Reducing the Cost of Wastewater Upgrades by Changing day-to-day Operations

CIFA SRF Workshop
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Creative Funding Notwithstanding … Wastewater treatment facilities are expensive!

Expensive to build

For many rural American communities …

So expensive as to be unaffordable.

Expensive to operate

Creative Funding Notwithstanding … Wastewater treatment facilities are expensive!

Expensive to build

Typical Cost for a Kansas community of 10,000 population
$8 million

Typical Cost for a Montana community of 10,000+ population
$20 million

Expensive to operate

Typical Cost for a family

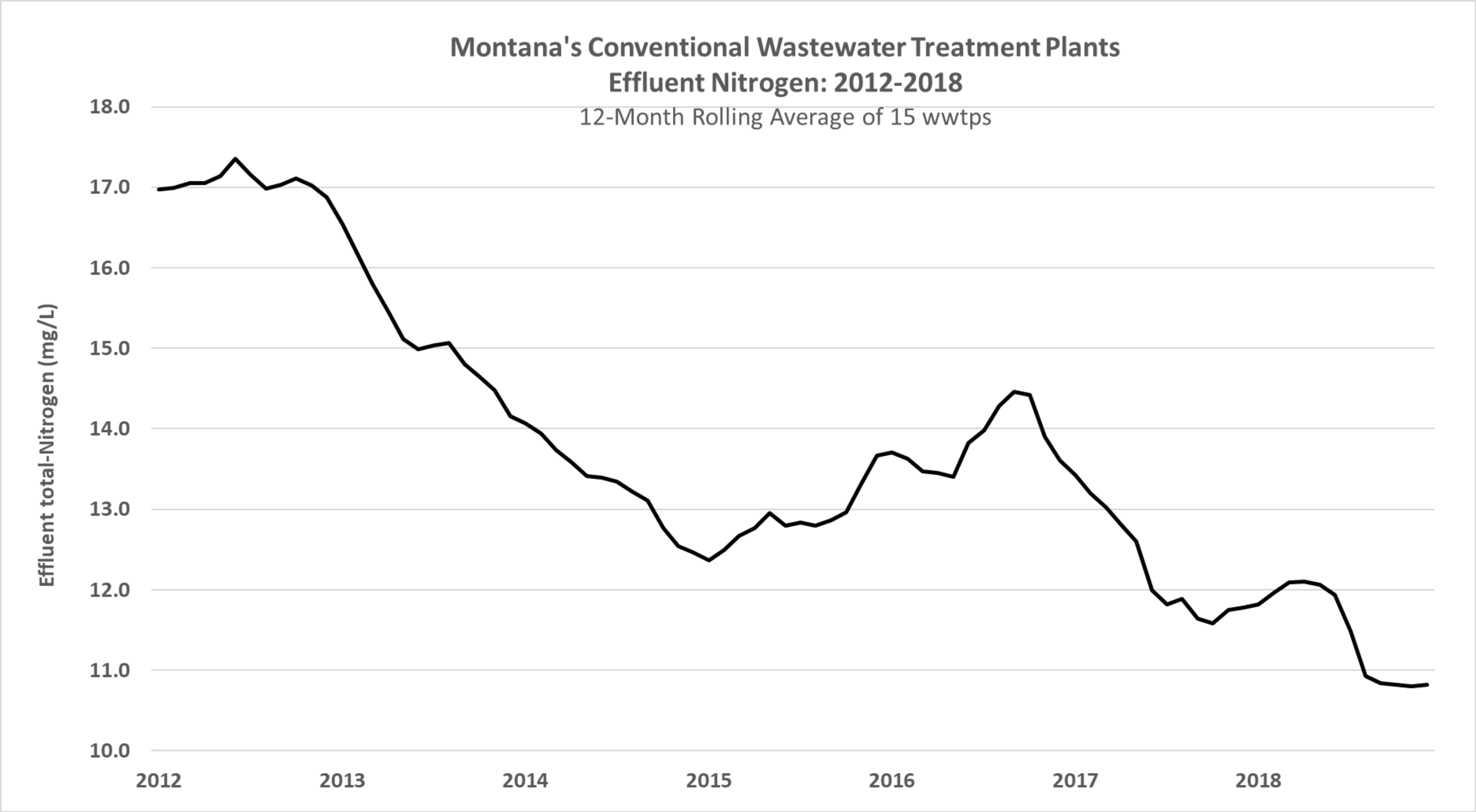
Up to $1200 per year: Kansas

$550 avg to $1200 per year: Montana

Montana

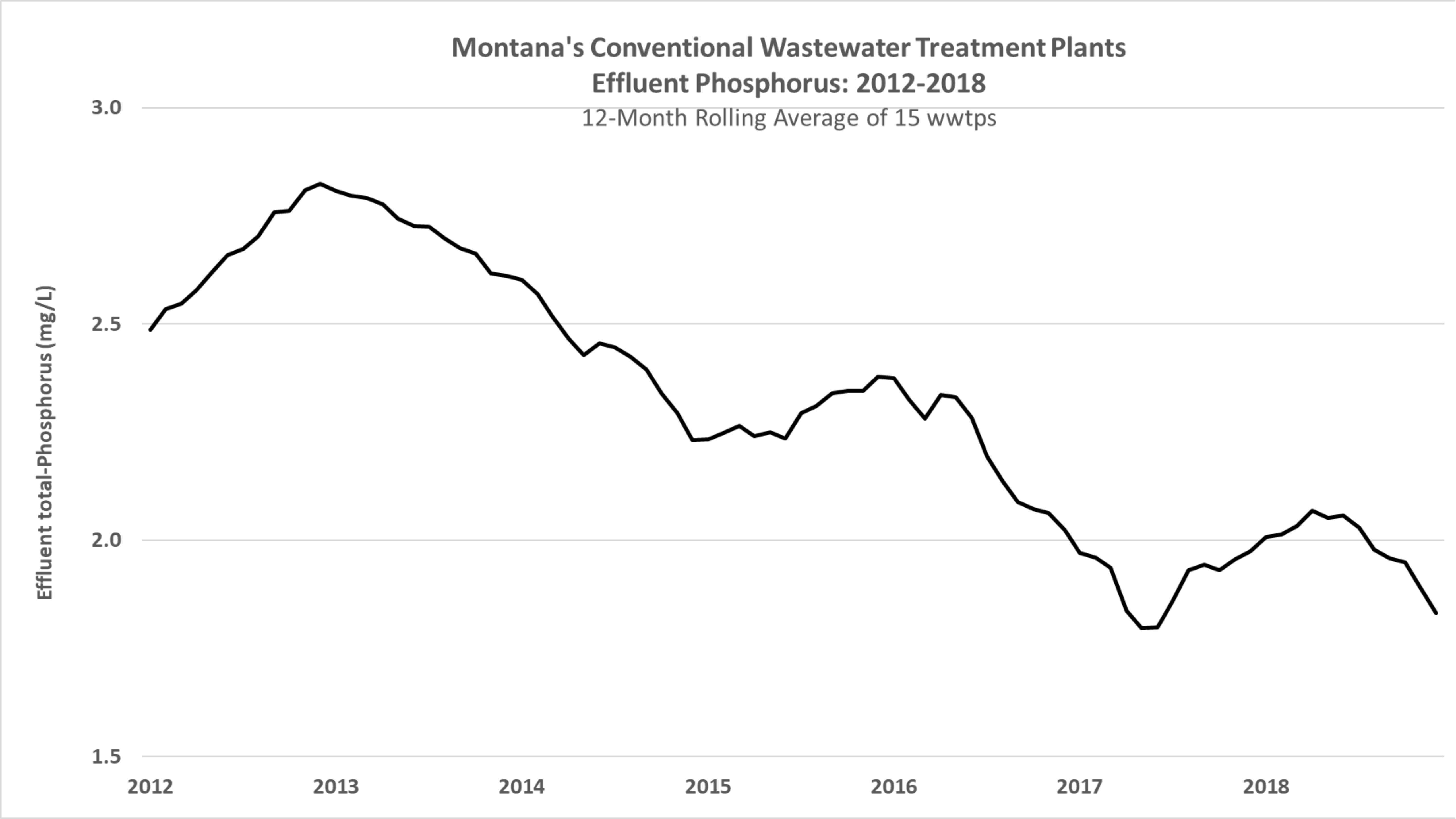
Nitrogen Discharge (mg/L) from Montana WWTPs

