

This presentation premiered at WaterSmart Innovations

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Greywater In Black & White

Session W-1214
Wednesday
1:35 PM – 2:05 PM

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Learning Objectives

Following this presentation, participants should be able to:

- Define greywater (or “gray water”)
- Explain the value of greywater harvesting compared to other on-site sources
- Identify the unique characteristics of greywater
- Explain how current codes & regulations vary across municipalities
- Describe how systems are designed to safely prepare greywater for reuse

Why Greywater?



Overuse

Drought

Groundwater Depletion

Rising Water Costs

What is Greywater?

Greywater is “lightly used” water that is collected from showers, bathtubs, lavatory sinks and laundry machines.

- Greywater is not to be confused with toilet waste or kitchen waste water (“black water”), which can contain food waste and fecal matter.
- Raw greywater is different than treated greywater.

Value of Greywater

- Reduced demand on potable water supplies
- LEED certification points
 - 2-4 points for water use reduction
 - 2 points for innovative wastewater technology
 - 2-4 points for water efficient landscaping
- Lower sewer costs for commercial buildings
- Less infrastructure required than reclaimed water
- Consistent water supply
 - Compared to rainwater
 - Building type is important (residential, new build)

Value of Greywater

Rainwater System

System: Rainwater from rooftop used for toilet flushing

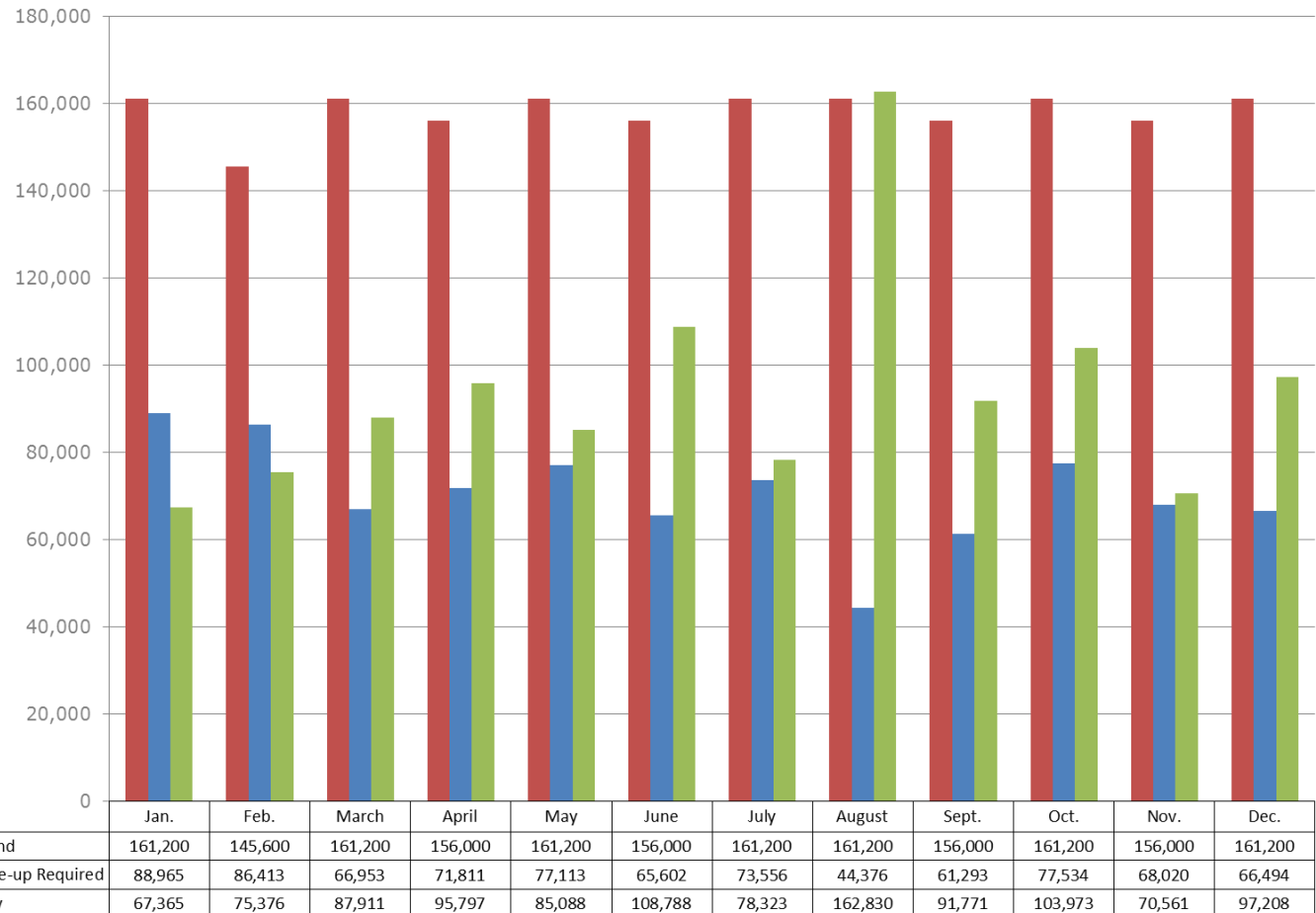
Location: Military barracks in New York

Residents: 650

Rooftop: 47K

Storage: 65K

Meets 55% of demand and saves one million gallons per year.



