

Hart Resources PA Brine Josephine Treatment Facility and Water Resources of the Conemaugh River Basin



Data obtained from the PA DEP at: https://www.padep.com/reporting/state_pa_uspsultrareport/010460362/04040001/Export/StateData.asp?PERIOD_ID=201912, www.PASDA.PSU.EDU
 Dept. of Environmental and Occupational Health, Center for Healthy Environments and Communities, Graduate School of Public Health, University of Pittsburgh

Contaminant Characterization of Effluent from Pennsylvania Brine Treatment Inc., Josephine Facility:

Implications for Disposal of Oil and Gas Flowback Fluids from Brine Treatment Plants

EPA Hydraulic Fracturing Study Technical Workshop 3,
 Fate and Transport
 March 28-29, 2011, EPA Potomac Yards Conference
 Facility

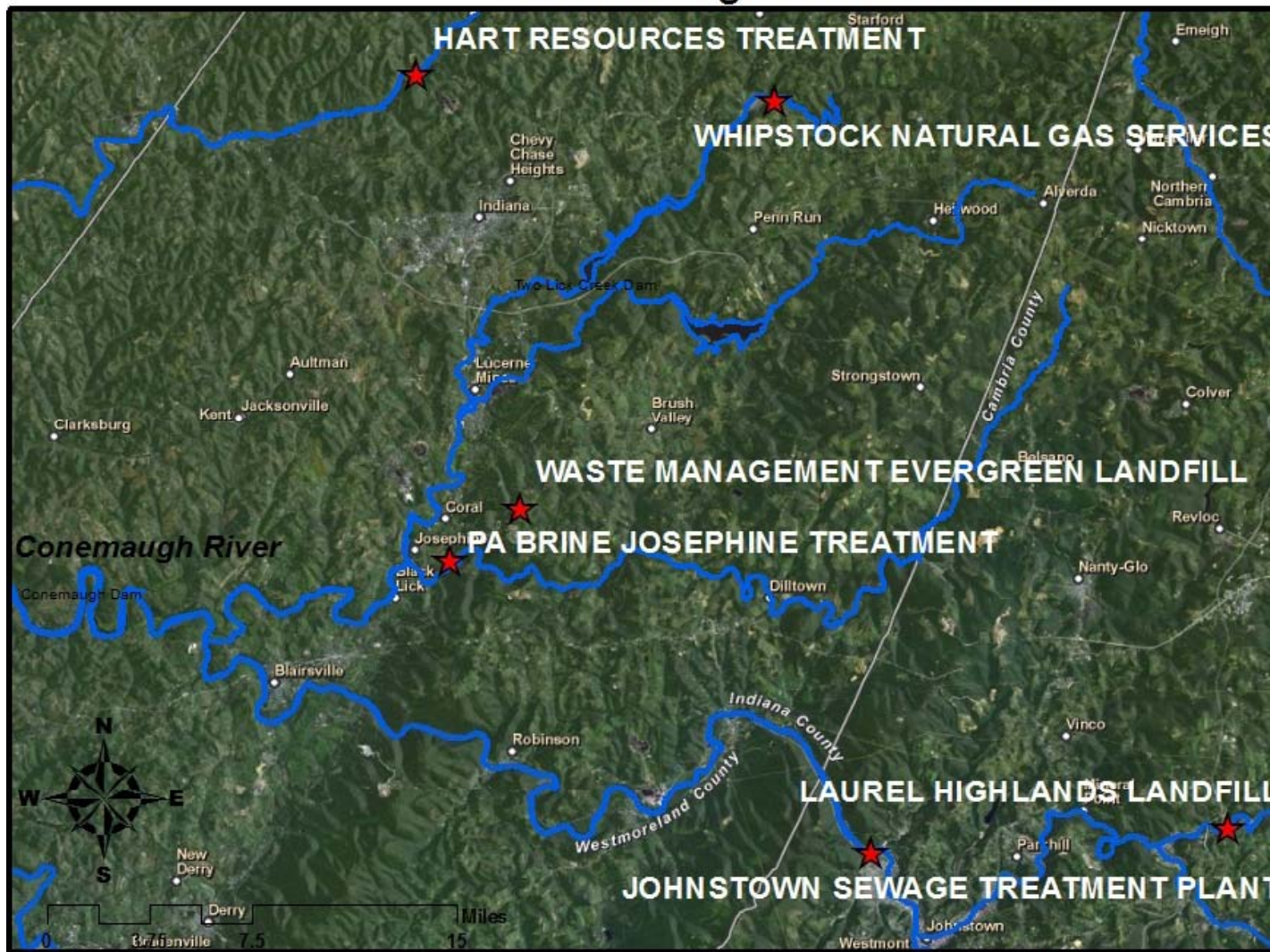
Conrad D. Volz, DrPH, MPH, Kyle Ferrar, MPH, Drew Michanowicz, MPH, CPH, Charles Christen, DrPH, MEd, Shannon Kearney, MPH, CPH, Matt Kelso, BS and Samantha Malone, MPH, CPH
 Department of Environmental and Occupational Health
 Center for Healthy Environments and Communities



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cdv5@pitt.edu

Facilities Accepting Natural Gas Solid Wastes and Waste Water Conemaugh River Basin



Legend

- ★ Facility
- Rivers

Data obtained from the PADEP at:
https://www.paoilandgasreporting.state.pa.us/publicreports/Modules/DataExports/ExportWasteData.aspx?PERIOD_ID=2010-2

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Pennsylvania Brine Treatment, Josephine Facility Offloading



[Picture taken by Kyle Ferrar, December 1, 2010, at location (40.826°N, 79.172°W)]

Concentrations of Selected Important Contaminants from Marcellus Shale Flowback Water

Total Dissolved Solids (TDS): 161,636 mg/L*

Barium: 2,950 mg/L*

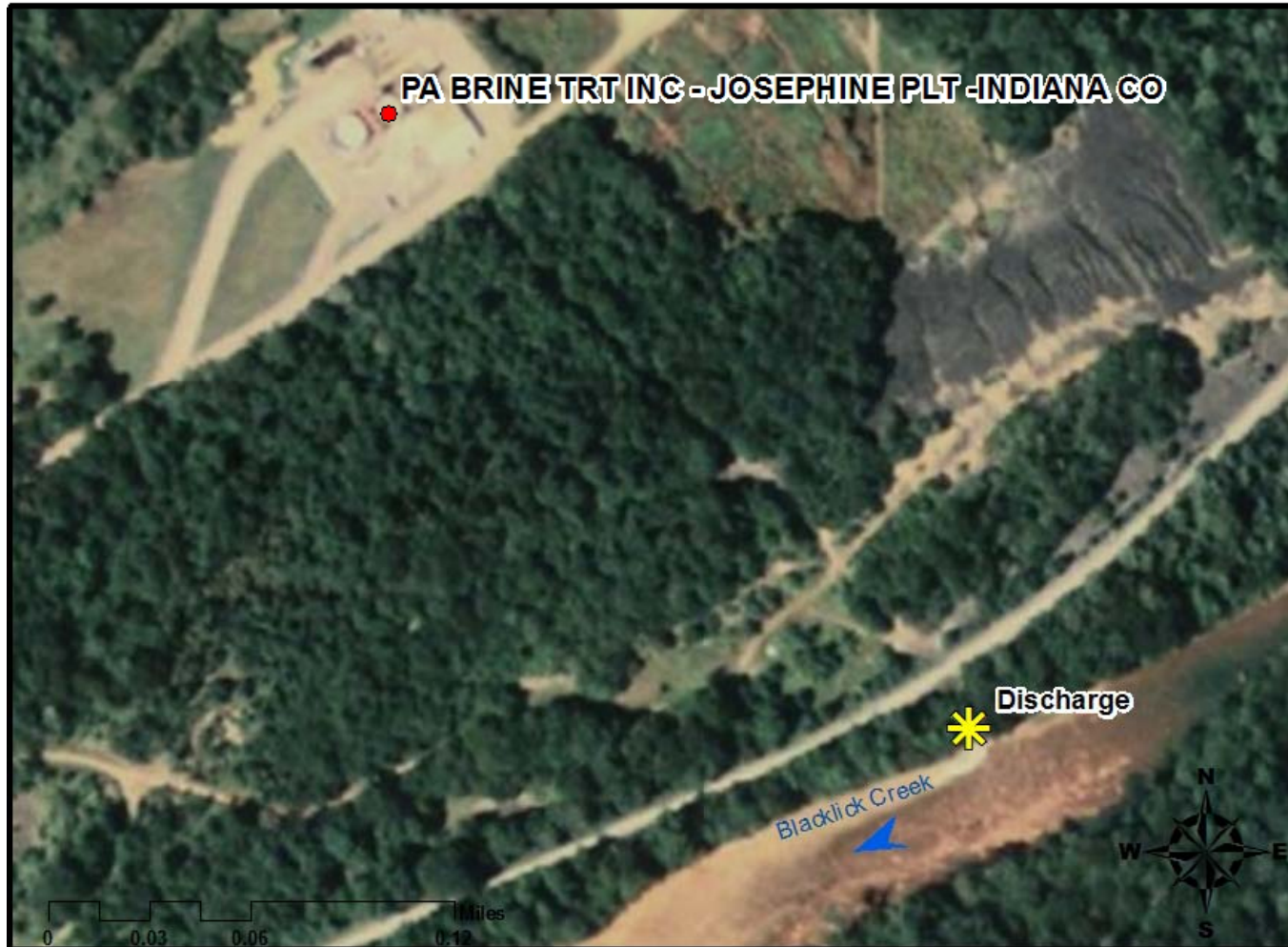
Strontium: 3,280 mg/L*

Chloride: 95,400 mg/L*

* From [Blauch, MF et al, 2009, Marcellus Shale Post-Frac Flowback Water-Where is all the Salt Coming From, SPE 125740.](#)



