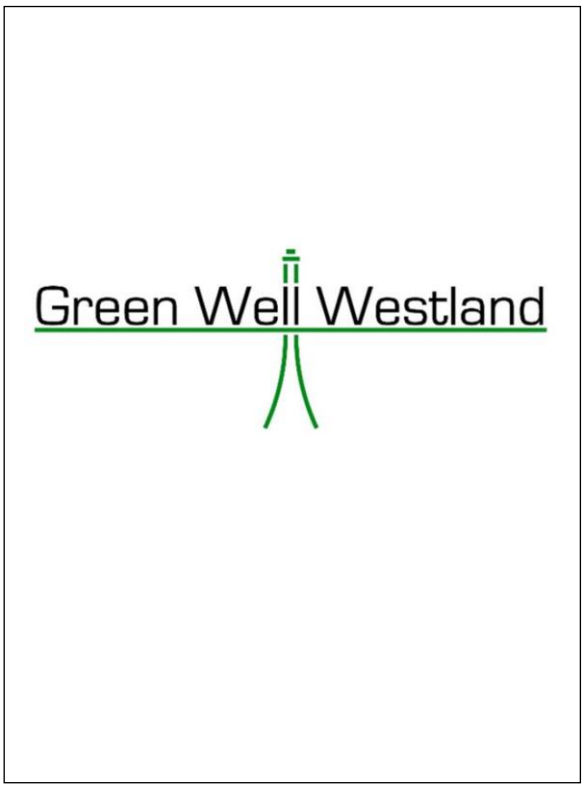

Green Well Westland

SIDETRACK GEOTHERMAL WELL HON-GT-01S2

WORK PROGRAMME

QUALITY

Reference-number operator's quality-system : GW-WP-20150423

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REVISION

Version	Date	Chapter(s) concerned	Modification
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DISTRIBUTION

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1. Introduction

1.1 Description of the reason for sidetrack

The well HON-GT-01 is drilled in 2011/2012. During drilling operations a technical sidetrack (S1) was required as a result of hole problems in the 6 ⅛" reservoir section. While running in the wire wrapped screen section the assembly got stuck. Attempts to fish & retrieve the lower completion were unsuccessful. The lower half of the assembly was therefore left in the hole and a sidetrack was drilled. The sidetrack was successfully completed with a wirewrapped screen section through the reservoir.

The produced warmth from the geothermal well is used to heat the connected greenhouses. After ca. 2,5 years production a marked increase in required production pump power was noted. This was further investigated and a blockage was found inside the upper section of the 4 ½" lower completion: 20 meters below the liner hanger and 50m above the 7" casing shoe. Attempts to remove the blockage in December 2014 with coiled tubing have been unsuccessful.

The source of the blockage has been researched further and severe damage to the production liner section is considered as the main cause. Therefore the drilling of a sidetrack is envisaged in order to re-establish well production.

The work programme for the corresponding operations is detailed in the following chapters.

1.2 Health, safety and environment framework

This work programme should be considered in conjunction with (and is an integral part of):

- HSE doc.: GW-HSE-20150423.
- NORM doc.: GW-NORM-20150423.

2. Well description

1.1 Well location. Well operation

According to article 8.2.3.1. of the Mining Act, the well operation has to be described.

The Main well bore was named HON-GT-01; a side track was drilled with the name HON-GT-01-ST1
The surface location is situated at (in accordance to "Rijksdriehoekmeting"):
X= 75242.83 E
Y= 448081.04 N
The well (tubing flange) is positioned 0,57m above NAP

When production is ceased the surface pressure inside the well is 0 barg.
Reservoir pressure at 2500m is ca. 253bar.
Maximum surface pressure (closed in with full displacement to gas) is 204 bar
The production water from the Delft Sandstone is measured at 86^{o}C temperature during production.
The flow capacity of the well is currently none (due to the blockage), but is expected to be restored to ca. 170m^{3}/hr after drilling of the sidetrack.

BOP's will be tested as per article 8.3.2 of the mining regulations.

The well is completed with:

9-5/8" surface casing	to 1102m
7" liner	from 1022m to 2472m
4-1/2" liner w/ wire-wrapped screens	from 2400m to 3180m

The top of the blockage inside the 4-1/2" liner is found at 2429m after the CT operations.

The well construction is given in figure 1, with the approximate location of the blockage marked in red. Thickness of the blockage is unknown.

