

# Science

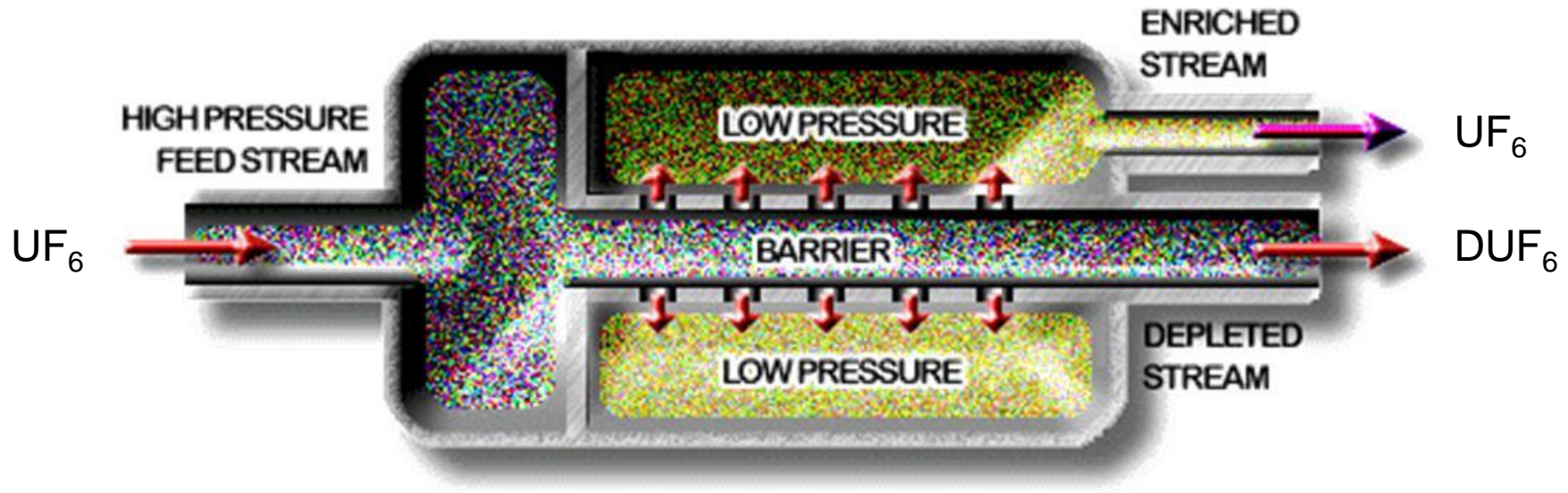
1. What type of uranium enrichment process is used at the PGDP?

1. Laser
2. Centrifuge
3. Gaseous diffusion
4. Electromagnetic separation
5. Thermal diffusion

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## ***GASEOUS DIFFUSION STAGE***



This process of uranium enrichment increases the concentration of U-235 from 0.7% up to 5.0%



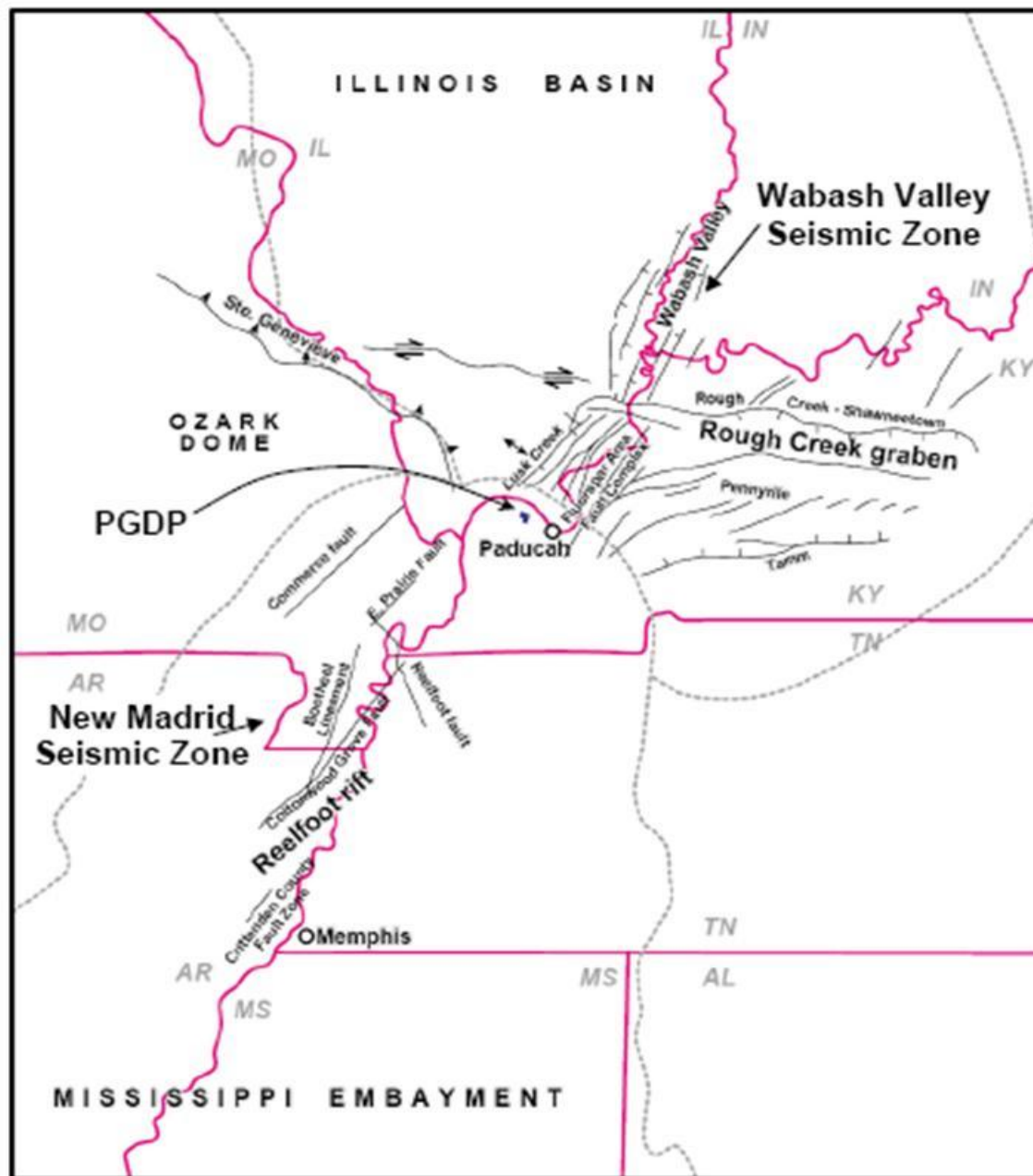
PGDP has 1,760 enrichment stages

2. According to the Kentucky Geological Survey, the PGDP site is located in what earthquake (seismic) zone?

1. The Big Foot Lake Seismic Zone
2. The New Madrid Seismic Zone
3. The Wabash Valley Seismic Zone
4. In between the New Madrid and Wabash Valley Seismic Zones
5. In between the New Madrid and Big Foot Lake Seismic Zones