BNR/AWT Plants		Conventional Plants after/before optimization	
Bozeman:	6.1	Chinook:	2.1 / 23.3
Kalispell:	5.4	Conrad:	8.2 / 30.1
Missoula:	9.2	Forsyth:	8.4 / 17.0
$15,000,000 each		$10,000 each	


Montana's Conventional Wastewater Treatment Plants
Effluent Nitrogen: 2012-2018
12-Month Rolling Average of 15 wwtps
Effluent total-Nitrogen (mg/L)
18.0
17.0
16.0
15.0
14.0
13.0
12.0
11.0
10.0
2012
2013
2014
2015
2016
2017
2018

Phosphorus Discharge (mg/L) from Montana WWTPs

BNR/AWT Plants		Conventional Plants after/before optimization	
Bozeman:	0.36	Chinook:	1.23 / 2.11
Kalispell:	0.18	Conrad:	0.11 / 2.47
Missoula:	0.60	Forsyth:	0.86 / 1.16
$15,000,000 each		$10,000 each	


Montana's Conventional Wastewater Treatment Plants
Effluent Phosphorus: 2012-2018
12-Month Rolling Average of 15 wwtps
Effluent total-Phosphorus (mg/L)
3.0
2.5
2.0
1.5
2012
2013
2014
2015
2016
2017
2018

Historical approach:
WWTP operators keep the Technology working


Modified Johannesburg


Oxidation Ditch with pre-anaerobic zone


MLE:
Modified Luczak-Ettinger


SBR:
Sequencing Batch Reactor

New way of thinking:

Empowering people to create & manage environmental habitats … negating the importance of capital "fixes"

AGING WATER INFRASTRUCTURE

Change day-to-day operations to
create ideal habitats for bacteria to remove Nitrogen & Phosphorus

Optimizing day-to-day Wastewater Operations to Reduce Capital Spending

HERE'S HOW:

Step 1: Convert Ammonia (NH_4) to Nitrate (NO_3)

Oxygen-rich
BOD-poor
pH of 6.5 or more

Step 2: Convert Nitrate (NO_3) to Nitrogen Gas (N_2)

Oxygen-poor
BOD-rich

Step 1. Prepare "dinner"

BOD-rich

Zero oxygen: anaerobic / fermentation

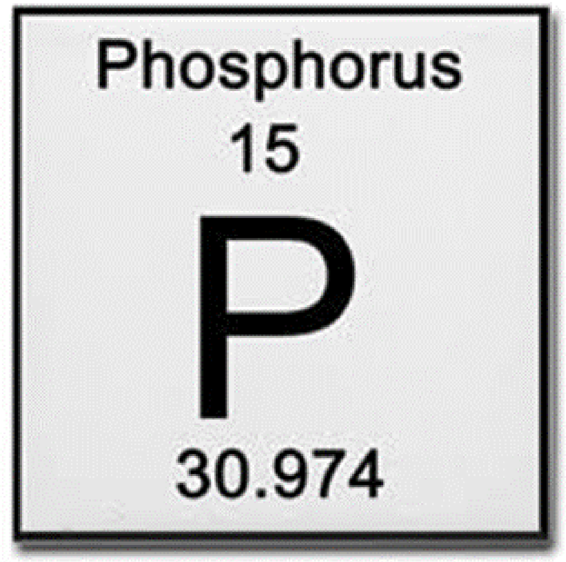
Step 2. Take bio-P bugs to "dinner"

Move food to bio-P bugs (PAOs) – or – move bio-P bugs to food

Zero oxygen: anaerobic / fermentation

Same tank

or, not



Step 3. Grow bio-P bugs

Oxygen-rich

pH of at least 6.8

Connecticut

Colchester-East Hampton
East Haddam
Farmington
Groton
New Canaan
New Hartford
Plainfield
Portland
Suffield
Windham

Iowa

Eldora

Kansas

Basehor
Derby
Eudora
Garden Plain
Goddard
Halstead
Hiawatha
Holden
Lansing
Osawatomie
Shawnee Co. Sherwood
Spring Hill

Kansas, cont'd

St. Marys
Topeka North
Wellington
Wellsville
Winfield

Kentucky

Hopkinsville

Massachusetts

Amherst
Barnstable
Easthampton
Greenfield
Montague
Newburyport
Northfield
Palmer
South Deerfield
South Hadley
Sunderland
Upton
Westfield

Montana

Bigfork
Big Sky
Billings
Boulder
Bozeman
Butte
Chinook
Choteau
Colstrip
Columbia Falls
Conrad
Dillon
East Helena
Forsyth
Glendive
Great Falls
Hamilton
Hardin
Havre
Helena
Kalispell
Laurel
Lewistown
Libby
Lolo
Miles City
Missoula

