

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

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

1. Laser

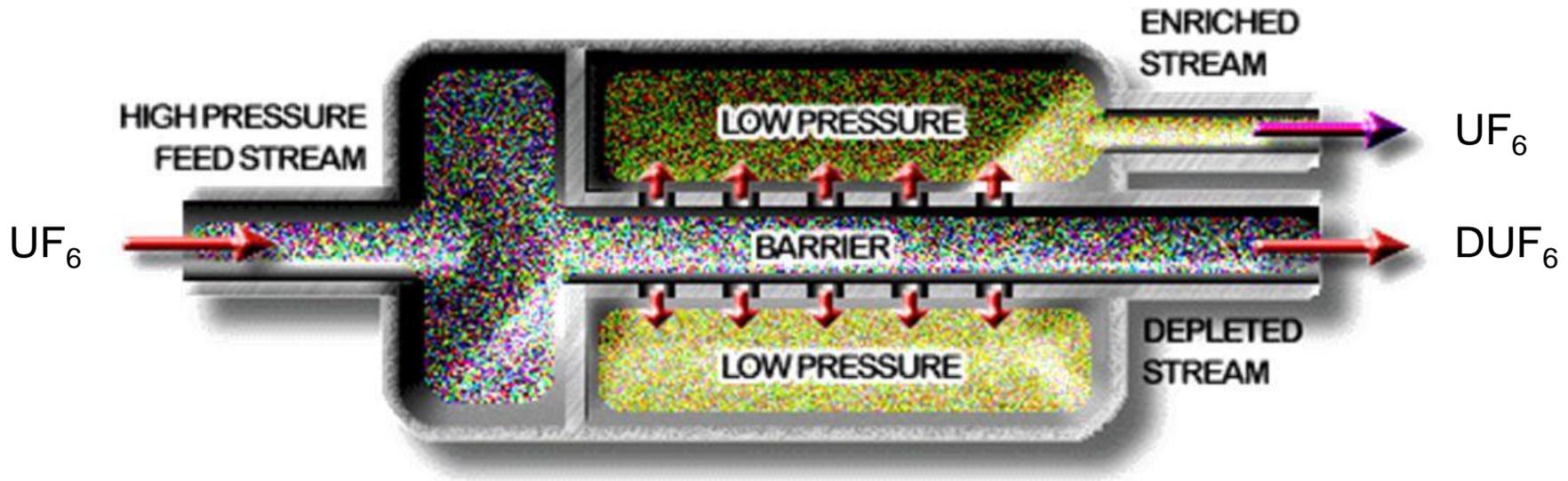
2. Centrifuge

3. Gaseous diffusion

4. Electromagnetic separation

5. Thermal diffusion

GASEOUS DIFFUSION STAGE



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



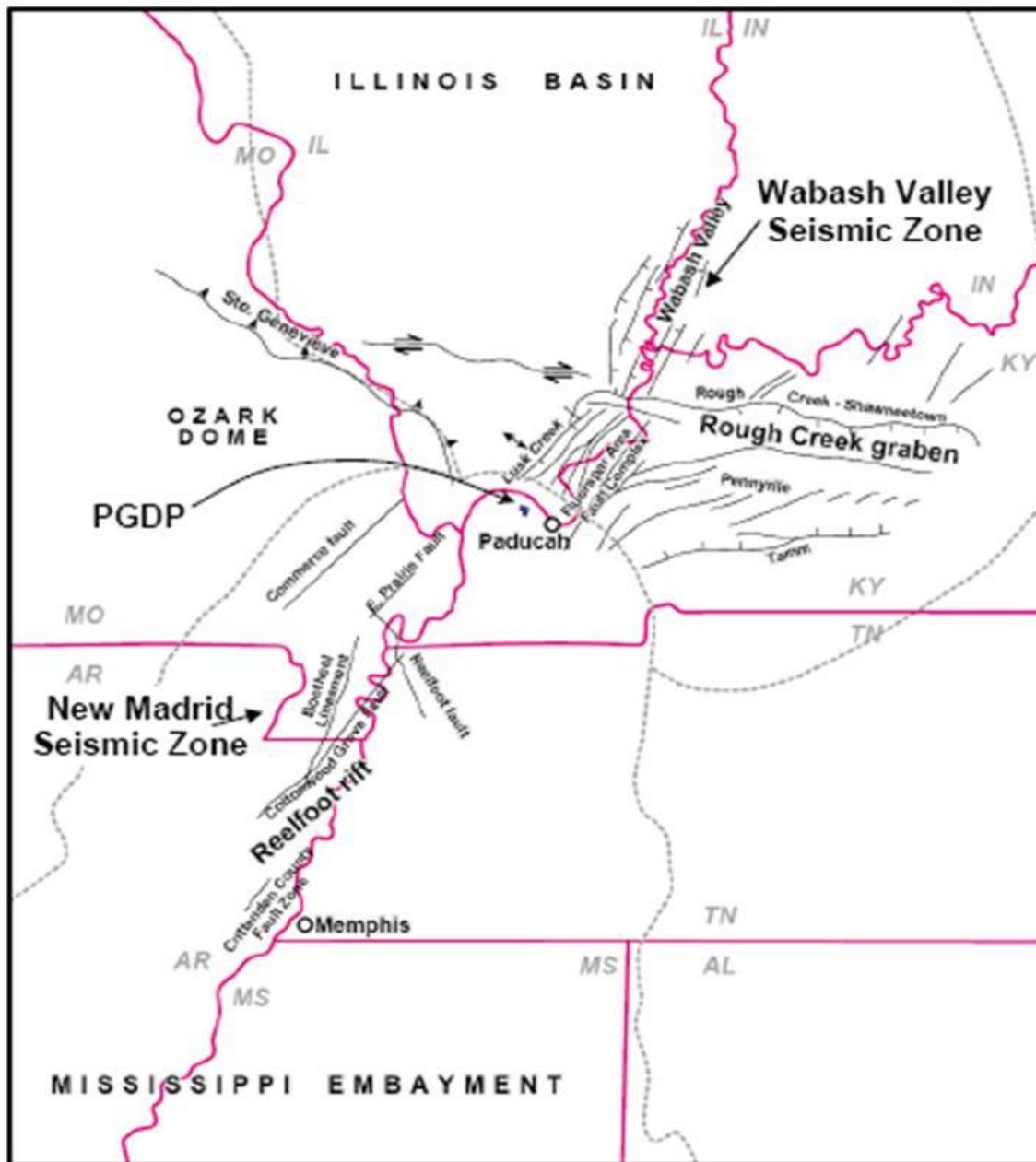