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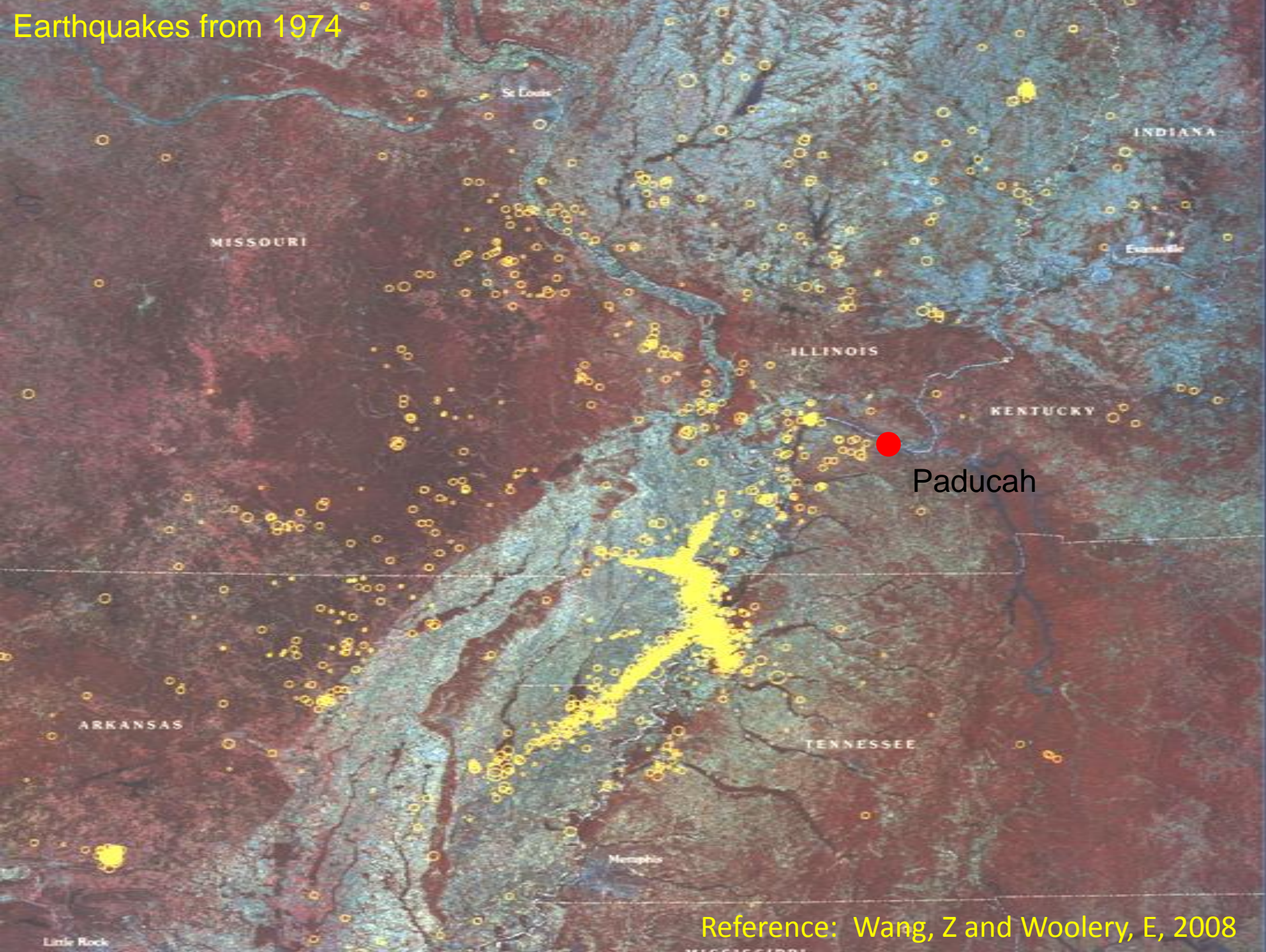
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Kolata, D., Treworgy, J., Master, J., 1981. Structural framework of the Mississippi embayment of southern Illinois. Ill. St. Geol. Surv. Circ. 516, pp. 2 – 19.



# Earthquakes from 1974



Reference: Wang, Z and Woolery, E, 2008

### 3. Which of the following statements about Technetium 99 is true?

1. It is produced in nuclear reactors
2. It is an atomic element with atomic number 43 on the periodic table
3. Its name comes from the Greek word meaning artificial
4. It is radioactive and has a half-life of 211,000 years
5. All of the above

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# THE PERIODIC TABLE

1 IA																	18 VIIIA				
<b>H</b> 1 1.008 Hydrogen																	<b>He</b> 2 4.00 Helium				
<b>Li</b> 3 6.94 Lithium	<b>Be</b> 4 9.01 Beryllium															<b>B</b> 5 10.81 Boron	<b>C</b> 6 12.01 Carbon	<b>N</b> 7 14.01 Nitrogen	<b>O</b> 8 16.00 Oxygen	<b>F</b> 9 19.00 Fluorine	<b>Ne</b> 10 20.18 Neon
<b>Na</b> 11 22.99 Sodium	<b>Mg</b> 12 24.31 Magnesium	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIII B	10	11 IB	12 IIB	<b>Al</b> 13 26.98 Aluminum	<b>Si</b> 14 28.09 Silicon	<b>P</b> 15 30.97 Phosphorus	<b>S</b> 16 32.07 Sulfur	<b>Cl</b> 17 35.45 Chlorine	<b>Ar</b> 18 39.95 Argon				
<b>K</b> 19 39.10 Potassium	<b>Ca</b> 20 40.08 Calcium	<b>Sc</b> 21 44.96 Scandium	<b>Ti</b> 22 47.88 Titanium	<b>V</b> 23 50.94 Vanadium	<b>Cr</b> 24 52.00 Chromium	<b>Mn</b> 25 54.94 Manganese	<b>Fe</b> 26 55.85 Iron	<b>Co</b> 27 58.93 Cobalt	<b>Ni</b> 28 58.69 Nickel	<b>Cu</b> 29 63.55 Copper	<b>Zn</b> 30 65.39 Zinc	<b>Ga</b> 31 69.72 Gallium	<b>Ge</b> 32 72.61 Germanium	<b>As</b> 33 74.92 Arsenic	<b>Se</b> 34 78.96 Selenium	<b>Br</b> 35 79.90 Bromine	<b>Kr</b> 36 83.80 Krypton				
<b>Rb</b> 37 85.47 Rubidium	<b>Sr</b> 38 87.62 Strontium	<b>Y</b> 39 88.91 Yttrium	<b>Zr</b> 40 91.22 Zirconium	<b>Nb</b> 41 92.91 Niobium	<b>Mo</b> 42 95.94 Molybdenum	<b>Tc</b> 43 (97.9) Technetium	<b>Ru</b> 44 101.07 Ruthenium	<b>Rh</b> 45 102.91 Rhodium	<b>Pd</b> 46 106.42 Palladium	<b>Ag</b> 47 107.87 Silver	<b>Cd</b> 48 112.41 Cadmium	<b>In</b> 49 114.82 Indium	<b>Sn</b> 50 118.71 Tin	<b>Sb</b> 51 121.76 Antimony	<b>Te</b> 52 127.60 Tellurium	<b>I</b> 53 126.90 Iodine	<b>Xe</b> 54 131.29 Xenon				
<b>Cs</b> 55 132.91 Cesium	<b>Ba</b> 56 137.33 Barium	<b>La</b> 57 138.91 Lanthanum	<b>Hf</b> 72 178.49 Hafnium	<b>Ta</b> 73 180.95 Tantalum	<b>W</b> 74 183.85 Tungsten	<b>Re</b> 75 186.21 Rhenium	<b>Os</b> 76 190.2 Osmium	<b>Ir</b> 77 192.22 Iridium	<b>Pt</b> 78 195.08 Platinum	<b>Au</b> 79 196.97 Gold	<b>Hg</b> 80 200.59 Mercury	<b>Tl</b> 81 204.38 Thallium	<b>Pb</b> 82 207.2 Lead	<b>Bi</b> 83 208.98 Bismuth	<b>Po</b> 84 (209) Polonium	<b>At</b> 85 (210) Astatine	<b>Rn</b> 86 (222) Radon				
<b>Fr</b> 87 223.02 Francium	<b>Ra</b> 88 226.03 Radium	<b>Ac</b> 89 227.03 Actinium	<b>Rf</b> 104 (261) Rutherfordium	<b>Db</b> 105 (262) Dubnium	<b>Sg</b> 106 (263) Seaborgium	<b>Bh</b> 107 (262) Bohrium	<b>Hs</b> 108 (265) Hassium	<b>Mt</b> 109 (266) Meitnerium	Unnamed Discovery 110 Nov. 1994	Unnamed Discovery 111 Nov. 1994	Unnamed Discovery 112 1996		Unnamed Discovery 114 1999		Unnamed Discovery 116 1999		Unnamed Discovery 118 1999				
ALKALI METALS	ALKALI EARTH METALS															HALOGENS	NOBLE GASES				

