Attachment "H"
Operating Data
Zelman#1 Injection Well

The proposed operating rates and volumes are based on:

(A) Previously accepted fracture gradients for the Chert/Oriskany formations by the EPA. (See attached EPA correspondence)

(B) Calculations from data obtained during an injectivity test performed on Dannic Energy's Green Glenn #1 well located in Huston Twp, Clearfield County. (See Green Glenn #1 Injection test data and calculations)

(C) Calculations from reported fracture treatment data on offsets to the proposed Zelman #1 injection well. (See attachment "I" for calculation)

1.

Proposed Average Daily Injection Rate:	2000 bbls/day
Proposed Average Daily Injection Volume:	2000 bbls
Proposed Average Injection Pressure (Bottom Hole):	5500 psi
Proposed Maximum Daily Injection Rate:	2296 bbls/day
Proposed Maximum Daily Injection Volume:	2296 bbls
Proposed Maximum Injection Pressure: (Bottom Hole):	6575 psi

2. The nature of the annulus fluid will be fresh water with corrosion control additives. Corrosion Inhibitor will be Alpha 2278W added at a rate of 2.5 gallons/1000 gallons of water.

3. Source of Injected fluid.
The injected fluid will be brines and produced fluids associated with the production of oil and gas. The source of the fluid will be produced fluids from oil & gas operators registered with the Pennsylvania Department of Environmental Resources.

The following four types of fluids will be disposed of at the facility:
Excessive surface waters encountered during drill operations
Produced fluids from shallow upper Devonian wells
Produced fluids from Marcellus wells
Produced fluids from Oriskany wells

4. Analysis of Injected fluid.
Attached are analyses of representative samples for each type of fluid to be disposed of at the facility. Additional analyses are attached of Marcellus drill pit and flow back fluids provided by a potential client.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
841 Chestnut Building
Philadelphia, Pennsylvania 19107

Mr. Ross Ashcom
Senior Staff Engineer
CNG Development Co.
One Park Ridge Center
P.O. Box 15746
Pittsburgh, PA. 15244

Dear Mr. Ashcom:

I have reviewed your letter of March 8, 1990 and the facsimile transmitted to this office on March 13, 1990, which request that an increase in the maximum injection pressure be allowed during CNG's planned injectivity test to be conducted on the Morris Critchfield Well #1 located in Jenner Township, Somerset County, PA.

The hydraulic fracturing data, submitted for the well mentioned above, agrees with similar data provided earlier for other wells in the immediate area drilled to the Oriskany. I agree that the use of a fracture gradient of 0.90 psi/ft. for the Oriskany is acceptable. Therefore, based on the following calculation, CNG will be permitted to inject up to a maximum injection pressure of 3218 psi during the injectivity test.

$$P_{max} = [\text{Frac. Grad.} - (.433 \times \text{Spec. Grav.})] \times \text{Depth}$$

$$= [0.90 - (.433 \times 1.2)] \times 8469$$

$$= 3218 \text{ psi}$$

If you should have any questions, please give me a call at (215) 597-2537.

Sincerely,

S. Stephen Platt
UIC Section (3WM43)
DW/GW Protection Branch

cc: Dave Rectenwald

THE PEOPLE NATURAL GAS COMPANY

REPORT ON HYDRAULIC FRACTURING

Well No. 4206

Map N E

1. Farm Name: Moris Critchfield Township: Jenner County: Somerset
2. Operator: Felmont Oil Corporation and Peoples Natural Gas Company
3. Sand Fraced: Chert & Sand T. Sand: 8,397, B. Sand: 8,540, T. Pay ?
4. Open Flow before fracing: 350 Mcf, Rock Pressure before fracing: N.T.#
5. Open Flow after fracing and cleanout: 5,030 Mcf, Rock Pressure after fracing: 3,590#. 7 days.
6. Surveys on well before fracing: Temp: Caliper: Gamma Ray: Other
7. Date well fraced: February 14, 1959
8. Size Tubing: 7" Length: 8,397'
9. Type Packer: On shoe Set at 8,397 feet, was packer cemented? Yes, 150 sacks
10. Fracing solution (kerosene, crude oil, etc.): Water Amount: 37,000 Gals.
11. Breakdown (or max.) pressure: 3,200 # Time required to breakdown: 2 Min.
12. Amount gel: 20,000 Gals Amount sand: 20,000 pounds
13. Pump pressure while pumping gel: 3,200 to 4,000 pounds
14. Injection rate from time starting gel: 1,344 gallons per minute
15. Amount gel breaker: None
16. Fluid recovered after fracing: None
17. Sand recoverd after fracing: None
18. New Well: X Drill Deeper: Old Well:
19. Was fraced sand ever shot? No
20. Service Company: Halliburton Oil Well Cementing Co.
21. Remarks:

Reported by: P. H. Reefer

Date: 2-18-59

Surface Breakdown Pressure = 3200 psia
(From PNG Report)

Gravity of Fluid = 1.2
10 lb./gal.
(Assumed)

Depth of Formation (ft). = 8469
(PNG Report)

Bottomhole Breakdown Pressure = Psurface + Phydrostatic

= 3200 + 1.2 (.433) (8469)

= 7600 psi

Frac Gradient = 7600/8469 = 0.9 psi/ft.

Proposed = Pbd - Ph
Injection Pressure = (.9 - .52)8469 = 3200 psia

Frictional Pressures*

Pump Rate (BPM)	Pressure Loss per 1000' of 2 7/8" Tubing (PSI/1000')	Pressure Loss 8400' of 2 7/8" Tubing (PSI)
1	20	168
2	34	286
3	65	546
4	110	924
5	155	1,302

*These pressure losses could theoretically be added to the 3200 psi surface pressure calculated without breakdown.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Region III - 6th & Walnut Sts.

Philadelphia, Pa. 19106

SUBJECT: Amoco/Damson West Shanksville, PA.
Disposal Well

DATE: OCT 26 1984

FROM: Charles Kleeman
PA Implementation Section
Water Supply Branch

TO: File

Amoco Production Company has recently conducted two step-rate tests on their Somerset County disposal well at the request of Damson Oil Company, potential purchaser of the well.

