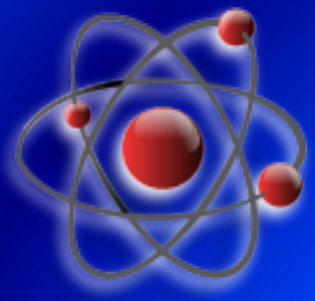
City of Virginia Beach
Uranium Mining Impact Study

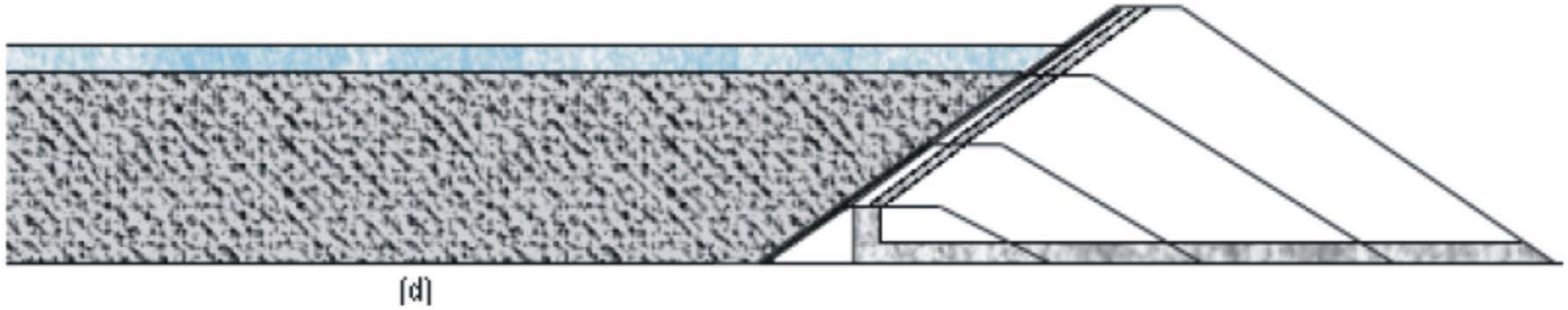


Virginia Conservation Network
2013 Environmental Assembly
September 21, 2013

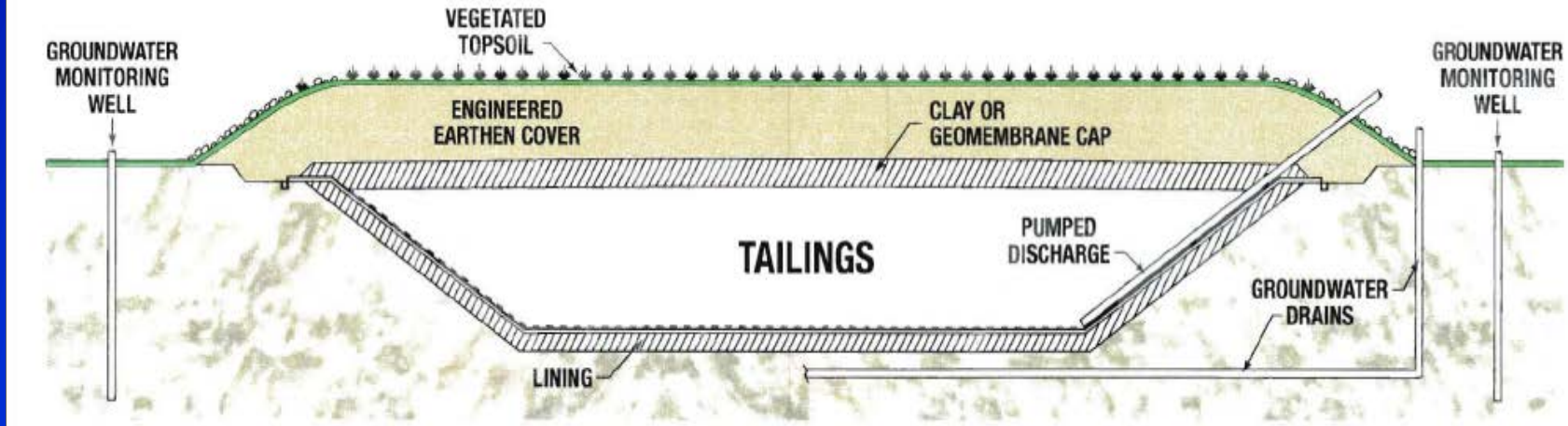
Uranium Mining in Virginia

- Excavate uranium ore: 25-100 M tons of rock
- Grind ore into sand and clay-like particles
- Leach out uranium – about 0.1% of the ore
- Dispose of tailings – about 99.9% of the ore
  - Tailings retain 85% of the total radioactivity for hundreds of thousands of years
  - Unlike original ore (buried solid rock), tailings are highly mobile via air and water
  - 20 – 76 MCY of tailings must be secured in disposal cells that may be above or below grade

