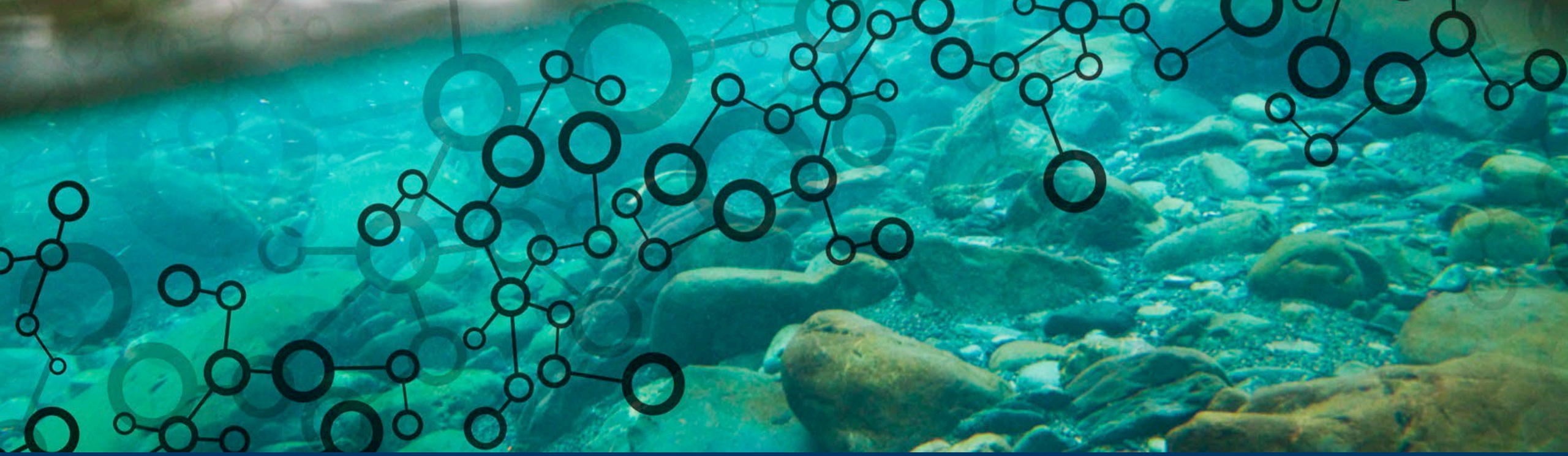
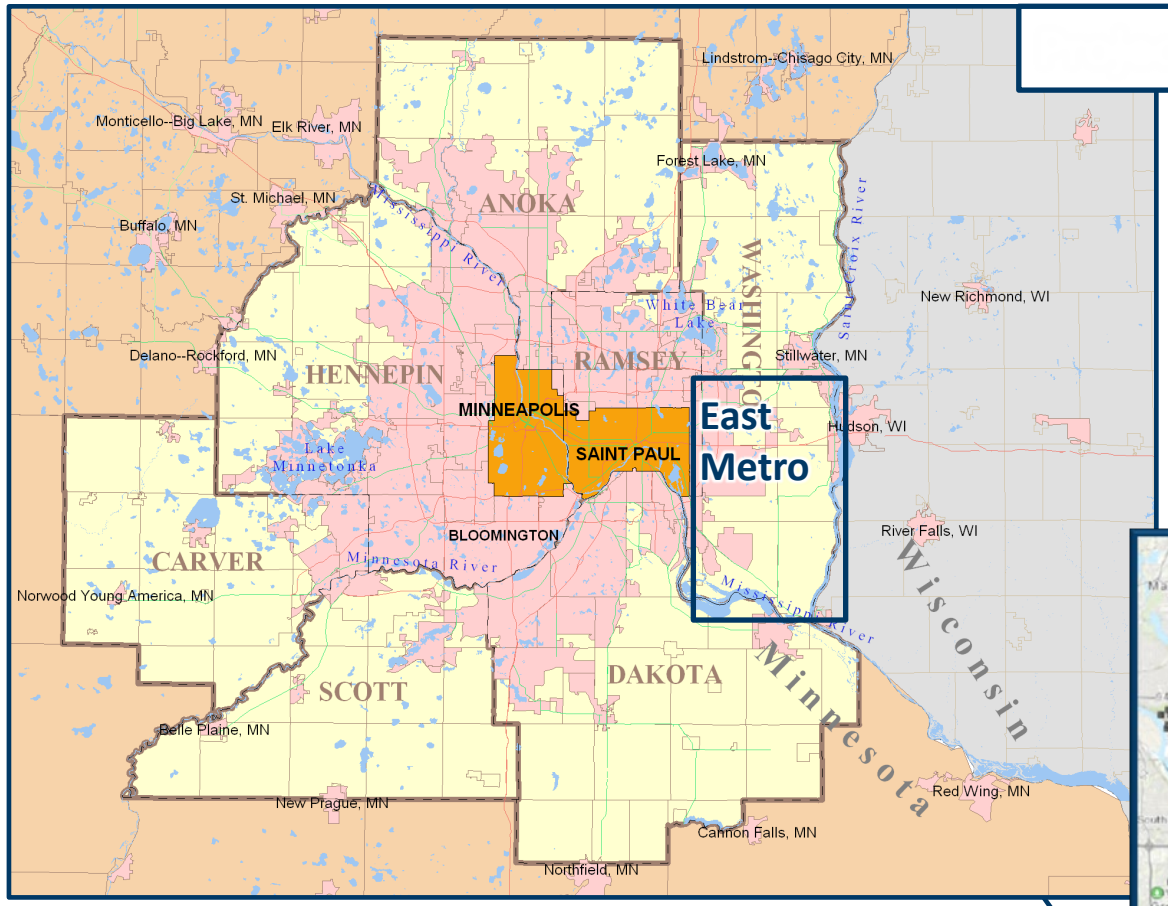