New Hampshire

Keene

South Carolina

Greeneville

Tennessee

Athens
Baileyton
Bartlett
Collierville
Cookeville
Crossville
Humboldt
Lafayette
LaFollette
Livingston
Millington
Missoula
Nashville
Norris
Oak Ridge

Texas

Nottingham MUD
(Houston)

Virginia

Strasburg

Wyoming

Laramie

Wastewater Operators are …

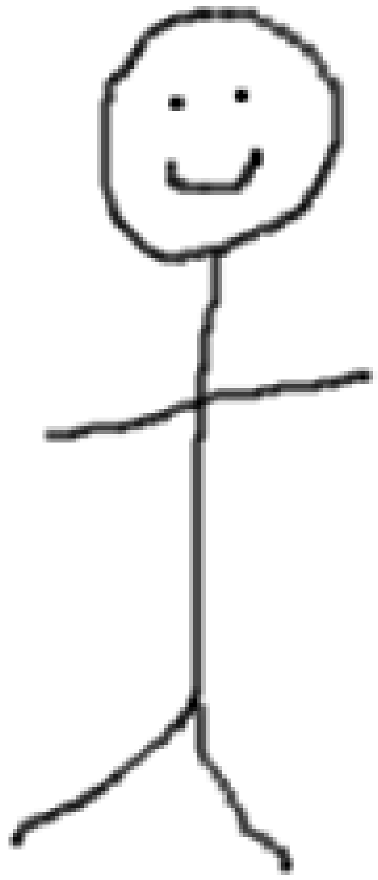
Under valued

Risk adverse / under the radar

Highly (overly?) regulated

Poorly trained

Poorly supported / oft ignored



Comments & Questions

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CascadeEnergy®

2019 CIFA SRF WORKSHOP

Hilton Cleveland Downtown
Cleveland, Ohio
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Water & Wastewater SEM
Saving Energy on Both Sides of the Toilet

Layne McWilliams, PE, JD
Director, Water/Wastewater
Customer Engagement

POP QUIZ!

Welcome to Idaho!

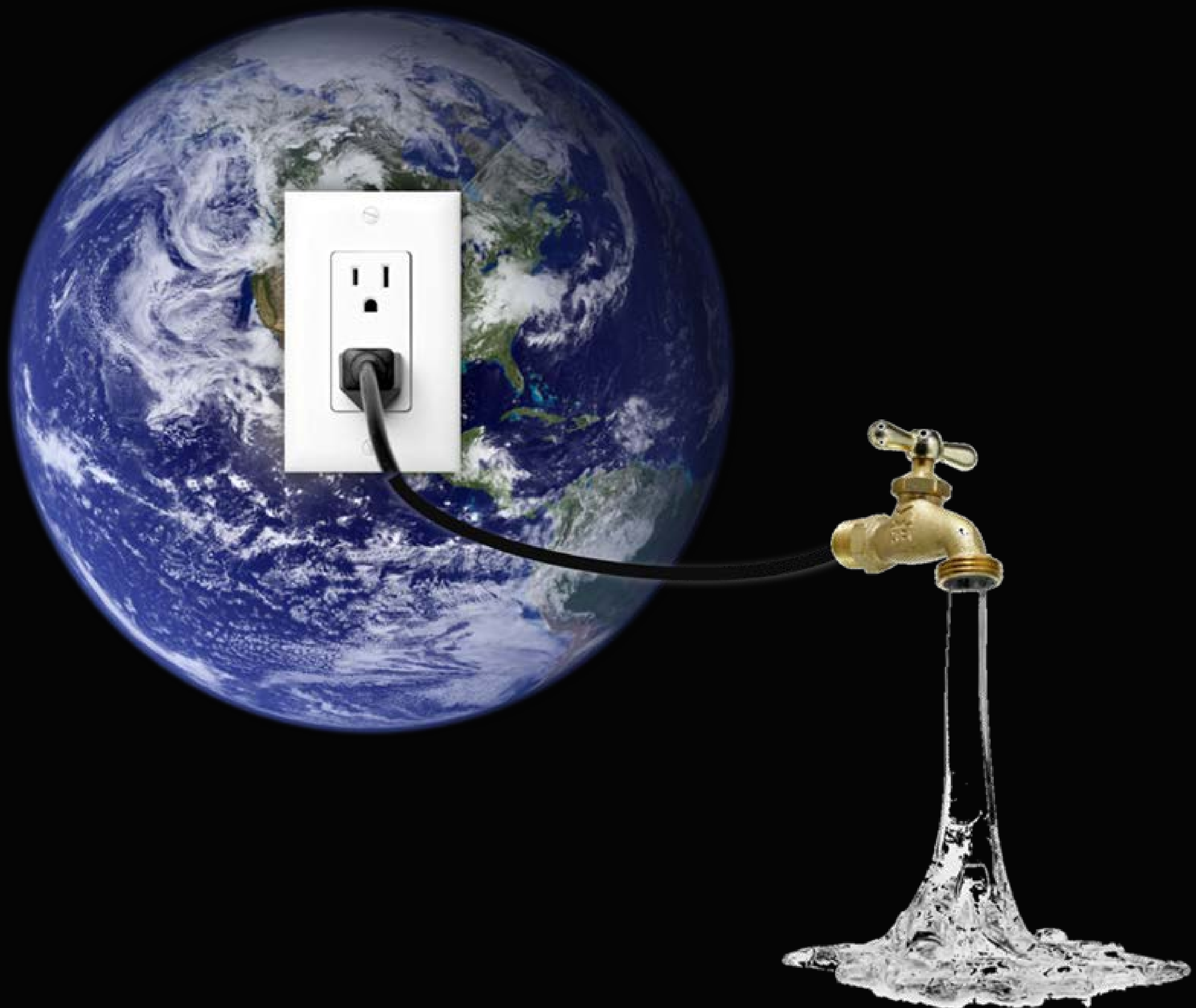
Two tickets to the gun show!

