

04/26/2019



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west virginia department of environmental protection

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Office of Oil and Gas  
601 57<sup>th</sup> Street, S.E.  
Charleston, WV 25304  
(304) 926-0450  
fax: (304) 926-0452

Austin Caperton, Cabinet Secretary  
[www.dep.wv.gov](http://www.dep.wv.gov)

Monday, April 22, 2019  
PERMIT MODIFICATION APPROVAL  
Horizontal 6A / Drilling Deeper

TUG HILL OPERATING, LLC  
380 SOUTHPOINTE BLVD

CANONSBURG, PA 15317

Re: Permit Modification Approval for LACKAWANNA 2H  
47-103-02983-00-00

**Lateral Extension**

TUG HILL OPERATING, LLC

The Office of Oil and Gas has reviewed the attached permit modification for the above referenced permit. The attached modification has been approved and well work may begin. Please be reminded that the oil and gas inspector is to be notified twenty-four (24) hours before permitted well work is commenced.

If there are any questions, please feel free to contact me at (304) 926- 0450.

James A. Martin  
Chief

A handwritten signature in blue ink, appearing to read "James A. Martin", is written over the typed name and title.

Operator's Well Number:  
Farm Name: M.B. INVESTMENTS  
U.S. WELL NUMBER: 47-103-02983-00-00  
Horizontal 6A Drilling Deeper  
Date Modification Issued: April 22, 2019

Promoting a healthy environment.

04/26/2019



March 5, 2019

WVDEP Office of Oil & Gas  
Attn: Laura Adkins  
601 5<sup>th</sup> Street, SE  
Charleston, WV 25304-2345

VIA: Fed-Ex

RE: Permit Application Modification Request for Lackawanna 2H (API # 47-103-02983) Lateral Extension

Dear Laura:

Tug Hill Operating, LLC would like to submit the enclosed permit modification request to our approved permit for the Lackawanna 2H. We recently secured leases that allow us to extend the bottom hole for this well.

Please find the following enclosed revisions for extending the bottom hole location of the well:

- Revised WW-6B with inspector signature
- Revised WW-6A1
- Revised Mylar Well Plat
- Revised Site Safety Plan
- Revised Area of Review for Communication Purposes

If you have any questions or concerns, please feel free to call me at 304-376-0111. Thank you for your consideration in this matter.

Sincerely,

A handwritten signature in blue ink that reads "Amy L. Miller".

Amy L. Miller  
Permitting Specialist – Appalachia

Alm  
Enclosures

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STATE OF WEST VIRGINIA  
DEPARTMENT OF ENVIRONMENTAL PROTECTION, OFFICE OF OIL AND GAS  
WELL WORK PERMIT APPLICATION

1) Well Operator: Tug Hill Operating, LLC 494510851 Wetzel Magnolia Porters Falls  
Operator ID County District Quadrangle

2) Operator's Well Number: Lackawanna 2H Well Pad Name: Lackawanna

3) Farm Name/Surface Owner: Wetzel County Sanitary Landfill Public Road Access: County Route 30

4) Elevation, current ground: 1306' Elevation, proposed post-construction: 1306'

5) Well Type (a) Gas  Oil  Underground Storage   
Other

(b) If Gas Shallow  Deep   
Horizontal  **X Drill Deeper**

6) Existing Pad: Yes or No Yes

*Dmt  
2-11-19*

7) Proposed Target Formation(s), Depth(s), Anticipated Thickness and Expected Pressure(s):  
Marcellus is the target formation at a depth of 6810' - 6755' thickness of 55' and anticipated pressure of approx. 3800 psi

8) Proposed Total Vertical Depth: 6,910'

9) Formation at Total Vertical Depth: Onondaga

10) Proposed Total Measured Depth: 18,693'

11) Proposed Horizontal Leg Length: 11,193'

12) Approximate Fresh Water Strata Depths: 70', 1116'

13) Method to Determine Fresh Water Depths: Use shallow offset wells to determine deepest freshwater. Or determine using prodrill tests, testing while drilling or petrophysical evaluation of resistivity.

14) Approximate Saltwater Depths: 2,167'

15) Approximate Coal Seam Depths: Sewickly Coal - 1016' and Pittsburgh Coal - 1111'

16) Approximate Depth to Possible Void (coal mine, karst, other): None anticipated

17) Does Proposed well location contain coal seams directly overlying or adjacent to an active mine? Yes  No

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(a) If Yes, provide Mine Info: Name: \_\_\_\_\_  
Depth: \_\_\_\_\_  
Seam: \_\_\_\_\_  
Owner: \_\_\_\_\_

18) CASING AND TUBING PROGRAM

<b>TYPE</b>	<u>Size (in)</u>	<u>New or Used</u>	<u>Grade</u>	<u>Weight per ft. (lb/ft)</u>	<u>FOOTAGE: For Drilling (ft)</u>	<u>INTERVALS: Left in Well (ft)</u>	<u>CEMENT: Fill-up (Cu. Ft.)/CTS</u>
Conductor	20"	NEW	BW	BW	set	40'	set
Fresh Water	13 3/8"	NEW	H40	48#	set	1,256'	set
Coal	13 3/8"	NEW	H40	48#	set	1,256'	set
Intermediate	9 5/8"	NEW	J55	36#	set	2,704'	set
Production	5 1/2"	NEW	P110	20#	18,693'	18,693'	4765ft^3(CTS)
Tubing	2 3/8"	NEW	N80	4.7#		7,429'	
Liners							

*DMH  
2-19-19*

<b>TYPE</b>	<u>Size (in)</u>	<u>Wellbore Diameter (in)</u>	<u>Wall Thickness (in)</u>	<u>Burst Pressure (psi)</u>	<u>Anticipated Max. Internal Pressure (psi)</u>	<u>Cement Type</u>	<u>Cement Yield (cu. ft./k)</u>
Conductor	20"	26"	1.0	2,333	1,866	CLASS A	1.2
Fresh Water	13 3/8"	17 1/2"	.33	1,730	1,384	SEE #24	1.2
Coal	13 3/8"	17 1/2"	.33	1,730	1,384	SEE#24	1.2
Intermediate	9 5/8"	12 1/4"	.352	3,520	2,816	SEE#24	1.19
Production	5 1/2"	8 7/8_8 3/4	.361	12,640	9,000	SEE#24	1.17/1.19
Tubing	2 3/8"		.19	11,200	8,960		
Liners							

PACKERS

Kind:	N/A			
Sizes:	N/A			
Depths Set:	N/A			

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19) Describe proposed well work, including the drilling and plugging back of any pilot hole:

Drill through the Marcellus utilizing existing casing and TD Pilot Hole 100' into the Onondaga. Log vertical section and run a solid cement plug back to proposed KOP. Drill curve and lateral per proposed well plan, run and cement production casing. Perform CBL from 60 deg to surface, make cleanout run, and stimulate.

20) Describe fracturing/stimulating methods in detail, including anticipated max pressure and max rate:

Well to be completed with approximately 27,982,500 lb proppant and 432,630 bbl of water. Max rate = 80 bpm; max psi = 9,000#.

DMH  
2-11-19

21) Total Area to be disturbed, including roads, stockpile area, pits, etc., (acres): 26.69 acres

22) Area to be disturbed for well pad only, less access road (acres): 4.32 acres

23) Describe centralizer placement for each casing string:

Will run 3 centralizers on surface casing at equal distance. Intermediate will have 1 centralizer every other joint. Production casing will have one centralizer every other joint in lateral, one centralizer every joint through curve, one centralizer every other joint to surface.

24) Describe all cement additives associated with each cement type:

\*See Attachment

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25) Proposed borehole conditioning procedures:

Will circulate a minimum of 3 hours at TD, short trip to curve, circulate bottoms up, check for flow  
POOH

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\*Note: Attach additional sheets as needed.

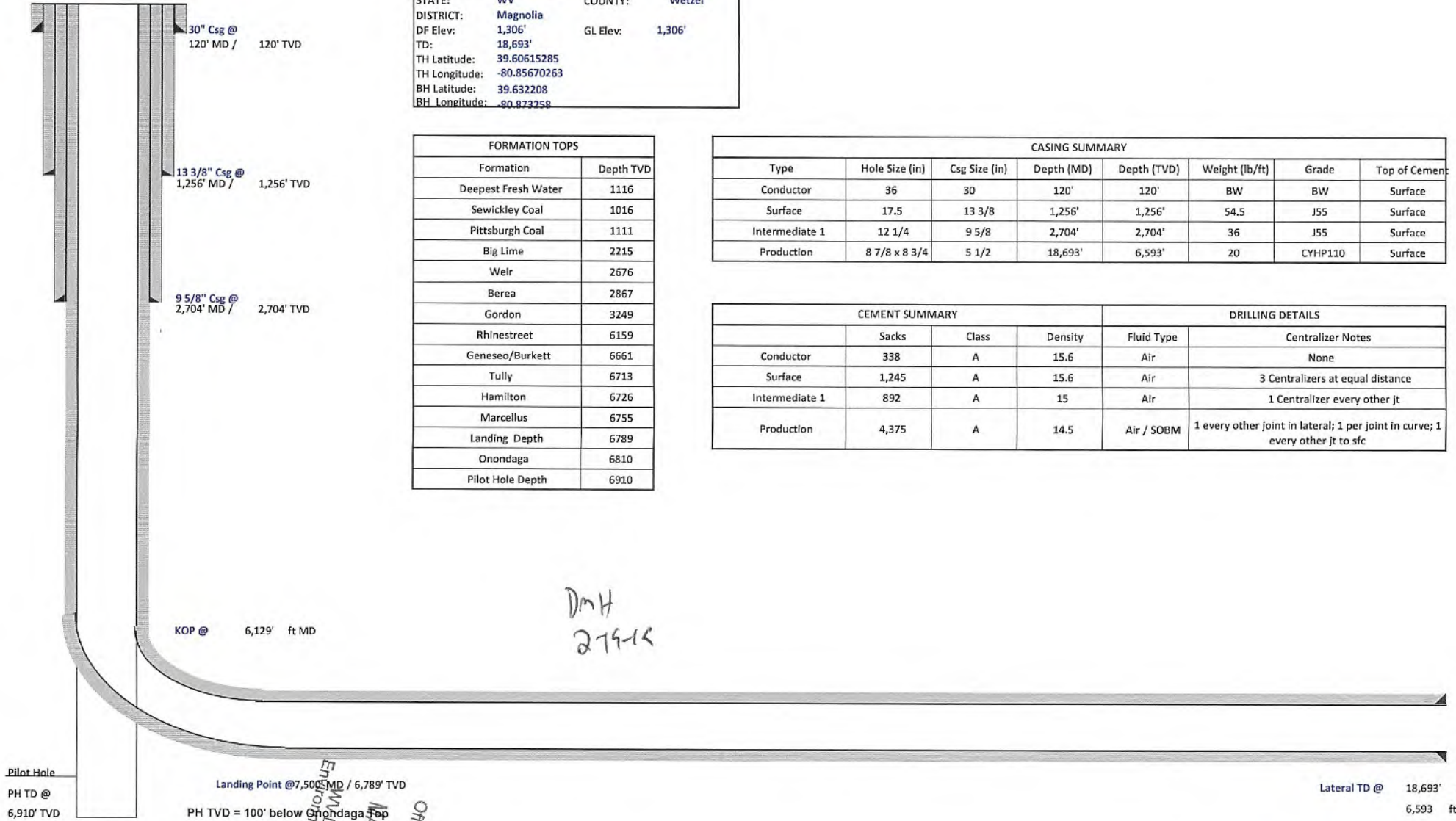


**WELL NAME:** Lackawanna 2HM  
**STATE:** WV **COUNTY:** Wetzel  
**DISTRICT:** Magnolia  
**DF Elev:** 1,306' **GL Elev:** 1,306'  
**TD:** 18,693'  
**TH Latitude:** 39.60615285  
**TH Longitude:** -80.85670263  
**BH Latitude:** 39.632208  
**BH Longitude:** -80.873258

