Anglian Oil Company Ltd.
Northern Lights
AA Pad
AA16

True North Directional Services Inc.
Hydraulics Report

Job No. AB-CD-12345678
Revision: 1
Case #1

True North
Directional Services Inc.

Hydraulics Report for AA Pad, AA16, Design #1, Case #1

Recommended Flow Rate = 0.86m³/min, TFA = 102.8mm², SPP = 26,890kPa

Operating Parameters

Bit Depth:	1,794.29 m
Bit Diameter:	152 mm
Mud Density:	800.00 kg/m³
Plastic Viscosity:	0.02 Pa-s
Yield Point:	10.00 Pa
Cutting Size:	20 mm
Cutting Density:	1,800.00 kg/m³
Slip Velocity:	26 m/min
ECD MD:	1,794.29 m
ECD TVD:	486.60 m
ECD:	1,188.37 kg/m³

Bit Hydraulics Summary

Bit PD:	8,612 kPa
% of Total PD:	32 %
Bit HHP:	123 kW
Bit HHSI:	7 W/mm²
Impact Force:	1,599 N
Jet Velocity:	139 m/sec

System Pressure Losses

Surface (Type 3):	99 kPa
Drillstring:	5,117 kPa
Downhole Motor:	6,206 kPa
Other BHA:	5,000 kPa
Annulus:	1,855 kPa
Drill Bit:	8,612 kPa
Total:	26,889 kPa
Fluid Model:	Bingham

Drillstring Details

Component Type	Description	Outside Diameter (mm)	Inside Diameter (mm)	Length (m)	Cumulative Length (m)	Volume (m³)	Pressure Drop (kPa)
DP (S) - Used - Premium	4" DP (S) NC46(IF) - 15.70 lb/ft	102	82	338.47	1,794.29	1.79	539
HWDP	4" HWDP NC40(FH) - 29.70 lb/ft	102	65	800.00	1,455.82	2.68	3,393
DP (X) - Used - Premium	4" DP (X) H90 - 15.70 lb/ft	102	82	600.00	655.82	3.15	976
Sub	5.118" Cross Over	130	58	0.82	55.82	0.00	6
Jar	4 3/4" Mechanical Jar	121	57	4.99	55.00	0.01	38
Sub	5.236" Cross Over	133	63	0.58	50.01	0.00	1
4 3/4" Drill Collar	4 3/4" DC - 44.00 lb/ft	121	64	18.86	49.43	0.06	90
MWD	4 3/4" MWD	121	72	20.29	30.57	0.08	56
Sub	4.843" Float Sub	123	50	1.17	10.28	0.00	16
Sub	4.843" Float Sub	123	50	1.16	9.11	0.00	5,000
Motor	4 3/4" Motor Lobe 4:5 - 6.3 stg	121	57	7.73	7.95	0.00	6,206
Bit	6" Bit	152	57	0.22	0.22	0.00	2

Annulus Details

Section Description	Hole I.D. (mm)	Pipe O.D. (mm)	Section Length (m)	Depth Range From (m)	Depth Range To (m)	Annular Volume (m³)	Critical Velocity (m/min)	Annular Velocity (m/min)	Pressure Drop (kPa)
7in Casing	166	102	338.47	0.00	338.47	4.59	130	63 L	362
7in Casing	166	102	661.53	338.47	1,000.00	8.97	130	63 L	708
171mm Open Hole	171	102	138.47	1,000.00	1,138.47	2.07	127	57 L	130
171mm Open Hole	171	102	600.00	1,138.47	1,738.47	8.99	127	57 L	565
171mm Open Hole	171	130	0.82	1,738.47	1,739.29	0.01	148	88 L	2
171mm Open Hole	171	121	4.99	1,739.29	1,744.28	0.06	139	74 L	8
171mm Open Hole	171	133	0.58	1,744.28	1,744.86	0.01	152	94 L	1
171mm Open Hole	171	121	18.86	1,744.86	1,763.72	0.22	139	74 L	29
171mm Open Hole	171	121	20.29	1,763.72	1,784.01	0.24	139	74 L	31
171mm Open Hole	171	123	1.17	1,784.01	1,785.18	0.01	141	77 L	2
171mm Open Hole	171	123	1.16	1,785.18	1,786.34	0.01	141	77 L	2
171mm Open Hole	171	121	7.73	1,786.34	1,794.07	0.09	139	74 L	12
171mm Open Hole	171	152	0.22	1,794.07	1,794.29	0.00	214	177 L	2