Value of Greywater

Greywater System

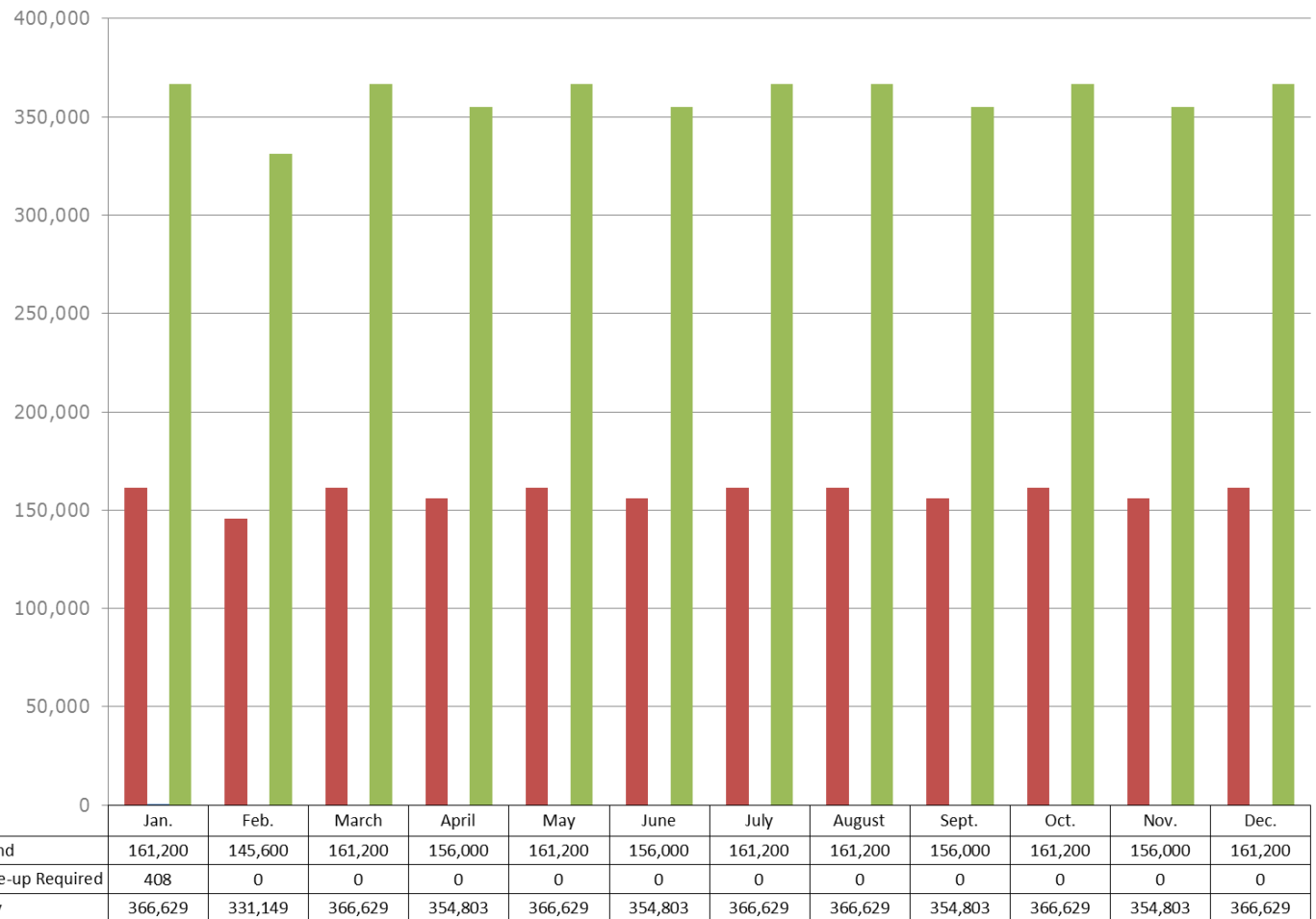
System: Greywater from showers and sinks used for toilet flushing

Location: Military barracks in New York

Residents: 650

Storage: 5,500

Meets 100% of demand and saves 1.9 million gallons per year.



Challenges of Greywater

Greywater Variables

Source Water

- Solids (i.e. hair, soap, toothpaste, lint)
- Bodily fluids (i.e. mucus, urine)
- Chemicals (i.e., cleaning products, drain cleaners, pharmaceuticals)
- Building's population

End Use

- Subsurface irrigation
- Drip irrigation
- Spray irrigation
- Toilet flushing
- Cooling tower make-up (not viable due to dissolved solids)

Challenges of Greywater

- Concerns about public health
 - Bacteria
 - Pathogens
- Stability of the treated water
 - Bacterial regrowth
 - Time limitations on holding greywater

Trade Codes & Certification

- Trade codes
 - International Plumbing Code (IPC)
 - Developed by the International Code Council (ICC)
 - Green Plumbing and Mechanical Code Supplement (GPMCS)
 - Developed by the International Association of Plumbing and Mechanical Officials (IAPMO)
 - NSF/ANSI 350
 - Developed by NSF International and the American National Standards Institute (ANSI)

Trade Codes & Certification

Greywater Source and End Use

	Source	Irrigation Use			Other Onsite Use		
	Standard Definition	Subsurface	Drip	Spray	Toilet Flushing	Cooling Tower Makeup	Other
IPC							
GMPSC							
NSF							

Trade Codes & Certification

Requirements

	Storage Requirements		System Requirements		Identification Requirements		
	Size Requirement	Time Limitation	Filter	Disinfectant	Storage	Piping	Blue Dye
IPC				TF			TF
GMPSC				TF, spray irr.			
NSF							

State Codes & Regulations

- Commonalities of greywater policies for irrigation only (i.e. AZ and MA):
 - Same definition of source water
 - Spray irrigation prohibited
 - No time limits on retention
 - No filtration required
 - No disinfection required
 - No identification of non-potable lines, storage and fixtures required