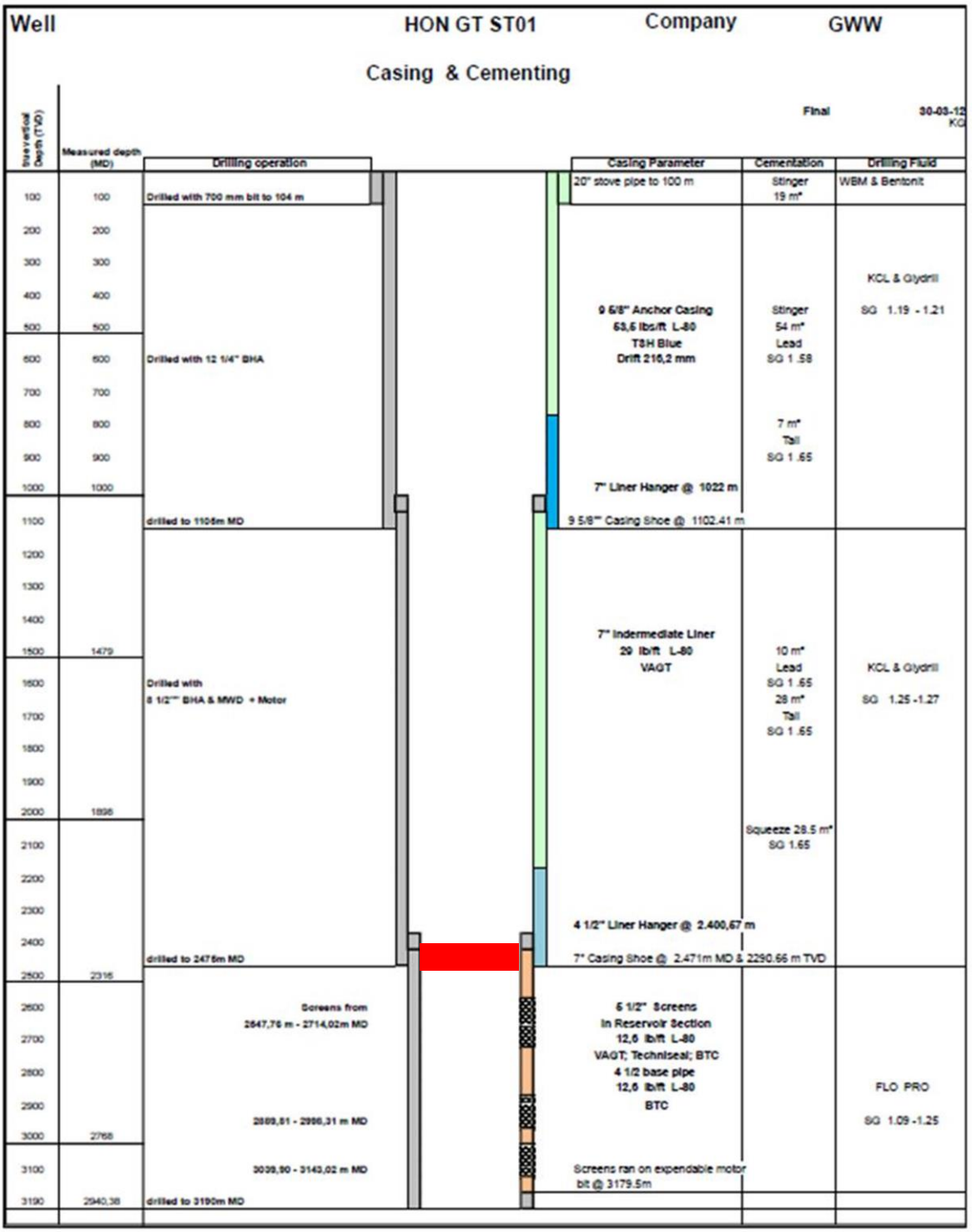

Figure 1: Well construction

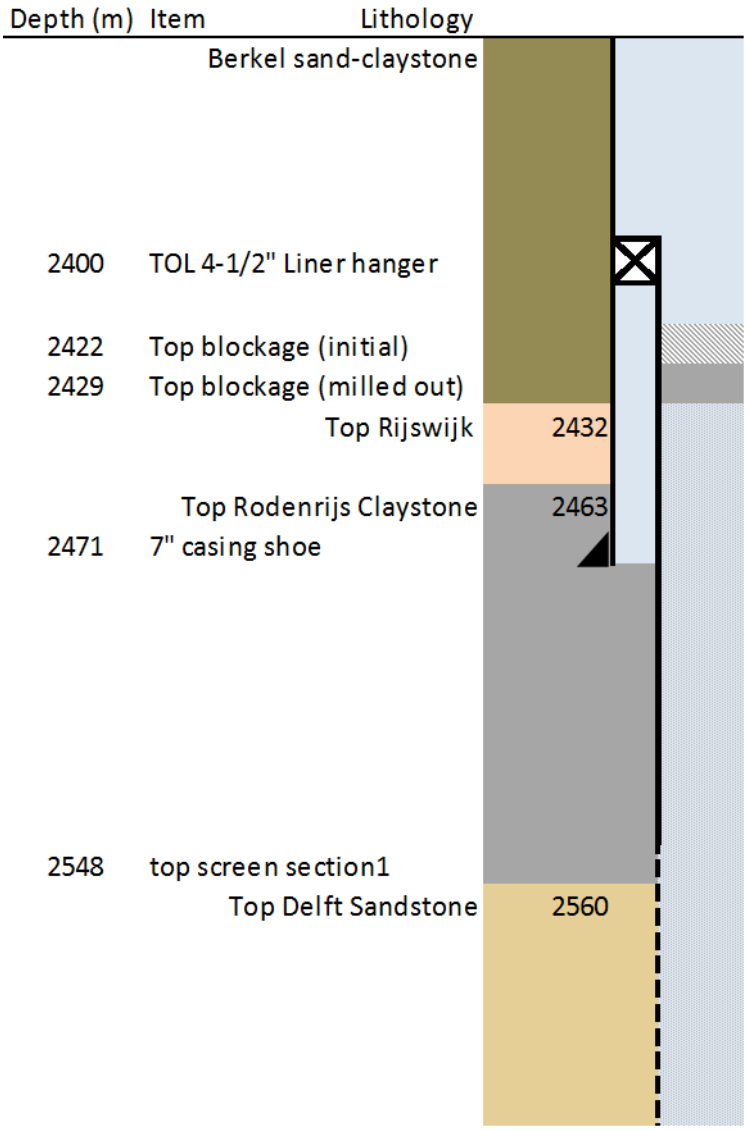

Figure 2: Zoomed section of well schematic at area of interest

The x-mas tree and cellar drawings are given in figure 3.

1.1. Cellar Dimensions

HON-GT-01 and HON-GT-02:

Cellar dimensions (l*w*h): 1.6 * 1.6 * 1.0 m

Bottom to cellar to top CHH flange: 1,29 m.

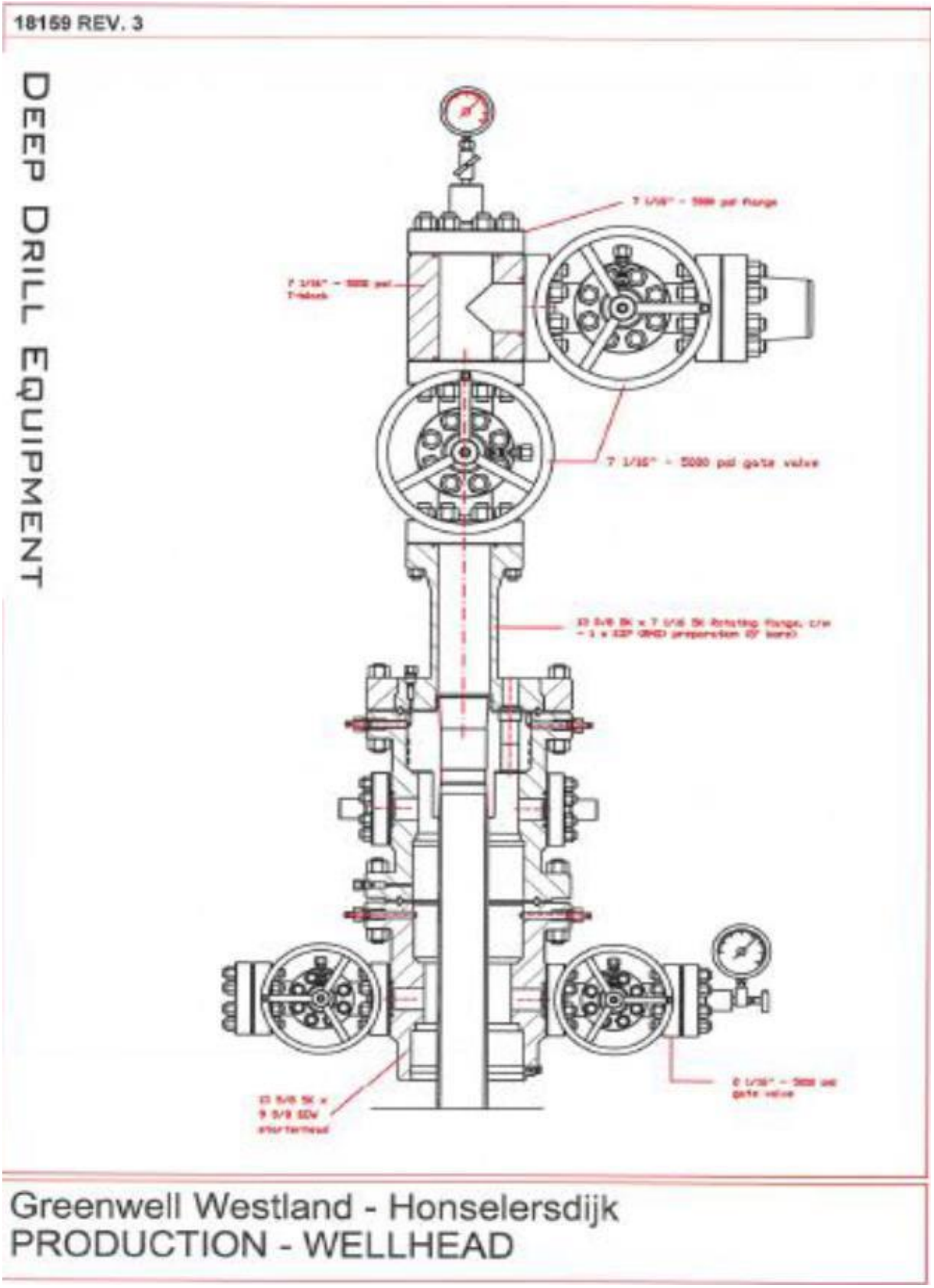

Figure 3: X-mas tree drawings

The well deviation for HON-GT-01(S1) is given in figure 3. Vertical section (325 azimuth) left & horizontal section (right)