PGDP has 1,760 enrichment stages

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

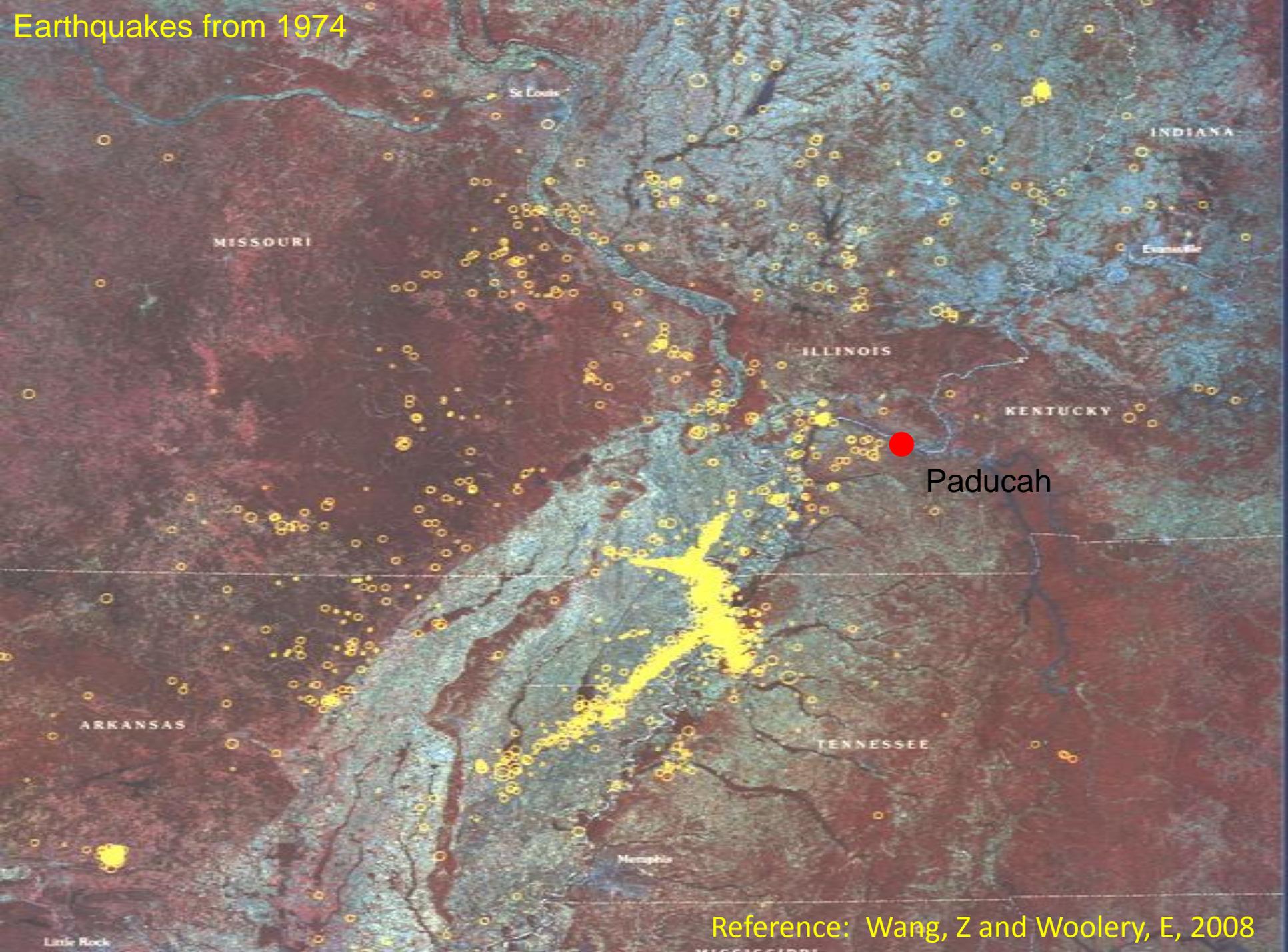
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Kolata, D., Treworgy, J., Master, J., 1981. Structural framework of the Mississippi embayment of southern Illinois. Ill. St. Geol. Surv. Circ. 516, pp. 2 – 19.

