URBANGREEN™
Stormwater Solutions

Rainwater Harvesting

October 8, 2014

Presented by:
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CONTECH Engineered Solutions, Inc.

UrbanGreen Rain Water Harvesting

- RWH: A Runoff Reduction Tool
- Components
  - Pretreatment
  - Storage
  - Mechanicals Systems
- Design and Sizing
  - Runoff Reduction Calculator
- Case Studies

2

Total Site Solutions from CONTECH

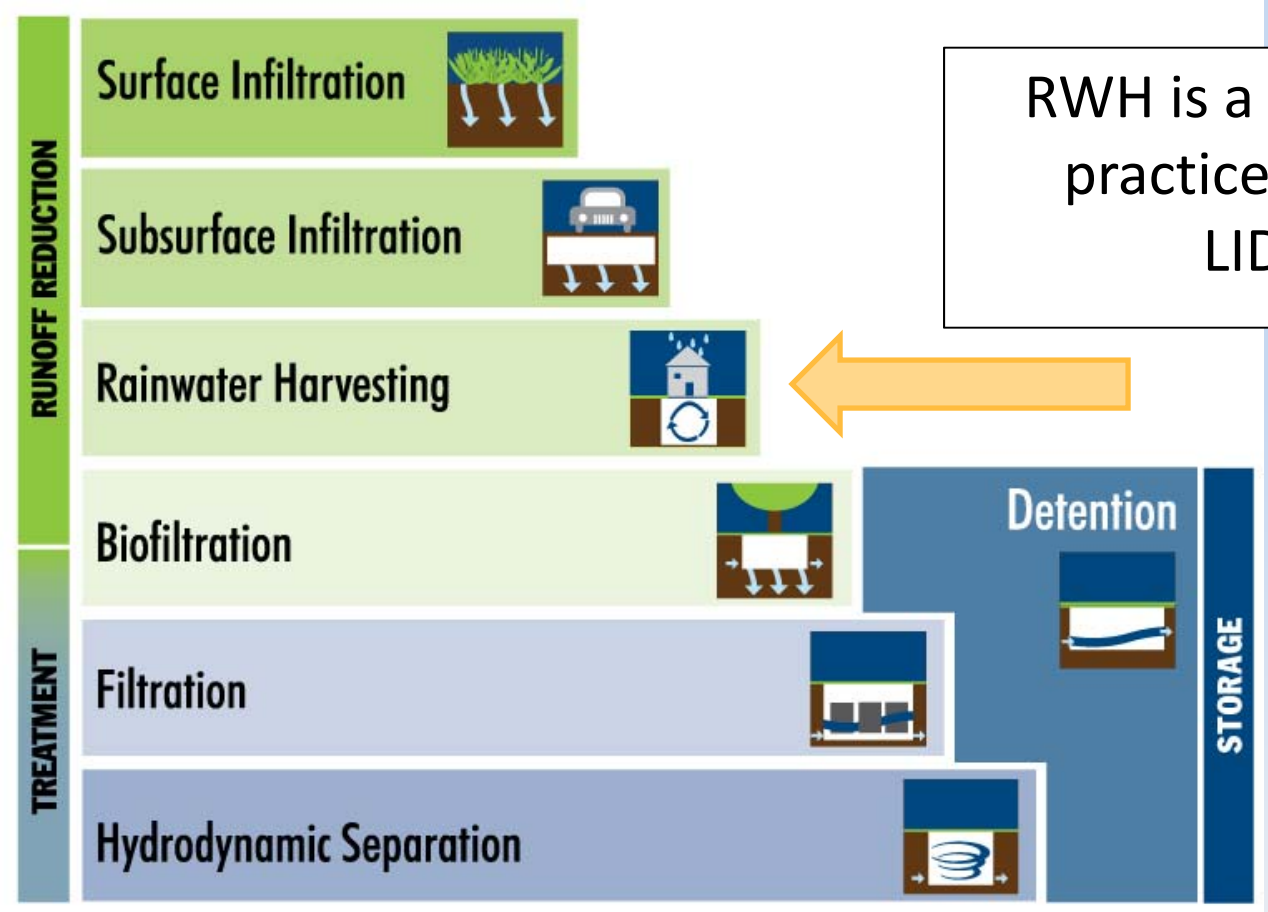
- **Stormwater**
- **Bridge**
- **Drainage / Sanitary / Irrigation**
- **Erosion Control**
- **Retaining Wall**
- **Soil Stabilization**

Water Management: Drinking, Waste, Storm

Commercial Development

- 43,000 ft² roof
- 43,000 ft² parking
- 43,000 ft² landscape
- 172,000 ft² office
- 35” per year

Stormwater Selection Staircase



RWH is a runoff reduction practice included in many LID regulations

RWH and LEED

Sustainable Sites

- 6.1 Stormwater Quantity
  - Pre-development peak and quantity – 1 Point
- 6.2 Stormwater Quality
  - Reduce annual TSS by 80% – 1 Point

Water Efficiency

- 1.0 Water Efficient Landscaping
  - Reduce by 50% - 2 Points
  - No Potable Use – 4 Points
- 2.0 Innovative Wastewater Technologies
  - Reduce potable water used for sewage – 2 points
  - OR
  - 50% onsite treatment – 2 points
- 3.0 Water Use Reduction
  - 30% reduction from Baseline – 2 points
  - 35% reduction from baseline – 3 points
  - 40% reduction from baseline – 4 points

LEED	**12**
• SS 6.1 (Quality)	1
• SS 6.2 (Quantity)	1
• WE 1 (Irrigation)	4
• WE2 (Wastewater)	2
• WE 3 (Indoor water)	4

DOE Volume 5 2012 Guidance

BMP T5.20: Rainwater Harvesting *Purpose and Definition*

Rainwater harvesting is the capture and storage of rainwater for beneficial use. Roof runoff may be routed to cisterns for storage and nonpotable uses such as irrigation, toilet flushing, and cold water laundry. Rainwater harvesting can help reduce peak stormwater flows, durations, and volumes. The amount of reduction achieved with cistern storage is a function of contributing area, storage volume, and rainwater use rate.

Design Criteria

- 100% reuse of the annual average runoff volume (use continuous runoff model to get annual average for drainage area).
- System designs involving interior uses must have a monthly water balance that demonstrates adequate capacity for each month and reuse of all stored water annually.

Runoff Model Representation

- Do not enter roof area draining to cistern into the runoff model.

Other Criteria

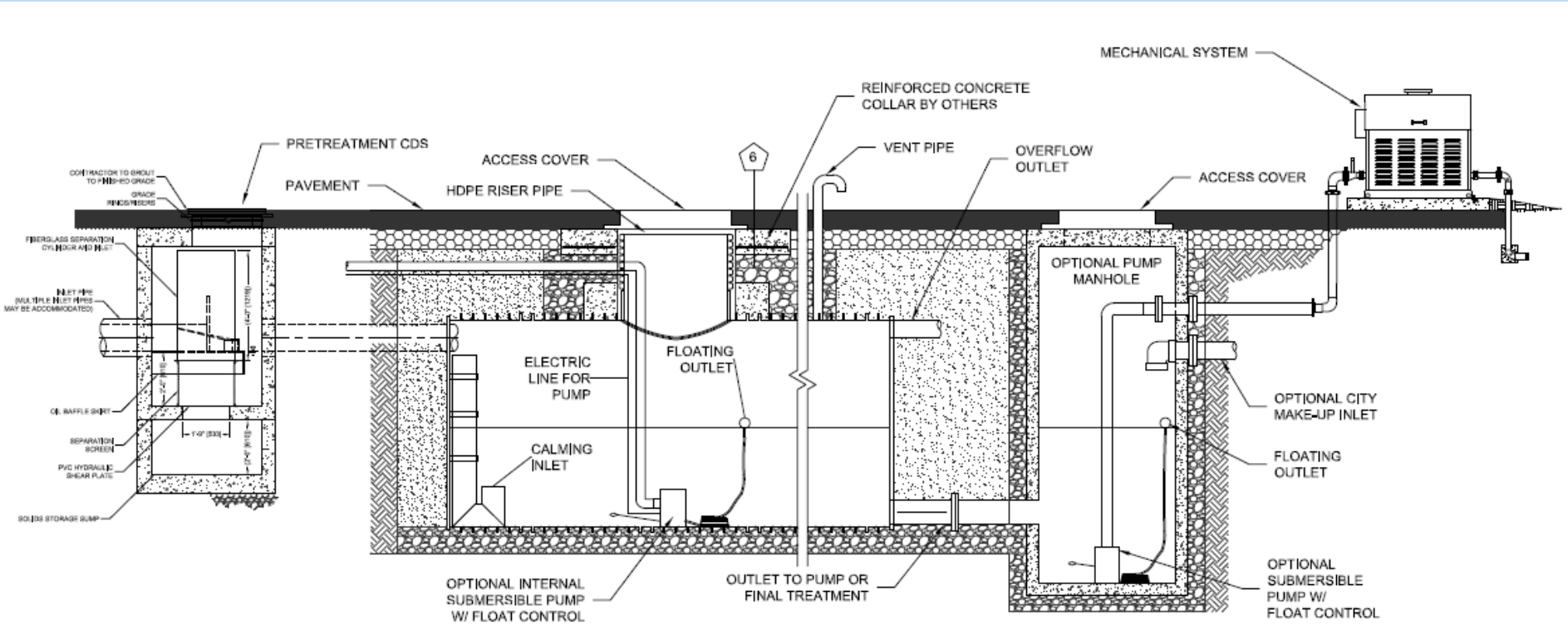
- Restrict use to 4 homes/acre housing and lower densities when the captured water is solely for outdoor use.

DOE LID Manual 2012 Guidance

- **Section 6.7.2 Design**
  - "In the Maritime Northwest rainwater collection should be sized to store as much rainfall as possible in April and May to provide water as far into the summer months as possible."
- **Section 7.7 of LID Design Manual**
  - "Do not enter roof drainage area into the runoff model. Note: This applies only to the roof drainage areas for which a monthly water balance indicates no overflow of the storage capacity."