FORMATION TOPS	
Formation	Depth TVD
Deepest Fresh Water	1116
Sewickley Coal	1016
Pittsburgh Coal	1111
Big Lime	2215
Weir	2676
Berea	2867
Gordon	3249
Rhinestreet	6159
Geneseo/Burkett	6661
Tully	6713
Hamilton	6726
Marcellus	6755
Landing Depth	6789
Onondaga	6810
Pilot Hole Depth	6910

CASING SUMMARY							
Type	Hole Size (in)	Csg Size (in)	Depth (MD)	Depth (TVD)	Weight (lb/ft)	Grade	Top of Cement
Conductor	36	30	120'	120'	BW	BW	Surface
Surface	17.5	13 3/8	1,256'	1,256'	54.5	J55	Surface
Intermediate 1	12 1/4	9 5/8	2,704'	2,704'	36	J55	Surface
Production	8 7/8 x 8 3/4	5 1/2	18,693'	6,593'	20	CYHP110	Surface

CEMENT SUMMARY				DRILLING DETAILS	
	Sacks	Class	Density	Fluid Type	Centralizer Notes
Conductor	338	A	15.6	Air	None
Surface	1,245	A	15.6	Air	3 Centralizers at equal distance
Intermediate 1	892	A	15	Air	1 Centralizer every other jt
Production	4,375	A	14.5	Air / SOBM	1 every other joint in lateral; 1 per joint in curve; 1 every other jt to sfc



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## Tug Hill Operating, LLC Casing and Cement Program

### Lackawanna 2HM

#### Casing

	String	Grade	Bit Size	Depth (Measured)	Cement Fill Up
Conductor	30"	BW	36"	120'	CTS
Surface	13 3/8"	J55	17 1/2"	1,256'	CTS
Intermediate	9 5/8"	J55	12 1/4"	2,704'	CTS
Production	5 1/2"	CYHP110	8 7/8 x 8 3/4	18,693'	CTS

#### Cement

Conductor: Premium NE-1 + 2% bwoc CaC12 + 46.5% Fresh Water – Conductor Cement mixed at 15.6 ppg, Y=1.2

Surface: Premium NE-1 + 2% bwoc CaC12 + 46.5% Fresh Water – Surface Cement mixed at 15.6 ppg, Y=1.2

Intermediate: Premium NE-1 + 1% bwoc CaC12 + 46.5% Fresh Water – Intermediate Cement mixed at 15.6 ppg, Y=1.19

Kick Off Plug: Class H Cement + 1% CD-32 + .7% Sodium Metasilicate + .1% R-3 + .75 gal/100sk FP-13L - KOP Plug

Production: 50:50 Poz: Premium NE-1 + .1% bwoc ASA-301 + 60lb/sk ASCA-1 + .35% bwoc BA-10A + .25% bwoc MPA-170, 44 lb sack + .5% bwoc R-3 + .75 gals/100sk FP-13L – Production Cement mixed at 15.2ppg, Y = 1.19

DMH  
2-15-15



Well: Lackawanna 2H (slot Y)  
 Site: Lackawanna  
 Project: Wetzel County, West Virginia (UTM17 NAD83)  
 Design: rev2  
 Rig:

SECTION DETAILS

Sec	MD	Inc	Azi	TVD	+N/-S	+E/-W	Dleg	TFace	VSec	Annotation
1	3207.00	4.54	8.47	3206.69	0.65	2.19	0.00	0.00	-0.39	S/T Begin 6°/100' build/turn
2	3736.08	29.23	128.76	3714.30	-61.12	108.75	6.00	126.73	-102.92	Begin 29.23° tangent
3	6129.22	29.23	128.76	5802.64	-792.84	1020.06	0.00	0.00	-1162.32	Begin 8°/100' build/turn
4	7079.69	50.00	340.07	6651.18	-560.84	1087.07	8.00	-155.78	-983.87	Begin 10°/100' build/turn
5	7499.92	91.00	330.00	6788.79	-211.80	919.59	10.00	-15.14	-596.76	Begin 91.00° lateral
6	18693.02	91.00	330.00	6593.00	9480.13	-4676.27	0.00	0.00	0570.73	PBHL/TD 18693.01 MD/6593.00 TVD

Geodetic System: Universal Transverse Mercator (US Survey Feet)  
 Datum: NAD83 West Virginia - HARN  
 Ellipsoid: GRS 1980  
 Zone: Zone 17N (84 W to 78 W)

System Datum: Mean Sea Level  
 Depth Reference: GL @ 1305.00ft

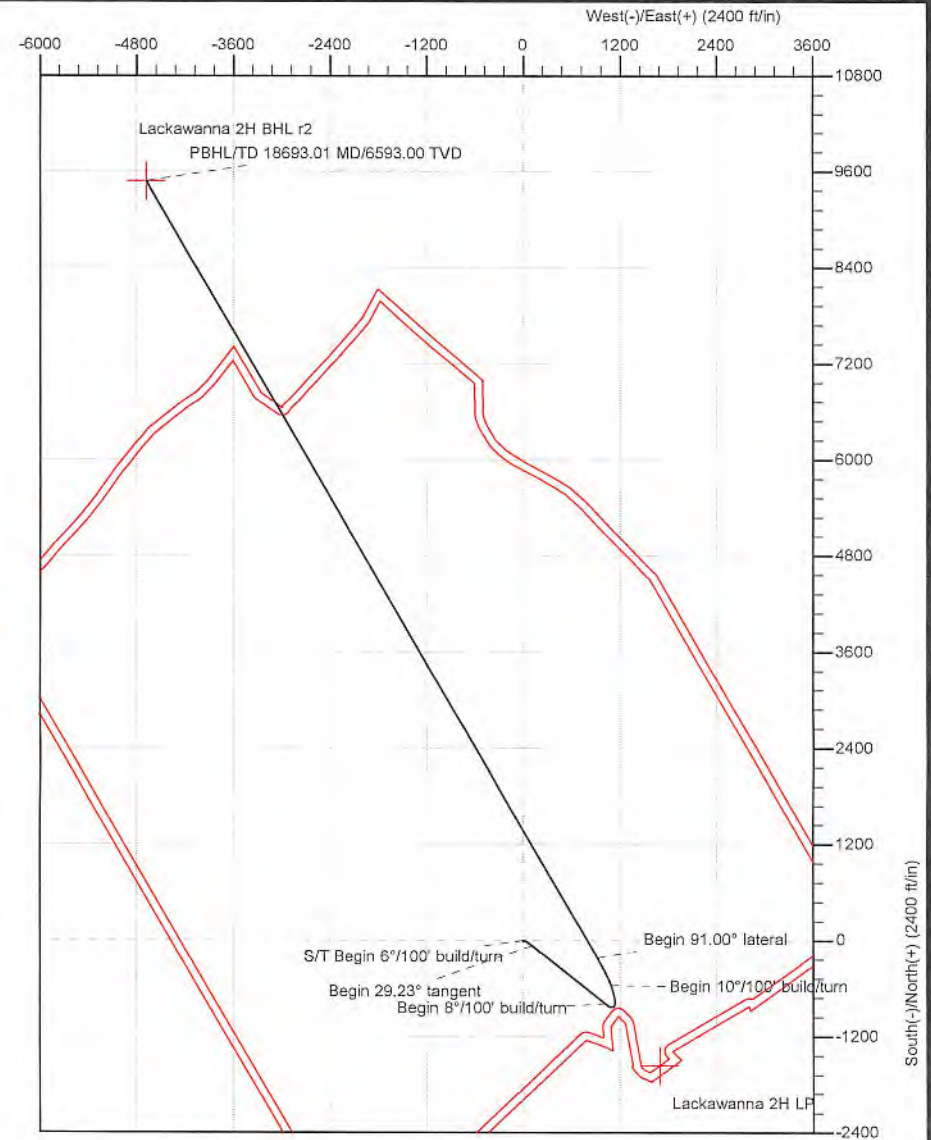
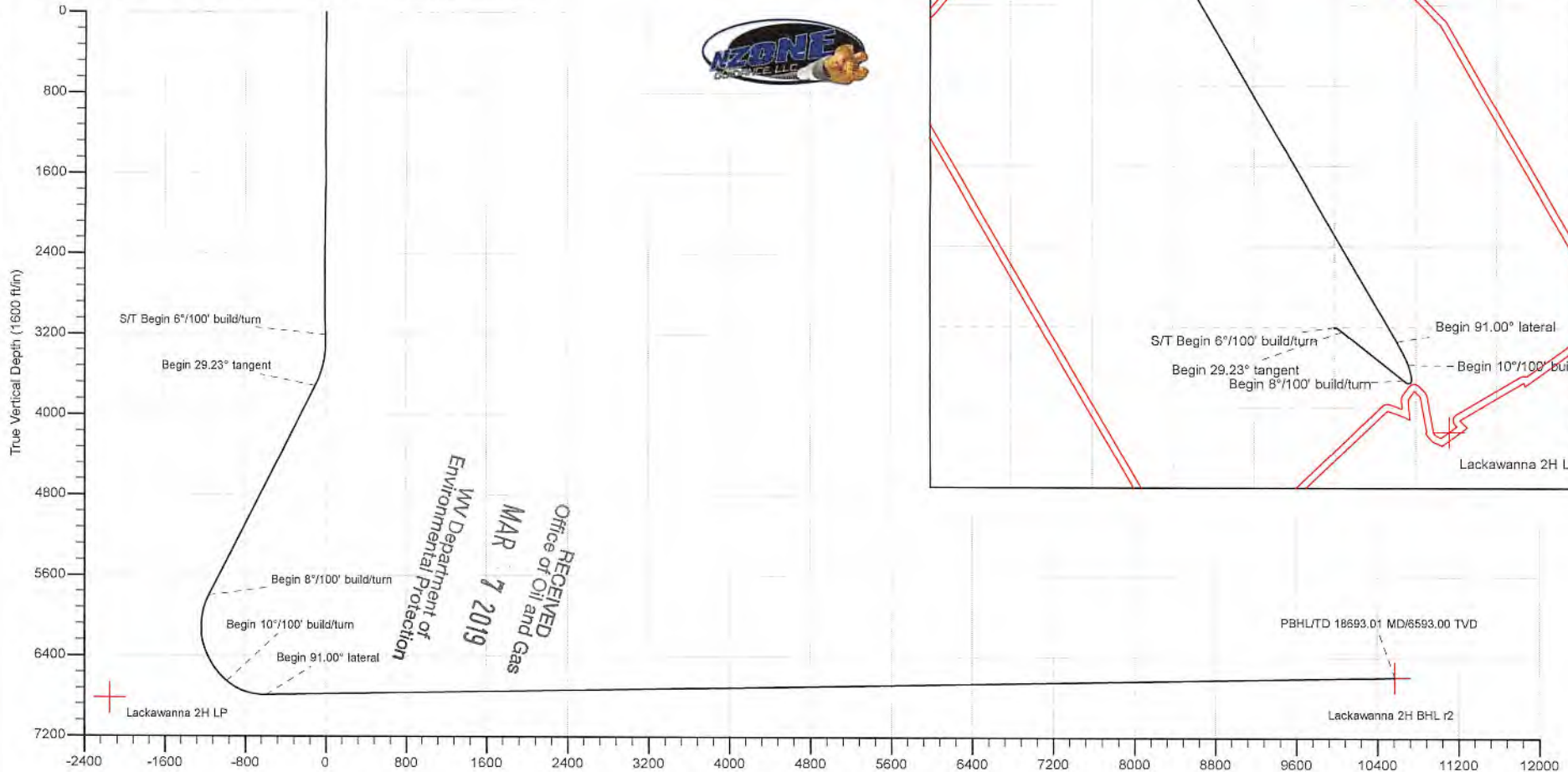
Northing: 14383354.87  
 Easting: 1680776.84  
 Latitude: 39.60615285  
 Longitude: -80.85670263