LANTHANIDES

<b>Ce</b> 58 140.12 Cerium	<b>Pr</b> 59 140.91 Praseodymium	<b>Nd</b> 60 144.24 Neodymium	<b>Pm</b> 61 (145) Promethium	<b>Sm</b> 62 150.36 Samarium	<b>Eu</b> 63 152.97 Europium	<b>Gd</b> 64 157.25 Gadolinium	<b>Tb</b> 65 158.93 Terbium	<b>Dy</b> 66 162.50 Dysprosium	<b>Ho</b> 67 164.93 Holmium	<b>Er</b> 68 167.26 Erbium	<b>Tm</b> 69 168.93 Thulium	<b>Yb</b> 70 173.04 Ytterbium	<b>Lu</b> 71 174.97 Lutetium
<b>Th</b> 90 232.04 Thorium	<b>Pa</b> 91 231.04 Protactinium	<b>U</b> 92 238.03 Uranium	<b>Np</b> 93 237.05 Neptunium	<b>Pu</b> 94 (240) Plutonium	<b>Am</b> 95 243.06 Americium	<b>Cm</b> 96 (247) Curium	<b>Bk</b> 97 (248) Berkelium	<b>Cf</b> 98 (251) Californium	<b>Es</b> 99 252.08 Einsteinium	<b>Fm</b> 100 257.10 Fermium	<b>Md</b> 101 (257) Mendelevium	<b>No</b> 102 259.10 Nobelium	<b>Lr</b> 103 262.11 Lawrencium

ACTINIDES

4. What keeps contaminated groundwater from moving south of the PGDP?

1. Nothing
2. DOE pump and Treat Facilities
3. Porters Creek Clay Geologic Formation
4. Large impervious area within the DOE property boundary
5. Forest

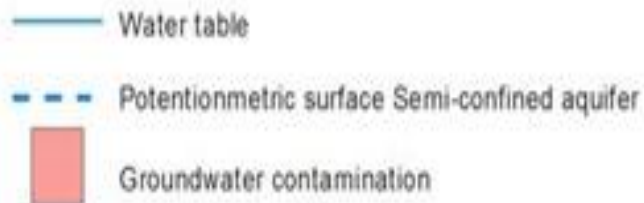
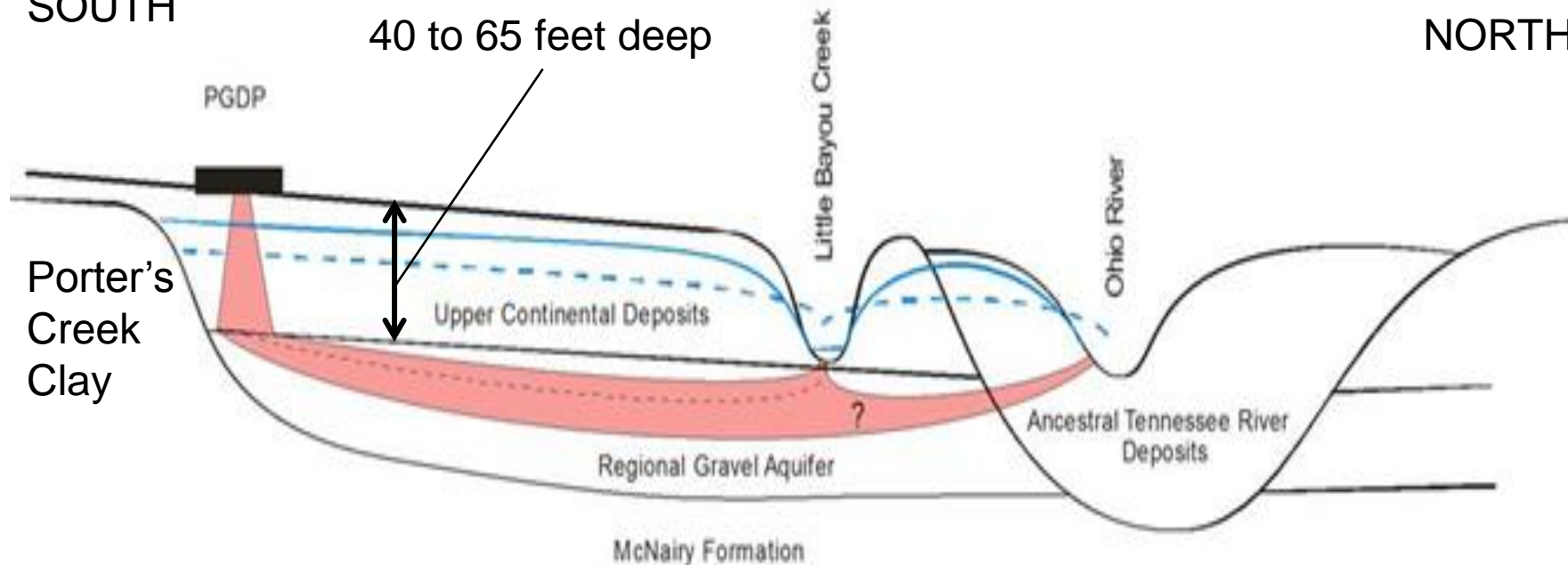
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SOUTH

