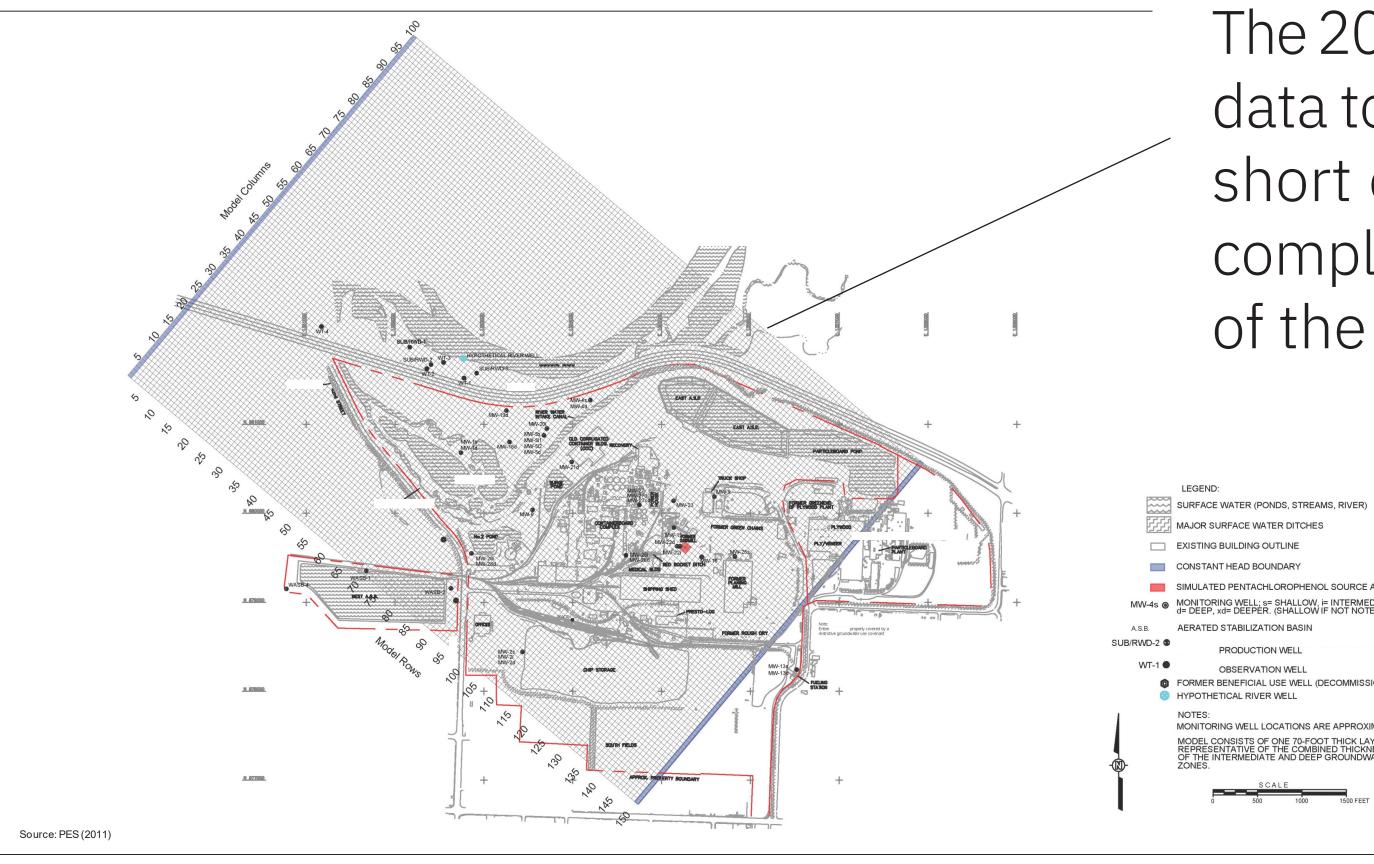
Ongoing Use of Fate and Transport Modeling to Support a Successful Natural Attenuation Remedy for PCP in Groundwater: A 10-Year Perspective

David Livermore, Integral Consulting Inc.

Addressing model inaccuracies

In 1999, an analytical model predicted pentachlorophenol (PCP) plume attenuation below the cleanup objective in 12 years. However, attenuation to below the cleanup objective did not occur. A 2011 MODFLOW/MT3D model predicted a 65-year attenuation time frame, raising concerns from state regulators about the protectiveness of the natural attenuation approach.

