

White Paper: Utilization of AMD in Well Development for Natural Gas Extraction

November 2011

Title: Establishment of an Evaluation and Approval Process for the Use of Abandoned Mine Drainage (AMD) for Industrial Uses Including Natural Gas Extraction.

Short Title: Utilization of AMD in Well Development for Natural Gas Extraction

Goals:

1. Define the roles of the various department programs.
2. Establish a process for the oil and gas industry to utilize AMD.
3. Establish a process for the department to facilitate review and evaluate proposals for use of AMD.

Process:

A Review Team made up of DEP staff was divided into two work groups that were tasked with preparing work products for review and approval by DEP's Executive Team. The review team and its project work groups met at least weekly.

Technical/Legal Review Team members provided initial comments/suggestions on the formation of Project Work Groups and defined roles of the various department programs. The Review Team and its Project Work Groups collaborated to provide recommendations to overcome the following obstacles:

- **Solutions to Technical Issues**
 - Target AMD sources for use by oil and gas industry.
 - Draft storage options for AMD
 - Draft proposal review process
- **Solutions to Industry Concerns**
 - Addressing concerns of industrial users so that AMD is a practicable water source (conference call with Chesapeake Energy and Winner Global Energy and Environmental Services).
- **Solutions to Legal Issues**
 - Liability
 - Permitting requirements, including storage options.
- **Department Coordination**
 - Coordination between multiple deputates and bureaus.
- **Program Integration**
 - Program integration within department.

Establishment of a process for the Oil and Gas Industry to utilize AMD.

The process detailed in the following pages represents a collaborative effort by Review Team members towards providing solutions to address the use of AMD for natural gas extraction including; AMD storage at AMD sites and at sites regulated by DEP's Office of Oil and Gas Management, draft preliminary storage standards for AMD to be stored in nonjurisdictional impoundments, a process of DEP review of proposals to utilize AMD and solutions to address long-term liability issues. Each of the previously noted topics are expanded upon below and represent a draft framework of an entire process that is a work-in-progress. Recommendations are provided to support the proposed solutions.

Storage Options for AMD prior to use by the Oil and Gas Industry for Well Development in Natural Gas Operations

Background: One of the most repeated concerns from Review Team members and oil and gas industry representatives was how would AMD be classified for storage requirements. To familiarize all Review Team members with the various types of storage facilities associated with oil & gas activities and how they are regulated, Review Team members from the Office of Oil and Gas Management developed a Summary of Storage Facilities associated with Oil and Gas Activities. This summary of impoundments can be found in Appendix A.

Several recommendations for AMD storage for hydraulic fracturing operations were generated by the review team members. These recommendations are as follows.

Option #1: Nonjurisdictional Impoundment - This option would allow operators to store AMD in nonjurisdictional impoundments (see *Appendix A*). In order to store AMD in a nonjurisdictional impoundment, the operator would be required to demonstrate that the AMD does not create a threat of pollution to waters of the Commonwealth. See 35 P.S. 691.402. To make this demonstration, the operator would need to establish that the source of AMD meets certain water quality standards currently being developed by the department (see discussion below). This option may require changes to the operator's well permit and additional requirements in the operator's water management plan regarding periodic testing.

Storage Standards for nonjurisdictional impoundments. For Option #1, the operator would be required to demonstrate that the AMD does not create a threat of pollution to waters of the Commonwealth. To make this demonstration, the operator would need to establish that the source of AMD meets certain water quality standards prior to department approval to store AMD in a nonjurisdictional impoundment.

Preliminary storage standards for AMD to be stored in nonjurisdictional impoundments were drafted using the parameters from the Environmental Protection Agency's NPDES requirements for mine drainage wastewater characterization (see *Appendix B*). Parameters that were not considered a significant constituent of AMD or were covered by other parameters in the table were removed from the original list of parameters included in the EPA's NPDES requirements for mine drainage.

The preliminary AMD storage standards found in Appendix B were developed using in-stream criteria, drinking water standards, and human health and aquatic life criteria for toxic substances.