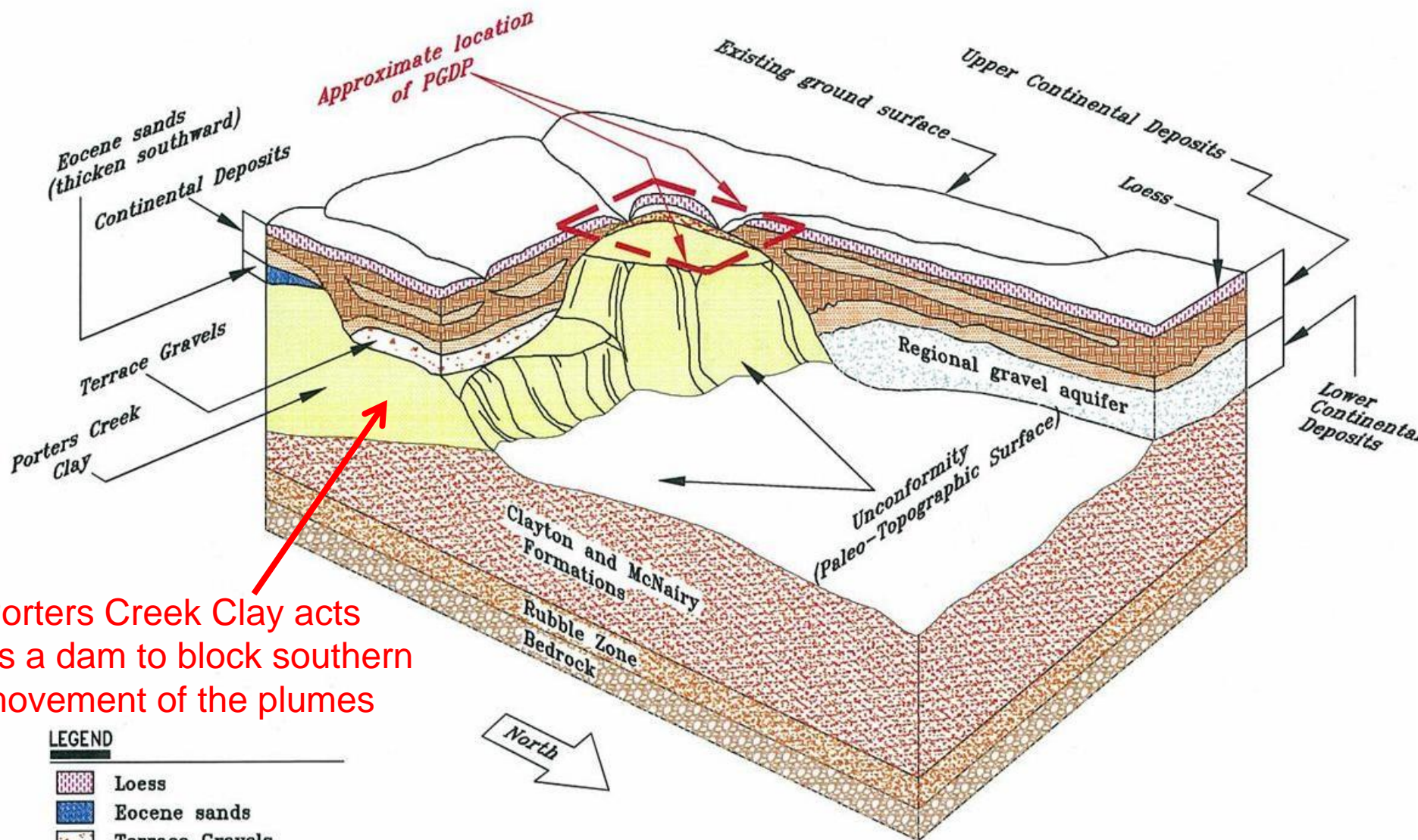
40 to 65 feet deep

NORTH



CROSS SECTION OF GEOLOGY AT THE PGDP SITE





Porters Creek Clay acts as a dam to block southern movement of the plumes

#### LEGEND

	Loess
	Eocene sands
	Terrace Gravels
	Clayton and McNairy Formations
	Porters Creek Clay
	Continental Deposits - Interbedded silts/clay and sand/gravel
	Regional Gravel Aquifer
	Sand
	Rubble Zone
	Bedrock

