



Haagse Aardwarmte



Leyweg



SODM FINAL REPORT HAG GT-02 & HAG GT-01



Haagse Aardwarmte Leyweg

Prepared by:	Well Engineering Partners Toldijk 17-19 7900 AP Hoogeveen (NL) Tel: +31 (0)528 227710 www.wellengineering.nl
Author:	LdV/WV
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 	End of Well Report HAG-GT-01 & HAG-GT-02	
	Revision No.	1.0
	Operator:	Hydreco Geomec

Contents

1. General Project data.....	3
1.1 Project management.....	3
1.2 Basic Well Data HAG GT-01.....	3
1.3 Basic Well Data HAG GT-02.....	4
2. Well Summary.....	4
2.1 Directional plots.....	4
2.2 Technical Summary.....	8
2.3 Summary of Operations.....	8
2.4 Well Diagram.....	9
3. Drilling Fluid Type.....	11
4. Geology.....	12
5. Wellhead after Operations.....	12
5.1 HAG GT-01 Wellhead.....	12
5.2 HAG GT-02 Wellhead after operations.....	13
6. Signing.....	13

 	End of Well Report HAG-GT-01 & HAG-GT-02	
	Revision No.	1.0
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1. General Project data

1.1 Project management



Title	Name	Company	Period from	Period to
Operator Project Manager	Ad Raaijmakers	Hydreco Geomec	09-02-2018	24-03-2018
Operator Engineer	Axel Sandén	Hydreco Geomec	09-02-2018	24-03-2018
HSE Manager	Peter van den Burg	Ben Advies	09-02-2018	24-03-2018
WEP Operations Manager	Alexander Nagelhout	Well Engineering Partners	09-02-2018	24-03-2018
WEP Project Managers	Maarten Middelburg Wouter Vink	Well Engineering Partners	09-02-2018	24-03-2018
WEP Sr Eng. / Specialist	Wouter Botermans	Well Engineering Partners	09-02-2018	24-03-2018
Workover Engineer	Bas Kaldenbach	Well Engineering Partners	09-02-2018	24-03-2018

Title	Name	Company	Period from	To
Wellsite Supervisor	S. Kaldenbach	Well Engineering Partners	09-02-2018 13-03-2018	20-02-2018 24-03-2018
Wellsite Supervisor Night Supervisor	W. Boeijen	Well Engineering Partners	20-02-2018 14-03-2018	23-02-2018 20-03-2018
Wellsite Supervisor	S. Viersen	Well Engineering Partners	24-02-2018	25-02-2018
Night Wellsite Supervisor	B. Timmer	Well Engineering Partners	12-02-2018	25-02-2018

1.2 Basic Well Data HAG GT-01

Well name	DEN HAAG -GT-01	
Type of well	Geothermal production well	
Operator	Haagse Aardwarmte Leyweg B.V.	
Exploration License	Den Haag	
Surface Location: Near leyweg (between Zuidwoldestraat & Florence Nightingaleweg)	Latitude & Longitude	Geographical
	N: 52° 3' 19,6" E: 4 ° 16' 3,5"	X: 78.210,95m Y: 452.500,55m
Grid Coordinate System	Rijksdriehoeksmeting (RD) / Netherlands New	
Primary objective	Coiled tubing cleanout and stimulation	
Start of operation	13/03/2018 12:00	
End of operation	24/03/2018 17:30	
Days operational*	12	
Coiled Tubing Contractor	Halliburton	

* Includes demobilization of coiled tubing unit

 	End of Well Report HAG-GT-01 & HAG-GT-02	
	Revision No.	1.0
	Operator:	Hydreco Geomec

1.3 Basic Well Data HAG GT-02

Well name	DEN HAAG-GT-02	
Type of well	Geothermal injection well	
Operator	Haagse Aardwarmte Leyweg B.V.	
Exploration License	Den Haag	
Surface Location Near leyweg (between Zuidwoldestraat & Florence Nightingaleweg)	Latitude & Longitude	Geographical
	N: 52° 3' 19,7"	X: 78.215,39m
	E: 4 ° 16' 3,2"	Y: 452.494,28m
Grid Coordinate System	Rijksdriehoeksmeting (RD) / Netherlands New	
Primary objective	Coiled tubing cleanout and stimulation	
Start of operation	09/02/2018 07:00 hr	
End of operation	25/02/2018 12:00 hr	
Days operational*	17	
Coiled Tubing Contractor	Halliburton	

* Includes mobilization of coiled tubing unit

2. Well Summary

2.1 Directional plots

The following section describes the well paths for HAG-GT-01 and HAG GT-02.