Option #2: Centralized Wastewater Impoundment Dam for Oil and Gas Activities– This option would allow operators to store AMD in a centralized wastewater impoundment dam for oil and gas activities (See *Appendix A*). Under this option, an operator would not be required to establish that the source of AMD meets certain water quality standards (*Appendix B Storage Standards* would not be applicable). This option may require changes to the operator’s well permit or Water Management Plan regarding the storage of AMD in such impoundments.

Option #3: On-Site Pits and Tanks – This option allows operators to store treated or untreated AMD in pits at the well site (*Appendix B Storage Standards* would not be applicable).

Process for DEP to review and evaluate proposals for use of AMD

The Review Team has provided below an outline for the establishment of a process for the oil and gas industry to submit proposals to utilize AMD. The review team will refine the process upon Executive Team review.

The draft process is found below:

1. Oil and gas industry will initiate the process by reviewing databases of AMD sites with water quality and flow data provided on DEP’s website.
 - a. The oil and gas company, on its own or with the assistance of the department or local watershed groups, would identify an AMD source.
 - b. AMD sources the commonwealth has identified as a priority to treat will be targeted to the extent possible.
2. Oil and gas industry representatives are encouraged to meet with DEP’s Bureau of Abandoned Mine Reclamation, District Mining Operations and Office of Oil and Gas Management staff at prospective AMD and active mining sites.
 - a. During the pre-proposal site visit the oil and gas industry representative will need to identify its anticipated method of storage (Options No. 1 through No. 3) and location of storage facilities of AMD (existing and proposed).
 - b. The oil and gas company could choose to partner with a local entity, third party service company or watershed group to implement the project.
3. An evaluation by the Bureau of Abandoned Mine Reclamation or District Mining Operations will determine the treatment requirements of the AMD or mine drainage, if necessary, at each AMD and active mining site. This information will be provided to the oil and gas industry representative.
4. Secondary treatment, if necessary and specified by oil and gas industry, is reviewed for consistency with the Bureau of Abandoned Mine Reclamation or District Mining Operations standards.
 - a. Any additional treatment above and beyond the AMD treatment determined by the Bureau of Abandoned Mine Reclamation or District Mining Operations that is needed to make the treated AMD acceptable for use in the hydraulic fracturing operations would be the responsibility of the company.

5. Oil and gas industry to conduct sampling and testing of AMD at prospective AMD sites for independent review prior to treatment process selection.
 - a. The oil and gas company, third party service company or its local partner would acquire property or leases for construction of the required treatment facilities
 - b. The oil and gas company, third party service company or its local partner would develop the design of the treatment facilities and submit them to the DEP for review and approval.
 - c. Where required, treatment facilities could be permitted under a Water Quality Management Permit with performance criteria for treatment facility and design engineer (P.E.) certification requirements (pre and post construction).
6. Proposals are submitted with the following information (all necessary information for a complete proposal to be included on fact sheet and outlined on DEP's website):
 - a. Oil and gas company name(s)
 - b. Name of third party service company, if applicable.
 - c. Name of watershed group and/or other non-profit, if applicable.
 - d. AMD site location (point(s) of use and/or withdrawal)
 - e. Proposed AMD discharge(s) and/or mine pool(s) to be utilized
 - f. Total amount of AMD discharge(s) and/or total volume of mine pool(s) at site
 - g. Volume of AMD discharge(s) and/ or mine pool(s) to be utilized
 - h. Characterization (chemistry) of the AMD discharge(s) and/or mine pool(s)
 - i. Is the AMD source from an existing AMD discharge treatment facility?
 - j. Will treatment of the AMD be required? If so, what type of AMD treatment is proposed (passive or active treatment)? What is the expected water quality to be produced from the treatment?
 - k. Identify the landowner(s) and provide proof of consent for the proposed withdrawal/use of the AMD.
 - l. What is the timeframe for the use of the AMD?
 - m. What is the classification of the watershed(s) where the water will be stored/utilized?
 - n. How will on-site and off-site storage requirements be met based on level of treatment?
 - Types of storage facilities associated with oil and gas activities:
 - Centralized freshwater impoundment (jurisdictional freshwater impoundment or nonjurisdictional impoundment)
 - Centralized wastewater impoundment dam for oil and gas activities
 - On-site impoundment pits and tanks
 - Pumped directly from mine pool
 - o. What is the distance from the AMD discharge to the storage facility or end use?
 - p. If withdrawal from a mine pool is being proposed, what is the potential for mine subsidence or impacts to individual water supplies? Have impacts to receiving streams been evaluated?
 - q. If withdrawal from a mine pool is being proposed, have all outfalls (discharges) from the mine pool been identified and monitored? If monitored, for how long?
 - r. If withdrawal from a mine pool is being proposed, what is the extent of the mine pool, mining history, and mine pool recharge rate?
 - s. Are there any other known or planned users of the AMD source?