Azimuths to Grid North  
 True North: -0.09°  
 Magnetic North: -8.67°

Magnetic Field  
 Strength: 51973.5nT  
 Dip Angle: 66.75°  
 Date: 7/16/2018  
 Model: IGRF2015

Total Corr (M->G): To convert a Magnetic Direction to a Grid Direction, Subtract 8.6°





Database:	DB_Jul2216dt_v14	Local Co-ordinate Reference:	Well Lackawanna 2H (slot Y)
Company:	Tug Hill Operating LLC	TVD Reference:	GL @ 1306.00ft
Project:	Wetzel County, West Virginia (UTM17 NAD83)	MD Reference:	GL @ 1306.00ft
Site:	Lackawanna	North Reference:	Grid
Well:	Lackawanna 2H (slot Y)	Survey Calculation Method:	Minimum Curvature
Wellbore:	Sidetrack 01		
Design:	rev2		

Project	Wetzel County, West Virginia (UTM17 NAD83)		
Map System:	Universal Transverse Mercator (US Survey Feet)	System Datum:	Mean Sea Level
Geo Datum:	NAD83 West Virginia - HARN		
Map Zone:	Zone 17N (84 W to 78 W)		

Site	Lackawanna				
Site Position:		Northing:	14,383,374.84 usft	Latitude:	39.60620769
From:	Lat/Long	Easting:	1,680,777.71 usft	Longitude:	-80.85669942
Position Uncertainty:	0.00 ft	Slot Radius:	13-3/16 "	Grid Convergence:	0.09 °

Well	Lackawanna 2H (slot Y)					
Well Position	+N/-S	0.00 ft	Northing:	14,383,354.87 usft	Latitude:	39.60615285
	+E/-W	0.00 ft	Easting:	1,680,776.84 usft	Longitude:	-80.85670263
Position Uncertainty	0.00 ft	Wellhead Elevation:		Ground Level:	1,306.00 ft	

Wellbore	Sidetrack 01				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2015	7/16/2018	-8.58	66.75	51,973.54906711

Design	rev2			
Audit Notes:				
Version:	Phase:	PLAN	Tie On Depth:	3,207.00
Vertical Section:	Depth From (TVD) (ft)	+N/-S (ft)	+E/-W (ft)	Direction (°)
	0.00	0.00	0.00	333.74

Plan Survey Tool Program	Date	2/11/2019		
Depth From (ft)	Depth To (ft)	Survey (Wellbore)	Tool Name	Remarks
1	3,207.00	18,693.02 rev2 (Sidetrack 01)	MWD MWD - Standard	

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Plan Sections											
Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Turn Rate (°/100ft)	TFO (°)	Target	
3,207.00	4.54	8.47	3,206.69	0.65	2.19	0.00	0.00	0.00	0.00		
3,736.08	29.23	128.76	3,714.30	-61.12	108.75	6.00	4.67	22.74	126.73		
6,129.22	29.23	128.76	5,802.64	-792.87	1,020.06	0.00	0.00	0.00	0.00		
7,079.69	50.00	340.07	6,651.18	-560.84	1,087.07	8.00	2.18	-15.64	-155.78		
7,499.92	91.00	330.00	6,788.79	-211.80	919.59	10.00	9.76	-2.40	-15.14		
18,693.02	91.00	330.00	6,593.00	9,480.13	-4,676.27	0.00	0.00	0.00	0.00	Lackawanna 2H BHL	



<b>Database:</b>	DB_Jul2216dt_v14	<b>Local Co-ordinate Reference:</b>	Well Lackawanna 2H (slot Y)
<b>Company:</b>	Tug Hill Operating LLC	<b>TVD Reference:</b>	GL @ 1306.00ft
<b>Project:</b>	Wetzel County, West Virginia (UTM17 NAD83)	<b>MD Reference:</b>	GL @ 1306.00ft
<b>Site:</b>	Lackawanna	<b>North Reference:</b>	Grid
<b>Well:</b>	Lackawanna 2H (slot Y)	<b>Survey Calculation Method:</b>	Minimum Curvature
<b>Wellbore:</b>	Sidetrack 01		
<b>Design:</b>	rev2		

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**Planned Survey**

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude
3,207.00	4.54	8.47	3,206.69	0.65	2.19	14,383,355.52	1,680,779.03	39.60615462	-80.85669486
<b>S/T Begin 6°/100' build/turn</b>									
3,300.00	4.63	83.52	3,299.46	4.71	6.46	14,383,359.59	1,680,783.30	39.60616577	-80.85667967
3,400.00	9.57	113.14	3,398.70	1.90	18.12	14,383,356.77	1,680,794.96	39.60615799	-80.85663827
3,500.00	15.29	121.84	3,496.32	-8.33	36.99	14,383,346.54	1,680,813.83	39.60612980	-80.85657135
3,600.00	21.16	125.83	3,591.26	-25.87	62.85	14,383,329.00	1,680,839.69	39.60608152	-80.85647964
3,700.00	27.09	128.15	3,682.49	-50.53	95.42	14,383,304.35	1,680,872.26	39.60601367	-80.85636415
3,736.08	29.23	128.76	3,714.30	-61.12	108.75	14,383,293.75	1,680,885.59	39.60598452	-80.85631687
<b>Begin 29.23° tangent</b>									
3,800.00	29.23	128.76	3,770.08	-80.66	133.09	14,383,274.21	1,680,909.93	39.60593074	-80.85623056
3,900.00	29.23	128.76	3,857.34	-111.24	171.17	14,383,243.63	1,680,948.01	39.60584659	-80.85609554
4,000.00	29.23	128.76	3,944.60	-141.82	209.25	14,383,213.06	1,680,986.09	39.60576245	-80.85596051
4,100.00	29.23	128.76	4,031.87	-172.40	247.33	14,383,182.48	1,681,024.17	39.60567830	-80.85582548
4,200.00	29.23	128.76	4,119.13	-202.97	285.41	14,383,151.90	1,681,062.25	39.60559416	-80.85569046
4,300.00	29.23	128.76	4,206.39	-233.55	323.49	14,383,121.32	1,681,100.33	39.60551002	-80.85555543
4,400.00	29.23	128.76	4,293.66	-264.13	361.57	14,383,090.75	1,681,138.41	39.60542587	-80.85542041
4,500.00	29.23	128.76	4,380.92	-294.70	399.65	14,383,060.17	1,681,176.49	39.60534173	-80.85528538
4,600.00	29.23	128.76	4,468.19	-325.28	437.73	14,383,029.59	1,681,214.57	39.60525758	-80.85515036
4,700.00	29.23	128.76	4,555.45	-355.86	475.81	14,382,999.01	1,681,252.65	39.60517344	-80.85501533
4,800.00	29.23	128.76	4,642.71	-386.44	513.89	14,382,968.44	1,681,290.73	39.60508929	-80.85488031
4,900.00	29.23	128.76	4,729.98	-417.01	551.97	14,382,937.86	1,681,328.81	39.60500515	-80.85474528
5,000.00	29.23	128.76	4,817.24	-447.59	590.05	14,382,907.28	1,681,366.89	39.60492100	-80.85461026
5,100.00	29.23	128.76	4,904.50	-478.17	628.13	14,382,876.71	1,681,404.97	39.60483685	-80.85447524
5,200.00	29.23	128.76	4,991.77	-508.75	666.21	14,382,846.13	1,681,443.05	39.60475271	-80.85434021
5,300.00	29.23	128.76	5,079.03	-539.32	704.29	14,382,815.55	1,681,481.13	39.60466856	-80.85420519
5,400.00	29.23	128.76	5,166.29	-569.90	742.37	14,382,784.97	1,681,519.21	39.60458442	-80.85407017
5,500.00	29.23	128.76	5,253.56	-600.48	780.45	14,382,754.40	1,681,557.29	39.60450027	-80.85393515
5,600.00	29.23	128.76	5,340.82	-631.05	818.53	14,382,723.82	1,681,595.37	39.60441612	-80.85380013
5,700.00	29.23	128.76	5,428.09	-661.63	856.61	14,382,693.24	1,681,633.45	39.60433198	-80.85366510
5,800.00	29.23	128.76	5,515.35	-692.21	894.69	14,382,662.67	1,681,671.53	39.60424783	-80.85353008
5,900.00	29.23	128.76	5,602.61	-722.79	932.77	14,382,632.09	1,681,709.61	39.60416368	-80.85339506
6,000.00	29.23	128.76	5,689.88	-753.36	970.85	14,382,601.51	1,681,747.69	39.60407954	-80.85326004
6,100.00	29.23	128.76	5,777.14	-783.94	1,008.93	14,382,570.93	1,681,785.77	39.60399539	-80.85312502
6,129.22	29.23	128.76	5,802.64	-792.88	1,020.06	14,382,562.00	1,681,796.90	39.60397080	-80.85308557
<b>Begin 8°/100' build/turn</b>									
6,200.00	24.17	123.09	5,865.86	-811.62	1,045.70	14,382,543.25	1,681,822.53	39.60391920	-80.85299466
6,300.00	17.61	110.08	5,959.28	-828.02	1,077.11	14,382,526.85	1,681,853.94	39.60387402	-80.85288324
6,400.00	12.73	85.36	6,055.87	-832.33	1,102.33	14,382,522.54	1,681,879.17	39.60386207	-80.85279370
6,500.00	11.85	47.31	6,153.74	-824.47	1,120.89	14,382,530.41	1,681,897.73	39.60388358	-80.85272777
6,600.00	15.65	17.08	6,250.98	-804.59	1,132.41	14,382,550.29	1,681,909.25	39.60393813	-80.85268674
6,700.00	21.81	0.92	6,345.70	-773.07	1,136.68	14,382,581.80	1,681,913.52	39.60402466	-80.85267142
6,800.00	28.85	351.97	6,436.06	-730.54	1,133.60	14,382,624.33	1,681,910.44	39.60414149	-80.85268209
6,900.00	36.27	346.37	6,520.30	-677.82	1,123.25	14,382,677.06	1,681,900.08	39.60428633	-80.85271855
7,000.00	43.87	342.47	6,596.78	-615.93	1,105.81	14,382,738.95	1,681,882.65	39.60445638	-80.85278009
7,079.69	50.00	340.07	6,651.18	-560.84	1,087.07	14,382,794.03	1,681,863.91	39.60460775	-80.85284630
<b>Begin 10°/100' build/turn</b>									
7,100.00	51.96	339.40	6,663.96	-546.04	1,081.60	14,382,808.83	1,681,858.44	39.60464842	-80.85286563
7,200.00	61.67	336.52	6,718.64	-468.62	1,050.13	14,382,886.26	1,681,826.97	39.60486120	-80.85297691
7,300.00	71.43	334.14	6,758.39	-385.39	1,011.83	14,382,969.49	1,681,788.67	39.60508995	-80.85311242
7,400.00	81.21	332.01	6,782.01	-298.88	967.85	14,383,055.99	1,681,744.69	39.60532772	-80.85326805
7,499.92	91.00	330.00	6,788.79	-211.80	919.59	14,383,143.07	1,681,696.42	39.60556709	-80.85343892
<b>Begin 91.00° lateral</b>									
7,500.00	91.00	330.00	6,788.79	-211.73	919.55	14,383,143.14	1,681,696.38	39.60556728	-80.85343906



Database:	DB_Jul2216dt_v14	Local Co-ordinate Reference:	Well Lackawanna 2H (slot Y)
Company:	Tug Hill Operating LLC	TVD Reference:	GL @ 1306.00ft
Project:	Wetzel County, West Virginia (UTM17 NAD83)	MD Reference:	GL @ 1306.00ft
Site:	Lackawanna	North Reference:	Grid
Well:	Lackawanna 2H (slot Y)	Survey Calculation Method:	Minimum Curvature
Wellbore:	Sidetrack 01		
Design:	rev2		

