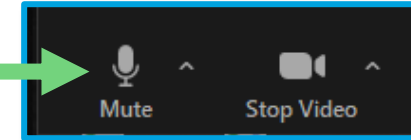


Using Zoom!

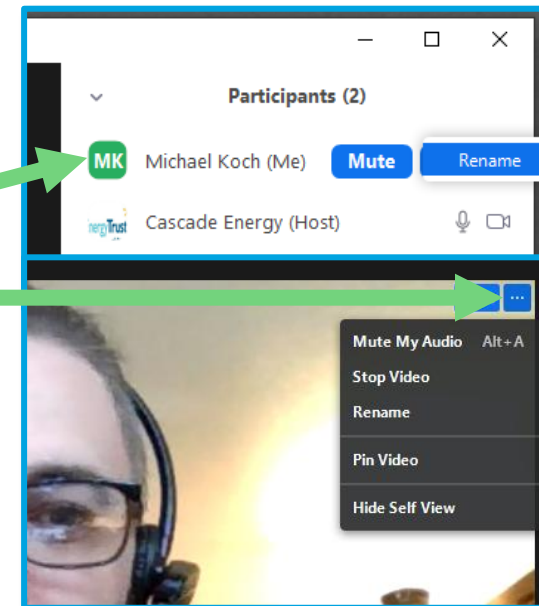
Mute yourself!

Have a question?
Use the chat feature or unmute.
Controls accessed at the bottom

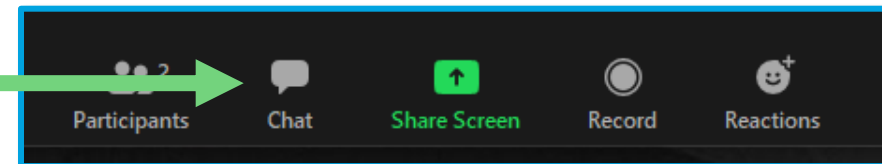


Rename yourself

"Name (Company)"
Right click on your picture or 3 dots
OR
Controls accessed at the right after clicking 'Participants' at bottom.



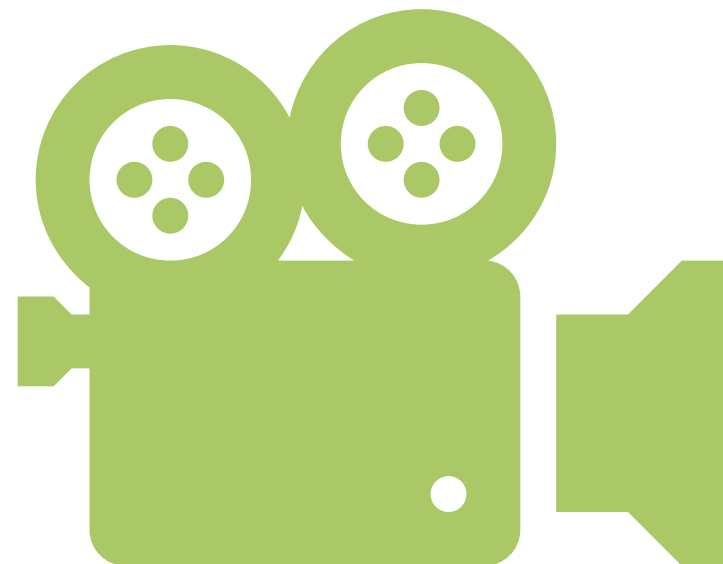
Access Chat at the bottom



Recording

This meeting is being recorded (both audio and video)

*If you do not consent to being recorded,
please let the meeting moderator know
ASAP and we will facilitate your
participation in another way or adjust
our procedure.*





WATER VIRTUAL IN-PLANT (VINPLT) TRAINING

Session 4

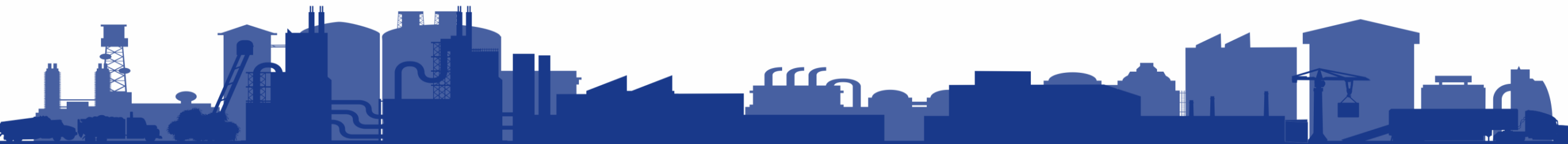


Thank You!

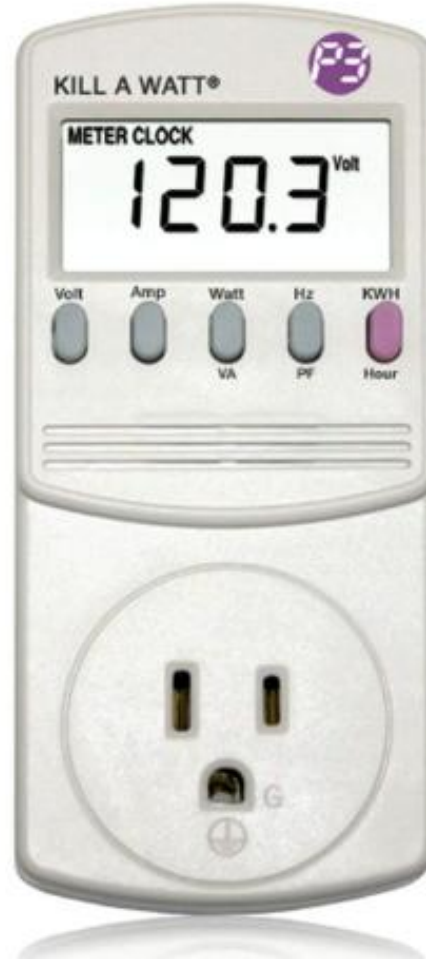
Sponsor:



Session 4: The 5 L's and Treasure Hunts



Kahoot Prizes!



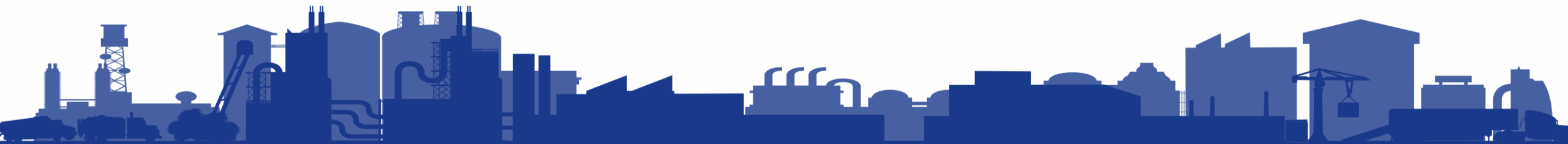
Training Schedule Overview

Week	Date and Time	Content
Week 1	Oct 2, 2025 10:00 AM ET	Introduction, Energy Basics, & Power Company Relationships
Week 2	Oct 9, 2025 10:00 AM ET	Water Source Selection, KPIs, and Energy Teams
Week 3	Oct 16, 2025 10:00 AM ET	Water Treatment Energy Opportunities, the 5 L's
Week 4	Oct 23, 2025 10:00 AM ET	The 5L's (cont'd), Treasure Hunts
Week 5	Oct 30, 2025 10:00 AM ET	Pumps
Week 6	Nov 6, 2025 10:00 AM ET	Hydraulic Modeling and Energy-Efficient Design
Week 7	Nov 13, 2025 10:00 AM ET	Persistence Strategies
Week 8	Nov 20, 2025 10:00 AM ET	Closeout

The 5 L's: Common Water System Inefficiencies

- Leaping
- Looping
- Leaking
- Losing
- Loading

LEAKING



Leaking – Problem

High-Pressure Leak



Low-Pressure Leak



WATER LOSS IS ENERGY LOSS!

Tim Waldron, “Success Techniques in Applying Water Loss Strategies for Financial Benefits,”
Workshop on Water and Energy/Water Loss (International Water Association, 2014)

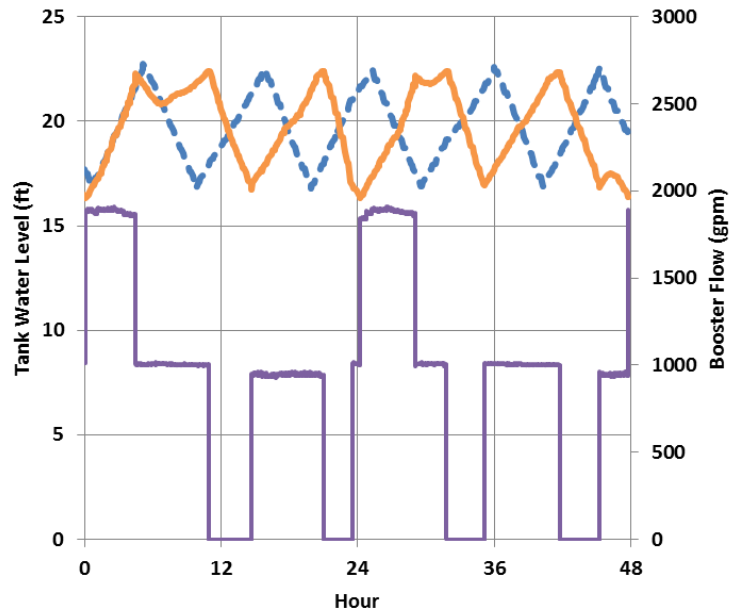
Water Loss Audit

Volume from Own Sources (corrected for known errors)	System Input Volume	Water Exported (corrected for known errors)	Billed Water Exported				Revenue Water
		Water Supplied	Authorized Consumption	Billed Authorized Consumption	Billed Metered Consumption		Revenue Water
					Billed Unmetered Consumption		
				Unbilled Authorized Consumption	Unbilled Unmetered Consumption		Non-revenue Water
					Unbilled Metered Consumption		
			Water Losses	Apparent Losses	Customer Metering Inaccuracies		Non-revenue Water
					Unauthorized Consumption		
					Systematic Data Handling Errors		
				Real Losses	Leakage on Transmission and Distribution Mains		
					Leakage and Overflows at Utility's Storage Tanks		
Leakage on Service Connections up to the point of Customer Metering							
Water Imported (corrected for known errors)							

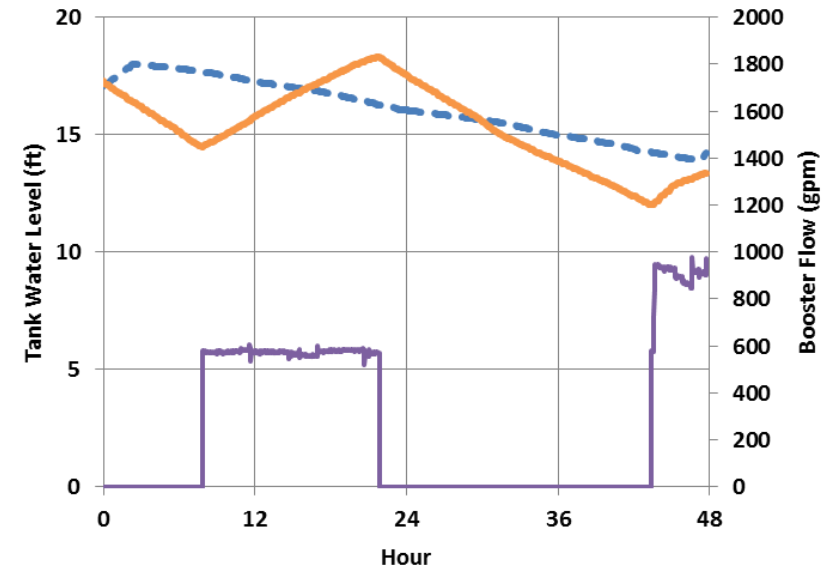
AWWA/IWA

Leaking – Example

Probable Leak



Normal



- Spring Tank Level
- Summer Tank Level
- Summer Booster Flow

Pumping a lot, using a little.
Where is all the water going?

Leaking – Example

Before



After

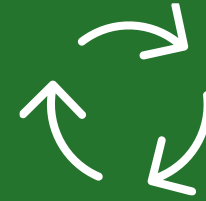


Leaking – Diagnosis



How to detect:

- Water production exceeds water use
- Pumping, but no demand
- Leak detection equipment
- You see it!



How to resolve:

- Replace leaky pipes
- Fix leaky storage tanks
- Lower the pressure

Leaking – Where to Focus

- Old pipes
- High pressures
- Hot spots



Leak on 12" main. Photo courtesy of Harold Hargaves, City of Pocatello, ID.

Leaking – Activity

In Zone 4, there is a serious leak that consumes approximately 100 MG per year. The pressure in the pipe is currently 100 psi. Your energy team has identified this leak as well as recognized that the pressure can be reduced to 60 psi. The pump that serves this zone uses 1,200 kWh/MG.

