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Metrics Beyond The Meter: Evaluating Tucson's Water Harvesting Program

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WaterReliability



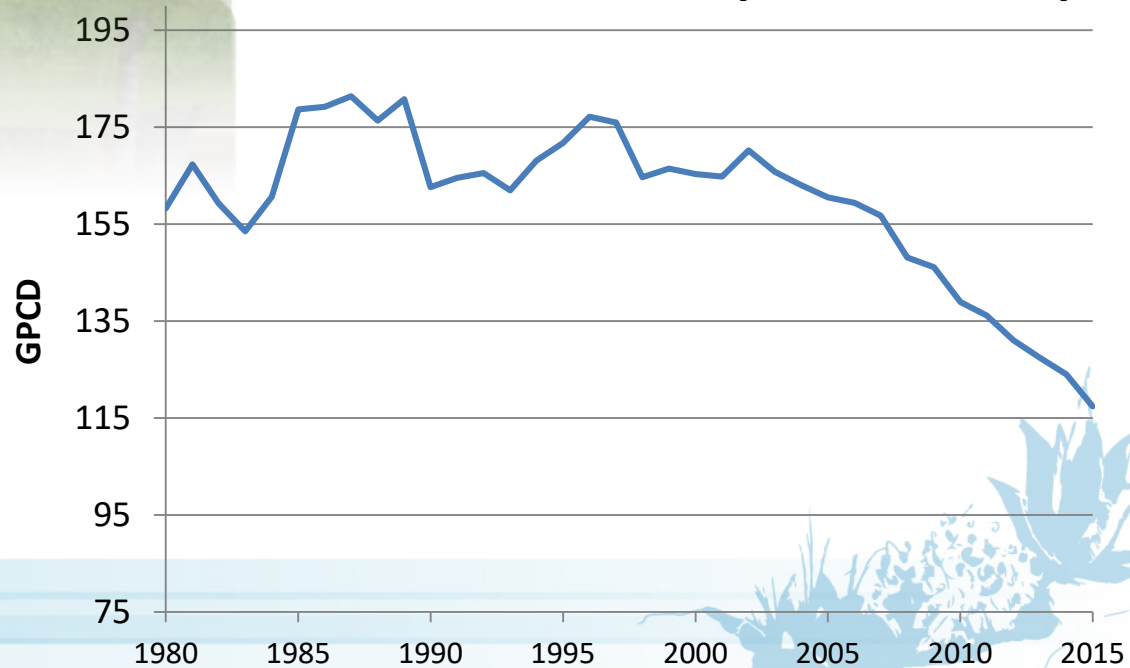


Typical Tucson landscape in the 1960s & 1970s



Tucson's GPCD (1980 - 2015)

Outdoor water use has dropped over 50% in the last 3 decades.



The Conservation Ethic Sticks

And begins to drive new approach to resiliency...

2012:
Rebate
Program



2017:
Neighborhood
Grant Program
& Low-income
RWH program



Commercial
Rainwater
Harvesting

Residential
Rainwater
Harvesting

Green Streets
Policy

Neighborhood-
Scale Rainwater
Harvesting

One Watershed
Solutions



2010:
Ordinance

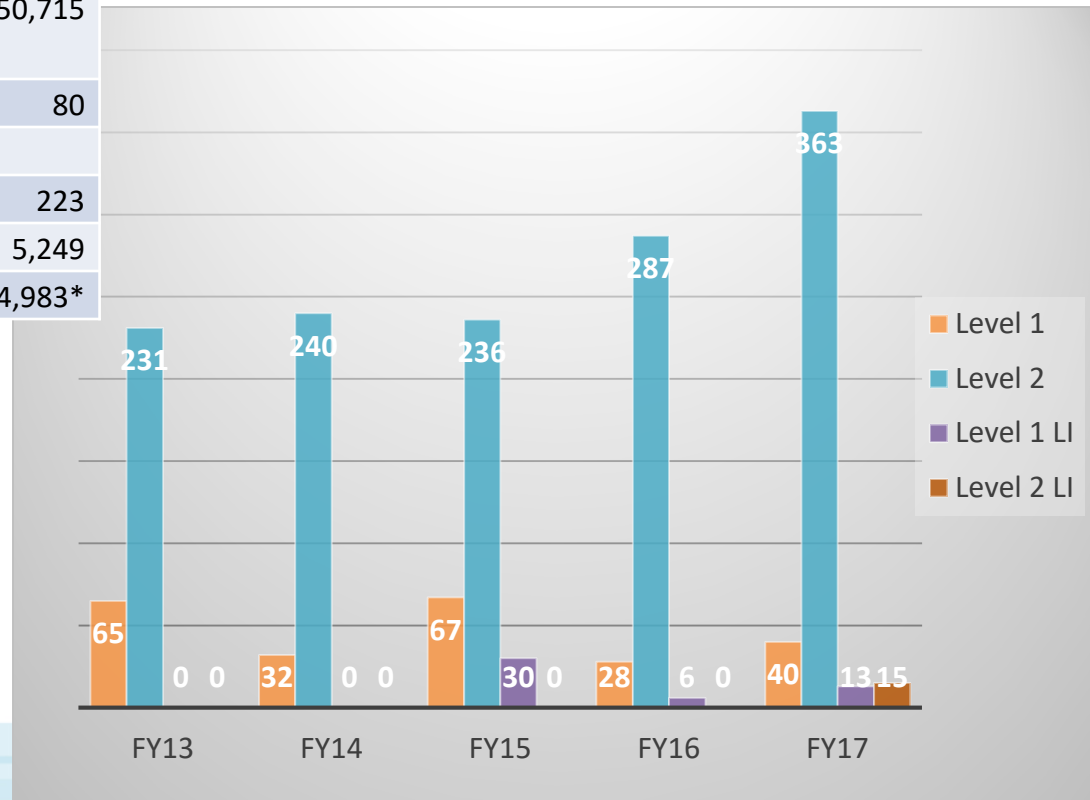


2013:
New
const.
policy

One Water solutions involve
Individuals, neighborhoods, non-profits,
city & county