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Planned Survey										
Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude	
7,600.00	91.00	330.00	6,787.04	-125.14	869.55	14,383,229.73	1,681,646.39	39.60580531	-80.85361606	
7,700.00	91.00	330.00	6,785.29	-38.56	819.56	14,383,316.32	1,681,596.40	39.60604334	-80.85379306	
7,800.00	91.00	330.00	6,783.54	48.03	769.56	14,383,402.91	1,681,546.40	39.60628136	-80.85397006	
7,900.00	91.00	330.00	6,781.79	134.62	719.57	14,383,489.49	1,681,496.41	39.60651939	-80.85414706	
8,000.00	91.00	330.00	6,780.04	221.21	669.58	14,383,576.08	1,681,446.42	39.60675742	-80.85432406	
8,100.00	91.00	330.00	6,778.29	307.80	619.58	14,383,662.67	1,681,396.42	39.60699544	-80.85450107	
8,200.00	91.00	330.00	6,776.54	394.39	569.59	14,383,749.26	1,681,346.43	39.60723347	-80.85467807	
8,300.00	91.00	330.00	6,774.79	480.97	519.60	14,383,835.85	1,681,296.43	39.60747149	-80.85485508	
8,400.00	91.00	330.00	6,773.04	567.56	469.60	14,383,922.43	1,681,246.44	39.60770952	-80.85503209	
8,500.00	91.00	330.00	6,771.29	654.15	419.61	14,384,009.02	1,681,196.45	39.60794754	-80.85520910	
8,600.00	91.00	330.00	6,769.54	740.74	369.61	14,384,095.61	1,681,146.45	39.60818557	-80.85538611	
8,700.00	91.00	330.00	6,767.80	827.33	319.62	14,384,182.20	1,681,096.46	39.60842359	-80.85556312	
8,800.00	91.00	330.00	6,766.05	913.92	269.63	14,384,268.79	1,681,046.47	39.60866162	-80.85574013	
8,900.00	91.00	330.00	6,764.30	1,000.51	219.63	14,384,355.38	1,680,996.47	39.60889964	-80.85591714	
9,000.00	91.00	330.00	6,762.55	1,087.09	169.64	14,384,441.96	1,680,946.48	39.60913766	-80.85609416	
9,100.00	91.00	330.00	6,760.80	1,173.68	119.64	14,384,528.55	1,680,896.48	39.60937569	-80.85627117	
9,200.00	91.00	330.00	6,759.05	1,260.27	69.65	14,384,615.14	1,680,846.49	39.60961371	-80.85644819	
9,300.00	91.00	330.00	6,757.30	1,346.86	19.66	14,384,701.73	1,680,796.50	39.60985173	-80.85662521	
9,400.00	91.00	330.00	6,755.55	1,433.45	-30.34	14,384,788.32	1,680,746.50	39.61008975	-80.85680223	
9,500.00	91.00	330.00	6,753.80	1,520.04	-80.33	14,384,874.91	1,680,696.51	39.61032778	-80.85697925	
9,600.00	91.00	330.00	6,752.05	1,606.62	-130.32	14,384,961.49	1,680,646.52	39.61056580	-80.85715627	
9,700.00	91.00	330.00	6,750.30	1,693.21	-180.32	14,385,048.08	1,680,596.52	39.61080382	-80.85733330	
9,800.00	91.00	330.00	6,748.55	1,779.80	-230.31	14,385,134.67	1,680,546.53	39.61104184	-80.85751032	
9,900.00	91.00	330.00	6,746.81	1,866.39	-280.31	14,385,221.26	1,680,496.53	39.61127986	-80.85768735	
10,000.00	91.00	330.00	6,745.06	1,952.98	-330.30	14,385,307.85	1,680,446.54	39.61151788	-80.85786438	
10,100.00	91.00	330.00	6,743.31	2,039.57	-380.29	14,385,394.44	1,680,396.55	39.61175590	-80.85804140	
10,200.00	91.00	330.00	6,741.56	2,126.16	-430.29	14,385,481.02	1,680,346.55	39.61199392	-80.85821843	
10,300.00	91.00	330.00	6,739.81	2,212.74	-480.28	14,385,567.61	1,680,296.56	39.61223194	-80.85839546	
10,400.00	91.00	330.00	6,738.06	2,299.33	-530.27	14,385,654.20	1,680,246.57	39.61246996	-80.85857250	
10,500.00	91.00	330.00	6,736.31	2,385.92	-580.27	14,385,740.79	1,680,196.57	39.61270798	-80.85874953	
10,600.00	91.00	330.00	6,734.56	2,472.51	-630.26	14,385,827.38	1,680,146.58	39.61294600	-80.85892656	
10,700.00	91.00	330.00	6,732.81	2,559.10	-680.26	14,385,913.97	1,680,096.59	39.61318402	-80.85910360	
10,800.00	91.00	330.00	6,731.06	2,645.69	-730.25	14,386,000.55	1,680,046.59	39.61342204	-80.85928064	
10,900.00	91.00	330.00	6,729.31	2,732.27	-780.24	14,386,087.14	1,679,996.60	39.61366006	-80.85945767	
11,000.00	91.00	330.00	6,727.56	2,818.86	-830.24	14,386,173.73	1,679,946.60	39.61389807	-80.85963471	
11,100.00	91.00	330.00	6,725.82	2,905.45	-880.23	14,386,260.32	1,679,896.61	39.61413609	-80.85981175	
11,200.00	91.00	330.00	6,724.07	2,992.04	-930.22	14,386,346.91	1,679,846.62	39.61437411	-80.85998880	
11,300.00	91.00	330.00	6,722.32	3,078.63	-980.22	14,386,433.50	1,679,796.62	39.61461213	-80.86016584	
11,400.00	91.00	330.00	6,720.57	3,165.22	-1,030.21	14,386,520.08	1,679,746.63	39.61485014	-80.86034288	
11,500.00	91.00	330.00	6,718.82	3,251.81	-1,080.21	14,386,606.67	1,679,696.64	39.61508816	-80.86051993	
11,600.00	91.00	330.00	6,717.07	3,338.39	-1,130.20	14,386,693.26	1,679,646.64	39.61532618	-80.86069697	
11,700.00	91.00	330.00	6,715.32	3,424.98	-1,180.19	14,386,779.85	1,679,596.65	39.61556419	-80.86087402	
11,800.00	91.00	330.00	6,713.57	3,511.57	-1,230.19	14,386,866.44	1,679,546.65	39.61580221	-80.86105107	
11,900.00	91.00	330.00	6,711.82	3,598.16	-1,280.18	14,386,953.03	1,679,496.66	39.61604022	-80.86122812	
12,000.00	91.00	330.00	6,710.07	3,684.75	-1,330.18	14,387,039.61	1,679,446.67	39.61627824	-80.86140517	
12,100.00	91.00	330.00	6,708.32	3,771.34	-1,380.17	14,387,126.20	1,679,396.67	39.61651625	-80.86158222	
12,200.00	91.00	330.00	6,706.57	3,857.92	-1,430.16	14,387,212.79	1,679,346.68	39.61675427	-80.86175928	
12,300.00	91.00	330.00	6,704.83	3,944.51	-1,480.16	14,387,299.38	1,679,296.69	39.61699228	-80.86193633	
12,400.00	91.00	330.00	6,703.08	4,031.10	-1,530.15	14,387,385.97	1,679,246.69	39.61723030	-80.86211339	
12,500.00	91.00	330.00	6,701.33	4,117.69	-1,580.14	14,387,472.55	1,679,196.70	39.61746831	-80.86229045	
12,600.00	91.00	330.00	6,699.58	4,204.28	-1,630.14	14,387,559.14	1,679,146.71	39.61770632	-80.86246751	
12,700.00	91.00	330.00	6,697.83	4,290.87	-1,680.13	14,387,645.73	1,679,096.71	39.61794434	-80.86264457	
12,800.00	91.00	330.00	6,696.08	4,377.46	-1,730.13	14,387,732.32	1,679,046.72	39.61818235	-80.86282163	
12,900.00	91.00	330.00	6,694.33	4,464.04	-1,780.12	14,387,818.91	1,678,996.72	39.61842036	-80.86299869	



<b>Database:</b>	DB_Jul2216dt_v14	<b>Local Co-ordinate Reference:</b>	Well Lackawanna 2H (slot Y)
<b>Company:</b>	Tug Hill Operating LLC	<b>TVD Reference:</b>	GL @ 1306.00ft
<b>Project:</b>	Wetzel County, West Virginia (UTM17 NAD83)	<b>MD Reference:</b>	GL @ 1306.00ft
<b>Site:</b>	Lackawanna	<b>North Reference:</b>	Grid
<b>Well:</b>	Lackawanna 2H (slot Y)	<b>Survey Calculation Method:</b>	Minimum Curvature
<b>Wellbore:</b>	Sidetrack 01		
<b>Design:</b>	rev2		

