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**How many disposal wells does PA need and where can they be located?**

**Shale Network 2017 Workshop  
Penn State University**

**Dale E. Skoff, PG**

**May 19, 2017  
State College, Pennsylvania**



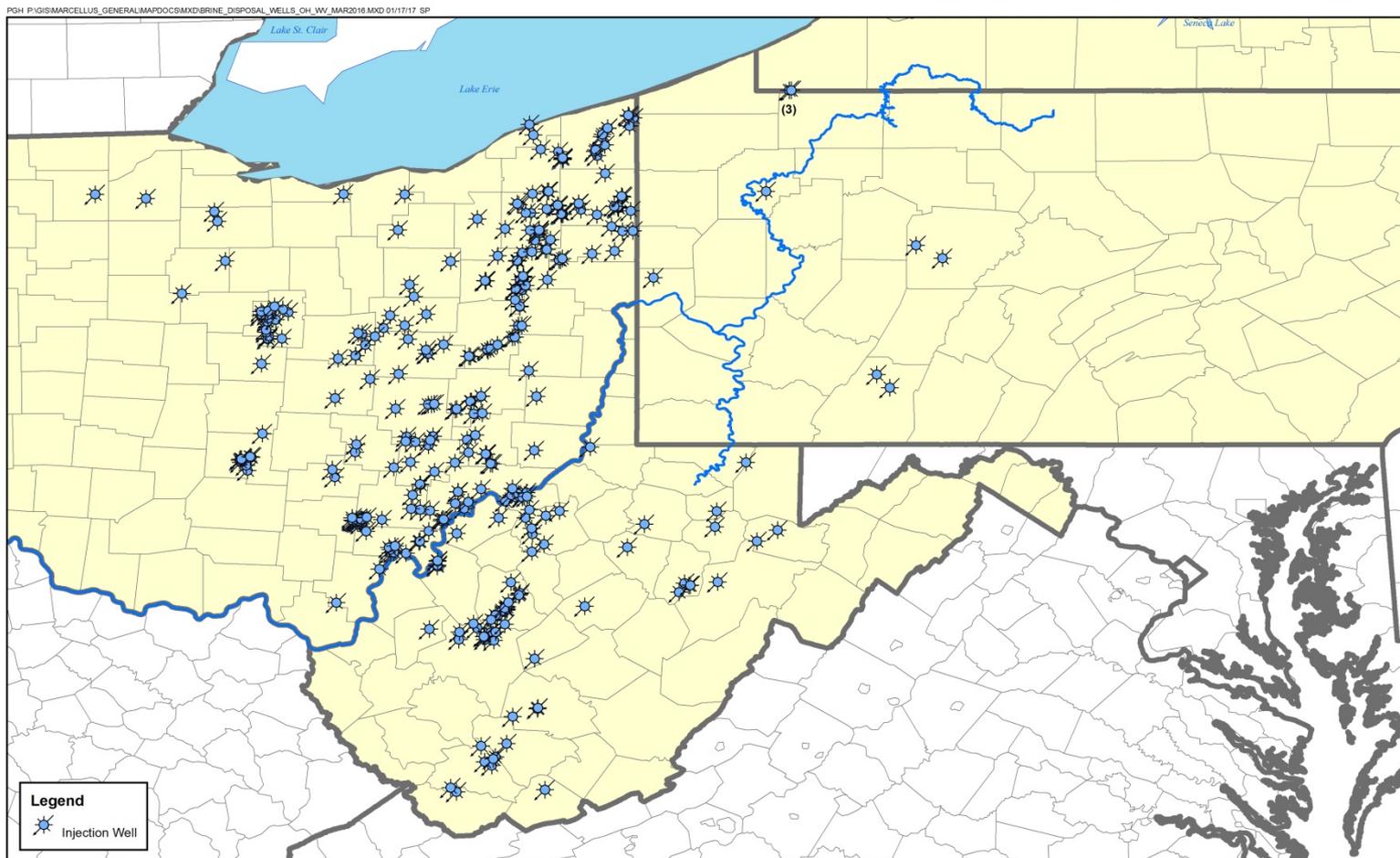
# Introduction

- EPA classifies brine disposal wells (aka saltwater injection or saltwater disposal wells) as UIC Class IID Wells
- Regulated under the Safe Drinking Water Act
- Approximately 30,000 UIC Class IID wells
- Approximately 280 such wells in Marcellus and Utica Shale Play area with most in OH (~220)

