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OGAP 2007 Produced Water Report: Options and Costs for Disposal of Produced Water

In the United States, more than 99% of the produced water generated onshore is managed onsite by the operators.[1] Under certain circumstances, however, operators prefer to send their produced water offsite to a commercial disposal facility. This is typically accomplished by having a truck periodically visit the well locations, remove the accumulated water, and haul it away to the destination facilities.

Offsite commercial disposal becomes the option of choice when small producers do not want to have the responsibility for constructing, operating, and closing onsite facilities. Operators who do not have access to nearby formations deemed suitable for accepting produced water through injection wells may also look to offsite disposal. This fact sheet describes the commercial produced water disposal business in the United States.

In 2006, Argonne National Laboratory published a report and database describing the network of offsite commercial disposal facilities that accept different types of exploration and production (E&P) wastes.[2] Because the Argonne report focuses on costs, this fact sheet, unlike most of the others, contains detailed cost information. The following discussion on offsite commercial disposal options for produced water is based on that report.

The most common commercial disposal method for produced water involves injection, followed by evaporation and burial. Commercial produced water injection operations occur throughout the United States.

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[1] API, Overview of Exploration and Production Waste Volumes and Waste Management Practices in the United States, prepared for the American Petroleum Institute by ICF Consulting, (May 2000).
[2] Puder, M.G., and J.A. Veil, 2006, Offsite Commercial Disposal of Oil and Gas Exploration and Production Waste: Availability, Options, and Cost, prepared for U.S. Department of Energy, National Energy Technology Laboratory, Aug., 148 pp. (2006) Available at: http://www.ead.anl.gov/pub/dsp_detail.cfm?PubID=2006

Texas, Louisiana, and Oklahoma are home to many companies that operate commercial disposal wells. The disposal costs range between $0.30/bbl and $10.00/bbl. In most cases, costs are less than $1.00/bbl.

Evaporation of produced water is most widely reported in Wyoming (seven companies), followed by Colorado (four companies), Utah (four companies), and New Mexico (three companies). The disposal costs range between $0.40/bbl and $3.95/bbl — one company in Colorado asks $84.00/bbl.

Burial in municipal landfills is potentially available for produced water across the nation. However, solidification, which is generally required, drives up the costs. Volume-based costs range between $3.00/bbl and $22.00/bbl in Texas and North Dakota, and $18.00 yd in New Mexico. Weight-based costs vary significantly by state, but generally fall into a range between $15.00/ton and $80.00/ton. Mississippi and Louisiana report higher ranges of up to $128.00/ton and $250.00/ton, respectively. Burial of produced water in commercial pits is not widely reported. Three companies — one in Oklahoma, one in Utah, and another one in Wyoming — report costs ranging between $0.35 and $4.00/bbl.

Cavern disposal offers a competitive option for produced water in Texas. Five companies at multiple facilities indicate a cost between $0.30/bbl and $10.00/bbl.

Discharge of produced water was reported by three commercial disposal companies in Pennsylvania and one company in Wyoming. The costs range between $0.045/gal and $0.055/gal ($2.25/bbl and $2.75/bbl) in Pennsylvania, and between $2.50/bbl and $3.50/bbl in Wyoming. All four companies conduct treatment prior to discharge operations. Two facilities in Pennsylvania discharge produced water to a municipal wastewater treatment plant for a disposal fee of $0.015/gal to $0.050/gal ($0.75/bbl to $2.50/bbl).

Land application of produced water is available in Arkansas (one company), New Mexico (two companies) and Utah (one company). Costs are $0.30/bbl to $0.40/bbl in Arkansas, $5.18/bbl to $18.00/bbl in New Mexico, and $100/ton ($26.25/bbl) in Utah.

Treatment of produced water is offered by one company in Alabama and another in Texas. Costs range from $5.00/bbl to $14.00/bbl.

Recycling of produced water is not widely reported. However, this method has been increasingly applied in some areas. One company

identified in California charges $5.00/bbl for recycling; another company in Oklahoma indicates a cost of $25.00/load.