Components

System Components



Pretreatment

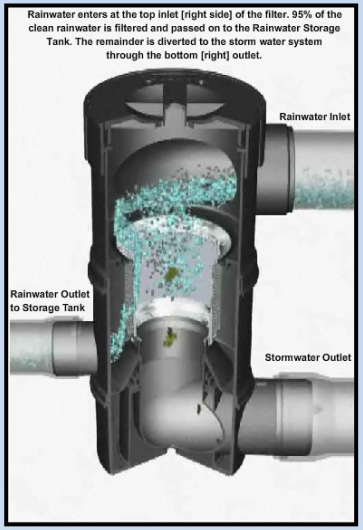
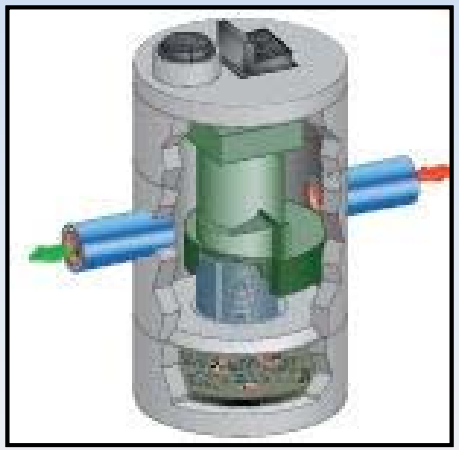


Photo source: http://www.wisy.de/eng/eng/wff1xx.htm

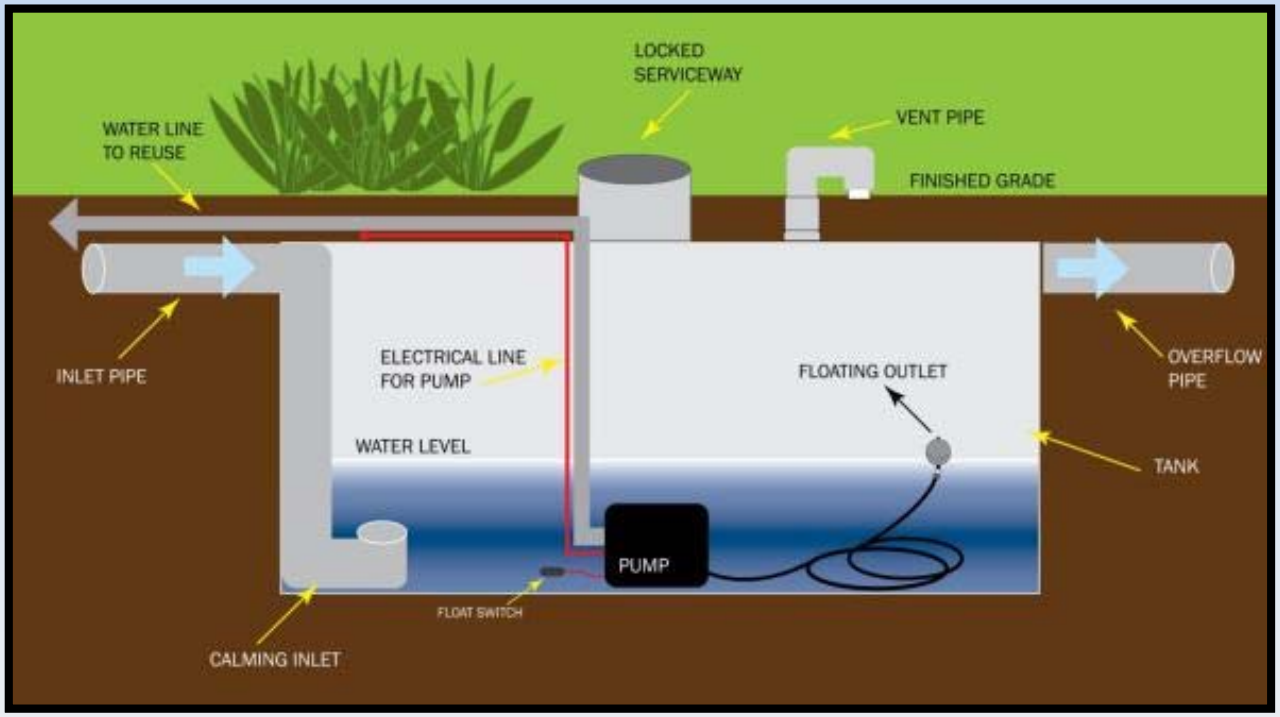


- Wall mounted or Underground
- Often called filtration but in reality it is usually screening
- Remove organic matter
- Recommended even for roof collection
- Look for:
  - Easy maintenance
  - Non-clogging

Photo source: http://www.rainharvest.com/graf-optimax-filter-pedestrian.asp

How to Store

- **Location:** Above or below ground
- **Loading :**HS-20 or higher
- **Longevity :** 20-100 years
- What Differentiates a Cistern from Detention:



Cistern Options

- Fiberglass
- Plastic Crates
- Concrete
- Metal
- Steel Reinforced Polyethylene

Photo source: http://wahaso.com

Steel Reinforced Polyethylene Cistern

Material

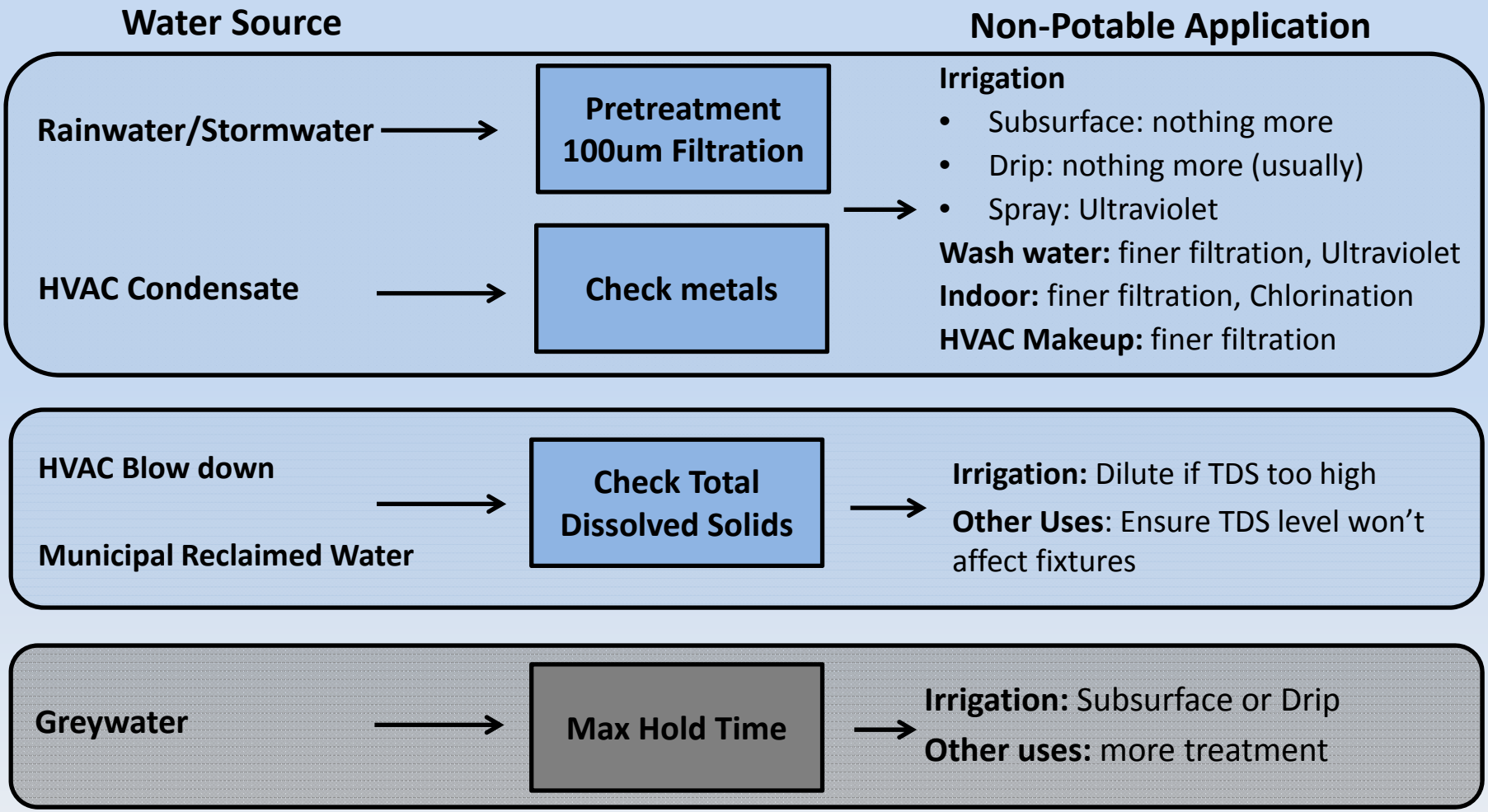
- HDPE
  - –High Performance Resin
  - –Recycled not allowed by standards
  - –1/3 of weight
- Steel
  - –55% post consumer recycled
  - –2/3 of weight
- Total Recycled Content: 37%

Design Life (depends of pressure)

