Conceptual Drinking Water Supply Plan: Preliminary Results Summary

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3M PFC Settlement Work Group Meetings

February 18-19, 2020

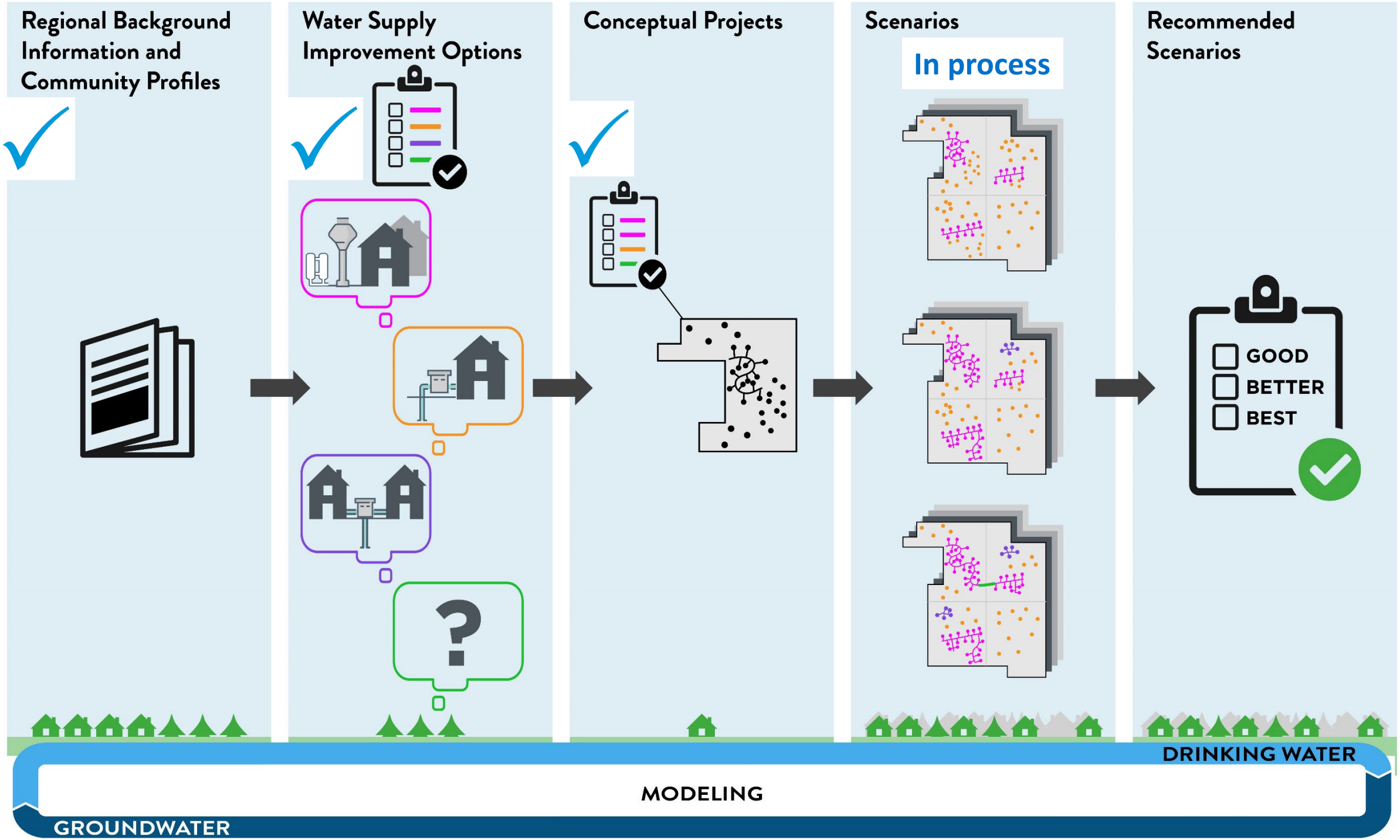
Agenda

- Overview
- Scenario Evaluation and Results Summary
  - Regional
  - Treatment
  - Community-Specific
  - Integrated

Rules of engagement

- ❑ Parking Lot
- ❑ Sticky notes

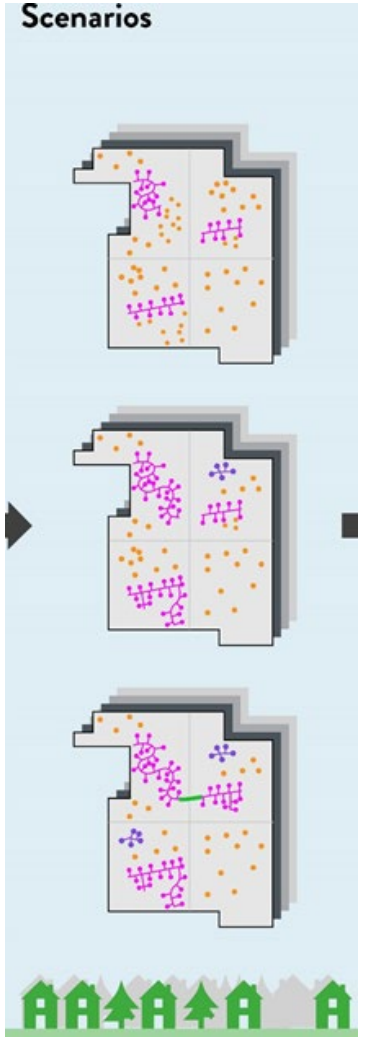
Overview


Regional Background Information and Community Profiles
Water Supply Improvement Options
Conceptual Projects
Scenarios
In process
Recommended Scenarios
GOOD
BETTER
BEST
?
DRINKING WATER
MODELING
GROUNDWATER

Scenarios

For each scenario

1. Determine projects to be included
2. Evaluate feasibility of the project
3. Evaluate feasibility of the scenario (group of projects)
    i. Drinking water distribution
    ii. Groundwater quality, quantity
4. Develop costs



What we know – drinking water conditions

- Groundwater is the primary source of drinking water
  - 8 communities with their own public water system and 1 community connected to St. Paul Regional Water Services
  - Over 6,000 private wells across all 14 communities
  - Population and water demand is expected to grow
    - Population by more than 28% and demand by over 18% from 2020 to 2040
- There are other water quantity and quality considerations

Health index review

What is an HI?

- Health Risk Index (HI) developed by MDH
- Evaluates risk across all PFAS that have published health criteria
- HI > 1 considered an exceedance

	PFOA	PFOS	PFBA	PFBS	PFHxS*
2002	7	1			
2006	1	0.6	1		
2007	0.5	0.3	7		
2009	0.3	0.3	7	7	
2013	0.3	0.3	7	7	0.3
2016	0.07	0.07	7	7	0.07
2017	0.035	0.015	7	3 or 2	0.047

Black = HRL; Red = HBV; Green = Surrogate

Published new values in 2019

$$HI = \frac{PFOA_{[conc]}}{0.035} + \frac{PFOS_{[conc]}}{0.015} + \frac{PFBA_{[conc]}}{7} + \frac{PFBS_{[conc]}}{3} + \frac{PFHxS_{[conc]}}{0.047}$$

About the models

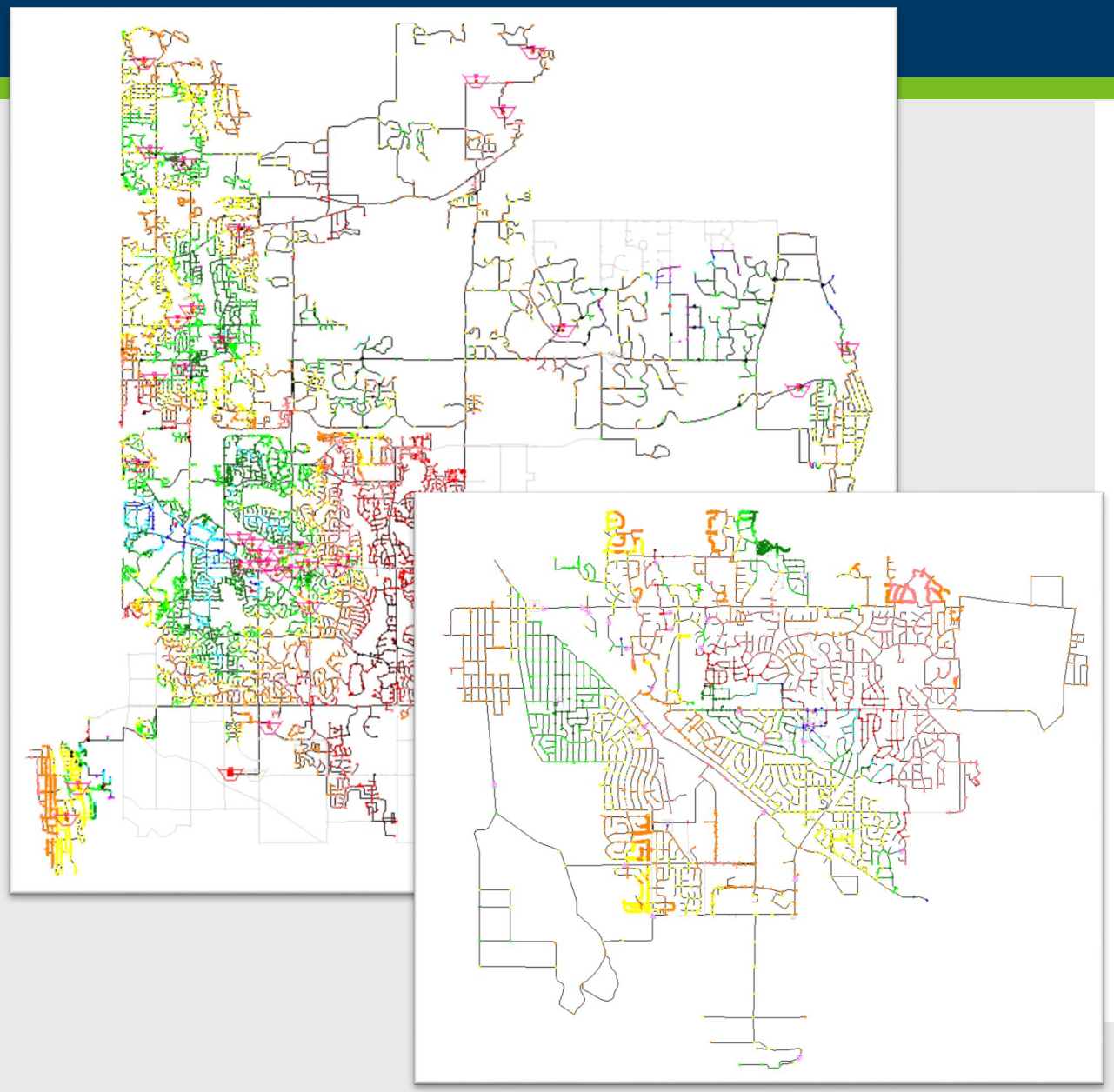
Drinking water model

Constructing the model

1. Abt initially gathered community profile information, including water supply plans
2. Wood followed up by engaging LGUs via SG-1 and SharePoint to gather/exchange model files
   - RFIs to set up phone calls, and followed up with emails, phone calls, and data exchange via SharePoint
3. Wood met 1:1 with LGUs in June, July, August, and October to discuss CPs and scenarios, but also reviewed models with communities that have supply systems
4. Additional Skype meetings were scheduled as needed for outstanding information requests or model review