- t. Has a detailed monitoring plan been developed or proposed for some timeframe (including before, during and after) for use of the AMD?

The proposal for use of AMD as noted above would be submitted to the Office of Oil and Gas Management and would then be distributed to a team based on the Bureau of Abandoned Mine Reclamation or District Mining Operations staff member determination. That team would consist of at least two additional staff members from the following organizations (Bureau of Abandoned Mine Reclamation, Water Management, District Mining Operations and Waste Management) as well as a representative from Chief Counsel. The team would provide feedback to the requestor (oil and gas company representative) within 15 days of receipt of a completed proposal package. That feedback would include guidance on the type of permits needed, if any, and means of addressing issues concerning potential long-term liability for treatment of the AMD source proposed for use by the requestor.

Solutions to Long-term Liability Issues

A key concern for anyone considering the use of AMD for fracking water is the potential to incur long-term liability for treating an AMD discharge collected and treated for such use. The Clean Streams Law contains broad provisions regarding responsibility of landowners and “land occupiers” to correct conditions on their land which present a danger or pollution to waters of the Commonwealth. 35 P.S. § 691.316. In the mining context, Pennsylvania courts have interpreted the Clean Streams Law as imposing long-term treatment liability on mine operators who pump abandoned mine pools to facilitate active mining operations. Although the mine operator was not responsible for creating the adjacent abandoned mine pool, the act of pumping water from abandoned mine pool to facilitate its new underground mining operation has been determined to create a legal obligation to treat the resulting discharge.

There are several possible solutions for addressing the potential for long term liability being incurred by users of AMD for fracking water.

Option #1 - Environmental Good Samaritan: The project could be structured to fit within the Environmental Good Samaritan Act, 27 Pa.C.S. §§ 8101 et seq. (EGSA). The EGSA provides immunity from civil liability under state law to landowners or providers of equipment, materials or services at no charge or at cost for a “water pollution abatement project”—defined essentially as treatment of water pollution on abandoned mine lands or treatment of AMD. The immunity provided by the EGSA includes liability for operating and maintaining water pollution abatement facilities constructed as part of an EGSA project.

Option #2 - Consent Order and Agreement: Through the use of a Consent Order and Agreement, DEP could agree not to hold the person using AMD for frack water liable for long-term treatment of the AMD source, so long as specific conditions are met by the operator. These conditions would vary, depending on the nature of the project. The goal of the Commonwealth would be to ensure long-term treatment of the discharge after the use of the AMD source for frac water by the operator has ended. In situations where the department has already constructed and is operating a treatment system for a targeted AMD source, this may simply involve sale of the treated water to those proposing to use it as frac water, and putting the proceeds into a trust fund

like those currently used by the mining program. In situations where treatment facilities must be constructed by the operator proposing to use the AMD source for frac water, this may involve ultimate transfer of any treatment facility, either to the department or a non-profit watershed group, at the conclusion of the operator's need for the AMD as a source of hydraulic fracturing water. In addition, DEP may seek funding for long-term treatment of the AMD source. The goal of the department would be to develop a fully-funded trust at the end of the term of the Consent Order and Agreement which would ultimately generate sufficient funds to operate and maintain the treatment facility for the AMD source.