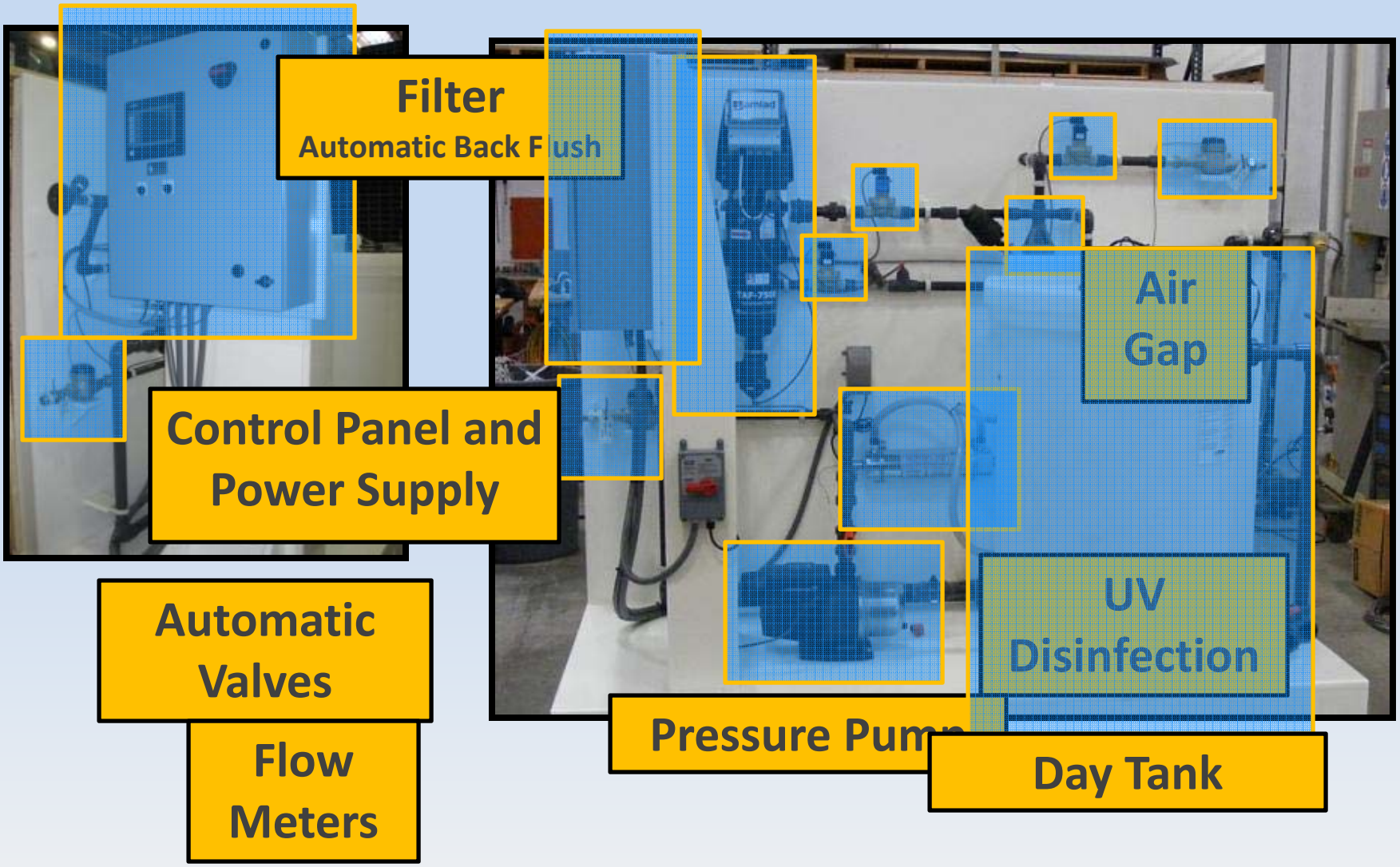
- Cisterns: 75 years
  - –Max pressure is storage head
  - –Intermittent pressure up to 4.3 psi (120”)
- Pressure Applications: 50 years
  - –15 psi continuous pressure
- Drainage: 100 years
  - –Gravity Flow

Mechanical System Components

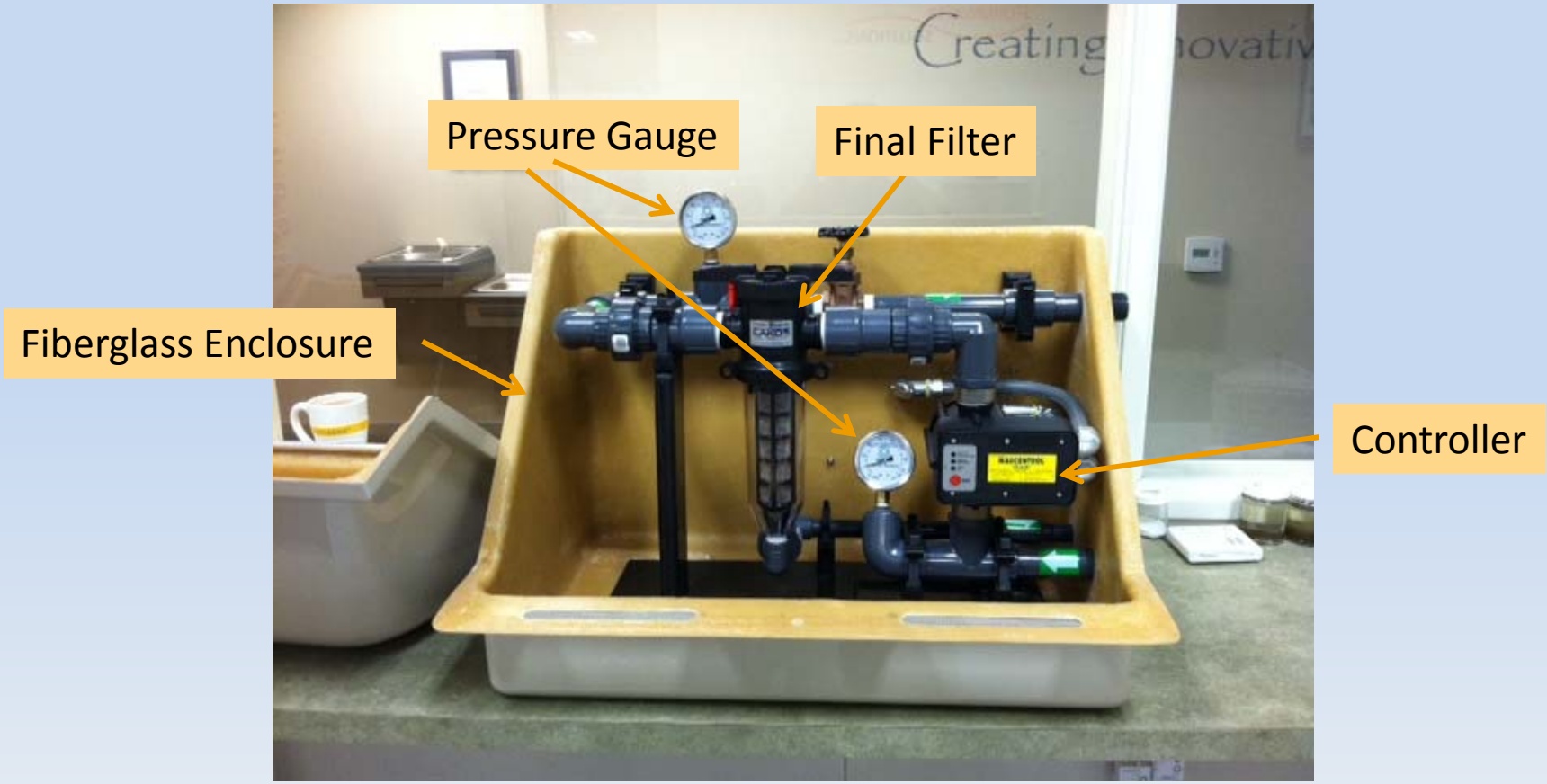
Treatment Guidelines: Check Local Code



Example: Mechanical System



Example: Drip Irrigation Mechanical Skid

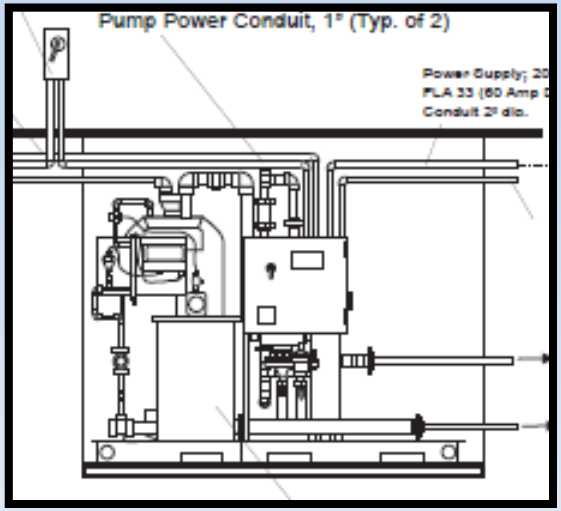


Mechanical System – Install Location

Indoor
Skid Mounted

Outdoor
Enclosure

Underground
Vault



Pump Location

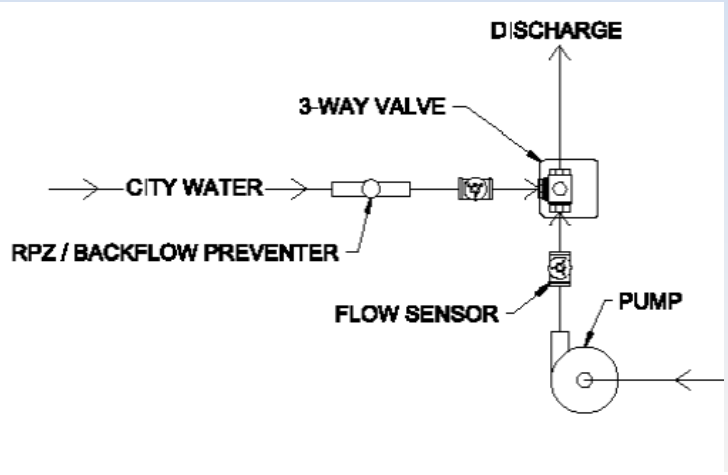
Submersible in Wetwell

Submersible in Cistern

Suction Above Ground

Make-up Water

- **Air Gap**
  - Required in Some States (Oregon)
  - Requires Re-Pressurization of Make-Up Water
- **3-Way Valve with Backflow Preventer**
  - Most Economical Design
  - Pressurizes Line when Cistern Level is Low
  - Not Allowed in All Areas



Final Treatment

- **Manual Filtration**
  - Bag filter/Screen
  - Maintenance: Manually clean/replace
  - Typically 50-200 microns
- **Automatic Filtration**
  - Bag Filter/Screen with drain
  - Maintenance: Automatic Drain Opening to Flush Filter
  - Typically 20-200 microns
- **Suction Scanning Filtration**
  - Auto-backflush based on pressure, time, and volume
  - Maintenance: Automatic Scrubbing of Screen with Waste to Drain
  - Typically 5-200 microns

