OMB No. 2040-0042 Approval Expires 4/30/2022

United States Environmental Protection Agency

Underground Injection Control
Permit Application for a Class II Well

(Collected under the authority of the Safe Drinking Water Act, Sections 1421, 1422, and 40 CFR Part 144)

For Official Use Only

Date Received

Permit Number

Read Attached Instructions Before Starting

I. Owner Name, Address, Phone Number and/or Email

Pennhills Resources, LLC
3055 Rt 219 Kane, PA
16735 814-975-3096

II. Operator Name, Address, Phone Number and/or Email

Pennhills Resources, LLC
3055 Rt 219 Kane, PA
16735 814-975-3096

III. Commercial Facility

- [ ] Yes
- [x] No

IV. Ownership

- [x] Private
- [ ] Federal
- [ ] State/Tribal/ Municipal

V. Permit Action Requested

- [x] New Permit
- [ ] Permit Renewal
- [ ] Modification
- [ ] Add Well to Area Permit
- [ ] Other

VI. SIC Code(s)

1311

VII. Indian Country

- [ ] Yes
- [x] No

VIII. Type of Permit (For multiple wells, use additional page(s) to provide the information requested for each additional well)

- [ ] A. Individual
- [x] B. Area

Number of Wells: 3

Well Field and/or Project Names: Kane Field

IX. Class and Type of Well (see reverse)

A. Class	B. Type (enter code(s))	C. If type code is "X," explain.
2	R	NA

X. Well Status

- [ ] A. Operating
- [x] B. Conversion
- [ ] C. Proposed

Date Injection Started:

Date Well Constructed: NA

XI. Well Information

API Number: Area Permit 3 wells

Permit (or EPA ID) Number:

Full Well Name:

XII. Location of Well or, for Multiple Wells, Approximate Center of Field or Project

Locate well in two directions from nearest lines of quarter section and drilling unit

Surface Location

____ 1/4 of ____ 1/4 of Section ____ Township ____ Range ____

____ ft. from (N/S) ____ Line of quarter section

____ ft. from (E/W) ____ Line of quarter section.

Latitude: 41° 41' 43.8200"

Longitude: 78° 47' 32.4900"

WE 3181 #39

XIII. Attachments

In addition to this form, complete Attachments A-U (as appropriate for the specific well class) on separate sheets. Submit complete information, as required in the instructions and list all attachments, maps or other figures, by the applicable letter.

XIV. Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (Ref. 40 CFR § 144.32)

Name and Official Title *(Please Type or Print)*	Signature	Date Signed
Thomas J Morris III President	Thomas J Morris III	3-30-2020

EPA Form 7520-6 (Rev. 4-19)

ATTACHMENT A

MAPS AND AREA OF REVIEW

Attached are three individual maps for the following Area Permit. The fixed radius method was applied to all three maps (1/4 mile, ½ mile, and 1 ¼ mile) for each proposed injection well (1002,1007,39). All springs, surface bodies of water, and pertinent surface structures (none) have been identified on all three maps.

MAP 1: ¼ Mile from injection wells

The first map shows a ¼ mile buffer around each proposed injection well (yellow dots). All wells within the AOR have been identified in a table which includes the location, well number, date drilled, status, tubulars, cement top, and total depth information. There are several wells within the AOR that were plugged and abandoned (red dots). The Certificate of Plugging is attached for each. In addition to that information their cross sections were analyzed from north to south and east to west. Those wells are labeled with a red dashed line connecting them with the distance between wells noted in red.

MAP 2: ½ Mile from injection wells

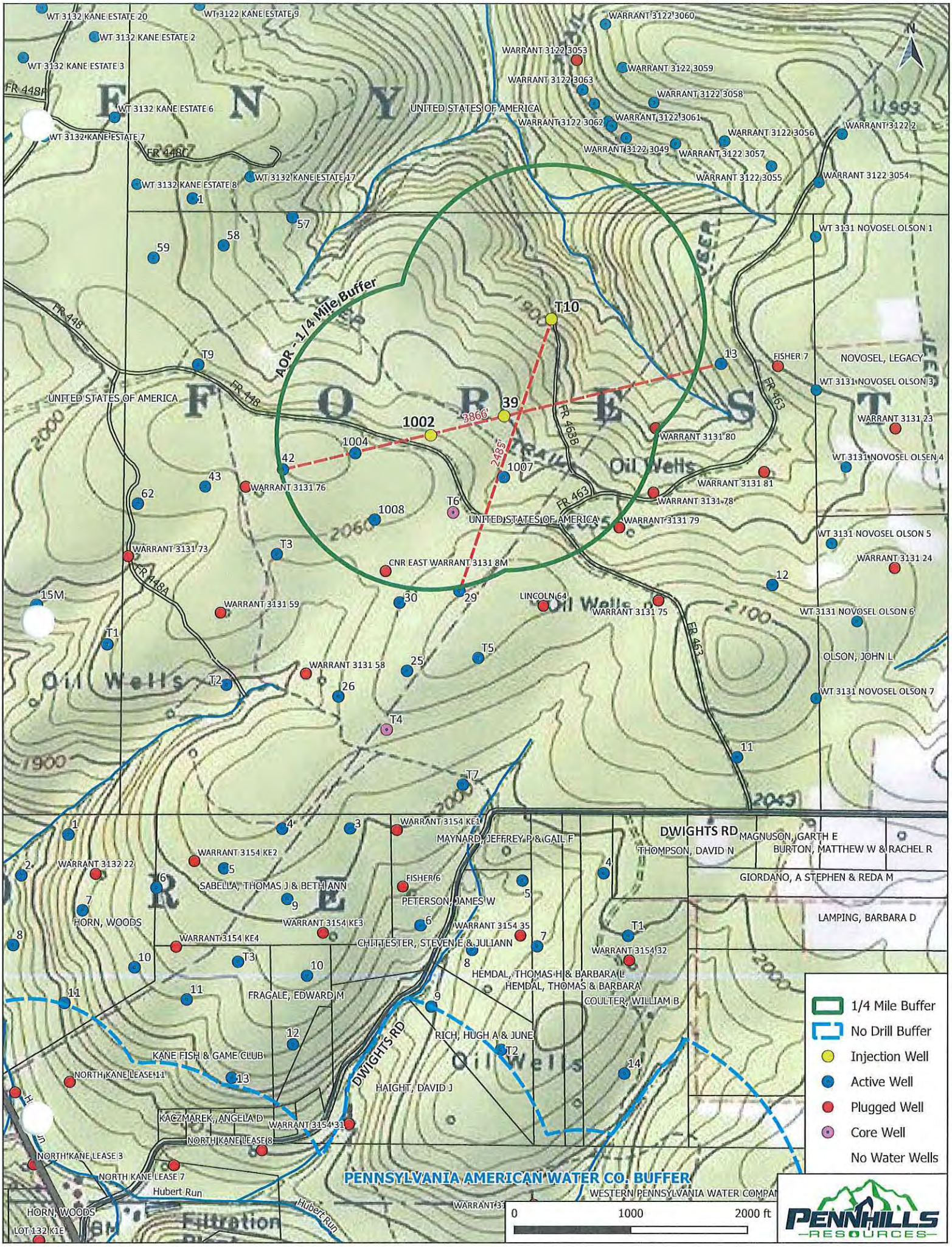
The second map shows the same information as well as another buffer extending ½ mile from the injection wellbores. The surface owners that fall within this buffer are the Allegheny National Forest and Legacy Novosel.

NATIONAL FOREST: US Forest Service. 4 Farm Colony Drive. Warren,PA 16365

NOVOSEL LEGACY REVOCABLE TRUST: 301 West Pine Ave. Kane,PA 16735

MAP 3: 1 ¼ Mile from injection wells

The third map shows the initial AOR as well as a 1 ¼ mile buffer. Within the 1 ¼ mile buffer there is no outcropping of the injection or confining zones, no surface water intake or discharge structures, or hazardous waste treatment/storage/disposal facilities. It is important to note that the Kane sewer treatment plant falls just outside of the 1 ¼ mile buffer. There is a "No Drill Buffer" labeled with a blue dashed line in the southern section of each map.


AOR - 1/4 Mile Buffer
T10
T9
T1
T2
T3
T4
T5
T6
T7
39
1002
1004
1007
1008
42
43
62
57
58
59
1
30
29
25
26
11
12
13
14
15M
FISHER 7
FISHER 6
NOVOSEL, LEGACY
WT 3131 NOVOSEL OLSON 1
WT 3131 NOVOSEL OLSON 3
WT 3131 NOVOSEL OLSEN 4
WT 3131 NOVOSEL OLSON 5
WT 3131 NOVOSEL OLSON 6
WT 3131 NOVOSEL OLSON 7
WARRANT 3131 23
WARRANT 3131 24
WARRANT 3131 80
WARRANT 3131 81
WARRANT 3131 78
WARRANT 3131 79
WARRANT 3131 76
WARRANT 3131 73
WARRANT 3131 59
WARRANT 3131 58
WARRANT 3131 75
WARRANT 3154 KE1
WARRANT 3154 KE2
WARRANT 3154 KE3
WARRANT 3154 KE4
WARRANT 3154 35
WARRANT 3154 32
WARRANT 3154 31
WARRANT 3132 22
WT 3132 KANE ESTATE 20
WT 3132 KANE ESTATE 2
WT 3132 KANE ESTATE 3
WT 3132 KANE ESTATE 6
WT 3132 KANE ESTATE 7
WT 3132 KANE ESTATE 8
WT 3122 KANE ESTATE 9
WT 3132 KANE ESTATE 17
WARRANT 3122 3060
WARRANT 3122 3053
WARRANT 3122 3059
WARRANT 3122 3063
WARRANT 3122 3058
WARRANT 3122 3062
WARRANT 3122 3061
WARRANT 3122 3056
WARRANT 3122 3049
WARRANT 3122 3057
WARRANT 3122 3055
WARRANT 3122 3054
WARRANT 3122 2
CNR EAST WARRANT 3131 8M
LINCOLN 64
UNITED STATES OF AMERICA
FR 448
FR 448A
FR 448B
FR 448C
FR 463
3866'
2485'
2060
2000
1900
2100
2043
Oil Wells
Oil Wells
Oil Wells
Oil Wells
F O R E S T
F E N N Y
DWIGHTS RD
MAYNARD, JEFFREY P & GAIL F
THOMPSON, DAVID N
MAGNUSON, GARTH E
BURTON, MATTHEW W & RACHEL R
GIORDANO, A STEPHEN & REDA M
LAMPING, BARBARA D
OLSON, JOHN L
SABELLA, THOMAS J & BETH ANN
PETERSON, JAMES W
HORN, WOODS
CHITTESTER, STEVEN E & JULIANN
HEMDAL, THOMAS H & BARBARA L
HEMDAL, THOMAS & BARBARA
COULTER, WILLIAM B
FRAGALE, EDWARD M
RICH, HUGH A & JUNE
HAIGHT, DAVID J
KACZMAREK, ANGELA D
KANE FISH & GAME CLUB
NORTH KANE LEASE 11
NORTH KANE LEASE 8
NORTH KANE LEASE 3
NORTH KANE LEASE 7
PENNSYLVANIA AMERICAN WATER CO. BUFFER
WESTERN PENNSYLVANIA WATER COMPANY
Hubert Run
Filtration
LOT 132 K1E
1/4 Mile Buffer
No Drill Buffer
Injection Well
Active Well
Plugged Well
Core Well
No Water Wells
0
1000
2000 ft
PENNHILLS RESOURCES

WELLS WITHIN THE 1/4 MILE AOR

Well Name	API	Well #	Date Drilled	Status	Conductor	Surface Casing	Cement Returns	TOC If No Returns	TD	3 1/2"
CNR EAST WARRANT 3131	37-083-53196	T-6	5/12/2008	Active	22	486	Yes	-	2,706	2,578
CNR EAST WARRANT 3131	37-083-53687	T-10	7/28/2009	Active	19	487	Yes	-	2,554	2,025
CNR EAST WT 3131	37-083-56741	1002	8/24/2015	Active	31	516	No	120	2,723	2,566
CNR EAST WT 3131	37-083-56742	1004	8/25/2015	Active	40	516	Yes	-	2,812	2,612
CNR EAST WT 3131	37-083-56743	1007	9/1/2015	Active	32	516	Yes	-	2,690	2,542
CNR EAST WT 3131	37-083-56744	1008	8/31/2015	Active	32	516	Yes	-	2,737	2,412
PHR WT 3131	37-083-56945	39	11/10/2017	Active	21	520	No	226	2,670	2,529
PHR WT 3131	37-083-56946	42	11/6/2017	Active	24	520	Yes	-	2,745	2,218
WARRANT 3131	37-083-07063	80	1/1/1800	Plugged	-	-	-	-	-	-
CNR EAST WARRANT 3131	37-083-15964	8M	1/1/1800	Plugged	-	-	-	-	-	-

5500-FM-OG0006 Rev. 2/2000

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
OIL & GAS MANAGEMENT PROGRAM

DEP USE ONLY	
Site ID#	Primary Facility ID#
eFACTS Client #	Sub-facility ID#
Bonded Well? ☐ Yes ☐ No	Bond Agreement #

Certificate of Well Plugging

Well Operator	DEP ID#	Well API # (Permit / Reg)	Project Number	Type of Well
East Resources Inc	28854	37-083-15964	ERI-72	Oil

Address	Well Farm Name	Well #	Serial #
P.O. Box 426	CRN East Wt 3131	8M	N/A

City	State	Zip Code	County	Municipality
Mt Jewett	PA	16740	McKean	Wetmore

Phone	Fax
814-778-5521	814-778-5523

Complete the next section (coal) if applicable.

Coal ☐ Operator ☐ Owner ☐ Lessee	Coal ☐ Operator ☐ Owner ☐ Lessee	Coal ☐ Operator ☐ Owner ☐ Lessee
Address	Address	Address
City, State, Zip	City, State, Zip	City, State, Zip

RECEIVED
MAR 05 2010
ENVIRONMENTAL PROTECTION
NORTHWEST REGIONAL OFFICE

The undersigned representatives of the Well Operator certify that we participated in plugging this well, and that the work was started on *(date)* 1-21-2010, and that the well was plugged as follows.

Filling Material and Plugs	Depth From	Depth To	Casing and Tubing Size	Pulled	Left
10 Sacks Class A Cement	1872	1822			
Gel	1822	1740			
10 Sacks Class A Cement	1740	1687			
Gel	1687	1570			
10 Sacks Class A Cement	1570	1520			
Gel	1520	1400	**Depth to coal seams, if any**		
10 Sacks Class A Cement	1400	1350			
Gel	1350	800			
10 Sacks Class A Cement	800	750			
Gel	750	505			
10 Sacks Class A Cement	505	455	**Describe Monument**		
Dirt & Gravel	455	15	2" Monument		
Cement & 2" Monument	15	0			

RECEIVED
MAR 15 2010
ENVIRONMENTAL PROTECTION
WARREN DISTRICT OFFICE

Signature of Participants

Signature – Well Operator	Signature – Qualified Participant	Signature – Qualified Participant
Print or Type Signer's Name and Title: Jeferson Long, Project Manager	Print or Type Signer's Name, Title, & Co.: Edward Fidurko, East Resources Inc	Print or Type Signer's Name, Title, & Co.: Fred Damon, TD Well Service

Signers certify that the work of plugging this well was completed on *(date)* 2-11-2010, and that the information above is true and accurate.

DEP USE ONLY

DEP Rep: ☐ Approved ☐ Denied — Review Date 3-16-10

Plug Inspector	Site Restoration (WQS)	Bond Rel.?
Date:	Date:	☐ Yes ☐ No

Upon completion of plugging, mail one copy of this certificate to each coal operator, owner, or lessee, if any, and one copy to the appropriate DEP Regional Oil and Gas Management Program office.

Dept. of Environmental Protection
NW Regional Office – Oil & Gas
230 Chestnut Street
Meadville, PA 16335-3481

Dept. of Environmental Protection
SW Regional Office – Oil & Gas
400 Waterfront Drive
Pittsburgh, PA 15222-4745

5500-FM-OG0006 6/96

DEP Office Use Only

Code	
Oil & Gas Inspector	RR
Date Approved	14 Oct 98
INV	EXA

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF OIL AND GAS MANAGEMENT

RECEIVED
OCT - 7 1998
WARREN DISTRICT OFFICE

CERTIFICATE OF WELL PLUGGING

Coal ☐ Operator ☐ Owner ☐ Lessee

Address

Coal ☐ Operator ☐ Owner ☐ Lessee

Address

Coal ☐ Operator ☐ Owner ☐ Lessee

Address

COMPLETE ABOVE SECTION IF APPLICABLE

RECEIVED
OCT - 5 1998

Oil & Gas
Type of Well

East Resources, Inc.
Operator Name

PO Box 279
Address

Allegany NY 14706

Wetmore Twp.
Municipality

McKean
County

37-083-07063
Permit/Registration Number — Project Number

Wt 3131
Farm Name

80
Well Number — Serial Number

We, the undersigned representatives of the Well Operator certify that we participated in the plugging of the above well, and that the work was started July 15, 19 98, and that the well was plugged as follows:

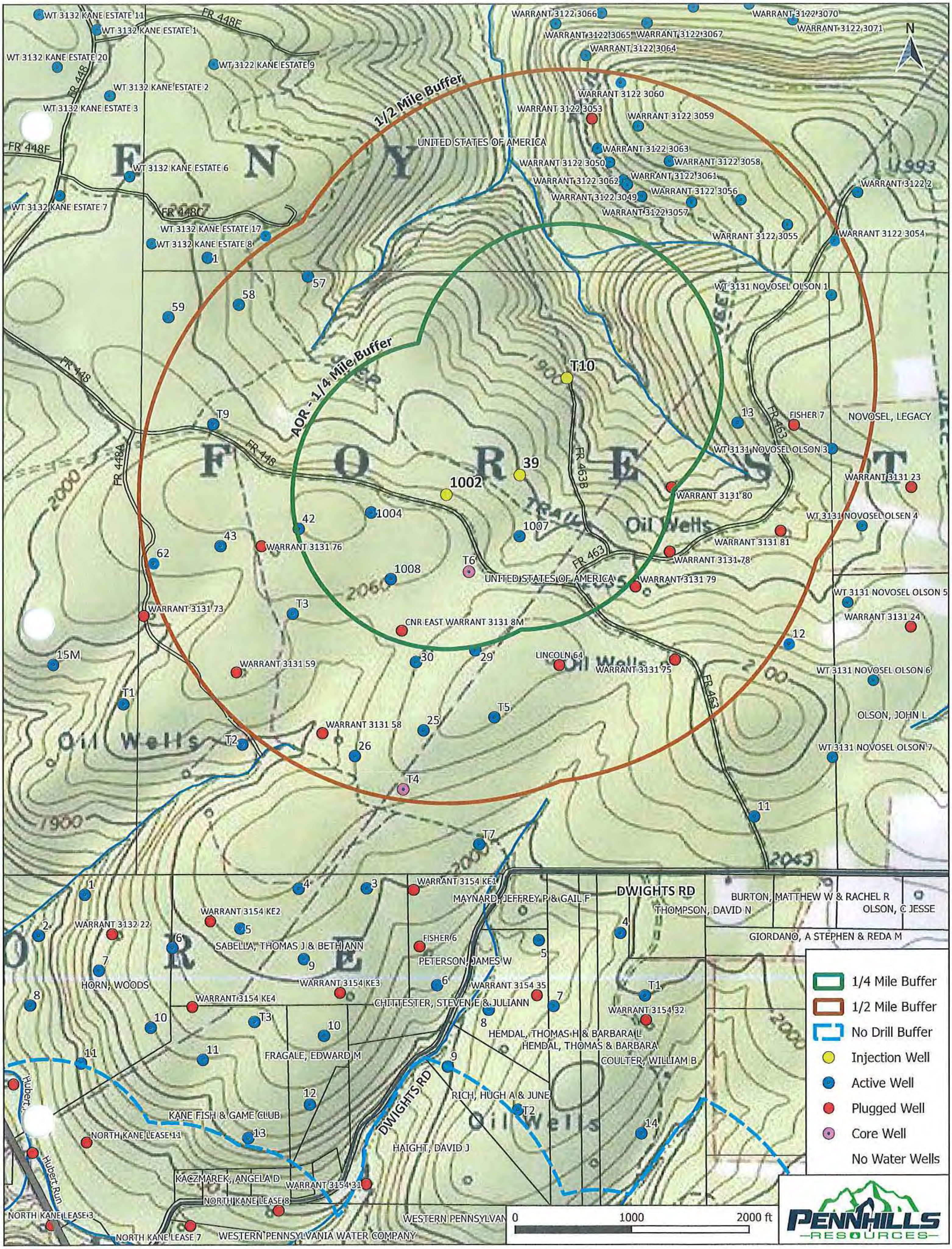
FILLING MATERIAL AND PLUGS	FROM	TO	Casing and Tubing SIZE	PULLED	LEFT
Tar Bottom Gel	2450'	2400'	5/8 rods	2425'	–
Grout	2400'	2350'	2"	2450'	–
Gel	2350'	2220'	6 1/4"	–	444'
Grout	2220'	2170'			
Gel	2170'	1990'			
Grout	1990'	1940'			
Gel	1940'	1800'	Depth of Coal Seam(s), if Any		
Grout	1800'	1750'			
Gel	1750'	1426'			
Grout	1426'	1376'			
Gel	1376'	494'			
Grout	494'	444'	Description of Monument		
Dirt & Gravel	444'	10'	2" x 4' pipe marker.		
Grout	10'	0'			

I certify that the work of plugging and filling said well was completed on the 12 day of July, 19 98 and that the above information is true and accurate.