2.1.1 HAG GT-01 well trajectory

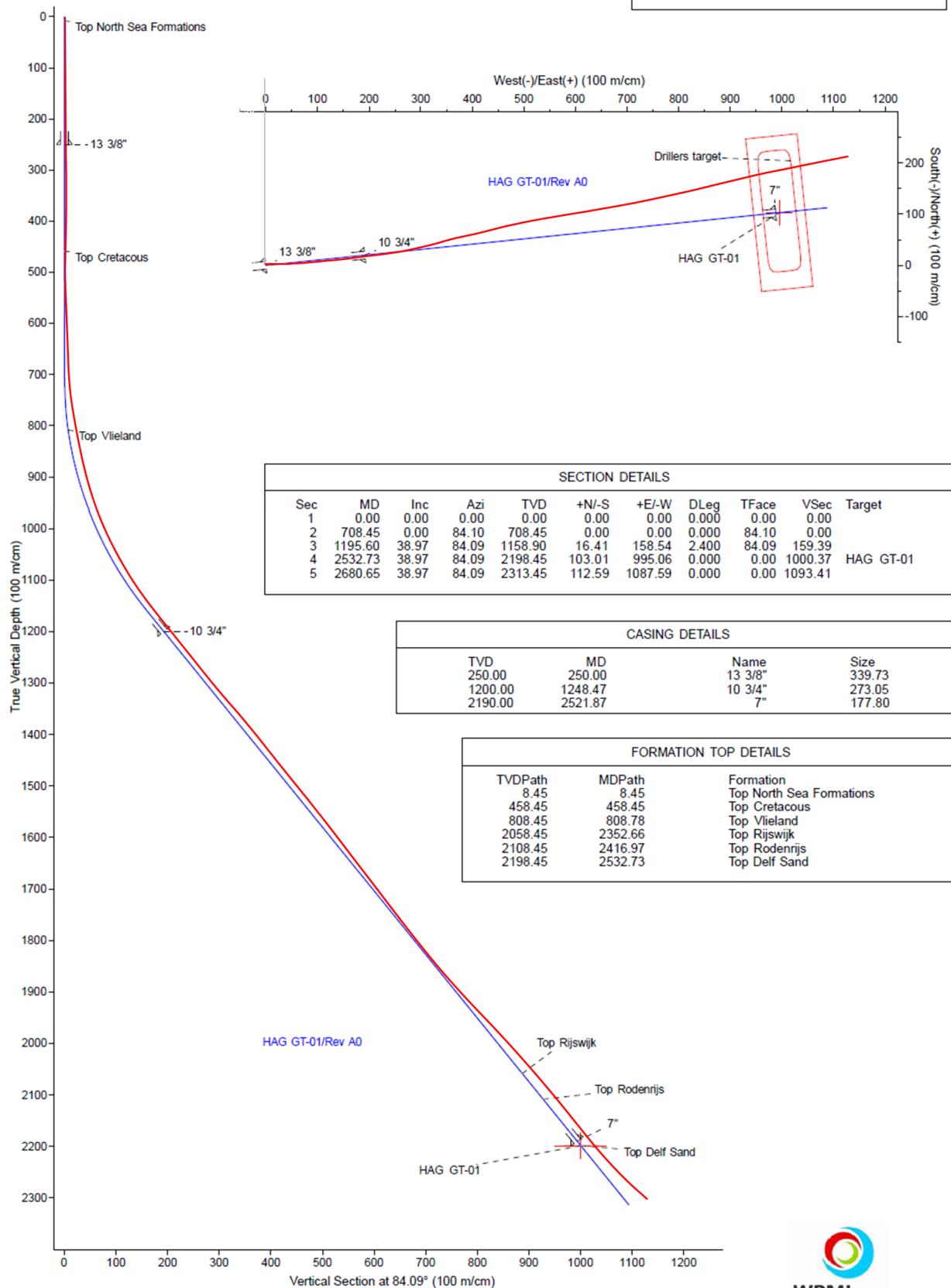
Elevation – depth referenced to tie-down bolts	Tied-down bolts → Ground level	1,42m
	Ground level → NAP	0,23m
	Kelly bushing (RKB) → NAP	8,47m
	RKB → Ground level	8,24m
Total Depth	2702 m AHD (RKB)	2306m TVD (RKB)
Deviation	Kick-off-point (KOP)	700m AHD (RKB)
	Max. DLS	3,82°/30m
	End-of-build (EOB)	1473m
	Max. Inclination	49,34° @ 2694m





