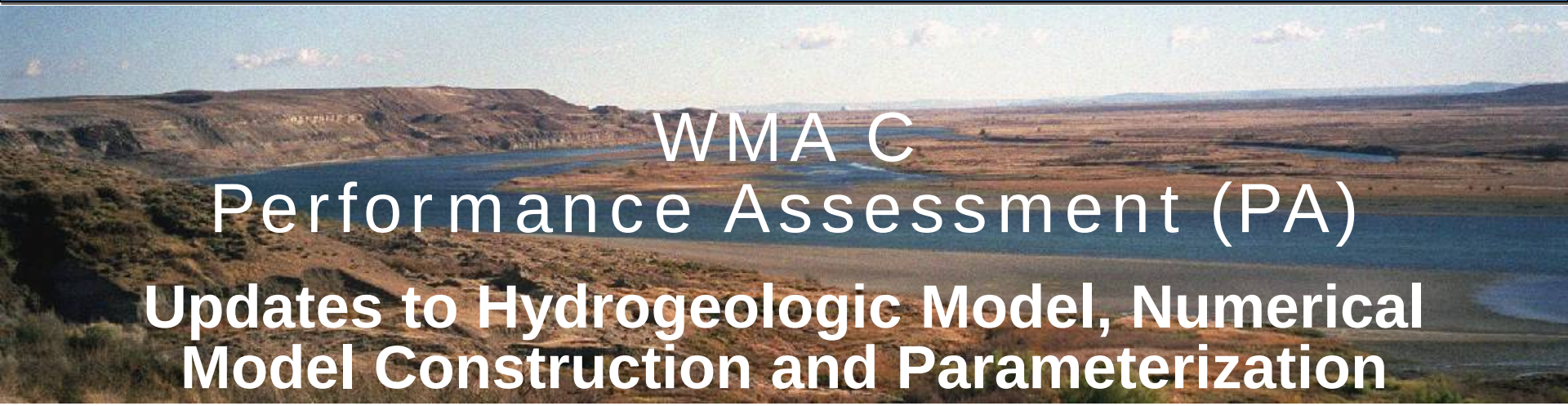
washington river protection solutions



WMA C Performance Assessment (PA)

Updates to Hydrogeologic Model, Numerical Model Construction and Parameterization

- Bill McMahon
- Mike Connelly
- Raz Khaleel
- Sunil Mehta

CH2MHILL Plateau Remediation Company

TecGeo, Inc.

INTERA GEOSCIENCE & ENGINEERING SOLUTIONS

June 23, 2014

washington river protection solutions

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Update to Hydrogeologic Framework

- **Development of Alternative Geological Models based on:**
  - WMA C Alternative I (DOE Interpretation)
  - WMA C Alternative II (Nez Perce Interpretation)
- **Basis for new Interpretations: Geophysical and Geologic data:**
  - 70 dry wells
  - 50 direct pushes
  - 22 Groundwater wells
- **New Geologic Report** – **RPP-RPT-56356**, Rev. 0, *Development of Alternative Geologic Models of Waste Management Area C*

Developing a 3-Dimensional Grid

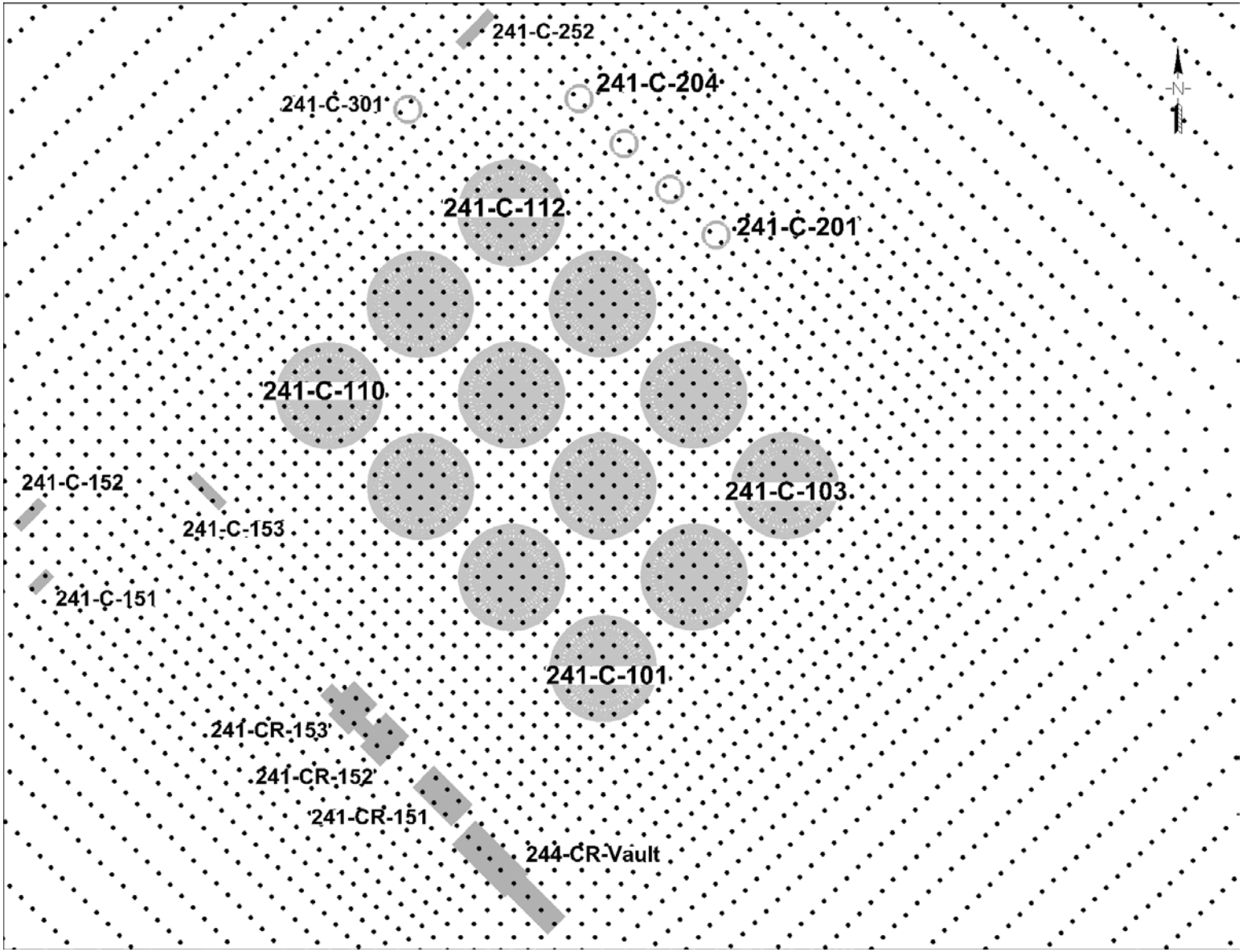
The objective is to represent the natural and engineered systems

- The vertical spacing
  - must address the contacts between the different geologic units
  - must address tanks and ancillary structures
- The node horizontal spacing must represent the tanks and ancillary structures