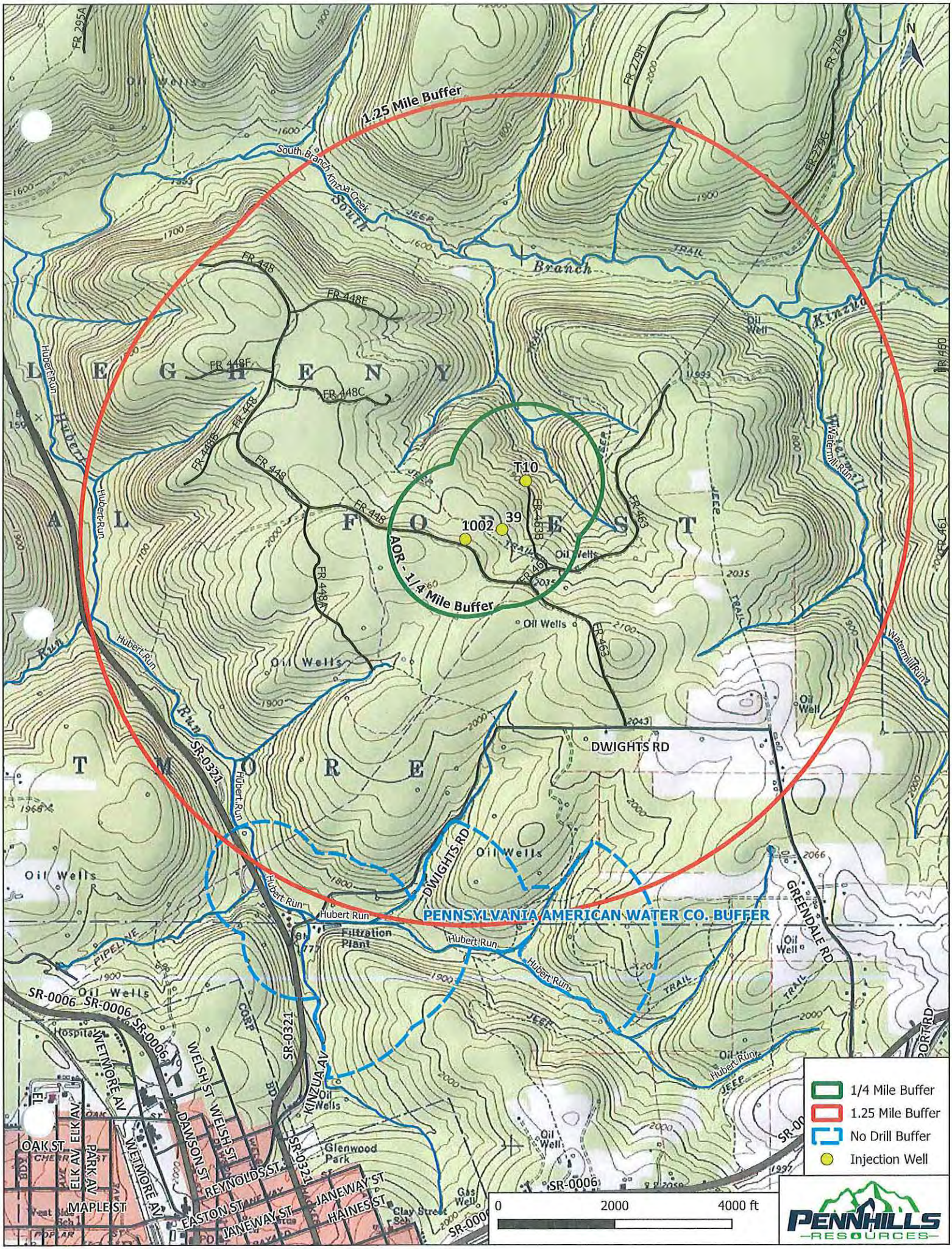
(Well Operator) — 10-1-98 Date — (Qualified Participant) — (Qualified Participant)

One copy of this certificate to be mailed to each coal operator, lessee, or owner, if any, and one to the Bureau of Oil and Gas Management, upon completion of plugging.

Recycled Paper



1/2 Mile Buffer
AOR - 1/4 Mile Buffer
UNITED STATES OF AMERICA
WT 3132 KANE ESTATE 11
WT 3132 KANE ESTATE 1
WT 3132 KANE ESTATE 20
WT 3122 KANE ESTATE 9
WT 3132 KANE ESTATE 2
WT 3132 KANE ESTATE 3
WT 3132 KANE ESTATE 6
WT 3132 KANE ESTATE 7
WT 3132 KANE ESTATE 17
WT 3132 KANE ESTATE 8
FR 448E
FR 448F
FR 448C
FR 448
FR 448A
FR 463
FR 463B
WARRANT 3122 3066
WARRANT 3122 3070
WARRANT 3122 3071
WARRANT 3122 3065
WARRANT 3122 3067
WARRANT 3122 3064
WARRANT 3122 3060
WARRANT 3122 3053
WARRANT 3122 3059
WARRANT 3122 3063
WARRANT 3122 3050
WARRANT 3122 3058
WARRANT 3122 3062
WARRANT 3122 3061
WARRANT 3122 3049
WARRANT 3122 3056
WARRANT 3122 3057
WARRANT 3122 3055
WARRANT 3122 3054
WARRANT 3122 2
WT 3131 NOVOSEL OLSON 1
WT 3131 NOVOSEL OLSON 3
WT 3131 NOVOSEL OLSEN 4
WT 3131 NOVOSEL OLSON 5
WT 3131 NOVOSEL OLSON 6
WT 3131 NOVOSEL OLSON 7
FISHER 7
NOVOSEL, LEGACY
WARRANT 3131 23
WARRANT 3131 24
WARRANT 3131 80
WARRANT 3131 81
WARRANT 3131 78
WARRANT 3131 79
WARRANT 3131 76
WARRANT 3131 73
WARRANT 3131 59
WARRANT 3131 58
WARRANT 3131 75
CNR EAST WARRANT 3131 8M
LINCOLN 64
OLSON, JOHN L
T10
T9
T6
T3
T1
T2
T4
T5
T7
1002
39
1004
1007
1008
42
43
62
57
58
59
13
12
11
15M
30
29
25
26
F O R E S T
Oil Wells
DWIGHTS RD
WARRANT 3154 KE1
MAYNARD, JEFFREY P & GAIL F
BURTON, MATTHEW W & RACHEL R
THOMPSON, DAVID N
OLSON, C JESSE
GIORDANO, A STEPHEN & REDA M
WARRANT 3154 KE2
WARRANT 3132 22
SABELLA, THOMAS J & BETH ANN
FISHER 6
PETERSON, JAMES W
HORN, WOODS
WARRANT 3154 KE3
WARRANT 3154 35
WARRANT 3154 KE4
CHITTESTER, STEVEN E & JULIANN
WARRANT 3154 32
HEMDAL, THOMAS H & BARBARA L
HEMDAL, THOMAS & BARBARA
FRAGALE, EDWARD M
COULTER, WILLIAM B
RICH, HUGH A & JUNE
KANE FISH & GAME CLUB
NORTH KANE LEASE 11
HAIGHT, DAVID J
KACZMAREK, ANGELA D
WARRANT 3154 31
NORTH KANE LEASE 8
NORTH KANE LEASE 3
NORTH KANE LEASE 7
WESTERN PENNSYLVANIA WATER COMPANY
Hubert Run
1/4 Mile Buffer
1/2 Mile Buffer
No Drill Buffer
Injection Well
Active Well
Plugged Well
Core Well
No Water Wells
0 1000 2000 ft
N
PENNHILLS RESOURCES


1.25 Mile Buffer
AOR - 1/4 Mile Buffer
T10
1002
39
PENNSYLVANIA AMERICAN WATER CO. BUFFER
DWIGHTS RD
GREENDALE RD
Hubert Run
South Branch Kinzua Creek
Kinzua
Watermill Run
SR-0321
SR-0006
FR 448
FR 448E
FR 448F
FR 448C
FR 448B
FR 448A
FR 463
FR 461
FR 461B
FR 279G
FR 279H
FR 460
Oil Wells
Oil Well
Filtration Plant
Hospital
Glenwood Park
Gas Well
Clay Street
OAK ST
ELK AV
PARK AV
MAPLE ST
WETMORE AV
DAWSON ST
WELSH ST
REYNOLDS ST
EASTON ST
JANEWAY ST
HAINES ST
KINZUA AV
CORP
PIPELINE
TRAIL
JEEP
1/4 Mile Buffer
1.25 Mile Buffer
No Drill Buffer
Injection Well
0
2000
4000 ft
N
PENNHILLS RESOURCES

ATTACHMENT B. GEOLOGICAL AND GEOPHYSICAL INFORMATION

Geological and geophysical information was obtained from each of the wells drillers logs as well as cross reference to the well logs provided by PENN GOLD and SCHLUMBERGER. Fresh water was encountered approximately 200 ft from surface while drilling on air as noted in the table below. In addition to the drillers logs, we identified a nearby water well (3,965' away as noted by red dashed line) which was drilled to a dept of 140'. The Haskell formation is surrounded by a dense, black, organic shale which is the confining zone to the injection zone. More specifically, the interval between the Kane and Haskell Sand is the confining zone to prevent upward movement of fluids. This interval is approximately 170' thick and is comprised of a dense black shale. The Haskell sand body has a gross thickness of 80 ft and a net thickness of approximately 30 ft. Based on permeability and porosity data, we expect to yield most of the additional hydrocarbons from those 30 ft of sandstone

The Haskell Sand, known by old time drillers in this specific area as the Kane Sand, has produced a significant amount of gas over a wide region, including the Guffey Pool. East Resources successfully identified an oil window within the Haskell Sand where it drilled and completely approximately forty wells. East performed core analysis of two wells (T-2 and T-6). The Haskell Sand, commonly referred to as the Elk, was deposited during the early times of the upper Devonian. From the side-wall cores, this formation is light brown in color, appears to be well sorted with fine to medium grain size, and relatively homogenous through the pay zone. TerraTek's core analysis illustrates significant permeability within parts of the pay zone. Perm ranges from 0.248 mD to 19.722 mD. The brown color of the sand could be due to the saturation of oil, akin to the Bradford 3rd, or the source rock for this sand happened to have minerals that constituted this hue.

Stratigraphically beneath the Haskell Sand, a marine transgression occurs over a developing barrier bar. The depositional environment for the base of the Haskell appears to be a delta-marine fringe. A small distributary channel appears atop of the fringe at T-6 and decreases in development south in the direction of T-7 and east towards T-1. Moving up the stratigraphic column, the basal channel has been totally abandoned, and successive graded beds, approximately 10'-15' thick and as thick as 25' where the channel is not present, are the major deposition style of the Haskell Sand. Side-wall cores have confirmed.

PART I. GEOLOGICAL DATA

DRILLERS LOG - WELL # T-10

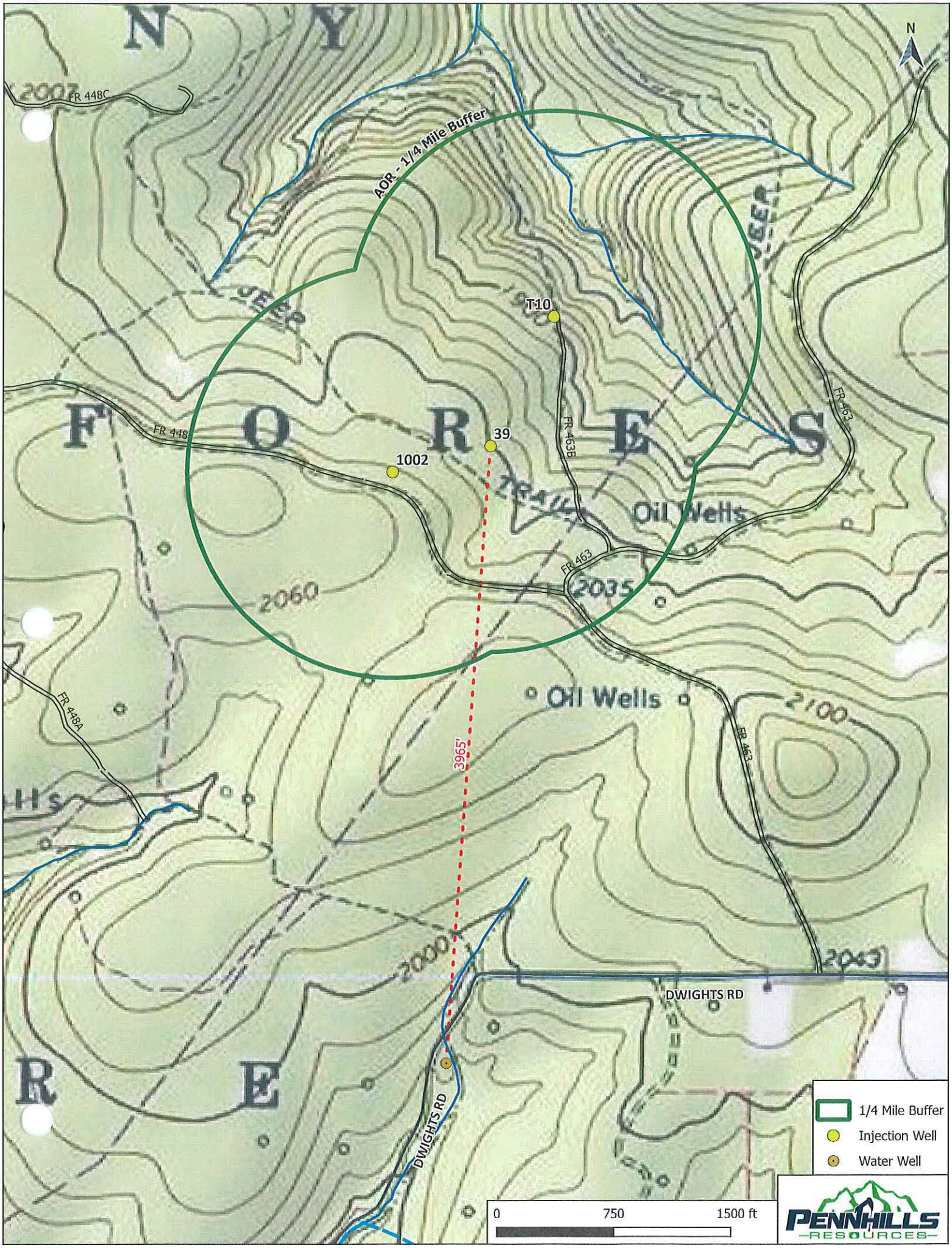
FORMATION INFORMATION	TOP (FROM SURFACE - FT)	BOTTOM	THICKNESS (FT)	USDWS
UNCONSOLIDATED MATERIAL	-	42.00	42.00	
SHALE	42.00	549.00	507.00	APPOX 105 FT
SANDSTONE	549.00	610.00	61.00	
SHALE	610.00	631.00	21.00	
SANDSTONE	631.00	680.00	49.00	
SHALE	680.00	1,008.00	328.00	
SILTSTONE	1,008.00	1,264.00	256.00	
WARREN 2ND	1,264.00	1,325.00	61.00	
SHALE	1,325.00	1,410.00	85.00	
BRADFORD 1ST	1,410.00	1,473.00	63.00	
SHALE	1,473.00	1,614.00	141.00	
CHERRY GROVE	1,614.00	1,632.00	18.00	
SHALE	1,632.00	1,760.00	128.00	
COOPER SANDSTONE	1,760.00	1,836.00	76.00	
SHALE	1,836.00	1,975.00	139.00	
BRADFORD 3RD	1,975.00	2,027.00	52.00	
SHALE	2,027.00	2,050.00	23.00	
LEWIS RUN SANDSTONE	2,050.00	2,077.00	27.00	
SHALE	2,077.00	2,227.00	150.00	
KANE SANDSTONE	2,227.00	2,256.00	29.00	
SHALE - DENSE, BLACK, ORGANIC IN NATURE	2,256.00	2,410.00	154.00	
HASKEL SANDSTONE	2,410.00	2,475.00	65.00	
SHALE - DENSE, BLACK, ORGANIC IN NATURE	2,475.00	2,556.00	81.00	

DRILLERS LOG - WELL # 39

FORMATION INFORMATION	TOP (FROM SURFACE - FT)	BOTTOM	THICKNESS (FT)	USDWS
UNCONSOLIDATED MATERIAL	-	3.00	3.00	
RED SHALE	3.00	1,550.00	1,547.00	APPROX 235 FT
BRADFORD 1ST SANDSTONE	1,550.00	1,560.00	10.00	
SHALE	1,560.00	1,730.00	170.00	
CHERRY GROVE SANDSTONE	1,730.00	1,745.00	15.00	
SHALE	1,745.00	2,120.00	375.00	
BRADFORD 3RD SANDSTONE	2,120.00	2,135.00	15.00	
SHALE	2,135.00	2,140.00	5.00	
SANDSTONE	2,140.00	2,160.00	20.00	
SHALE	2,160.00	2,345.00	185.00	
KANE SANDSTONE	2,345.00	2,365.00	20.00	
SHALE - DENSE, BLACK, ORGANIC IN NATURE	2,365.00	2,520.00	155.00	
HASKELL SANDSTONE	2,520.00	2,600.00	80.00	
SHALE - DENSE, BLACK, ORGANIC IN NATURE	2,600.00	2,670.00	70.00	

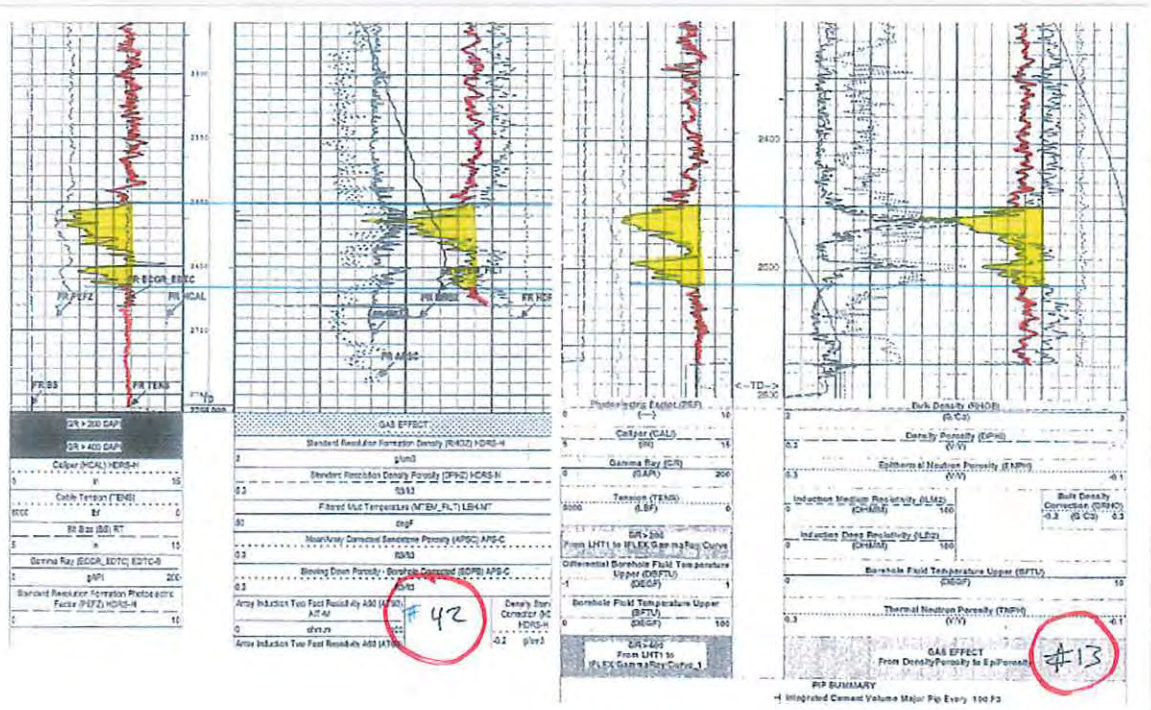
DRILLERS LOG - WELL # 1002

FORMATION INFORMATION	TOP (FROM SURFACE - FT)	BOTTOM	THICKNESS (FT)	USDWS
UNCONSOLIDATED MATERIAL	-	31.00	31.00	
SHALE	31.00	36.00	5.00	
SHALE	36.00	85.00	49.00	
SANDSTONE & SHALE	85.00	135.00	50.00	
SANDSTONE	135.00	305.00	170.00	APPROX 200 FT
SHALE	305.00	308.00	3.00	
BLACK SHALE	308.00	405.00	97.00	
SHALE	405.00	525.00	120.00	
SANDSTONE	525.00	615.00	90.00	
SHALE	615.00	720.00	105.00	
SANDSTONE	720.00	830.00	110.00	
SHALE	830.00	985.00	155.00	
SANDSTONE	985.00	1,065.00	80.00	
SHALE	1,065.00	1,130.00	65.00	
SAND	1,130.00	1,260.00	130.00	
SHALE&SANDSTONE	1,260.00	1,355.00	95.00	
BRADFORD 1ST SANDSTONE	1,355.00	1,450.00	95.00	
SHALE	1,450.00	1,600.00	150.00	
SHALE	1,600.00	1,725.00	125.00	
CHERRY GROVE SANDSTONE	1,725.00	1,795.00	70.00	
SHALE	1,795.00	1,855.00	60.00	
SANDSTONE&SHALE	1,855.00	1,950.00	95.00	
COOPER SANDSTONE	1,950.00	2,010.00	60.00	
SHALE	2,010.00	2,170.00	160.00	
BRADFORD 3RD SANDSTONE	2,170.00	2,200.00	30.00	
SANDSTONE & SHALE	2,200.00	2,390.00	190.00	
KANE SANDSTONE	2,390.00	2,420.00	30.00	
SHALE - DENSE, BLACK, ORGANIC IN NATURE	2,420.00	2,560.00	140.00	
HASKEL SANDSTONE	2,560.00	2,640.00	80.00	
SHALE - DENSE, BLACK, ORGANIC IN NATURE	2,640.00	2,723.00	83.00	

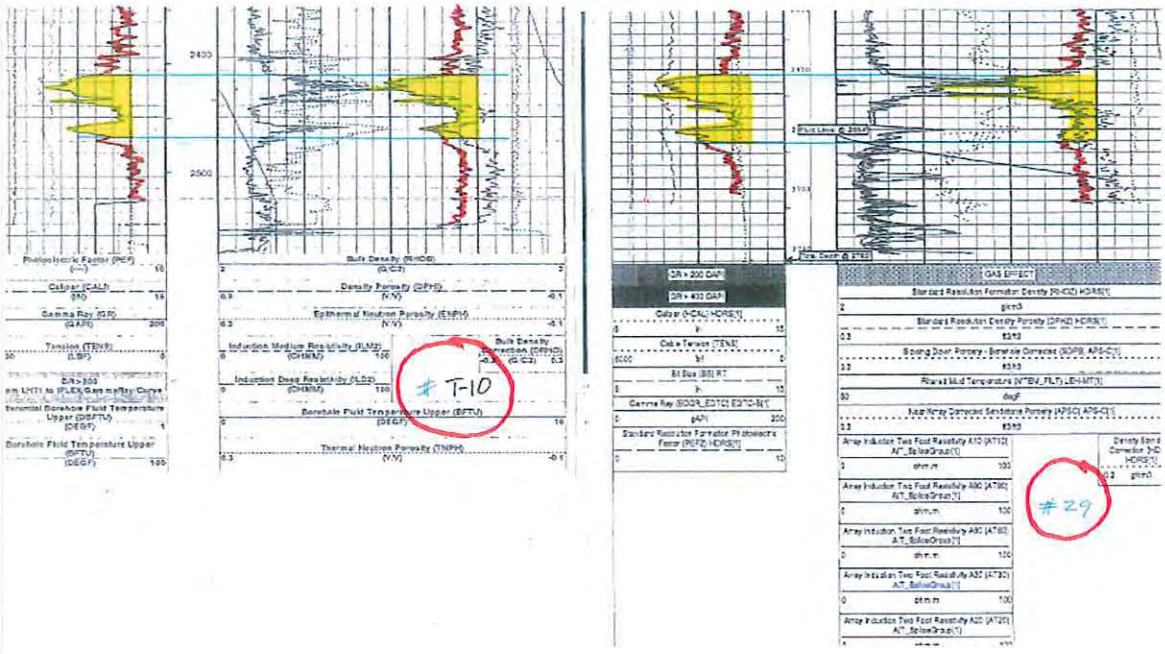

N
AOR - 1/4 Mile Buffer
T10
39
1002
FR 448C
FR 448
FR 448A
FR 463
FR 463B
Oil Wells
Oil Wells
2060
2035
2100
2043
2000
3965'
DWIGHTS RD
DWIGHTS RD
1/4 Mile Buffer
Injection Well
Water Well
0
750
1500 ft
PENNHILLS RESOURCES

CROSS SECTIONS

Cross sections were obtained from N to S and W to E to display both continuity and homogeneity of the field. This is demonstrated by "mirror" like imaging of the gross thicknesses of each cross section as well as porosity and density curves. The Haskell is highlighted in yellow. The confining zones are illustrated in red and which are shown to be to a dense shale (170' thick) as previously stated. A map which shows the AOR (1/4 mile) with the four wells that were used in the cross sections. Refer to the distances between wells (N to S 2,485' W to E 3,866'). This confirms there is no faulting within the AOR. Continuity is displayed further, encompassing the entire Warrant 3131. Furthermore, no known seismicity has occurred anywhere near the AOR. A report conducted by the **Commonwealth of Pennsylvania Department of Conservation and Natural Resources Bureau of Topographic and Geologic Survey**, "Earthquake Hazard in Pennsylvania" documented known epicenters found in Pennsylvania (page 8 of the report). A red "x" denotes the location of the AOR. Per the report, there are no documented cases where the epicenter of an earthquake was traced back to McKean County, Pennsylvania. On Page 7 within the report, the author states, *"The great majority of earthquakes occur along boundaries between tectonic plates. The reason for this is not completely clear, but it appears that stress levels are higher along plate boundaries, and that strain energy builds up more rapidly in those areas. Eastern North America, including Pennsylvania, today is far from the nearest plate boundary – the Mid-Atlantic Ridge, some 2,000 miles to the east."* See attached.



