

State of West Virginia  
Department of Environmental Protection - Office of Oil and Gas  
Well Operator's Report of Well Work

API 47-051-02331 County Marshall District Mead  
Quad Glen Easton 7.5' Pad Name Keith Stern Field/Pool Name \_\_\_\_\_  
Farm name TH Exploration, LLC Well Number Keith Stern S-11HM

Operator (as registered with the OOG) Tug Hill Operating, LLC  
Address 380 Southpointe Boulevard, Plaza II, Suite 200 City Canonsburg State PA Zip 15317

As Drilled location NAD 83/UTM Attach an as-drilled plat, profile view, and deviation survey  
Top hole Northing 4,402,798.24 Easting 526,363.63  
Landing Point of Curve Northing 4,402,499.9 Easting 526,755.5  
Bottom Hole Northing 4,400,598.6 Easting 527,837.8

Elevation (ft) 741.50' GL Type of Well  New  Existing Type of Report  Interim  Final

Permit Type  Deviated  Horizontal  Horizontal 6A  Vertical Depth Type  Deep  Shallow

Type of Operation  Convert  Deepen  Drill  Plug Back  Redrilling  Rework  Stimulate

Well Type  Brine Disposal  CBM  Gas  Oil  Secondary Recovery  Solution Mining  Storage  Other \_\_\_\_\_

Type of Completion  Single  Multiple Fluids Produced  Brine  Gas  NGL  Oil  Other \_\_\_\_\_

Drilled with  Cable  Rotary

Drilling Media Surface hole  Air  Mud  Fresh Water Intermediate hole  Air  Mud  Fresh Water  Brine  
Production hole  Air  Mud  Fresh Water  Brine

Mud Type(s) and Additive(s)  
SOBM; Base oil, osmotic inhibitor, weighting agent, viscosifier, emulsifier, hardness buffer, fluid loss additive, LCM, Shale inhibitor, de-foamer, soaping agent, coagulant, flocculant; specific additives per WSSP and Permit.

Date permit issued 9/11/2020 Date drilling commenced spud: 10/16/2020 big rig: 8/3/2022 Date drilling ceased 8/15/2022  
Date completion activities began 12/30/2022 Date completion activities ceased 1/14/2023  
Verbal plugging (Y/N) N Date permission granted n/a Granted by n/a

Please note: Operator is required to submit a plugging application within 5 days of verbal permission to plug

Freshwater depth(s) ft 440' Open mine(s) (Y/N) depths N  
Salt water depth(s) ft 933' Void(s) encountered (Y/N) depths \_\_\_\_\_  
Coal depth(s) ft 341-347', 434-440' Cavern(s) encountered (Y/N) depths N  
Is coal being mined in area (Y/N) N



Reviewed by: [Signature]  
12/08/2023

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CASING STRINGS	Hole Size	Casing Size	Depth	New or Used	Grade wt/ft	Basket Depth(s)	Did cement circulate (Y/N) * Provide details below*
Conductor	36"	30"	120'	NEW	94.5#	N/A	Y
Surface	17 1/2"	13 3/8"	537'	NEW	54.5#	N/A	Y
Coal	17 1/2"	13 3/8"	537'	NEW	54.5#	N/A	Y
Intermediate 1	12 1/4"	9 5/8"	2,262'	NEW	36#	N/A	Y
Intermediate 2							
Intermediate 3							
Production	8 3/4"	5 1/2"	13,995'	NEW	20#	N/A	Y
Tubing		2 7/8"	6,998'	NEW	4.7#	N/A	Y
Packer type and depth set							

Comment Details \_\_\_\_\_

CEMENT DATA	Class/Type of Cement	Number of Sacks	Slurry wt (ppg)	Yield (ft <sup>3</sup> /sks)	Volume (ft <sup>3</sup> )	Cement Top (MD)	WOC (hrs)
Conductor	A	65	15.6	1.21	78	0	8
Surface	A	750	15.6	1.2	900	0	8
Coal	A	750	15.6	1.2	900	0	8
Intermediate 1	A	753	15	1.38	1039.14	0	8
Intermediate 2							
Intermediate 3							
Production	A	3265	14.7	1.19	3885.35	0	8
Tubing							

Drillers TD (ft) 14,035' Loggers TD (ft) n/a  
 Deepest formation penetrated Marcellus Plug back to (ft) n/a  
 Plug back procedure n/a

Kick off depth (ft) 5,838'

Check all wireline logs run  caliper  density  deviated/directional  induction  
 neutron  resistivity  gamma ray  temperature  sonic

Well cored  Yes  No Conventional Sidewall Were cuttings collected  Yes  No

DESCRIBE THE CENTRALIZER PLACEMENT USED FOR EACH CASING STRING 3 centralizers on surface casing at equal distance.  
 Intermediate - 1 centralizer every other joint.  
 Production - one centralizer every other joint in lateral, one centralizer every joint through curve, one centralizer every other joint to surface.