Hart Resources PA Brine Josephine Facility



Legend

- Facility

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https://www.paoilandgasreporting.state.pa.us/publicreports/Modules/DataExports/ExportWasteData.aspx?PERIOD_ID=2010-2

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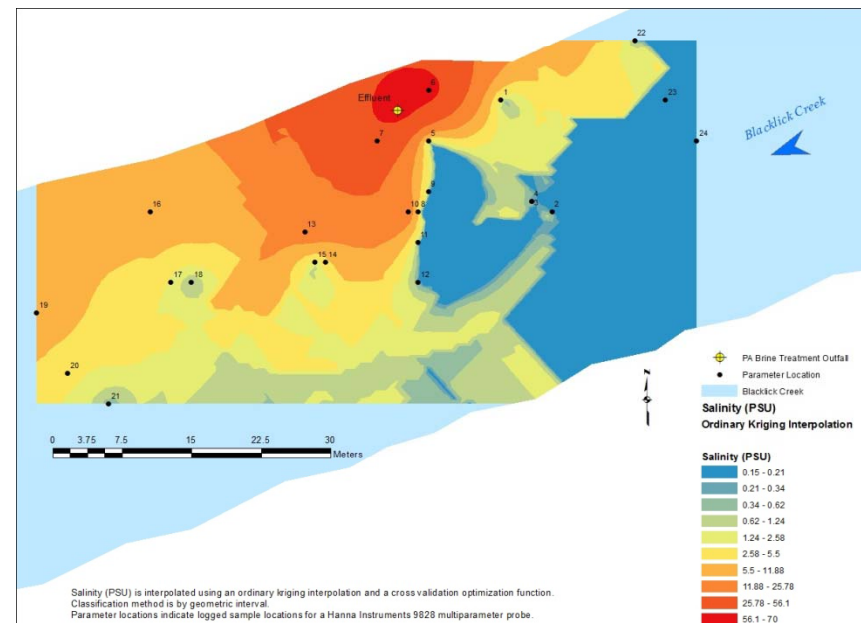
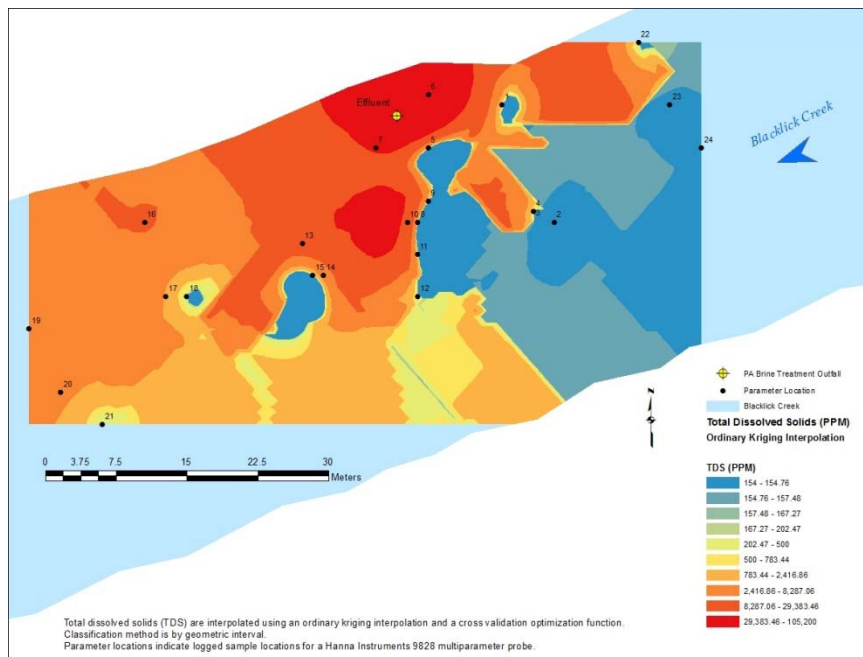
Volz, et al., 2011

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PBT-Josephine Facility Outfall on Blacklick Creek and Kriging Interpolation of Instream TDS and Salinity



Contaminants of environmental public health importance that were detected in all samples taken over the 24 hour period

Contaminants over MCL's, MRL's, consumption of fish criteria and/or aquatic CMC CCC concentrations;

- barium (Ba) [mean, 27.3 ppm; maximum, 37.0 ppm]
- bromides (Br) [mean, 1068.8 ppm; maximum, 1100.0 ppm]
- strontium (Sr) [mean, 2983.1 ppm, maximum 3120.0 ppm]
- benzene [mean 0.012 ppm; maximum 0.013 ppm]
- 2 butoxyethanol (2-BE) [mean 59ppm; maximum 66 ppm]

Detected Contaminants

- ethylbenzene (mean, 0.002 ppm)
- toluene (mean, 0.025 ppm)
- xylenes (mean, 0.028 ppm)



Contaminant concentrations of ecological and secondary drinking water importance include:

- chlorides (Cl) [mean 117,625 ppm, maximum 125,000 ppm]
- magnesium (Mg) [mean 1247.5 ppm; maximum 1300.0 ppm]
- manganese (Mn) [mean 0.08 mg/L; maximum 0.15]
- total dissolved solids (TDS) [mean 186,625 ppm; maximum 190,000 ppm]
- sulfate (SO₄) [mean 560 ppm; maximum 585 ppm], and pH [mean 9.58 units; maximum 10 units].

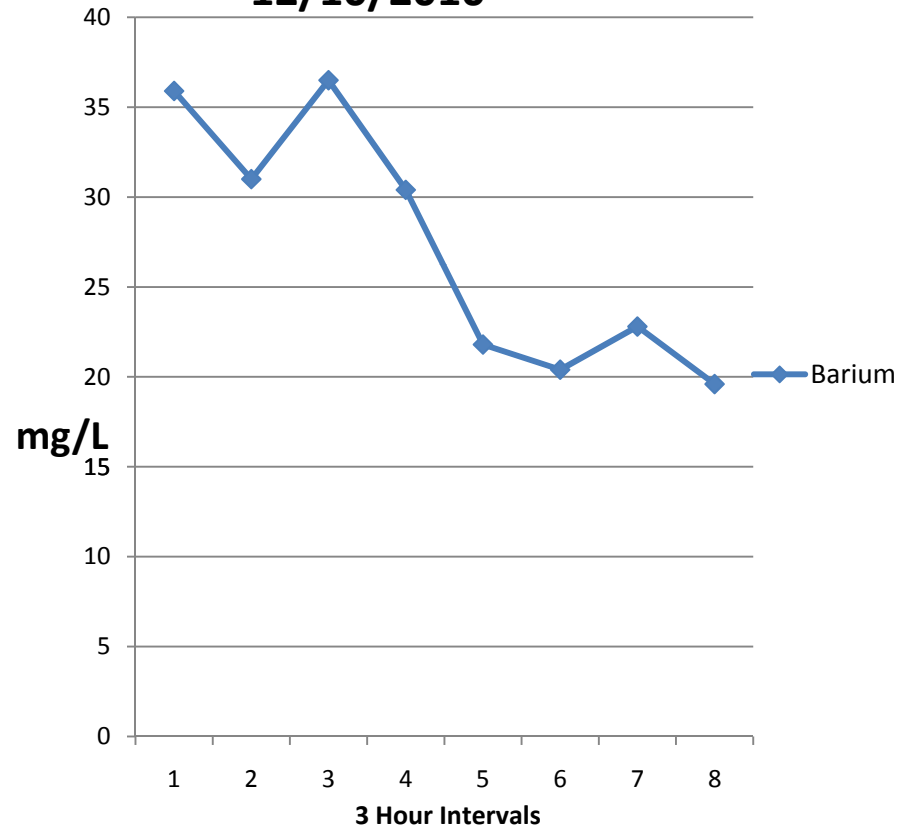


Barium in PBT-Josephine Facility Effluent

[Ba Mean] = 27.30 mg/L; σ = 6.96 [Min.] = 20 mg/L; [Max.] = 37 mg/L; MDL; 0.002 mg/L

- [Mean Ba] \approx 14 x (MCL) of Ba in drinking water of 2 ppm.
- The Ba ATSDR MRL's oral intermediate/chronic exposure are .2 mg/kg/day. Derived MRLs for barium in drinking are 6.89, 5.77, and 3.04 (mg/L/day) for adult men, adult women, and children, respectively (renal). [Mean Ba] is 3.96, 4.73, and 8.98 X the derived drinking water MRL's for intermediate and chronic exposures for adult men, women, and children, respectively.
- The Ba consumption concentration of "water and organism" and "organism alone" is 1 ppm. The [Ba Mean] is over 27 times these criteria.
- EPA Ba CMC of 21 ppm exceeded; EPA CCC Ba is 4.1 ppm, 6.66X [Mean Ba].

