HYDROFRAC SAND: THE RESOURCE AND THE ISSUES IN WISCONSIN

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December 12, 2011

HYDROFRACKING A WELL

Fluid pressure fractures the rock, sand grains keep the fractures open
IN IDEAL FRAC SETTING, ZONE OF PRODUCTION IS CAPPED BY 5000+ FEET OF IMPERVIOUS OVERBURDEN AND WELL IS PROPERLY CONSTRUCTED

WHERE THE SHALE GAS AND OIL IS
THERE ARE POTENTIAL PROBLEMS WHEN THE RESERVOIR FORMATION DEPTH IS LESS THAN 3000 FT.

Although most documented problems involve well construction, there is the possibility of aquifer contamination.
IDEAL FRAC SITUATION - BAKKEN SHALE NORTH DAKOTA

Dual-zone development
- 8 Potential wells per 1,280-acre unit
- 4 Middle Bakken and 4 Three Forks

4.1 MMBoe total EUR
- 518 MBoe EUR X 8 wells

Multiple fracture stages with a 500' stimulation radius

WHERE THE BEST FRAC SAND IS
THE BEST FRAC SAND IS WELL ROUNDED AND NEARLY PURE QUARTZ

Many younger sands are too angular or contain other minerals or rock fragments.
GLACIAL LOBES AND SEQUENCE OF QUATERNARY DEPOSITS

Most of the areas of prime interest for sand mining are within the “driftless” area of Wisconsin.

NEW SAND OPERATIONS, 2010-2011

Figure 1. Locations of recent frac sand mines and processing facilities

Source: Wisconsin Geological and Natural History Survey, November 2011
BEDROCK SAND RESOURCES

**Cambrian Wonewoc Fm.**
Important producer and potential resource in west, not exposed elsewhere.

**Cambrian Jordan Fm.**
Extensive potential in west, currently important source of frac sand from underground mines. Poor exposure in east.

**Ordovician St. Peter Fm.**
Long production history and good potential in south and east. Channels can make prospecting a challenge in the northeast.

COMPARISON OF FRACSAND CHARACTERISTICS
Orange areas are Jordan Sandstone, Red is Wonewoc sandstone.
GEOLOGY AND PRE-BOOM SAND PRODUCTION SITES IN WEST-CENTRAL WISCONSIN

EXTENT OF WONEWOC AND JORDAN RESOURCE IN DRIFTLESS AREA OF WESTERN WISCONSIN

Major roads in blue, rail shown in red

Wonewoc (red) is widely exposed, Jordan (gold) is on ridges
WEST CENTRAL GEOLOGY

Area of intense interest for frac sand mining

Wonewoc in red, Jordan in gold, Mt. Simon in light yellow

WONEWOC (GALESVILLE) EXPOSURES
BADGER TAYLOR MINE AND PLANT

Produces from Cambrian Wonewoc sandstone in Jackson County

JORDAN SANDSTONE, WESTERN WISCONSIN

ANOMALOUS LOCAL SILICA CEMENTATION, CALCITE CEMENT ALSO OCCURS AS CONCRETIONS
UNDERGROUND SAND MINING, PIERCE COUNTY

Current production is based in the Utley (Markesan, Fairwater, Ripon) area of northeast, but much of southern Wis. has potential.
St. Peter, Southern Wi.

BADGER FAIRWATER MINE AND PROCESSING PLANT

WISCONSIN’S LARGEST MINE IN THE ST. PETER

Located in Green Lake County, an area with a long history of industrial sand mining

PRIMARILY FOUNDRY SAND
THE ST. PETER SANDSTONE OCCURS IN CHANNELS CUT IN TO THE UNDERLYING CARBONATES. IT MAY VARY FROM ZERO TO 300', AND IS UNDERLAIN BY RED SHALY READINGSTOWN MBR.

SAND PRODUCING REGION OF WESTERN WISCONSIN

Major mines prior to “sand boom”
Bay City and Maiden Rock in Jordan, others in Wonewoc Mt. Simon is also being developed.
LOCAL JOBS AND ECONOMIC GROWTH.

The demand for natural gas as a clean fuel, and the time it will take to phase out petroleum-based fuels will sustain the industry well into the future.

WISCONSIN HAS A 100+ YEAR HISTORY OF INDUSTRIAL SAND MINING WITH A RECORD OF VERY FEW ENVIRONMENTAL OR OTHER PROBLEMS.

WHEN COMPARED TO OTHER TYPES OF MINING, INDUSTRIAL SAND MINING HAS MINIMAL ENVIRONMENTAL IMPACT AND SAND MINES CAN BE RECLAIMED SUCCESSFULLY, AS REQUIRED BY WISCONSIN LAW.
POTENTIAL PROBLEMS AND ISSUES

- Groundwater usage and potential for contamination.
- Air quality; fugitive dust and the risks from crystalline silica.
- Truck traffic, safety and the cost of road maintenance and upgrades.
- Blasting and potential damage to structures.
- Noise levels and hours of operation.
- Reclamation and subsequent land use.

