SAFER Cost Assessment Methodology Development

November 20, 2020

CALIFORNIA Water Boards

Welcome and Meeting Logistics

Vanessa Soto
Office of Public Participation (OPP)

CALIFORNIA
Water Boards

Water Board's Mission Statement

Preserve, enhance, and restore the quality of California's water resources and drinking water for the protection of the environment, public health, and all beneficial uses, and to ensure proper water resource allocation and efficient use, for the benefit of present and future generations.

What is the SAFER Drinking Water Program?

SAFER = Safe and Affordable Funding for Equity and Resilience

Division of Drinking Water	Division of Financial Assistance	Office of Public Participation	SAFER Advisory Group
systems	*funding*	*communities*	*local expertise*

Ways to Participate-

1. Watch ONLY: Visit video.calepa.ca.gov

2. Email: Submit a comment or ask a question that will be read aloud, send an email to:
safer@waterboards.ca.gov

3. Q&A: Submit a question using the Q&A feature at the bottom of your Zoom Screen. You can UPVOTE any question you would like answered.

4. Raise Hand: Attendees will be given the opportunity to provide verbal comment or ask questions, if you're interested in this option, please raise your virtual hand when the time is right.

- Please wait for your name to be called.
- Public comments are 3 minutes each.

Needs Assessment Overview

Kristyn Abhold
SAFER Section
Division of Drinking Water

CALIFORNIA
Water Boards

Presentation Outline

- Overview of Needs Assessment and Cost Assessment
- Proposed Metrics for Step 4a of the Cost Model: Evaluating Modeled Solutions for Sustainability & Resiliency
- Overview of Step 4b: Cost Estimates for Possible Modeled Solutions
- Next Steps and Timeline

Audience Poll Question 1

Did you participate in or review the August 28, 2020 webinar on the Cost Assessment Methodology for Public Water Systems and Domestic Wells?

- Yes
- No

View recording here: https://www.youtube.com/embed/ndsVqRS_-s8?modestbranding=1&rel=0&autoplay=1

Provide a written response to poll questions at the link below by **December 20th**:

- **https://bit.ly/3nv7Q4x**

Audience Poll Question 2

Have you read the White Paper: ***"Long Term Solutions Cost Methodology for Public Water Systems and Domestic Wells: Version 2"***?

- Yes, read the whole thing
- Yes, I skimmed it
- No, but I plan to
- No, I don't intend to read it

Access White Paper here: https://www.waterboards.ca.gov/drinking_water/programs/safer_drinking_water/docs/draft_whitepaper_lt_solutions_cost_methd_pws_dom_wells.pdf

Provide a written response to poll questions at the link below by **December 20th**:

- **https://bit.ly/3nv7Q4x**

Human Right to Water (HR2W) - 2012

Water Code Section 106.3, the state statutorily recognizes that:

"every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes."

SB 200 and the Needs Assessment

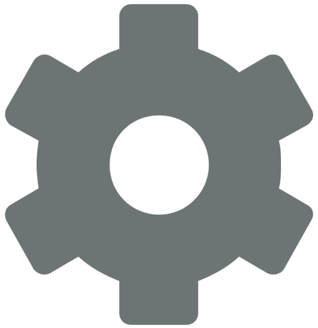
Senate Bill 200 created the Safe and Affordable Drinking Water Fund.

- Up to $130 million per year through 2030
- The annual Fund Expenditure Plan prioritizes projects for funding, documents past and planned expenditures, and is "based on data and analysis drawn from the drinking water **Needs Assessment.**"