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Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude
13,000.00	91.00	330.00	6,692.58	4,550.63	-1,830.11	14,387,905.50	1,678,946.73	39.61865838	-80.86317575
13,100.00	91.00	330.00	6,690.83	4,637.22	-1,880.11	14,387,992.08	1,678,896.74	39.61889639	-80.86335282
13,200.00	91.00	330.00	6,689.08	4,723.81	-1,930.10	14,388,078.67	1,678,846.74	39.61913440	-80.86352988
13,300.00	91.00	330.00	6,687.33	4,810.40	-1,980.09	14,388,165.26	1,678,796.75	39.61937241	-80.86370695
13,400.00	91.00	330.00	6,685.58	4,896.99	-2,030.09	14,388,251.85	1,678,746.76	39.61961042	-80.86388402
13,500.00	91.00	330.00	6,683.84	4,983.57	-2,080.08	14,388,338.44	1,678,696.76	39.61984843	-80.86406109
13,600.00	91.00	330.00	6,682.09	5,070.16	-2,130.08	14,388,425.03	1,678,646.77	39.62008644	-80.86423816
13,700.00	91.00	330.00	6,680.34	5,156.75	-2,180.07	14,388,511.61	1,678,596.77	39.62032445	-80.86441523
13,800.00	91.00	330.00	6,678.59	5,243.34	-2,230.06	14,388,598.20	1,678,546.78	39.62056246	-80.86459230
13,900.00	91.00	330.00	6,676.84	5,329.93	-2,280.06	14,388,684.79	1,678,496.79	39.62080047	-80.86476938
14,000.00	91.00	330.00	6,675.09	5,416.52	-2,330.05	14,388,771.38	1,678,446.79	39.62103848	-80.86494645
14,100.00	91.00	330.00	6,673.34	5,503.11	-2,380.05	14,388,857.97	1,678,396.80	39.62127649	-80.86512353
14,200.00	91.00	330.00	6,671.59	5,589.69	-2,430.04	14,388,944.56	1,678,346.81	39.62151450	-80.86530061
14,300.00	91.00	330.00	6,669.84	5,676.28	-2,480.03	14,389,031.14	1,678,296.81	39.62175251	-80.86547769
14,400.00	91.00	330.00	6,668.09	5,762.87	-2,530.03	14,389,117.73	1,678,246.82	39.62199052	-80.86565477
14,500.00	91.00	330.00	6,666.34	5,849.46	-2,580.02	14,389,204.32	1,678,196.83	39.62222853	-80.86583185
14,600.00	91.00	330.00	6,664.59	5,936.05	-2,630.01	14,389,290.91	1,678,146.83	39.62246654	-80.86600893
14,700.00	91.00	330.00	6,662.84	6,022.64	-2,680.01	14,389,377.50	1,678,096.84	39.62270454	-80.86618602
14,800.00	91.00	330.00	6,661.10	6,109.22	-2,730.00	14,389,464.09	1,678,046.84	39.62294255	-80.86636310
14,900.00	91.00	330.00	6,659.35	6,195.81	-2,780.00	14,389,550.67	1,677,996.85	39.62318056	-80.86654019
15,000.00	91.00	330.00	6,657.60	6,282.40	-2,829.99	14,389,637.26	1,677,946.86	39.62341857	-80.86671728
15,100.00	91.00	330.00	6,655.85	6,368.99	-2,879.98	14,389,723.85	1,677,896.86	39.62365657	-80.86689437
15,200.00	91.00	330.00	6,654.10	6,455.58	-2,929.98	14,389,810.44	1,677,846.87	39.62389458	-80.86707146
15,300.00	91.00	330.00	6,652.35	6,542.17	-2,979.97	14,389,897.03	1,677,796.88	39.62413258	-80.86724855
15,400.00	91.00	330.00	6,650.60	6,628.76	-3,029.96	14,389,983.62	1,677,746.88	39.62437059	-80.86742564
15,500.00	91.00	330.00	6,648.85	6,715.34	-3,079.96	14,390,070.20	1,677,696.89	39.62460860	-80.86760273
15,600.00	91.00	330.00	6,647.10	6,801.93	-3,129.95	14,390,156.79	1,677,646.89	39.62484660	-80.86777983
15,700.00	91.00	330.00	6,645.35	6,888.52	-3,179.95	14,390,243.38	1,677,596.90	39.62508461	-80.86795692
15,800.00	91.00	330.00	6,643.60	6,975.11	-3,229.94	14,390,329.97	1,677,546.91	39.62532261	-80.86813402
15,900.00	91.00	330.00	6,641.85	7,061.70	-3,279.93	14,390,416.56	1,677,496.91	39.62556061	-80.86831112
16,000.00	91.00	330.00	6,640.11	7,148.29	-3,329.93	14,390,503.14	1,677,446.92	39.62579862	-80.86848822
16,100.00	91.00	330.00	6,638.36	7,234.87	-3,379.92	14,390,589.73	1,677,396.93	39.62603662	-80.86866532
16,200.00	91.00	330.00	6,636.61	7,321.46	-3,429.91	14,390,676.32	1,677,346.93	39.62627463	-80.86884242
16,300.00	91.00	330.00	6,634.86	7,408.05	-3,479.91	14,390,762.91	1,677,296.94	39.62651263	-80.86901953
16,400.00	91.00	330.00	6,633.11	7,494.64	-3,529.90	14,390,849.50	1,677,246.94	39.62675063	-80.86919663
16,500.00	91.00	330.00	6,631.36	7,581.23	-3,579.90	14,390,936.09	1,677,196.95	39.62698863	-80.86937374
16,600.00	91.00	330.00	6,629.61	7,667.82	-3,629.89	14,391,022.67	1,677,146.96	39.62722664	-80.86955084
16,700.00	91.00	330.00	6,627.86	7,754.41	-3,679.88	14,391,109.26	1,677,096.96	39.62746464	-80.86972795
16,800.00	91.00	330.00	6,626.11	7,840.99	-3,729.88	14,391,195.85	1,677,046.97	39.62770264	-80.86990506
16,900.00	91.00	330.00	6,624.36	7,927.58	-3,779.87	14,391,282.44	1,676,996.98	39.62794064	-80.87008217
17,000.00	91.00	330.00	6,622.61	8,014.17	-3,829.87	14,391,369.03	1,676,946.98	39.62817864	-80.87025928
17,100.00	91.00	330.00	6,620.86	8,100.76	-3,879.86	14,391,455.62	1,676,896.99	39.62841664	-80.87043640
17,200.00	91.00	330.00	6,619.12	8,187.35	-3,929.85	14,391,542.20	1,676,847.00	39.62865465	-80.87061351
17,300.00	91.00	330.00	6,617.37	8,273.94	-3,979.85	14,391,628.79	1,676,797.00	39.62889265	-80.87079063
17,400.00	91.00	330.00	6,615.62	8,360.52	-4,029.84	14,391,715.38	1,676,747.01	39.62913065	-80.87096774
17,500.00	91.00	330.00	6,613.87	8,447.11	-4,079.83	14,391,801.97	1,676,697.01	39.62936865	-80.87114486
17,600.00	91.00	330.00	6,612.12	8,533.70	-4,129.83	14,391,888.56	1,676,647.02	39.62960665	-80.87132198
17,700.00	91.00	330.00	6,610.37	8,620.29	-4,179.82	14,391,975.15	1,676,597.03	39.62984464	-80.87149910
17,800.00	91.00	330.00	6,608.62	8,706.88	-4,229.82	14,392,061.73	1,676,547.03	39.63008264	-80.87167622
17,900.00	91.00	330.00	6,606.87	8,793.47	-4,279.81	14,392,148.32	1,676,497.04	39.63032064	-80.87185335
18,000.00	91.00	330.00	6,605.12	8,880.06	-4,329.80	14,392,234.91	1,676,447.05	39.63055864	-80.87203047
18,100.00	91.00	330.00	6,603.37	8,966.64	-4,379.80	14,392,321.50	1,676,397.05	39.63079664	-80.87220760
18,200.00	91.00	330.00	6,601.62	9,053.23	-4,429.79	14,392,408.09	1,676,347.06	39.63103464	-80.87238472
18,300.00	91.00	330.00	6,599.87	9,139.82	-4,479.78	14,392,494.68	1,676,297.06	39.63127264	-80.87256185



<b>Database:</b>	DB_Jul2216dt_v14	<b>Local Co-ordinate Reference:</b>	Well Lackawanna 2H (slot Y)
<b>Company:</b>	Tug Hill Operating LLC	<b>TVD Reference:</b>	GL @ 1306.00ft
<b>Project:</b>	Wetzel County, West Virginia (UTM17 NAD83)	<b>MD Reference:</b>	GL @ 1306.00ft
<b>Site:</b>	Lackawanna	<b>North Reference:</b>	Grid
<b>Well:</b>	Lackawanna 2H (slot Y)	<b>Survey Calculation Method:</b>	Minimum Curvature
<b>Wellbore:</b>	Sidetrack 01		
<b>Design:</b>	rev2		

Planned Survey										
Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Map Northing (usft)	Map Easting (usft)	Latitude	Longitude	
18,400.00	91.00	330.00	6,598.13	9,226.41	-4,529.78	14,392,581.26	1,676,247.07	39.63151063	-80.87273898	
18,500.00	91.00	330.00	6,596.38	9,313.00	-4,579.77	14,392,667.85	1,676,197.08	39.63174863	-80.87291611	
18,600.00	91.00	330.00	6,594.63	9,399.59	-4,629.77	14,392,754.44	1,676,147.08	39.63198663	-80.87309324	
18,693.01	91.00	330.00	6,593.00	9,480.12	-4,676.27	14,392,834.98	1,676,100.58	39.63220799	-80.87325799	
<b>PBHL/TD 18693.01 MD/6593.00 TVD</b>										
18,693.02	91.00	330.00	6,593.00	9,480.13	-4,676.27	14,392,834.98	1,676,100.58	39.63220800	-80.87325800	

Design Targets										
Target Name	Dip Angle (°)	Dip Dir. (°)	TVD (ft)	+N/-S (ft)	+E/-W (ft)	Northing (usft)	Easting (usft)	Latitude	Longitude	
Lackawanna 2H BHL r2 - hit/miss target - Shape - Point	0.00	0.00	6,593.00	9,480.13	-4,676.27	14,392,834.98	1,676,100.58	39.63220800	-80.87325800	
Lackawanna 2H LP - plan misses target center by 1069.80ft at 6773.62ft MD (6412.75 TVD, -742.79 N, 1135.13 E) - Point	0.00	0.01	6,816.00	-1,558.89	1,697.11	14,381,795.98	1,682,473.95	39.60186397	-80.85068633	

Plan Annotations					
Measured Depth (ft)	Vertical Depth (ft)	Local Coordinates		Comment	
		+N/-S (ft)	+E/-W (ft)		
3,207.00	3,206.69	0.65	2.19	S/T Begin 6°/100' build/turn	
3,736.08	3,714.30	-61.12	108.75	Begin 29.23° tangent	
6,129.22	5,802.64	-792.88	1,020.06	Begin 8°/100' build/turn	
7,079.69	6,651.18	-560.84	1,087.07	Begin 10°/100' build/turn	
7,499.92	6,788.79	-211.80	919.59	Begin 91.00° lateral	
18,693.01	6,593.00	9,480.12	-4,676.27	PBHL/TD 18693.01 MD/6593.00 TVD	

RECEIVED  
 Office of Oil and Gas  
 MAR 7 2019  
 WV Department of  
 Environmental Protection

WW-6A1  
(5/13)

Operator's Well No. Lackawanna 2H

**INFORMATION SUPPLIED UNDER WEST VIRGINIA CODE  
Chapter 22, Article 6A, Section 5(a)(5)  
IN LIEU OF FILING LEASE(S) AND OTHER CONTINUING CONTRACT(S)**

Under the oath required to make the verification on page 1 of this Notice and Application, I depose and say that I am the person who signed the Notice and Application for the Applicant, and that –

- (1) the tract of land is the same tract described in this Application, partly or wholly depicted in the accompanying plat, and described in the Construction and Reclamation Plan;
- (2) the parties and recordation data (if recorded) for lease(s) or other continuing contract(s) by which the Applicant claims the right to extract, produce or market the oil or gas are as follows:

Lease Name or Number	Grantor, Lessor, etc.	Grantee, Lessee, etc.	Royalty	Book/Page
----------------------	-----------------------	-----------------------	---------	-----------

\*See attachment

**Acknowledgement of Possible Permitting/Approval  
In Addition to the Office of Oil and Gas**

The permit applicant for the proposed well work addressed in this application hereby acknowledges the possibility of the need for permits and/or approvals from local, state, or federal entities in addition to the DEP, Office of Oil and Gas, including but not limited to the following:

- WV Division of Water and Waste Management
- WV Division of Natural Resources WV Division of Highways
- U.S. Army Corps of Engineers
- U.S. Fish and Wildlife Service
- County Floodplain Coordinator

The applicant further acknowledges that any Office of Oil and Gas permit in no way overrides, nullifies the need for other permits/approvals that may be necessary and further affirms that all needed permits/approvals should be acquired from the appropriate authority before the affected activity is initiated.