Not to Scale

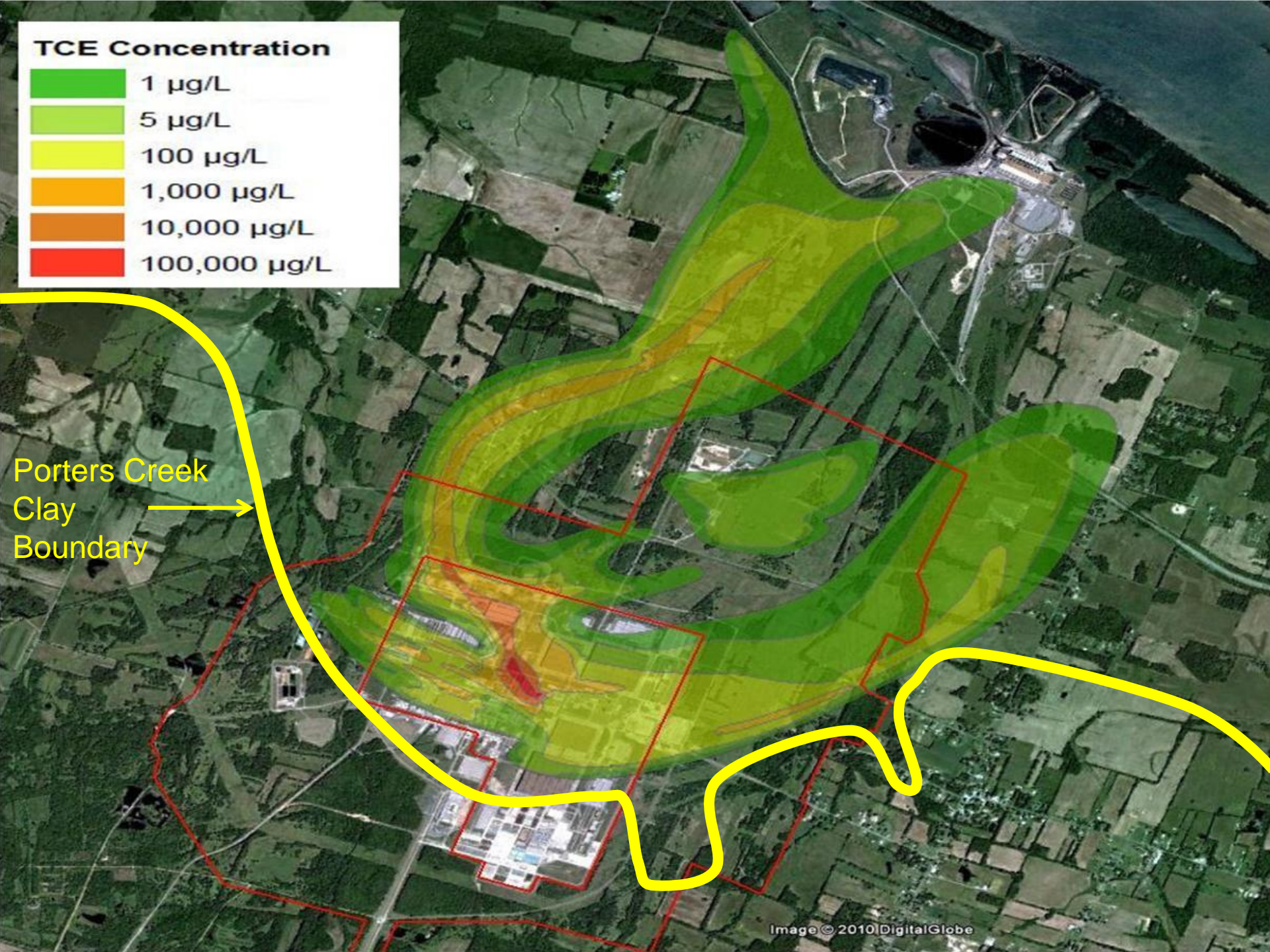
3-D IMAGE OF GEOLOGY AT THE PGDP SITE



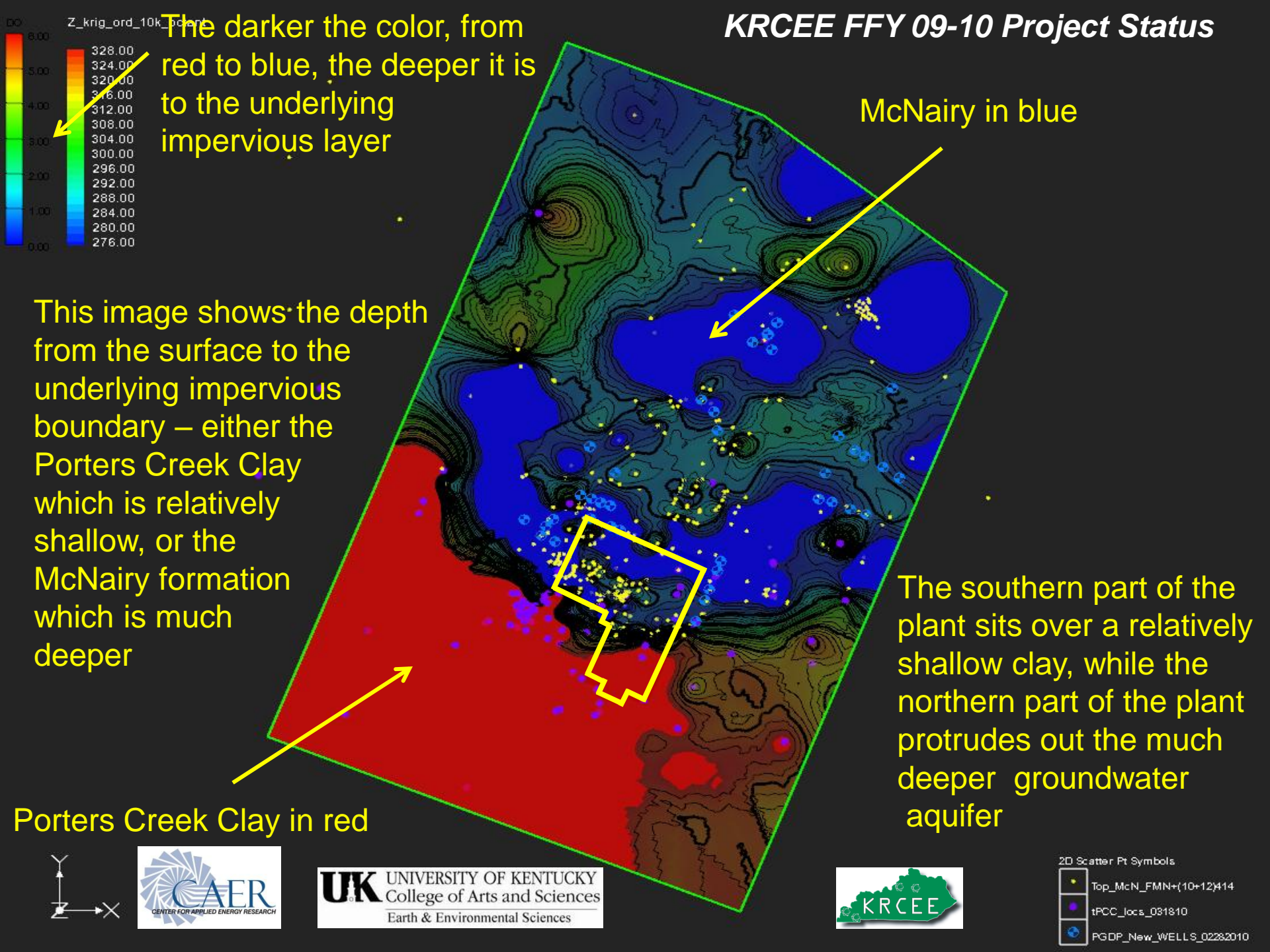
# TCE Concentration

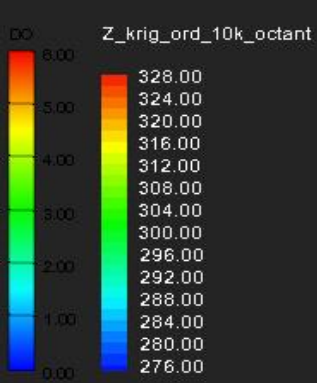


Porters Creek  
Clay  
Boundary