PA Brine Treatment Josephine
12/10/2010

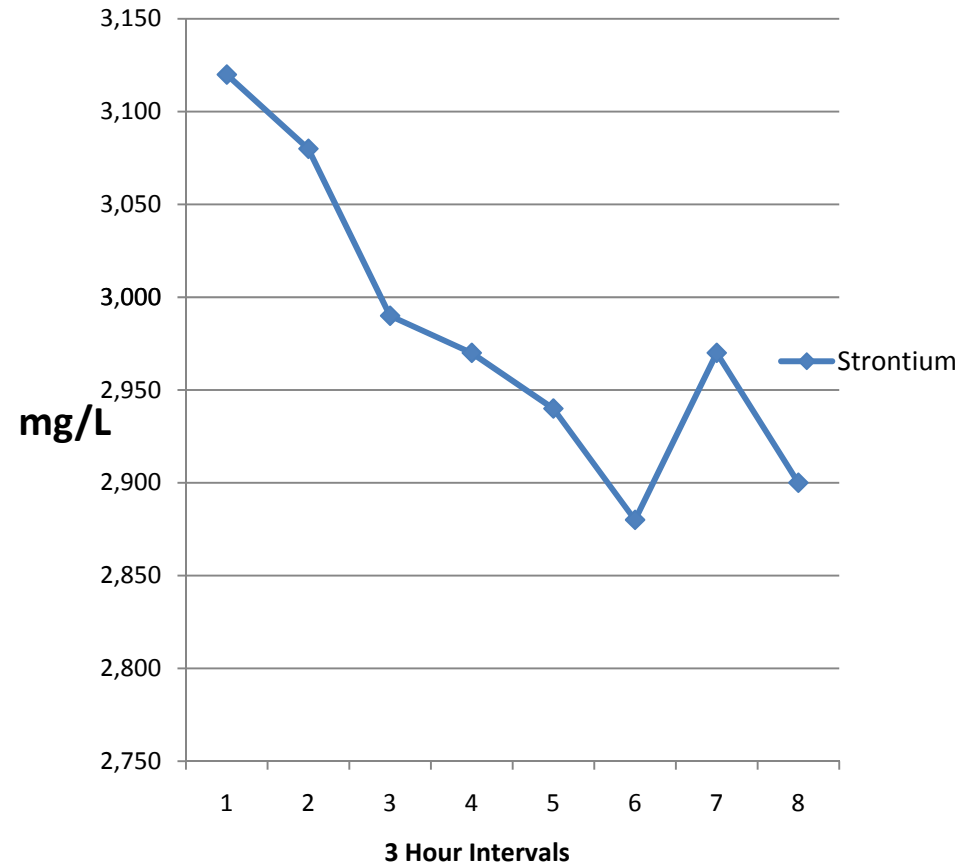


Strontium in PBT-Josephine Facility Effluent

[Mean Sr]= 2981 mg/L; $\sigma = 82.71$
[Min.] = 2,880 mg/L; [Max.] = 3,120 mg/L; MDL; 0.03 mg/L

- Sr ATSDR MRL for oral route, intermediate exposure is 2 mg/kg of body mass/day (musculoskeletal endpoints). The derived Sr MRL's adult men, and women, and children are 68.87 mg/L/day, 57.67 mg/L/day, and 30.45 mg/L/day, respectively.
- [Mean Sr] is 43.29, 51.68 and 97.90 X the derived drinking water MRL's for intermediate exposures for adult men, women, and children, respectively.
- The [Mean Sr] is 29,811 and 5,962 times the 100 ppb and 500 ppb notification levels required by its PA DEP NPDES permit.

PA Brine Treatment Josephine
12/10/2010



Volz, C.D. et al., 2011

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Bromide in PBT-Josephine Facility Effluent

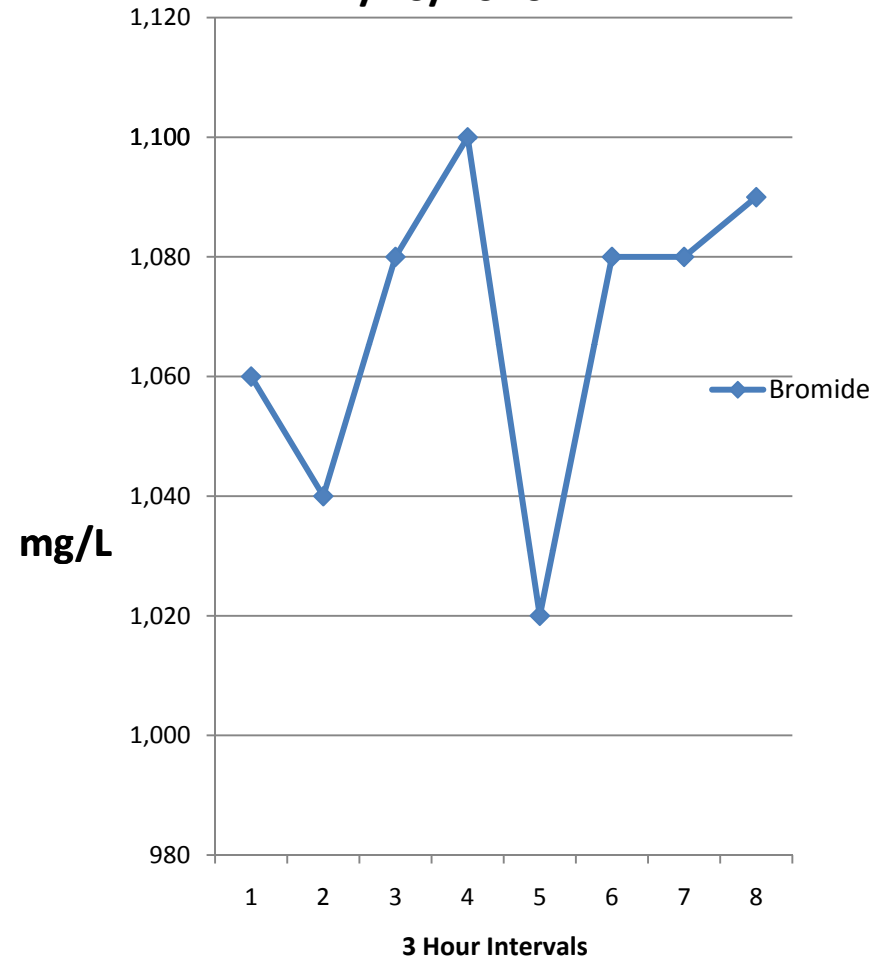
[Mean] = 1068.75 mg/L; σ = 26.96 [Min.] = 1020 mg/L; [Max.] = 1100 mg/L; MDL; 0.016 mg/L

- Bromide can be involved in reactions between chlorine and naturally occurring organic matter in drinking-water, forming brominated and mixed chloro-bromo byproducts, such as trihalomethanes or halogenated acetic acids.
- There is general agreement that background bromide levels in fresh-water sources be kept at about 0.1 ppm (Bonacquisti, 2006).
- [Mean Br], which is 1,068,800 ppb; is 10,688X the 100 ppb level at which authorities become concerned.
- Reports from PSWA and other SW PA authorities indicate upward trends of THM's.

Volz, C.D. et al., 2011

<http://www.fractracker.org>

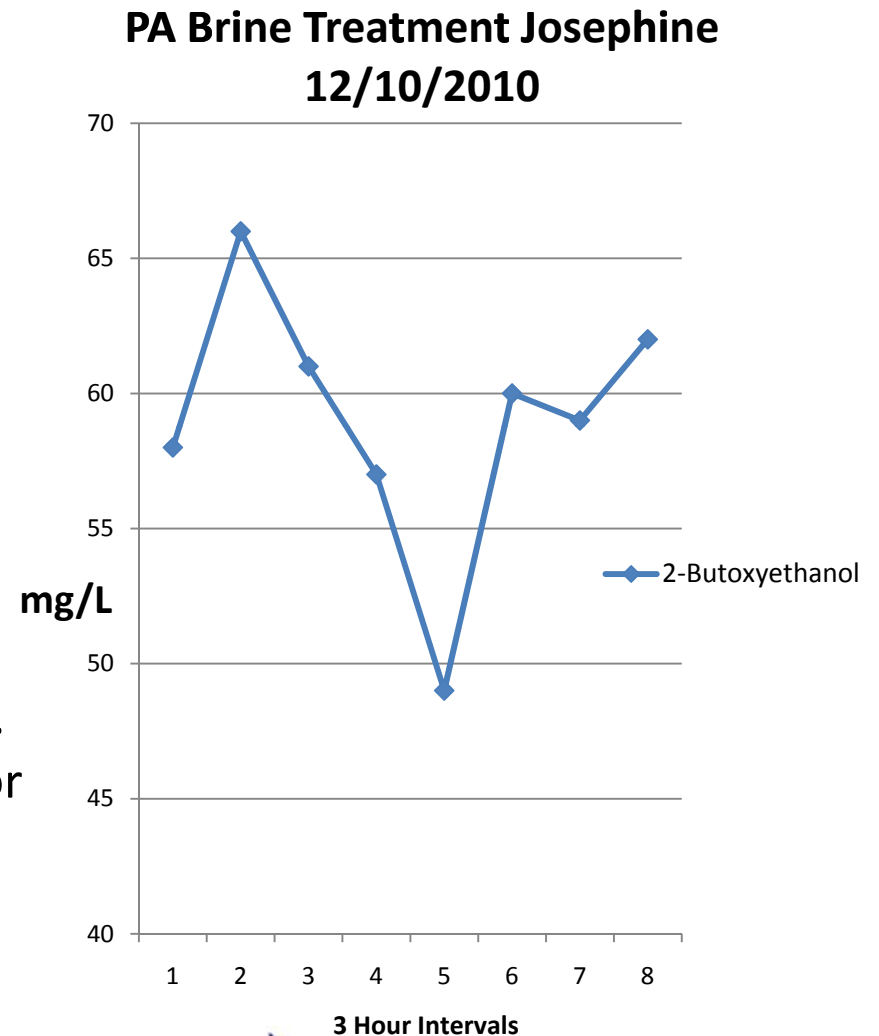
PA Brine Treatment Josephine
12/10/2010



2-butoxyethanol in PBT-Josephine Effluent

[Mean 2-BE] = 59.0 mg/L; σ = 4.9; [Min.] = 49 mg/L; [Max.] = 66 mg/L; MDL; 0.63 mg/L

- 2-BE, glycol ether, anti-foaming and anti-corrosion agent in slickwater formulations.
- ATSDR MRL for oral route, acute exposures is 0.4 mg/kg/day (hematological effects), [UF= 90]; MRL for oral route, intermediate exposure is 0.07 mg/kg/day (hepatic) [UF= 1000].
- The derived water MRL's acute exposure for adult men, adult women, and children are 13.77, 11.53, and 6.09 (mg/L/day), respectively.
- The derived MRL's for 2-BE in drinking water for intermediate exposure for adult men, adult women, and children are 2.41, 2.02, and 1.07 (mg/L/day), respectively.
- [Mean 2-BE] is 4.28, 5.12, and 9.69 X and 24.48, 29.21, and 55.14 X the derived acute and intermediate MRL's, respectively, for adult males and females, and children, respectively.