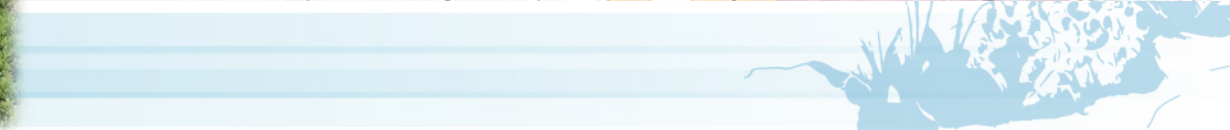
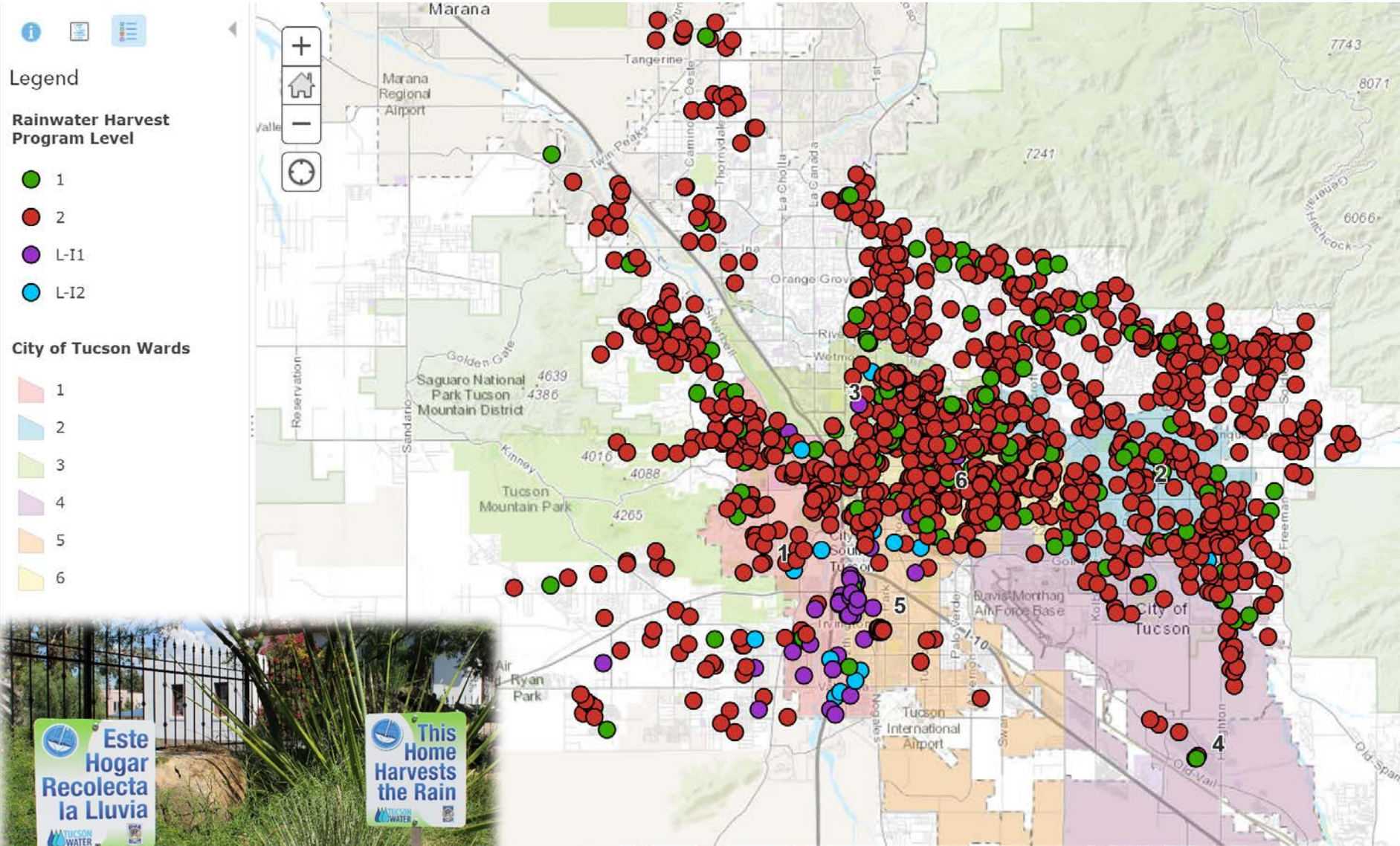
RWH Program Activity

	FY 2016-17 Activity:	Cumulative:
Approved Applications:	438	1,697
Expenditure Level 1:	\$118,531	\$88,578
Expenditure Level 2:	\$395,899	\$1,835,361
Expenditure L-I Level 1:	\$4,853	\$21,910
Expenditure L-I Level 2:	\$19,570	\$22,210
Estimated Gallons Saved:	2,134,225	25,950,715
Estimated AF Saved:	7	80
Staff Labor Hours:	340	
Workshops:	54	223
Workshop Attendees:	1,132	5,249
Gallons of Storage	426,845*	1,874,983*