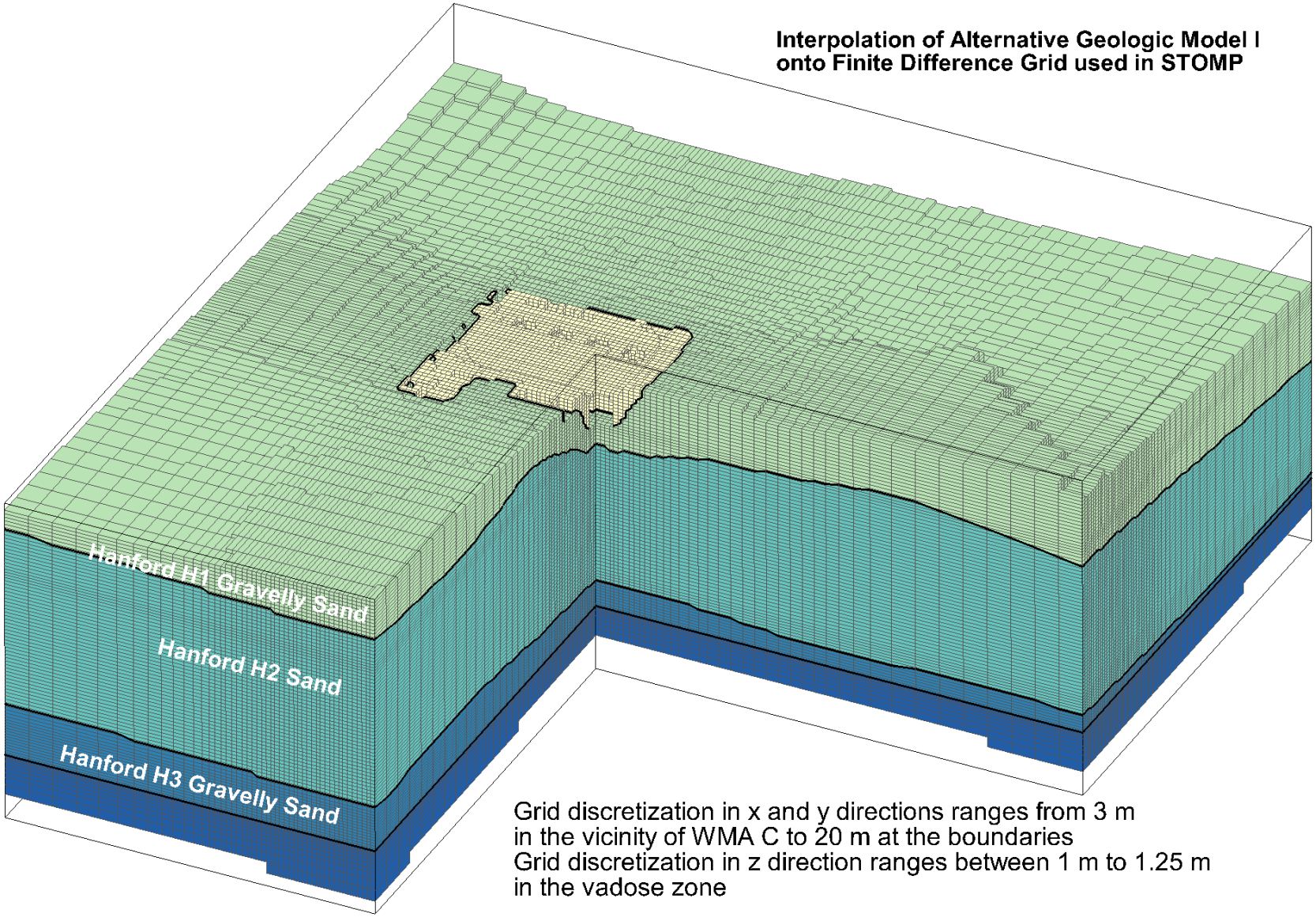
Plan View of WMA C Tanks and STOMP Grid

Black =
grid node

Gray =
tank or vault
outline

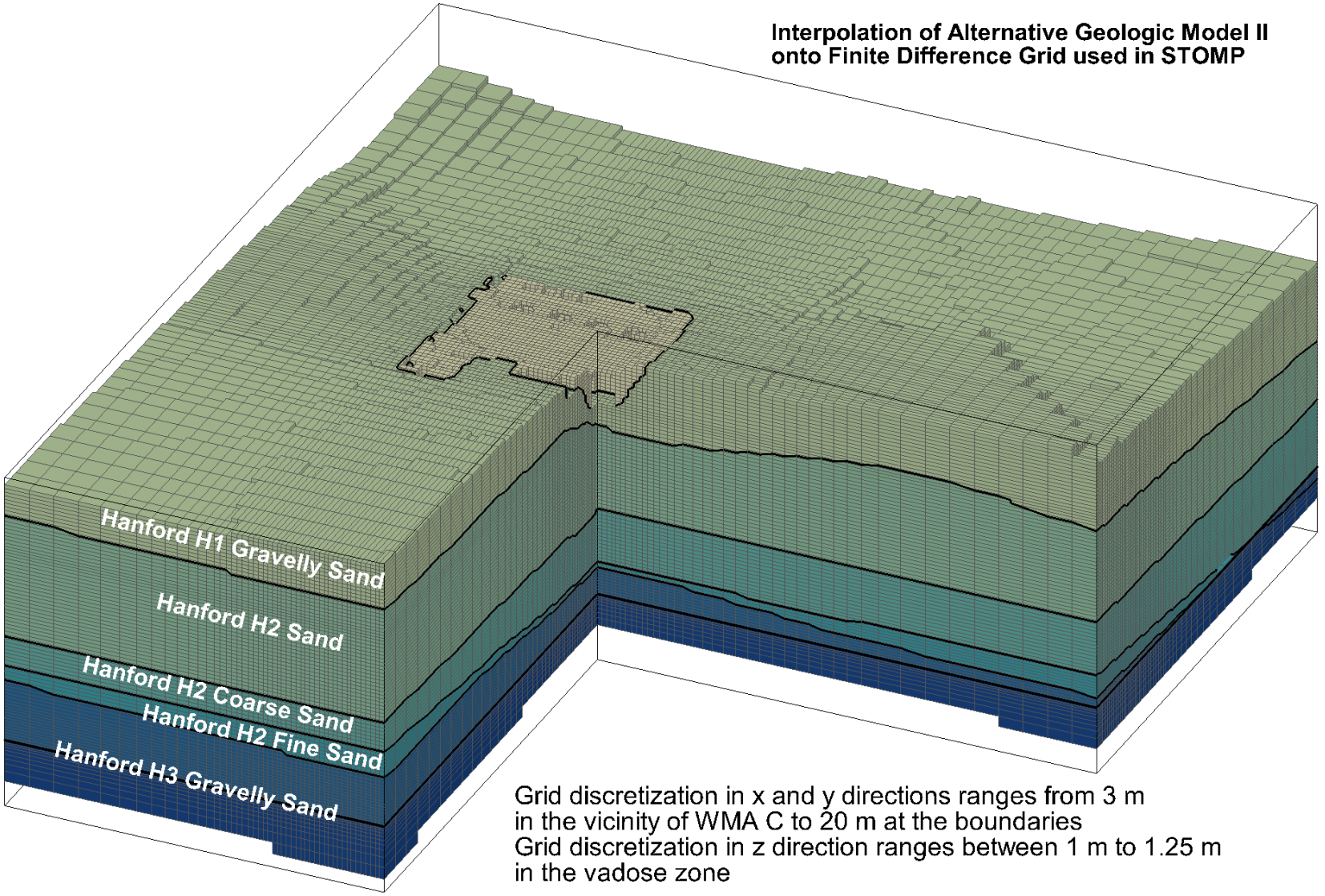


WMA C Alternative Model I



Grid discretization in x and y directions ranges from 3 m in the vicinity of WMA C to 20 m at the boundaries
Grid discretization in z direction ranges between 1 m to 1.25 m in the vadose zone

