End of Well Report NLW-GT-02-S1

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Version: 0.1

Publication date: 01 June 2018

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Document Revision Control:

Revision no.	Chapter	Changed Items
0.1		Draft issued for internal reviews

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GLOSSARY

AH	Along hole
AKO	Adjustable Kick-Off
BGL	Below ground level
BHA	Bottom hole assembly
BOP	Blowout preventer
NLW-GT-01	Naaldwijk Geothermal 01
NLW-GT-02	Naaldwijk Geothermal 02
CBL	Cement bond log
CHH	Casing head housing
C/O	Change Out
CP	Conductor Pipe
CRT	Casing running Tool
DC	Drill Collar
DP	Drill pipe
DSV	Drilling supervisor
EMW	Equivalent mud weight
ESP	Electric submersible pump
FMS	Flush Mounted Spider
FIT	Formation integrity test
FOSV	Full opening safety valve
GL	Ground level
GOT	German Oil Tools
GR	Gamma-Ray
HSE	Health, Safety & Environment
HWDP	Heavyweight drillpipe
IR	Iron Roughneck
LCM	Lost circulation material
LOT	Leak Of Test
LTI	Lost Time Incident
MD	Measured Depth
MW	Mud Weight
MWD	Measurement while drilling
NAP	Normaal Amsterdams Peil
NDSV	Night Drilling Supervisor
NPT	Non-productive time
OH	Open hole
PBL	Circulation sub
PBR	Polished Bore Receptacle
PDC	Polycrystalline diamond compact
PDM	Positive displacement (mud) motor
PJSM	Pre-job safety meeting
POA	Plan of action
POOH	Pull out of hole
ppf	pounds per foot
P/U	Pick Up
PUW	Pick up weight
PV	Plastic viscosity
R/D	Rig Down
RF	Rig Floor
RIH	Run in hole
ROP	Rate of penetration
RSS	Rotary steerable system
RT	Rotary table
RTTS	Retrievable Test-Treat-Squeeze (packer)
R/U	Rig Up
s.g.	Specific gravity
SodM	Staatstoezicht op de Mijnen
SOW	Slack off weight
Spm	Strokes per minute
SPP	Stand pipe pressure
TD	Total depth
TDS	Top Drive Swivel
TOC	Top of cement
TOL	Top of liner
TRS	Tubular Running Services
TP	Toolpusher
TSP	Top Set Packer
TVD	True vertical depth
TWCV	Two Way Check Valve
USIT	Ultrasonic Imager Tool
VFD	Variable Frequency Drive
WBM	Water Based Mud
WEP	Well Engineering Partners
WOB	Weight on bit
WOC	Wait on cement
WSG	Well Services Group
WTF	Weatherford
WWS	Wire-wrapped screen
YP	Yield point

1. General Project data

Field	Naaldwijk
Well Number:	NLW-GT-02-S1
Well Name	Naaldwijk-GT-02-Sidetrack-1
Well Type	Geothermal Production
Start operations	09-03-2018; 00:00 hr
Spud date	10-03-2018; 04:45 hr
Start rig down (end of well)	02-05-2018; 09:00 hr
Days Operational	53,6 days
Operator	Trias Westland

Surface Location	Latitude & Longitude	Geographical
	51° 59' 26,96"N 4° 14' 22,36"E	X: 76154m (RD) Y: 445230m (RD)

Grid Coordinate System	Rijksdriehoeksmeting / Netherlands New
Drilling Contractor	KCA Deutag
Drilling Rig	T-207
Depth reference	Rotary Table (RT), unless otherwise stated

Project Management:

Project Director	Marco van Soerland
Project Manager	Floris Veeger
Drilling Manager	Maarten Middelburg
Sr. Drilling Engineer	Bert Jan Koers
Drilling Engineer	Andrea Di Cicco
Sr. Well Site Geologist	Dick Stegers
HSE Manager	Peter v.d. Burg
HSE Coordinator	Arno Otten

Drilling Supervisors on 2 week rotational scheme:

Drilling Supervisor	Karl Gollob	09-03-2018 / 13-3-2018 27-03-2018 / 10-04-2018 24-03-2018 / 30-04-2018
Drilling Supervisor	Per Gwalter	13-03-2018 / 27-03-2018 10-04-2018 / 24-03-2018
Night Drilling Supervisor	Joost van Tilborg	09-03-2018 / 19-03-2018 02-04-2018 / 16-04-2018 30-04-2018 / 02-05-2018 (DSV)
Night Drilling Supervisor	Barry Ross	19-03-2018 / 02-04-2018 16-04-2018 / 30-04-2018

2. Well summary

Primary Objective		Lower Cretaceous reservoir (Delft Sandstone)	
Primary Objective Depth		2463 m MD	2367 m TVD
Total Depth		2680 m MD	2525 m TVD
Elevation	RT – GL	9.32 m	
	GL – NAP	-0.90 m (NAP is 0.9m below ground level)	
	NAP – RT	8.42 m	

Table 1: Well summary

Item	MD (m)	TVD (m)	Comments
30" Conductor	134	134	The 30" Conductor was pre-installed to 134m MD RT using a truck mounted unit as part of the drill site construction.
24" Hole TD	1105	1088	This vertical section was drilled with a TCI (IADC 415) bit type GO4BCPS below a PDM directional BHA. Shaker system of the rig, (x3 single deck shakers) and additional MD3 triple deck shaker were sufficient to allow proper flow rates. At 1188 m drilled trough a fault, causing total losses. No success in curing losses and pipe stuck. Decided to severe pipe at 298 m. LCM pills not effective, pumped Zonelock S pill, losses stopped. POOH to run clean out BHA. Washed/reamed to 210 m, still losses. Decided to set cement plug for side track. Cleaned out cement plug to 141 m. Started sidetrack with Bentonite mud. Another LCM pill was needed to cure losses. At 442 m displaced well back to KCl Glydril mud and continued drilling to section TD at 1105 m.
20" Casing	1102	1085	RIH 20" casing and stood up at 142 m, POOH and ran 2 x clean out BHA. RIH casing without centralizers, stood up at 156 m but managed to work casing down to planned setting depth. Ran cement stinger and cemented casing as per program. Installed 21-1/4" wellhead and BOP's
17 ½" Hole	2385	2304	The fault experienced in the first 24" hole section was now expected in this section in the Upper Holland Marl. A dumb-iron BHA was used to drill float equipment and performed a limit test to 1.45 s.g. at 1108 m MD. Continued drilling with same hold BHA to 1264 m. BHA was changed out for RSS to perform directional work. The BHA was showing a strong building tendency. High stick-slip was experienced from 1944m onwards. At 2185 m it was decied to POOH for steering issues, low ROP and high stick-slip. Drill collars were removed from the string and a stabilizer added. Bit was in good condition and although perhaps too aggressive (519) for the sandstones it was re-run. Drilled to section TD at 2385 m. BHA had to be pumped OOH due to overpulls when pulling only on elevators.
13 ⅝" Liner	(TOL) 993 (SHOE) 2376		The 13 ⅝" liner was run to setting depth 9m off proposed depth. Setting the liner hanger went as per plan. The cement job was carried out as per plan and the plugs bumped and liner tested. Reverse circulating showed 3m³ of pure cement. Set packer and circulated clean above TOL.