HOW SERIOUS ARE THE PROBLEMS AND HOW DO WE DEAL WITH THEM?

- **Groundwater use**- DNR regulates high capacity wells. Permits are based on extensive review.
- Mines and processing plants routinely recycle as much water as possible.
- Impact to private wells can be minimized if mining companies agree to do a well survey and guarantee a water supply for close neighbors. This type of arrangement has worked successfully for the aggregate industry and protects the operator at a small cost compared to litigation.
**Water quality** - Runoff and surface water impact is regulated by DNR. Sand mining has the same potential for groundwater impact as a limestone quarry or gravel pit.

An issue of some concern is potential contamination from flocculants used in settling ponds. There is currently little data available and no specific regulations, but also no record of problems from older mines. Many of the same chemicals are used in treating municipal water supplies.

**AIR QUALITY ISSUES**

- Frac sand requires clean, round unbroken grains. Processing involves disaggregation and screening, usually done wet, rather than dry grinding.
- A frac sand plant will produce less angular crystalline silica dust than a quarry that crushes quartzite or a gravel pit that dry crushes coarse material.
- There are standard ways to minimize dust such as watering haul roads, paving roads, spraying conveyor belts, and wash baths for truck tires that have proven successful in other mining operations.
- MSHA and OSHA have strict workplace standards, and DNR and EPA air standards apply to fugitive dust.
OPERATING ISSUES

- Blasting is regulated by Dept of Commerce. Blasting is only used to loosen material. If rock is too heavily cemented, it is not even useful for frac sand!
- Traffic, operating schedule, road maintenance etc. are best handled in a conditional use permit, but if no zoning, direct negotiation between Town government and the mining company can be productive as in Town of Howard in Chippewa Co.
- Reclamation is regulated under N.R.135, and a plan subject to public comment, along with financial assurance must be in place before mining begins.

SO WHAT CAN WE EXPECT?

- The sandstone formations of Wisconsin and Minnesota are the best available for frac sand.
- As long as fracking is the best available technology for producing previously unrecoverable natural gas, frac sand mining will continue to be big business in our region.
- Interest in Wisconsin sand has been growing, but the “sand boom” took us by surprise. Many counties were overwhelmed by mining applications, and the scale of mining has presented problems we haven’t dealt with before.
CONTINUED....

• The good news is that Wisconsin has a 100 year history of sand mining with very few problems. Most environmental issues can be dealt with under existing regulations, by using existing technology, and applying standard industry practices.
• Many new mines rely on truck transport. This means traffic and safety issues and potential road maintenance issues that need to be resolved.
• Operational issues can usually be resolved by zoning conditions or negotiation.
• As new mines come into production, the demand should be met and the pace of development should slow, allowing time to work out remaining issues.

CONCLUSIONS

• Mother Nature didn’t give us any oil or gas in Wisconsin, but we got the sand that is now needed to produce both more efficiently with less waste.
• Frac sand mining should continue as a strong and stable industry as long as the demand for hydrocarbons is there, and we wish to reduce dependence on imports.
• The current “boom” will settle down as supply catches up with demand.
• The industry will stabilize with the larger and more efficient producers with access to rail or barge transportation surviving.
HOW DO I FIND OUT IF I HAVE A GOLD MINE?

- You need to do some real “mineral exploration”
- How thick is the underlying sand, how much waste?
- Does it meet spec? Drill some cores and test for grain size gradation, cementation, crush strength.
- How much do you have, enough to interest a sand producer?
- How close is your deposit to a processing facility and rail loading access?
- Can you get the permits or modifications to go deeper?
- What will going for the sand require in modifying your current reclamation plan?
- How much waste can you incorporate into reclamation?

WEST CENTRAL GEOLOGY

Area of intense interest for frac sand mining

Wonewoc in red, Jordan in gold, Mt. Simon in light yellow
WHAT ARE THE PROSPECTS FOR SAND MINING IN SOUTHWEST WISCONSIN?

Both the Jordan and St. Peter are exposed in the bluffs along the Lower Wisconsin River, and the St. Peter outcrops in stream valleys throughout the area, but so far there has been little serious interest.
EXTENT OF WONEWOC AND JORDAN RESOURCE IN DRIFTLESS AREA OF WESTERN WISCONSIN

Major roads in blue, rail shown in red

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PROCESSING PLANT IN TOMAH AREA
SAND IS PART BEDROCK, PART ALLUVIAL, EXCAVATED AS PART OF CRANBERRY DEVELOPMENT