RECEIVED  
Office of Oil and Gas  
MAR 7 2019  
WV Department of Environmental Protection

Well Operator: Tug Hill Operating, LLC  
 By: Amy L. Miller *Amy Miller*  
 Its: Permitting Specialist - Appalachia Region

WW-6A1 Supplement

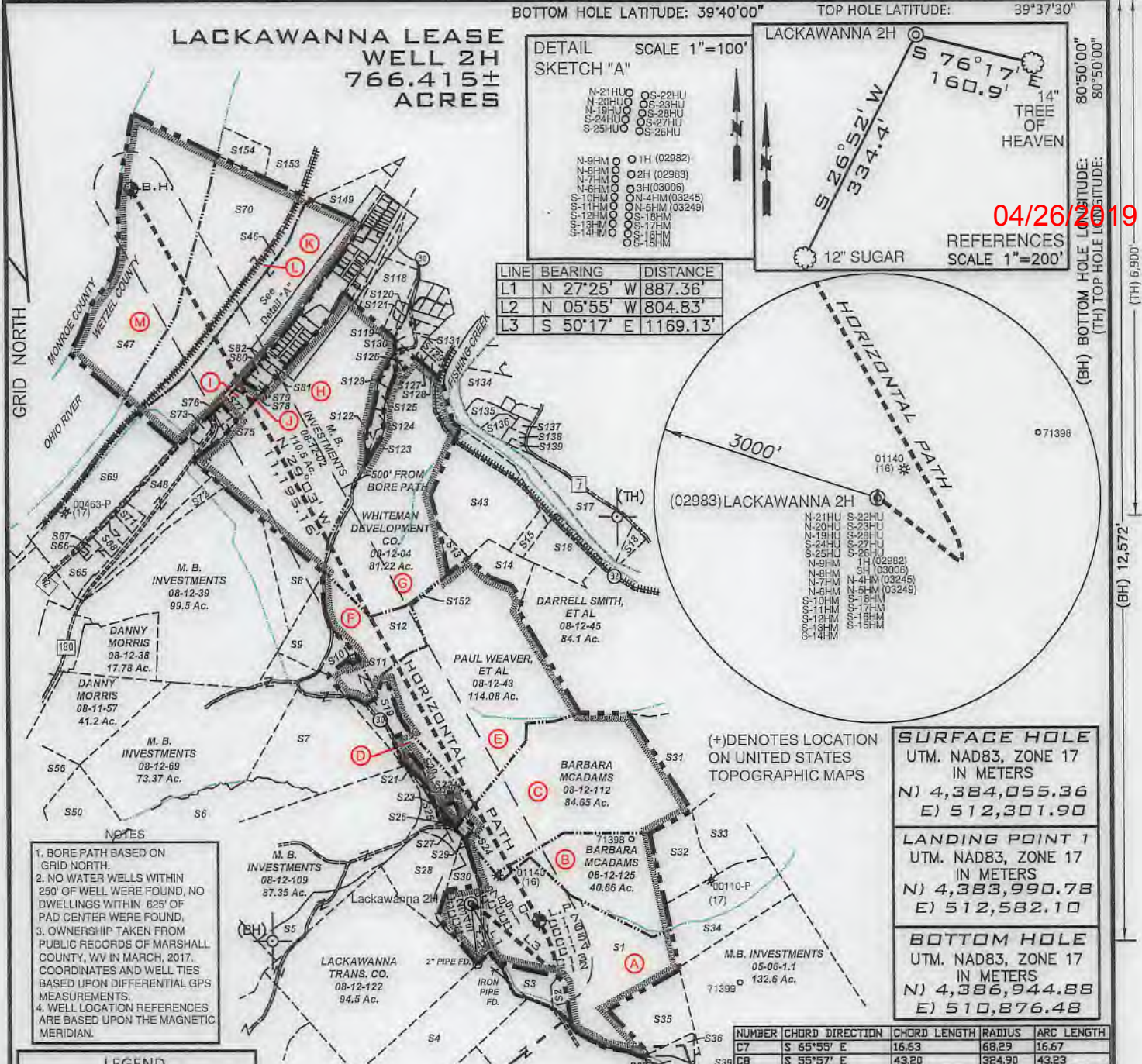
Operator's Well No. Lackawanna - 2H

RECEIVED  
Office of Oil and Gas  
MAR 7 2019  
WV Department of  
Environmental Protection

Lease ID	Parcel	Tags	Grantor, Lessor, Etc.	Grantee, Lessee, Etc.	Royalty	Deed Book/Page		Assignment	Assignment	Assignment
10*47103.061.2	8-12-134	A	M B INVESTMENTS	TH EXPLORATION LLC	1/8+	179A	475	N/A	N/A	N/A
10*16201	8-12-125	B	BARBARA MCADAMS	TH EXPLORATION LLC	1/8+	189A	465	N/A	N/A	N/A
10*16201	8-12-112	C	BARBARA MCADAMS	TH EXPLORATION LLC	1/8+	189A	465	N/A	N/A	N/A
10*47103.061.2	8-12-43.5	D	M B INVESTMENTS	TH EXPLORATION LLC	1/8+	179A	475	N/A	N/A	N/A
10*15191	8-12-43	E	MICHAEL A CORBIN	GASTAR EXPLORATION USA INC	1/8+	127A	392	Gastar Exploration USA Inc to Atinum Marcellus I LLC: 129A/217	Gastar Exploration USA Inc merged into Gastar Exploration Inc: CB13/270	Gastar Exploration Inc to TH Exploration II LLC: 173A/431
10*15192	8-12-43	E	PAUL E WEAVER	GASTAR EXPLORATION USA INC	1/8+	127A	395	Gastar Exploration USA Inc to Atinum Marcellus I LLC: 129A/217	Gastar Exploration USA Inc merged into Gastar Exploration Inc: CB13/270	Gastar Exploration Inc to TH Exploration II LLC: 173A/431
10*15191	8-12-43.1	F	MICHAEL A CORBIN	GASTAR EXPLORATION USA INC	1/8+	127A	392	Gastar Exploration USA Inc to Atinum Marcellus I LLC: 129A/217	Gastar Exploration USA Inc merged into Gastar Exploration Inc: CB13/270	Gastar Exploration Inc to TH Exploration II LLC: 173A/431
10*15192	8-12-43.1	F	PAUL E WEAVER	GASTAR EXPLORATION USA INC	1/8+	127A	395	Gastar Exploration USA Inc to Atinum Marcellus I LLC: 129A/217	Gastar Exploration USA Inc merged into Gastar Exploration Inc: CB13/270	Gastar Exploration Inc to TH Exploration II LLC: 173A/431
10*15242	8-12-4	G	PRN LLC	GASTAR EXPLORATION USA INC	1/8+	129A	576	Gastar Exploration USA Inc to Atinum Marcellus I LLC: 135A/284	Gastar Exploration USA Inc merged into Gastar Exploration Inc: CB13/270	Gastar Exploration Inc to TH Exploration II LLC: 173A/431
10*15243	8-12-4	G	WHITEMAN DEVELOPMENT COMPANY LLC	GASTAR EXPLORATION USA INC	1/8+	128A	931	Gastar Exploration USA Inc to Atinum Marcellus I LLC: 135A/284	Gastar Exploration USA Inc merged into Gastar Exploration Inc: CB13/270	Gastar Exploration Inc to TH Exploration II LLC: 173A/431
10*47103.061.2	8-12-2	H	M B INVESTMENTS	TH EXPLORATION LLC	1/8+	179A	475	N/A	N/A	N/A
10*15188	8-12-2	H	REBECCA E. SULLIVAN	GASTAR EXPLORATION USA INC	1/8+	146A	401	Gastar Exploration USA Inc to Atinum Marcellus I LLC: 150A/11	Gastar Exploration USA Inc merged into Gastar Exploration Inc: CB13/270	Gastar Exploration Inc to TH Exploration II LLC: 173A/431
10*22140	8-12-2	H	PAMELA E WEISENBARGER AND PHILLIP C WEISENBARGER	TH EXPLORATION LLC	1/8+	203A	253	N/A	N/A	N/A
10*18117	8-7-87	I	H. LEE SCOTT, JR	TH EXPLORATION LLC	1/8+	187A	623	N/A	N/A	N/A
10*18449	8-7-87	I	STEPHEN & BETTY DAVIS	TH EXPLORATION LLC	1/8+	190A	181	N/A	N/A	N/A
10*24658	8-7-88	J	LIVING QUARTERS LLC	TH EXPLORATION LLC	1/8+	219A	385	N/A	N/A	N/A
10*24142	8-7-105	K	CSX TRANSPORTATION INC DIRECTOR - CONTRACT MANAGEMENT	TH EXPLORATION LLC	1/8+	220A	809	N/A	N/A	N/A
10*24142	8-7-105	L	CSX TRANSPORTATION INC DIRECTOR - CONTRACT MANAGEMENT	TH EXPLORATION LLC	1/8+	220A	809	N/A	N/A	N/A
PENDING	OHIO RIVER	M	STATE OF WEST VIRGINIA DIVISION OF NATURAL RESOURCES	TH EXPLORATION LLC	1/8+	221a	850	N/A	N/A	N/A



# LACKAWANNA LEASE WELL 2H 766.415± ACRES



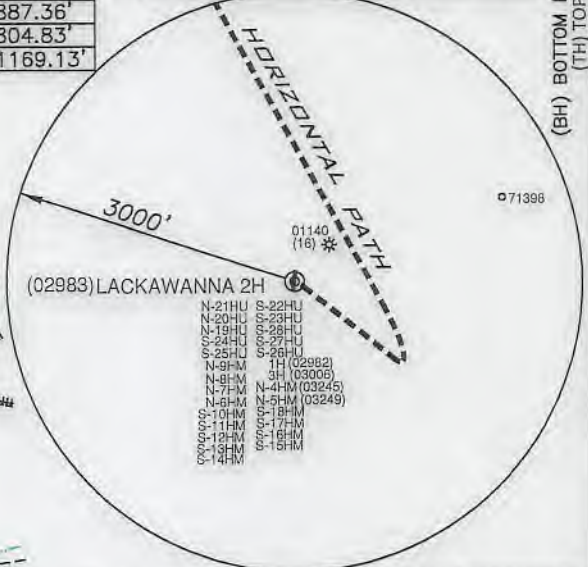
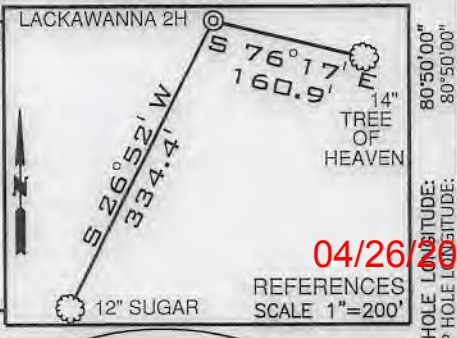
DETAIL SKETCH "A" SCALE 1"=100'

N-21HU	O-22HU
N-20HU	O-23HU
N-19HU	O-24HU
S-24HU	O-27HU
S-25HU	O-26HU

N-9HM	O-1H (02982)
N-9HM	O-2H (02983)
N-7HM	O-3H (03006)
N-10HM	O-4HM (03245)
N-11HM	O-5HM (03249)
N-12HM	O-6HM
N-13HM	O-7HM
N-14HM	O-8HM
N-15HM	O-9HM
N-16HM	O-10HM

LINE	BEARING	DISTANCE
L1	N 27°25' W	887.36'
L2	N 05°55' W	804.83'
L3	S 50°17' E	1169.13'



(+) DENOTES LOCATION ON UNITED STATES TOPOGRAPHIC MAPS

SURFACE HOLE	
UTM. NAD83, ZONE 17 IN METERS	
N)	4,384,055.36
E)	512,301.90
LANDING POINT 1	
UTM. NAD83, ZONE 17 IN METERS	
N)	4,383,990.78
E)	512,582.10
BOTTOM HOLE	
UTM. NAD83, ZONE 17 IN METERS	
N)	4,386,944.88
E)	510,876.48

- NOTES
- BORE PATH BASED ON GRID NORTH.
  - NO WATER WELLS WITHIN 250' OF WELL WERE FOUND, NO DWELLINGS WITHIN 625' OF PAD CENTER WERE FOUND.
  - OWNERSHIP TAKEN FROM PUBLIC RECORDS OF MARSHALL COUNTY, WV IN MARCH, 2017. COORDINATES AND WELL TIES BASED UPON DIFFERENTIAL GPS MEASUREMENTS.
  - WELL LOCATION REFERENCES ARE BASED UPON THE MAGNETIC MERIDIAN.

