ALLARM Shale Gas Volunteer Monitoring Workshop





Dickinson

Workshop funded by Colcom Foundation and Consortium for Scientific Assistance to Watersheds (C-SAW)

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ALLARM Background

Empower communities with scientific tools to monitor, protect, and restore PA streams.





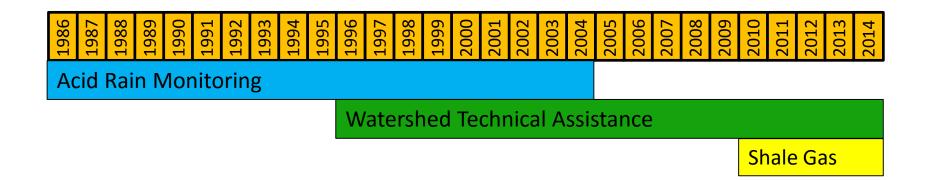
Educate. Engage. Empower.

Who we are

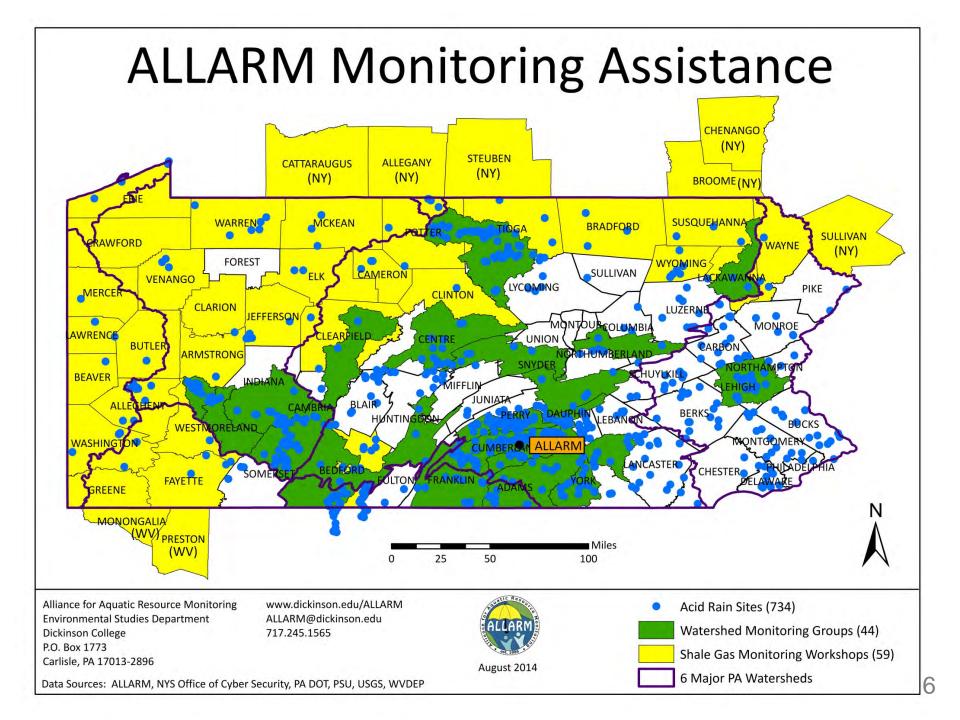
- Project of the environmental studies department (1986)
- 3 full time directors
- 1 science advisor/Dickinson faculty member
- 10 14 students



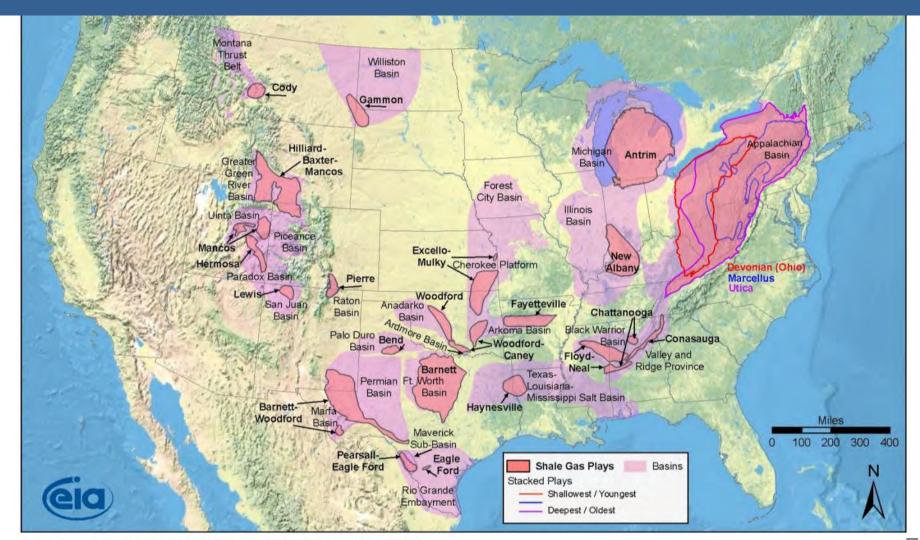
ALLARM History



Monitoring Program	Region	Volunteers	Model
Acid Rain	Statewide	Individuals	Contributory
Watershed TA	Southcentral PA	Groups	Co-created
Shale Gas	Marcellus & Utica	Groups & Individuals	Collaborative

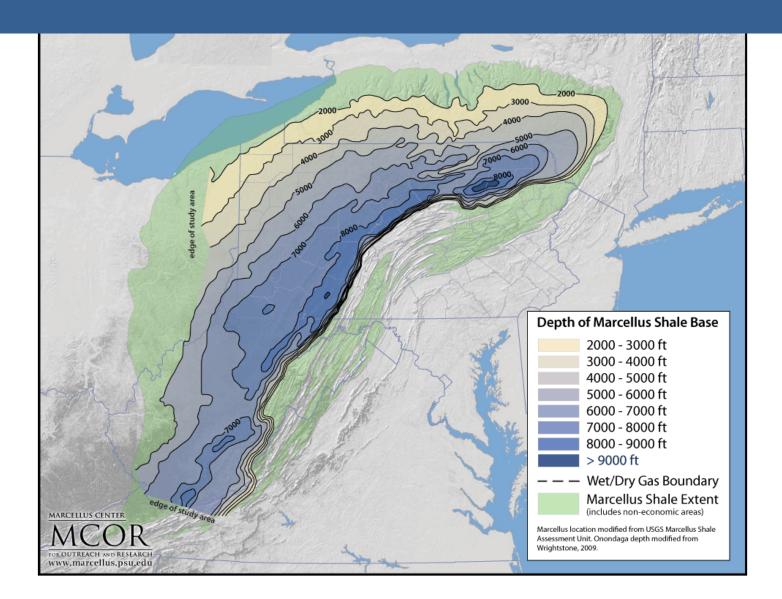


Science of Shale Gas

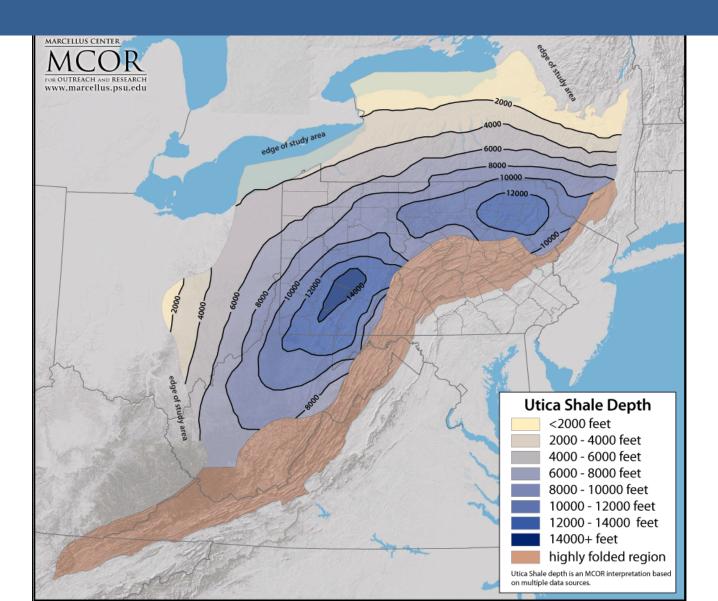


Source: Energy Information Administration based on data from various published studies Updated: May 28, 2009

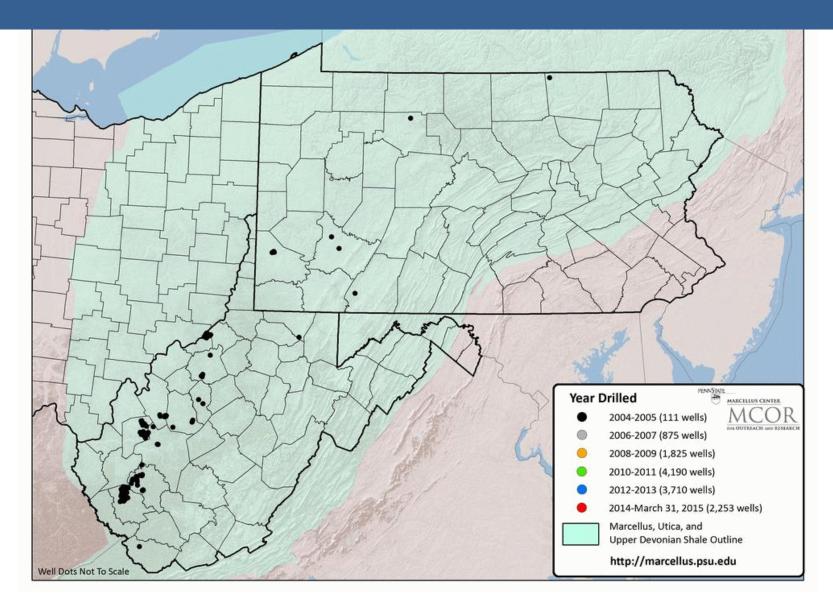
Depth of Marcellus Shale



Depth to Utica Shale

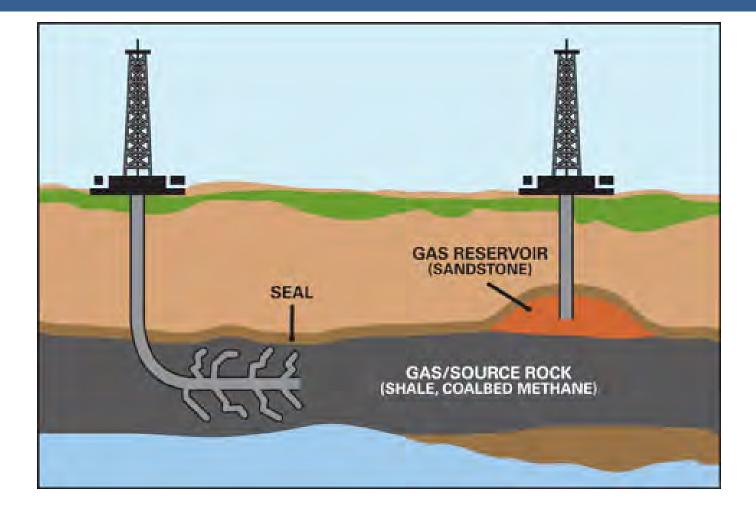


Shale Gas Wells in Region



10

Unconventional vs. Conventional



http://seekingalpha.com/article/131641-unconventional-natural-gas-just-a-frac-away

Differences in Drilling

Traditional Hydrofracking

 In traditional hydrofracking, typically 20,000 to 80,000 gallons of fluid were used each time a well was hydrofractured.

 Traditional hydrofracking used 700 to 2,800 lbs. of chemical additives

• 1940s

High Volume Hydrofracking (HVHF)

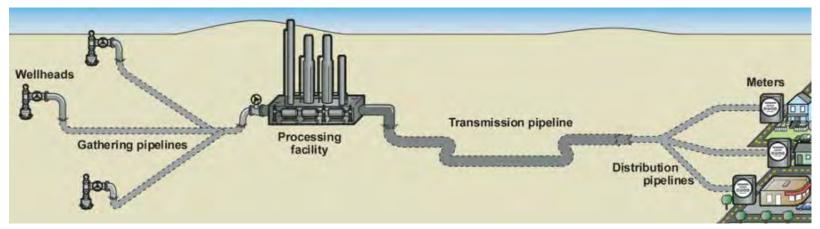
- HVHF uses between 2 and 10 million gallons of fluid (on average 5.6 million), the exact amount depends upon the length of the well bore and the number of fractures created along the lateral extent.
- HVHF uses between 205,000 and 935,000 lbs. of chemical additives, per well many of which are toxic to humans and wildlife.
- Late 1990s

3 Types of Pipelines

1. Gathering: Usually 6-24 inches in diameter. Carry gas at about 715 psi. These pipelines can travel long distances and there is no requirements to mark them or continually make sure they are cleared of vegetation etc. May clear rights-of-way of 30 to 150 feet wide.