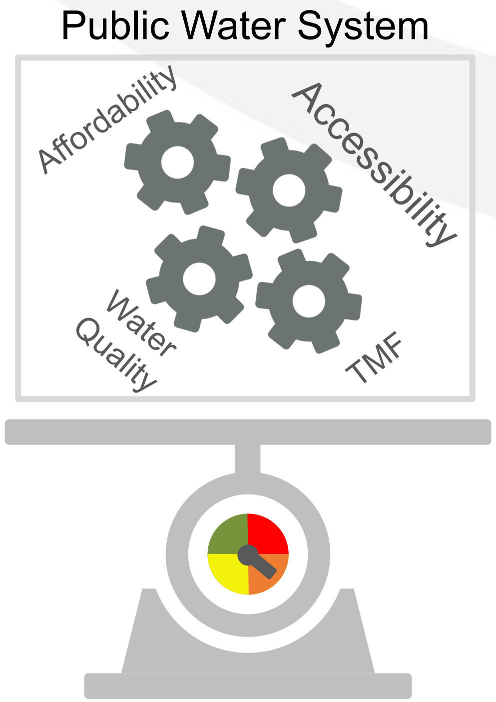
Health and Safety Code §116769

Needs Assessment for Public Water Systems

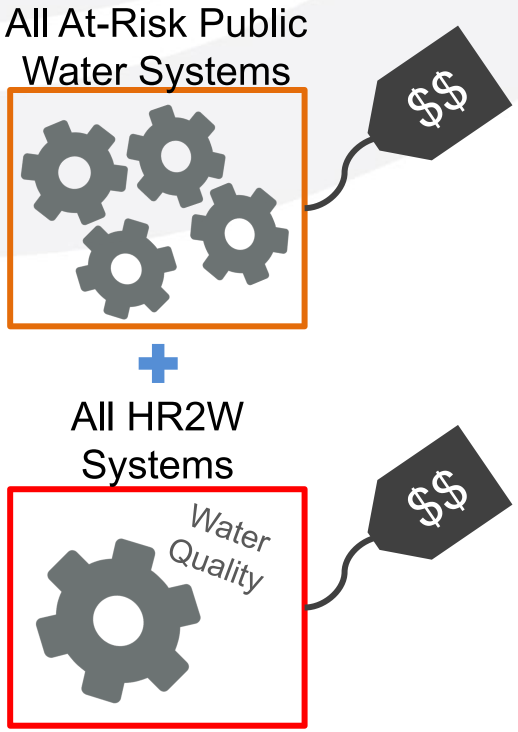
AFFORDABILITY ASSESSMENT



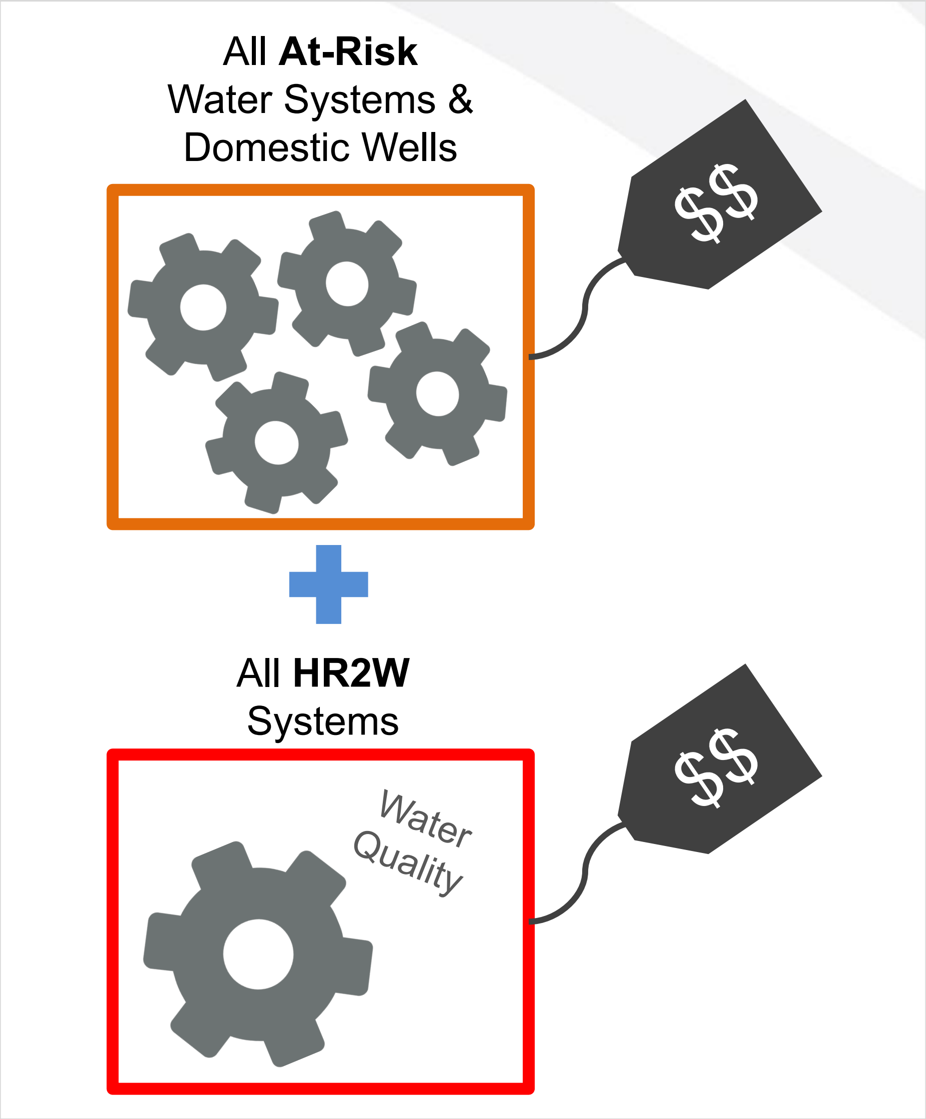
RISK ASSESSMENT



COST ESTIMATE



Cost Assessment



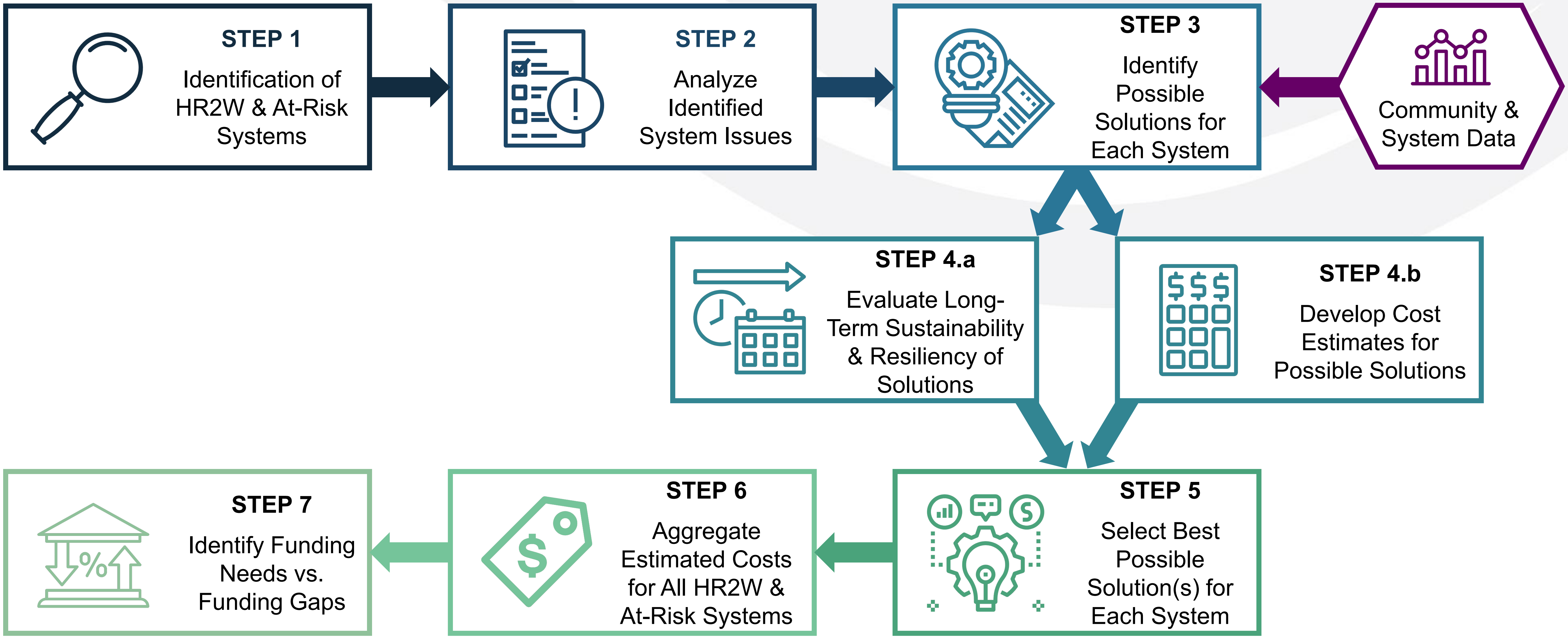
- SB 200 explicitly requires the annual Fund Expenditure Plan include:

  "an estimate of the funding needed for the next fiscal year based on the amount available in the fund, **anticipated funding needs**, other existing funding sources, and other relevant data and information"

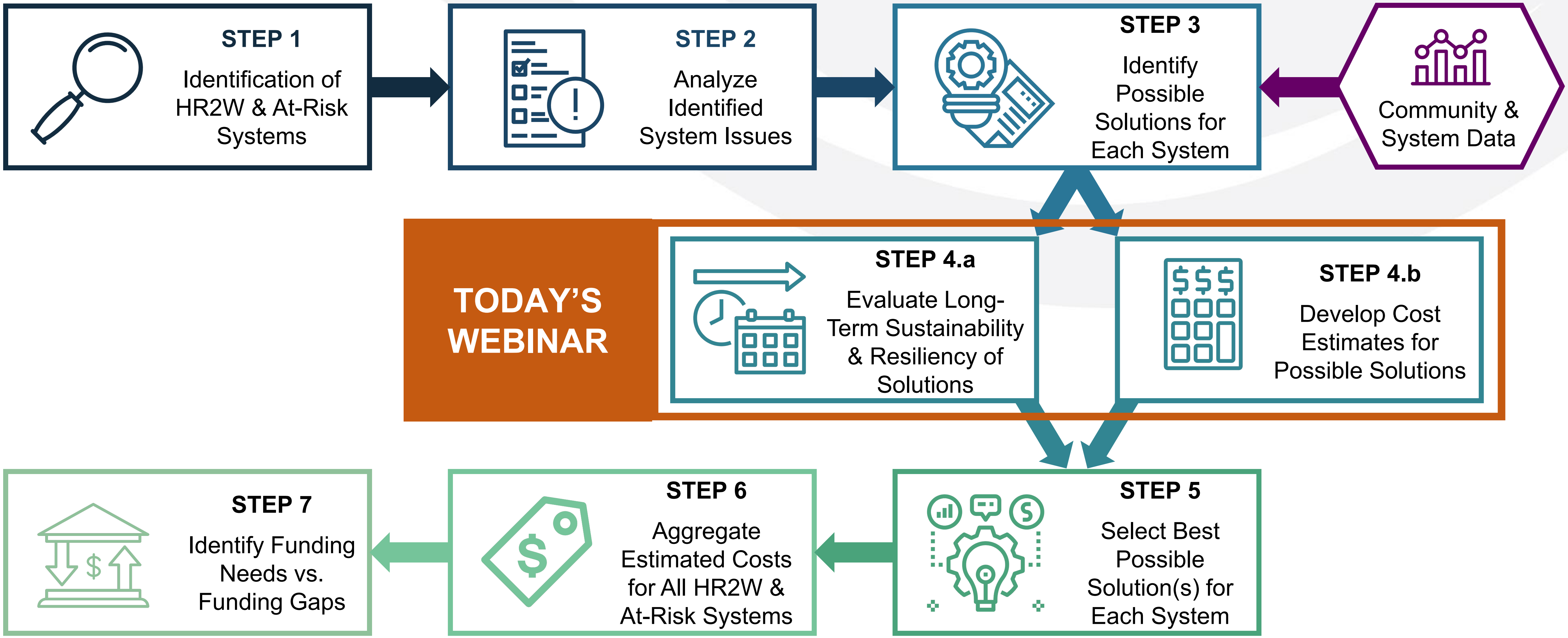
- The State Water Board is developing a model for estimating long-term cost solutions for water systems and domestic wells that are in violation (HR2W) or determined to be At-Risk.

White Paper:
https://www.waterboards.ca.gov/drinking_water/programs/safer_drinking_water/docs/draft_whitepaper_lt_solutions_cost_methd_pws_dom_wells.pdf

Cost Assessment Model Process (1/2)



Cost Assessment Model Process (2/2)



Cost Assessment Methodology for Long Term Solutions

Maureen Kerner and Khalil Lezzaik

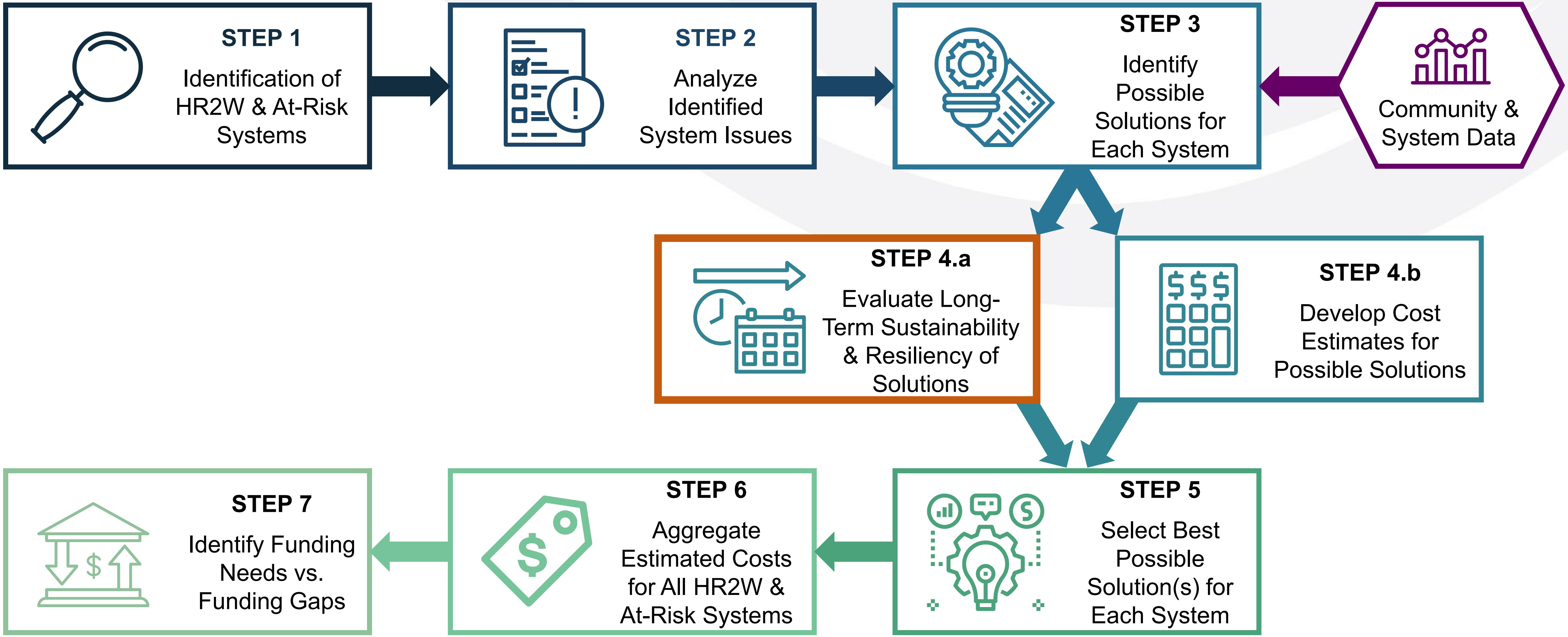
Office of Water Programs, Sacramento State

