Class II Injection Wells in Kentucky—An Update of the Map Service of Wastewater, Brine-Disposal, and Enhanced-Recovery Wells in Kentucky*

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Abstract

Following creation of a map service providing information on Kentucky's Class II injection wells, new data have been made available and integrated into the online map through permits issued by the Kentucky Division of Oil and Gas for proposed injection well locations and by the release of new information from the U.S. Environmental Protection Agency (USEPA) through Freedom of Information Act (FOIA) requests. Administrative data identified an additional eighteen injection wells now cataloged into the Class II database, seventeen permitted or recompleted as brine disposal wells and one permitted for enhanced recovery.

Monthly operations data (casing pressures and injection volumes) for selected active Class II wastewater wells covering a five-year period (2008-2012) were compiled from yearly records and examined during the course of a multistate research investigation of brine disposal in the Northern Appalachian Basin. Subsequent to that study, injection volumes reported on a yearly basis were later released for 25- and 30-year periods for brine disposal and enhanced recovery wells, respectively. Analysis of this longer term injection history has identified increases in both disposal and recovery operations over the past fifteen years.

Active injection zones include shallow Pennsylvanian sandstones to deeper Ordovician Knox Group porous dolomites and sandstones. Recently permitted injection wells are also targeting Cambrian Copper Ridge Dolomite (Lower Knox Group) and Conasauga Group intervals.
Kentucky has requested and received tentative approval for oversight (primacy) over Class II injection wells. Approval should result in more timely access to data for map service updates and in monitoring ongoing injection activity.

Reference Cited


Websites


Class II Injection Wells in Kentucky—An Update of the Map Service of Wastewater, Brine-Disposal, and Enhanced-Recovery Wells in Kentucky

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Kentucky Geological Survey
Outline of presentation

• **Class II brine disposal and injection wells** (overview, definition, types, purposes)

• **EPA Region 4** (UIC Program, FOIA requests, data availability, primacy, map products)

• **Map service** of disposal and injection wells in Kentucky (online database 2014, tools, tables, statewide numbers, spatial locations, geology, updates)

• **Newly released injection volumes** (March 2016), reconnaissance maps, charts, data currently under evaluation
Purpose for study

• Establish a baseline database to identify, catalog, and track brine disposal in Kentucky by location and geologic setting
• Distinguish between Class II saltwater disposal (SWD) and enhanced recovery injection (ERI) wells
• Provide a mapping tool for disposal and injection (recovery) wells to assist KGS Hazards Section in analyzing potential risks for induced seismicity

Source: http://earthquake.usgs.gov/research/induced/

Presenter’s notes: Develop database of brine disposal in Kentucky from EPA-provided FOIA requests.
What are Class II injection wells?

- **Inject fluids** associated with oil and gas production into underground porous formations – wastewater, brines (salt water), steam, CO₂, flowback fluids (frack fluids)
- **Protect** underground sources of drinking water (USDW)
- **Two types of Class II wells:**
  - Type D for permanent disposal for brines (SWD)
  - Type R for injection into existing reservoir for increased recovery of hydrocarbons (80%, 95% KY)
- **2 billion gallons** brine injected every day in US
- **180,000 Class II wells** in US, majority in Texas, California, Kansas, Oklahoma (Kentucky >3,000)
- **Service wells** (SWD, ERI, EOR, SRI, TRI, GI, waterflood)

Source: Injection Partners LP
http://www.injectionpartners.com
Permitting and Regulatory Agency
• Primary enforcement authority for Underground Injection Control (UIC) Program
• Primacy of Kentucky’s Class I-VI wells (in transition)

Administrative & Operations Data
• Review, approve locations, issue UIC permits
• Form 7520-11 (Well Monitoring Report) for reporting monthly pressure & volume
• Periodic laboratory analysis (pH, TDS, sp. gr.)