WMA C Alternative Model II



Grid discretization in x and y directions ranges from 3 m in the vicinity of WMA C to 20 m at the boundaries
Grid discretization in z direction ranges between 1 m to 1.25 m in the vadose zone

Surface Conditions of WMA C Model

Recharge Rates of WMA C Model

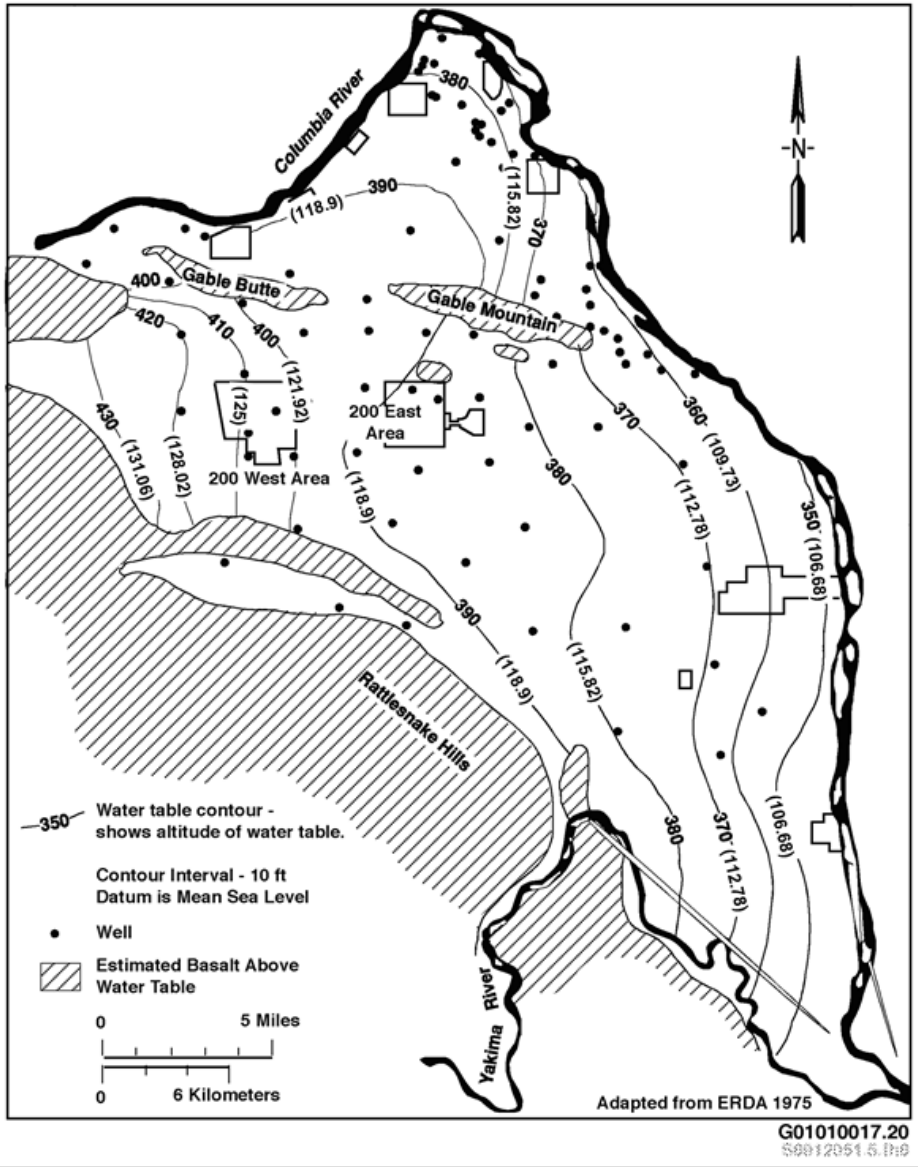
Barrier Status	Pre-Hanford (mm/yr)	Operational Period (mm/yr)	Institutional Control (100 yr) (mm/yr)	Barrier design life (500 yr after closure) (mm/yr)	End of Barrier Design life (mm/yr)
Denominator Case	3.5	100	0.5	0.5	3.5
Sensitivity Case 1	3.5	100	0.5	0.5	1.0
Sensitivity Case 2	3.5	40	0.5	0.5	1.0
Sensitivity Case 3	3.5	140	0.5	100	100

RPP-RPT-44042, *Recharge and Waste Release within Engineered System in Waste Management Area C*

Aquifer Conditions of WMA C Model

Current conditions show groundwater flow in the WMA C area is generally to the south and southeast.

Slowly returning to pre-operational Hanford Site conditions



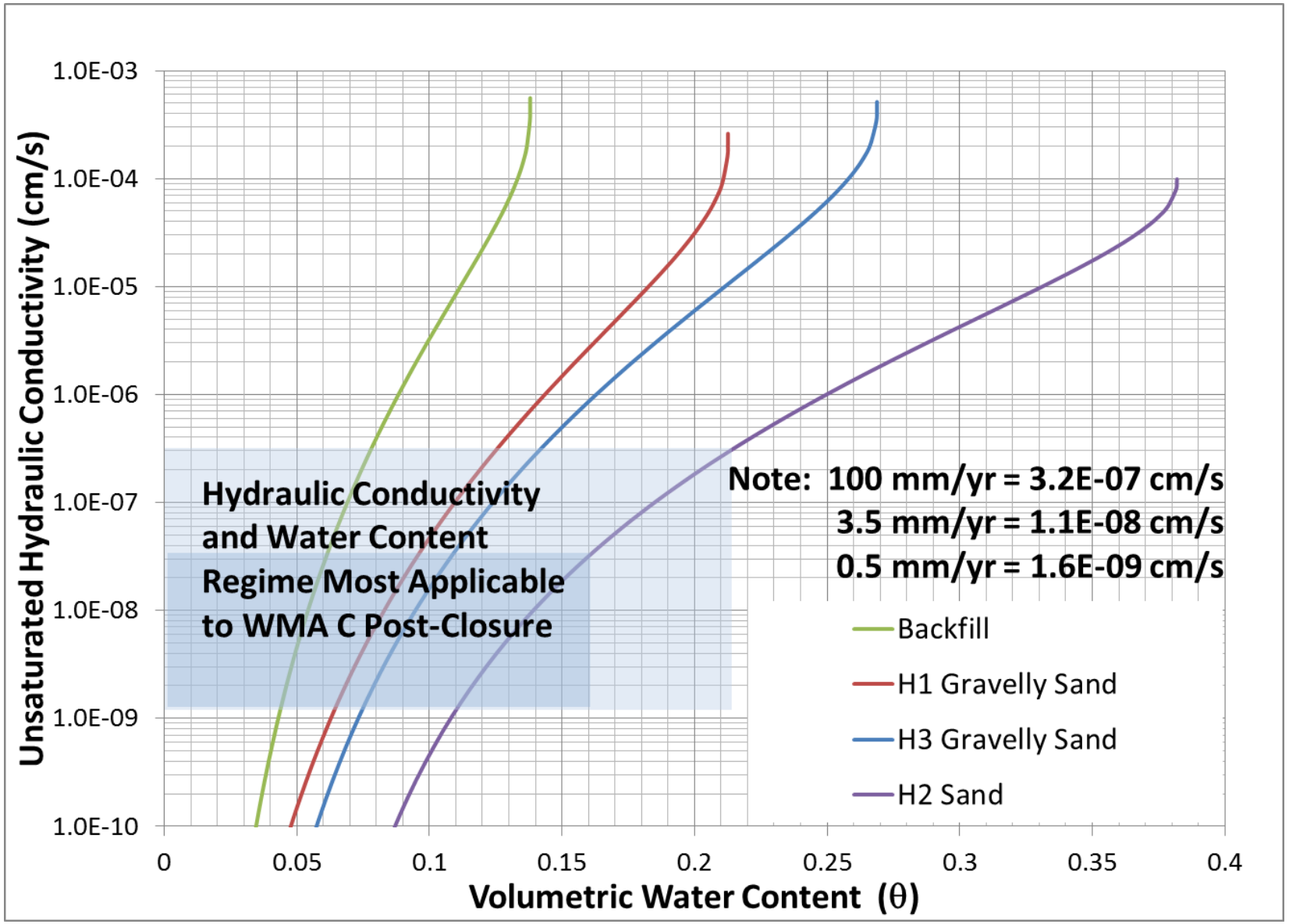
Hindcast Water Table Map of the Hanford Site, January 1944