The tests were performed on September 27 and October 15, 1984 and yielded fracture gradients of 0.907 and 0.905 psi/ft respectively. Relevant test data follows:

Date of Test	9/27/84	10/15/84
Fluid Density (lbs/gal)	9.9	10.4
I.S.I.P. (psi)	3500	3250
Depth	~~8~~ 8912	~~8~~ 8912
Fracture Gradient	0.907	0.905

The I.S.I.P. valves were read off of the Halliburton test chart by myself and Steve Platt.

The question of whether these test results compare favorably with data in the PA. DER permit application which reported an ISIP of 4000 psi is resolved if one assumes a fluid density of about 8.5 lbs/gal for "gelled water" as reported in the DER application. These data yield a fracture gradient of 0.890 psi/ft, which is very close to the results of the recent step rate tests.

The formula used is:

$$\text{F.G. (psi/ft)} = \frac{\text{Fluid Density (\#/gal)} \times 0.052 \frac{\text{(psi/ft)}}{\text{(\#/gal)}} \times \text{Depth (ft)} + \text{ISIP (ps.}}{\text{Depth (ft)}}$$

cc: Jon Capacasa
Steve Platt

Injectivity Test Data and Calculations for Green Glenn #1 well:

An Injectivity Test was conducted on the Green Glenn # 1 Well (Permit # 37-033-20220) from 10/13/2009 to 10/22/2009. This well was tested as a disposal well coordinated with and witnessed by Dave Rectenwald of the EPA. The reservoir at the proposed Zelman #1 well is similar in all parameters: depth, depletion, thickness and permeability as indicated by offset flow rates and production data. The following data was obtained:

Total volume injected	4311 bbls
Fluid Density (Marcellus produced fluids)	8.7 to 9.1 ppg
Average Injection Rate	1040 bbls per day
Average Injection Surface Pressure	1225 psig
Draw Down Time	1 minute
Draw Down Pressure	0 psi

Permeability: Utilizing Darcy Flow Equation = 6.1Darcy (see calculations below)

$$Q = \frac{7.082\ KH\ (Pe-Pw)}{\ln (Re/Rw)}$$

Where: Q = flow rate (bbls/day)
K = formation permeability (darcy's)
H = formation thickness (ft)
Pe = static external boundary pressure (psia)
Pw = wellbore pressure during injection (psia)
Re = external radius (ft)
Rw = wellbore radius (ft)

Well Data: Depth to Injection zone	= 7200 G.L.
Average Test injection rate (Q)	= 1040 bbls/day
Reservoir Surface pressure	= 15 psig
Average Wellbore Injection Pressure	= 1225 psig
Wellbore Radius (Rw)	= 0.1979 ft
Average Specific Gravity of test fluid	=1.07
External Radius (Re)	= 50.5 ft
Specific Gravity of reservoir gas	= .60
Injection Volume	= 4311 bbls
Gross Thickness	= 78 ft
Net Formation Thickness (H)	= 30 ft
Porosity	= 0.10

Due to the extremely high natural flows encountered in the Chert/Oriskany formations in our project area, standard completion procedures were to top set the Production casing in the Onondago Limestone and then drill –in to the Chert/Oriskany reservoir. When high volumes were encountered the drill piped was tripped and the formation was produced open hole. Therefore most wells were not drilled completely through the Oriskany. Since the field was developed in the late 1950's and early 1960's; log data is not available. Well records closest to the proposed injection well reported the following thickness data:

Permit Number	Distance/Direction	Chert	Oriskany
37-033-20236	1600' Northeast	46	17' in sand
37-033-20047	1850' Southwest	66'	18' in sand

Records research of wells drilled through the Oriskany in Huston Township, Clearfield County provided the following thickness data:

Permit Number	Chert	Oriskany
37-033-20245	63'	31' (located 3450' northeast of the proposed injection well)
37-033-20299	38'	31'
37-033-20183	45'	34'
37-033-20182	47'	29'
37-033-20179	46'	30'

The Chert thickness at the Green Glenn # 1 well is 48' and we will assume an oriskany thickness of 30 for an overall Chert/Oriskany Reservoir of 78'. However for net thickness we will use 30' with a porosity of 10%. This porosity in the Oriskany has been well documented from wells with similar IP data.

Wellbore Pressure Calculation(Pw):
Pw = Psurface +PHydrostatic
Pw = 1225 + ((1.07)(.433)(7200))
Pw = 4560 psig
Pw = 4560 psig + 14.7
Pw = 4575 psia

External Boundary Pressure Calculation(Pe):
Pe = Surface Pressure + delta P (gas gradient)
Delta P =((0.25 (Pw/100)(Depth/100))
Delta P =((.25)(29.7/100)(7200/100))
Delta P = 5.3 psi
Pe = 15 psig + 14.7 + 5.3
Pe= 35 psia

Volumetric Calculation of External Radius(Re):
Volume= .7854 ((DxD))(H)(Porosity)
4311 bbls (5.615 ft3/bbl) = 0.7854 (DxD sq ft)(30 ft)(.10)
D xD = 10,273 sq ft
D = 101 ft
Re = 50.5 ft

Permeability Calculation(K):
-1040=7.082 K (30)(35-4575)

Ln (50.5/0.1979)
K = .0061 md

K = 6.1 Darcys

Fracture Gradient of injection Zone = .9518psi/ft

There is no record of any fracture treatment of this well. However, well records in this area provide the following fracture data:

Permit Number	Operator	Distance/Direction	Breakdown Press	Depth	Fluid
37-033-20238	NYSNG	4800' NE	4075 psi	7363	Water
37-033-20260	Fairman	4950' SW	4500 psi	7257	Water
37-033-20262	NYSNG	5850' NNE	3800 psi	7324	Water

The lowest fracture gradient calculated for the offset wells listed was 0.9518 psi/ft for Well 37-033-20262 as shown below:

Pbtm = bottom hole pressure
Psurface= surface pressure
Phydrostatic= hydrostatic pressure of the wellbore

Pbtm = Psurface + P hydrostatic
Pbtm = 3800 + (1)(.433)(7324)
Pbtm = 3800 + 3171
Pbtm = 6971

Fracture Gradient = Bottom hole breakdown pressure/depth
Fracture Gradient = 6971psi/7324ft
Fracture Gradient = 0.9518 psi/ft