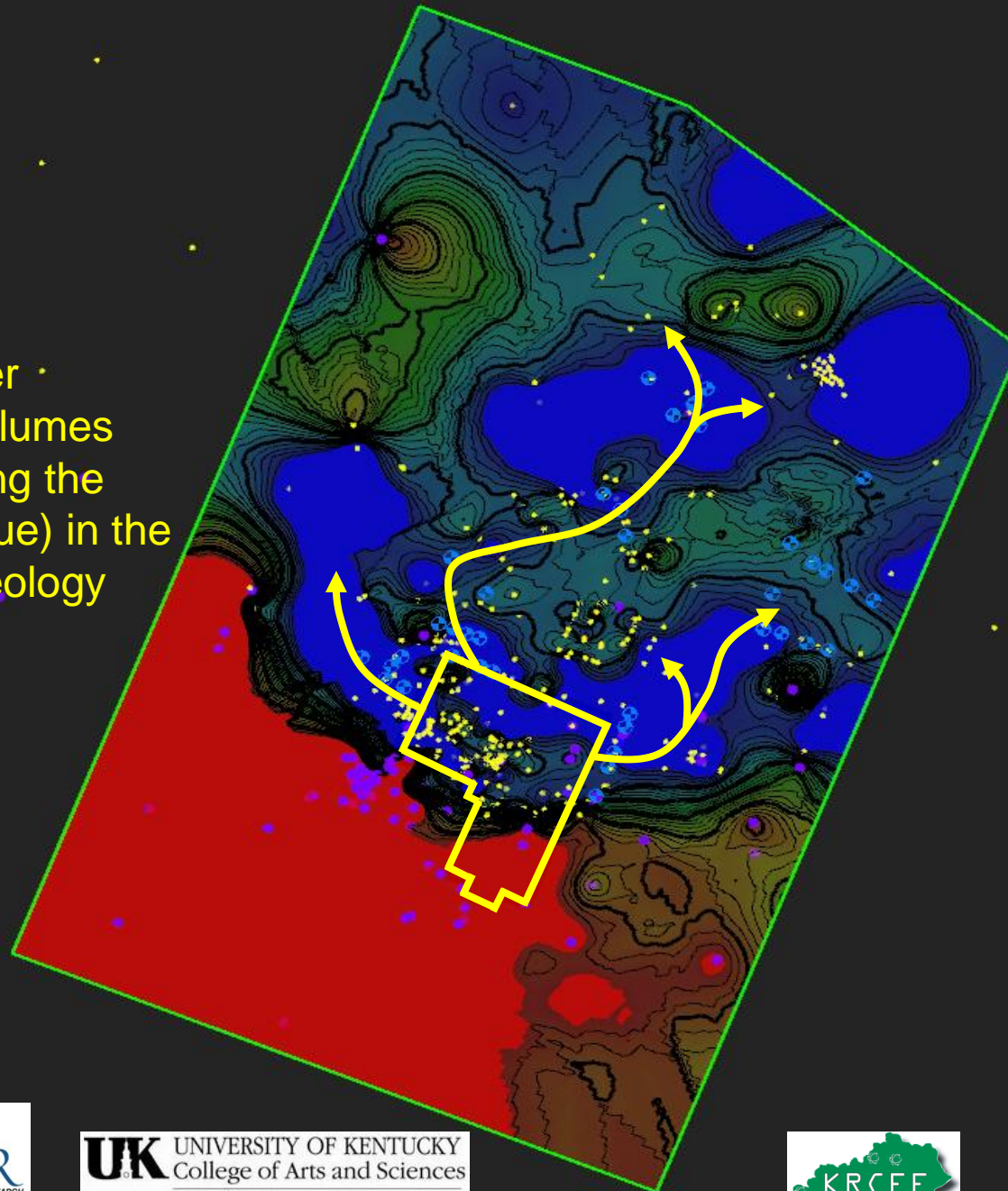




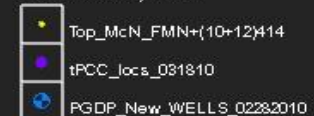




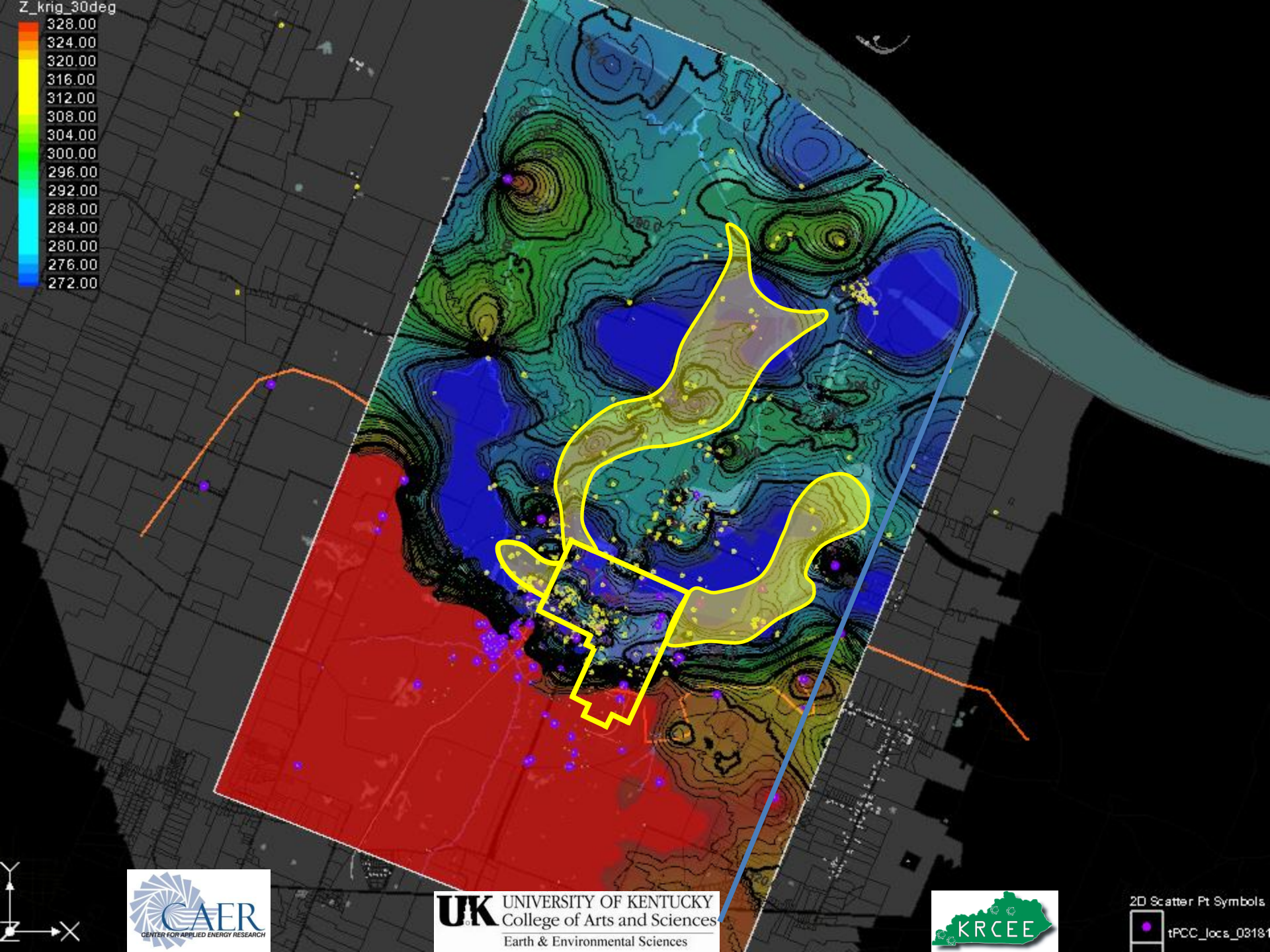
The groundwater contamination plumes tend to flow along the lowest spots (blue) in the Groundwater geology