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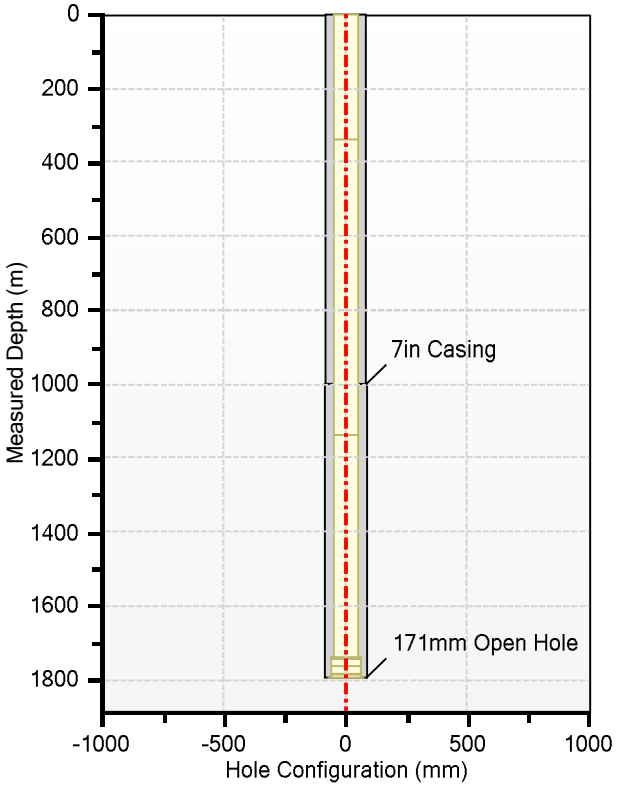