13-5/8" Tie-back	surface	1005	Run 12-1/4" Dress/Mill BHA into liner top and landed NO-GO 1m deeper than expected. Displaced well to inhibited water. Run tie-back string and pressure test casing and tie-back to 100 bar.
12 ¼" Hole TD	2680	2525	RIH 12 ¼" RSS with PDC bit. Drilled out shoe track and rat hole without any issues. Performed limit test to 1.50 s.g. below 13 5/8" shoe. Displace to drill-in fluid and commenced drilling. Overall performance was good with ROP's varying between 10 – 15 m/hr. Inclination was built to 45 deg. TD was called at 2680m. POOH on elevator to 2541m where 10ton overpull was observed. The tight spot was reamed and BHA pumped OOH to 13 5/8" casing shoe.
9 ⅝"Liner	2642	2499	The 9-5/8", 53,5#, L80, VAM21 liner with Wire Wrapped screens was run with a 5 ½" DP as inner string to 13 5/8" casing shoe. Upon entering the open significant drag was observed and the liner had to be worked all the down to setting depth at 2642 m. The liner hanger set successfully. While displacing the well to brine the annulus packed off. Decided to set packer and complete displacement via inside of 9 5/8" liner.
Suspend well			Installed tubing hanger + one 8 5/8" casing joint. X-mas tree installed and tested against TWCV. Removed TWCV after pressure test.
Welltest			The welltest is performed with the rigless intervention unit (RIU) of Franks. Before installation of the ESP wireline logs (USIT- CBL- VDL) of the 13 5/8" liner and tie-back string were taken by Schlumberger. ESP run on 8 5/8" 32# L80 Polseal tubing to 749 m BGL with Expro memory P&T gauges on slickline suspended below the ESP centraliser. Depth of memory gauges is 2259 m MD BGL. Welltest is performed successfully, total volume produced 2991m³ water and 4591 Nm³ gas. After 24 hrs build up the ESP is POOH and memory gauges retrieved on slickline. A downhole fluid sample was taken at 2319 m MD. The well is suspended with tubing hanger + one 8 5/8" casing joint and X-mas tree installed. TWCV is removed after pressure test.

2.1 Directional plots

SURVEY MANAGEMENT — **DEFINITIVE SURVEY SIGN-OFF**

Client:		Job No.:	17hol0035	Report Date:	18-May-18
Field:	Naaldwijk (Trias Westland)	Well Name:	NLW-GT-02	Borehole:	NLW-GT-02-S1
Stru/Slot:	NLW-GT-02/NLW-GT-02	Survey:	NLW-GT-02-S1 Def Survey		

Structure Reference:	445230.00	76154.00
	N 51° 59' 26.96188"	E 4° 14' 22.35732"
Slot Coordinates:	445230.00	76154.00
	N 51° 59' 26.96188"	E 4° 14' 22.35732"
Structure/Slot Uncertainty:	0.00 m(3.00 sigma)	0.00 m(3.00 sigma)
Grid Coordinate System:	Amersfoort * OGP-Nld / RD Dutch Onshore	
TVD Reference Datum:	Borehole: Unknown	
TVD Reference Elevation:	8.420 m above NAP	
Seabed/GroundLevel:	0.900 m below NAP	

Depth Units:	(m)	
Survey Date:	3-Apr-18	
Azimuth Reference:	Grid North	
Mag. Model / Mag. Decl. Date:	HDGM 2017	4-Feb-18
Magnetic Declination:	1.102 °	
Grid Convergence:	-0.90562969 °	
Total Correction:	2.0078 °	
Vertical Section Origin:	0.000 m, 0.000 m	
Vertical Section Plane:	107.442 ° (Grid North)	

DEFINITIVE SURVEY CONSTRUCTION - ORIGINAL WELL

Instrument Type	Survey From	Survey To	Hole Size	Casing Size
SLB_MWD+SAG-Depth Only	0.00	9.32		
SLB_MWD+SAG	9.32	137.00	30.00	30.00
SLB_MWD+SAG	137.00	137.00	30.00	30.00
SLB_MWD+SAG	137.00	1102.00	24.00	20.00
SLB_MWD+SAG	1102.00	2376.00	17.50	13.63
SLB_MWD+SAG	2376.00	2680.00	12.25	12.25
	Projection to TD:		Type:	

WELL REFERENCE POINT LOCATION

MD	INC	AZ	TVD	VS	NS	EW	Northing	Easting	Latitude	Longitude
9.32	0.00	0.00	9.32	0.00	0.00	0.00	445230.00	76154.00	N 51° 59' 26.96188"	E 4° 14' 22.35732"

BOTTOM HOLE LOCATION

MD	INC	AZ	TVD	VS	NS	EW	Northing	Easting	Latitude	Longitude
2680.00	45.00	108.05	2525.60	724.20	-213.54	692.02	445016.47	76845.98	N 51° 59' 20.40543"	E 4° 14' 58.79969"

BOTTOM HOLE LOCATION COMPARISON — SOURCE :

MD	INC	AZ	TVD	VS	NS	EW	Northing	Easting	Latitude	Longitude

COMMENTS

Surveys in 24" section and partially in 17.5" section corrected for drillstring magnetism (DMAG).

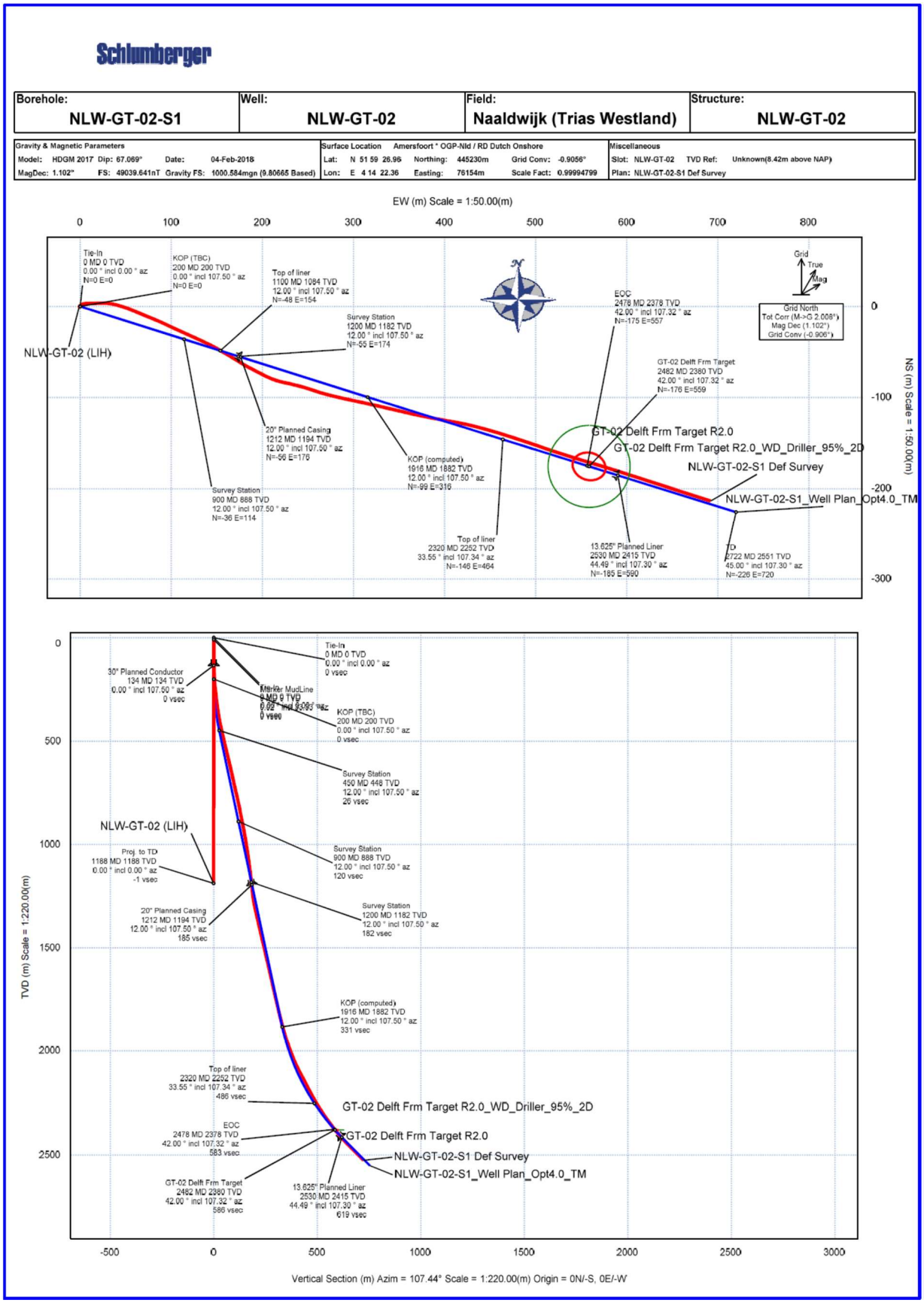


Figure 1: NLW-GT-02-S1 Vertical Section plot and plan view plot- drilled vs. planned