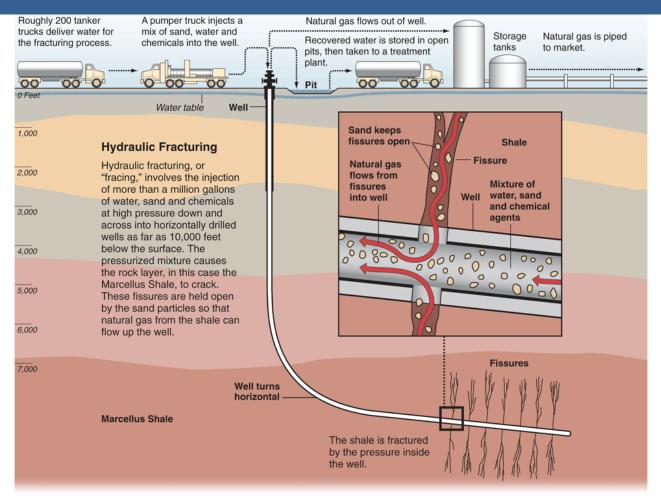
2. Transmission: Large steel pipes (usually 24-48" in diameter), carry gas 200-1200psi. These federally regulated pipelines fall under eminent domain so don't need land owner permission. The land is periodically cleared of large vegetation. Permanent structures and trees may never be placed there. Right-of-way widths of up to 200 feet.

3. Distribution: Small pipes (2-24" in diameter) that can be made of steel, cast iron, plastic or copper. Pressure of gas is reduced to less than 200psi. Mercaptan is added to the gas to give it a rotten egg odor at the city gate prior to being sent through distribution lines.



Source: Pipeline and Hazardous Materials Safety Administration

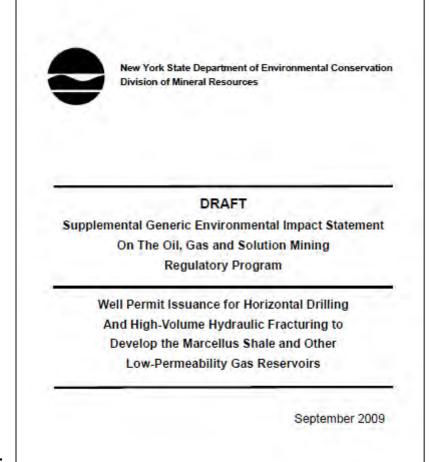
Hydraulic Fracturing (Fracking)



This protocol documents flowback pollution and visual observations in small streams.

Drilling Wastewater

- Frack water
 - Fluid that goes down the well
 - 160+ known hazardous materials
- Flowback water
 - Fluid that comes back out of the well
 - Steel and power companies can't use it because TDS levels are too high
 - Recycled
 - Inject water into ground or caverns/mines
 - Treat at authorized treatment facilities



Flowback water

Flowback water: water that returns to surface it consists of frack water plus chemicals released from underground rock formations.

- Quantity: 10-15% of frack water flows back
- Quality:
 - Brine (salty water) including high concentrations of chlorides, sulfates: very high TDS
 - Metals, e.g. barium iron, manganese, arsenic, strontium, lead, cadmium, chromium, aluminum
 - Naturally occurring radioactive materials such as uranium, radium, and radon
 - Bacteria
 - Methane
- Pathway to environment: spills, incomplete treatment, well casing leaks, migration through bedrock, illegal dumping



Volunteer Monitoring Protocol

Survey Type	Parameters	Methodology	Frequency
Chemical	 Conductivity and total dissolved solids Barium and strontium 	 LaMotte PockeTester Certified lab analysis 	 Weekly Twice a year and to confirm contamination event
Water quantity	• Stage	 Stream stage measurement 	Weekly
Physical	 Gas Related Earth Disturbance Spills and Discharges Gas Migration or Leakage Pipelines 	 Visual survey 	• Weekly



Why Volunteer Monitoring?



Volunteer Monitoring

- Citizens involved in data collection
- US: 1890 2016
- 48 states
- PA Streams: 1980s





Georgia Adopt-A-Stream Georgia's volunteer water quality monitoring program

National Weather Service



Citizen Stewards Water Quality Monitoring Program

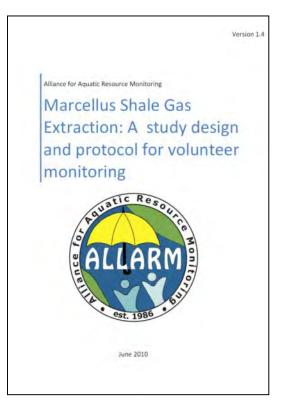
TEXAS STREAM TEAM



NJ Watershed Watch Network

Volunteer Monitoring

- Feasibility
- Affordability
- Scientifically robust





ALLARMwater.org

Red Flag Protocol: What Will You Monitor?

1. Flowback Monitoring: *Chemical Parameters*

<u>Indicator chemicals</u> Conductivity & TDS <u>Signature Chemicals</u> Barium Strontium

Stage Monitoring Relationship to conductivity



2. Physical Impacts *Visual Observations:*

- Land disturbances
- Spills and discharges
- Gas migration/leakages
- Pipelines



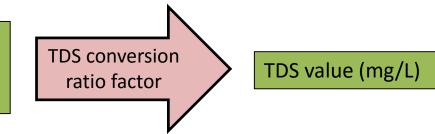


Conductivity and Total Dissolved Solids

- Conductivity measures the ability of water to pass an electrical current
- Total Dissolved Solids (TDS) measures the amount of ions dissolved in the water

(PA standard – 500 mg/L)

Voltage is applied between two probes to measure conductivity in microSiemens/centimeter (µS/cm)



Why Conductivity and TDS?

- Frack water mixes with natural brine, found in the shale
- Flowback water contains higher concentrations of salts and metals



Picture by Amy Bergdale, US EPA

Meter Trials



Dickinson students, faculty, and staff helped test conductivity/TDS meters to determine which meter is most accurate, precise, and easy to use.

Conductivity/Total Dissolved Solids Meter Testing

Thank you for participating in this meter testing session sponsored by the Alliance for Aquatic Resource Monitoring (ALLARM). Please answer the questions on page 1 about each water quality meter. Additional questions are found on page 2 – please provide as much feedback as possible!

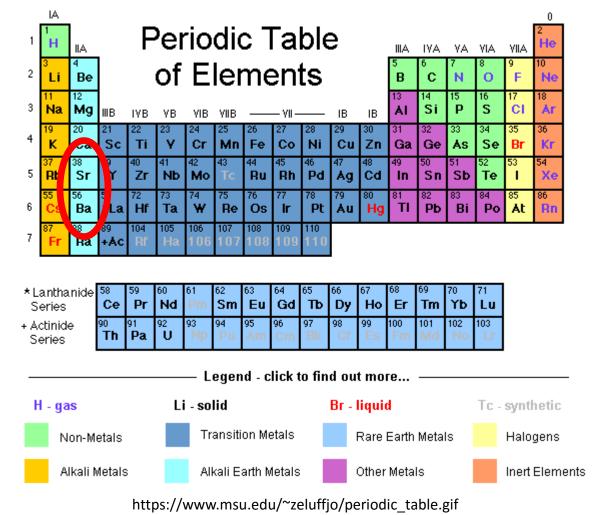
Meter A: LaMott	e Tracer Pocks	Tester			
Results	Solution	A	Solution	в	Solution C
Conductiv	vity				
TDS					
Did the reading st	tabilize? 1	/ES	ΝΟ		
How difficult was [1 = very (um 4 = e asy; 5 = •	very easy]	
1	2	3	4	5	
How difficult was [1 = very o			s? um 4 = easy; 5 = :	very easy]	
1	2	3	4	5	

Meter B: Oakton Mu	lti-Parameter PC	CSTestr 35			
Results	Solution &		Solution B		Solution C
Conductivity					
TDS					
Did the reading stabil	ize? YES	NO			
How difficult was it to [1 = very diffi	calibrate the m cult; 2 = difficult;		easy; 5 = very e	asy]	
1	2	3	4	5	
How difficult was it to [1 = very diffi	understand the icult; 2 = difficult		= easy; 5 = very (easy]	
1	2	3	4	5	

Barium and Strontium

 Naturallyoccurring metals found deep underground

 Indicate contamination from shale gas activities (signature chemicals)



Stage Monitoring







Visual Observations

- Earth Disturbances Gas Migration/Leakages
- Spills and Discharges Pipelines



Marcellus Shale Well Sites in Dimock, PA; 2010

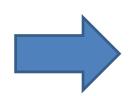
Monitoring Locations & Well Permits



Step 1:

Find where drilling permits have been issued, or identify priority streams or existing pollution issues:

- PADEP map/reports
- PADEP eNotice
- FracTracker

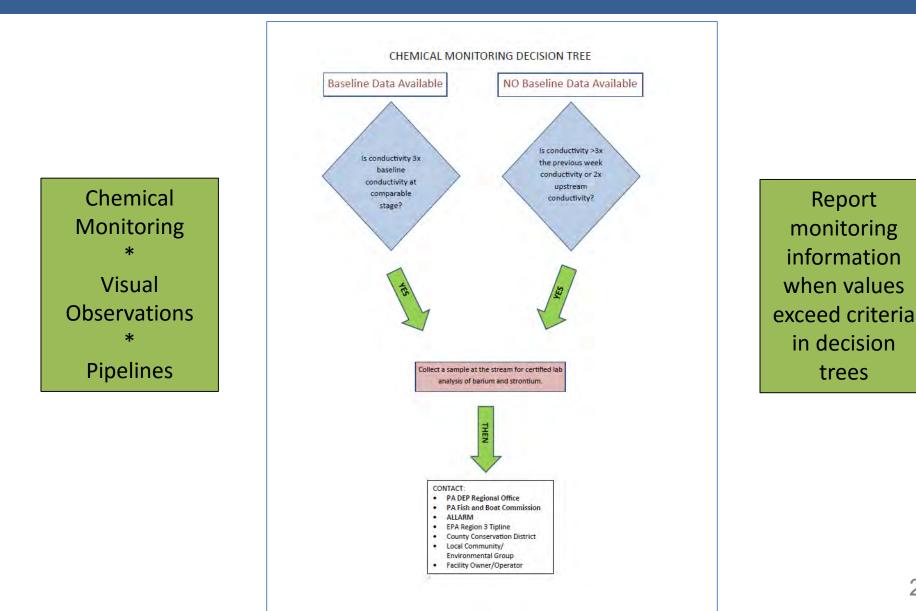


Step 2:

Find coordinates and choose monitoring site based on important features:

- Well locations
- Stream access
- Availability

Data Use: Decision Trees



Online Database and Toolkit

III OC

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		Regional Data (ALLAF	RM)		
Data				and an internet	
Name: ALLARM 11 County(s) 73 Site(s) 1648 Observation(s) 113 QA/QC reports		Map Satellite Fort	Buffalo NEW YOR	IK Albany	NEW MPSHI JSETTS Providen CUT
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Workshop Presentatio	ons	west ///	DELA	WARE	-
Meter Directions		VIRGINIA	1 2	1	+
More Resources					
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	Last Observation 09/25/2015		Map data ©2016 Google, 1		map error
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ALLARMwater.org

Building a Monitoring Constituency

- Movement 2000 people trained since the start of 2010
- ALLARM, DRN, PACTU, PASA, MWA, Sierra Club, Waterdogs







Alliance for Aquatic Resource Monitoring (ALLARM) Dickinson College P.O. Box 1773 Carlisle, PA 17013 717.245.1565 allarm@dickinson.edu <u>dickinson.edu/allarm</u>

ALLARMwater.org

Monitoring Locations & Well Permits



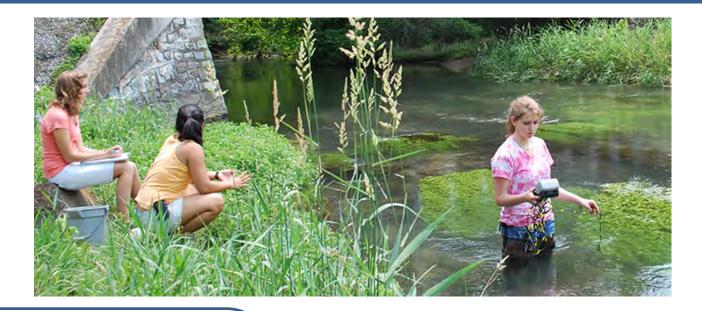
Identifying Monitoring Locations

We will be discussing:

- Tools for finding and tracking wells
- Considerations for monitoring sites
- Volunteer roles for the group



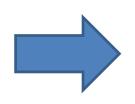
Determine Monitoring Locations



Step 1:

Find where drilling permits have been issued, or identify priority streams or existing pollution issues.

