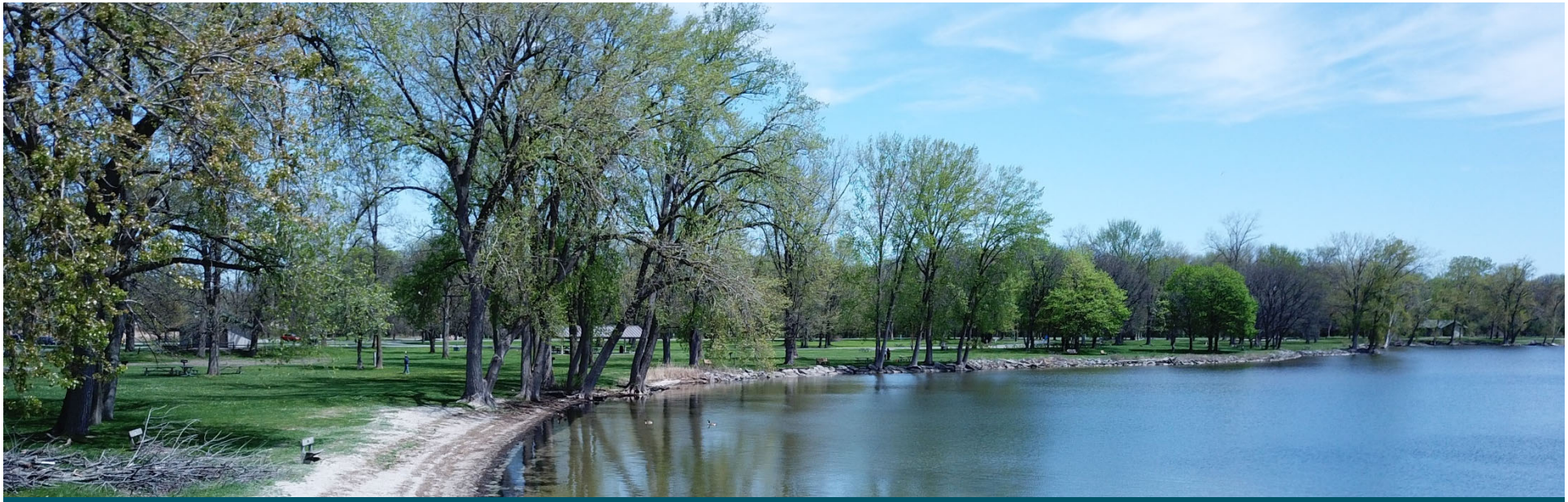

MNR at Onondaga Lake: Good Things Come to Those Who Wait

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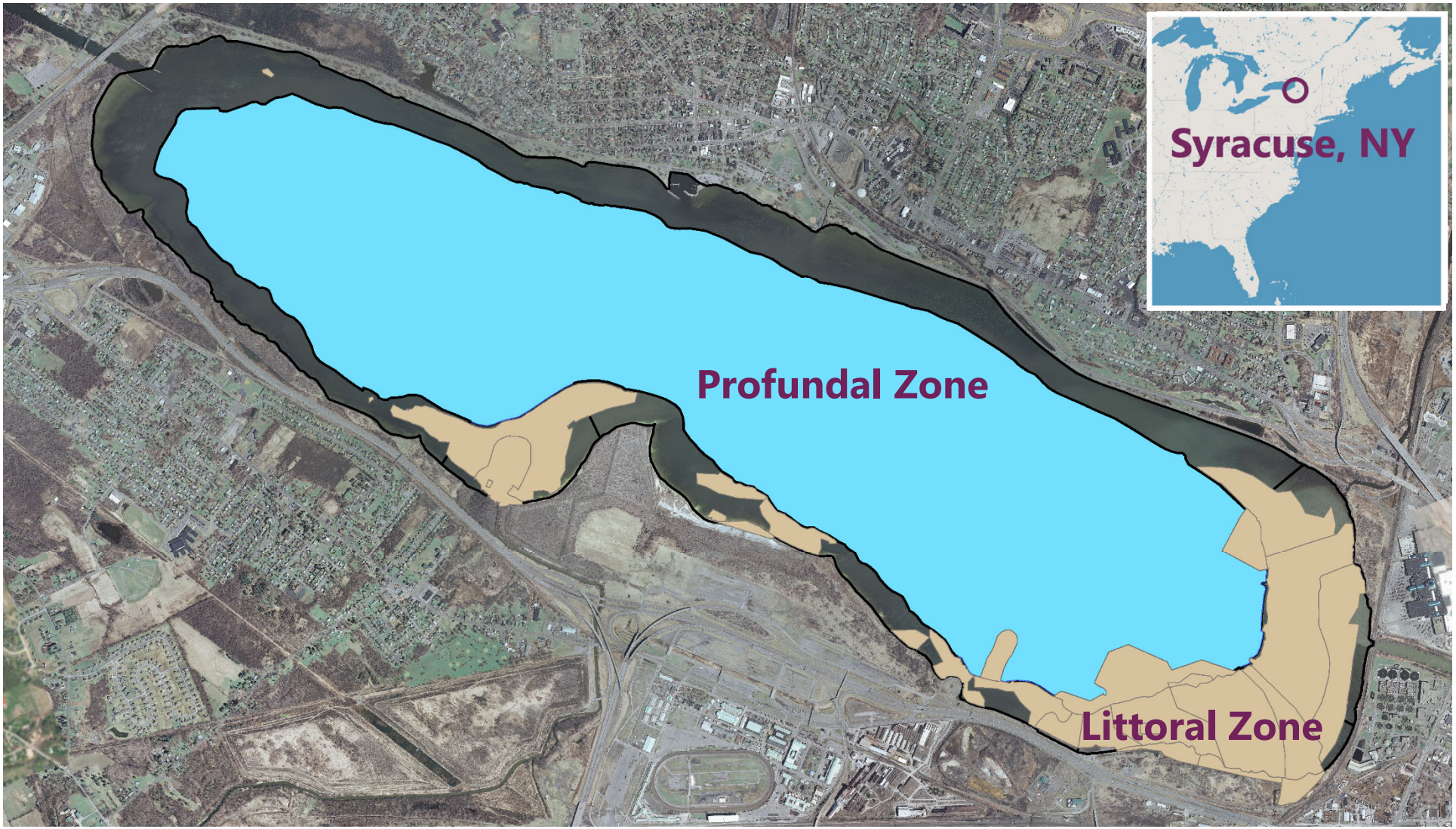
Overview