Tarrah Henrie and Craig Gorman

Corona Environmental Consulting

CALIFORNIA
Water Boards

Cost Assessment Model Process: Step 4.a



STEP 4.a: Evaluate Long-Term Sustainability & Resiliency

- IDENTIFICATION OF SYSTEMS
- ANALYZE IDENTIFIED ISSUES
- IDENTIFY POSSIBLE SOLUTIONS
- **EVALUATE LONG-TERM SUSTAINABILITY AND RESILIENCY** | DEVELOP COST ESTIMATE
- SELECT SOLUTION(S)
- AGGREGATE ESTIMATED COST
- IDENTIFY FUNDING GAPS

- Lowest-cost model solution may not be the best long-term solution for a system or community.
- The Model uses multi-criteria decision analysis to compare the sustainability and resiliency of potential modeled solutions.
- The Model examines the economic viability, technical performance, social acceptability, and environmental sustainability of potential modeled solutions.

S&R Assessment Methodology Development (1/2)

Metric Selection → **Thresholds Determination** → **Weight/Score Determination**

Metric Selection: Quantifiable measurements of key data used to assess the modeled solutions' sustainability and resiliency

Thresholds Determination: Values associated with a metric that designates when the modeled solutions are more sustainable & resilient

Weight/Score Determination: Application of weight to each S&R Metric, as some may be deemed more critical to sustainability and resiliency

S&R Assessment Methodology Development (2/2)

Metric Selection

Quantifiable measurements of key data used to assess the modeled solutions' sustainability and resiliency

Thresholds Determination

Values associated with a metric that designates when the modeled solutions are more sustainable & resilient

Weight/Score Determination

Application of weight to each S&R Metric, as some may be deemed more critical to sustainability and resiliency

Development of Potential S&R Metrics: Literature Review

58 potential Sustainability and Resiliency Metrics for small drinking water system solutions were identified from a literature review

Metric Categories	# Metrics Identified	Definition
Economic Viability	10	Affordability of a solution for residents and the capacity of the system's owner/operator to manage and maintain its operation in the long term
Technical Performance	25	Capacity of a solution to provide safe and affordable access to drinking water that can be sustained in the long term based on contaminants of concern for a community
Environmental Sustainability	16	Environmental impacts and considerations of a solution during operation, with benefits weighed against the negative impacts on the environment
Social Acceptance	7	Community's willingness to adopt a solution based on its perceived effectiveness and benefits.

Selection of Tentative Metrics: Internal Consultation

Selected a list of 11 S&R metrics that augment the Cost Assessment Model's scope at a state-wide level.

Economic Viability	Technical Performance	Environmental Sustainability	Social Acceptance
▪ Household Income Trends ▪ Number of Service Connections ▪ Trend in Number of Service Connections ▪ O&M Cost/Household	▪ Assets' Useful Life ▪ Relative Operational Difficulty ▪ Operator Training Requirement	▪ Regional Water Stress ▪ Greenhouse Gases Emissions ▪ Waste Stream Generation	▪ Local Job and Career Development

Economic Viability Metrics

Affordability of a solution for residents and the capacity of the system's owner/operator to manage and maintain its operation in the long term

Metric	Definition	Relationship to S&R Score
Household Income Trends	The combined gross income of all members of a household over a period of time	Directly Proportional
# Service Connections	Current water lines or pipes connected to a distribution supply main or pipe to convey water	Directly Proportional
# Service Connections Over Time	The number of customer connections/accounts a water system serves	Directly Proportional
O&M Cost /Household	Continuous operation and maintenance costs including labor, energy, chemicals, staffing, spare parts, and facility management per household	Inversely Proportional

Technical Performance Metrics

Capacity of a solution to provide safe and affordable access to drinking water based on contaminants of concern for a community that can be sustained in the long term

Metric	Definition	Relationship to S&R Score
Asset Useful Life	Period of time or amount of use that the solution will provide	Directly Proportional
Relative Operational Difficulty	An evaluation of the difficulty and complexity of treating water, using the identified possible modeled water solutions, to comply with water quality regulatory requirements	Inversely Proportional
Operator Training Requirement	The grade level certification a person must hold to operate a treatment/distribution system	Inversely Proportional

Environmental Sustainability Metrics

Environmental impacts and considerations of a solution during operation, with benefits are weighed against the negative impacts on the environment

Metric	Definition	Relationship to S&R Score
Regional Water Stress	The ability to meet human and ecological water demand based on factors such as physical water availability, baseline water stress, water quality, source vulnerability, and drought risk	Inversely Proportional
Greenhouse Gas (GHG) Emissions	The amount of GHG emissions by a modeled solution in its lifetime determined by evaluating the energy use and sourcing of each system.	Inversely Proportional
Waste Stream Generation	Residuals generated from the treatment process (e.g. sludge, brine concentrates, spent adsorption media)	Inversely Proportional

Social Acceptance Metrics

Community's willingness to adopt a solution based on its perceived effectiveness and benefits.

Metric	Definition	Relationship to S&R Score
Jobs and Career Development	Jobs or opportunities for career development offered by a solution	Directly Proportional

Audience Poll Question 3

Do the proposed Sustainability and Resiliency metrics for modeled solutions seem appropriate for inclusion in the Cost Assessment Model?

- Yes, these metrics seem appropriate
- Maybe, I think the list needs some adjustments
- None, I don’t think any of these metrics are appropriate
- I need more time to consider this question (send feedback to SAFER@waterboards.ca.gov)

Draft Evaluation of Sustainability & Resiliency Metrics for Modeled Solutions

Metrics	Step 1 Site-Specific Data Requirements?	Step 2 Applicability	Step 3 Data Availability	Step 3 Data Accuracy/ Quality	Step 4 Decision on Inclusion in Assessment
# Current Service Connections	Readily Available	Fair	Good	Good	Maybe
# Service Connections /Time	Readily Available	Fair	Good	Good	Maybe
Household Income Trends	Not Readily Available	Good	Poor to Fair	Poor to Fair	Future
O&M Cost /Household	Readily Available	Good	Good	Good	Yes
Operator Training Requirement	Readily Available	Good	Good	Good	Yes
Asset Useful Life	Readily Available	Good	Good	Good	Yes
Relative Operational Difficulty	Readily Available	Good	Good	Fair	Yes
Greenhouse Gases	Not Readily Available	Good	Fair	Fair	Future
Waste Stream Generation	Readily Available	Good	Good	Good	Yes
Regional Water Stress	Not Readily Available	Fair	Fair	Fair	Future
Job And Career Development	Not Readily Available	Poor	Poor	Poor	Future

Next Steps

Further refine and improve list of proposed metrics:

- Gather and incorporate expert and public feedback

Mapping metrics and modeled solutions using case studies:

- Develop a matrix to identify how the sustainability and resiliency metrics map to combinations of modeled solutions
- Demonstrate how sustainability and resiliency metrics functions for several case studies of past infrastructure projects in small California communities
- Evaluate scoring criteria to ensure proposed metrics capture sufficient details to differentiate modeled solutions

Audience Poll Question 4

When considering the challenges facing physical consolidation projects in general, which of the following do you view as the most difficult?

You can mark as many as are applicable.