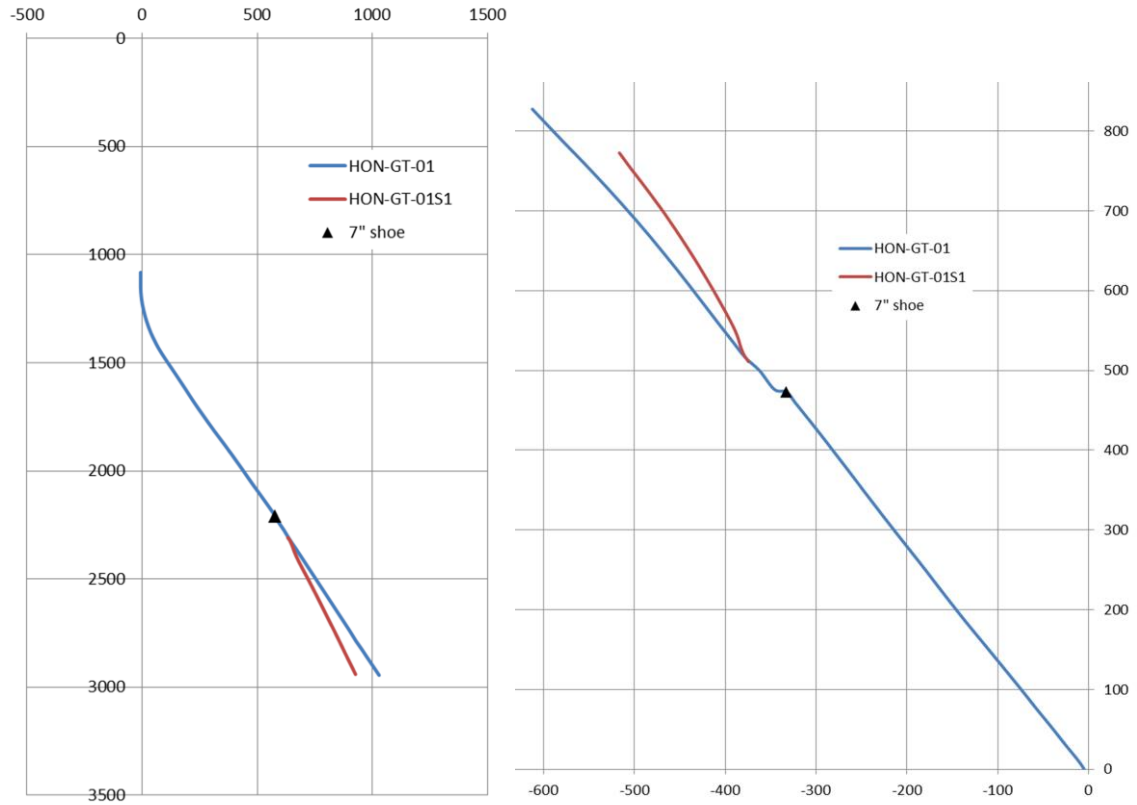

Figure 4: Well deviation plots

The detailed well deviation is given in Table **1**

Table 1: Detailed well deviation

N°	MD	Incl	Azim	TVD	+N/-S	+E/-W	VS	DLS	Build	Turn	Survey
	m	deg	deg	m	m	m	m	Deg/30m	Deg/30m	Deg/30m	Type
1	1.082,10	0,31	138,40	1.082,06	-8,19	-0,59	-6,37	-	-	-	PMWD
2	1.121,00	0,44	135,65	1.120,96	-8,38	-0,41	-6,63	0,10	0,10	-2,12	PMWD
3	1.148,50	1,14	330,59	1.148,46	-8,21	-0,47	-6,46	1,71	0,76	-180,07	PMWD
4	1.175,50	3,69	329,36	1.175,43	-7,23	-1,05	-5,32	2,83	2,83	-1,37	PMWD
5	1.202,50	6,42	329,18	1.202,32	-5,19	-2,26	-2,95	3,03	3,03	-0,20	PMWD
6	1.230,00	9,85	333,84	1.229,54	-1,76	-4,09	0,91	3,81	3,74	5,08	PMWD
7	1.257,00	12,57	331,64	1.256,02	2,90	-6,50	6,11	3,06	3,02	-2,44	PMWD
8	1.284,00	14,51	327,78	1.282,27	8,35	-9,70	12,41	2,38	2,16	-4,29	PMWD
9	1.311,50	16,53	324,35	1.308,77	14,45	-13,82	19,76	2,42	2,20	-3,74	PMWD
10	1.339,00	18,99	323,65	1.334,96	21,23	-18,75	28,15	2,69	2,68	-0,76	PMWD
11	1.366,00	21,72	324,88	1.360,27	28,86	-24,23	37,54	3,07	3,03	1,37	PMWD
12	1.393,00	24,18	325,05	1.385,13	37,48	-30,27	48,06	2,73	2,73	0,19	PMWD
13	1.420,50	26,38	325,49	1.409,99	47,13	-36,96	59,81	2,41	2,40	0,480	PMWD
14	1.447,50	28,49	324,52	1.433,96	57,32	-44,10	72,24	2,40	2,34	-1,078	PMWD
15	1.474,50	30,78	324,09	1.457,42	68,16	-51,89	85,59	2,56	2,54	-0,478	PMWD
16	1.502,00	32,27	325,05	1.480,86	79,87	-60,22	99,97	1,72	1,63	1,047	PMWD
17	1.528,50	32,45	325,49	1.503,25	91,53	-68,30	114,15	0,34	0,20	0,498	PMWD
18	1.556,00	32,18	324,61	1.526,49	103,58	-76,72	128,85	0,59	-0,30	-0,960	PMWD
19	1.583,00	32,36	324,44	1.549,32	115,32	-85,09	143,27	0,22	0,20	-0,189	PMWD
20	1.610,00	32,01	324,09	1.572,17	126,99	-93,49	157,65	0,44	-0,39	-0,189	PMWD
21	1.637,50	31,83	324,52	1.595,51	138,80	-101,97	172,19	0,32	-0,20	0,469	PMWD
22	1.667,50	31,57	324,35	1.621,04	151,63	-111,14	187,95	0,28	-0,26	-0,170	PMWD
23	1.694,50	31,22	323,65	1.644,08	163,00	-119,41	202,02	0,56	-0,39	-0,778	PMWD