- Background/description of remedy
- Progress of natural recovery
  - Year 1 post-remedy monitoring
- Evaluation of rate of recovery

Onondaga Lake Remediation



The Remedy

Dredging

Habitat Restoration

Capping

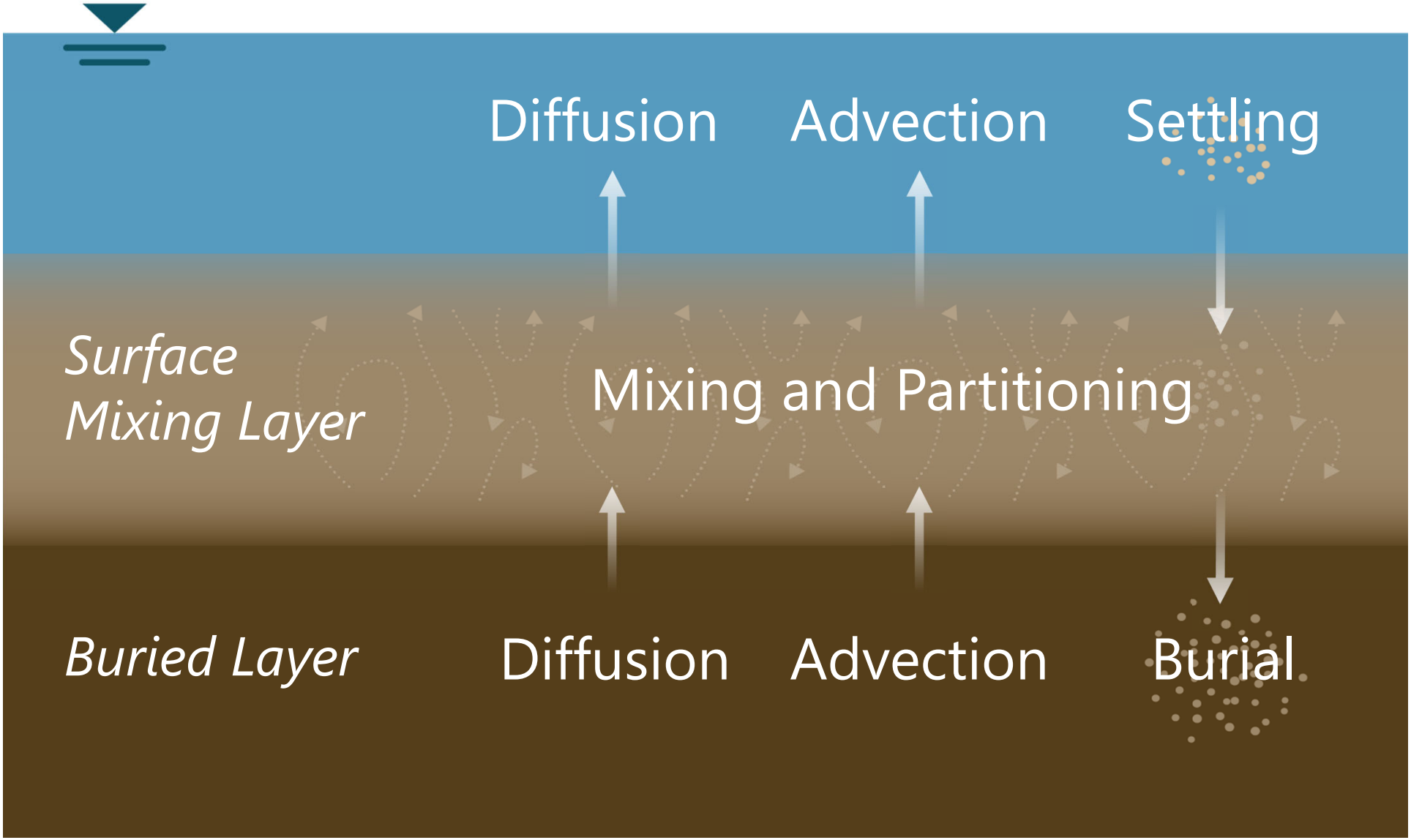
Source Control

Nitrate Addition and MNR