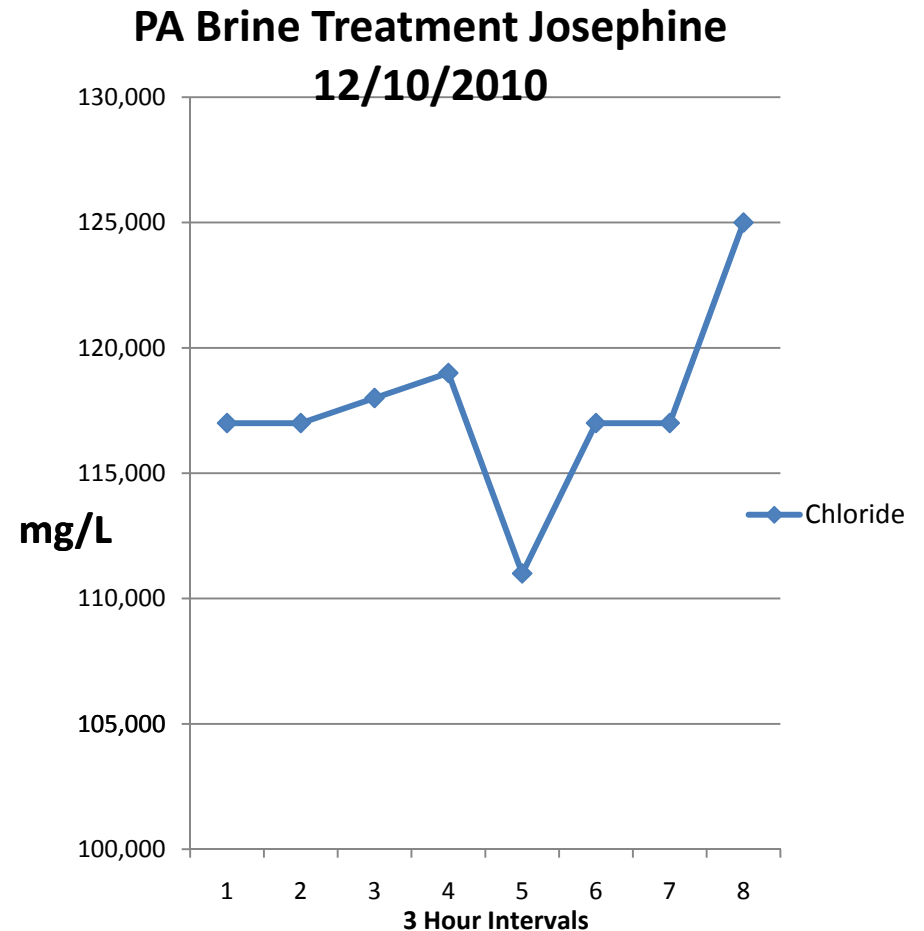


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Volz, C.D. et al., 2011

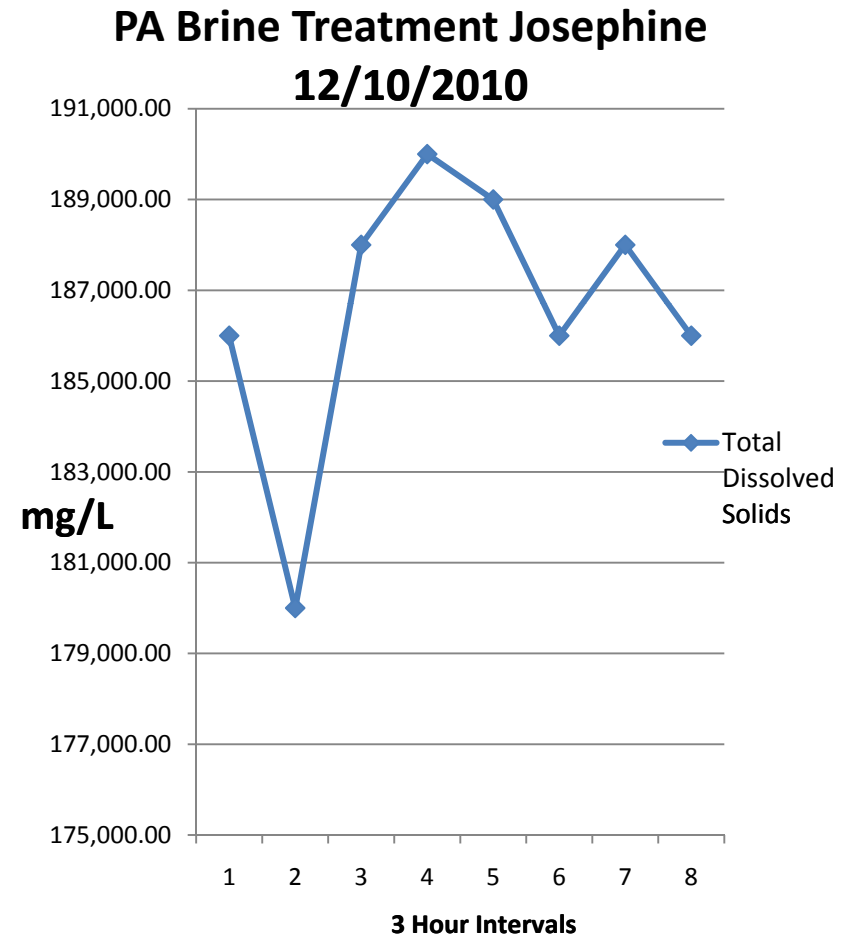
Chloride in PBT-Josephine Facility Effluent

- [Mean Cl] = 117,625 mg/L; σ = 3,815;
[Min.] = 111,000 mg/L; [Max.] = 125,000 mg/L; MDL; 1.5 mg/L
- [Mean Cl] is 470.5 times the SMCL for chlorides in drinking water of 250 mg/L.
 - To protect aquatic communities, the EPA CMC for chlorides in surface water is 860 mg/L, and the EPA CCC for chlorides in surface water is 230 mg/L.
 - The [Mean Cl] was 138 times the CMC and 511 times the CCC.