Maximum Allowable Injection Rate Calculation = of 2296 bbls/day

$$MAIR = \frac{(R)\ (MAIP)}{MIP}$$

Where: MAIR = maximum allowable injection rate (bbls/day)
R = maximum rate during the injection test (bbls/day)
MAIP = maximum allowable injection pressure (psi)
MIP = maximum pressure during injection test (psi)

$$MAIR = \frac{(1350)(2552)}{1500}$$

MAIR = 2296 bbls/day

	Dannic Energy Injection Test								
	Green Glenn #1 DEP ID #37-033-20228								
Date	Time	Rate	Vol.	Press.	Density	Remarks	Pi	Pf	time
		bbls/day	bbls	psi	ppg		psi	psi	minutes
10/13/2009	8:00:00 AM		0	0	9.10	Gravity fed well to load hole for pump test			
	6:00:00 PM		180	0	9.10				
10/14/2009	6:45:00 AM	850	180	0	9.10	Start Injection Test			
	7:45:00 AM	840	215	0	9.10	increase rate			
	8:45:00 AM	1200	260	0	9.10				
	9:15:00 AM	1175	284	300	9.10	Caught Pressure at 104 bbls on pump			
	9:20:00 AM	0	286	1500	9.10	Shut down; monitor pressure decline	1500	300	40
	10:00:00 AM	620	286	300	9.10	Start Pump			
	10:30:00 AM	0	292	1500	9.10	Shut down; monitor pressure decline	1500	0	25
	11:00:00 AM	425	292	0	9.10	Start Pump			
	11:30:00 AM	0	300	1500	9.10	Shut down; monitor pressure decline	1500	0	20
	12:00:00 PM	425	300	0	9.10	Start Pump			
	12:30:00 PM	0	309	1500	9.10	Shut down; monitor pressure decline	1500	0	10
	1:30:00 PM	425	309	0	9.10	Start Pump			
	1:30:00 PM	0	318	1400	9.10	Shut down; monitor pressure decline	1400	0	7
	2:00:00 PM	425	318	0	9.10	Start pump			
	2:30:00 PM	0	326	1380	9.10	Shut down; monitor pressure decline	1380	0	5
	3:00:00 PM	425	326	0	9.10	Start Pump			
	3:30:00 PM	425	335	1300	9.10	Well taking fluid at 1300 psi			
	4:00:00 PM	850	344	1300	9.10	increase rate			
	5:00:00 PM	850	379	1320	9.10				
	5:15:00 PM	0	390	1320	9.10	shut down for night	1320	0	3
10/15/2009	6:00:00 AM		390	0	9.10	Open well; well on vacuum			
	6:00:00 AM	950	390	0	9.10	Start pump			
	7:00:00 AM	1030	430	0	9.10				
	8:00:00 AM	990	471	0	9.10				
	9:00:00 AM	800	504	0	8.90	Change suction tank			
	10:00:00 AM	800	537	0	8.90				
	11:00:00 AM	800	570	300	8.90				

	12:00:00 PM	900	610	1400	8.90				
	1:00:00 PM	900	645	1380	8.90				
	2:00:00 PM	1000	686	1380	8.90				
	3:00:00 PM	900	722	1380	8.90				
	4:00:00 PM	1000	767	1380	8.90	Shut down pump for night; gravity fed hole	1380	0	3
10/16/2009	8:00:00 AM	340	992	0	8.90	well on vacuum; gravity 225 bbls			
	8:00:00 AM	335	992	0	8.80	Change suction tank; start pump			
	8:05:00 AM	900	995	1400	8.80				
	9:00:00 AM	620	1020	1300	8.80	Pump problems; shut down high temp			
	9:30:00 AM	0	1042	1300	8.80	Bad Temp sensor in pump motor shut down	1300	0	3
						Scheduled bond log; gravity fed hole			
10/17/2009	9:30:00 AM	350	1392	0	8.80	gravity 350 bbls			
10/18/2009	9:30:00 AM	250	1642	0	8.80	gravity 250 bbls			
10/19/2009	7:00:00 AM	300	1927	0	8.60	gravity 300 bbls; log well			
	1:00:00 PM	900	1927	0	8.60	Start Pump			
	2:00:00 PM	940	1964	1500	8.60				
	3:00:00 PM	900	2003	1500	8.60				
	4:00:00 PM	920	2040	1480	8.60				
	5:00:00 PM	1000	2080	1320	8.60				
	6:00:00 PM	950	2120	1240	8.60	Shut pump down for night; gravity fed well			
10/20/009	6:45:00 AM	480	2370	0	8.70	Start Pump			
	7:00:00 AM	1000	2390	1175	8.70				
	8:00:00 AM	1000	2432	1200	8.70				
	9:00:00 AM	975	2471	1200	8.70				
	10:00:00 AM	900	2508	1250	8.70				
	11:00:00 AM	900	2545	1275	8.70				
	12:00:00 PM	1000	2587	1275	9.10	Change suction tank			
	1:00:00 PM	980	2628	1220	9.10				
	2:00:00 PM	1200	2678	1220	9.10				
	3:00:00 PM	1025	2721	1210	9.10				
	4:00:00 PM	1025	2763	1170	9.10				
	5:00:00 PM	1030	2806	1140	9.10				
	6:00:00 PM	1030	2850	1100	9.10				
	7:00:00 PM	1025	2889	1100	9.10	Shut pump down for night; gravity fed well	1100	0	1

10/21/2009	7:00:00 AM	500	3189	0	8.70	Change suction tank; start pump			
	8:00:00 AM	1000	3231	1150	8.70				
	9:00:00 AM	1050	3275	1200	8.70				
	10:00:00 AM	1050	3318	1220	8.70	Increase pump rate			
	11:00:00 AM	1200	3368	1220	8.70				
	12:00:00 PM	1200	3419	1220	8.70				
	1:00:00 PM	1350	3474	1250	8.70	Increase pump rate			
	2:00:00 PM	1350	3530	1250	8.70				
	3:00:00 PM	1350	3585	1250	8.70				
	4:00:00 PM	1350	3642	1240	8.70				
	5:00:00 PM	1350	3698	1240	8.70				
	6:00:00 PM	1350	3755	1240	8.70				
	7:00:00 PM	1350	3811	1240	8.70		1240	0	1
10/22/2009	7:00:00 AM	500	4311	0	8.80	Change suction tank; gravity fed well			
						Test Complete			
						Witness Test: Michael G. Hoover			
						Witness Test: Douglas A. Hoover			

RESOURCE MANAGEMENT SERVICES, INC.