HALLIBURTON

Sperry Drilling
Chart Title

Project: The Hague Geothermal
Site: The Hague
Well: HAG GT-01
Wellbore: HAG GT-01
Design: Rev A0



 	End of Well Report HAG-GT-01 & HAG-GT-02	
	Revision No.	1.0
	Operator:	Hydreco Geomec

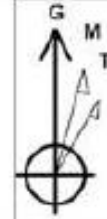
2.1.2 HAG GT-02 Well trajectory

Elevation – depth referenced to tie-down bolts	Tied-down bolts → Ground level	1,42m
	Ground level → NAP	0,23m
	Kelly bushing (RKB) → NAP	8,49m
	RKB → Ground level	8,26m
Total Depth	2330 m AHD (RKB)	1891,6m TVD (RKB)
Deviation	Kick-off-point (KOP)	1136m AHD (RKB)
	Max. DLS	3,59°/30m
	End-of-build (EOB)	1774m
	Max. Inclination	49,6° @ 1852m



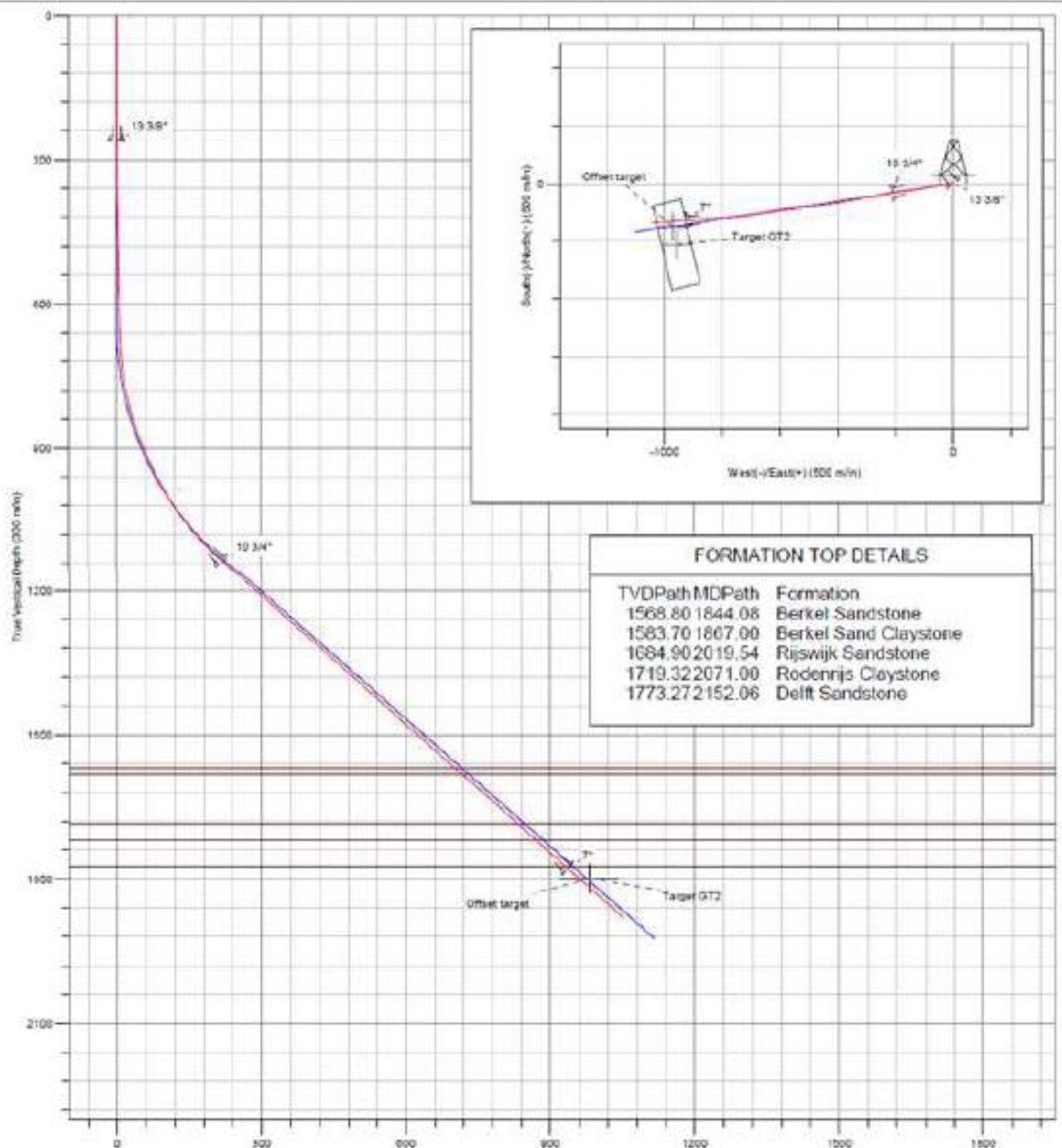
Scientific Drilling
Continental Europe

Project: Aardwarmte den Haag
Site: HAG-GT
Well: HAG-GT-02
Wellbore: HAG-GT-02
Design: HAG-GT-02



Azimuths to Grid North
True North: 0.89°
Magnetic North: 0.76°

Magnetic Field
Strength: 48881.0nT
Dip Angle: 67.07°
Date: 09/27/2010
Model: IGRF2010



FORMATION TOP DETAILS

TVDP	MD	Path	Formation
1568.80	1844.08		Berkel Sandstone
1583.70	1867.00		Berkel Sand Claystone
1684.90	2019.54		Rijswijk Sandstone
1719.32	2071.00		Rodenrijs Claystone
1773.27	2152.06		Delft Sandstone

REFERENCE INFORMATION