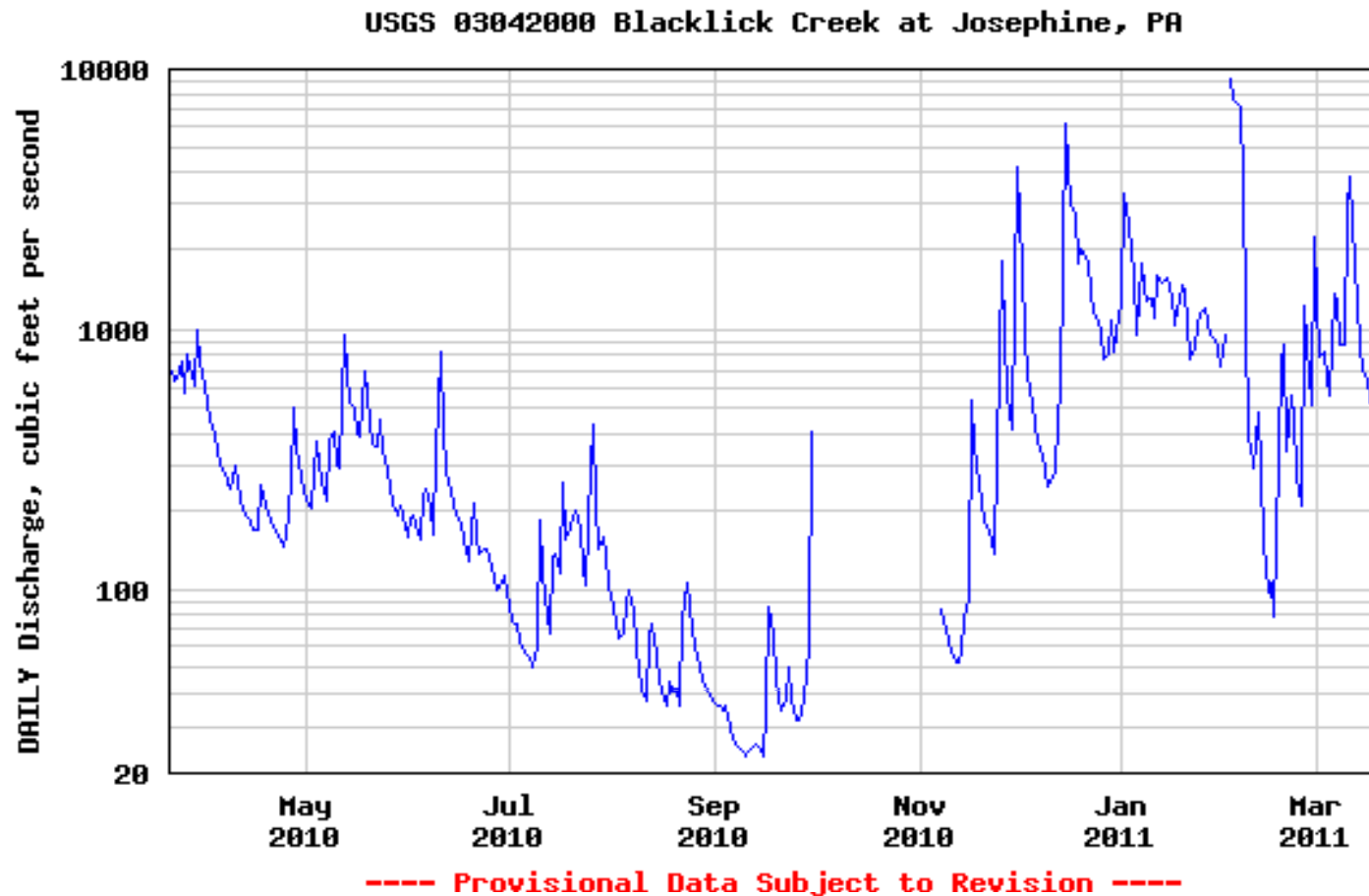


Total Dissolved Solids (TDS) in PBT-Josephine Facility Effluent

- EPA SMCL for TDS in drinking water is 500 mg/L; the mean concentration of TDS in effluent water is 373 times the SMCL.
- It should be noted that new or expanded discharges of TDS in Pennsylvania are limited to discharging only 500 mg/L of TDS as a monthly average.
- The DEP permit allows the PBT-Josephine plant to discharge unlimited levels of chloride and TDS into Blacklick Creek, and only requires monitoring and reporting of these discharges.

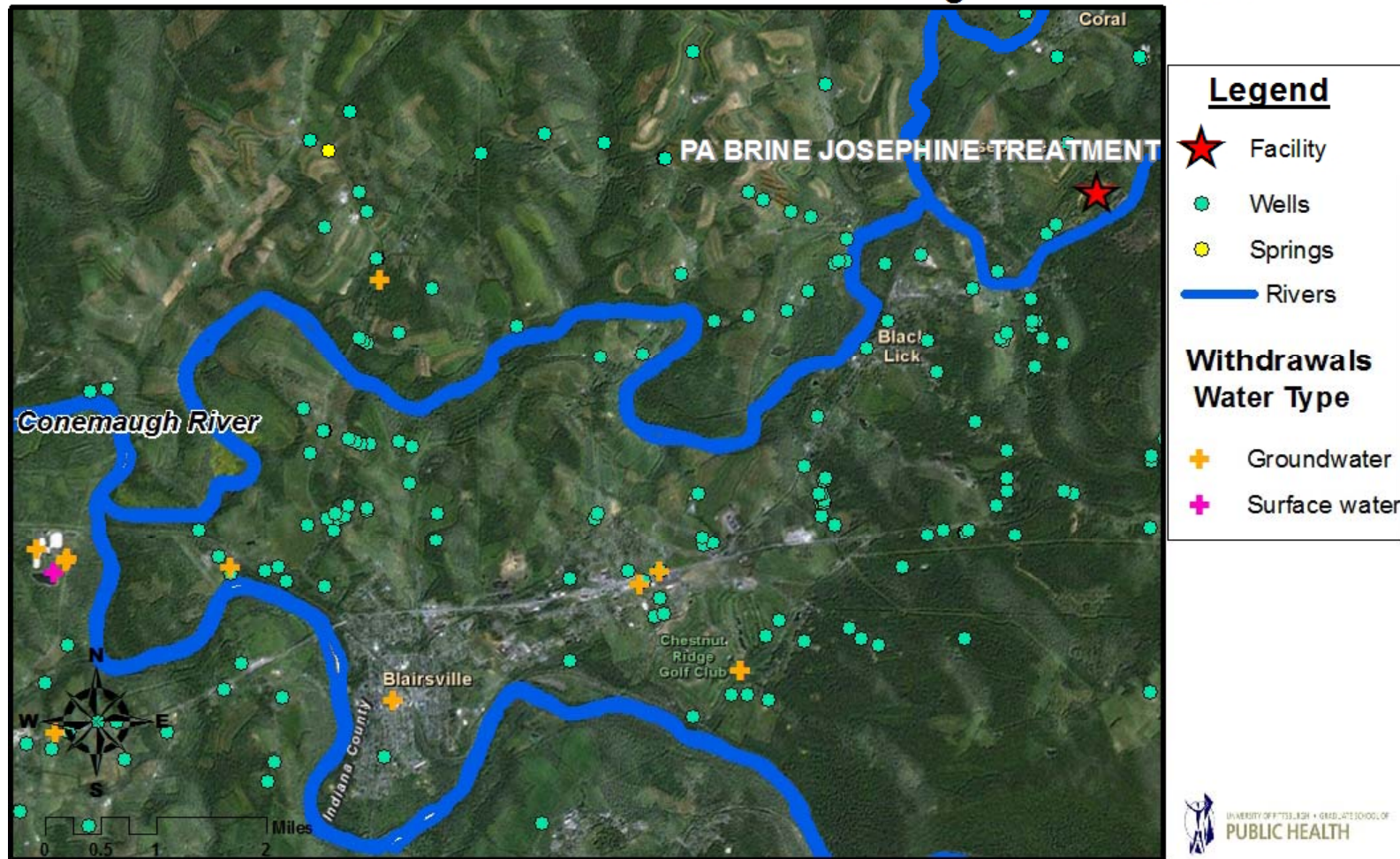


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- TDS and CI levels from Kriged Interpolation indicate potential for Golden Algae bloom in Blacklick Creek
- Stream flow during September 2010 reached a low of 25 cfs.

Hart Resources PA Brine Josephine Treatment Facility and Water Resources of the Conemaugh River Basin

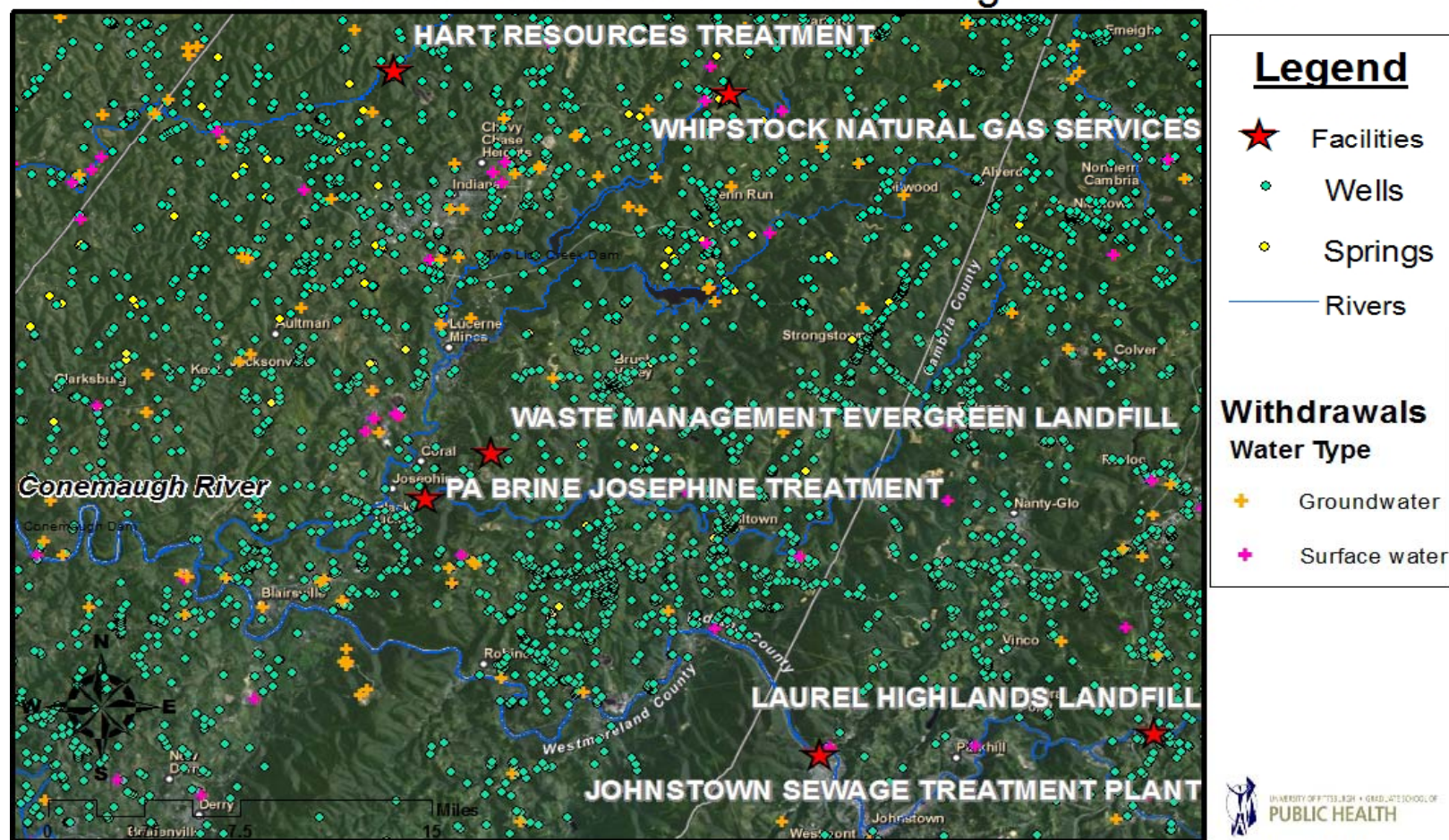


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www.PASDA.PSU.EDU

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Facilities Accepting Natural Gas Solid Wastes and Waste Water and Water Resources of the Conemaugh River Basin