65 Fenton Road
Indiana, Pennsylvania
15701

Tel: (724) 465-6556
Fax: (724) 465-8292

December 4, 2009

Waste Characterization
Dannic Energy – Green Glen #1 Disposal Well

Collector: Dannic/MH
Analyses By: Geo-Chemical Testing

Sample Identification:	RMS 1/11/13	RMS 2/11/13	RMS 3/11/13	RMS 4/11/13	
Lab Identification:	G0911360-1	G0911360-2	G0911360-3	G0911360-4	
Analyte					
pH	4.91	6.30	7.50	5.31	Std Units
Alkalinity	<5	10	40	<5	Mg/l as CaCO3
Specific Conductance	186,000	705	91	199,000	umhos/cm
T. Dissolved Solids	199,000	2750	72	341,000	Mg/l
Chlorides	120,000	210	11	190,000	Mg/l
Lab Dissolved Oxygen	10	7.9	10	NA	Mg/l
T. Organic Carbon	18.6	210	12.7	2.2	Mg/l
Specific Gravity	1.150	1.001	1.001	NA	gm/ml
Sulfate	<5	10	<5	22	Mg/l
Sulfide	<0.1	<0.1	<0.1	<0.1	Mg/l
Aluminum	<1.0	3.1	32.6	<1.0	Mg/l
Barium	426	1.47	0.77	1,960	Mg/l
Calcium	20,500	38.2	14.3	36,900	Mg/l
Iron	70.4	15.6	88.7	300	Mg/l
Magnesium	2,410	3.6	14.7	2,200	Mg/l
Manganese	21.7	0.43	2.31	3.85	Mg/l
Sodium	23,800	94.2	6.5	22,300	Mg/l
Strontium	885	3.22	0.1700	25,300	Mg/l
Hardness	61,000	110	96.5	101,000	Mg/l as CaCO3

Submitted By: Resource Management Services

Rick F. Bonazza
President

RMS 1/11/13 shallow brine
RMS 2/11/13 Marcellus
RMS 3/11/13 Drill Pit water
RMS 4/11/13 Oriskany

Clarion County, PA

Constituent	Units	Drill Pit Fluid 5/21/2010		Produced Water 11/17/2010	
Acidity	mg/L	22.2		265	
Aluminum	ug/L	442	B	399	B J
Ammonia Nitrogen	mg/L	199	J	241	
Arsenic	ug/L	94.4	B J	100	U
Barium	ug/L	10500		16200	
Benzene	ug/L	460		390	
Beryllium	ug/L	40	U	40	U
Biochemical Oxygen Demand	mg/L	783		>2010	
Boron	ug/L	15100		9330	
Bromide	mg/L	713		999	
Cadmium	ug/L	50	U	2.3	B
Calcium	ug/L	11500000	J	16800000	
Chemical Oxygen Demand (COD)	mg/L	3810	J	8810	
Chloride	mg/L	89100		135000	
Chromium	ug/L	12.8	B	22.5	B
Cobalt	ug/L	1250	U	500	U
Copper	ug/L	250	U	250	U
Hardness, as CaCO3	mg/L	45000		86000	
Iron	ug/L	30800		56600	
Iron Dissolved	ug/L	30800		47200	
Lead	ug/L	75	U	30	U
Lithium	ug/L	75600		148000	
Magnesium	ug/L	1120000		1490000	
Manganese	ug/L	3340		5280	
Mercury	ug/L	0.2	U	0.2	U
Molybdenum	ug/L	400	U	400	U
Nickel	ug/L	1000	U	400	U
Nitrate-Nitrite	ug/L	NA		NA	
Nitrate	mg/L	5	U G	25	U G
Nitrite	mg/L	5	U G	25	U G
Oil & Grease (HEM)	mg/L	63.9		2080	
pH	No Units	6.2		6.0	
Selenium	ug/L	50	U	50	U
Silver	ug/L	50	U	50	U
Sodium	ug/L	27900000		33400000	
Specific Conductance	umhos/cm	245000J		520000	
Strontium	ug/L	1170000 / 1770000		310000 / 2600000	
Sulfate	mg/L	240		153	B J
Toluene	ug/L	800		1900	
Total Alkalinity	mg/L	73.8	J	4.7	B J
Total Dissolved Solids	mg/L	119000		260000	
Total Kjeldahl Nitrogen	mg/L	NA		149	
Total Recoverable Phenolics	mg/L	0.045	J	0.11	J
Total Suspended Solids	mg/L	91.0		102.0	
Zinc	ug/L	75.4	B	90	B
MBAS	mg/L	0.199		0.025	U
Ethylene Glycol	mg/L	100	U	1000	U
Uranium	ug/L	5000	U	25000	U
Thorium	ug/L	10000	U	22100	
Strontium-90	pCi/L	-29	U	NA	
Gross Alpha	pCi/L	35000		10400	
Gross Beta	pCi/L	10900		1910	
Cesium 137	pCi/L	-6	U	NA	

NOTES

NA - Constituent not analyzed

NR - Analytical data has not been reported by the laboratory to date.

J - The reported result is an estimated result. The result is less than the laboratory reporting limit.

E - The reported result is an estimated result.

B - The constituent was detected in the associated method blank.