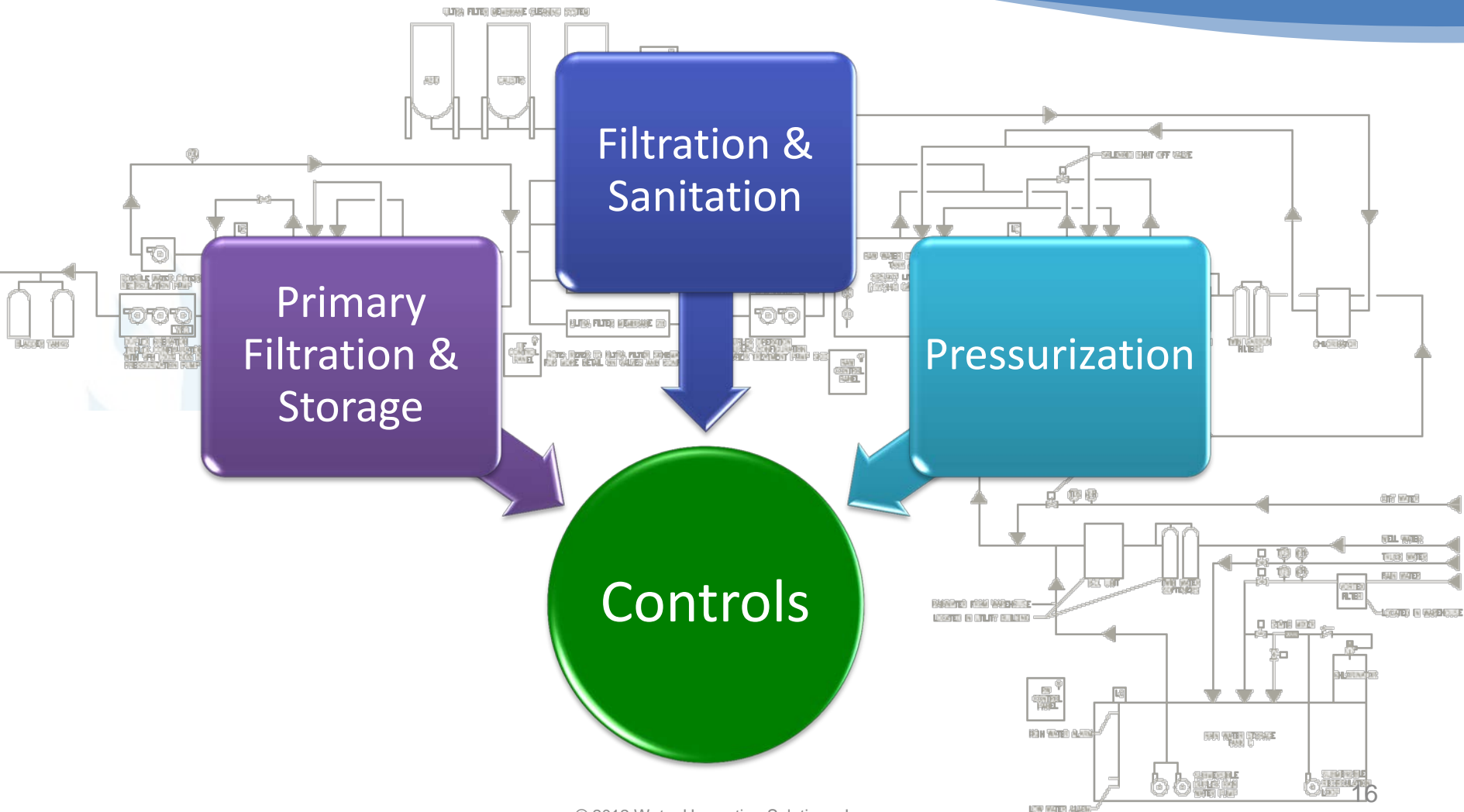
State Codes & Regulations

- Commonalities of greywater policies for use in toilet flushing (i.e. FL and NC):
 - Same definition of source water
 - Storage requirements: durable, non-corrosive, accessible, and fitted for venting, overflow and draining
 - Limits on retention time
 - Filtration required
 - Disinfection required
 - Storage, pipes and fixtures must be identified as non-potable