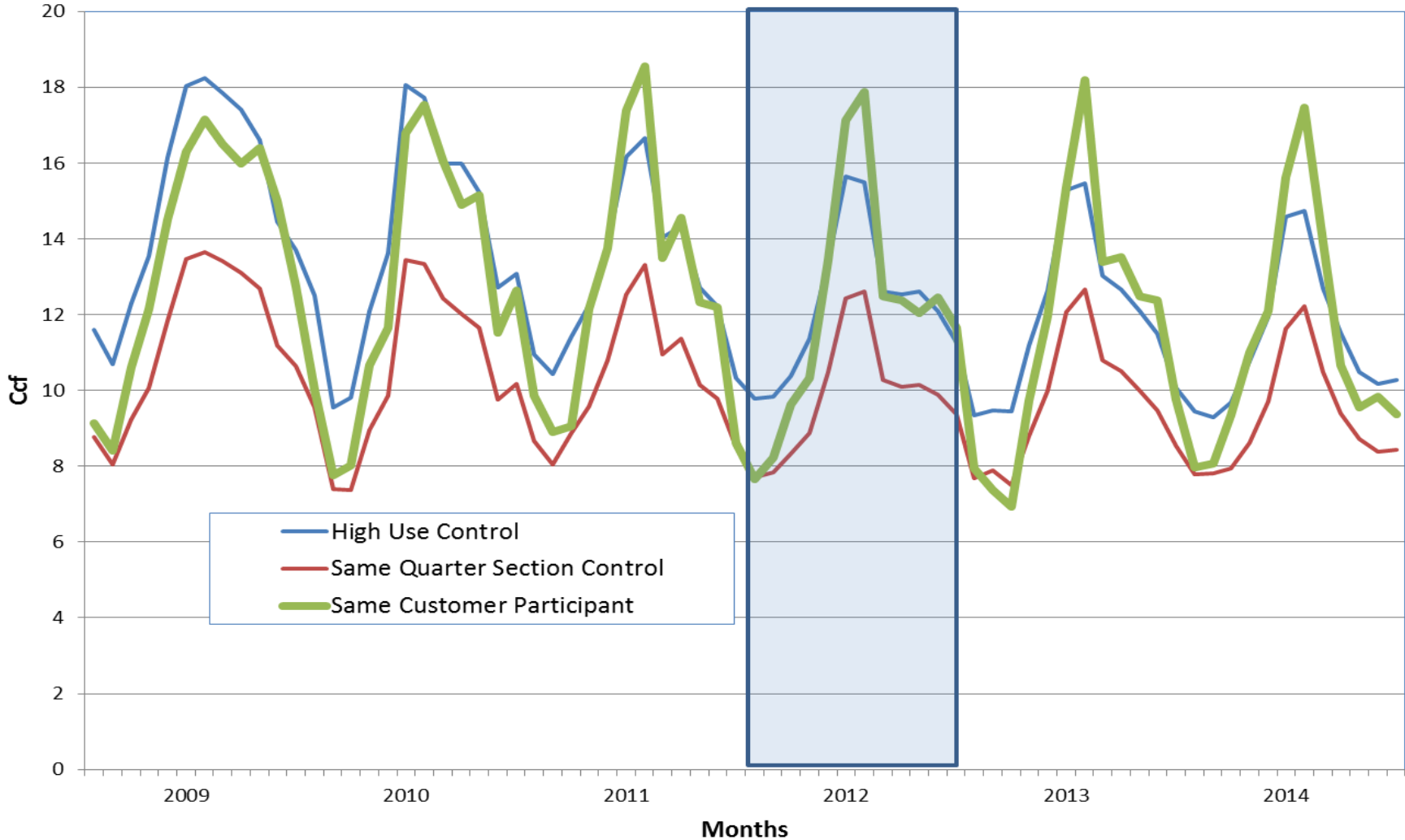
*The current estimated savings is based on the assumption that tanks will fill, on average, five times per year.

Residential Water Harvesting



Early Findings

Water Harvesting Program: Comparison of Water Harvesting Rebate Program Participant who purchased a water harvesting system in 2012 for those participant locations where the customers were the same from 2009 to 2014 to the usage of two reference groups or control groups



“I want to harvest water because... _____”

- The water is free.
- The water is better for my plants.
- I need to deal with a flooding problem.
- I want more shade & animal habitat.
- I want a garden.
- I'm tired of my water bills going up.
- It will slow traffic on my street.
- It makes my neighborhood look nicer.
- I think it's the “right” thing to do.
- I don't think we should depend on water from faraway rivers.

Additional benefits like:

- Beautification/aesthetics
- Flood reduction
- Increased habitat
- Pollution control
- Traffic calming
- Increased tree canopy
- UHI mitigation

Quality of Life & Community Ethic



Let's understand what's going on

What about this program is different than more traditional, demand management conservation programs?

Remotely

1. Maintenance Survey
2. NDVI remote sensing analysis

And finally...

5. Ongoing monthly water use analysis

Directly

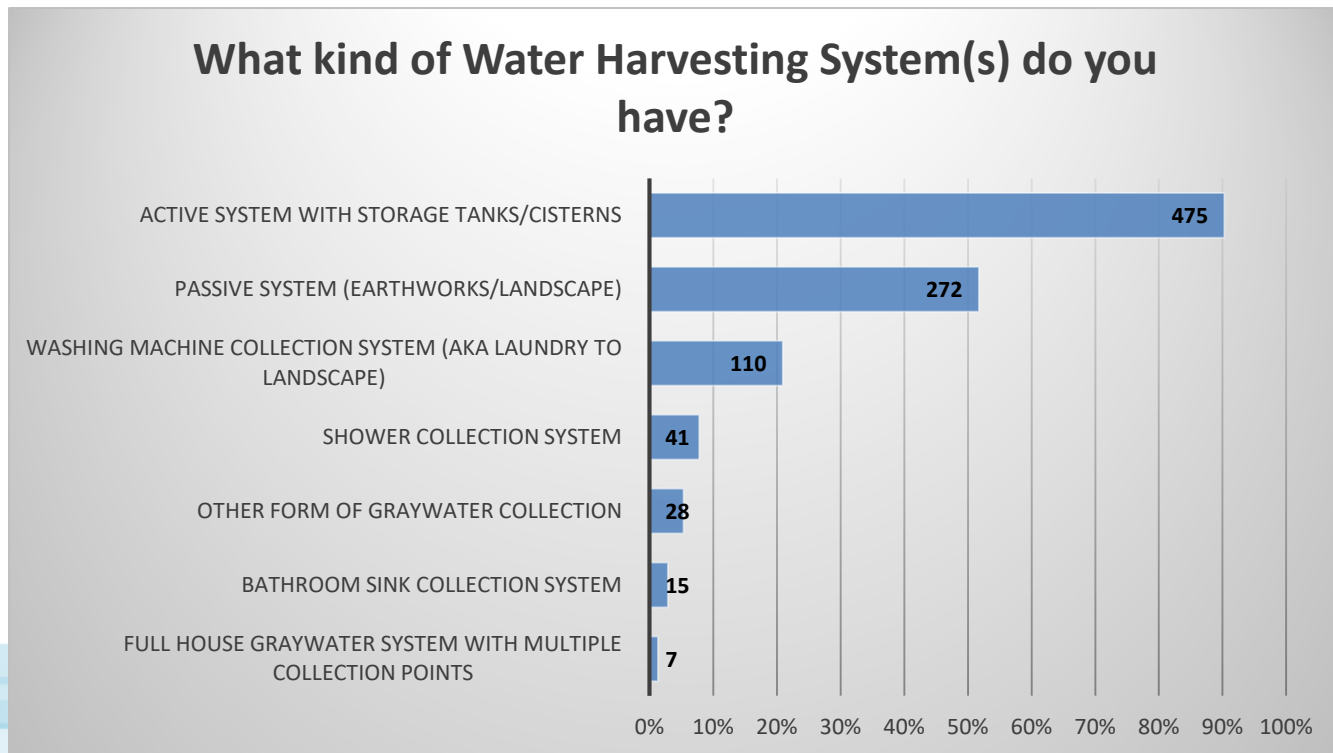
3. Participant motivation study
4. Cistern monitoring study

We find ourselves with an opportunity to re-think how we manage rainwater...