Lifting 1 million gallons 1 foot

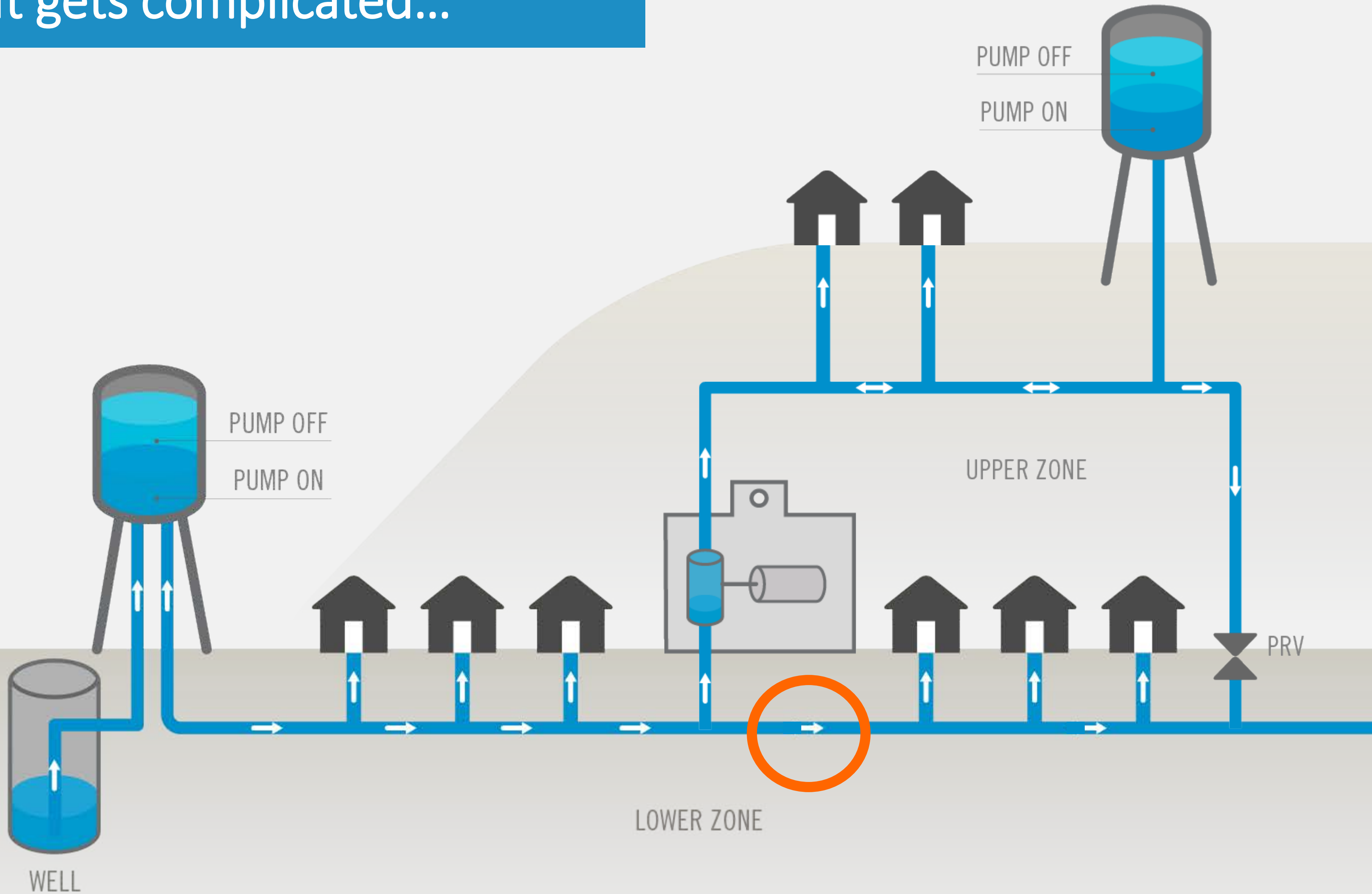
= 3.14 kWh

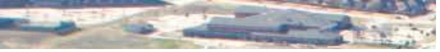
OR

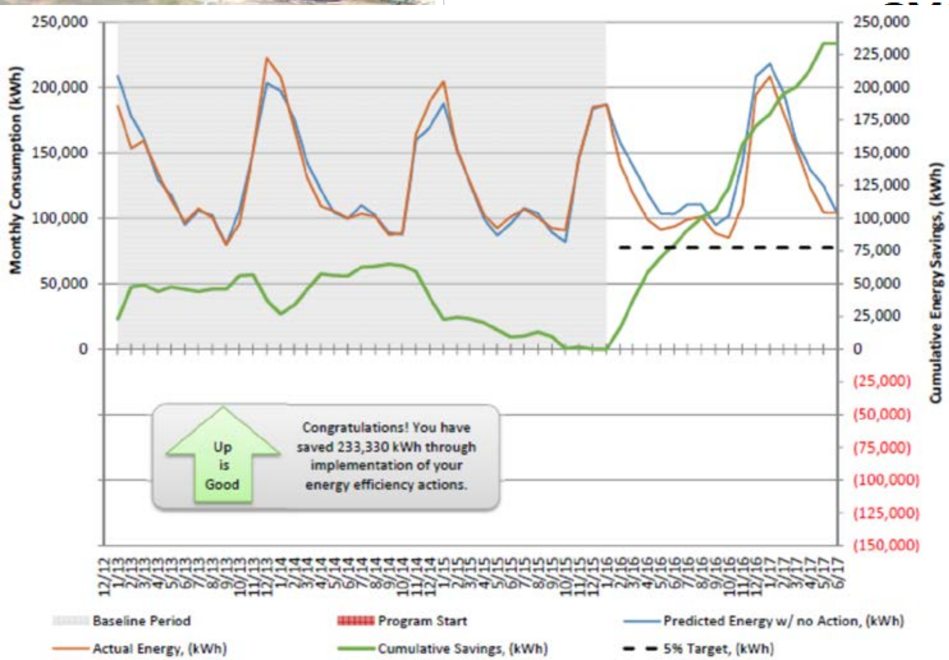
130 Watts!



It gets complicated...