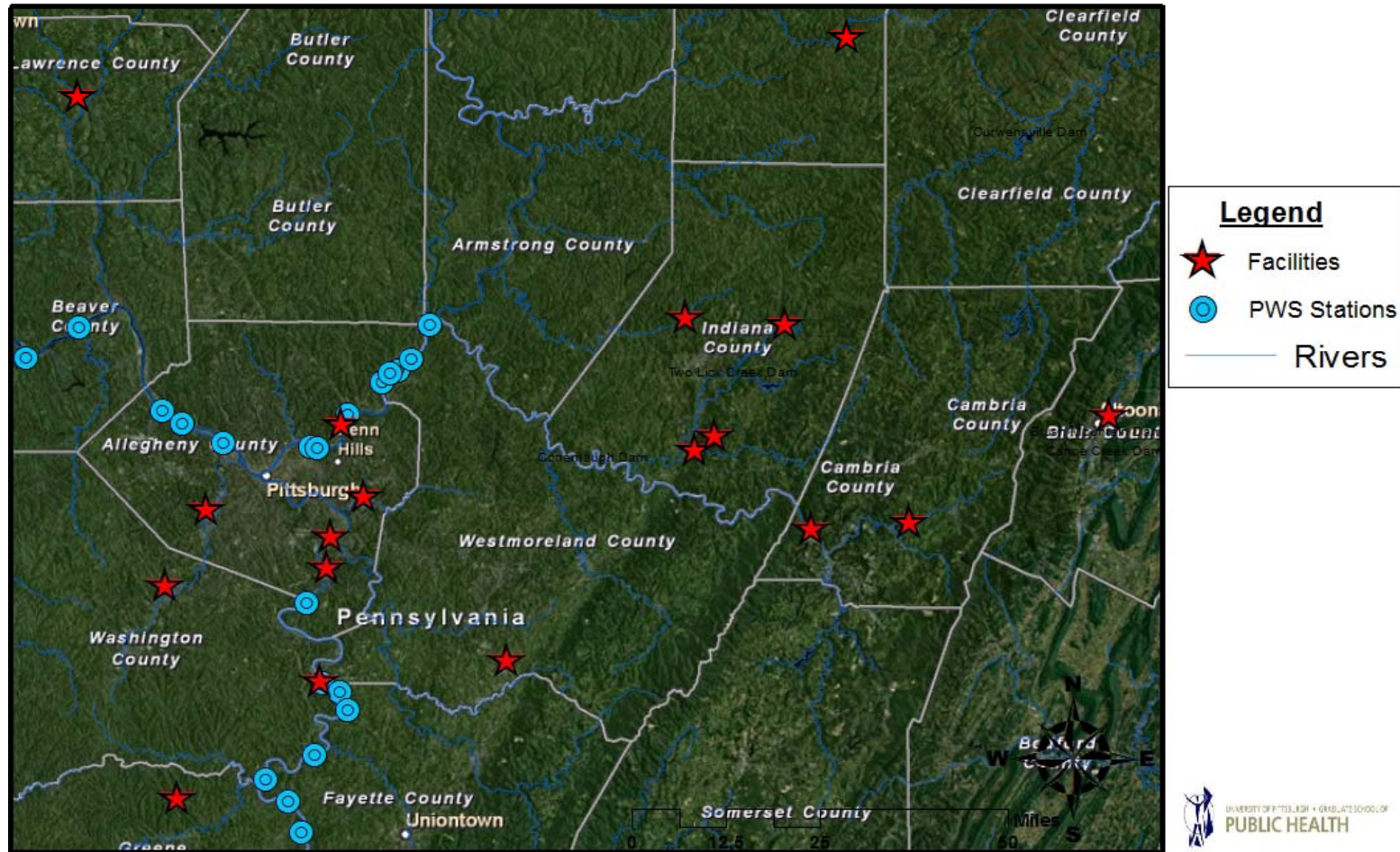


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Facilities Accepting Natural Gas Solid Wastes and Wastewater and Public Water Supply Withdrawal Stations

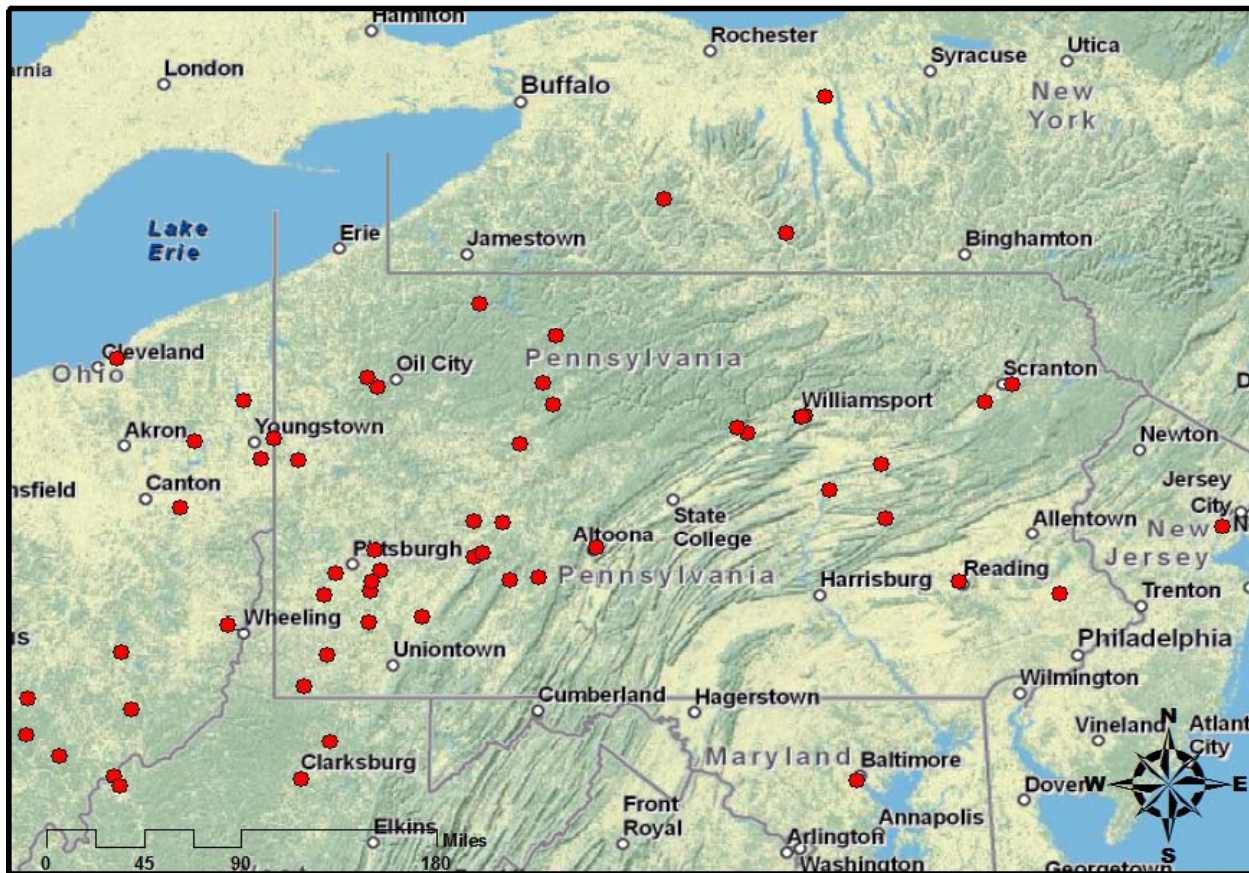


Data obtained from the PADEP at:
[https://www.pawillandgasreporting.state.pa.us/publicreports/Modules/DataExports/ExportWasteData.aspx?PERIOD_ID=2010-2,](https://www.pawillandgasreporting.state.pa.us/publicreports/Modules/DataExports/ExportWasteData.aspx?PERIOD_ID=2010-2)
www.PASDA.PSU.EDU

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Facilities Accepting Natural Gas Wastewater MD, NY, NJ, OH, WV & PA