3M Settlement: Project 1007 Feasibility Study Progress

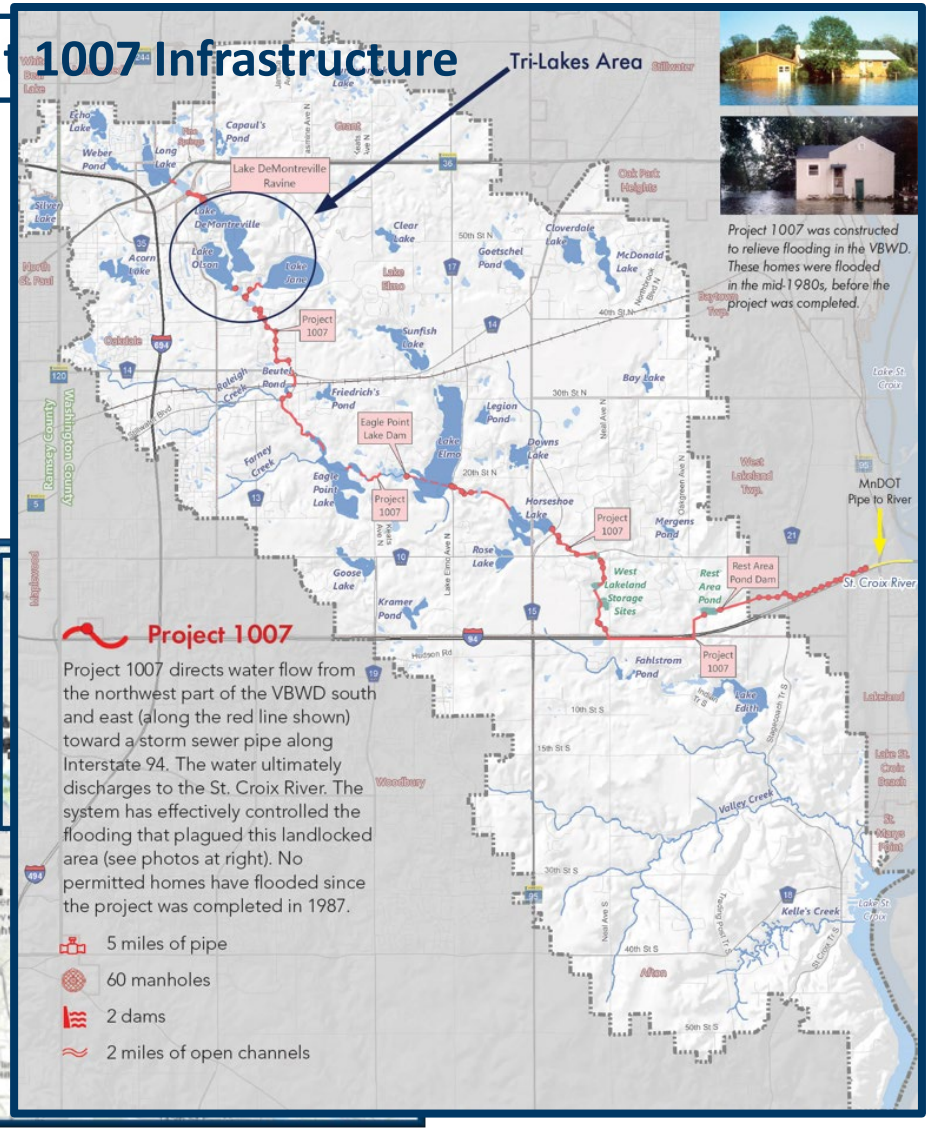
MINNESOTA POLLUTION CONTROL AGENCY

Rebecca Higgins, PG
East Metro Unit, MPCA
11/16/22

Project 1007 Site Extent



East Metro Well Advisories



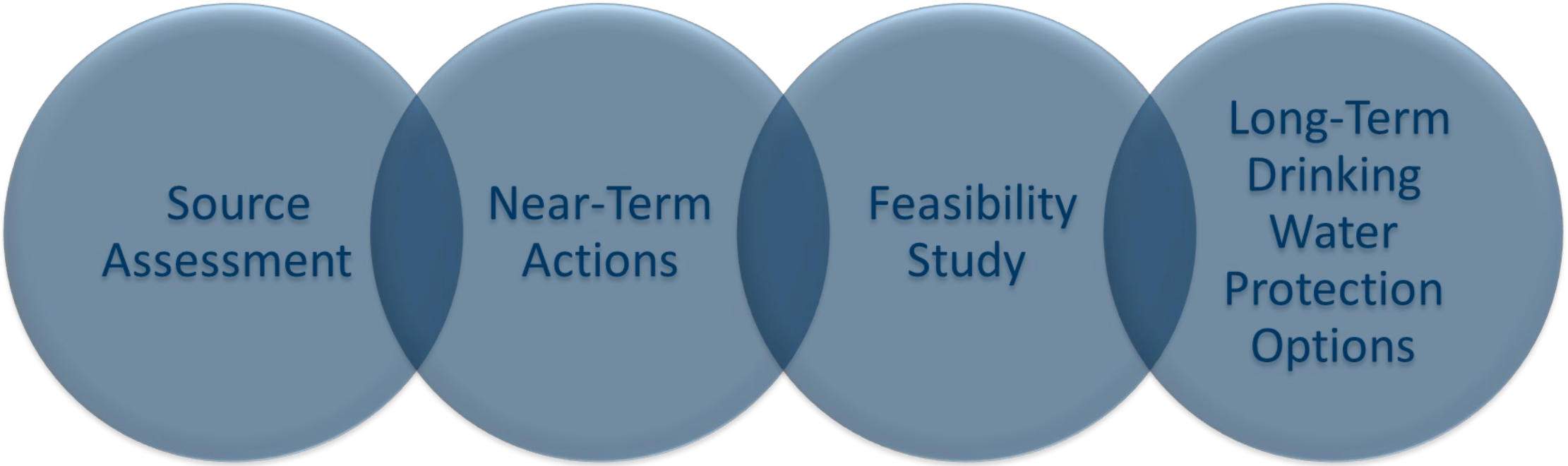
In the East Metro, approximately 1,400 public and private wells currently have drinking water health advisories.

Project 1007, constructed in 1987, is a large flood control project for the Tri-Lakes Area. It is being evaluated for its role as a conveyance system for PFAS impacts in the East Metro.

To date, the Project 1007 Study Area is >120 miles^2 in size and includes ~90 monitoring wells and over 150 surface sample locations.

Project 1007 High-Level Process

"The MPCA shall conduct a source assessment and feasibility study regarding the role of the Valley Branch Water District's project known as Project 1007 in the conveyance of PFCs in the environment." - 3M Settlement



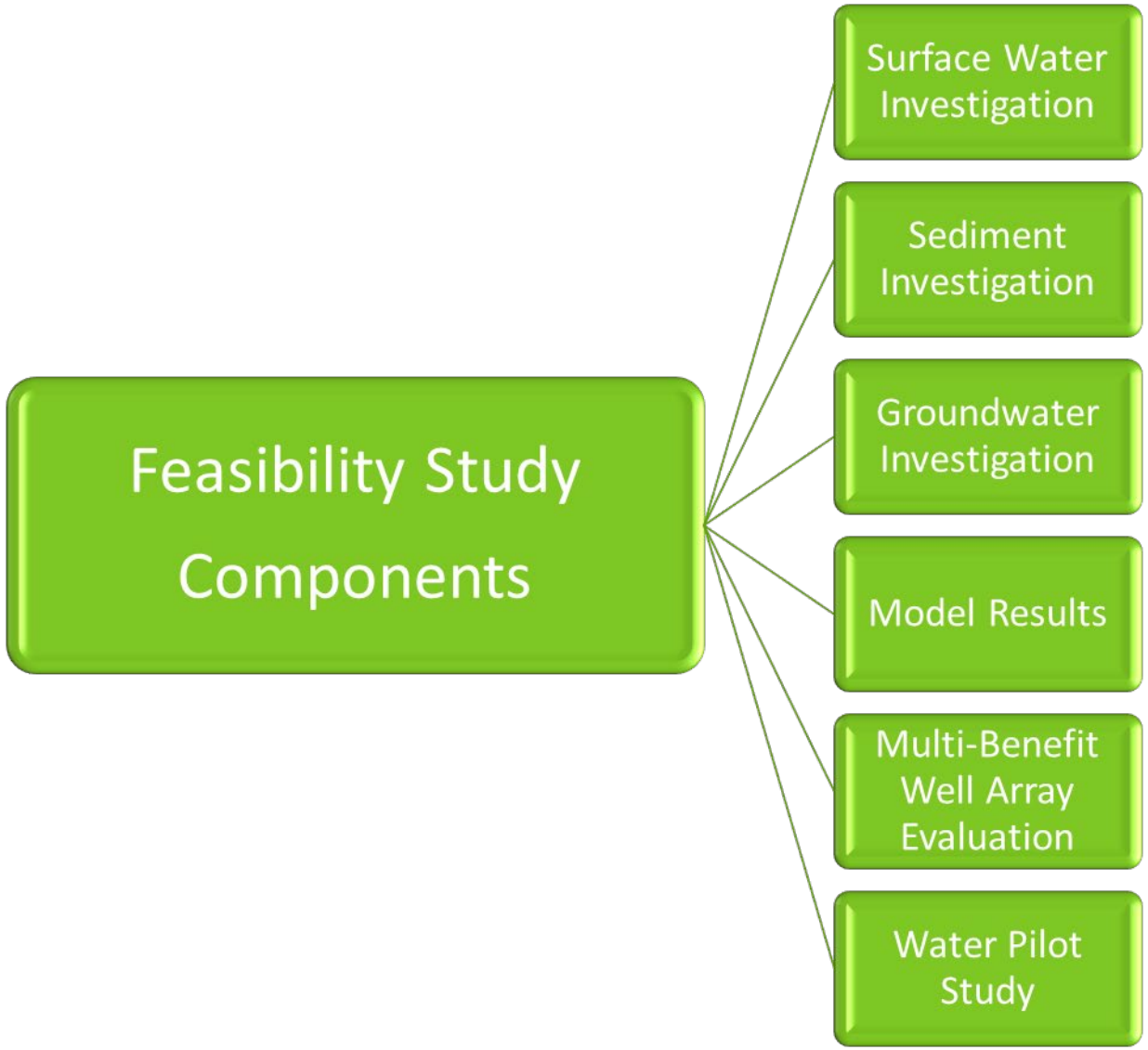
Drinking Water Protection and Project 1007 Feasibility Study Goals and Components