G - Reporting limit elevated due to matrix interference

Clearfield County, PA

Constituent	Units	Drill Pit Fluid 11/17/2010	Flow Back 11/17/2010
Acidity	mg/L	5 U	5 U
Aluminum	ug/L	1020 B	297 B J
Ammonia Nitrogen	mg/L	29.7	8
Arsenic	ug/L	33.5 B	100 U
Barium	ug/L	5180	9920
Benzene	ug/L	5 U	5 U
Beryllium	ug/L	40 U	40 U
Biochemical Oxygen Demand	mg/L	369	53.2
Boron	ug/L	362 B	1510 B J
Bromide	mg/L	5.1	28
Cadmium	ug/L	50 U	50 U
Calcium	ug/L	186000	373000
Chemical Oxygen Demand (COD)	mg/L	1420	286
Chloride	mg/L	13200	3490
Chromium	ug/L	1270	50 U
Cobalt	ug/L	500 U	500 U
Copper	ug/L	250 U	250 U
Hardness, as CaCO3	mg/L	580	1320
Iron	ug/L	1000	6800
Iron Dissolved	ug/L	491 B	3280
Lead	ug/L	14.5 B	30 U
Lithium	ug/L	242 B	3200
Magnesium	ug/L	15100 B	44300 B
Manganese	ug/L	4760	646
Mercury	ug/L	0.042 B	0.2 U
Molybdenum	ug/L	400 U	400 U
Nickel	ug/L	23.9 B	400 U
Nitrate-Nitrite	ug/L	NA	NA
Nitrate	mg/L	1.2 U	0.5 U G
Nitrite	mg/L	1.2 U G	0.5 U G
Oil & Grease (HEM)	mg/L	19.5	13.1
pH	No Units	7.1	7.4
Selenium	ug/L	50 U	50 U
Silver	ug/L	50 U	50 U
Sodium	ug/L	8030000	1570000
Specific Conductance	umhos/cm	45300	12300
Strontium	ug/L	5200 / 4130 J	117000 / 94700
Sulfate	mg/L	115	126 J
Toluene	ug/L	5 U	5 U
Total Alkalinity	mg/L	568	103 J
Total Dissolved Solids	mg/L	21700	6740
Total Kjeldahl Nitrogen	mg/L	34.3	8.52
Total Recoverable Phenolics	mg/L	0.024	0.016 J
Total Suspended Solids	mg/L	13.2	25.6
Zinc	ug/L	75.6 B	66.2 B
MBAS	mg/L	0.025 U	0.134
Ethylene Glycol	mg/L	1000 U	1000 U
Uranium	ug/L	10000 U	500 U
Thorium	ug/L	5000 U	510
Strontium-90	pCi/L	NA	NA
Gross Alpha	pCi/L	80 U	49
Gross Beta	pCi/L	170	21
Cesium 137	pCi/L	NA	NA

NOTES

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G - Reporting limit elevated due to matrix interference

Greene County, PA

Constituent	Units	Flow Back 3/24/2009		Flow Back 3/28/2009		Flow Back 4/1/2009		Produced Water 4/9/2009	
Acidity	mg/L	5	U	5	U	5	U	5	U
Aluminum	ug/L	985	B	2,000	U	417	B	522	B
Ammonia Nitrogen	mg/L	90.7	J	110	J	91.4	J	116	J
Arsenic	ug/L	100	U	100	U	26.2	B	100	U
Barium	ug/L	603	B	150	B	13,000		306,000	
Benzene	ug/L	75	U	5.1		3.1	J	31	
Beryllium	ug/L	40	U	40	U	40	U	40	U
Biochemical Oxygen Demand	mg/L	26.6		36.8		122		218	
Boron	ug/L	6,230	J	12,800	J	16,800	J	16,900	J
Bromide	mg/L	0.2	U	0.2	U	262		522	
Cadmium	ug/L	50	U	50	U	50	U	50	U
Calcium	ug/L	33,100	B	32,500	B	1,860,000		4,490,000	
Chemical Oxygen Demand (COD)	mg/L	705	J	506	J	1,380		3,040	
Chloride	mg/L	338		39.6		24,900		46,500	
Chromium	ug/L	12.7	B	50	U	28	B	49.9	B
Cobalt	ug/L	5.6	B	5.6	B	500	U	500	U
Copper	ug/L	90.1	B	250	U	250	U	250	U
Hardness, as CaCO3	mg/L	140		140		6,700		20,000	
Iron	ug/L	4,600		30,200		17,500		34,000	
Iron Dissolved	ug/L	NA		NA		NA		NA	
Lead	ug/L	30	U	30	U	30	U	20	B
Lithium	ug/L	43.6	B	36.3	B	19,200		34,900	
Magnesium	ug/L	7,820	B	8,530	B	201,000		472,000	
Manganese	ug/L	191		598		1,160		2,410	
Mercury	ug/L	0.82	B J	0.2	U	0.2	U	0.2	U
Molybdenum	ug/L	400	U	13	B	400	U	400	U
Nickel	ug/L	12.6	B	13.7	B	400	U	13.5	B
Nitrate-Nitrite	ug/L	0.57		0.77	J	0.87	J	0.77	J
Nitrate	mg/L	NA		NA		NA		NA	
Nitrite	mg/L	NA		NA		NA		NA	
Oil & Grease (HEM)	mg/L	8.6		8.2		6.8		6.4	
pH	No Units	50	U	50	U	50	U	29	B
Selenium	ug/L	NA		NA		NA		NA	
Silver	ug/L	NA		NA		NA		NA	
Sodium	ug/L	NA		NA		NA		NA	
Specific Conductance	umhos/cm	1,630		532		223,000		635,000	
Strontium	ug/L	NA		NA		NA		NA	
Sulfate	mg/L	10		25		2.3	J	23	
Toluene	ug/L	194	J	112	J	356	J	206	J
Total Alkalinity	mg/L	1,230		1,010		40,400		83,100	
Total Dissolved Solids	mg/L	108		181		148		131	
Total Kjeldahl Nitrogen	mg/L	NA		NA		NA		NA	
Total Recoverable Phenolics	mg/L	400		0.01	U	90		30.8	
Total Suspended Solids	mg/L	83	J	25		15	U	14	J
Zinc	ug/L	NA		NA		NA		NA	
MBAS	mg/L	10	U	10	U	100	U	100	U
Ethylene Glycol	mg/L	NA		NA		NA		NA	
Uranium	ug/L	NA		NA		NA		NA	
Thorium	ug/L	NA		NA		NA		NA	
Strontium-90	pCi/L	NA		NA		NA		NA	
Gross Alpha	pCi/L	NA		NA		NA		NA	
Gross Beta	pCi/L	NA		NA		NA		NA	
Cesium 137	pCi/L	NA		NA		NA		NA	