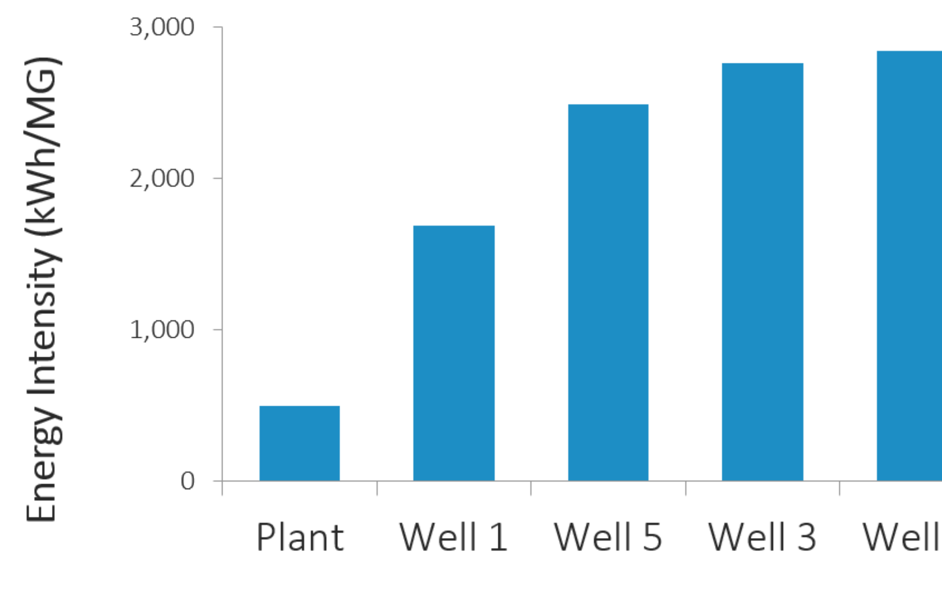






STEM MASS BALANCE

ORAGE	SOURCES		DEMAN
ame	Name	Flow (gpm)	Zone (gpm)
Tank	Peters Well	1700	2733
t Tank	A Street Well	1500	
reet Tank	10th Street Well	1300	
ll Tank	Marshall Well	400	1,261
	TOTALS	4,900	3,994



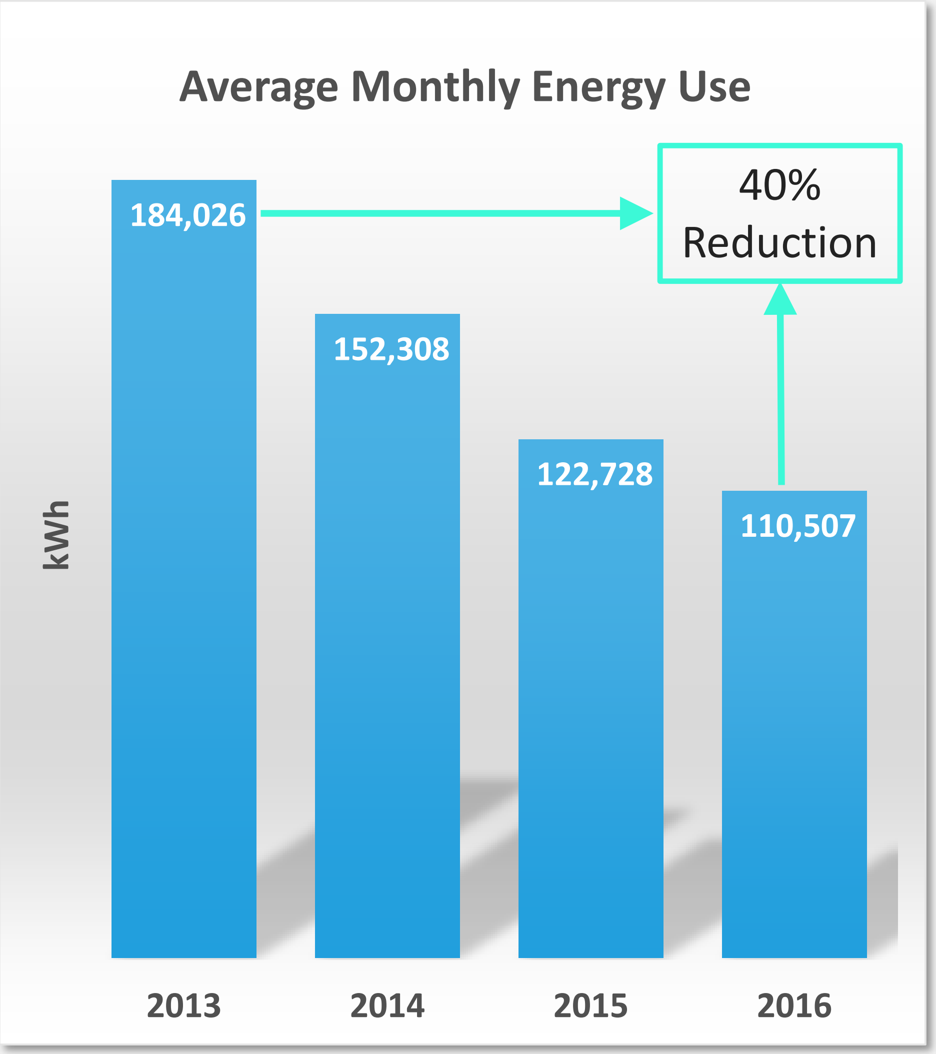
MORE IS BETTER!

MORE IS BETTER!