GOALS

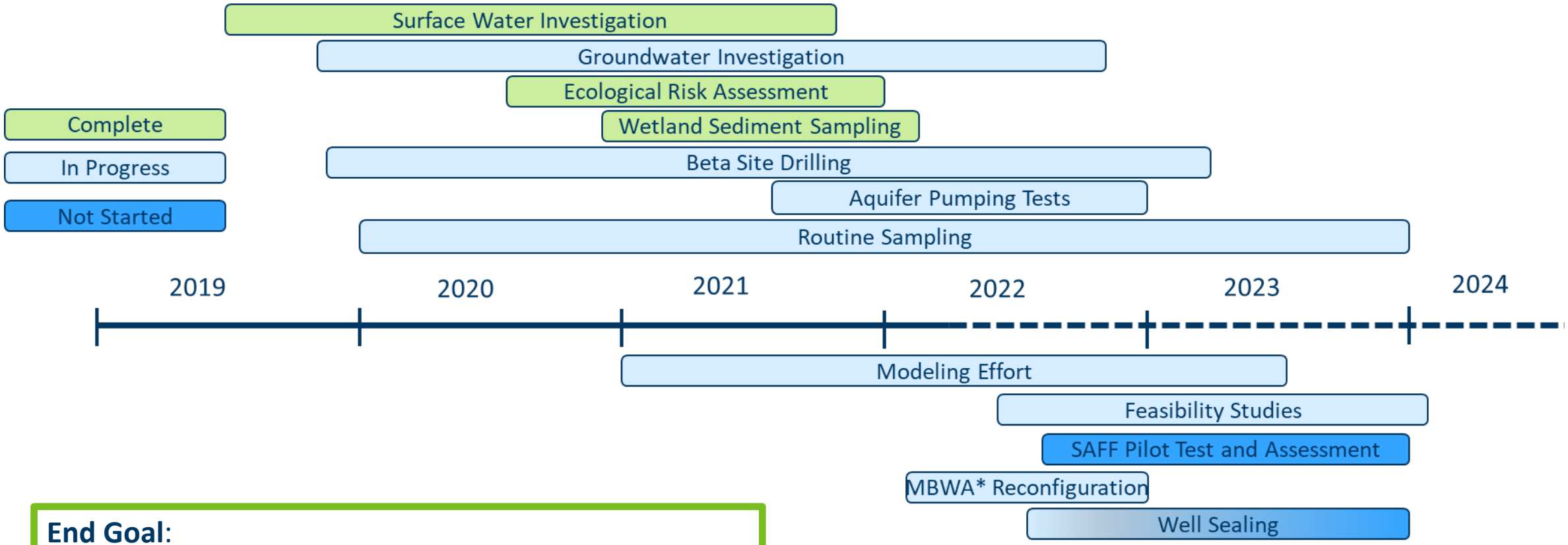
Identify areas where treatment of surface water, sediment, or groundwater is required.

Evaluate applicable treatment options.

Recommend solutions to address PFAS impacts in surface water, sediment, and groundwater.



Timeline



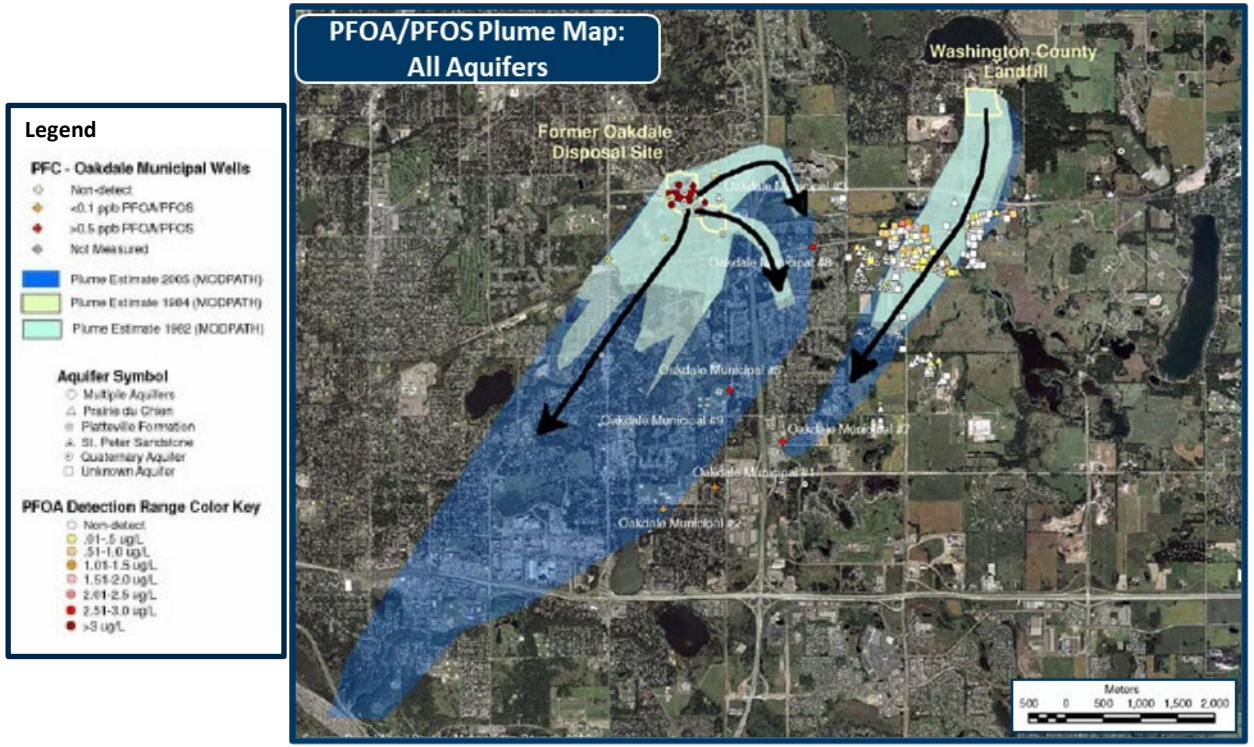
End Goal:

Develop a feasibility study to address PFAS impacts in groundwater, surface water, and sediment.