Processed:
- ✓ 806 miles of pipe
- ✓ 50 municipal wells
- ✓ 25 tanks
- ✓ 6 booster pump stations

Drinking water model

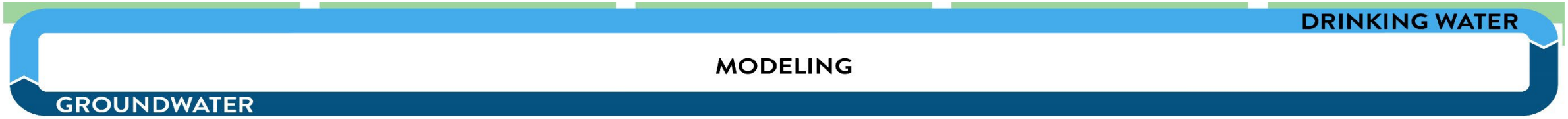


- ❑ Community-Specific Models
  - ✓ All communities with municipal water supply systems
- ❑ Integrated Models
  - ✓ PIIC/West Lakeland/Lakeland
  - ✓ Oakdale/Lake Elmo & Woodbury
  - ✓ Grey Cloud Island/St. Paul Park & Cottage Grove
- ❑ Subregional Models
  - ✓ Northern Region – Woodbury, Oakdale, Lake Elmo, West Lakeland, PIIC, North Afton, Lakeland
  - ✓ Southern Region – Cottage Grove, St. Paul Park, Grey Cloud Island
- ❑ Regional Model for Surface Water Scenario

Groundwater model

Assumptions

- Many collaborators to support input (MGS, MDH, MPCA, DNR, MetCouncil)
- Geology and model layers obtained from MGS
- Based on geologic and flow characteristics across East Metro Area
- Model calibrated to average groundwater elevations over a 3-year period (2016-2018)
- Scenario evaluations are simulated under static, constant (steady-state) conditions
- Areas of non-municipal wells with HI>0.5 used as areas of impact



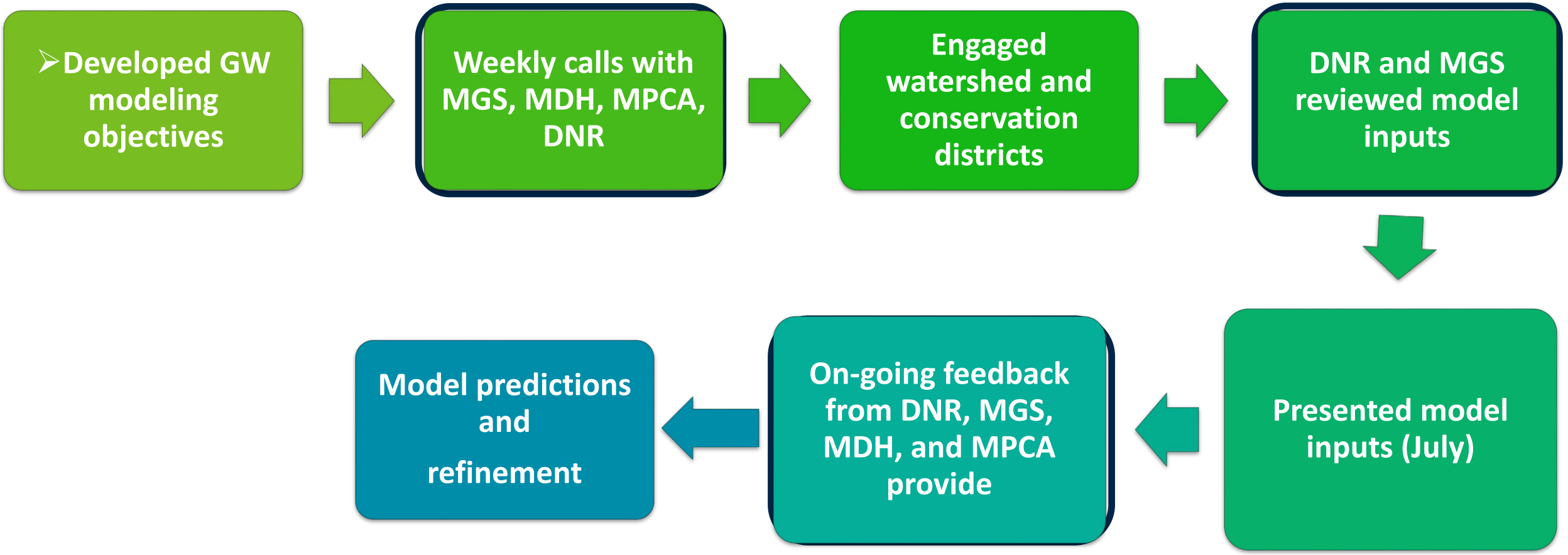
Groundwater model

The Model does	The Model does not
Show depths to groundwater	Show changes in groundwater with changing conditions over time
Show how water flows to wells	
Show the pull of groundwater into wells	
Show where chemicals could travel (e.g. PFAS)	Show concentrations of chemicals (e.g. PFAS)
Show what current or future wells might be impacted.	Show unknown sources of PFAS or look at each PFAS compound

Groundwater model data sources

Data	Source
Precipitation data	DNR (2019a)
Historic and current pumping volumes	DNR (2019b)
Lake bathymetry data	DNR (2019c)
Groundwater elevations	DNR (2019d), MDH (2019)
Surface water elevations	DNR (2019e)
DNR Northeast Metro Lakes Groundwater-Flow model files	DNR (2019f)
3-meter digital elevation model (DEM)	DNR (2019g)
Recharge and run-off estimates from 1990s through 2018	DNR (2019h)
Land use map	Minnesota IT Services (2019)
Surface water boundaries	U.S. Geological Survey (2019a)
U.S. Geological Survey (USGS) Northeast Metro Lakes Groundwater-Flow model files	U.S. Geological Survey (2019b)
Geologic maps	Minnesota Geological Survey (multiple sources)
Hydraulic conductivity	Runkel et al. (2003), Tipping et al. (2010), MNDNR (2019j)
Well construction details	MDH (2019)
Baseflow measurements	Jones et al. (2017)
Metro Model 3	Metropolitan Council (2019)
Groundwater sample data	MPCA (2019a)
PFAS source areas	MPCA (2019b)

Groundwater model



Scenario preliminary results summary

Preliminary results

- Results are preliminary options; **not** recommendations
- Focus is to share results with the public and receive feedback on options and key considerations
- Results will be evaluated using Priority 1 criteria developed with input from work group members that address areas, such as:
  - Address future unknown/uncertain conditions
  - Long-term benefits
  - Acceptable to the public
  - Minimal environmental impacts
  - Consistency with local planning

Basis of costs

- Inputs
  - Basis and consideration for unit costs
- Outputs
  - Screening (high) level cost estimate
  - Capital costs, O&M Costs, cost per 1,000 gallons
  - Contingencies
  - Accounted for Inflation at 3% (NPV)

		Communities Served
		Components
		Water Provided
		Capital Cost (1000s)
		Annual O&M Cost (1000s)
Total 20 Year Costs	Undiscounted	Total 20 Year Cost (1000s)
		Operating Only Cost per 1,000 Gal
		Capital and Operating Cost per 1,000 Gal
	3% Inflation	Total 20 Year Costs (1000s) 3% Inflation

Basis of costs

		Communities Served	- which communities receive water (via infrastructure)
		Components	- new wells, treatment plants, new infrastructure
		Water Provided	- water capacity that scenario is designed for
		Capital Cost (1000s)	- costs of new components and construction
		Annual O&M Cost (1000s)	- cost to maintain and operate the new components
Total 20 Year Costs	Undiscounted	Total 20 Year Cost (1000s)	- total (undiscounted) capital and O&M costs for 20 years
		Operating Only Cost per 1,000 Gal	- (undiscounted) O&M cost for 20 year per 1,000 gallons
		Capital and Operating Cost per 1,000 Gal	- total (undiscounted) capital and O&M cost for 20 year per 1,000 gallons
	3% Inflation	Total 20 Year Costs (1000s) 3% Inflation	- Net Present Value with 3% inflation applied to total capital and O&M costs for 20 years