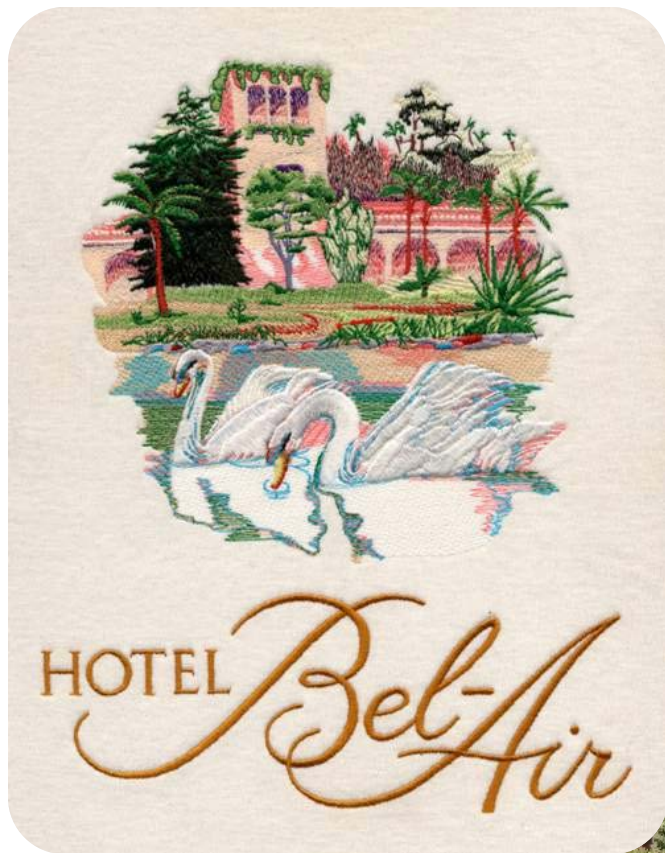
State Codes & Regulations

- Tiered regulations (i.e. CA and OR):
 - Simple systems:
 - Low risk of human contact, i.e. drip or subsurface irrigation
 - Generally no treatment required
 - Complex systems:
 - Higher risk of human contact, i.e. spray irrigation, toilet flushing, cooling tower make-up, decorative fountains, mechanical equipment
 - Requires filtration and disinfection and must meet state-defined standards

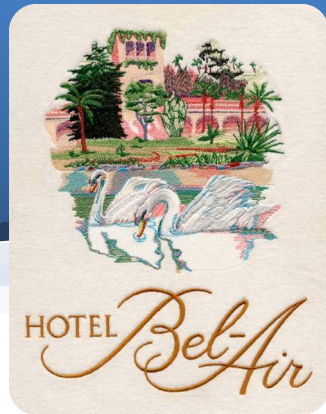
Greywater System Design



Case Study: Hotel Bel-Air Villas, California



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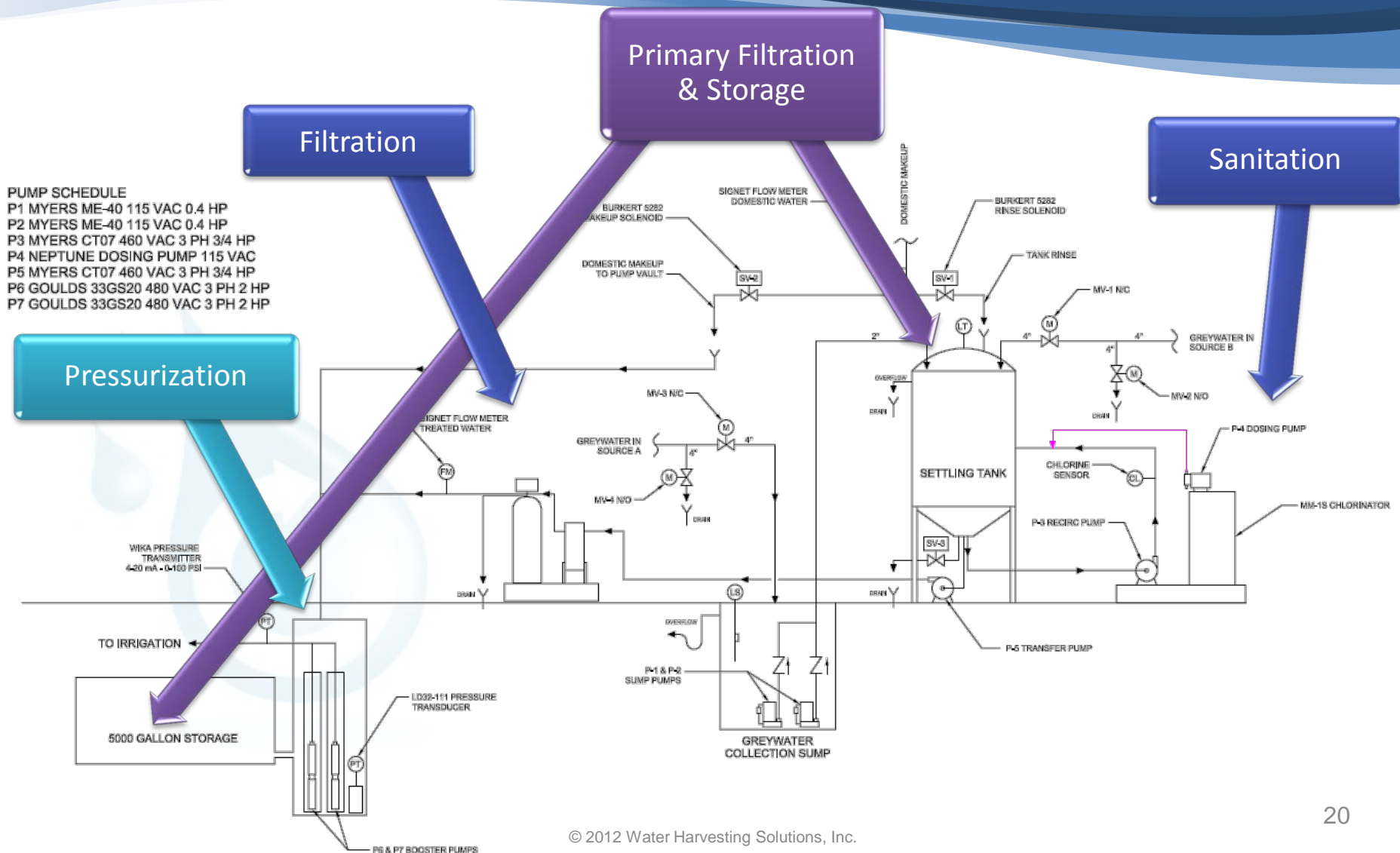
Greywater for Surface Irrigation: Hotel Bel Air

Project:	Hotel Bel Air Greywater
Location:	Bel Air California
Customer:	Hotel Bel Air
Engineers:	Psomas Engineering
System Type:	Greywater for Spray Irrigation
Considerations:	L.A. Code Exemption
Storage:	4,200 gallon fiberglass tank
Sanitation:	Chlorine (Calcium Hypochlorite)
Projected Annual Water Savings:	240K per month, 2.9 million gallons annually
Commissioning Date:	January, 2012