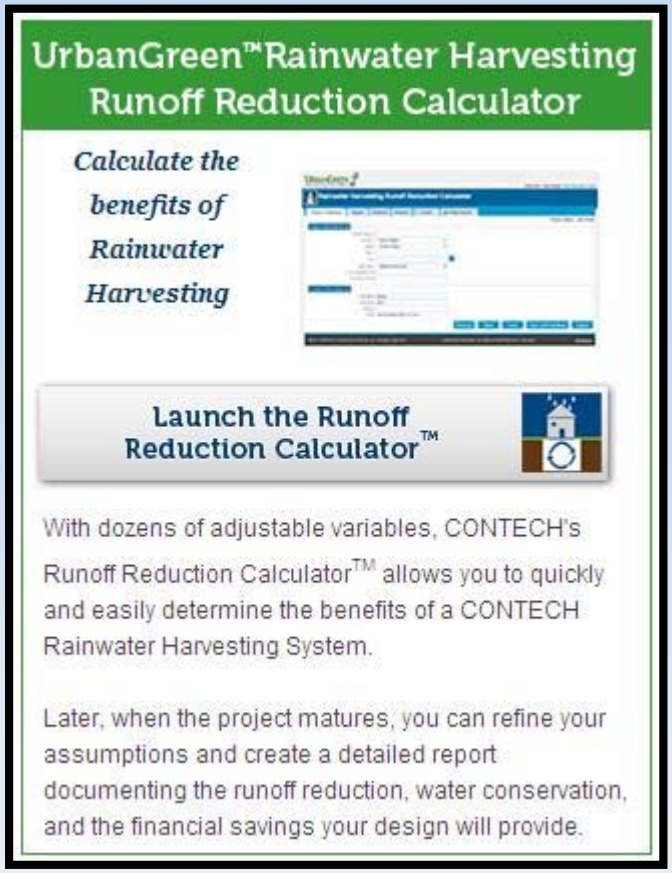
Maintenance

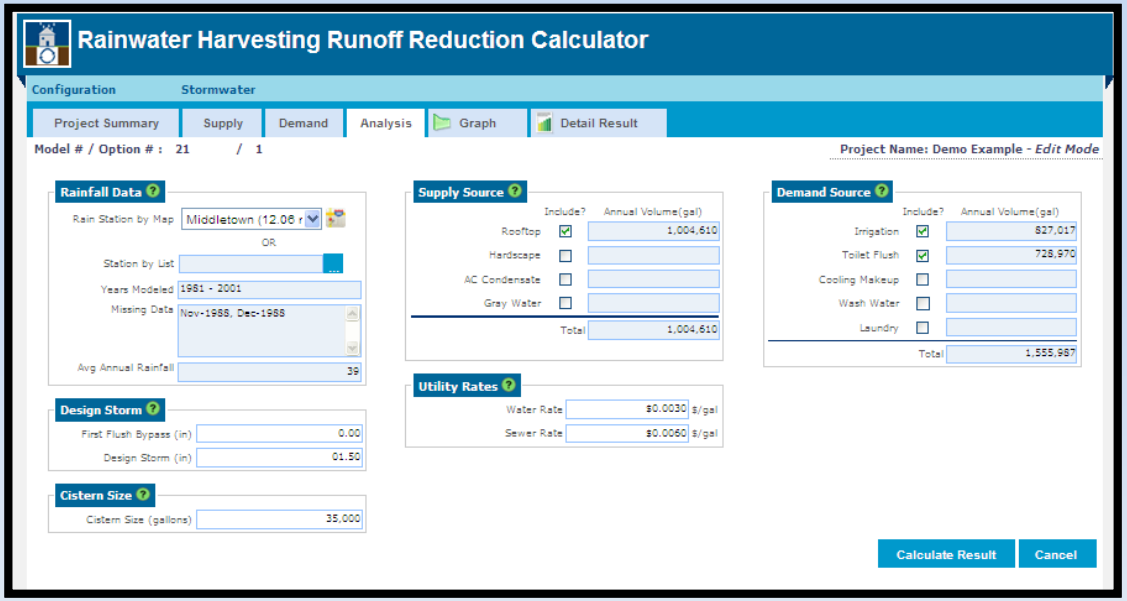
- **Cistern**
  - Ensure calming inlet is free from debris
  - Measure sediment depth > 4” indicates maintenance is needed
  - Check for floating debris and remove
- **Mechanical System**
  - Check Manual Filter – Clean or Replace
  - Replace UV Bulb Annually
  - Inspect Pumps for Wear

Runoff Reduction Model

RWH Sizing Online

www.conteches.com/Design-Toolbox/DYO-Project.aspx





Seattle Multi-Family: Site Overview

Mixed Use – Residential Portion

Rooftop Area: 20,000 ft^2

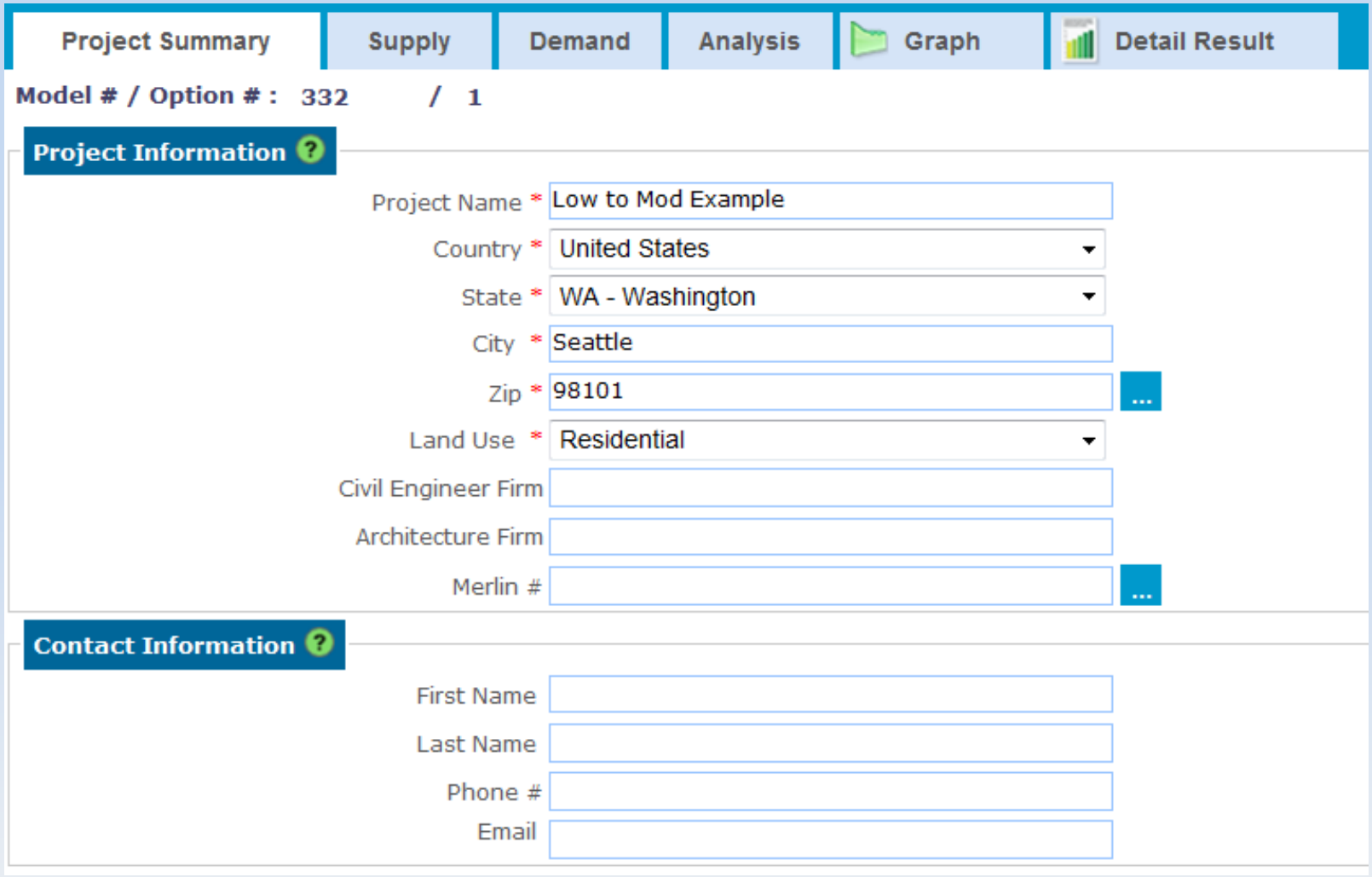
Building Area: 120,000 ft^2

- 85% of area res. Units
- 1,200 ft^2 per unit
- 85 units

Hardscape Area: 7,500 ft^2

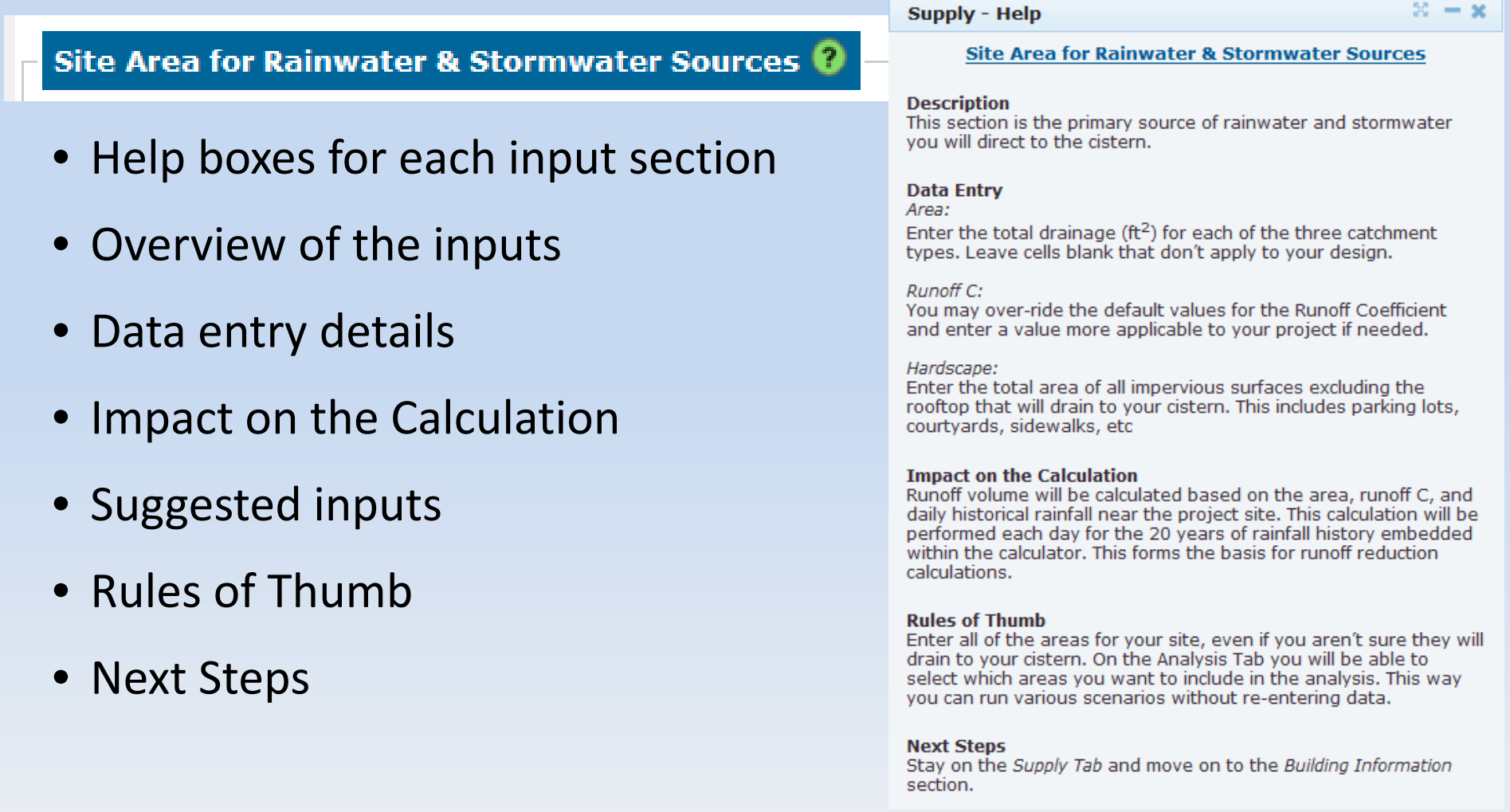
Landscape Area: 7,500 ft^2

Seattle – Multi-Family: Project Page



Questions and Help

- Help boxes for each input section
- Overview of the inputs
- Data entry details
- Impact on the Calculation
- Suggested inputs
- Rules of Thumb
- Next Steps