LEGEND

- LEASED TRACTS
- SURFACE TRACTS
- UNIT BOUNDARY
- (A) LEASE # (SEE 6A1 FORM)

NUMBER	CHORD	DIRECTION	CHORD LENGTH	RADIUS	ARC LENGTH
C1	S 06°33' V		2.82	2.00	3.12
C2	S 55°47' E		5.89	87.19	5.89
C3	S 24°39' V		1.97	0.99	2.82
C4	N 41°37' V		3.60	3.36	3.80
C5	N 11°57' E		8.57	13.15	8.73
C6	N 84°28' E		8.06	8.11	8.44

NUMBER	CHORD	DIRECTION	CHORD LENGTH	RADIUS	ARC LENGTH
C7	S 65°55' E		16.63	68.29	16.67
C8	S 55°57' E		43.20	324.90	43.23
C9	S 51°31' E		57.89	1097.64	57.90
C10	S 54°59' E		56.81	293.19	50.88
C11	S 68°58' E		30.24	99.08	30.36
C12	N 67°59' E		40.22	34.24	42.99
C13	N 18°02' E		26.96	70.36	27.13
C14	N 01°53' E		37.14	182.65	37.20
C15	N 11°28' V		140.55	543.47	140.95
C16	N 21°54' V		296.96	1682.06	297.35
C17	N 27°32' V		148.61	2784.34	148.62

FILE NUMBER \_\_\_\_\_

DRAWING NUMBER LACKAWANNA\_2H\_REV 1

SCALE 1" = 2000'

MINIMUM DEGREE OF ACCURACY 1/200

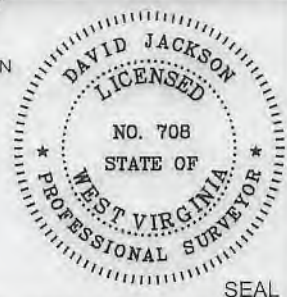
PROVEN SOURCE OF ELEVATION SUBMETER MAPPING GRADE GPS

I, THE UNDERSIGNED, HEREBY CERTIFY THAT THIS PLAT IS CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF AND SHOWS ALL THE INFORMATION REQUIRED BY LAW AND THE RULES ISSUED AND PRESCRIBED BY THE DEPARTMENT OF ENVIRONMENTAL PROTECTION

P.S. 708

*David L Jackson*

JACKSON SURVEYING INC.  
P.O. Box 1460  
Clarksburg, WV 26302  
304-623-5851



WVDEP  
OFFICE OF OIL & GAS  
601 57TH STREET, SE  
CHARLESTON, WV 25304

WELL TYPE: OIL \_\_\_ GAS X LIQUID INJECTION \_\_\_ WASTE DISPOSAL \_\_\_  
(IF "GAS") PRODUCTION X STORAGE \_\_\_ DEEP \_\_\_ SHALLOW X

LOCATION ELEVATION 1306.26' WATERSHED (HUC 10) OUTLET MIDDLE ISLAND CREEK

DISTRICT MAGNOLIA COUNTY WETZEL

QUADRANGLE PORTER FALLS 7.5' LEASE NUMBER \_\_\_\_\_ SEE WW-6A1 Form

SURFACE OWNER M. B. INVESTMENTS ACREAGE 88.09

OIL & GAS ROYALTY OWNER M. B. INVESTMENTS, ET AL LEASE ACREAGE 88.09

PROPOSED WORK: DRILL \_\_\_ CONVERT \_\_\_ DRILL DEEPER \_\_\_ REDRILL \_\_\_ FRACTURE OR STIMULATE X PLUG OFF OLD FORMATION \_\_\_  
PERFORATE NEW FORMATION \_\_\_ OTHER PHYSICAL CHANGE (SPECIFY) \_\_\_\_\_

TARGET FORMATION MARCELLUS ESTIMATED DEPTH TVD 6,910' TMD: 18,693'

WELL OPERATOR TUG HILL OPERATING, LLC DESIGNATED AGENT DIANNA STAMPER CT CORPORATION SYSTEM

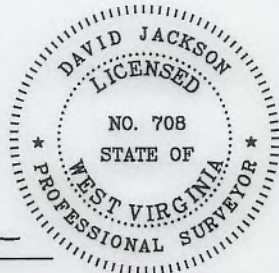
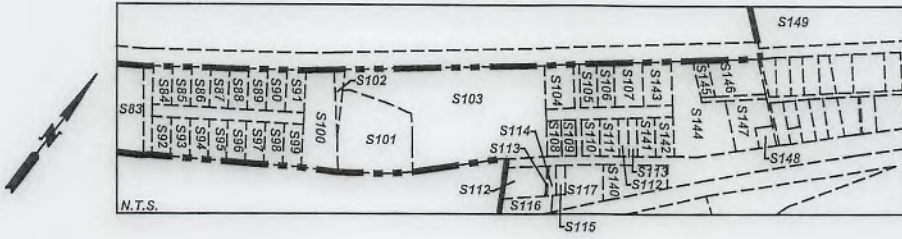
ADDRESS 1320 SOUTH UNIVERSITY DRIVE, SUITE 500 FORT WORTH, TX 76107 ADDRESS 5400 D BIG TYLER ROAD CHARLESTON, WV 25313

COUNTY NAME PERMIT



LACKAWANNA LEASE  
WELL 2H  
766.415± ACRES

04/26/2019



P.S.  
708

*David L Jackson*



**TUG HILL**  
**OPERATING**

OPERATOR'S  
WELL #: LACKAWANNA 2H  
DISTRICT: Magnolia  
COUNTY: Wetzel  
STATE: WV  
API NUMBER: 47-103-02983

WELL PLAT  
PAGE 2 OF 3  
DATE: 08/02/2018  
REVISED DATE:  
02/18/2019



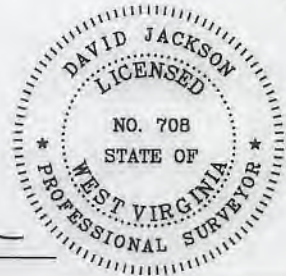
form wwg

**LACKAWANNA LEASE  
WELL 2H  
766.415± ACRES**

Number	TAX MAP-PARCEL	SURFACE OWNER	ACRES
S1	A 08-12-134	M. B. Investments	88.09
S2	08-12-134.1	Raymond L. & Elizabeth Pibble	2.14
S3	08-12-134.3	M. B. Investments	5.55
S4	08-17-04	M. B. Investments	46.75
S5	08-12-109.1	M. B. Investments	10.0019
S6	08-12-108	M. B. Investments	24.0
S7	08-12-70	M. B. Investments	50.37
S8	08-12-14	Thomas & Helena McLaughlin	10.5
S9	08-12-40	Timothy Doty & Helena McLaughlin	8.83
S10	08-12-41	Michael A. & Annabelle Corbin & Paul E. & Christine Weaver	3.39
S11	08-12-42	Shriver Cemetery	1.0
S12	F 08-12-43.1	Michael A. & Annabelle Corbin & Paul E. & Christine Weaver	22.25
S13	08-12-15	Michael A. & Annabelle Corbin & Paul E. & Christine Weaver	2.6
S14	08-12-44	Richard L. Armstrong	8.0
S15	08-12-5.1	Michael & Joyce Durig	4.0
S16	08-12-16	Russell Dalrymple, et al	11.87
S17	08-12-08	Calvin Dean Cross	14.96
S18	08-12-17	Virgie E. Kuhns	1.25
S19	08-12-43.2	Michael A. & Annabelle Corbin & Paul E. & Christine Weaver	7.25
S20	D 08-12-43.5	M. B. Investments	8.774
S21	08-12-43.4	Michael A. & Annabelle Corbin & Paul E. & Christine Weaver	0.996
S22	08-12-43.3	Geraldine C. Cross	0.13
S23	08-12-111	WV Conservation Comm.	1.0
S24	08-12-112.1	M. B. Investments	0.82
S25	08-12-110	Lackawanna Transport Company	3.59
S26	08-12-72	Paul E. & Christine Weaver	0.50
S27	08-12-124	M. B. Investments	2.23
S28	08-12-123	Lackawanna Transport Company	18.55
S29	08-12-134.2	M. B. Investments	0.23
S30	08-12-134.4	M. B. Investments	3.51
S31	08-12-113	Jacob Presley Morgan III	16.30
S32	08-12-126	Jacob Presley Morgan III	16.06
S33	08-12-127	Jacob Presley Morgan III	10.0
S34	08-12-136	Jacob Presley Morgan III	28.25
S35	08-12-135	Timothy J. Haynes & Gary W. Woofter	21.0
S36	02-01-5.2	Mark K. & Teresa J. Loy	2.945
S37	02-01-5.3	Mark K. & Teresa J. Loy	1.939
S38	02-01-5.1	Mark K. & Teresa J. Loy	4.56
S39	05-06-01	Mark K. & Teresa J. Loy	2.37
S40	02-01-05	Daniel A. Witschey	21.5
S41	08-12-121	Charles E. & Mary Elizabeth Clegg	31.94
S42	08-12-129	Charles E. & Mary Elizabeth Clegg	20.0
S43	08-12-05	Michael Lloyd & Joyce Diana Durig	30.5
S44	08-17-07	Lackawanna Transport Company	21.37
S45	08-17-7.1	Lackawanna Transport Company	25.64
S46	L	CSX Railroad	
S47	M Ohio River	State of WV, Department of Commerce, Division of Natural Resources	
S48	Rt 180	State Road Commission	15.96
S49	08-12-106	Thomas C. Pennell	15.96
S50	08-12-106.1	Thomas R. & Tamera D. Pennell	14.04
S56	08-11-61	Hunter B. McAdams & Doug McAdams	7.61
S61	08-11-19	Lisa Straight & Edwin Rial	6.3
S62	08-11-39.1	William L. & Beulah Talkington	1.83
S63	08-11-41	A+A Supply, LLC	1.63
S64	08-11-35	Lisa Straight & Edwin Rial	5.9
S65	08-12-11	Calvin T. Hedrick	6.64
S66	08-12-11.1	Larry D. McCaman	0.25
S67	08-12-11.3	Larry McCaman	0.807
S68	08-12-11.4	Paul Andrew James Simmons, Jr.	1.94
S69	08-12-01	Mount Clare Properties, Inc	50.71
S70	K 08-07-105	Mount Clare Properties, Inc	116.08
S71	08-12-11.2	Ascent Resources Marcellus Minerals, LLC	1.811
S72	08-12-13	M. B. Investments	8.18
S73	08-12-139	Department of Public Safety	1.37
S75	08-07-87.2	H. Lee Scott Jr.	1.110
S76	08-07-87.1	H. Lee Scott Jr.	0.95
S77	I 08-07-87	H. Lee Scott Jr. & Stephen A. & Betty A. Davis	2.221