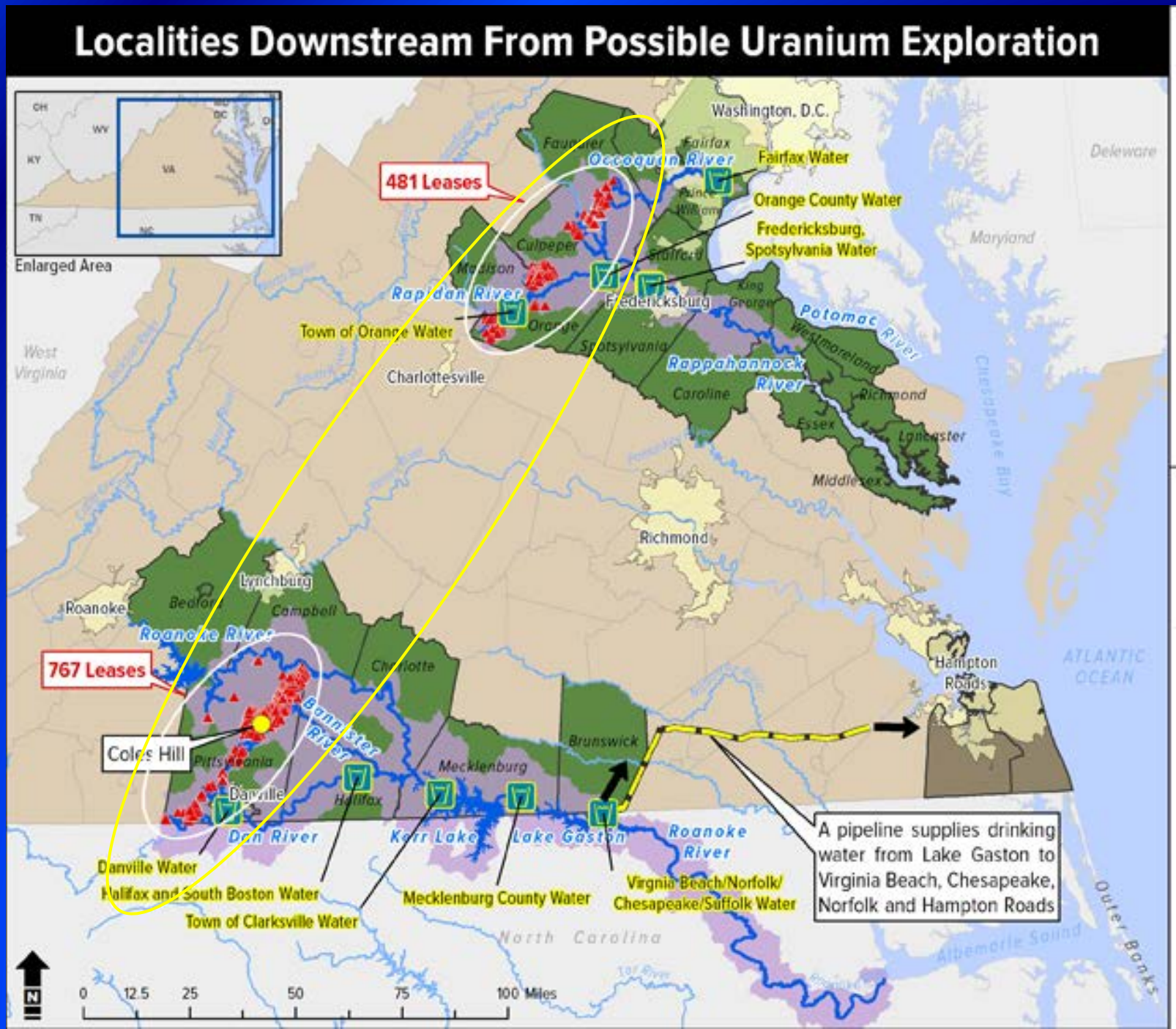
Above Grade vs Below Grade

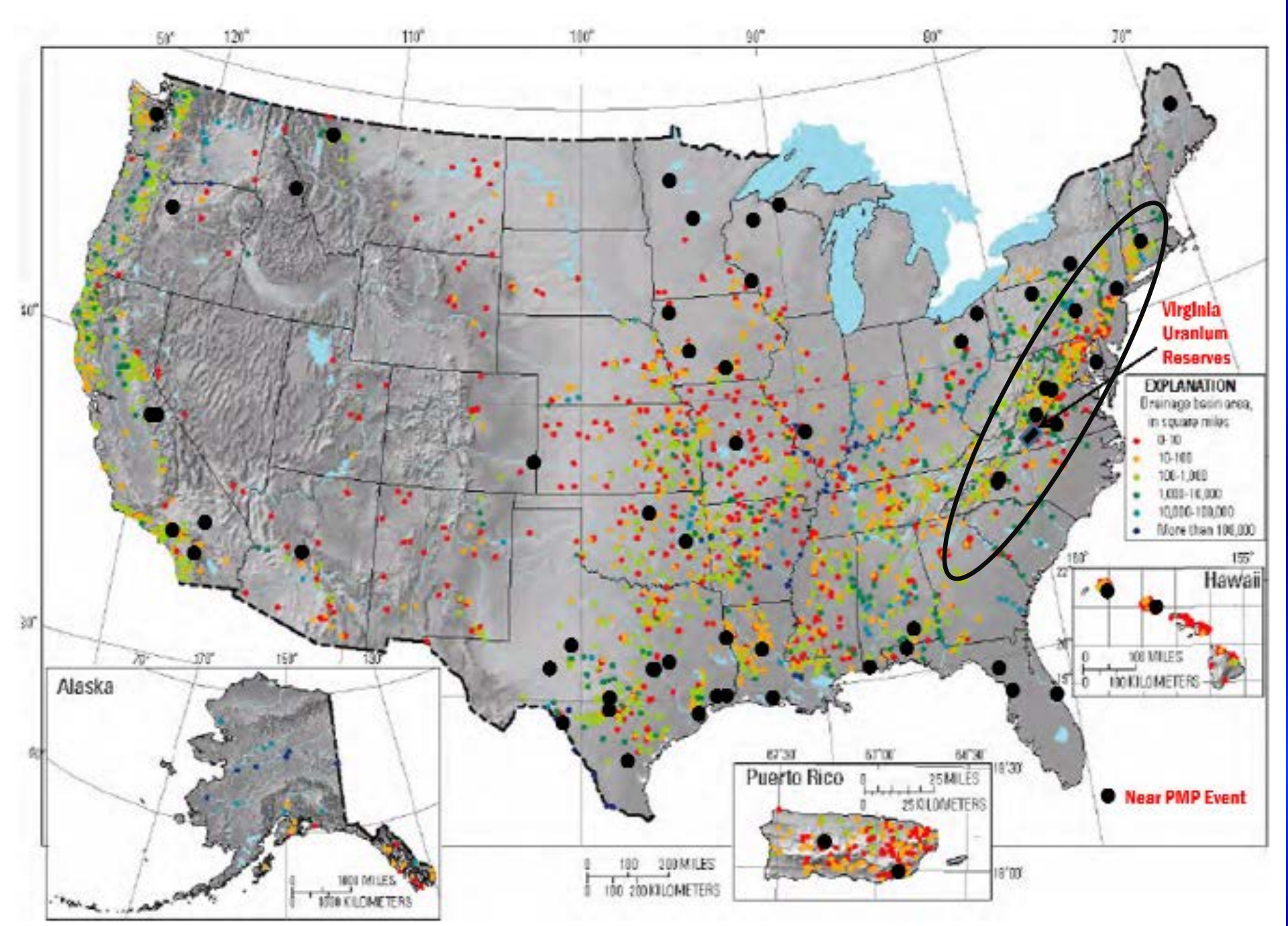


downstream tailings dam design