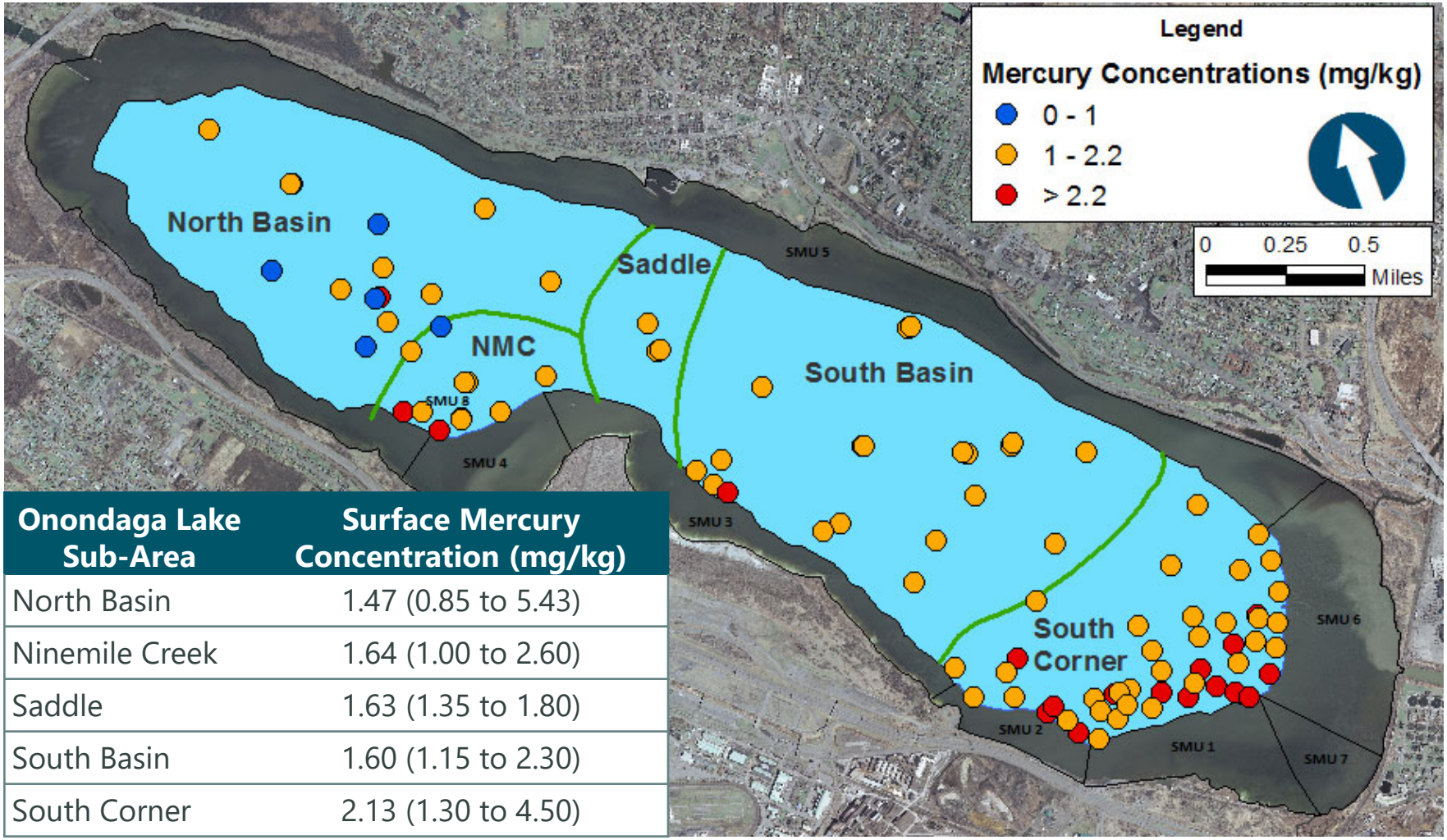
MNR Requirements

- Achieve MNR performance criteria within 10 years following remediation
  - Mercury concentrations less than 2.2 mg/kg in surface sediments on point-by-point basis
  - Mercury concentrations in surface sediment less than 0.8 mg/kg on an area-wide basis