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

H — SYMBOL
1 — ATOMIC NUMBER
1.008 — ATOMIC WEIGHT
Hydrogen — NAME

() = ESTIMATES

ALKALI METALS
ALKALI EARTH METALS

HALOGENS
NOBLE GASES

LANTHANIDES

Ce 58 140.12 Cerium	Pr 59 140.91 Praseodymium	Nd 60 144.24 Neodymium	Pm 61 (145) Promethium	Sm 62 150.36 Samarium	Eu 63 152.97 Europium	Gd 64 157.25 Gadolinium	Tb 65 158.93 Terbium	Dy 66 162.50 Dysprosium	Ho 67 164.93 Holmium	Er 68 167.26 Erbium	Tm 69 168.93 Thulium	Yb 70 173.04 Ytterbium	Lu 71 174.97 Lutetium
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ACTINIDES

Th 90 232.04 Thorium	Pa 91 231.04 Protactinium	U 92 238.03 Uranium	Np 93 237.05 Neptunium	Pu 94 (240) Plutonium	Am 95 243.06 Americium	Cm 96 (247) Curium	Bk 97 (248) Berkelium	Cf 98 (251) Californium	Es 99 252.08 Einsteinium	Fm 100 257.10 Fermium	Md 101 (257) Mendelevium	No 102 259.10 Nobelium	Lr 103 262.11 Lawrencium
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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