24	1.722,00	31,48	324,35	1.667,57	174,58	-127,82	216,32	0,49	0,28	0,764	PMWD
25	1.749,00	32,71	324,61	1.690,44	186,26	-136,15	230,67	1,38	1,37	0,289	PMWD
26	1.776,00	33,33	325,40	1.713,08	198,31	-144,59	245,38	0,84	0,69	0,878	PMWD
27	1.803,00	33,50	325,58	1.735,62	210,56	-153,01	260,25	0,22	0,19	0,200	PMWD
28	1.830,00	33,15	325,76	1.758,18	222,81	-161,38	275,08	0,40	-0,39	0,200	PMWD
29	1.857,50	34,38	325,93	1.781,04	235,46	-169,96	290,36	1,35	1,34	0,185	PMWD
30	1.884,50	34,29	326,28	1.803,33	248,10	-178,45	305,59	0,24	-0,10	0,389	PMWD
31	1.911,00	34,65	325,14	1.825,18	260,49	-186,90	320,58	0,84	0,41	-1,291	PMWD
32	1.924,50	35,09	324,88	1.836,26	266,81	-191,33	328,30	1,03	0,98	-0,578	PMWD
33	1.952,00	35,09	325,58	1.858,76	279,80	-200,34	344,11	0,44	-	0,764	PMWD
34	1.979,00	34,82	325,14	1.880,89	292,53	-209,14	359,58	0,41	-0,30	-0,489	PMWD
35	2.020,00	34,47	325,58	1.914,62	311,70	-222,39	382,89	0,32	-0,26	0,322	PMWD
36	2.047,00	34,12	326,28	1.936,92	324,30	-230,91	398,10	0,59	-0,39	0,778	PMWD
37	2.074,00	33,77	325,67	1.959,32	336,80	-239,34	413,17	0,54	-0,39	-0,678	PMWD
38	2.101,00	33,50	326,37	1.981,80	349,20	-247,70	428,12	0,53	-0,30	0,778	PMWD
39	2.128,00	33,15	326,55	2.004,36	361,56	-255,90	442,95	0,40	-0,39	0,200	PMWD
40	2.155,50	32,89	326,11	2.027,42	374,04	-264,21	457,93	0,39	-0,28	-0,480	PMWD
41	2.182,50	33,24	326,11	2.050,05	386,26	-272,42	472,66	0,39	0,39	-	PMWD
42	2.209,50	34,38	325,67	2.072,48	398,70	-280,85	487,68	1,30	1,27	-0,489	PMWD
43	2.237,00	34,47	326,02	2.095,17	411,57	-289,57	503,23	0,24	0,10	0,382	PMWD
44	2.263,50	34,21	325,40	2.117,05	423,92	-298,00	518,18	0,49	-0,29	-0,702	PMWD
45	2.291,00	33,77	324,88	2.139,85	436,53	-306,78	533,55	0,58	-0,48	-0,567	PMWD
46	2.318,00	33,59	324,96	2.162,32	448,79	-315,39	548,52	0,21	-0,20	0,089	PMWD
47	2.345,00	33,15	324,96	2.184,87	460,95	-323,91	563,37	0,49	-0,49	-	PMWD
48	2.372,00	32,89	325,05	2.207,50	473,00	-332,35	578,09	0,29	-0,29	0,10	PMWD