Coordinate (NE) Reference: Well HAG-GT-02, Grid North
Vertical (TVD) Reference: RKB @ 8.26m (No Limit D1)
Section (YS) Reference: Slope: -0.00H, 0.00E
Measured Depth Reference: RKB @ 8.26m (No Limit D1)
Calculation Method: Minimum Curvature

SECTION DETAILS

Sec	MD	Inc	Azi	TVD	+N-S	+E-W	Dleg	TFace	VSec	Target
1	0.00	8.00	0.00	6.60	0.00	0.00	0.000	0.00	0.90	
2	660.00	8.00	0.00	666.60	0.00	0.00	0.000	0.00	0.90	
3	1189.27	48.53	261.32	1127.05	-32.45	-212.51	2.760	261.32	215.87	
4	2215.39	48.53	341.32	1806.52	-148.45	-472.73	0.000	0.00	683.96	Target GT2
5	2391.69	48.53	261.32	1623.26	-168.30	-1103.32	0.000	0.00	1115.10	

2.2 Technical Summary

2.2.1 Casing

The following tables summarize the casing scheme for wells HAG-GT-01 and HAG-GT-02

HAG-GT-01 casing scheme

Item	Top MD (m)	Bottom AHD (m)	Weight (ppf)	Grade	Connection
13-3/8"	0	252	54,5	K55	
10-3/4"	0	1238,3	45,5	P110	VAMTOP
7"	1110	2457,8	23	K55	VAGT
4-1/2"	2421,5	2680,3	13,5	L80	VAGT

HAG-GT-02 casing scheme

Item	Top MD (m)	Bottom AHD (m)	Weight (ppf)	Grade	Connection
13-3/8"	0	250	54,5	K55	
10-3/4"	0	1188	45,5	P110	VAMTOP
7"	1086	2152	23	K55	VAGT
4-1/2"	2107	2316,3	13,5	L80	VAGT

2.2.2 Cement

No cementing operations were performed during this project.