2D Scatter Pt Symbols







Z\_krig\_30deg

328.00
324.00
320.00
316.00
312.00
308.00
304.00
300.00
296.00
292.00
288.00
284.00
280.00
276.00
272.00

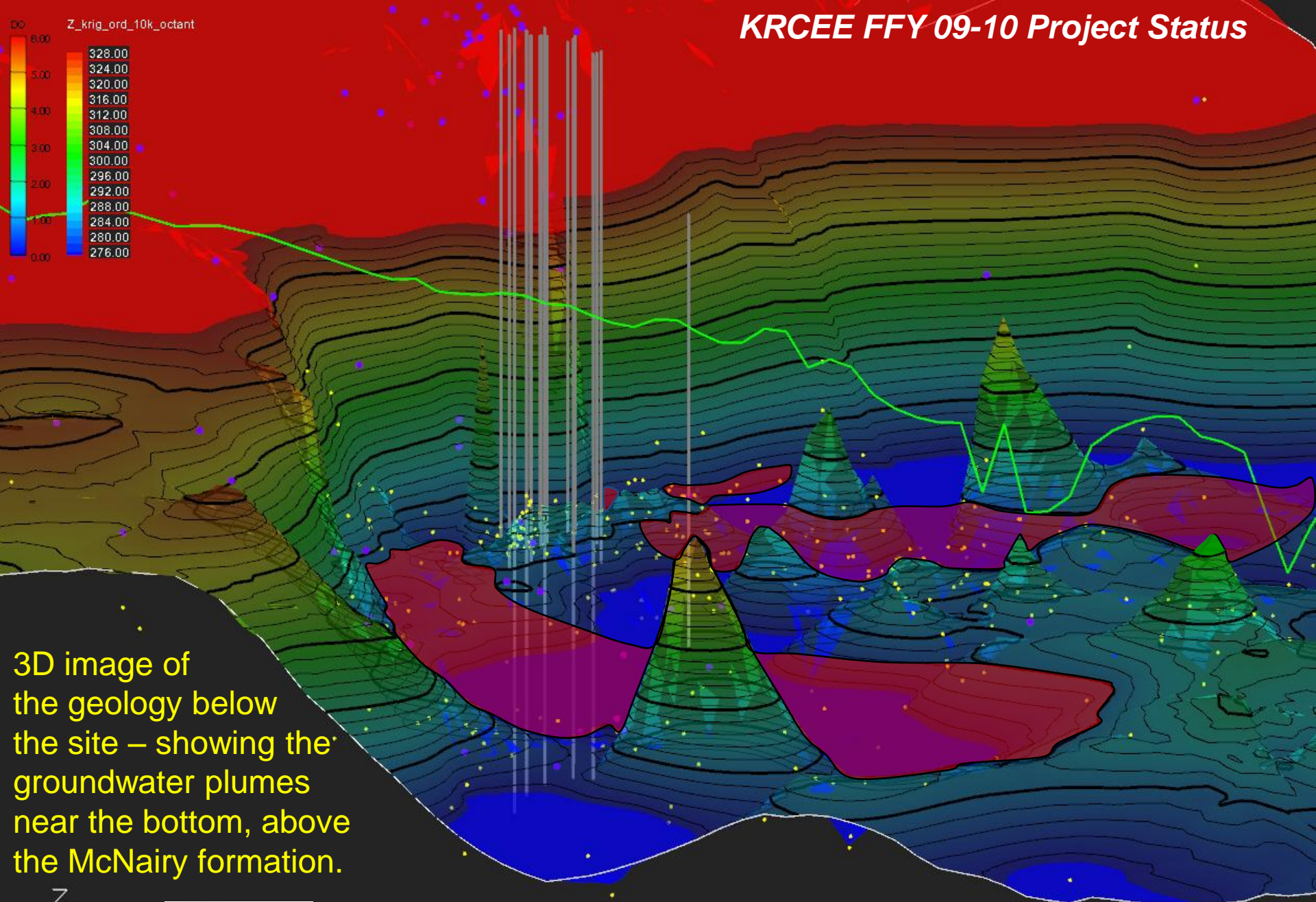


**UK** UNIVERSITY OF KENTUCKY  
College of Arts and Sciences  
Earth & Environmental Sciences



2D Scatter Pt Symbols  
tPCC\_locs\_03181





5. According to the National Renewable Energy Lab, areas with annual average wind speeds around 6.5m/s and greater at 80-m height are generally considered to have suitable resources for wind development. The average such wind speeds around the PGDP are?

1. 2 to 3 m/s
2. 3 to 4 m/s
3. 5 to 5.5 m/s
4. 6 to 7 m/s
5. 8 to 9 m/s

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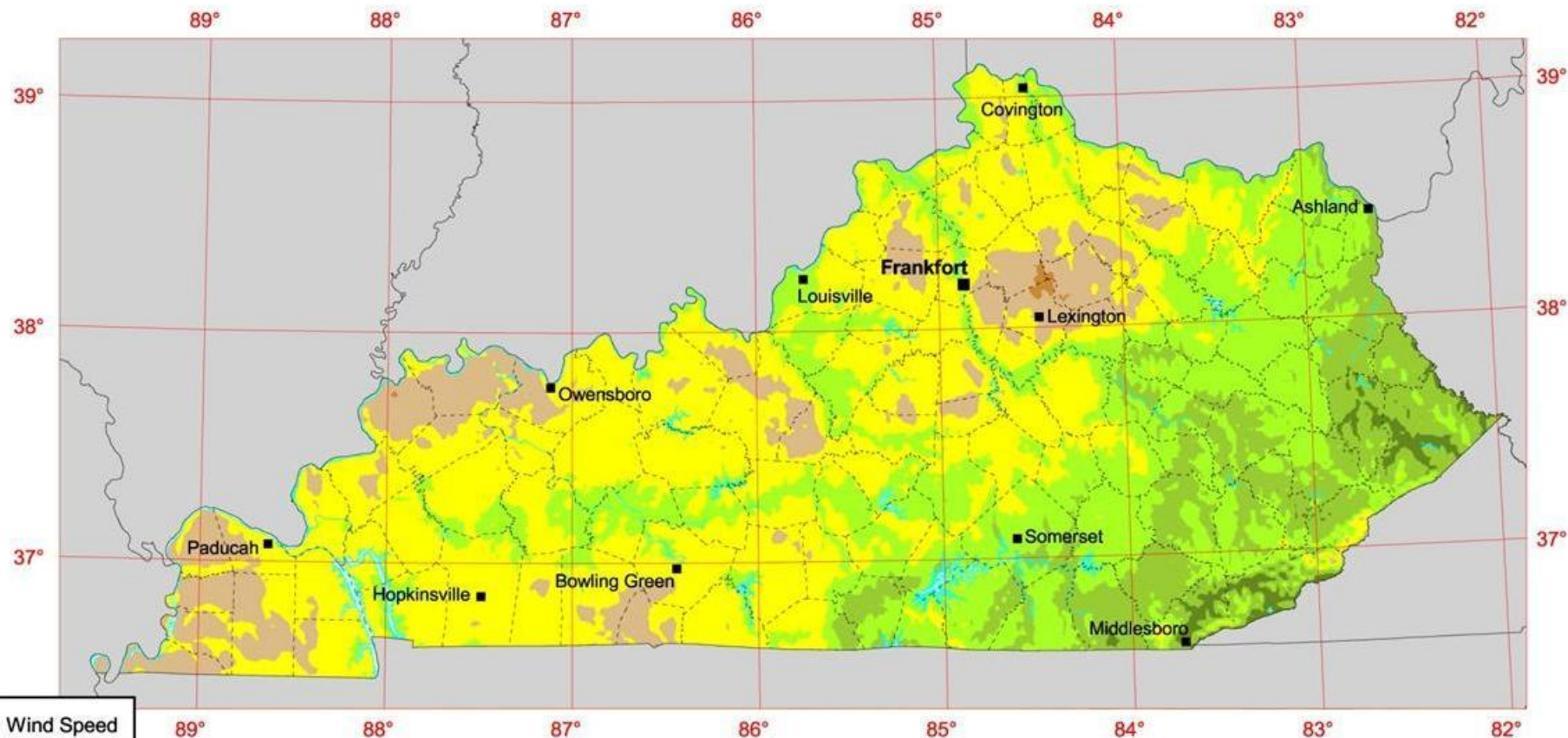
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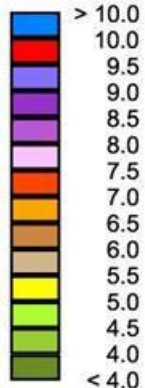