- Accessing funding
- Potential change in rates for the consolidated water system
- Potential change in rates for the receiving water system
- Jurisdictional boundary changes
- Adequacy of water supply of the receiving water system
- Negotiating agreements between the joining and receiving system
- Other (please send an email to SAFER@waterboards.ca.gov with additional details)
- None of the above

Discussion Topic 1: Solutions for At-Risk Systems

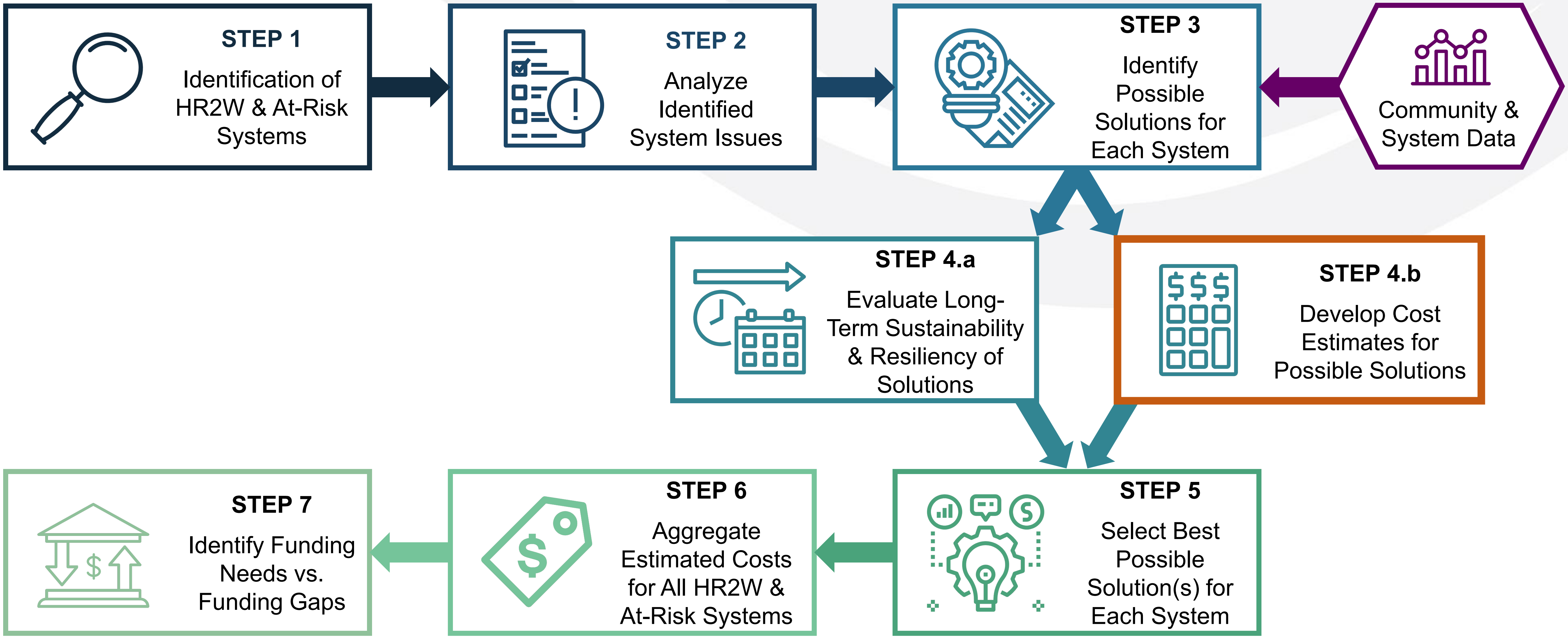
- For systems that are considered to be At-Risk due to Affordability or TMF (Technical, Managerial or Financial) Capacity, what solutions should be considered to address the issues?

To ask a question or share a comment:

- *From your Zoom screen:*
  → ✋ *Raise your hand on your Zoom screen to ask a question or comment.*
  → ***9 if you are joining by phone.***

- Technical or language interpretation assistance email: safer@waterboards.ca.gov

Cost Assessment Model Process: Step 4.b



STEP 4.b: Develop Cost Estimate

- IDENTIFICATION OF SYSTEMS
- ANALYZE IDENTIFIED ISSUES
- IDENTIFY POSSIBLE SOLUTIONS
- EVALUATE LONG-TERM SUSTAINABILITY AND RESILIENCY
- **DEVELOP COST ESTIMATE**
- SELECT SOLUTION(S)
- AGGREGATE ESTIMATED COST
- IDENTIFY FUNDING GAPS

High-level cost estimates are generated for all possible modeled solutions:

- Generalized costs with no site-specific information.
- Planning level costs.
- Considers capital costs as well as 20-year operational and maintenance costs as appropriate.

*NOT a decision-making tool for any specific system.

Topics

- General Cost Information
- Physical Consolidation
- New Well Costs
- Treatment
- POU/POE
- Other Infrastructure Needs Costs

Topic: General Cost Information

General Cost Information	Physical Consolidation	New Well Costs
Treatment	POU/POE	Other Infrastructure Needs Costs

Cost Estimation Level of Accuracy

- The methodology described above corresponds with a Class 5 cost estimate as defined by Association for the Advancement of Cost Engineering (AACE) International.
- Range of -50% to +100%.
- For example, if a cost of $100 is presented the corresponding range of anticipated costs is $50 to $200.

Cost Model Considerations

Physical Consolidation	Receiving Utility & Distance	Pipeline Costs	Connection Fees	Legal and Admin. Fees	Boosters and electricity use
Managerial Consolidation	Administrative Costs				
Blend	Other Sources	Contaminant Concentration			
New Well	Regional Water Quality	Current Well Depth			
Treatment	Contaminant(s)	Demand / Production Rates	Capital Costs 20-year O&M		
POU/POE	Regulation Criteria	Contaminant(s)	Number of Connections	Capital Costs 20-year O&M	
Additional Costs	Storage Tanks Land Acquisition	Supply needed	Electrical Improvements / Backup Generator	SCADA System	

Additional Costs will be applied

Regional Cost Adjustment

RSMeans City	Generalized Model Location	RSMeans CCI	Percent Adjustment
National Average	Central Valley	+3.0	0%
Oakland	Urban	+3.97	+32%
San Jose	Suburban	+3.89	+30%

Construction or Engineering Multiplier

A construction or engineering multiplier is a factor used to estimate additional costs such as engineering, permitting, and electrical work for a given project. For simpler projects, the multiplier can be as low as 0.25 and for treatment projects it can be over 3.0.

Cost of Infrastructure x Construction Cost Multiplier = Installed Capital Cost

Topic: Physical Consolidation

General Cost Information	Physical Consolidation	New Well Costs
Treatment	POU/POE	Other Infrastructure Needs Costs

Physical Consolidation Cost Estimate Include:

Item	Cost
Pipeline Cost	$155 per linear foot
Service Line Cost	$5,000
Connection Fees	$6,600 per connection
Legal and Administrative Costs for System Acquisition[3]	$200,000
Contingency	20% applied to total

A construction multiplier, which is still under development, will also be applied

Topic: New Well Costs

General Cost Information	Physical Consolidation	New Well Costs
Treatment	POU/POE	Other Infrastructure Needs Costs

New Well Costs

Well drilling				
Test hole drilling and zone sampling (5 zones)				
Depth (feet)	**500**	**1,000**	**1,500**	
Cost	$120,000	$140,000	$170,000	
Production Well Drilling				
Depth (feet)	**500**	**1,000**	**1,500**	
Cost	$500,000	$650,000	$770,000	
Well Development				
Estimated production (gpm)	200	440	780	
Cost	$60,000	$100,000	$140,000	
Well pump and motor				
Motor size (HP)	25	50	75	100
Rated flow (gpm)	85	170	255	340
Cost	$125,000	$135,000	$155,000	$165,000
Electrical upgrades (cost per site)				
SCADA (cost per site)	$100,000			
Electrical upgrades (cost per site)	$440,000			

A construction multiplier, which is still under development, will also be applied

Application of New Well Costs to HR2W and At-Risk Systems

- 48% need a second well
- 46% need a replacement well due to well age
- A new well, for the purpose of this methodology, is not assumed to alleviate the need for treatment
- New wells will be assumed to be 1,000 feet deep
- Land purchase will be needed at a cost of $150,000 for each well

Topic: Treatment

General Cost Information	Physical Consolidation	New Well Costs
Treatment	POU/POE	Other Infrastructure Needs Costs

Estimating Water Demand, Design and Average Flow Rates

- Average Daily Demand: 150 gallons/person/day
- Peaking factor of 1.5 will be applied to the ADD to calculate the maximum day demand (MDD)
- Maximum day demand must be produced during 16 hours of operation.
- Results in a 33% increase in capacity for treatment units and back-up wells

Treatment Technologies

Violation Type	Regulatory Limit	Chemical Class	Best Available Technology
Arsenic[1]	10 µg/L	Inorganic	Activated Alumina, **Coagulation/Filtration[2],** Lime Softening[2], Reverse Osmosis, Electrodialysis, Oxidation Filtration
1,2,3-TCP	5 ng/L	Organic	**Granular Active Carbon (GAC)**
Nitrate	10 mg/L as NO_3	Inorganic	**Ion Exchange**, Reverse Osmosis, Electrodialysis
Uranium (Combined)	20 pCi/L	Radionuclides	**Ion Exchange**, Reverse Osmosis, Lime Softening, Coagulation/Filtration
Fluoride	2 mg/L	Inorganic	**Activated Alumina**

[1]Adsorption technology, although not listed as a BAT, will be considered for arsenic treatment in small systems because of demonstrated experience and ease of operation.

[2]Not considered BAT for systems <500 service connections.