Aquifer Hydraulic Properties of WMA C Model

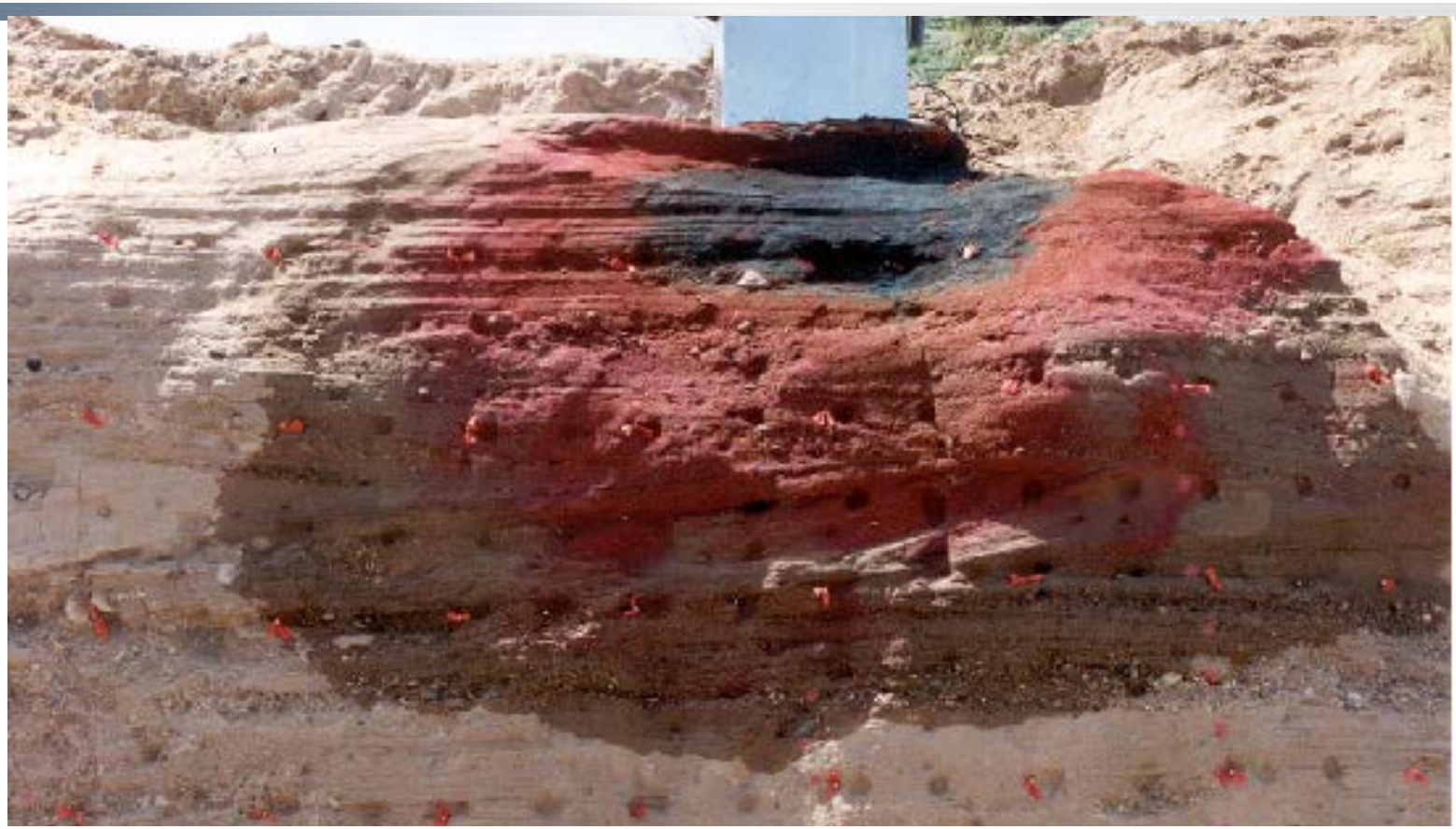
Property	Denominator Case	Minimum	Maximum
Hydraulic Conductivity (m/d)	3000	100	7000
Effective Porosity (-)	0.25 (Hanford gravel)	NC	NC
Hydraulic Gradient (-)	10^{-5}	$2x10^{-6}$	10^{-4}

RPP-RPT-46088, Rev. 1

Hydraulic Properties of WMA C Model



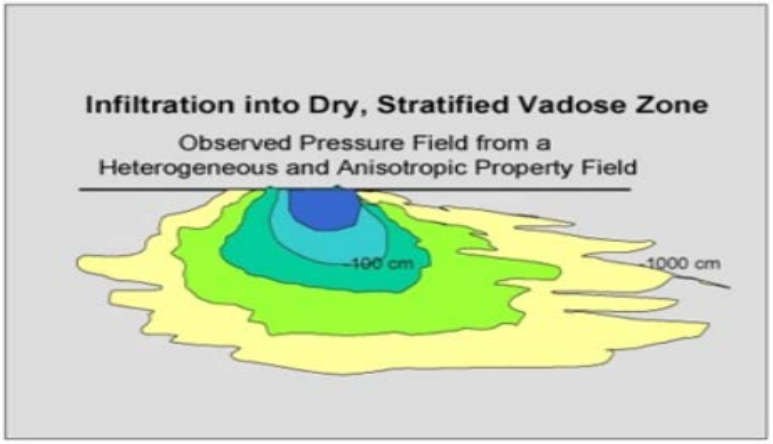
Field Test Results from Tracer Injection