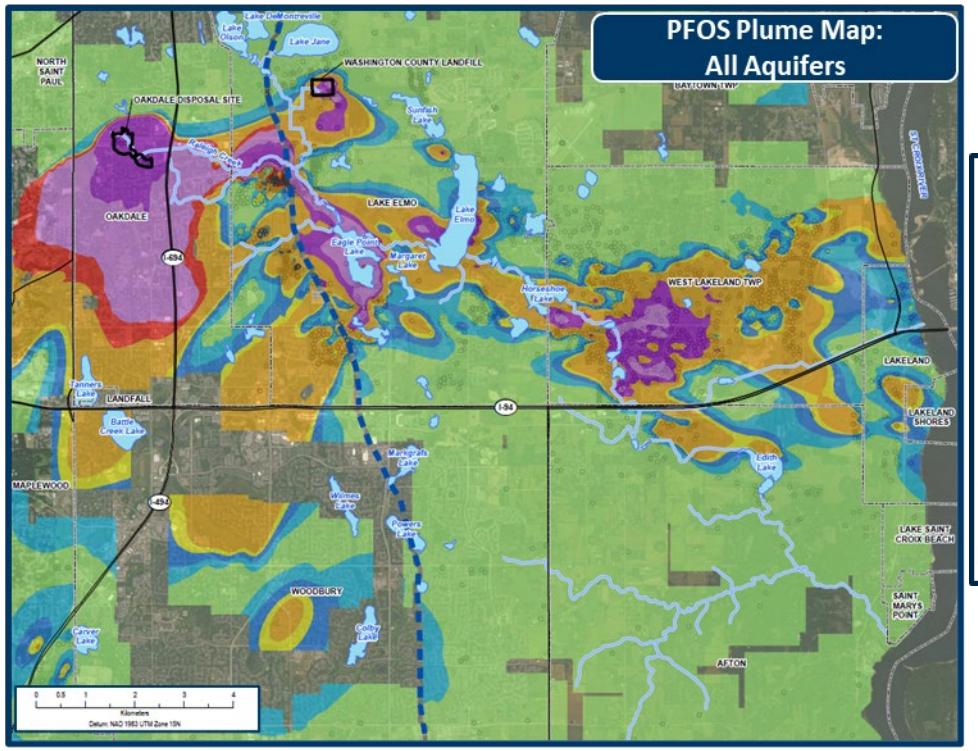
*MBWA = Multi-Benefit Well Array

Evolving Conceptual Site Model and Next Steps

Initial Conceptual Site Model: 2005



Revised Conceptual Site Model: 2021



Next Steps

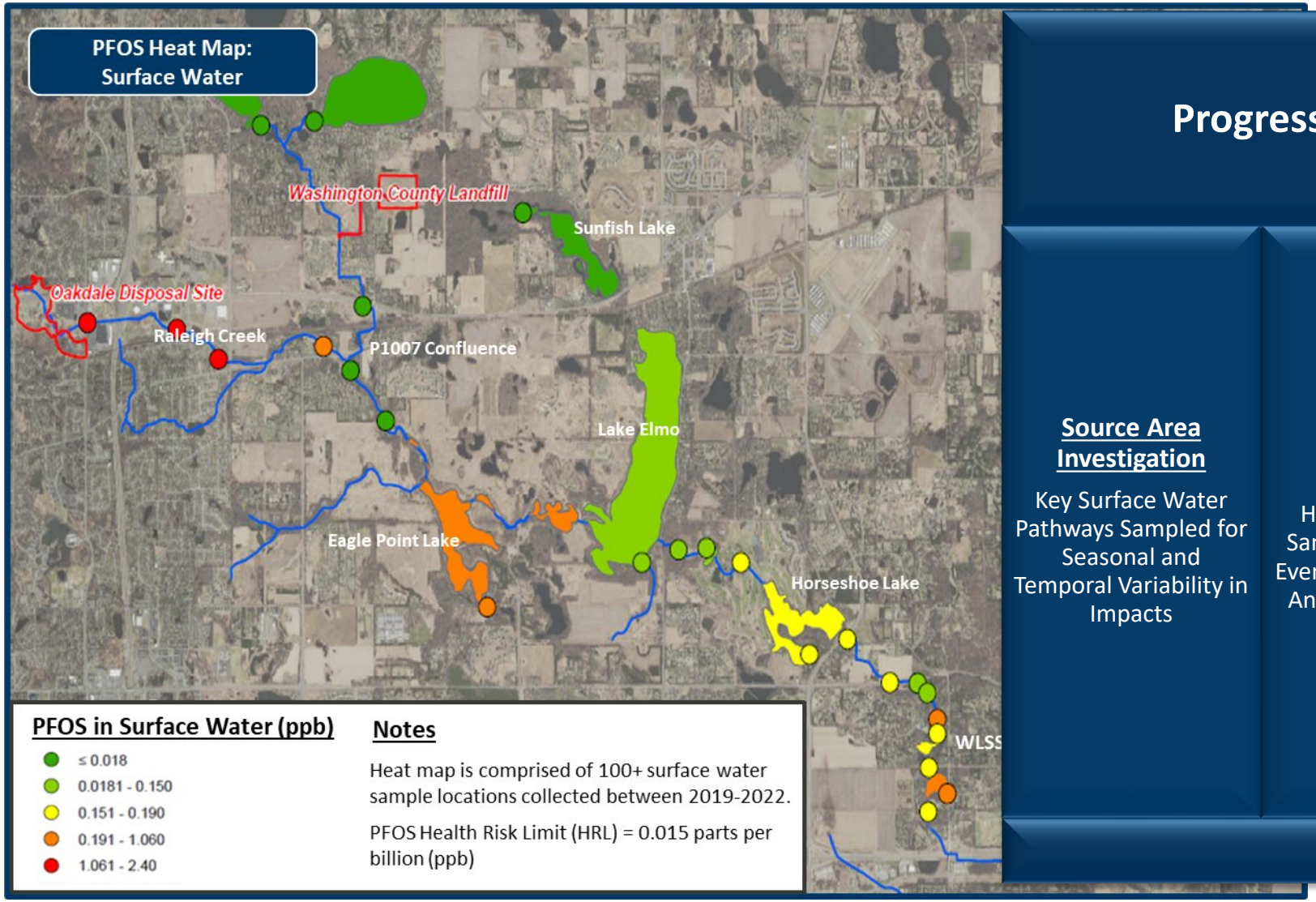
Continued Data Collection
- Routine and Targeted Sampling
- Additional Multi-Aquifer Well Nests

Refinement of Conceptual Site Model
- Integrated Surface Water and Groundwater Model
- 3D Modeling

Surface Water Treatment
- Feasibility Study
- Bench-Scale and Pilot Testing
- Implementation in Multiple Locations

Long-Term Drinking Water Protection
- Aquifer Tests
- Multi-Benefit Well Array Reconfiguration
- Feasibility Study

PFAS in Surface Water: Results and Approach Going Forward



Progress To Date and Current Strategies

Source Area Investigation

Key Surface Water Pathways Sampled for Seasonal and Temporal Variability in Impacts

Hydrologic Assessment

High vs Low Flow Sampling + Gauging Events in Partner with Analytical Sampling

Fate and Transport: Targeted Sampling

Targeted Water Body and Wetland Sampling to Identify Secondary Source Areas

Remedial Approach: Targeted Sampling

Water Body Sampling for Evaluation of Remedial System Implementation

Updated Aquifer-Specific PFAS Plume Map: Key Drinking Water Aquifer

Plume Assessment in Key Drinking Water Aquifers

Aquifer-specific plume maps developed based on investigation work and comprehensive reassessment of available historic analytical and hydrogeologic data.

Key Improvements

Expanded and Refined Plume Delineation

Corrected Aquifer Divide and Flow Pathways

Plume mapping is key to determining optimal solutions for preventing further PFAS migration and addressing currently contaminated drinking water supply.

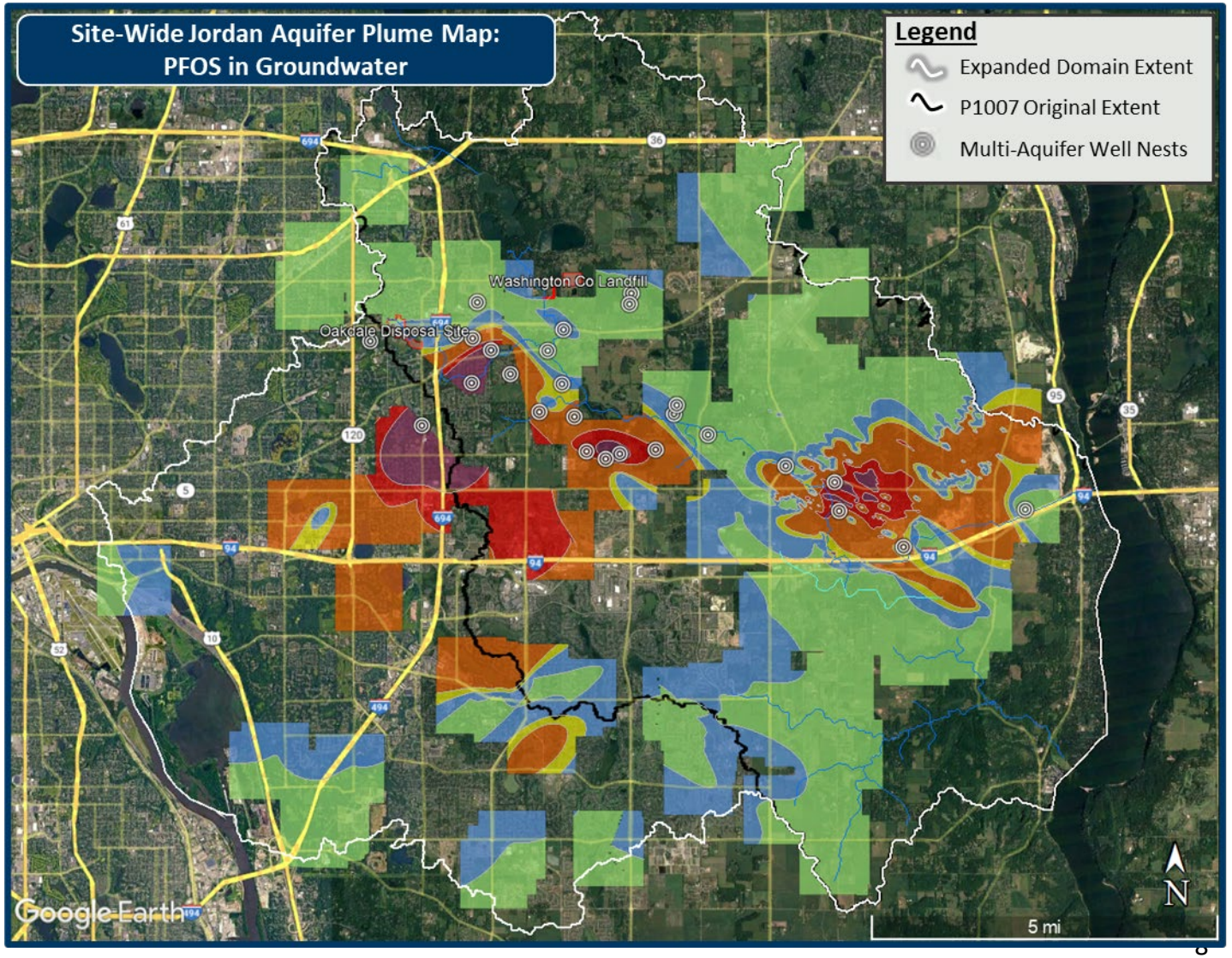
PFOS in Groundwater (ppb)

- PFOS greater than 50x HRL (>0.75 ppb)
- PFOS 10-50x HRL (0.15 – 0.75 ppb)
- PFOS 5-10x HRL (0.075 – 0.15 ppb)
- PFOS 1-5x HRL (0.015 – 0.075 ppb)
- PFOS 75-100% HRL (0.0112 – 0.015 ppb)
- PFOS 50-75% HRL (0.007 – 0.0112 ppb)
- PFOS not detected

Notes

Blank areas indicate insufficient well data to generate plume imagery (i.e., no wells within 0.5 miles).