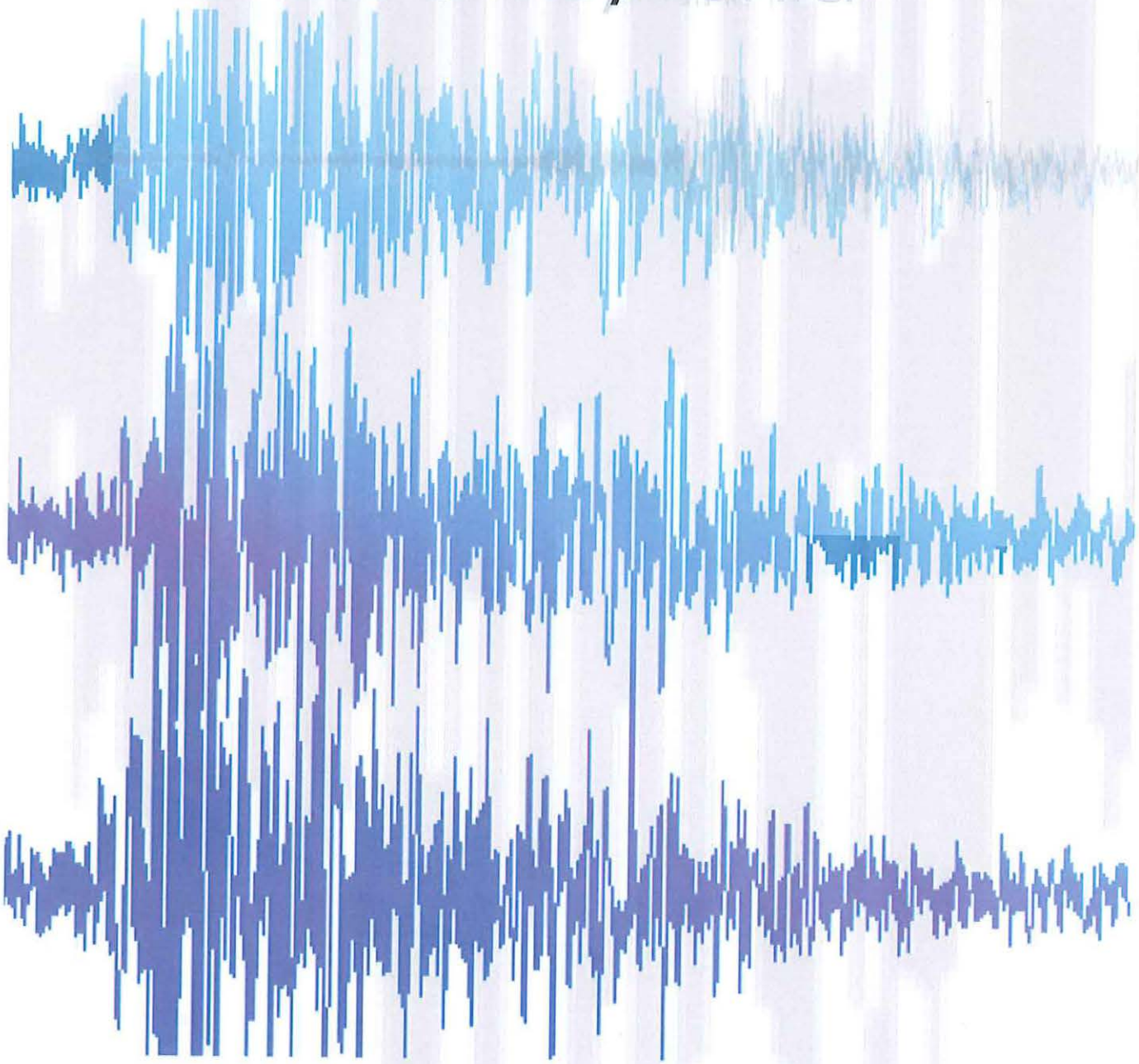
W → E



N → S

Educational Series 10

Earthquake Hazard in Pennsylvania



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DEPARTMENT OF
CONSERVATION AND NATURAL RESOURCES
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web site: www.dcnr.state.pa.us
Bureau of Topographic and Geologic Survey web site:
www.dcnr.state.pa.us/topogeo

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Fourth Printing, June 2007

ON THE COVER: A seismograph recording (in purple-blue) of a Richter magnitude 5.3 earthquake that had an epicenter near Au Sable Forks, N. Y. It includes all three components of ground motion: vertical (top), north-south (middle) and east-west (bottom). Recorded at Millersville University, Millersville, Pa., on April 20, 2002.

Educational Series 10

Earthquake Hazard in Pennsylvania

by Charles K. Scharnberger
Millersville University

PENNSYLVANIA GEOLOGICAL SURVEY
FOURTH SERIES
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2003

Contents

	Page
Introduction	1
What is an earthquake?	1
Earthquake magnitude	2
Earthquake intensity	3
Earthquakes beyond Pennsylvania	4
New Madrid, Missouri	4
The St. Lawrence region	4
Charleston, South Carolina	6
Other East Coast areas	6
Earthquakes in Pennsylvania	7
What is the level of earthquake hazard in Pennsylvania?	7
Geologic history and faults	7
A probabilistic approach	12
Conclusion	13
References	14

Earthquake Hazard in Pennsylvania

by
Charles K. Scharnberger

Introduction

Compared to other states, especially California and Alaska, Pennsylvania is relatively free of earthquake activity. Even considering only the eastern half of North America, Pennsylvania has experienced fewer and milder earthquakes than most other states or Canadian provinces. Nevertheless, earthquakes do occur in our commonwealth, and Pennsylvania may be subject to the effects of earthquakes that have epicenters located outside our borders. Therefore, it is worth considering how much hazard earthquakes present to Pennsylvanians.

What Is an Earthquake?

Earthquakes occur when there is a sudden release of stored energy from a portion of a fault plane within the earth. Faults are fractures in the lithosphere—the rather brittle outer layer of the solid earth. Energy in the form of ***strain,*** small elastic distortion of the lithosphere, accumulates over a period of time due to ***stress*** acting on the rock of the lithosphere. The origin of this stress is believed by most geophysicists to be slow convective motion, driven by heat energy, which occurs below the lithosphere in the mantle. One consequence of this convection is the fragmentation of the lithosphere into tectonic plates, and the slow movement of these plates relative to each other. Much of our understanding of earthquakes, as well as other geologic phenomena such as volcanic eruptions and mountain building, is based on this theory of ***plate tectonics.***

The rock of the lithosphere can accommodate only so much strain energy. Eventually, the rock must fracture. When this happens, strain is relieved, the stress level drops, some energy is converted into heat, some movement (slip) occurs along the plane of fracture (the fault plane), and some energy is radiated away from the area of fracture in the form of elastic waves—called ***seismic waves***—which travel through the earth or along the surface of the earth. The arrival of these seismic waves at a point on the surface causes rapid and complex motions of the ground. This is what we feel as an earthquake. Once a

fault has formed as the result of an initial fracture, earthquakes are likely to recur along the same fault, because this plane is now a zone of weakness in the lithosphere.

Figure 1 shows the relationship of a fault plane to the origin point of the seismic waves (called the ***hypocenter*** or ***focus*** of the earthquake) and the ***epicenter,*** the point on the surface of the earth directly above the hypocenter. Note that, unless the attitude of the fault plane is vertical, the epicenter will be located some distance from the trace of the fault along the surface of the earth.

Earthquake Magnitude

Seismic waves are detected and measured by seismographs. The energies of earthquakes are compared on the basis of their magnitudes, a concept first defined in the 1930s by Charles Richter of the California Institute of Technology. Richter wished to have a single number to describe an earthquake, independent of the distance from the epicenter at which the earthquake waves were recorded. The system he devised is commonly called the ***Richter Scale,*** a term that

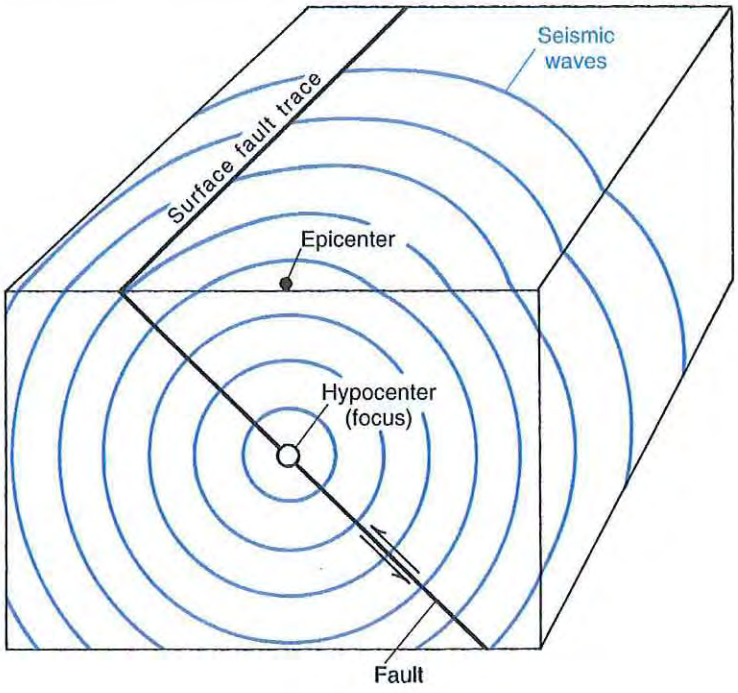

Figure 1. Relationships among the fault plane, the fault trace on the surface of the earth, the earthquake hypocenter (focus), the epicenter, fault slip (arrows), and seismic waves. (Based on Plummer, C. C., and McGeary, David, Physical geology, 4th ed., Wm. C. Brown Publishers, Figure 16.2, p. 345. Copyright © 1988. Reproduced with permission of The McGraw-Hill Companies.)

frequently leads to the mistaken impression that there is a kind of physical instrument—a scale similar to those used to measure weights—to which the term applies. In fact, the Richter Scale—Richter himself preferred to call it the ***magnitude scale***—is a scale of numbers that expresses the relative sizes of earthquakes. The numbers of the magnitude scale are logarithms, that is, numbers that express powers of 10. As originally defined by Richter on the basis of California earthquakes recorded locally on a particular type of seismograph, the magnitude represented the maximum amount of ground movement at a distance of 100 kilometers (62 miles) from the epicenter of an earthquake. Each whole number on the scale represented a tenfold difference in this amplitude of ground motion.

As the concept of magnitude came to be used worldwide and had to be calculated from many different types of seismographs, new ways of defining the magnitude were introduced, so that today several different magnitude numbers might be found for the same earthquake. Thus, magnitudes are useful mostly for comparing earthquakes (the purpose Richter had in mind), rather than for finding the actual energy of an earthquake with more than rough precision.

There is no upper or lower limit to the Richter Scale, but as a matter of historical fact, no magnitude greater than about 9.5 has ever been calculated for an earthquake. Earthquakes in eastern North America seldom have magnitudes greater than 5.

Earthquake Intensity

Before the development of the magnitude scale, earthquakes were compared on the basis of ***intensity.*** Today, intensity values are an important supplement to the magnitudes because intensity is a semiquantitative expression of the effects caused by an earthquake. These may be effects on people, on man-made structures, or on natural features of the landscape. Intensities are determined after the earthquake on the basis of field observations made by trained personnel, or from survey forms filled out by persons who experienced the earthquake. The U.S. Geological Survey (USGS) uses reports sent in by postmasters and compiles intensity data by postal ZIP code.

Obviously, intensity is not a single number for a particular earthquake, but varies from place to place. Usually, the intensity is greatest in the immediate vicinity of the epicenter and decreases with increasing distance from the epicenter. However, many factors affect intensity; among them are topography, type and thickness of soil, direction from the epicenter relative to regional rock structure, and type of

bedrock. The greatest intensities are commonly caused by landslides or other modes of ground failure induced by the seismic waves rather than by the direct effects of seismic shaking.

In the United States, intensities are expressed in terms of the ***Modified Mercalli scale.*** This scale was first proposed in Italy by Giuseppi Mercalli in the early 1900s and was modified in 1931 by the American seismologists H. O. Wood and F. Neumann (for this reason, it is also called the Wood-Neumann scale). Table 1 is an abridged version of the Modified Mercalli scale; Roman numerals are usually used to avoid confusion with earthquake magnitude.

Earthquakes Beyond Pennsylvania

Historically, large earthquakes have occurred in three regions of eastern North America: (1) the Mississippi Valley, especially near the town of New Madrid, Mo.; (2) the St. Lawrence Valley; and (3) Charleston, S. C.

New Madrid, Missouri

Three great earthquakes struck the vicinity of New Madrid in December 1811, January 1812, and February 1812. Although there were no seismographs to record these events, each earthquake in the series is estimated to have had a magnitude in excess of 7. These earthquakes were felt in western Pennsylvania, but no damage is known to have occurred there (Abdypoor and Bischke, 1982; all other references to the effects of large historic earthquakes in Pennsylvania are from this source). It is unlikely that future New Madrid earthquakes would be any greater than those of 1811–12, so Pennsylvanians probably do not have to worry about a threat from that quarter.

The St. Lawrence Region

One of the largest earthquakes in eastern North America occurred on February 28, 1925, and had an epicenter in the La Malbaie-Charlevoix region of Quebec. This earthquake had a magnitude near 7. Earthquakes having magnitudes estimated to have exceeded 6.5 occurred in the same region in 1663 and 1870 (Johnston and others, 1994; most magnitudes given in this section are from this source). At least a dozen earthquakes strong enough to be felt in Pennsylvania have originated in the St. Lawrence Seismic Zone since the time of European settlement, the most recent on November 25, 1988. Earthquake activity in Ontario, western New York, northwestern Pennsyl-

Table 1. *The Modified Mercalli Scale of 1931 (Abridged Version)*

I. Not felt except by a very few under especially favorable circumstances.

II. Felt only by a few persons at rest, especially on the upper floors of buildings. Delicately suspended objects may swing.

III. Felt quite noticeably indoors, especially on the upper floors of buildings, but many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration is like the passing of a truck. Duration is estimated.

IV. During the day felt indoors by many, outdoors by few. At night some are awakened. Dishes, windows, and doors are disturbed; walls make a creaking sound. Sensation is like a heavy truck striking a building. Standing motor cars are rocked noticeably.

V. Felt by nearly everyone; many are awakened. Some dishes, windows, etc., are broken; a few instances of cracked plaster occur; unstable objects are overturned. Disturbance of trees, poles, and other tall objects is sometimes noticed. Pendulum clocks may stop.

VI. Felt by all; many are frightened and run outdoors. Some heavy furniture is moved; a few instances of fallen plaster or damaged chimneys occur. Damage is slight.

VII. Everybody runs outdoors. Damage is *negligible* in buildings of good design and construction; *slight* to *moderate* in well-built ordinary structures; *considerable* in poorly built or badly designed structures. Some chimneys are broken. Noticed by persons driving motor cars.

VIII. Damage is *slight* in specially designed structures; *considerable* in ordinary substantial buildings, with partial collapse; *great* in poorly built structures. Panel walls are thrown out of frame structures. Chimneys, factory stacks, columns, walls, and monuments fall; heavy furniture is overturned. Sand and mud are ejected from the ground in small amounts. Changes occur in well water. Persons driving motor cars are disturbed.

IX. Damage is *considerable* in specially designed structures; well-designed frame structures are thrown out of plumb; damage is *great* in substantial buildings, with partial collapse. Buildings are shifted off their foundations. Ground is cracked conspicuously. Underground pipes are broken.

X. Some well-built wooden structures are destroyed; most masonry and frame structures are destroyed along with their foundations. Ground is badly cracked. Rails are bent. Considerable landslides occur on river banks and steep slopes. Sand and mud are shifted. Water is splashed (slopped) over banks.

XI. Few, if any, masonry structures remain standing. Bridges are destroyed. Broad fissures occur in the ground. Underground pipelines are completely out of service. Earth slumps and land slips occur in soft ground. Rails are bent greatly.

XII. Damage is total. Waves are seen on the ground surface. Lines of sight and level are distorted. Objects are thrown upward into the air.

vania, and eastern Ohio may represent a westward extension of this zone. An earthquake of unknown magnitude with an epicenter near Attica, N. Y., is reported to have cracked walls in Sayre (Bradford County), Pa., on August 12, 1929. On November 1, 1935, an earthquake with an epicenter near Timiskaming, Ontario (northwest of the St. Lawrence Seismic Zone proper), and an estimated magnitude of 6.4, was felt with intensity IV in northwestern Pennsylvania and, at lower intensities, throughout the commonwealth. The lower St. Lawrence region is too far away for even a large future earthquake to be likely to cause damage in Pennsylvania. If an earthquake having a magnitude of 6 or greater were to occur on the western extension of the St. Lawrence Seismic Zone, however, at least moderate damage might be expected in one or more of the counties of Pennsylvania's "northern tier."

Charleston, South Carolina

Charleston was the site of the largest historic earthquake to have struck the eastern seaboard of the United States, and one of the 10 largest earthquakes to occur anywhere in the world away from an active tectonic plate margin. The earthquake on August 31, 1886, had a magnitude estimated to have been around 7.5. Intensity reached X on the Modified Mercalli scale, and the city of Charleston was heavily damaged. Although this earthquake was felt in most of Pennsylvania, intensity here did not exceed IV, so a recurrence of the great Charleston earthquake would pose little hazard to Pennsylvanians.

Other East Coast Areas

Eastern Massachusetts experienced strong earthquake shocks in 1658, 1727, 1755, and 1925. The largest of these was the earthquake of November 18, 1755, which had an estimated magnitude of about 6.3. The epicenter is generally thought to have been offshore of Cape Ann, north of Boston, although the exact location is uncertain. This earthquake was felt with intensities of IV and V in eastern Pennsylvania. Intensity as high as VI might be expected from a magnitude 7 earthquake originating in the vicinity of Boston.

Southeastern New York and northern New Jersey have been the sites of moderate earthquakes. Two of these events, in 1737 and 1884, produced intensities as high as VII in New York City and were felt at intensity IV in eastern Pennsylvania. If an earthquake of magnitude 6 or greater were to occur in this area, it is likely that damage would result in the easternmost counties of Pennsylvania.

Earthquakes in Pennsylvania

Figure 2 shows the locations of historic epicenters in Pennsylvania; a list of Pennsylvania earthquakes by county is given in Table 2. Ambiguities always exist in lists of earthquakes, and no two lists for the same region are likely to agree in every detail. Some events identified as earthquakes in some lists may, in fact, have been something else—blasting in the course of mining operations, for example. Table 2 includes only those events that the author considers to be earthquakes with a high degree of certainty. Aftershocks—smaller earthquakes following a larger one in approximately the same location—are listed only if they occurred more than a year after the main shock; otherwise they are mentioned in the "Remarks" column. Earthquakes that can be considered foreshocks of larger events have been listed separately from their main shocks only if they occurred months to years earlier. It is likely that some earthquakes having magnitudes less than 3, other than aftershocks, have occurred in Pennsylvania but were not detected by seismographs or recognized as earthquakes and reported by persons who felt them. It is also possible that evidence for some earthquakes that occurred prior to the mid-twentieth century has not yet been discovered in historical documents. For example, the entire earthquake history of Lancaster County prior to 1885 was unknown to the scientific community until Armbruster and Seeber (1987) published the results of their search of newspapers and other archives.

Earthquakes having magnitudes greater than 5 can occur in Pennsylvania, as demonstrated by the earthquake of September 25, 1998 (Armbruster and others, 1998) (Table 2, Crawford County). Southeastern Pennsylvania, the state's most seismically active region, is not known to have experienced an earthquake with magnitude greater than 4.7, but the historical record goes back only about 200 years. No obvious reason exists to conclude that an earthquake of magnitude between 5 and 6 could not occur there also. An earthquake with magnitude greater than 6 is much less likely, but the fact that such large earthquakes have occurred elsewhere in the East means that this possibility cannot be ruled out entirely for Pennsylvania.