# Introduction

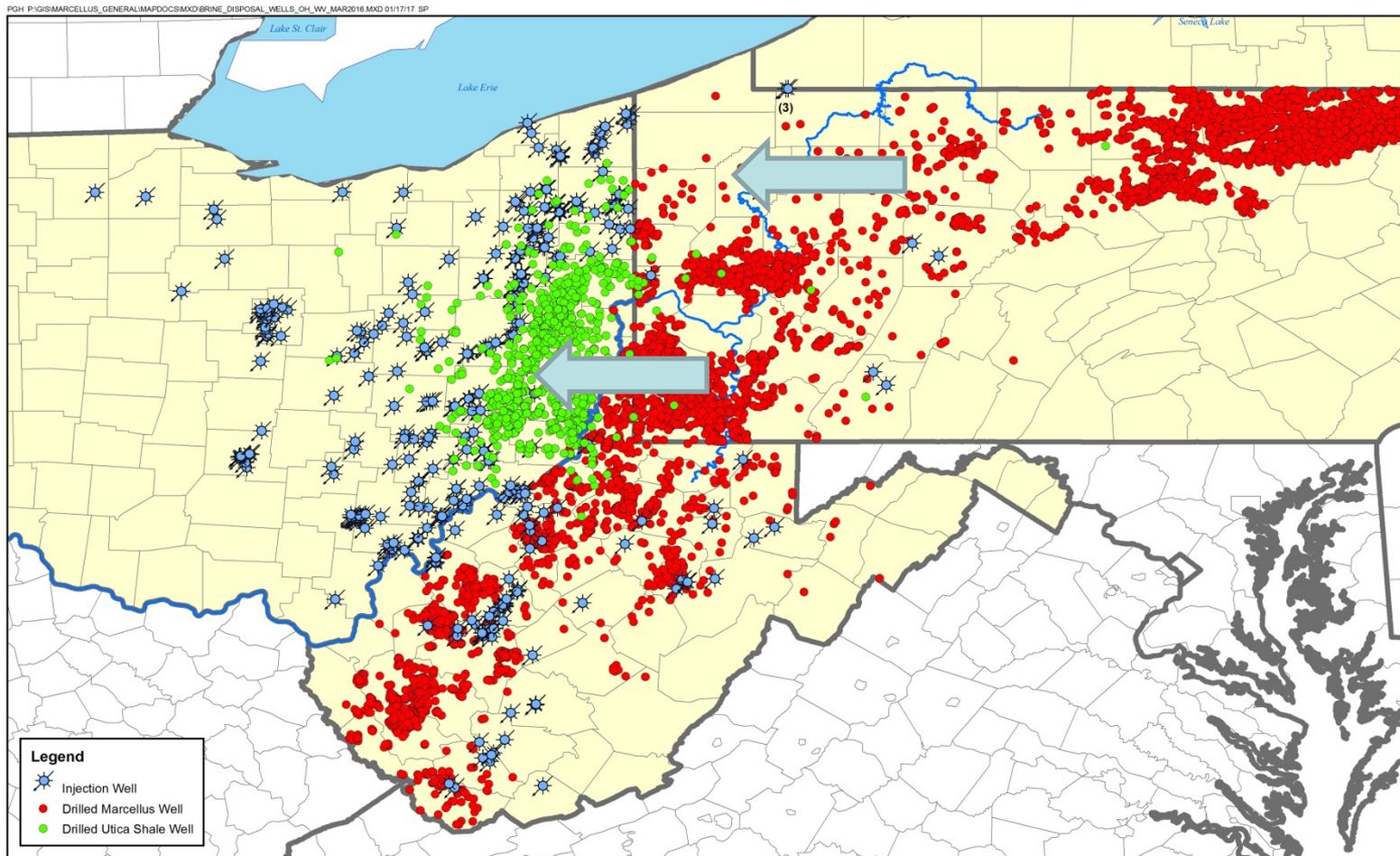
- Both Marcellus Shale Play and conventional operators need these wells
- Currently vast majority of non-recycled brine shipped to OH resulting in extra cost and truck traffic
- EPA and State approved disposal method
- Over the past few years, concern over induced seismicity has increased

# OH and WV Have Many More Brine Disposal Wells Than PA



Source: OH DNR, WVDEP and USEPA Region 3 UIC Class IID well databases.