2.3 Summary of Operations

2.3.1 Operations Summary

The main objectives of the planned operations were:

HAG-GT-01 (producer):



1. Cleanout near wellbore and screens from debris/substances
2. Stimulate the near-wellbore reservoir matrix
3. Produce out spent stimulation fluids
4. Carry out production test to assess the inflow performance after stimulation

HAG-GT-02 (injector):

1. Cleanout near wellbore and screens from debris/substances
2. Stimulate the near-wellbore reservoir matrix
3. Produce back spent stimulation fluids
4. Carry out production test to assess the inflow performance after stimulation

The operations were performed using a coiled tubing unit and welltest equipment supplied by Halliburton.

Planned (ref. Work Program Coiled Tubing operations HAG GT-01 & HAG GT-02)	Actual (ref. HAG GT-01-02 CT Cleanout EOWR v1.0)
<ol style="list-style-type: none"> 1. Pre-mobilization operations 2. Mobilize and rig up Halliburton coiled tubing and well test equipment on HAG GT-02 3. Underbalanced wash-out HAG GT-02 4. Overbalanced stimulation of formation HAG GT-02 	<ol style="list-style-type: none"> 1. Pre-mobilization operations 2. Mobilize and rig up Halliburton coiled tubing and well test equipment on HAG GT-02 3. Balanced / slight overbalanced wash-out HAG GT-02



 		End of Well Report HAG-GT-01 & HAG-GT-02	
		Revision No.	1.0
		Operator:	Hydreco Geomec
<ol style="list-style-type: none"> 5. Production test HAG GT-02, produce 3000m³ 6. Rig down coiled tubing from HAG GT-02 7. Stop coil operations and water treatment and disposal 8. Rig up coiled tubing on well HAG GT-01 9. Underbalanced wash-out HAG GT-01 10. Overbalanced stimulation of formation HAG GT-01 11. Production test HAG GT-01, produce 3000m³ 12. Rig down and demobilize coiled tubing and well test equipment. 		<ol style="list-style-type: none"> 4. Overbalanced stimulation of formation HAG GT-02 5. Production test HAG GT-02 (injector), produced 1205m³ 6. Stop coil operations and water treatment and disposal 7. Rig up coiled tubing on well HAG GT-01 8. Underbalanced wash-out HAG GT-01 9. Overbalanced stimulation of formation HAG GT-01 10. Production test HAG GT-01, produced 1517m³ 11. Rig down and demobilize coiled tubing and well test equipment 	

The clean up and stimulation had a positive result on the performance of both wells. Due to technical issues and positive feedback on the production tests were stopped earlier than planned (less volume produced).

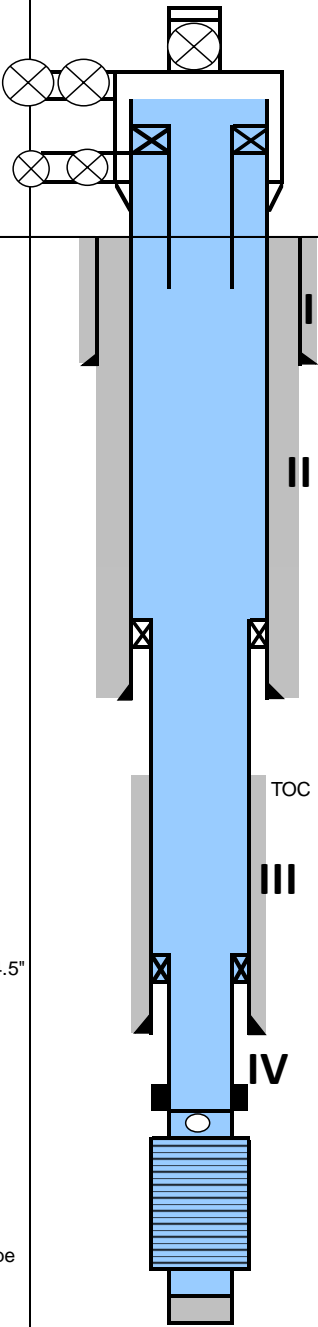
With the clean out and stimulation higher levels of H₂S were seen than anticipate, use of a scavenger and scrubber aided in operations to work with the higher levels. Also the volumes of spent acid were a lot higher: 8-10 times the volume acid pumped.



2.4 Well Diagram

The workover operations did not result in any changes in the well configurations. The following sections show the well configurations of both HAG GT-01 and HAG GT-02.