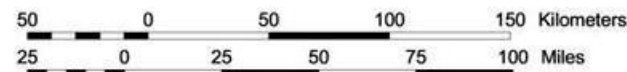
# Kentucky - Annual Average Wind Speed at 80 m



Wind Speed  
m/s



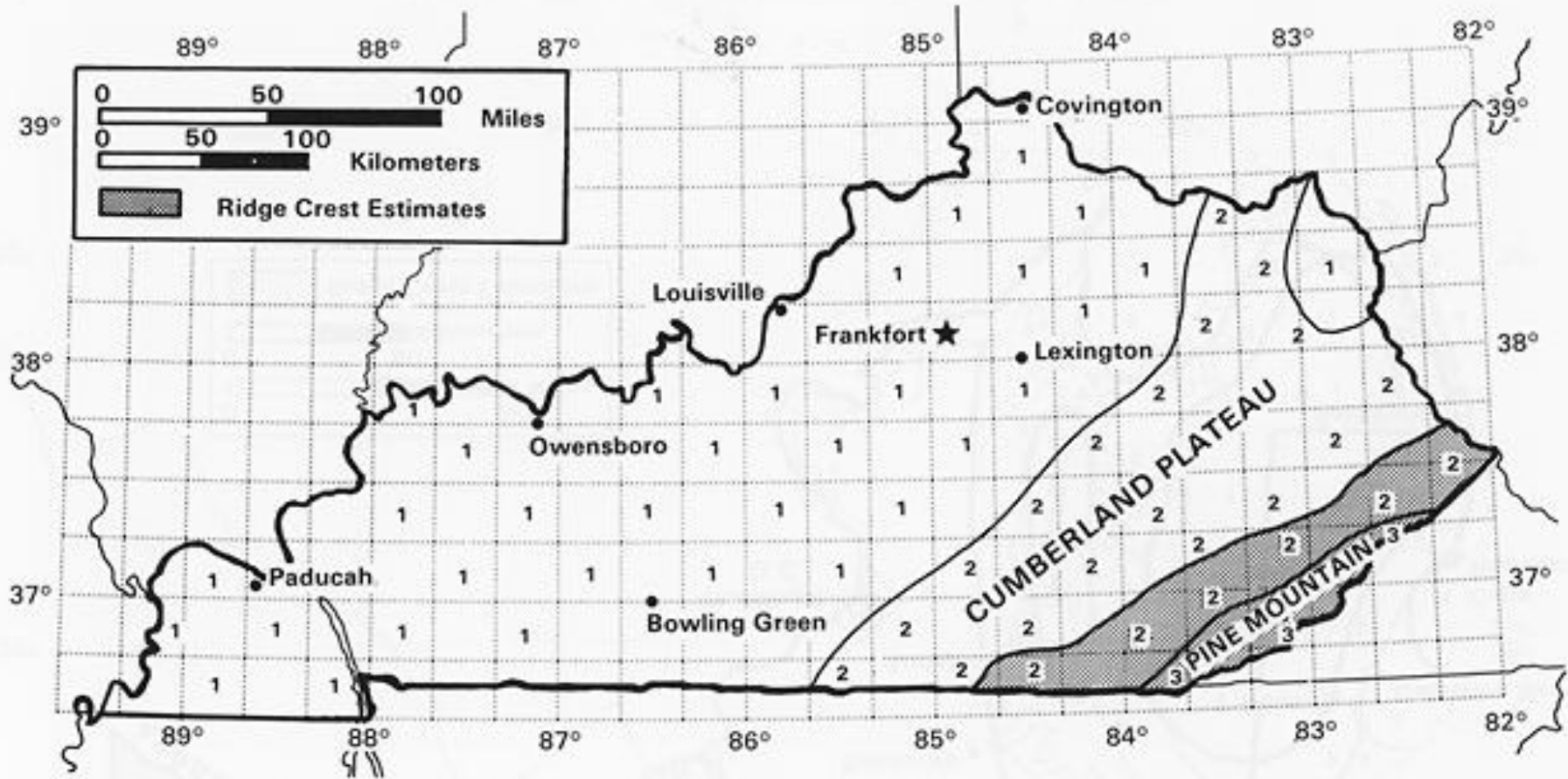
Source: Wind resource estimates developed by AWS Truewind, LLC for windNavigator®. Web: <http://navigator.awstruewind.com> | [www.awstruewind.com](http://www.awstruewind.com). Spatial resolution of wind resource data: 2.5 km. Projection: UTM Zone 16 WGS84.



AWS Truewind

**NREL**  
National Renewable  
Energy Laboratory  
*Innovation for Our Energy Future*

Kentucky Annual Average Wind Power: Minimum Wind Class Required = 3



<http://rredc.nrel.gov/wind/pubs/atlas/maps/chap3/3-29m.html>

6. According to the Commonwealth of Kentucky Alternative Energy Facilities Site Bank, the PGDP site is best suited for which type of alternative energy plant?

1. Nuclear
2. Solar
3. Biomass
4. Clean coal
5. Other

6. According to the Commonwealth of Kentucky Alternative Energy Facilities Site Bank, the PGDP site is best suited for which type of alternative energy plant?

1. Nuclear (70%)
2. Solar (59%)
3. Biomass (83%)
4. Clean coal (79%)
5. Other





COMMONWEALTH AGRI-ENERGY ETHANOL PLANT, HOPKINSVILLE ROAD  
20 MILLION GALLON/YEAR – EMPLOYEES 30 EMPLOYEES