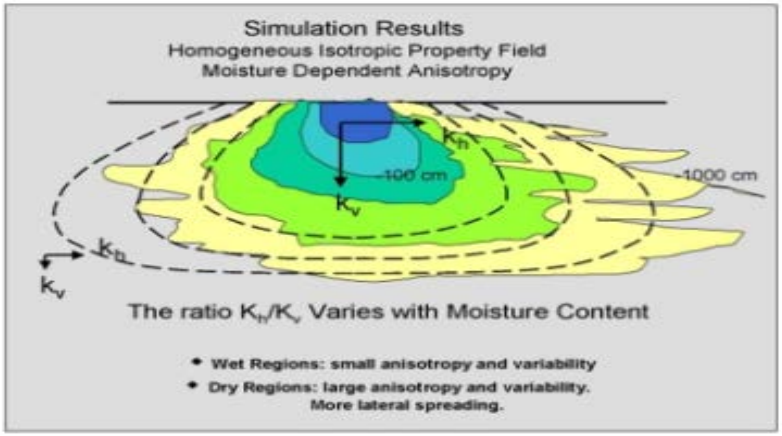
Media heterogeneity (and the resulting variability in unsaturated K) induces variable moisture-dependent anisotropy in the field

Moisture Dependent Anisotropy

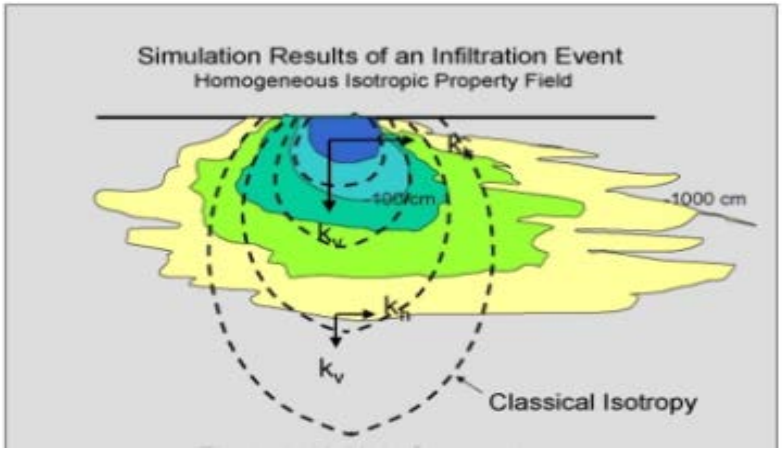
Schematic Illustrations



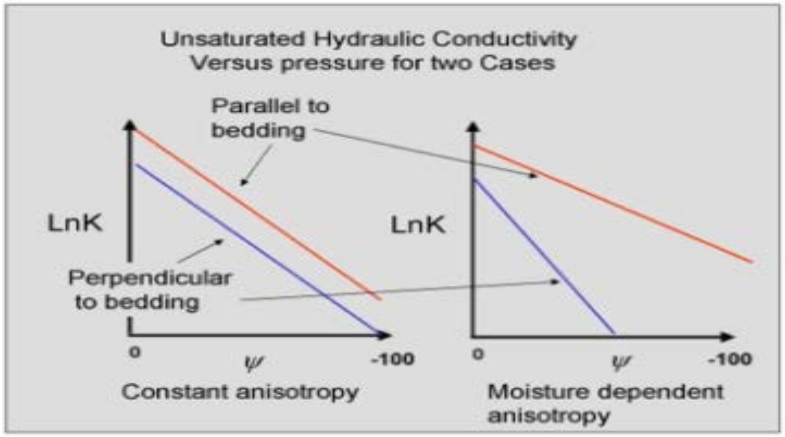
(a)



(c)



(b)



(d)

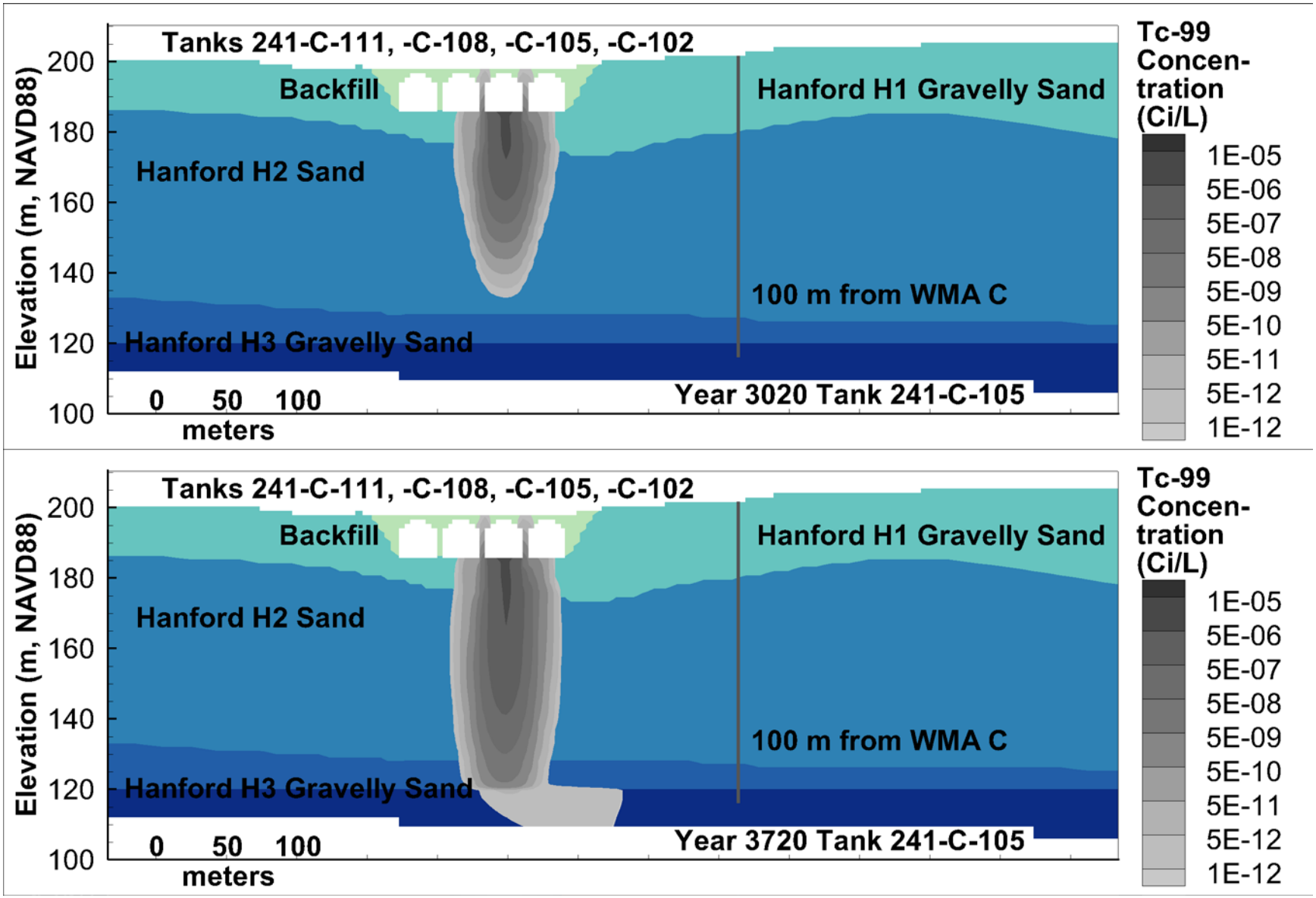
Local-scale Model Development & Testing

- Two alternative hydrogeologic models implemented using STOMP
- Evaluation of model domain, design, and discretization completed
- Model simulations using unit source inventories and different combinations of hydraulic properties and recharge rates have been initiated.
- Preliminary runs using a variety of recharge conditions to support model abstraction of flow into GoldSim System Model have been initiated.