Integral identified flaws in the 2011 model and was tasked to build a robust and defensible model for PCP plume attenuation predictions to support decision-making.



The 2011 model generalized data to a single layer, falling short of encapsulating the complex geological system of the site.

MODEL CONSISTS OF ONE 70-FOOT THICK LAYER REPRESENTATIVE OF THE COMBINED THICKNESSES OF THE INTERMEDIATE AND DEEP GROUNDWATER

Refining the conceptual site model (CSM)

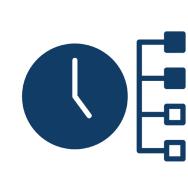
Our team conducted a detailed refinement of the CSM, with the goal to:



Understand the multilayered, unconsolidated, alluvial sediments at the site underlain by volcanic bedrock



Understand the key regional and local hydrogeologic factors affecting the groundwater flow system

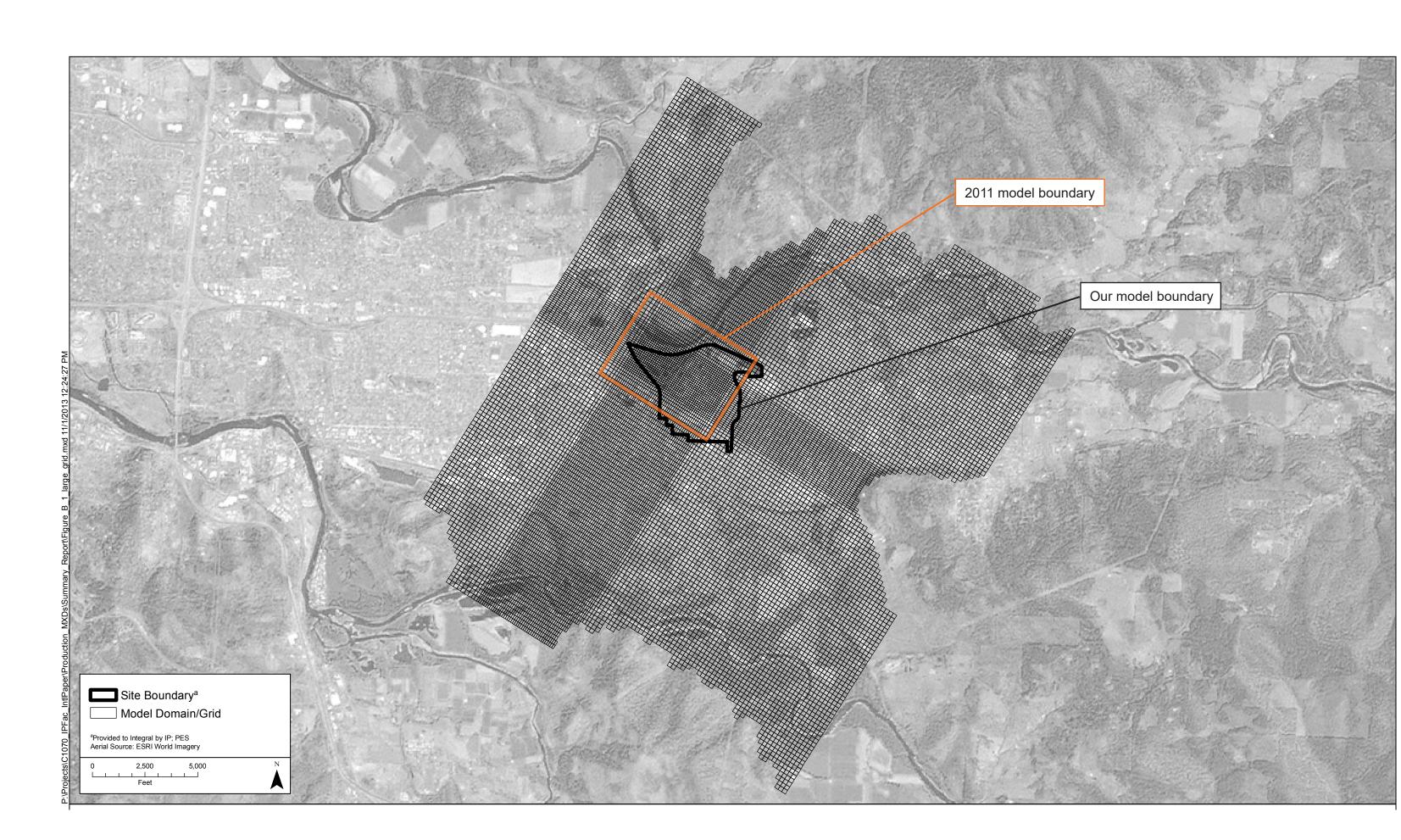


Estimate the initial PCP source, remediation timeline, and contaminant loading rates to groundwater