(a) start up state
(d) final state



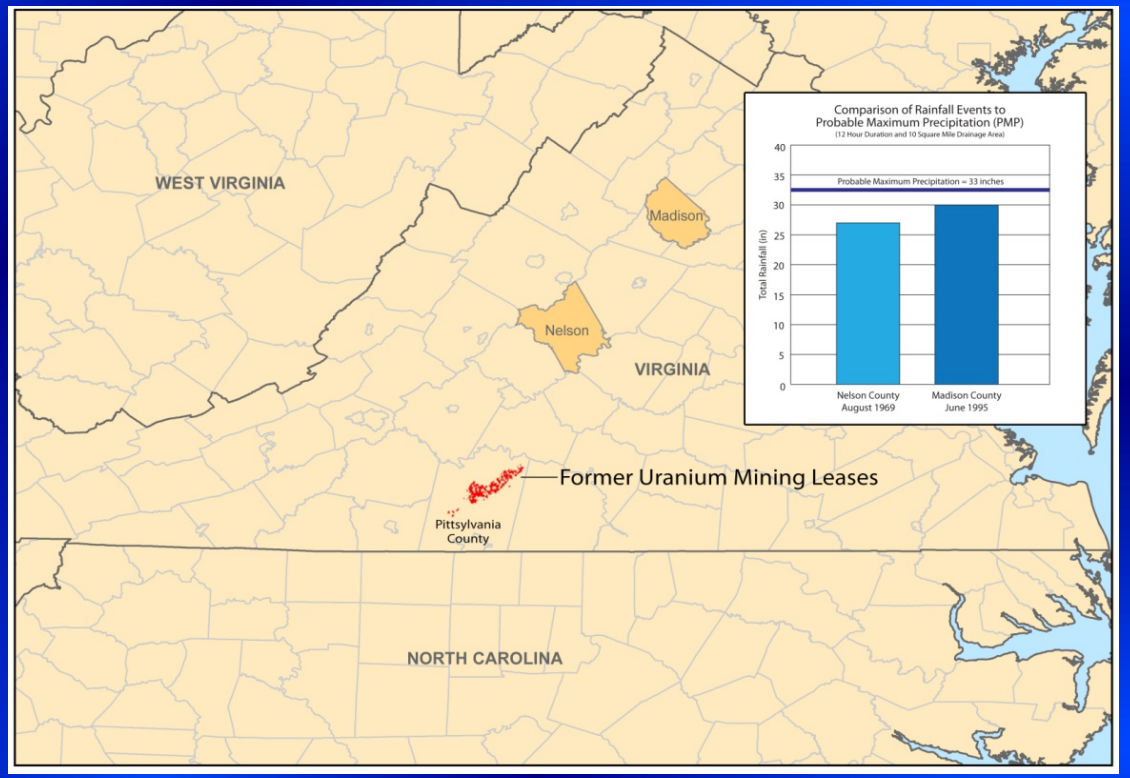
Localities Downstream From Possible Uranium Exploration