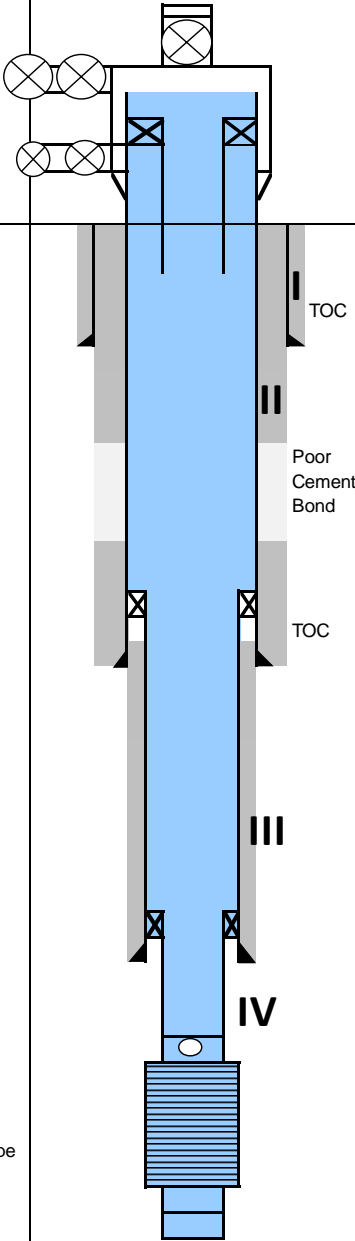
 	End of Well Report HAG-GT-01 & HAG-GT-02	
	Revision No.	1.0
	Operator:	Hydreco Geomec

2.4.1 HAG GT-01 Schematic

Item Description	HAG-GT-01	Depth	Depth	Hole ID	Pipe OD	Collar OD	Pipe ID	Pipe ID
		m tvd	m ah	in	in	in	in	in Drift
Depth reference: Tie Down Bolts 7 1/16" 3K gate valve + blind flange 2x 7 1/16" 3K gate valves 2x 4 1/16" 3K gate valves		13 5/8" 3K slip on Cameron wellhead Hanger thread: 7" LTC box - box RKB-TDB=9.6m ; RKB-NAP = 8.47m						
7" 23# K55 VAGT		~10	~10	n/a	7.000	7.681	6.366	6.241
13 3/8" K55 conductor			252		13.375			
Top liner		1078	1110					
10 3/4 45.5# P110 VAMTOP		1180	1238.3	14.000	10.750	11.400	9.950	9.794
	TOC		1543.3					
WWS Top 4.5"		2095	2421.5					
7" 23# K55 VAGT		2120	2457.8	8.5	7.000	7.681	6.366	6.241
4.5 13.5# L80 blanks					4.500		3.920	3.795
Swellable packer		2202	2537.3					
Port collar		2183	2538.3		4.500			
Screens 5" on 4.5" 13.5# L80 base pipe		2290	2663.3		5.000			
4.5 13.5# L80 blank		2275	2673.3		4.500		3.920	3.795
Motor + bit 5 7/8		2280	2680.3		4.750			

 	End of Well Report HAG-GT-01 & HAG-GT-02		
	Revision No.	1.0	
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2.4.2 HAG GT-02 Schematic before operations

Item Description	HAG-GT-02	Depth	Depth	Hole ID	Pipe OD	Collar OD	Pipe ID	Pipe ID
		m tvd	m ah	in	in	in	in	in Drift
Depth reference: Tie Down Bolts 7 1/16" 3K gate valve + blind flange 2x 7 1/16" 3K gate valves 2x 4 1/16" 3K gate valves		13 5/8" 3K slip on Cameron wellhead Hanger thread: 7" LTC box - box RKB-TDB=9.66m ; RKB-NAP = 8.49m !!! BPV thread was machined off!! MIN ID hanger = 6,377"						
7" 23# K55 VAGT		~10	~10	n/a	7.000	7.681	6.366	6.241
13 3/8" K55 conductor	TOC	241	250		13.375			
	Poor Cement Bond	500	500					
			810					
Top 7" liner	TOC	1054	1086					
10 3/4 45.5# P110 VAMTOP		1127	1188	14.000	10.750	11.400	9.950	9.794
	III							
Top 4.5" liner		1740	2107					
7" 23# K55 VAGT	IV	1770	2152	8.5	7.000	7.681	6.366	6.241
4.5 13.5# L80 blanks					4.500		3.920	3.795
Swellable packer								
Port collar		1772.1	2155.32		4.500			
Top screens		1772.7	2156.32					
Screens 5" on 4.5" 13.5# L80 base pipe								
Bottom screens		1870	2304.32		5.000			
4.5 13.5# L80 blank		1878	2315.8		4.500		3.920	3.795
Shoe		1878	2316.32					