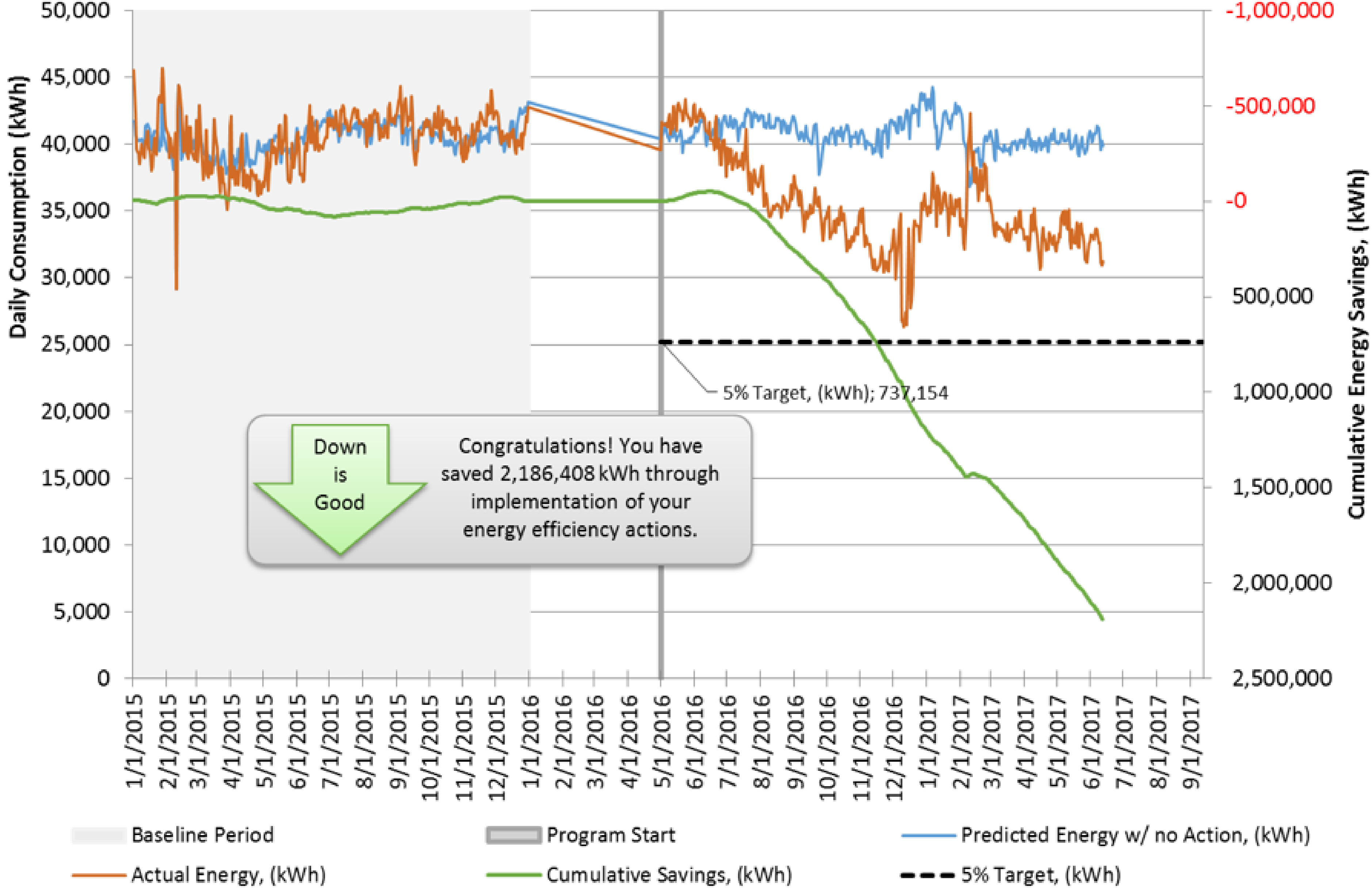
Plant Background

- **Extended Aeration Plant with Tertiary Filtration and Ultraviolet Disinfection**
- **Class A Reuse for Irrigation, Fire Suppression and Snowmaking**
- **Average Annual Flow: 1.1 MGD**
- **Design Flow: 4.02 MGD Average**