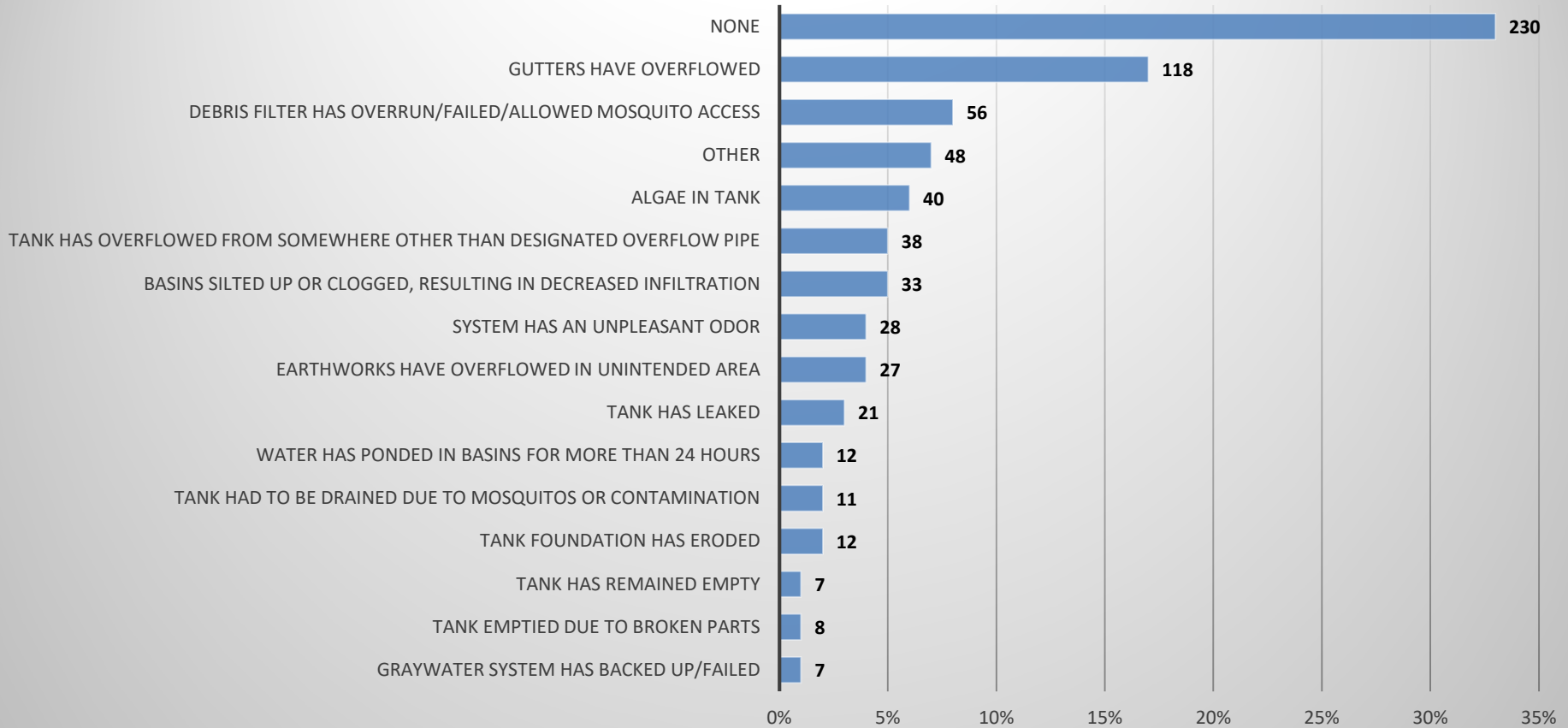


Maintenance Survey

- Goal: ID barriers to effective use of water harvesting systems & make recommend best practices