Construction or Engineering Multiplier

Technology	GAC	Anion/ Cation Exchange	Coagulation Filtration	Surface Water Package Plant	4-Log Virus Inactivation	Adsorption
Multiplier	2.36	2.4 to 3.0[1]	2.36	3.06	3.06	2.36

[1]Indirect/installation costs included in the EPA Work Breakdown Structure plus 20% contingency

Operator Labor Costs

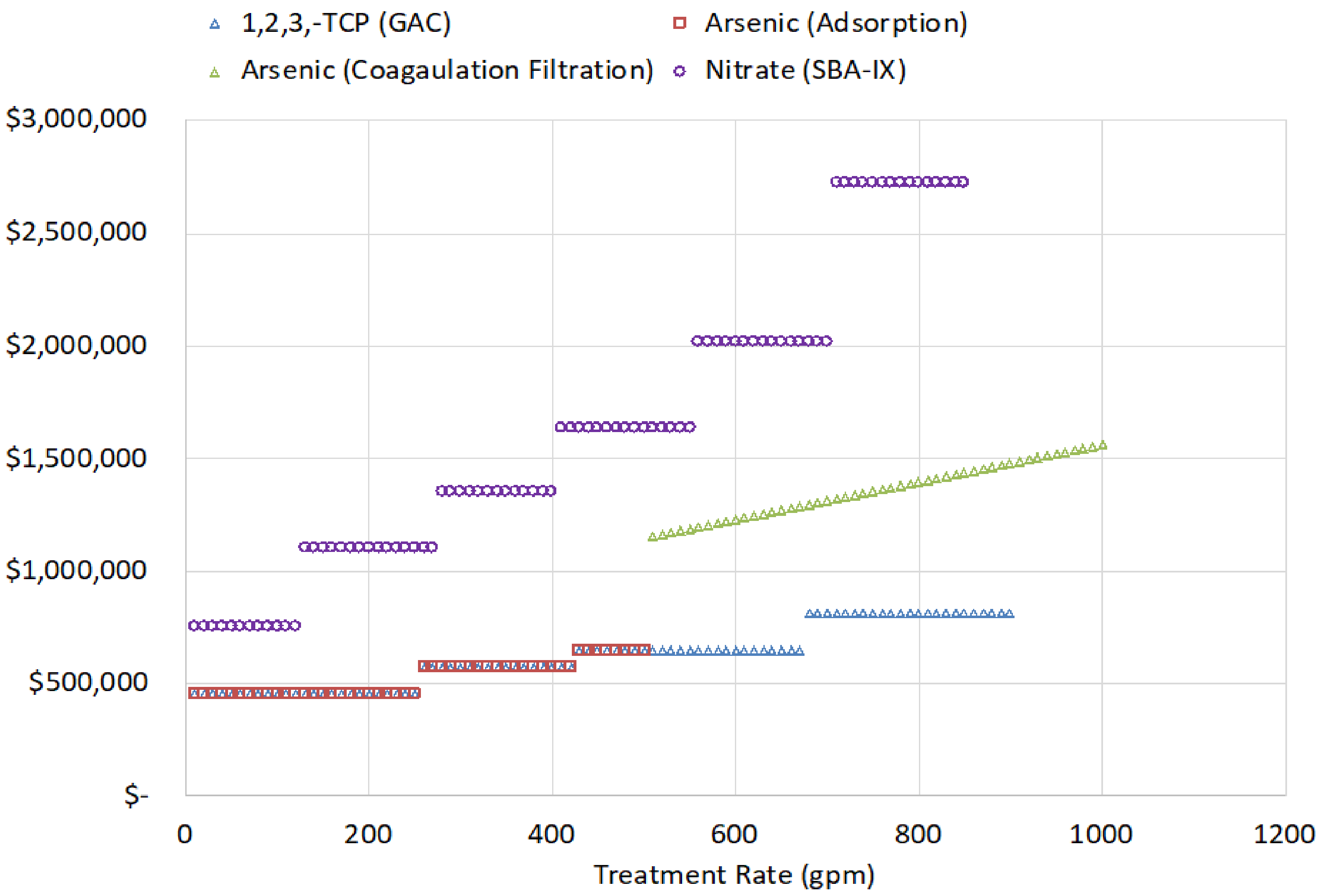
Certification Level & Treatment Type	Average of Total Pay and Benefits [1]	Percent of Full Time	Annual Cost
T1	$97,000	N/A	N/A
T2	$105,000		
T2: High time intensity treatment (nitrate)		25%	$27,000
T2: Medium time intensity (U, As using CF)		20%	$22,000
T2: Low time intensity (GAC, Fe/Mn removal)		10%	$11,000
T3: Multiple contaminants with different treatment technologies; Surface Water/Groundwater Under the Direct Influence of Surface Water	$132,000	25%	$41,000
T4: Surface water with high levels of source contamination	$164,000	25%	$34,000
T5	$181,000	N/A	N/A

[1] https://transparentcalifornia.com/salaries/search/?page=20&y=2018&q=treatment+operator&s=-base
Base salaries and benefits from Transparent California were analyzed by Gregory Peirce at UCLA using 2018 data. Outliers were removed. Labor cost was adjusted to 2020 dollars.

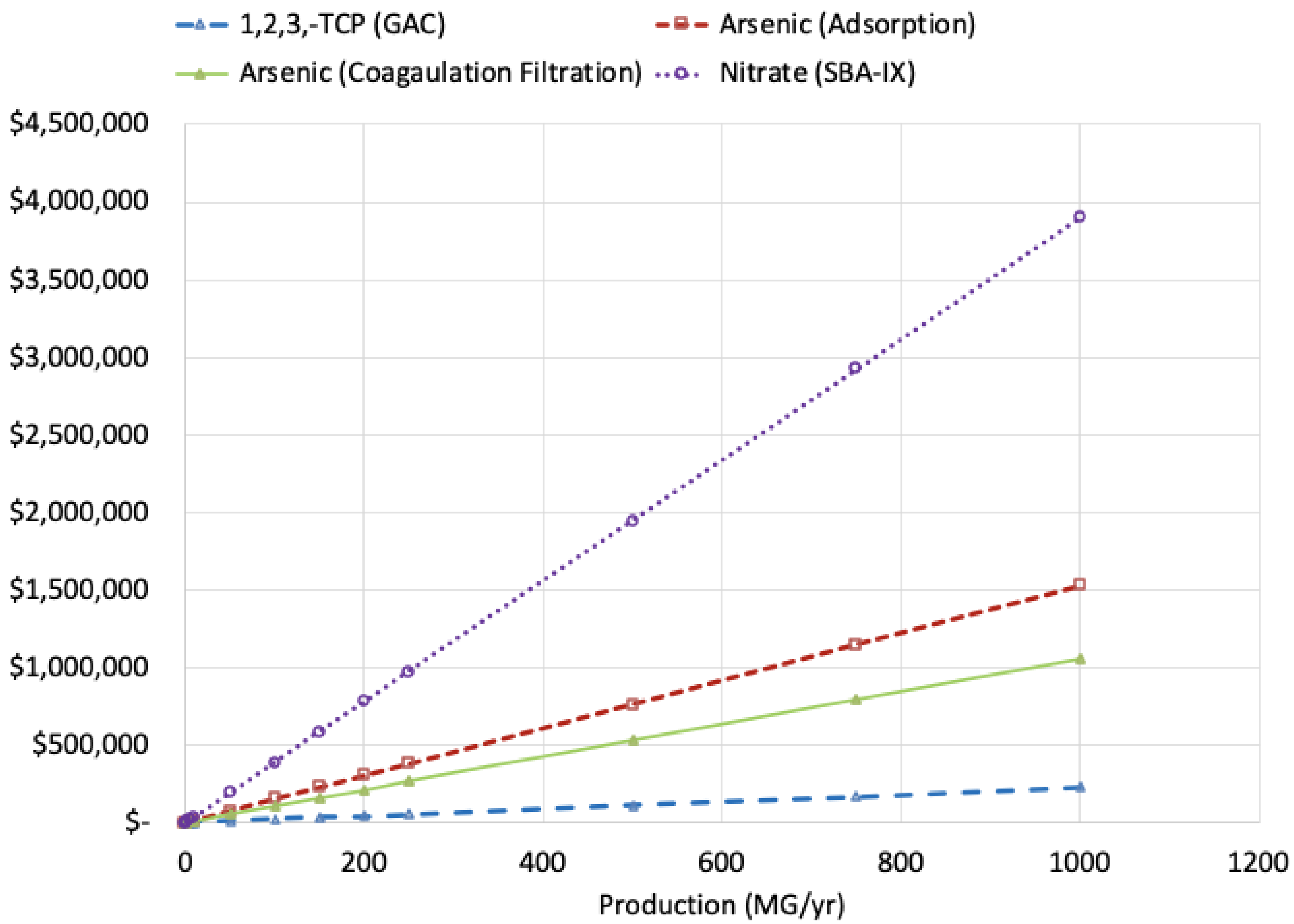
Most Common Contaminants and Treatments

- 1,2,3 TCP – GAC
- Nitrate – Strong Base Ion-exchange
- Arsenic
  - Adsorption
  - Coagulation

Installed Capital Cost Comparison



Annual Consumables Cost Comparison



Other Contaminants and Treatment

- Activated Alumina
  - Fluoride
- Iron and Manganese
  - Filtration
  - Same capital cost as arsenic
- Regenerable Cation Exchange
  - Radium
  - Same capital cost as nitrate
- Single-Use Ion Exchange
  - Perchlorate
  - Uranium
  - Gross Alpha due to Uranium
- Surface Water Treatment
- Virus Inactivation

Topic: POU/POE

General Cost Information	Physical Consolidation	New Well Costs
Treatment	POU/POE	Other Infrastructure Needs Costs

Point of Use and Point of Entry Treatment

- Only allowed for systems with 200 connections or less
- May only be realistic for much smaller (~30 connections)
- Considered for Domestic Wells
- POE GAC will be assumed for 1,2,3-TCP and other contaminants that have exposure routes other than ingestion
- POU Reverse Osmosis (RO) systems will be considered for inorganic contaminants such as nitrate and arsenic
  - Nitrate over 25 mg/L as N is not treated effectively with POU RO

NSF/ANSI 58 – 2018, *Reverse Osmosis Drinking Water Treatment Systems*. Lists an influent nitrate concentration of 30 mg/L-N to achieve a treated water of 10 mg/L-N in the treated water. A safety factor has been applied to keep the treated water below 10 mg/L-N.