Recommendations

The Review Team offers the following recommendations to support the solutions outlined above:

Ongoing Recommendations:

- Support adoption of polices by the Susquehanna River and Delaware River Basin commissions that incentivize the use of AMD and mine drainage in well development for natural gas extraction.
 - Expedited reviews and docket approvals of AMD sources.
 - Require that operators seeking freshwater withdrawals in watersheds where AMD is available must consider first the available AMD sources or contribute to ongoing or future AMD treatment activities in the watershed.

Short-Term (0-1 Year) Recommendations:

- Development of storage standards for AMD to allow for storage of AMD in Nonjurisdictional Impoundments (finalizing the draft standards proposed in *Appendix B*).
- Draft a fact sheet to detail the process for the submission of a proposal package to use AMD.
- Revise DEP documents where necessary to include treated AMD as “centralized wastewater or treated AMD storage [fluids other than fresh water (e.g. drilling or fracking fluids, treated acid mine drainage, or wastewater treatment plant effluent)]:”
- Compile the existing inventories of AMD and active mining sources and make the multiple databases available on DEP's website.
 - AMD sources the Commonwealth has identified as a priority to treat will be targeted to the extent possible.
 - Consider identifying existing surface water withdrawal locations and oil and gas well sites in a database and then compare these locations to the databases of AMD and active mining sources.
- Develop a Team of DEP staff from the following programs to review proposals for the use of AMD:
 - Office of Oil and Gas Management
 - Bureau of Abandoned Mine Reclamation
 - District Mining Operations
 - Office of Chief Counsel
 - Bureau of Waste Management (Division of Municipal and Residual Waste)
 - Office of Water Management

- Provide guidance document to review proposals including the following:
 - Proposal review process as noted above in findings.
 - Time period for review not to exceed 15 days.
 - Notification process of appropriate DEP regional office that proposal is accepted.
 - Expectations of regional office when approved proposal is submitted in water management plan.
 - Administrative responsibility for review team and Consent Order & Agreement development.
- Development of standard approval letters for AMD proposals.
- Development of standard Consent Order & Agreements to simplify processing.
- Standard rules for oversight of proposed AMD treatment systems now and in the future.

Long-Term (1+ Years) Recommendations:

- If necessary and applicable, development of an Office of Oil and Gas Management General Permit for the use of AMD in well development for natural gas extraction. The following considerations could be included in the general permit requirements:
 - Storage standards to be included in General Permit.
 - Pre-alteration survey of groundwater resources required for all new nonjurisdictional impoundments to store AMD. Parameters in the survey to be determined upon further review but should include typical constituents of AMD and indicators of misuse.
 - Design and construction standards, including a primary liner, leak detection zone, secondary liner, and a groundwater monitoring system.
 - Periodic testing for compliance with storage standards to be conducted by Office of Oil and Gas Management inspectors.
- Long-term solutions regarding the management of AMD for use by oil and gas companies in natural gas well development should be included in future revisions to Oil and Gas regulations (Title 25, Chapter 78).

Appendix A

Types of Storage Facilities Associated with Oil and Gas Activities:

Centralized Freshwater Impoundment –A facility used to store freshwater that services multiple well sites. This type of impoundment may be located on a well site, adjacent to a well site, or at a separate location. There are two different types of centralized freshwater impoundments that depend on the size of the facility-- a Jurisdictional Freshwater Impoundment and a Nonjurisdictional Impoundment. See definitions below.

- ***Jurisdictional Freshwater Impoundment*** – An impoundment used for the storage of water not located on a watercourse and which has no contributory drainage where the greatest depth of water measured at the upstream toe of the dam at maximum storage elevation exceeds 15 feet and the impounding capacity at minimum storage elevation exceeds 50 acre-feet (approximately 16.3 million gallons). (25 Pa. Code § 105.3(2)).
- ***Nonjurisdictional Impoundment*** – An impoundment used for the storage of freshwater or fluids or semifluids other than water, the escape of which does not pose a potential for pollution or danger to persons or property, not located on a watercourse and which does not have a contributory drainage and is less than 15 feet deep and the impounding capacity at maximum storage is less than 50 acre feet (approximately 16.3 million gallons). A nonjurisdictional dam is not regulated under the Dam Safety and Encroachments Act, 32 P.S. §§ 693.1-693.27 and 25 Pa. Code Chapter 105. While these dams do not require a Chapter 105 permit prior to construction, a Chapter 102 Erosion and Sediment Control Permit may be required depending on the extent of the associated earth disturbance activity. 25 Pa. Code Chapter 102. Accordingly, there are no requirements regarding the construction or monitoring of these facilities.