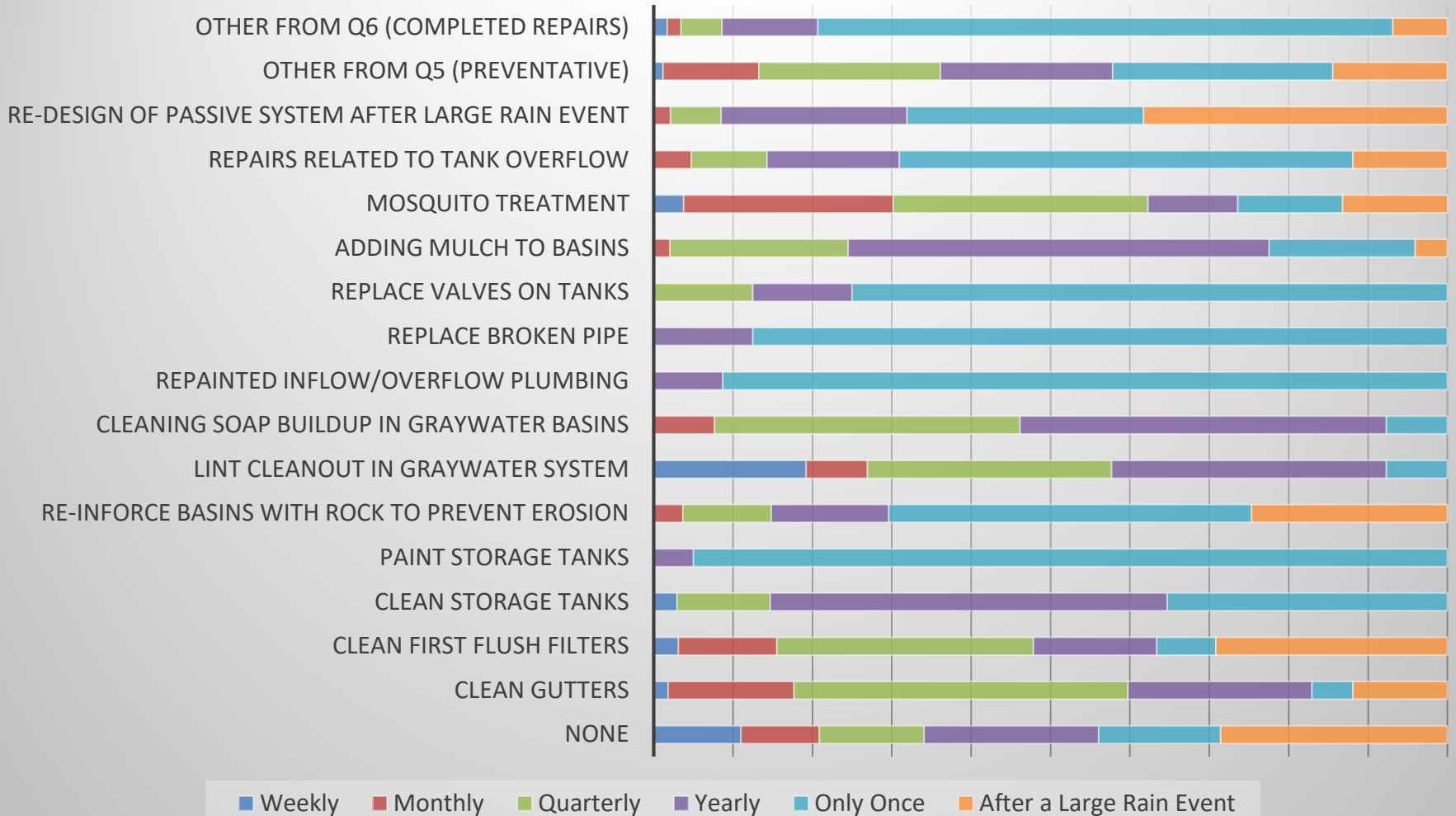
Maintenance Issues that have Occurred



Of the respondents who indicated they had experienced issues, 62% indicated the issues were expected and 38% indicated they were not expected (N=501).



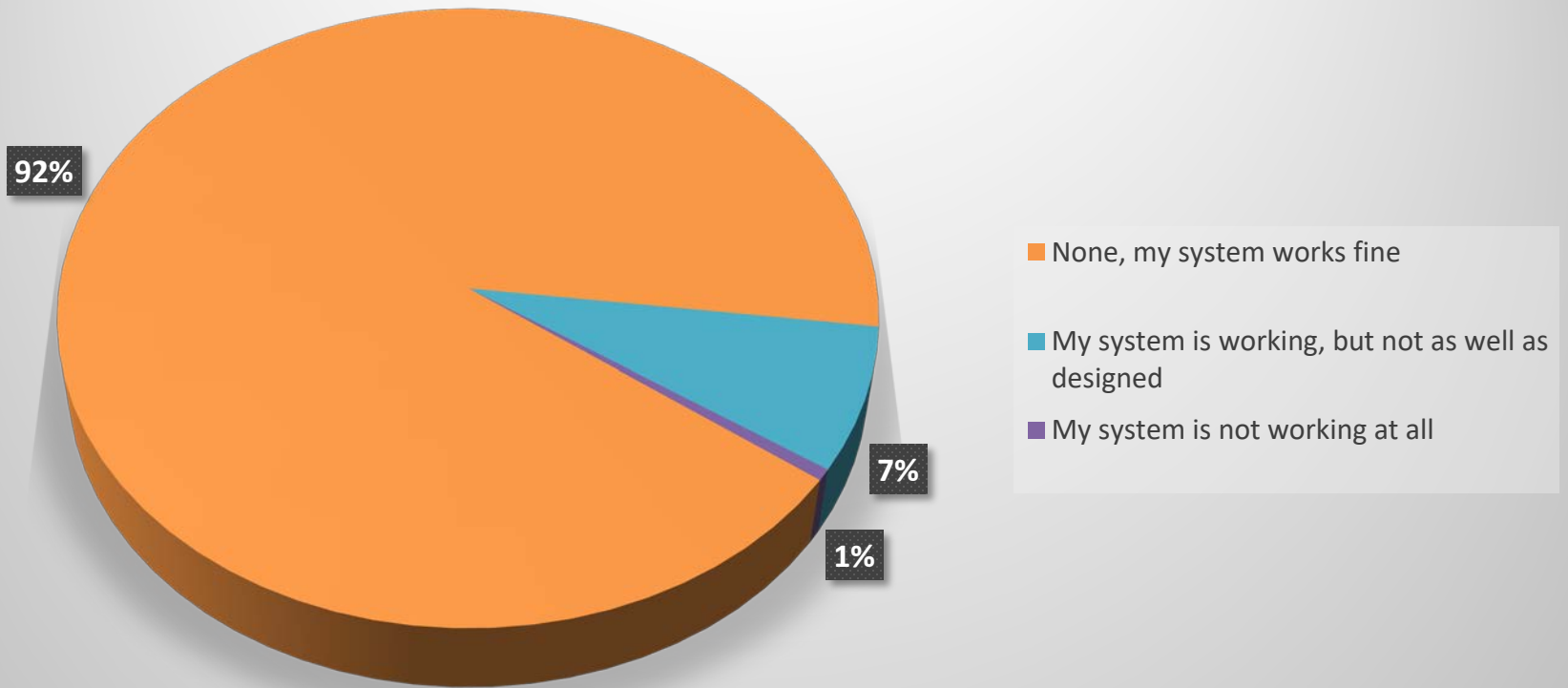
Maintenance Intervals



More regular frequency corresponds to greater reporting of certain issues.



Maintenance Requirements Preventing Use of System



The respondents were also asked whether they would install the same system again. The majority (93%) indicated they would install the same system again and 7% said they would not.