NORTH

40 to 65 feet deep

PGDP

Porter's
Creek
Clay

Upper Continental Deposits

Little Bayou Creek

Ohio River

Regional Gravel Aquifer

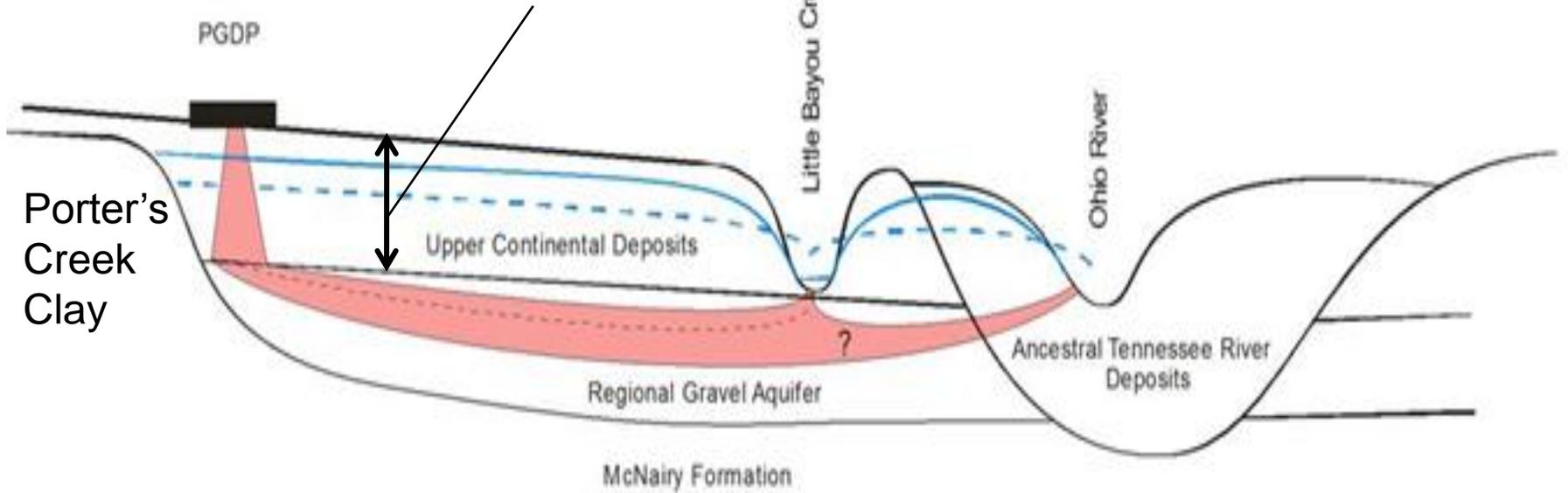
Ancestral Tennessee River
Deposits

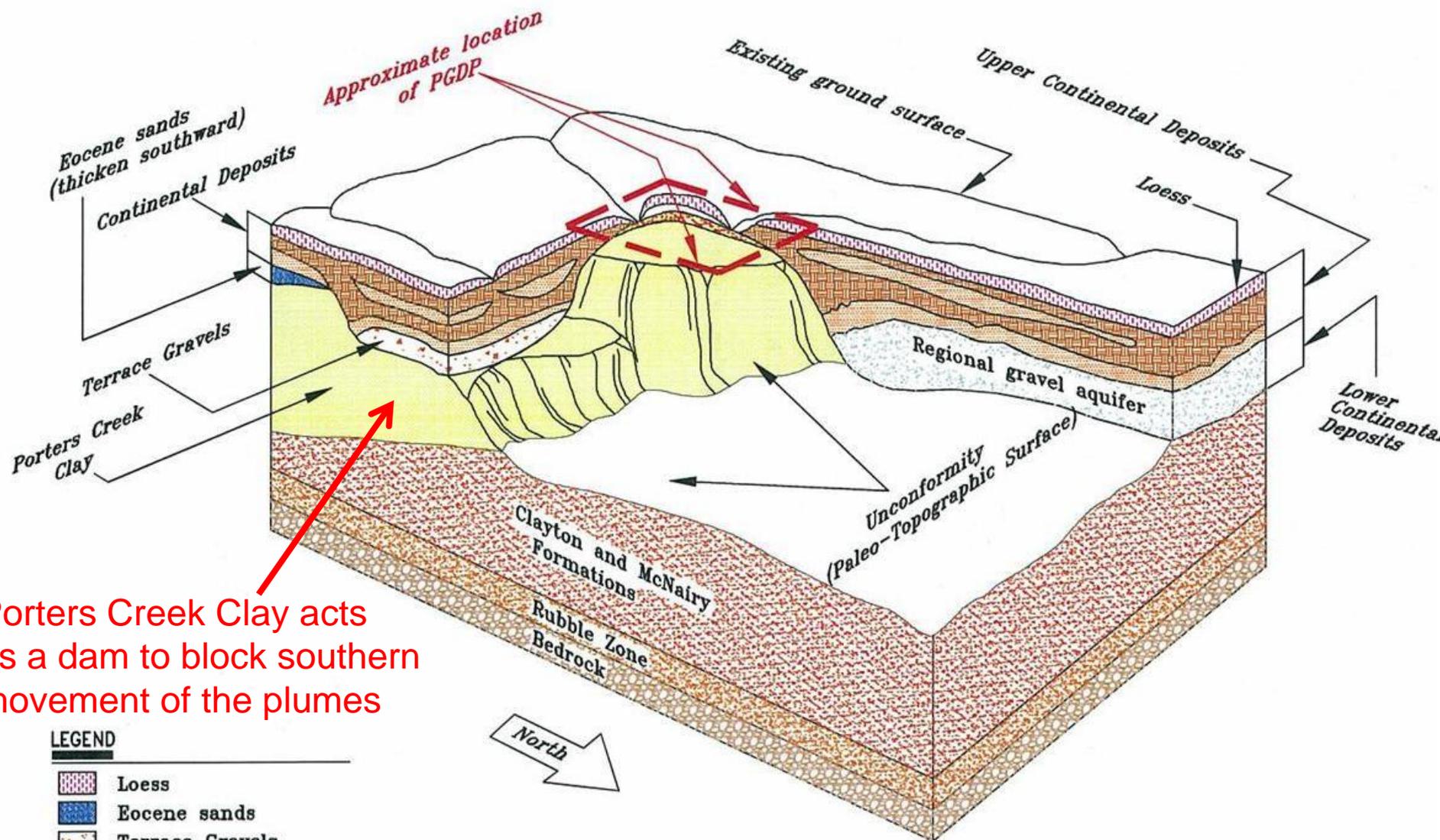
McNairy Formation

Not to scale

- Water table
- - - Potentionmetric surface Semi-confined aquifer
- Groundwater contamination