Natural Recovery Modeling Conducted to Support Remedial Design



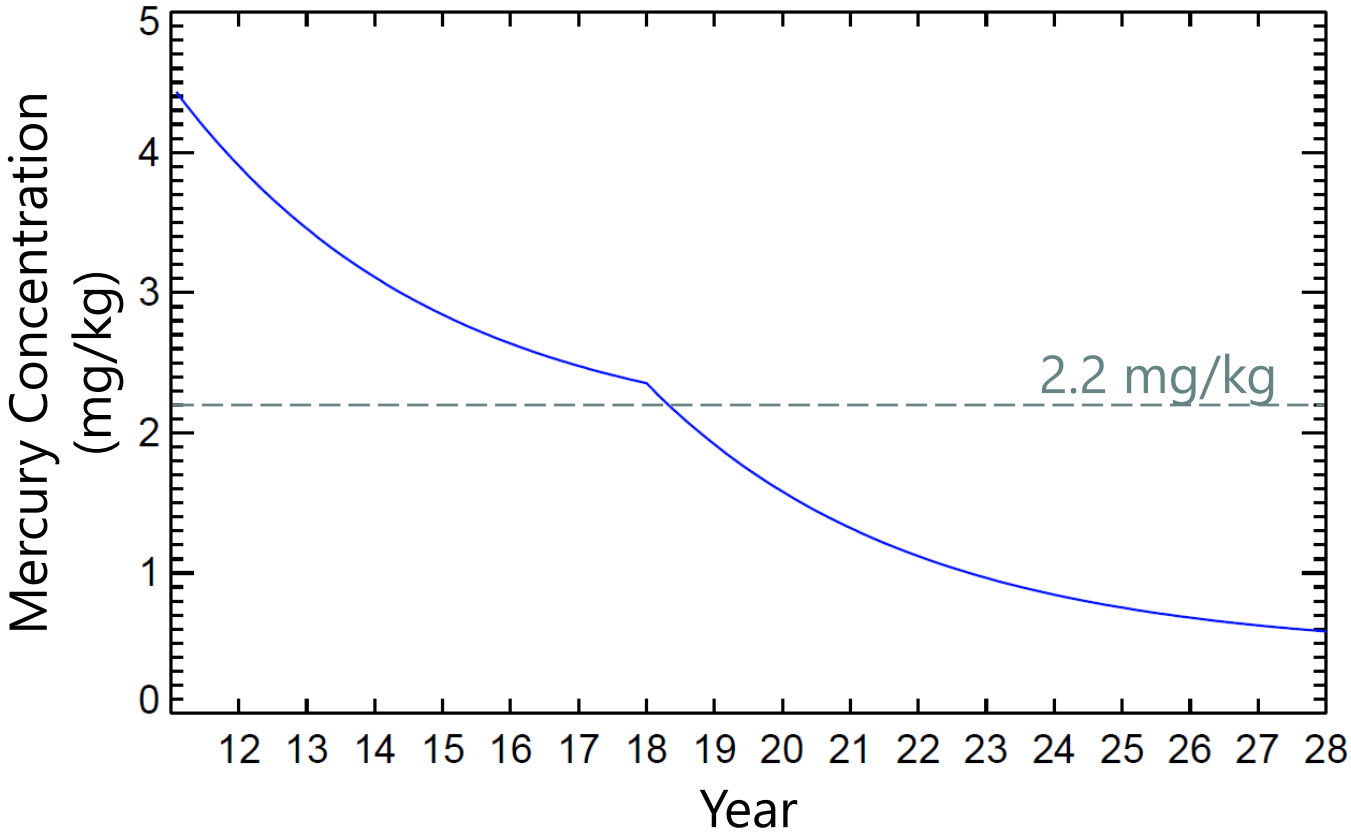
Pre-Remedy Sediment Mercury Concentrations in Profundal Zone (2007 to 2011)



Onondaga Lake Sub-Area	Surface Mercury Concentration (mg/kg)
North Basin	1.47 (0.85 to 5.43)
Ninemile Creek	1.64 (1.00 to 2.60)
Saddle	1.63 (1.35 to 1.80)
South Basin	1.60 (1.15 to 2.30)
South Corner	2.13 (1.30 to 4.50)

Model Projections

Example: South Corner (OL-VC-80220)



Predicted to meet PEC of 2.2 mg/kg mercury at all locations by year 2018.