- PADEP map/reports
- PADEP eNotice
- FracTracker



Step 2:

Use reports and coordinates to choose monitoring site based on important features

- Well locations
- Stream access
- Availability

PA Oil and Gas Mapping

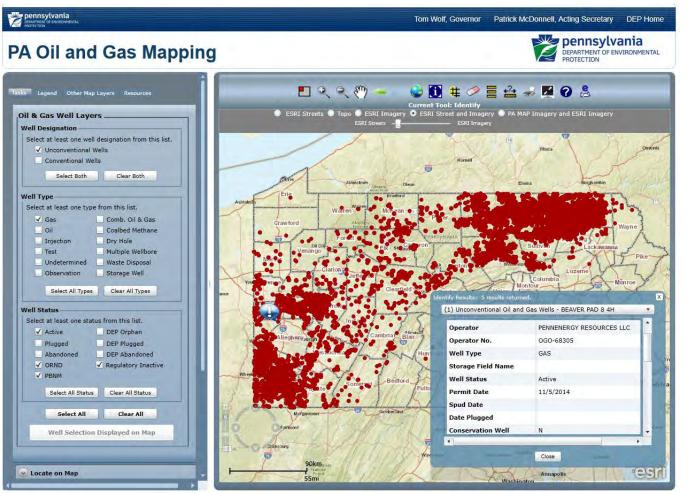
http://www.depgis.state.pa.us/PaOilAndGasMapping

Pros:

- Most current information
- Many options for searching (can search by well status, operator, permit number)

<u>Cons:</u>

- Somewhat clunky interface (but does have help page with definitions and guides)
- May have limited browser support



FracTracker

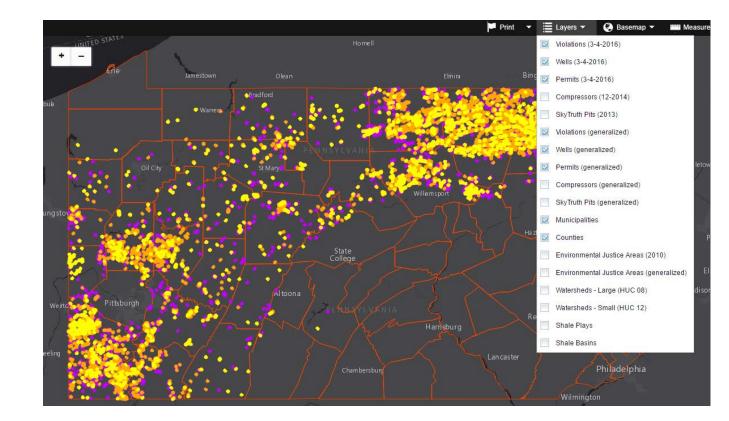
https://www.fractracker.org/map/us/pennsylvania/pa-shale-viewer/

Pros:

- Wider browser support
- Easier to use

<u>Cons:</u>

 Not always the most up-to-date information



http://www.depweb.state.pa.us





DEP > Data and Tools > Reports

REPORTS

In an effort to maximize transparency and improve efficiency, DEP provides easy access to dozens of online reports and key data about the many programs the agency administers.

RELATED INFORMATION OIL AND GAS REPORTS LAND RECYCLING REPORTS RADIATION PROTECTION REPORTS STORAGE TANK REPORTS

Oil and Gas Mapping

INTERACTIVE REPORTS

Interactive Reports Data Dictionary

Permits Issued Detail Report

Monthly - Permits Issued by County and Well Type Report

Year to Date - Permits Issued by County and Well Type Report

Oil and Gas Operator Well Inventory

Oil and Gas Compliance Report

SPUD Data Report

Wells Drilled By County

Wells Drilled By Operator

Oil and Gas Production Reports

Oil and Gas Well Production Status

Oil and Gas Electronic Notifications

DEP Orphan and Abandoned Wells

OIL AND GAS FAQ CONSERVATION LAW CONTACTS AND DIRECTIONS OIL AND GAS ELECTRONIC SUBMISSION GUIDES OIL AND GAS PRODUCTION REPORTS

PUBLIC RESOURCES

CONVENTIONAL OIL AND GAS ADVISORY COMMITTEE

MARCELLUS SHALE ADVISORY

OIL AND GAS TECHNICAL ADVISORY BOARD

ANNUAL REPORT

ABANDONED AND ORPHAN WELL PROGRAM

LAWS, REGULATIONS AND GUIDELINES

PERMIT ISSUED /YYYY)	START DATE (MI	M/DD 1/1/201	3	PER /YYY	MIT ISSUED END DATE (YY)	(MM/DD 6/9	9/2016			(View Report
COUNTY		26 - Fa	yette	I MUM	VICIPALITY	A	U.	*		4-14	\smile
REGION		All		OPE	RATOR	A				0	
UNCONVENTION	IAL ONLY	Yes	8	WEL	LL TYPE	GA	s				
14 4 1	of 5 🕨 🔰	Fin	d Next 🛃	· ③ 🔲						_	
	ayette; Mu	INTERPORTAL	Region: A	ll: Operator: A	ll; Unconventio	onal Only: Yes;	Well Type: G	AS	DEP O		F OIL AND G/ MITS ISSUED 6/8/2016 10:22:54
REGION ÷	COUNTY ÷		PERMIT ISSUED DATE	OPERATOR ÷	APPLICATION TYPE		API/PERMIT	UNCONVENTIONAL		WELL	FARM N
EP DOGO SWDO Dstr Off	Fayette	Franklin Twp		CHEVRON APPALACHIA LLC	NEW	Drill & Operate Well Permit	051-24602	Yes	Horizontal Well	GAS	MARTIN UI NORTH 1H
EP DOGO SWDO Dstr Off	Fayette	Franklin Twp	1/23/2014	CHEVRON APPALACHIA LLC	NEW	Drill & Operate Well Permit	051-24603	Yes	Horizontal Well	GAS	MARTIN UI NORTH 2H
EP DOGO SWDO Dstr Off	Fayette	Franklin Twp	1/23/2014	CHEVRON APPALACHIA LLC	NEW	Drill & Operate Well Permit	051-24605	Yes	Horizontal Well	GAS	MARTIN UI NORTH 3H
EP DOGO SWDO Dstr Off	Fayette	Franklin Twp	1/23/2014	CHEVRON APPALACHIA LLC	NEW	Drill & Operate Well Permit	051-24606	Yes	Horizontal Well	GAS	MARTIN UN NORTH 4H
EP DOGO SWDO Dstr Off	Fayette	Franklin Twp	8/22/2014	CHEVRON APPALACHIA LLC	NEW	Drill & Operate Well Permit Drill Deeper	051-24520	Yes	Horizontal Well	GAS	ROSA UNIT
EP DOGO SWDO Dstr Off	Fayette	Franklin Twp	8/22/2014	CHEVRON APPALACHIA LLC	NEW	Drill & Operate Well Permit Drill Deeper	051-24524	Yes	Horizontal Well	GAS	ROSA UNI
EP DOGO SWDO Dstr Off	Fayette	German Twp	1/20/2015	CHEVRON APPALACHIA LLC	NEW	Drill & Operate Well Permit	051-24617	Yes	Horizontal Well	GAS	ZALAC UN
EP DOGO	Fayette	German Twp	3/19/2015	CHEVRON	NEW	Drill &	051-24622	Yes	Horizontal Well	GAS	ZALAC UNI

Contains information about oil & gas wells:

- Permits issued (by operator and county, updated weekly)
- Active well inventory (by county)
- Spud reports/date drilling begins (updated weekly)

DEP's Active Well Inventory: All of the active oil & gas wells in Washington County

COUNTY	MUNICIPALITY	PERMIT ISSUED DATE	OPERATOR	APPLICATION TYPE	WELL API	UNCONVENTINONAL	HORIZONTAL WELL	WELL TYPE	LATITUDE DECIMAL	LONGITUDE DECIMAL
Washington	Buffalo Twp	6/27/2012	RANGE RESOURCES	NEW	125-24793-00- 00	Yes	Yes	GAS	40.169305	-80.350775
Washington	Hanover Twp	6/13/2012	RANGE RESOURCES	NEW	125-24787-00- 00	Yes	Yes	GAS	40.421611	-80.511644
Washington	Hanover Twp	6/13/2012	RANGE RESOURCES	NEW	125-24788-00- 00	Yes	Yes	GAS	40.42163	-80.511538
Washington	Independence Twp	6/26/2012	RANGE RESOURCES	NEW	125-24692-00- 00	Yes	Yes	GAS	40.226336	-80.445855
Washington	Independence Twp	6/26/2012	RANGE RESOURCES	NEW	125-24692-00- 01	Yes	Yes	GAS	40.226336	-80.445855
Washington	Independence Twp	6/26/2012	RANGE RESOURCES	NEW	125-24693-00- 00	Yes	Yes	GAS	40.226369	-80.445952
Washington	Independence Twp	6/26/2012	RANGE RESOURCES	NEW	125-24693-00- 01	Yes	Yes	GAS	40.226369	-80.445952

eNOTICE

- DEP's Electronic Notification system
- Receive information and track changes to oil & gas permits
- http://www.ahs2.dep.state.pa.us/eNOTICEWeb/

