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Scott E. Walters, Chief
General Permits/Beneficial Use Section
Division of Municipal and Residual Waste
Bureau of Waste Management
PO Box 8472
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Delivered via e-mail and overnight USPS

RE: Natural Gas Brine Dispersal on Roadways and the Risk of Surface and Groundwater Contamination (Comments on DEP Permit # WMGR064)

Dear Mr. Walters,

Introduction

On behalf of Damascus Citizens for Sustainability (PO Box 147, Milanville, PA 18443), I have reviewed the Special Conditions General Permit WMGR064 amendment that proposes the authorization of the use of natural gas well brine for roadway pre-wetting, anti-icing, and roadway de-icing. Our comments relate to the potential degradation of freshwater resources stemming from overland transport of gas well brines and contaminants within it to waterways, lakes and reservoirs. In addition, we address the certain likelihood of brine and contaminant infiltration to groundwater resources incident to aquifers, freshwater wells, and surface water.

I offer comments based on my training as a geologist, hydrogeologist, and hydrologist with 30 years of professional environmental experience which includes work conducted for the New York State Attorney General's Office (Environmental Protection Bureau), Oak Ridge National Laboratory (Environmental Sciences Division), the New York City Department of Environmental Protection, and as an independent environmental consultant as President of HydroQuest. I have conducted detailed assessments of streams, wetlands, watersheds, and aquifers for professional characterizations, for clients, and as part of my own personal research. I have authored numerous reports and affidavits related to this work and have made presentations to judges and juries. In addition, I have published papers and led all day field trips relating to this work at professional conferences. I have also authored extensive comments relating to exploratory wells in the Delaware River Basin, as well other material related to gas drilling and hydraulic fracturing.

This general permit will fail to protect the public and the environment. General Permit WMGR064 paragraph 12 acknowledges the "… *potential for groundwater contamination* …" This permit does not adequately address the short and long-term hydrologic picture and, as such, willingly seeks to conduct "… *an activity that harms or presents a threat of harm to the health, safety, or welfare of the people or the environment*." (Paragraph 14). Similarly, paragraph 6 states that: "*The activities authorized by this permit shall not harm or present a threat of harm to the health, safety, or welfare of the people or environment of this Commonwealth.*" The serious contaminant risk associated with the proposed "beneficial" use of natural gas well brines is accented in paragraph 21 of the Special Conditions:

> *"The permittee/registrant shall immediately notify the Department's Emergency Hotline at (717) 787-4343 and the appropriate DEP regional office in the event of any spill of natural gas well brines in a quantity* ***capable of reaching surface water*** (emphasis added) *and shall take immediate action to protect the health and safety of the public and the environment."*

As a hydrogeologist with 30 years of professional experience I am well aware that road salt which has a high sodium chloride content, like brines, has a long history of contaminating groundwater supplies – often with related litigation. For example, as a hydrogeologist with the New York State Attorney General's Office (Environmental Protection Bureau), I worked with the NYSDEC and NYS Thruway Authority to document the migration of road salt from the road edge to a number adversely impacted homeowner wells. Here, the NYS Thruway Authority ultimately paid to extend a water line to provide potable water to homeowners. This situation spurred extensive research which documented the magnitude of road salt based groundwater contamination cases throughout the United States. This work, in turn, led to drafting legislation oriented toward protecting aquifers from road salt contamination. The proposed application of brines under General Permit WMGR064 would present a similar hydrogeologic risk to groundwater and surface water resources – with the added risk of widespread dispersal of additional and, quite likely, unknown fracking-related chemical compounds. The dispersal of gas well brines on our roadways, potentially laced with toxic and carcinogenic chemical compounds, is completely unnecessary and will needlessly jeopardize our finite freshwater resources. General Permit WMGR064, and any other related permits (e.g., for dust suppression) should be abandoned in deference to traditional means of de-icing our roadways. This permit should be denied.

In part, these comments relate to the potential degradation of freshwater resources stemming from overland transport of gas well brines and contaminants within it to waterways, lakes and reservoirs. In addition, we address the certain likelihood of brine and contaminant infiltration to groundwater resources incident to aquifers, freshwater wells, and surface water.

Production-Related Brines

It is likely that gas well brine wastewater produced along with gas or oil production will be

targeted for de-icing, dust suppression, and related uses. In this case, it is likely that an even greater percentage or concentration of fracking-related chemicals will be present vs. further along in the final production life of wells. Concentrated and chemically-laden brines should not be discharged into the environment. This is not a beneficial use. These brines need to be properly treated and disposed of.