CHECK-IN

Scenario overview

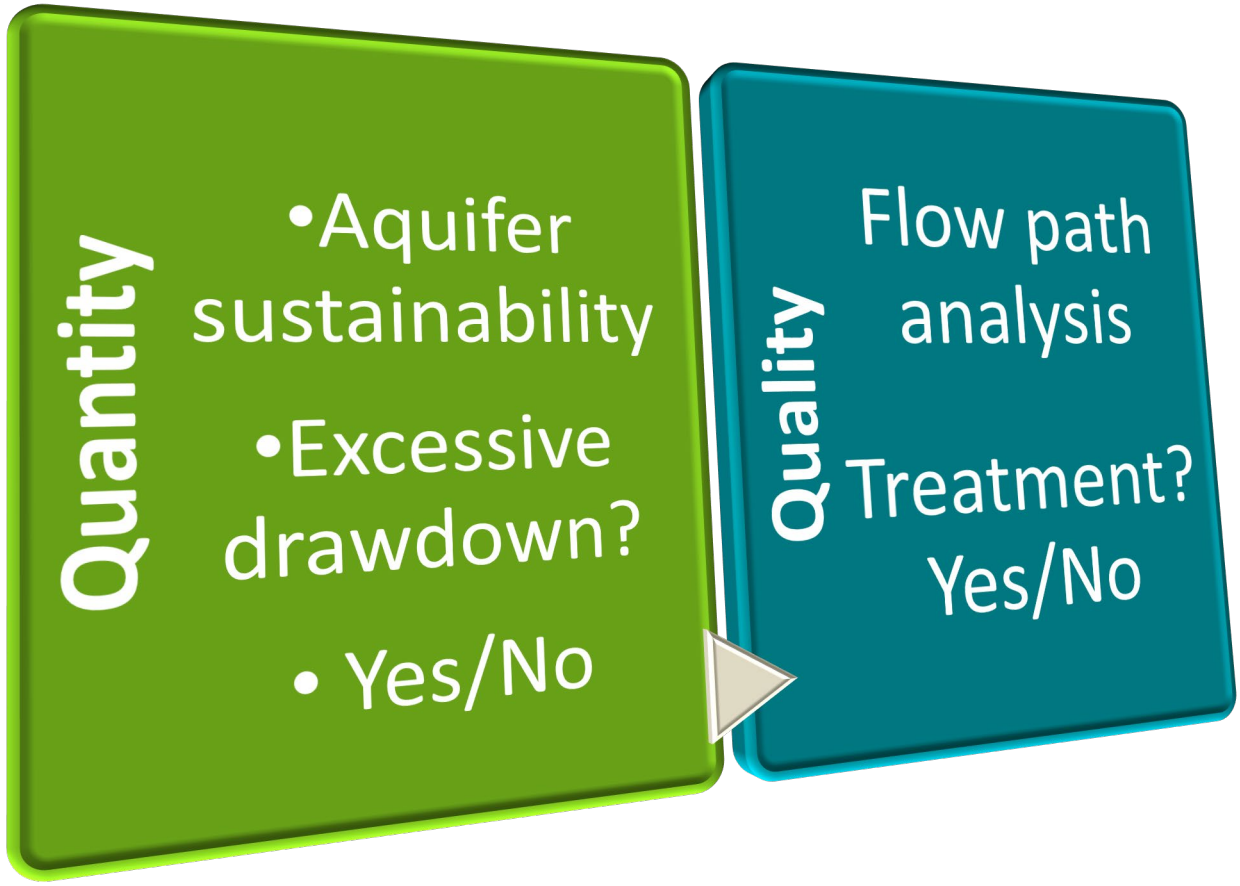
What are the potential long-term options?

- Four groups of scenarios were developed and assessed:
  - **Regional:** Shared public water systems
  - **Treatment:** Treating existing public and private drinking water wells. Costs include treating irrigation and commercial wells
  - **Community-specific:** Projects submitted by the community
  - **Integrated:** Combination of projects

Preliminary scenario results

Objectives for each scenario…

- Is additional infrastructure needed?
- Is there enough water?
- Does it require treatment?



Preliminary scenario results

Simulate conditions when all municipal wells are turned off

- **Regional**
- One Regional Surface Water Plant
- Two Regional Surface Water Plants
  - Woodbury served by Mississippi Plant
  - Woodbury served by St Croix Plant
- St Paul Regional Water Services

Simulate placement of new municipal wells and well fields across the east metro

- **Regional**
- One Groundwater well field
- Sub-regional (three groundwater well fields)

- **Community-specific and Integrated**
- Cottage Grove, Lake Elmo, Lakeland, Oakdale, West Lakeland

Preliminary scenario results

Assumptions

- For POETS, assumed GAC as treatment option
- Wells selected for treatment based on HI>0.5, except for Treatment and Community-specific scenarios
- Groundwater model used to determine potential 2040 PFAS impacts (Y/N)
- 2020 impacts persist in 2040
- POET well counts conservatively include unknown well types

Regional scenarios

- Provide drinking water to the whole East Metro Area via a shared public water system

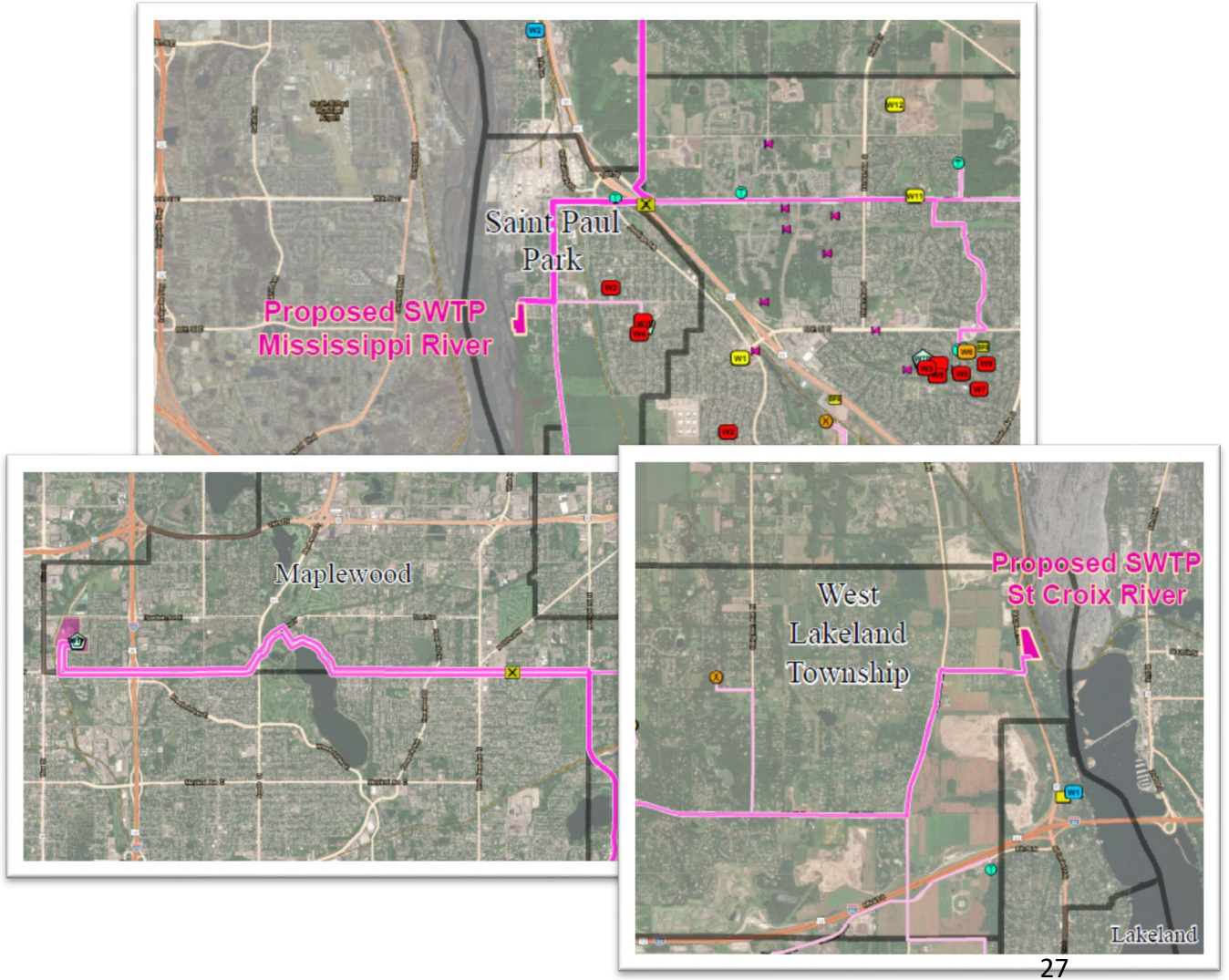
Reasons for considering:

- Potential for cost savings through centralized treatment for region
- Surface water quantity availability
- Potential for low treatment costs for “unimpacted” area(s)

Regional scenarios - surface water

Modeling questions

- What effect does turning all municipal wells off have on groundwater flow patterns?
- What are the effects of different model simulation of the distribution of PFAS in groundwater?
- What are the additional cost impacts (treatment, infrastructure, etc.)?



Regional surface water scenarios, current and future

Draft Numbers

2A - Mississippi River surface water treatment plant

52 MGD plant on the Mississippi River to serve all 14 communities

	Cost estimate*
Capital cost	$391,306,000
Capital plus 20-year O & M	**$751,326,000**

2B.1 - Mississippi and St. Croix River surface water treatment plants

Replace existing groundwater supplies with two SWTPs:

- 43.5 MGD plant on the Mississippi River to serve Cottage Grove, Grey Cloud Island, Newport, Oakdale, St. Paul Park, and Woodbury
- 8.5 MGD plant on the St. Croix River, to serve Afton, Denmark, Lake Elmo, Lakeland and Shores, Prairie Island Indian Community, and West Lakeland.

	Cost estimate*
Capital cost	$415,021,000
Capital plus 20-year O & M	**$808,381,000**

2B.2 – Mississippi and St. Croix River surface water treatment plants

Replace existing groundwater supplies with two SWTPs:

- 24 MGD plant on the Mississippi River to serve Cottage Grove, Grey Cloud Island, Newport, Oakdale, and 9 St. Paul Park.
- 28 MGD plant on the St. Croix River to serve Afton, Denmark, Lake Elmo, Lakeland, Lakeland Shores, Prairie Island Indian Community, West Lakeland, and Woodbury.

	Cost estimate*
Capital cost	$422,837,000
Capital plus 20-year O & M	**$828,117,000**

2C – St. Paul Regional Water Services

Extending St. Paul Regional Water Services (SPRWS) throughout the East Metropolitan Area.