Virginia
Uranium
Reserves
EXPLANATION
Drainage basin area,
in square miles
0-10
10-100
100-1,000
1,000-10,000
10,000-100,000
More than 100,000
Hawaii
Alaska
Puerto Rico
Near PMP Event

Near PMP Storms in Virginia

- **Examples:**
  - Nelson County – August 1969
    - 27 – 31 inches in 8-hours (Hurricane Camille)
  - Madison County – June 1995
    - 30 inches in 14 hours



National Academy of Sciences Study

- Uranium mining in VA has the potential for significant, long-term environmental impacts
- VA experiences extreme natural events
- Tailings disposal cells represent significant long-term risks and may release tailings if not designed, constructed and maintained to withstand such events, or fail to perform as planned

NAS on the Existing Regulatory Framework

- Virginia has no experience with uranium mining
- Nuclear Regulatory Commission has no experience in states with wet climates and high precipitation events
- *"there are gaps in legal and regulatory coverage for . . . uranium mining, processing, reclamation, and long-term stewardship."*
- *"there are steep hurdles . . . before mining and/or processing could be established within a regulatory environment that is . . . protective of the health and safety of workers, the public, and the environment."*

What if a Catastrophe Happened?

- Will the concentrations of radioactive pollutants increase above standards and for how long?

Virginia Beach/Michael Baker Study

- The model does not simulate how or why a disposal cell might fail – it simulates the outcome if one did fail as a result of a catastrophic precipitation event
- Worst case scenario for a single, above grade cell failure on the Banister River
- The event is very unlikely and one that technology and regulations should prevent

Technology and Regulations Don't Always Prevent Catastrophes

- 1976: Grand Teton Dam – Failed While Being Filled
- 1979: United Nuclear Corp – 0.5 MCY Radioactive Tailings Spill
- 2000: Massey Energy – 1.5 MCY Coal Sludge Spill
- 2008: TVA Kingston Fossil Plant – 5.0 MCY Fly Ash Spill
- 2010: Deep Water Horizon – Oil Well Blowout
- 2011: Fukushima Daiichi Nuclear Plant – Tsunami

Virginia Uranium has Questioned Virginia Beach Impact Study

- The only valid question raised is the above-grade vs below-grade tailings disposal argument
- The threat to surface water will be dramatically reduced if the tailings are stored below grade
  - Nuclear Regulatory Commission (NRC) regulations strongly encourage below grade disposal, but make exceptions for groundwater conditions or economic feasibility issues
  - Prior engineering study ruled out below-grade storage because of groundwater conditions

Below Grade Disposal is not Assured

- Although NRC Regulations strongly encourage below- grade disposal, the Piñon Ridge, CO mine – only mine permitted in 30 years – was approved with above grade disposal
- VUI Feasibility Studies (DEC 2010 and Jun 2012) are both based upon above grade storage
- No assurance that the NRC will even allow below grade storage given existing groundwater framework
- Proposed 2013 legislation would not have guaranteed below grade storage