49	2.399,50	32,45	325,40	2.230,52	476,20	-345,88	588,56	0,52	-	-	Good_Ma
50	2.453,00	33,15	325,05	2.275,69	499,72	-362,27	617,22	1,29	-	-	Good_Ma
51	2.500,12	32,78	325,24	2.315,75	516,38	-378,12	640,02	4,43	-	-	Good_Ma
52	2.550,11	32,03	325,24	2.357,86	538,49	-393,48	666,93	13,55	-	-	Good_Ma
53	2.600,10	31,63	326,24	2.400,30	560,29	-408,42	693,35	1,72	-	-	Good_Ma
54	2.650,08	31,92	326,22	2.442,86	582,06	-423,03	719,55	6,30	-	-	Good_Ma
55	2.700,07	31,76	325,72	2.485,39	603,86	-437,69	745,80	8,26	-	-	Good_Ma
56	2.750,06	31,63	325,24	2.527,96	625,43	-452,55	771,99	22,80	-	-	Good_Ma
57	2.800,05	31,48	324,62	2.570,53	646,82	-467,69	798,19	9,57	-	-	Good_Ma
58	2.850,03	31,59	324,00	2.613,11	668,06	-482,99	824,37	68,48	-	-	Good_Ma
59	2.900,02	31,46	323,09	2.655,72	688,98	-498,67	850,51	8,88	-	-	Good_Ma
60	2.950,01	31,51	322,01	2.698,26	709,72	-514,73	876,73	5,86	-	-	Good_Ma
61	3.000,15	31,61	321,16	2.741,05	730,16	-531,01	902,83	13,93	-	-	Good_Ma
62	3.050,13	32,01	320,13	2.786,20	750,45	-547,60	929,00	13,75	-	-	Good_Ma
63	3.100,12	31,89	319,65	2.826,15	770,54	-564,51	955,20	5,98	-	-	Good_Ma
64	3.146,15	32,25	320,27	2.865,22	789,03	-580,32	979,46	0,05	-	-	Good_Ma
65	3.240,00	32,25	320,27	2.944,50	827,54	-612,33	1.029,45	-	-	-	Good_Ma

3. Contents of work programme

1.1 Introduction

During all preceding phases, the geothermal wellhead and x-mas tree ensured the safety of the well. Before the x-mas tree can be disconnected and removed, have at least six hours of recordings showing no pressure (barg) under the wellhead and a stable well. If these criteria cannot be met it is necessary to have two safety barriers in place in the well in order to maintain a satisfactory degree of blow-out safety. In that case a new Work Programme will be prepared. After removal of the tree a BOP will be installed to provide secondary well control during the drilling operations. After successful drilling & testing of the well the well will be monitored prior to removal of the BOP and installation of the tree.

The less time it takes to complete the BOP/tree change-out operations, the lower the risks concerning well safety will be. It is therefore important to very carefully prepare and plan the different steps in order to have the necessary equipment and personnel with the right instructions ready in time on location.

1.2 Steps of the work programme

The steps of the work programme are as follows:

Mobilise and rig up

1. Mobilise and spot equipment workover unit
   a. Mud system
   b. Office units/cabins
   c. Generators
   d. Fuel tank etc.
2. N/U BOP's & install substructure
   a. Meanwhile mix mud
3. Rig up workover unit
4. Rig up auxillary equipment
   a. Mud pumps
   b. Solids control
   c. Drillpipe package
5. Pressure test BOP's & commission equipment
   a. Test to 225bar (maximum surface pressure+10%)

Fishing attempt

6. M/U fishing BHA
7. RIH to 2410m
8. Displace well to 1,10sg Drill –in fluid
9. Attempt to pull 4-1/2" x 7" liner hanger & liner
   a. Pull & jar several times to max equipment rating
10. Release spear
11. Perform post jarring inspection on workover unit
12. POOH & L/D fishing BHA
    a. If fish <90m (<20m free below 7" shoe) – continue with whipstock scenario (A)
    b. If fish >90m (<20m free below 7" shoe) – continue with open hole scenario (B)