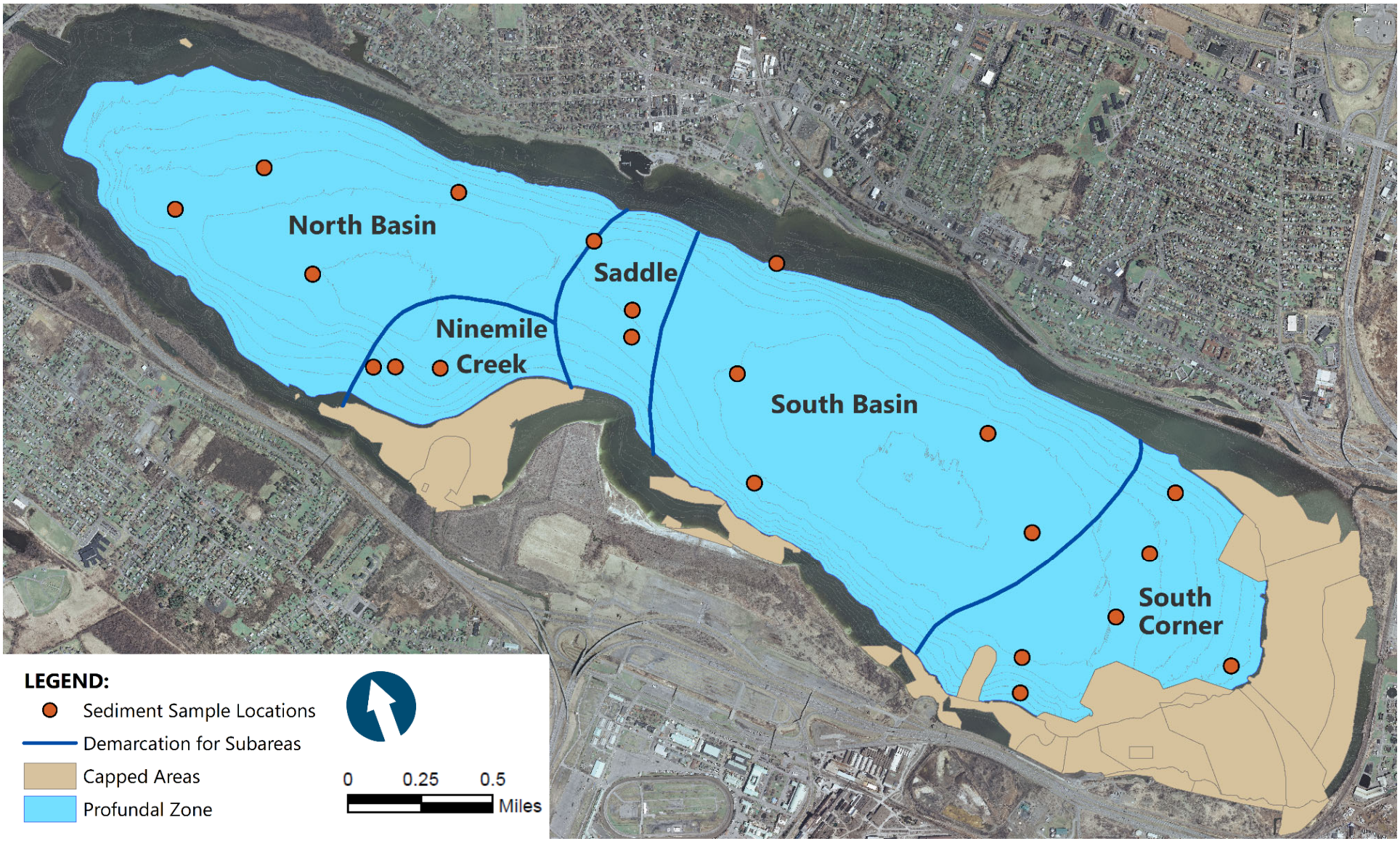
In-Lake Remedy Timeline

2011	
2012	Final Design Approved Capping and Dredging Begins
2013	
2014	Dredging Complete (2.2 million cubic yards)
2015	
2016	Capping Complete (3.1 million cubic yards placed)
2017	Year 1 Performance Monitoring
2018	

Tracking Progress of MNR

- Measure mercury concentrations of profundal zone surface sediments
  - Compare to predictions from modeling
- Measurements to confirm mechanisms of natural recovery
  - Mixing depth
  - Sedimentation rates
  - Mercury concentration of depositing particles (via sediment traps)