# Overall Brine Movement is Westward



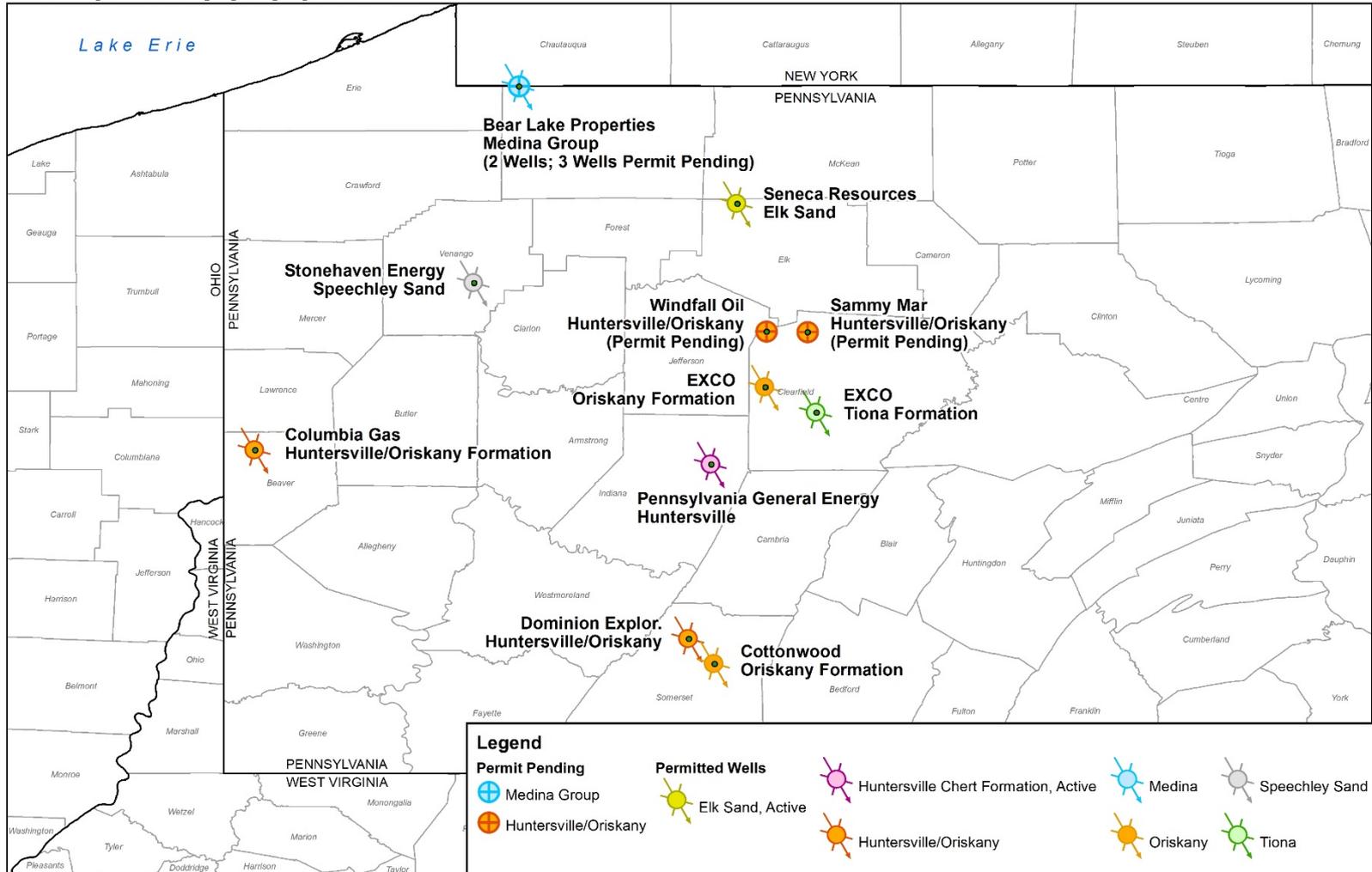
Source: OH DNR, WVDEP and USEPA Region 3 UIC Class IID well databases.

# Brine Disposal Wells Pennsylvania

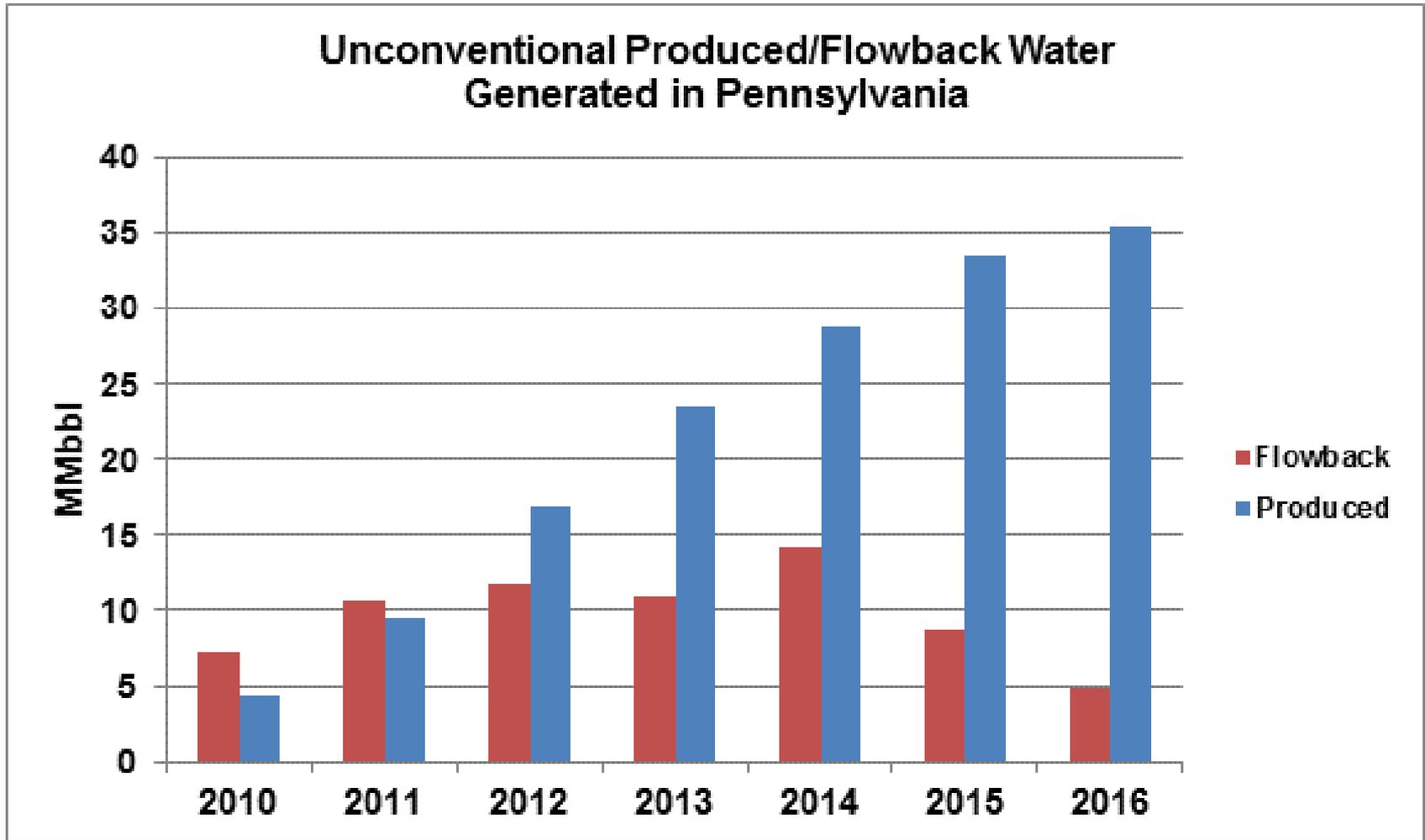
- Total: 10 permitted by both EPA and PADEP
- Only one commercial facility (in NW PA)
- Formations
  - Upper Devonian (Tiona, Speechley and Elk Sands)
  - Huntersville Chert – Oriskany Sandstone
  - Medina Sandstone
- Depth – 1900 to 8900 ft.
- EPA has primacy for permitting
- PADEP approval now also required via new UIC Well approval program.