What is the Level of Earthquake Hazard in Pennsylvania?

Geologic History and Faults

The great majority of earthquakes occur along boundaries between tectonic plates. The reason for this is not completely clear, but it appears

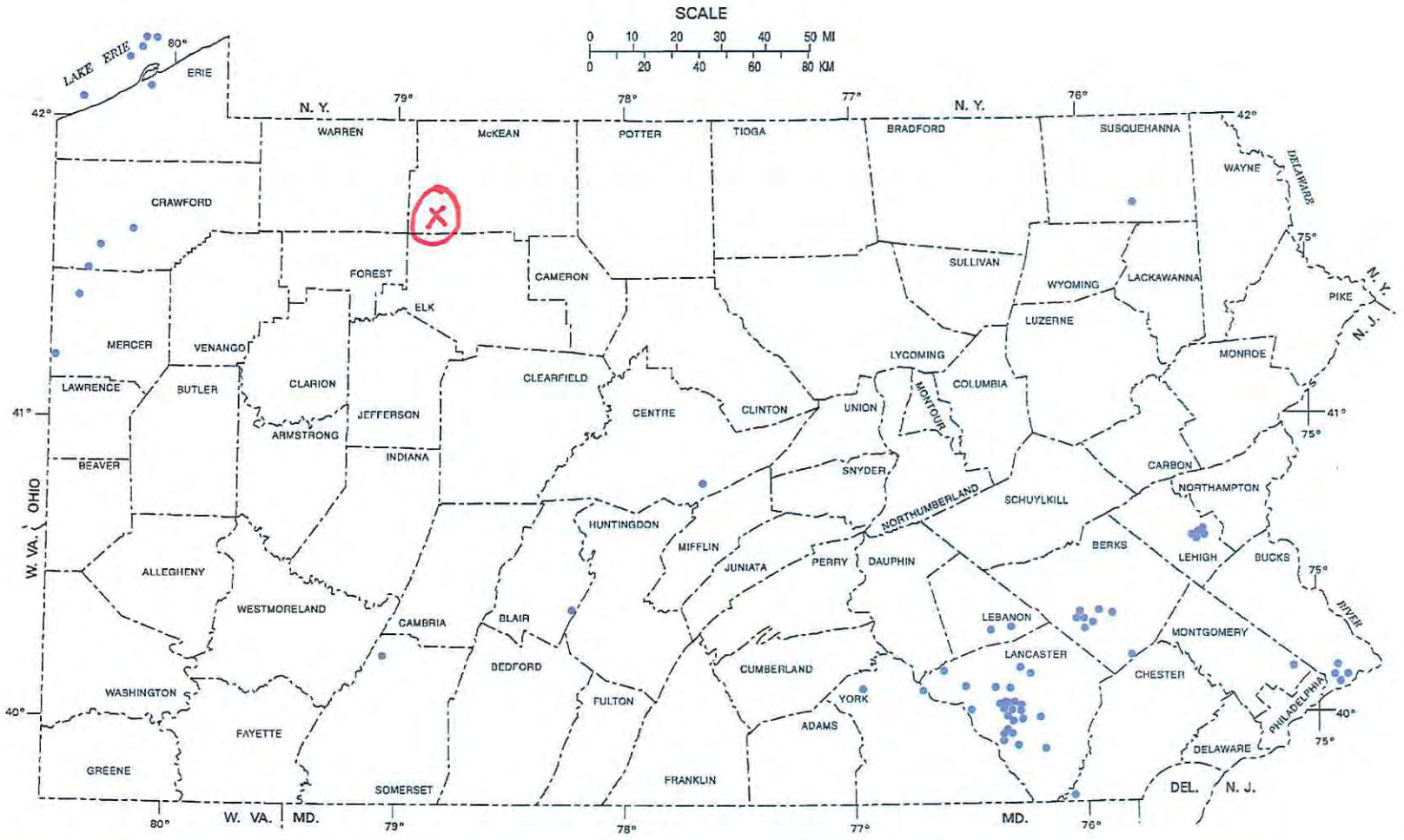

Figure 2. Locations of historic earthquake epicenters in Pennsylvania. Many locations are approximate. Pre-twentieth-century earthquakes felt in Philadelphia are not shown because their epicenter locations are unknown.

Table 2. *Selected Earthquakes in Pennsylvania Through March 2006*

Date (local time)		Where strongly felt	Magnitude	Remarks
		ADAMS COUNTY		
May 26,	1994		2.8	
		BERKS COUNTY		
Nov. 21,	1777	Unknown	Unknown	
May 28,	1906	Geigertown	Unknown	
June 8,	1937	Reading	Unknown	
Jan. 7,	1954	Sinking Spring	3.2 (est.)	Aftershocks for 1 year
June 25,	1972	Wyomissing	Unknown	Start of series of small earthquakes lasting a few days
Aug. 12,	1973	Wyomissing	Unknown	
May 10,	1993	Spring Twp.	2.8	
Jan. 15,	1994	Spring Twp.	4.0, 4.6	Two events about 1 hour apart. Long aftershock sequence into the late 1990s
Oct. 28,	1996	Wyomissing	2.5	May be delayed aftershock of Jan. 15, 1994, earthquake
		BLAIR COUNTY		
July 15,	1938	Clover Creek	3.2 (est.)	
		BUCKS COUNTY		
Dec. 27,	1961	Bristol-Levittown	Unknown	Epicenter may have been in New Jersey
Nov. 14,	1981	Bristol-Levittown	Unknown	Epicenter may have been in New Jersey
Apr. 12,	1982	Bristol-Levittown	2.5	Epicenter may have been in New Jersey
May 12,	1982	Bristol-Levittown	2.5	Epicenter may have been in New Jersey
May 12,	1982		2.4	
May 10,	1984		2.2	
Feb. 2,	1989		Unknown	
		CENTRE COUNTY		
Mar. 25,	1937		Unknown	
Aug. 15,	1991	Centre Hall	3.0	
		CHESTER COUNTY		
Dec. 17,	1752		3.6	
Jan. 25,	1821	New London	3.1	
Oct. 17,	1996	Nottingham	2.3	Epicenter may have been in Maryland
		CRAWFORD COUNTY		
Sept. 15,	1852	Meadville	Unknown	
Apr. 14,	1985	Conneaut Lake	3.2	
Sept. 25,	1998	Jamestown (Mercer Co.)	5.2	Largest known Pennsylvania earthquake; many aftershocks
		ERIE COUNTY		
Nov. 1,	1870	Erie	3.5	
Sept. 26,	1921	Erie	2.9	
Feb. 16,	1930	Erie	2.9	
Oct. 29,	1934	Erie	3.2 (est.)	Strongest aftershock felt at Albion on Nov. 5
Dec. 17,	1990	Erie	2.5	
Aug. 30,	1998	Erie	2.1	
Oct. 30,	1999	Erie	2.5	
		FAYETTE COUNTY		
Dec. 8,	1896	Dunbar	3.8	
Oct. 8,	1965	Connellsville	3.3	
		FRANKLIN COUNTY		
Mar. 19,	1880	Chambersburg	3.5	Epicenter may have been in Maryland

Table 2. *Continued.*

Date (local time)		Where strongly felt	Magnitude	Remarks
		LACKAWANNA COUNTY		
Sept. 27,	1940	Unknown	Unknown	May be mining-related event
		LANCASTER COUNTY		
Dec. 17,	1752	Lancaster	3.6 (est.)	Epicenter may have been in Chester County
Jan. 11,	1798	Lancaster	Unknown	
Nov. 20,	1800	Lititz	3.9 (est.)	
Jan. 27,	1801	Lancaster	Unknown	
Mar. 19,	1818	Lancaster	Unknown	
Aug. 21,	1820	Mt. Joy	3.4 (est.)	
May 4,	1822	Lancaster	Unknown	
May 1,	1825	Millersville	3.1	Reported from "Millerstown," which was the name of present-day Millersville in 1825
Sept. 5,	1829	Lancaster	Unknown	
Feb. 5,	1834	Marticville	3.8 (est.)	
Jan. 20,	1861	Lancaster	3.5	
Sept. 17,	1865	Willow Street	Unknown	
Nov. 7,	1866	Lancaster	Unknown	
Mar. 8,	1885	Lancaster	Unknown	
Sept. 26,	1886	Elizabethtown	Unknown	
Mar. 8,	1889	Conestoga	4.1 (est.)	
May 6,	1892	Terre Hill	Unknown	
Dec. 7,	1972	Lititz	3.5 (est.)	
July 16,	1978	Conestoga	3.1	
Oct. 6,	1978	Manheim Twp.	3.0	
Apr. 22,	1984	Marticville	4.1	Magnitude 3 foreshock 4 days earlier; many aftershocks
Sept. 19,	1984	Lancaster	Unknown	
May 2,	1986	Conestoga	2.6	May be delayed aftershock of Apr. 22, 1984, earthquake
Mar. 11,	1995	East Petersburg	2.0, 2.4	Two events about 1 hour apart
Nov. 14,	1997	Lititz	3.0	
Oct. 5,	2000	Conestoga	2.3	May be delayed aftershock of Apr. 22, 1984, earthquake
		LEBANON COUNTY		
Jan. 15,	1885	Schaefferstown	2.7 (est.)	
May 12,	1964	Cornwall	3.2 (est.)	
		LEHIGH COUNTY		
May 31,	1884	Allentown	2.9 (est.)	
May 31,	1908	Allentown	3.1 (est.)	
June 22,	1928	Allentown	2.4 (est.)	
Nov. 23,	1951	Allentown	3.3 (est.)	
Sept. 14,	1961	Allentown	Unknown	
		LUZERNE COUNTY		
Feb. 24,	2000		2.3	
		MERCER COUNTY		
Aug. 17,	1873	Sharon	Unknown	Epicenter may have been in Ohio
Dec. 11,	1890	Greenville	2.9	
Aug. 26,	1936	Greenville	2.9	
		MONROE COUNTY		
Oct. 24,	1942	Stroudsburg	3.4	Epicenter may have been in New Jersey
		MONTGOMERY COUNTY		
Mar. 5,	1980	Abington	3.5	Strongest of a series of 6 earthquakes over 9 days felt in Montgomery and lower Bucks Counties

Table 2. *Continued.*

Date (local time)	Where strongly felt	Magnitude	Remarks
PHILADELPHIA AREA[1]			
Dec. 18, 1737			
Nov. 27, 1755			
Mar. 23, 1758			
Mar. 22, 1763			
Oct. 13, 1763			
Oct. 30, 1763			
Apr. 25, 1772			
Nov. 22–23, 1777			
Nov. 29, 1780			
Mar. 17, 1800			
Nov. 29, 1800			
Nov. 12, 1801			
Dec. 8–9, 1811			
Dec. 16, 1811			
Jan. 8, 1817			
Aug. 17, 1840			
Nov. 11 and 14, 1840			
June 17, 1871			
Mar. 25, 1879			
SOMERSET COUNTY			
Feb. 3, 1982	Jennerstown	2.6	
SULLIVAN COUNTY			
Oct. 28, 1946	Unknown	Unknown	May be mining-related event
SUSQUEHANNA COUNTY			
Aug. 14, 1982	Hop Bottom	Unknown	
TIOGA COUNTY			
Dec. 16, 1869	Tioga	3.1	
Dec. 14, 1990	Tioga	3.0	
WARREN COUNTY			
July 8, 1995	Warren	2.4	
YORK COUNTY			
June 16, 1997	Dillsburg	2.4	

[1]Earthquakes whose epicenters are unknown and that were felt in Philadelphia.

that stress levels are higher along plate boundaries, and that strain energy builds up more rapidly in those areas. Eastern North America, including Pennsylvania, today is far from the nearest plate boundary—the Mid-Atlantic Ridge, some 2,000 miles to the east. Nevertheless, the eastern states and eastern provinces of Canada do experience a moderate level of earthquake activity, including occasional earthquakes with magnitudes greater than 6 that are capable of producing significant damage. Seismicity in the East may be related to what happened here about 200 million years ago. At that time, the supercontinent called Pangaea broke up and the Atlantic Ocean began to form. This event, called ***rifting*** by geologists, produced many faults, and some of these faults may be experiencing reactivation by the present-day

stress, which is squeezing eastern North America in a roughly east-west direction. Johnston and others (1994) found that nearly 70 percent of earthquakes with magnitudes of at least 6 in so-called stable continental regions occur in areas that experienced rifting sometime during the past 200 million years.

It might seem, then, that a straightforward approach to earthquake hazard evaluation in the East would be to locate all the faults, or at least those that are 200 million years old or younger. Unfortunately, this approach does not work very well because it is impossible to demonstrate that any particular fault is active, even when earthquake epicenters are located in the vicinity of the fault's surface trace. Actual displacement of the earth's surface along a fault line during an earthquake is extremely rare in the East. Complicating the problem is the fact that the vast majority of mapped faults in our region have no seismicity at all associated with them. Therefore, simply knowing where the faults are tells us little, if anything, about earthquake hazard.

Despite the difficulty of identifying specific faults that are responsible for earthquakes in the East, regions of perisistent earthquake activity have been delineated and named. An example in Pennsylvania is the Lancaster Seismic Zone (Armbruster and Seeber, 1987), which encompasses all seismicity in Lancaster, York, Lebanon, and Berks Counties. As indicated in Table 2, this is the most active seismic zone in Pennsylvania.

A Probabilistic Approach

It appears that the best guides to seismic hazard in Pennsylvania and elsewhere in the East are the earthquakes themselves. The earthquake history of a region can be the basis for conducting a probabilistic earthquake-hazard analysis.

As part of the National Earthquake Hazard Reduction Program, seismologists working for the USGS have used earthquake history to estimate the probabilities of earthquakes of various magnitudes occurring in various locations over a given period of time. They have produced a series of maps that show the results as ground-motion hazard maps. These maps have been designed to be useful for the determination of building codes. Usually, 50 years is the time frame considered because that is what architects and structural engineers take to be the useful lifetime of a new building. The expected decrease in intensity with distance from the epicenter is also taken into consideration to arrive at an estimate of the probability that certain levels of ground shaking will be experienced at any given location.

The expected level of ground shaking is expressed in terms of some measure of ground acceleration or velocity, such as the peak hori-

zontal ground acceleration (the largest acceleration recorded during an earthquake). These terms are used because building codes are written to indicate how much horizontal force a building should be able to withstand during an earthquake. Table 3 gives the levels of peak acceleration and the *roughly* equivalent values of earthquake intensity on the Modified Mercalli scale. Figure 3 shows contours of peak horizontal ground acceleration having a 2 percent probability of being experienced in any 50-year period, as calculated by USGS seismologists. The contour values are percentages of the acceleration due to gravity (g), which is 9.8 meters/second/second, or 32 feet/second/second. The original map on which Figure 3 is based, as well as other seismic-hazard maps, may be viewed on the USGS web site at http://eqhazmaps.usgs.gov/.

Table 3. *Approximate Correlation of Peak Horizontal Ground Acceleration (PHGA) with Modified Mercalli Intensity (MMI)*

PHGA (percent of g, acceleration due to gravity)	MMI
<6	<VI
6–8	VI
8–16	VII
16–32	VIII
>32	IX+

The Pennsylvania Department of Environmental Protection requires that structures built in areas that can expect peak horizontal ground acceleration to exceed 10 percent g with a probability of 10 percent in 250 years (which is equivalent to 2 percent probability in 50 years) incorporate specific seismic safety design features.

Conclusion

Two of the areas that have generated the largest historical earthquakes in eastern North America—New Madrid, Mo., and Charleston, S. C.—are too far away for earthquakes having epicenters there to cause damage in Pennsylvania, although earthquakes occurring in those areas that have magnitudes near 7 would be felt in Pennsylvania. Eastern Massachusetts is closer, and a magnitude 7 earthquake there could produce intensity VI effects in northeastern Pennsylvania.

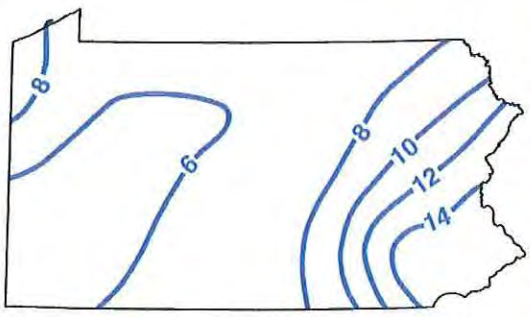

Figure 3. An earthquake-hazard map for Pennsylvania. The contours represent earthquake ground motions that have a 2 percent probability of being experienced in 50 years. The numbers are percentages of g, the acceleration due to gravity. See Table 3 for approximate corresponding values of Modified Mercalli intensity. From Frankel and others (2002).

Similar intensities might be expected in north-central and northwestern Pennsylvania from earthquakes that have epicenters in the western part of the St. Lawrence zone. The possibility that a magnitude 7 earthquake could occur having an epicenter near New York City cannot be completely discounted, and such an earthquake could produce significant damage (intensity VIII) in eastern Pennsylvania.

Pennsylvanians probably will continue to feel small earthquakes generated on local faults, although the exact identity of those faults is likely to remain elusive. A large local earthquake, one with magnitude greater than 6, though unlikely, is not impossible. A probabilistic analysis that takes into consideration the threat from earthquakes both outside and inside Pennsylvania's borders indicates a relatively low level of earthquake hazard in our commonwealth. Nevertheless, some precautions might be in order. These include contingency planning by emergency management agencies and emergency response services; incorporation of at least moderate earthquake resistance into the design of new buildings and other engineered structures, such as bridges and pipelines; and individual preparedness that would include having on hand a flashlight, battery-powered radio, water and food supply, and first-aid kit—as one might prepare for the possibility of a disaster of any sort. Further information about how to prepare for earthquakes and other emergencies may be obtained from the Southeastern Pennsylvania Chapter of the American Red Cross, 23rd and Chestnut Streets, Philadelphia, PA 19103, or from their web site at http://www.redcross-philly.org.

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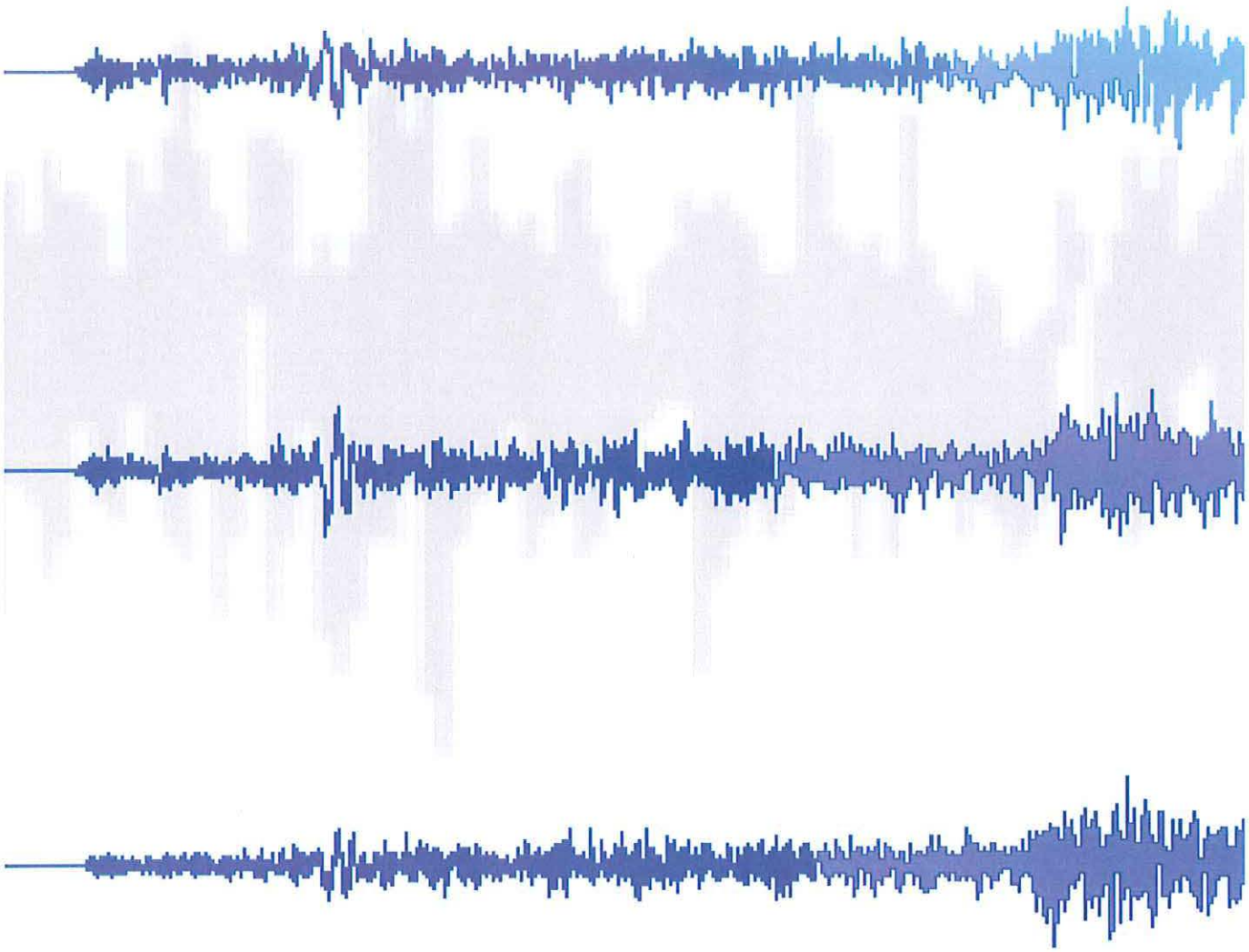