Archive	Report spam	Delete	Move to▼	Labels▼	More actions▼	<u>Refresh</u>			
Select: All, None, Read, Unread, Starred, Unstarred									
eNOTICE - Changes to Tracked Permits									

ra-epenotice@state.pa.us to me show details 10:00 AM The following Permit Applications have changed as of Friday, June 04, 2010. Bradford County: Authorization # 832571 has been updated on 6/2/2010. Subfacility ID=1012995 Name=COATES 5H eMapPA search Authorization # 835515 has been updated on 6/2/2010. Subfacility ID=1014502 Name=RICH 2H eMapPA search Authorization # 835521 has been updated on 6/2/2010. Subfacility ID=1014502 Name=RICH 2H eMapPA search Authorization # 835502 has been updated on 6/2/2010. Subfacility ID=1014514 Name=HAYWARD 5H eMapPA search Authorization # 835518 has been updated on 6/2/2010. Subfacility ID=1014549 Name=OATES 5H eMapPA search Authorization # 835612 has been updated on 6/2/2010. Subfacility ID=1014549 Name=COATES 5H eMapPA search Authorization # 836423 has been updated on 6/2/2010. Subfacility ID=1012995 Name=COATES 5H eMapPA search Authorization # 836432 has been updated on 6/2/2010. Subfacility ID=1014971 Name=FEUSNER 03 045 01 J 1H eMapPA search Authorization # 836433 has been updated on 6/2/2010. Subfacility ID=1014873 Name=YURKANIN 03 014 01 J 1H eMapPA search Authorization # 836443 has been updated on 6/2/2010. Subfacility ID=1014873 Name=YURKANIN 03 014 01 J 1H eMapPA search Authorization # 836449 has been updated on 6/2/2010. Subfacility ID=1014878 Name=YURKANIN 03 014 01 J 1H eMapPA search Authorization # 836459 has been updated on 6/2/2010. Subfacility ID=1014878 Name=YURKANIN 03 014 01 J 1H eMapPA search Authorization # 836459 has been updated on 6/2/2010. Subfacility ID=1014878 Name=YURKANIN 03 014 01 J 3H eMapPA search Authorization # 836459 has been updated on 6/2/2010. Subfacility ID=1014888 Name=YURKANIN 03 014 05 J 5H eMapPA search Authorization # 836459 has been updated on 6/2/2010. Subfacility ID=1014888 Name=YURKANIN 03 014 05 J			-	
Bradford County: Authorization # 832571 has been updated on 6/2/2010. Subfacility ID=1012995 Name=COATES SH eMapPA search Authorization # 835515 has been updated on 6/2/2010. Subfacility ID=1014502 Name=RICH 2H eMapPA search Authorization # 835521 has been updated on 6/2/2010. Subfacility ID=1014514 Name=HAYWARD SH eMapPA search Authorization # 835508 has been updated on 6/2/2010. Subfacility ID=1014514 Name=HAYWARD SH eMapPA search Authorization # 835508 has been updated on 6/2/2010. Subfacility ID=1014549 Name=HAYWARD SH eMapPA search Authorization # 836508 has been updated on 6/2/2010. Subfacility ID=1014549 Name=HAYTWILL FARMS 2H eMapPA search Authorization # 836423 has been updated on 6/2/2010. Subfacility ID=1014891 Name=FGUSINE SH eMapPA search Authorization # 836423 has been updated on 6/2/2010. Subfacility ID=1014871 Name=FEUSINE 03 045 01 J 1H eMapPA search Authorization # 836433 has been updated on 6/2/2010. Subfacility ID=1014871 Name=FEUSINE 03 045 02 J 2H eMapPA search Authorization # 836435 has been updated on 6/2/2010. Subfacility ID=1014873 Name=YURKANIN 03 014 01 J 1H eMapPA search Authorization # 836449 has been updated on 6/2/2010. Subfacility ID=1014873 Name=YURKANIN 03 014 02 J 2H eMapPA search Authorization # 836449 has been updated on 6/2/2010. Subfacility ID=1014877 Name=YURKANIN 03 014 03 J 3H eMapPA search Authorization # 836454 has been updated on 6/2/2010. Subfacility ID=1014878 Name=YURKANIN 03 014 03 J 3H eMapPA search Authorization # 836454 has been updated on 6/2/2010. Subfacility ID=1014878 Name=YURKANIN 03 014 04 J 4H eMapPA search Authorization # 836454 has been updated on 6/2/2010. Subfacility ID=1014888 Name=YURKANIN 03 014 05 J SH eMapPA search Authorization # 836454 has been updated on 6/2/2010. Subfacility ID=1014888 Name=YURKANIN 03 014 05 J SH eMapPA search Authorization # 836470 has been updated on 6/2/2010. Subfacility ID=1014888 Name=YURKANIN 03 014 05 J SH eMapPA search Authorization # 836470 has been updated on 6/2/2010. Subfaci		ra-epenotice@	state.pa.us to me	show details 10:00 AM
Authorization # <u>832571</u> has been updated on 6/2/2010. Subfacility ID=1012995 Name=COATES 5H <u>eMapPA search</u> Authorization # <u>835515</u> has been updated on 6/2/2010. Subfacility ID=1014502 Name=RICH 2H <u>eMapPA search</u> Authorization # <u>835521</u> has been updated on 6/2/2010. Subfacility ID=1014514 Name=HAYWARD 5H <u>eMapPA search</u> Authorization # <u>835608</u> has been updated on 6/2/2010. Subfacility ID=1014543 Name=OSHEA 2H <u>eMapPA search</u> Authorization # <u>835618</u> has been updated on 6/2/2010. Subfacility ID=1014543 Name=CATE WILL FARNS 2H <u>eMapPA search</u> Authorization # <u>836423</u> has been updated on 6/2/2010. Subfacility ID=1014599 Name=COATES 5H <u>eMapPA search</u> Authorization # <u>836429</u> has been updated on 6/2/2010. Subfacility ID=1014871 Name=FEUSNER 03 045 01 J 1H <u>eMapPA search</u> Authorization # <u>836429</u> has been updated on 6/2/2010. Subfacility ID=1014871 Name=FEUSNER 03 045 02 J 2H <u>eMapPA search</u> Authorization # <u>836429</u> has been updated on 6/2/2010. Subfacility ID=1014872 Name=FUUSNER 03 045 02 J 2H <u>eMapPA search</u> Authorization # <u>836429</u> has been updated on 6/2/2010. Subfacility ID=1014873 Name=YUKKANIN 03 014 01 J 1H <u>eMapPA search</u> Authorization # <u>836449</u> has been updated on 6/2/2010. Subfacility ID=1014878 Name=YUKKANIN 03 014 01 J 1H <u>eMapPA search</u> Authorization # <u>836459</u> has been updated on 6/2/2010. Subfacility ID=1014878 Name=YUKKANIN 03 014 01 J 3H <u>eMapPA search</u> Authorization # <u>836459</u> has been updated on 6/2/2010. Subfacility ID=1014878 Name=YUKKANIN 03 014 01 J 1H <u>eMapPA search</u> Authorization # <u>836459</u> has been updated on 6/2/2010. Subfacility ID=1014878 Name=YUKKANIN 03 014 01 J 3H <u>eMapPA search</u> Authorization # <u>836459</u> has been updated on 6/2/2010. Subfacility ID=1014888 Name=YUKKANIN 03 014 05 J 5H <u>eMapPA search</u> Authorization # <u>8364570</u> has been updated on 6/2/2010. Subfacility ID=1014888 Name=YUKKANIN 03 014 05 J 5H <u>eMapPA search</u> Authorization # <u>836470</u> has been updated on 6/2/2010. Subfacility ID=1014888 Name=YUKKANIN 03 014 05 J 5H <u>eMapPA search</u>	T	ne following Pe	rmit Applications have changed as of Friday, June 04	4, 2010.
Subfacility ID=1012995 Name=COATES SH eMapPA search Authorization # 835515 has been updated on 6/2/2010. Subfacility ID=1014502 Name=RICH 2H eMapPA search Authorization # 835521 has been updated on 6/2/2010. Subfacility ID=1014514 Name=HAYWARD SH eMapPA search Authorization # 835618 has been updated on 6/2/2010. Subfacility ID=1014514 Name=COATES SH eMapPA search Authorization # 835618 has been updated on 6/2/2010. Subfacility ID=1014549 Name=MAYT WILL FARMS 2H eMapPA search Authorization # 836423 has been updated on 6/2/2010. Subfacility ID=1014974 Name=COATES SH eMapPA search Authorization # 836429 has been updated on 6/2/2010. Subfacility ID=1014971 Name=FLOSNER 03 045 01 J 1H eMapPA search Authorization # 836432 has been updated on 6/2/2010. Subfacility ID=1014871 Name=FUSNER 03 045 02 J 2H eMapPA search Authorization # 836433 has been updated on 6/2/2010. Subfacility ID=1014871 Name=FUSNER 03 045 02 J 2H eMapPA search Authorization # 836435 has been updated on 6/2/2010. Subfacility ID=1014877 Name=YURKANIN 03 014 01 J 1H eMapPA search Authorization # 836444 has been updated on 6/2/2010. Subfacility ID=1014877 Name=YURKANIN 03 014 02 J 2H eMapPA search Authorization # 836445 has been updated on 6/2/2010. Subfacility ID=1014877 Name=YURKANIN 03 014 03 J 3H eMapPA search Authorization # 836454 has been updated on 6/2/2010. Subfacility ID=1014878 Name=YURKANIN 03 014 04 J 3H eMapPA search Authorization # 836454 has been updated on 6/2/2010. Subfacility ID=1014878 Name=YURKANIN 03 014 04 J 3H eMapPA search Authorization # 836454 has been updated on 6/2/2010. Subfacility ID=1014888 Name=YURKANIN 03 014 04 J 3H eMapPA search Authorization # 836454 has been updated on 6/2/2010. Subfacility ID=1014888 Name=YURKANIN 03 014 05 J SH eMapPA search Authorization # 836457 has been updated on 6/2/2010. Subfacility ID=1014885 Name=YURKANIN 03 014 05 J SH eMapPA search Authorization # 836470 has been updated on 6/2/2010. Subfacility ID=1014885 Name=YURKANIN 03 014 05 J SH eMapPA search Aut	В	radford Count	y:	
Authorization # <u>835515</u> has been updated on <u>6</u> /27010. Subfacility ID=1014502 Name=RICH 2H <u>eMapPA search</u> Authorization # <u>835521</u> has been updated on <u>6</u> /27010. Subfacility ID=1014514 Name=HAYWARD 5H <u>eMapPA search</u> Authorization # <u>835521</u> has been updated on <u>6</u> /27010. Subfacility ID=1014549 Name=OATEA 2H <u>eMapPA search</u> Authorization # <u>835618</u> has been updated on <u>6</u> /27010. Subfacility ID=1014549 Name=MATT WILL FARMS 2H <u>eMapPA search</u> Authorization # <u>836423</u> has been updated on <u>6</u> /27010. Subfacility ID=1012995 Name=COATES 5H <u>eMapPA search</u> Authorization # <u>836429</u> has been updated on <u>6</u> /27010. Subfacility ID=1012995 Name=CEVES 5H <u>eMapPA search</u> Authorization # <u>836429</u> has been updated on <u>6</u> /27010. Subfacility ID=1014871 Name=FEUSNER 03 04501 J 1H <u>eMapPA search</u> Authorization # <u>836431</u> has been updated on <u>6</u> /27010. Subfacility ID=1014872 Name=FEUSNER 03 04502 J 2H <u>eMapPA search</u> Authorization # <u>836449</u> has been updated on <u>6</u> /27010. Subfacility ID=1014873 Name=YURKANIN 03 014 01 J 1H <u>eMapPA search</u> Authorization # <u>836449</u> has been updated on <u>6</u> /27010. Subfacility ID=1014874 Name=YURKANIN 03 014 02 J 2H <u>eMapPA search</u> Authorization # <u>836449</u> has been updated on <u>6</u> /27010. Subfacility ID=1014878 Name=YURKANIN 03 014 03 J 3H <u>eMapPA search</u> Authorization # <u>836452</u> has been updated on <u>6</u> /27010. Subfacility ID=1014878 Name=YURKANIN 03 014 03 J 3H <u>eMapPA search</u> Authorization # <u>836452</u> has been updated on <u>6</u> /27010. Subfacility ID=1014878 Name=YURKANIN 03 014 05 J 5H <u>eMapPA search</u> Authorization # <u>836457</u> has been updated on <u>6</u> /27010. Subfacility ID=1014888 Name=YURKANIN 03 014 05 J 5H <u>eMapPA search</u> Authorization # <u>836457</u> has been updated on <u>6</u> /27010. Subfacility ID=1014885 Name=YURKANIN 03 014 05 J 5H <u>eMapPA search</u> Authorization # <u>836470</u> has been updated on <u>6</u> /27010. Subfacility ID=1014885 Name=YURKANIN 03 014 05 J 5H <u>eMapPA search</u> Authorization # <u>836470</u> has been updated on <u>6</u> /27010. Subfacility ID=1014885 Name=YURKANIN 03 014 05 J 5H <u>eM</u>		Authorization	# <u>832571</u> has been updated on 6/2/2010.	