Seattle Multi-Family: Supply

Site Area for Rainwater & Stormwater Sources

	Rooftop - Traditional	Rooftop - Green Roof	Hardscape
Area (sq.ft)	20,000		7,500
Runoff C	0.95	0.50	0.90
Effective Runoff Area	19,000		6,750

Building Information

# of Floors	6	
Total Building Sq Footage	120,000	sq.ft
Peak Condensation Rate	0.0004	gal/hr/sq.ft
Peak Condensation Volume	35,021	gal/month

Secondary Sources of Re-use Water

Calculation of AC with: % of Peak

Air Condition Condensation Supply

Month	(% of Peak)	(gal/month)
January		
February		
March		
April	5%	1,751
May	15%	5,253
June	30%	10,506
July	45%	15,759
August	60%	21,013
September	40%	14,008
October	20%	7,004
November		
December		
Annual Total		**75,294**

Gray Water Supply

Month	(gal/month)
January	
February	
March	
April	
May	
June	
July	
August	
September	
October	
November	
December	
Annual Total	

Seattle Multi-Family: Demand

Toilet Re-use Demand

	Residential
Units	85
People/Unit	2.0
Occupancy	95%
GPD/Person	8.5
Annual Total	501,054

Laundry Re-use Demand

Loads/day	40.00
Gallons/Load	20
Cold Fraction	70%
Daily Total	560
Annual Total	204,400

Wash Water Re-use Demand

Daily Average	
Annual Total	

Irrigation Re-use Demand

Input Units: Inches per week

Irrigation Area: 7,500 sq.ft

Irrigation		
Month	Inches per week	Gallons per week
January		
February		
March		
April	0.25	1,169
May	0.75	3,506
June	1.00	4,675
July	1.50	7,013
August	1.50	7,013
September	1.25	5,844
October	0.75	3,506
November		
December		
Annual Total		142,592

Cooling Makeup Re-use Demand

Input Units: % of Peak Month Volume

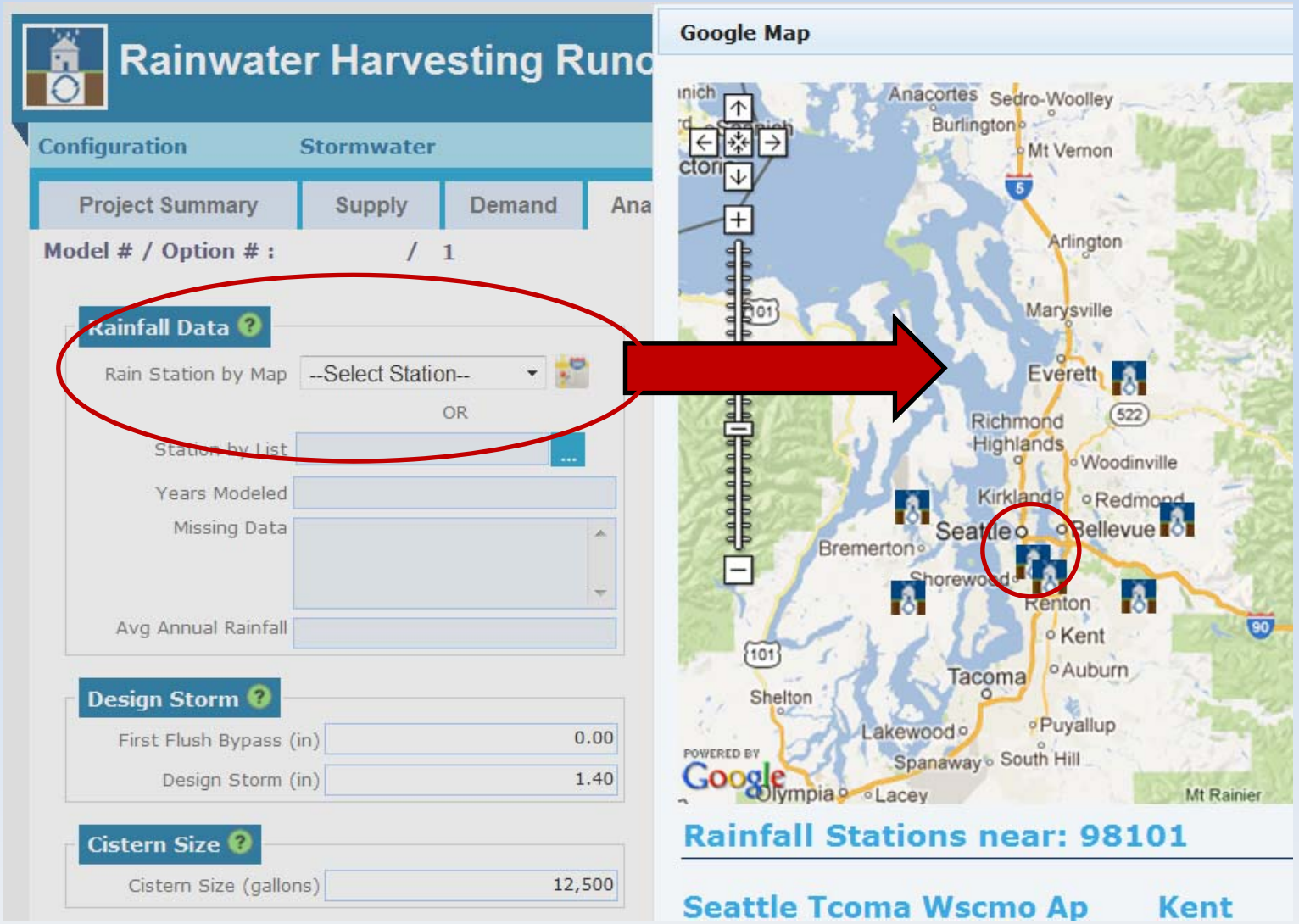
Volume in Peak Month: 4.60 gal/sq.ft

Total Cooled Area: 120,000 sq.ft

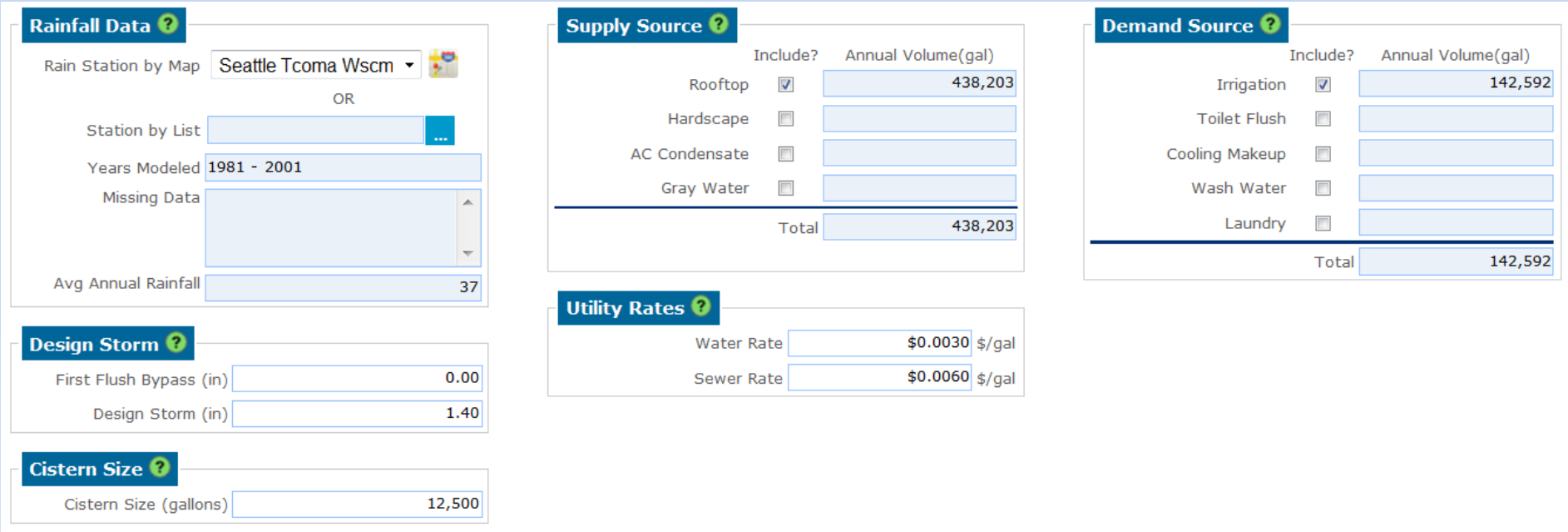
Peak Monthly Demand: 552,000 gal

Cooling Makeup		
Month	(% of Peak)	(gal/month)
January		
February		
March		
April	5.0%	27,600
May	15.0%	82,800
June	30.0%	165,600
July	45.0%	248,400
August	60.0%	331,200
September	40.0%	220,800
October	20.0%	110,400
November		
December		
Annual Total		1,186,800

Seattle Multi-Family: Analysis – Rain Gage



Seattle Multi-Family: Analysis Inputs



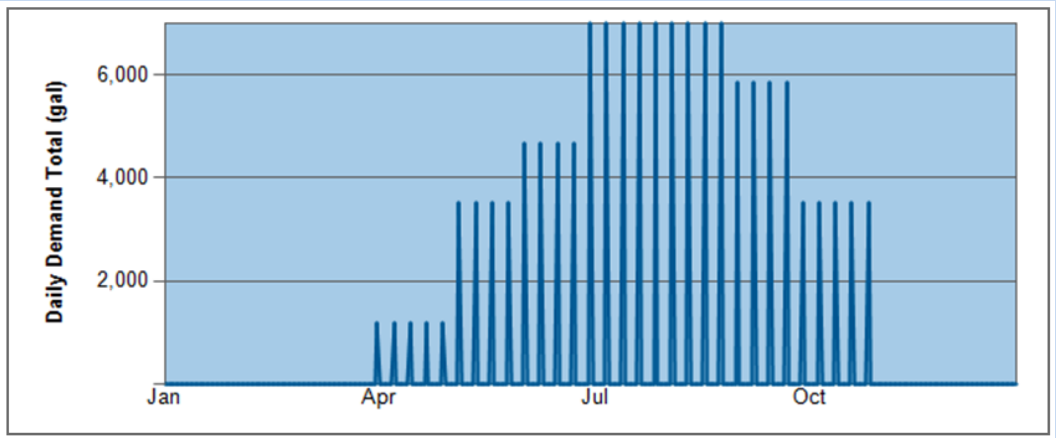
Annual Rainfall: 37in
First Flush Bypass: 0
Design Storm: 1.4in
Cistern Size: 12,500