CROSS SECTION OF GEOLOGY AT THE PGDP SITE





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

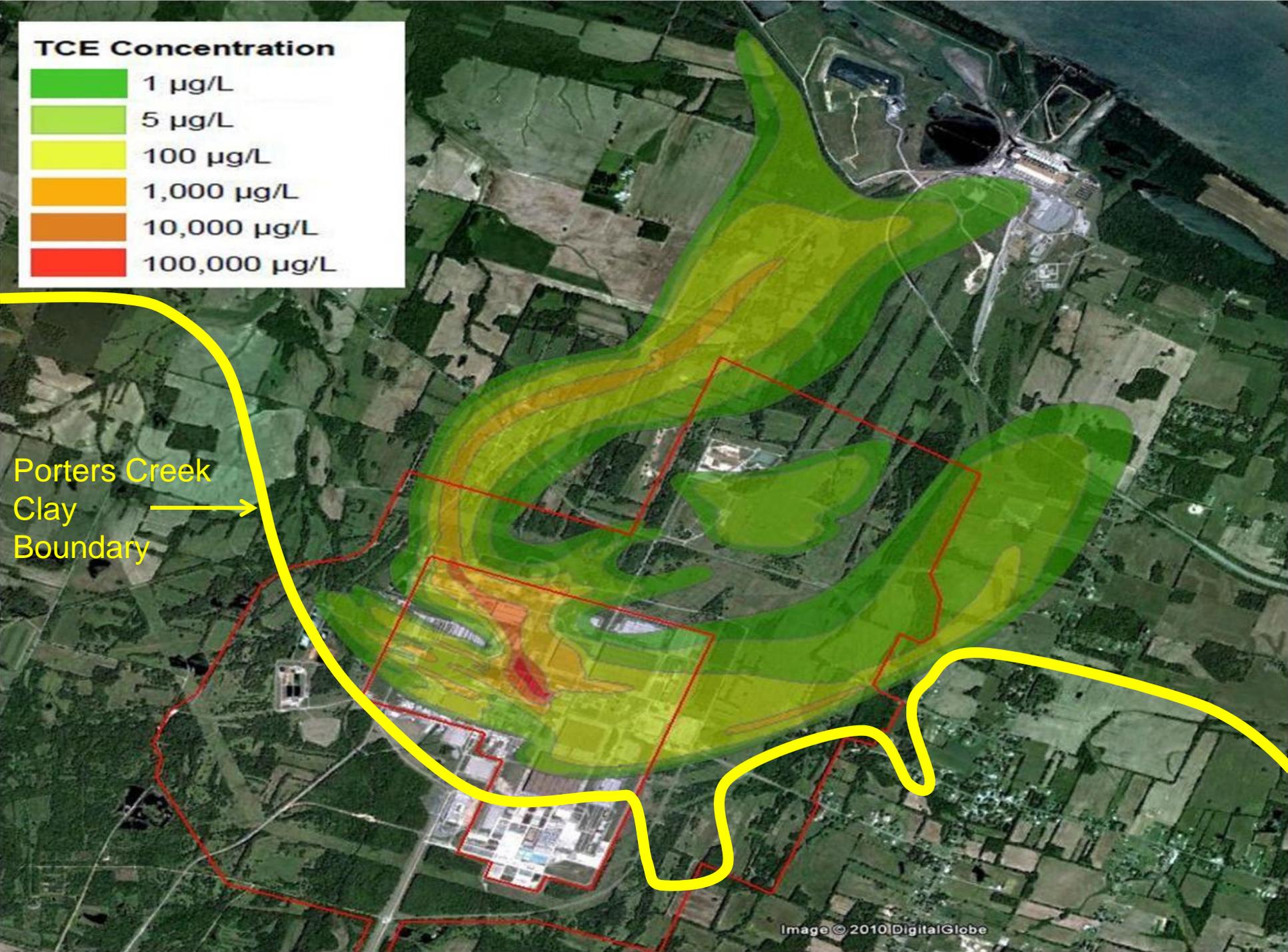
LEGEND

-  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

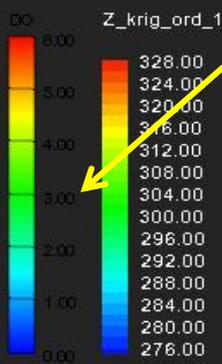
3-D IMAGE OF GEOLOGY AT THE PGDP SITE

TCE Concentration



Porters Creek
Clay
Boundary

→



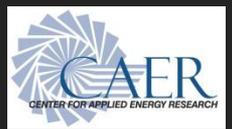
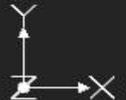
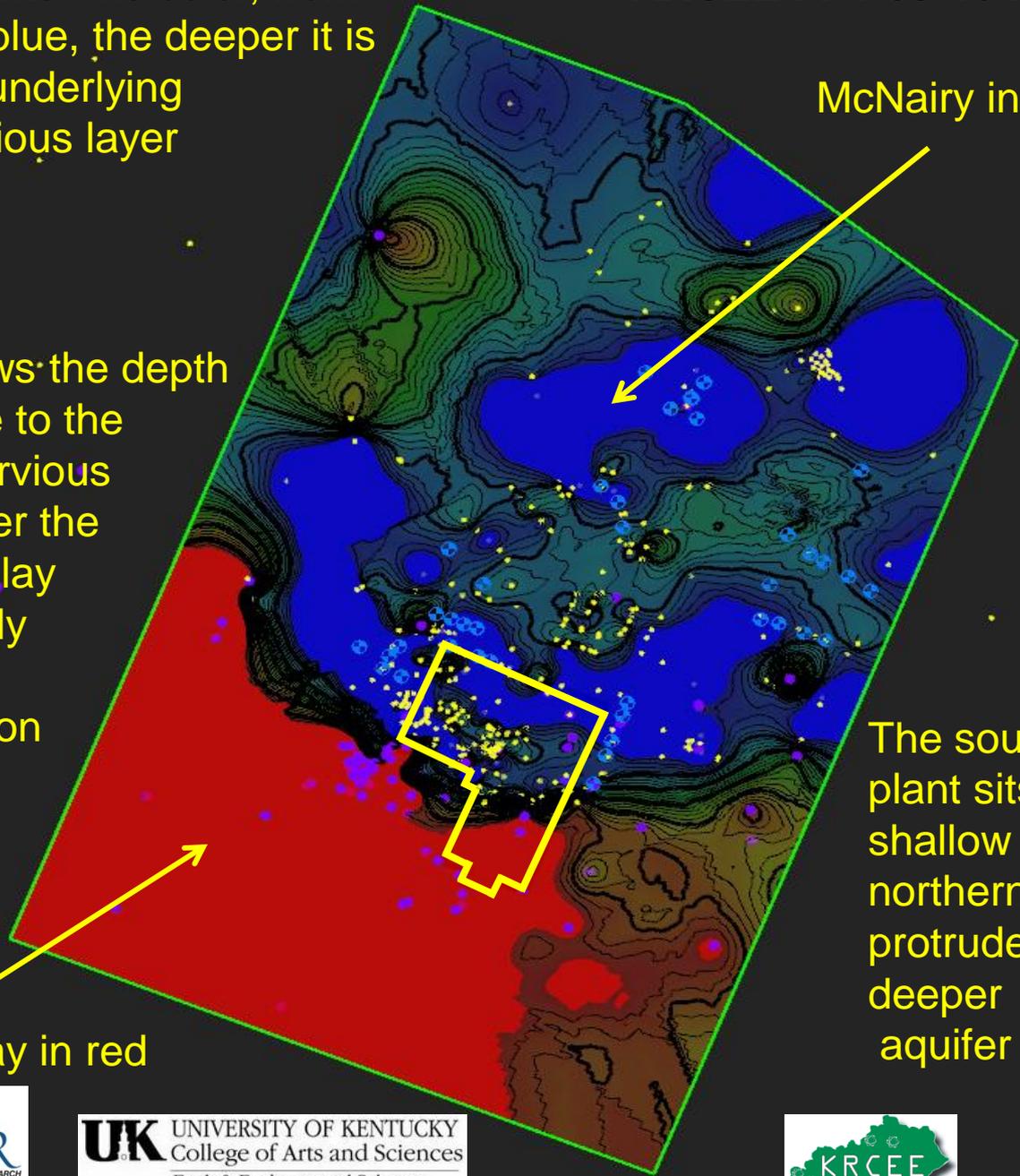
The darker the color, from red to blue, the deeper it is to the underlying impervious layer

This image shows the depth from the surface to the underlying impervious boundary – either the Porters Creek Clay which is relatively shallow, or the McNairy formation which is much deeper

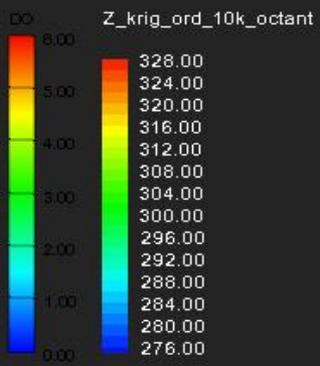
McNairy in blue

The southern part of the plant sits over a relatively shallow clay, while the northern part of the plant protrudes out the much deeper groundwater aquifer

