Switching to a New Regional Groundwater Model in Virginia? Not so Fast

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NGWA Ground Water Summit
Eastern States Water Withdrawal and Allocation

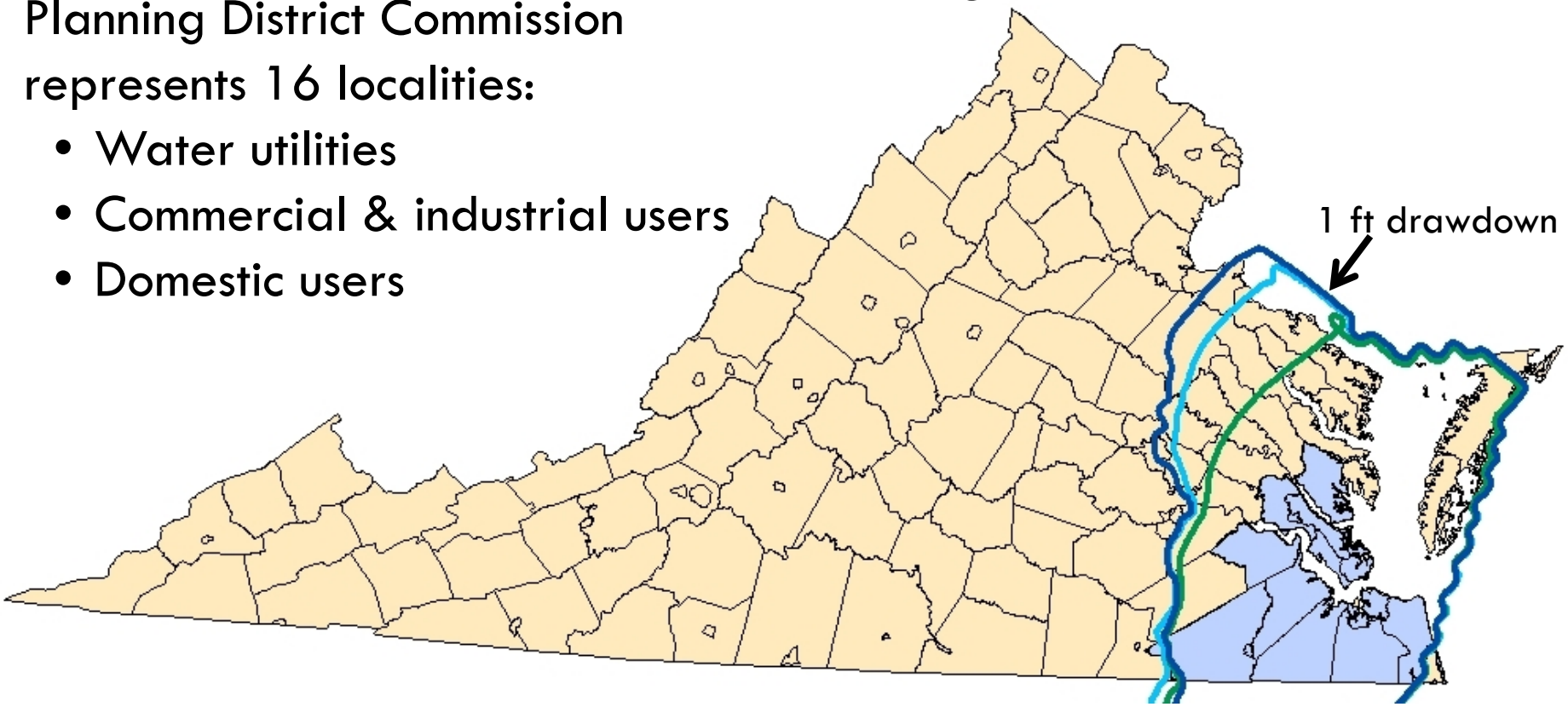
Where is Hampton Roads? What is a Planning District Commission?

Hampton Roads = Southeastern Coastal Virginia

Withdrawals for Hampton Roads public water systems influence the entire groundwater management area.

Planning District Commission represents 16 localities:

- Water utilities
- Commercial & industrial users
- Domestic users



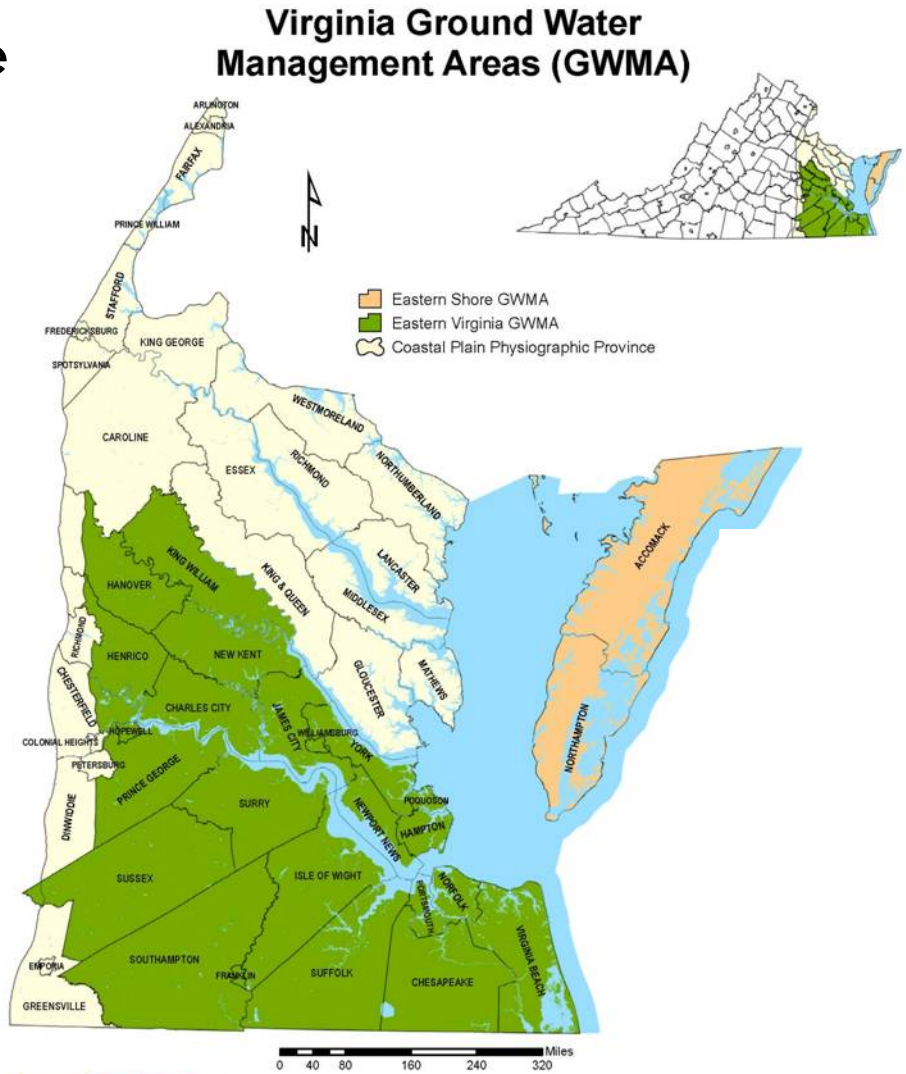
HAMPTON ROADS PDC PLANNING DISTRICT COMMISSION