# Brine Disposal Wells in PA

DGH P:\GIS\MARCELLUS\_GENERAL\MAPDOC\SMK\O\PA\_BRINE\_DISPOSAL\_WATER\_TREATMENT.MXD 04/09/17\_SP



# Trend in Unconventional Brine Generation in PA



## Est. UIC Class IID Wells Needed in PA Based on 2016 Disposed Volumes

<b>Total Unconventional Brine to UIC Wells (Bbls)</b>	<b>6,300,000</b>
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<b>Total Unconventional Brine to UIC Wells in PA (Bbls)</b>	<b>300,000</b>
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<b>Total Not Disposed in PA (Bbls)</b>	<b>6,000,000</b>
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<b>Injection Rate - Avg Barrels / Day</b>	<b>No. of Wells Needed</b>
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<b>250</b>	<b>69</b>
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<b>500</b>	<b>34</b>
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<b>750</b>	<b>23</b>
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<b>1000</b>	<b>17</b>
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# Where to Find the Disposal Capacity?

- A common myth is that Pennsylvania geology not conducive to siting injection wells
- In general, geology does require more “surgical” approach than in certain other states (e.g., Texas)
- There is great opportunity to “recycle” depleted oil and gas wells/fields for safe disposal
- In some areas, potential also exist for drilling new wells to access favorable formations
- Site wells based on geologic conditions and proximity to producing areas, while being sensitive to public concerns (e.g., regarding residential areas, truck traffic, etc.)

## Where to Find the Disposal Capacity? (Cont'd)

- Finding the needed lateral extent, porosity, permeability and thickness can depend on
  - Trend of individual sand interval (e.g., many Upper Devonian Sandstones)
  - Structural position (e.g., Oriskany Sandstone and Huntersville Chert)
- Site wells to avoid faults and reduce the risk of induced seismicity
- Beware of poorly plugged wells to target depth
- Injectivity testing can help confirm viability of candidate wells/intervals

SYSTEM	SERIES	FORMATION
PERMIAN		Dunkard Gr. Monongahela Gr.
PENNSYLVANIAN		Conemaugh Gr. Allegheny Gr. Pottsville Gr.
MISSISSIPPIAN		
DEVONIAN	Upper	Venango Gr.      Catskill Fm.
		Chagrin Fm.      Bradford Gr.      Elk Gr.
		Huron Sh.      Brallier Fm.
	Middle	Rhinestreet Sh.      Harrell Fm.
		Mahantango Fm.      Marcellus Fm.
	Lower	Onondaga Fm.      Huntersville Chert*      More Sh.
SILURIAN	Upper	Oriskany Ss.      Helderberg Gr.
		Salina Gr.      Tonoloway Fm.
		Wills Creek Fm.
	Lower	Bloomsburg Fm.
		Lockport Fm.      McKenzie Fm.
		Rochester Sh.      Rose Hill Sh.
ORDOVICIAN	Upper	Medina Gr.      Tuscarora Fm.
		Queenston Fm.      Juniata Fm.
		Bald Eagle Fm.
	Middle	Reedsville Sh.      Antes Sh.
		Utica Sh.
		Trenton Gr.      Black River Gr.      Loysburg Fm.
Lower	Shadow Lake Fm.      Beekmantown Fm.      Bellefonte Fm.	
	Nittany Fm.      Stonehenge Fm.	
CAMBRIAN	Upper	Gatesburg Fm.
	Middle	Warrior Fm.      Pleasant Hill Fm.
	Lower	Potsdam Ss.      ?
PRE-CAMBRIAN		Crystalline Basement