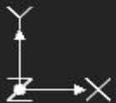
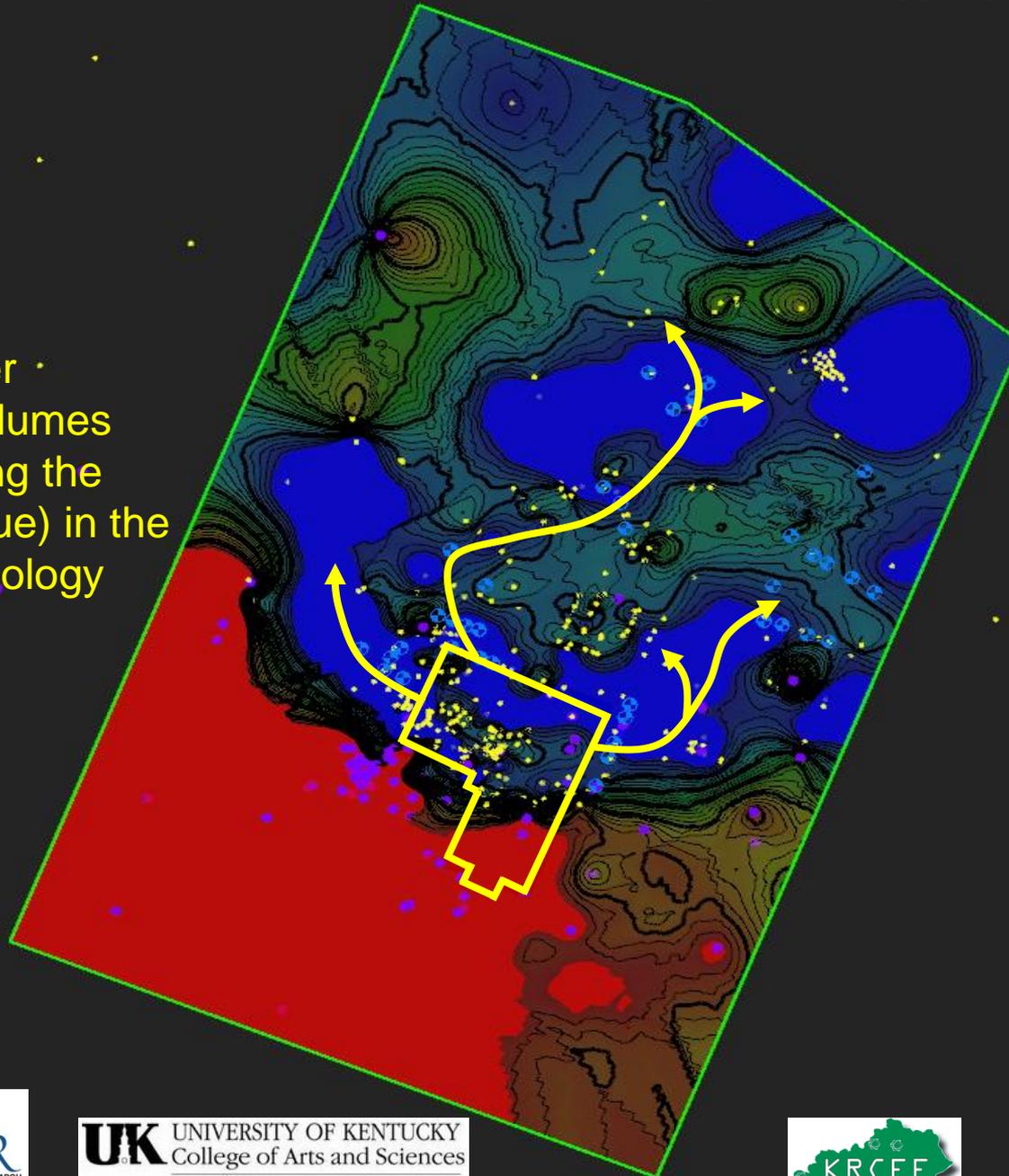
Porters Creek Clay in red



- 2D Scatter Pt Symbols
- Top_McN_FMNI+(10+12)414
 - tPCC_locs_031810
 - PGDP_New_WELLS_02282010

