

Centrica Production Nederland B.V.

Winningsplan J3b/J6

September 2017

A. General data

A.1.1 Name applicant

Centrica Production Nederland B.V.

A.1.2 Address

Polarisavenue 39
2132 JH Hoofddorp

A.1.3 Contact

5.1.2.e

A.1.4 Email

5.1.2.e @centrica.com

A.1.5 Telephone

5.1.2.e

A.1.6 Applicant

The applicant is holder of the production licenses and is the designated operator in accordance with Article 22 of the Mining Act. The Dutch production licenses are shared with the following partners; Dyas B.V., Total E&P Nederland B.V. and EBN B.V. The UK production licenses are shared with Euroil Exploration Limited, Total E&P UK Plc, Ineos UK Limited.

A.2 Production license area(s)

The Markham field is located in the Dutch license area J3b and J6 and in the UK sector within licenses 49/5a and 49/10b. See Appendix I location map

A.2.1 Hydrocarbon accumulations

The Markham field currently estimated to have a Static GIIP of 20.9 GNm³.

A.2.2 Composition of hydrocarbon produced

PVT properties are detailed in the table below.

Property	Units	Value
Gas Gravity	(air = 1)	0.65
Reservoir Datum Pressure, P_i	bara	394
Reservoir Datum Temperature, T_i	°C	112
Datum Depth	m TVDss	3495
Gas Expansion Factor	vol/vol	272
CO ₂	mol %	1.27
H ₂ S	ppm	nil
N ₂	mol %	6.75

The separator gas analysis performed at the lab gives the following Markham Gas composition as in the table below.

Component	Mol%
Hydrogen Sulphide	0.00
Carbon Dioxide	1.53
Nitrogen	5.68
Methane	78.58
Ethane	5.05
Propane	1.31
i-Butane	0.22
n-Butane	0.31
i-Pentane	0.11
n-Pentane	0.11
Hexane	0.13
Heptane+	0.12
Total	100%

A.3 Existing or new produced

The production plan is for existing production.

B. Company and production data

B.1 Description of production method by means of mining work

The Markham unit crosses the Dutch/UK median line in the Southern North Sea being located in blocks 49/5a and 49/10b on the UK side and blocks J3b and J6 in the Netherlands sector. It is about 170km Northwest of Den Helder in the Silverpit basin in 36m water depth. The field was discovered in April 1984 by well 49/5a-2 with a further UK appraisal well in August of the following year. The first Dutch exploration well J6-01 was drilled in 1987 confirming the extension of the Markham field across the median line.

Markham is developed in four phases via three platforms. Firstly, the main central processing, wellhead, accommodation and compression platform located in the Dutch sector J6A was installed in 1992 with four production wells A1, A2, A3 & A4. An unmanned platform (ST1) in the UK sector was then tied back to J6A in 1994 and has subsequently had the 6 B-wells drilled from it. Thirdly a compression module was added to the main J6A platform in 1996. The fourth stage of Markham development is the 2006 installation of the new low low pressure (LLP) compression platform (Markham CT) which houses another stage of compression facilities for Markham field gas and several risers and reception facilities for new incoming fields. Together the platforms that comprise Markham have processing capacity of 10.7 MNm³/d which leaves capacity for additional equity or third party processing.

Gas and condensate is transported from Markham to the Wintershall operated K13 platform and then through the Westgastransport pipeline to Den Helder. At Den Helder the gas and condensate are separated, treated, metered and delivered to the GTS network entry point at Balgzand. Condensates are stabilized and stored prior to transportation by barge.

B.2 Geological description of accumulation(s)

The Markham field is located in the central part of the Southern Permian Basin, south of the Silverpit Lake and North of the Cleaver Bank High. The field lies along the northern margin of the Permian Rotliegend sandstone fairway where the majority of the sequence comprises the predominantly argillaceous Silverpit Formation. However, in the basal Rotliegend section, the Slochteren/Leman Sandstone Formation is well developed, with porosities ranging from 12-22%, and forms the gas-bearing reservoir of the Markham field.

The overall trapping mechanism in the Markham field is a four-way dip closure, with a two major structural culminations. The eastern lobe is a well-defined horst feature bounded by a NNW/SSE trending fault. On the western side of the horst the faulting is more complex, comprising a set of three differing trends. The Rotliegend Silverpit Formation is acting as seal with an ultimate top seal of the Zechstein. The underlying Carboniferous section consists of deltaic sediments with interbedded sandstones, shales, and coals of Westphalian age. These coals act as source rock and generated the gas present in the Markham field.

See appendices II and III for a top reservoir map and field cross section.