1a. How much energy (kWh) is currently lost by the leak each year?

$$\frac{100 \text{ MG}}{\text{year}} * \frac{1,200 \text{ kWh}}{\text{MG}} = 120,000 \text{ kWh/year}$$

1b. At \$0.05 per kWh, how much does this leak cost in terms of energy?

$$\frac{120,000 \text{ kWh}}{\text{year}} * \frac{\$0.05}{\text{kWh}} = \$6,000/\text{year}$$

Leaking – Activity

2. How much water (MG) can be saved by reducing the pressure to 60 psi? Assume the % water savings = half of the % pressure reduction.

$$\text{Pressure reduction} = 100 \text{ psi} - 60 \text{ psi} = 40 \text{ psi}$$

$$40 \text{ psi} / 100 \text{ psi} = 40\%$$

$$\text{Percent water savings} = 0.5 * 40\% = 20\%$$

$$\text{Water saved} = 20\% * 100 \text{ MG} = 20 \text{ MG}$$

Leaking – Activity

3a. How much energy (kWh) can be saved by reducing the pressure?

$$\frac{20 \text{ MG}}{\text{year}} * \frac{1,200 \text{ kWh}}{\text{MG}} = 24,000 \text{ kWh/year}$$

3b. At \$0.05 per kWh, how much money would this save?

$$\frac{24,000 \text{ kWh}}{\text{year}} * \frac{\$0.05}{\text{kWh}} = \$1,200$$

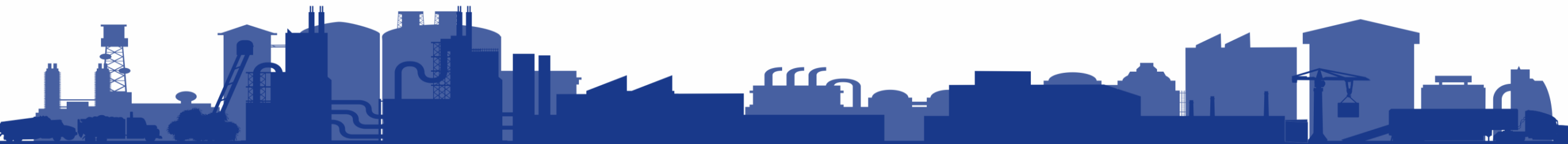
4a. If the leak can be repaired (new pipe), how much energy can be saved?

$$\frac{100 \text{ MG}}{\text{year}} * \frac{1,200 \text{ kWh}}{\text{MG}} = 120,000 \text{ kWh/year}$$

4b. At \$0.05 per kWh, how much would this repair save?

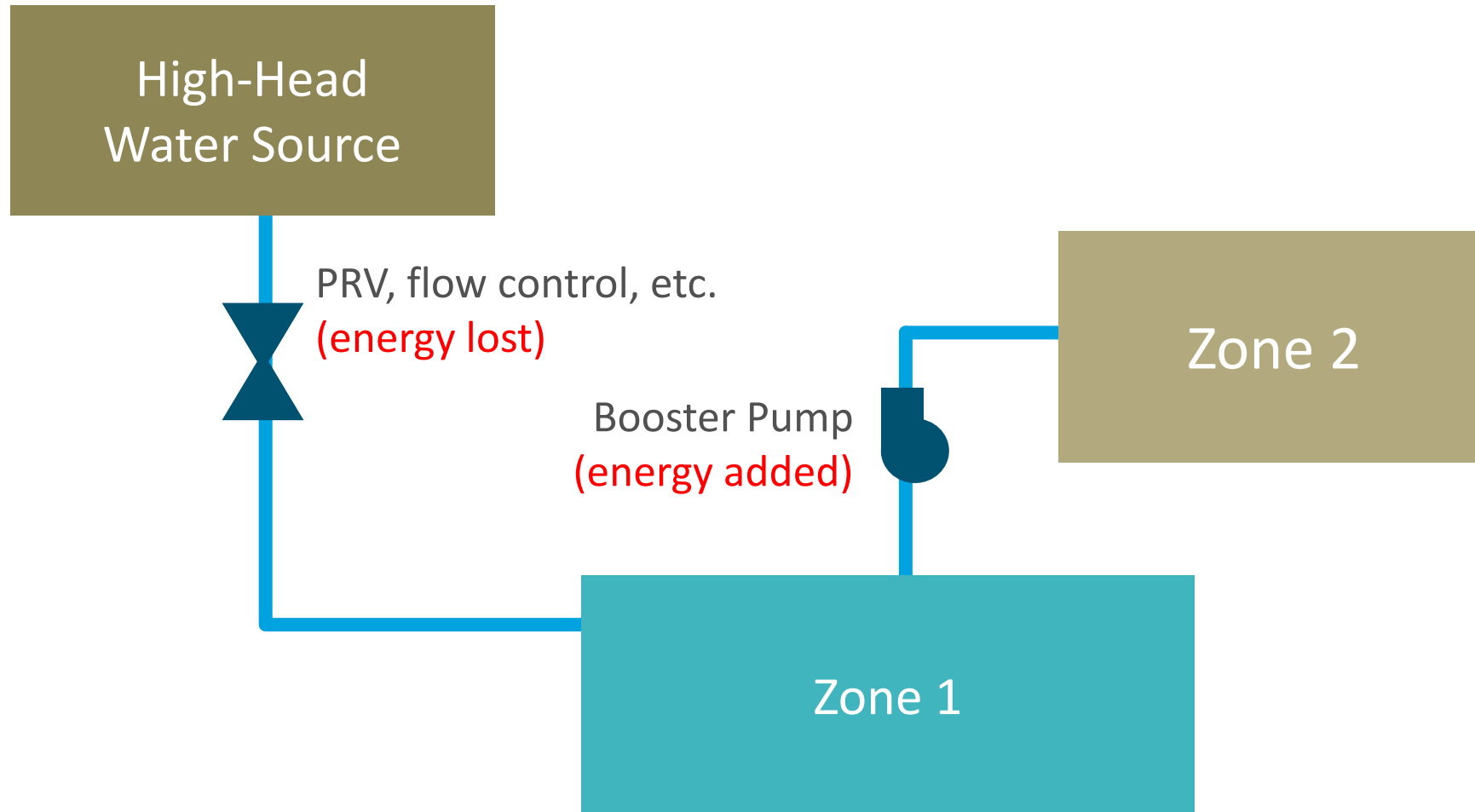
$$\frac{120,000 \text{ kWh}}{\text{year}} * \frac{\$0.05}{\text{kWh}} = \$6,000/\text{year}$$

LOSING

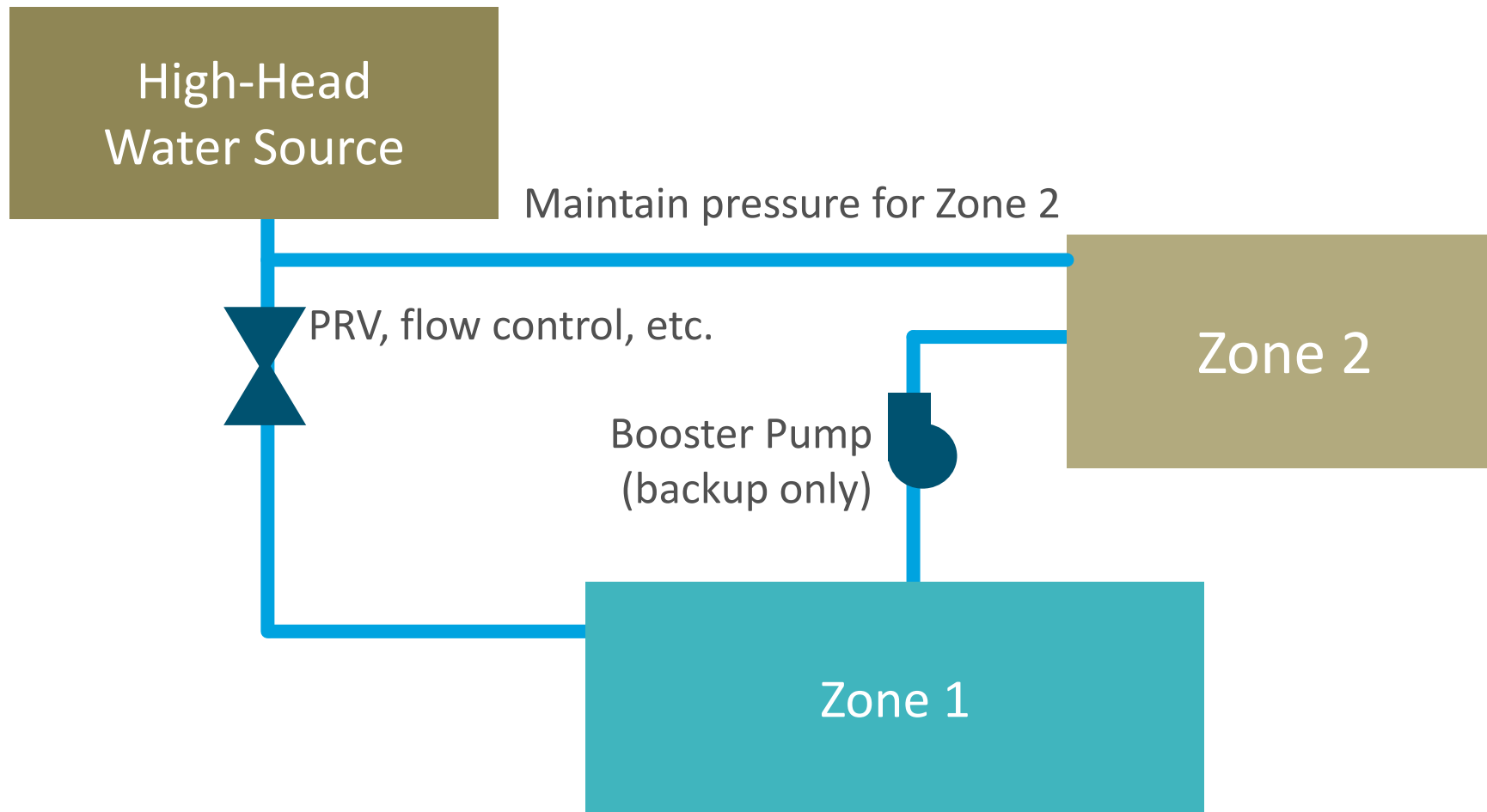


Losing – Problem

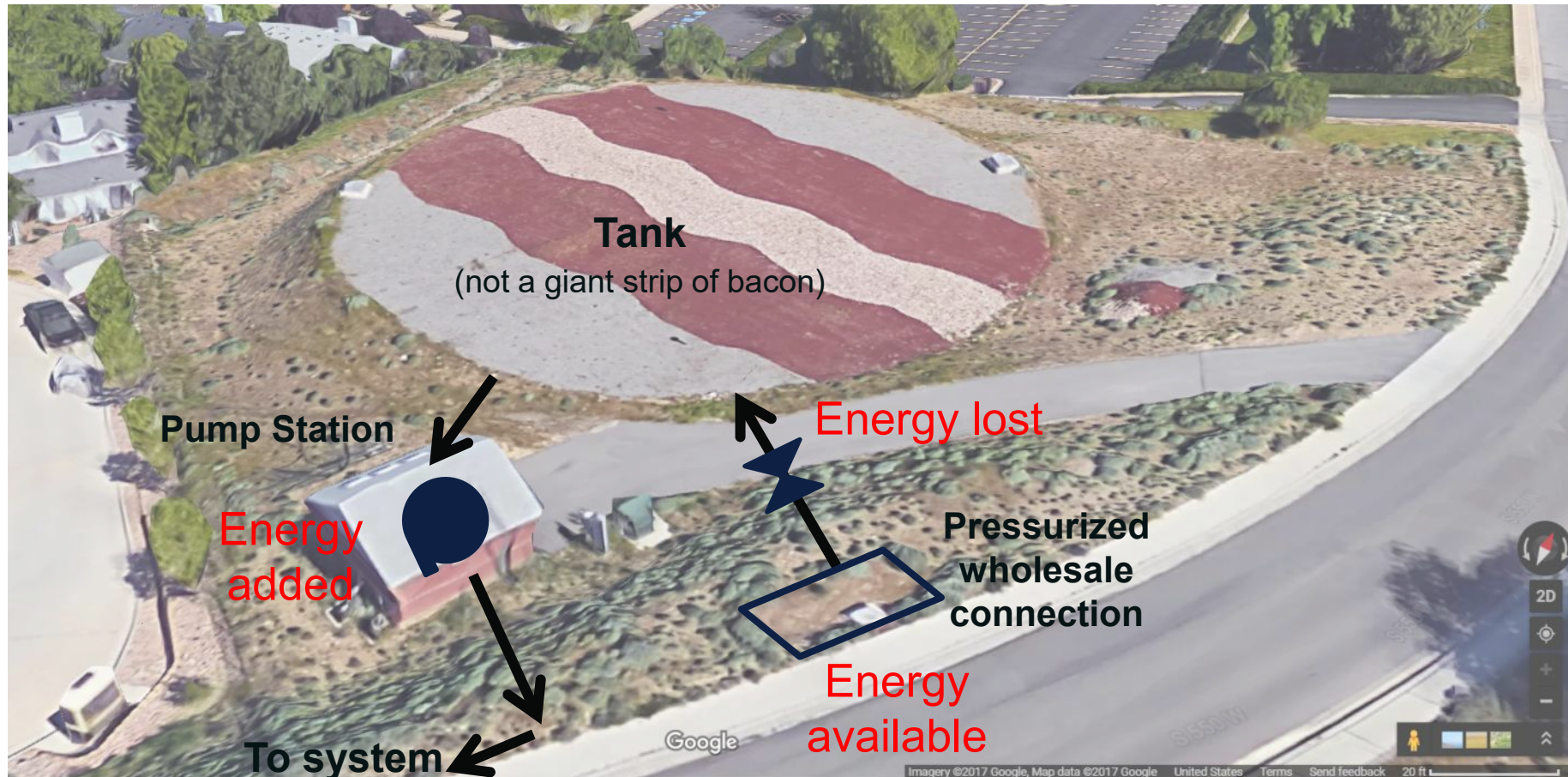
“Breaking pressure prematurely”