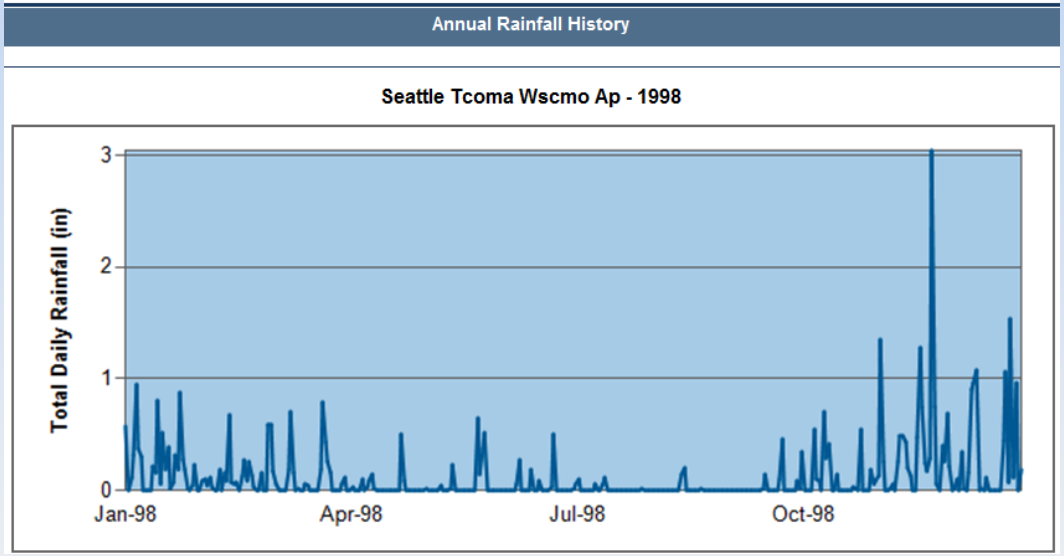
Rooftop: 430k gal/yr

Irrigation: 142k gal/yr

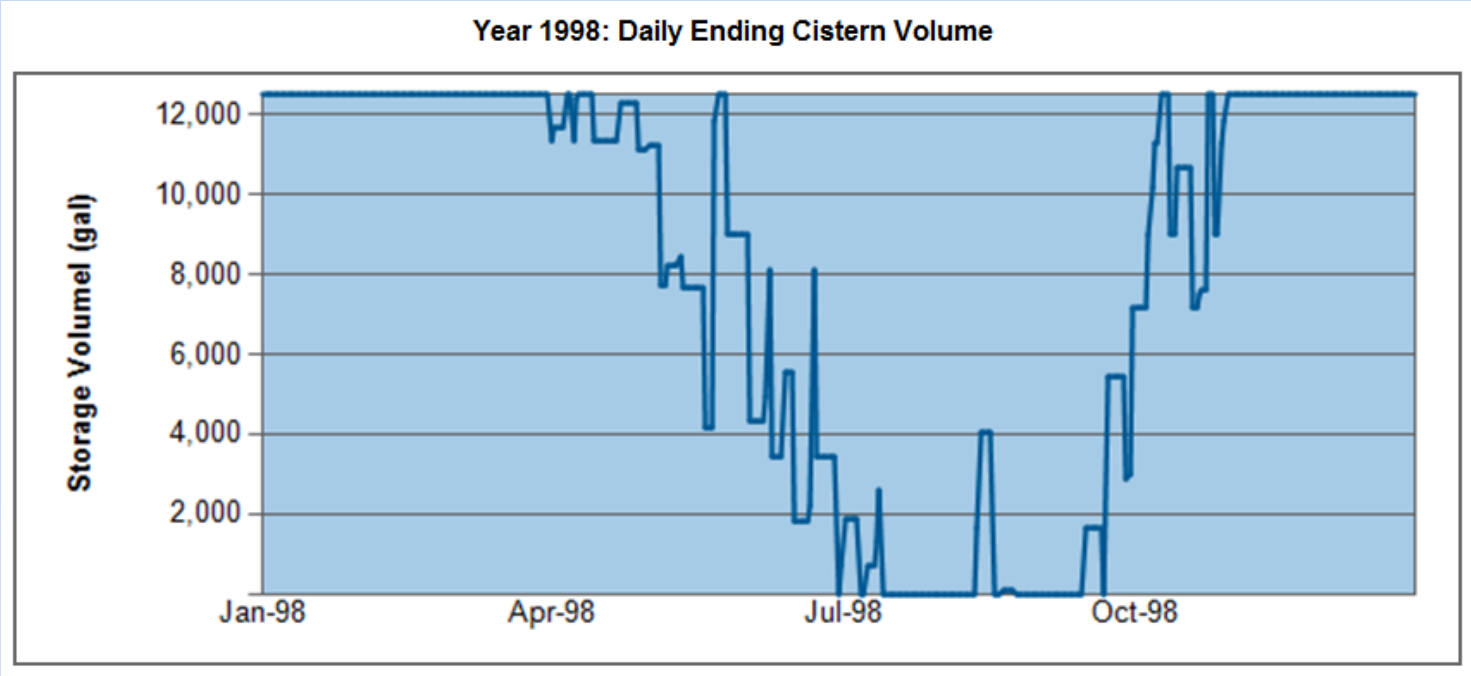
Seattle Multi-Family: Graphs

- Annual Demand pattern
  - Weekly irrigation
  - Minimal in winter
  - Max in summer
- 1998 Rainfall Data
  - Dry Summers
  - Not aligned with Demand
- Need Winter demand





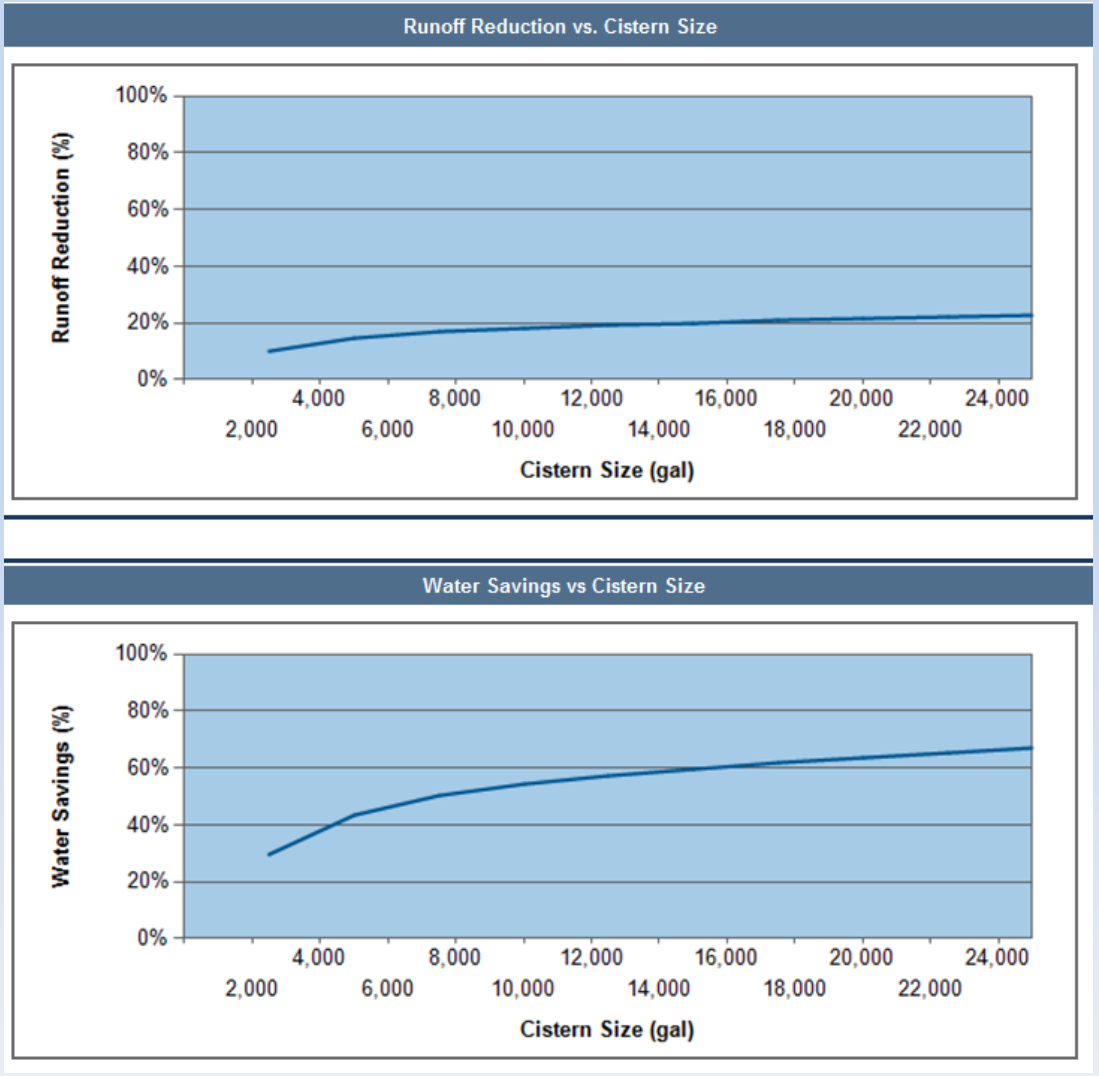
Seattle Multi-Family: Graphs



- Daily Ending Cistern Volume
  - Full in winter
  - Fills/empties in spring/fall
  - Mostly empty in summer

Seattle Multi-Family: Graphs

- **Cistern vs Runoff Red.**
  - 19% Runoff Reduction
  - Diminishing returns on cistern size
- **Cistern Size vs. Water Savings**
  - 55% water savings
  - For irrigation