NAS on Below Grade Disposal

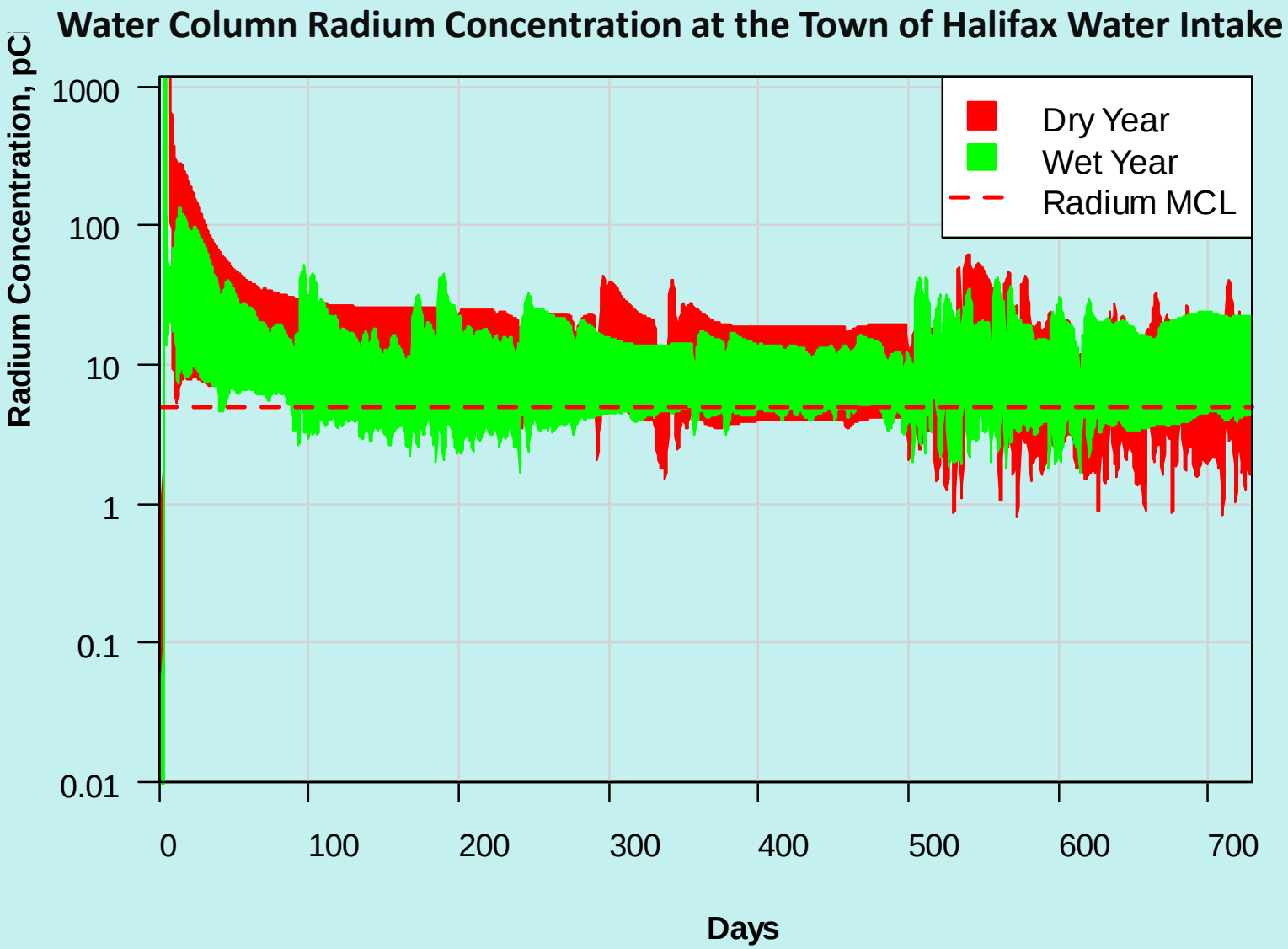
[T]he use of partially above-grade tailings facilities cannot be discounted. For example, the uranium mill, the first new uranium mill in the United States in a generation, recently received license approval from the state of Colorado. At that site, full below-grade tailings disposal was considered the best option, but a partially above-grade design with perimeter berms satisfied the relevant regulations and was recommended following detailed site-specific characterization. Therefore, the potential hazard of a sudden release resulting from the failure of a constructed retaining berm remains. An aboveground tailings dam failure (e.g., due to liquefaction associated with a seismic event, an exceptionally high rising rate from local precipitation, improper spillway design leading to overtopping) would allow for a significant sudden release of ponded water and solid tailings into receiving waters.

Source: Uranium Mining in Virginia, NAS Committee on Uranium Mining, December 2011, responding to arguments lodged against the Baker model. Emphasis added.