NDVI Greenness Analysis

- Goal: Determine if RWH rebate properties have “greened up” more than non-rebate properties
- Remote Sensing using National Agriculture Imagery Program (NAIP) data from USDA ARS
- Normalized Difference Vegetation Index (NDVI) values between June 2010 and 2015
 - Used unirrigated desert as control
 - NDVI proxy for irrigation that grows canopy

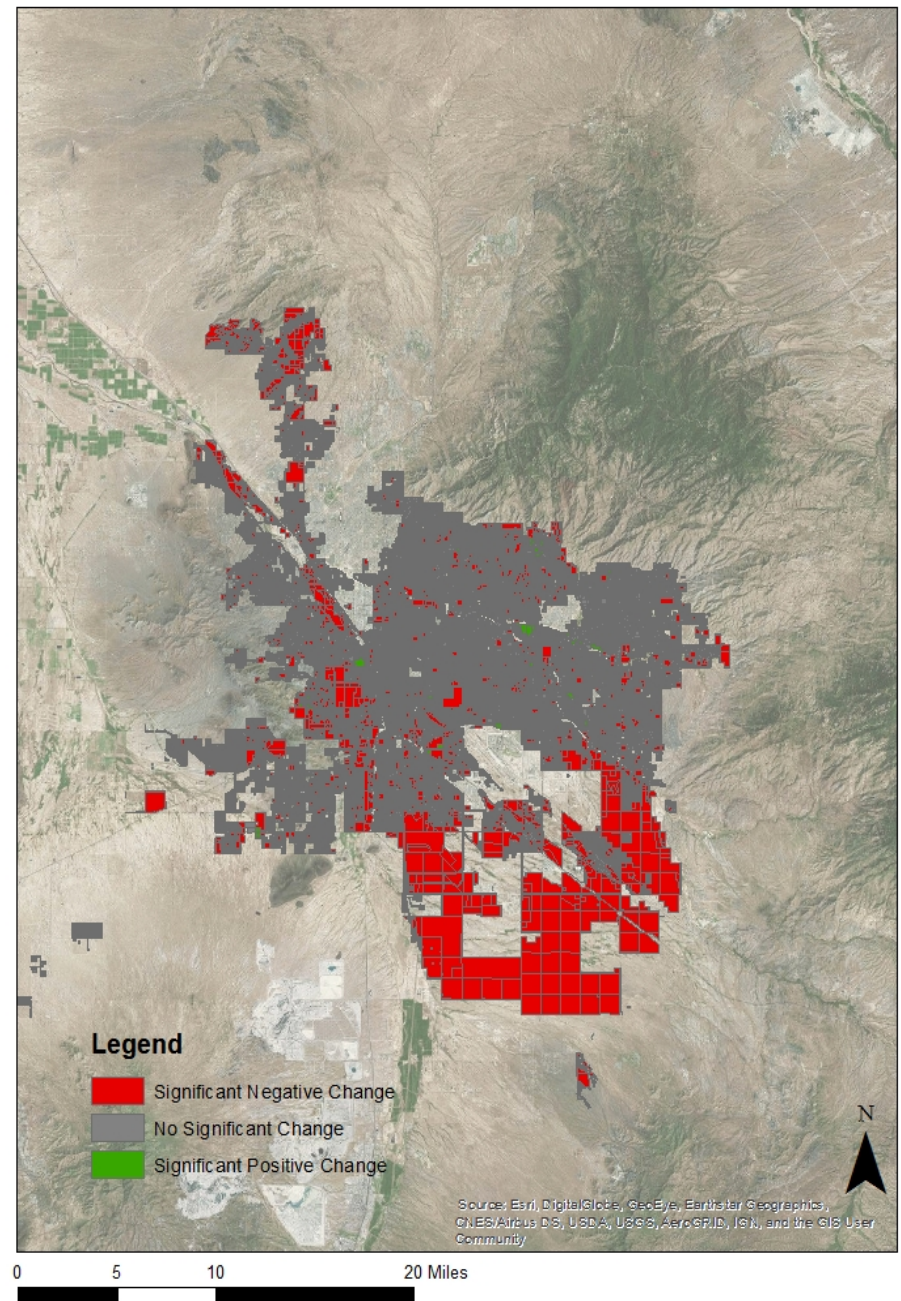


No significant positive changes in NDVI:

- People have not significantly increased irrigation volume after installing harvested water systems,
- Or, not at a level that is sufficient to change NDVI,
- Or, plants added between 2010 and 2015 are not yet large enough to significantly change NDVI

The methods used in this study to establish significant NDVI changes are typically used for landscape-scale analyses.

Future efforts: use another multi-spectral remote sensing technique (like LIDAR) and allow for more growing seasons



RWH Participant Motivation Study

Study Goals – “What we want to learn”