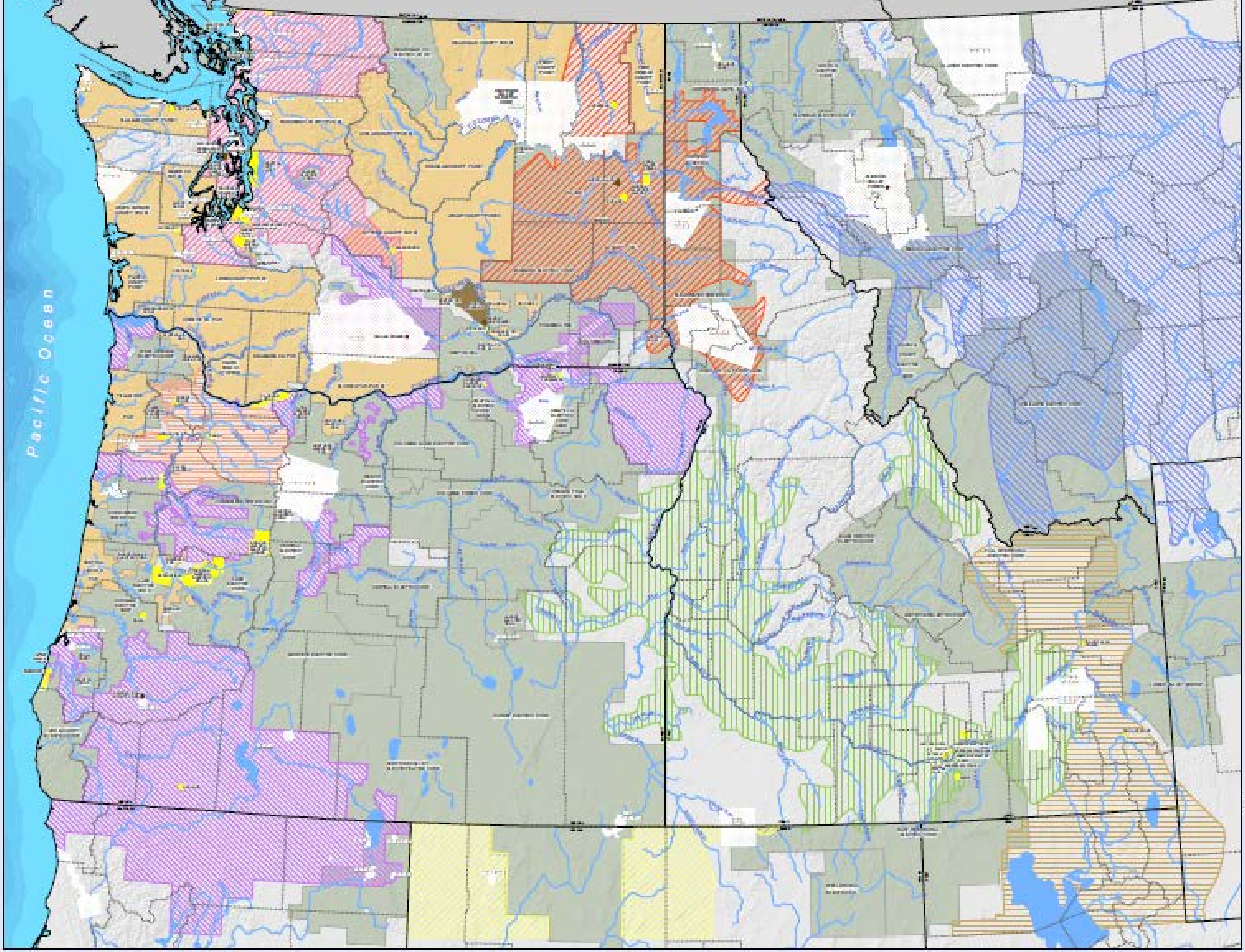

Energy Usage & Annual costs



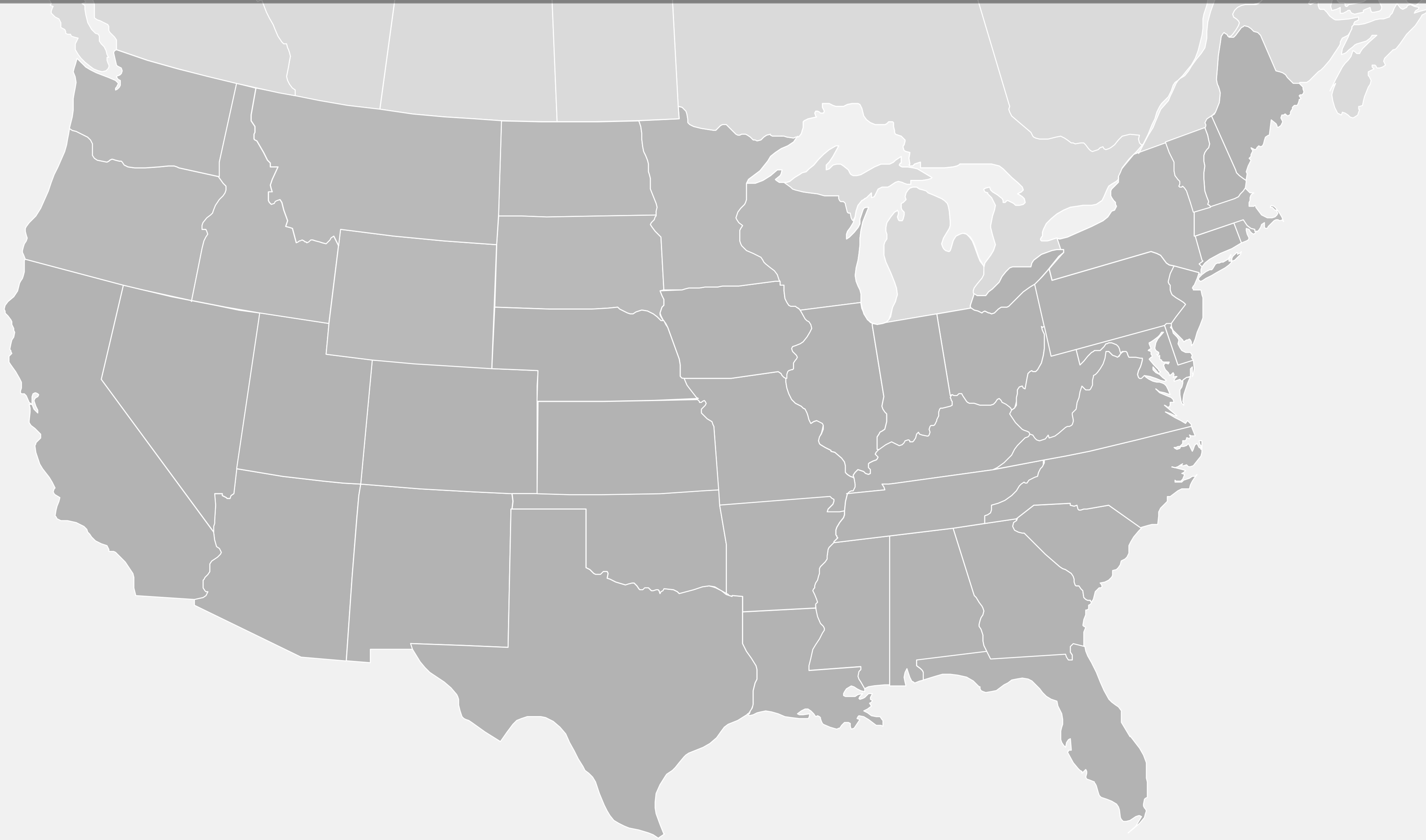
Wastewater Treatment Facility Power Costs			
Fiscal Year	Annual Cost	Percentage Annual Reduction	Percentage Reduction from FY 12-13
2012-2013	$ 121,447.14		
2013-2014	$ 136,420.93	-12%	-12%
2014-2015	$ 99,743.69	27%	18%
2015-2016	$ 91,396.95	8%	25%



Daily Consumption (kWh)
Cumulative Energy Savings, (kWh)
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
-1,000,000
-500,000
-0
500,000
1,000,000
1,500,000
2,000,000
2,500,000
1/1/2015
2/1/2015
3/1/2015
4/1/2015
5/1/2015
6/1/2015
7/1/2015
8/1/2015
9/1/2015
10/1/2015
11/1/2015
12/1/2015
1/1/2016
2/1/2016
3/1/2016
4/1/2016
5/1/2016
6/1/2016
7/1/2016
8/1/2016
9/1/2016
10/1/2016
11/1/2016
12/1/2016
1/1/2017
2/1/2017
3/1/2017
4/1/2017
5/1/2017
6/1/2017
7/1/2017
8/1/2017
9/1/2017
5% Target, (kWh); 737,154
Down is Good
Congratulations! You have saved 2,186,408 kWh through implementation of your energy efficiency actions.
Baseline Period
Program Start
Predicted Energy w/ no Action, (kWh)
Actual Energy, (kWh)
Cumulative Savings, (kWh)
5% Target, (kWh)


Pacific Ocean

POP QUIZ!



Thank you!

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120WaterAudit

Data Management & Optimization

The Operational Challenge of Identifying Lead Services Lines

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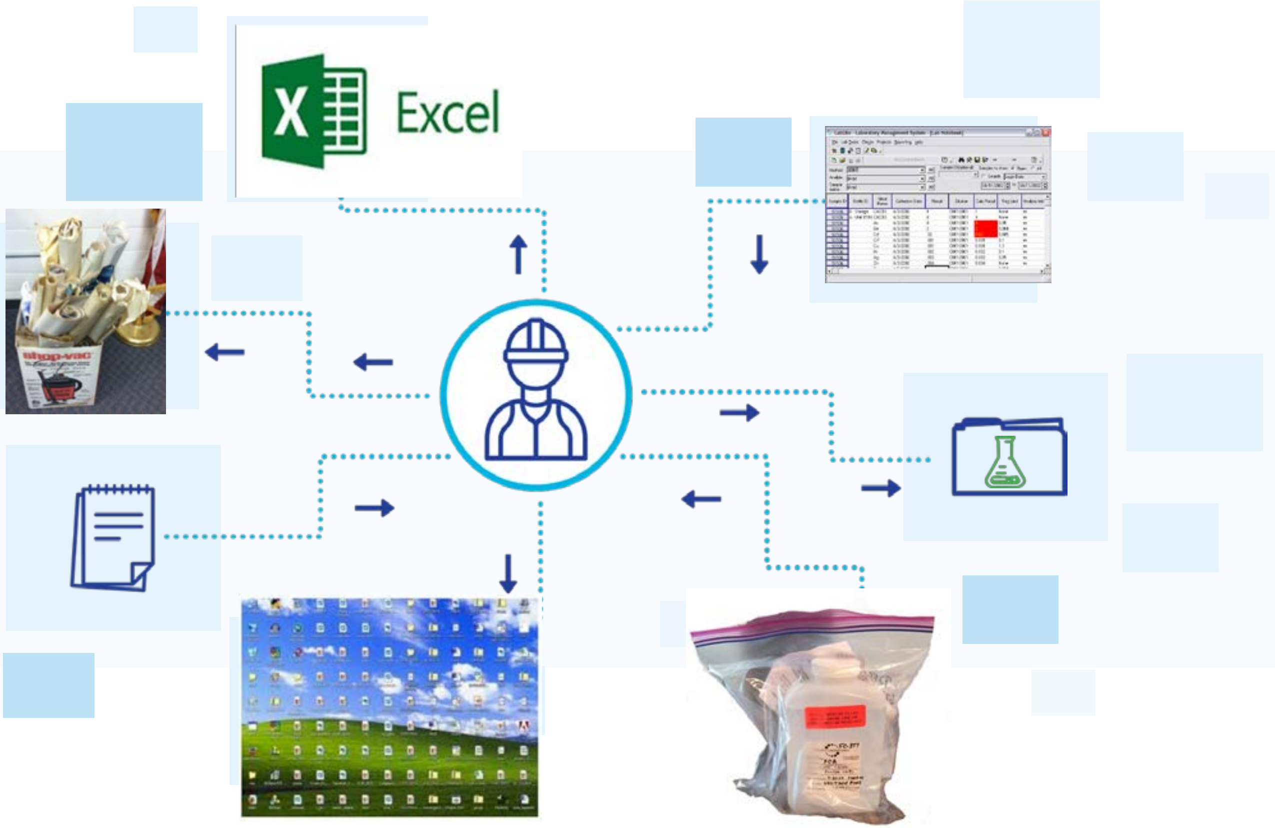
120WaterAudit provides cloud software, kits and services to help Government Agencies, Public Water Systems and Facilities manage lead in drinking water programs and protect public health