WAS WELL COMPLETED AS SHOT HOLE  Yes  No DETAILS \_\_\_\_\_

WAS WELL COMPLETED OPEN HOLE?  Yes  No DETAILS \_\_\_\_\_

WERE TRACERS USED  Yes  No TYPE OF TRACER(S) USED \_\_\_\_\_

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API 47- 051 - 02331 Farm name TH Exploration, LLC Well number Keith Stern S-11HM

PERFORATION RECORD

Stage No.	Perforation date	Perforated from MD ft.	Perforated to MD ft.	Number of Perforations	Formation(s)
	*see attached				

Please insert additional pages as applicable.

STIMULATION INFORMATION PER STAGE

Complete a separate record for each stimulation stage.

Stage No.	Stimulations Date	Ave Pump Rate (BPM)	Ave Treatment Pressure (PSI)	Max Breakdown Pressure (PSI)	ISIP (PSI)	Amount of Proppant (lbs)	Amount of Water (bbls)	Amount of Nitrogen/other (units)
	attached							

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PRODUCING FORMATION(S)	DEPTHS	
MARCELLUS	6,308'-6,451' TVD	6,855'-14,035' MD

Please insert additional pages as applicable.

GAS TEST  Build up  Drawdown  Open Flow OIL TEST  Flow  Pump

SHUT-IN PRESSURE Surface 3737 psi Bottom Hole \_\_\_\_\_ psi DURATION OF TEST 4 hrs

OPEN FLOW Gas 1470 mcfpd Oil 48 bpd NGL 0 bpd Water 480 bpd GAS MEASURED BY  Estimated  Orifice  Pilot

LITHOLOGY/ FORMATION	TOP DEPTH IN FT NAME TVD	BOTTOM DEPTH IN FT TVD	TOP DEPTH IN FT MD	BOTTOM DEPTH IN FT MD	DESCRIBE ROCK TYPE AND RECORD QUANTITY AND TYPE OF FLUID (FRESHWATER, BRINE, OIL, GAS, H <sub>2</sub> S, ETC)
	0		0		
*see attached					

Please insert additional pages as applicable.

Drilling Contractor Nabors Drilling USA  
Address 505 West Greens Road, Suite 1000 City Houston State TX Zip 77067

Logging Company n/a  
Address \_\_\_\_\_ City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Cementing Company Halliburton Energy Services, Inc.  
Address 121 Champion Way, Suite 200 City Canonsburg State PA Zip 15317

Stimulating Company Producers Service Corp.  
Address 109 S. Graham St. City Zanesville State OH Zip 43701

Please insert additional pages as applicable.

Completed by Amy L. Morris Telephone 304-376-0111  
Signature Amy L. Morris Title Permitting Specialist - Appalachia Region Date 5-2-2023

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**KEITH STERN S-11HM  
PEFORATION RECORD**

Stage No.	Perforation Date	Perforated from MD ft.	Perforated to MD. Ft.	Number of Perforations	Formation(s)
1	13/30/2022	12,969	13,015	30	MARCELLUS
2	12/31/2022	12,768	12,914	30	MARCELLUS
3	12/31/2022	12,593	12,739	30	MARCELLUS
4	12/31/2022	12,417	12,563	30	MARCELLUS
5	1/1/2023	12,242	12,387	30	MARCELLUS
6	1/1/2023	12,067	12,211	30	MARCELLUS
7	1/1/2023	11,891	12,035	30	MARCELLUS
8	1/2/2023	11,716	11,859	30	MARCELLUS
9	1/2/2023	11,540	11,683	30	MARCELLUS
10	1/2/2023	11,365	11,507	30	MARCELLUS
11	1/4/2023	11,190	11,331	30	MARCELLUS
12	1/4/2023	11,014	11,155	30	MARCELLUS
13	1/4/2023	10,838	10,979	30	MARCELLUS
14	1/5/2023	10,662	10,803	30	MARCELLUS
15	1/5/2023	10,486	10,627	30	MARCELLUS
16	1/6/2023	10,310	10,451	30	MARCELLUS
17	1/6/2023	10,134	10,275	30	MARCELLUS
18	1/6/2023	9,958	10,099	30	MARCELLUS
19	1/6/2023	9,782	9,923	30	MARCELLUS
20	1/7/2023	9,606	9,747	30	MARCELLUS
21	1/7/2023	9,430	9,571	30	MARCELLUS
22	1/7/2023	9,254	9,395	30	MARCELLUS
23	1/8/2023	9,078	9,219	30	MARCELLUS
24	1/8/2023	8,902	9,043	30	MARCELLUS
25	1/8/2023	8,726	8,867	30	MARCELLUS
26	1/8/2023	8,550	8,691	30	MARCELLUS
27	1/9/2023	8,374	8,515	30	MARCELLUS
28	1/9/2023	8,198	8,339	30	MARCELLUS
29	1/9/2023	8,022	8,163	30	MARCELLUS
30	1/10/2023	7,846	7,987	30	MARCELLUS
31	1/10/2023	7,670	7,811	30	MARCELLUS
32	1/10/2023	7,494	7,635	30	MARCELLUS
33	1/10/2023	7,318	7,459	30	MARCELLUS
34	1/11/2023	7,142	7,283	30	MARCELLUS
35	1/11/2023	6,966	7,107	30	MARCELLUS
36	1/12/2023	6,790	6,931	30	MARCELLUS
37	1/12/2023	6,614	6,755	30	MARCELLUS
38	1/12/2023	6,438	6,579	30	MARCELLUS
39	1/13/2023	6,262	6,403	30	MARCELLUS
40	1/14/2023	6,086	6,227	30	MARCELLUS
41	1/14/2023	5,910	6,051	30	MARCELLUS