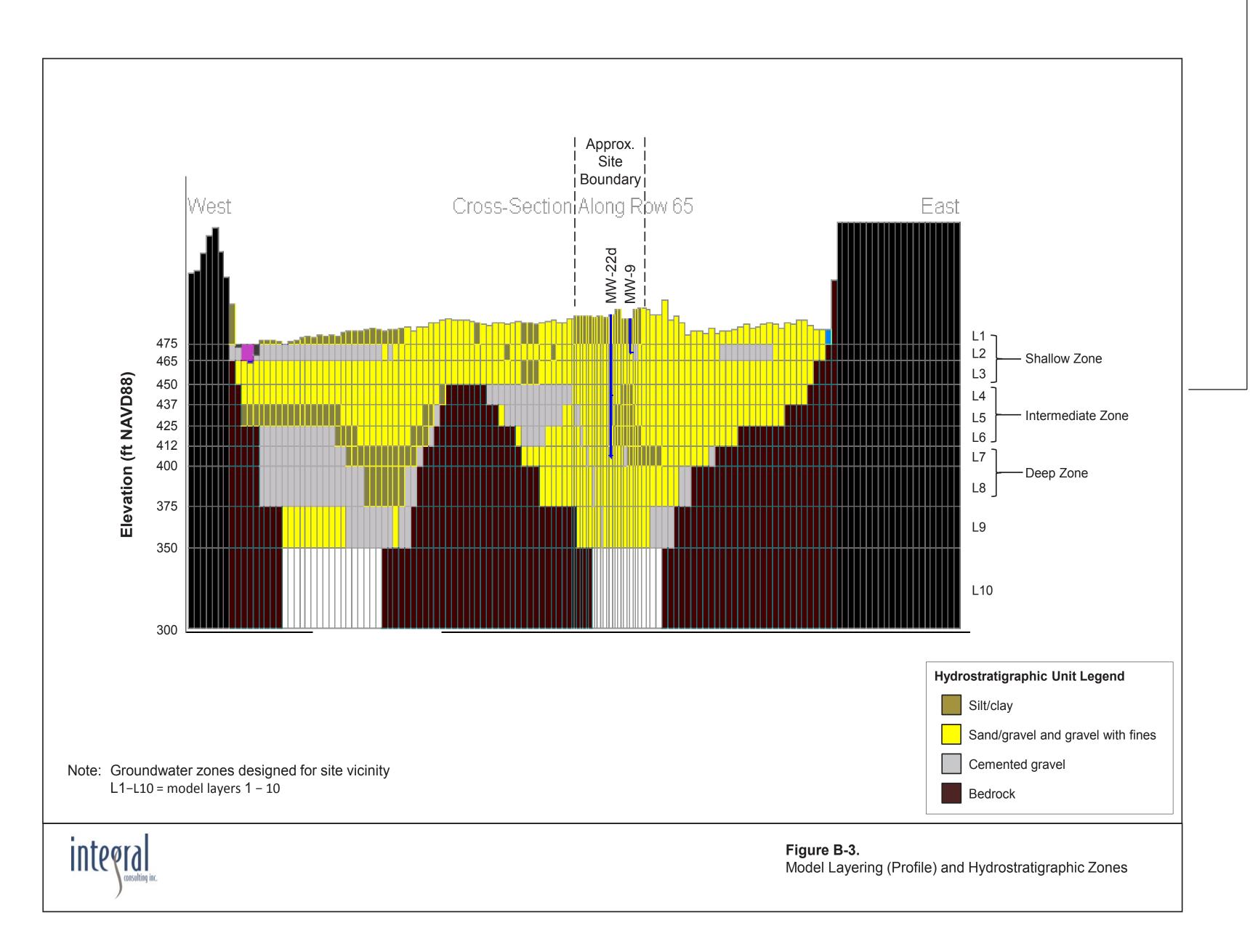


Assess changes in the 3-dimensional PCP plume over time

Our revised 11-layer, 3-dimensional numerical