## Potential Injection Targets - PA

Upper Devonian Sandstones\*

Huntersville Chert\*

Oriskany Sandstone\*

Bass Island

Lockport Dolomite

Medina – Tuscarora Sandstones\*

Bald Eagle Sandstone

Trenton – Black River

Gatesburg Formation\*

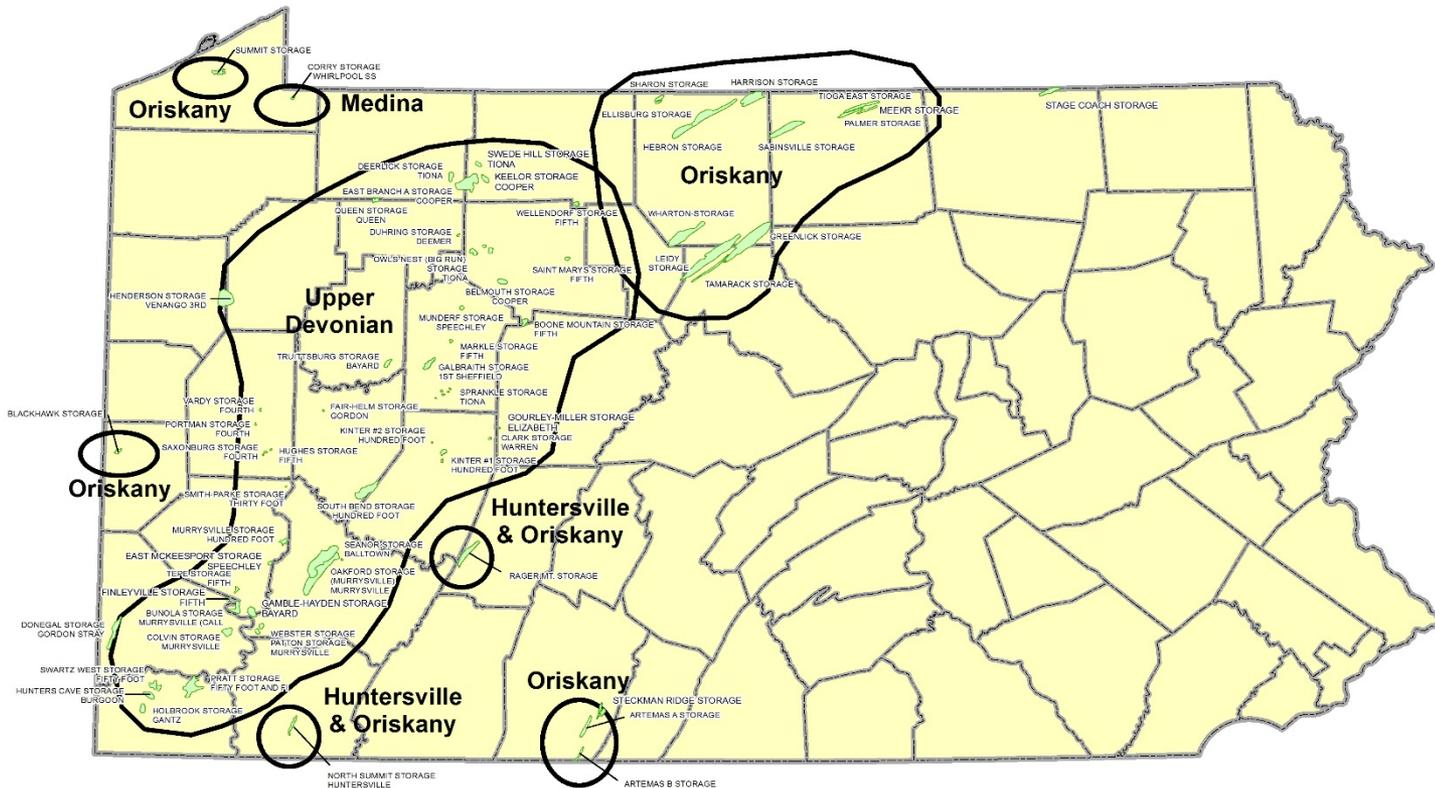
\*Existing injection well in PA

Source: Stratigraphic Column from PADCNR

# Natural Gas Storage Fields

PGH\_P:\GIS\MISC\_UIC\MAPDOCS\IMXD\PA\_GAS\_STORAGE\_FIELDS\_V1.MXD 05/18/17 JN

Data from WIS, 2009



**Legend**

- Natural Gas Storage Area
- Storage Field Formation

NATURAL GAS STORAGE FIELDS  
IN PENNSYLVANIA

MARCELLUS SHALE COALITION  
UIC WELL STUDY

DRAWN BY: S. PAXTON 06/13/13  
CHECKED BY: D. SKOFF 5/18/2017  
APPROVED BY:

CONTRACT NUMBER: 112C05292

FIGURE 2-5

REVISION  
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# Certain Depleted O&G Wells/Fields Can Be “Recycled” For Brine Disposal