POROSITY & PERMEABILITY CHARACTERISTICS

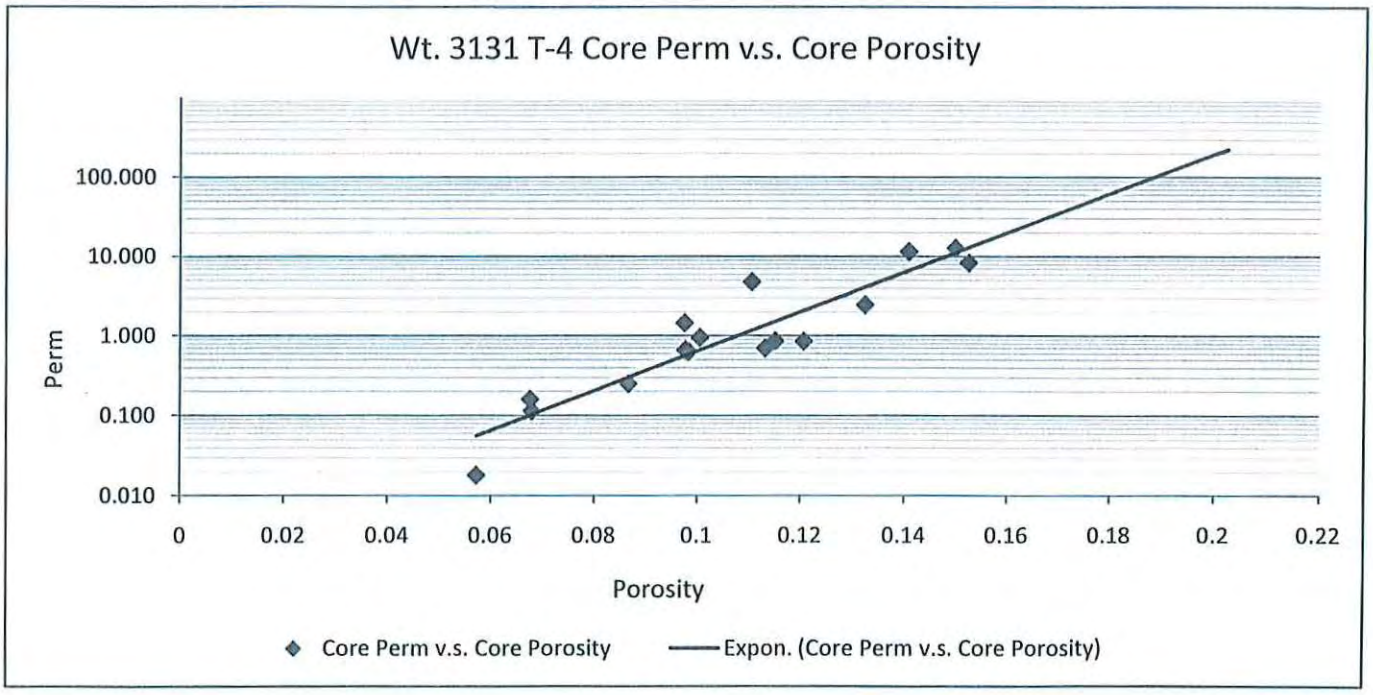
As previously mentioned, East Resources conducted core analysis on two wells within the Haskell sand. This information was obtained by TerraTek, a company of Schlumberger. Two wells were cored (T4 & T6) to determine the viability of the Haskell sand. It was determined that due to high above average permeability, ample porosity, and hydrocarbon saturations, the Haskell would be a good candidate to hydraulically fracture. East Resources proceeded to develop the field with positive results. The results are listed below:

East Resources Inc.
3131 T4
Routine Core Analysis Test Results
Project No: 502514
August 8, 2008

TerraTek
Pioneer Business Park
1935 S. Fremont Drive
Salt Lake City, Utah 84104

Sample Number	Sample Depth (ft)	Sample Length (in)	Sample Diameter (in)	Ambient Porosity (%)	Dry Bulk Density (g/cc)	Grain Density (g/cc)	Saturation		Average Permeability (md)	Klinkenberg Correction (md)	Lithology
							Water (%)	Oil (%)			
1	2608.50	0.645	0.917	4.42	2.554	2.672	3.24	36.57	0.032		
2	2597.00	1.267	0.914	3.82	2.668	2.774	57.66	35.27	0.139	0.079	
3	2593.00	0.659	0.917	11.50	2.344	2.649	0.98	49.50	0.858	0.5781	
4	2592.50	0.916	0.915	6.76	2.460	2.639	7.49	34.19	0.159	0.0826	
5	2585.50	0.753	0.919	6.80	2.502	2.685	1.62	55.82	0.113	0.0768	
6	2579.00	1.349	0.920	11.31	2.334	2.631	6.02	23.36	0.697	0.5069	
7	2578.50	1.285	0.914	8.67	2.444	2.676	16.70	35.75	0.248	0.0758	
8	2578.00	1.247	0.916	12.06	2.354	2.676	7.39	36.02	0.850	0.4748	
9	2577.50	0.957	0.919	9.83	2.396	2.657	7.82	39.01	0.629	0.4682	
10	2577.00	1.249	0.920	13.23	2.296	2.646	11.11	27.85	2.439	2.0253	
11	2576.50	1.331	0.923	15.24	2.231	2.632	4.50	33.75	8.291		
12	2576.00	1.286	0.920	14.98	2.240	2.635	9.06	26.75	12.686		
13	2575.00	1.323	0.923	9.75	2.411	2.672	26.85	8.81	1.449		
14	2572.50	0.977	0.922	8.37	2.444	2.667	20.13	17.23	0.659	0.5596	
15	2571.00			8.36	2.440	2.662	17.21	27.93	NSA	NSA	
16	2569.00	1.197	0.921	11.05	2.342	2.633	6.93	23.72	4.785		
17	2568.50	0.756	0.921	14.07	2.248	2.616	0.26	34.34	11.470		
18	2568.00	1.390	0.921	9.78	2.403	2.664	13.47	26.31	0.649	0.5111	
19	2567.50	1.291	0.919	5.73	2.609	2.767	49.71	24.71	0.018		
20	2562.00	1.297	0.921	10.05	2.409	2.679	4.22	21.32	0.947	0.7109	

TerraTek
A Schlumberger Company
Pioneer Buisiness Park
1935 S Fremont Dr - .ake City , Utah 84104
Telephon I) 584-2400
Fax (801) 584-2432


Wt. 3131 T-4 Core Perm v.s. Core Porosity
100.000
10.000
1.000
0.100
0.010
Perm
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2
0.22
Porosity
Core Perm v.s. Core Porosity
Expon. (Core Perm v.s. Core Porosity)

East Resources Inc.
3131 T6
Routine Core Analysis Test Results
Project No: 502514
August 8, 2008

TerraTek
Pioneer Business Park
1935 S. Fremont Drive
Salt Lake City, Utah 84104

Sample Number	Sample Depth (ft)	Sample Length (in)	Sample Diameter (in)	Ambient Porosity (%)	Dry Bulk Density (g/cc)	Grain Density (g/cc)	Saturation		Average Permeability (md)	Klinkenberg Correction (md)	Lithology
							Water (%)	Oil (%)			
1	2630.00	1.459	0.918	3.30	2.644	2.734	76.61	9.91	0.013		
2	2623.50	1.504	0.917	3.87	2.581	2.685	63.53	9.90	0.052	0.0137	
3	2601.00	0.804	0.917	13.08	2.298	2.643	26.36	21.40	8.365	6.372	
4	2598.50	1.255	0.920	16.29	2.223	2.656	34.58	16.49	11.001		
5	2598.00	1.363	0.921	16.05	2.224	2.649	30.15	18.48	10.785		
6	2597.50	1.321	0.922	16.85	2.197	2.643	20.53	25.21	18.328		
7	257.00	1.325	0.921	13.91	2.284	2.653	19.88	20.53	5.369	4.184	
8	2596.50	0.446	0.920	13.22	2.270	2.616	15.57	31.87	7.805	7.5697	
9	2596.00	0.759	0.915	12.54	2.307	2.638	19.50	25.34	4.389	2.9747	
10	2595.50	0.776	0.921	10.72	2.381	2.667	12.12	25.53	0.403	0.2556	
11	2595.00	1.258	0.919	13.13	2.301	2.649	16.71	23.79	2.836	1.9136	
12	2594.50	1.244	0.921	13.98	2.290	2.663	10.53	21.62	3.403	2.0804	
13	2594.00	1.224	0.919	15.23	2.238	2.640	13.82	29.38	7.727		
14	2593.50	1.233	0.921	15.63	2.238	2.652	9.98	29.36	7.916		
15	2593.00	1.295	0.921	14.82	2.249	2.640	12.41	26.00	7.319		
16	2592.50	0.892	0.918	15.22	2.244	2.647	13.59	27.33	10.637		
17	2592.00	1.456	0.921	10.60	2.385	2.668	28.50	10.69	2.306		
18	2588.00	0.875	0.922	10.94	2.363	2.653	7.64	21.34	1.771		
19	2586.50	0.667	0.920	11.03	2.401	2.698	11.23	17.17	0.807	0.6754	
20	2584.00	0.926	0.918	9.79	2.453	2.719	20.35	21.07	19.283	11.151	
21	2583.50	1.374	0.919	15.32	2.247	2.653	6.56	26.43	7.864		
22	2583.00	1.324	0.920	16.06	2.223	2.648	4.32	27.79	19.722		
23	2582.50	0.911	0.918	15.87	2.231	2.652	5.10	24.69	18.950		
24	2582.00	1.084	0.921	10.47	2.414	2.696	16.14	12.34	0.911		
25	2580.00	1.416	0.920	5.52	2.534	2.682	23.48	12.02	0.018		

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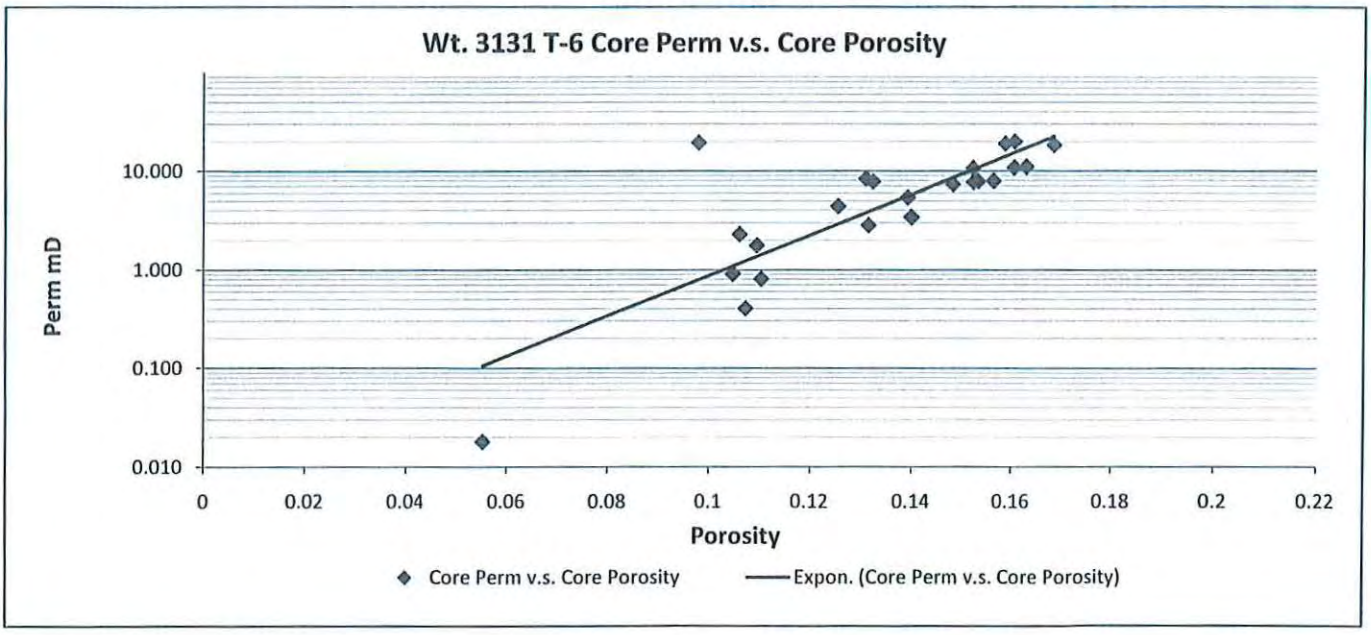
Wt. 3131 T-6 Core Perm v.s. Core Porosity
Perm mD
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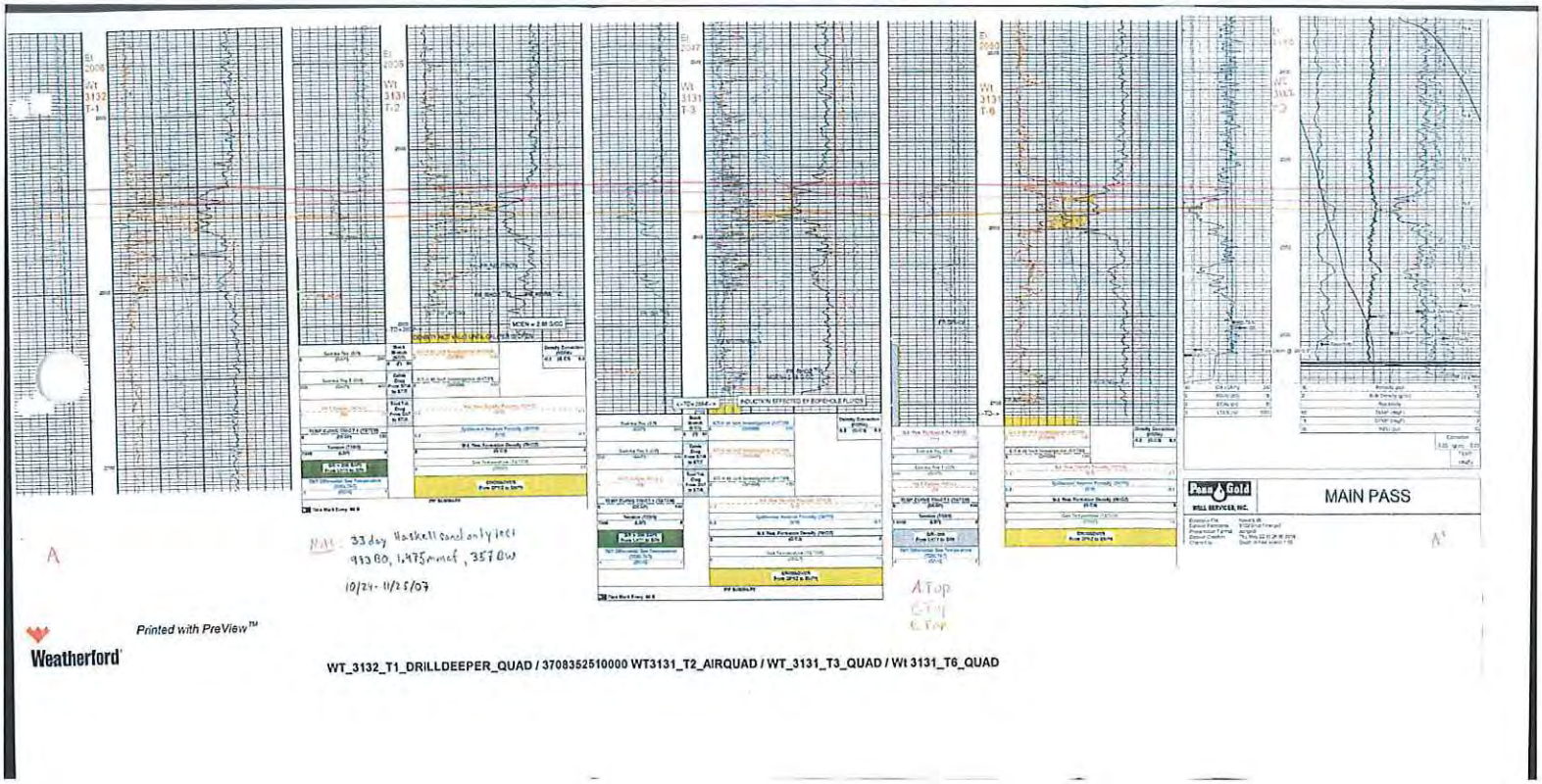
1.000
0.100
0.010
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2
0.22
Porosity
Core Perm v.s. Core Porosity
Expon. (Core Perm v.s. Core Porosity)



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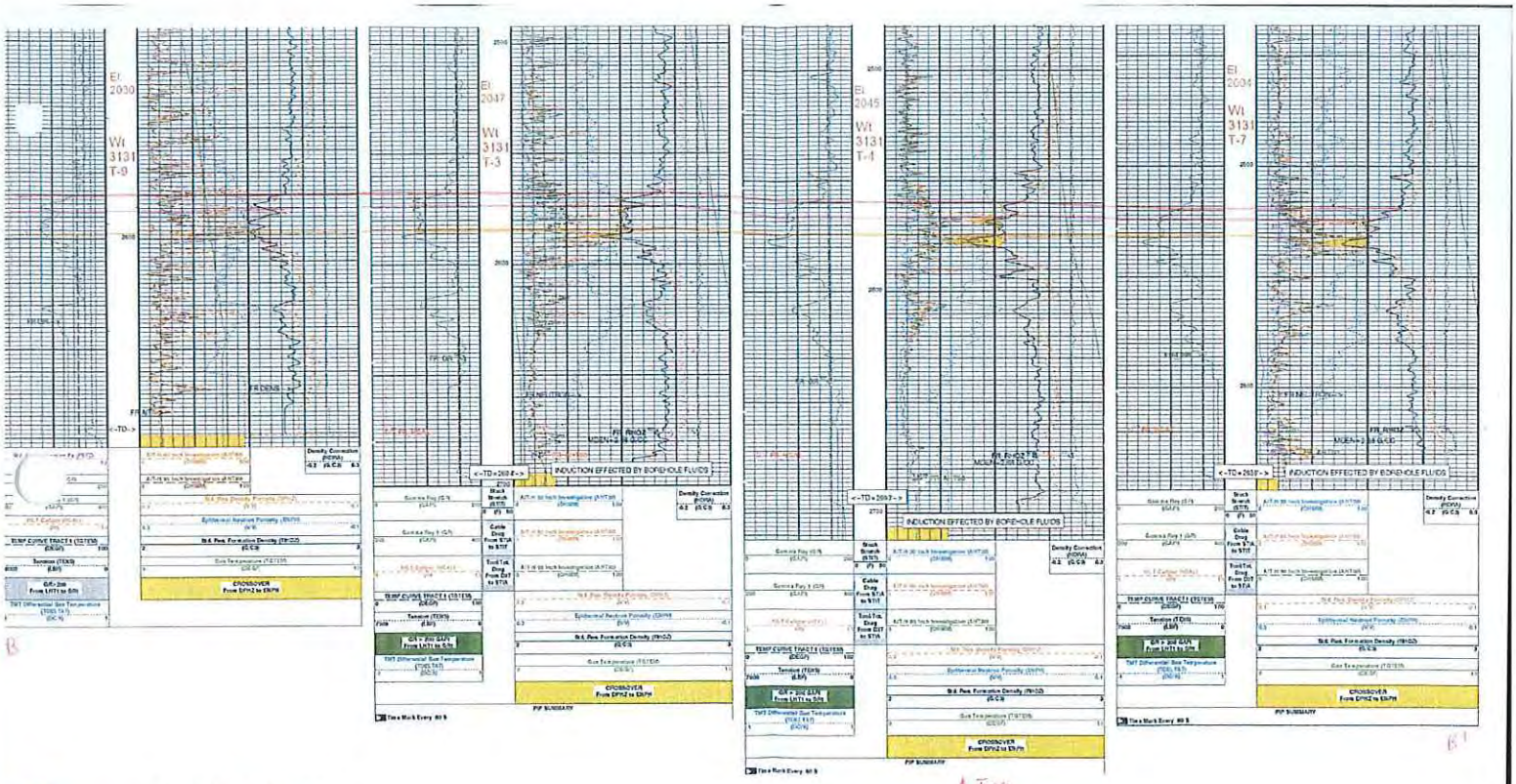

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WT 3131 #T9_QUAD / WT_3131_T3_QUAD / WT_3131_T4_QUAD / EAST_WT3131_T7_QUAD

PROPOSED FORMATION TESTING PROGRAM

Due to the fact we plan to convert producing wells to injection wells, we have a broad set of data that allows us to reasonably ascertain the technical information requested. The following tables summarize hydrostatic pressure, fracture pressure (demonstrated), as well as the physical and chemical characteristics of the Haskell sand. The information provided was obtained from the PA DEP as well as TightRock Solutions (formation geochemistry). Initially, we plan to gravity feed produced water into the injection well/s until a pump is needed. When the time comes for an injection pump, the maximum injection pressure will not exceed the minimum initial shut in pressure for any stage within the Haskell (1,810 psig in blue – T-10)

	HYDROSTATIC PSIG	FRAC PSIG	
WELL #39	1,202.76	3,200.00	***LOWEST BDP IN HASKELL
WELL #T-10	1,196.21	3,220.00	***LOWEST BDP IN HASKELL
WELL #1002	1,231.31	2,800.00	***LOWEST BDP IN HASKELL

		T-10	WELL 39	WELL 1002
AVG	DAILY RATE BBL/HR	8.33	8.33	8.33
	DAILY VOLUME BBL	100.00	100.00	100.00
MAX	DAILY RATE BBL/HR	50	50	50
	DAILY VOLUME BBL	500	500	500
INJECTION PSIG	ISIP - PSIG	1,810.00	2,075.00	1,820.00
	FG PSI/FT	1.1947	1.2889	1.1897
	AVG PSIG	1,357.50	1,556.25	1,365.00
	MAX PSIG	1,810.00	2,075.00	1,820.00
	SG	1.1120	1.1120	1.1120
	DEPTH	2,538.00	2,570.00	2,570.00

Formation Geochemistry

Pennhills CNR 42 Haskell		
Constituent	**Weight Composition Weight (%)**	**Geochemistry**
Illite + Mica	1.6	$(K, H_3O)(Al, Mg, Fe)_2 (Si,Al)_4O_{10}[(OH)_2,(H_2O)]$
		$X_2Y_{4-6}Z_8O_{20}(OH,F)_4$
		X is K, Na, or Ca or less commonly Ba, Rb, or Cs
		Y is Al, Mg, or Fe or less commonly Mn, Cr, Ti, Li
		Z is chiefly Si or Al, but also may include Fe^{3+} or Ti
Chlorite	3.7	$(Mg,Fe)_3(Si,Al)_4O_{10}(OH)_2 \cdot (Mg,Fe)_3(OH)_6$
Illite + Smectite	0.0	(Al2 - yMg2+/y)(Si4 - xAlx)O10(OH)2M+/x + y · nH2O (Mg, Fe2+)3(si4 - xAlx)O10(OH)2M+/x · nH20
Plagioclase	10.1	$NaAlSi_3O_8$ - $CaAl_2Si_2O_8$
Silica Quartz	80.2	SiO_2
Feldspar	0.5	$KAlSi_3O_8$ – $NaAlSi_3O_8$ – $CaAl_2Si_2O_8$
Calcite	0.5	$CaCO_3$
Dolomite	1.1	$CaMg(CO_3)_2$
Pyrite	0.4	FeS_2
Kaolinitie	1.8	$Al_2Si_2O_5(OH)_4$
Siderite	0	$FeCO_3$

ATTACHEMENT C.