	Cost estimate*
Capital cost	$347,425,000
Capital plus 20-year O & M	**$969,045,000**

***All surface water regional scenario costs include 1,457 new GAC POETs, 2,070 total**

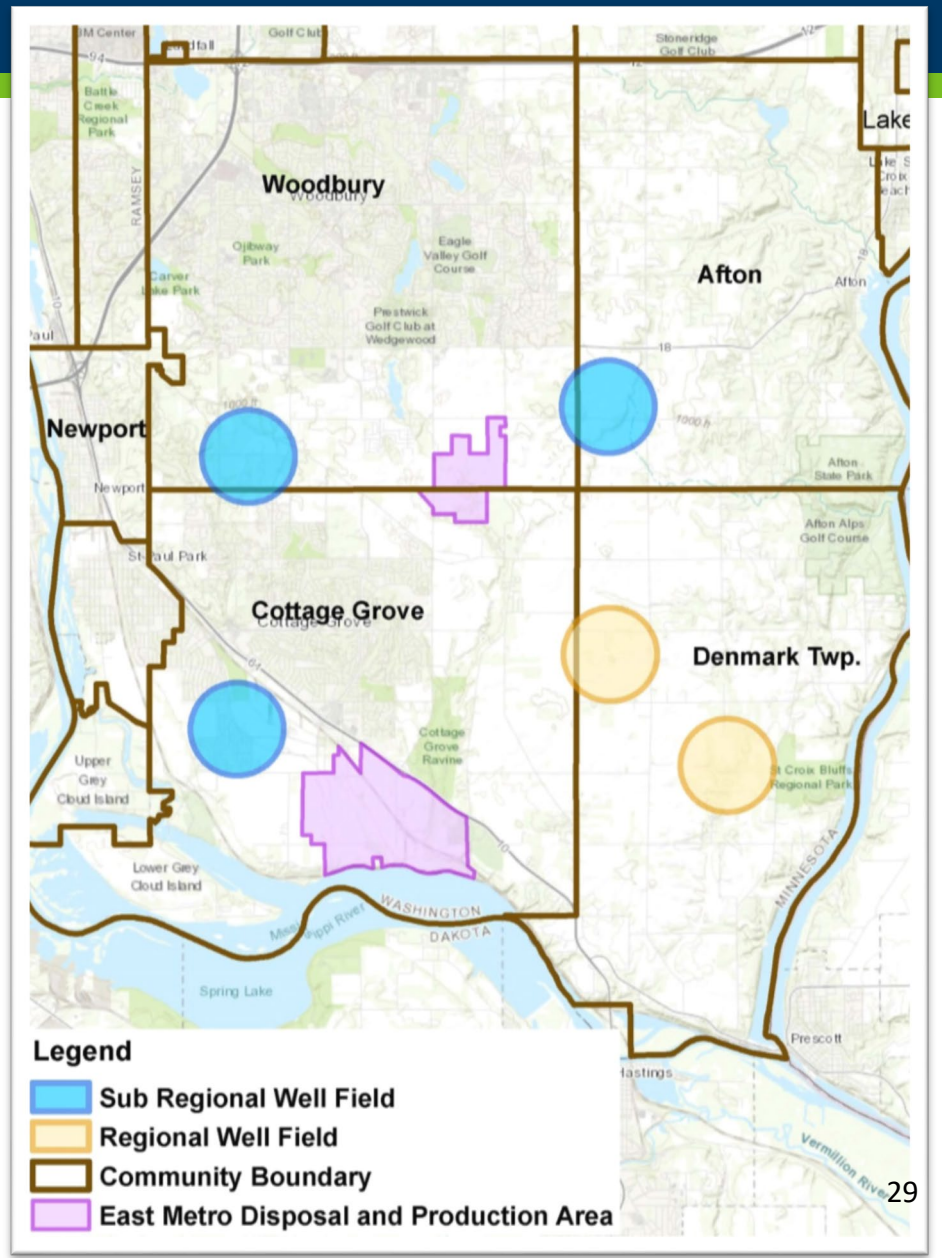
Regional and sub-regional groundwater

Two alternatives:

- One new well field (52 MGD MDD)
- Three new well fields (18 MGD MDD ea.)

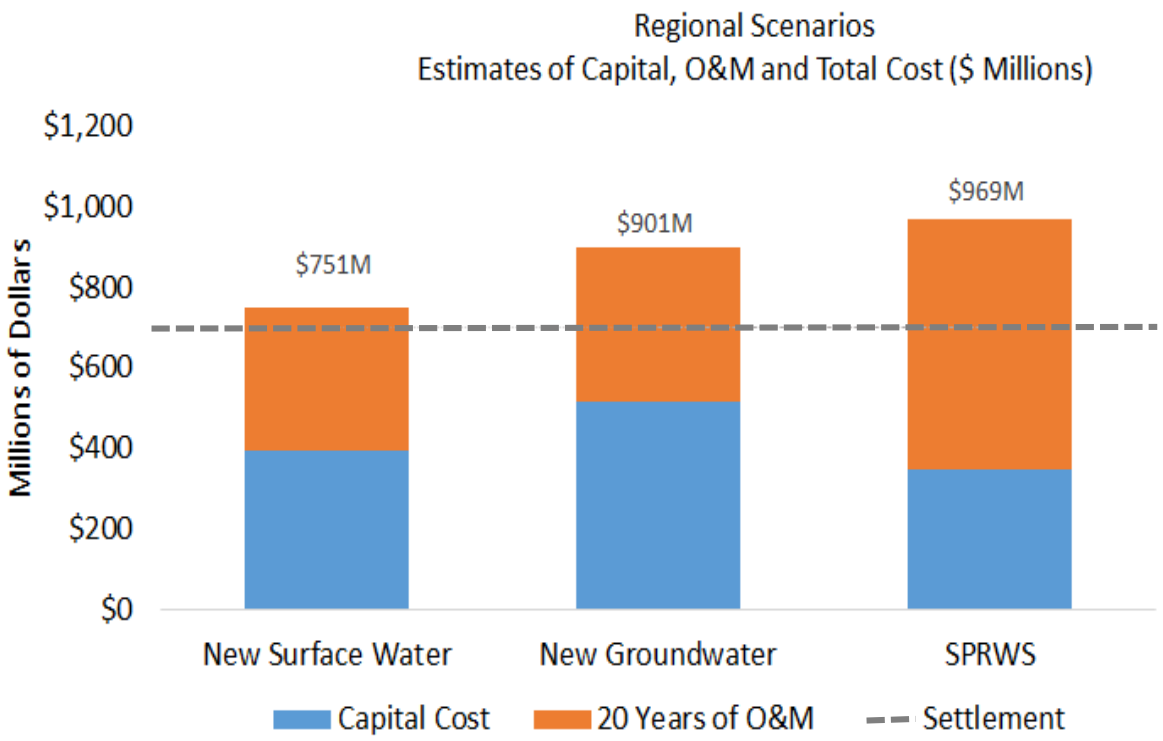
Modeling questions

- Is capacity available? – Yes/no, # gpm
- Can the aquifer sustain the required pumping rates without excessive drawdown? – yes/no



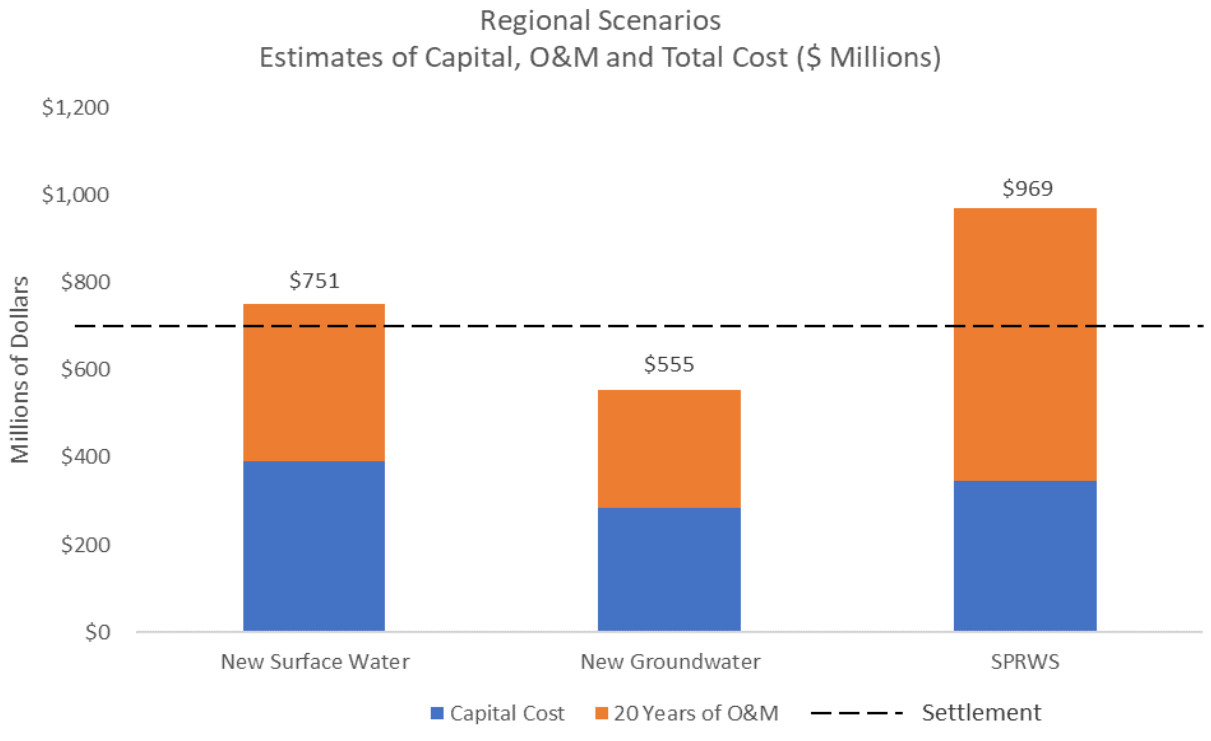
Regional scenario
Draft Numbers

Old



"New Groundwater" scenario includes costs of additional infrastructure not provided in other regional scenarios – not apples to apples.