Number	TAX MAP-PARCEL	SURFACE OWNER	ACRES
S78	J 08-07-88	Living Quarters, LLC	1.08
S79	08-07-89.3	Living Quarters, LLC	0.94
S80	08-07-89.2	Barbara S. Nice	0.89
S81	08-07-89	Barbara S. Nice	0.40
S82	08-07-89.1	Barbara S. Nice	0.40
S83	08-07-90	Barbara Shank	0.70
S84	08-07-91	Dennis Phillips	0.20
S85	08-07-92	Karen D. Pugh	0.20
S86	08-07-93	Darrell S. & Diana Lynn Hartwig	0.20
S87	08-07-94	Ronald D. & Carole Dawson	0.21
S88	08-07-95	Debra Barrile, (Leslie L. Debolt, land contract)	0.21
S89	08-07-96	Rita E. Barrick	0.21
S90	08-07-102	Michael Vaughn Skeen & Patricia Ann Sawyer	0.22
S91	08-07-103.1	Charlotte M. Adams	0.22
S92	08-07-97	David Ray Christian	0.20
S93	08-07-98	David Ray Christian	0.20
S94	08-07-98.1	Lionel Kent, Helen A. Potts & Deloris Potts (Life)	0.20
S95	08-07-99	Lionel Kent, Helen A. Potts & Deloris Potts (Life)	0.20
S96	08-07-100	James J. & Carol Clark	0.21
S97	08-07-101	Doris A. Fannin & Richard S. Williamson	0.21
S98	08-07-102.1	Ronald E. Jr. & Lori J McCoy	0.21
S99	08-07-103	Michael L. & Joyce D. Durig	0.21
S100	08-07-104	Lisa Denise Bridge	0.12
S101	08-07-106.1	Tiona Henthorn	1.49
S102	08-07-104.1	Lisa Denise Bridge	0.06
S103	08-07-106	Route 2 South, LLC	4.33
S104	08-07-107	Route 2 South, LLC	0.36
S105	08-07-108	Donald W. Owens, Jr.	0.21
S106	08-07-109	Douglas E. & Amber L. Straight	0.21
S107	08-07-110	Allen R. & Malinda J. Laugh	0.34
S108	08-07-114	William & Ruth Leek	0.14
S109	08-07-115	William J. Leek	0.14
S110	08-07-116	Betty J. Yoho (Life), Sandra M. Hardman	0.20
S111	08-07-117	Jerry W. & Elizabeth Southerly	0.21
S112	08-07-123.1	William & Ruth Ann Leek	0.23
S113	08-07-123.2	William & Ruth Ann Leek	0.01
S114	08-07-124	William & Ruth Ann Leek	0.08
S115	08-07-125	William & Ruth Ann Leek	0.07
S116	08-07-129	Mary Burton, et al	1.10
S117	08-07-127	William Sherman & Ruth Ann Leek	0.49
S118	08-07-131.3	Nancy J. Todd	9.726
S119	08-07-131.1	Edgar W. Whiteman, Jr.	1.25
S120	08-07-131.4	Nancy J. Todd	0.989
S121			
S122	08-12-03	O. Terrell Coffield Family Trust	0.98
S123	08-12-4.1	Whiteman Development Co., LLC & PRN, LLC	2.59
S124	08-07-142	Pamela E. Weisenbarger	1.35
S125	08-07-142.1	Thomas W, II & Teena B. Emch	1.35
S126	08-07-160	Frank L. Price, Jr.	1.28
S127	08-07-144	Roger Hall, et al	5.58
S128	08-07-143	Dominic D. Yost	1.0
S129	08-07-144.1	Donald J. & Debby J. Powell	2.25
S130	08-07-137	462 Properties, LLC	1.836
S131	08-07-137.1	Anna E. McPeak	0.94
S134	08-07-145	Lois J. Day	8.008
S135	08-07-145.5	Jodi Forni	3.65
S136	08-07-145.3	Jodi Forni	2.641
S137	08-07-145.2	David J. Jackson,(Life), James & Ruth Jackson	0.813
S138	08-12-06	David J. Jackson,(Life), James & Ruth Jackson	1.74
S139	08-12-07	David J. Jackson,(Life), James & Ruth Jackson	0.35
S140	08-07-126	William Sherman & Ruth Ann Leek	0.30
S141	08-07-117.1	Donald L. Larsen, Jr.	0.21
S142	08-07-119	Joshua D. Larsen, Jr.	0.22
S143	08-07-111	Allen R. & Malinda J. Laugh	0.34
S144	08-07-120	William D. Lawrence	1.51
S145	08-07-112	Charles D. & Shirley L. White	0.17
S146	08-07-113	Joe's Tire III, LLC	0.60
S147	08-07-122	Moser & Moser Associates, Inc.	0.50
S148	08-07-121	Moser & Moser Associates, Inc.	0.10
S149	08-07-123	M.B. Investments	8.50
S152	08-12-140	Paul Weaver, et al	0.35
S153	08-12-121	M.B. Investments	28.0
S154	08-12-122	City of Martinsville	6.33

04/26/2019



P.S. 708 *David L Jackson*



**TUG HILL  
OPERATING**

OPERATOR'S  
WELL #: LACKAWANNA 2H  
DISTRICT: Magnolia  
COUNTY: Wetzel  
STATE: WV  
API NUMBER: 47-103-02983

WELL PLAT  
PAGE 3 OF 3  
DATE: 08/02/2018  
REVISED DATE:  
02/18/2019





# **Well Site Safety Plan**

## **Tug Hill Operating, LLC**

Well Name: Lackawanna 2H

Pad Location: Lackawanna Pad  
Wetzel County, West Virginia

UTM (meters), NAD83, Zone 17:

Northing: 4,384,055.36

Easting: 512,301.90

Updated February 2019

*DMH*  
*2-15-19*

## Area of Review

### Sources of information to Support 35CSR8 - 5.11: 9.3 et seq.

Description of process to identify potential pathways for well communication during hydraulic fracturing activities.

#### Data Sources Reviewed:

1. IHS Well Data service: Public nationwide data service that pulls directly from State agency Oil and Gas databases
2. Farm Maps
3. Topo Maps: Recent and older (contact WVGES)
4. Check with DPS

Contacted Devin Ducoeur 724-705-0444, [dducoeur@dpslandservices.com](mailto:dducoeur@dpslandservices.com) DPS GIS (7/27/2018) to have him make maps of the wellbores with his information. DPS utilizes WVGES maps for their mapping seems it as the best publicly available. See attached map he provided.

#### Request maps for:

1. Wellbore with IHS All Wells Layer
2. Map with Farm lines overlain and any well spots identified on Farm Maps
3. More recent (1970s vintage) topos and older topos

#### Discussion with Phil Dinterman WVGES GIS Department (7/15/2016)

- WVGES has plotted every well spot they have access to and are aware of with that contains a coordinate. 30000, 70000, and 90000 series wells are available via the WVGES online map. Some locations aren't great due to vintage and manipulation of maps through time
- 30000 series – any well drilled prior to 1929 – APIs were not assigned to original wells
- 70000 series – Well spots pulled from old Farm line maps that the WVGES has access to
- 90000 series – Any sources that the WVGES has access that shows a well spot but has no additional supporting information. DEP does not have 90000 series on their maps.
- There can be duplication between wells in the 3 series
- Phil indicated that other Operators are providing a screenshot of the WVGES map with their planned well and using that for permits

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Page 1 of 4



Permit well - Lackawanna 2HM

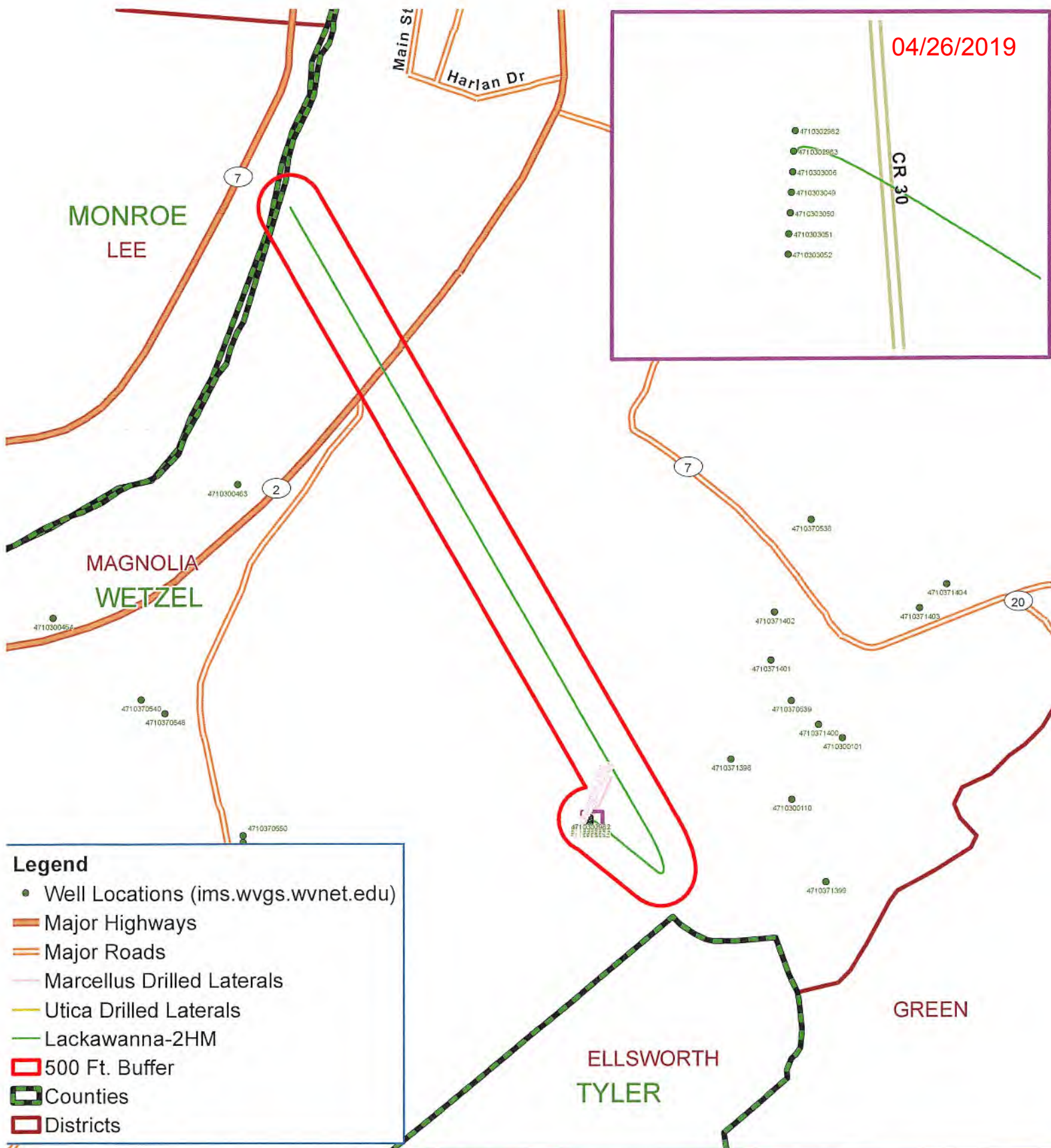
Wells within 500' Buffer

Note: Well spots depicted on Area of Review map (page 3) are derived from State held coordinates. The spots may differ from those depicted on the Well Plat because the Plat locations represent actual field surveyed locations. Please refer to the Plat for surveyed well spots

API Number	Operator Name	Total Depth	Perforated Fms	Producing zones not perforated	Is this well "known or reasonably expected to penetrate a depth that could be within the range of Fracture propagation"? 1000' is max limit I would assign to wells that might be within in range of fracture propagation	Comments
4710302982	Tug Hill Operating	5685' MD 5616' TVD	None	None	Yes, existing Marcellus top hole wellbore. Proper casing and cement should prevent migration of fluids from new wellbore to existing wellbore	This is a shallow top hole wellbore for an undrilled lateral Marcellus well.
4710302983	Tug Hill Operating	5530' MD	None	None	Yes, existing Marcellus top hole wellbore. Proper casing and cement should prevent migration of fluids from new wellbore to existing wellbore	This is a shallow top hole wellbore for an undrilled lateral Marcellus well.
4710303006	Tug Hill Operating	2480' MD	None	None	No, existing shallow top hole well bore. Proper casing and cement should prevent migration of fluids from new wellbore to existing wellbore.	This is a shallow top hole wellbore for an undrilled lateral Utica well
4710303049	Gastar Exploration	n/a	None	None	No	Permit
4710303050	Gastar Exploration	n/a	None	None	No	Permit
4710303051	Gastar Exploration	n/a	None	None	No	Permit
4710303052	Gastar Exploration	n/a	None	None	No	Permit

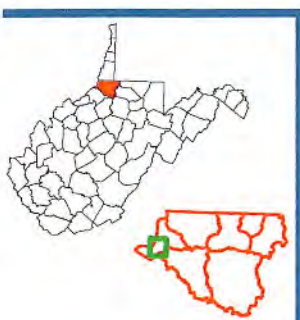
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**Legend**

- Well Locations (ims.wvgs.wvnet.edu)
- Major Highways
- Major Roads
- Marcellus Drilled Laterals
- Utica Drilled Laterals
- Lackawanna-2HM
- 500 Ft. Buffer
- Counties
- Districts



Lackawanna - 2HM  
 Magnolia District  
 Wetzel County, WV



Notes:  
 All locations are approximate and are for visualization purposes only.

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Map Prepared by:  
**PS**  
 LAND SERVICES