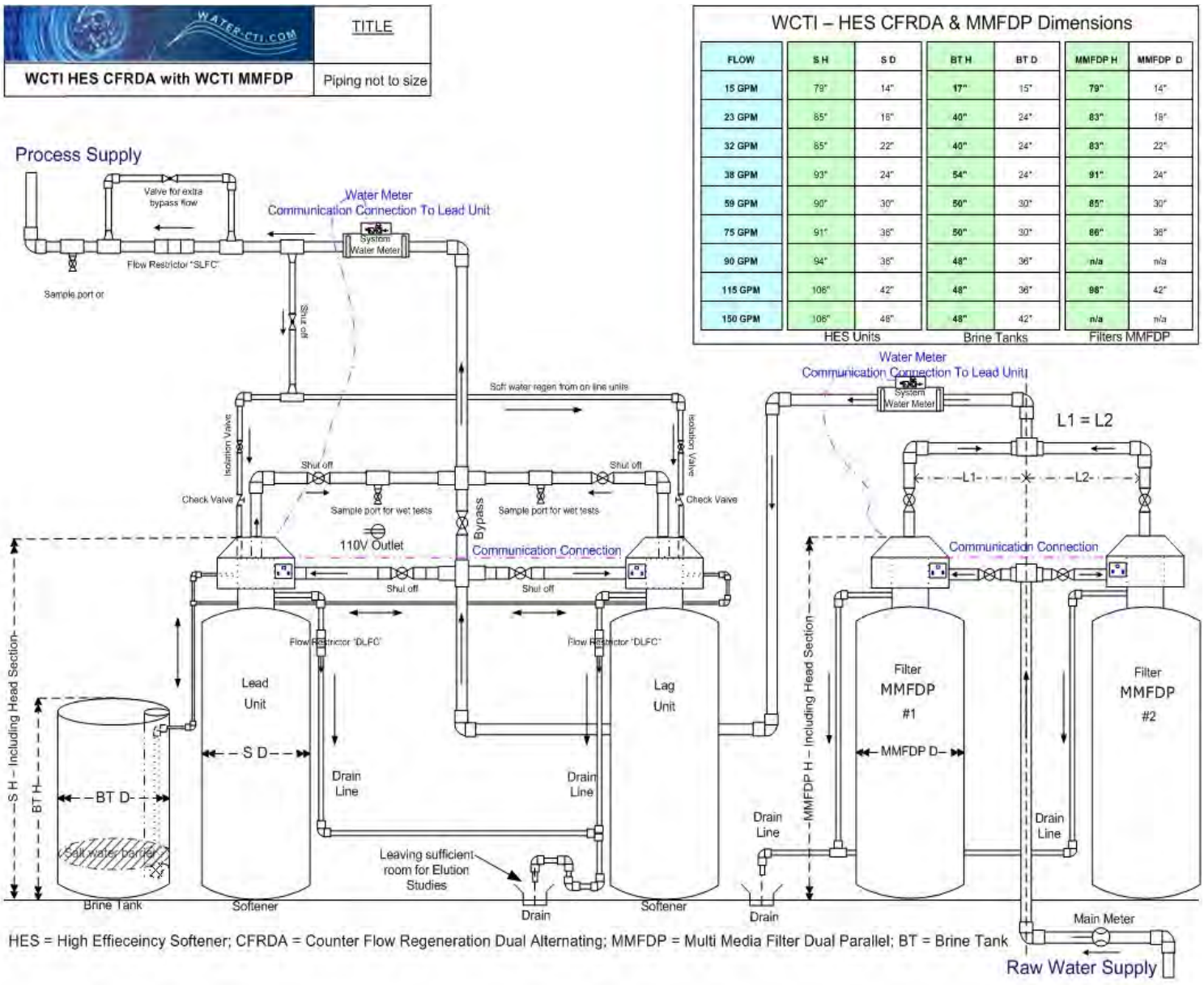
Also requested was magnesium. We obtain this by subtracting the calcium hardness from the total hardness. In this case the magnesium hardness is 10 ppm.

Should you need any other information, please fee free to contact me.