New

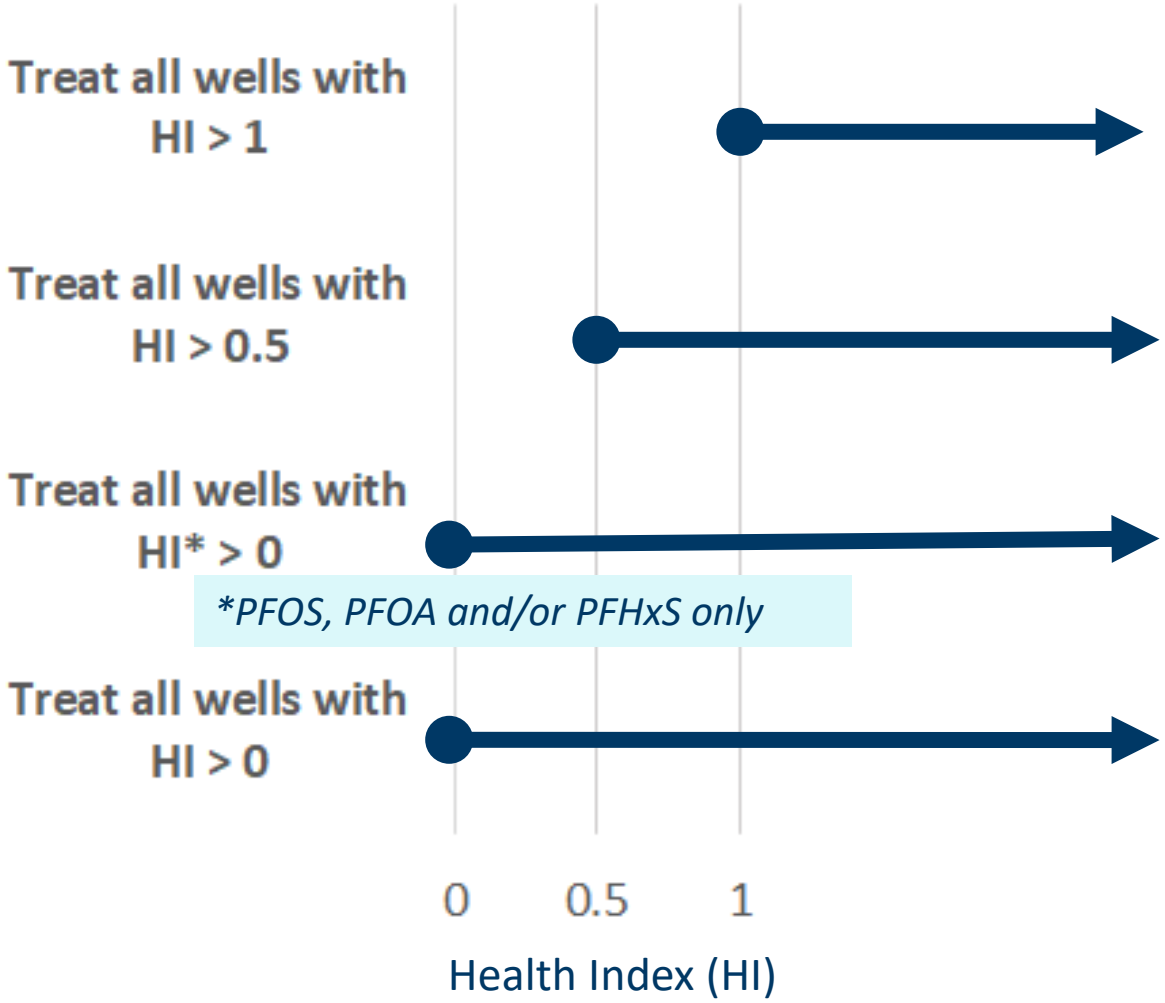


"New Groundwater" scenario now <u>does not</u> include costs of additional infrastructure that is also not included in other regional scenarios – apples to apples. ✓

CHECK-IN

Treatment scenarios

- Provide treatment for existing public and private drinking water wells, at the individual well sites
- Two options for treatment technology: granular activated carbon and ion-exchange
- Four alternatives of this scenario were included – wells selected for treatment based on HI



Treatment scenarios – 2040

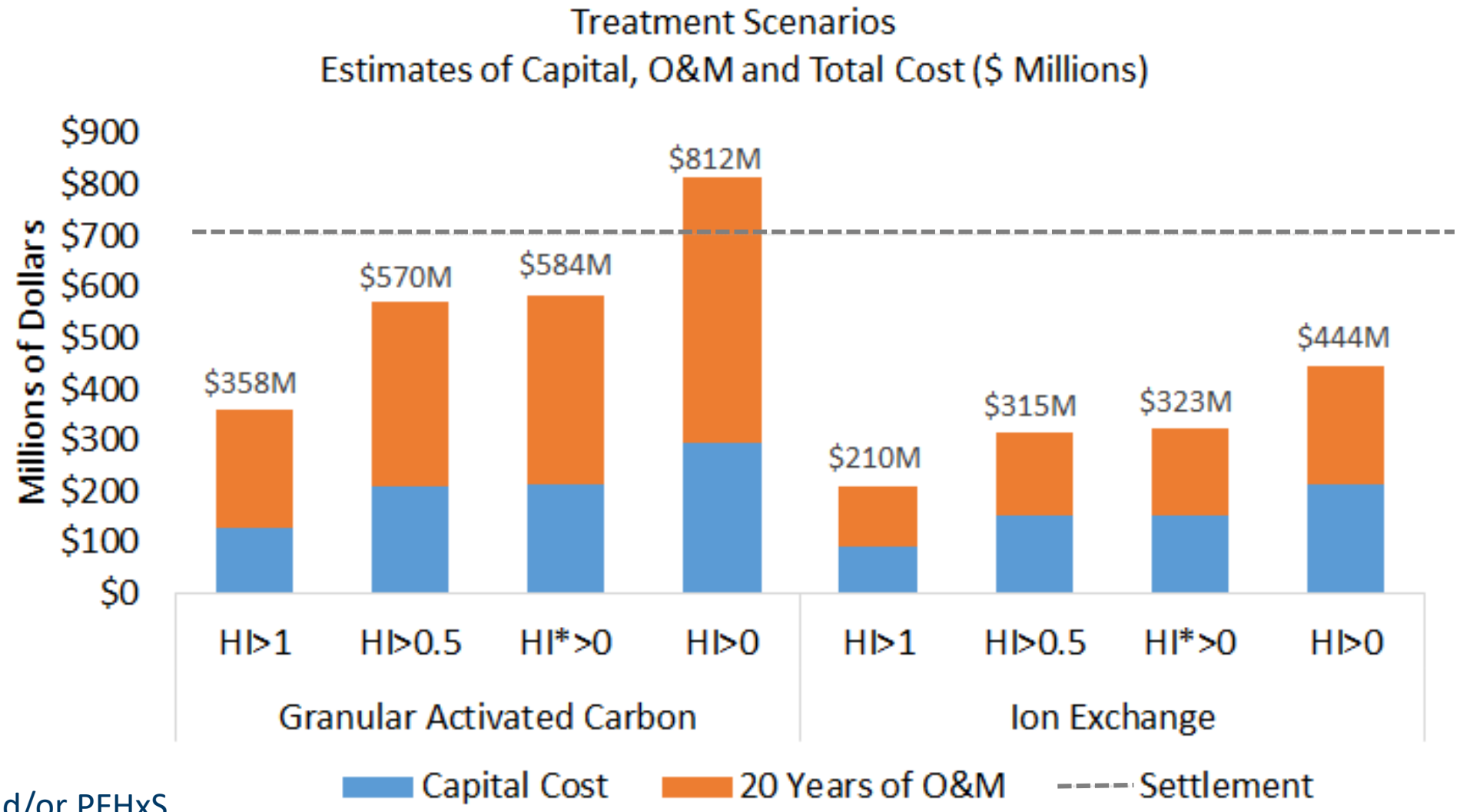
Draft Numbers

City	TOTAL WELLS[1]	SAMPLED WELLS[2]	Wells Sampled[3,4] w/o GAC, connection, or water delivery				POETs added from GW Model	Municipal Wells[3,4]				Wells with GAC installed for O&M only[5]	Wells Connected or on Water Delivery[5]
			HI>1.0	HI>0.5	PFOS, PFOA, PFHxS>0	HI>0		HI>1.0	HI>0.5	PFOS, PFOA, PFHxS>0	HI>0		
Afton	708	124	74	74	78	115	74					11	0
Cottage Grove	820	672	99	117	138	382	95	8	12	12	12	75	3
Denmark Twp.	487	103	0	0	6	62						0	0
Grey Cloud Island Twp.	121	109	60	62	62	65	60					52	3
Lake Elmo	1309	503	419	420	425	454	420	4	4	4	6	95	30
Lakeland	296	58	238	238	238	236	238	0	0	0	2	3	0
Lakeland Shores	41	12	29	29	29	29	29					0	0
Maplewood	602	38	0	0	1	27						4	0
Newport	112	25	15	15	19	32	15	0	0	0	2	0	0
Oakdale	124	39	41	41	41	42	45	6	8	8	8	0	0
Prairie Island Indian Community	1	1	0	0	0	0		1	1	1	1	0	0
St. Paul Park	50	17	34	34	34	35	37	2	3	3	3	4	0
West Lakeland Twp.	1189	689	593	593	595	602	593					377	1
Woodbury	632	215	21	24	46	191	21	8	13	14	21	1	0
Total (Region)	**6492**	**2605**	**1623**	**1647**	**1712**	**2272**	**1627**	**29**	**41**	**42**	**55**	**622**	**37**

1. Well types include: commercial, domestic, irrigation, municipal, other, community supply, public supply/non-comm.-transient, public supply/non-community-non-transient, public supply/non-community, and unknown.
2. Sampled wells with HI > 1.0 will have GAC installed or will be connected to a municipal water supply by the end of 2020.
3. HI categories are not exclusive of each other and have overlap from one HI category to the next.
4. Counts for Oakdale do include 2 municipal wells that are already receiving treatment. These wells were not included in the counts used to calculate costs to install new treatment systems.
5. The GAC counts exclude those residences that will be connected to a municipal system as a result of the approved expedited projects.