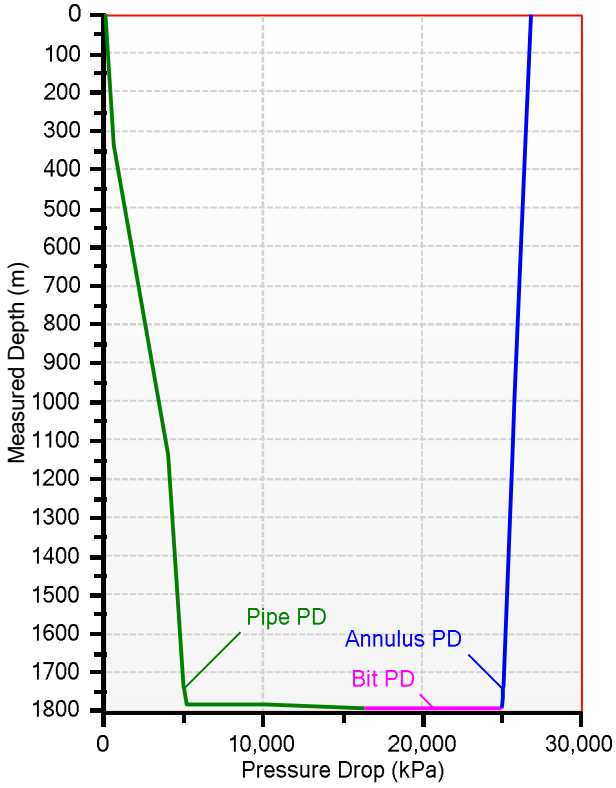

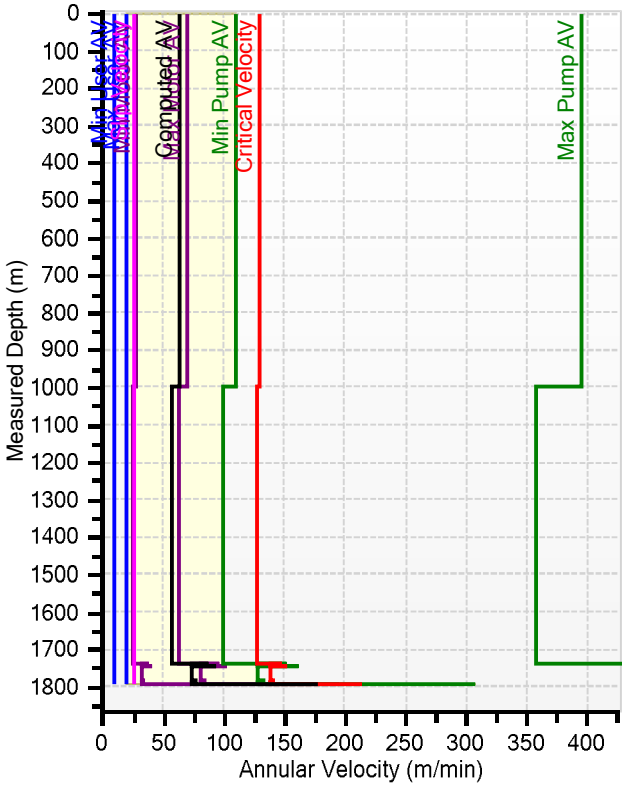

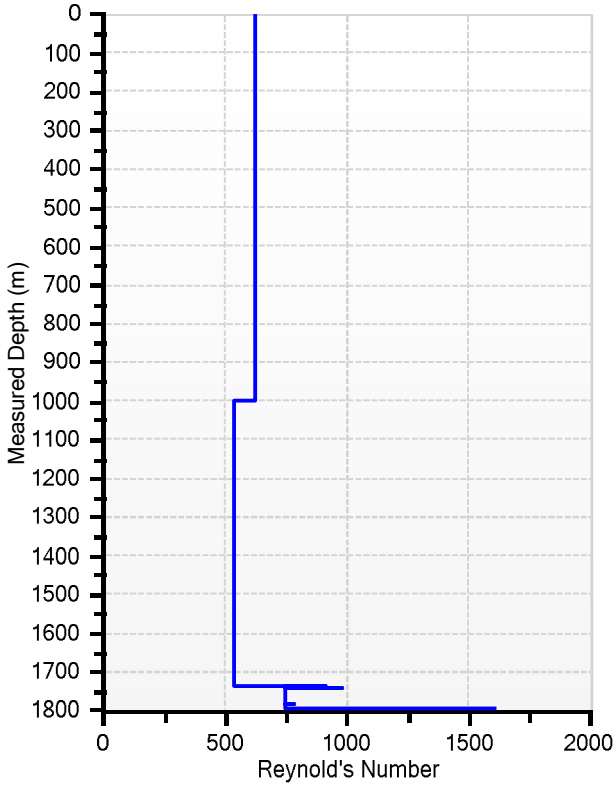

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Operating Parameters

Bit Depth (m)	Bit Diameter (mm)	Mud Weight (kg/m³)	Plastic Viscosity (Pa-s)	Yield Point (Pa)	Cutting Size (mm)	Cutting Density (kg/m³)	Slip Velocity (m/min)	ECD MD (m)	ECD TVD (m)	Computed ECD (kg/m³)
1,794.29	152	800.00	0.02	10.00	20	1,800.00	26	1,794.29	486.60	1,188.37

Optimized TFA

	Units	Min	1	2	3	4	5	6	7	8	9	Max
Flow	m³/min	0.15	0.29	0.42	0.56	0.70	0.83	0.97	1.11	1.24	1.38	1.51
SSP	kPa	26,890	26,890	26,890	26,890	26,890	26,890	26,890	26,890	26,890	26,890	26,890
Bit TFA	mm²	14.7	28.3	42.6	58.3	76.5	98.0	124.6	160.1	213.4	315.6	831.2
Bit PD	kPa	13,042	12,732	12,221	11,382	10,206	8,891	7,442	5,866	4,167	2,347	409
HHP	kW	33	61	86	106	118	123	120	108	86	54	10
HHSI	W/mm²	2	3	5	6	6	7	7	6	5	3	1
Bit IF	N	346	650	939	1,197	1,409	1,573	1,674	1,696	1,605	1,337	613
Bit JV	m/min	172	169	166	160	152	142	130	115	97	73	30