fate and transport model



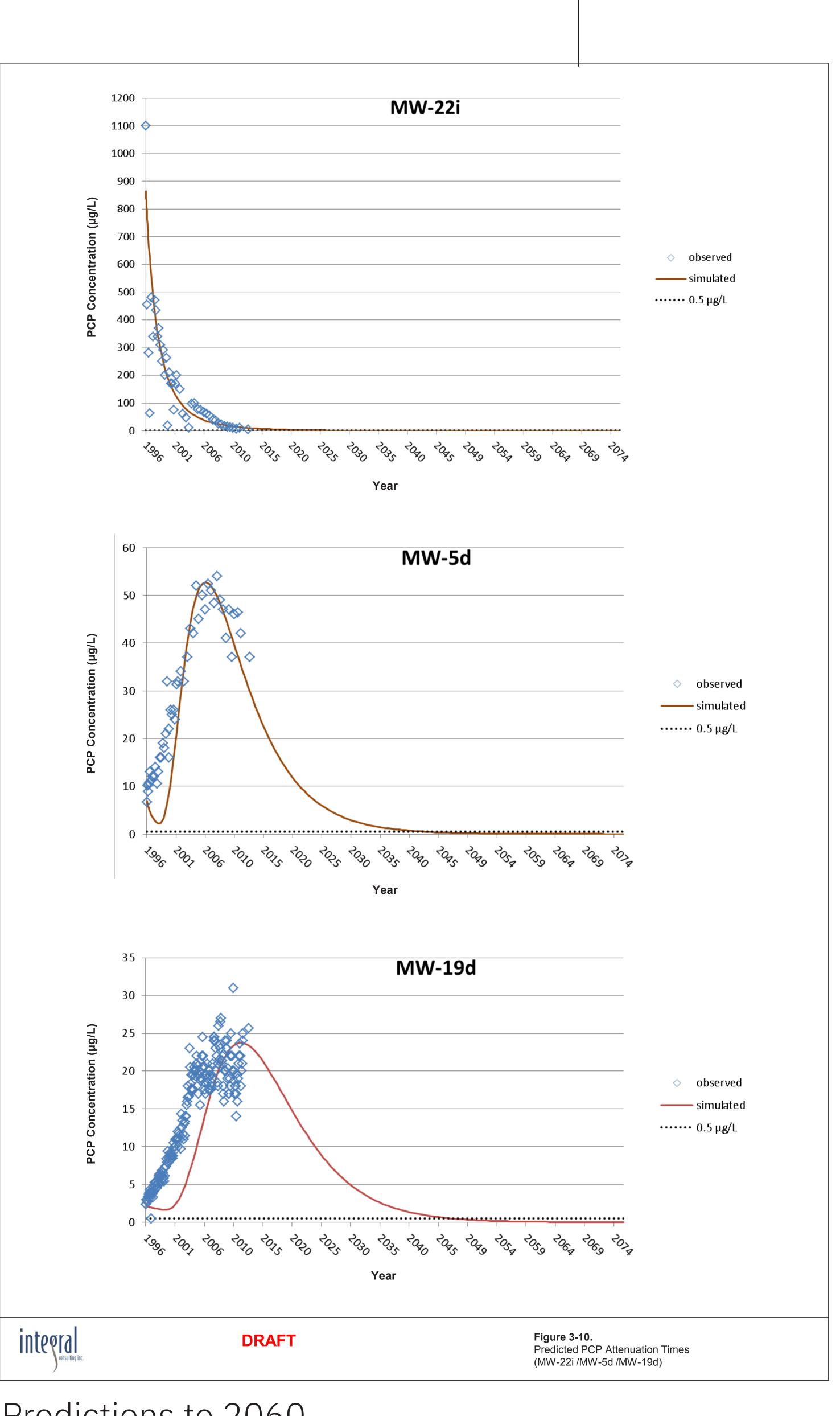
Map View of Our 11-layer Model (2011 Boundary Shown for Comparison)