B.3 Schematic overview accumulation

The Markham unit crosses the Dutch/UK median line in the Southern North Sea being located in blocks 49/5a and 49/10b on the UK side and blocks J3b and J6 in the Netherlands sector.

See Appendix I location map.

B.4 Well Casing design

B.4.1 Well casing design

See Appendices IV and V for the well casing design and the well completion design. The J6-A1 well is shown as an example.

B.4.2 Location where hydrocarbons enter the casing

The Markham wells have been perforated across a cemented liner in the Lower Leman Sandstones. The wells are all completed with a tubing and packer incorporating a scsssv at a shallow depth in the wellbore.

B.5 Production-development strategy

The total GIIP of the Markham field is estimated at 20.9 GNm³, of which 17.9 GNm³ had been produced at 31st August 2017. The field is nearing end of field life and the strategy is to maintain tail end production and optimize using foam injection.

B.5.1 Production philosophy

The Markham reservoir has been producing from a total of 10 wells over 2 production platforms, the manned J6A platform and the unmanned ST-1 NUI. Six B-wells are located on the ST-1 NUI, with the remaining four A-wells being on the J6A platform. From these original 10 production wells the J6A, A4 well is the Markham field's core producer with the A1 and A3 wells contribution intermittent due to their dependency on foam injection and cyclic production. The ST-1 platform has reached cessation of production as of March 2016 and decommissioning plans and currently being worked up. Apart from Markham, gas from seven satellite fields (Chiswick, Kew, Grove, K4aD, J3C and K1A) are processed on the J6A platform. The J6A-CT platform was installed next to the J6A platform and commissioned in February 2007, including incoming risers and LLP compression (5 barg on J6A).

B.5.2 Reservoir management

The water treatment of the J6A gas production platform, up until 2008, had a pre-skimmer vessel, filter coalescing unit and skimmer tank. In 2008 it became necessary to modify this water treatment facility to ensure that overboard water quality would remain in line with regulatory demands.

To dispose of the process water which flowed onto the J6A platform, the A2 well was converted into a produced water re-injector (PWRI) well to dispose of the process water into the Markham reservoir. This solution almost eliminates the emissions to the environment (open drain water is still discharged overboard). The produced water flow on J6A consists of produced water from Centrica's own platform wells and the surrounding fields tied back to the J6A platform.

The A2 PWRI was used to dispose of the GMA's process water since 2014 and since then has had a series of blockages where injection had to be stopped. This has been investigated and remediated. However the issue has not been resolved and the Markham A2 well has been offline since March 2017 due to a second rise in THP. Alternative wells will be assessed for suitability for injection to be commissioned as a back-up or new injection well.

The field is currently (Q3 2017) producing at a gross rate of 100,000 – 250,000 Nm³/day on LLP compression (± 5 barg suction pressure), the range in the gas rate is due to the A4 well the only core producer at 100,000 Nm³/day while other wells production contribution are cyclic. The A1 and A3 wells that contribute to the Markham field's production are cyclic and foam injection dependent, which contribute an additional 110,000 Nm³/day and 40,000 Nm³/day respectively. To aid the injection of foam into these wells a permanent water/foam injection skid has been successfully installed and integrated into the Markham field production philosophy.

B.5.3 Production volume (amounts produced per accumulation / per year)

The accumulation has an estimated dynamic volume of 20.9 GNm³ with an estimated recovery factor of 85%. The PRMS classification table shows that the static and dynamic volumes are very much inline.

PRMS Resource Classification (2P)		
GIIP	Volumetric	21.0 GNm ³
	Dynamic	20.9 GNm ³
Cumulative Production (as of mid-2017)		17.9 GNm ³
Remaining Production (as of mid-2017)	Low Case	6.3 MNm ³
	Mid Case	9.9 MNm ³
	High Case	35.4 MNm ³

The expected production numbers are shown in the table below. The profiles assume cyclic tail end production. This includes foam lift which has been adopted as standard practice within the Markham field.

Remaining Production Prognosis			
As of mid-2017	Volume, MNm ³	Volume, MNm ³	Volume in, MNm ³
Year	Low	Mid	High
2017	6.3	9.9	20.7
2018			14.6

B.5.4 Duration of production (for each accumulation)

It is anticipated that in the base case the Markham field will produce until Q4 2017 and assuming further intermitted gas production in the high case the field could maintain deliverability until end 2018.

B.6 Substances that are co-produced annually

Together with the hydrocarbon gas the annual co-produced condensate and water are approximately, 860 Sm³ and 2200 m³ respectively.