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STIMULATION INFORMATION PER STAGE**

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Stage No.	Ave. Pump Rate (BPM)	Ave Treatment Pressure (PSI)	Max Breakdown Pressure (PSI)	ISIP (PSI)	Amount of Proppant (lbs)	Amount of Water (bbls)	Amount of Nitrogen/other (units)
1	85.00	7786	6854	3711	250200	6,966	0
2	86.00	7529	5426	4730	438980	8,931	0
3	87.00	7975	5679	5182	440520	7,657	0
4	88.00	7473	5510	5157	442800	7,822	0
5	89.00	7175	5460	5173	441800	7,594	0
6	89.00	6832	5371	5166	444700	7,979	0
7	91.00	7449	5549	5178	435880	7,434	0
8	90.00	6828	5303	5240	448100	8,095	0
9	89.00	6772	5223	5319	440040	8,078	0
10	88.00	6801	5517	5130	447300	7,712	0
11	89.00	7071	5529	5134	446480	8,082	0
12	88.00	6760	5143	5056	444600	7,949	0
13	90.00	6787	5416	5225	440101	7,712	0
14	90.00	6918	5332	5284	440040	7,781	0
15	89.00	6951	5800	5299	441380	7,849	0
16	88.00	6689	5475	5390	442500	8,367	0
17	89.00	6805	5279	5329	442360	8,199	0
18	90.00	6769	5329	5222	447260	8,348	0
19	89.00	6823	5406	5183	445900	8,200	0
20	87.00	6702	5448	5339	448100	9,125	0
21	88.00	6777	5506	8532	441540	7,752	0
22	89.00	6666	5639	5381	444410	7,576	0
23	90.00	6585	5499	5394	446500	7,681	0
24	90.00	6465	5322	5246	444920	7,683	0
25	75.00	6318	5367	5473	444840	8,872	0
26	90.00	6588	5394	5364	442300	7,994	0
27	87.00	6376	5482	5473	441300	8,069	0
28	90.00	6587	5446	5258	443680	7,680	0
29	89.00	6584	5318	5474	446040	7,660	0
30	90.00	6628	5249	5147	446700	7,563	0
31	90.00	6769	5471	5092	444620	7,571	0
32	90.00	6578	5574	5166	442020	8,190	0

Stage No.	Ave. Pump Rate (BPM)	Ave Treatment Pressure (PSI)	Max Breakdown Pressure (PSI)	ISIP (PSI)	Amount of Proppant (lbs)	Amount of Water (bbls)	Amount of Nitrogen/other (units)
33	89.00	6607	5418	5305	446300	8,075	0
34	90.10	6468	5575	5247	442880	8,106	0
35	89.00	6393	5720	5250	444380	7,913	0
36	89.60	6340	5574	5392	443870	8,054	0
37	90.00	6388	5388	4887	445300	8,155	0
38	90.00	6410	5286	5074	445420	7,640	0
39	89.00	6452	5393	4849	447640	8,102	0
40	89.00	6253	5411	5072	443900	7,848	0
41	90.00	6387	5846	5486	440840	8,648	0