Model Layering (Profile) and Hydrostratigraphic Zones

Model simulation results

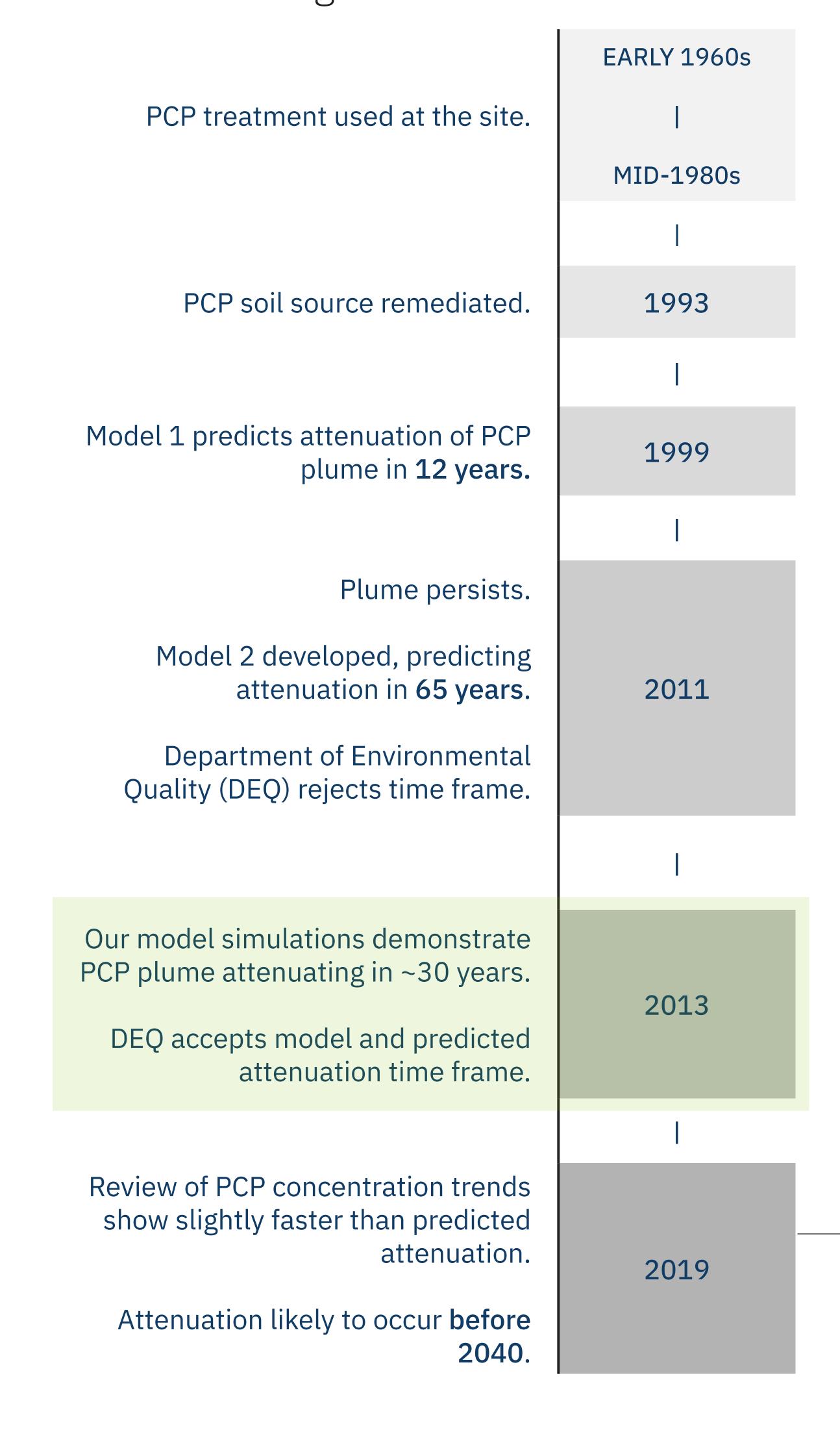
Simulations in 2013 demonstrated that the site PCP plume would attenuate in about 30 years.