2.2 Technical summary

2.2.1 Casing

Table 2: NLW-GT-02-S1 tubular summary

Item	Top (m MD)	Bottom (m MD)	Weight	Grade	Connection
30" Conductor	0	134	0.5" WT	S355	Welded
20" Conductor	0	1102	133 ppf	NT95	BTC
13 ⅝" Tie-back	0	1005	88.2 ppf	L80	VAM21
13 ⅝" Liner	993	2376.5	88.2 ppf	L80	VAM 21
9 ⅝" WWS Liner	2325	2642	53.5 ppf	L80	VAM 21

2.2.2 Cement

Table 3: NLW-GT-02-S1 cement summary

Item	TOC (m MD)	Lead Slurry Volume (m^3)	Lead Slurry Weight (s.g.)	Tail Slurry Volume (m^3)	Tail Slurry Weight (s.g.)	Type
20" Casing	Surface	153	1,57	38	1,67	PozzoCemoil w/Cemnet fibres
13 ⅜" Liner	Liner Top	107	1.67	21	1.88	PozzoCemoil lead G class Tail

3. Drilling fluid summary

Per section the following drilling fluid types have been used:

Table 4: NLW-GT-02-S1 drilling fluid summary

Section	Type	Density (s.g.) Min – Max	PV (cP) Min – Max	YP (lbf/100ft2) Min – Max
24"	Bentonite spud mud & KCl Glycol WBM	1,05– 1,26	13 – 20	14 – 18
17 ½"	KCl Glycol WBM	1,24 – 1,28	15-29	17 - 25
12 ¼"	Drill-in Fluid (Flo Pro)	1,13 – 1,15	14 - 16	15 - 26

The figure below shows the mud weight, PV and YP versus depth during drilling operations.

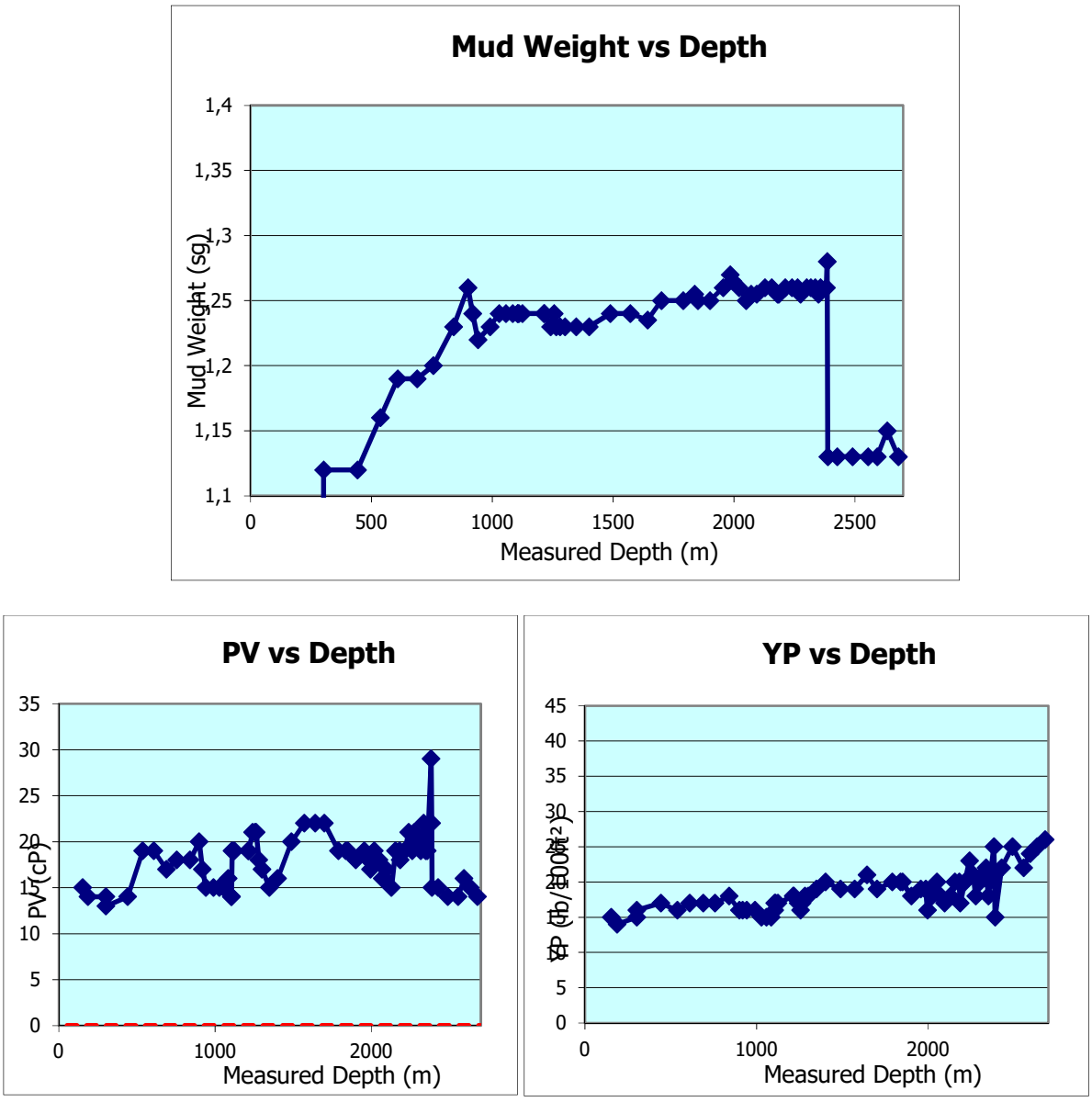


Figure 2: NLW-GT-02-S1 mud weight vs. depth

4. Geology

Below the geological column with vertical and along hole depths below RT.

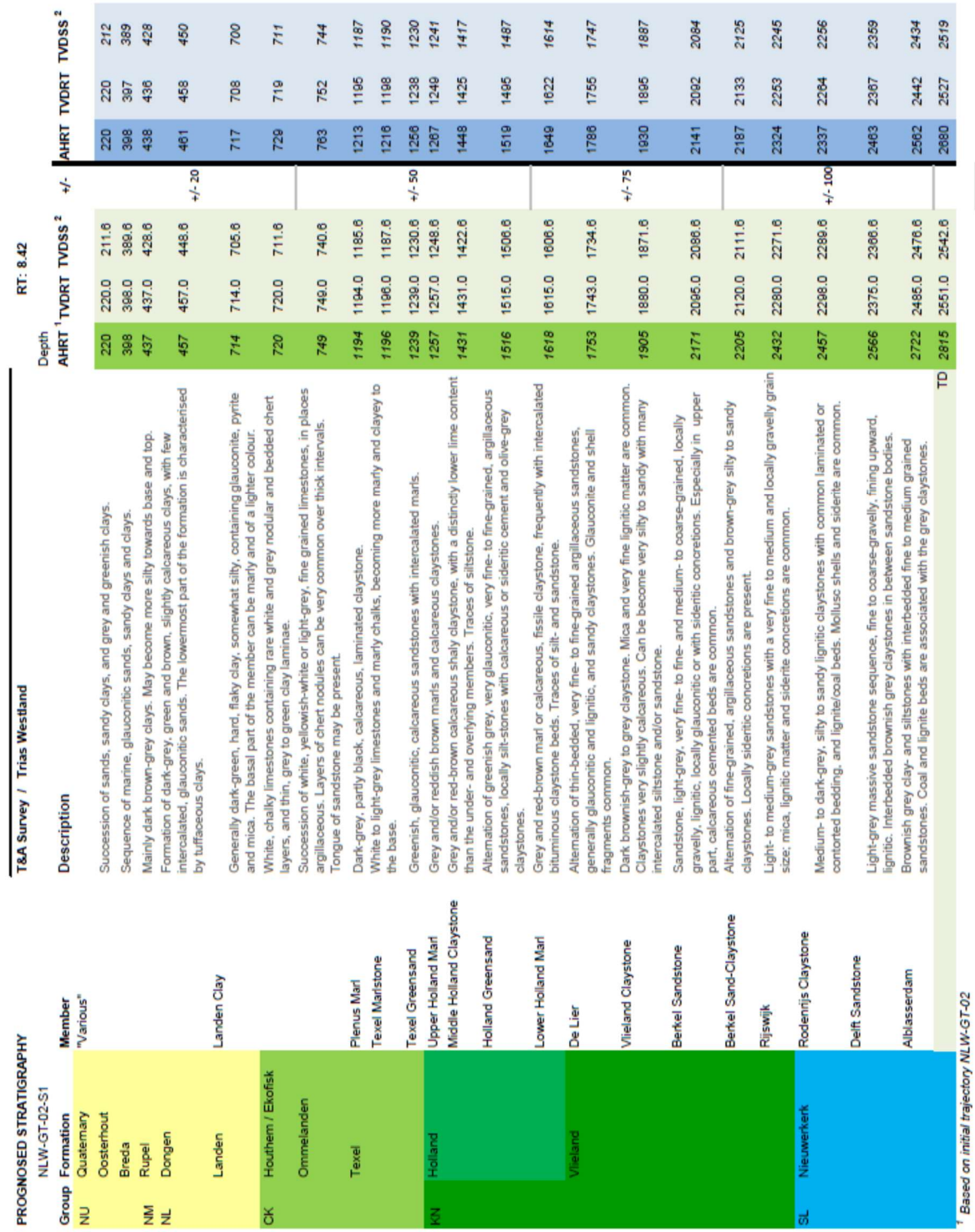


Table 5: NLW-GT-02-S1 geological lithostratigraphic column

5. Well schematic

A detailed well schematic summarizing all casing sizes is shown below.