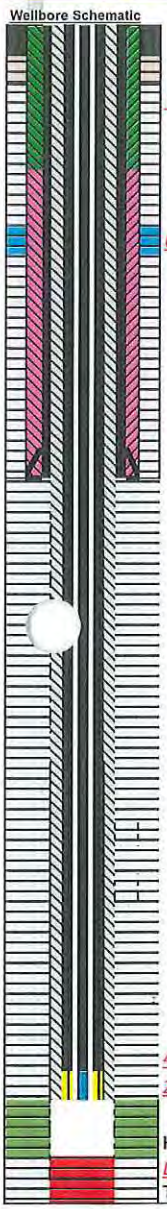
WELLBORE SCHEMATIC

The following wellbore is a good representation of what we will encounter with the existing wells and what we will do to convert the wells to injectors. The existing wells will have 9 5/8'' conductor sanded in and set at bedrock (approx. 30 ft). Approximately 500 ft of 7'' casing has been run and cemented to to surface using 30% excess. In instances where cement was not returned to surface, a bond log was run in accordance with the PA DEP to prove the top of cement (TOC). From there, the production hole was drilled to a total depth of approximately 2,700 ft. The Haskell formation was hydraulically fractured with sand and fluid. We will pull all production tubulars out of the well in preparation for well conversion. First, we will perform "grouting" operations in wells where cement was not returned to surface on the 7'' casing (Wells 1002 and 39). From there, we will run 4.5'' casing with a "set down" packer and cement to surface. We will pump cement down the wellbore and force it up the annulus to surface. We will engage the packer once finished cementing to ensure proper hold. We will wait approximately 8 hours for the cement to harden and we will run 2'' tubing inside the 4.5'' pipe and set the tubing inside that pipe with a tension packer. The tubing will be used to inject fluid to the Haskell. This design will give protection to the USDW's at approximately 200 ft from surface. Fluids to be injected will be approximately 2,300 ft from the nearest USDW's. Two strings of cemented casing will be used to protect the water table as well 2'' production tubing. In the event there is mechanical failure, we will see pressure withing the 4.5'' and/or 7'' casing. At such time we will cease operations and report to the necessary agencies.

PENNHILLS RESOURCES, LLC
Drill Well Schematic - Logging Data Sheet

Wellbore and Centralizer Schematic & Prognosis (no vertical scale)
(Measured Depths) - THIS SCHEMATIC REPRESENTS THE "TYPICAL" WELL. EACH WELL WILL BE TREATED SLIGHTLY DIFFERENT. ALL VALUES ARE APPROXIMATE

Wellbore Schematic



Centralizer Schema

16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1

Shoe

9-5/8" conductor set @ ~30 ft

GROUT CEMENT WHEN NECESSARY

USDW's - APPROX 200 ft

CENTRALIZERS
One centralizer to be installed within 50' of 7" casing seat and then one centralizer in intervals no greater than every 150' above the first centralizer.

7" surface casing set @ ~510 ft

- denotes tubulars
- denotes cement
- denotes TOC WATER STRG
- denotes GROUT TO SURF
- denotes formation
- denotes USDW's
- denotes 4.5" packer
- denotes 2" packer
- denotes "open hole" haskell sand
- denotes pea gravel

4.5" long string to surface. Set using hook wall packer and cement to surface

2.0"tubing set with packer at the top of the Haskell @ 2570

HASKELL SAND TOP: 2570, BOT: 2630

Dump pea gravel from TD to the bottom of the Haskell for cement control

TOTAL DEPTH 2,731.00

Wellbore Data		Location Data	
API #		City	KANE
Operator	PENNHILLS RESOURCES	State	PA
Well Name	WT 3131	Twp	WETMORE
Well #		7.5' Quad	KANE
Ground Elev		Dec. Lat	
Datum Elev		Dec. Lng	
Measured From		*Cement/Float Equipment :*	
Casing Size/lb. per foot		20% EXCESS WITH GEL	
Casing Size/lb. per foot		1 cement shoe, 1 guide shoe	
Casing Size/lb. per foot		4 centralizers	
Casing Depths	See wellbore schematic	*Special Logging Instructions:* If Hi-Res data acquired, designate HiRes curves from standard Res curves in LAS file	
Fluid in Hole			
Fluid Level			
Gas Volume			
Oil Show Depths			

Logging Services: Log from rig _____ *Log from mast _____*

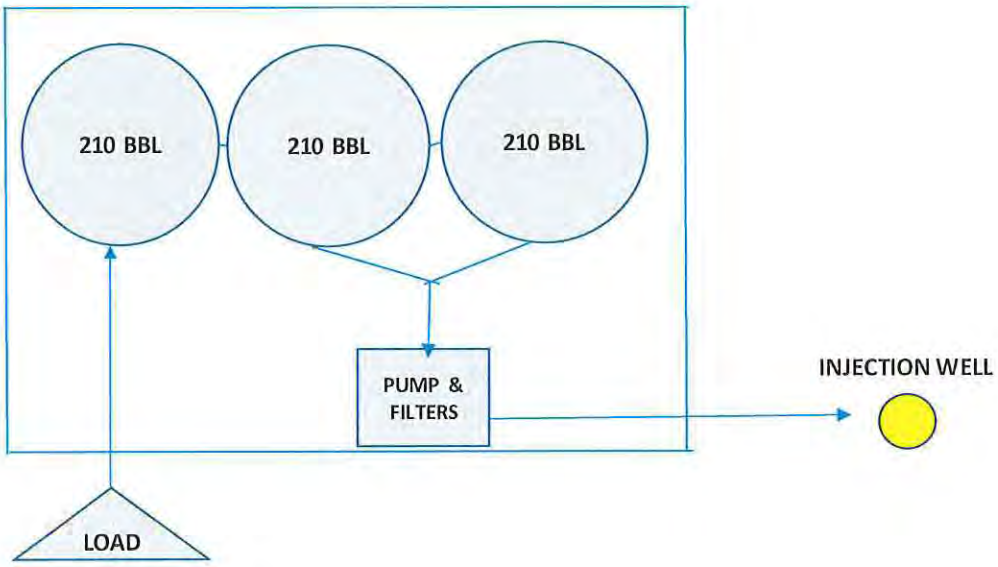
Service	Logs	Scale(s)	Comments
Gamma Ray	X	5" / 20"	20" high res
Caliper (density)	X	5" / 20"	20" high res
Induction	X	5" / 20"	20" high res
Laterolog	X	5" / 20"	if needed
Neutron Porosity	X	5" / 20"	20" high res
Bulk Density	X	5" / 20"	20" high res
Lithodensity			
Density Porosity	X	5"/20"	optional
Temperature	X	5"	
Audio (noise)			
Sidewall Cores			
Csg Collar Locator			
Cement Bond			
Hard Copy Logs	5	5" / 20"	
Other Media	Yes		Tiff & LAS (0.5 ft step)
Prepared by			Date:

ATTACHMENT D

INJECTION OPERATION AND MONITORING PROGRAM

As previously identified, the following technical data was calculated to determine the applicable rates and pressures to be encountered. Produced water samples were taken across producing fields and are good representations of the fluids to be injected. For calculation purposes we used the highest specific gravity found in the following samples. In addition, the facility design is listed below. An earthen dyke will be constructed around 2-4 210 BBL holding tanks. Trucks will unload the brine water where it will be collected. The tanks will be connected to each other and a pump will be used to draw brine out of the tanks and discharged through piping to the well head. The well head will be equipped with gauges to monitor injection pressures. The 2'' tubing will show a gauge as well as the 4.5'' long string. If at any point in time the 4.5'' shows pressure, we will shut down operations, report the issue to the EPA, and assess why we are seeing pressure migration. Pumping operations will cease until we have written approval from the EPA to proceed.

PROPOSED FACILITY - CLASS II. EOR PROJECT



		T-10	WELL 39	WELL 1002
AVG	DAILY RATE BBL/HR	8.33	8.33	8.33
	DAILY VOLUME BBL	100.00	100.00	100.00
MAX	DAILY RATE BBL/HR	50	50	50
	DAILY VOLUME BBL	500	500	500
INJECTION PSIG	ISIP - PSIG	1,810.00	2,075.00	1,820.00
	FG PSI/FT	1.1947	1.2889	1.1897
	AVG PSIG	1,357.50	1,556.25	1,365.00
	MAX PSIG	1,810.00	2,075.00	1,820.00
	SG	1.1120	1.1120	1.1120
	DEPTH	2,538.00	2,570.00	2,570.00

FORMATION WATER CHEMISTRY

Brine water samples have been analyzed across our Pennsylvania field. The sample showing the highest specific gravity was used in the calculations within the data set. The injecting fluid will be conventional brine water sourced from our Pennsylvania operations.

Chemstream, Inc.
511 Railroad Ave
Homer City, PA 15748
Phone: 724-915-8388
Fax: 724-915-8374

Water Quality by ICP-OES and HPIC

		Infield	5573 West	5573 Main	CNR 3131 Project 1
pH	S.U.	5.75	5.41	5.28	5.01
P Alkalinity	mg/L (as $CaCO_3$)	0.00	0.00	0.00	0.00
M Alkalinity	mg/L (as $CaCO_3$)	16	18	14	8
Conductivity	µS/cm	178,306	123,317	157,130	198,310
Specific Gravity		1.100	1.067	1.087	* 1.112 *
Hardness	mg/L (as $CaCO_3$)	48,577	29,944	44,142	60,266
TDS	mg/L	114,116	78,923	100,563	126,918
Aluminum	mg/L (as Al)	BDL	BDL	BDL	BDL
Barium	mg/L (as Ba)	BDL	BDL	BDL	BDL
Boron	mg/L (as B)	BDL	BDL	BDL	BDL
Calcium	mg/L (as Ca)	15,371.06	9,379.66	14,074.37	19,332.04
Iron (Total)	mg/L (as Fe)	BDL	116.30	27.30	63.25
Iron (Ferrous)	mg/L (as Fe^{+2})	N/A	N/A	N/A	N/A
Magnesium	mg/L (as Mg)	2,475.85	1,584.12	2,185.13	2,912.52
Manganese	mg/L (as Mn)	BDL	BDL	BDL	BDL
Potassium	mg/L (as K)	160.13	122.51	160.98	187.27
Sodium	mg/L (as Na)	40,066.55	24,905.90	37,240.39	46,707.26
Strontium	mg/L (as Sr)	74.3	41.1	64.4	104.8
Bromide	mg/L (as Br^{-1})	948	586	847	1,082
Chloride	mg/L (as Cl^{-1})	91,246	56,670	82,487	107,206
Nitrate	mg/L (as NO_3^{-1})	BDL	BDL	BDL	BDL
Sulfate	mg/L (as SO_4^{-2})	242	BDL	BDL	668

BDL – Below Detection Limits

Well Name	Burns
Sample ID	Produced
Sample Location	N/A
Source	Produced
Sample Date	11/20/2017

TightROCK SOLUTIONS

This sample was analyzed as received, the results being as follows:

Test Method		
Physical	**Total**	
Conductivity at 25 C	164,700	µs
pH at 25 C	5.64	
TDS measured, ppm	N/A	ppm
Oxidation Reduction Potential (ORP)	184	ppm
Color	Brown	
Odor	Mild	
Measured	**PPM**	
Specific Gravity	1.0914	g/cm3
Soluble Iron, ppm	0.0	
Total Iron	11.0	
Hardess as COCO3	46,842.1	
Calcium	15,230.4	
Magnesium	2,139.3	
Barium and Strontium	40.0	
Chlorides	91,100.1	
Carbonate	0	
Bicarbonate	36.6	
Sulfate	180	
Ammonia	80	
TDS (calculated)	146,376.4	

ATP Bacterial Kill Study **Inapplicable**

Biocide: N/A

Note: Analysis indicates no presence of Hydroxide ion (OH^-).

ATP testing measures all living bacteria present. Best Practice experience recommends treating completion waters to below 100,000 ME/ml.

Testing		Results		
	measurement		ME/ml	% Kill
Blank	20	none	752	
100 ppm	0	N/A	0	100.0
200 ppm	0	N/A	0	100.0
300 ppm	0	N/A	0	100.0
400 ppm	0	N/A	0	100.0

Well Name	3408 Main
Sample ID	Produced
Sample Location	N/A
Source	Produced
Sample Date	11/20/2017

This sample was analyzed as received, the results being as follows:

Test Method		
Physical	**Total**	
Conductivity at 25 C	82,500	µs
pH at 25 C	6.22	
TDS measured, ppm	107000	ppm
Oxidation Reduction Potential (ORP)	102	ppm
Color	Brown	
Odor	Mild	
Measured	**PPM**	
Specific Gravity	1.0349	g/cm3
Soluble Iron, ppm	15.0	
Total Iron	19.0	
Hardess as COCO3	26,523.9	
Calcium	5,811.6	
Magnesium	2,917.2	
Barium and Strontium	500.0	
Chlorides	51,723.5	
Carbonate	0	
Bicarbonate	122	
Sulfate	0	
Ammonia	60	
TDS (calculated)	82,315.2	

ATP Bacterial Kill Study If applicable

Biocide: N/A

Note: Analyss indicates no prescence of Hydroxide ion (OH^-).

ATP testing measures all living bacteria present. Best Practice experience recommends treating completion waters to below 100,000 ME/ml.

Testing		Results		
	measurement		ME/ml	% Kill
Blank	1901	none	71,450	
100 ppm	0	N/A	0	100.0
200 ppm	0	N/A	0	100.0
300 ppm	0	N/A	0	100.0
400 ppm	0	N/A	0	100.0

Well Name	Heekel
Sample ID	Produced
Sample Location	N/A
Source	Produced
Sample Date	11/20/2017

TightROCK SOLUTIONS

This sample was analyzed as received, the results being as follows:

Test Method		
Physical	**Total**	
Conductivity at 25 C	80,200	µs
pH at 25 C	6.25	
TDS measured, ppm	108000	ppm
Oxidation Reduction Potential (ORP)	105	ppm
Color	Brown	
Odor	Mild	
Measured	**PPM**	
Specific Gravity	1.0319	g/cm3
Soluble Iron, ppm	0.0	
Total Iron	17.0	
Hardess as COCO3	27,024.3	
Calcium	7,815.6	
Magnesium	1,823.3	
Barium and Strontium	200.0	
Chlorides	83,425.0	
Carbonate	0	
Bicarbonate	140.3	
Sulfate	0	
Ammonia	15	
TDS (calculated)	135,081.2	

ATP Bacterial Kill Study If applicable

Biocide: N/A

Note: Analyss indicates no prescence of Hydroxide ion (OH^-).

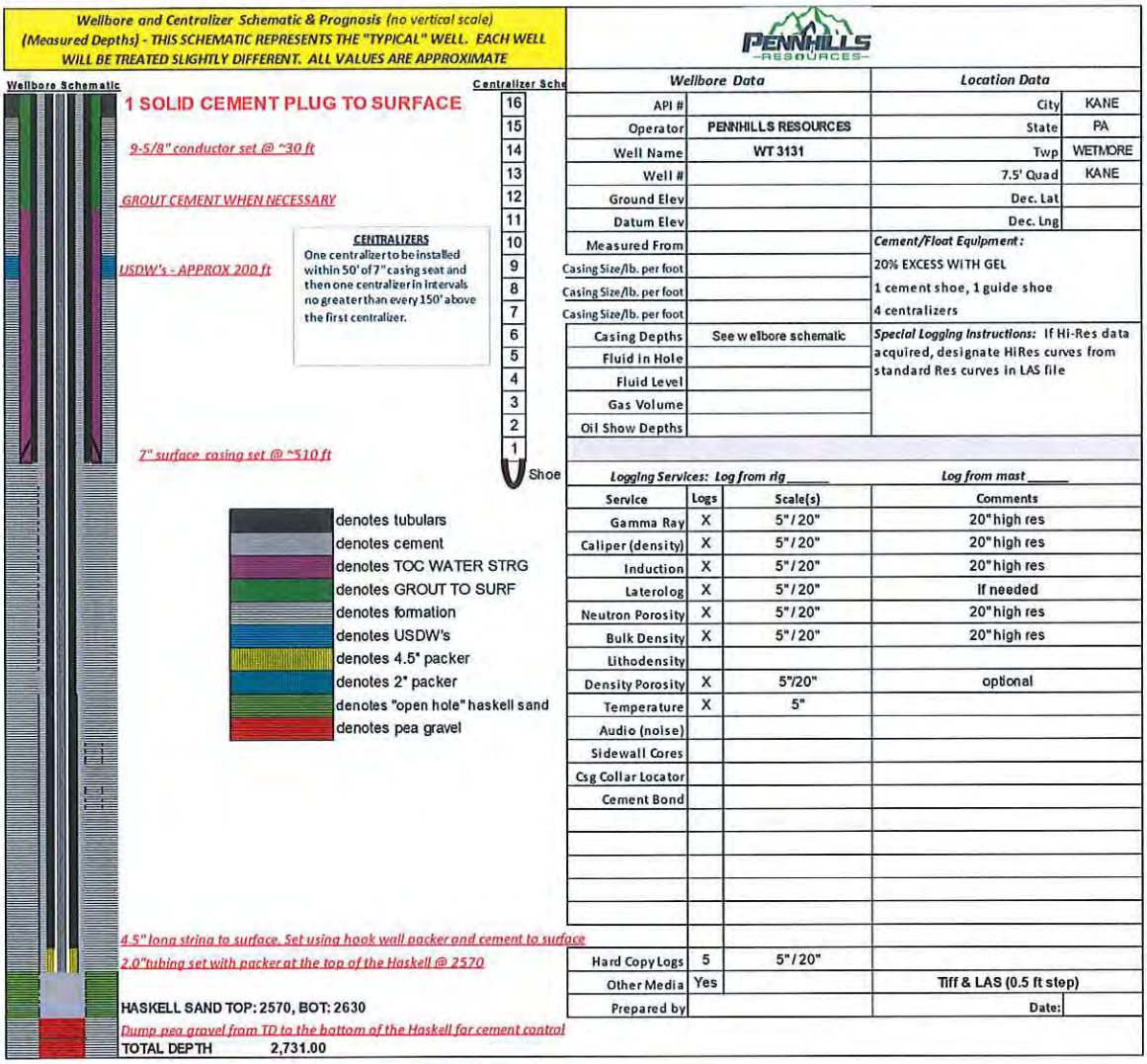
ATP testing measures all living bacteria present. Best Practice experience recommends treating completion waters to below 100,000 ME/ml.

Testing		Results		
	measurement		ME/ml	% Kill
Blank	1101	none	41,382	
100 ppm	0	N/A	0	100.0
200 ppm	0	N/A	0	100.0
300 ppm	0	N/A	0	100.0
400 ppm	0	N/A	0	100.0

ATTACHMENT E

PLUGGING & ABANDONMENT

In the event any injection is plugged, 2'' tubing will be retrieved, and a solid cement plug will be placed. The well bore at that time will have 7'' cemented (and grouted) to surface, 4.5'' casing cemented to surface, and a solid cement plug from the Haskell inside the 4.5'' to surface. See proposed wellbore schematic for plugging and abandonment. The volume of cement slurry need will be approximately 40 barrels. This will cement off the entire injection zone (Haskell) all the way back to surface. Anticipated plugging expense is $8,220 (see attached quote).



Howard Drilling LLC

PO BOX N
11 Bridge Street
Mount Jewett PA 16740

814-778-5820 Tel
814-778-5826 Fax

2/26/2020

Pennhills
PO Box 426
Mt Jewett PA16740

Our plugging rates are as followed:

Cement Truck- $1,600 a day rate
Cement Class A- $16.00/ per sack
Service Rig Time- $225.00/ Hour
Water Truck time- $90.00/ Hour
Tractor Truck time- $110.00/ Hour

For your plugging job Howard Drilling would estimate your job to be around **$8,220.00.** This would include cement truck rate for a day, 200 sacks of class A cement, service rig for 8 hours, water truck time for 8 hours, and moving equipment in and out of location.

Should you have any additional questions, please feel free to call me on my cell phone, [redacted].

Sincerely,

[redacted]

OMB No. 2040-0042 Approval Expires 4/30/2022

United States Environmental Protection Agency

WELL REWORK RECORD, PLUGGING AND ABANDONMENT PLAN, OR PLUGGING AND ABANDONMENT AFFIDAVIT

Name and Address, Phone Number and/or Email of Permittee

Pennhills Resources, LLC
3055 Rt 219
Kane, PA 16735
tmorris3@pennhillsresources.com
(814) 558-1855

Permit or EPA ID Number	API Number	Full Well Name
	37-083-56741	CNR EAST WARRANT 3131 1002

State	County
PA	McKean

Locate well in two directions from nearest lines of quarter section and drilling unit

Latitude: 41.69507

Longitude: -78.79476

Surface Location

[ ] 1/4 of [ ] 1/4 of Section [ ] Township [ ] Range [ ]

[ ] ft. from (N/S) [ ] Line of quarter section

[ ] ft. from (E/W) [ ] Line of quarter section.

Well Class	Timing of Action (pick one)	Type of Action (pick one)
[ ] Class I	[ ] Notice Prior to Work	[ ] Well Rework
[✓] Class II	Date Expected to Commence	[✓] Plugging and Abandonment
[ ] Class III	[ ] Report After Work	[ ] Conversion to a Non-Injection Well
[ ] Class V	Date Work Ended	

Provide a narrative description of the work planned to be performed, or that was performed. Use additional pages as necessary. See instructions.

PLUGGING & ABANDONMENT

In the event any injection is plugged, 2" tubing will be retrieved, and a solid cement plug will be placed. The well bore at that time will have 7" cemented (and grouted) to surface, 4.5" casing cemented to surface, and a solid cement plug from the Haskell inside the 4.5" to surface. See proposed well-bore schematic for plugging and abandonment. The volume of cement slurry need will be approximately 40 barrels. This will cement off the entire injection zone (Haskell) all the way back to surface. Anticipated plugging expense is $8,220 (see attached quote).