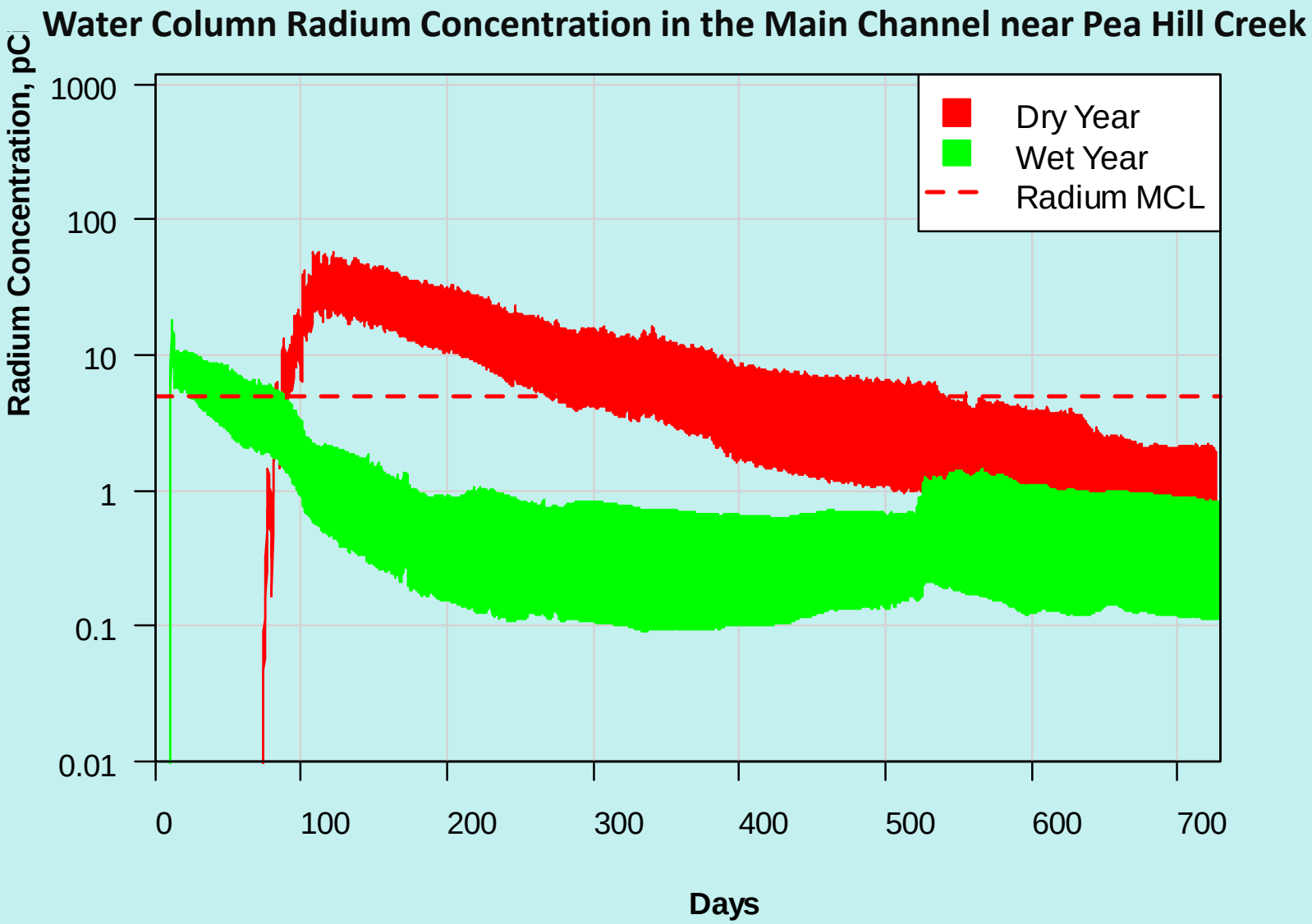
Contaminants Included in the Model

Contaminant	SDWA & CWA Regulatory Limits	
Radium 226/228	5 pCi/L	Radium Only
Alpha Particles	15 pCi/L	Radium + Thorium
Uranium	30 µg/L	Uranium as a heavy metal