2017 Sediment Monitoring Locations



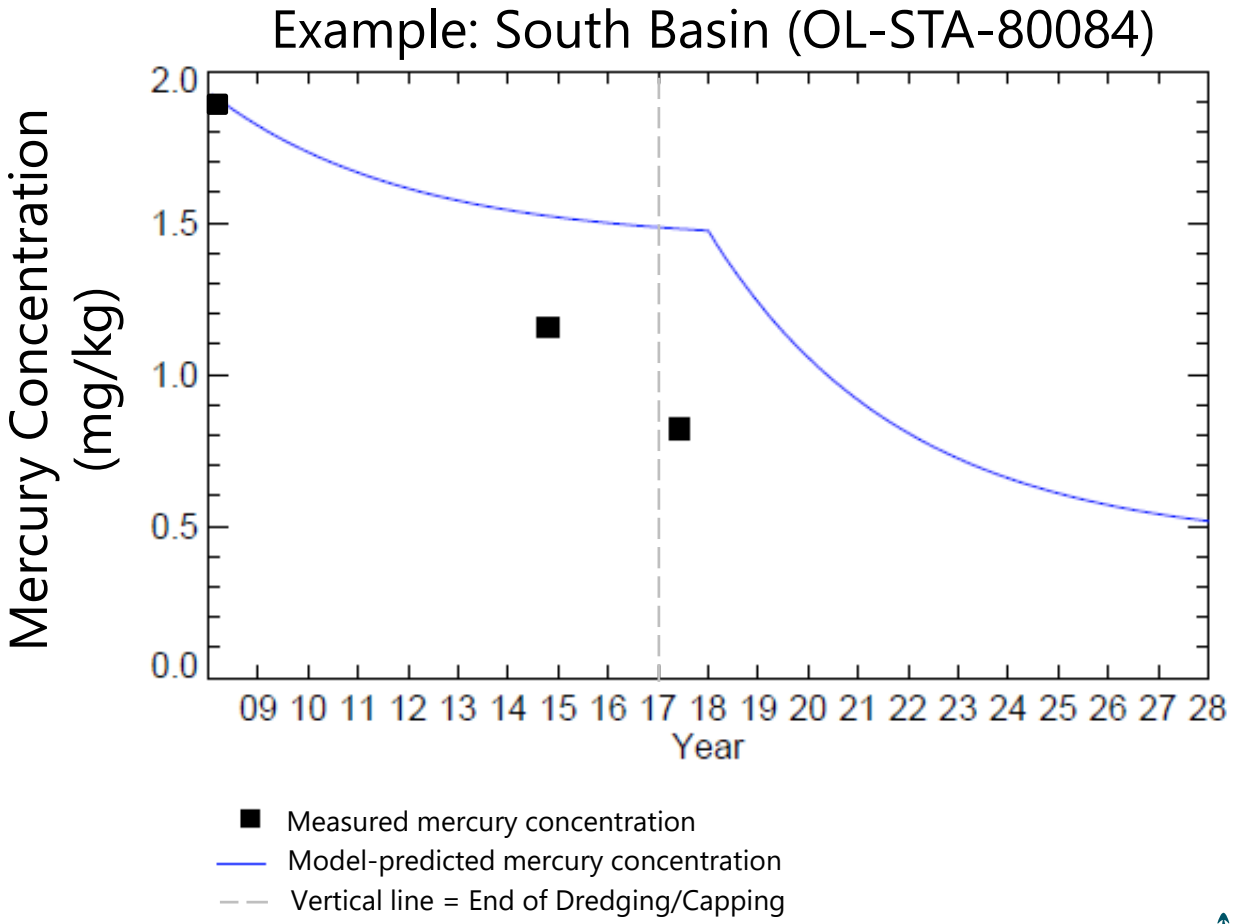
Chemical Monitoring: Year 1 Post-Remediation

Area	No. Sample Locations	Minimum Mercury Concentration (mg/kg)	Maximum Mercury Concentration (mg/kg)
North Basin	4	0.57	0.70
Ninemile Creek Outlet	3	0.44	1.1
Saddle	3	0.55	1.0
South Basin	6	0.57	0.91
South Corner	6	0.41	1.4

Note:
mg/kg: milligram per kilogram

Compliance Monitoring

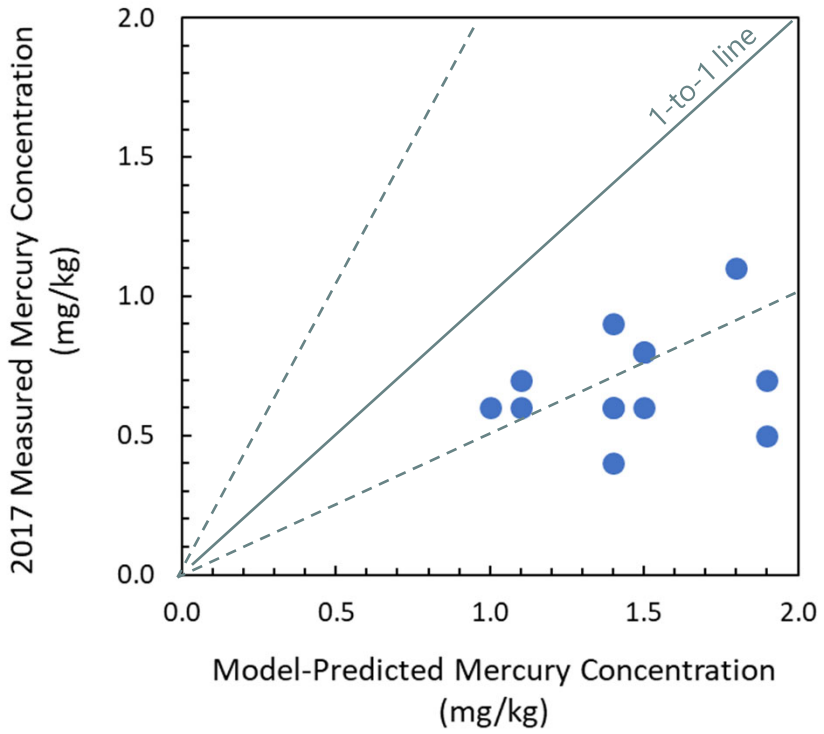
- Year 1 post-remediation chemical monitoring compared to model predictions