Centralized Wastewater Impoundment Dam for Oil and Gas Activities- A facility used to store wastewater constructed for the purpose of servicing multiple well sites. This is not a residual waste impoundment. This impoundment may be located on a well site, adjacent to a well site or at a separate location. To construct such an impoundment, an operator is required to obtain a “Dam Permit for a Centralized Impoundment Dam for Oil and Gas Activities.” This permit is authorized by 25 Pa. Code Chapter 105 and administered by the Office of Oil and Gas Management. Additionally, an operator constructing this type of impoundment must meet certain design and construction standards, including a primary liner, leak detection zone, secondary liner with a minimum thickness of 40 mil, and a groundwater monitoring system.

On-Site Impoundment Pits and Tanks -- Pits and tanks located at the well site used to store freshwater or wastewater to service a single well site. These pits and tanks must meet the

requirements of 25 Pa. Code § 78.56 (Single 30 mil liner, NO leak detection, NO GW monitoring) and must be restored within 9 months of completion of drilling pursuant to section 206(c) of the Oil and Gas Act and 25 Pa. Code § 78.65.

Definitions:

Abandoned Mine Drainage – A discharge of a fluid caused by prior mining or fluids contained in a mine pool that, depending on its quality, may create a threat of pollution to waters of the Commonwealth when stored for use in hydraulic fracturing operations.

Freshwater – For the purposes of this discussion, freshwater is water from surface water or groundwater sources.

Pollution – Contamination of any waters of the Commonwealth such as will create or is likely to create a nuisance or to render such waters harmful, detrimental or injurious to public health, safety or welfare, or to domestic, municipal, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or to livestock, wild animals, birds, fish or other aquatic life, including but not limited to such contamination by alteration of the physical, chemical or biological properties of such waters, or change in temperature, taste, color or odor thereof, or the discharge of any liquid, gaseous, radioactive, solid or other substances into such waters. The department shall determine when a discharge constitutes pollution, as herein defined, and shall establish standards whereby and wherefrom it can be ascertained and determined whether any such discharge does or does not constitute pollution as herein defined. (35 P.S. § 691.1).

Wastewater – Includes, but is not limited to, flowback and production water from oil and gas activities, sewage, and other industrial wastes.

Appendix B

PRELIMINARY RESULTS TABLE

POSSIBLE STORAGE STANDARDS FOR AMD IN NONJURISDICTIONAL IMPOUNDMENTS BY O&G FIRMS

PARAMETER	Units	AMD STORAGE STANDARDS FOR NONJURISDICTIONAL IMPOUNDMENTS
Alkalinity	mg/L	Minimum of 20 mg/L
Aluminum	mg/L	0.2
Ammonia	mg/L	1.0
Arsenic	µg/L	10.0
Barium	mg/L	2.0
Bromide	mg/L	0.2
Cadmium	µg/L	5.0
Chloride	mg/L	250
Chromium	µg/L	100
Copper	mg/L	1.0
Iron	mg/L	1.5
Lead	µg/L	15
Manganese	mg/L	0.2
Nickel	µg/L	470
pH		6.5-8.5
phenol	µg/L	5.0
Selenium	µg/L	50
Specific Conductance (Conductivity)	µmho/cm	1,000
Sulfate	mg/L	250
TDS	mg/L	500
TSS	mg/L	45
Zinc	mg/L	5.0

Note 1: All metals reported as Total.

Note 2: Applicant must identify all other pollutants or parameters in AMD that may exceed drinking water MCLs or SMCLs, Chapter 93 water quality criteria, or other applicable standards for the protection of human health and aquatic life.