Certification

I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. (Ref. 40 CFR § 144.32)

Name and Official Title *(Please type or print)*	Signature	Date Signed
Tom Morris III President	Thomas J Morris III	3-2-2020

OMB No. 2040-0042 Approval Expires 4/30/2022

United States Environmental Protection Agency

WELL REWORK RECORD, PLUGGING AND ABANDONMENT PLAN, OR PLUGGING AND ABANDONMENT AFFIDAVIT

Name and Address, Phone Number and/or Email of Permittee

Pennhills Resources, LLC
3055 Rt 219
Kane, PA 16735
tmorris3@pennhillsresources.com
(814) 558-1855

Permit or EPA ID Number	API Number	Full Well Name
	37-083-53687	CNR EAST WARRANT 3131 T-10

State	County
PA	McKean

Locate well in two directions from nearest lines of quarter section and drilling unit

Latitude: 41.71452

Longitude: -78.79091

Surface Location

[ ] 1/4 of [ ] 1/4 of Section [ ] Township [ ] Range [ ]

[ ] ft. from (N/S) [ ] Line of quarter section

[ ] ft. from (E/W) [ ] Line of quarter section.

Well Class	Timing of Action (pick one)	Type of Action (pick one)
[ ] Class I	[ ] Notice Prior to Work	[ ] Well Rework
[✓] Class II	Date Expected to Commence	[✓] Plugging and Abandonment
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Name and Official Title *(Please type or print)*	Signature	Date Signed
Tom Morris III President	Thomas J Morris III	3-2-2020

OMB No. 2040-0042 Approval Expires 4/30/2022

United States Environmental Protection Agency

EPA WELL REWORK RECORD, PLUGGING AND ABANDONMENT PLAN, OR PLUGGING AND ABANDONMENT AFFIDAVIT

Name and Address, Phone Number and/or Email of Permittee

Pennhills Resources, LLC
3055 Rt 219
Kane, PA 16735
tmorris3@pennhillsresources.com
(814) 558-1855

Permit or EPA ID Number	API Number	Full Well Name
	37-083-56945	PHR WT 3131 #39

State	County
PA	McKean

Locate well in two directions from nearest lines of quarter section and drilling unit

Latitude: 41.69551

Longitude: -78.79236

Surface Location

[ ] 1/4 of [ ] 1/4 of Section [ ] Township [ ] Range [ ]

[ ] ft. from (N/S) [ ] Line of quarter section

[ ] ft. from (E/W) [ ] Line of quarter section.

Well Class	Timing of Action (pick one)	Type of Action (pick one)
[ ] Class I	[ ] Notice Prior to Work	[ ] Well Rework
[✓] Class II	Date Expected to Commence [ ]	[✓] Plugging and Abandonment
[ ] Class III	[ ] Report After Work	[ ] Conversion to a Non-Injection Well
[ ] Class V	Date Work Ended [ ]	

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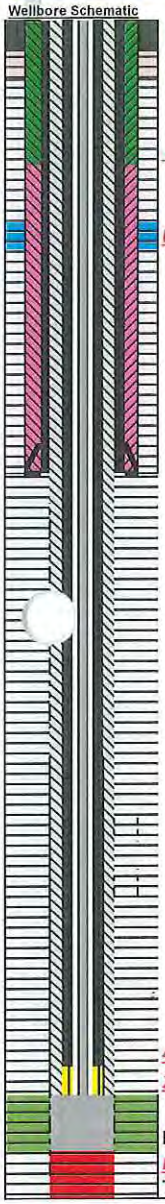
Name and Official Title *(Please type or print)*	Signature	Date Signed
Tom Morris III President	Thomas J Morris III	3-2-2020

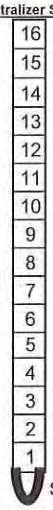
PENNHILLS RESOURCES, LLC
Drill Well Schematic - Logging Data Sheet

Wellbore and Centralizer Schematic & Prognosis (no vertical scale)
(Measured Depths) - THIS SCHEMATIC REPRESENTS THE "TYPICAL" WELL. EACH WELL WILL BE TREATED SLIGHTLY DIFFERENT. ALL VALUES ARE APPROXIMATE

Wellbore Schematic



Centralizer Schema



1 SOLID CEMENT PLUG TO SURFACE

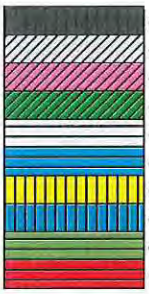
9-5/8" conductor set @ ~30 ft

GROUT CEMENT WHEN NECESSARY

USDW's - APPROX 200 ft

CENTRALIZERS
One centralizer to be installed within 50' of 7" casing seat and then one centralizer in intervals no greater than every 150' above the first centralizer.

7" surface casing set @ ~510 ft



denotes tubulars
denotes cement
denotes TOC WATER STRG
denotes GROUT TO SURF
denotes formation
denotes USDW's
denotes 4.5" packer
denotes 2" packer
denotes "open hole" haskell sand
denotes pea gravel

4.5" long string to surface. Set using hook wall packer and cement to surface
2.0"tubing set with packer at the top of the Haskell @ 2570

HASKELL SAND TOP: 2570, BOT: 2630
Dump pea gravel from TD to the bottom of the Haskell for cement control
TOTAL DEPTH 2,731.00

Wellbore Data		*Location Data*	
API #		City	KANE
Operator	PENNHILLS RESOURCES	State	PA
Well Name	WT 3131	Twp	WETMORE
Well #		7.5' Quad	KANE
Ground Elev		Dec. Lat	
Datum Elev		Dec. Lng	
Measured From		*Cement/Float Equipment :*	
Casing Size/lb. per foot		20% EXCESS WITH GEL	
Casing Size/lb. per foot		1 cement shoe, 1 guide shoe	
Casing Size/lb. per foot		4 centralizers	
Casing Depths	See wellbore schematic	*Special Logging Instructions:* If Hi-Res data acquired, designate HiRes curves from standard Res curves in LAS file	
Fluid in Hole			
Fluid Level			
Gas Volume			
Oil Show Depths			

Logging Services: Log from rig _____ *Log from mast _____*

Service	Logs	Scale(s)	Comments
Gamma Ray	X	5" / 20"	20" high res
Caliper (density)	X	5" / 20"	20" high res
Induction	X	5" / 20"	20" high res
Laterolog	X	5" / 20"	**if needed**
Neutron Porosity	X	5" / 20"	20" high res
Bulk Density	X	5" / 20"	20" high res
Lithodensity			
Density Porosity	X	5"/20"	optional
Temperature	X	5"	
Audio (noise)			
Sidewall Cores			
Csg Collar Locator			
Cement Bond			
Hard Copy Logs	5	5" / 20"	
Other Media	Yes		**Tiff & LAS (0.5 ft step)**
Prepared by			Date:

THE PIONEER BANK of McKean County

HAMLIN BANK AND TRUST COMPANY
Established 1863
TRUST DEPARTMENT

March 23, 2020

US EPA Region 3

c/o James Bennett
1650 Arch Street
Philadelphia, PA 19103-2029

RE: Trust #867; Pennhills Resources LLC T/U/A

Greetings Mr. Bennett,

Please find enclosed the proper documentation to show that as of March 20, 2020, Pennhills Resources LLC currently holds a Standby Trust Agreement with the Trust Department of Hamlin Bank and Trust Company. This Standby Trust Agreement holds Hamlin Bank Certificate of Deposit #13273010 in the amount of $8,220.00.

The schedule to report this holding to the US EPA Region 3 and also to Pennhills Resources LLC is April 1, 2020, then every April thereafter. If there are any questions or concerns, please call our department at (814) 887-5555. We can also receive email at trust@hamlinbank.com. Thank you for your time and have a nice day.

Sincerely,

Crystal VanGorder
Trust Operations

Encl.

STANDBY TRUST AGREEMENT

U.S. Environmental Protection Agency
Underground Injection Control
Financial Responsibility Requirement

THIS TRUST AGREEMENT (the "Agreement") is entered into as of March 19, 2020 by and between Pennhills Resources, LLC, owner or operator, a partnership corporation / partnership / association / proprietorship (the "Grantor"), and Hamlin Bank and Trust Company (the "Trustee"), a Financial corporation/financial institution.

Whereas, the United States Environmental Protection Agency ("EPA"), an agency of the United States Government, has established certain regulations applicable to the Grantor, requiring that an owner or operator of an injection well shall provide assurance that funds will be available when needed for plugging and abandonment of the injection well or wells,

Whereas, the Grantor has elected to establish a trust to provide all or part of such financial assurance for the facility or facilities identified herein, and

Whereas, the Grantor, acting through its duly authorized officers, has selected the Trustee to be the trustee under this Agreement, and the Trustee is willing to act as trustee,

NOW THEREFORE, the Grantor and the Trustee agree as follows:

Section 1. Definitions. As used in this Agreement: (a) The term "Grantor" means the owner or operator who enters into this Agreement and any successors or assigns of the Grantor. (b) The term " Trustee" means the Trustee who enters into this Agreement and any successor Trustee. (c) Facility or activity means any "underground injection well" or any other facility or activity that is subject to regulation under the Underground Injection Control Program.

Section 2. Identification of Facilities and Cost Estimates. This Agreement pertains to the facilities and cost estimates identified on attached Schedule A.

Section 3. Establishment of Fund. The Grantor and the Trustee hereby establish a trust fund (the "'Fund") for the purpose of assuring compliance with the plugging and abandonment requirements established by EPA for the facilities identified on Schedule A. The Underground Injection Control regulations which govern the authorization to inject include a requirement for such financial assurance that the well or wells shall be plugged and abandoned at the time designated by EPA. The Grantor and the Trustee acknowledge that the Fund and all expenditures from the Fund shall be to fulfill the legal obligations of the Grantor under such regulations, and not any obligation of EPA. The Grantor and the Trustee intend that no third party have access to the Fund except as herein provided. The Fund is established initially as consisting of the property, which is acceptable to the Trustee, described in Schedule B attached hereto. Such property and any other property subsequently transferred to the Trustee is referred

to as the Fund, together with all earnings and profits thereon, less any payments or distributions made by the Trustee pursuant to this Agreement. The Fund shall be held by the Trustee, IN TRUST, as hereinafter provided. The Trustee shall not be responsible, nor shall it undertake any responsibility, for the amount or adequacy of any additional payments necessary to discharge any liabilities of the Grantor established by EPA, nor shall the Trustee have any duty to collect such additional amounts from the Grantor.

Section 4. Payment for Plugging and Abandonment. The Trustee shall make payments from the Fund only for the costs of plugging and abandonment ("P&A") of the injection wells covered by this Agreement and the associated P&A Plan, only after EPA has advised the Trustee that work has been completed under the P&A Plan that complies with 40 C.F.R. § 144.28 and/or § 144.52. The Trustee shall not refund to the Grantor any amounts from the Fund unless and until EPA has advised the Trustee that the P&A Plan has been successfully completed. The Trustee shall not release any funds to the Grantor that are necessary to cover liability for any injection wells covered by this Agreement that remain unplugged.

Section 5. Payments Comprising the Fund. Payments made to the Trustee for the Fund shall consist of cash or securities acceptable to the Trustee.

Section 6. Trustee Management. The Trustee shall invest and reinvest the principal and income of the Fund and keep the Fund invested as a single fund, without distinction between principal and income, in accordance with general investment policies and guidelines which the Grantor may communicate in writing to the Trustee from time to time, subject, however, to the provisions of this Section. In investing, reinvesting, exchanging, selling, and managing the Fund, the Trustee shall discharge his duties with respect to the trust fund solely in the interest of the beneficiary and with the care, skill, prudence, and diligence under the circumstances then prevailing which persons of prudence, acting in a like capacity and familiar with such matters, would use in the conduct of an enterprise of a like character and with like aims; *except that:*

(i) Securities or other obligations of the Grantor, or any other owner or operator of the facilities, or any of their affiliates as defined in the Investment Company Act of 1940, as amended, 15 U.S.C. 80a-2.(a), shall not be acquired or held, unless they are securities or other obligations of the Federal or a State government;

(ii) The Trustee is authorized to invest the Fund in time or demand deposits of the Trustee, to the extent insured by an agency of the Federal or State government; and

(iii) The Trustee is authorized to hold cash awaiting investment or distribution uninvested for a reasonable time and without liability for the payment of interest thereon.

Section 7. Commingling and Investment. The Trustee is expressly authorized in its discretion: (a) To transfer from time to time any or all of the assets of the Fund to any common, commingled, or collective trust fund created by the Trustee in which the Fund is eligible to participate, subject to all of the provisions thereof, to be commingled with the assets of other

trusts participating therein; and (b) To purchase shares in any investment company registered under the Investment Company Act of 1940, 15 U. S. C. 80a-1 *et seq.,* including one which may be created, managed, underwritten, or to which investment advice is rendered or the shares of which are sold by the Trustee. The Trustee may vote shares in its discretion.

Section 8. Express Powers of Trustee. Without in any way limiting the powers and discretions conferred upon the Trustee by the other provisions of this Agreement or by law, the Trustee is expressly authorized and empowered: (a) To sell, exchange, convey, transfer, or otherwise dispose of any property held by it, by public or private sale. No person dealing with the Trustee shall be bound to see to the application of the purchase money or to inquire into the validity or expediency of any such sale or other disposition; (b) To make, execute, acknowledge, and deliver any and all documents of transfer and conveyance and any and all other instruments that may be necessary or appropriate to carry out the powers herein granted; (c) To register any securities held in the Fund in its own name or in the name of a nominee and to hold any security in bearer form or in book entry, or to combine certificates representing such securities with certificates of the same issue held by the Trustee in other fiduciary capacities, or to deposit or arrange for the deposit of such securities in a qualified central depository even though, when so deposited, such securities may be merged and held in bulk in the name of the nominee of such depositary with other securities deposited therein by another person, or to deposit or arrange for the deposit of any securities issued by the United States Government, or any agency or instrumentality thereof, with a Federal Reserve bank, but the books and records of the Trustee shall at all times show that all such securities are part of the Fund; (d) To deposit any cash in the Fund in interest-bearing accounts maintained or savings certificates issued by the Trustee, in its separate corporate capacity, or in any other banking institution affiliated with the Trustee, to the extent insured by an agency of the Federal or State government; and (e) To compromise or otherwise adjust all claims in favor of or against the Fund.

Section 9. Taxes and Expenses. All taxes of any kind that may be assessed or levied against or in respect of the Fund and all brokerage commissions incurred by the Fund shall be paid from the Fund. All other expenses incurred by the Trustee in connection with the administration of this Trust, including fees for legal services rendered to the Trustee, the compensation of the Trustee to the extent not paid directly by the Grantor, and all other proper charges and disbursements of the Trustee shall be paid from the Fund.

Section 10. Annual Valuation. The Trustee shall annually, at least 30 days prior to the anniversary date of establishment of the Fund, furnish to the Grantor and to the appropriate EPA Regional Administrator a statement confirming the value of the Trust. Any securities in the Fund shall be valued at market value as of no more than 60 days prior to the anniversary date of establishment of the Fund. The failure of the Grantor to object in writing to the Trustee within 90 days after the statement has been furnished to the Grantor and the EPA Regional Administrator shall constitute a conclusively binding assent by the Grantor, barring the Grantor from asserting any claim or liability against the Trustee with respect to matters disclosed in the statement.

Section 11. Advice of Counsel. The Trustee may from time to time consult with counsel, who may be counsel to the Grantor, with respect to any question arising as to the construction of this

Agreement of any action to be taken hereunder. The Trustee shall be fully protected, to the extent permitted by law, in acting upon the advice of counsel.

Section 12. Trustee Compensation. The Trustee shall be entitled to reasonable compensation for its services as agreed upon in writing from time to time with the Grantor.

Section 13. Successor Trustee. The Trustee may resign or the Grantor may replace the Trustee, but such resignation or replacement shall not be effective until the Grantor has appointed a successor trustee and this successor accepts the appointment. The successor trustee shall have the same powers and duties as those conferred upon the Trustee hereunder. Upon the successor trustee's acceptance of the appointment, the Trustee shall assign, transfer, and pay over to the successor trustee the funds and properties then constituting the Fund. If for any reason the Grantor cannot or does not act in the event of the resignation of the Trustee, the Trustee may apply to a court of competent jurisdiction for the appointment of a successor trustee or for instructions. The successor trustee shall specify the date on which it assumes administration of the trust in a writing sent to the Grantor, the EPA Regional Administrator, and the present Trustee by certified mail 10 days before such change becomes effective. Any expenses incurred by the Trustee as a result of any of the acts contemplated by this Section shall be paid as provided in Section 9.

Section 14. Instructions to the Trustee. All orders, requests, and instructions by the Grantor to the Trustee shall be in writing, signed by such persons as are designated in the attached Exhibit A or such other designees as the Grantor may designate by amendment to Exhibit A. The Trustee shall be fully protected in acting without inquiry in accordance with the Grantor's orders, requests, and instructions. All orders, requests, and instructions by the EPA Regional Administrator to the Trustee shall be in writing, signed by the EPA Regional Administrators of the Regions in which the facilities are located, or their designees, and the Trustee shall act and shall be fully protected in acting in accordance with such orders, requests, and instructions. The Trustee shall have the right to assume, in the absence of written notice to the contrary, that no event constituting a change or a termination of the authority of any person to act on behalf of the Grantor or EPA hereunder has occurred. The Trustee shall have no duty to act in the absence of such orders, requests, and instructions from the Grantor and/or EPA, except as provided for herein.

Section 15. Notice of Nonpayment. The Trustee shall notify the Grantor and the appropriate EPA Regional Administrator, by certified mail within 10 days following the expiration of the 30-day period after the anniversary of the establishment of the Trust, if no payment is received from the Grantor during that period. After the pay-in period is completed, the Trustee shall not be required to send a notice of nonpayment.

Section 16. Amendment of Agreement. This Agreement may be amended by an instrument in writing executed by the Grantor, the Trustee, and the appropriate EPA Regional

Administrator, or by the Trustee and the appropriate EPA Regional Administrator if the Grantor ceases to exist.

Section 17. Irrevocability and Termination. Subject to the right of the parties to amend this Agreement as provided in Section 16, this Trust shall be irrevocable and shall continue until terminated at the written agreement of the Grantor, the Trustee, and the EPA Regional Administrator, or by the Trustee and the EPA Regional Administrator if the Grantor ceases to exist. Upon termination of the Trust, all remaining trust property, less final trust administration expenses, shall be delivered to the Grantor.

Section 18. Immunity and Indemnification. The Trustee shall not incur personal liability of any nature in connection with any act or omission, made in good faith, in the administration of this Trust, or in carrying out any directions by the Grantor or the EPA Regional Administrator issued in accordance with this Agreement. The Trustee shall be indemnified and saved harmless by the Grantor or from the Trust Fund, or both, from and against any personal liability to which the Trustee may be subjected by reason of any act or conduct in its official capacity, including all expenses reasonably incurred in its defense in the event the Grantor fails to provide such defense.

Section 19. Choice of Law. This Agreement shall be administered, construed, and enforced according to the laws of the State of Pennsylvania.

Section 20. Interpretation. As used in this Agreement, words in the singular include the plural and words in the plural include the singular. The descriptive headings for each Section of this Agreement shall not affect the interpretation or the legal efficacy of this Agreement.

IN WITNESS WHEREOF the parties have caused this Agreement to be executed by their respective representatives duly authorized and their seals to be hereunto affixed and attested as of the date first above written.

GRANTOR

Pennhills Resources, LLC

By: Stuart J. Morris
[Print name]

Its: CEO
[Title]

Attest: Stuart J. Morris

Its: CEO
[Title]

[SEAL]

Before me came the individual whose identity I confirmed as Stuart J. Morris, and whose true signature is set forth above; wherefor have I set my hand and seal this 19 day of March, 2020.

Notary Public

Commonwealth of Pennsylvania - Notary Seal
Michelle Eschrich, Notary Public
McKean County
My commission expires May 17, 2023
Commission number 1262519
Member, Pennsylvania Association of Notaries

TRUSTEE

Hamlin Bank and Trust Company

By: Dave Seipp
[Print name]

Its: Trust Officer
[Title]

Attest:

Its: Trust Officer
[Title]

[SEAL]

Before me came the individual whose identity I confirmed as Dave Seipp, and whose true signature is set forth above; wherefor have I set my hand and seal this 19 day of March, 2020.

Jeanmarie A McClure

Notary Public

Commonwealth of Pennsylvania - Notary Seal
Jeanmarie A. McClure, Notary Public
Mckean County
My commission expires January 12, 2022
Commission number 1220862

CERTIFICATE OF ACKNOWLEDGMENT

FOR

STANDBY TRUST FUND AGREEMENT

STATE OF Pennsylvania

COUNTY OF McKean

On this 19th day of March, 20 20, before me personally came

Stuart J. Morris to me known, who, being by me duly sworn, did depose
(Owner or Operator)

and say that he/she resides at 315 Orchard Valley Rd Bradford PA 16701,
(Address)

That he/she is CEO of Pennhills Resources, LLC,
(Title) (Corporation)

the corporation described in and which executed the above instrument; that he/she knows the seal of said corporation; that the seal affixed to such instrument in such corporate seal; that it was so affixed by order of the Board of Directors of said corporation, and that he/she signed his/her name thereto by like order.

Commonwealth of Pennsylvania - Notary Seal
Michelle Eschrich, Notary Public
McKean County
My commission expires May 17, 2023
Commission number 1262519
Member, Pennsylvania Association of Notaries

(Notary Public)

[Seal]

SCHEDULE A

Identification of Facilities and Cost Estimates

Schedule A is referenced in the standby trust agreement dated March 20 2020 by and between Pennhills Resources, LLC, the Grantor and Hamlin Bank and Trust Company, the Trustee.

(Name of owner or operator)

(Name of trustee)

EPA identification number	37-083-53687
Name of facility	CNR 3131 #T-10
Address of facility	41.71452; -78.79091
	Kane, PA 16735
Current plugging and abandonment cost estimate	$8,220.00
Date of estimate	2/26/2020
EPA identification number	
Name of facility	
Address of facility	
Current plugging and abandonment cost estimate	
Date of estimate	

SCHEDULE B

Description of Property / Financial Instrument

[Surety, Letter of Credit, etc.]

Schedule B is referenced in the Standby Trust Agreement (Section 3) dated March 20 2020

by and between Pennhills Resources, LLC , the "Grantor,"
(name of owner or operator)

and Hamlin Bank and Trust Company , the "Trustee."
(name of the trustee)

The fund consists of: (Check on e and provide identification number)

- ○ Irrevocable Letter of Credit No. _____
- ○ Surety Performance Bond No. _____
- ◉ Other (Describe) Certificate of Deposit 13273010

ATTACHMENT J

DESCRIPTION OF BUSINESS

Pennhills Resources is a privately held Exploration & Production company established in 2017 and is engaged in developing oil and natural gas resources in the Appalachian region of Northwestern Pennsylvania and Southwest New York. Pennhills acquired its assets from Shell Oil company who was preceded by East Resources and Pennzoil Exploration and Production Company.