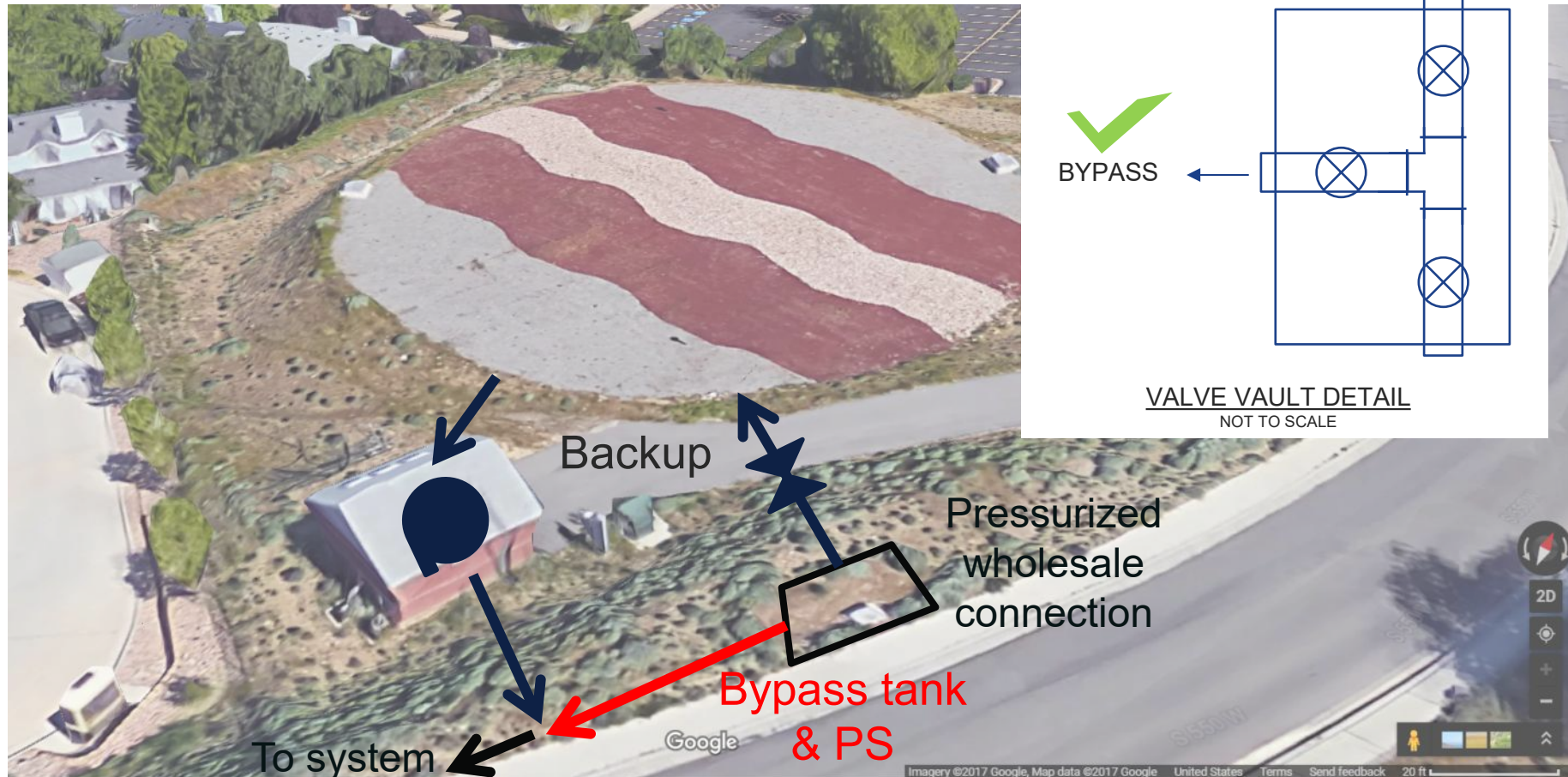
Losing – Solution



Losing – Example



Losing – Example

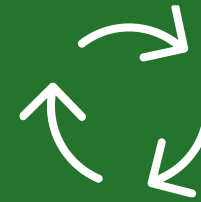


Losing – Diagnosis



How to detect:

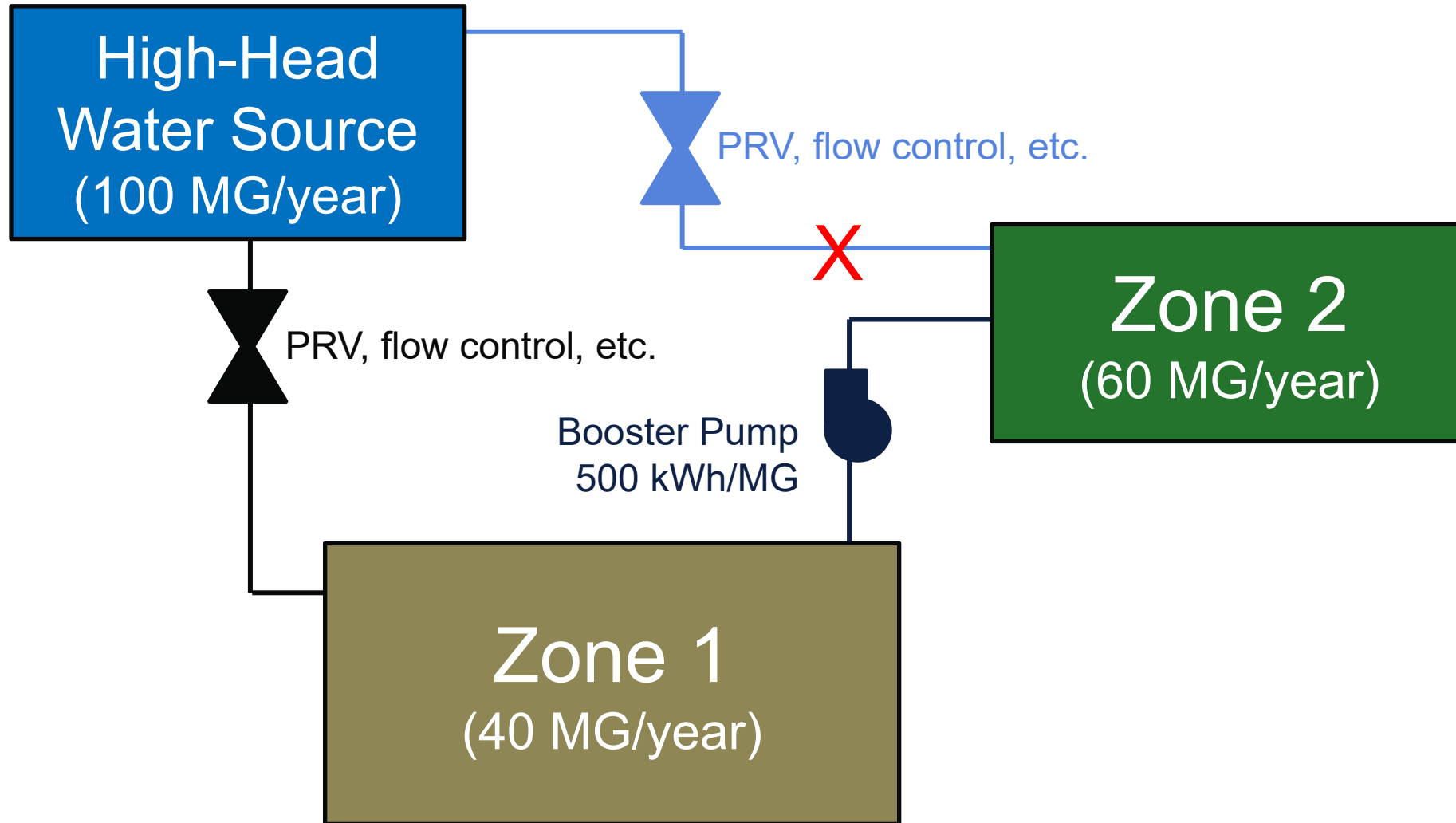
- A water source's head is higher than a pumped zone
- Hydraulic modeling



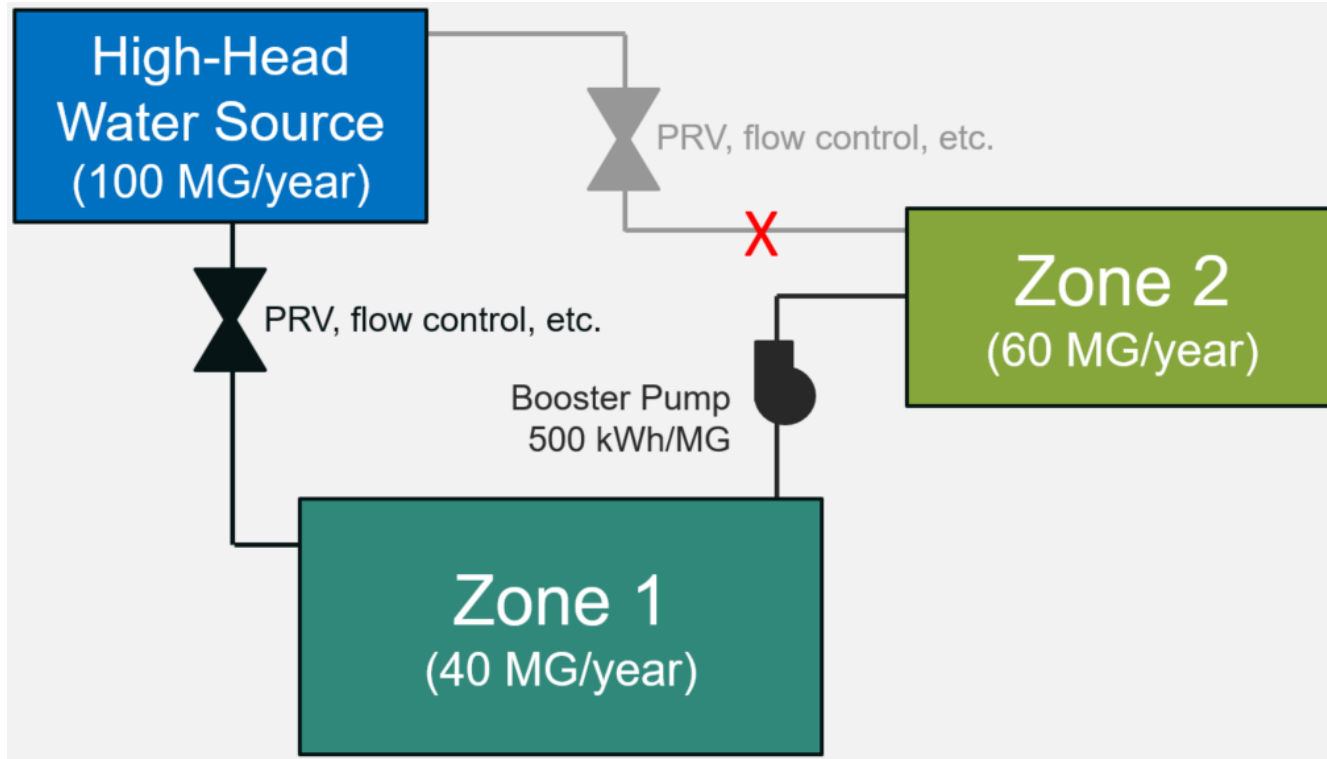
How to resolve:

- Bypass pressure break and serve zone directly
- Maintain booster backup if needed