Compliance Monitoring

- Recovery occurring faster than predicted
- Mercury concentrations less than 2.2 mg/kg at all 22 Year 1 Post-Remedy sampling locations

Year 1 Measured Mercury Concentrations versus Model-Predicted Mercury Concentrations for the Same Year



Why is the profundal zone recovering faster than predicted?

Tracking Progress of MNR

- Measurements to confirm mechanisms of natural recovery
  - Mixing depth
    - Thickness of laminations from frozen cores
  - Sedimentation rates
    - Depth to microbead marker
    - Accumulation of sediment in sediment traps
  - Mercury concentration of depositing particles (via sediment traps)

Mixing Depth

- Laminations in cores collected post-remedy indicate mixing is less than assumed in modeling
  - Thickness of first lamination ranges from 0.1 to 3 cm, with an average of 0.67 cm
  - 4 cm mixing in the model is conservative

Sedimentation

- Sedimentation within range evaluated with MNR model
- Depth to microbead marker
  - 1.2 to 10.4 cm (average of 4.8 cm)

$$S = \frac{T}{t} \times \rho_b$$

S = sedimentation rate (g/cm^2/year)

T = thickness of sediment accumulation (cm)

t = time over which accumulation occurred (years)

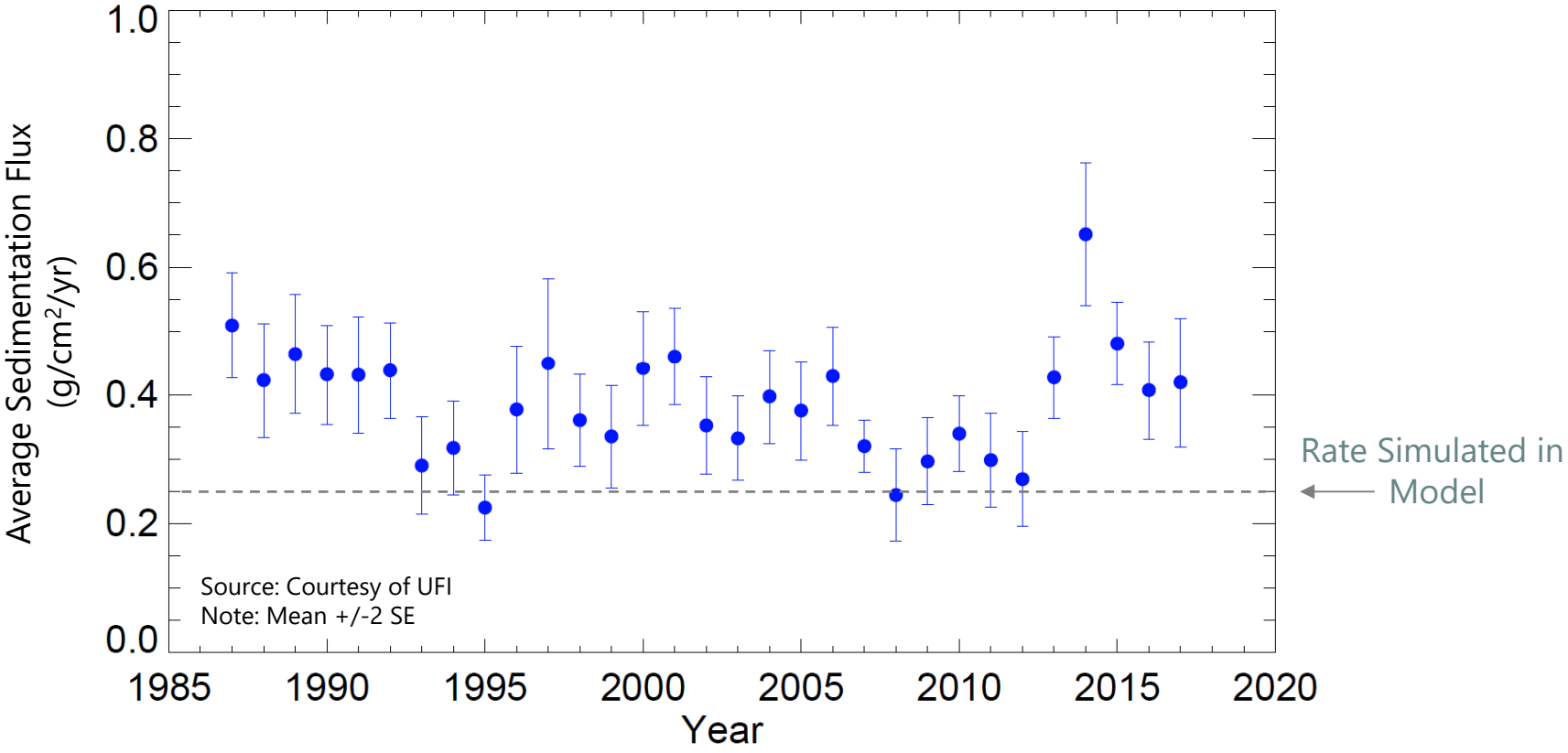
Pb= dry bulk density (g/cm^3)