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LITHOLOGY/FORMATION	TOP DEPTH IN FT/ Name TVD	BOTTOM DEPTH IN FT TVD	TOP DEPTH IN FT MD	BOTTOM DEPTH IN FT MD	DESCRIBE ROCK TYPE AND RECORD QUANTITY AND TYPE OF FLUID
Maxton	1537	1711	1537	1712	Sandstone
Big Lime	1711	1777	1712	1778	Limestone
Big Injun	1777	1995	1778	1997	Sandstone
Weir	1995	2198	1997	2200	Sandstone
Berea	2198	2461	2200	2464	Sandstone
Gordon	2461	2541	2464	2544	Sandstone
Fifty Foot	2541	3123	2544	3129	Sandstone
Speechley	3123	4604	3129	4659	Sandstone
Benson	4604	4979	4659	5068	Sandstone
Alexander	4979	5607	5068	5752	Siltstone
Rhinestreet	5607	6060	5752	6265	Black Shale
Middlesex	6060	6133	6265	6369	Black Shale
Geneseo/Burkett	6133	6167	6369	6421	Black Shale
Tully	6167	6193	6421	6465	Limestone
Hamilton	6193	6282	6465	6680	Gray Shale
Marcellus	6282	-	6680	-	Black Shale

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# Hydraulic Fracturing Fluid Product Component Information Disclosure

Job Start Date:	12/30/2022
Job End Date:	1/14/2023
State:	West Virginia
County:	Marshall
API Number:	47-051-02041-00-00
Operator Name:	Tug Hill Operating, LLC
Well Name and Number:	Keith Stern S-11HM
Latitude:	39.77472000
Longitude:	-80.69216000
Datum:	NAD27
Federal Well:	NO
Indian Well:	NO
True Vertical Depth:	6,256
Total Base Water Volume (gal):	14,422,128
Total Base Non Water Volume:	0



## Hydraulic Fracturing Fluid Composition:

Trade Name	Supplier	Purpose	Ingredients	Chemical Abstract Service Number (CAS #)	Maximum Ingredient Concentration in Additive (% by mass)**	Maximum Ingredient Concentration in HF Fluid (% by mass)**	Comments
Water	Tug Hill Operating	Carrier/Base Fluid	Water	7732-18-5	100.00000	87.77180	None
Sand (Proppant)	Tug Hill Operating	Proppant	Silica Substrate	14808-60-7	100.00000	11.88460	None
Hydrochloric Acid (7.5%)	Producers Service Corp.	Acidizing	Water	7732-18-5	85.00000	0.21880	None
			Hydrochloric Acid (Hydrogen Chloride)	7647-01-0	37.00000	0.09524	None
StimStream FR 9800	Chemstream	Friction Reducer	Butene, homopolymer	9003-29-6	25.00000	0.01930	None
			Alkanes, C16-20-iso-	90622-59-6	25.00000	0.01930	None
			Ethoxylated alcohols (C12-18)	68213-23-0	3.00000	0.00232	None
LD-750W	Multi-Chem	Scale Inhibitor	Methanol	67-56-1	60.00000	0.00508	None
			Phosphonic Acid Salt	Proprietary	5.00000	0.00042	None
4-N-1	Producers Service Corp.	Corrosion Inhibitor	Acetic acid	64-19-7	90.00000	0.00046	None

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			Methanol	67-56-1	10.00000	0.00005	None
			2-Ethylhexanol	104-76-7	10.00000	0.00005	None
			Cocamide Diethanolamine	68603-42-9	5.00000	0.00003	None
			Diethanolamine	111-42-2	1.00000	0.00001	None
Ingredients shown above are subject to 29 CFR 1910.1200(i) and appear on Material Safety Data Sheets (MSDS). Ingredients shown below are Non-MSDS.							
Other Chemical(s)	Listed Above	See Trade Name(s) List					
			Hydrochloric Acid (Hydrogen Chloride)	7647-01-0	37.00000	0.09524	
			Alkanes, C16-20-iso-	90622-59-6	25.00000	0.01930	
			Ethoxylated alcohols (C12-18)	68213-23-0	3.00000	0.00232	
			Phosphonic Acid Salt	Proprietary	5.00000	0.00042	
			Methanol	67-56-1	10.00000	0.00005	
			2-Ethylhexanol	104-76-7	10.00000	0.00005	
			Cocamide Diethanolamine	68603-42-9	5.00000	0.00003	
			Diethanolamine	111-42-2	1.00000	0.00001	

\* Total Water Volume sources may include fresh water, produced water, and/or recycled water

\*\* Information is based on the maximum potential for concentration and thus the total may be over 100%

Note: For Field Development Products (products that begin with FDP), MSDS level only information has been provided.

Ingredient information for chemicals subject to 29 CFR 1910.1200(i) and Appendix D are obtained from suppliers Material Safety Data Sheets (MSDS)

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