Losing – Activity



Losing – Activity

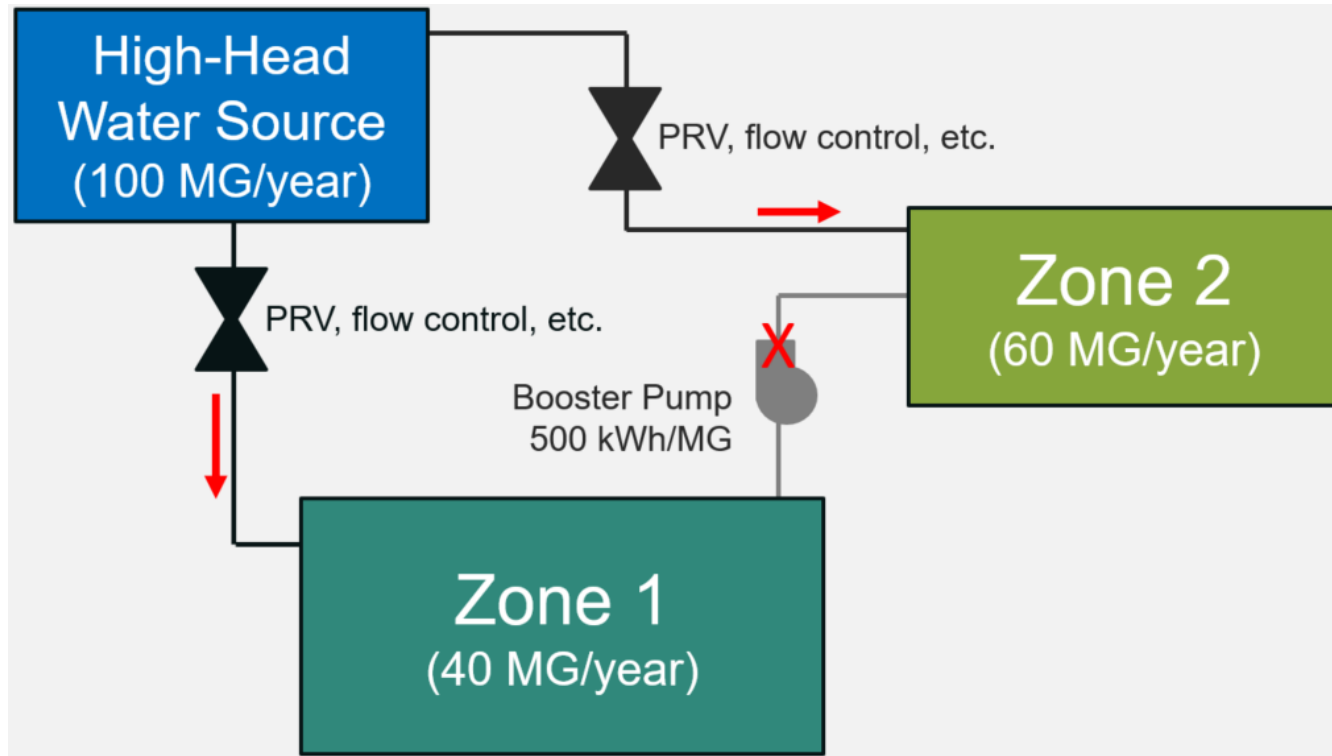


$$\frac{60 \text{ MG}}{\text{year}} * \frac{500 \text{ kWh}}{\text{MG}} = 30,000 \frac{\text{kWh}}{\text{year}}$$

$$30,000 \frac{\text{kWh}}{\text{year}} * \frac{\$0.05}{\text{kWh}} = \$1,500 \text{ year}$$

1. How much energy (kWh) is currently consumed by flowing to Zone 1 and boosting to Zone 2 to meet demands?
2. At \$0.05 per kWh, what is the energy cost to flow to Zone 1 and boost to Zone 2?

Losing – Activity



$$\frac{60 \text{ MG}}{\text{year}} * \frac{500 \text{ kWh}}{\text{MG}} = 30,000 \frac{\text{kWh}}{\text{year}}$$

$$30,000 \frac{\text{kWh}}{\text{year}} * \frac{\$0.05}{\text{kWh}} = \$1,500 \frac{\text{year}}{\text{year}}$$

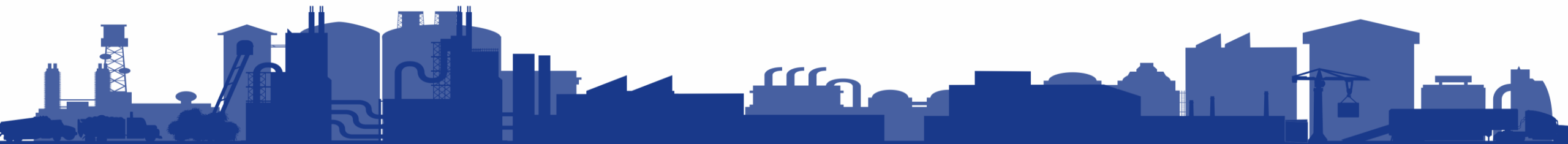
3a. How much energy (kWh) can be saved by fixing the valve and supplying the appropriate amounts to each zone without using the booster pump?

3b. At \$0.05 per kWh, how much money would this adjustment save?