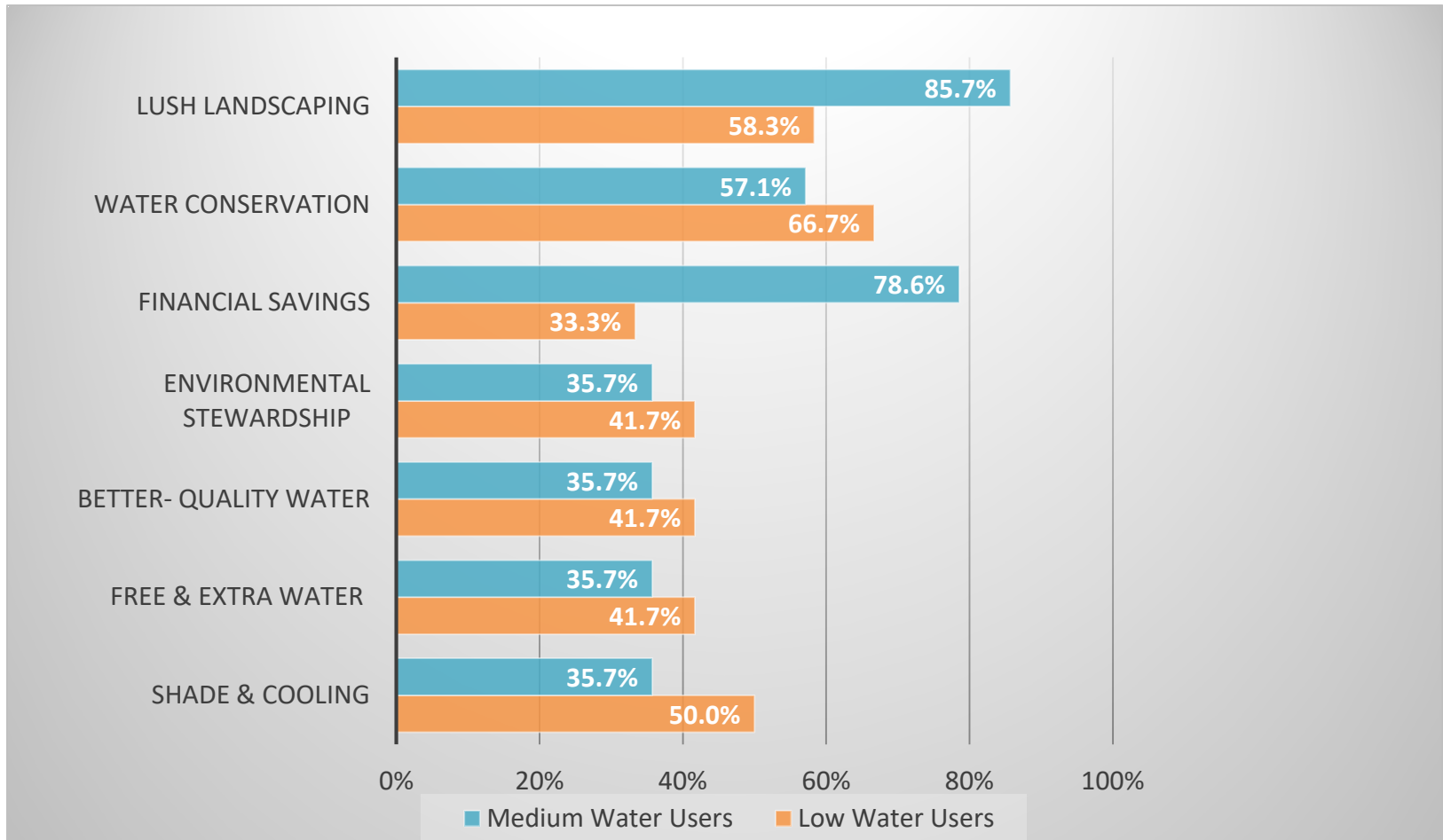
1. To understand **why** people decided to do rainwater harvesting and **how** they are doing it?

Research Design - “How to collect info”

- Interviews
- Landscape surveys
- Monthly surveys

	Property value	Beauty	Rainwater harvesting	soil health	Lush landscape	Potable water use	Shade	Biodiversity	source of better quality water
Property value									
Beauty	0.15								
Rainwater harvesting	0.15					-1			1
soil health					1				
Lush landscape		0.5					0.5		
Potable water use									
Shade		0.15						0.51	
Biodiversity									
source of better quality water				0.5	1				

RWH Participant Perceived Benefits



Cistern-level Monitoring

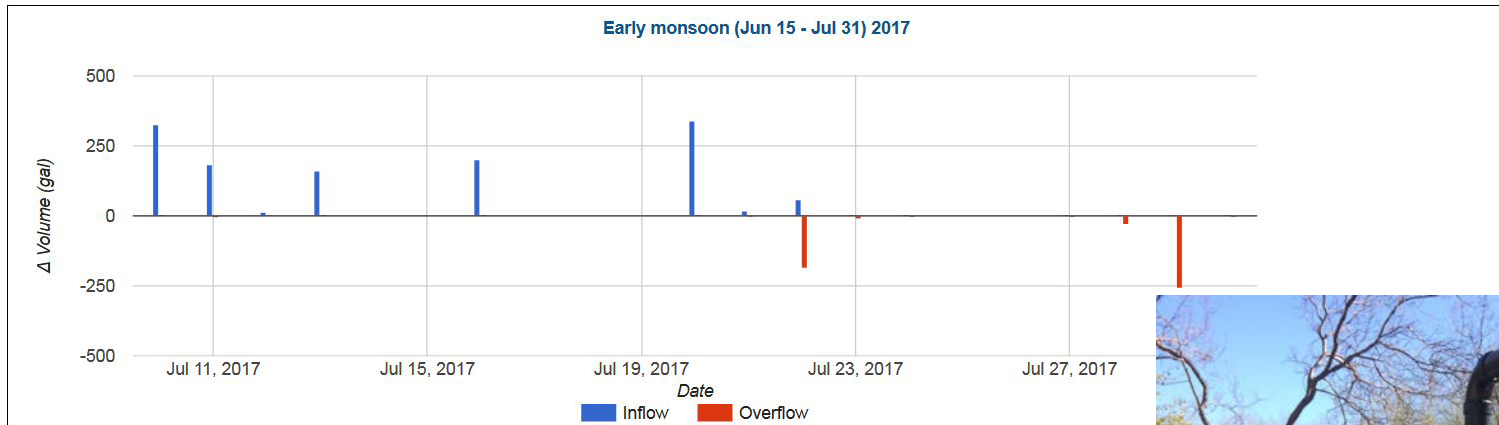
- Goal: Determine frequency & duration of cistern inflows, outflows & overflows to improve sizing & savings estimates
- 15 sites with weather stations & pressure transducers on their tanks
- Water used for: pools, winter gardens, citrus, xeriscapes, mesquite bosques