Gas Well Closure

Former natural gas wells should be immediately plugged and abandoned following cessation of production. They should not be adapted for yet another use (i.e., brine extraction) that will, without doubt, degrade the water quality in the Commonwealth. General Permit WMGR064 seeks to provide a beneficial use of natural gas well brines for roadway and walkway purposes. Although unclear in the permit description, one underlying premise here may be that gas wells should remain open for a period of time after productivity diminishes. This would require that wells not be fully plugged and abandoned following cessation of gas production. To delay permanent closure of any natural gas well actively accepts and knowingly extends the great environmental and water quality risks attendant to gas production in the Commonwealth and elsewhere. On behalf of Damascus Citizens for Sustainability, the Delaware Riverkeeper Network, and independently on behalf of HydroQuest, HydroQuest has documented the environmental risks to freshwater aquifers stemming from gas wells.

All gas wells should be immediately plugged and abandoned once production is stopped because the durability and mechanical properties of well sealant materials are NOT sufficiently advanced such that freshwater aquifers will be safely protected for hundreds of thousands of years. Existing and so-called "state-of-the-art" plugging and abandonment (P&A) practices and materials are not sufficiently advanced to insure long-term isolation between saline and freshwater zones. The aquifers we enjoy today took about a million years to form and can reasonably be expected to last another one million years (see, for example, attached *Aquifer Protection Expert Fact Sheet*). [This Fact Sheet may also be viewed and downloaded at: http://hydroquest.com/Hydrofracking/] Without unnatural alteration from gas drilling activities, aquifers should be capable of providing potable water for future generations for another one million plus years. Industry documentation establishes that, under the best of circumstances, cement and steel used to effect zonal isolation may last up to 100 years and 80 years, respectively – often far less. Once the inevitable failure of cement sheath and casing sealant material occurs, additional contaminant migration pathways are available. Then, methane released under pressure from failed cement sheaths and casings follows fractures to homeowner wells, water bodies, and the land surface. With continued degradation of cement sheaths, concentrated brine fluid will rise under hydraulic pressure and commingle with freshwater aquifers. Thus, under this scenario, the intended "beneficial use" of natural gas well brines requires that freshwater resources remain at risk for extended periods of time.

As stated in Chapter 7 of Pennsylvania's Well Abandonment Procedures (Section 7.1 Introduction):

> *"Unsealed or improperly sealed wells **may threaten public health and safety, and the quality of the groundwater resources*** (emphasis added***)***. *Therefore, the proper abandonment (decommissioning) of a well is a critical final step in its service life. ... Proper well abandonment accomplishes the following: 1) eliminates the physical hazard of the well (the hole in the ground), 2) eliminates a pathway for migration of contamination, and 3) prevents hydrologic changes in the aquifer system, such as the changes in hydraulic head and the mixing of water between aquifers."*

Clearly, any action regarding non-producing gas wells, other than immediate plugging and abandonment, should be banned and construed as not following the intent of existing well field regulations. Extended gas well life threatens freshwater resources in the Commonwealth, with the result being the dispersal of contaminants that hydrologically must and will enter surface and groundwater resources if spread in this manner – anything but a "beneficial use". This permit must be denied.

Gas Well Brines

De-icing chemicals commonly enter nearby groundwater flow systems and degrade water quality. State and Federal drinking water standards for groundwater, against which adversely impacted homeowner well waters will be compared for gas well brine chemicals, are limited and do **NOT** adequately require sampling and analysis for all of the many toxic and carcinogenic chemical compounds used in fracking/drilling fluids. As a result, State sign-off on supposedly clean, potable, groundwater will occur while people's health may remain in serious jeopardy from unknown and untested brine chemicals. Therefore, this permit must be denied.

Natural gas well brines are comprised of concentrated solutions of sodium chloride, laced with numerous known and unknown hydrofracking chemicals, many of which may be toxic. The Pennsylvania Department of Environmental Protection developed a Fact Sheet that pointedly explains to the public the definition and the potential "beneficial use" of brine in the Commonwealth:

> *"Brine is the general term used for wastewater produced along with oil or gas; it can be very salty, therefore, **injurious to plants and aquatic life*** (emphasis added)."