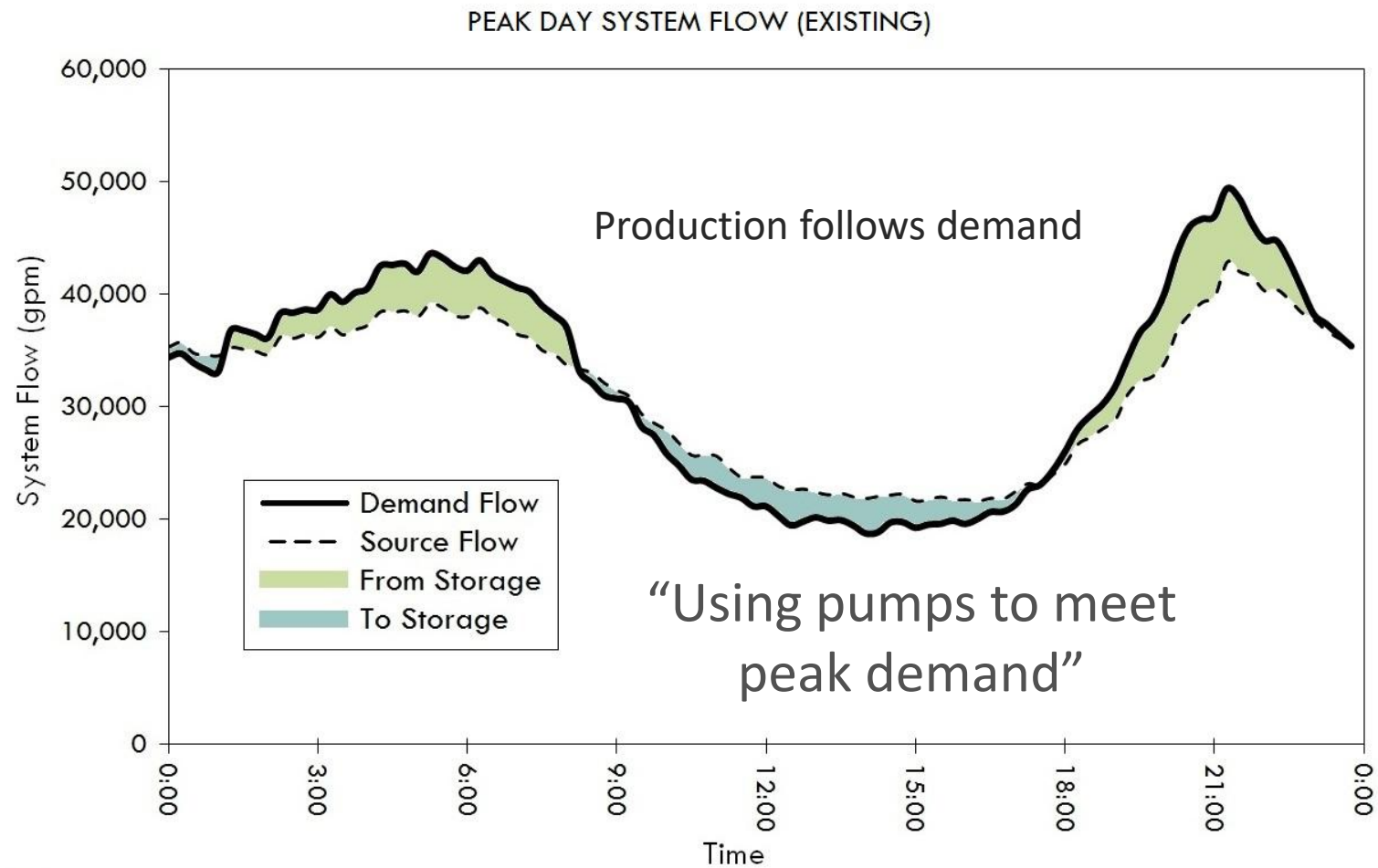
BREAK



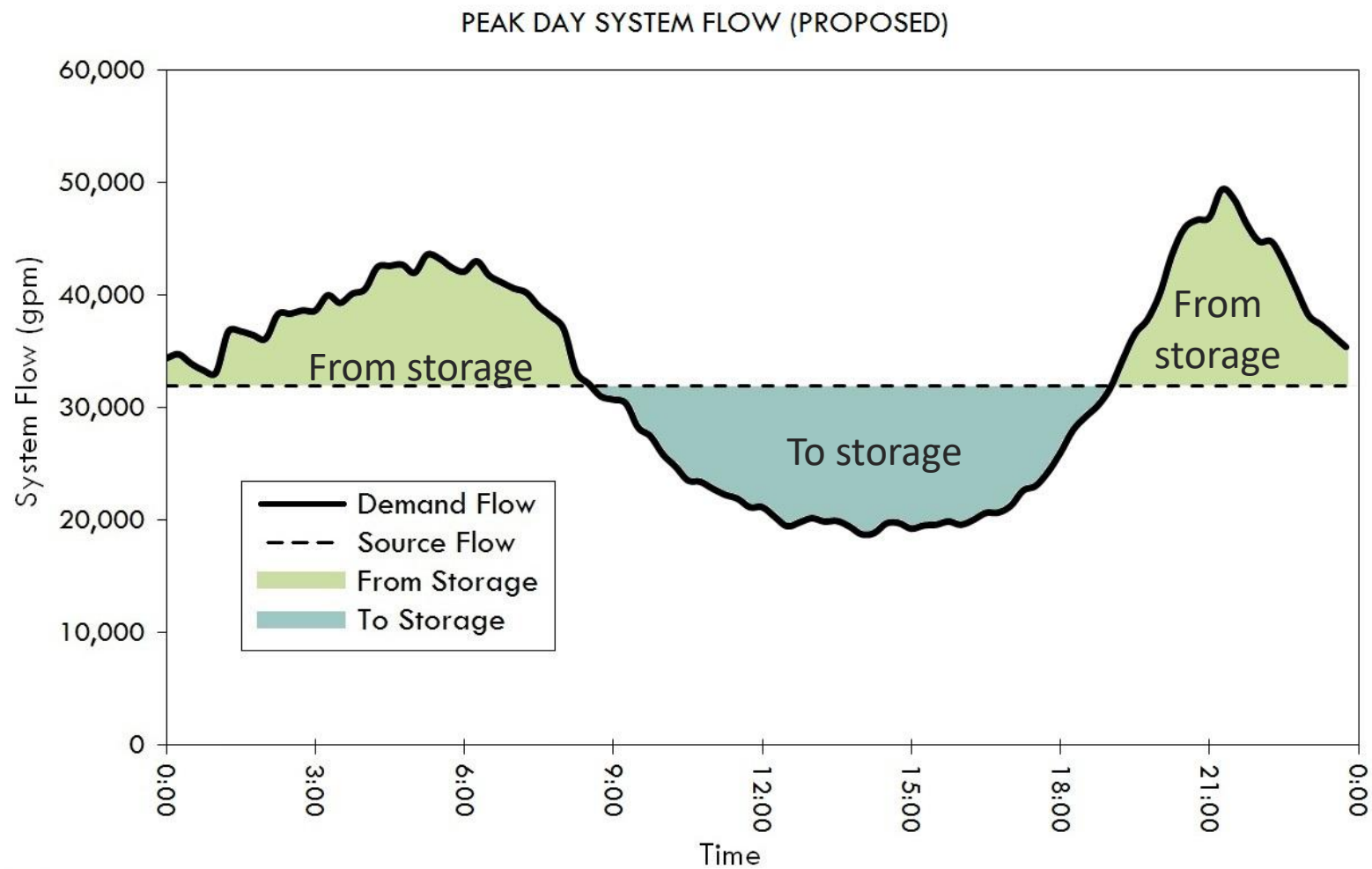
LOADING



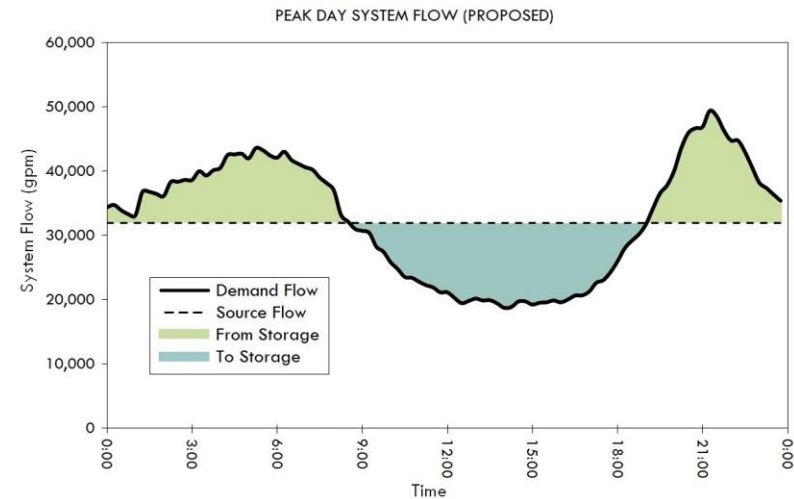
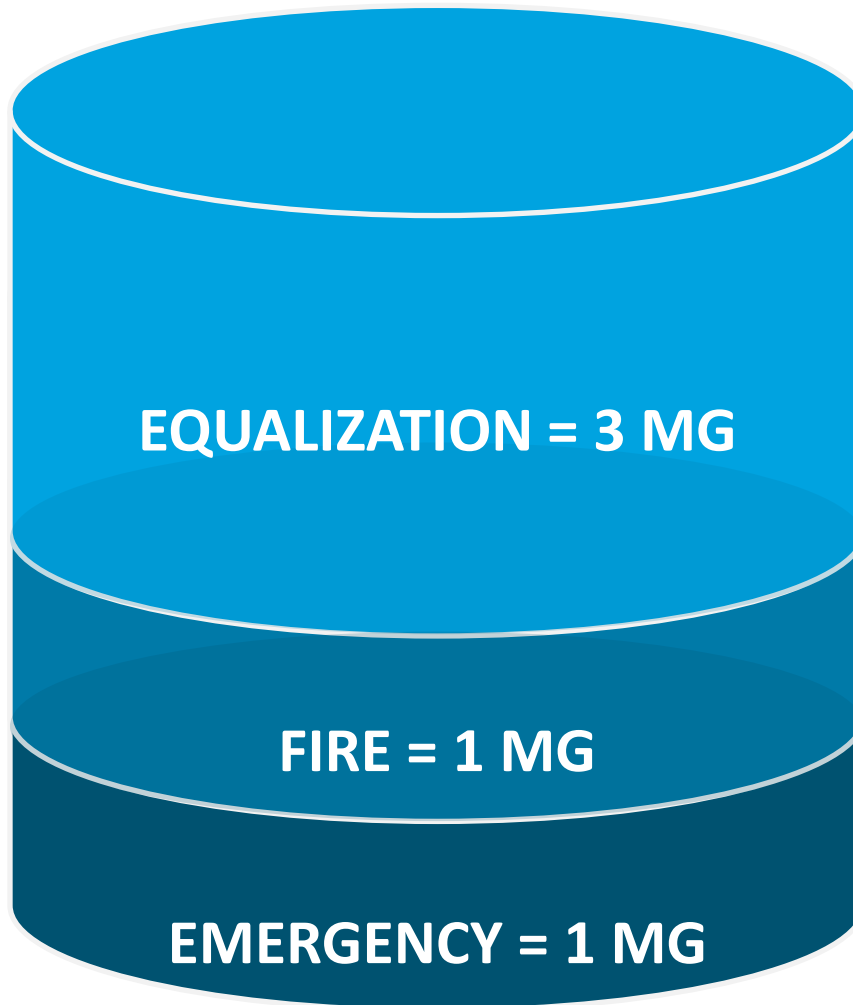
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Loading

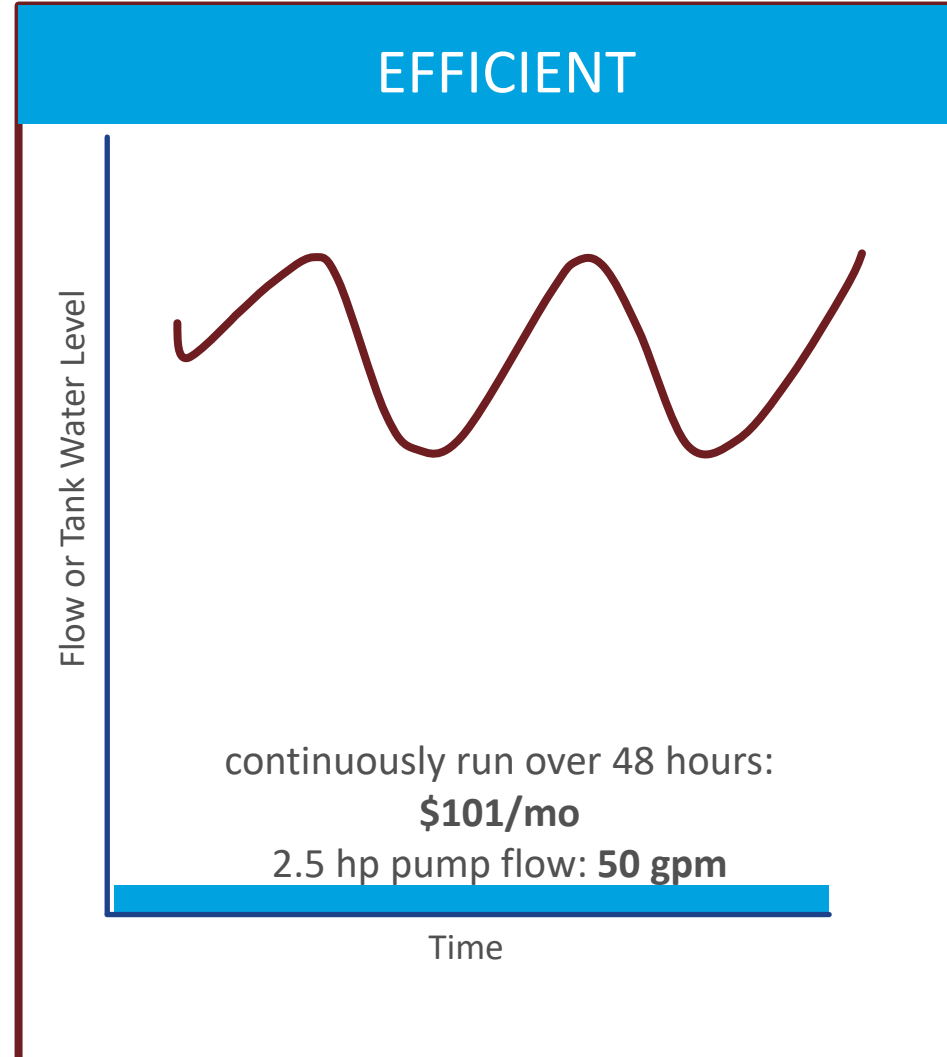
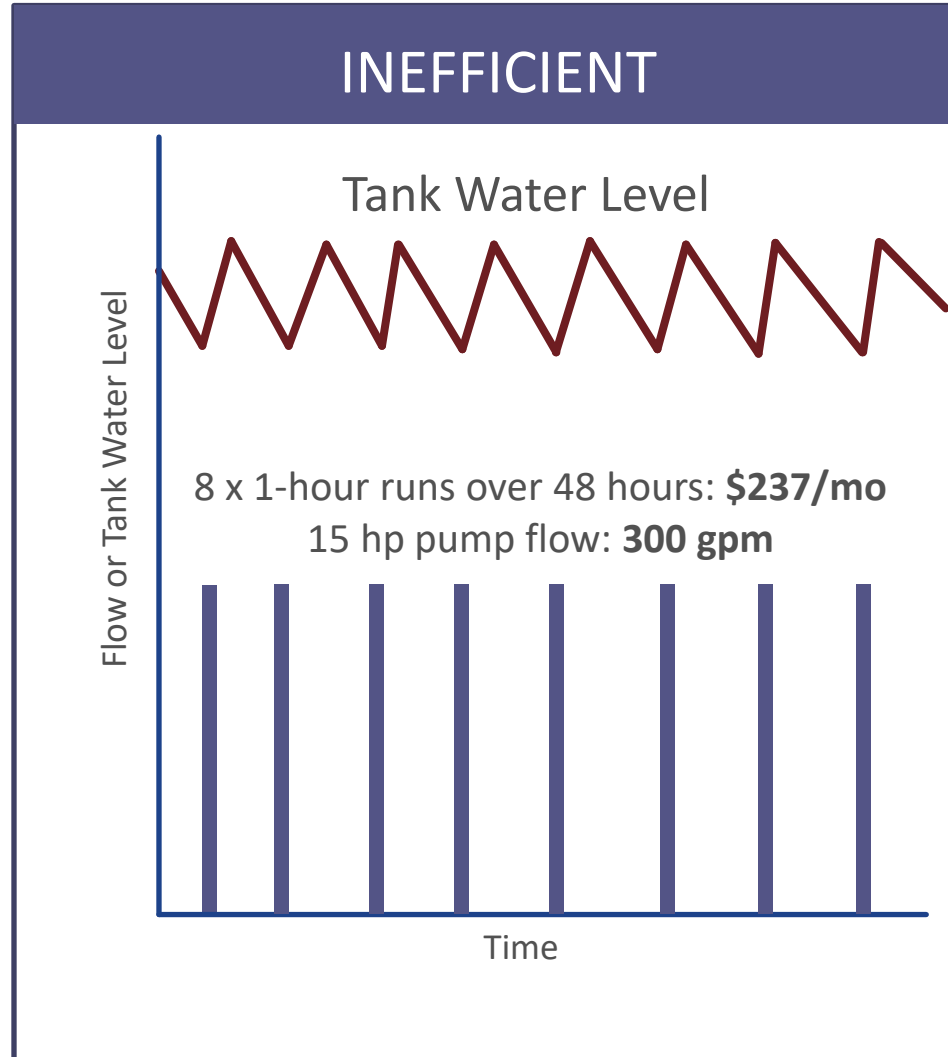


Tank Utilization

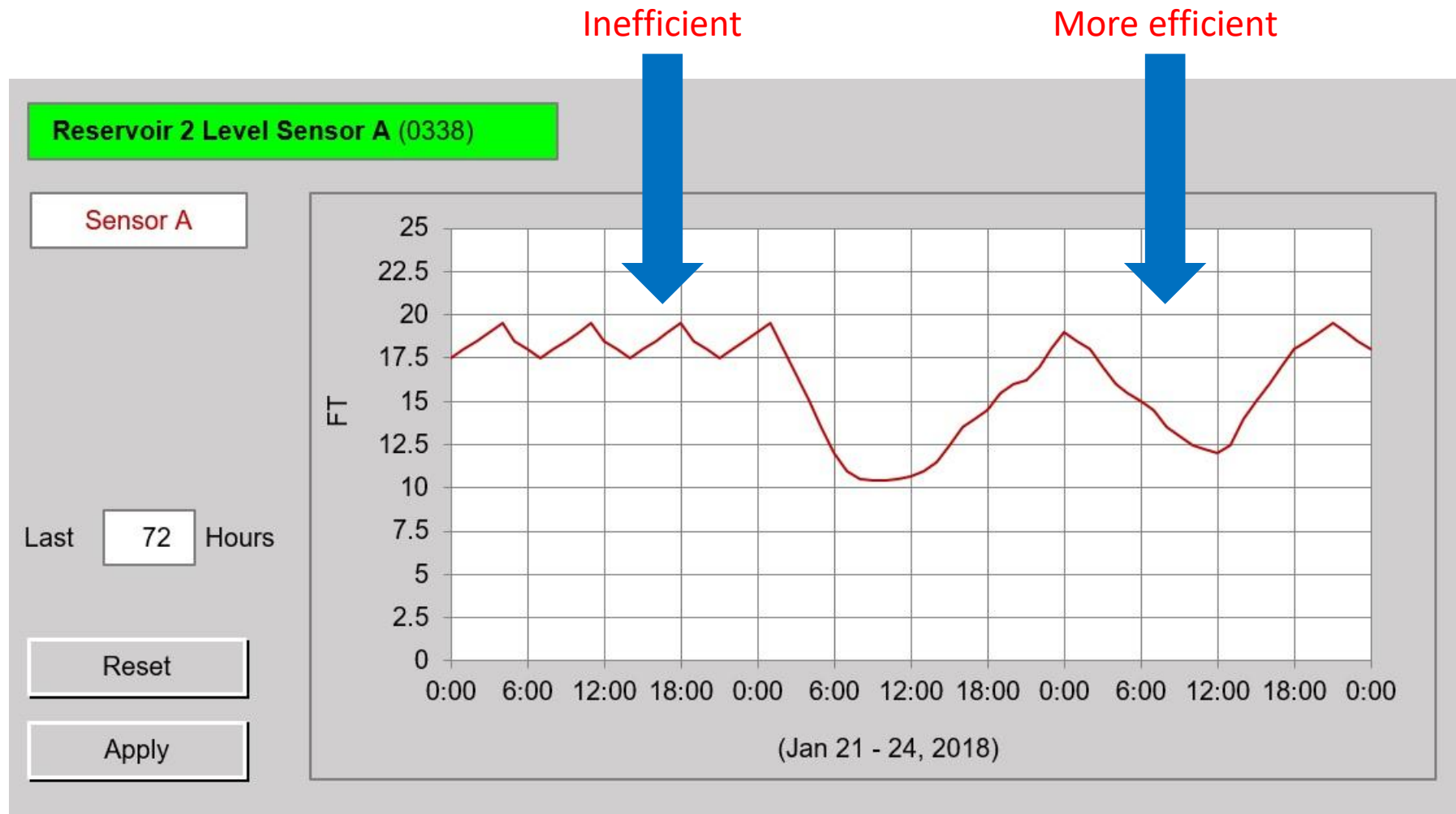


Tanks are batteries! Use storage to meet peak demand

Loading – Example



Loading

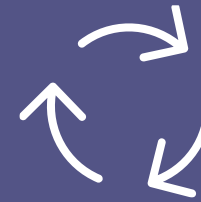


Loading



How to detect:

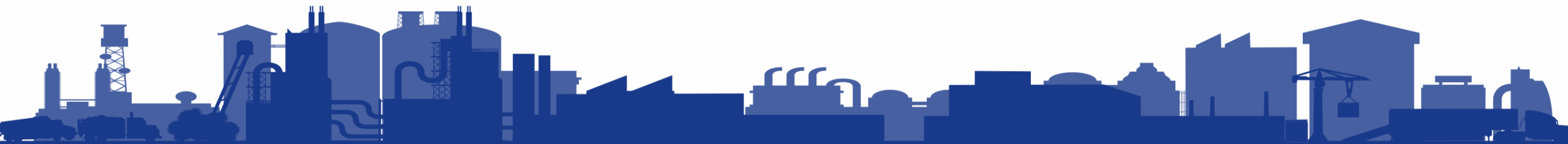
- Intermittent pump operation (short run, high flow)
- Oversized pumping facilities
- Little storage fluctuation
- Hydraulic modeling



How to resolve:

- Use equalization storage
- Modify tank setpoints
- Keep source and pump flow as constant as possible
- Modify pump station

TREASURE HUNTS

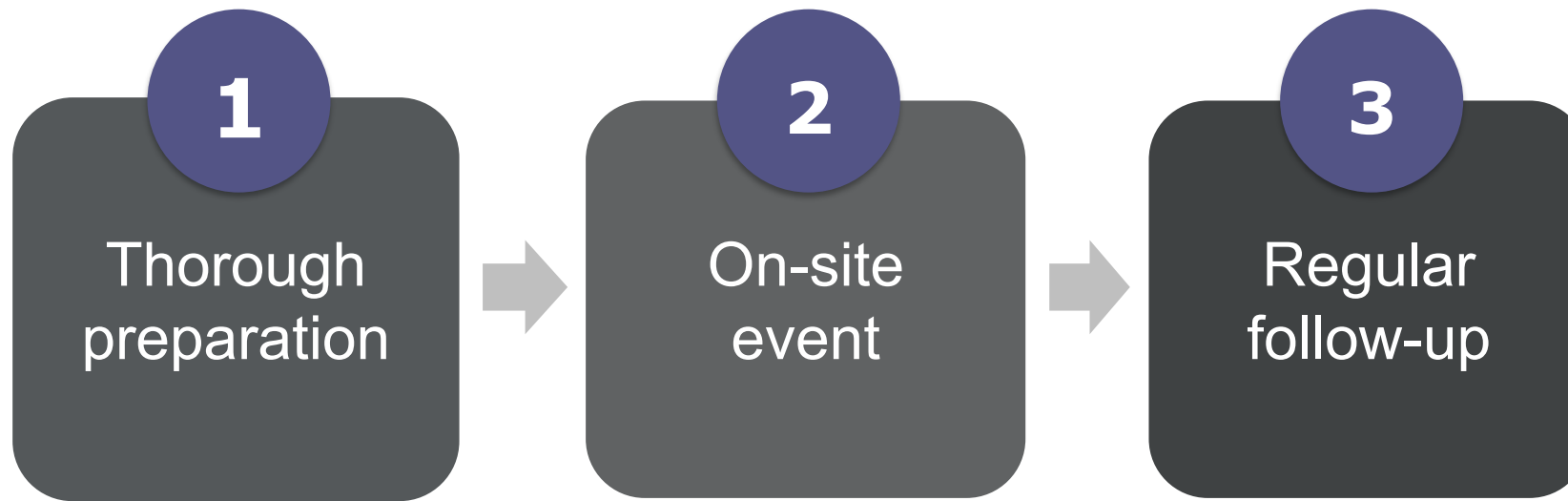


What do you see? What questions do you have?





Conducting a Treasure Hunt



Preparation

- ☐ Identify focus areas based on energy map and facility knowledge.

- ☐ Who?
- ☐ When?
- ☐ Where?

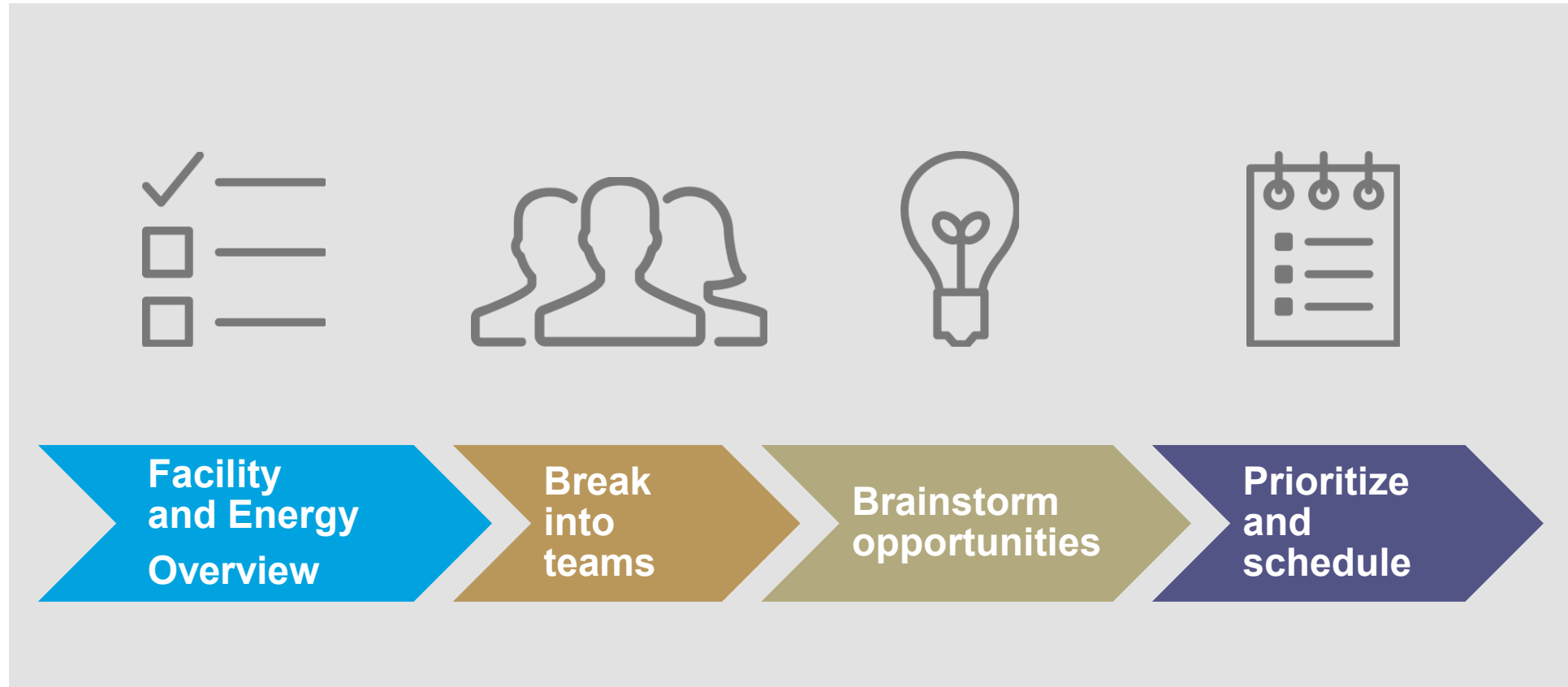
- ☐ Identify relevant facility staff
- ☐ Facilitator and technical support