'Vortex' - Hydrodynamic Cavitation **-** *Schematic*



'Zero Blowdown' - *Schematic*



Water Efficiency Technologies

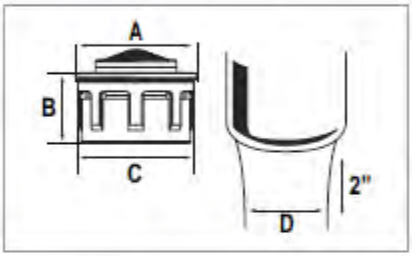
Neoperl – 0.5 gpm Flow Restrictor -*Cut Sheet*

PCA® Cascade®
Faucet Aerator - 0.5 gpm
Pressure Compensating **Regular Size**

NEOPERL®
flow, stop and go®

Features and Benefits

- Watercolours® design: Color coding to identify flow rate and stream pattern.
- Patented construction provides a splash-free stream, well aerated and soft to the touch.
- Unique screenless 100% plastic cascade construction prevents lime buildup.
- Pressure compensating for constant flow from 20 to 80 psi.
- Anti-clogging dome screen filters sediment and particles.
- Also compatible with regular and vandal proof M22 and M24 metric housing.
- Available housing finishes: unplated, chrome and PVD.
- Laser marked housings: Custom logo and/or statutory marking.



Certifications

ANSI/NSF 61 (pending)
Meets ASME A112.18.1M and CSA B125 requirements

Thread & Part Number

Part #	Designation	Thread Size
31 235	Insert only	
31 200	Regular male	15/16"-27
31 210	Regular female	55/64"-27
31 220	Regular dual thread	15/16"-27 x 55/64"-27

Packaging:

Inserts	*1pc (bag), 6pcs (tube), 50pcs (bag)*
Reg. male/female/dual thread	*1pc (bag), 6pcs (tube), 50pcs (tray)*
Reg. vandal proof male/female/dual thread	*1pc (bag), 6pcs (tube), 40pcs (tray)*

other product combinations available

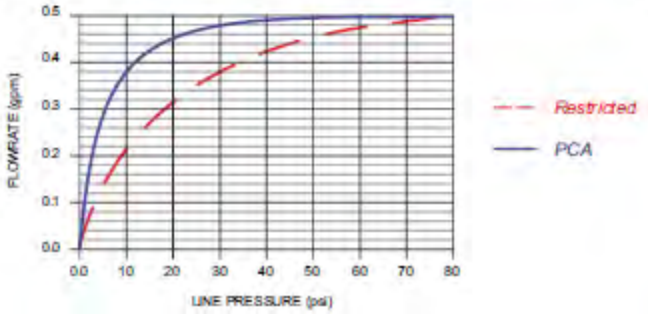
Dimensions

No	mm	In
A	20.88	.822
B	12.00	.472
C	19.97	.786
D	≈ 13	≈ 1/2

Color Code

Dome	Flow Regulator	Basket
White	Lime Green	Dark Gray

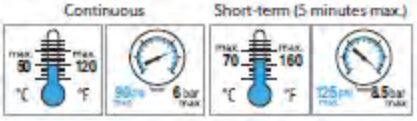
Flow Rate Curve



Housings

Technical Data

Materials:	Body	Acetal
	O-ring	EPDM
	Washer	EPDM
Wetted surface area:		4834.0 mm²



California – Evapotranspiration Zones

California – Evapotranspiration Table

Reference EvapoTranspiration (ETo) Zones

1 **COASTAL PLAINS HEAVY FOG BELT** lowest ETo in California, characterized by dense fog

2 **COASTAL MIXED FOG AREA** less fog and higher ETo than zone 1

3 **COASTAL VALLEYS & PLAINS & NORTH COAST MOUNTAINS** more sunlight than zone 2

4 **SOUTH COAST INLAND PLAINS & MOUNTAINS NORTH OF SAN FRANCISCO** more sunlight and higher summer ETo than zone 3

5 **NORTHERN INLAND VALLEYS** valleys north of San Franciaco

6 **UPLAND CENTRAL COAST & LOS ANGELES BASIN** higher elevation coastal areas

7 **NORTHEASTERN PLAINS**

8 **INLAND SAN FRANCISCO BAY AREA** inland area near San Francisco with some marine influence