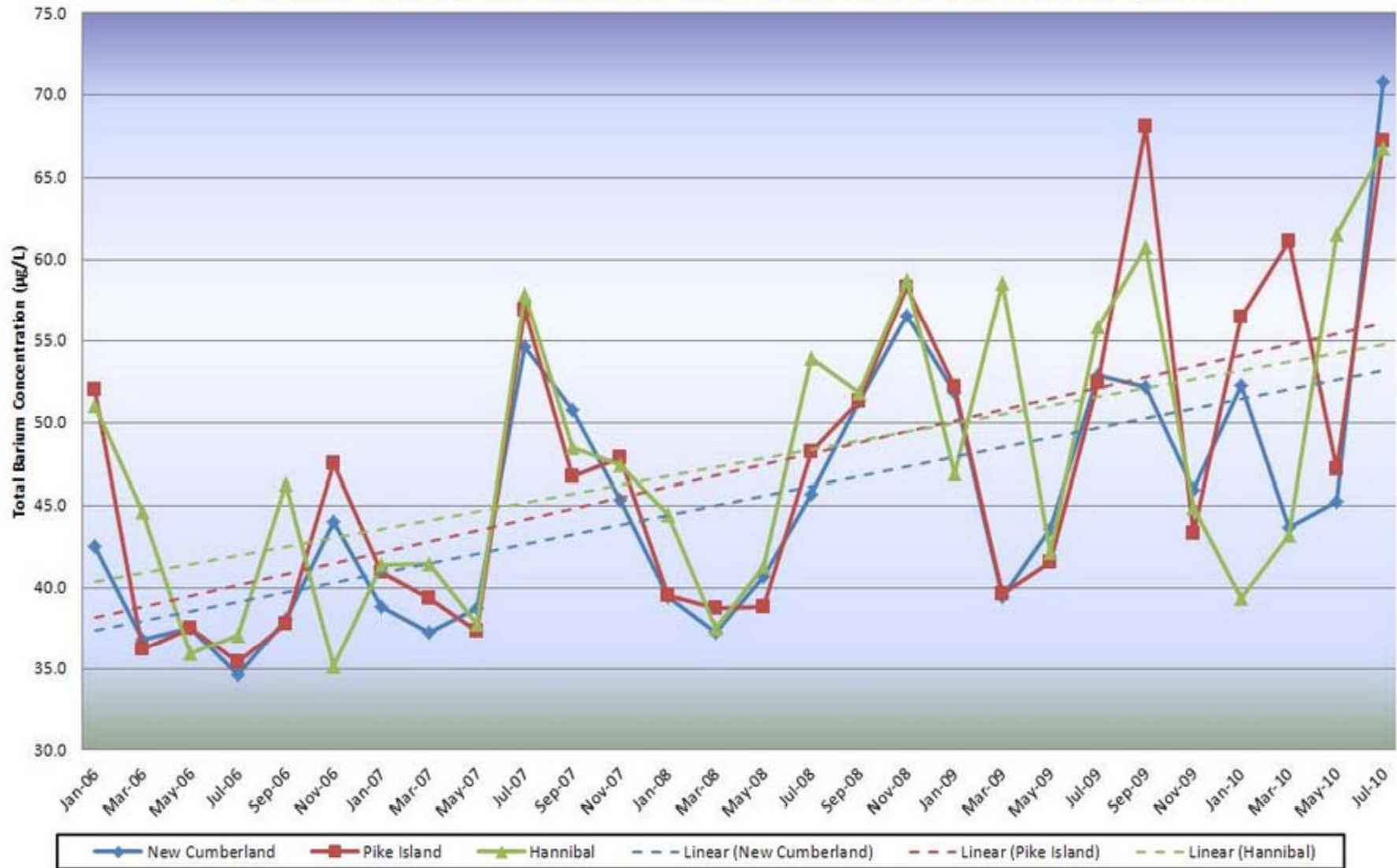
Legend

- Facilities

Data obtained from the PADEP at:
https://www.paoilandgasreporting.state.pa.us/publicreports/Modules/DataExports/ExportWasteData.aspx?PERIOD_ID=2010-2

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ORSANCO Ohio River Total Barium Concentration ($\mu\text{g/L}$) with Trend Lines
 January 2006 through July 2010 at New Cumberland, Pike Island, and Hannibal Testing Locations



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Environmental Public Health Recommendations

- Operations at this plant should be halted until all contaminants of human and aquatic health concern in accepted oil and gas fluids are known and it can be determined that the treatment processes used at the plant effectively remove these contaminants from the fluids being treated.
- The PA DEP should reevaluate the permit given to this operator as it clearly allows for chlorides and total dissolved solids to be discharged at levels exceeding aquatic health criteria.
- All approaches to the effluent discharge area and a reasonable distance downstream (at least 100 meters) from streamside and landside should be posted with warning signs. These signs should discourage any use of and/or contact with stream water.
- An advisory to all anglers should be issued stating that fish taken from this stream, both up and down stream may be contaminated in order to discourage fish take and consumption.

Environmental Public Health Recommendations

- Studies to determine the levels of all potential Marcellus Shale flowback fluid contaminants in downstream water, sediments and pore water should be undertaken immediately.
- Residential and other private well water users downstream of the effluent outfall of the PBT-Josephine Facility should be advised that there may be contaminants in their well water and discouraged from using it for drinking, cooking or bathing until such water is tested for continuous safe use.
- Municipal water authorities downstream of this outfall should be notified of the contaminants found in effluent from the PBT- Josephine Facility, of other possible contaminants in Marcellus Shale flowback fluids and oil and gas wastewater, and that there are other treatment facilities and POTW's in the Blacklick, Conemaugh, and Kiskikiminetas drainages that accept and discharge oil and gas waste fluids into surface water.

Environmental Public Health Recommendations

- All municipal water authorities at reasonable distances downstream of “brine treatment” and POTW’s accepting Marcellus Shale flowback fluids and other oil and gas wastewater in the region extending eastward across Ohio, Pennsylvania and West Virginia and New York should be notified of these results.
- The PA DEP and other state and federal regulatory authorities should immediately review all surface water discharge permits granted to brine treatment facilities and POTW’s that accept Marcellus Shale flowback fluids and oil and gas wastewater, to ensure that 2-BE concentrations being discharged are below all applicable standards, guidelines and criteria. This review should be informed by results of this report but should be extended to all known contaminants in flowback and other oil and gas wastewater.

Contaminant Characterization of Effluent from Pennsylvania Brine Treatment Inc., Josephine Facility Being Released into Blacklick Creek, Indiana County, Pennsylvania: Implications for Disposal of Oil and Gas Flowback Fluids from Brine Treatment Plants

Conrad D. Volz, DrPH, MPH; Kyle Ferrar, MPH; Drew Michanowicz, MPH, CPH; Charles Christen, DrPH, MEd; Shannon Kearney, MPH, CPH; Matt Kelso, BS; and Samantha Malone, MPH, CPH
University of Pittsburgh

The statements made during the workshop do not represent the views or opinions of EPA. The claims made by participants have not been verified or endorsed by EPA.

This report contains results from sampling and analysis of wastewater effluent entering Blacklick Creek, Indiana County Pennsylvania from the Pennsylvania Brine Treatment (PBT) Josephine Facility conducted by the Center for Healthy Environments and Communities (CHEC). The PBT-Josephine Facility accepts only wastewater from the oil and gas industry, including flowback water from Marcellus Shale gas extraction operations. This report describes the concentrations of selected analyzed contaminants in the effluent water and compares the contaminant effluent concentrations to standards, guidelines and criteria set by federal and state regulatory and investigative agencies for the protection of human and aquatic health.

Sampling Methodology and Concentrations of Contaminants in Effluent Water from Pennsylvania Brine Treatment Facility, Josephine Plant

CHEC conducted sampling of wastewater as it was discharged into Blacklick Creek, Indiana County, Pennsylvania from the PBT-Josephine Facility on December 10, 2010. Samples were taken at 3-hour intervals over the course of one 24-hour period. These samples were analyzed for listed inorganic and organic species by R. J. Lee Inc, a PA State Certified Laboratory (Certificate # 006).

The concentrations of analyzed contaminants in this effluent of primary environmental public health importance, which may also stress aquatic life, include: barium (Ba) [mean, 27.3 ppm; maximum, 37.0 ppm]; bromides (Br) [mean, 1068.8 ppm; maximum, 1100.0 ppm; strontium (Sr) [mean, 2983.1 ppm, maximum 3120.0 ppm]; benzene [mean 0.012 ppm; maximum 0.013 ppm] and 2 butoxyethanol (2-BE) [mean 59ppm; maximum 66 ppm]. Contaminant concentrations of ecological and secondary drinking water importance include: chlorides (Cl) [mean 117,625 ppm, maximum 125,000 ppm]; magnesium (Mg) [mean 1247.5 ppm; maximum 1300.0 ppm]; total dissolved solids (TDS) [mean 186,625 ppm; maximum 190,000 ppm]; sulfate (SO₄) [mean 560 ppm; maximum 585 ppm], and pH [mean 9.58 units; maximum 10 units].

Comparisons of Effluent Contaminant Concentrations to Standards, Guidelines and Criteria set by Federal and State Regulatory and Investigative Agencies for the Protection of Human and Aquatic Health

Levels of contaminants in effluent from the PBT- Josephine Facility were interpreted according to comparisons with applicable federal and state standards and recommended guidelines for both human and aquatic health. Barium had a mean concentration in effluent of 27.3 ppm (maximum of 37 ppm); this is approximately 14 times the United States Environmental Protection Agency (EPA) maximum concentration limit (MCL) of Ba in drinking water of 2 ppm. The EPA consumption concentrations 'water and organism' and 'organism alone' for barium are both 1 ppm. The levels of barium in the effluent are over 27 times these consumption concentrations. The U.S. EPA criteria maximum concentration (CMC) and the EPA criteria continuous concentration (CCC), both for protection of aquatic health, are 21 ppm and 4.1 ppm, respectively; the mean level of barium in effluent exceeds these criteria by 1.3 and 6.7 times, respectively. The mean level of barium in effluent water was 4, 4.73, and 9 times the derived drinking water minimum risk level (MRL) for intermediate and chronic exposures in adult men, adult women, and children, respectively.