Whipstock scenario

A1. R/U wireline
  a. M/U bridgeplug and CCL tools
A2. RIH to HUD to log CCL
A3. Set Bridgeplug above 7” casing collar
  a. Ensure sufficient space above plug to accommodate whipstock
A4. POOH wireline
A5. R/D wireline
A6. M/U whipstock assembly
A7. RIH whipstock assembly
  a. Careful at 7” liner hanger
A8. Set whipstock on top bridgeplug
  a. Oriented towards exit to upper left of 7” casing (315° right/ or 45° left)
A9. Mill window
A10. Mill up to 10m fresh formation
  a. Accommodate 2nd stabilizer of directional BHA to be out of casing
A11. POOH milling assembly
A12. L/D milling assembly
A13. Continue with Drilling (13)

Open hole sidetrack scenario

B1. RIH cementing string
  a. Open ended DP
B2. R/U cement unit
B3. Mix cement
  a. 50m 6” hole plug requires 1m3
B4. Pump cement
B5. Displace string
B6. POOH & L/D string
B7. Continue with Drilling (13)

Drilling

13. M/U directional BHA
  a. Shallow test per DD
14. RIH same to window/cement plug
15. Drill directionally to ca. 2650m MD
  a. Azimuth ca. 315°, Inclination ca. 25-30°
  b. Follow anti-colision plan to prevent drilling into existing wellbore/liner
  c. 10m below base Delft Sandstone – Geologist to confirm
  d. Flowrate >1070lpm to ensure hole cleaning (also inside 9-5/8” surface casing)
16. Circulate hole clean
  a. Flowrate >1070lpm to ensure hole cleaning (also inside 9-5/8” surface casing)
17. Perform wiper trip only if required
18. POOH

19. L/D directional BHA
20. R/U casing running services
    a. Crane services to prevent damage to screens
21. M/U& RIH 5” liner/screen section
22. Install false rotary
23. M/U & RIH 2-7/8” inner string
24. M/U liner hanger
25. RIH liner hanger on DP
26. Circulate hole clean & displace well to brine
27. Set liner hanger
    a. Check presence of 7” casing couplings for liner hanger placement (see CCL)
28. M/U ESP assembly
29. RIH ESP
30. N/D BOP
    a. Ensure well has been static during previous operations
31. Install tree
32. Rig down workover unit

1.3 **Geological prognosis**

The geological prognosis for HON-GT-01S2 is identical to the encountered geology in HON-GT-01, due to the close vicinity of both wellbores. The prognosis is shown below in Table 2

Table 2: Geological summary HON-GT-01S1

Lithostratigraphic Column GreenWell				HON-GT-01	Total gas ppm	
Era	Group	Member	Lithology	*AH-GL Depth (m)*	HON-GT-01	HON-GT-02
Mesozoicum	**Rijnland** KN	**Vlieland Clay** KNNCM	Dark brownish-grey to grey claystone. Mica and very fine lignitic matter are common. The formation can be very silty to sandy. It's also slightly calcareous.	1920	200 - 10,000 CG up to 77,000	1000 - 6000 CG up to 29,000
		Berkel Sandstone KNNSB	Sandstone, light-grey, very fine- to coarse-grained, locally gravelly, lignitic, locally glauconitic or with sideritic concretions. Especially in the upper part calcareous cemented beds are common.	2227	1000 - 10,000 CG up to 51,000	3000 - 7000 CG up to 49,000
		Berkel Sand/Claystone KNCC	Alternation of fine-grained, argillaceous sandstones and brown-grey silty to sandy claystones. Locally sideritic concretions are present.	2270	0 - 9000 CG up to 40,000	1500 - 7000 CG up to 45,000
		Rijswijk Sandstone KNNSR	Light- to medium-grey sandstones with a very fine to medium and locally gravelly grain size; mica, lignitic matter and siderite concretions are common.	2434	0 - 9000 CG up to 22,000	2000 - 6000 CG up to 34,000
	Schieland SL	**Rodenrijs Claystone** SLDNR	Medium- to dark-grey and dark brown, silty to sandy lignitic claystones with laminated or contorted bedding, and lignite/coal beds. Traces of mollusc shells, pyrite and siderite.	2466	0 - 2000 CG up to 15,000	150 - 6000 CG up to 11,000
		Delft Sandstone SLDND	Light-grey massive sandstone sequence, fine to coarse-gravelly, fining upward, lignitic.	2553	200- 2700	150 - 3400
		Alblasserdam SLDNA	The upper part consists of grey to greyish brown, soft claystone with some intercalated red bands and well sorted, very fine loose sand, sandstone & siltstone.	2611	200 - 7400	150 - 17,000
				TD 3190		

1.4 **Plot of the location**

The plot of the location is given in figure 4.