PFOS Health Risk Limit (HRL) = 0.015 parts per billion (ppb)



Remaining Data Gaps: Planned Monitoring Well Installation

Map Features

- Multi-Aquifer Well Nests
- New Well Nests
- Planned Well Nests
- Groundwater Divide

PFOS in Groundwater (ppb)

- PFOS greater than 50x HRL (>0.75 ppb)
- PFOS 10-50x HRL (0.15 – 0.75 ppb)
- PFOS 5-10x HRL (0.075 – 0.15 ppb)
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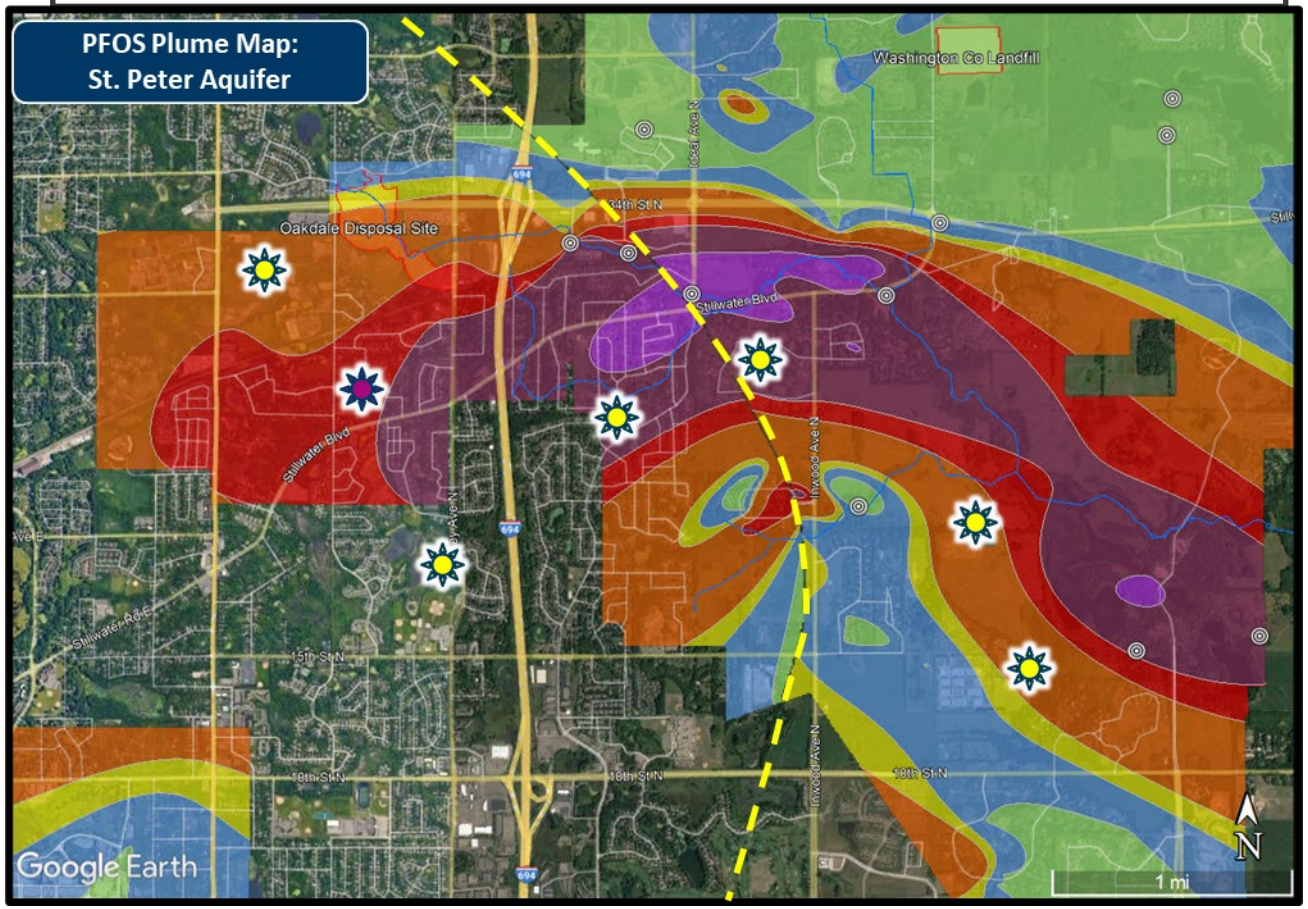
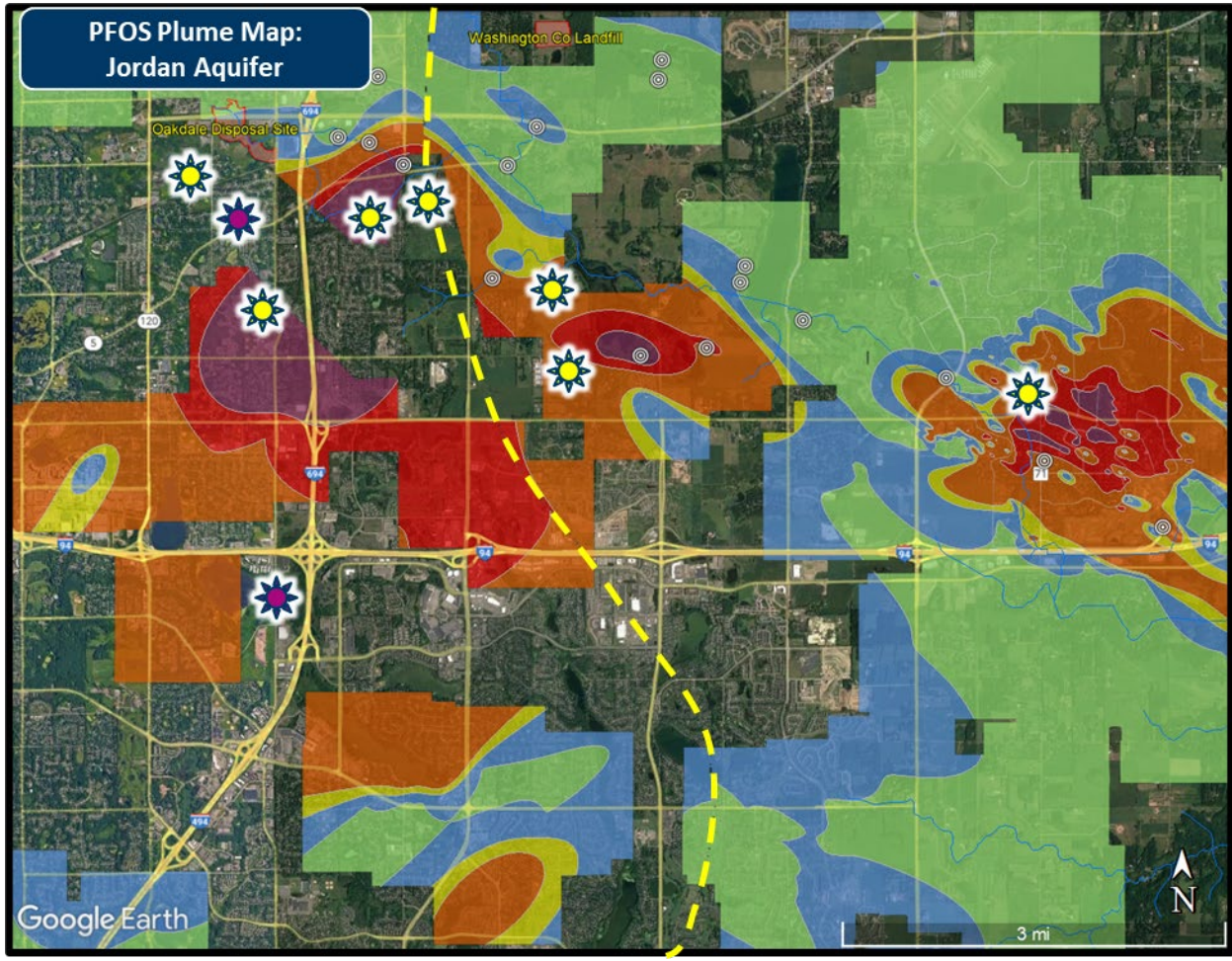