Nr.	Item Description Production well All depths from RT *RT = 9,32 m above GL* *RT =8,42 m above NAP*	Wellhead and Xmastree **NLW-GT-02-S1** 1x joint 8 5/8" 32# L80 installed below tubing hanger.	Depth m tvd	Depth m ah	Hole ID in	Pipe OD in	Collar OD in (nom)	Pipe ID in	Pipe ID in (drift)
1	30" 0,5" WT S355 Conductor		134	134	35,433	30,000	welded	29,000	29,000
	20" x 16" liner hanger & packer X/O to 13 5/8"		976	992	Top of liner				
2	20" 133# NT95DE ERW BTC Casing		1085	1102	24,00	20,000	21,000	18,730	18,542
			1089	1106	section TD				
	13 5/8" x 9 5/8" Liner Hanger + Packer		2254	2325	Top of liner (50 m liner lap)				
3	13 5/8" 88.2# L80 VAM21 Liner + Tie back		2297	2376	17,5"	13,625	14,699	12,375	12,250
			2304	2385	section TD				
			2365	2460	Top Screens				
			2368	2464	Top Delft Sandstone				
			2453	2578	Bottom Screens				
4	9 5/8" 53,5# L80 VAM21 WWS		2499	2642	12,25"	9,625	10,542	8,535	8,500
			2525	2680	TD				
*Not in scale.									

Figure 3: NLW-GT-02-S1 well schematic

Figure 4 shows the well schematic during the welltest. The installation of the ESP was done with a crane based operations in May 2018. (note all depths referred to Ground level).

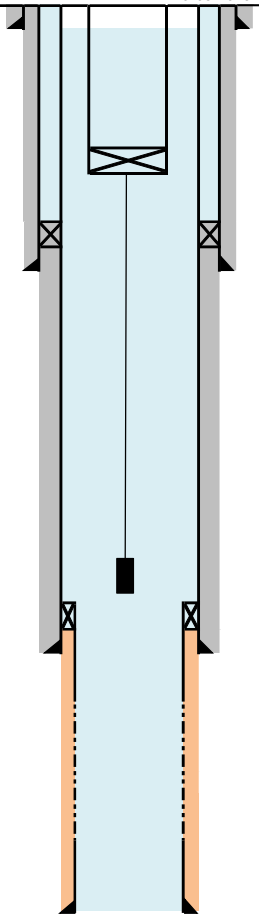
Nr.	Item Description Production well All depths from GL *GL - NAP: -0,9 (NAP is 0,9 m above GL)*	Wellhead and Xmastree **NLW-GT-02-S1** Static fluid level: 95m BGL Measured with E-line on 29-05-2018	Depth m tvd	Depth m ah	Hole ID in	Pipe OD in	Collar OD in (nom)	Pipe ID in	Pipe ID in (drift)
1	30" 0,5" WT S355 Conductor		125	125	35,433	30,000	welded	29,000	29,000
	8 5/8" 32# L80 Polseal tubing ESP on 8 5/8" tubing					8,625	9,650	7,921	7,796
			ESP intake at: 721,7 m MD / 711,6 m TVD ESP P/T gauge at: 747,8 m MD / 737,1 m TVD						
	20" x 16" liner hanger & packer X/O to 13 5/8"		967	983	Top of liner				
2	20" 133# NT95DE ERW BTC Casing		1076 1080	1093 1097	24,00 section TD	20,000	21,000	18,730	18,542
			P&T gauges at: 2259,8 m MD / 2197,1 m TVD						
	13 5/8" x 9 5/8" Liner Hanger + Packer		2245	2316	Top of liner				
3	13 5/8" 88.2# L80 VAM21 Liner + Tie back		2287 2295	2366 2376	17,5" section TD	13,625	14,699	12,375	12,250
			2356 2359	2451 2455	Top Screens Top Delft Sandstone				
			2444	2569	Bottom Screens				
4	9 5/8" 53,5# L80 VAM21 WWS		2490 2516	2633 2671	12,25" TD	9,625	10,542	8,535	8,500
	*Not in scale.								

Figure 4. Well schematic during welltest

6. HSE performance

6.1 General

To ensure that the operation was carried out in a safe manner, several HSE tools were implemented both by Trias Westland and KCA Deutag.

KCA Deutag's Permit to Work system was a tool used in order to perform additional activities outside regular drilling activities that carry a potential risk. Both the Toolpusher's and DSV's approval were required for a Permit to Work to come into effect.

Other HSE tools utilized on location were:

- Toolbox meeting during every shift change of rig contractor (06:45 & 18:45)
- Pre-job safety meetings (PJSM) before every non-drilling operation (casing running, cementing, well-test etc.)
- General safety meetings with rig crews
- Local Fire brigade location visit and acquaintance to operations
- SET card system of KCA Deutag
- Regular HSE inspections carried out by HSE coordinator
- Weekly HSE meeting

6.2 Incidents

- 1x collision outside the site with scooter – Injured person was brought to hospital for medical treatment.

6.3 Drills / Emergency exercises, inspections & audits

Drill / emergency exercises:

- Fire drills 28/02/2018, 24/03/2018,
- Muster drills 28/02/2018, 24/03/2018
- Kick drills 06/04/2018, 28/4/2018
- BOP tests 04/04/2018, 23/04/2018

7. Timing summary

Start operation : 09-03-2018 at 00:00h
Start Sidetrack 1: 23-03-2018 at 00:00h
End Operation : 02-05-2018 09:00
Total duration : 53,6 days
NPT : 388,8 hours (16,20 days)

For reference Non-Productive Time is included in the total duration of the operation. A time-depth graph of all operations from spud date is displayed below.