Treatment scenarios for 2040 population

Draft Numbers



*PFOS, PFOA, and/or PFHxS

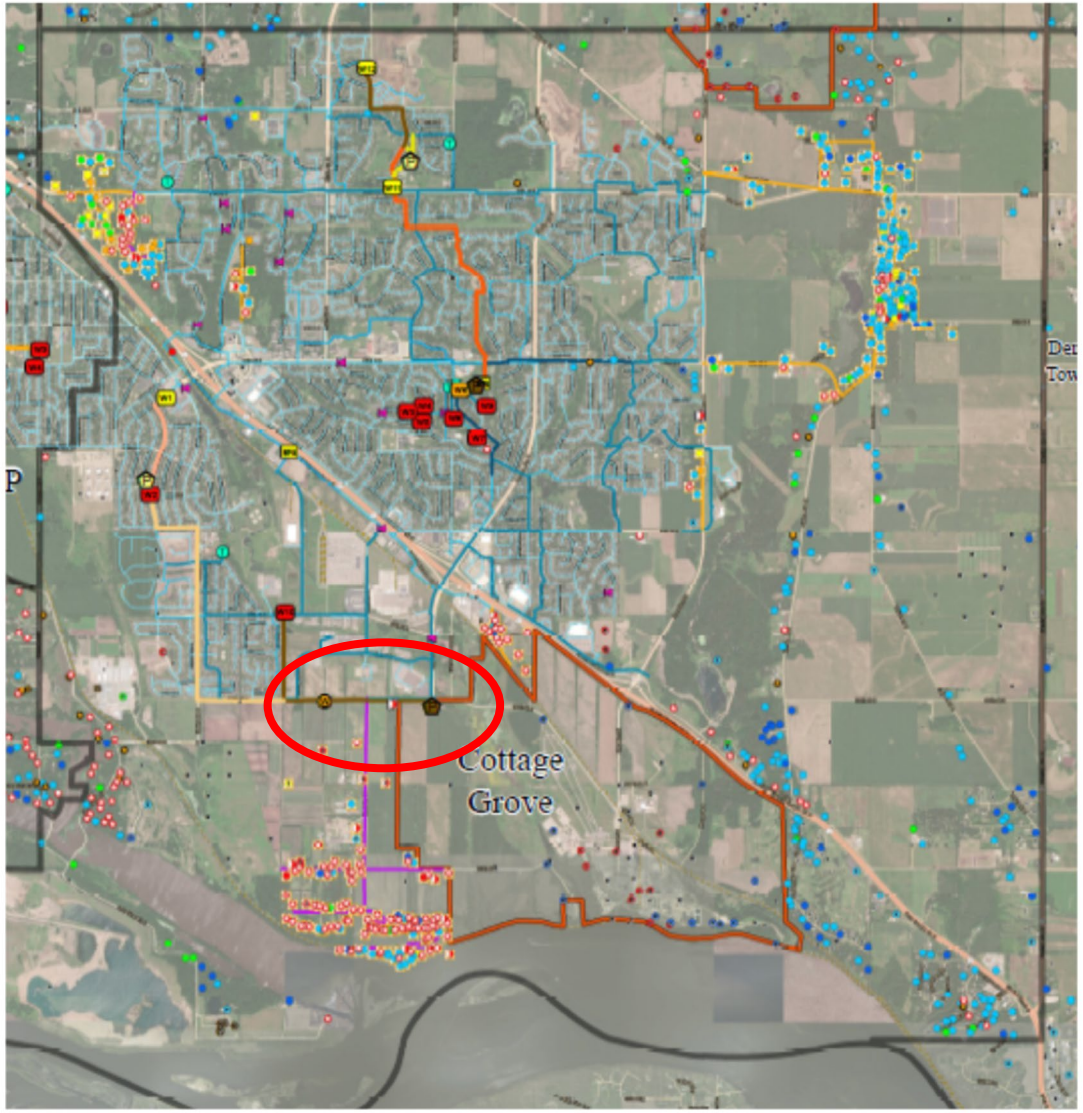
CHECK-IN

Community-specific scenarios

- Conceptual projects submitted by local governments, including:
  - 2 new public water systems (Prairie Island Indian Community and West Lakeland)
  - 1 community connected to St. Paul Regional Water Services (Maplewood)
  - 8 communities with a mix of modifying current public water system, connecting residences on private wells to the public water system, and treatment on private wells (Cottage Grove, Lake Elmo, Lakeland & Lakeland Shores, Oakdale, St. Paul Park, and Woodbury)
  - 3 communities with only treatment on private wells (Afton, Denmark, Grey Cloud Island)
  - 1 community no municipal water system improvements anticipated; POETs as needed (Newport)

Community-specific

- **Drinking water model questions**
  - New wells – Cottage Grove, Lake Elmo, Oakdale, West Lakeland, and Woodbury
    - Is capacity available? – Yes/no # gpm
    - Can the aquifer sustain the required pumping rates without excessive drawdown? – yes/no



Submitted projects – Afton
Draft Numbers

- Install Point of Entry Treatment (POET) system for private wells and non-community public water system wells (85)
- 2040 cost estimates

	Cost estimate*
Capital cost	$250,000
Capital plus 20-year O & M	**$2,184,000**

* Based on GAC treatment

Submitted projects – Cottage Grove
Draft Numbers

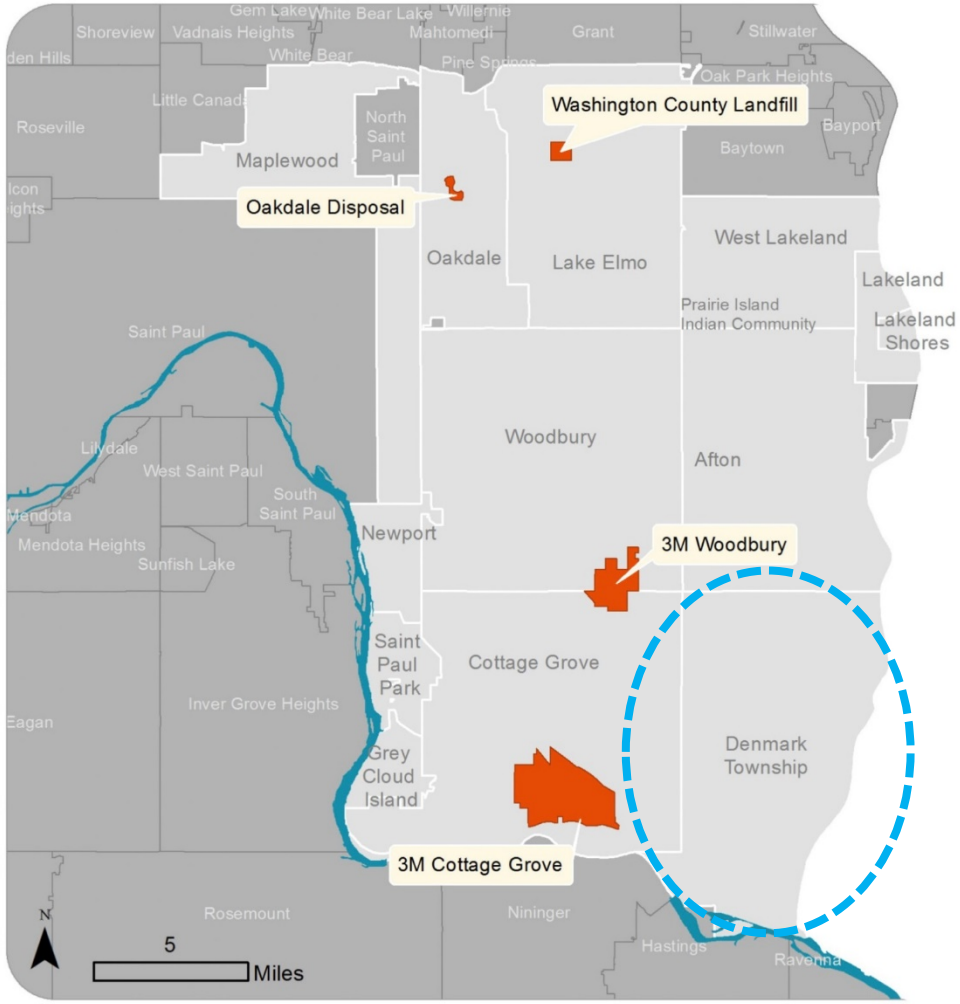
- Install centralized water treatment plants (WTPs) and extending water mains to neighborhoods that have PFAS impact non-municipal wells
- Install POET systems for private wells and non-community public water system wells (140)
- 2040 cost estimates

	GAC	Ion Exchange
Capital cost	$78,837,000	$70,295,000
Capital plus 20-year O & M	**$182,837,000**	**$117,015,000**

Submitted projects – Denmark
Draft Numbers

- Install POET systems for private wells and non-community public water system wells (3)
- 2040 cost estimates

	Cost estimate
Capital cost	$10,200
Capital plus 20-year O & M	**$70,200**



Submitted projects – Grey Cloud Island
Draft Numbers

- Install POET system for private wells and non-community public water system wells (116)
- 2040 cost estimates

	Cost estimate
Grey Capital cost	$216,000
Capital plus 20-year O & M	**$2,536,000**

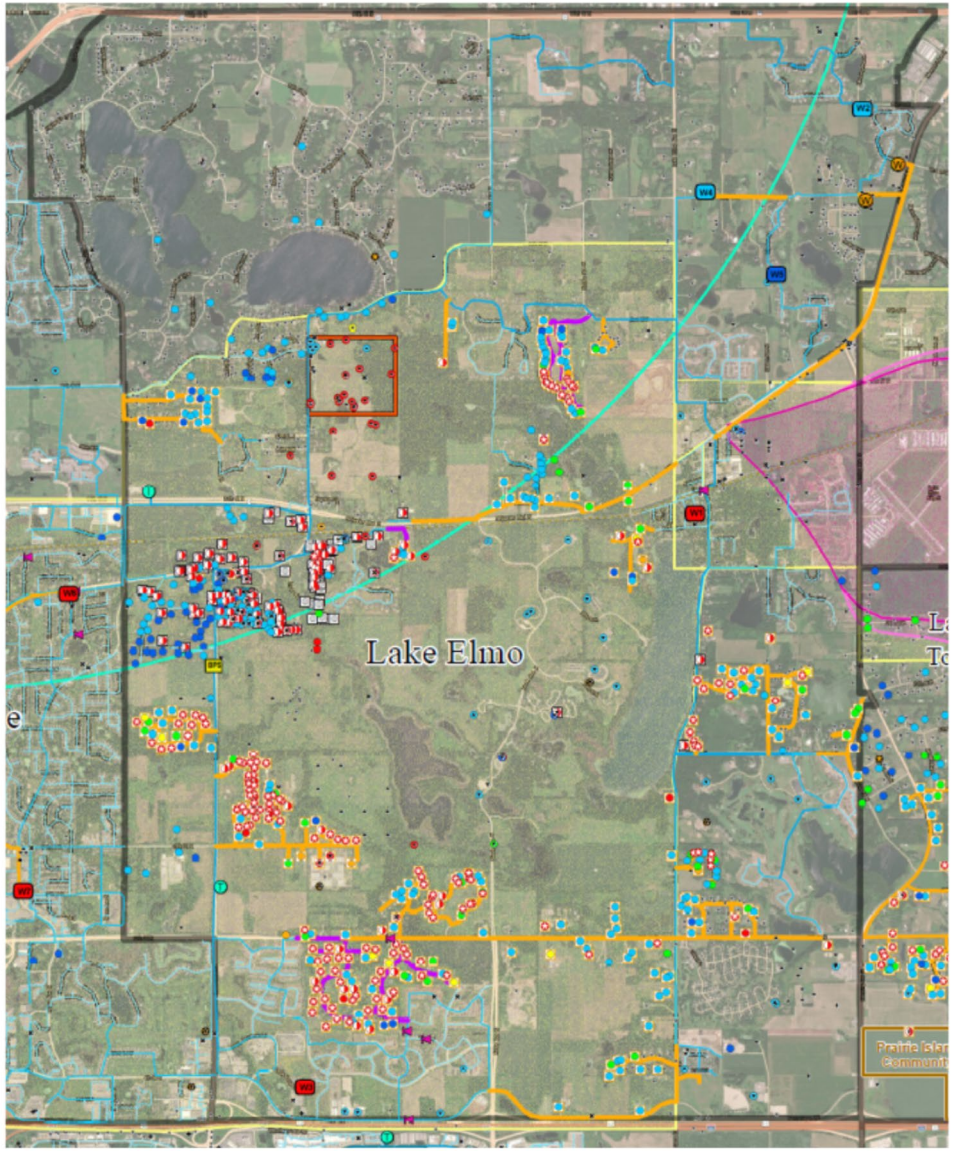
* Based on GAC treatment

Submitted projects – Lake Elmo

Draft Numbers

- Install two municipal supply wells and extend water mains to nearby neighborhoods currently on PFAS impacted non-municipal wells
- Install POET system for private wells and non-community public water system wells that are not connected to the municipal supply wells (131)
- 2040 cost estimates