- ☐ Prepare energy map
- ☐ Collect and analyze facility information, as needed

- ☐ Select date
- ☐ Reserve conference room
- ☐ Order food

- ☐ Communicate agenda, goals and expectations
- ☐ Ensure staff availability

Treasure Hunt Overview

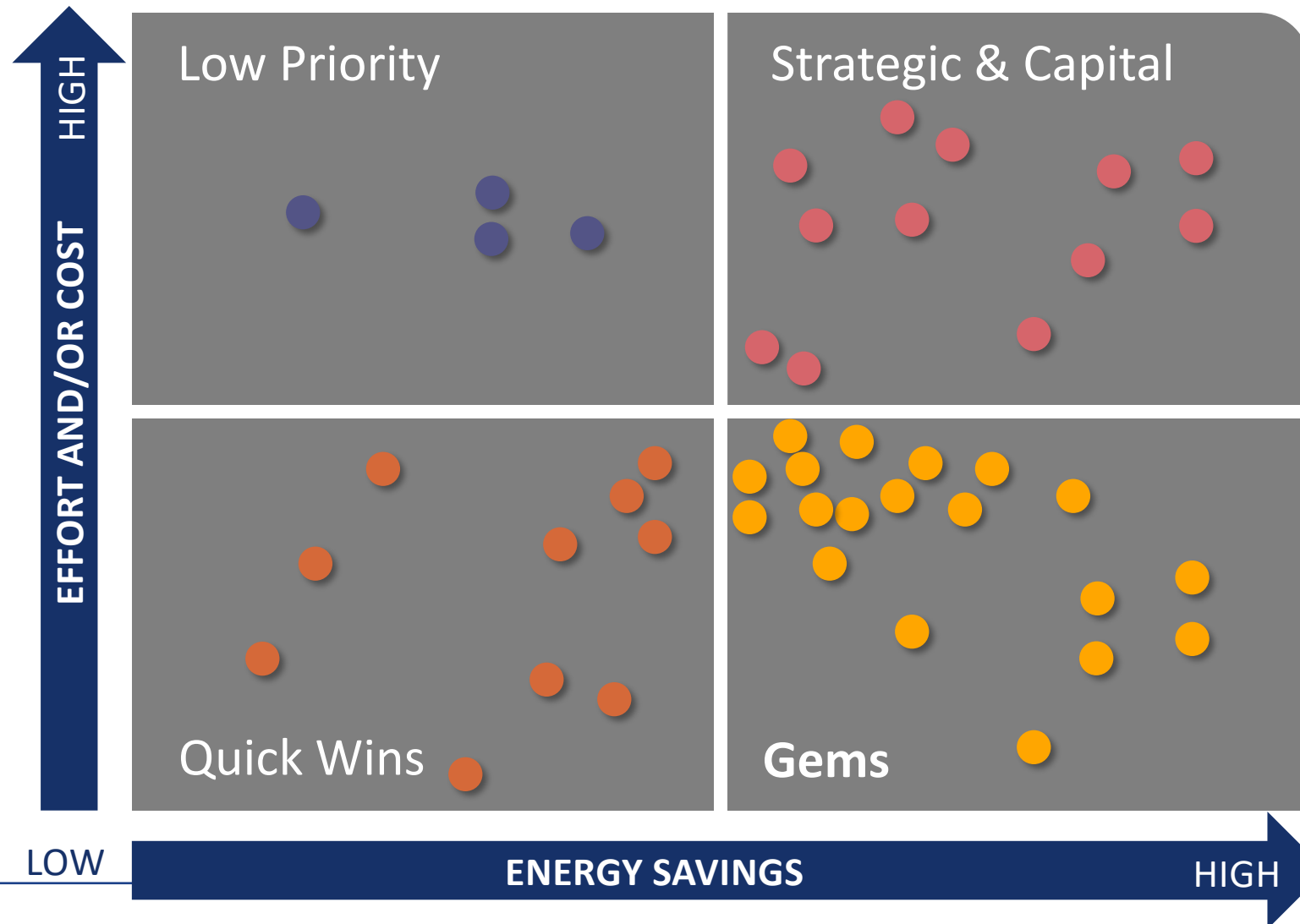


POLL

Ensuring a Successful Treasure Hunt



Energy value graph



After the Treasure Hunt



Good Project Management

Identify

- Project name
- Description
- Location
- System

Prioritize

- Energy savings
- Cost/effort required
- Decision to implement

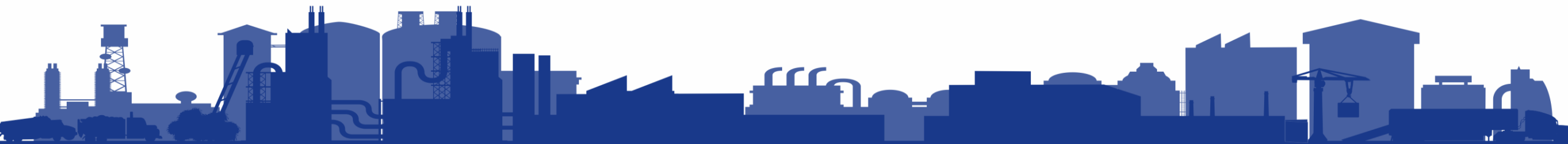
Implement

- Assigned to
- Required action
- Status
- Important dates

Ensure Persistence

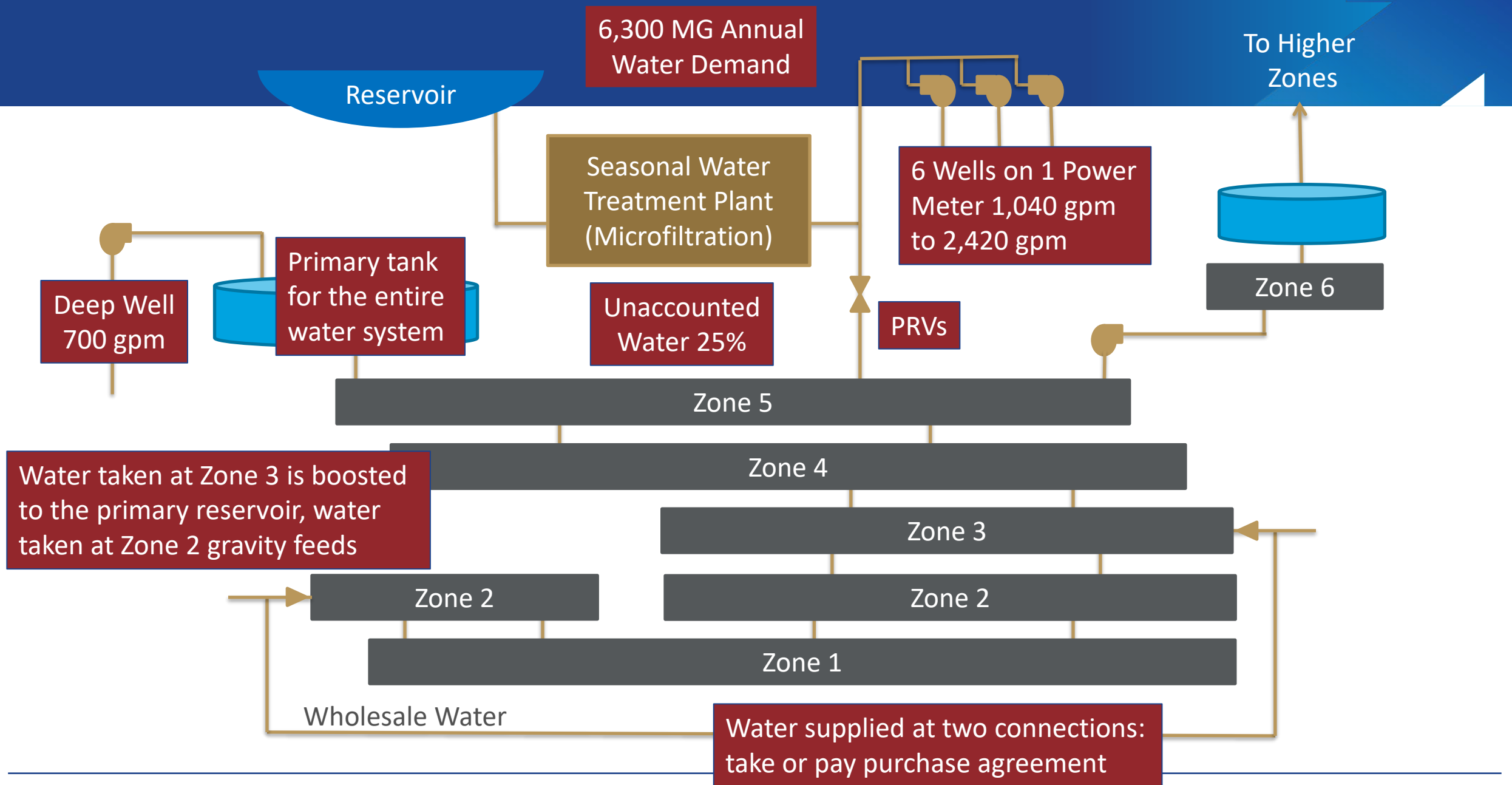
- Risk of backsliding
- Persistence strategy

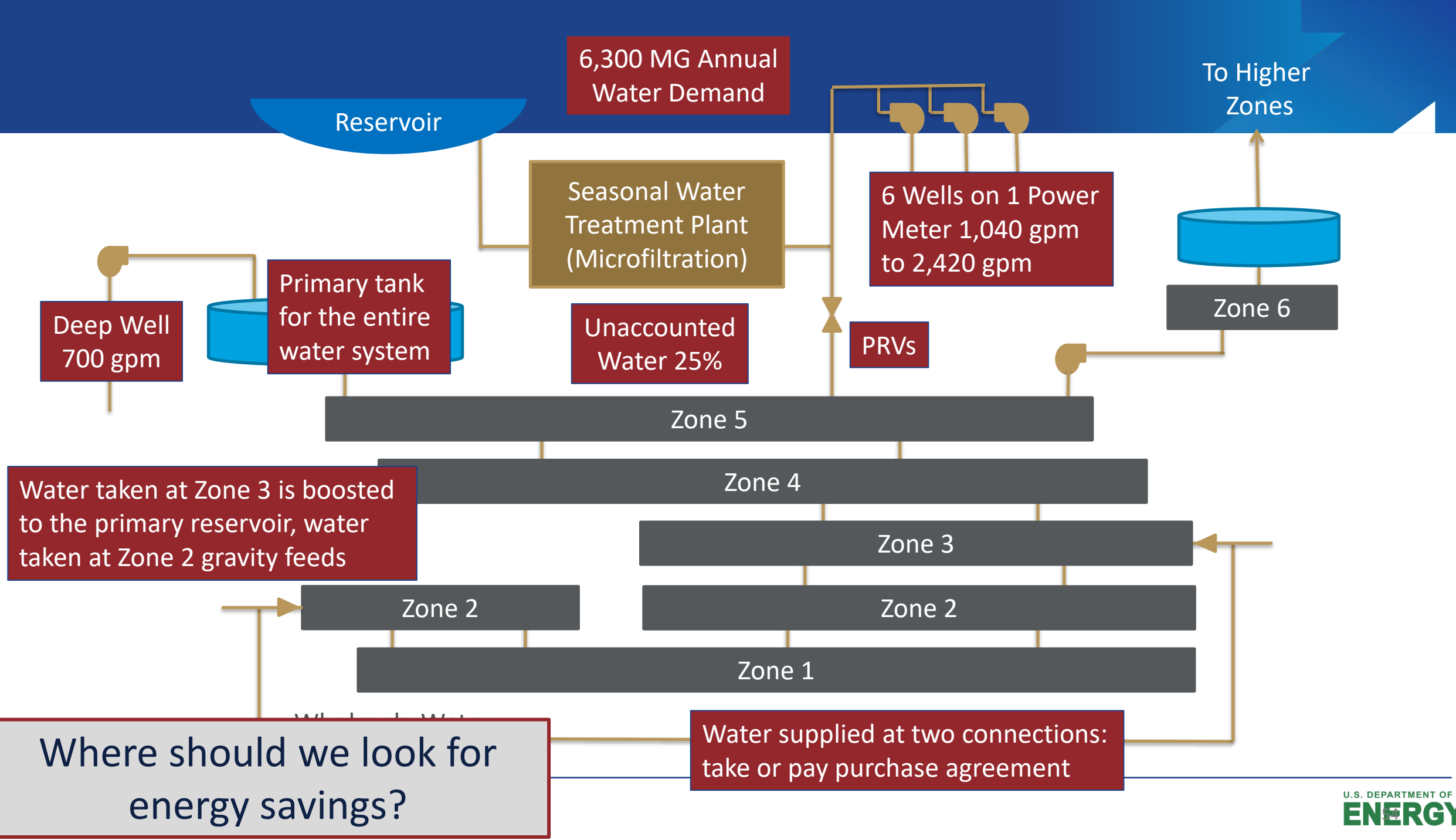
TREASURE HUNT ACTIVITY





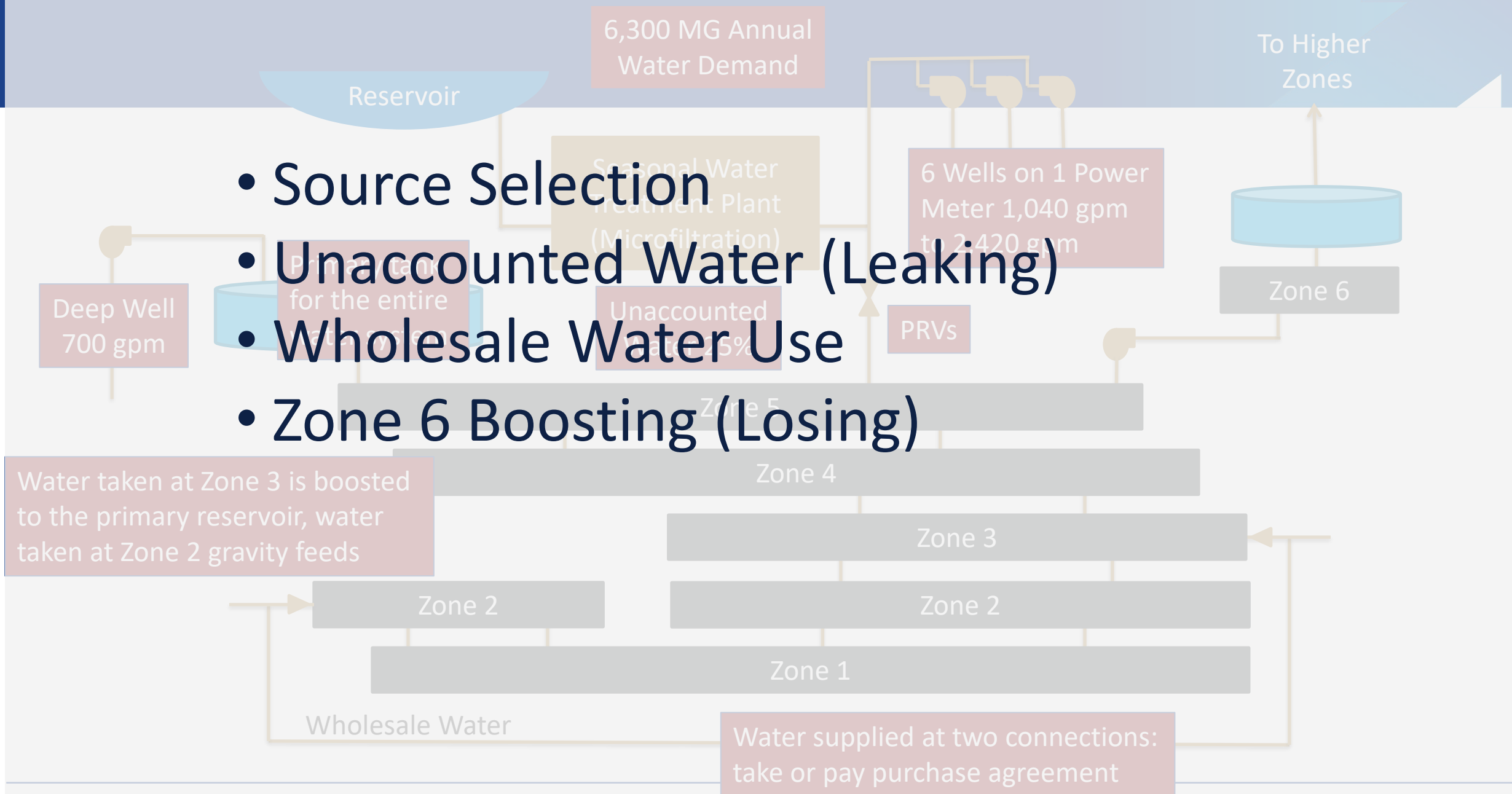
Buenaventura Water System





Where should we look for energy savings?

- Source Selection
- Unaccounted Water (Leaking)
- Wholesale Water Use
- Zone 6 Boosting (Losing)



Unaccounted Water Reduction

- Total Water Production: 6,300 MG
 - Unaccounted Water: 1,575 MG
 - Delivered Water: 4,725 MG
- It is not reasonable to eliminate all unaccounted water losses:
 - Target an unaccounted water percentage of 15% through leak reduction
 - New production target: 5,670 MG
 - Monthly production reduction: 52.5 MG

Source Selection - Water Supply by Source

- Total Produced: 6,300 MG
 - Wellfield: 3,798 MG
 - Wholesale Purchase: 1,227 MG
 - Treatment Plant: 1,081 MG
 - Deep Well: 194 MG

Wellfield Energy Intensity

Wellfield Energy Intensity Comparison

Well	Power	Power	Flow	Flow	Energy
	kW	Factor %	gpm	MGD	Intensity kWh/MG
1	64.7	89.6%	1477	2.1	730
2	37.7	87.4%	1040	1.5	604
3	47.1	83.0%	1310	1.9	599
4	64.0	90.3%	1197	1.7	891
5	74.4	92.2%	1960	2.8	633
6	70.8	90.6%	2420	3.5	488