Thermal treatment of produced water is offered by a Texas company. Costs range from $0.02/lb to $0.20/lb ($40.00/ton to $400/ton, or $10.5/bbl to $105.00/bbl)

Colorado

In 2006, 388, 385, 119 barrels of produced water were extracted from coal bed methane (CBM) wells across the state. La Plata County alone had 24, 084, 087 barrels of produced water extracted from approximately 1798 wells. The counties with the largest amounts of produced water for the past few years have been Rio Blanco, Las Animas, and Huerfano respectively.[3] In 2006 alone, these three counties produced 275, 232, 155 barrels of produced water. Because only a small portion of this water is reused/recycled, the majority of it must be properly disposed of in some fashion.

Top 10 Water Producing for 2006 in Colorado[4]

County	**Barrels**
Rio Blanco	105, 010, 340
Las Animas	99, 465, 786
Huerfano	70, 847, 029
La Plata	24, 084, 087
Washington	21, 442, 281
Moffat	15, 312, 680
Garfield	9, 276, 513
Cheyenne	7, 280, 666
Weld	7, 268, 820
Logan	6, 081, 711

In Colorado, according to COGCC rules, there are four approved methods for disposing of produced water,[5] plus a fifth that requires permitting by a different state agency. Produced water may also be re-used or recycled

[3] Colorado Oil and Gas Conservation Commission, on-line production data, Rules and Regulations, Rules of Procedure, and Oil and Gas Conservation Act, revised September 2001. Website address: http://oil-gas.state.co.us/.

[4] http://www.oil-gas.state.co.us/.

[5] COGCC Rule 907 (c) 2 [COGCC Rules & Regulations - 900 Series].

in enhanced recovery and drilling.[6] The approved methods of disposal are:

1. reinjection
2. evaporation/percolation pits
3. approved commercial facilities
4. road spreading
5. discharges to state waters.

Injection wells must be permitted by COGCC. The water is injected to aquifers that would not be used as sources for drinking water. Water disposal or evaporation pits must also be permitted by COGCC and are lined only when they are in an area determined to be environmentally sensitive for water quality. Quality standards also apply to road spreading; road spreading may not result in pooling or runoff. Produced water may only be discharged to state waters if a discharge permit is obtained from the state Department of Public Health and Environment's Water Quality Control Division. This requirement also applies to water disposal or evaporation pits that discharge water to the surrounding environment.

San Juan Basin

The San Juan Basin is located in southwestern corner of Colorado and extends into the northwestern corner of New Mexico. The basin encompasses parts of Archuleta and La Plata counties in Colorado and into parts of San Juan, Rio Arriba, Sandoval and McKinley counties in New Mexico.

On the Colorado side of the basin, the Ignacio Blanco Field is where the vast majority of wells are producing gas and water. In 2000, an estimated 1,790 wells generated conservatively 25,293,071 barrels of produced water with 403,025,158 mcf gas.[7] On the New Mexico side, producers reported that the Basin Fruitland Coal gas pool produced the highest volume of water associated with gas in the basin, in the amount of 6,033,799 barrels of water associated with 491,374,058 mcf gas. High volumes of water (over 1 million

[6] COGCC Rule 907(c)3 [COGCC Rules & Regulations - 900 Series].
[7] Colorado Oil and Gas Conservation Commission, on-line production data, Rules and Regulations, Rules of Procedure, and Oil and Gas Conservation Act, revised September 2001. Website address: http://oil-gas.state.co.us/.

barrels each) were also reported at the Blanco-Mesa Verde pool and the Basin Dakota Pool.[8]

Producers with gas leases at the Ignacio Blanco Field were interviewed by telephone in 1998 and in 2001.[9] In 1998, operators reported that they managed produced water at their leases using a variety of methods, including company-owned disposal wells, secondary recovery wells, fresh water disposal wells, commercial disposal services, and/or evaporation pits. Costs for produced water disposal (including disposal fees and/or accompanying handling fees) ranged from $.04/bbl to $1.88/bbl. An operator who used a company-owned fresh water disposal well reported the lowest per barrel cost ($.04/bbl) for disposal. Economic data was not provided by the operators who reported using evaporation pits, although that cost has traditionally been very low. Midrange values reflected variations in whether or not the disposal well was company owned or commercially operated and whether a pipeline or commercial trucking service was used to transport the water. The highest values were always reported for commercial trucking coupled with a commercial disposal service.