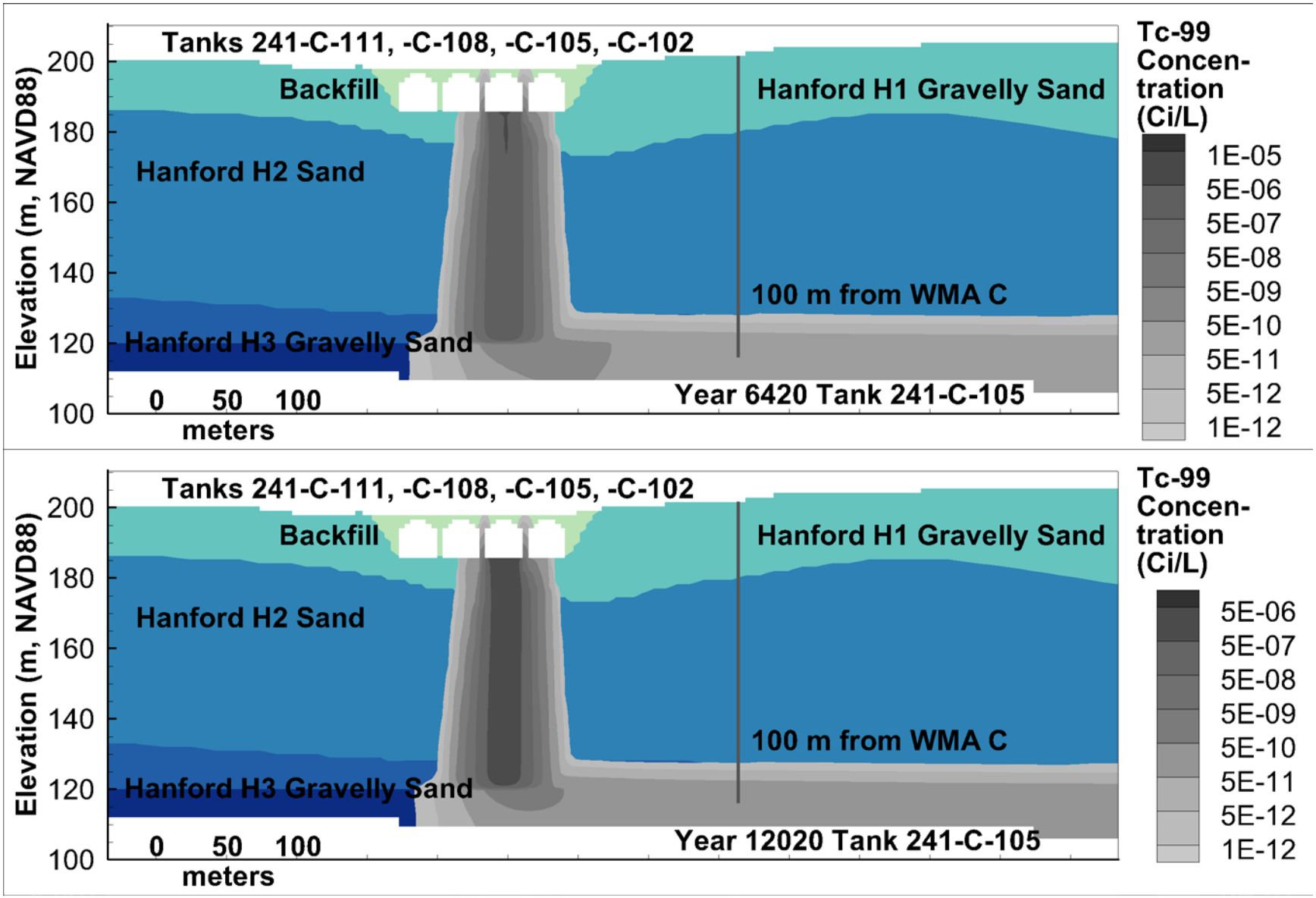
Sample Model Results

- Diffusive release of 1 Ci of Tc-99 from C-105
- Breakthrough curves presented at 100 m points of calculation
- Spatial distribution of Tc-99 in groundwater at time of peak concentration
- Superposition of concentration from diffusive releases from additional tanks.