  - Average 0.14 g/cm^2/year
  - Range 0.04 to 0.32 g/cm^2/year


Example: Core OL-MB-80098-A

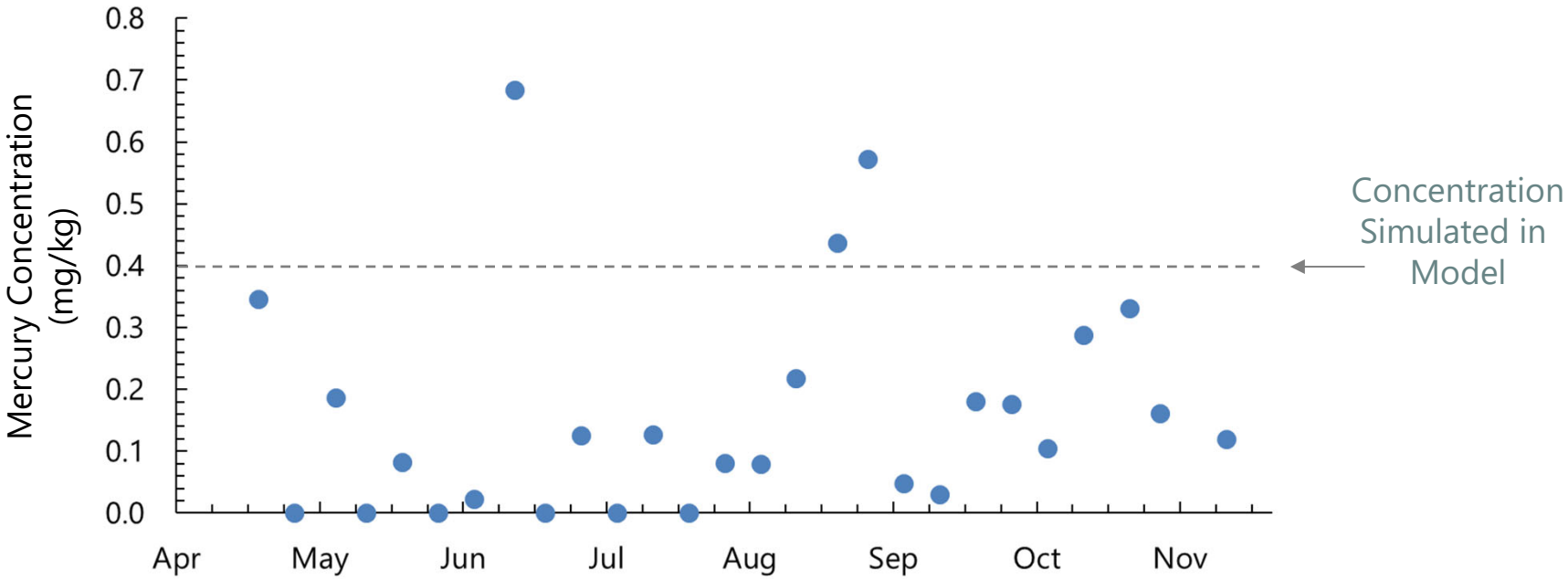
Sedimentation

- Sediment traps



Concentrations of Depositing Particles

- Sediment traps
  - Post-remedy concentrations on depositing particles lower than the assumed value of 0.4 mg/kg mercury used in the model to represent post-construction conditions



Summary

- Recovery is ahead of schedule
- Likely contributing factors relative to model assumptions
  - Lower average mixing depths
  - Similar or possibly higher average sedimentation rates
  - Lower concentrations on depositing particles
- Natural recovery at contaminated sediment sites often underestimated
- Continue monitoring
  - Next routine monitoring event to occur in 2020

Questions/Discussion