Subfacility ID=1014502 Name=RiCH 2H <u>eMapPA search</u> Authorization # <u>835521</u> has been updated on 6/2/2010. Subfacility ID=1014514 Name=HAYWARD 5H <u>eMapPA search</u> Authorization # <u>835608</u> has been updated on 6/2/2010. Subfacility ID=1014543 Name=OSHEA 2H <u>eMapPA search</u> Authorization # <u>835618</u> has been updated on 6/2/2010. Subfacility ID=1014549 Name=MATT WILL FARMS 2H <u>eMapPA search</u> Authorization # <u>836423</u> has been updated on 6/2/2010. Subfacility ID=10149549 Name=CATES 5H <u>eMapPA search</u> Authorization # <u>836423</u> has been updated on 6/2/2010. Subfacility ID=1014971 Name=FEUSNER 03 045 01 J 1H <u>eMapPA search</u> Authorization # <u>836433</u> has been updated on 6/2/2010. Subfacility ID=1014871 Name=FEUSNER 03 045 02 J 2H <u>eMapPA search</u> Authorization # <u>836435</u> has been updated on 6/2/2010. Subfacility ID=1014871 Name=FEUSNER 03 045 02 J 2H <u>eMapPA search</u> Authorization # <u>836434</u> has been updated on 6/2/2010. Subfacility ID=1014873 Name=YURKANIN 03 014 01 J 1H <u>eMapPA search</u> Authorization # <u>836444</u> has been updated on 6/2/2010. Subfacility ID=1014874 Name=YURKANIN 03 014 02 J 2H <u>eMapPA search</u> Authorization # <u>836454</u> has been updated on 6/2/2010. Subfacility ID=1014878 Name=YURKANIN 03 014 03 J 3H <u>eMapPA search</u> Authorization # <u>836454</u> has been updated on 6/2/2010. Subfacility ID=1014878 Name=YURKANIN 03 014 04 J 4H <u>eMapPA search</u> Authorization # <u>836454</u> has been updated on 6/2/2010. Subfacility ID=1014878 Name=YURKANIN 03 014 05 J 5H <u>eMapPA search</u> Authorization # <u>836454</u> has been updated on 6/2/2010. Subfacility ID=1014888 Name=YURKANIN 03 014 05 J 5H <u>eMapPA search</u> Authorization # <u>836454</u> has been updated on 6/2/2010. Subfacility ID=1014885 Name=YURKANIN 03 014 05 J 6H <u>eMapPA search</u> Authorization # <u>836457</u> has been updated on 6/2/2010. Subfacility ID=1014885 Name=YURKANIN 03 014 05 J 6H <u>eMapPA search</u> Authorization # <u>836470</u> has been updated on 6/2/2010. Subfacility ID=1014885 Name=YURKANIN 03 014 05 J 7H <u>eMapPA search</u> Authorization # <u>836470</u> has been updated on 6/2/2010.		Subfacility	ID=1012995 Name=COATES 5H eMapPA search	
Authorization # <u>835521</u> has been updated on <u>6</u> /27010. Subfacility ID=1014514 Name=HAYWARD 5H <u>eMapPA search</u> Authorization # <u>83500</u> has been updated on <u>6</u> /27010. Subfacility ID=1014549 Name=OSHEA 2H <u>eMapPA search</u> Authorization # <u>836518</u> has been updated on <u>6</u> /27010. Subfacility ID=1014549 Name=MATT WILL FARMS 2H <u>eMapPA search</u> Authorization # <u>836423</u> has been updated on <u>6</u> /27010. Subfacility ID=1014549 Name=COATES 5H <u>eMapPA search</u> Authorization # <u>836423</u> has been updated on <u>6</u> /27010. Subfacility ID=1014971 Name=FCUSNER 03 045 01 J 1H <u>eMapPA search</u> Authorization # <u>836432</u> has been updated on <u>6</u> /27010. Subfacility ID=1014871 Name=FCUSNER 03 045 02 J 2H <u>eMapPA search</u> Authorization # <u>836435</u> has been updated on <u>6</u> /27010. Subfacility ID=1014877 Name=FUSNER 03 045 02 J 2H <u>eMapPA search</u> Authorization # <u>836445</u> has been updated on <u>6</u> /27010. Subfacility ID=1014877 Name=YURKANIN 03 014 02 J 2H <u>eMapPA search</u> Authorization # <u>836444</u> has been updated on <u>6</u> /27010. Subfacility ID=1014877 Name=YURKANIN 03 014 02 J 2H <u>eMapPA search</u> Authorization # <u>836454</u> has been updated on <u>6</u> /27010. Subfacility ID=1014878 Name=YURKANIN 03 014 02 J 2H <u>eMapPA search</u> Authorization # <u>836454</u> has been updated on <u>6</u> /27010. Subfacility ID=1014878 Name=YURKANIN 03 014 03 J 3H <u>eMapPA search</u> Authorization # <u>8364554</u> has been updated on <u>6</u> /27010. Subfacility ID=1014888 Name=YURKANIN 03 014 05 J 5H <u>eMapPA search</u> Authorization # <u>836457</u> has been updated on <u>6</u> /27010. Subfacility ID=1014885 Name=YURKANIN 03 014 05 J 6H <u>eMapPA search</u> Authorization # <u>836457</u> has been updated on <u>6</u> /27010. Subfacility ID=1014885 Name=YURKANIN 03 014 05 J 6H <u>eMapPA search</u> Authorization # <u>836470</u> has been updated on <u>6</u> /27010. Subfacility ID=1014885 Name=YURKANIN 03 014 05 J 6H <u>eMapPA search</u> Authorization # <u>836470</u> has been updated on <u>6</u> /27010. Subfacility ID=1014885 Name=YURKANIN 03 014 07 J 7H <u>eMapPA search</u>		Authorization	# 835515 has been updated on 6/2/2010.	
Subfacility ID=1014514 Name=HXYWARD SH <u>eMapPA search</u> Authorization # <u>835608</u> has been updated on 6/2/2010. Subfacility ID=1014543 Name=OSHEA 2H <u>eMapPA search</u> Authorization # <u>83618</u> has been updated on 6/2/2010. Subfacility ID=1014549 Name=MATT WILL FARMS 2H <u>eMapPA search</u> Authorization # <u>836423</u> has been updated on 6/2/2010. Subfacility ID=1014599 Name=COATES SH <u>eMapPA search</u> Authorization # <u>836429</u> has been updated on 6/2/2010. Subfacility ID=1014871 Name=FEUSNER 03 045 01 J 1H <u>eMapPA search</u> Authorization # <u>836429</u> has been updated on 6/2/2010. Subfacility ID=1014871 Name=FEUSNER 03 045 02 J 2H <u>eMapPA search</u> Authorization # <u>836439</u> has been updated on 6/2/2010. Subfacility ID=1014872 Name=FUUSNER 03 045 02 J 2H <u>eMapPA search</u> Authorization # <u>836444</u> has been updated on 6/2/2010. Subfacility ID=1014873 Name=YUKKANIN 03 014 01 J 1H <u>eMapPA search</u> Authorization # <u>836454</u> has been updated on 6/2/2010. Subfacility ID=1014877 Name=YUKKANIN 03 014 01 J 3H <u>eMapPA search</u> Authorization # <u>836454</u> has been updated on 6/2/2010. Subfacility ID=1014878 Name=YUKKANIN 03 1014 03 J 3H <u>eMapPA search</u> Authorization # <u>836452</u> has been updated on 6/2/2010. Subfacility ID=1014878 Name=YUKKANIN 03 014 03 J 3H <u>eMapPA search</u> Authorization # <u>836452</u> has been updated on 6/2/2010. Subfacility ID=1014878 Name=YUKKANIN 03 014 05 J SH <u>eMapPA search</u> Authorization # <u>836457</u> has been updated on 6/2/2010. Subfacility ID=1014888 Name=YUKKANIN 03 014 05 J SH <u>eMapPA search</u> Authorization # <u>836470</u> has been updated on 6/2/2010. Subfacility ID=1014885 Name=YUKKANIN 03 014 05 J SH <u>eMapPA search</u> Authorization # <u>836470</u> has been updated on 6/2/2010. Subfacility ID=1014885 Name=YUKKANIN 03 014 05 J SH <u>eMapPA search</u> Authorization # <u>836470</u> has been updated on 6/2/2010. Subfacility ID=1014885 Name=YUKKANIN 03 014 05 J SH <u>eMapPA search</u> Authorization # <u>836470</u> has been updated on 6/2/2010.		Subfacility	ID=1014502 Name=RICH 2H eMapPA search	
Authorization # 835098 has been updated on 6/2/2010. Subfacility ID=1014543 Name=OSHEA 2H eMapPA search Authorization # 835018 has been updated on 6/2/2010. Subfacility ID=1014594 Name=MATT WILL FARMS 2H eMapPA search Authorization # 836423 has been updated on 6/2/2010. Subfacility ID=1014971 Name=FCUSNER 03 045 01 J 1H eMapPA search Authorization # 836433 has been updated on 6/2/2010. Subfacility ID=1014871 Name=FEUSNER 03 045 01 J 1H eMapPA search Authorization # 836433 has been updated on 6/2/2010. Subfacility ID=1014871 Name=FEUSNER 03 045 02 J 2H eMapPA search Authorization # 836433 has been updated on 6/2/2010. Subfacility ID=1014872 Name=FEUSNER 03 045 02 J 2H eMapPA search Authorization # 836434 has been updated on 6/2/2010. Subfacility ID=1014873 Name=YURKANIN 03 014 01 J 1H eMapPA search Authorization # 836444 has been updated on 6/2/2010. Subfacility ID=1014874 Name=YURKANIN 03 014 02 J 2H eMapPA search Authorization # 836454 has been updated on 6/2/2010. Subfacility ID=1014874 Name=YURKANIN 03 014 03 J 3H eMapPA search Authorization # 836454 has been updated on 6/2/2010. Subfacility ID=1014878 Name=YURKANIN 03 014 03 J 3H eMapPA search Authorization # 836454 has been updated on 6/2/2010. Subfacility ID=1014878 Name=YURKANIN 03 014 04 J 4H eMapPA search Authorization # 836454 has been updated on 6/2/2010. Subfacility ID=1014888 Name=YURKANIN 03 014 05 J SH eMapPA search Authorization # 836457 has been updated on 6/2/2010. Subfacility ID=1014885 Name=YURKANIN 03 014 05 J SH eMapPA search Authorization # 836470 has been updated on 6/2/2010. Subfacility ID=1014885 Name=YURKANIN 03 014 05 J SH eMapPA search Authorization # 836470 has been updated on 6/2/2010. Subfacility ID=1014885 Name=YURKANIN 03 014 05 J SH eMapPA search Authorization # 836470 has been updated on 6/2/2010. Subfacility ID=1014885 Name=YURKANIN 03 014 07 J 7H eMapPA search				
Subfacility ID=1014543 Name=OSHEA 2H <u>eMapPA search</u> Authorization # <u>835618</u> has been updated on 6/2/2010. Subfacility ID=1014549 Name=MATT WILL FARMS 2H <u>eMapPA search</u> Authorization # <u>836423</u> has been updated on 6/2/2010. Subfacility ID=1012995 Name=COATES 5H <u>eMapPA search</u> Authorization # <u>836429</u> has been updated on 6/2/2010. Subfacility ID=1014871 Name=FEUSNER 03 04501 J 1H <u>eMapPA search</u> Authorization # <u>836432</u> has been updated on 6/2/2010. Subfacility ID=1014872 Name=FEUSNER 03 04502 J 2H <u>eMapPA search</u> Authorization # <u>836434</u> has been updated on 6/2/2010. Subfacility ID=1014873 Name=YURKANIN 03 014 01 J 1H <u>eMapPA search</u> Authorization # <u>836443</u> has been updated on 6/2/2010. Subfacility ID=1014873 Name=YURKANIN 03 014 02 J 2H <u>eMapPA search</u> Authorization # <u>836449</u> has been updated on 6/2/2010. Subfacility ID=1014874 Name=YURKANIN 03 014 02 J 2H <u>eMapPA search</u> Authorization # <u>836452</u> has been updated on 6/2/2010. Subfacility ID=1014878 Name=YURKANIN 03 014 03 J 3H <u>eMapPA search</u> Authorization # <u>836452</u> has been updated on 6/2/2010. Subfacility ID=1014878 Name=YURKANIN 03 014 03 J 3H <u>eMapPA search</u> Authorization # <u>836454</u> has been updated on 6/2/2010. Subfacility ID=1014888 Name=YURKANIN 03 014 05 J 5H <u>eMapPA search</u> Authorization # <u>8364570</u> has been updated on 6/2/2010. Subfacility ID=1014885 Name=YURKANIN 03 014 05 J 6H <u>eMapPA search</u> Authorization # <u>836470</u> has been updated on 6/2/2010. Subfacility ID=1014885 Name=YURKANIN 03 014 05 J 6H <u>eMapPA search</u> Authorization # <u>836470</u> has been updated on 6/2/2010. Subfacility ID=1014885 Name=YURKANIN 03 014 07 J 7H <u>eMapPA search</u>				
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Authorization # 836478 has been updated on 6/2/2010.				PA search
		Authorization	# 836478 has been updated on 6/2/2010.	