Greene County, PA

Constituent	Units	Flow Back				Produced Water
		4/1/2009	4/3/2009	4/7/2009	4/17/2009	4/17/2009
Acidity	mg/L	5 U	5 U	5 U	40.8	345
Aluminum	ug/L	166 B	176 B	571 B	539 B J	1020 B J
Ammonia Nitrogen	mg/L	15.6 J	36.3 J	70.3 J	NA	214 J
Arsenic	ug/L	100 U	100 U	35.4 B	50.8 B	100 U
Barium	ug/L	2210	26700	434000	1010000 J	2110000
Benzene	ug/L	5 U	7.8	5.8	17	5 U
Beryllium	ug/L	40 U	40 U	40 U	40 U	40 U
Biochemical Oxygen Demand	mg/L	788	158	106	32.4	26
Boron	ug/L	414 B J	8360 J	14400 J	16800	18600
Bromide	mg/L	32.8	172	536	880	1430
Cadmium	ug/L	50 U	50 U	50 U	4.4 B J	50 U
Calcium	ug/L	227000	1030000	4950000	9600000 J	19400000
Chemical Oxygen Demand (COD)	mg/L	996	1330	17700	4670	8570
Chloride	mg/L	3560	16900	48900	76800	121000 J
Chromium	ug/L	50 U	50 U	50 U	14 B J	50 U
Cobalt	ug/L	500 U	500 U	1000 U	1000 U	5000 U
Copper	ug/L	250 U	250 U	250 U	250 U	250 U
Hardness, as CaCO3	mg/L	1060	4700	20000	39200	106000
Iron	ug/L	1180	12400	28200	74800	144000
Iron Dissolved	ug/L	NA	NA	NA	NA	NA
Lead	ug/L	30 U	30 U	60 U	38.2 B J	30 U
Lithium	ug/L	808	11800	34600	56100	112000
Magnesium	ug/L	49400 B	131000	559000	1000000	1810000
Manganese	ug/L	189	782	2630	5170 J	10400
Mercury	ug/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Molybdenum	ug/L	400 U	19.7 B	8.7 B	400 U	400 U
Nickel	ug/L	400 U	10.6 B	800 U	800 U	400 U
Nitrate-Nitrite	ug/L	1.1 J	0.38 J	0.38 J	0.91 J	0.085 B
Nitrate	mg/L	NA	NA	NA	NA	NA
Nitrite	mg/L	NA	NA	NA	NA	NA
Oil & Grease (HEM)	mg/L	6.6 U	5 U	5.1	4.9 U	6.1
pH	No Units	7	6.9	6.5	6	5.9
Selenium	ug/L	50 U	50 U	50 U	30.1 B	50 U
Silver	ug/L	50 U	50 U	50 U	50 U	50 U
Sodium	ug/L	1460000	7540000	21300000	32600000	47700000
Specific Conductance	umhos/cm	4980 J	68400 J	183000 J	256000 J	468000
Strontium	ug/L	23200	139000	650000	1370000 J	2870000 J
Sulfate	mg/L	50.3	10.7 B J	40.2 B J	39.8 B J	42.4 B J
Toluene	ug/L	5.6	3.8 J	7.7	13	5 U
Total Alkalinity	mg/L	308 J	278 J	135 J	87.9 J	40.3 J
Total Dissolved Solids	mg/L	5910	28900	55100	124000	199000
Total Kjeldahl Nitrogen	mg/L	7.8	42.5	86.1	95.5	146
Total Recoverable Phenolics	mg/L	0.14 J	0.057 J	0.0076 B	0.011	0.0089 B
Total Suspended Solids	mg/L	1040	7	47	1100	237
Zinc	ug/L	200 U	406	264	200 U	147 B J
MBAS	mg/L	0.05 U	0.0621	0.258	0.05 U	0.05 U
Ethylene Glycol	mg/L	1000 UJ	100 UJ	100 UJ	50 UJ	50 UJ
Uranium	ug/L	NA	NA	NA	NA	NA
Thorium	ug/L	NA	NA	NA	NA	NA
Strontium-90	pCi/L	NA	NA	NA	NA	NA
Gross Alpha	pCi/L	NA	NA	NA	NA	NA
Gross Beta	pCi/L	NA	NA	NA	NA	NA
Cesium 137	pCi/L	NA	NA	NA	NA	NA

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Greene County, PA

Constituent	Units	Flow Back 2/12/2009	Flow Back 2/13/2009	Flow Back 2/17/2009	Produced Water 5/13/2009
Acidity	mg/L	5 U	5 U	5 U	162
Aluminum	ug/L	298 J	887 J	47200 J	358 B
Ammonia Nitrogen	mg/L	1.8 J	5.4 J	34.1 J	96
Arsenic	ug/L	10 U	17.5	92.9	54 B
Barium	ug/L	111 B	7620	165000	1440000
Benzene	ug/L	2000 U	250 U	100 U	5 U
Beryllium	ug/L	4 U	4 U	20 U	40 U
Biochemical Oxygen Demand	mg/L	438	656	721	1080
Boron	ug/L	109 B E	5420	12200	13000 J
Bromide	mg/L	1	35.5	242	766
Cadmium	ug/L	5 U	5 U	7.4 B	2.5 B
Calcium	ug/L	52700	297000	2260000 J	8500000 J
Chemical Oxygen Demand (COD)	mg/L	3450	1290	6970	8590
Chloride	mg/L	234	4900 J	26800 J	78300
Chromium	ug/L	4.3 B	32.6	130	50 U
Cobalt	ug/L	1.1 B	50 U	250 U	1000 U
Copper	ug/L	28.6	22.5 B	2280	250 U
Hardness, as CaCO3	mg/L	230	1500	8400	40000
Iron	ug/L	1720	14700	140000 J	87800
Iron Dissolved	ug/L	NA	NA	NA	NA
Lead	ug/L	4.7	3	349	45.6 B
Lithium	ug/L	17.5 B	4350	21400	44500
Magnesium	ug/L	16700	40800	291000	933000
Manganese	ug/L	146	1150	3290	4720
Mercury	ug/L	0.025 B	0.05 B J	0.24 J	0.2 U
Molybdenum	ug/L	40 U	10.5 B	50.5 B J	400 U
Nickel	ug/L	6.2 B	17.6 B	187 B	800 U
Nitrate-Nitrite	ug/L	0.73 J	0.61 J	0.52 J	0.1 U
Nitrate	mg/L	NA	NA	NA	NA
Nitrite	mg/L	NA	NA	NA	NA
Oil & Grease (HEM)	mg/L	NA	4.8 U	350	21.3
pH	No Units	7.1	7.7	6.6	6.2
Selenium	ug/L	5 U	4.3 B	25 U	50 U
Silver	ug/L	5 U	5 U	25 U	50 U
Sodium	ug/L	321000	2860000	12900000	26900000
Specific Conductance	umhos/cm	1970 J	19200 J	122000 J	249000 J
Strontium	ug/L	789 J E	24100 J	345000	1220000
Sulfate	mg/L	374 J	348 J	25.9 J	50 G U
Toluene	ug/L	2000 U	250 U	100 U	5 U
Total Alkalinity	mg/L	120 J	577 J	266 J	75.2 J
Total Dissolved Solids	mg/L	1410	9020	40700	155000
Total Kjeldahl Nitrogen	mg/L	25.8	21.8	46.5	92.8
Total Recoverable Phenolics	mg/L	0.065 J	0.01 U	0.028	0.0091 B
Total Suspended Solids	mg/L	16	23.2	3220	153
Zinc	ug/L	43.6	248	2930 J	29.3 B J
MBAS	mg/L	NA	3.38	0.210	4.54
Ethylene Glycol	mg/L	50 U	50 U	52	100 UJ
Uranium	ug/L	NA	NA	NA	NA
Thorium	ug/L	NA	NA	NA	NA
Strontium-90	pCi/L	NA	NA	NA	NA
Gross Alpha	pCi/L	NA	NA	NA	NA
Gross Beta	pCi/L	NA	NA	NA	NA
Cesium 137	pCi/L	NA	NA	NA	NA