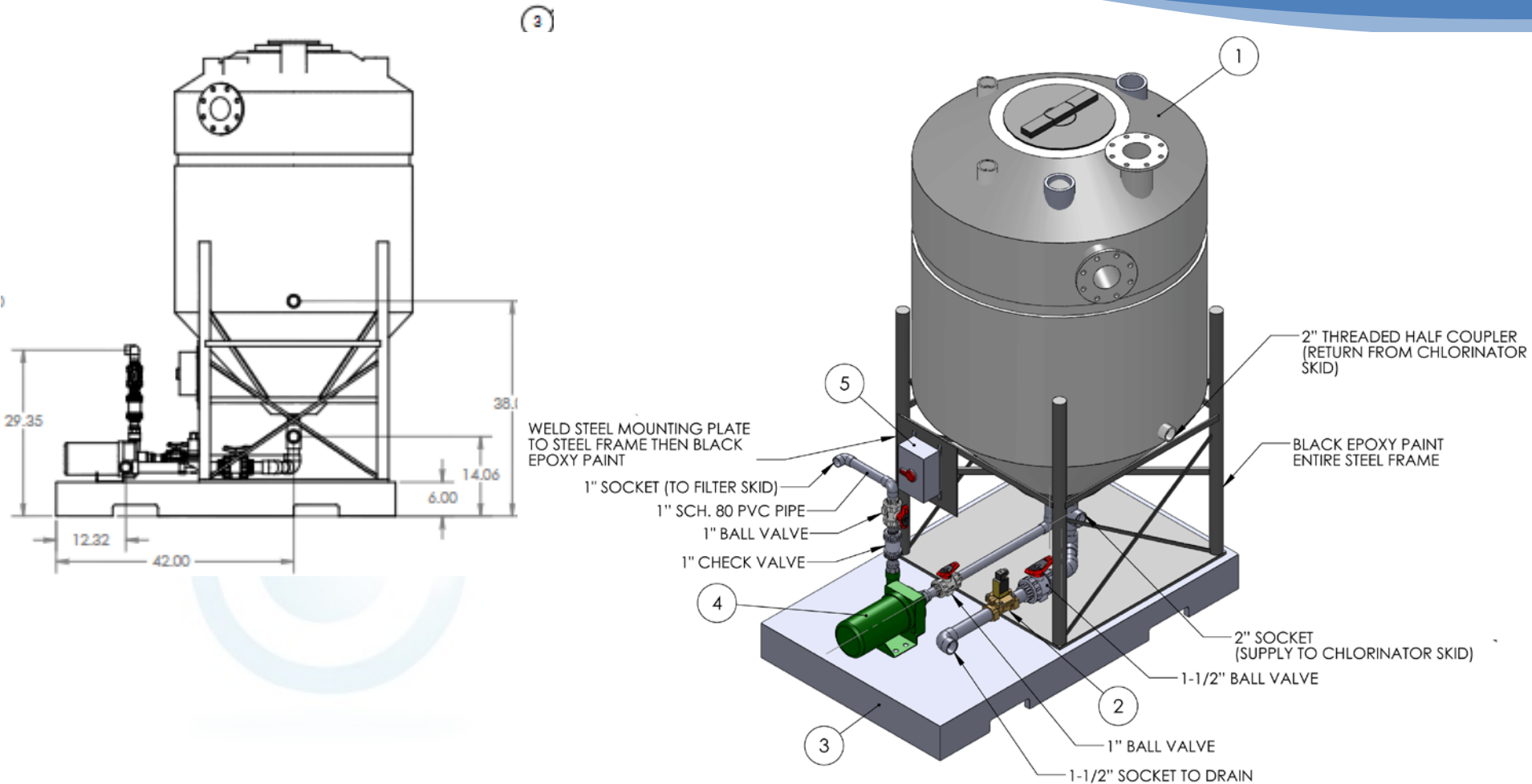
Sizing the System

Key Assumptions - HBA Villas Supply & Demand					
Supply					
Occupancy Rate Per Room - Weekly Average		60%	75%	85%	95%
Number of Guest Rooms		12.0	12.0	12.0	12.0
Average Number Guests Per Room	2.0	2	2	2	2
- Average Number of Showers Per Guest Per Day	1.5				
- Average Length of Shower in Minutes	12.0				
- Shower GPM	10.0				
Total Showers Gallons PP PD	360.0				
Bath Usage per day	0.5				
- GP filled tub	51.5				
Average Bath Usage PD	25.8				
Bathroom Sink Usage					
- Minutes Per Day Per Person*	5.0				
- GPM per sink usage	1.5				
Average Sink Usage PP PD	7.5				
Total Greywater Production PP PD (Gallons)	393.3	393.3	393.3	393.3	393.3
Total Greywater Production Per Day (Gallons)	786.5	5,663	7,079	8,022	8,966
Monthly Greywater Production. Assumes use of all available processed water		169,884	212,355	240,669	268,983
Conversion to Hundred Cubic Feet	7.4805	227	284	322	360
Monthly Water Savings (Cost per CCF)	\$ 3.83	870	1,087	1,232	1,377
Annual Gallons of Water Saved		2,038,608	2,548,260	2,888,028	3,227,796
Annual Water Cost Savings		\$ 10,438	\$ 13,047	\$ 14,787	\$ 16,526
Demand					
Daily Irrigation Demand, Villa Courtyard, Upper Hillside	663				
Adjoining Gardens	5,296				
Total Irrigation Demand Per Cycle (in gallons)	5,959				