eNOTICE - Changes to Tracked Permits Inbox X

Group Roles – Checking Permits

- It may be effective to designate one person to check for new permits in the area
 - Can be someone who is already checking permits, or someone interested in permitting information, and report information to the group



Safety Considerations



http://farm3.static.flickr.com/2405/1516087369_fb0226bc11.jpg

General advice

Develop language as a group that describes what you are doing...

"Monitoring stream health" vs. "Tracking down fracking polluters"



http://www.alicia-logic.com/email/_ Close%20Encounter%20with%20a%20Pit%20bull.jpg

Property Access

- Public land, such as State Game Lands or state forests, are open to the public
 - Access rights are not a concern
 - However, you are not allowed on active drilling sites due to safety concerns (industrial site)
- For private properties, always ask the landowner's permission



http://unitednuclear.com/images/sign3.jpg

Personal Safety

- Do not make contact with water or soil that could be contaminated unless you have protective clothing
 - Wading boots
 - Latex gloves
- Do not put yourself into a situation that may be dangerous.



http://3.bp.blogspot.com/_aJqybhzJII4/TCmffCsTpsI/AAAAAAAAA Mo/Bv7vB1LsJWw/s1600/NZRACH2+431.jpg

Personal Safety

- When out in the field, bring a cell phone and *leave it on*
- Steer clear of confrontation. Leave the area if someone confronts or threatens you.



http://www.jaimesmcneal.com/Jaimes_McNeal/Blog/Entries/2009 /12/21_Conflict,_it%E2%80%99s_not_just_for_breakfast_anymore !_files/shapeimage_2.png

Physical Parameters



Protocol developed alongside:

- Bradford County Conservation District
- Mountain Watershed Association
- PA Trout Unlimited
- Pine Creek Waterdogs
- EarthJustice



Visual Observations

- Document physical status of the stream
- Identify potential impacts/pollution events
- Report violations and/or suspicious activity



Recording Observations: Data Sheet

June 2016

	sure to enter all data at ALLARMwa	ter.org			
CS.B.					
Site Information	Sample Inform	ation	-		
Monitor's Name	Assessment Da	t Date			
Site Location	A sessment II	me			
A 10 10 10 10 10 10 10 10 10 10 10 10 10					_
Earth Disturbances:					
Stream:		Yes	No	Pipeline	Photo
Sediment enters stream, pond, or other wate	rbody	12.11	1:21	1	
Access Road:		Yes	Na	Pipeline	Photo
Banks are not stabilized (no mulch, seeding, v	regetation, etc.)			-	
Crosses stream and drainage from road empt	ies into stream				
Not stabilized with clean substrate material (i	.e. gravel)			1	1.
Drainage/mud/sediment from access road en	ters road ditch				
Drainage/mud/sediment from access road tra	ivels to main road			-	
Drill Pad, Storage Pond & Staging Area:		Yes	No	Pipeline	Photo
Earth disturbed at edge of water; no controls	to stop/filter runoff				
Clean water enters the site from uphill with n	o diversion ditch				
Sediment BMP outlets empty into water body	without filtering runoff	1		1	
	nulch, seeding, vegetation, etc.)				

Yes	Ne	Pipeline	Photo
	1	1.1.1.1	
			1
	+		
		1	11
	Yes	Yes No	Yes No Pipeline

Gas Migration and Leakages:

Stream:	Yes	No	Pipeline	Photo
Gas bubbling to surface				
Unusual gas-like odor (mercantan)				

Description of Observation(s):

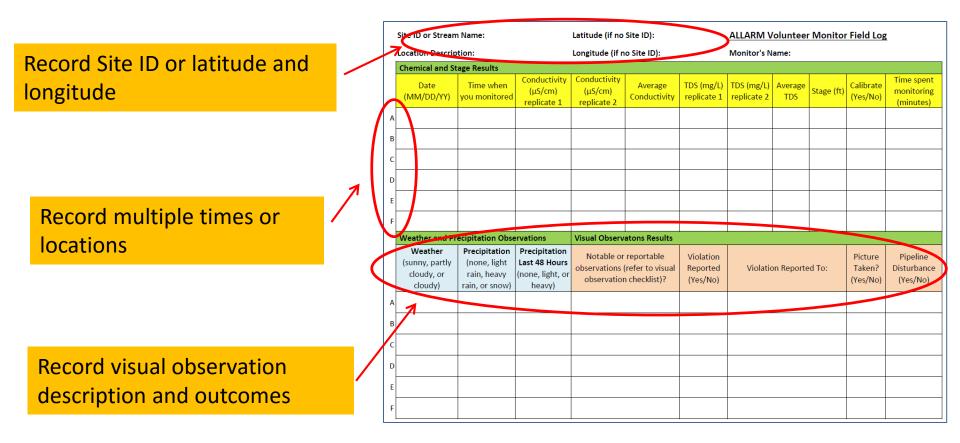
Record latitude and longitude or Site ID/ location description

Take photograph (date and time stamp) and record on the data sheet

Record thorough description of the observation

Alliance for Aquatic Resource Monitoring (ALLARM)

Recording Observations: Field Data Log



Recording Observations: ALLARMwater.org

8/websites/allar	m/DataEnt	NEOrm pho	LocationPicklist=
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	Regional Data Resource	es About Contact		Welcome K Logout My Profile	
ALLARM					
		Data Entry Form	1		
Select a location: UNT	T Little Sugar Creek	٠	Map Satellite	1. A. 4. 12	
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Time spent sampling:	minutes		Tened .	9	
Meter calibrated?Se	elect •		301	1 1	
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Conductivity replic	ate 1: Cond rep 1	replicate 2: Cond rep 2	average	µS/cm	
		1	-		
Total dissolved solids replic (TDS)	ate 1: TDS rep 1	replicate 2: TDS rep 2	average:	mg/L	
Steen		12.0			
Stage:		feet			
	Stage should be entered with	decimals in feet, not inches (exa	imple: 1.4)		
Cross sectional area:		square feet			
Weather:	Select				
Device and	Select Sunny				
Precipitation:	Partly cloudy Cloudy				
Precipitation last 48 hours:	Select *				
Did you look for visual	Select				
observations?					
Other observations, or details?					

Visual Observation Categories

- Earth Disturbances
 Gas Migration/Leakages
- Spills and Discharges Pipelines

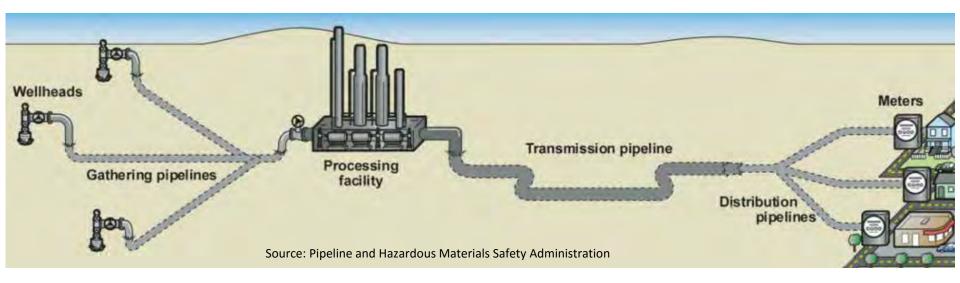


Marcellus Shale Well Sites in Dimock, PA; 2010

Pipelines

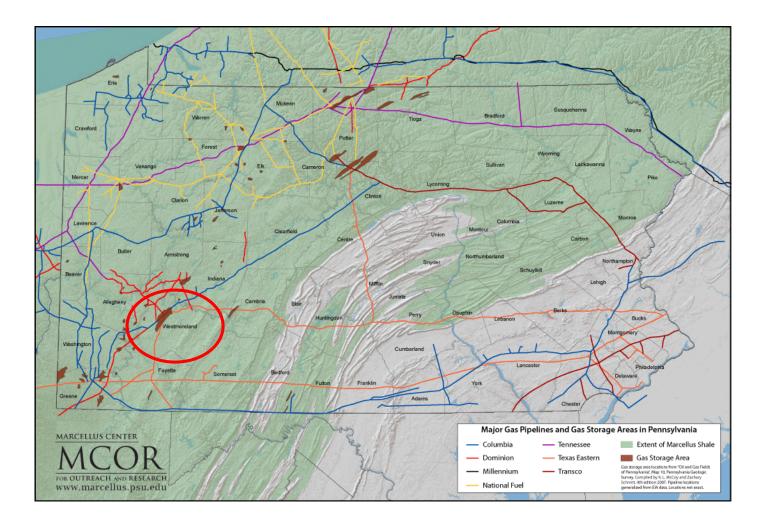


Types of Pipelines



- Gathering Lines: Small lines from wells.
- **Transmission Lines**: Larger lines that transport gas long distances, compressor stations every 40-60 mi to keep gas at a high enough pressure for travel.
- **Distribution Lines**: Small lines going into homes, businesses etc.

Major Pipelines



Environmental Concerns

- Erosion and sedimentation (largest concern, most common violation)
- Loss of riparian zones vegetated buffer along the stream
- Stream geomorphology impacts (changes in stream shape)
- Habitat fragmentation
- Methane leakages



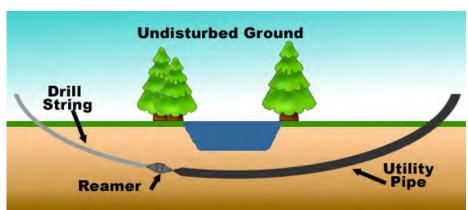
ALLARM

Stream Crossings

Through the stream

Under the stream





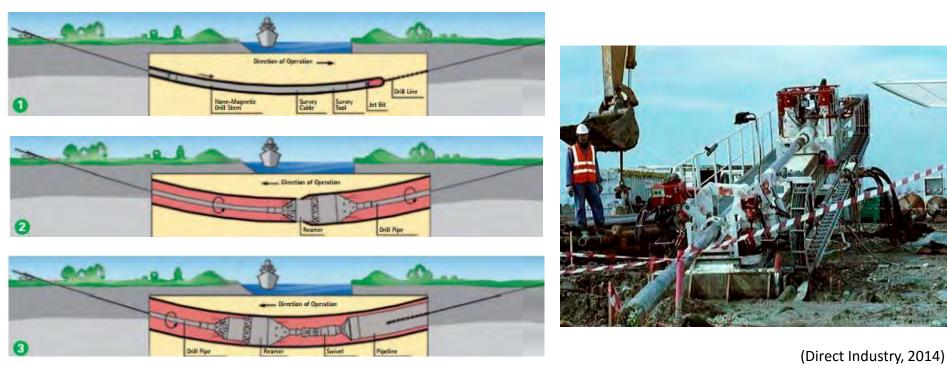
Through the Stream

- Open-cut
- Flumed or Partial Diversion
- Dam & Pump method



Under the Stream

Horizontal Directional Drilling



⁽Nacap, 2014)

DELAWARE RIVERKEEPER

Earth Disturbances



Earth Disturbances

- Sediment entering streams as a result of any earth disturbance
- Sediment on/from access roads, well pads.



What do you notice?



Access Roads



What do you notice with these access roads?

Main Roads



What's the issue here? Is this reportable?

Best Management Practices for E&S

Silt fence



Silt Sock



Diversion Ditch



Monitoring erosion and sedimentation best management practices (E&S BMPs): need to confirm that they are installed correctly and maintained properly.

Sediment from Earth Disturbances





Is there a problem with these best management practices?

E&S Best Management Practices



Is there anything wrong with this?