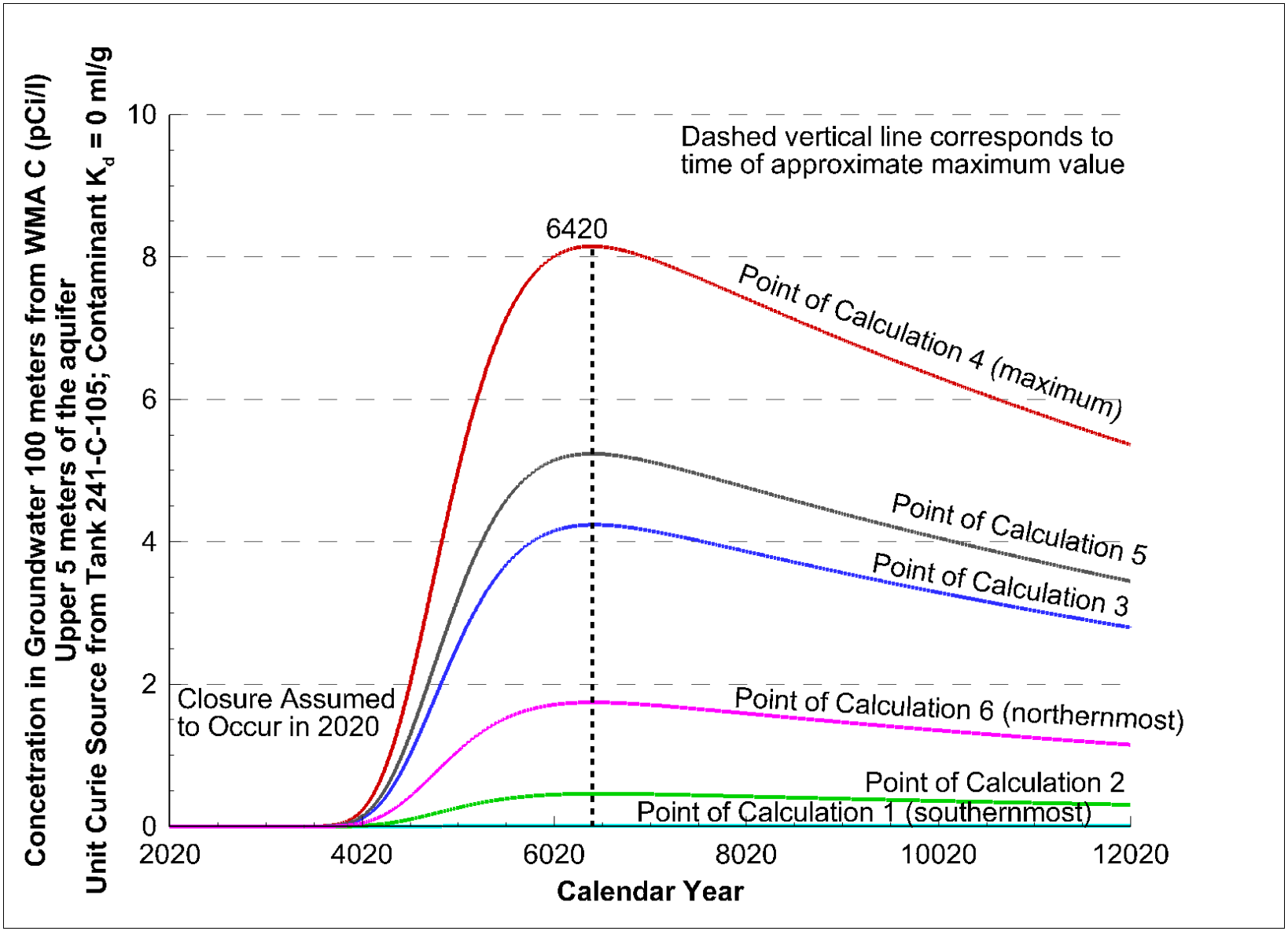
WMA C Alternative Model I



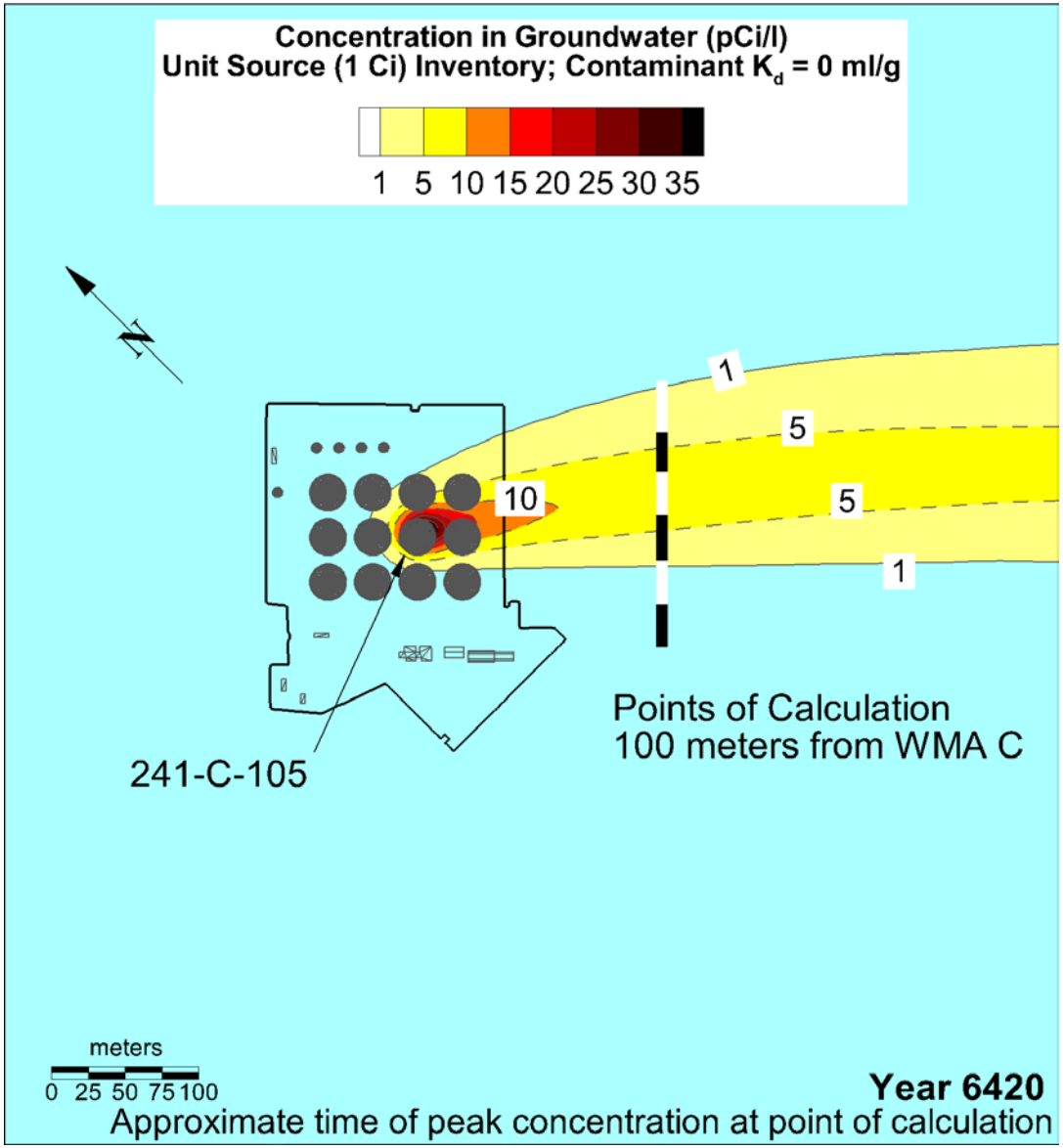
WMA C Alternative Model I



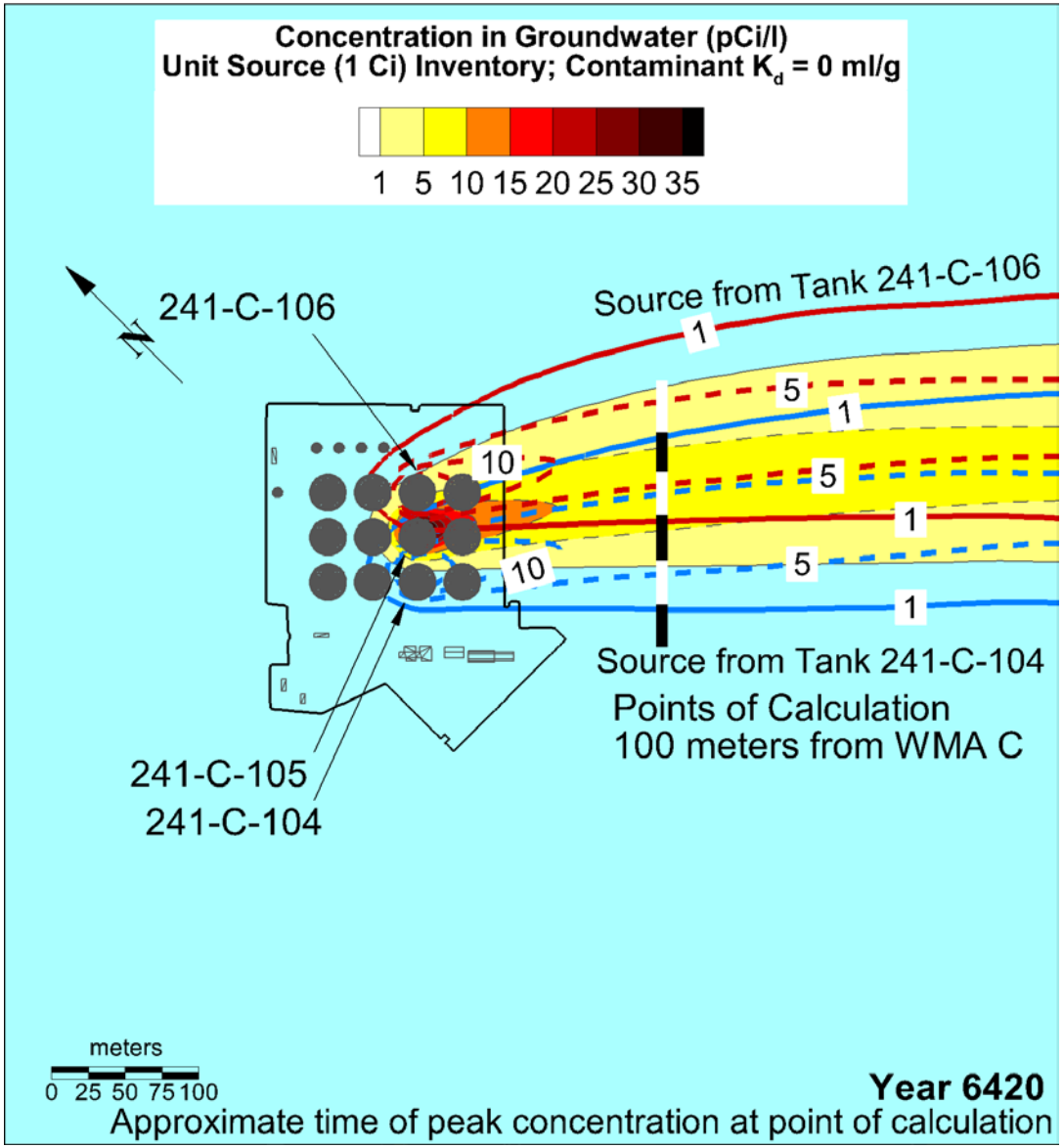
Breakthrough Curves for Tank 241-C-105 Residual Waste Unit Source (1 Ci) Inventory; Contaminant K_d = 0 ml/g