System Design: Process Schematic

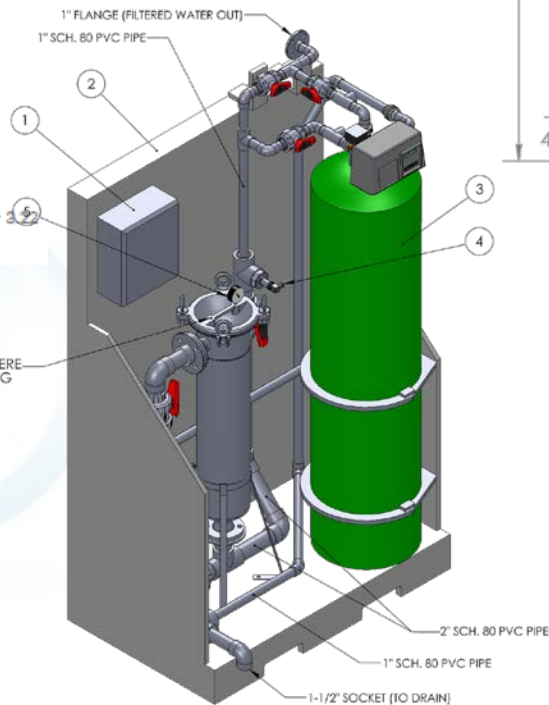
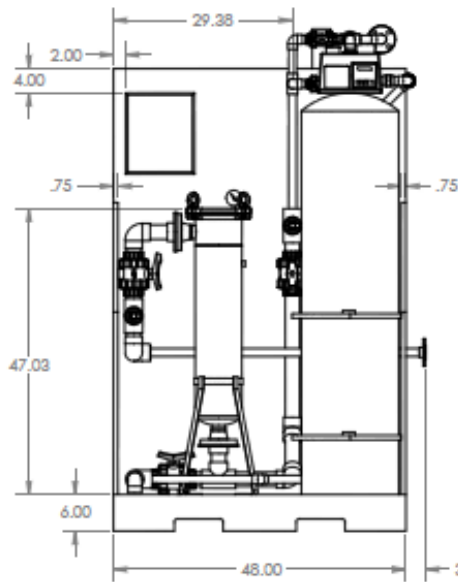


System Design: Settling Tank

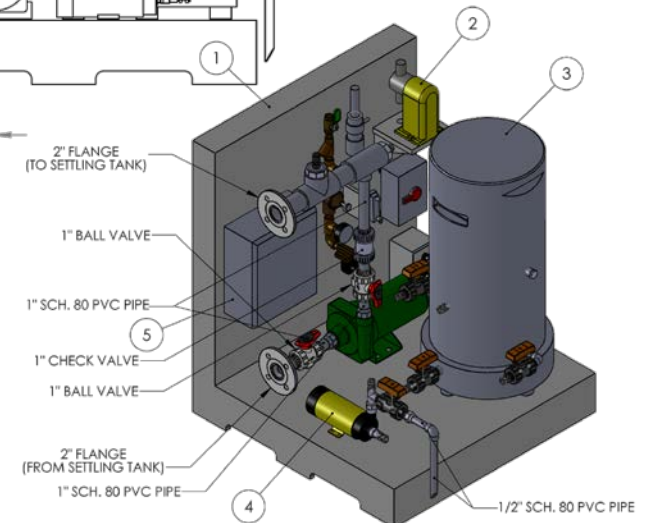
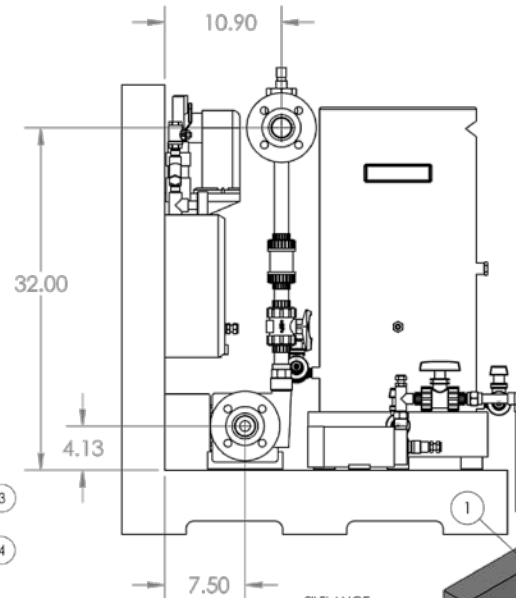