Virginia's Groundwater Permitting Program

Hampton Roads is located in the Eastern Virginia Groundwater Management Area.

Permits are evaluated with model of Coastal Plain aquifer system.

- **Existing withdrawals equal 100 MGD.**
- **70% of withdrawals are in Hampton Roads.**

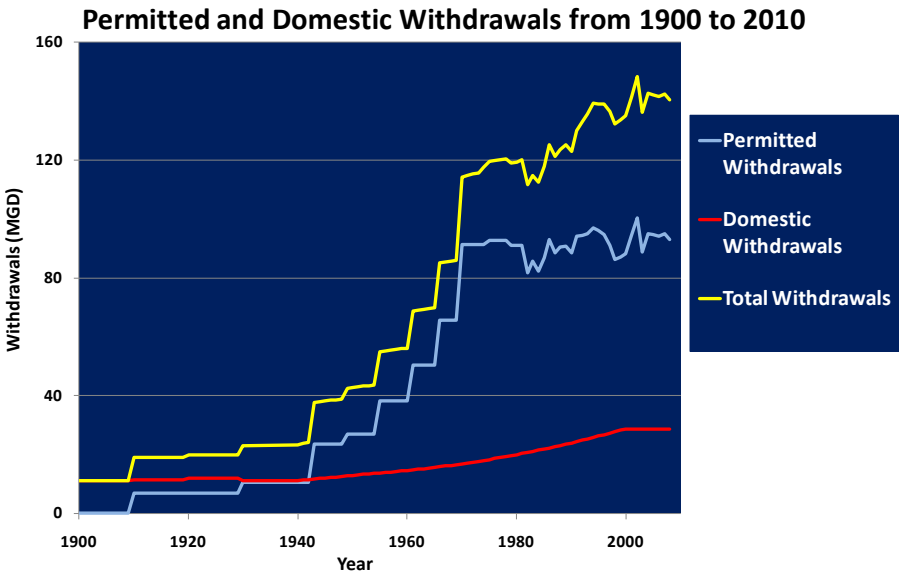


Why update the RASA groundwater model?

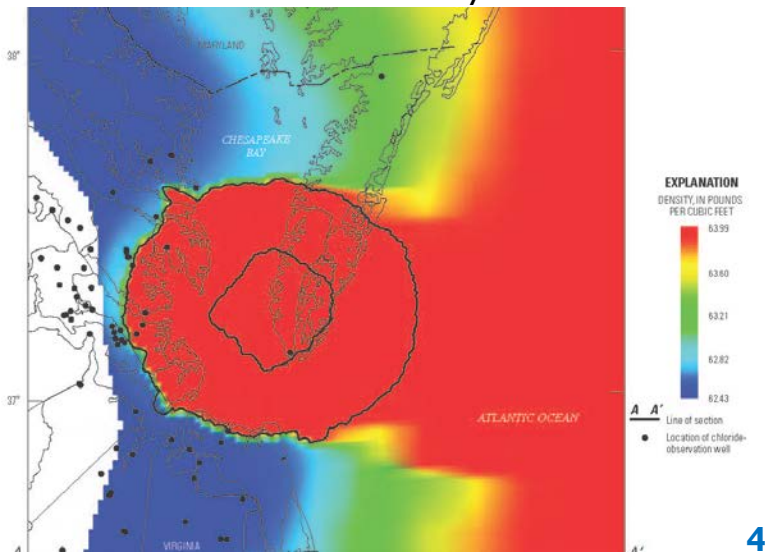
Simulated water levels increasingly deviate from measured water levels.

Five issues addressed with new model:

- ✓ Domestic wells
- ✓ Saltwater transition zone
- ✓ Computational limitations
- ✓ New hydrogeologic framework
- ✓ Hydraulic functions of aquifers and confining units