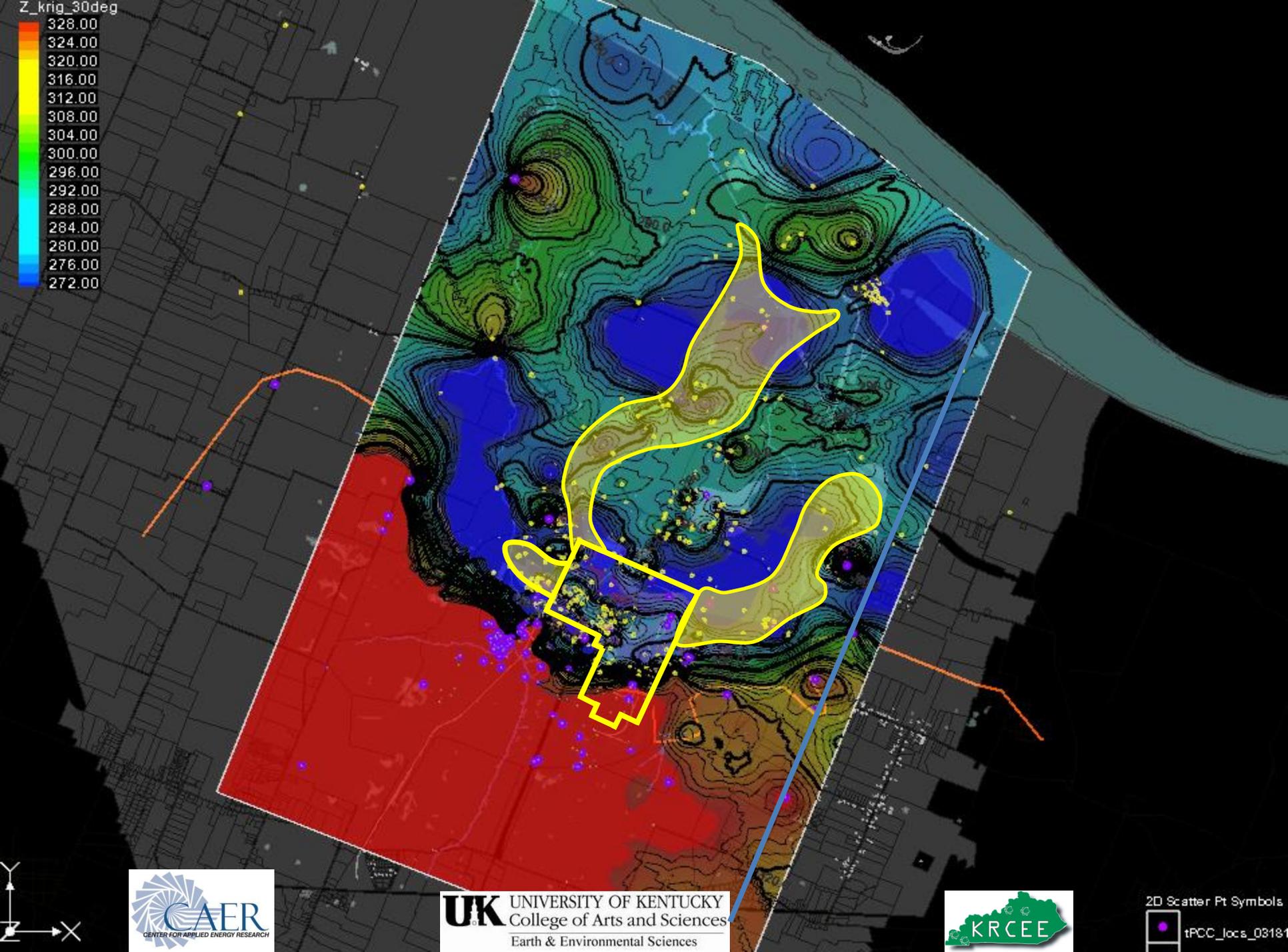


The groundwater contamination plumes tend to flow along the lowest spots (blue) in the Groundwater geology

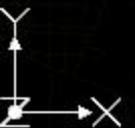


2D Scatter Pt Symbols

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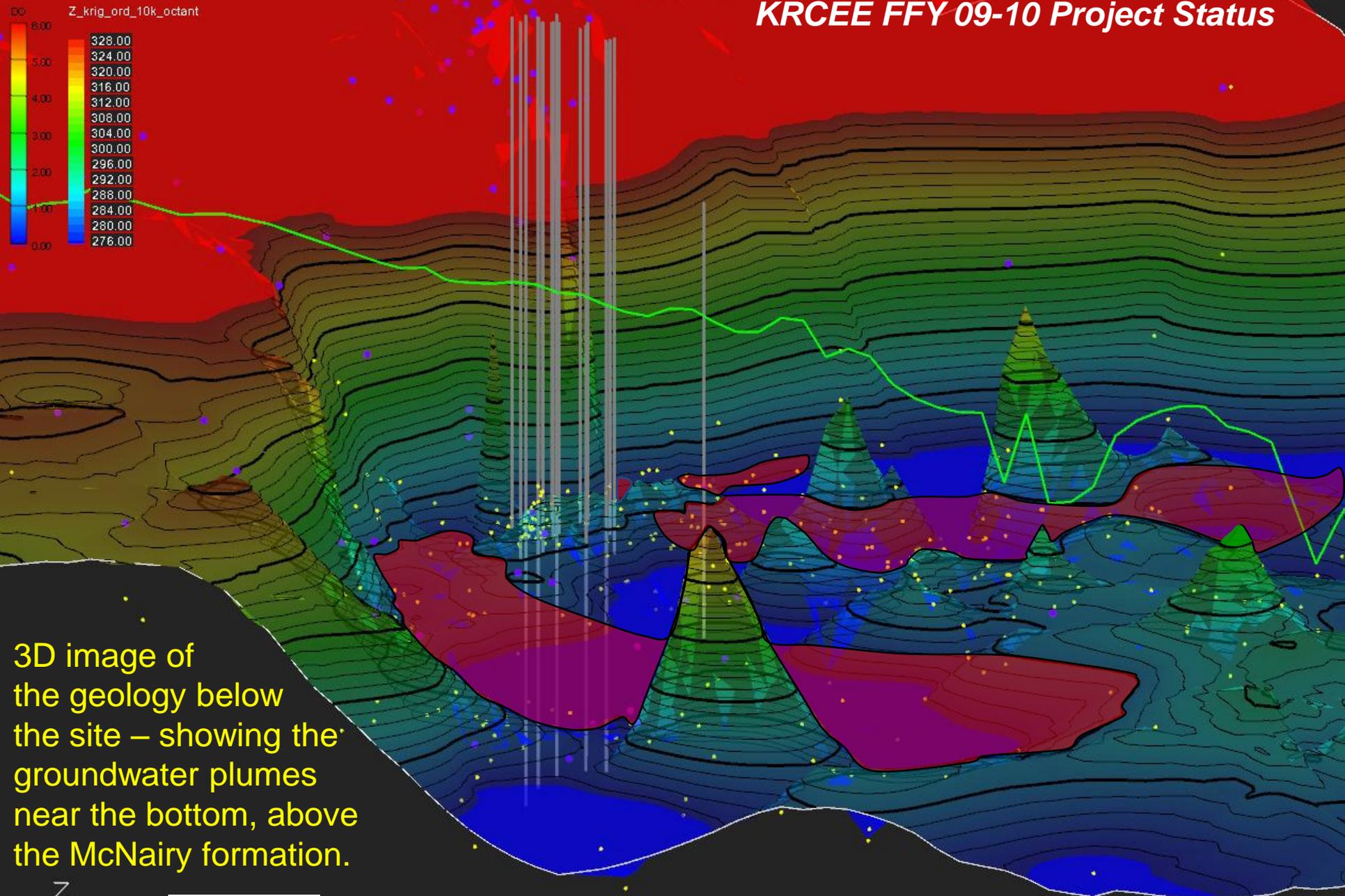
Z_krig_30deg
328.00
324.00
320.00
316.00
312.00
308.00
304.00
300.00
296.00
292.00
288.00
284.00
280.00
276.00
272.00