Energy Used: 2,621,279 kWh

Energy Intensity: 690 kWh/MG

Water Produced: 3,798 MG

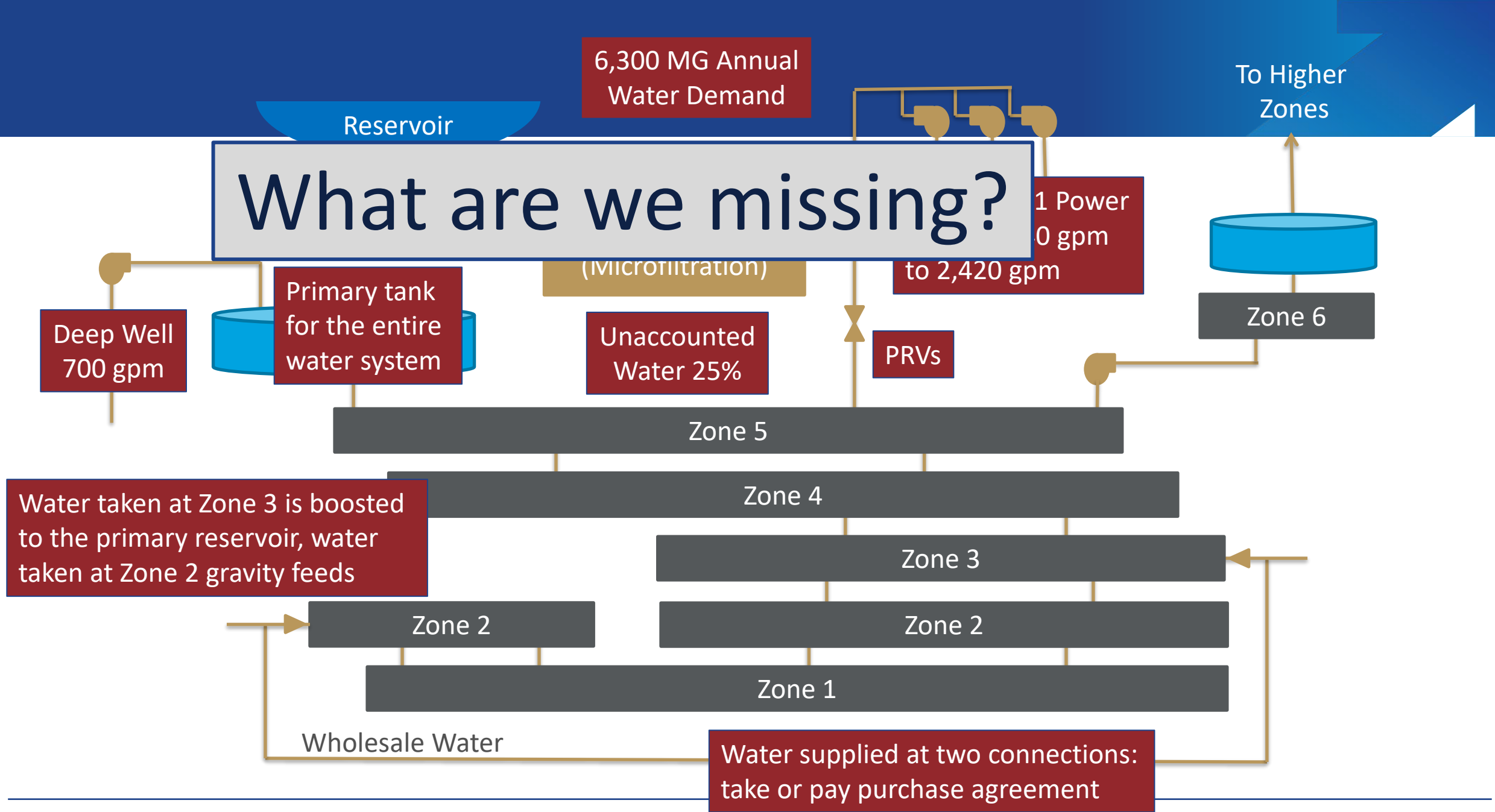
Energy Intensity of Wholesale Water

- Total Purchased Water Taken: 1,227 MG
- Zone 3:
 - Water taken and boosted to primary reservoir: 905 MG
 - Energy to boost water: 760,001 kWh
 - Energy Intensity: 840 kWh/MG
- Zone 2:
 - Water gravity fed: 322 MG
 - Energy to gravity feed: 0 kWh
 - Energy Intensity: 0 kWh/MG

Wholesale Water Purchase

- Total Purchased Water: 2,200 MG/year
- Water Taken by City: 1,227 MG
 - 55.8% of purchased water
- What are some reasons for using less than purchased?
- Target: 90% of purchased water
 - 1,980 MG

But are we missing something?



Water Demand by Zone

Total Annual Water Use (Including Unaccounted Water)	6,300	MG
Zone 1	630	MG
Zone 2	1890	MG
Zone 3	1575	MG
Zone 4	945	MG
Zone 5	630	MG
Zone 6 and Higher	315	MG

- Can all the wholesale water be used in Zone 3 or lower?
- Target: 90% of purchased water
 - 1,980 MG
 - Energy intensity: 0 kWh/MG

Energy Intensity of the Water Treatment Plant

- Energy Used: 1,101,599 kWh
- Water Produced: 1,081 MG
- Energy Intensity: 1,019 kWh/MG
- Oct – Mar Energy Use: 57,700 kWh
- Assumed Baseload: 692,400 kWh
- Production Energy Used: 409,199 kWh
- Production Energy Intensity:
379 kWh/MG

	Treatment Plant	
	kWh	MG
January	59,100	0.0
February	59,400	0.0
March	47,400	0.0
April	43,800	7.7
May	60,600	108.2
June	132,300	224.8
July	170,100	288.8
August	173,100	304.7
September	175,500	146.5
October	64,499	0.0
November	50,400	0.0
December	65,400	0.0
Total	1,101,599	1,081

Energy Intensity of the Deep Well

- Energy Used: 512,840 kWh
- Water Produced: 195 MG
- Energy Intensity: 2,624 kWh/MG

Non-Production Energy Use

- Total Energy Use: 5,475,778 kWh
 - Wellfield Energy: 2,621,279 kWh
 - Deep Well Energy: 512,840 kWh
 - Treatment Plant Energy: 1,101,599 kWh
 - Wholesale Water Energy: 760,001
- Production Energy Use: 4,995,719 kWh
- Non-Production Energy Use: 480,059 kWh
 - What is the energy?
 - Can it be reduced?

Energy Intensity Summary

- Non-Production Energy Use: 480,059 kWh
- Treatment Plant Fixed Energy Use: 692,400 kWh
- Water Sources:
 - Wellfield:
 - Well 1: 730 kWh/MG
 - Well 2: 604 kWh/MG
 - Well 3: 599 kWh/MG
 - Well 4: 891 kWh/MG
 - Well 5: 633 kWh/MG
 - Well 6: 488 kWh/MG
 - Treatment Plant (variable): 379 kWh/MG
 - Deep Well: 2,624 kWh/MG
 - Wholesale: 0 kWh/MG

Buenaventura Water System

- Annual Energy Use: 5,475,778 kWh
- Annual Production: 6,300 MG
- Annual Energy Intensity: 793 kWh/MG
- Production Capacity
 - WTP: 216 MGM (May – Sep)
 - Wholesale: 1,980 MGY
 - Deep Well: 25 MGM
 - Wellfield:
 - Well 1: 64 MGM
 - Well 2: 45 MGM
 - Well 3: 57 MGM
 - Well 4: 52 MGM
 - Well 5: 85 MGM
 - Well 6: 104 MGM

New Buenaventura Strategy

Only
May – Sep

		WTP	DW	#1	#2	#3	#4	#5	#6	Wholesale
Capacity (MGM)		216	25	64	45	57	52	85	104	1980/yr
Intensity (kWh/MG)		379	2,624	730	604	599	891	633	488	0
Demand (MGM)										
Jan	358									
Feb	312									
Mar	374									
Apr	333									
May	539									
Jun	669									
Jul	805									
Aug	752									
Sep	543									
Oct	385									
Nov	291									
Dec	311									

New Buenaventura Strategy

		WTP	DW	#1	#2	#3	#4	#5	#6	Wholesale
Capacity (MGM)		216	25	64	45	57	52	85	104	1980/yr
Intensity (kWh/MG)		379	2,624	730	604	599	891	633	488	0
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May	539	216								
Jun	669	216								
Jul	805	216								
Aug	752	216								
Sep	543	216								
Oct	385	0								
Nov	291	0								
Dec	311	0								

409,320

New Buenaventura Strategy

		WTP	DW	#1	#2	#3	#4	#5	#6	Wholesale
Capacity (MGM)		216	25	64	45	57	52	85	104	1980/yr
Intensity (kWh/MG)		379	2,624	730	604	599	891	633	488	0
Demand (MGM)										
Jan	358	0							104	
Feb	312	0							104	
Mar	374	0							104	
Apr	333	0							104	
May	539	216							104	
Jun	669	216							104	
Jul	805	216							104	
Aug	752	216							104	
Sep	543	216							104	
Oct	385	0							104	
Nov	291	0							104	
Dec	311	0							104	

New Buenaventura Strategy

		WTP	DW	#1	#2	#3	#4	#5	#6	Wholesale
Capacity (MGM)		216	25	64	45	57	52	85	104	1980/yr
Intensity (kWh/MG)		379	2,624	730	604	599	891	633	488	0
Demand (MGM)										
Jan	358	0				57			104	
Feb	312	0				57			104	
Mar	374	0				57			104	
Apr	333	0				57			104	
May	539	216				57			104	
Jun	669	216				57			104	
Jul	805	216				57			104	
Aug	752	216				57			104	
Sep	543	216				57			104	
Oct	385	0				57			104	
Nov	291	0				57			104	
Dec	311	0				57			104	

409,320

409,716

609,024

New Buenaventura Strategy

		WTP	DW	#1	#2	#3	#4	#5	#6	Wholesale
Capacity (MGM)		216	25	64	45	57	52	85	104	1980/yr
Intensity (kWh/MG)		379	2,624	730	604	599	891	633	488	0
Demand (MGM)										
Jan	358	0			45	57			104	
Feb	312	0			45	57			104	
Mar	374	0			45	57			104	
Apr	333	0			45	57			104	
May	539	216			45	57			104	
Jun	669	216			45	57			104	
Jul	805	216			45	57			104	
Aug	752	216			45	57			104	
Sep	543	216			45	57			104	
Oct	385	0			45	57			104	
Nov	291	0			45	57			104	
Dec	311	0			45	57			104	

409,320

409,716
326,160

609,024

New Buenaventura Strategy

		WTP	DW	#1	#2	#3	#4	#5	#6	Wholesale
Capacity (MGM)		216	25	64	45	57	52	85	104	1980/yr
Intensity (kWh/MG)		379	2,624	730	604	599	891	633	488	0
Demand (MGM)										
Jan	358	0			45	57			104	
Feb	312	0			45	57			104	
Mar	374	0			45	57			104	
Apr	333	0			45	57			104	
May	539	216			45	57			104	
Jun	669	216			45	57			104	
Jul	805	216			45	57		85	104	
Aug	752	216			45	57		55	104	
Sep	543	216			45	57			104	
Oct	385	0			45	57			104	
Nov	291	0			45	57			104	
Dec	311	0			45	57			104	

409,320

409,716

609,024

326,160

88,620

New Buenaventura Strategy

		WTP	DW	#1	#2	#3	#4	#5	#6	Wholesale
Capacity (MGM)		216	25	64	45	57	52	85	104	1980/yr
Intensity (kWh/MG)		379	2,624	730	604	599	891	633	488	0
Demand (MGM)										
Jan	358	0			45	57			104	152
Feb	312	0			45	57			104	106
Mar	374	0			45	57			104	168
Apr	333	0			45	57			104	127
May	539	216			45	57			104	117
Jun	669	216			45	57			104	247
Jul	805	216			45	57		85	104	298
Aug	752	216			45	57		55	104	275
Sep	543	216			45	57			104	121
Oct	385	0			45	57			104	179
Nov	291	0			45	57			104	85
Dec	311	0			45	57			104	105
		409,320			409,716		609,024		0	
					326,160		88,620			

Water System Energy Use

Non-Production Energy: 408,059 kWh

WTP Fixed Energy: 692,400 kWh

WTP Variable Energy: 409,320 kWh

Well #2: 326,160 kWh

Well #3: 409,716 kWh

Well #5: 88,620 kWh

Well #6: 609,024 kWh

Wholesale Water: 0 kWh

Total: 2,943,299 kWh

Energy Savings

Original Strategy: 5,475,778 kWh

Revised Strategy: 2,943,299 kWh

Energy Savings: 2,532,479 kWh

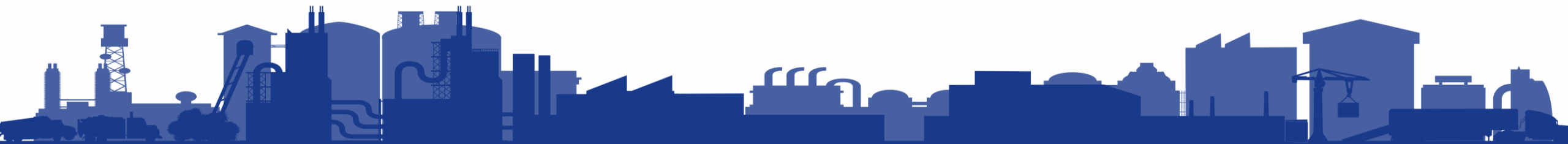
Percent Savings: 46.2%

Original Intensity: 793 kWh/MG

Revised Intensity: 519 kWh/MG

On your smart phone
Go to: <https://kahoot.it/>
Game PIN:

KAHOOT!



Takeaways

- Identify leaking, losing, and loading opportunities in your water system
- Keep track of energy saving opportunities
- Start working on energy saving opportunities

Closing

Questions
Comments
Discussion

Email Giulia, Katie or Mike

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mike.lewis@cascadeenergy.com

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Q&A Session



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Questions?