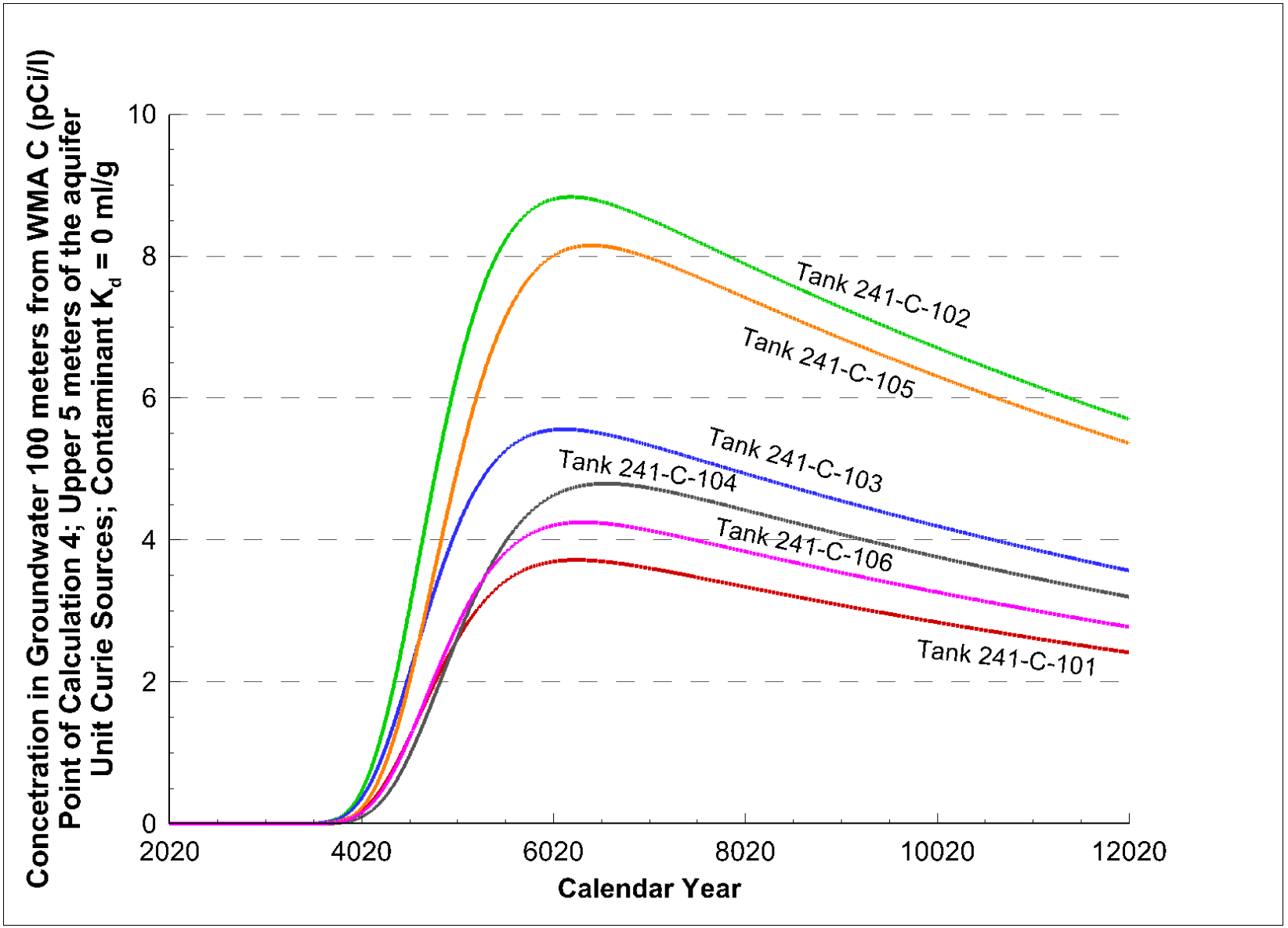
Plan View of Tank 241-C-105 Residual Waste Fate and Transport Model Results



Plan View of Fate and Transport Model Results: Plume Interaction



Breakthrough Curves at Point of Calculation 4
Residual Waste Unit Sources (1 Ci); Contaminant K_d = 0 ml/g



Contaminant Inventory and Mobility Arrival Time Evaluation

Which contaminants in the WMA C inventory are sufficiently mobile to impact groundwater within the 1,000 year and 10,000 year timeframes?

"Sufficiently mobile" = low enough distribution coefficient K_d value

Long-Term Recharge Rates Associated With the Different Modeling Periods Used in the Arrival Time Evaluation

Period	Duration	Surface Condition of WMA C	Arrival Time Analysis Recharge Rate (mm/yr)
Pre-WMA C Construction	Steady state	Undisturbed natural conditions	5.2
WMA C Operational Period	1945.5 – 2020	Disturbed bare gravel surface	140
WMA C Post-Closure Period (500 Years)	2020 – 2520	Evapotranspiration (ET) surface barrier	1
WMA C Post-Closure Period (after 500 Years)	2520 – 12020	ET barrier reverts to natural conditions	5.2

Vadose Zone Properties Assigned the Maximum Transport Values Developed for the Uncertainty Analysis

Contaminant Inventory and Mobility Arrival Time Evaluation Results

	Years to First Arrival					
	Distribution Coefficient K_d (ml/g)					
Location	0.1	0.2	0.3	0.6	2.0	3.0
Water Table	547	975	1430	2740	8750	DNA
100 meters from WMA C	695	1080	1575	3029	9680	DNA

Contaminant Transport Starts Year 2030
Contaminant Release Concludes Year 2031
DNA = Did Not Arrive in 10,000 years.