Seattle Multi-Family – Summary Results

	Rainfall		Stormwater		Supply		Demand	Captured
	Total	Targeted	Targeted	Peak	TargetedSW	Total		
Typical Rainfall Year	37	36	427,454	13,422	427,454	438,959	142,592	82,077
Max Rainfall Year	51	48	567,296	32,806	567,296	600,102	142,592	93,841
21 Year Total	**779**	**759**	**8,976,538**	**241,603**	**8,976,538**	**9,218,141**	**2,994,432**	**1,723,626**

	Runoff Retained (Targeted Rainfall)		Water Savings		Total Retained (Targeted, Peak, Secondary)		Savings
Typical Rainfall Year	82,078	20%	81,482	57%	82,077	19%	$733
Max Rainfall Year	93,841	17%	93,841	66%	93,841	16%	$845
21 Year Total	**1,723,628**	**19%**	**1,711,125**	**57%**	**1,723,626**	**19%**	**$15,401**

Previous | Next | Save | Save and Download | Cancel

- 19% Runoff Reduction
- 57% Water Savings
- $733 savings per year

Seattle Multi-Family: Toilet Flushing

Rainfall Data

Rain Station by Map: Seattle Tcoma Wscm

OR

Station by List:

Years Modeled: 1981 - 2001

Missing Data:

Avg Annual Rainfall: 37

Design Storm

First Flush Bypass (in): 0.00

Design Storm (in): 1.40

Cistern Size

Cistern Size (gallons): 12,500

Supply Source

	Include?	Annual Volume(gal)
Rooftop	☑	438,203
Hardscape	☐	
AC Condensate	☐	
Gray Water	☐	
Total		438,203

Utility Rates

Water Rate: $0.0030 $/gal

Sewer Rate: $0.0060 $/gal

Demand Source

	Include?	Annual Volume(gal)
Irrigation	☐	
Toilet Flush	☑	501,054
Cooling Makeup	☐	
Wash Water	☐	
Laundry	☐	
Total		501,054

Edit Configuration | Cancel

	Rainfall		Stormwater		Supply		Demand	Captured
	Total	Targeted	Targeted	Peak	TargetedSW	Total		
Typical Rainfall Year	37	36	427,454	13,422	427,454	438,959	501,054	301,959
Max Rainfall Year	51	48	567,296	32,806	567,296	600,102	501,054	345,863
21 Year Total	**779**	**759**	**8,976,538**	**241,603**	**8,976,538**	**9,218,141**	**10,522,134**	**6,341,133**

	Runoff Retained (Targeted Rainfall)		Water Savings		Total Retained (Targeted, Peak, Secondary)		Savings
Typical Rainfall Year	301,959	72%	301,934	60%	301,959	70%	$2,717
Max Rainfall Year	345,863	61%	344,641	69%	345,863	58%	$3,102
21 Year Total	**6,341,133**	**71%**	**6,340,614**	**60%**	**6,341,133**	**69%**	**$57,066**

- 71% Runoff Reduction, 60% water savings, $2,700/yr

Detailed Results and Report

- Detailed Results
  - Each year
- Report
  - Documentation
  - Input screens
  - Graphs
  - Summary Results
  - Detailed Results
  - Download – excel or PDF

Year	Rainfall				Supply							
	Total	FF Rainfall	Target 0 to 1.4 in	Peak Rainfall	Stormwater			Secondary Supply		Total		
					FF BP	Targeted	Peak	AC	Gray Water	Targeted	Total	Targeted /Total
1981	35		34	01		547,013	21,187			547,013	568,200	96%
1982	39		39			624,859	6,260			624,859	631,119	99%
1983	41		41			656,961				656,961	656,961	100%
1984	37		37			591,152				591,152	591,152	100%
1985	25		25			401,111	2,247			401,111	403,358	99%
1986	38		35	03		560,816	54,573			560,816	615,389	91%
1987	30		29	01		470,771	9,631			470,771	480,402	98%
1988	33		33			525,023	3,371			525,023	528,394	99%
1989	35		35			556,643	161			556,643	556,804	100%
1990	45		40	05		645,886	72,389			645,886	718,275	90%
1991	35		34	01		544,765	23,755			544,765	568,521	96%
1992	33		33			524,541	1,605			524,541	526,146	100%
1993	29		28			455,683	6,581			455,683	462,264	99%
1994	35		35			554,878	4,013			554,878	558,890	99%
1995	43		42	01		669,641	14,125			669,641	683,766	98%
1996	51		48	03		768,835	44,461			768,835	813,296	95%
1997	43		43	01		684,889	9,470			684,889	694,359	99%
1998	44		42	02		678,790	28,410			678,790	707,200	96%
1999	42		42			673,975	1,926			673,975	675,901	100%
2000	28		28			449,744				449,744	449,744	100%
2001	38		36	01		579,596	23,274			579,596	602,869	96%
Total	779		759	19		12,165,572	327,439			12,165,572	12,493,010	97%

Case Studies

South Seattle Transfer Station

ElectroFusion Coupler

Power Core Heating Coils

- **Double Seal on each pipe**
- **Field testable after install**
- **No water or pressure test needed**

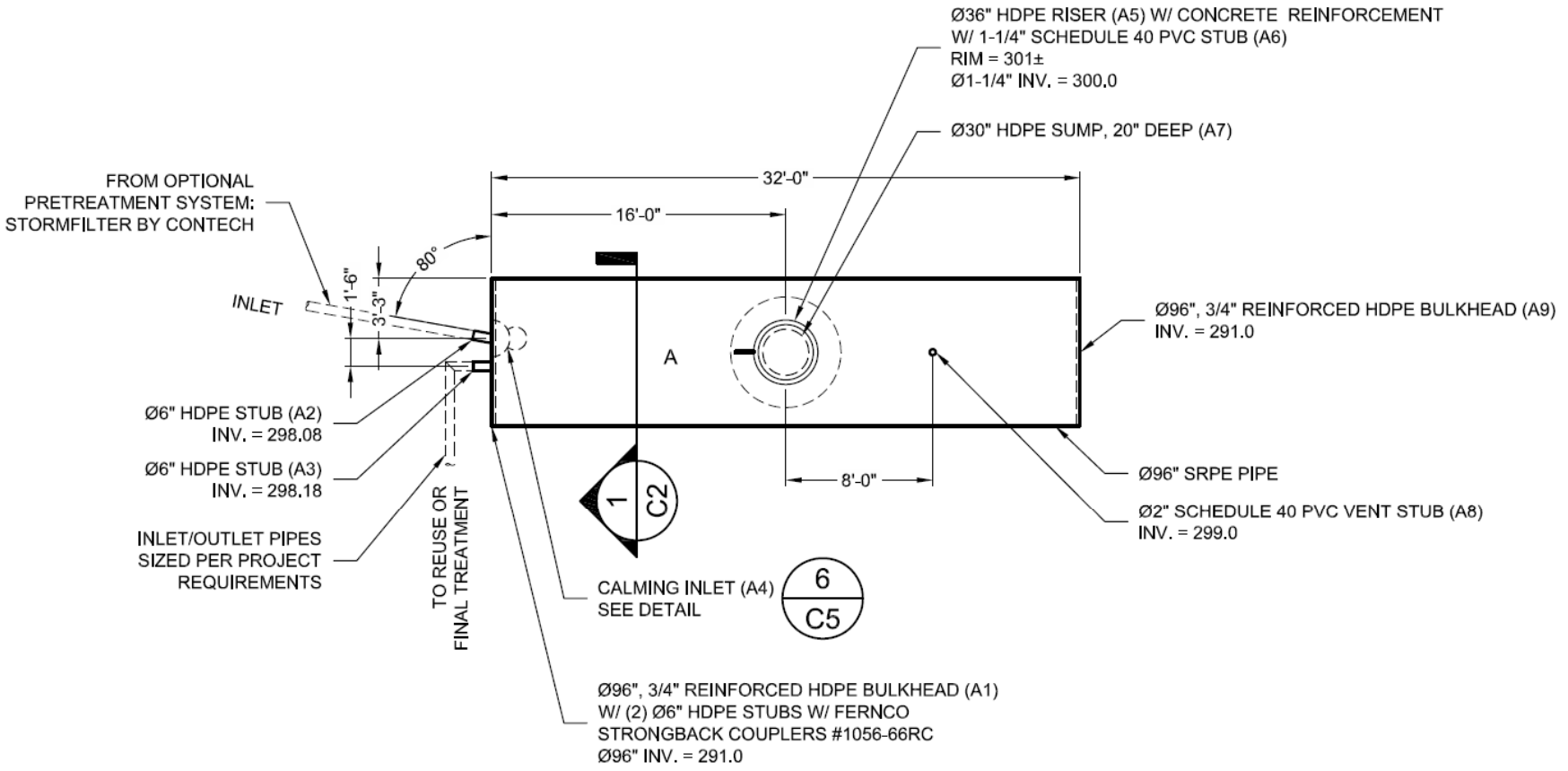

DuroMaxx
MILLER

Fort Lewis Air Support Ops Squadron

- Rainwater Harvesting Cistern Collects rainwater from the roof of the weather squadron facility
- Rainwater is used for irrigation
- Overflow is routed to infiltration trench and rain garden
- Cistern size: 12,000 gallons
- Cistern Footprint: 96” Diameter, 32’ long
- Integrated sump for pump

JOINT BASE LEWIS-McCHORD
SOLDIERS & AIRMEN DEFENDING AMERICA
JBLM
Joint Base Lewis-McChord

Fort Lewis Cistern Detail



ASSEMBLY

SCALE: 1" = 10'

VOLUME: 12,000 GAL.