Freedom of Information Act (FOIA) documents
• Spreadsheet or PDF document (EPA-ID, company, well name & no., status, lat-long, intervals, formation)
KGS map products from FOIA documents

• March 2013: published ‘Class I waste-disposal wells and Class II brine-injection wells in Kentucky,’ KGS Map and Chart 204, ser. 12

• December 2014: online map service, updated inclusion of 2,900 ERI wells: http://goo.gl/xQZ2QD

• Available on KGS Online Maps Home

GIS Map service of EPA permitted Class I industrial waste-disposal wells, Class II brine-disposal (SWD) and enhanced-recovery injection (ERI) wells
Map service of disposal and injection wells

Layers:
- 11 Class I wells
- 152 Class II SWD wells
- 2,939 Class II ERI wells
- Faults
- O&G Fields

Penn-Miss. Ss & Ls (Illinois Basin)

Berea Ss
Corn., Knox Gp
Weir sd
Big Lime

E&F Payne-Knox Gp
Map service of disposal and injection wells

Service includes:
- Legends
- Tables
- Popups
- Metadata
- Links to KGS DB
Current inventory 2016 (updated legend 2)

**ERI wells (2939)**
- **792 Active** (70 Penn, 538 Miss, 6 Dev-Sil, 143 Sil, 12 Ord, 1 Cam, 22?)
- **2,028 Inactive** (SI, TA, Abn, Unk)
- **68 Pending** (Loc), **51 Other** (P&A)

**SWD wells (152)**
- **63 Active** (6 Penn, 23 Miss, 2 Dev, 13 Sil, 19 Ord)
- **33 Inactive** (SI, TA, Abn, Unk)
- **17 Pending** (Loc), **39 Other** (P&A)
Recent activity – Class II SWD only

Disposal well activity – deeper targets
- Deeper permitted depths
- Commercial disposal company identified (2014)
- Horizontal (hz) SWD wells (converted oil, D&A)
New FOIA release (March 2016) - Injection Volumes EPA-R4-2016-002431

What was the data, what was revealed?

• Database of 512 yearly injection volumes for 65 SWD wells in 27 counties, over a 25-year period (1989-2014)
• Database of 14,008 yearly injection volumes for 1,535 ERI wells in 40 counties, over a 30-year period (1985-2014)
• Preliminary, reconnaissance charts and maps based on liquid barrels reported injected on yearly basis (no MCF included)

Note:

• Some injection volumes appear to be missing or not reported to EPA (2015 data was still being added in March 2016, duplicate values noted, overlapping report periods)
Saltwater (Brine) Disposal
Annual Volume (BBL) & SWD count

- **ANNUAL VOL**
- **SWD Count**

Data missing?
Not reported
Not recorded
Saltwater (Brine) Disposal
Annual Volume (BBL)

Henderson – N. Smith Mills 2 (10 MMB)
Harlan – Millers Cove 4 (2 MMB)
Hart – Clarence Wilson 3 (2 MMB)
Lee – Minnie Hill 1-D (1.7 MMB)

Data missing?
Not reported
Not recorded
**Class II Type D (SWD) wells**

**County Totals**

- 21.8 million barrels (1989-2014)
- 27 counties (2 no data)
- 65 wells reported (2 no data)
Class II Type D (SWD) wells
County Totals

21.8 million barrels (1989-2014)
27 counties (2 no data)
65 wells reported (2 no data)
Enhanced Recovery Injection
Annual Volume (BBL) & ERI Count

BBL

ERI

ANNUAL VOL
ERI Count
Enhanced Recovery Injection
Annual Volume (BBL)

Union – 141 MMB
Henderson – 112 MMB
Hopkins – 23 MMB
Lee – 21 MMB
Magoffin – 17 MMB
Daviess – 16 MMB
Muhlenberg – 13 MMB
Class II Type R (ERI) wells
County Totals

385.7 million barrels (1985-2014)
40 counties reported
1535 wells reported
Class II Type R (ERI) wells
County Totals

385.7 million barrels (1985-2014)
40 counties reported
1535 wells reported, 1119 displayed

Top WKY
Union
Henderson
Hopkins
Daviess
Muhlenberg
Webster
McLean
Meade
Ohio

Top EKY
Lee
Magoffin
Leslie
Powell
Perry
Insights and conclusions

• **Significant increase** in disposal and recovery injection volumes beginning in the late 1990s; drop off in recovery injection noted

• Volatility since 2000 is observed, overall high disposal rate **likely to continue** (horizontal drilling, deeper targets, fracking, potential commercial disposal operators)

• Brine disposal **1.25 MMB/year**; recovery injection **15 MMB/year**

• Injection volumes informative, **needs further review** (limited public data, incomplete reports, some duplicate and overlapping records)

• Kentucky would benefit with **Primacy of Class II wells** (direct permitting, reporting, oversight, greater access to data)

• **Kentucky Oil & Gas applied for primacy of Class II wells, Nov. 10, 2015, application currently USEPA Washington, approval expected**
Thank you!

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www.esaapgmtg.org