The EPA recommended limit for strontium (Sr) in finished municipal drinking water is 4 ppm. The mean concentration of Sr in PBT-Josephine effluent water is 2981.1 ppm (over 745 times the recommended level). The MRL for Sr set by the Agency for Toxic Substances and Disease Registry (ATSDR) for intermediate length exposure is 2 mg/kg of body weight/day. The sampled mean level of strontium in PBT-Josephine effluent water was over 43, 51.7, and 97.9 times the derived drinking water MRL for intermediate exposures in adult men, adult women, and children, respectively.

Bromide in water is of concern because of its ability to form brominated analogs of drinking water disinfection by-products (DBP). Specifically, bromide can be involved in reactions between chlorine and naturally occurring organic matter in drinking-water, forming brominated and mixed chloro-bromo byproducts, such as trihalomethanes or halogenated acetic acids. There is general agreement that bromide levels in fresh-water sources be kept below about 100 ppb. The PBT- Josephine facility discharged effluent into Blacklick Creek with a measured mean concentration of bromide of 1068.8 ppm, which is 1,068,800 ppb. This is 10,688 times the 100 ppb level at which authorities become concerned.

The mean level of benzene, a known carcinogen, in outfall effluent from PBT-Josephine was 0.012 ppm or 12 ppb. The drinking water MCL for benzene is 5 ppb, thus effluent levels were above twice the drinking water MCL. The EPA consumption, water and organism risk level for benzene is 2.2 ppb in water; the mean level of benzene in PBT-Josephine effluent water is almost 6 times this criterion. The organism-only risk level for benzene is 50 ppb in water, and the mean level of benzene in effluent water is 24% of this guideline. The measured Benzene value was 0.6 times, 1.2 times, and 1.5 times the derived drinking water MRL for chronic exposures in adult men, women and children, respectively.

2-butoxyethanol (2-BE) is a glycol ether and is used as an anti-foaming and anti-corrosion agent, as well as an emulsifier in slick-water formulations for Marcellus Shale gas extraction. The mean concentration of 2-BE in the effluent exceeded derived drinking water MRL's for 2-BE for both acute and intermediate exposure for adult men and women and children.

Contaminants with secondary MCLs (SMCL) and aquatic receptor effects that were measured in the PBT-Josephine Facility effluent include magnesium, manganese, chlorides, sulfates, and total dissolved solids (TDS). Magnesium was found in the effluent with a mean concentration of 1,247.5 mg/L, which is 24,950 times the EPA Mg SMCL of .05 mg/L. The mean concentration of Manganese in the effluent was .08 mg/L, and the SMCL for Manganese concentration in drinking water is .05 mg/L. Therefore, the SMCL for manganese concentration is 62.5% lower than the concentration in the effluent. The mean concentration of chlorides in the sample analysis was 117,625 mg/L, which is 470.5 times the SMCL for chlorides in drinking water of 250 mg/L. To protect aquatic communities, the criteria maximum concentration (CMC) for chlorides in surface water is 860 mg/L, and the criteria continuous concentration (CCC) for chlorides in surface water is 230 mg/L. The mean concentration of chlorides measured in samples was 138 times the CMC and 511 times the CCC. The mean concentration of sulfates in the sample analysis was 560 mg/L, or 2.2 times the SMCL for sulfates in drinking water (250 mg/L). The SMCL for total dissolved solids (TDS) in drinking water is 500 mg/L, and the mean concentration of TDS measured in samples was 186,625 mg/L, or 373 times the SMCL.

Levels of strontium and 2-BE exceeded the NPDES reporting requirement set by the Pennsylvania DEP of 100 ppb and 500 ppb, respectively, for discharge of a toxic substance regularly or irregularly, respectively.

Masses of Contaminants Entering Blacklick Creek

CHEC has information from the Pennsylvania Department of Environmental Protection (PA DEP) that the PBT – Josephine Facility treated 15,728,241 gallons of oil and gas wastewater in the 6 month period from July 1, 2010 to December 31, 2010. Using this figure as the amount of effluent wastewater exiting the Josephine outfall and using the mean level of each contaminant found in the effluent over the sampling period of the study, the masses of contaminants with important human and ecological consequences discharged from the PBT, Josephine Facility into Blacklick Creek in the last 6 months of 2010 are projected to be: barium - 1627 kg (3588 pounds); strontium - 177,712 kg (391,856 pounds; 196 tons); bromides -63,708 kg (140,476 pounds; 70.2 tons); chloride – 7,011,631 kg (15, 460,646 pounds; 7,730 tons); sulfate – 33,382 kg (73,607 pounds; 36.8 tons); 2-BE – 3517 kg (7,755 pounds; 3.88 tons); and TDS – 11,124,733 kg (24,530,036 pounds; 12,265 tons).

Potentially Exposed Populations

Recreationalists are at high risk of being exposed to outfall contaminants through ingestion, inhalation and through dermal exposure. The outfall of the Josephine Facility is easily accessible to users of nearby rails-to-trails pathways, and there are indications that anglers frequent the

area.¹ Additionally, children wade and swim in the creek during warmer weather, and regional watershed websites indicate that paddlers use the creek for canoeing and kayaking. 2-BE released into Blacklick Creek may be ingested by swimmers in the creek, as this pollutant can become airborne and present an inhalation hazard to anglers, swimmers and boaters. It is also taken in to the body via dermal absorption. Anglers catching and eating fish from upstream or downstream of the effluent outfall are at risk for exposure to multiple contaminants that were sampled in this study.

CHEC has developed maps showing numerous private water wells in the immediate vicinity of Blacklick Creek downstream from the effluent discharge. Private well water users are at risk of exposure to contaminants in effluent being released into Blacklick Creek because these private wells may capture water from the creek when the well pump rate is sufficiently high. High pump rates can occur especially during peak usage by residents.

The first identified municipal drinking water intake downstream of this discharge is at Freeport, Pennsylvania on the Allegheny River. Populations served by the Freeport authority and water authorities downstream of Freeport are at potential risk for exposure to contaminants identified in effluent, as well as other contaminants in Marcellus Shale flowback water that were not sampled for in this study.

Implications of Effluent Discharge from the PBT – Josephine Facility Discharge for Exposures to Other Contaminants Known to be Present in Marcellus Shale Flowback Fluids and a Regional Appreciation of These Results

Of particular environmental public health significance is that Marcellus Shale flowback water contains other contaminants, in addition to those analyzed for in this study, which have health consequences if ingested, inhaled, and/or absorbed through the skin. While we make no statements regarding the presence of other contaminants in this effluent water being discharged into Blacklick Creek, it is imperative that additional testing be conducted immediately by federal and state health and enforcement agencies to determine if other contaminants of public health significance are entering this watershed.

Oil and gas wastewater and Marcellus shale flowback fluids are being disposed of in “brine treatment” facilities and at Publicly Owned Treatment Works (POTW’s) throughout the Commonwealth of Pennsylvania and in Ohio, West Virginia, and New York. Therefore, the ramifications of disposal of large quantities of oil and gas wastewater through ineffectual brine treatment plants and POTW’s needs further evaluation throughout the region to determine its impact on stream and river systems and public drinking water supplies, as well as to recreationalists and private well water users.

¹ Blacklick Creek has been classified as a ‘trout stocking’ stream.

² US EPA. 2004. "Evaluation of impacts to underground sources of drinking water by hydraulic fracturing of coalbed methane reservoirs (Final)." Office of Water, June.

³ New York State Department of Environmental Conservation (NYSDEC). 2009. "Draft Supplemental Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program—Well Permit Issuance for Horizontal Drilling and

Recommendations

- Operations at this plant should be halted until all contaminants of human and aquatic health concern in accepted oil and gas fluids are known and it can be determined that the treatment processes used at the plant effectively remove these contaminants from the fluids being treated.
- All approaches to the effluent discharge area and a reasonable distance downstream (at least 100 meters) from streamside and landside should be posted with warning signs. These signs should discourage any use of and/or contact with stream water.
- An advisory to all anglers should be issued stating that fish taken from this stream, both upstream and downstream may be contaminated in order to discourage fish take and consumption.
- Studies to determine the levels of all potential Marcellus Shale flowback fluid contaminants in downstream water, sediments and pore water should be undertaken immediately.
- Residential and other private well water users downstream of the effluent outfall of the PBT-Josephine Facility should be advised that there may be contaminants in their well water and discouraged from using it for drinking, cooking or bathing until such water is tested for continuous safe use.
- Municipal water authorities downstream of this outfall should be notified of the contaminants found in effluent from the PBT- Josephine Facility, of other possible contaminants in Marcellus Shale flowback fluids and oil and gas wastewater, and that there are other treatment facilities and POTW's in the Blacklick, Conemaugh, and Kiskikiminetas drainages that accept and discharge oil and gas waste fluids into surface water.
- All municipal water authorities at reasonable distances downstream of "brine treatment" and POTW's accepting Marcellus Shale flowback fluids and other oil and gas wastewater in the region extending eastward across Ohio, Pennsylvania and West Virginia and New York should be notified of these results.
- The PA DEP and other state and federal regulatory authorities should immediately review all surface water discharge permits granted to brine treatment facilities and POTW's that accept Marcellus Shale flowback fluids and oil and gas wastewater, to ensure that 2-BE concentrations being discharged are below all applicable standards, guidelines and criteria. This review should be informed by results of this report but should be extended to all known contaminants in flowback and other oil and gas wastewater.