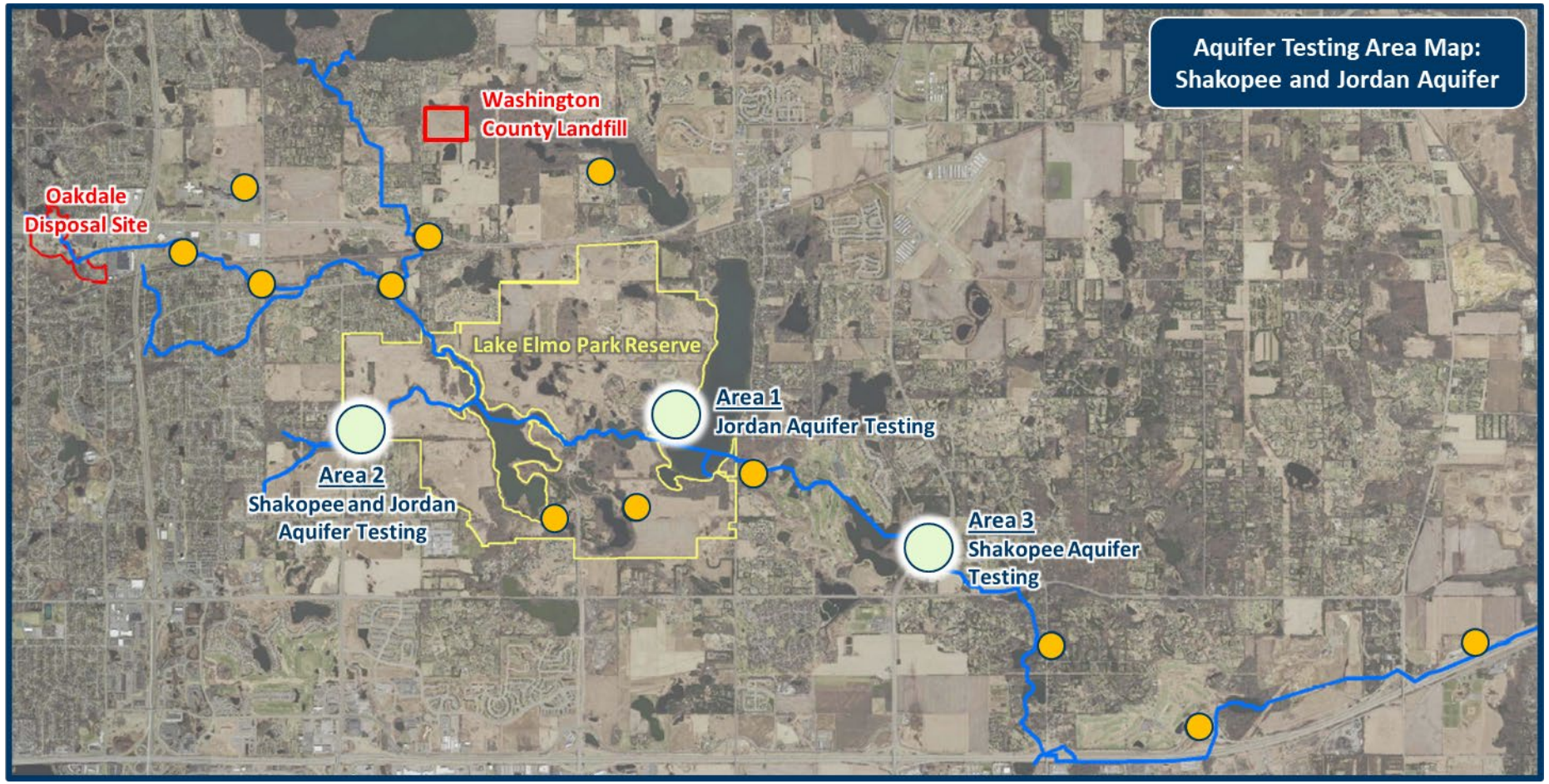


Timeline

Expected Completion of Well Installation by End of CY 2022

Expected Completion of Routine Well Sampling by End of CY 2023

Completed and Planned Aquifer Testing



P1007 Completed and Planned Aquifer Tests

Area 1: Central Portion of Corridor
Jordan Aquifer Test - Completed, September 2021

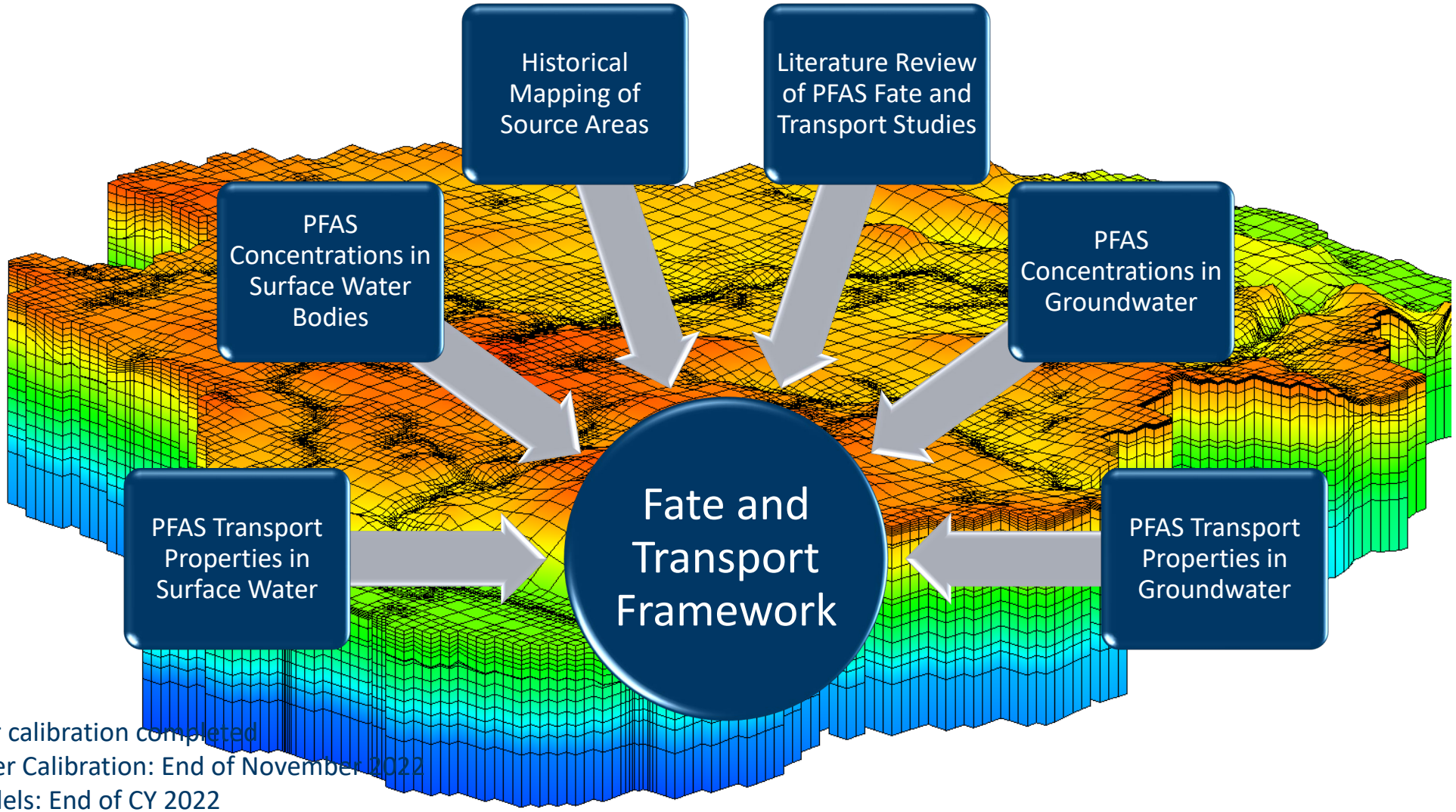
Area 2: Western Portion of Corridor
Jordan Aquifer Test - Completed, November 2021
Shakopee Aquifer Test - Planned

Area 3: Eastern Portion of Corridor
Shakopee Aquifer Test – Completed, September 2022

Timeline
Expected Completion of Well Installation for Aquifer Tests by End of CY 2022
Expected Completion of Aquifer Testing, Assessment, and Final Reporting by Summer CY 2023

Map Features
- Existing Multi-Aquifer Well Nests (Beta Sites)
- Planned Aquifer Testing Locations
- Extent of Lake Elmo Park Reserve

PFAS Fate and Transport Model



Timeline

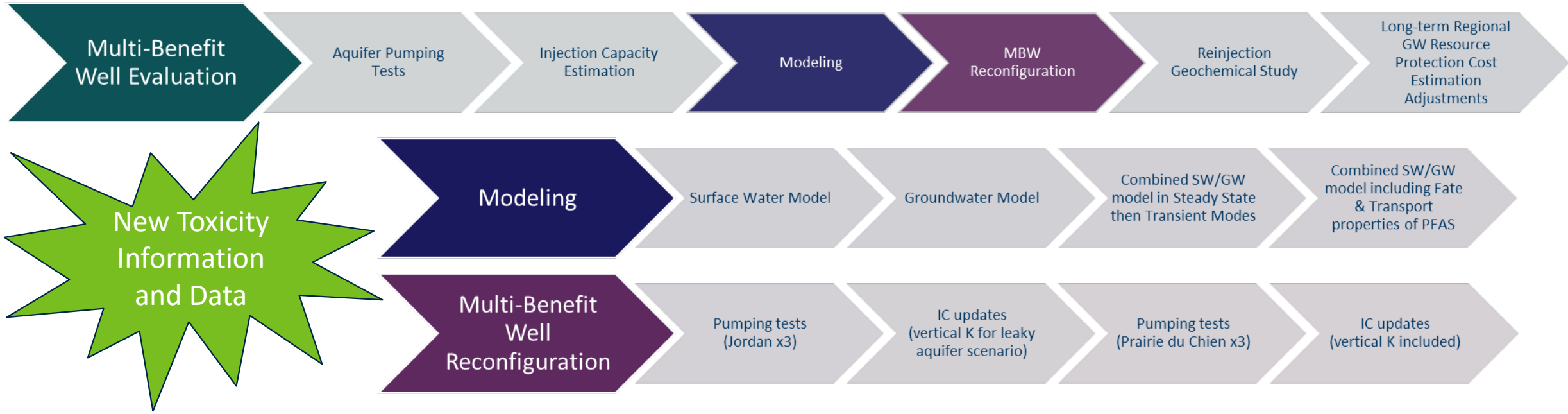
Groundwater layer calibration completed

Surface Water Layer Calibration: End of November 2022

Integration of Models: End of CY 2022

Drinking Water Protection: Multi-Benefit Well Conceptual Design Framework

Multi-Benefit Wells (MBWs) are wells designed to obtain remedial objectives while providing municipal supply to achieve long-term regional groundwater resource protection goals.