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Indiana County, PA

Constituent	Units	Produced Water 11/17/2010	
Acidity	mg/L	24.0	
Aluminum	ug/L	226	B J
Ammonia Nitrogen	mg/L	85.1	
Arsenic	ug/L	100	U
Barium	ug/L	2610000	
Benzene	ug/L	5	U
Beryllium	ug/L	40	U
Biochemical Oxygen Demand	mg/L	668	
Boron	ug/L	16300	
Bromide	mg/L	624	
Cadmium	ug/L	50	U
Calcium	ug/L	10300000	
Chemical Oxygen Demand (COD)	mg/L	7770	
Chloride	mg/L	68900	
Chromium	ug/L	155	
Cobalt	ug/L	2500	U
Copper	ug/L	250	U
Hardness, as CaCO3	mg/L	36000	
Iron	ug/L	131000	
Iron Dissolved	ug/L	101000	
Lead	ug/L	30	U
Lithium	ug/L	89900	
Magnesium	ug/L	914000	
Manganese	ug/L	3780	
Mercury	ug/L	0.2	U
Molybdenum	ug/L	400	U
Nickel	ug/L	400	U
Nitrate-Nitrite	ug/L	NA	
Nitrate	mg/L	5	U G
Nitrite	mg/L	5	U G
Oil & Grease (HEM)	mg/L	95.3	
pH	No Units	6.6	
Selenium	ug/L	50	U
Silver	ug/L	50	U
Sodium	ug/L	28000000	
Specific Conductance	umhos/cm	245000	
Strontium	ug/L	1900000 / 2440000	
Sulfate	mg/L	35.7	B J
Toluene	ug/L	5	U
Total Alkalinity	mg/L	141	J
Total Dissolved Solids	mg/L	94400	
Total Kjeldahl Nitrogen	mg/L	23.1	
Total Recoverable Phenolics	mg/L	0.065	J
Total Suspended Solids	mg/L	97	
Zinc	ug/L	110	B
MBAS	mg/L	0.0581	
Ethylene Glycol	mg/L	1000	U
Uranium	ug/L	25000	U
Thorium	ug/L	12700	
Strontium-90	pCi/L	NA	
Gross Alpha	pCi/L	16600	
Gross Beta	pCi/L	4790	
Cesium 137	pCi/L	NA	

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Washington County, PA

Constituent	Units	Flow Back				Produced Water
		1/26/2009	1/29/2009	2/2/2009	2/10/2009	4/29/2009
Acidity	mg/L	5 U	5 U	107	106	185
Aluminum	ug/L	481	328	166 B	1000 U	811 B J
Ammonia Nitrogen	mg/L	9.3 J	32 J	82.4 J	107 J	259
Arsenic	ug/L	9.1 B	13.5	50 U	12.6 B	114
Barium	ug/L	9810	3570	21400 J	74200 J	133000
Benzene	ug/L	150 U	240	1200	420	360
Beryllium	ug/L	4 U	4 U	20 U	2.2 B	40 U
Biochemical Oxygen Demand	mg/L	2 U	132	1950	149	33.6
Boron	ug/L	2140 J	9260 J	14300 J	16200 J	13500 J
Bromide	mg/L	107	120	544	849	1380 J
Cadmium	ug/L	10.5	5 U	25 U	1.4 B	7.7 B
Calcium	ug/L	2990000	1370000 J	7630000 J	12500000 J	1.8E+07 J
Chemical Oxygen Demand (COD)	mg/L	1730	1340	6120	4340	36600
Chloride	mg/L	10700 J	10500 J	50000	78600 J	122000
Chromium	ug/L	4.8 B	11.1	7.5 B	8.4 B	20.9 B
Cobalt	ug/L	50 U	50 U	250 U	250 U	2500 U
Copper	ug/L	21 B	25 U	125 U	125 U	27.2 B
Hardness, as CaCO3	mg/L	9500	4700	26400	43500	85000
Iron	ug/L	11600	6030	20400 J	54200	69700
Iron Dissolved	ug/L	NA	NA	NA	NA	NA
Lead	ug/L	111	3.8	15 U	15 U	68 B
Lithium	ug/L	14900 J E	13900 E	49100 J E	73700 J	88600
Magnesium	ug/L	235000	153000	817000	1330000 J	1710000
Manganese	ug/L	3640	1060	4220	7090	8830
Mercury	ug/L	0.55 J	0.05 B	0.023 B	0.049 B J	0.2 U
Molybdenum	ug/L	8.9 B J	28.8 B J	9.6 B J	6.8 B J	400 U
Nickel	ug/L	10.4 B	18.6 B J	11 B	7 B	2000 U
Nitrate-Nitrite	ug/L	0.15	0.27 J	0.15 J	0.089 B J	NA
Nitrate	mg/L	NA	NA	NA	NA	NA
Nitrite	mg/L	NA	NA	NA	NA	NA
Oil & Grease (HEM)	mg/L	19.4	5.7	4.8 U	30.8	14.7
pH	No Units	7.6	7.8	6.6	5.5	6.1
Selenium	ug/L	5 U	5 U	25 U	25 U	44 B
Silver	ug/L	0.82 B	0.73 B	2.8 B	5.5 B	50 U
Sodium	ug/L	6190000	6370000	22000000 J	32500000 J	3.4E+07
Specific Conductance	umhos/cm	34600 J	48800 J	175000 J	284000 J	440000 J
Strontium	ug/L	439000 E	167000 E	1080000 J E	1850000 J	2520000
Sulfate	mg/L	198 J	222 J	106	60.1 J	83.8 J
Toluene	ug/L	81 J	340	2300	820	660
Total Alkalinity	mg/L	121 J	226 J	97.6 J	53.2 J	43.1 J
Total Dissolved Solids	mg/L	27800	22400	87800	112000	194000
Total Kjeldahl Nitrogen	mg/L	23	51	71.7	112	136
Total Recoverable Phenolics	mg/L	0.082	0.064	0.01 U	0.015	0.039 J
Total Suspended Solids	mg/L	790	81	35.6	17	150
Zinc	ug/L	117 J	86.9 J	84.9 B J	66.8 B	73.8 B J
MBAS	mg/L	0.500 U	0.0691	0.131	0.0857	0.138
Ethylene Glycol	mg/L	20.1	20.6	20.8	11	100 UJ
Uranium	ug/L	NA	NA	NA	NA	NA
Thorium	ug/L	NA	NA	NA	NA	NA
Strontium-90	pCi/L	NA	NA	NA	NA	NA
Gross Alpha	pCi/L	NA	NA	NA	NA	NA
Gross Beta	pCi/L	NA	NA	NA	NA	NA
Cesium 137	pCi/L	NA	NA	NA	NA	NA