PA: Publicly available information

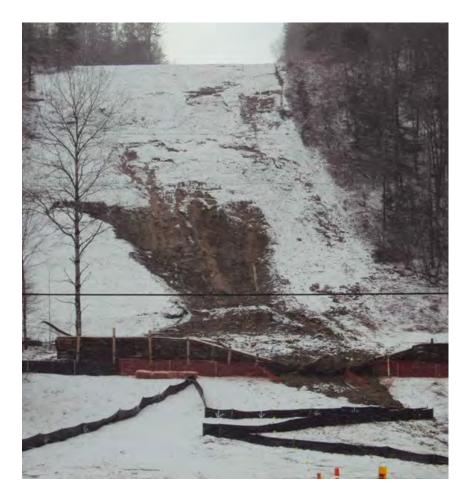


• E&S plans are on site & are available to the public.72

Pipeline Erosion & Sedimentation



Tioga County, PA - Mudslides





Tioga County Conservation District

Spills and Discharges



Spills and Discharges

Unusual odor, color, foam and/or bubbles

Dead fish and/or other organisms





Spills and Discharges

Photo courtesy of Delaware Riverkeeper Network

Photo courtesy of Delaware Riverkeeper Network

Drilling fluid spill at Cabot site Dimock, PA September 2009

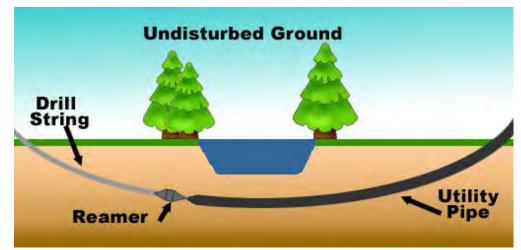
Photo courtesy of Delaware Riverkeeper Network

Photo courtesy of Delaware Riverkeeper Network

Pipeline Spills and Discharges Bentonite Blowouts







Illegal Dumping into Streams

- No pump running
- Bubbling at end of hose
- Unusual odors
- Discoloration of water near hose



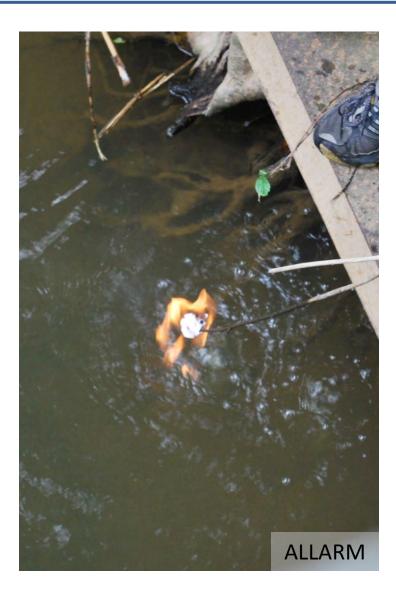
Illegal Dumping





Which is illegal dumping?

Gas Migration or Leakages







What do you see?



Data Management: Record Results

-	Site ID or Stream	Name:		Latitude (if no	Site ID):		ALLARM Volunteer Monitor Field Log					
1	ocation Description:			Longitude (if r	o Site ID):	Monitor's Neme:						
Ī	Chemical and St	age Results					and the second					
	Date (MM/DD/YY)	Time when you monitored	Conductivity (#5/cm) replicate 1	Conductivity (µS/cm) replicate 2	Average Conductivity	TDS.(mg/l) replicate 1	TDS (mg/l) replicate 2	Average TD5	Scare (ft)	Calibrate (Yes/No)	Time spent monitoring (minutes)	
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	Weether and Pr	ecipitation Obse	ervations	Visual Observ	atons Results		-		-			
	Weather (sunny, partly cloudy, or cloudy)	Precipitation (none, light rain, heavy rain, or snow)	Precipitation Last 48 Hours (none, light, or heavy)	observations	reportable (refer to visual n checklist)?	Violation Reported (Yes/No)	violatio	an Report	ed To:	Picture Taken? (Yes/No)	Pipeline Disturtiance (Yes/No)	
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Stream N	ame	1				Monitor	's Name				
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	he descriptio	n that	best m			ation:		2			
Weather	- 1	_	-	Precipita	tion	-	_	Precipita	tion Last	t 43 Hours	
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Partly Cio	udy			Heavy rai	0		Light				
Cloudy				Snow				Неачу			
Record	your results	in the	boxes t								
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Conductio	vity	μ	i/cm							_	
		n	ng/L								
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June 2016

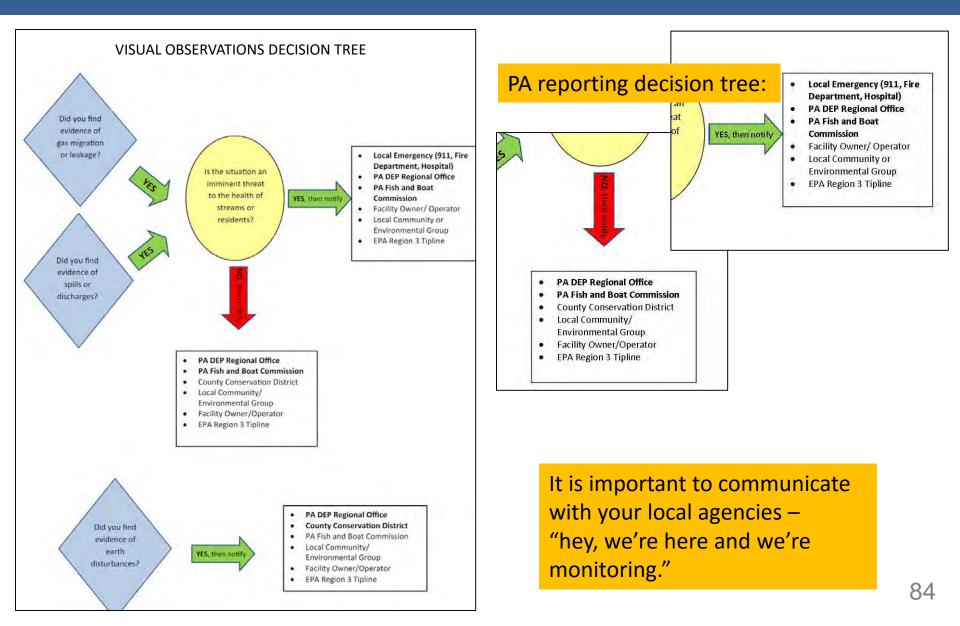
4. Did you calibrate your meter the day you monitored

5. How much time did you spend monitoring? Alliance for Aquatic Resource Monitoring (ALLARM)

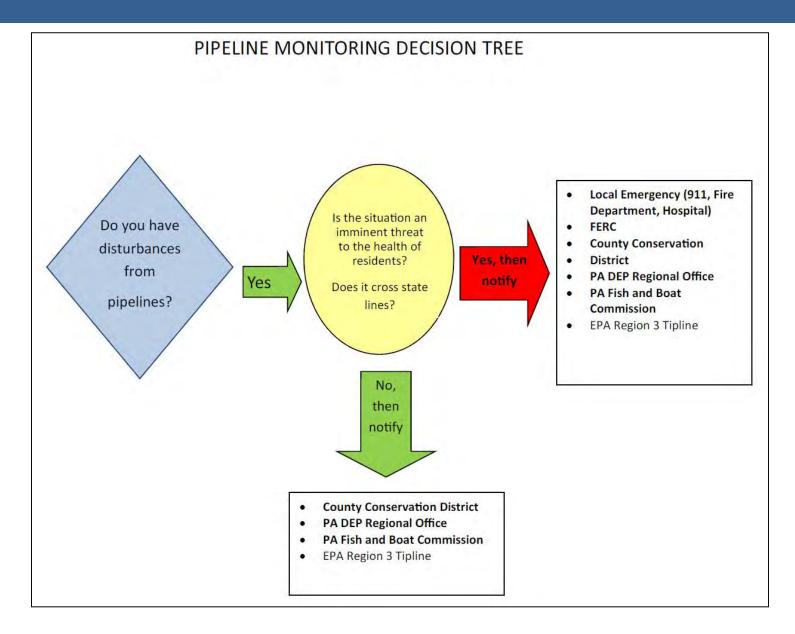
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ALLARMwater.org

Reporting Observations



Pipeline Decision Tree



Chemical Parameters





Alliance for Aquatic Resource Monitoring

Objectives

- Learn about water quality parameters.
- Build basic skills for monitoring.
- Learn about quality assurance/quality control.



Indicators

Water Quality:

- Conductivity
- Total Dissolved Solids (TDS)

Water Quantity:

• Stage (water depth)



Meter Trials



Dickinson students, faculty, and staff helped test conductivity/TDS meters to determine which meter is most accurate, precise, and easy to use.

Conductivity/Total Dissolved Solids Meter Testing

Thank you for participating in this meter testing session sponsored by the Alliance for Aquatic Resource Monitoring (ALLARM). Please answer the questions on page 1 about each water quality meter. Additional questions are found on page 2 – please provide as much feedback as possible!

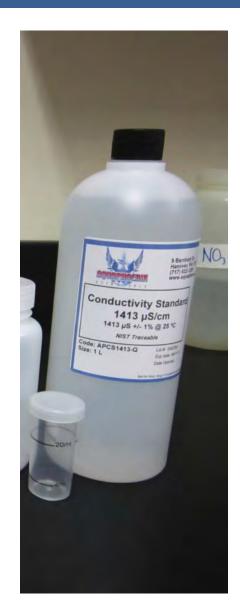
Meter A: LaMot	te Tracer Pocke	Tester			
Results	Solution	A .	Solution	в	Solution C
Conducti	ivity	-			
TDS		-			
Did the reading s	stabilize?)	ES	NO		
How difficult was [1 = very			ium 4 = e asy; 5 = •	very easy]	
1	2	з	4	5	
How difficult was [1 = very			s? ium 4 = easy; 5 = :	very easy]	
1	2	з	4	5	

Meter B: Oakton Multi-Parameter PCSTestr 35										
Results Solution & Solution B Solution C										
Conductivity										
TDS										
Did the reading stabili	Did the reading stabilize? YES NO									
How difficult was it to [1 = very diffic	calibrate the me ult; 2 = difficult; 3		easy; 5 = very ea	sy]						
1	2	3	4	5						
How difficult was it to understand the directions? [1 = very difficult; 2 = difficult; 3 = medium 4 = easy; 5 = very easy]										
1	2	3	4	5						

Calibration

- Calibrate every day you monitor
- Dispose of calibration fluid after use





Conductivity (µS/cm)

- Conductivity measures the ability of water to carry an electrical current/presence of ions:
 - Inorganic compounds = good conductors
 - Example: dissolved salts and heavy metals
 - Organic compounds = poor conductors
 - Example: pesticides
- Conductivity is measured with a meter. Voltage is applied between two electrodes in a probe immersed in water.

Ra	nges
Distilled Water:	0.5 – 3 <i>μS/</i> cm
US Streams:	15 <i>–</i> 500 <i>μS/</i> cm
US Rivers:	50 – 1500 <i>μS/</i> cm
Industrial Waters:	up to 10,000 <i>µS</i> /cm



Total Dissolved Solids (mg/L)

- TDS measures the amount of ions in the water.
 - Example: dissolved salts, nutrients, heavy metals
- Meters first measure conductivity and calculate TDS using an equation.
- TDS can be measured directly using the gravimetric method (actual weight).

<u>R</u>	anges
Fresh Water:	< 1,500 mg/L
Brackish Water:	1,500 – 5,000 mg/L
Saline Water:	> 5,000 mg/L



Why Conductivity and TDS?