3. Drilling Fluid Type

No drilling operations were performed during this project.

4. Geology

Operations were performed within existing well. No lithological data was gathered during operations.

Production and build up tests were performed on both wells after acid stimulation.

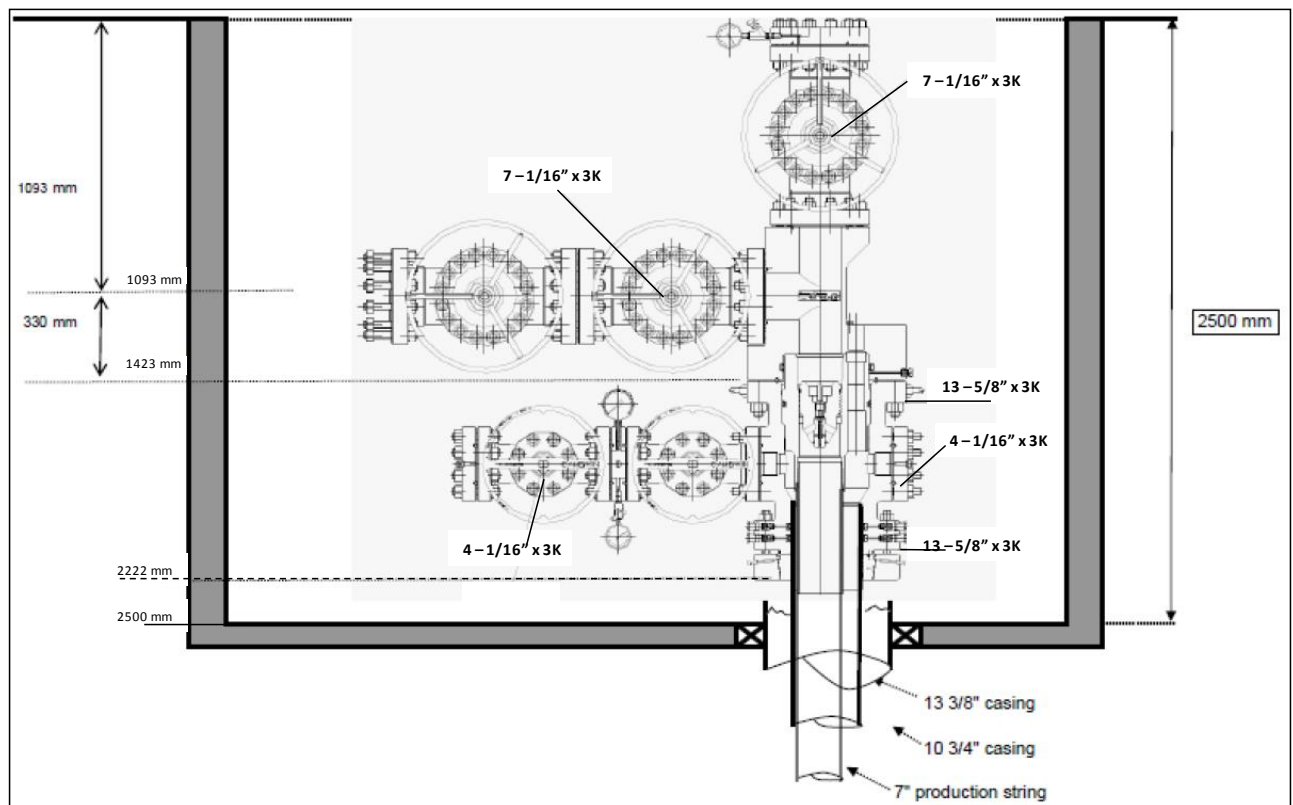
Well	Maximum flowrate	Total volume produced	Build-up time
HAG GT-01	~100m ³ /hr	2079m ³	12hrs
HAG GT-02	~100m ³ /hr	2207m ³	12hrs

Interpretation of welltest and downhole memory data performed by Hydreco and considered confidential.