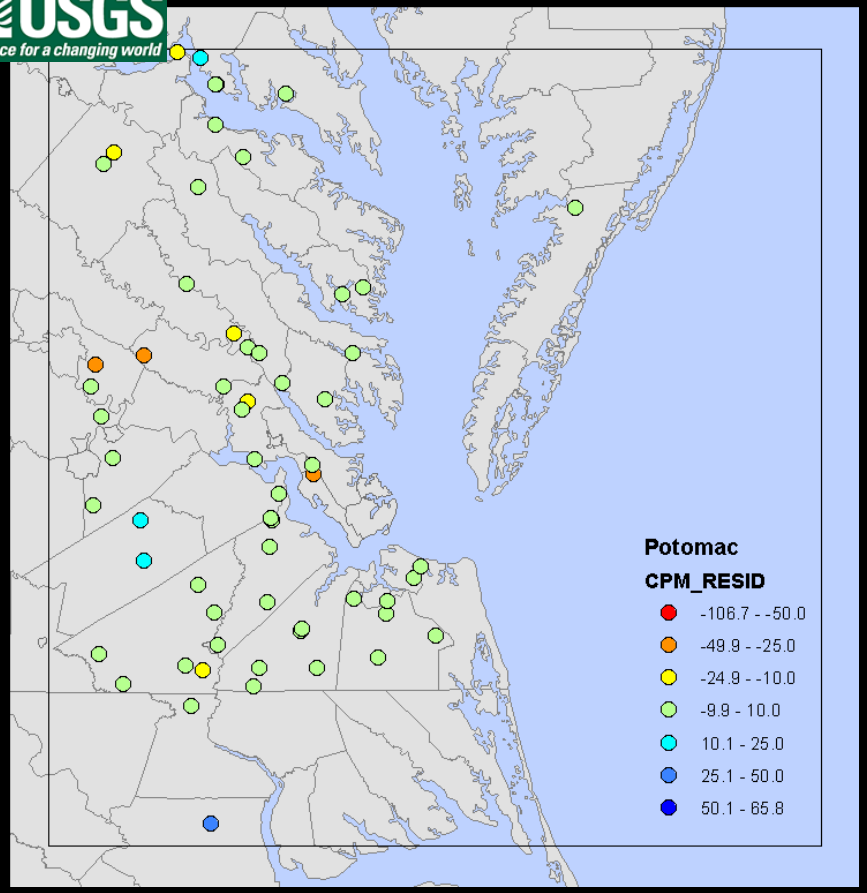


Simulated Water Density

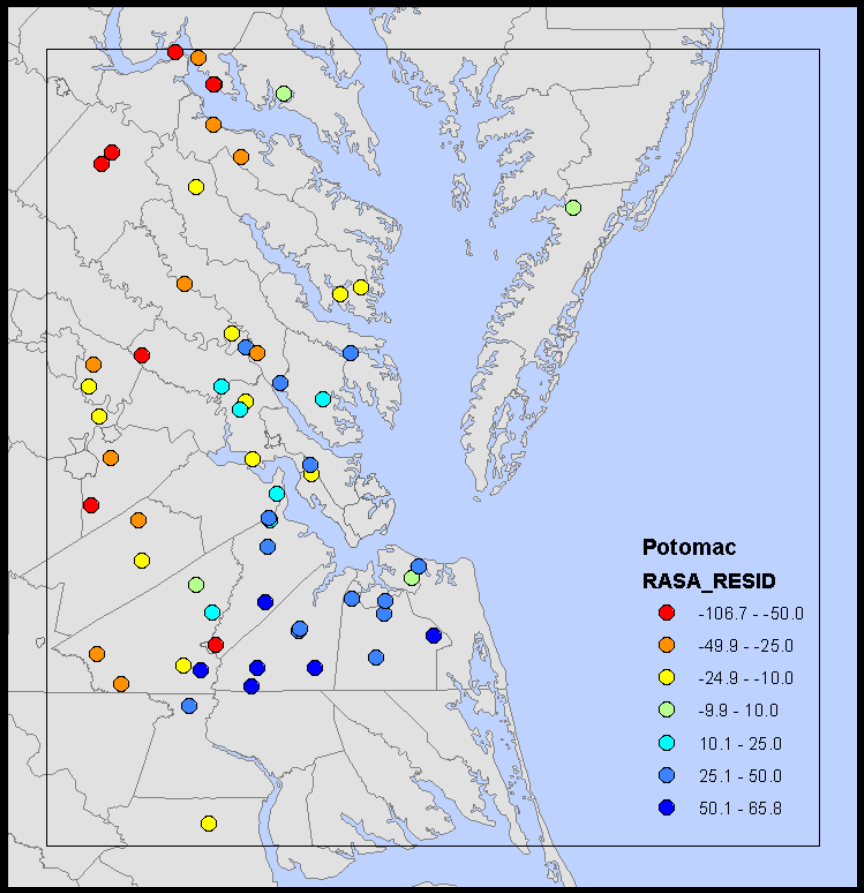


Calibration of old RASA model vs. new VCP model

Residuals = Observed Water Level – Simulated Water Level



VCP Model Residuals
Potomac Aquifer



RASA Model Residuals
Potomac Aquifer

New model for permitting? Not so fast

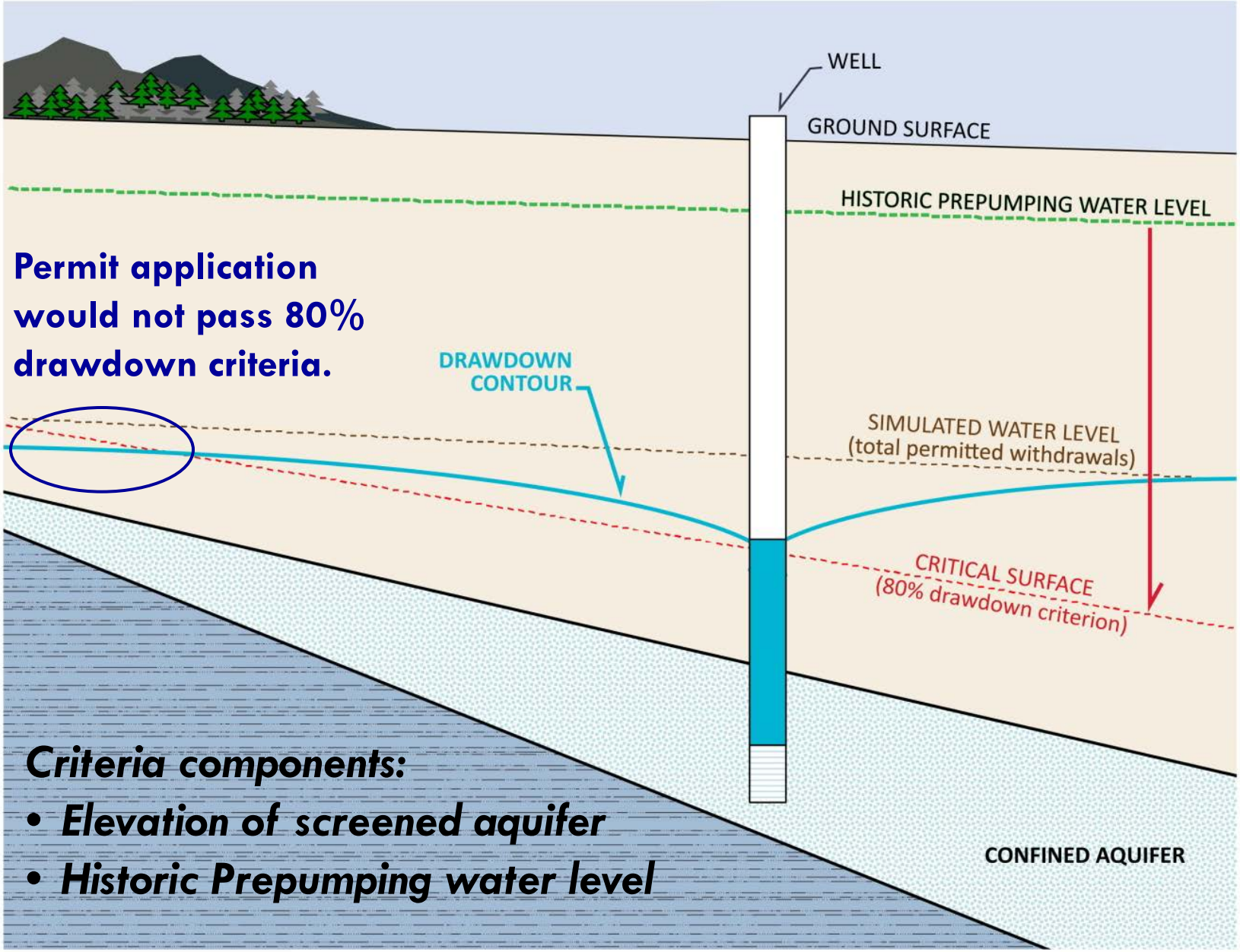
Two key aspects of new VCP model have delayed its adoption as tool to evaluate groundwater permits.