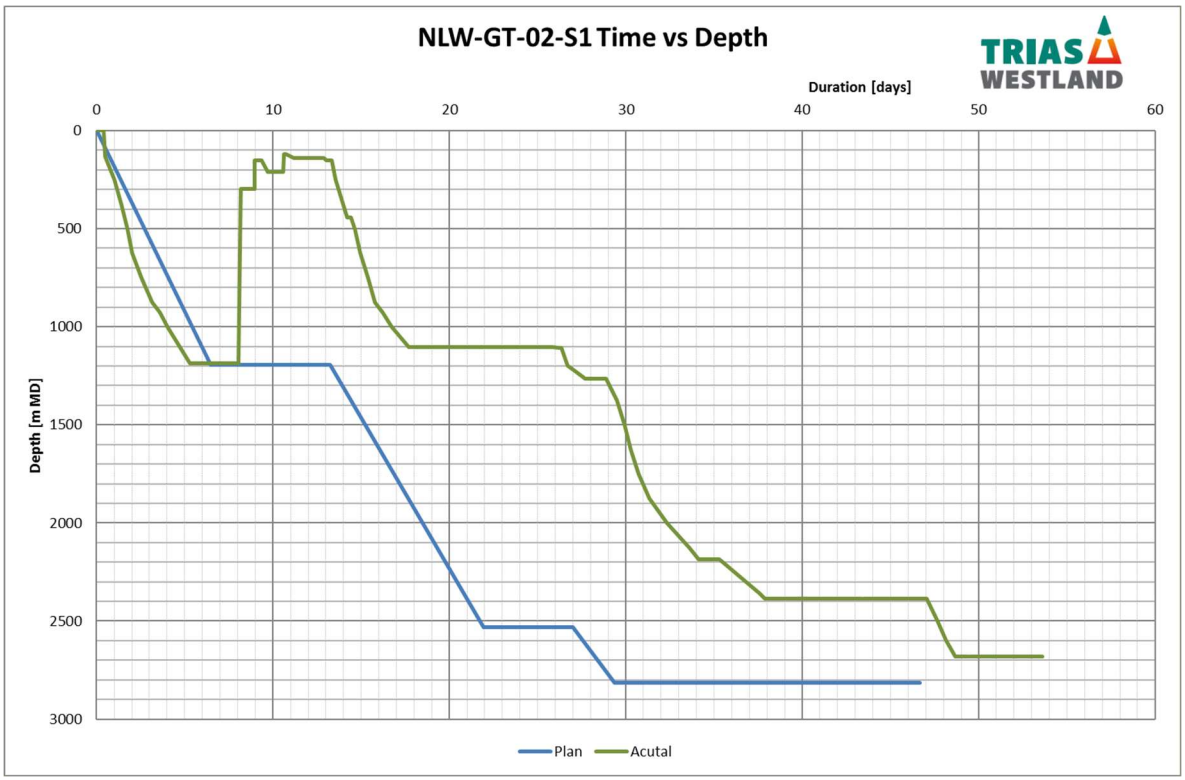
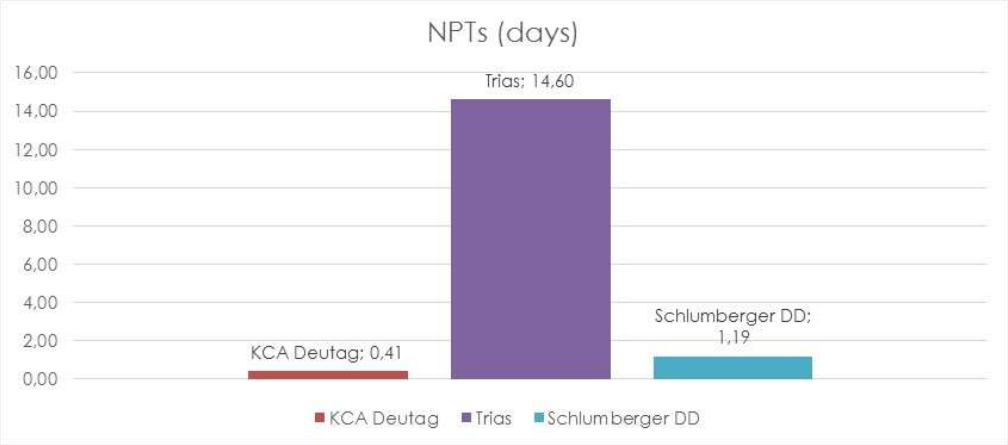


Figure 5: NLW-GT-02-S1 Time-depth Graph actual vs. planned

7.1 Non Productive Time (NPT)

Total NPT: 16,20 days.
Following the NPT distribution divided per contractor:



Main NPT events:

Responsible	**Description**
TRIAS	24" sidetrack
TRIAS	20"casing running issues
KCA-Deutag	Trouble shoot P/U and L/D machine. Problem with sensor. Pipe cartwill not move back or forward.
Schlumberger	Unplanned round trip in 17 ½" section because of low ROP, high stick slip and difficulties to maintain directional control.

8. Operations review

8.1 Conductor Operations

A 30" conductor was installed to 134 m and cemented in place prior to the rig arriving on location.

8.2 Skidding and rig up

Started	:	5-3-2018 07:00 hrs
Finished	:	9-3-2018 00:00 hrs
Duration	:	89 hrs (3,7 days)

8.2.1 Summary

T207 KCA Deutag rig was released from well NLW-GT-01 on 5th of March 2018 at 07:00hrs. Skidded rig in three steps to new position and continued maintenance and repairs in order to get rig ready for spudding new well NLW-GT-02. A protection wall of concrete blocks was built for the wellhead of NLW-GT-01. Major repairs were undertaken for the pick-up and lay-down machine, mud pumps, iron roughneck and shakers.

8.2.2 Highlights / lowlights

- Major maintenance and repairs required to get the rig ready for NLW-GT-02.

8.2.3 Learning points / recommendations

Rig had to be skidded in reverse direction, therefore well NLW-GT-01 was in the way for the MCS (pipe handler). NLW-GT-01 was suspended with a blind-flange to minimize the height of the wellhead. This was known at the start of the project but ideally NLW-GT-02 should have been drilled first to overcome this problem.

8.3 24" hole section

Started : 09-03-2018 at 00:00 hrs
Started sidetrack 1: 23-03-2018 at 00:00 hrs
Finished : 28-03-2018 at05:45 hrs (ready to run 20" casing)
Duration : 461.75 hrs (19.2 days)
NPT : 303.5 hrs (12.6 days)

8.3.1 Summary

Operations started by preparing 5-1/2" DP stands, racked back in the mast. The P/U and L/D machine is still requiring some repairs. A directional BHA was RIH with 24" TCI bit, type G04BCPS (IADC415X) on a 9 5/8" PowerPak G1 motor with 1.15° Bend and a TeleScope 900NF MWD. The conductor shoe was drilled out without issues. The planned 24" hole section is vertical up to section TD at +/- 1197 m. The ROP was controlled to 20 m/hr mainly due to the shakers blinding and the flowrate also had to be lowered to try and decrease the loss rate. The 3 shaker screens were changed as required to get the optimum flow and continue to drill ahead. A fourth MI shaker was in operation all the time.
Severe vibrations/bit bounce were experienced in the top hole. Trying to mitigate with reduced rpm (20) and increasing ROP to 25m/h. Not able to get WOB. Reduced surface rpm further to only 15. Most vibrations are gone. Downlinked MWD to 2hz 2 bps to increase signal quality.
Continued drilling with poor demodulation. Tried different troubleshooting. Signal is back, but with time to time poor demodulation. Ideal signal at 32 RPM. Swap mudpumps trying to get better signal. Slight improvement. As from 726 m in Ommelanden Chalk with chert intercalations. Vibration causing bad MWD-demodulation. Increased flow to 3500 lpm. String standing up due to chert bands.
Bit bouncing when applying more weight, No MWD signal while on bottom drilling. Adjust parameters to minimise bit bouncing. Drilling through Chalk and chert decreased ROP. Increased WOB.
As from +/- 800 m drilling conditions and MWD signal improved. Drilling in the Chalk caused the MW to increase to 1,30 sg.
As from 1180 m the ROP was reduced to 3 m/hr to enable selection of the shoe depth.
At 1188,5 m experienced total loss of returns. While preparing a LCM pill the string was rotated and reciprocated, however torque increased and caused string to stall and get stuck. Pumped 6 x 10 m3 LCM pills without success. Also no jarring action because string stuck above the jar. Ran out of mud and changed to pumping 1.08 sg brine from the NLW-GT-01 production test. Filled annulus and DP and measured fluid levels: DP 20 m and annulus 21,6 m.
Mobilised BPC (Balance Point Control) to run a Free Point Indicator tool. RIH FPI tool, checking pipe movement at different depths with 40-50 t overpull. Free pipe down to 285 m. Pipe stuck at 300 m. POOH FPI. By pumping with 3500 lpm into the drillstring, managed to work the string up and obtain rotation. Pulled string up to 1157,9 m. R/U for Schlumberger Zonelock S loss circulation treatment program. Pump into drill string with 2000 lpm, 113 bar and 700 lpm, 51 bar. Stopped pumping and observe remaining pressure of 16 bar, not bleeding off. Stopped Zonelock S treatment because not able to pump freely through drill string. String stuck again without rotation. Decided to run BPC severing tool and cut pipe at the tooljoint at 293 m. POOH severed joint from 298 m to 273 m. Still no returns, pumped 3 x 20 m3 LCM pills with increasing concentration up to 500 kg/m3. No success.
POOH string from 273 m to 138 m. Pump Zonelock S treatment as follows: 10 m3 CaCl2 1,09 sg, 3 m3 fresh water spacer, 10 m3 Zonelock S, 3 m3 fresh water spacer, 10 m3 CaCl2 1,09 sg, displace string with 2 m3 fresh water. Observed returns while pumping the last 5 m3 CaCl2. POOH to 102 m and RIH again, standing up at 152,8 m. Decided to POOH and run a clean out BHA assembly.