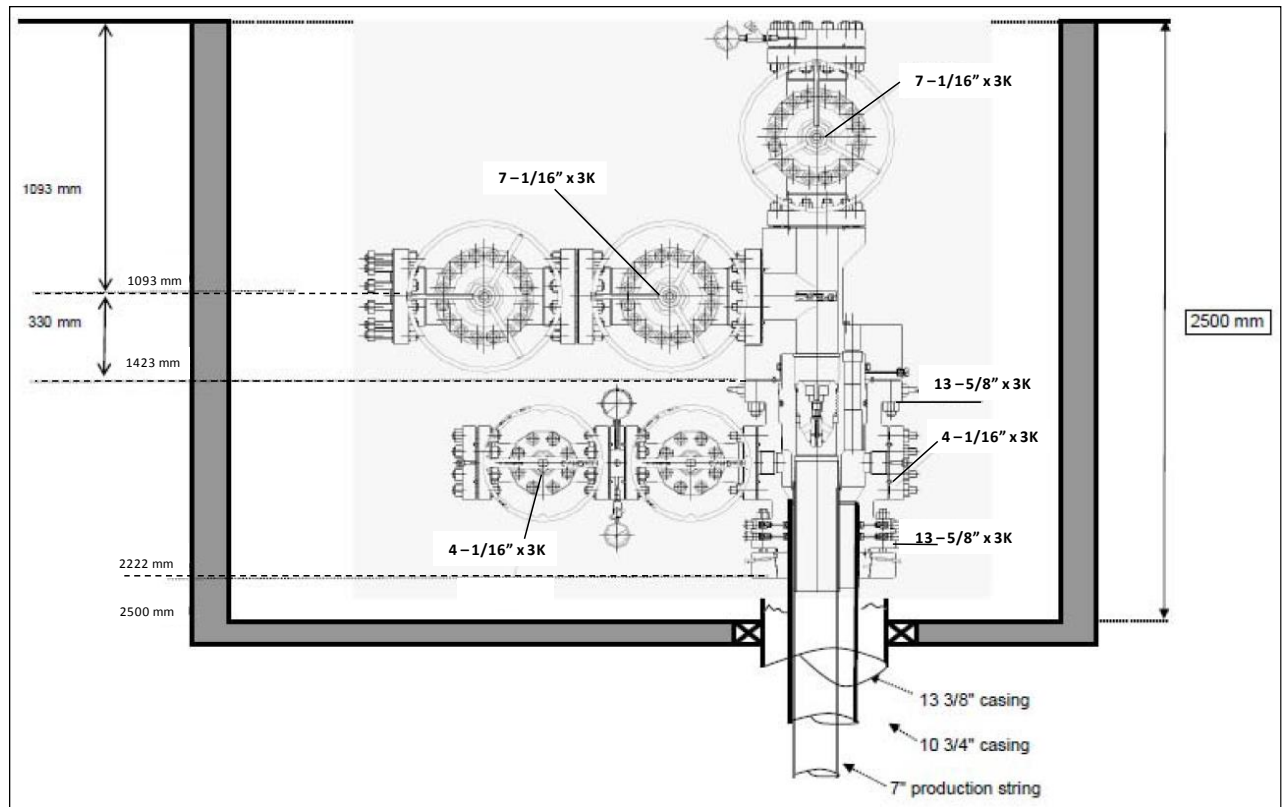
5. Wellhead after Operations

Operations performed had no impact on the wellhead.

5.1 HAG GT-01 Wellhead



5.2 HAG GT-02 Wellhead after operations



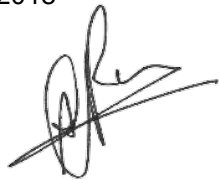
6. Signing

Place: Breda

Date: 19-5-2018

Signature:

Ad Raaijmakers
Projectmanager



Hydreco GeoMEC
bezoekadres:
Minervum 7181
4817 ZN Breda
T. (076) - 572 77 20