It is not prudent from a hydrologic and water quality standpoint to intentionally disperse **wastewater** throughout the Commonwealth so that it will flow and infiltrate into our surface water and groundwater resources. Whether brine contaminants are applied on dry days, wet days, 50 or 200 feet from streams or houses, or in one concentration or another is largely irrelevant. The hydrology is simple and straight forward. Under wet hydrologic conditions, and with repeated applications, whether today, tomorrow, or in two months – the contaminants **will move** into our waterways, reservoirs, and aquifers (i.e., toward our drinking water supplies). Once significant precipitation occurs, brines will then be mobilized and transported away from source areas. To categorize gas well brine applications under the term "beneficial use" can only be considered from a financial perspective relative to saving gas companies from having to pay

to properly dispose or treat their wastewater. The concept of intentionally dispersing gas well wastewater into our environment defies all common sense. Thus, this permit application should be denied.

General Permit WMGR064, Table 1, provides acceptance criteria (i.e., allowable concentrations) for fourteen chemical parameters, some of which are not typically contaminants when present in normal background concentrations in groundwater. The comparative table provided below readily indicates that this general permit will knowingly allow chemical laden brines to enter contaminant-free surface and groundwater flow systems.

Parameter	**Allowable Level Pre-wetting (mg/l except pH)**	**Primary or Secondary Drinking Water Standard (mg/l except pH)**	**Minimum number of times in excess of Groundwater Standard**
TDS	>170,000	500	>340
Chloride	>80,000	250	>320
Sodium	>40,000	-----	------
Calcium	>20,000	-----	------
pH	5 to 9.5	6.5-8.5	10-50
Iron	<500	0.3	<1,667
Barium	100	2	50
Lead	10	0.005	2,000
Sulfate	<1,000	250	<4
Oil & Grease	< 15	-----	------
Benzene	<0.5	0.005	<1,000
Ethylbenzene	<0.7	0.7	<1
Toluene	<1	1	<1
Xylene	<1	10 (total)	------

Even if we erroneously assume that the only chemicals present in brine-rich waters pumped from gas wells are all included in the above parameter list, many of those present will assuredly contaminate surface and groundwater resources adjacent to and beyond roadways. Chloride, for example, is extremely soluble in water and is readily transported in both surface and groundwater flow systems. It is well-recognized as a contaminant that has degraded numerous homeowner wells. Studies have shown that it often moves coincident with large snowmelt, precipitation, and runoff events. Repeated applications provide regular replenishment of contaminant source material. The addition of fracking-related chemicals to traditional de-icing materials will serve to greatly increase the health risk to the general populous and the environment. To limit permit *acceptance criteria* largely to chemical parameters that have established MCL's would ignore hundreds of other chemicals that are used in underground fracking injection, plus many others that are hidden from public scrutiny by being labeled as "proprietary". This would oppose the best interests of the population at large. A comprehensive listing of hydrofracking related chemicals is provided in the text and many tables of Chapter 5 of

the NYS Revised DSGEIS. The material in this chapter (http://www.dec.ny.gov/docs/materials_minerals_pdf/rdsgeisch50911.pdf) is hereby incorporated by reference. Permit acceptance criteria must be greatly expanded to include all toxic and carcinogenic chemicals that may well be within the brine "chemical soup" as indicated within Chapter 5 of the NYS DSGEIS. Allowable levels of these many chemical parameters must be based on detailed toxologic testing and risk assessment evaluations. In addition, individual testing of gas well brines should be conducted at least annually on a well-specific basis.

Many more contaminants that are present in flow back water are also likely to be present in brines pumped from gas production wells. Some of these are extremely toxic, some are carcinogens, and others have not been adequately studied to determine their potential impact on humans and animals (e.g., 2-butoxyethanol, formaldehyde). For example, Dr. Ronald Bishop details many of the toxic qualities and potential health impacts associated with chemicals wastes found in gas well flow back water (http://www.fmce.org/Beyond%20MSDS.pdf; *Beyond MSDS: A Review of Hazardous Materials Used by New York's Natural Gas Industry*). Dr. Bishop's report is hereby incorporated into this comment letter by reference. As discussed above, these and all other hydraulic fracturing and drilling fluid chemicals should be comprehensively assessed by toxicologists and should then be added to the very short and incomplete list above. There are hundreds of chemicals used in the hydraulic fracturing and well drilling process, many not disclosed to the public. To not identify and test for **all** these chemicals and to then exclude them from the "*acceptance criteria*" is short-sighted and irresponsible, especially in light of the many documented and serious public health risks.