1. New model structure does not match old model structure.

   a) 60 layers in model instead of 10 layers.
   b) Potomac aquifer defined as a single aquifer instead of Upper, Middle, and Lower Potomac.

2. New model explicitly modeled the confining units and results indicate permit evaluations cannot be based on steady-state simulations.

80% Drawdown Criteria

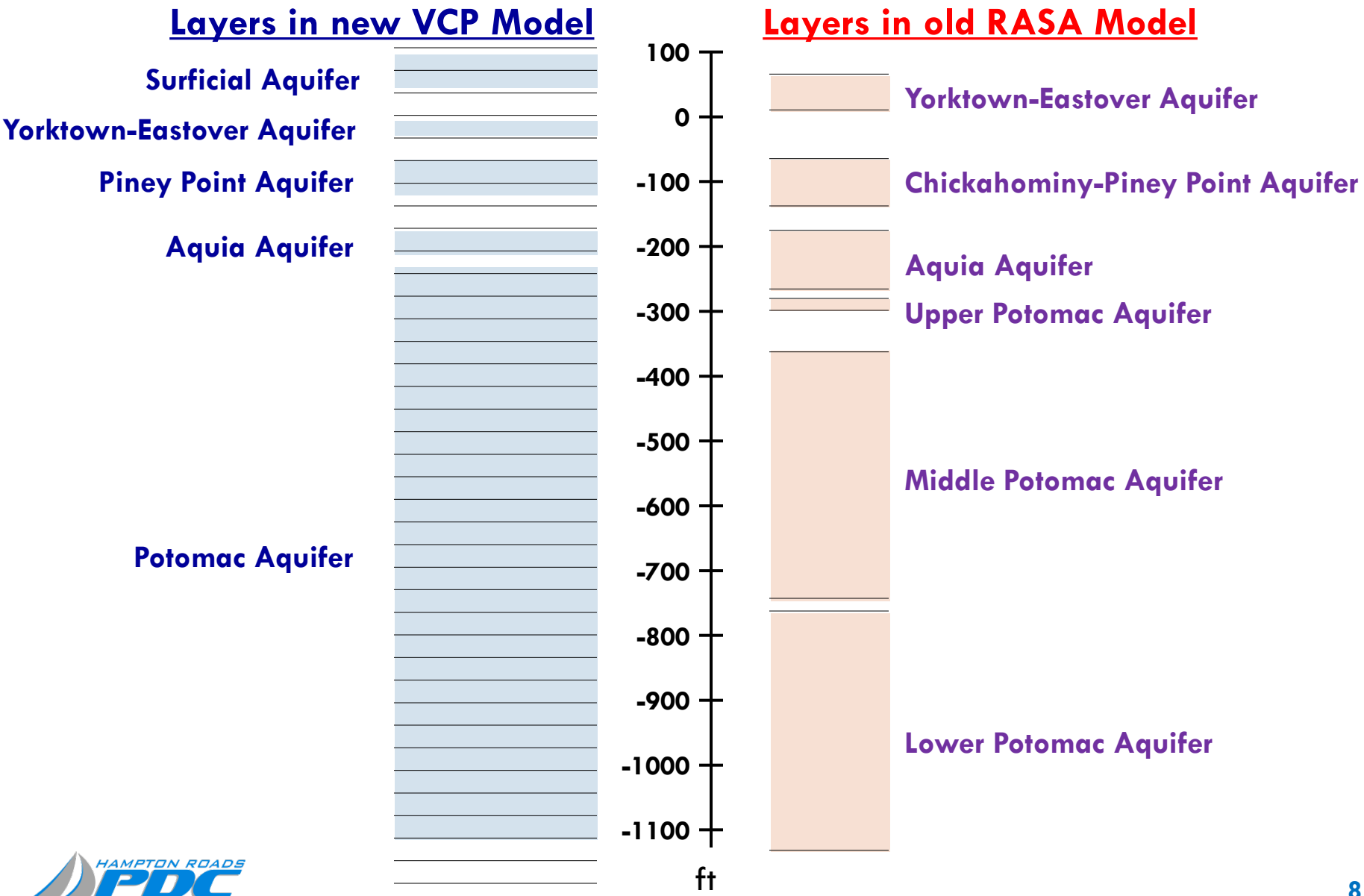


Permit application would not pass 80% drawdown criteria.