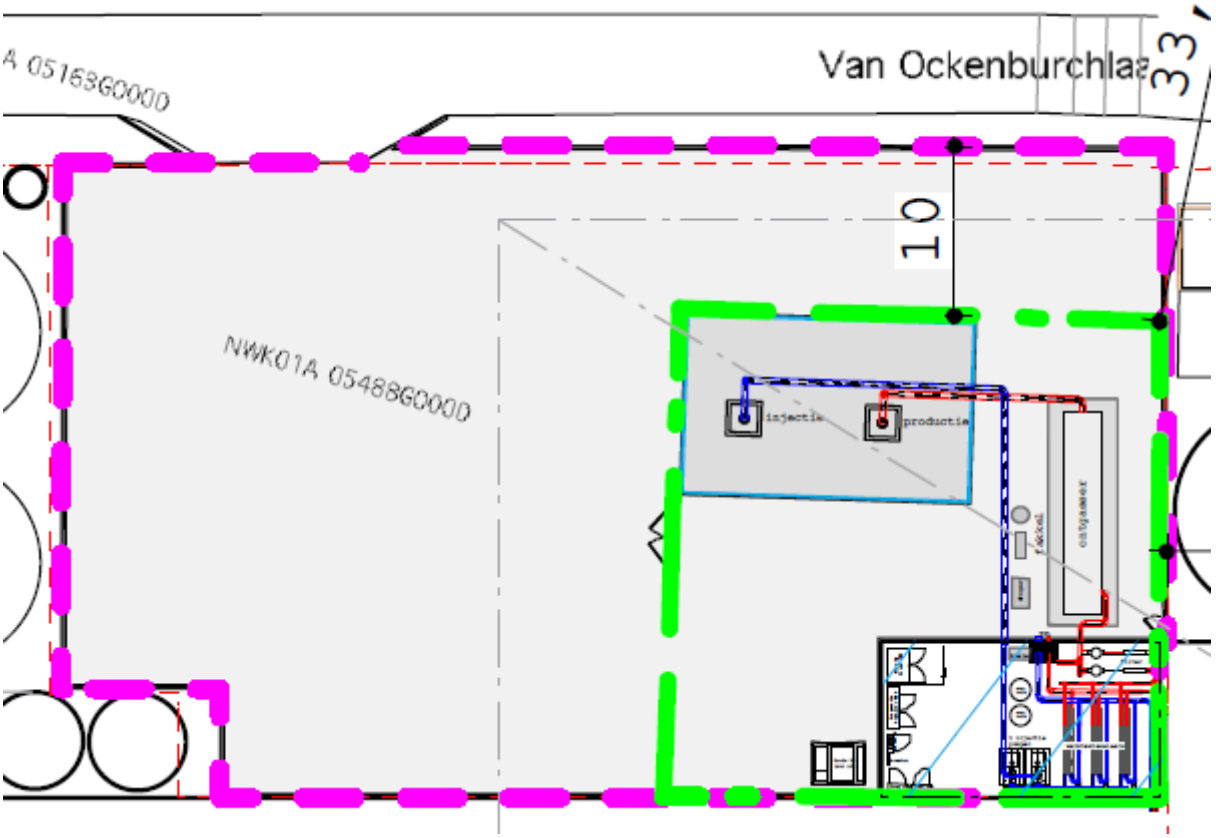

Figure 5: Location plot

1.5 **Detailed work programmes**

The detailed work programmes of contractors are added as appendices to this document:

- Fishing BHA's
- Whipstock schematic
- Directional drilling proposal w/ BHA's
- Mud program
- Liner hanger details

4. Resources and Planning

1.1 Selected companies

For the described programme operator will mobilise the following companies:

Workover unit	BPC
Drilling fluids	AMC
Fishing services	Weatherford/Smith
Whipstock	Weatherford/Smith
Cementing services	SLB
Directional drilling	Weatherford/Baker Hughes
Liner hanger	GOT
Screens/liner	HP Wellscreens
Craning and lifting :	Boekenstijn
On site supervisor & engineering:	WEP

1.2 Personnel

The following personnel / functions are involved in the operations

Project manager	G.J. Verkade
Site supervisor	J. Scheffers
Drilling manager	Maarten Middelburg
Drilling engineer	Kornelius Boersma

1.3 Planning

The operations are planned to start on 01 June 2015. The expected time required for carrying out the work programme is 19 days.

The tentative planning is shown in Table 3

Table 3: Planning

Open hole sidetrack	hrs	day
Rig up	78,0	3,3
Attempt fish liner	38,8	1,6
Set cementplug	35,9	1,5
Drill OH sidetrack	72,1	3,0
RIH liner	43,2	1,8
RIH ESP assembly	11,7	0,5
Install wellhead	12,0	0,5
Rig down	64,0	2,7
Total	**355,6**	**14,8**
Contingency	**15%**	**2,2**
Total		**17,0**

Cased hole sidetrack	hrs	day
Rig up	78,0	3,3
Attempt fish liner	38,8	1,6
Set mechanical bridgeplug on wireline	16,3	0,7
Set whipstock & mill window	48,6	2,0
Drill cased hole sidetrack	81,2	3,4
RIH liner	43,2	1,8
RIH ESP assembly	11,7	0,5
Install wellhead	12,0	0,5
Rig down	64,0	2,7
Total	**393,8**	**16,4**
Contingency	**15%**	**2,5**
Total		**18,9**