POU/POE Capital Cost

Capital Cost per Connection for POE GAC Treatment				Capital Cost per Connection for POU Reverse Osmosis Treatment			
POE Cost per Unit	Installation Labor Cost per Unit ($100 / hr)	Admin/ Project Man.	Outreach Cost	POU Cost per Unit	Installation Labor Cost per Unit ($100 / hr)	Admin/ Project Man.	Outreach Cost
$3,700	$1,000	$1,000	$300	$1,500	$200	$1,000	$300
Note: For Domestic Wells and State Small Water Systems an additional initial analytical budget of $500 is included because these wells rarely have water quality data.							

- POE/POU unit costs also include flow meters and prefilters
- Administration project costs include: time for coordinating the purchase and installation of the units
- Outreach costs include: written material for distribution to residents and time for local meetings

[1] Based on costs of available POE treatment units in California, with freight.
[2] Porse, Erik, 2019. Sacramento State Office of Water Programs. Unpublished. Also used in the interim solutions cost part of the Needs Assessment project completed by Gregory Pierce at UCLA. Corona added operator labor costs and analytical costs on an annual basis.

POU/POE Annual Operations and Maintenance Costs

POE GAC Annual O&M per Connection

Prefilter and GAC replacement (2x/year)[1]	Operator and Outreach Labor ($100/hr)	Analytical ($125 2x/year) [2]	Total
$410	$300	$250	**$960**

POU RO Annual O&M per Connection

Prefilter and Membrane Replacement (2x/year)[1]	Operator and Outreach Labor ($100/hr)	Analytical (2x/yr)[2]	Total
$100	$300	$40 - $110	**$440 - $510**

[1] Based on vendor recommendations and pricing.
[2] Pricing quotes provided by BSK Analytical, in Fresno, California.

Topic: Other Infrastructure Needs Costs

General Cost Information	Physical Consolidation	New Well Costs
Treatment	POU/POE	Other Infrastructure Needs Costs

Infrastructure Costs

- Pipelines
- Tanks
- Booster Pumps
- Well Pumps
- Electrical

A construction multiplier, which is still under development, will also be applied

- Meters
- Backflow Prevention

Other Infrastructure Needs Cost - Pipelines

Pipelines C-900 PVC				
Pipeline diameter	4"	6"	8"	12"
Cost per foot	$75	$90	$100	$140
Rated flow (gpm)	195	440	780	1750

Assumptions:

- 3 feet burial, C900 pipe
- Open trenching (add $15/LF for asphalt replacement)
- Maximum velocity of 5 feet per second

Other Infrastructure Needs Cost - Tanks

Hydropneumatic tanks			
Volume (gallons)	2,000	4,000	10,000
Cost	$35,000	$41,750	$62,100

- Assumptions:
  - Gross Volume (water storage volume roughly 50% of gross)
  - Includes top mounted air compressor

Ground level tanks					
Volume (gallons)	50,000	100,000	250,000	500,000	1,000,000
Cost	$150,000	$250,000	$500,000	$875,000	$1,200,000

- Assumptions:
  - Bolted steel
  - Ring wall base
  - No corrosion protection

Other Infrastructure Needs Cost – Booster Pumps

Booster pump systems (one operational and one standby)							
Capacity (gpm)	100	200	300	400	500	750	1,000
Motor size (HP)	5	10	15	20	25	35	60
Cost	$40,000	$70,000	$82,000	$100,000	$115,000	$130,000	$150,000

- Assumptions:
  - VFD Package system - skid mounted with PLC and controls
  - Piping and valving between pumps included
  - Electrical costs not included
  - Discharge pressure of 55 psi assumed

Other Infrastructure Needs Cost – Well Pumps

Well pump and motor replacement				
Motor size (HP)	25	50	75	100
Rated flow (gpm)	85	170	255	340
Cost	$125,000	$135,000	$155,000	$165,000

- Assumptions:
  - 1,000-foot depth
  - Vertical turbine pumps
  - Discharge pressure of 55 psi
  - 20 feet draw down
  - 800-foot static water level
  - Surface mounted motor
  - New power and control connection

Other Infrastructure Needs Cost – Electrical and Generators

Electrical upgrades (cost per site)	
SCADA (cost per site)	$100,000
Electrical upgrades (cost per site)	$440,000

- Assumptions:
  - Main switchboard and motor control center
  - Electrical Conduit and wire - all equipment on a single 200' x 200' site
  - Site lighting
  - Transformer slab

Generators					
Size (KW)	5	30	50	75	100
Rated flow (gpm)	18	110	180	270	365
Cost	$50,000	$64,000	$80,000	$110,000	$160,000

- Assumptions:
  - Sized with 25% reserve
  - Based on powering well pump based on the assumptions above
  - Power to booster pumps and ancillary equipment
  - Diesel generators
  - Automatic transfer switch

Other Infrastructure Needs Cost – Meters

Residential Water Meters	
Equipment and Software (Drive by)	$29,000
1" meters (drive by)	$825

Assumptions:

- Installation on an existing service
- Assuming 1” meter for residential services

Other Infrastructure Needs Cost - Backflow Prevention

Connection Size:	3/4"	1"	1 1/4"	1 1/2"	2"
Total:	$ 5,840	$ 6,090	$ 7,000	$ 7,080	$ 7,710

Costs courtesy of Ben Bennet, owner of Backflow Prevention Specialists, Inc., in Sunnyvale, CA

Costs included: labor, material, testing, and taxes.

Costs excluded: fees charged by water systems for shutting off water, permit fees, as built drawings, or any blueprints, water system hydraulic calculations.

Other Infrastructure Needs Cost Application Assumptions

- 48% need a second well
- 46% need a replacement well due to well age
- 29% need pump and motor replacement due to age
- 29% need electrical upgrades due to age
- 56% need additional storage
- 58% need back up power
- 66% need distribution system replacement due to main age
  - Assuming 80 feet of 4” PVC main for each connection
- 82% need meters
- Backflow prevention assemblies would be paid for at schools, but not businesses

Assumptions for At-Risk Water Systems

- Evaluated for physical consolidation
- Where physical consolidation is cost effective, particularly if part of a potential regional project, that cost will be used in the model
- Use “Other Infrastructure Needs” assumptions
- System Administrator costs of $12,000 per year for 5 years will be assumed to assist systems in developing:
  - Financial and managerial structures to ensure a sustainable water system
  - Including asset management plans, water rate studies, fiscal policies, drought plans
  - Updating rate structures and fiscal policies to ensure repair and replacement of any installed infrastructure upgrades funded by the State
  - **Therefore long-term O&M was not included in the cost estimate**

Audience Poll Question 5

What interim operation and maintenance support costs should be considered for HR2W systems as part of the long-term cost model?

You can mark as many as are applicable.

- Treatment Media Replacement
- Parts Replacement and/or Maintenance
- Operator salary/benefits
- General Manager salary/benefits
- Lab testing / sampling
- Electricity Costs
- Other (please send an email to SAFER@waterboards.ca.gov with additional details)
- None

Audience Poll Question 6

What interim operation and maintenance support costs should be considered for At-Risk systems as part of the long-term cost model?

You can mark as many as are applicable.

- Treatment Media Replacement
- Parts Replacement and/or Maintenance
- Operator salary/benefits
- General Manager salary/benefits
- Lab testing / sampling
- Cover Electricity Costs
- Other (please send an email to SAFER@waterboards.ca.gov with additional details)
- None

Audience Poll Question 7

How do you feel about the level of technical detail in this report and the corresponding White Paper?

Select one.

- More technical detail is needed.
- The level of detail is good.
- The material is too technical.
- Other (please send an email to SAFER@waterboards.ca.gov with additional details).

Discussion Topic 2: Cost Assessment

- Does this process capture all of the necessary steps required for conducting a statewide cost assessment for providing solutions to Human Right to Water systems and At-Risk Systems?

- What, if any, additional analysis or consideration should be made when conducting this cost assessment?