A 24" TCI clean up assembly was RIH to 130m before observing some resistance, the TDS was made up and the string was washed / reamed to 210m. At this depth losses were observed again in the range of 22m3 / hr. A Hi-Vis pill was spotted and the string POOH to surface. The 5-1/2" cement stinger was RIH to 209m and a 50m3 (1.90sg) kick off cement plug was placed. POOH with cement stinger and flow checked well, well was static.

RIH Dumb Iron BHA and tagged TOC plug at 119m (inside conductor), continued to drill / dress of cement plug to 137m and again losses were observed up to 48 – 57m3 / hr (dynamic). Continued to dress off cement plug to 141m whereby losses had decreased to 4m3 / hr (dynamic). Prior to POOH for the steering BHA an LCM pill was spotted on bottom to help cure any losses. POOH with Dumb Iron BHA to 130m and displaced the well from Brine fluid to KCL Glydril and POOH to surface. On surface the decision was made to attempt to drill the section with a new fluid system, a Pre Hydrated Bentonite fluid system was to be used.

The new 24" TCI sidetrack BHA was made up and RIH to 130m and the well was displaced from KCL Glydril WBM to Bentonite WBM. Commenced slide drilling to initiate sidetrack to 153m, at this depth dynamic losses were observed of 70m3 / hr. The BHA was pumped out of hole back into the conductor shoe to establish static hole losses, observed 3m3 / hr. Opened well commander by pumping opening ball down string and then followed by an LCM pill to try and plug the losses. Allowed the LCM pill to soak for 2hrs prior to drilling ahead and as the fluid level in the annulus was measured and found to be only 2m with around 0.5m3 / hr static losses so the decision was made to drill ahead. The BHA was washed to bottom and continued to sidetrack the main wellbore with 100% cuttings confirmation at 180m. Continued to drill ahead in sliding / rotary mode as required to maintain directional plan, at 442m displaced the well back to KCL Glydril prior to drilling into the clays. Continued to drill the 24" section to TD at 1105m AHBRT / 1088m TVDBRT into the Ommelanden formation. Sweeped the hole clean with a Hi-Vis pill and pumped out of hole the first 3 stands prior to pulling out of hole on the elevators with only one small restriction seen at 546m which was washed past no further issues seen to surface.

8.3.2 Highlights / lowlights

+ Drilled sidetrack section in one bit run
+ Total losses after drilling into suspected fault. As a result the North Sea formation collapsed causing the BHA to become stuck and unable to retrieve.
+ Multiple loss zones observed with upto 70m3 / hr losses seen
+ Had to change fluid system several times

8.3.3 Learning points / recommendations

- If there is a risk of total losses in the base of the chalk consider to set the first casing in the top of the chalk to secure the unstable North Sea formations.
- 4th shaker proofed to be effective for solids control.

8.4 20" casing, cementing, wellhead and BOP

Started	:	28-03-2018 05:45 hrs
Finished	:	04-04-2018 02:15 hrs (Casing RIH, Cemented, WH and BOP installed)
Duration	:	164.5 hrs (6.9 days)
NPT	:	52.75 hrs (2.2 days)

8.4.1 Summary

Casing running

Franks casing running equipment including air operated Flush Mounted Spider (FMS) and Casing Running Tool (CRT) system was rigged up using a crane. Picked up 20" stab-in float shoe jt, checked floats OK. P/U and M/U next joint of 20", 133#, NT-95DE BTC casing and Bakerlok connection.

RIH casing making up BTC connections with the CRT to 1000-1200 daN.m (base of triangle), installing bowspring centralisers over stop collar every other jt. After exiting conductor shoe at 137m resistance was observed at 142m up to 22t set down weight and working the string up and down with flow and some rotation was no successful to pass restriction. The casing string was POOH and the bottom centralisers removed from the casing to aid with running in hole, however after going back to bottom this proved ineffective and the trajectory of the well exiting the conductor shoe was such that it could not be worked past. The decision was made to perform a wiper trip with 2 x Dumb Iron assemblies with different stabiliser positions to simulate the stiffness of the casing and attempt to pass the restriction. The restriction was seen again at 142m however this was gently reamed away until no longer seen and the area was reamed multiple times to confirm clear.

The 20" stab-in float shoe jt was picked up again and the floats checked – ok. P/U and M/U next joint of 20", 133#, NT-95DE BTC casing and Bakerlok connection.

RIH casing making up BTC connections with the CRT to 1000-1200 daNm (base of triangle), this time all centralisers were to be removed except for the final 200m which would be placed within the conductor string. However at 150m resistance was seen and the string was worked down to 156m whereby no further progress could be made, so the decision was made to POOH to surface and run another steering BHA with under-reamer assembly. Attempts to POOH and into the conductor shoe were unsuccessful and the casing could not be POOH past 147m, with the overpull being so quickly applied it would seem the issue was mechanical. After further discussion the decision was made to attempt to RIH again, this was done and at 156m the same resistance was seen and managed to be worked through with 500lpm, the 20" casing was continued to be washed in hole with 500 – 1000lpm to landing off with the shoe at 1102m.

The casing was landed in a side-door elevator on metals beams and a stick-up above the RT of 0,85 m. Once at final depth the well was circulated clean prior to RIH the inner string of 5-1/2" DP with stab in cement stinger. The stinger was stabbed into the shoe with 15t set down weight and the casing / well were circulated to clean and condition the mud whilst rigging up Schlumberger cement truck and equipment.

Cementing

Pressure tested cement line to 250 bar. Closed IBOP above cement side entry sub and pressure up to 30 bar behind. Pumped 10m³ fresh water mudpush spacer at 1000 lpm. Mixed and pumped Pozzocemoil lead cement (1.57sg) at 1000 lpm. 35 - 45 bar. Observed cement at surface after 153m³ of lead slurry, switched to tail slurry. Mixed and pumped 38m³ Pozzocemoil tail cement (1.67sg) at 1000 lpm. 35 bar. Commenced displacing with 2m³ fresh water, followed by 10.5m³ mud (underdisplaced by 2m³). Added Cemnet fibres as required to mitigate losses. Observed 10.7m³ losses throughout cement operations.

Checked back flow, floats holding.Unstung from stab in shoe, dropped sponge ball and pumped down and out of stinger. Observed back flow, circulated strough stinger to stop back flow. POOH stinger and WOC. Meanwhile testing TDS and surface lines to 25 and 345 bar.
After surface samples were hard, removed H beams and side door elevator. Cut riser and rough cut 20" landing joint and removed same. No cement was seen in the annulus but TOC was estimated at 87 m below surface.

CHH installation
Hartmann technician cold cut the 20" csg at 580 mm from bottom cellar and installed the slip lock mounted 20"x21-1/4" 5k CHH and pressure tested between FS seals 25 bar/15 min and 50 bar/20 min (no plastic injected).

BOP installation.
Installed 21-1/4"5k blind/shear rams, 5-1/2" 5k pipe ram and 21-1/4" 5k annular BOP with overhead winches. Installed bell nipple,kill line and Coflex hose. Function tested BOP's. Tested wellhead to 50 bar against cup type tester. Installed plug type tester and pressure tested BOP's as per KCAD procedure: annular to 240 bar and all other BOP equipment, choke and kill line to 345 bar. Installed wear bushing. Performed BOP function test from all operating panels and did drawdown test on accumulator.

8.4.2 Highlights / lowlights

+ Good cement returns but TOC not seen at surface.
- Could not run casing past 142 m. POOH and made two wiper trips. Removed centralisers and ran casing again, hold up at 156 m. Finally worked casing down to planned depth.

8.4.3 Learning points / recommendations

- In case of shallow sidetrack from cement kick-off plug perform checktrip with stiff assembly before running casing.