In 2001, operators who were contacted reported the use of either company owned or commercial salt water disposal wells coupled with either pipeline systems or commercial water hauling services – or some combination using these components. Disposal costs reported during this set of interviews ranged from $.30/bbl - $2.80/bbl, with the high end of the range reflecting the use of commercial water hauling and disposal services and the low end of the range reflecting a combination of pipeline system with company owned disposal well. One producer reported being permitted for surface discharge, but that the water quality at the company leases had not yet met the standards established by the state for discharge.[10] He said they had been using reverse osmosis to treat

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[8] New Mexico Energy, Minerals and Natural Resources Department – Oil Conservation Division. On-line version of the Oil Conservation Division Rulebook (oil and gas regulations) and the Environmental Handbook (guidance for oil and gas industry). Website address: http://www.emnrd.state.nm.us/ocd/.

[9] Boysen et al., *Creative Strategies For Produced Water Disposal in The Rocky Mountain Region* (2002).

[10] Colorado Department of Public Health and Environment – Water Quality Control Commission; Colorado Discharge Permit System Regulations –

their water prior to surface discharge but that technology did not work for their situation. One producer with leases in this basin reported beneficially using the produced water for treating oil wells.

On the New Mexico side of the basin, the story is somewhat different.[11] In 1998, the vast majority of producers who were contacted reported that water is reinjected for disposal in this basin. Approximately 1/3 of the respondents said they utilized company-owned injection wells. Another 1/3 reported the use of commercial disposal facilities, and the remainder reported that they utilized injection wells that were "partner-owned". In addition, one respondent reported that a "fresh water" disposal well was utilized and another reported the use of a commercial disposal pit.

The cost of disposal utilizing an "owner-operated" injection well ranged from $.025 - $2.00/bbl, with the median value at $1.00/bbl. That disposal cost included transportation or handling of the water as well as any disposal fees that applied. Producers who reported using commercial disposal services reported paying between $.069 - $2.23, with the median value at about $1.50/bbl. Again, that range included handling as well as disposal fees. The amount reported by operators for disposal into "partner-owned" disposal wells was generally about $1.80/bbl. No value was reported for disposal using evaporation.

The interviews were conducted again in Fall 2001, and different operators in the basin were contacted. Almost 1/2 of the respondents reported utilizing commercial disposal wells, while approximately the other half reported using company owned salt water disposal wells. One respondent reported using evaporation tanks, and another stated that company owned disposal pits were used. One producer said that they used both active and passive evaporation tanks and pits. The active evaporation process utilizes a system of sprays to enhance the evaporation of water contained in reserve pits by convective heating, while the passive system relies on radiation heating from the hot, dry climate found in New Mexico to drive the evaporation process. Most operators reported the use

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Regulation No. 61; effective June 30, 2002. Website Address: http://www.cdphe.state.co.us/.

[11] Boysen et al., *Creative Strategies For Produced Water Disposal in The Rocky Mountain Region* (2002).

of commercial water hauling services although many said that pipeline systems were also utilized on some of their properties. Whether or not to use a commercial service depended on the location of the well.

The costs of disposal in 2001 ranged from $0.50/bbl to $4.20/bbl. The low end of the range reflected the cost of handling and disposal using an evaporation pit. Many of the responses fell into the range of $1.00/bbl to $2.50/bbl. Some producers were able to break out handling costs and those figures ranged from $0.70 - $3.20/bbl. Disposal fees were generally reported in the range of $0.75 - $1.10/bbl. Most of the operators who used commercial water hauling services and/or commercial disposal facilities were able to very quickly and accurately identify their disposal costs.

Some producers in this basin reported how they were recycling the water to lower disposal costs. Two producers reported beneficially using/recycling some of the water produced on their lease for hot oil service and about 1/3 of the respondents reported recycling some of their water for drilling purposes.

One company representative said that his company had worked long and hard to transfer water rights from their oil company to a nearby coal mine so that the mine could use the water for dust control. The producer said that it was a long, painful process just to give their water away.