Hydrology Discussion

Under 25 Pa. Code § 287.611(a)(3), the Department of Environmental Protection—here through the Bureau of Waste Management—can issue a general permit for beneficial use of residual waste if it can be used "without harming or presenting a threat of harm to the health, safety or welfare of the people or environment" of the Commonwealth. **Hydrologically, this cannot be done.** Slow groundwater flow rates and rapid surface runoff will recharge aquifers and streams with brines and related contaminants. Thus, contaminant plumes will move toward homeowner wells and streams. These plumes, like those present at other contaminant sites, need to be treated as outwardly expanding contaminant plumes that warrant expensive, full-scale, hydrogeologic characterization, groundwater clean-up, and remedial action. Hydrogeologically, overland brine dispersal is short-sighted and virtually guarantees degradation of both surface and groundwater resources. The draft permit regulations need to be modified to reflect characterization and clean-up of brine-rich waters and all related toxic chemicals present and moving within the environment.

Brine application is not needed for dust suppression. Dust suppression can be achieved with the application of clean water and need NOT contain ANY brines or chemical additions that pose an unnecessary threat to clean surface and groundwaters of the Commonwealth. As such, General Permit WGMR064 should be abandoned.

Tracers

Tracer additions to brines would provide a much needed checks and balance type approach to scientifically and legally address claims of brine excursions. On the one hand, tracers would readily allow brine applicators to show they are not behind brine-related contaminant issues that are not of their making, while on the other hand it would remove the oneness of proof from homeowners actually adversely impacted. **Importantly, there is no reason whatsoever that ALL brine applications should not require tracer additions and monitoring effective immediately, even before general Permit WMGR064 is approved. This would demonstrate a good faith effort on behalf of the regulators.**

To reduce the onus of legal and expert consultant costs to homeowners, **all** brine waters/fluids should first have company-specific tracers added to them so contaminant source and responsibility can be properly assigned (should this permit be approved). The addition of gas well company-specific tracers is needed to provide sufficient documentation of uncontrolled non-point source de-icing chemical excursions from roadways and walkways. Otherwise, the limited number of Maximum Contaminant Level (MCL) chemicals may erroneously instill a false sense of potable water quality when people's health may be severely impacted. The enforcement of these provisions is nearly impossible. The department cannot consider approval of this permit application without a highly detailed enforcement plan to be implemented with the completed permit application. An enforcement plan should be part of the permit. Without this, the permit should be rejected.

Proposed Modifications in the Event the Permit Application is Approved

Substantively, the proposed modifications present a risk of damage to human health and the environment and should therefore be rejected. Hydrologically, dispersed/applied brines will enter and degrade the environment in a very non-beneficial manner. Application rates, timing, and set-back distances will do little other than postpone the inevitable. Besides, there is no provision for enforcement in this permit application. Therefore, we recommend rejection of this permit. If, however, the Bureau decides to go ahead with the new uses, it should include the following criteria in the General Permit in order to substantively comply with its mandate to somewhat protect human health and the environment:

- THIS IS THE MOST IMPORTANT NEW CRITERIA. Add company-specific chemical tracers to all gas well fluids prior to brine application so that contaminant responsibility, aquifer restoration and alternate water supply costs may be properly designated. Tracer experts should be used to determine appropriate tracers and concentrations so as to fully allow for detection in degraded surface and groundwater resources of the Commonwealth.

- **NO PERMIT APPROVAL SHOULD BE POSSIBLE WITHOUT THIS CRITICALLY IMPORTANT CRITERIA DESIGNED TO PROTECT BOTH ADVERSELY IMPACTED HOMEOWNERS AND BRINE APPLICATORS. UNWILLINGNESS TO USE TRACERS TO DOCUMENT CONTAMINANT RESPONSIBILITY SHOULD BE CAUSE ALONE TO NOT APPROVE GENERAL PERMIT WMGR064**;

- Develop appropriate acceptance criteria for the new uses that includes all chemicals used in gas well drilling and fracking;

- Conduct comprehensive chemical and toxicological testing of fluids from all gas wells targeted for brine extraction for ALL chemicals previously used in them during construction and development. Sample collection and analysis should be conducted by an independent party;