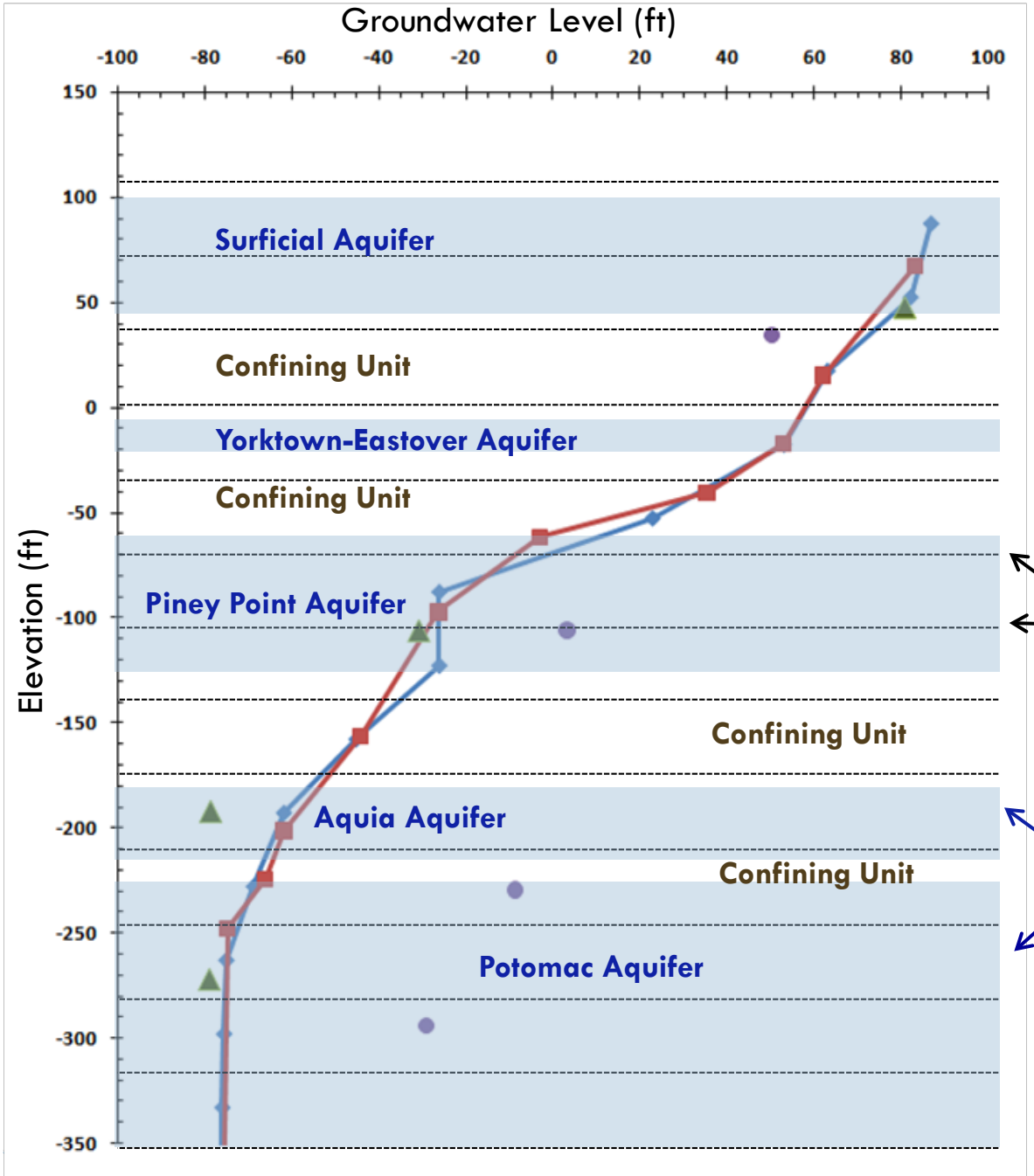
Criteria components:

- ***Elevation of screened aquifer***
- ***Historic Prepumping water level***

Model Structure: Layers & Hydrogeologic Units



Model Structure: Layers & Hydrogeologic Units



Observed Heads

RASA Heads

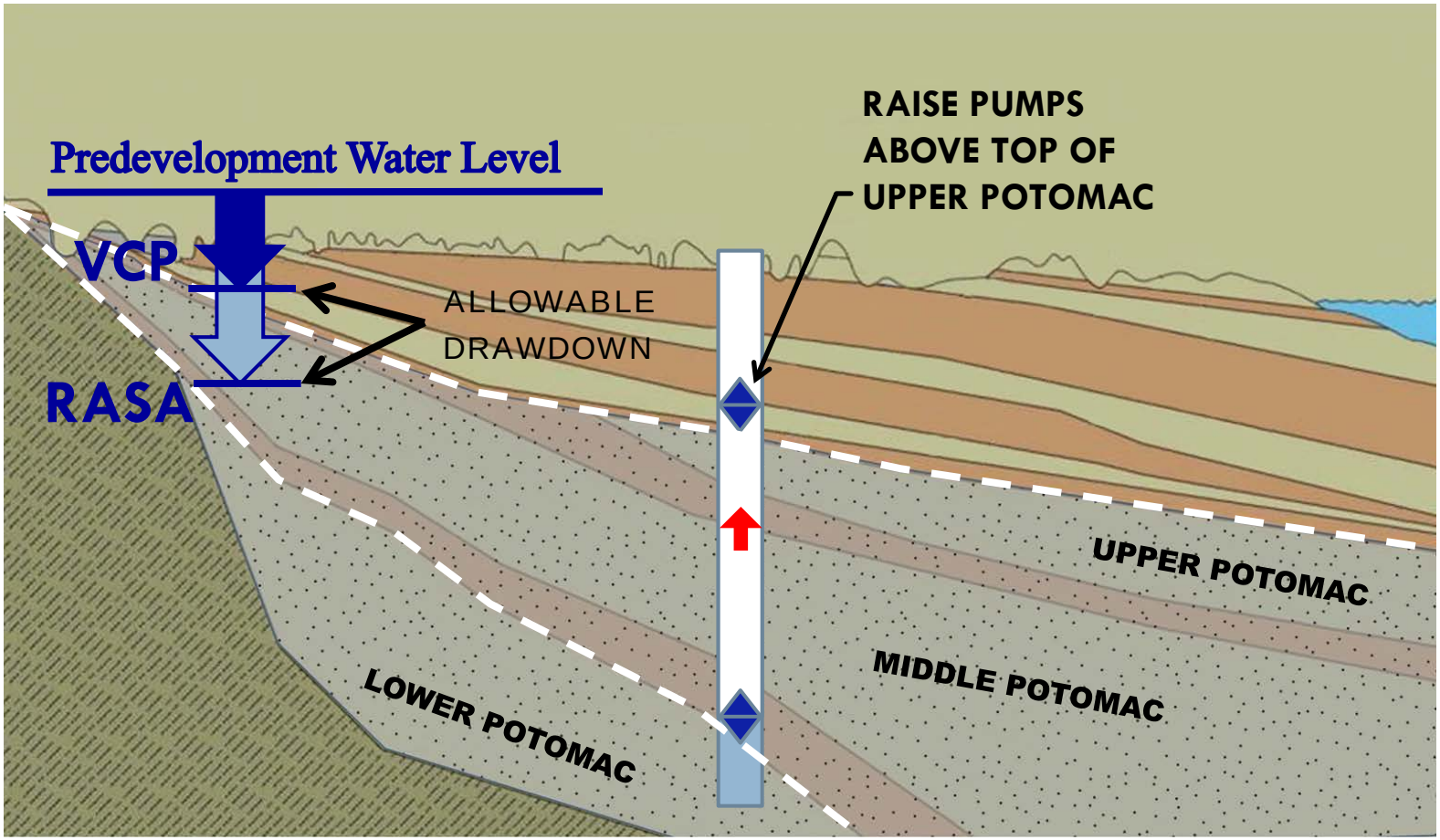
VCP Layer Heads

VCP Aquifer Heads

Model Layers

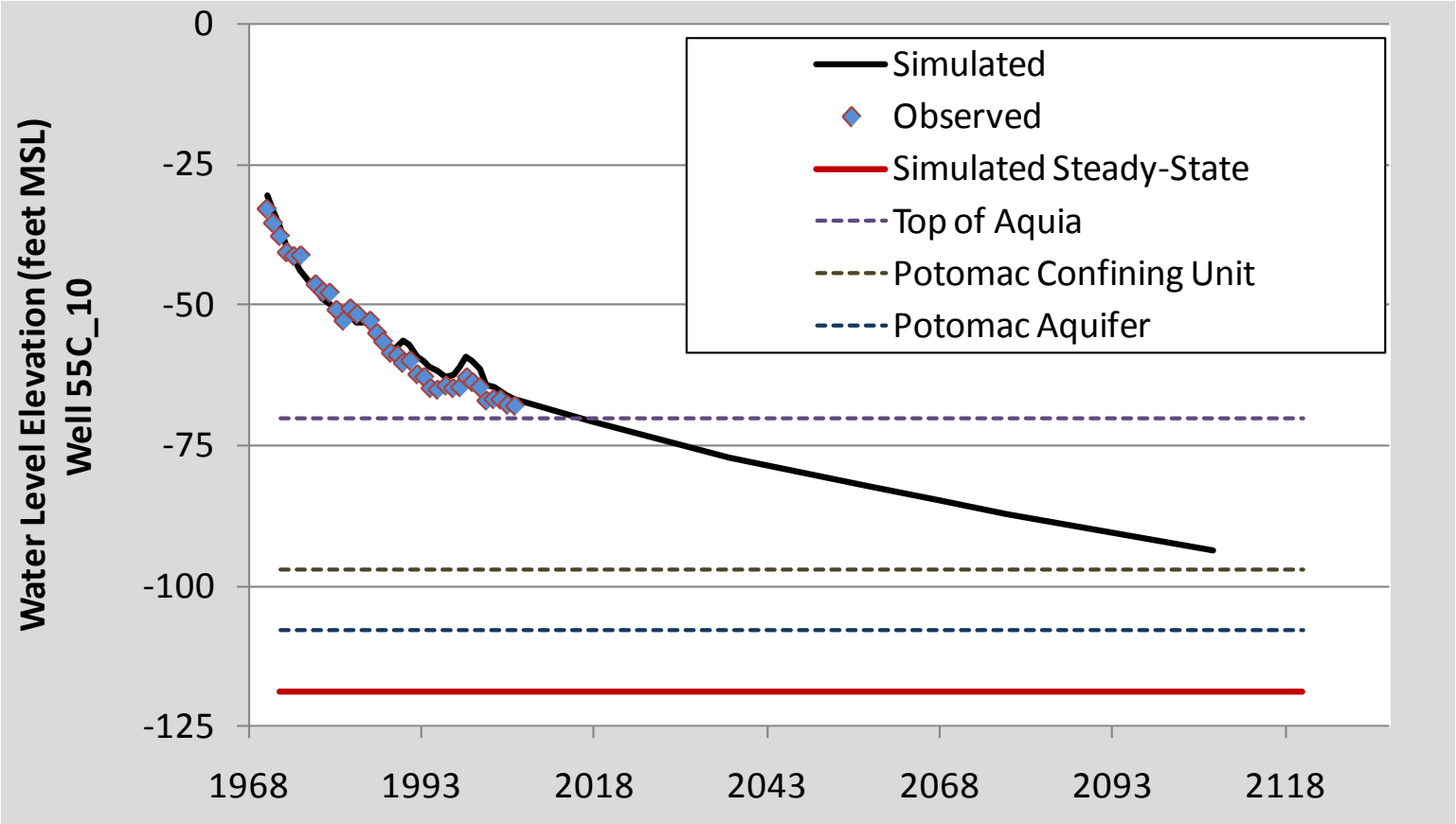
Aquifer (HUF) Units

Structure Complication: "80% drawdown criteria" in Potomac



Allowable drawdown would be reduced for wells in the Middle & Lower Potomac if the 80% criteria is measured from the top of the Upper Potomac aquifer.