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Washington County, PA

Constituent	Units	Flow Back 4/16/2009	Flow Back 4/16/2009	Flow Back 4/18/2009	Produced Water 4/22/2009
Acidity	mg/L	5 U	5 U	5 U	5 U
Aluminum	ug/L	176 B J	2000 U	526 B J	315 B J
Ammonia Nitrogen	mg/L	0.2 U	2	16	165 J
Arsenic	ug/L	100 U	100 U	100 U	57.1 B
Barium	ug/L	61 B J	114 B J	2,520 J	249,000 J
Benzene	ug/L	5 U	5 U	2.5 J	17
Beryllium	ug/L	40 U	40 U	40 U	40 U
Biochemical Oxygen Demand	mg/L	2 U	442	101	122
Boron	ug/L	42.6 B	87.1 B	6,520	15,700
Bromide	mg/L	0.2 U	1 G U	82.9	386
Cadmium	ug/L	50 U	50 U	50 U	1.4 B J
Calcium	ug/L	23,500 B J	29,700 B J	465,000 J	3,400,000 J
Chemical Oxygen Demand (COD)	mg/L	32.6	1,740	1,080	2,820
Chloride	mg/L	19.6	75.5	7,430	35,600
Chromium	ug/L	50 U	50 U	13.1 B J	30 B J
Cobalt	ug/L	500 U	500 U	5.7 B	500 U
Copper	ug/L	250 U	250 U	250 U	250 U
Hardness, as CaCO3	mg/L	84	110	1,660	11,000
Iron	ug/L	105 B	293 B	7,660	27,200
Iron Dissolved	ug/L	NA	NA	NA	NA
Lead	ug/L	30 U	30 U	30 U	30 U
Lithium	ug/L	500 U	27.5 B	8,730	34,400
Magnesium	ug/L	5,540 B	6,200 B	45,100 B	329,000
Manganese	ug/L	10.4 B J	64 B J	681 J	1,680 J
Mercury	ug/L	0.2 U	0.2 U	0.2 U	0.2 U
Molybdenum	ug/L	400 U	400 U	73.1 B E	46.2 B
Nickel	ug/L	400 U	400 U	400 U	400 U
Nitrate-Nitrite	ug/L	0.4 J	0.46 J	0.51 J	0.43 J
Nitrate	mg/L	NA	NA	NA	NA
Nitrite	mg/L	NA	NA	NA	NA
Oil & Grease (HEM)	mg/L	7.3	7	7.3	6.6
pH	No Units	50 U	50 U	50 U	50 U
Selenium	ug/L	NA	NA	NA	NA
Silver	ug/L	NA	NA	NA	NA
Sodium	ug/L	NA	NA	NA	NA
Specific Conductance	umhos/cm	208 B J	564 J	53,800 J	477,000 J
Strontium	ug/L	NA	NA	NA	NA
Sulfate	mg/L	5 U	5 U	1.6 J	20
Toluene	ug/L	32.6 J	75.8 J	270 J	176 J
Total Alkalinity	mg/L	80	657	12,900	64,700
Total Dissolved Solids	mg/L	2.8 B	50	17.6	107
Total Kjeldahl Nitrogen	mg/L	NA	NA	NA	NA
Total Recoverable Phenolics	mg/L	4.4	220	109	24
Total Suspended Solids	mg/L	15 U	3.3 J	15 U	15
Zinc	ug/L	NA	NA	NA	NA
MBAS	mg/L	50 U	100 U	NA	NA
Ethylene Glycol	mg/L	NA	NA	NA	NA
Uranium	ug/L	NA	NA	NA	NA
Thorium	ug/L	NA	NA	NA	NA
Strontium-90	pCi/L	NA	NA	NA	NA
Gross Alpha	pCi/L	NA	NA	NA	NA
Gross Beta	pCi/L	NA	NA	NA	NA
Cesium 137	pCi/L	NA	NA	NA	NA

NOTES

NA - Constituent not analyzed

NR - Analytical data has not been reported by the laboratory to date.

J - The reported result is an estimated result. The result is less than the laboratory reporting limit.

E - The reported result is an estimated result.

B - The constituent was detected in the associated method blank.

G - Reporting limit elevated due to matrix interference