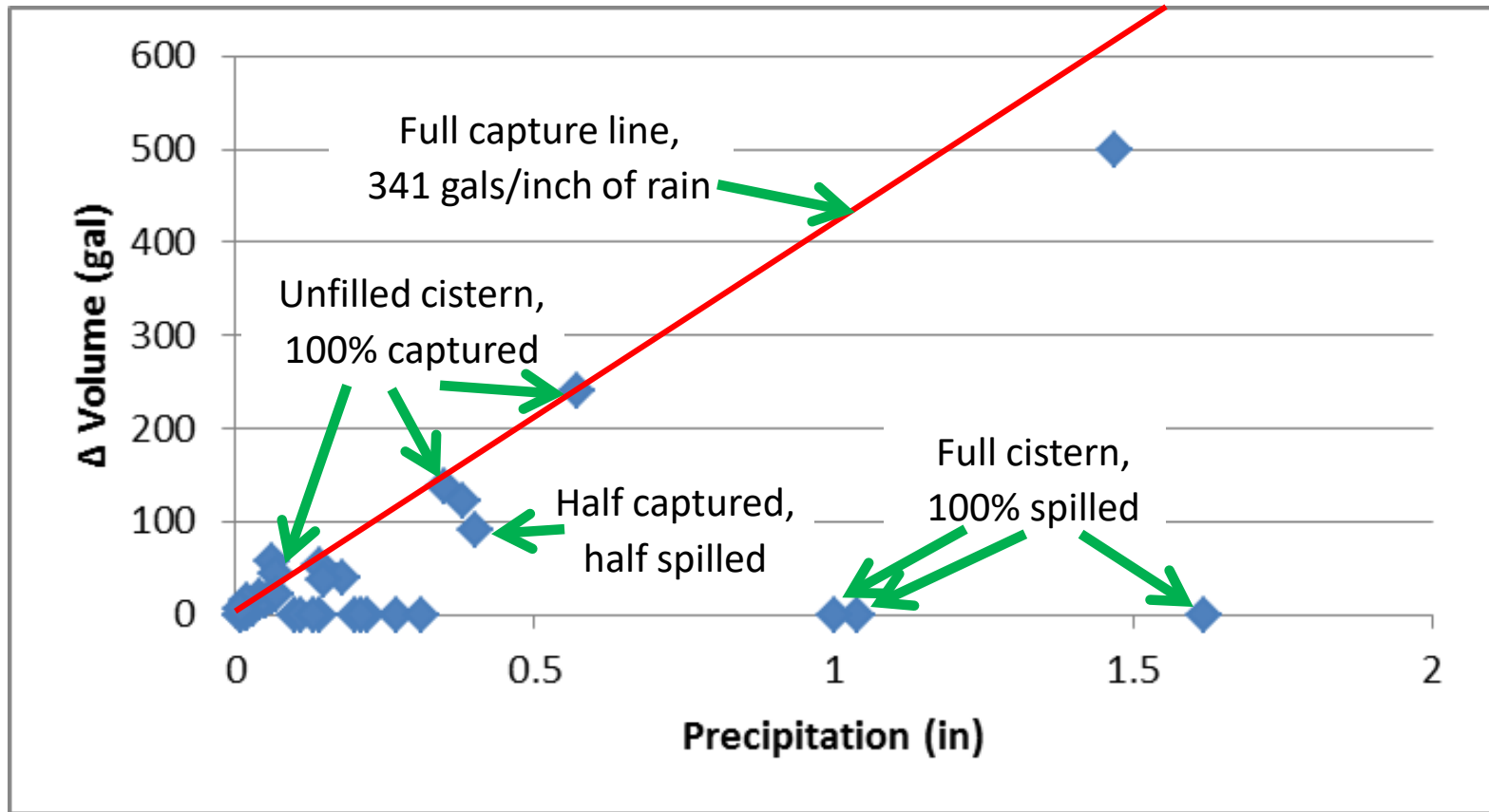
Data logging cisterns

☰ **Graphs**

Inflows and Overflows

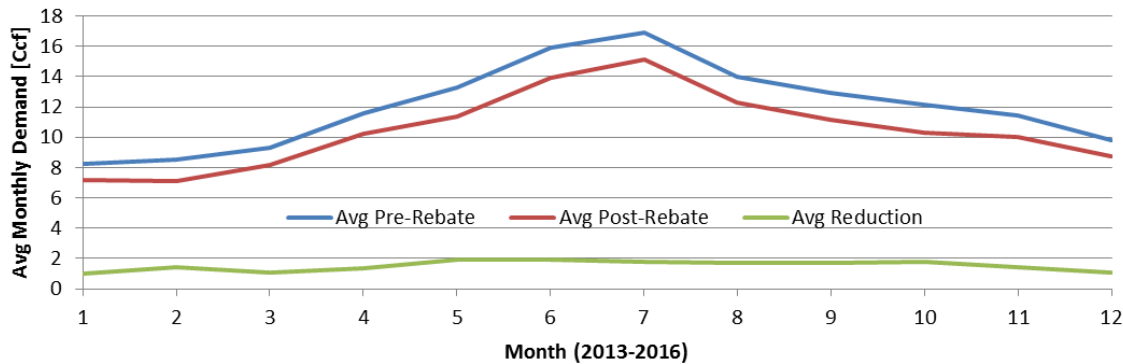


Running out vs. running over – pick your poison



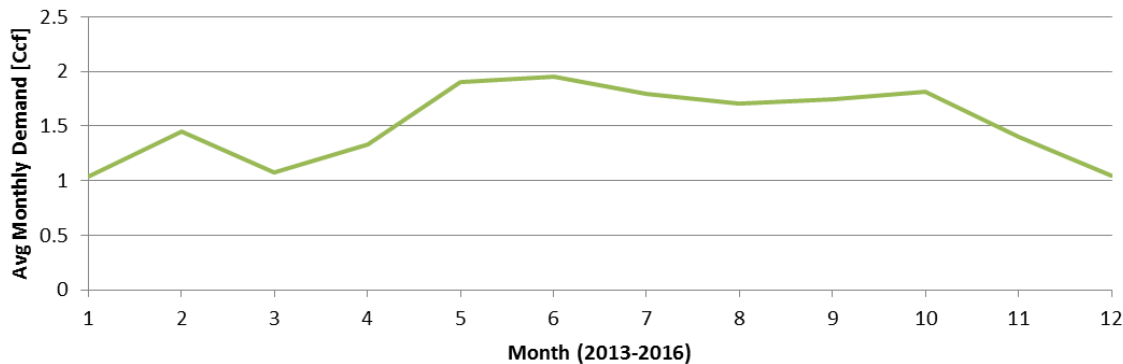
An update on Savings

Water Demand by Month - Active rebate Recipients [Ccf/mo]



Average demand reduction of 1.67 ccf/mo for active systems

Avg Demand Reduction - Active rebate Recipients [Ccf/mo]



Inconclusive results for passive systems, but possibly slight increase in demand



Conclusions

- Complex, complicated program that should involve regular communication with participants
- What people do with harvested water is highly variable – we can probably help shape this
- Savings seem to be appearing, but not like other fixture or device savings
 - Weather-dependent; transiency of customers; plant water need change



Thank You!

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