	Cost estimate
Capital cost	$72,629,500
Capital plus 20-year O & M	**$107,469,500**



Submitted projects – Lakeland, Lakeland Shores, and Lake St. Croix Beach

Draft Numbers

- Extend water mains to nearby neighborhoods and connect all non-municipal wells to the municipal water system
- Install POET systems for the impacted non-municipal wells until they are connected to the municipal water system (171 residential wells 2020- 2040)
- 2040 cost estimates

	Cost estimate
Capital cost	$648,000
Capital plus 20-year O & M	**$648,000**

*2040 costs reflects all residential wells being connected to municipal

Submitted projects – Maplewood
Draft Numbers

- Connect the majority of residents to the existing St. Paul Regional Water Services system
- No POETS
- 2040 cost estimates

	Cost estimate
Capital cost	$4,887,000
Capital plus 20-year O & M	**$7,107,000**

Submitted projects – Newport
Draft Numbers

- Conceptual projects were not considered for Newport under this scenario as there are no municipal or non-municipal wells in 2020 with HI values greater or equal to 0.5.
- POETs are anticipated to be necessary by 2040 in the southeast corner of Newport (15)
- 2040 cost estimates

	Cost estimate
Capital cost	$52,000
Capital plus 20-year O & M	**$352,000**

Submitted projects – Oakdale
Draft Numbers

- Expand the City's centralized WTP and install a new municipal supply well
- Install POET systems for impacted non-municipal wells (28)
- Two scenarios to expand the City's centralized WTP
- 2040 cost estimates

	GAC	Ion Exchange
Capital cost	$23,979,000	$20,850,000
Capital plus 20-year O & M	**$53,959,000**	**$34,310,000**

Submitted projects – Prairie Island Indian Community
Draft Numbers

- Install a WTP at the existing well to provide water service to the property and serve future residents of the community
- No POETS
- 2040 cost estimates

	GAC	Ion Exchange
Capital cost	$3,551,000	$2,534,000
Capital plus 20-year O & M	**$8,611,000**	**$4,674,000**

Submitted projects – Saint Paul Park
Draft Numbers

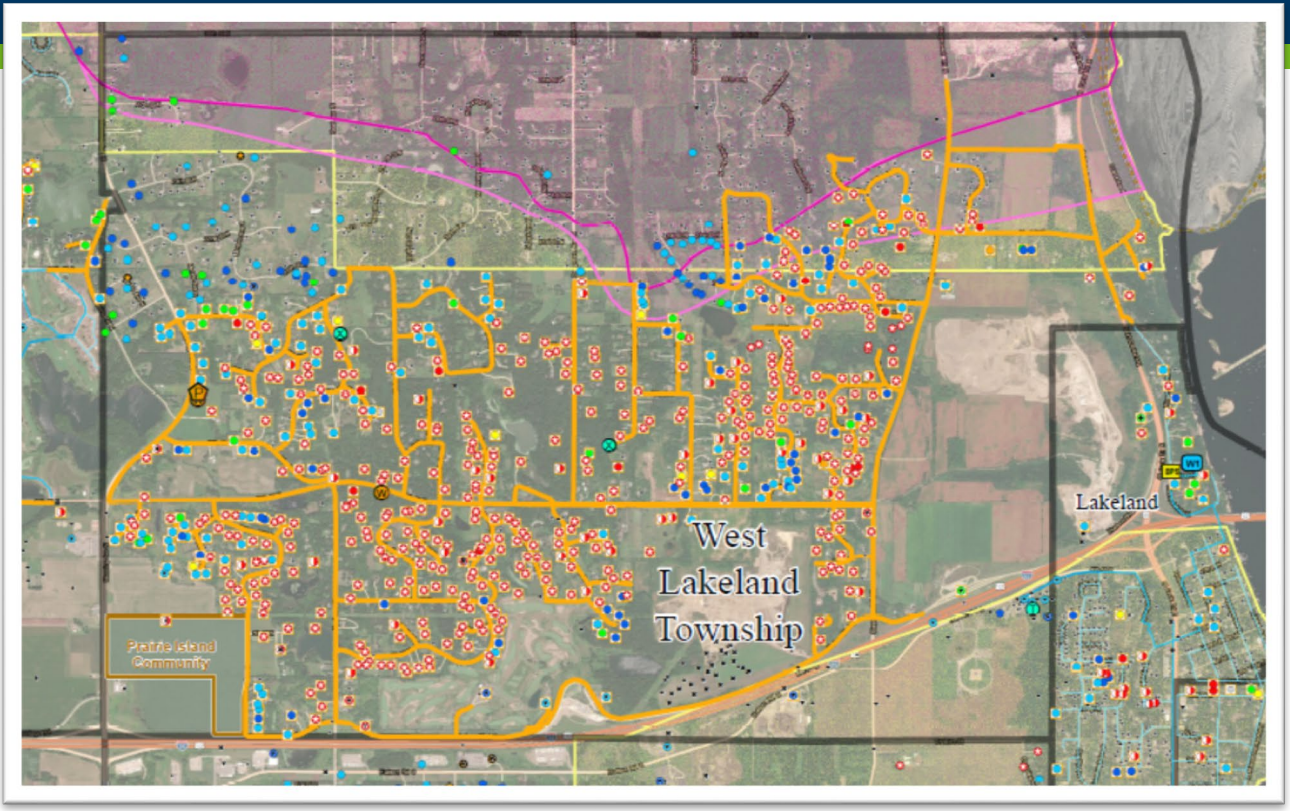
- Make temporary WTP permanent to provide centralized treatment for all 3 wells
- Connect residences to the municipal water system
- POET systems (34 estimated)

	GAC	Ion Exchange
Capital cost	$9,960,000	$7,890,000
Capital plus 20-year O & M	**$26,176,000**	**$14,389,000**

Submitted projects – West Lakeland

Draft Numbers

- Install a new municipal water system to supply treated water to residents on PFAS-impacted, non-municipal wells (969 residential wells 2020- 2040)
- Install POET systems for impacted non-municipal wells that cannot be connected to the municipal water system 2040 cost estimates



	GAC	Ion Exchange
Capital cost	$173,536,000	$172,469,000
Capital plus 20-year O & M	**$258,016,000**	**$253,789,000**

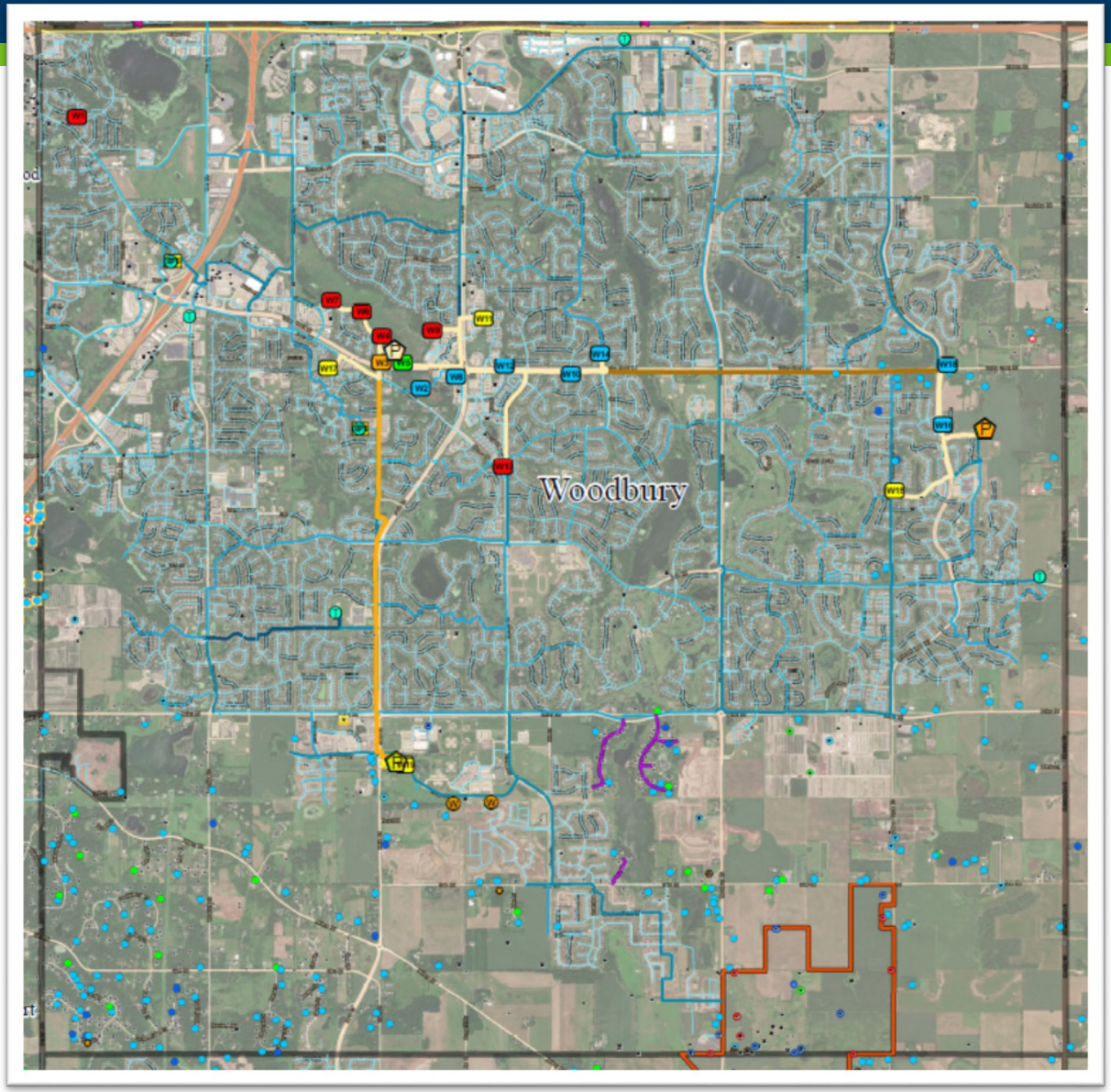
*2040 costs reflects residential wells being connected to municipal