- Conduct baseline chemical testing of all well water and surface waterways, lakes, and reservoirs for ALL chemicals previously used in the gas wells to a distance of 2,000 feet outward from all roadways and walkways;

- Provide for regular testing of brines including gas well chemicals used every six months or sooner where degraded groundwater and/or surface water is suspected;

- Provide for regular testing of soil and groundwater within 2,000 feet of application for ALL chemicals used in gas well fluids during construction and operation of gas wells;

- Provide criteria to stop all brine spreading should **any** surface or groundwater contamination be documented;

- Establish a 2,000 foot limit on brine application distance from water bodies and streams;

- Special Protection Waters, Caves & Mines. Recognize, locate, investigate, inventory, and characterize rare, threatened, and endangered species and their habitats which are likely to be degraded from brine-related contaminant excursions. Omit these habitat areas from brine applications, inclusive of a large buffer distance. Some of the species of greatest concern are endangered stream dwellers (i.e., Dwarf Wedge mussel [*Alasmidonta heterodon])* and assorted bat species (e.g., including the federally endangered Indiana bat [*Myotis sodalis]*). There are real environmental, water quality, health, and endangered species concerns regarding brine excursions into carbonate beds, inclusive of in caves and mines. Carbonate formations in portions of the Commonwealth are recognized among karst hydrologists as being karstic or cave/ conduit bearing in nature. Brine and related contaminants that may enter karstic

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solution conduits, from below or above, would quickly degrade groundwater and surface water quality;

- Add a monitoring section. The General Permit lacks detail on surface and groundwater monitoring. This should be added. Until such time as it can be demonstrated that adequate staffing is present to monitor this general permit, it should not be approved;

- Add an enforcement section. The General Permit lacks provision for enforcement. This should be added. Until such time as it can be demonstrated that adequate staffing is present to regulate and enforce this general permit, it should not be approved;

- Add record keeping detail by PA DEP. Detailed records of the quantity of brine fluids withdrawn and applied should be required;

- Add record keeping detail BY PA DEP. Detailed records of the exact location of brine applications should be required;

- Establish a very substantial escrow or bond type account for all brine applicators to off-set contaminant testing, aquifer restoration, and replacement water supplies costs for adversely impacted parties. This might be set-up on a fee per application basis;

- Establish a rigorous fee structure based on volume of brine application for applicators such that monies are regularly added to the coffers of the Commonwealth. Otherwise, there is no logical reason or beneficial use that may reasonably be attributed to intentionally applying brine wastewater that will threaten and degrade fresh surface and groundwaters of the Commonwealth; and

- Strengthen permit regulations to insure that brine applicators, and/or their suppliers, assume full legal and financial responsibility for contaminating aquifers and fully clean them up to the maximum extent possible **AND** develop permanent alternate water supply systems for all adversely affected water supplies. Permit regulations should be modified to provide for system operation and maintenance costs in perpetuity. As written, permit regulations do not have adequate provision to protect the health and safety of homeowners. The importance of this must be underscored because aquifer restoration from brine and gas field contaminants, even if cost were not an issue, may not be possible. Whereas monetary compensation to adversely affected homeowners may be warranted as settlement for inconvenience, property devaluation, and health issues, any settlements should in no way remove the

responsibility of brine applicators to restore the waters of the Commonwealth. Provision of whole house water filtration systems should not be an acceptable means of abdicating responsibility and liability.

Conclusions

The Bureau should reject the permit modifications, ban any and all gas well brine applications, and not allow the additional proposed uses because of the increased risk of contamination of groundwater, surface waters, and soil. The Bureau's proposed modifications, which will likely drastically increase the amount of brine being spread on Pennsylvania roads, present a threat of harm to the health, safety, and welfare of the people and the environment, and therefore the modifications should be denied.

The key to maintaining high quality groundwater and surface water throughout the Commonwealth is to NOT apply concentrated and contaminated brines at any time whatsoever. There is NO sound environmental benefit in applying brines anywhere, as they will eventually reach surface and groundwater resources. Thus, General Permit WGMR064 should be abandoned and gas well brine applications should be banned permanently. The Bureau should therefore deny the proposed modifications and ban gas well brine dispersal into the environment.

Sincerely.

Paul A. Rubin

Paul A. Rubin
Hyrogeologist
HydroQuest

CC: Damascus Citizens for Sustainability