Confining Units: Release from Storage Takes Decades

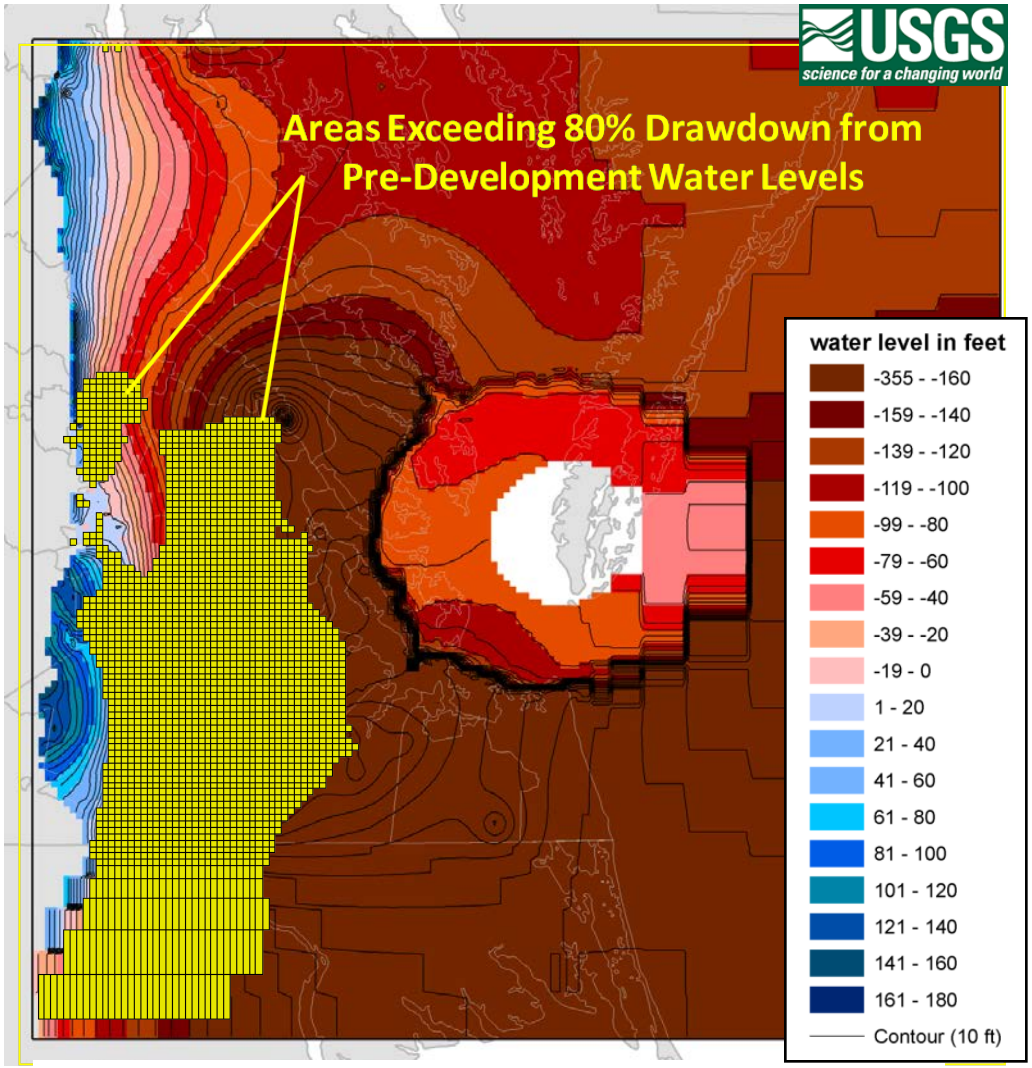


Simulation of future water level if groundwater withdrawals continue at the current rate for next 100 years.

Steady-State simulations: Violations of 80% criteria

Steady-State Simulation of 2005 Total Permitted Withdrawals shows extensive violations of the 80% drawdown criteria along western edge of the Coastal Plain.

System takes over 150 years to reach steady-state.



Water Levels in Potomac Aquifer VCP Steady-State Simulation

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New model for permitting? Not so fast

Problem: VCP model has 60 layers representing 10 aquifers.

Solution: Develop policy defining how 80% criteria will be evaluated <u>or</u> translate model into simple version with one layer per aquifer.

Problem: Accepting one Potomac aquifer would reduce capacity of many existing wells.

Solution: Grandfather existing users <u>or</u> change the Virginia Code.

Problem: VCP model reaches steady state in 300+ years instead of 10 years for the RASA model.

Solution: Develop policy defining planning horizon and transient simulation period to evaluate 80% criteria.

New Priorities - Opportunity for change?