8.5 17 ½" hole section

Started	:	04-04-2018 at 02:15 hrs
Finished	:	17-04-2018 at 14:00 hrs (Laid down BHA, clean rig floor)
Duration	:	443,75 hrs (18,5 days)
NPT	:	34,5 hrs (1,4 days)

8.5.1 Summary

The fault experienced in the first 24" hole was now expected to be encountered in the Upper Holland Marl. Therefore no expensive items were run in the BHA. RIH a 17-1/2" TCI bit on a normal drilling "hold" BHA and tagged cement at 1091 m with 8 t. Pressure tested the casing to 50 bar. Drilled out cement, shoe and rathole and new formation from 1105 m to 1108 m. Perform FIT with Schlumberger pump truck to limit pressure of 22.3 bar, equivalent MW 1,45 sg, no leak off observed. Pumped total 188 liter, returned approx. 178 liter.

Drilled to 1214 m where 10 m3/hr losses were observed. Two different LCM pills were needed to reduce the dynamic losses to 5 m3/hr. Adding LCM directly into the suction tank and lowering the MW to 1,23 sg reduced the losses to nil. Continued drilling to 1264 m. Because of low ROP it was decided to stop drilling here and POOH for bit and BHA change.

A PDC bit was RIH on a RSS assy with Wellcommander. After logging with MWD from 1092 m to 1264 m, continued directional drilling from 1264 m to 1336 m building inclination to 13°. Continued with tangent section where at 1381 m observed momentarily (during 2 minutes) slight losses: fault?
The BHA shows a strong building tendency (only one stabiliser) which is difficult to control with the RSS. Tangent section continued to 1936 m, followed by a build section. Observed increasing stick-slip as from 1944 m. At 1985 m had to repair a leaking wash pipe and at 2048 m repaired a leaking riser. Due to the building tendency of the BHA it became more and more difficult to follow the directional plan. Due to the excessive stick-slip and low ROP it was decided to stop drilling at 2185 m for bit and BHA change. Opened the Wellcommander and circulated hole clean with 4000 lpm. After 1 x BU noticed slight losses, reduced flowrate to 3000 lpm which stopped the losses. POOH on elevator, slight overpull around 1300 m (DLS >3).

The bit looked still in good condition so decided to re-run it, however with different nozzles in order to allow a higher pump rate of 3400-4000 lpm. PowerDrive and Telescope were replaced and a second stabilizer was placed in the string in order to stop the building tendency of the previous BHA. Removed Wellcommander, 1x 9-1/2" DC and 1x 8-1/4" DC. RIH and at 1260 m observed slight decrease in slack off weight, backream 1 stand , thereafter RIH freely to bottom. Started drilling at 2185m to section TD of 2385m, some seepage losses were observed however LCM was added straight into the active mix system and these cleared up.

At TD hole was circulated clean with a bottoms up then a Hi-Vis pill was pumped around and another bottoms up completed to clean the hole. The string was pumped out of hole due to some overpull observed whilst attempting to pull on elevators. From 2,100m the string was POOH to surface on elevators with no issues observed and good hole conditions.

On surface and inspection of the BHA some balling up was seen on the NB stab but all was in gauge. The Powerdrive was observed to be in good condition - seals were good and there was no wear observed on NB Stab. On inspection of the 17 ½`` drill bit it was some minor damage and it was graded 3-4-BT-A-E-1/16-ER-TD was not able to be re-run.

Average parameters for the section were: 4000 lpm, 215 bar, 120 rpm, 40 kNm and 6-12t. At section TD samples were circulated up and the WSG confirmed TD in the Top Rodenrijs claystone formation.

8.5.2 Highlights / lowlights

+ Mud weight was kept within required parameters
- Round trip required to adjust BHA and complete section
- High torque and stick slip

8.5.3 Learning points / recommendations

- Limit amount of DC's if possible to reduce torque and stick-slip.
- Aggressive bit choice (519) was good for clay's to prevent bit balling but the high reactive torque results in more stick slip, therefore WOB had to be limited. In sand stones a less aggressive bit such as 616 is most likely the better choice.

8.6 13 ⅝" liner & cementing

Started	:	17-04-2018 at 14:00 hrs
Finished	:	20-04-2018 at 14:30 hrs (LH running tool at surface)
Duration	:	72,5 hrs (3,0 days)
NPT	:	0 hr

8.6.1 Summary

Liner running

Removed wear bushing for liner running and rigged up Franks casing running equipment. Picked up the 13-5/8" reamer shoe joint and tested float - good test, Picked up Intermediate joint A and attempted to make up to reamer shoe joint - no success due to damaged threads. Laid out Intermediate joint to deck and picked up Intermediate joint B and made up to reamer shoe joint - no issues. Made up Float collar and tested float equipment - no issues.

The 13 5/8", #88.2 L80 VAM 21 liner was RIH to the 20"casing shoe without issues. Circulation was broken at shoe prior to entering open hole, no losses were observed whilst circulating. The casing was RIH with reduced speed to 1367m MD. Franks running equipment was changed over to the liner hanger equipment. The liner hanger was made up and the casing was RIH on 5.5" HWDP / DP from 1367m MD to 2283m MD. Resistance was met and the casing was worked / washed down to a final setting depth of 2376.5m MD whereby no further progress could be achieved. The liner hanger was set without issues. The mud was conditioned into spec for upcoming cement job.

Cementing

Rigged up cementing unit, flushed and pressure tested lines. Pumped 14m^3 fresh water spacer and released bottom dart (Bottom plug shear was observed after 10.4m^3 with 70bar) followed by 107m^3 Pozzocemoil lead cement (1.67sg) and 21m^3 G class Tail cement (1.88sg).

Released the top dart and displaced with 2 m^3 fresh water spacer, 102.3m^3 WBM mud (Top plug shear was observed after 10.4m^3 with 130bar), 2m^3 freshwater spacer and 10.4m^3 WBM bumping plugs on volume total of 116.7m^3. The FCP pressure of 70 bar was increased to 100 bar and the 13-5/8" liner was tested for 20 mins – good test.

The packer was set with 40t set down weight and a clear shear observed.
After pulling the hanger setting tool to above the TOL the string was circulated clean, with 60m^3 of contaminated returns sent to the skips (3m^3 of pure cement).

The Annular BOP was closed and the 13-5/8" liner packer was tested to 50 bar for 20 mins - good test, the Annular BOP opened and the liner hanger running tool was pulled without issues to surface. On inspection positive indications were observed that the packer had set correctly and the tool was cleaned on the rig floor and laid out to deck.

8.6.2 Highlights / lowlights

+ Liner hanger set as per program.
+ Cement job went as planned with good densities held throughout
+ No losses observed whilst cementing.
+ Plug bumped on correct displacement volume and PT was achieved

- 1 Intermediate joint rejected

8.6.3 Learning points / recommendations

- A lesson learned from the GT-01 well was to use HP hoses to the rig floor instead of hard piping this was done and worked very well and also saved time.

8.7 13-5/8" tie-back string, install THS and BOP.

Started	:	20-04-2018 at 14:30 hrs
Finished	:	23-04-2018 at 23:15 hrs
Duration	:	80,75 hrs (3,4 days)
NPT	:	0 hrs

8.7.1 Summary

13-5/8" tie-back string.

A 12-1/4" TCI bit and Dress/Mill BHA was made up and RIH to 981 m. The string was washed down from 981m and entered TOL landing off NO-GO at 1,010.4m. Set down 1t weight on TOL and dressed off TOL - good tag observed. NO-GO land off observed to be 1m deeper than expected. No cement returns were seen at surface whilst dressing TOL and washing down to tag NO-GO.

The well was displaced to inhibited water prior to running the 13-5/8" tieback string. Pumped inhibited water as per MI instructions with 2200 lpm, 40 bar and displaced well above liner hanger. Good interface observed at surface of inhibited water. Pumped total of 180m³ inhibited water fluid.

POOH 12-1/4" bit and Dress/Mill BHA to surface, On surface inspected Dress mill and NO-GO. Dress mill had slight wear to lower side. NO-GO had good indications that it had landed off on the TOL.

Made up wear bushing combination tool to 1 x stand of DP. RIH and pulled wearbushing. POOH to surface and observed wearbushing. Broke out and laid out combination running tool. Made up jetting assembly and jetted 13-5/8" Hanger profile area and BOP area with 1500 lpm, 18 bar making 3 x passes. POOH and laid out jetting assembly.