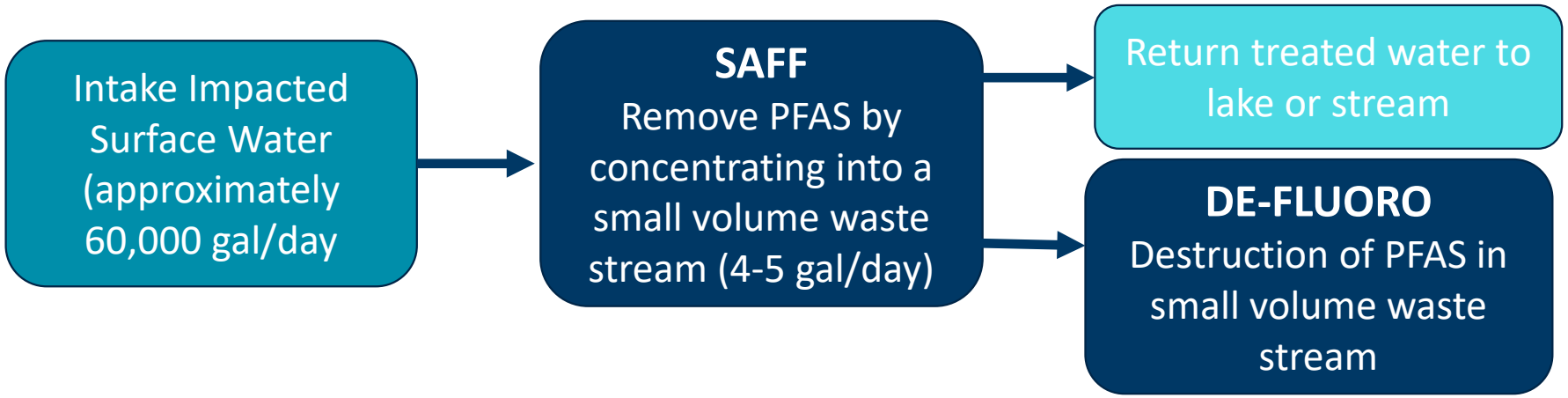
Groundwater and Surface Water Treatment Pilot Study

Goals

Operate the PFAS removal system at locations of varying PFAS concentrations, water chemistry, and flow conditions

Evaluate system performance to determine optimal operational parameters

Determine if removal and destruction efficiency would be applicable as a full-scale treatment approach



SAFF and DE-FLUORO pilot test results will be presented in the feasibility study and compared to other surface water treatment options

2-Part Pilot Study

Surface Activated Foam Fractionation
Electrochemical Oxidation

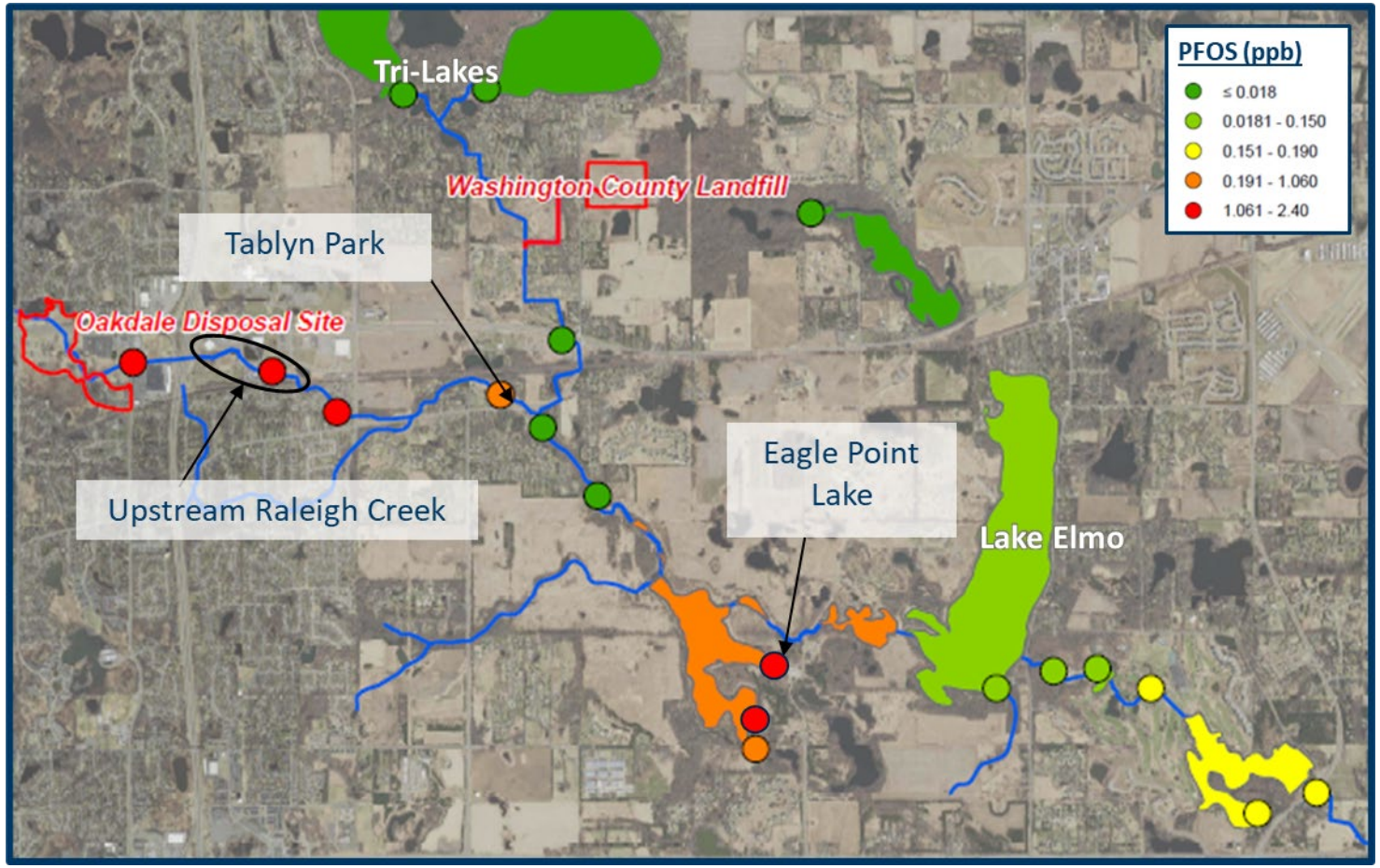
SAFF

Will be located at

DEFLUORO

Will be located at

Proposed Surface Water and Groundwater Pilot Study Locations



Timeline

Planning and Design until October/November 2022
Expected Pilot Testing from November 2022 to August 2023.
Expected Assessment and Final Reporting end of CY2023.

Tablyn Park

Scheduled implementation Nov/Dec 2022

Treat groundwater from multiple aquifers and surface water in Raleigh Creek upstream of confluence during spring thaw/flow

Eagle Point Lake

Tentative implementation 2023

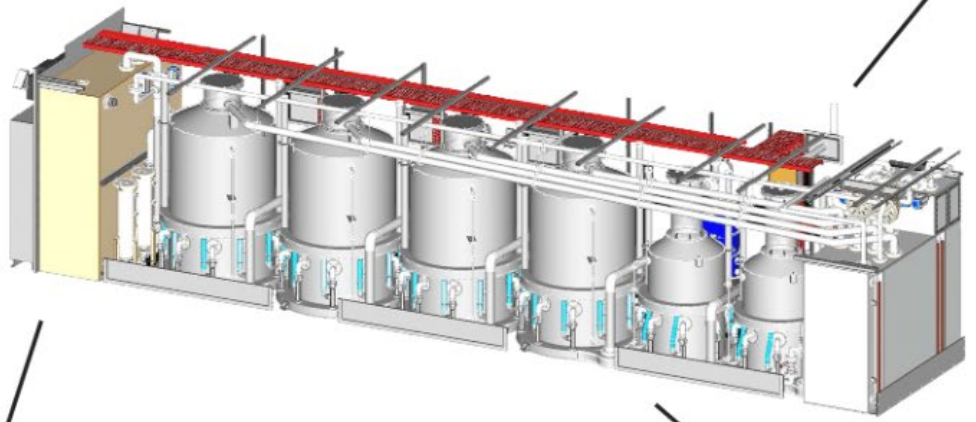
Upstream Raleigh Creek

Tentative implementation 2023

SAFF® VERSATILITY

FEED WATER

- Landfill leachate water
- Surface water
- Groundwater extraction wells
- Industrial water
- Reverse osmosis brine
- Sewage water