ATTACHMENT K OPTIONAL ADDITIONAL PROJECT INFORMATION

The National Historic Preservation Act of 1966

No historic properties will be affected by issuance of a Class II Well Permit. No new drilling will occur and land disturbance will be minimal as existing production wells are being converted into injection wells.

The Endangered Species Act.

A Pennsylvania Natural Diversity Inventory (PNDI) environmental review was conducted on July 17, 2018. The review screened a project area of 1,521.71 acres, which includes the AOR, for potential impacts to threatened, endangered and special concern species. Pennsylvania Game Commission was the only agency requiring further review; however, it was indicated in the attached letter that no impact was anticipated.

1. PROJECT INFORMATION

Project Name: **CNR 3131 East and West ESCGP-2**
Date of Review: **7/11/2018 11:24:16 AM**
Project Category: **Energy Storage, Production, and Transfer, Energy Production (generation), Oil or Gas - new wells, expansion of well field**
Project Area: **1,521.71 acres**
County(s): **McKean**
Township/Municipality(s): **WETMORE**
ZIP Code: **16735**
Quadrangle Name(s): **KANE**
Watersheds HUC 8: **Upper Allegheny**
Watersheds HUC 12: **South Branch**
Decimal Degrees: **41.696969, -78.797647**
Degrees Minutes Seconds: **41° 41' 49.877" N, 78° 47' 51.5287" W**

2. SEARCH RESULTS

Agency	Results	Response
PA Game Commission	**Potential Impact**	**FURTHER REVIEW IS REQUIRED, See Agency Response**
PA Department of Conservation and Natural Resources	No Known Impact	No Further Review Required
PA Fish and Boat Commission	No Known Impact	No Further Review Required
U.S. Fish and Wildlife Service	No Known Impact	No Further Review Required

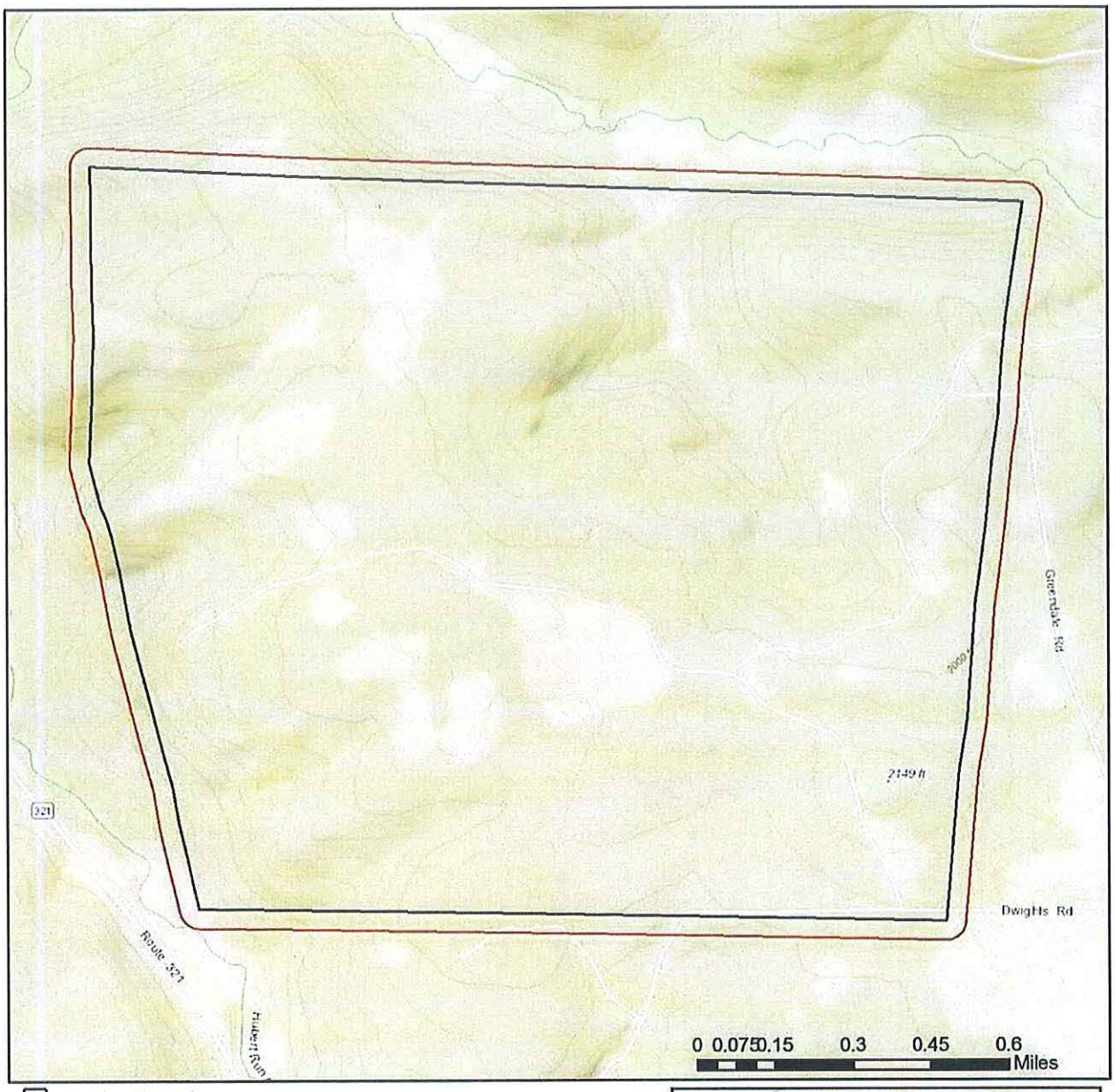
As summarized above, Pennsylvania Natural Diversity Inventory (PNDI) records indicate there may be potential impacts to threatened and endangered and/or special concern species and resources within the project area. If the response above indicates "No Further Review Required" no additional communication with the respective agency is required. If the response is "Further Review Required" or "See Agency Response," refer to the appropriate agency comments below. Please see the DEP Information Section of this receipt if a PA Department of Environmental Protection Permit is required.

CNR 3131 East and West ESCGP-2

Project Boundary

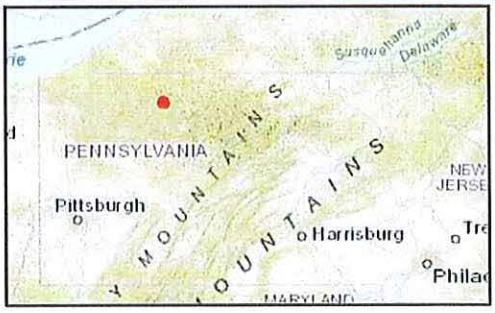
Buffered Project Boundary

CNR 3131 East and West ESCGP-2



Project Boundary

Buffered Project Boundary



Service Layer Credits: Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS,

3. AGENCY COMMENTS

Regardless of whether a DEP permit is necessary for this proposed project, any potential impacts to threatened and endangered species and/or special concern species and resources must be resolved with the appropriate jurisdictional agency. In some cases, a permit or authorization from the jurisdictional agency may be needed if adverse impacts to these species and habitats cannot be avoided.

These agency determinations and responses are **valid for two years** (from the date of the review), and are based on the project information that was provided, including the exact project location; the project type, description, and features; and any responses to questions that were generated during this search. If any of the following change: 1) project location, 2) project size or configuration, 3) project type, or 4) responses to the questions that were asked during the online review, the results of this review are not valid, and the review must be searched again via the PNDI Environmental Review Tool and resubmitted to the jurisdictional agencies. The PNDI tool is a primary screening tool, and a desktop review may reveal more or fewer impacts than what is listed on this PNDI receipt. The jursidictional agencies **strongly advise against** conducting surveys for the species listed on the receipt prior to consultation with the agencies.

PA Game Commission

RESPONSE:

Further review of this project is necessary to resolve the potential impact(s). Please send project information to this agency for review (see WHAT TO SEND).

PGC Species: (Note: The Pennsylvania Conservation Explorer tool is a primary screening tool, and a desktop review may reveal more or fewer species than what is listed below.)

Scientific Name	Common Name	Current Status
Sensitive Species**		Special Concern Species*

PA Department of Conservation and Natural Resources

RESPONSE:

No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

PA Fish and Boat Commission

RESPONSE:

No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

U.S. Fish and Wildlife Service

RESPONSE:

No impacts to **federally** listed or proposed species are anticipated. Therefore, no further consultation/coordination under the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq. is required. Because no take of federally listed species is anticipated, none is authorized. This response does not reflect potential Fish and Wildlife Service concerns under the Fish and Wildlife Coordination Act or other authorities.

* Special Concern Species or Resource - Plant or animal species classified as rare, tentatively undetermined or candidate as well as other taxa of conservation concern, significant natural communities, special concern populations (plants or animals) and unique geologic features.
** Sensitive Species - Species identified by the jurisdictional agency as collectible, having economic value, or being susceptible to decline as a result of visitation.

WHAT TO SEND TO JURISDICTIONAL AGENCIES

If project information was requested by one or more of the agencies above, upload* or email* the following information to the agency(s). Instructions for uploading project materials can be found here. This option provides the applicant with the convenience of sending project materials to a single location accessible to all three state agencies. Alternatively, applicants may email or mail their project materials (see AGENCY CONTACT INFORMATION).
***Note:** U.S.Fish and Wildlife Service requires applicants to mail project materials to the USFWS PA field office (see AGENCY CONTACT INFORMATION). USFWS will not accept project materials submitted electronically (by upload or email).

Check-list of Minimum Materials to be submitted:
____Project narrative with a description of the overall project, the work to be performed, current physical characteristics of the site and acreage to be impacted.
____A map with the project boundary and/or a basic site plan(particularly showing the relationship of the project to the physical features such as wetlands, streams, ponds, rock outcrops, etc.)
In addition to the materials listed above, USFWS REQUIRES the following
____**SIGNED** copy of a Final Project Environmental Review Receipt

The inclusion of the following information may expedite the review process.
____Color photos keyed to the basic site plan (i.e. showing on the site plan where and in what direction each photo was taken and the date of the photos)
____Information about the presence and location of wetlands in the project area, and how this was determined (e.g., by a qualified wetlands biologist), if wetlands are present in the project area, provide project plans showing the location of all project features, as well as wetlands and streams.

4. DEP INFORMATION

The Pa Department of Environmental Protection (DEP) requires that a signed copy of this receipt, along with any required documentation from jurisdictional agencies concerning resolution of potential impacts, be submitted with applications for permits requiring PNDI review. Two review options are available to permit applicants for handling PNDI coordination in conjunction with DEP's permit review process involving either T&E Species or species of special concern. Under sequential review, the permit applicant performs a PNDI screening and completes all coordination with the appropriate jurisdictional agencies prior to submitting the permit application. The applicant will include with its application, both a PNDI receipt and/or a clearance letter from the jurisdictional agency if the PNDI Receipt shows a Potential Impact to a species or the applicant chooses to obtain letters directly from the jurisdictional agencies. Under concurrent review, DEP, where feasible, will allow technical review of the permit to occur concurrently with the T&E species consultation with the jurisdictional agency. The applicant must still supply a copy of the PNDI Receipt with its permit application. The PNDI Receipt should also be submitted to the appropriate agency according to directions on the PNDI Receipt. The applicant and the jurisdictional agency will work together to resolve the potential impact(s). See the DEP PNDI policy at https://conservationexplorer.dcnr.pa.gov/content/resources.

5. ADDITIONAL INFORMATION

The PNDI environmental review website is a preliminary screening tool. There are often delays in updating species status classifications. Because the proposed status represents the best available information regarding the conservation status of the species, state jurisdictional agency staff give the proposed statuses at least the same consideration as the current legal status. If surveys or further information reveal that a threatened and endangered and/or special concern species and resources exist in your project area, contact the appropriate jurisdictional agency/agencies immediately to identify and resolve any impacts.

For a list of species known to occur in the county where your project is located, please see the species lists by county found on the PA Natural Heritage Program (PNHP) home page (www.naturalheritage.state.pa.us). Also note that the PNDI Environmental Review Tool only contains information about species occurrences that have actually been reported to the PNHP.

6. AGENCY CONTACT INFORMATION

PA Department of Conservation and Natural Resources
Bureau of Forestry, Ecological Services Section
400 Market Street, PO Box 8552
Harrisburg, PA 17105-8552
Email: RA-HeritageReview@pa.gov

U.S. Fish and Wildlife Service
Pennsylvania Field Office
Endangered Species Section
110 Radnor Rd; Suite 101
State College, PA 16801
NO Faxes Please

PA Fish and Boat Commission
Division of Environmental Services
595 E. Rolling Ridge Dr., Bellefonte, PA 16823
Email: RA-FBPACENOTIFY@pa.gov

PA Game Commission
Bureau of Wildlife Habitat Management
Division of Environmental Planning and Habitat Protection
2001 Elmerton Avenue, Harrisburg, PA 17110-9797
Email: RA-PGC_PNDI@pa.gov
NO Faxes Please

7. PROJECT CONTACT INFORMATION

Name:_____
Company/Business Name:_
Address:_____
City, State, Zip:_____
Phone:(_____)_____
Email:_____

STUART MORRIS - CEO
PENNHILLS RESOURCES, LLC
PO BOX 426
MT. JEWETT, PA 16740
O: 814-975-3009 FX: 814-778-6874
EMAIL: STUART.MORRIS@PENNHILLSRESOURCES.COM

8. CERTIFICATION

I certify that ALL of the project information contained in this receipt (including project location, project size/configuration, project type, answers to questions) is true, accurate and complete. In addition, if the project type, location, size or configuration changes, or if the answers to any questions that were asked during this online review change, I agree to re-do the online environmental review.

Stuart J. Morris
applicant/project proponent signature

7/11/2018
date

PNDI-643142 revision due to change in polygon. Original polygon did not include all well locations on the original ESCGP-1 map. All procedures have remained the same.

Warrant 3131, 3132 & 3122 Project Narrative for PNDI-643142

INTRODUCTION

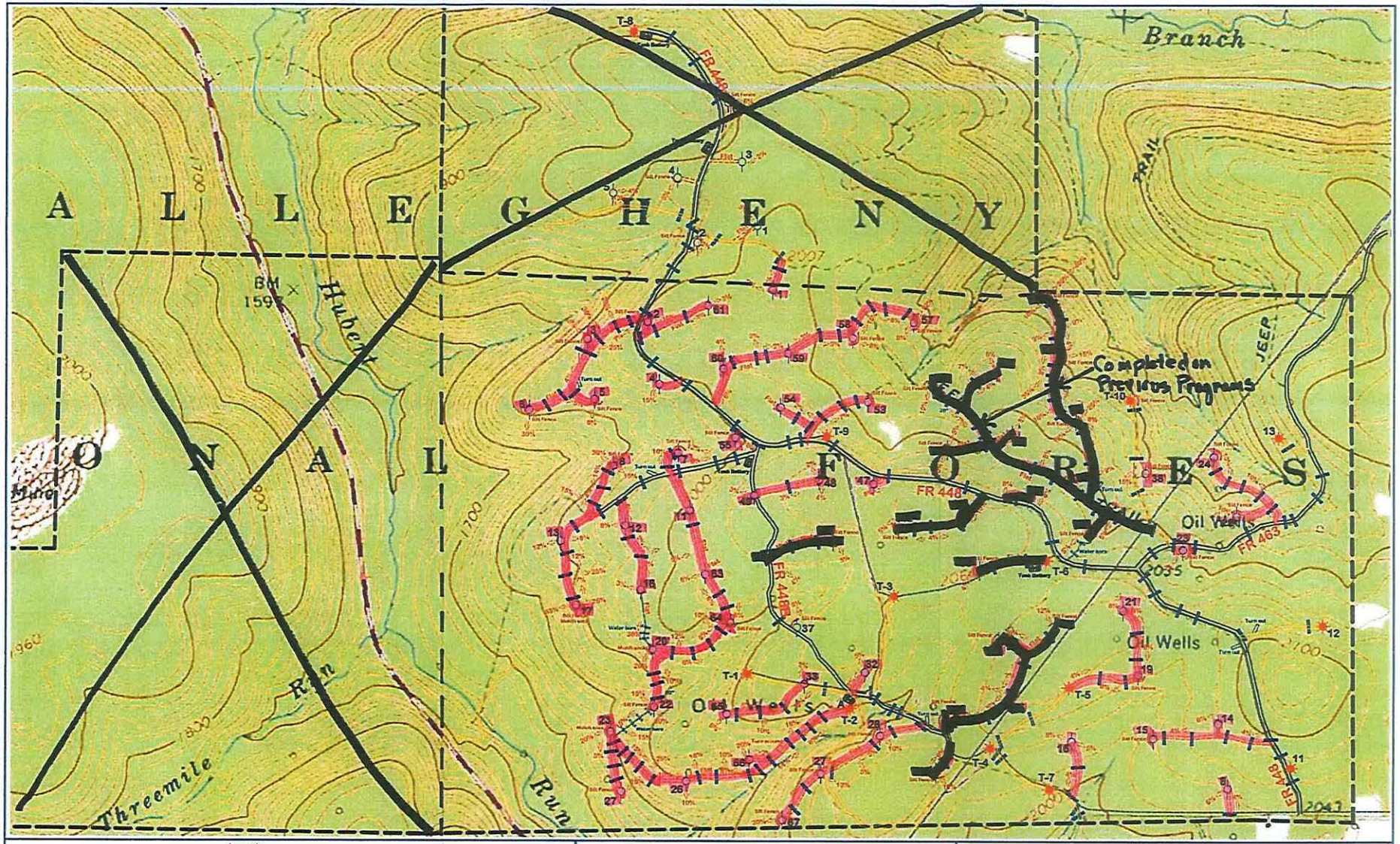
Pennhills Resources, LLC is successor in title to this lease that is on the western portion of Warrant 3131, the southern portion of Warrant 3132, and a southern portion of Warrant 3122, in Wetmore Township, McKean County, Commonwealth of Pennsylvania, and is within the Allegheny National Forest. A previous successor in title to this lease was East Resources, Inc., who around May of 2010 had applied for an ESCGP-1 permit for a 75 well program on this same lease. The principles of Pennhills Resources, LLC are experienced in drainage control techniques having developed projects in Pennsylvania involving more than 200 oil wells over the past several decades.

NARRATIVE

Pennhills Resources, LLC is proposing to construct 60 new well pads (60' x 80' each) along with new access roads (each 15' wide), all new pipelines will be within the 30 foot width of the new access roads. Stone will be hauled from an existing borrow pit located within the lease (see attached map). All work will follow the requirements required by the Pennsylvania Department of Environmental Protection. All access roads and well pad locations are in upland wooded areas. A full environmental survey will be conducted as part of the ESCGP-2 permit process. **The total disturbed area for this project is calculated to be 40.1 acres.**

Project Location: **Warrant 3131, 3132 & 3122**
Wetmore Township
McKean County

Responsible Officials: **Stuart J. Morris, CEO**
Pennhills Resources, LLC
3055 Route 219
Lantz Corners, PA 16735
814-975-3009



Legend:

- East completed well.
- East proposed well.
- Existing road.
- Existing ANF road.
- New Lease Road.
- Culvert. 16" unless other wise noted.
- East Resources pipeline.
- ESCGP-1 project boundary.
- Tank battery.
- To Be Covered under New ESCGP-2 permit.

EAST RESOURCES INC.

Title:

East Resources, Inc.
Kane Area Development on ANF
ESCGP-1 Map #3

Located: Twp.: Wetmore	Co.: McKean	State: Pennsylvania	
Scale: 1"=600'	Dwn By: Marty Dahler	Dwn Date: 05/17/2010	
Rev. By: MD	Rev. Date:	CAD File: Wt3131_3132_DrillingDevelopment	

COMMONWEALTH OF PENNSYLVANIA
PENNSYLVANIA GAME COMMISSION
2001 Elmerton Avenue
Harrisburg, PA 17110-9797
Wildlife Habitat Management
(717) 787-6818

August 7, 2018 **PGC ID Number: 201711160301**

Ms. Michelle Eschrich
Pennhills Resources, LLC
P.O. Box 426
Mt. Jewett, Pennsylvania 16740
Michelle.Eschrich@pennhillsresources.com

Re: *Pennhills Resources, LLC* - CNR 3131 East and West ESCGP-2
PNDI Receipt File: *project_receipt_cnr_3131_east_west_escgp__643142_FINAL_2.pdf*
Wetmore Township, McKean County, Pennsylvania

Dear Ms. Eschrich,

Thank you for submitting the Pennsylvania Natural Diversity Inventory (PNDI) Environmental Review Receipt File *project_receipt_cnr_3131_east_west_escgp__643142_FINAL_2.pdf* for review. The Pennsylvania Game Commission (PGC) screened this project for potential impacts to species and resources of concern under PGC responsibility, which includes birds and mammals only.

No Impact Anticipated – PNDI Species

PNDI records indicate species or resources of concern are located within the vicinity of the project. However, based on the information you submitted concerning the nature of the project, the immediate location, and our detailed resource information, the PGC has determined that no impact is likely. Therefore, no further PNDI coordination with the PGC will be necessary for this project at this time.

This response represents the most up-to-date summary of the PNDI data files and is valid for two (2) years from the date of this letter. An absence of recorded information does not necessarily imply actual conditions on site. Should project plans change or additional information on listed or proposed species become available, this determination may be reconsidered.

Should the proposed work continue beyond the period covered by this letter, please resubmit the project to this agency as an "Update" (including an updated PNDI receipt, project narrative and accurate map). If the proposed work has not changed and no additional information concerning listed species is found, the project will be cleared for PNDI requirements under this agency for two additional years.

This finding applies to impacts to birds and mammals only. To complete your review of state and federally-listed threatened and endangered species and species of special concern, please be sure

that the U.S. Fish and Wildlife Service, the PA Department of Conservation and Natural Resources, and/or the PA Fish and Boat Commission have been contacted regarding this project as directed by the online PNDI ER Tool found at www.naturalheritage.state.pa.us.

Please be sure to include the above-referenced PGC ID Number on any future correspondence with the PGC regarding this project.

Sincerely,

Olivia A. Braun
Environmental Planner
Division of Environmental Planning & Habitat Protection
Bureau of Wildlife Habitat Management
Phone: 717-787-4250, Extension 3128
Fax: 717-787-6957
E-mail: Olbraun@pa.gov

A PNHP Partner

Pennsylvania Natural Heritage Program

OAB/oab

cc: H:\OIL&GAS_PNDI_Reviews\Northcentral Region