Rigged up Frank's casing running equipment and P/U 13-5/8" Weatherford tie-back seal stem. Continued to RIH 13-5/8", 88,2lb/ft, L80, VAM21 casing as per tally from surface to 994 m. Picked up 13-5/8" Hanger and made up to 13-5/8" casing. Made up TDS and washed down to land 13-5/8" Hanger in CHH with 200 lpm, 2 bar. Observed pressure build up indicating seals entering PBR and activated shear ring with 8t set down weight. Hartmann technician tightened 13-5/8" Hanger tie down bolts and pressure tested 13-5/8" Hanger seals to 345 bar for 20 mins - good test. Backed out 13-5/8" Hanger landing joint with 13-5/8" waterbushing and XO to 1 x joint of DP and broke down same. Closed blind rams and lined up well through kill line. Pressure tested casing and tie back seals to 90 bar for 20 mins - good test. Note: Monitored for leaks through open side outlet valve on the CHH - none observed.

Rigged down remaining Franks casing runnning equipment from rig floor. Cleaned rig floor of any excess equipment.

THS installation.

Bled down accumulator pressure and shut down Koomey unit. Removed flow riser and bell nipple, disconnected C&K lines. Nippled down 21-1/4" 5k BOP and removed via crane. Installed 13-5/8" 10k Tubing Head Spool complete with 2-1/16" 10k double side outlet valves. Pressure tested between FS - seals and below seals on the flange connection to 345 bar for 15 mins - good test.

13-5/8" BOP installation.

N/U 13-5/8", 10k BOP (annular 5k) and performed function test and accumulator test prior to a full BOP test as per KCAD procedures.

8.7.2 Highlights / lowlights

+ Successful tie-back installation and pressure test.

8.7.3 Learning points / recommendations

- None.

8.8 12 ¼" hole section

Started	:	23-04-2018 23:15 hrs
Finished	:	28-04-2018 07:00 hrs (Laid down BHA, clean rig floor)
Duration	:	103, 75 hrs (4,3 days)
NPT	:	0 hrs

8.8.1 Summary

The 12 ¼" RSS BHA was picked up with a Smith MSiZ616LPX PDC bit. After drilling out the shoe track and rat hole, bottom was tagged at 2385 m and 3 m of new formation was drilled. The mud system was conditioned to 1,26 SG prior to performing the FIT to 1.50 SG EMW with a designated cement pump truck. Mud sytem was exchanged for 1.12 s.g. Flo-Pro drill-in fluid.

Drilling commenced from 2388m to 2680m into the Alblasserdam formation, no real issues with the drilling except for MWD data which required several variations of drilling parameters and mud pump pulsation damper pressures to improve the signals.

Drilling ROP was very good also with 10 – 15m/hr averaged and average drilling parameters of 8 - 12t WOB, 3400 lpm, 145 bar, 80 - 100 rpm, 3500 - 4500 daNm.

The well was built out of the 13-5/8" shoe to 45 deg and then the tangent was held until TD.

The well was circulated clean with 2 bottoms to confirm the hole was clean , after the first bottoms up observed cuttings diminishing.

POOH with 12-1/4" BHA on 5-1/2" DP from 2,680m to 2,541m and at 2,541m a 10t overpull was observed. It was decided to make up the TDS and pump out of hole to the shoe with 2500 lpm, 83 bar - no further issues observed pumping out of hole.

At the 13-5/8" casing shoe a static flow check was carried out and the BHA was POOH to surface and all components laid out to deck for backload.

The bit was broken off, inspected and graded 2-1-BT-C-X-IN-ER-TD.

8.8.2 Highlights / lowlights

+ One bit run – good ROPs
+ 1.50 SG EMW FIT achieved
- SLB real time GR data was very poor
- Overpulls on trip out, had to pump out of hole.

8.8.3 Learning points / recommendations

+ Spent more time on circulating the hole clean at max. flowrate and RPM before POOH.

8.9 9 ⅝" WWS Liner, lay down drill pipe

Started	:	28-04-2018 07:00 hrs
Finished	:	02-05-2018 9:00 hrs
Duration	:	98 hrs (4 days)
NPT	:	1 hrs

8.9.1 Summary

Liner running
Removed wear bushing in place for liner running operations.
Rigged up Frank's casing running equipment including powertong, FMS and long bail arms. Picked up the reamer shoe joint to the rig floor and tested float – no issues.

The 9 5/8", #53.5 L80 VAM 21 WWS / Blank liner was RIH without issues. A false rotary table was rigged up and a 5-1/2" DP inner string was run and stabbed into the stab-in valve before making up the hanger. The liner hanger was picked up and made up and then continued to be RIH on 5-1/2" DP to the 13-5/8" shoe. Circulation was broken at shoe prior to entering open hole. Upon entering open hole drag was observed and the liner had to be worked all the way to bottom with varying parameters. Successfully managed to land the liner on depth with the shoe at 2642m.

The liner hanger was set without issues. Displaced well to 1.07 s.g. brine, after 50m³ pumped the annulus packed-off. Pulled running tool up (unlatching inner string from pack-off sub). Set the liner hanger packer without problems and Ptested to 100bar. Continued displacing well to brine, flowchecked well and POOH liner hanger running tool to surface.

All pipes from the derrick were laid down to prepare for rig move.
The well is suspended with tubing hanger + one 8 5/8" casing joint and X-mas tree installed. The TWCV was removed after a successful Ptest to 100 bar of the X-mas tree.

8.9.2 Highlights / lowlights

+ Liner reach planned setting depth, hanger and packer set as per program.
- Tight hole conditions, hence liner had to be worked down all the way.
- Annulus Pack-off during displacement to brine.

8.9.3 Learning points / recommendations

- Consider hole opening in a similar case where 9 5/8" base pipe + WWS are run in a build section. Maximum OD of screens = 10.27".

8.10 Rig less welltest

Started	:	28-05-2018 7:30 hrs
Finished	:	03-06-2018 18:30hrs
Duration	:	155 hrs (6,45 days)
NPT	:	8,5 hrs (6,5 hrs waiting on weather / 2 hrs waiting on Centrilift crew)

8.10.1 Summary

About two weeks after demobilisation of the rig operations continued with the rigless intervention unit of Franks in combination with their pipe handler. Installed Fugro pressure gauges in NLW-GT-01 for interference testing.

Removed X-mas tree and adaptor flange. Noticed that top penetrator was damaged by not adapted TH adaptor flange. (recess not machined properly by Hartmann, arrangements made to perform prior 48 hrs ahead to install final ESP).
Pulled tubing hanger from NLW-GT-02-S1 and performed cased hole wireline logs (USIT-CBL-VDL) in the 13 5/8" cemented liner and tie-back string.

Rigged up Expro slickline and performed a drift run with 2.375" gauge cutter to 2270m. Made up toolstring with 2 memory gauges and RIH to 1510 m. Suspend wire with fishing clampt and cut wire. Made up rope socket. In the meantime the ESP was assembled in the mousehole. Changed out 100 ton crane for 200 ton crane and lifted ESP from mousehole to NLW-GT-02-S1. Connected slickline to ESP centraliser and RIH same on 8 5/8" 32# L80 Polseal tubing to 749 m. Baker Oil Field Supply rig up welltest equipment in the meantime. After landing the hanger the Franks RIU was lifted of the well enabling the X-mas tree to be installed.

The production test was performed successfully with a maximum recorded flowrate of 450 m^3/hr. Total volumes produced are 2991m^3 water and 4591 Nm^3 gas. After 24 hrs shut-in period the annulus pressure is bled-off and X-mas tree disassembled. The RIU was repositioned over the well and ESP pulled out of hole. Expro retrieved the memory gauges and RIH a downhole fluid sampling tool which was unable to pass TOL 9 5/8 " liner at 2320 meter (W/L depth), due not run with centralizers! Took down hole samples at 2319 meter. All equipment was rigged down and demobilised. The well is suspended with tubing hanger + one 8 5/8" casing joint and X-mas tree installed.

8.10.2 Highlights / lowlights

+ Pipe handler proofed to be efficient with running speed of 8 jnts per hour.
+ Successful production test with good flowrates.
- Bad weather condition caused NPT (waiting on weather)
- Oil spill in didge due to overflooding rainwater buffer silo caused by heavy rain fall. Silo capacity and water disposal rate into sewage system are insufficient in situation with heavy rainfall.

8.10.3 Learning points / recommendations

When heavy rain fall is expected mobilize extra storage tanks + pump to store rainwater and prevent overflooding buffer silo which can potentially result in oil spills into environment.