Submitted projects – Woodbury

Draft Numbers

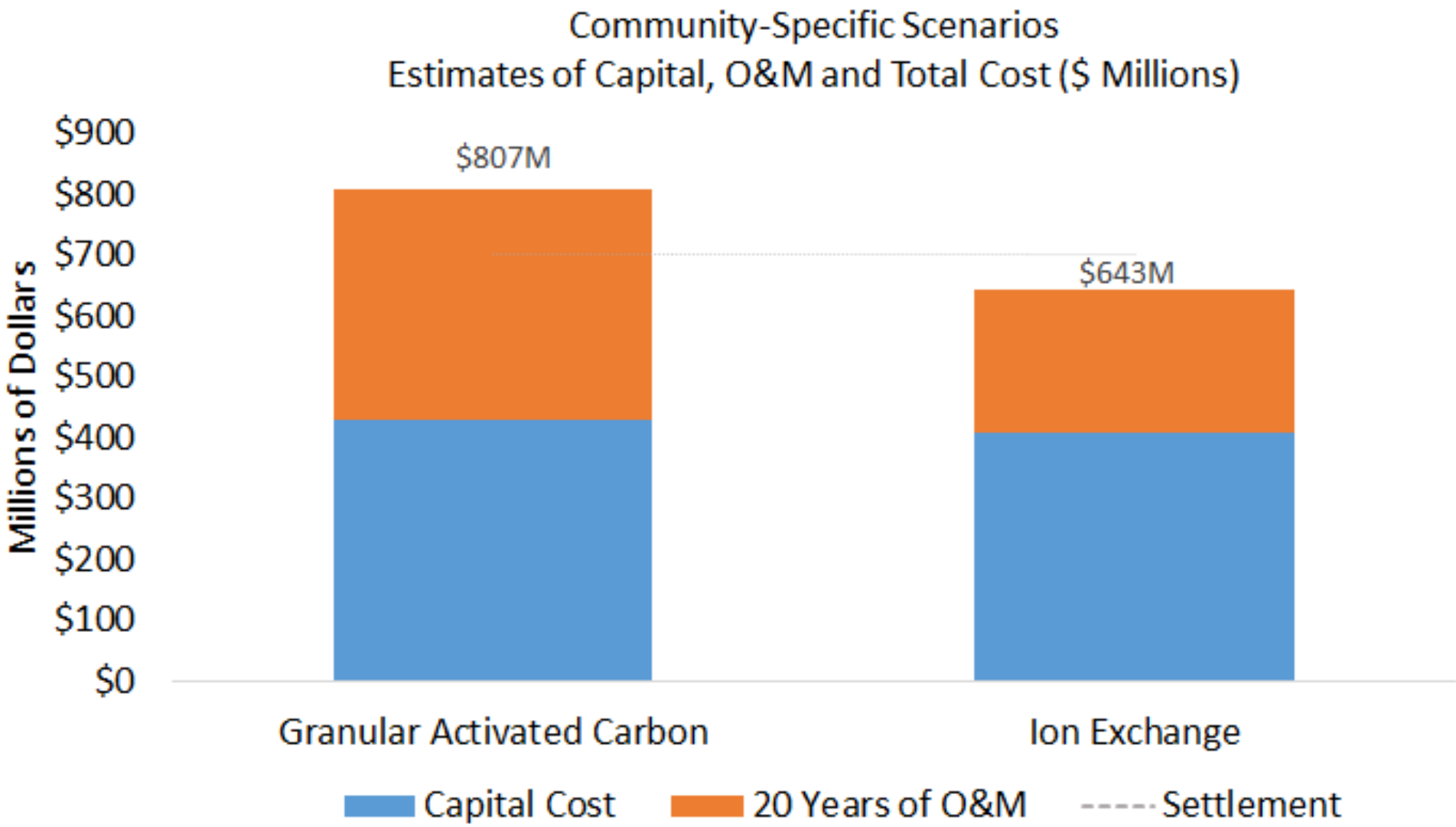
- Install centralized WTPs and extend water mains to nearby neighborhoods with expedited projects that currently have PFAS impacted non-municipal wells
- Install POET systems for the rest of the impacted non-municipal wells with HI values greater than zero (181)
- Three alternatives to configure the WTPs
- 2040 cost estimates

	GAC	Ion Exchange
Capital cost	$61,418,000	$52,871,000
Capital plus 20-year O & M	**$156,318,000**	**$91,931,000**



Community-specific scenario for 2040 population

Draft Numbers



CHECK-IN

Integrated scenario

- Integration of the community and other scenarios to achieve benefits such as cost savings, including:
  - additional interconnections between some communities
  - optimizing treatment capacity
  - spatial distribution of municipal wells
  - conceptual projects not previously assessed

Integrated scenario

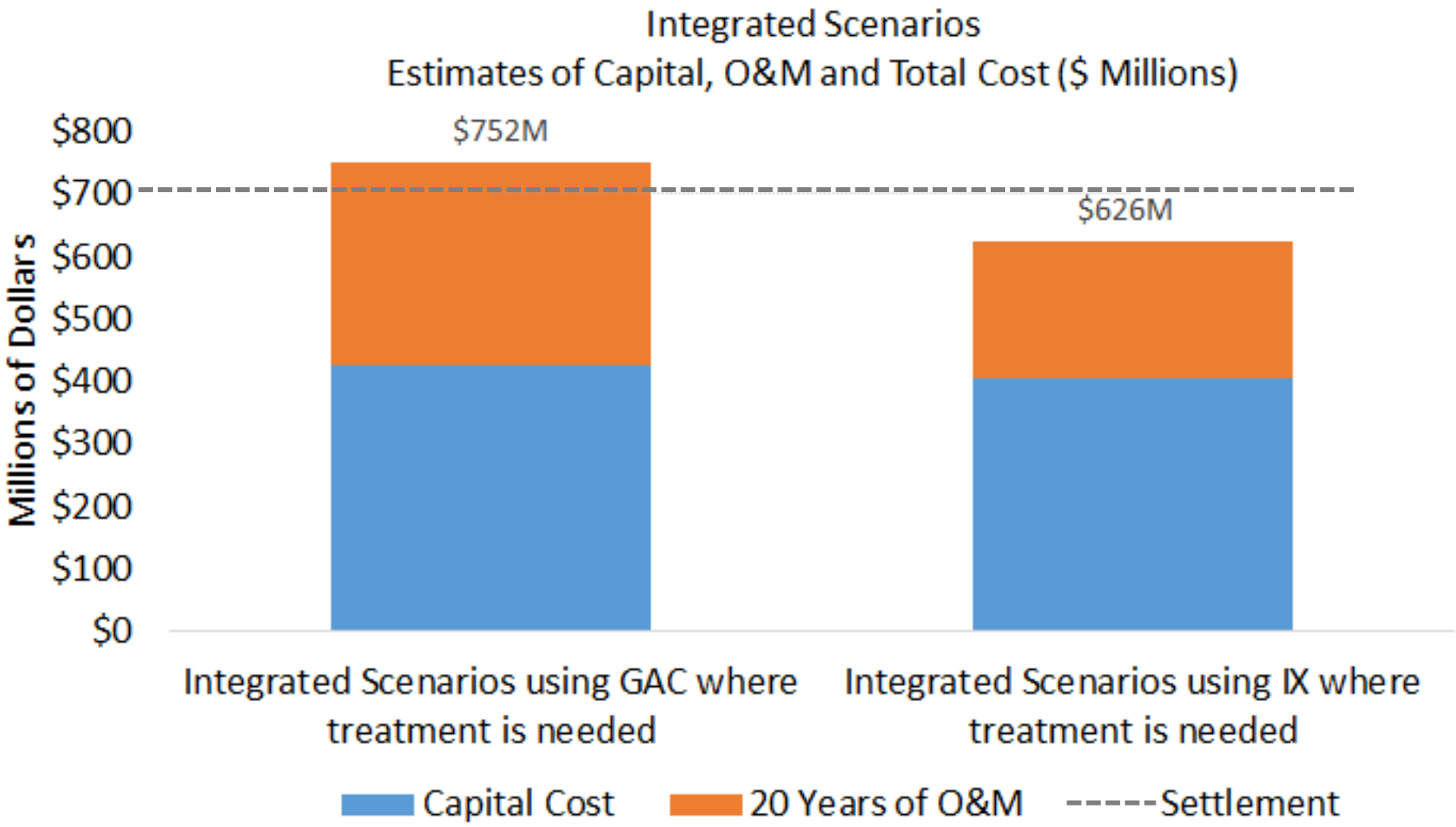
- Cost-effective, technically feasible modifications are in the overall scenario costs, including:
  - 2 communities constructing new infrastructure and connecting to another community's public water system (West Lakeland and Prairie Island Indian Community supplied by Lakeland)
  - 1 community connected to St. Paul Regional Water Services (Maplewood)
  - 8 communities with a mix of modifying city's current public water system, connecting residences on private wells to city's public water system, and treatment on private wells (Cottage Grove, Lake Elmo, Lakeland, Oakdale, St. Paul Park, and Woodbury)
  - 3 communities with only treatment on private wells (Afton, Denmark, Grey Cloud Island)
  - 1 community no municipal water system improvements anticipated; POETs as needed (Newport)

Integrated scenario

- Grouped projects by geographic area to assess interconnects
  - Cottage Grove, St. Paul Park, Grey Cloud Island
  - Woodbury, Lake Elmo, Oakdale
  - West Lakeland, Lakeland, Prairie Island
- Viable options for integrated scenario
  - Cottage Grove to St. Paul Park
  - Oakdale to Lake Elmo
  - Prairie Island to West Lakeland
- Optimizing treatment capacity
  - Cottage Grove
  - Woodbury
  - Oakdale

Integrated scenario for 2040 population

Draft Numbers



CHECK-IN

Next Steps

- 1-on-1 with LGUs to discuss results
- Refine existing scenarios as needed
- Potentially model new scenarios

Questions

AGENCY LOGO HERE

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