

Draft of White Paper on Waste Water Disposal

Problem Statement: The Mining and Energy Commission is considering the rules for disposal of flowback and produced water from fracturing operations. The Water and Waste Management Committee has already agreed on wording that requires re-use in on-going operations. It recognizes the fact that at the end of useful operations the wastewater left unused will need to be disposed of somehow.

The only two disposal methods considered were:

- Deep discharge into underground formations in North Carolina per UIC Class II regulations.
- Treatment for some end use such as surface discharge.

The Committee recognizes that the first option is not legally available in North Carolina at this time. But the General Assembly came close to reversing that piece of law in 2013. Consequently, in order to be long lived, our rule set ought to comprehend the possibility of this happening in the future.

Whether legal or not, the Committee is opposed to the deep disposal option. This opinion is documented in the proceedings of the Committee. The only areas potentially suited to said disposal are near the coast. The wastewater would have to be transported great distances over roads to accomplish this. For this and other reasons the Committee is not in favor of this option.

Since this in effect gives oil and gas operators a single option for wastewater disposal, the Committee decided to research the viability of the option. The research included testimony from members of the DENR Stakeholder Group on Oil and Gas Management.

Nature of the Wastewater:

The flowback and produced waters from the Triassic are expected to have relatively low salinity. Based upon existing data and upon geologic considerations, we expect the salinity to be under 5,000 part per million (ppm).

This is compared to up to 350,000 ppm in the Marcellus. This has two implications. On the one hand, re-use ought to require minimal treatment, so that aspect of the rules will not be onerous. On the second hand, even the treatment for discharge or other use ought to have a relatively low cost.

Typical operations are likely to use 3 million gallons of water per well. About a third of that will return as flowback water. For subsequent wells, flowback water can be reused, but make up water will be required to reach the amount needed to conduct hydraulic fracturing. When drilling operations cease, one would be left with about 1 million gallons of wastewater. This is the amount for each drilling operation conducted by a single entity. It may be possible to transfer this water to an operation conducted by another entity, as is being permitted in some states. Absent that, each operation would expect to dispose of about a million gallons, or about 24,000 barrels.

Likely Treatment Options:

The TDS for these waters are within the range defined as brackish water. [Commercially available](#) Reverse Osmosis (RO) equipment can treat up to 900,000 gallons per day, well in excess of the volumes we expect operators to treat in North Carolina. [Treatment costs](#) (operating and maintenance costs) are expected to run between \$0.50 and \$1.50 per 1,200 gallons, with the lower numbers for TDS of 2,000 ppm. Twelve hundred gallons equates to about 28 barrels. Capital cost depends on size. Since each operation will need to clean about a million gallons every few months, the size of the plant is probably around 20,000 gallons per day. The capital cost, [according to the Army Corps of Engineers](#), would be about \$30,000. A ten year straight line depreciation would ascribe a monthly cost of \$250, which spread over a million gallons is pennies. Their numbers for operating costs are in line with the figures above.

Reverse Osmosis (RO) is a process that pushes fresh water across a membrane by the application of pressure. For brackish water these pressures are low, usually between 200 and 400 psi, so the energy to produce the pressure is low. These pressures are up to 1,200 psi for sea water treatment. Yield is defined as the percentage of the brackish water that results in useful water. The balance is

concentrated brine, referred to as concentrate. Disposal of concentrate is the main issue with RO. Yields with even single pass RO will be around 80% useful water for these salinities. This means the 1 million gallons treated would yield 200,000 gallons of concentrate requiring disposal.

Concentrate Disposal Options:

North Carolina currently has in excess of 20 RO water treatment facilities. Most of these are probably a good deal larger than the ones that may be necessary to manage wastewater disposal from hydraulic fracturing operations in North Carolina, however, the data are still being accumulated. RO water treatment facilities close to the ocean are discharging into the waters. This can have issues if not done properly. Others are discharging into surface waters, and again we are pulling together data on that. One argument would be that the concentrate produced by the oil and gas industry would simply fall into the jurisdiction of the state and get handled appropriately. But at first blush it seems that the department in question is facing a tough task, and so an examination of options could have broad application.

In other states RO concentrate is handled in one of two ways. One is to sequester it in UIC Class II wells, which is not legal in our state. As far as we are aware the only feasible locations are in the Coastal Plain close to the coast. If appropriate host rock is identified, this would be an alternative to ocean discharge. Perhaps the General Assembly should consider a lifting of the ban for the sole purpose of sequestering RO concentrate.

The other commercially available method is to evaporate the water, leaving behind a crystalline residue. This residue is used in some states as road salt in winter. Alternatively it could be disposed of in an appropriate landfill. The water derived from this would essentially be distilled water.

Conclusions

Wastewater from oil and gas operations in the Triassic can be treated at reasonable cost. Commercial systems exist for accomplishing this. Consequently, a rule set that in effect requires multiple re-uses, followed by treatment for

discharge or other purpose, will not be a deterrent to prospective operators. It will also be the most environmentally responsible option for our state.

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