System Design: Processing Skid

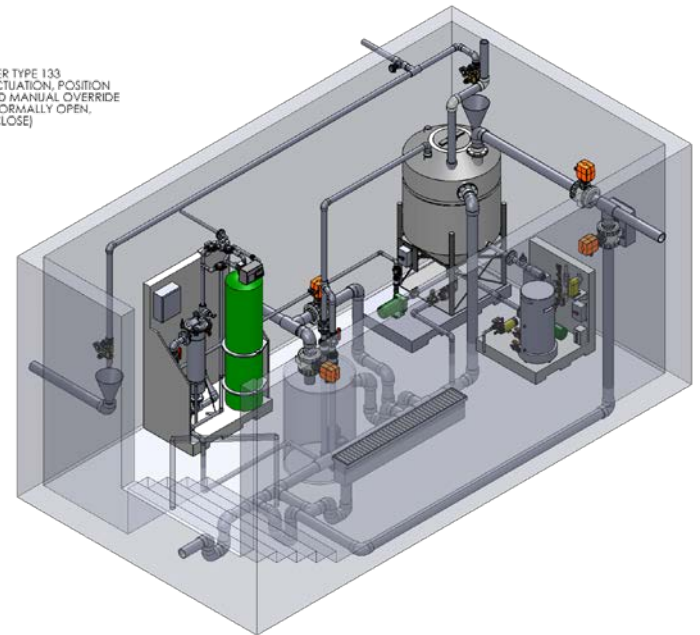
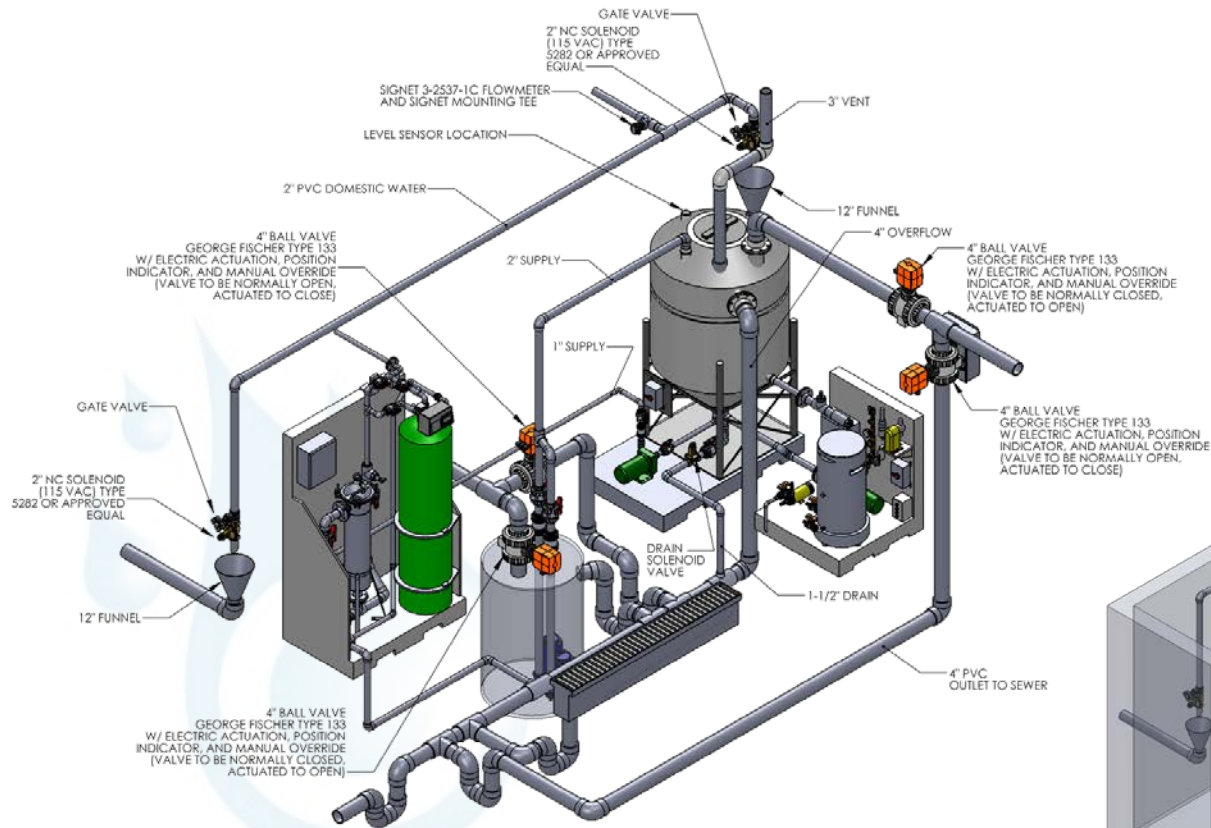
Filtration