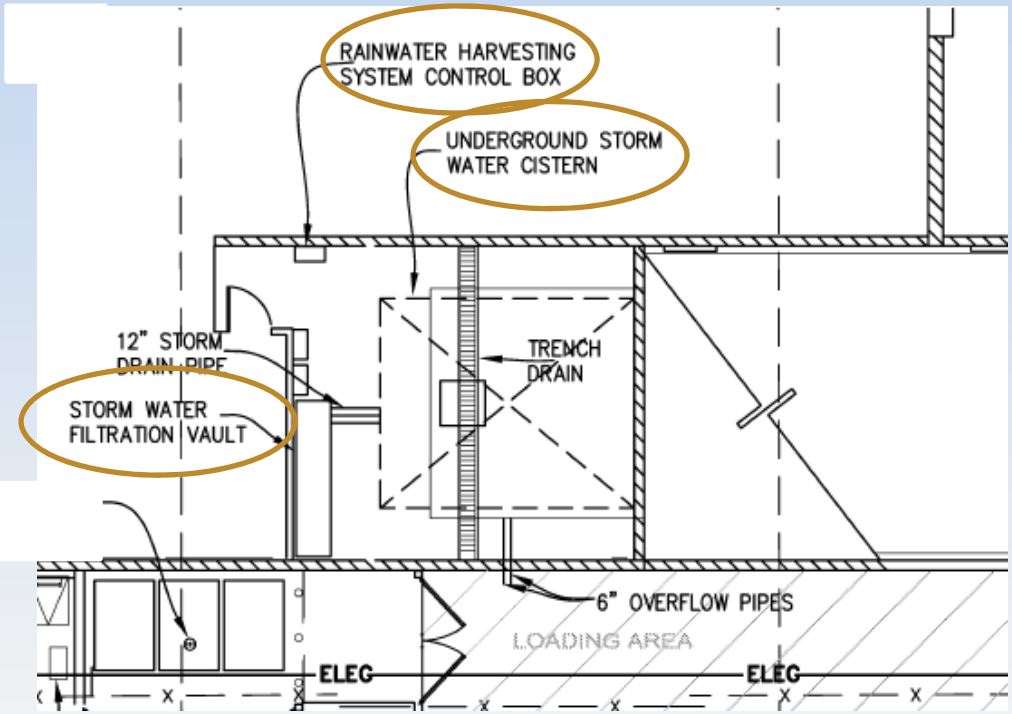
LOADING: H20/H25

SYSTEM INV = 291.0

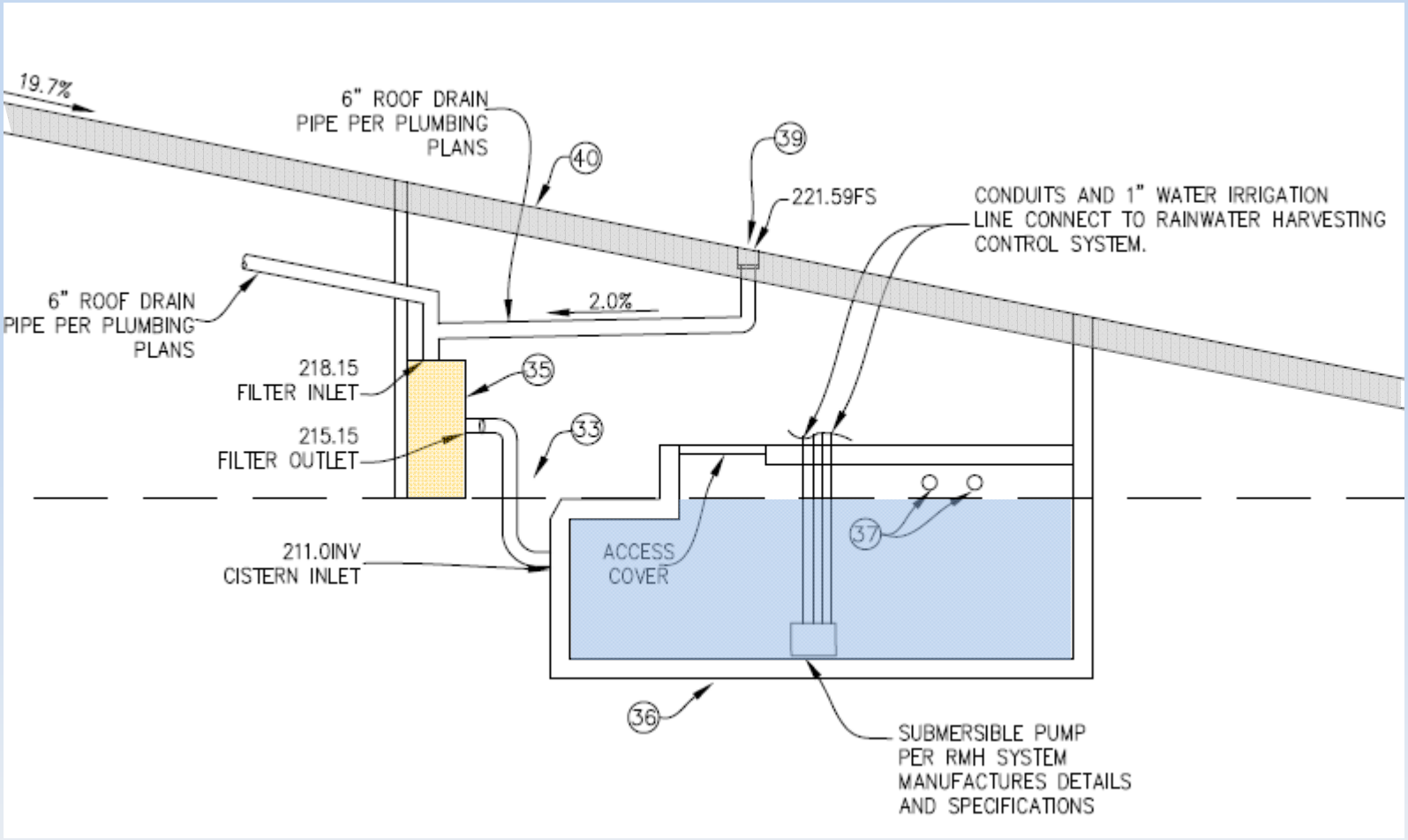
Fort Lewis Cistern

CVS Pharmacy

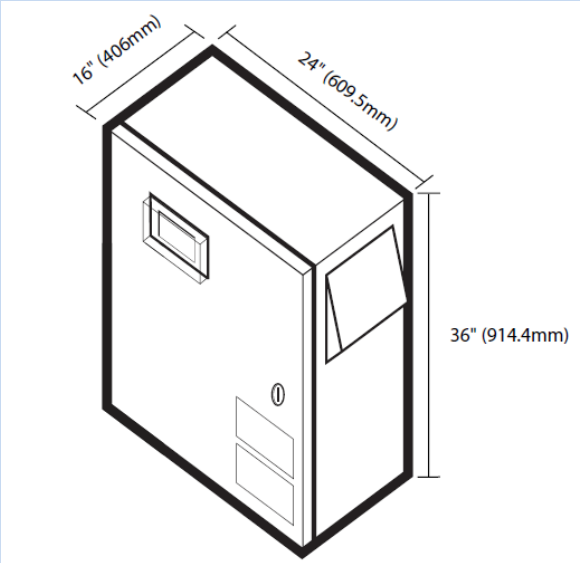
- Located in Los Angeles, CA
- Water used for irrigation and drip system to potted plants
- Installed Under Parking Garage Ramp



CVS Pharmacy Los Angeles



CVS Pharmacy Los Angeles



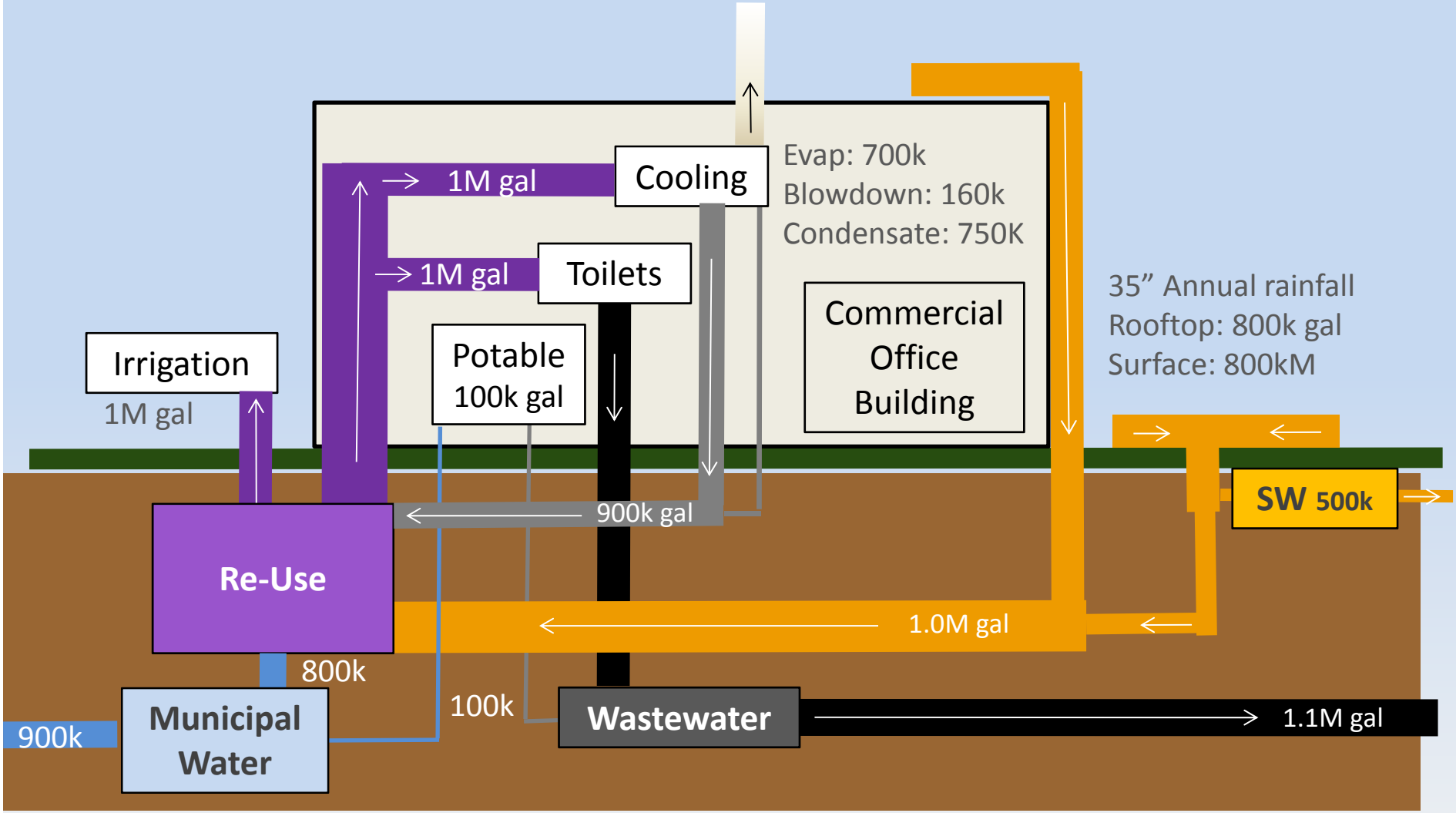
Summary

Water Management: Drinking, Waste, Storm

Commercial Development

- 43,000 ft² roof
- 43,000 ft² parking
- 43,000 ft² landscape
- 172,000 ft² office
- 35”/yr

Water Management: Drinking, Waste, Storm



QUESTIONS?

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