To ask a question or share a comment:

- *From your Zoom screen:*
  → *Raise your hand on your Zoom screen to ask a question or comment.*
  → ****9 if you are joining by phone.***

- Technical or language interpretation assistance email: safer@waterboards.ca.gov

Cost Assessment Timeline

Fall 2019
Project Starts

Spring 2020
- Identify HR2W systems & domestic wells
- Identify & Analyze issues
- Identify possible solutions
- Begin cost modeling

Summer 2020
- 08.28 Webinar on Long-Term Cost Model methodology

Fall 2020
- Continue cost model refinement
- 11.20 Webinar on detailed model methodology

Winter 2020
- Complete Cost Model development
- Utilize results of Risk Assessment to conduct Cost Assessment
- Conduct funding gap analysis
- 02.26 Webinar Update

Spring 2020
- Contract concludes
- Cost Assessment and Gap Analysis included in Fund Expenditure Plan

Immediate Next Steps

- Incorporate public feedback to refine **Long Term Solutions Cost Methodology for Public Water Systems and Domestic Wells: Version 2**
  - White Paper: https://www.waterboards.ca.gov/drinking_water/programs/safer_drinking_water/docs/draft_whitepaper_lt_solutions_cost_methd_pws_dom_wells.pdf
  - Submit feedback to: SAFER@waterboards.ca.gov
  - Email Title: Public Water System Cost Assessment
  - Please submit feedback on White Paper by **12.20.2020**
- Determine final cost methodology by **01.2021**

Audience Poll Question 8

Which of the following should be included in a budget for a small At-Risk system?

You can mark as many as are applicable.

- Technical assistance and/or administrative oversight assistance
- Storage tank(s)
- Meters
- Main replacement
- Generator set
- Interim O&M Support
- Other (please send an email to SAFER@waterboards.ca.gov with additional details)

Discussion Topic 3: Open Q&A

- Comments or Questions?

To ask a question or share a comment:

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Discussion Topic 4: Public Engagement

- How can we improve public engagement on the development of Cost Model?

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- Technical or language interpretation assistance email: safer@waterboards.ca.gov

Data Sources for Treatment Capital Cost

Technology	Contaminants	Data Source
Granular Activated Carbon (GAC)	Volatile organics and Total Organic Carbon (TTHM, HAA)	Vendor Supplied Quotes
Anion/Cation Exchange	Nitrate, uranium gross alpha due to uranium, radium, and perchlorate	EPA Work Breakdown Structure; calibrated to recent bid costs
Coagulation Filtration	Arsenic, and iron and manganese	Peer reviewed literature
Surface Water Package Plant	Surface Water Rule Treatment violations	Vendor Supplied Quotes
4-Log Virus Inactivation	Surface water and groundwater under the influence of surface water	Vendor Supplied Quotes

GAC Treatment Cost Capital

Vessel Diameter (ft)*	Mass of GAC (lb/vessel)	Flow Range (gpm)	Equipment Cost ($)
6	6,000	0 – 250	$421,000
8	10,000	251 – 425	$517,000
12	20,000	426 – 875	$720,000
Two Pair - 12	20,000	876 – 1,750	$1,440,000

*Assuming vessel pairs

GAC Operations & Maintenance Cost

- **Consumables**
  - Chemicals such as ferric chloride, sulfuric acid, caustic soda, etc.
  - Media replacement
    - Granular activated carbon (GAC), ion exchange resin, green sand, activated alumina, other adsorbents, etc.
  - Pre-filter replacement
- **Disposal of water treatment residuals**
  - Ion exchange brine, coagulation filtration dewatered solids, spent media
- **Electricity**
- **Labor**
- **Media replacement assumptions**
  - 38,200 bed volumes
  - Virgin carbon ($1.89/lb-GAC),
  - Transportation ($0.27/lb-GAC)
  - Disposal ($0.004/lb-GAC)
  - Normalized to a standard production cost equivalent to $0.22/1,000 gallons

GAC Throughput Assumptions

Contaminant	Raw Water Concentration	Treatment Objective	Estimated Throughput (BV)
1,1-DCE	7 µg/L	3.5 µg/L	10,000
DBCP	0.2 µg/L	0.1 µg/L	65,000
EDB	0.06 µg/L	0.03 µg/L	60,000
PCE	Still under development		
TCE	Still under development		
1,2,3-TCP	0.1 µg/L	0.005 µg/L	38,000
TOC	3 mg/L	2 mg/L	5,000

[1] AdDesignS using isotherms from Speth, T. F, & Miltner, R.(1990) Technical Note: Adsorption Capacity of GAC for Synthetic Organics. JournalAWWA, Vol. 82, Issue 2, 72-75 https://doi.org/10.1002/j.1551-8833.1990.tb06922.x

[2] Zachman, B.A., & Summers, R. (2010). Modeling TOC Breakthrough in Granular Activated Carbon Adsorbers. *Journal of Environmental Engineering, 136*, 204-210.