Predictions to 2060

Regulatory Approval

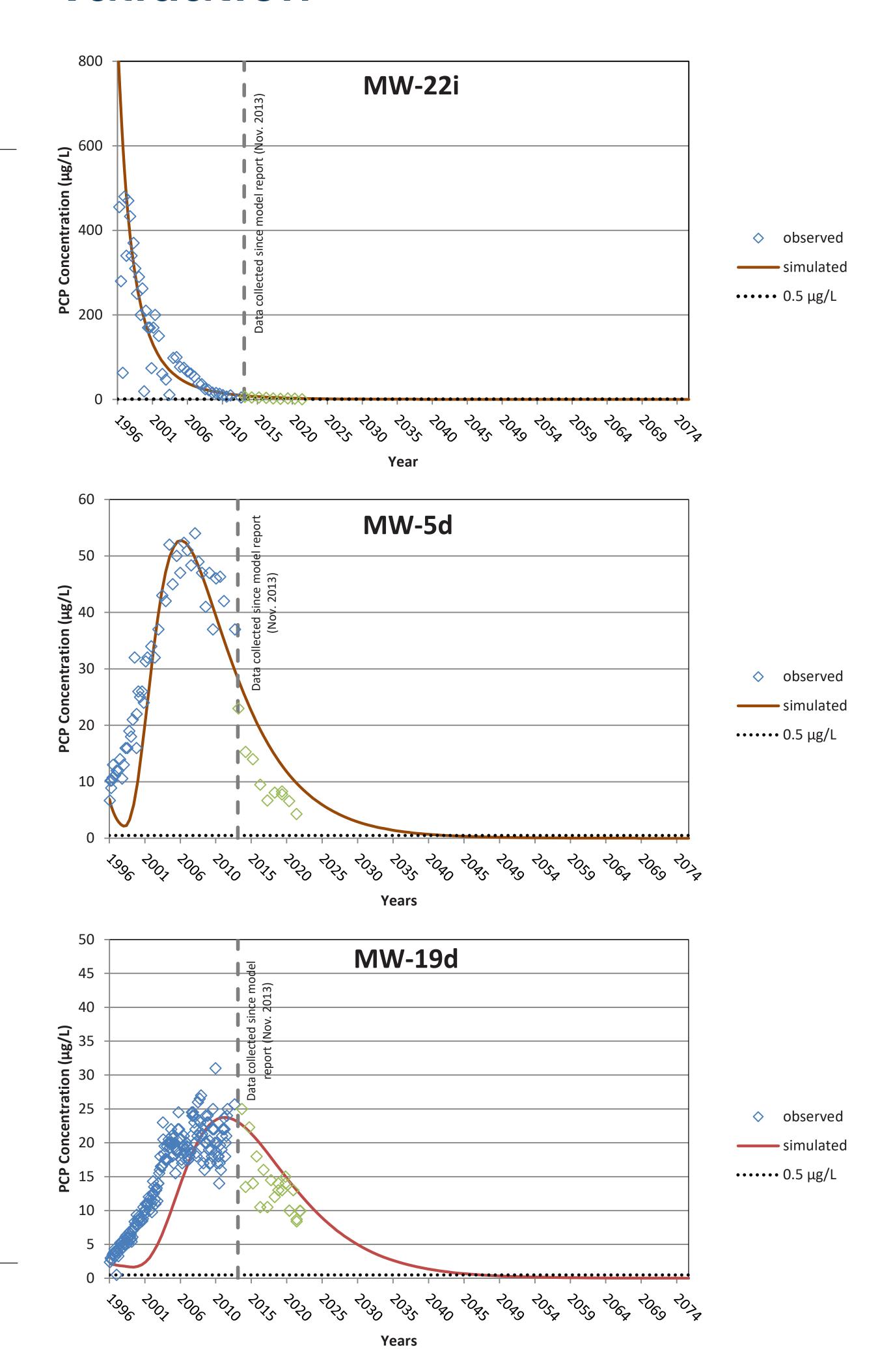
After comprehensive review, state regulators accepted the existing natural attenuation approach for the PCP plume based on Integral's 2013 modeling efforts.



Conclusion

Because of our robust, comprehensive approach, our client saved potentially millions of dollars in active remediation costs. Ten years of additional groundwater monitoring data continues to validate our model and predicted PCP plume attenuation time frames.

Subsequent monitoring validation



David Livermore, R.G., L.H.G. Principal 503.806.4665 dlivermore@integral-corp.com