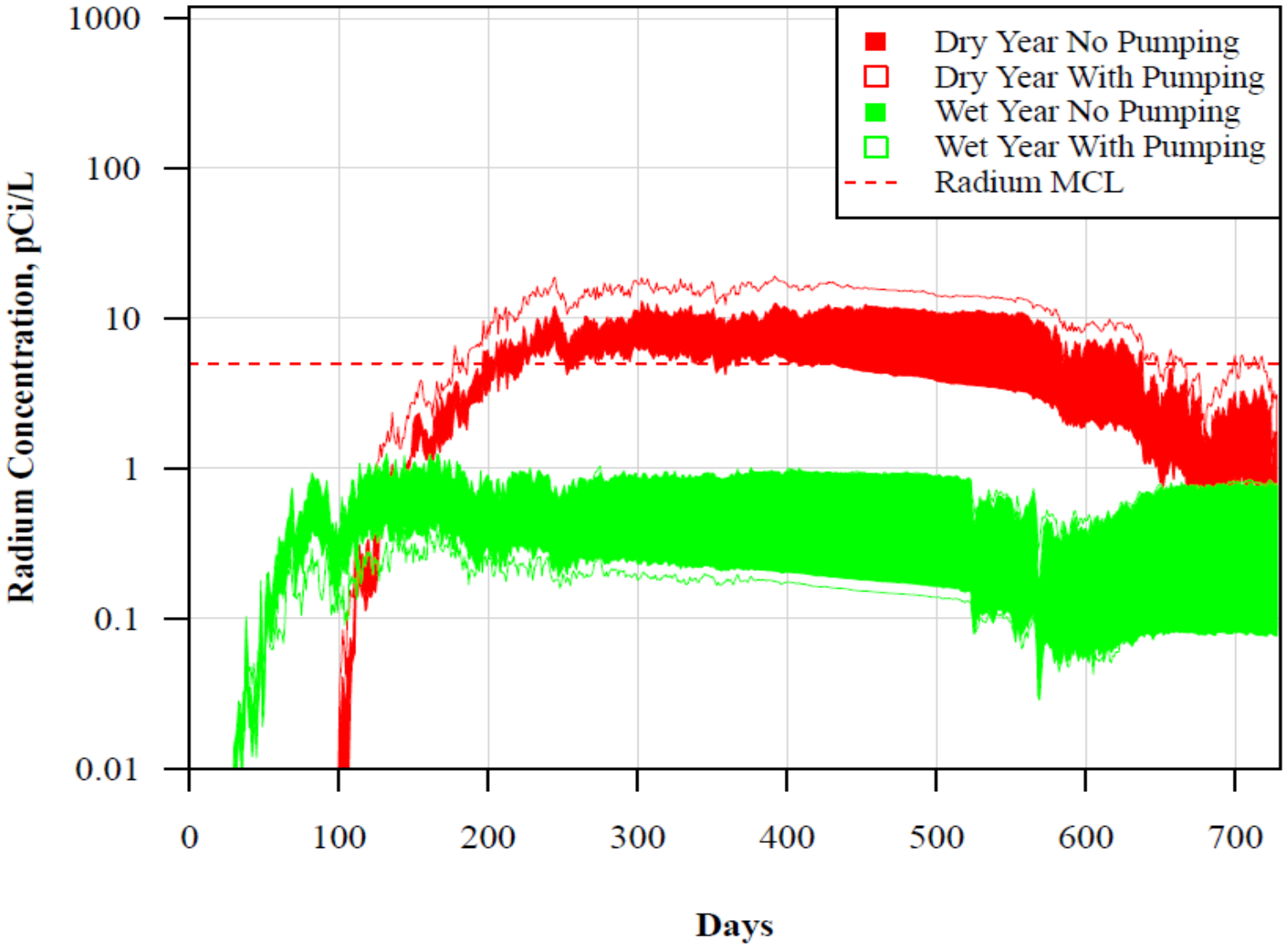
Impacts to Banister River



Impacts to Lake Gaston



Water Column Radium Concentration (G−Branch−A−Intake)



Videos Showing Progression of Radium Through the Water Column in Kerr Reservoir and Lake Gaston Dry Year Scenarios

Kerr Reservoir Dry Year Video – Phase 2

Lake Gaston - Dry Year Video – Phase 2, no Pumping

Lake Gaston - Dry Year Video – Phase 3, with Pumping

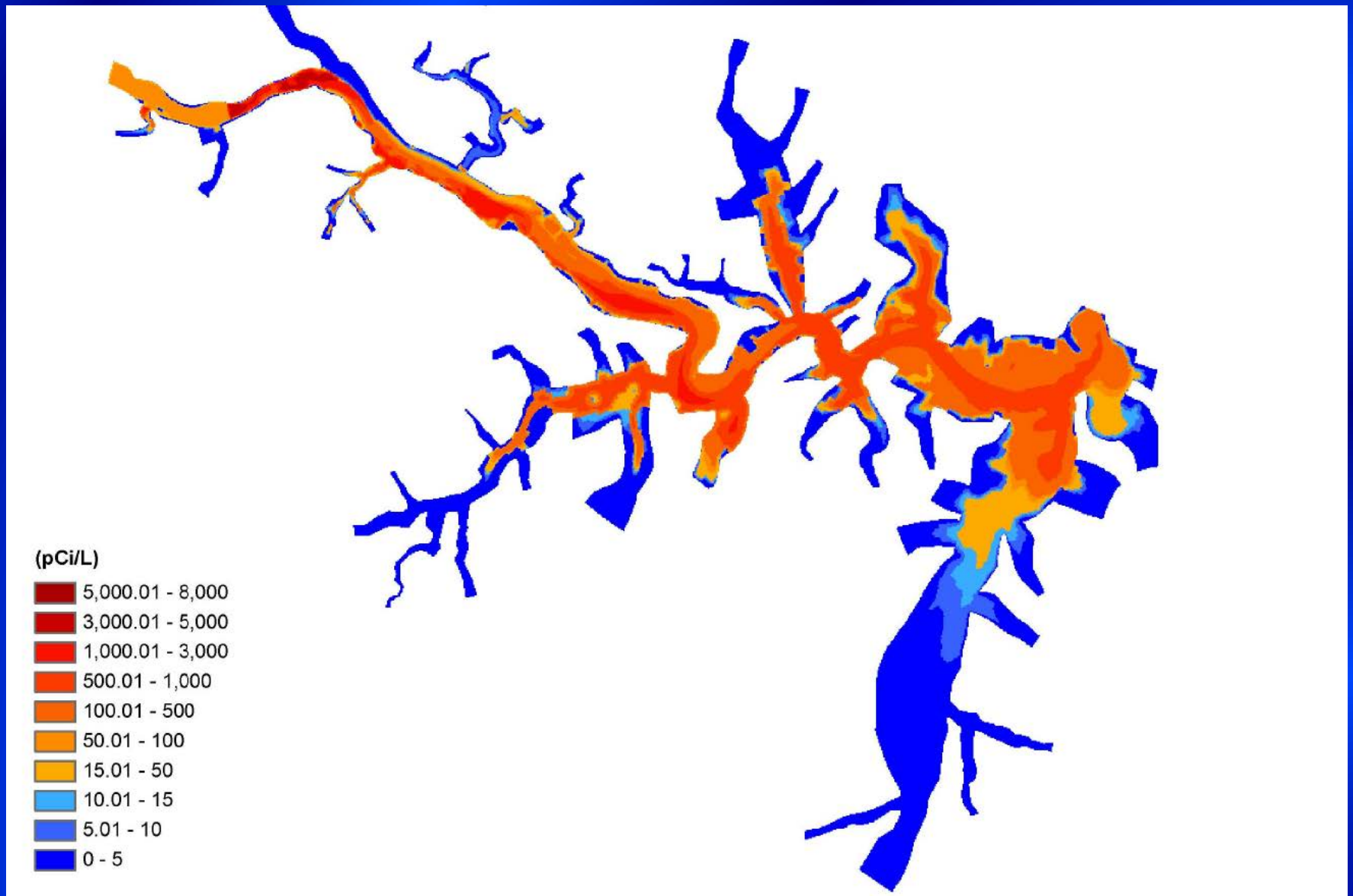
VA Beach/Baker Study Results

- Of the three contaminants modeled, radium has the most impact in the water column in terms of the SDWA and CWA
- 10-20% of radioactivity goes to the water column and flows downstream, thru Kerr & Gaston
- 80-90% of the radioactivity settles in the river and reservoir beds
- Radioactivity in the sediments is a far more significant and longer-term issue