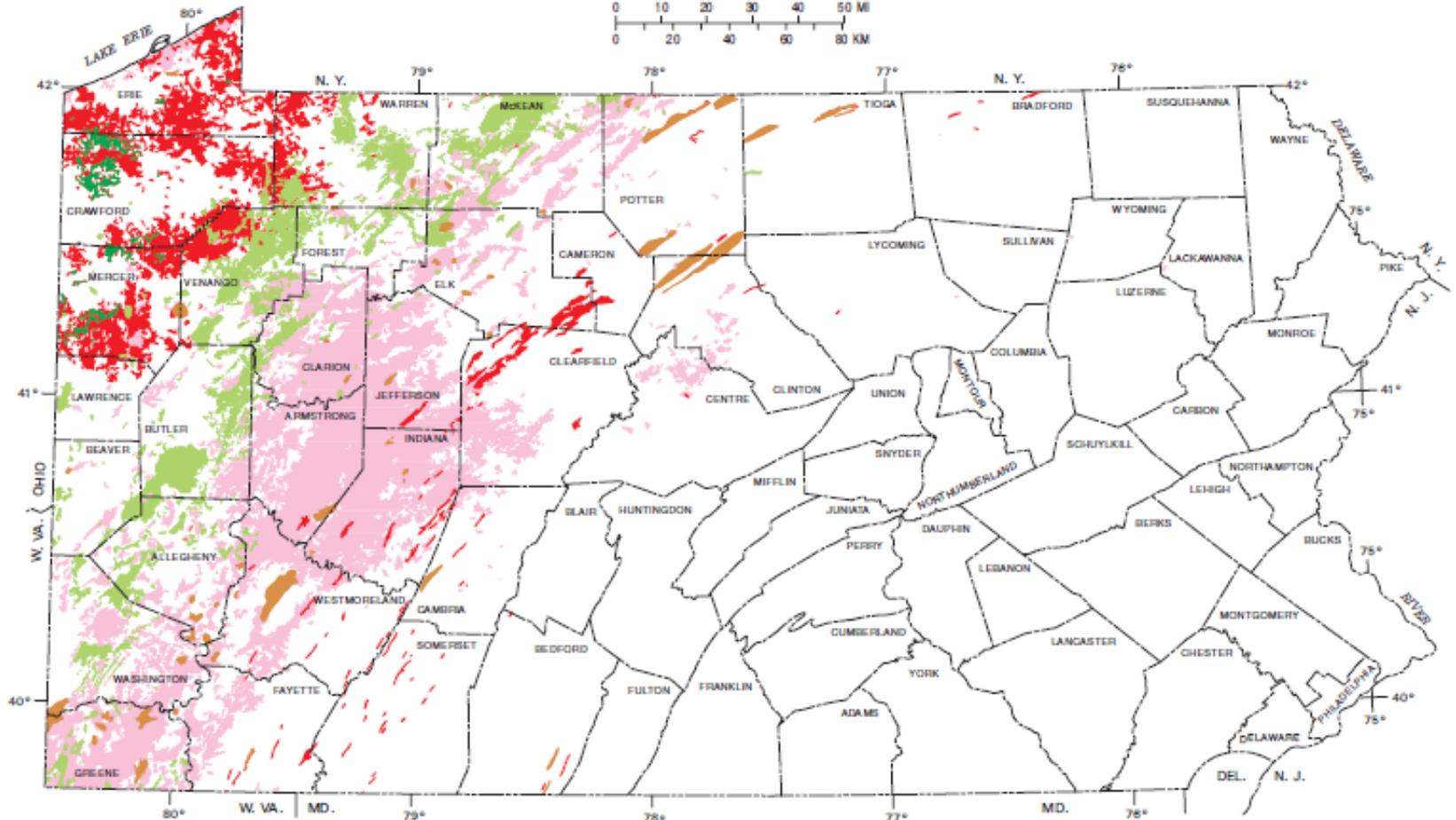
MAP 10



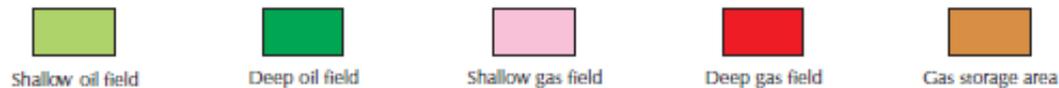
## OIL AND GAS FIELDS OF PENNSYLVANIA

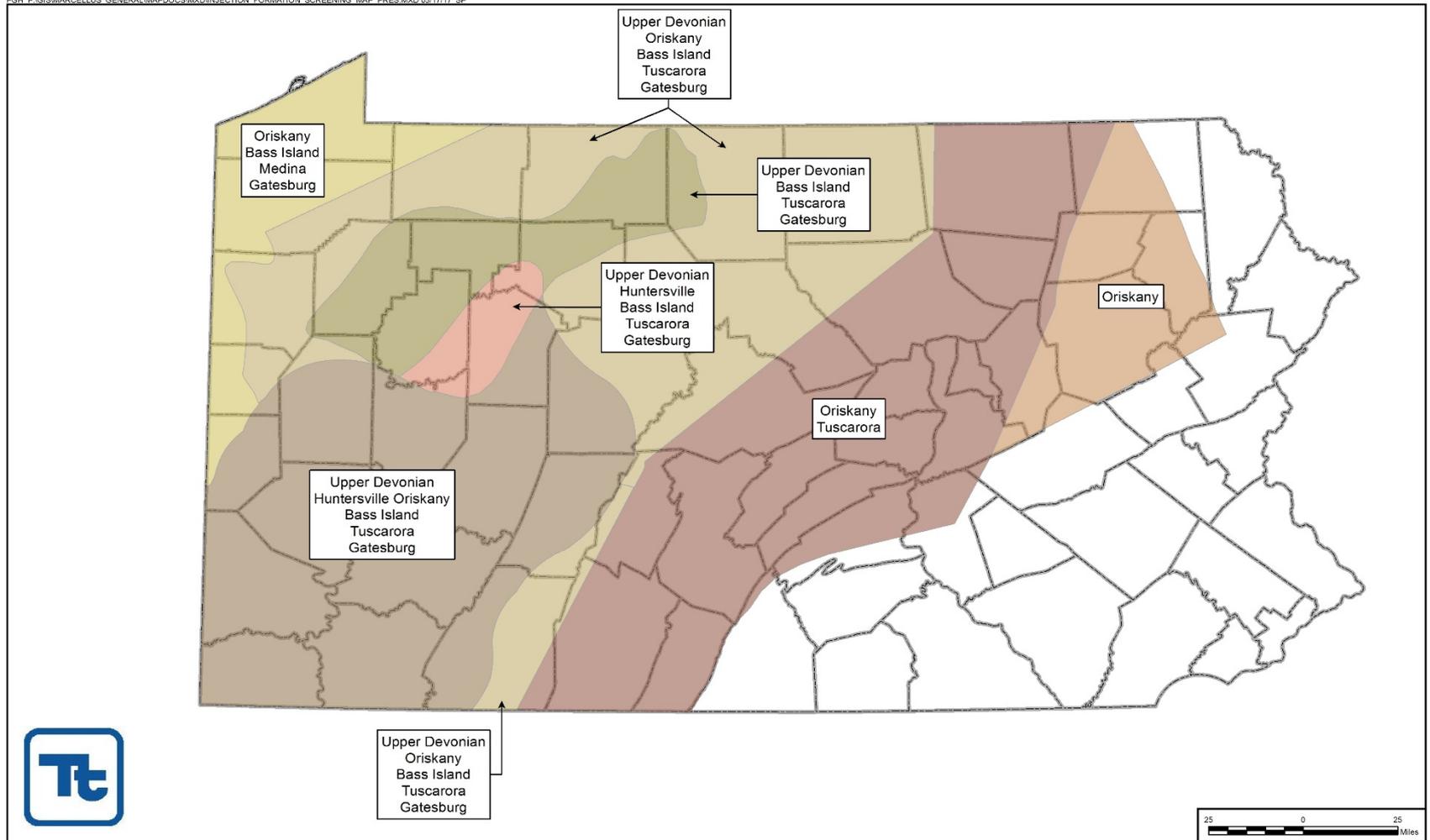
COMMONWEALTH OF PENNSYLVANIA  
DEPARTMENT OF  
CONSERVATION AND NATURAL RESOURCES  
BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY  
[www.dcnr.state.pa.us/topogeo](http://www.dcnr.state.pa.us/topogeo)