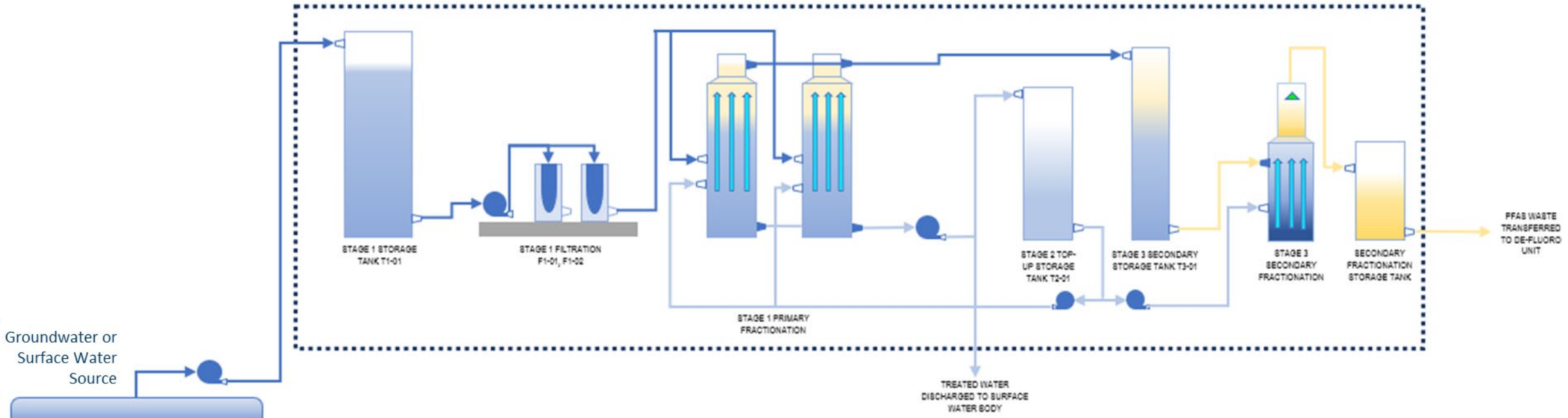
TREATED WATER USES

- Irrigation
- Aquifer reinjection
- Dust suppression
- Recycled process water
- Recycled soil wash water

SAFF PFAS WASTE DESTRUCTION

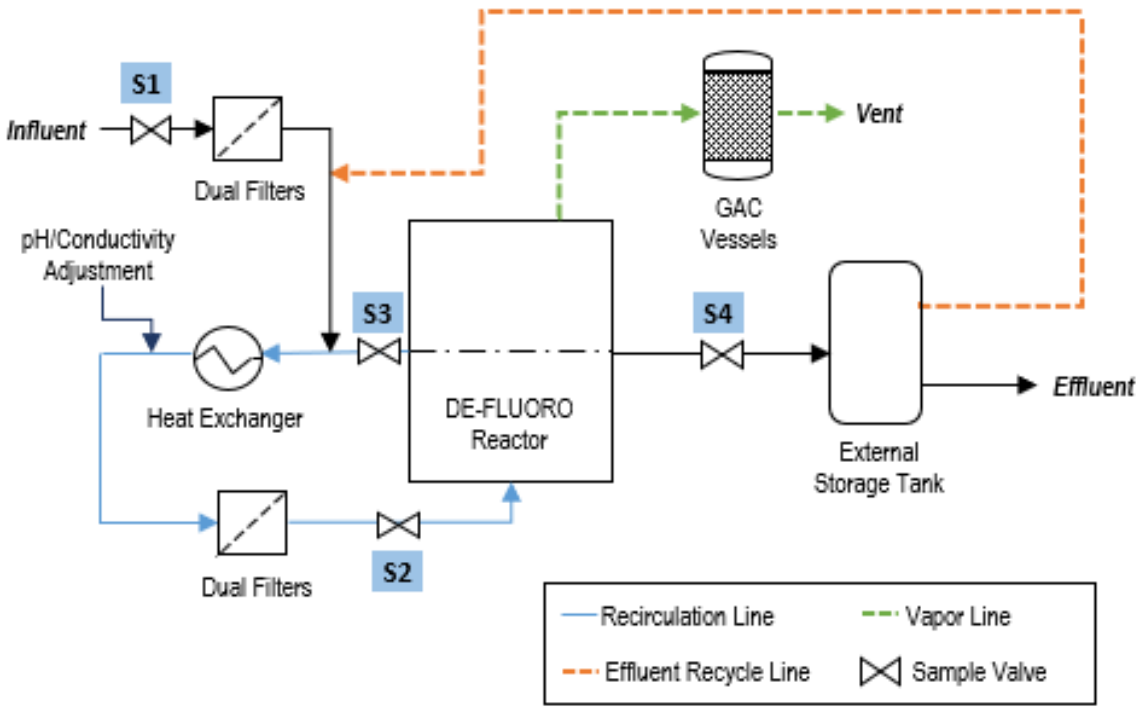
- Electrochemical oxidation
- Super critical water oxidation
- Pyrolysis

SAFF Overview



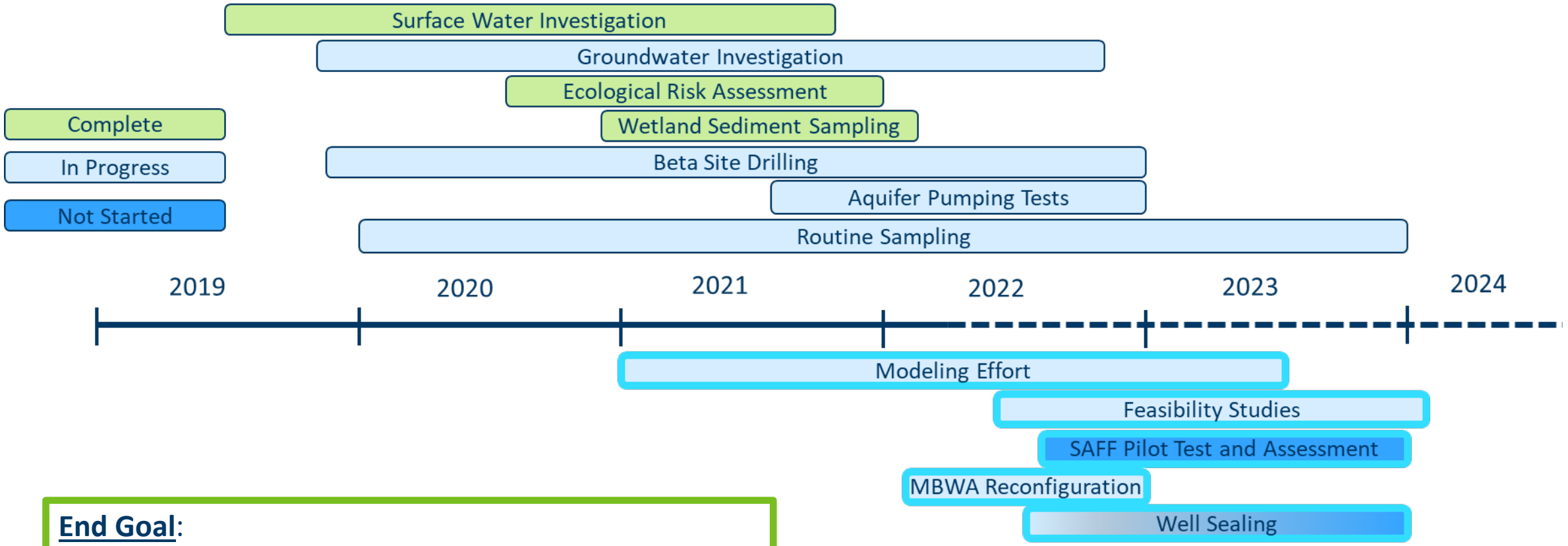
- Concentrates PFAS through foam formation
- Batch system requiring two fractionation steps
- Approximately 60,000 gallons/day treated resulting in 5 gallons/day of PFAS concentrate (referred to as secondary fractionate)

DE-FLUORO



- Utilizes electrochemical oxidation to destroy PFAS
- Adjust pH with sodium hydroxide or sulfuric acid and increase conductivity with sodium sulfite (small volume of reagents stored on site)
- Multiple cycles through reactor may be required to increase destruction efficiency; determined during startup testing
- Effluent fully characterized and evaluated for returned to SAFF system for further fractionation, polishing and/or offsite proper disposal.

Next Steps Timeline



End Goal:

Develop a feasibility study to address PFAS impacts in groundwater, surface water and sediment.

Project 1007 Partners:

DNR, MDH, MGS, UofM, VBWD, EPA ORD, East Metro Cities, Washington County, Met Council and Settlement Work Groups

Consultant: AECOM

Laboratory: AXYS SGS