- Frack water mixes with natural brine, found in the shale
- Flowback water contains high concentrations of salts and metals



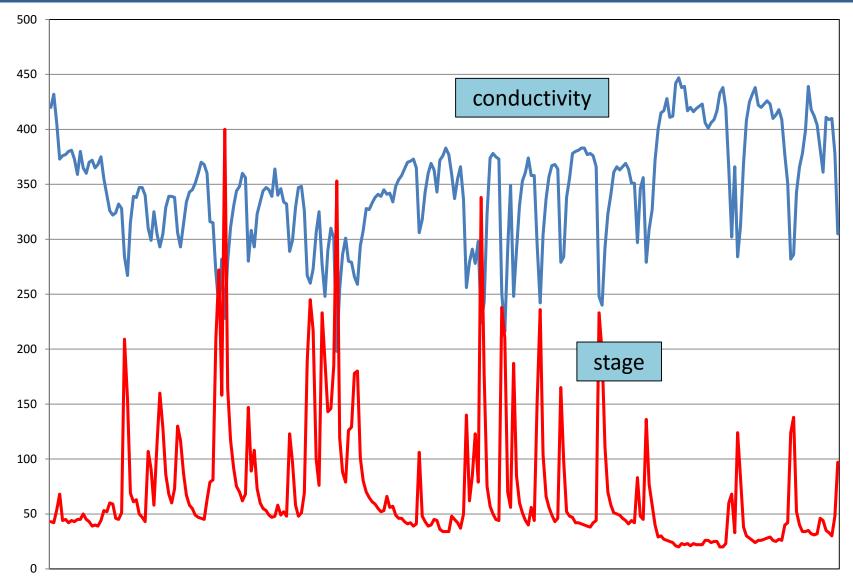
Stage Monitoring (ft)



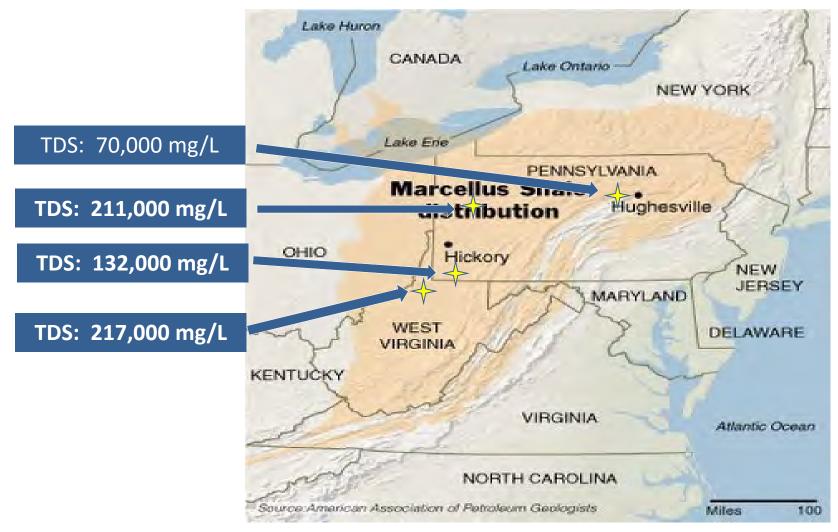




Conductivity and Stage Relationship



Flowback Water Concentrations



Source: Amy Bergdale, USEPA

Reportable Event

A conductivity level 3x or higher than a measurement at a comparable stage.

Date	Stage	Conductivity
2/6/2016	1.7	119.3
2/15/2016	1.7	132.3
3/7/2016	0.8	361
3/13/2016	1.7	670

What do you do if you have a reportable event?

Reporting Events

Reportable Event Steps:

- 1. Re-calibrate meter and re-test your water.
- 2. Collect a sample for barium & strontium analysis (to send to a local, certified lab).
- 3. Contact your local group leaders.
- 4. Contact enforcement agencies.
- 5. Contact ALLARM.

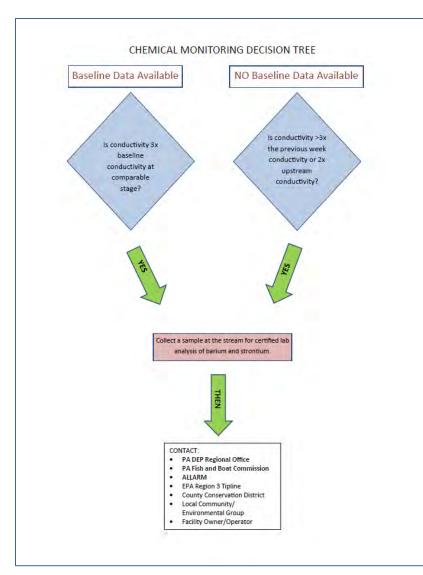
Barium & Strontium: Signature Chemicals

- If Conductivity/TDS levels increase, that *could* mean pollution from shale gas flowback water.
- Data are confirmed by analyzing samples for Ba & Sr



It is important to obtain baseline data for conductivity/TDS and barium/strontium. It is also important to understand how they relate under different flow conditions.

Reporting Events





Baseline Monitoring Steps



Conductivity & Total Dissolved Solids In-stream testing





1. Visual Observation Checklist

3. Stage Monitoring

Stream Testing

- Test stream water with meter
 - Walk into middle of the creek
 - Or sample from a bridge using a bucket





Creekside vs. Home testing

Mandatory Creekside Testing

- Stage
- Visual observations

Can do at home in bad weather

- Calibration
- Conductivity/TDS

Meter does not stabilize quickly in freezing temperatures, turn the meter on when you arrive at the site or let the water warm to room temperature test at home or in the car.



Recording Results

	-	_		Chemic	al and	Stage M	onitor	ing Data	Sheet		_
Record your		sampl	e infor	mation in t	he boxe	s below: Sample	Informa	tion			-
tream Name						Monitor					
ite Location					- 1	Collectio	n Date				
atitude Coord	dinate					Collectio	n Time				
ongitude Coo	rdinate					County I	Monitor	ed	-		
Check the de	scription	n that t	best ma	atches you	r observ	ation:					
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Partly Cloudy				Heavy rai	n			Light			
Cloudy				Snow				Heavy			
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Stage		fe	et								
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Record site information

Record weather information

Record conductivity, TDS, and stage results

Record calibration and volunteer time.

Data Management & Quality Control

ALLARMwater.org

- 'My Data' profile page
- Submit data through site
- Can view data and create graphs
- Resources, research and forms all housed on site

☆ My Data Local Data	n Regional Data Cour	nties Resources About	Contact	Welcome Holden Logout My
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UNTNORFORBIERUN 0.60 PINFOR 0.09	09/04/2013	52		
UNTNORFORBIERUN 0.60 PINFOR 0.09 UNTSHERIV 1.78 MCCRUN 1.06 LITSEWCRE 7.84	09/04/2013 09/26/2013 12/12/2012 10/19/2015	52 12 2 21	41.069167, -80.411667 41.12012, -80.34102 40.26861, -79.661694	
UNTNORFORBIERUN 0.60 PINFOR 0.09 UNTSHERIV 1.78 MCCRUN 1.06	09/04/2013 09/26/2013 12/12/2012	52 12 2	41.069167, -80.411667 41.12012, -80.34102	

Observations -

allarn

Date	Site ID	Latitude/Longitude	Observer(s)	Options	
03/21/2016	UNTBRUCRE 0.41	40.37272, -79.73981	CC	View Observation	-
12/21/2015	LITSUGCRE 6.01	41.60867, -79.79386		View Observation	3
12/10/2015	LITSEWCRE 2.30	40.57016, -80.18965	AC	View Observation	
12/10/2015	LITSEWCRE 6.09	40.57604, -80.13816	AC	View Observation	
12/10/2015	LITSEWCRE 4.54	40.57371, -80.158	AC	View Observation	
12/10/2015	LITSEWCRE 0.73	40.558278, -80.200556	AC	View Observation	

Data Management: ALLARMwater.org

My Data Local Data Regional Data Resources

8/websites/allarm/DataEntryForm.php?LocationPicklist=1

ALLAR Data Entry Form Select a location: UNT Little Sugar Creek ۳ Map Satellit Sampling date and time: Click to enter date and time Time spent sampling: minutes --Select--Meter calibrated? Conductivity replicate 1: Cond rep 1 uS/cm replicate 2: Cond rep 2 average replicate 1: TDS rep 1 Total dissolved solids mg/L replicate 2: TDS rep 2 average (TDS) Stage feet Stage should be entered with decimals in feet, not inches (example: 1.4) Cross sectional area: square feet Weather: --Select----Select--Sunny Precipitation: Cloudy Precipitation last 48 hours: --Select--Did you look for visual --Select-v observations? Other observations, or details?

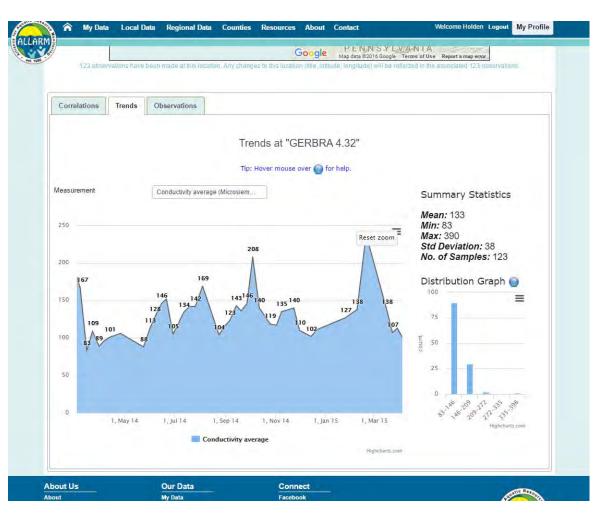
About Contact

- Submit data through site
- Checks values and tests for reportable events

Welcome K Logout My Profile

Data Management: ALLARMwater.org

- Can create data and create graphs
- Resources, research and forms all housed on site



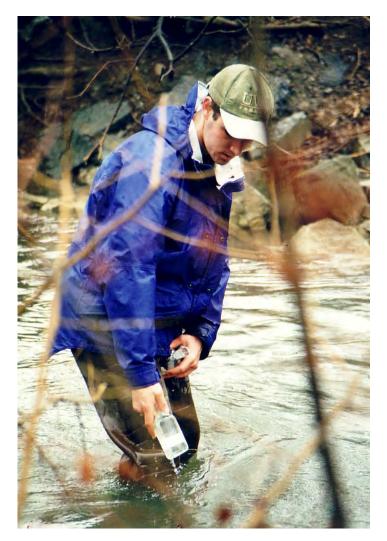
Quality Control Program

- Ensures the credibility of the data collected.
- ALLARM will test the water using the same equipment as well as other methods.
- Compare monitor's results to ALLARM's results.

	Conductivity (LaMotte)	Conductivity (Accumet)	TDS (LaMotte)	TDS (Accumet)
Monitor	Х		Х	
ALLARM	Х	Х	Х	Х

Quality Assurance, Quality Control (QA/QC)

- Fill out QA/QC form
- Collect sample
- Send form and sample to ALLARM lab
- Do twice a year high stage & low stage



Quality Control

14	ARME			NTORING PROGRAM ontrol (QA/QC) Form	R	
1. 1	Fill out the label on you	r QA/QC bot	le (shown to the	right).	A CONTRACTOR	
Ì	Enter the stream and face upstream. Fill your QA/QC bottle and pour the rinse water out downstream. Rinse your bottle and cap three times. Fill your QA/QC bottle completely with stream water and close it tightly with the cap. Record your data in the chart below, as well as on <u>ALLARMwater.org</u> :					
	Parameter	Units	Replicate #1	Replicate #2	Average Result	
	Conductivity	µS/cm				
	Total Dissolved Solids	mg/L	i i			
	Stage	feet				
4. 1	Fill out the information	in the boxes	below:			
	Monitor Information			Sample Information		
	Monitor's Name			Site ID or Stream Name		
	Mailing Address			Latitude Coordinate		
	Maning Address			Longitude Coordinate		

Appendix E: Quality Assurance/Quality Control Form

 Monitor's Name
 Sature

 Mailing Address
 Site ID or Stream Name

 Mailing Address
 Latitude Coordinate

 Email Address
 Collection Date

 County Monitored
 Collection Time

 Affiliation (if applicable)
 Equipment Used (i.e. LaMotte meter)

 Bottle # (on label):

5. Pack a small box with your QA/QC bottle and this QA/QC form. Secure the bottle so it cannot move around during shipment. Mail the box to ALLARM for QA/QC processing at: ALLARM

Dickinson College 5 N Orange Street Carlisle, PA 17013

- Send water sample to ALLARM within <u>first month of</u> <u>monitoring</u> for QA/QC and barium/strontium analysis.
- Be sure to log observations for QA/QC samples on ALLARMwater.org

In your kit

- LaMotte Tracer PockeTester and calibration solution vial
- 84 μS/cm & 1413 μS/cm standard calibration solution
- 3. Distilled water wash bottle
- 4. Stream testing bottle
- 5. 3 sample bottles
 - Two sample bottles for QA/QC
 - One bottle for pollution event Ba and Sr analysis
- 6. Gage Stick