9 **SOUTH COAST MARINE TO DESERT TRANSITION** inland area between marine & desert climates

10 **NORTH CENTRAL PLATEAU & CENTRAL COAST RANGE** cool, high elevation areas with strong summer sunlight, zone has limited climate data & the zones selection is somewhat subjective

11 **CENTRAL SIERRA NEVADA** mountain valleys east of Sacramento with some influence from delta breeze in summer

12 **EAST SIDE SACRAMENTO-SAN JOAQUIN VALLEY** low winter & high summer ETo with slightly lower ETo than zone 14

13 **NORTHERN SIERRA NEVADA** northern Sierra Nevada mountain valleys with less marine influence than zone 11

14 **MID-CENTRAL VALLEY, SOUTHERN SIERRA NEVADA, TEHACHAPI & HIGH DESERT MOUNTAINS** high summer sunshine and wind in some locations

15 **NORTHERN & SOUTHERN SAN JOAQUIN VALLEY** slightly lower winter ETo due to fog and slightly higher summer ETo than zones 12 & 14

16 **WESTSIDE SAN JOAQUIN VALLEY & MOUNTAINS EAST & WEST OF IMPERIAL VALLEY**

17 **HIGH DESERT VALLEYS** valleys in the high desert near Nevada and Arizona

18 **IMPERIAL VALLEY, DEATH VALLEY & PALO VERDE** low desert areas with high sunlight & considerable heat advection

Monthly Average Reference Evapotranspiration by ETo Zone (inches/month)

Zone	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	0.93	1.40	2.48	3.30	4.03	4.50	4.65	4.03	3.30	2.48	1.20	0.62	32.9
2	1.24	1.68	3.10	3.90	4.65	5.10	4.96	4.65	3.90	2.79	1.80	1.24	39.0
3	1.86	2.24	3.72	4.80	5.27	5.70	5.58	5.27	4.20	3.41	2.40	1.86	46.3
4	1.86	2.24	3.41	4.50	5.27	5.70	5.89	5.58	4.50	3.41	2.40	1.86	46.6
5	0.93	1.68	2.79	4.20	5.58	6.30	6.51	5.89	4.50	3.10	1.50	0.93	43.9
6	1.86	2.24	3.41	4.80	5.58	6.30	6.51	6.20	4.80	3.72	2.40	1.86	49.7
7	0.62	1.40	2.48	3.90	5.27	6.30	7.44	6.51	4.80	2.79	1.20	0.62	43.3
8	1.24	1.68	3.41	4.80	6.20	6.90	7.44	6.51	5.10	3.41	1.80	0.93	49.4
9	2.17	2.80	4.03	5.10	5.89	6.60	7.44	6.82	5.70	4.03	2.70	1.86	55.1
10	0.93	1.68	3.10	4.50	5.89	7.20	8.06	7.13	5.10	3.10	1.50	0.93	49.1
11	1.55	2.24	3.10	4.50	5.89	7.20	8.06	7.44	5.70	3.72	2.10	1.55	53.1
12	1.24	1.96	3.41	5.10	6.82	7.80	8.06	7.13	5.40	3.72	1.80	0.93	53.4
13	1.24	1.96	3.10	4.80	6.51	7.80	8.99	7.75	5.70	3.72	1.80	0.93	54.3
14	1.55	2.24	3.72	5.10	6.82	7.80	8.68	7.75	5.70	4.03	2.10	1.55	57.0
15	1.24	2.24	3.72	5.70	7.44	8.10	8.68	7.75	5.70	4.03	2.10	1.24	57.9
16	1.55	2.52	4.03	5.70	7.75	8.70	9.30	8.37	6.30	4.34	2.40	1.55	62.5
17	1.86	2.80	4.65	6.00	8.06	9.00	9.92	8.68	6.60	4.34	2.70	1.86	66.5
18	2.48	3.36	5.27	6.90	8.68	9.60	9.61	8.68	6.90	4.96	3.00	2.17	71.6

Variability between stations within single zones is as high as 0.02 inches per day for zone 1 and during winter months in zone 13. The average standard deviation of the ETo between estimation sites wihtin a zone for all months is about 0.01 inches per day for the 200 sites used to develop the map.