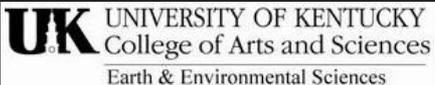
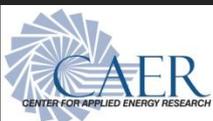
UK UNIVERSITY OF KENTUCKY
College of Arts and Sciences
Earth & Environmental Sciences



2D Scatter Pt Symbols
tPCC_locs_0318



3D image of the geology below the site – showing the groundwater plumes near the bottom, above the McNairy formation.



2D Scatter Pt Symbols
tPCC_Jocs_031810
Top_McN_FMNI+(10+12)414

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?

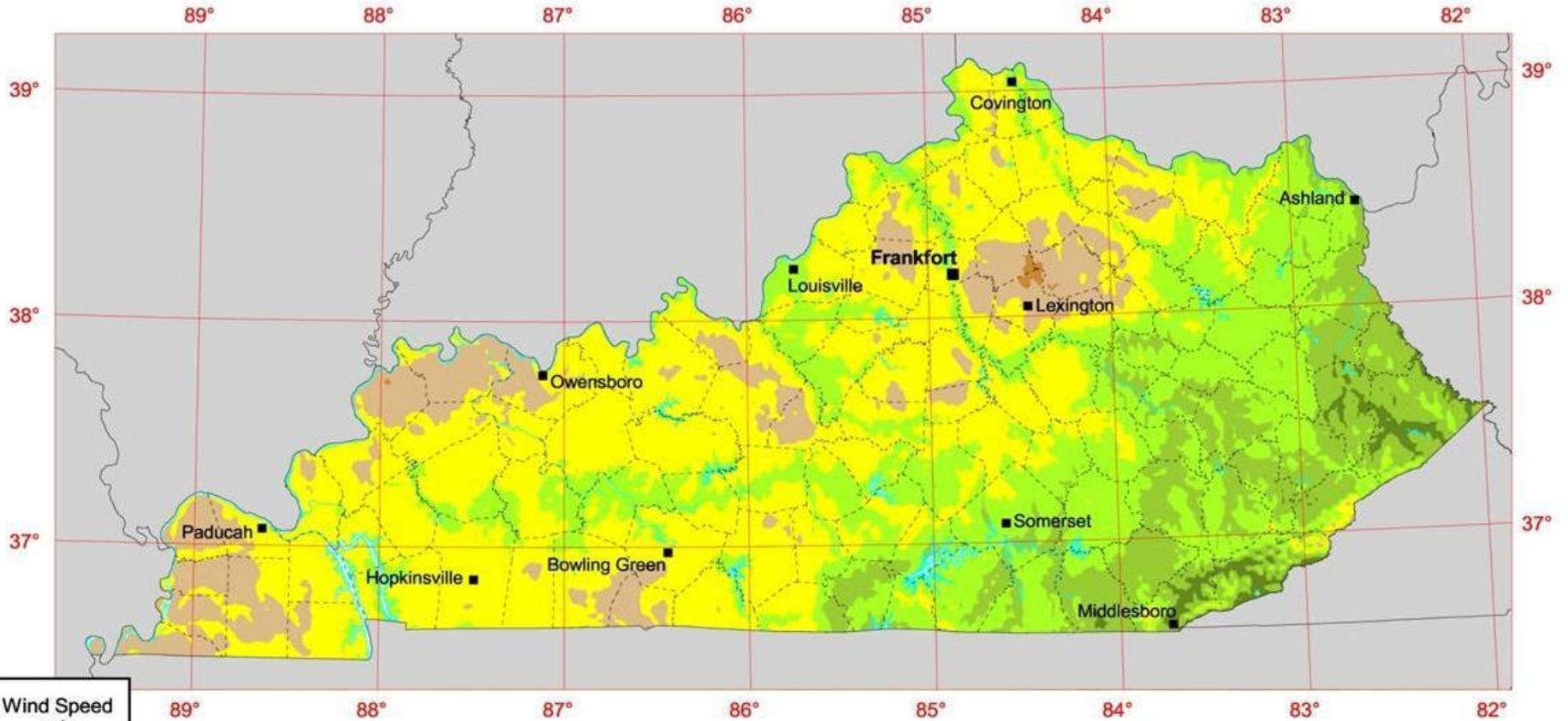
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2. 3 to 4 m/s
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4. 6 to 7 m/s
5. 8 to 9 m/s

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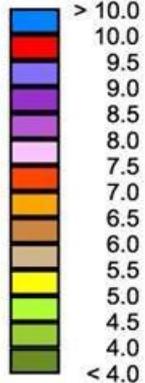
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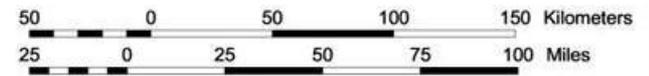
Kentucky - Annual Average Wind Speed at 80 m



Wind Speed
m/s



Source: Wind resource estimates developed by AWS Truewind, LLC for windNavigator®. Web: <http://navigator.awstruewind.com> | www.awstruewind.com. 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

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

NREL (<http://www.nrel.gov/solar/news/2010/888.html>),

NASA Atmospheric Science Data Center (<http://eosweb.larc.nasa.gov/sse/>)

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**