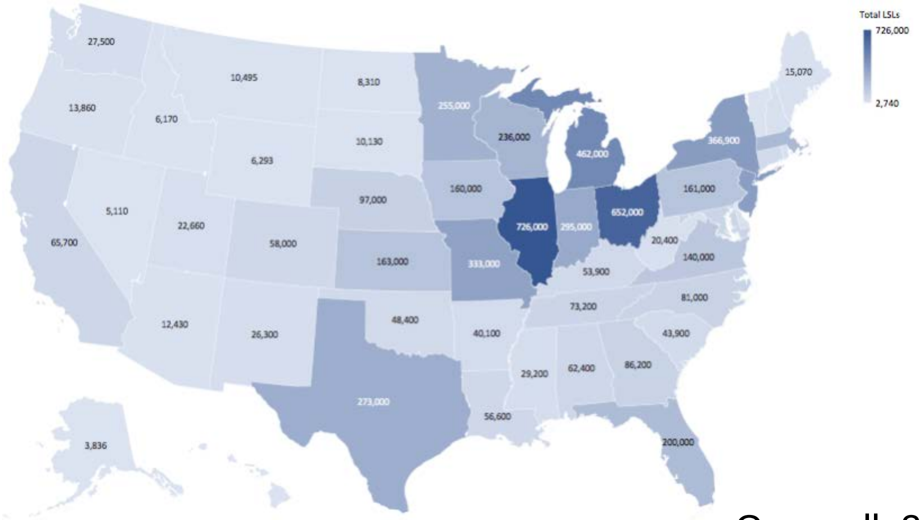
Data is Fragmented & Inaccessible



Digital Water Transformation

- Data Accessibility
- Data Analytics
- Customer Engagement
- Asset Management
  - Lead Service Lines are a component

Lead Service Lines



Cornwell, 2016

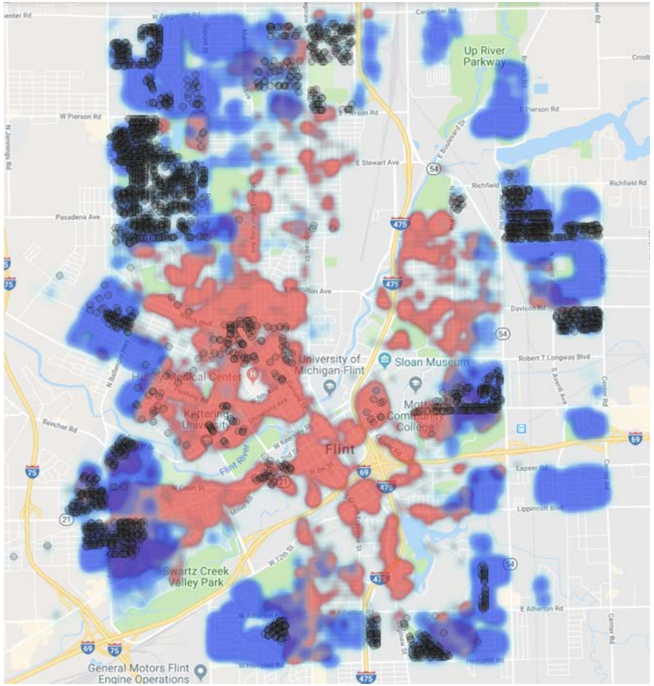
- Estimated 6-10 million LSLs in US
- Public/Private ownership challenge
- Useage ranges from 1920's-1980's
- Most cities do not have complete records
- Inspection can be costly ($500-$2K)
- Replacement costs vary ($2K-$10K)

Public & Regulatory Pressure to Replace LSLs is Increasing

- **4 States require LSLIs**
  - 5 states considered legislation in 2018-19
- **Lead & Copper Rule Revisions**
  - Annual public inventories
  - Replacement plan with goals
  - Stricter replacement provisions
  - Increased transparency measures
- **Drinking Water Infrastructure Needs Survey Estimates**
  - Costs to replace all LSLs of eligible Public Water Systems
  - Public and private LSLs costs must both be assessed (to the extent practicable)
  - We have a data problem!
- **Inventories can be labor and capital intensive**

Quality Inventories Drive Optimization

- **How we get there**
  - *Accessibility:* Gather data & connect data silos
  - *Analytics:* Predictive intelligence may be helpful
  - *Communication & Asset Mgmt*: Wholistic utility LSLI policies
- **Expands opportunities for CCT management**
- **Inspection/Replacement work can be coordinated with other projects in for DW & WW**
- **Inspection/Replacement work can be prioritized by risk**
- **Cost savings examples**
  - Decrease dig costs- machine learning estimated $10 M in potential savings (Flint, MI)
  - Avoid hopscotching- Marginal Cost of replacing customer side $500 (Lansing, MI)



(Abernathy et.al, 2018)