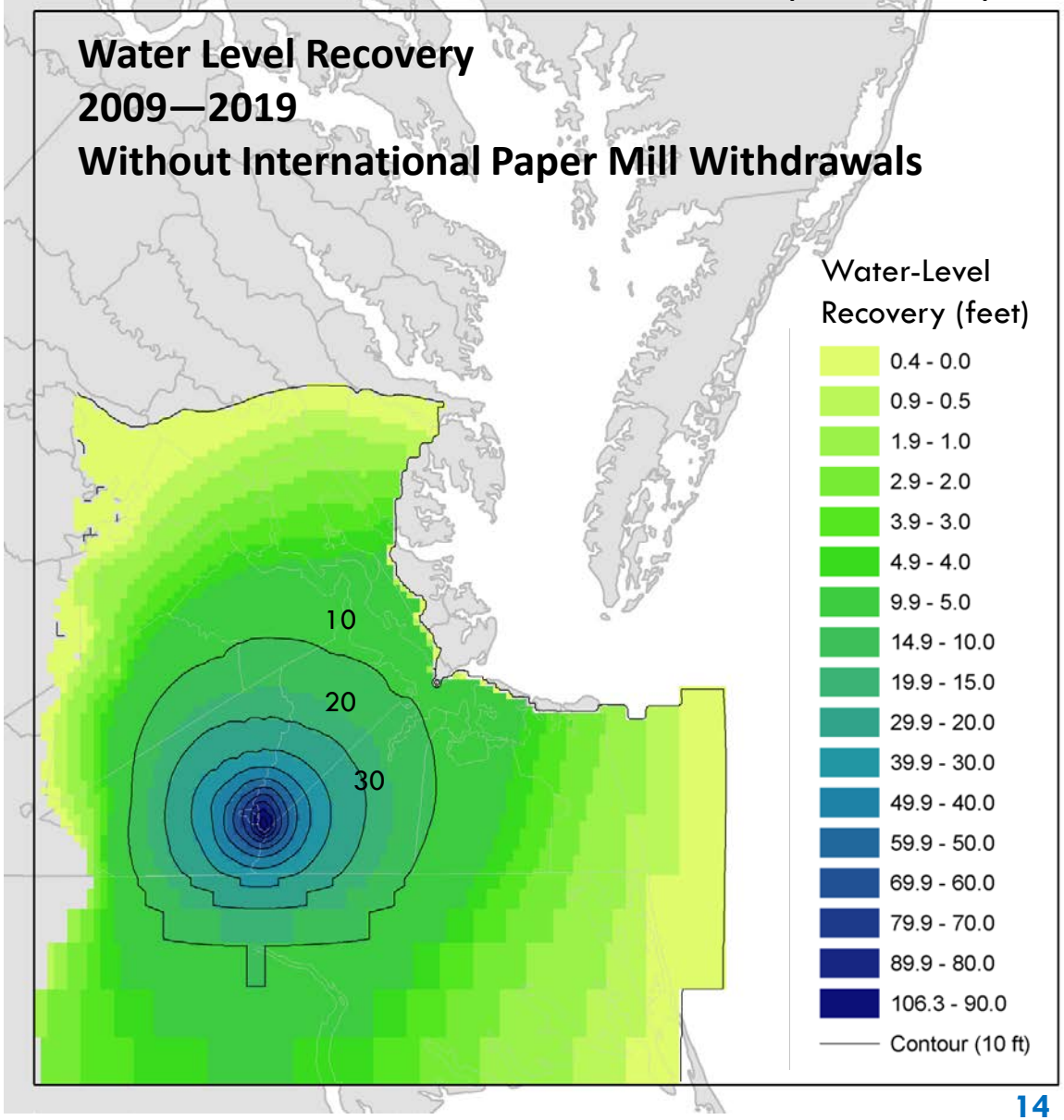
Model upgrades won't alleviate unsustainable use.

International Paper mill holds the largest withdrawal permit in Coastal Plain.

2008 – IP withdrew 33 MGD.
2010 - Mill was closed.

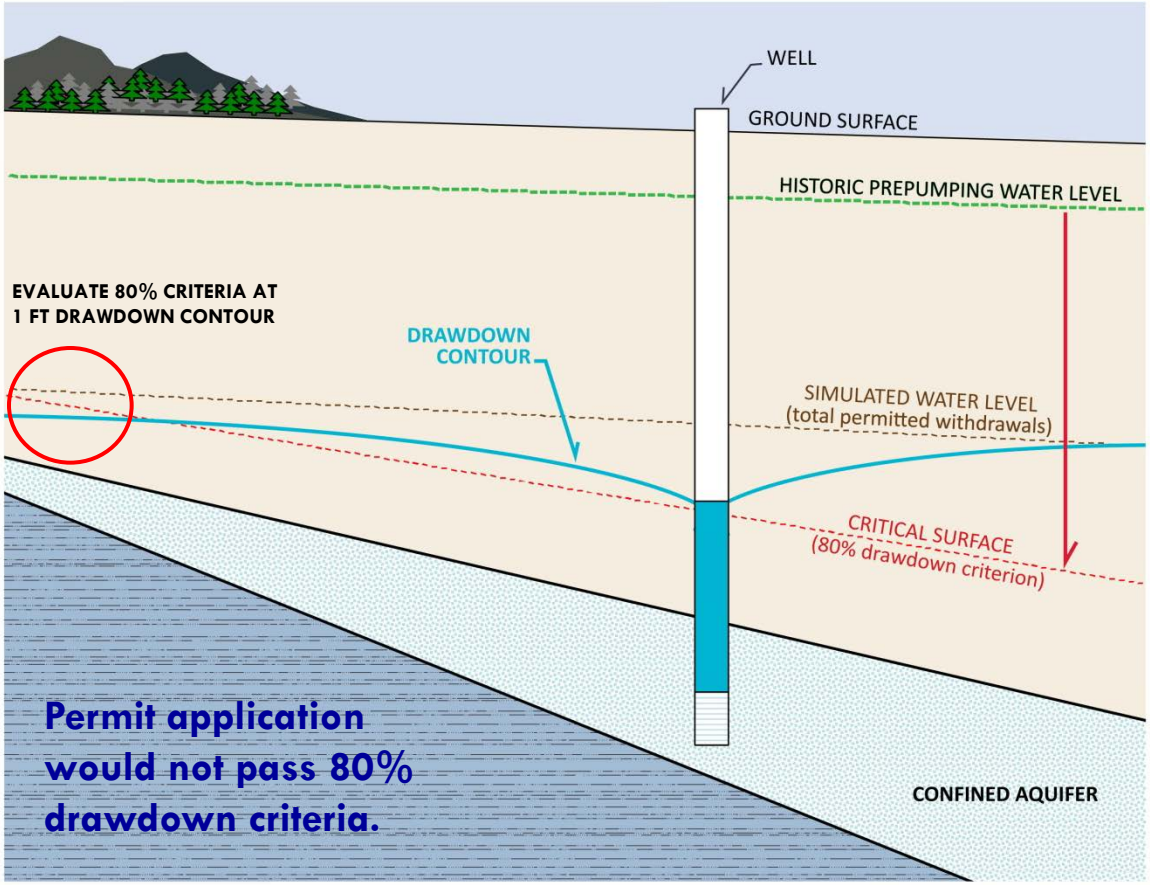
Need more research and stakeholder education to take advantage of opportunities to manage groundwater use and implement new priorities.

Simulated water levels at top of Potomac aquifer.



Model Update – Unforeseen Complications

Virginia has a good regulatory concept – applications for groundwater withdrawal permits in Management Areas are evaluated with a model of the entire aquifer system.

Updating the model has resulted in unforeseen complications:

- *New model structure is not compatible with permit review process.*
- *New model revealed that it takes decades, not years, for water levels to reach equilibrium in response to major withdrawals.*
- *New model demonstrates that current withdrawals of groundwater are not sustainable.*