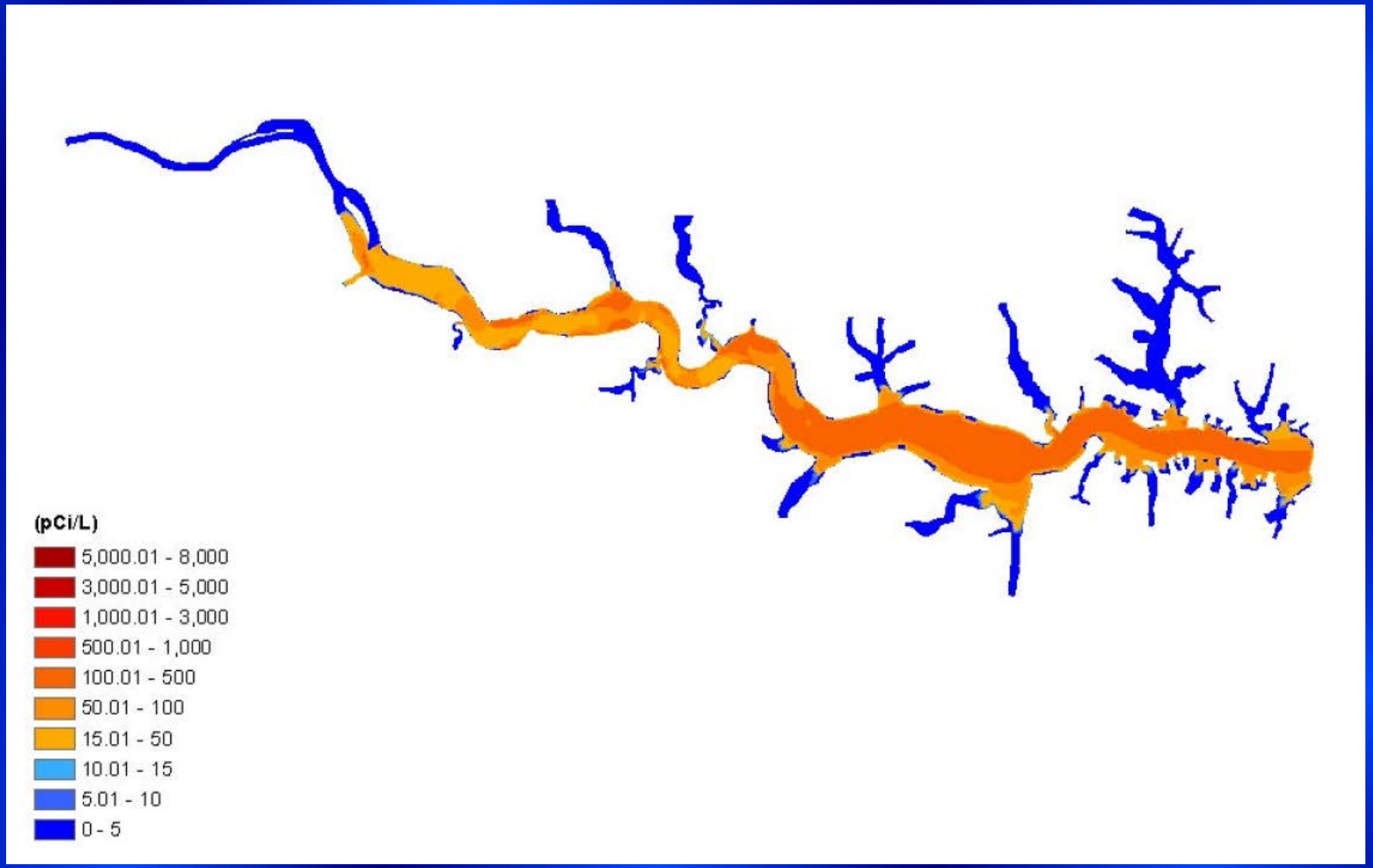
Fate of the Tailings

Water Body	Fraction of Contaminants Remaining in Sediments 2 years After Tailings Release		
	Radium	Thorium	Uranium
Banister River	54% - 83%	77% - 84%	67% - 78%
Kerr Lake	0.1% - 3.4%	2.3% - 4.2%	0.4% - 3.3%
Lake Gaston	0.03% - 0.4%	0.2% - 0.5%	0.1% - 0.6%

Radioactivity in Kerr Reservoir Sediments After 2 Years - Phase 2 Model



Radioactivity in Lake Gaston Sediments After 2 Years – Phase 2 Model



Uranium Mining in VA: Bottom Line

- The necessary regulatory framework is not in place and there are “steep hurdles” to overcome before it could
- Extreme natural events combined with human errors could result in a significant tailings release from above grade tailing disposal cells
- Long-term impacts are radioactive sediments in Banister River, Kerr Reservoir, and Lake Gaston
- Even small releases could be significant to Banister River and headwaters of Kerr Reservoir

Questions?