SCALE 1:2,000,000



### EXPLANATION

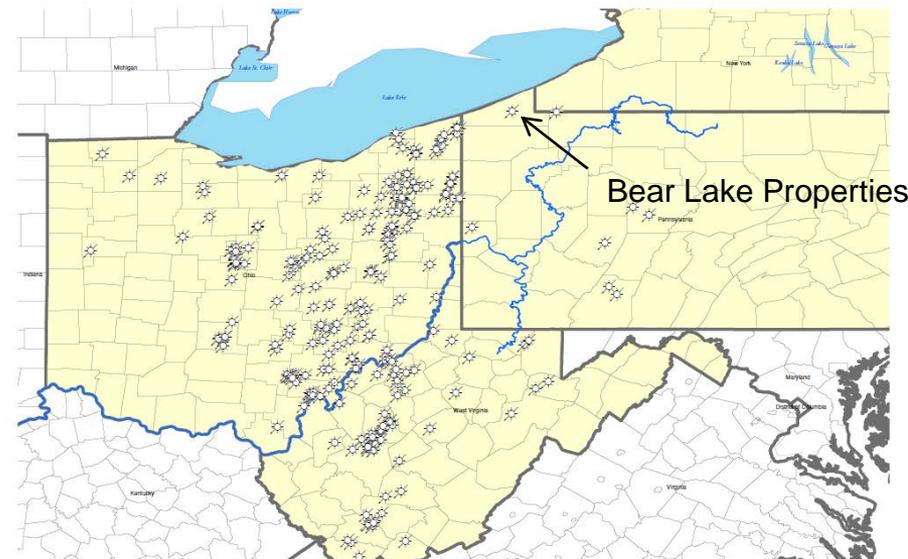




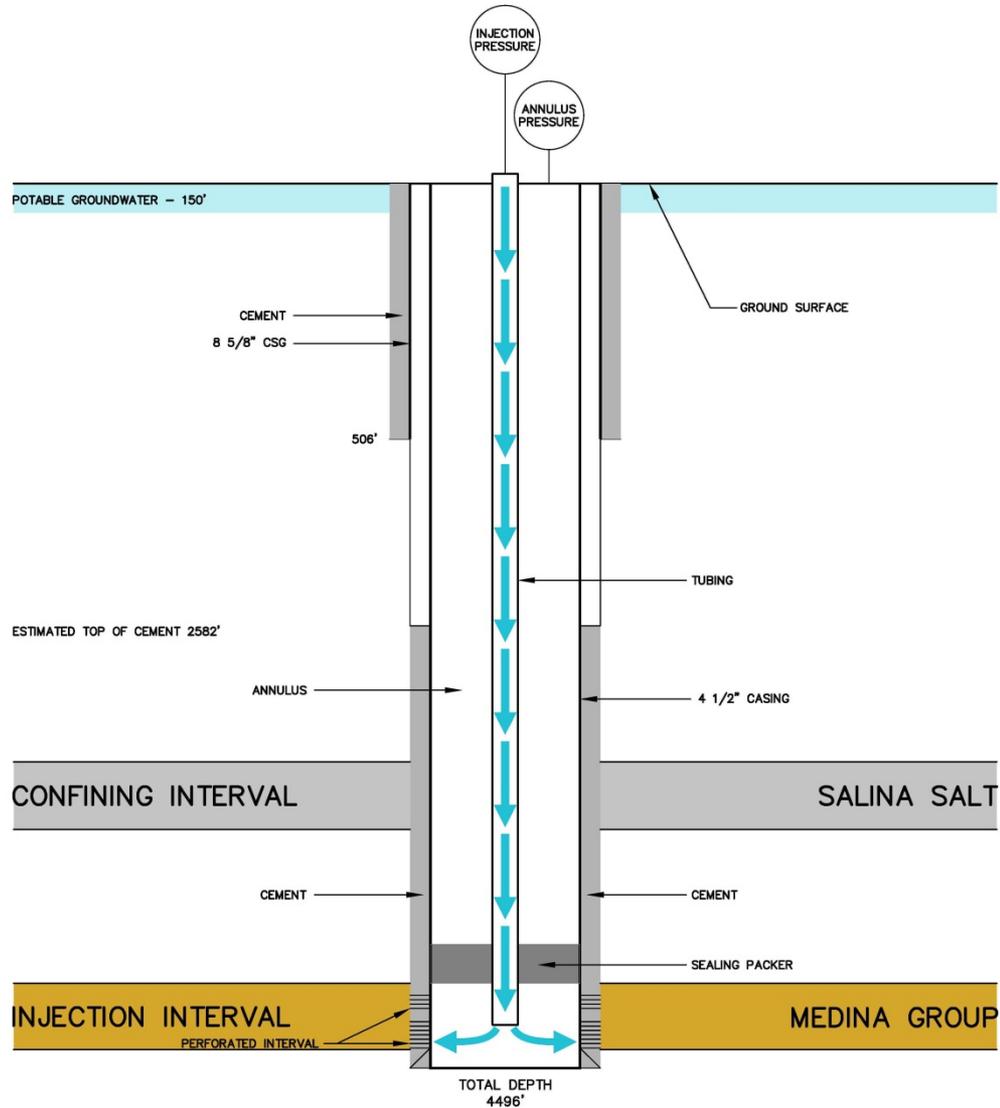
Formation	Analog Field	Volumetric (Net Ft Porosity / Areal Extent) Approach (Million bbls)
Upper Devonian Sandstone Formations	Council Run (Fifth Elk), Centre and Clinton Counties	45
Onondaga Limestone	Cyclone, McKean County	2.5
Oriskany Sandstone	Meade Gas Storage, Erie County	5
Oriskany Sandstone	Ulysses, Potter County	30
Oriskany Sandstone/Hunterville Chert	Strongstown, Indiana County	302
Bass Island Carbonates	Greenley, Erie County	12
Lockport Dolomite	Wolf Creek – Kilgor Mercer County	4
Medina/Whirlpool Sandstone	Lake Shore, Warren and Erie Counties	-
Tuscarora Sandstones	Devils Elbow, Centre County	46
Bald Eagle Sandstone	Grugan Field, Clinton and Lycoming Counties	109
Trenton – Black River	Gloades Corner, Steuben County, NY	-

# Bear Lake Properties Brine Disposal Well Permits Warren County, PA

- Depleted Medina Group (Grimsby and Whirlpool) gas well field
- Over 11,000 acres
- Approx. 20 wells potential conversion to injection
- Existing wells permitted for approx. 1,000 bbls/d
- 2 wells operational
- 3 wells pending
- Only commercial brine disposal wells in PA



# Bear Lake Properties - Well Construction



# Summary

- There is substantial need in PA for more brine disposal wells on the order of 17 (at 1,000 bbls/d) to 34 (at 500 bbls/d) to meet current demands.
- Many existing O&G wells and fields have potential to be “recycled” for such use.
- Successfully siting such wells includes both considering geologic conditions and public concerns.
- Having more in-state wells can overall reduce truck traffic and help sustain the conventional and unconventional oil and gas business in PA.

# Contact Information

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