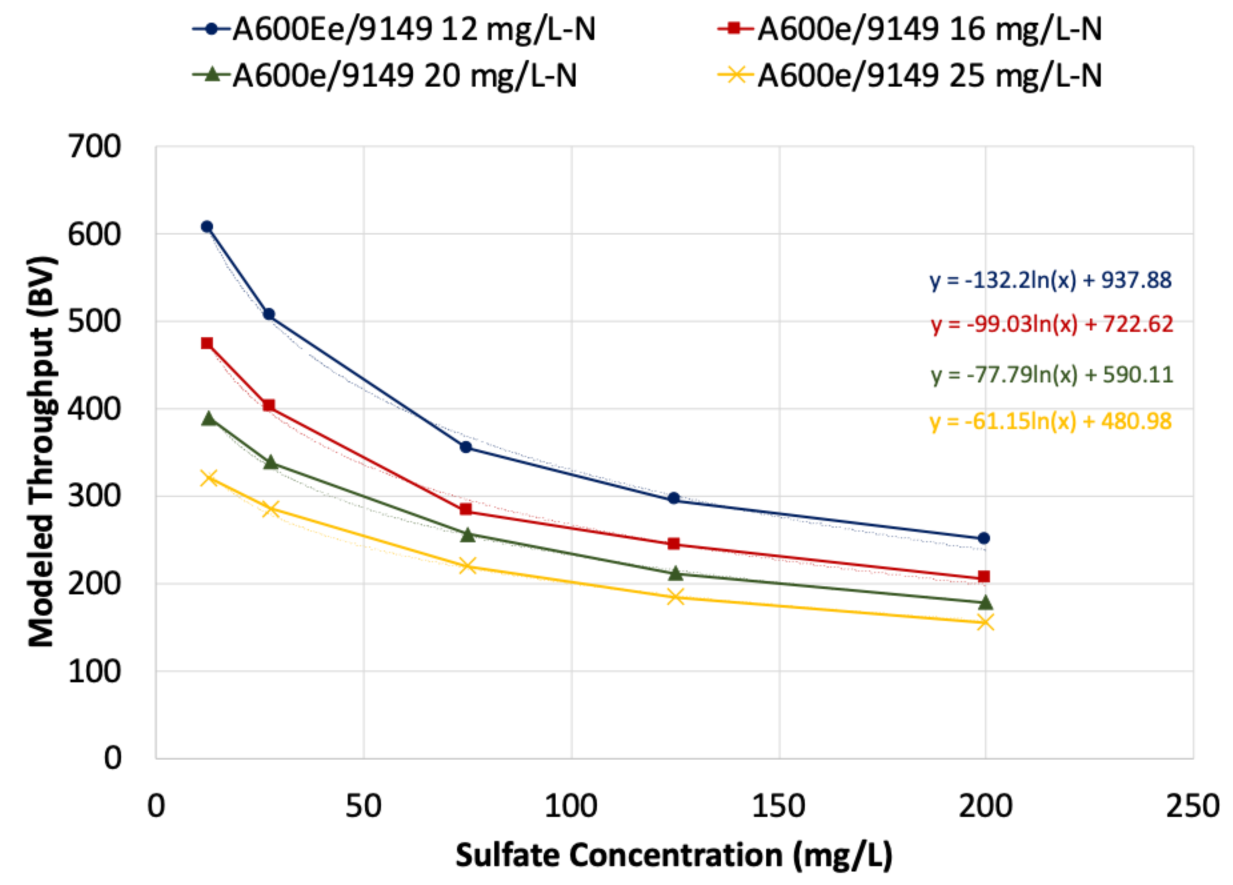
Nitrate Capital Costs

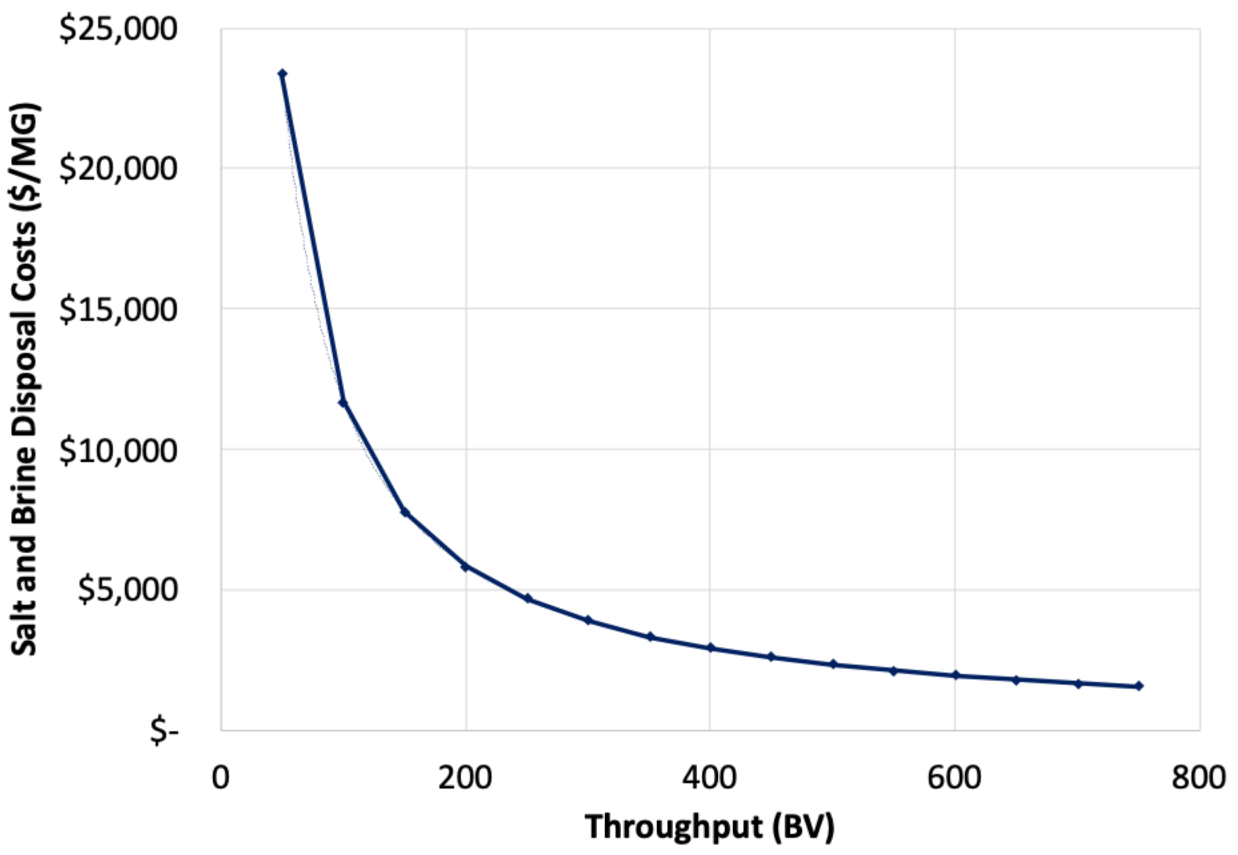
Flow Rate (gpm)	Installed Capital Cost
1-125	$756,000
126-275	$1,106,000
276-400	$1,355,000
401-550	$1,637,000
551-700	$2,022,000
701-850	$2,722,000

Arsenic Adsorption Installed Capital Costs

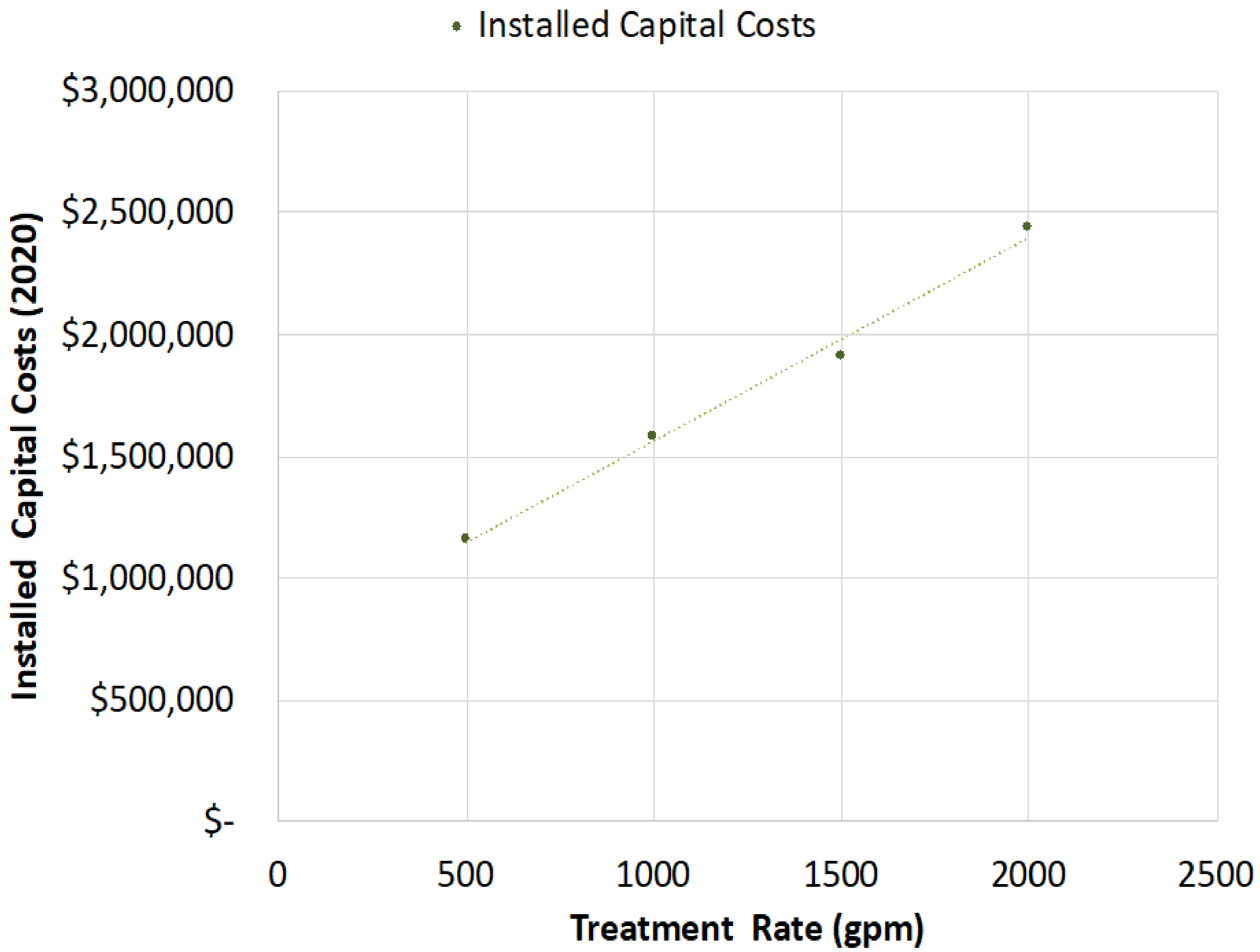
Treatment Flow Range (gpm)	Installed Capital Cost
1-250	$455,000
251-425	$570,000
426 – 875	$817,000

Nitrate Operational Costs





Installed Arsenic Coagulation Filtration Capital Costs



Arsenic O&M

- Coagulation Filtration: $1.05/kgal
- Adsorption: $1.51/kgal

Fluoride Treatment Capital Costs

Treatment Flow Range (gpm)	Installed Capital Cost
1-250	$657,000
251-425	$772,000
426 – 875	$1,019,000

Fluoride Treatment O&M

- Costs for pH adjustment were modeled assuming an initial pH of 7.9 and alkalinity fo 160 mg/L as $CaCO_3$
- pH was assumed to be adjusted to 5.5 with sulfuric acid and back to 7.9 using caustic soda following treatment
- Results in a chemical cost of approximately $60/MG produced
- Periodic media regeneration or replacement costs are not currently considered

Uranium, Gross Alpha due to Uranium, Perchlorate Capital Costs

Flow Rate (gpm)	Installed Capital Cost
1-101	$364,000
126-275	$545,000
276-400	$720,000
401-550	$1,400,000

Uranium, Gross Alpha due to Uranium, Perchlorate O&M

- Spent resin replacement and disposal represent the bulk of operational costs for uranium, perchlorate, and radium removal with this technology
- Unit cost of $0.65/kgal of water produced for uranium
- Assumes a throughput of 130,000 BV prior to replacement and reflects the cost for resin replacement, disposal, and associated services
- Perchlorate operational costs are still under development

Surface water treatment

Flow Rate (gpm)	Installed Capital Cost
1-175	$696,000
176-300	$972,000
301-700	$1,444,000
701-1,400	$1,929,000
1,401-2,100	$2,978,000

Installed capital cost estimates for package treatment systems

4-log Virus Inactivation Capital Costs

Flow Rate (gpm)	Installed Capital Cost
1-175	$22,000
176-300	$37,000
301-700	$193,000
701-1,400	$411,000
1,401-2,100	$620,000

Interim Solutions

- Bottled water may be considered as a solution for Domestic Wells
- Bottled water and vended water may be considered as an interim solution for some systems

Costs for the interim solutions will come from: Pierce, G. and Roquemore, P., 2020. *Needs Assessment Element 3 Phase 2: Feasibility and Cost of Emergency and Interim Solutions (Version 2.0).* Report produced by the UCLA Luskin Center for Innovation.