Chlorination



System Layout

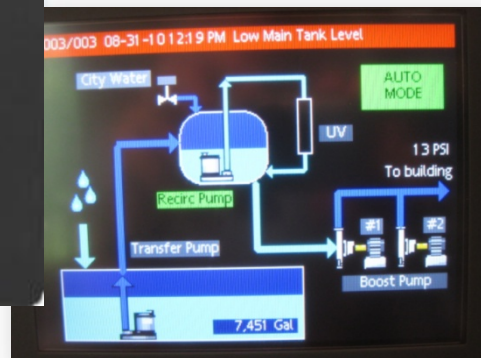


System Build & Installation



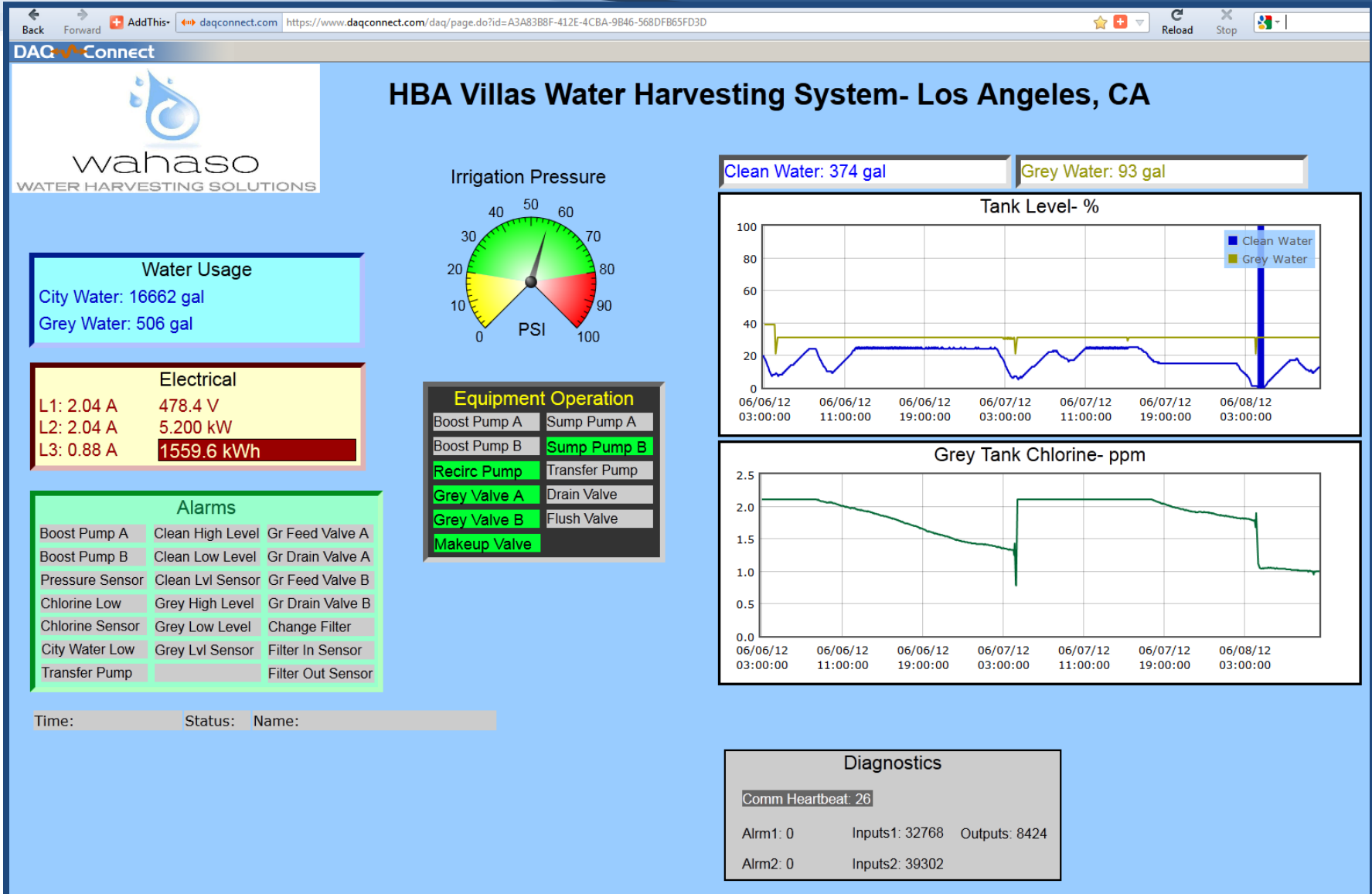
Proprietary Control System Monitors and Controls all System Activity

- Controller Considerations
 - Complexity of system
 - Need to record and report system statistics
 - Integration with irrigation control
 - Connectivity to Building Automation System
 - Educational opportunities



Remote Access
Capability

Remote Panel Monitoring



Key Concept Recap

- Greywater is a viable source for harvesting and reuse for non-potable applications – especially in dry regions
- Treatment standards being established by national code authorities, certification agencies and local municipalities
- Treatment concerns are for public safety, municipal water supply safety, end use requirements
- System design requires careful consideration of treatment & storage, filtration & sanitation, pressurization and controls
- Water shortage predicted for the next 20-30 years require planning now for future conservation measures.

Questions?



Greywater

In Black & White

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Appendix: Full Comparison

	Trade Codes and Regulations			Irrigation Only		Toilet Flushing Only		Irrigation and Toilet Flushing		Tiered Approach	
	IPC	GMPSC	NSF	AZ	MA	FL	NC	TX	UT	CA	OR
Source											
Bathtubs, showers, bathroom sinks and laundry machines	●	●	●	●	● *	●	●	●	●	●	●
Irrigation Use											
Subsurface	●	●	●	●	●	only by approval	only by approval	●	●	●	●
Drip		●		●				●		tier 3	●
Spray		●								tier 3	●
Other Onsite Use											
Toilet Flushing	●	●	●			●	●	●	●	tier 3	●
Urinal Flushing	●	●	●			●	●	●	●	tier 3	●
Cooling Tower Makeup										tier 3	
Other		●								tier 3	●
Storage Requirements											
Size Requirement	●		●		●	●	●	TF	TF, irr.		
Time Limitation	●					●	●	TF	TF		
System Requirements											
Filter	●	●				●	●	TF	TF		tier 2,3
Disinfectant	TF	TF, spray irr.				●	●	TF	TF	tier 3	tier 3
Identification Requirements (non-potable)											
Storage	●	●				●	●	●	●	●	●
Piping	●	●				●	●	●	●	●	●
Dye for Identification as Non-Potable	TF					●	●	TF	TF		

Appendix: State Codes & Regulations

Greywater Source and End Use

	Source	Irrigation Use			Other Onsite Use		
	Standard Definition	Subsurface	Drip	Spray	Toilet Flushing	Cooling Tower Makeup	Other
AZ							
MA	*						
FL		only by approval					
NC		only by approval					
TX							
UT							
CA			tier 3	tier 3	tier 3	tier 3	tier 3
OR							

* MA allows water from kitchen sinks and dishwashers

Appendix: State Codes & Regulations

Requirements

	Storage Requirements		System Requirements		Identification Requirements		
	Size Requirement	Time Limitation	Filter	Disinfectant	Storage	Piping	Blue Dye
AZ							
MA							
FL							
NC							
TX	TF	TF	TF	TF			TF
UT	TF, irr.	TF	TF	TF			TF
CA				tier 3			
OR			tier 2,3	tier 3			