B.7 Quantities of hydrocarbons produced that are annually needed for ‘own use’

The own usage on compression will be approximately 2.9 MNm³ of gas per year.

B.8 Quantities of hydrocarbons produced that are flared or vented annually

Under normal operating conditions the annual vent gas will be approximately 24 kNm³ of gas per year.

B.9 Quantities of minerals and other substances that are annually re-introduced into the subsurface

The J6-A2 PWRI well is being used as the water disposal well for the Greater Markham Area producing gas fields, which are tied back to the J6A receiving facility. The fluids introduced to the reservoir are produced water (i.e. excluding rain and deck-water). This amounts to approximately 30,000 m³ of injected water per year.

D. Detailed company and production data (confidential)

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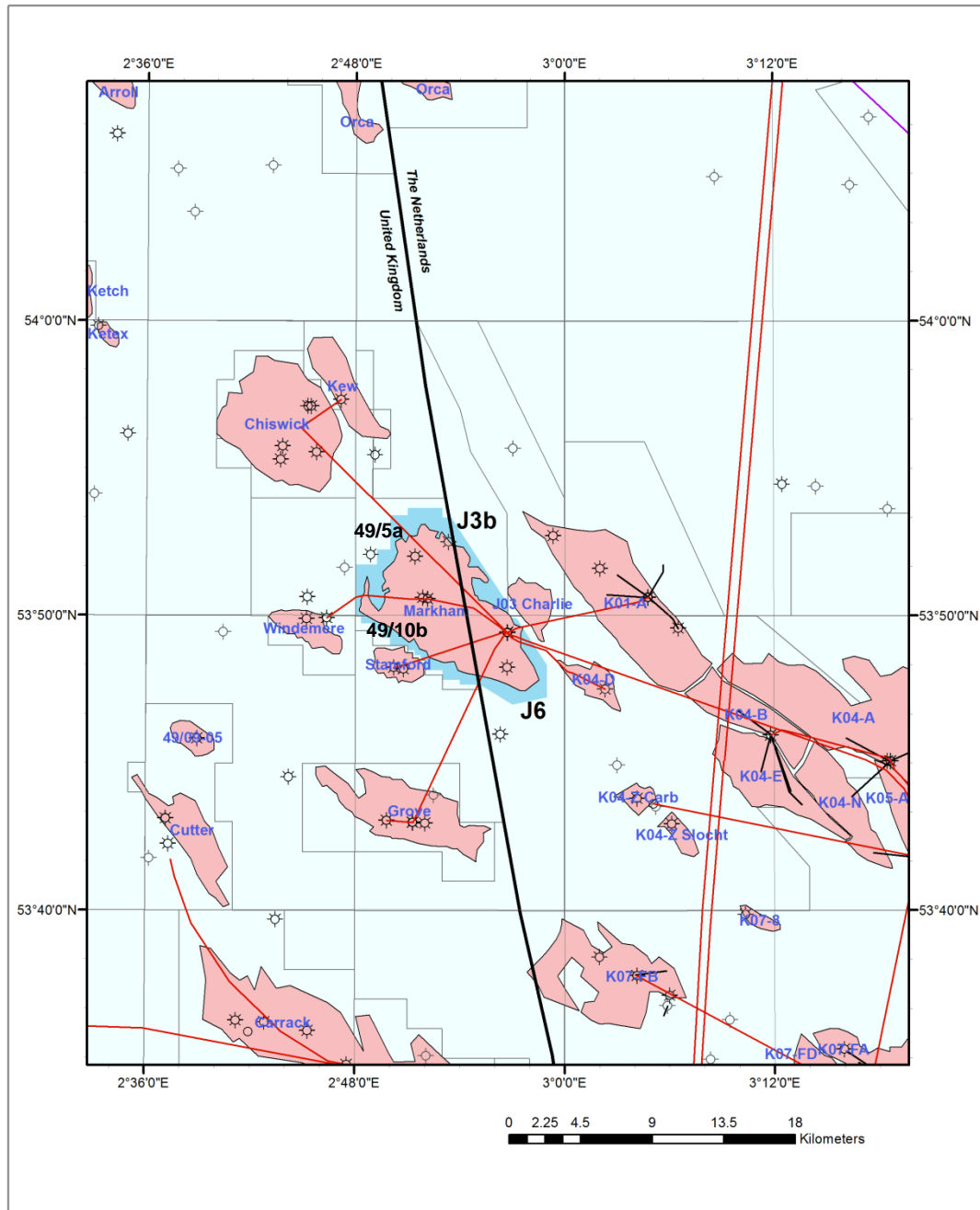
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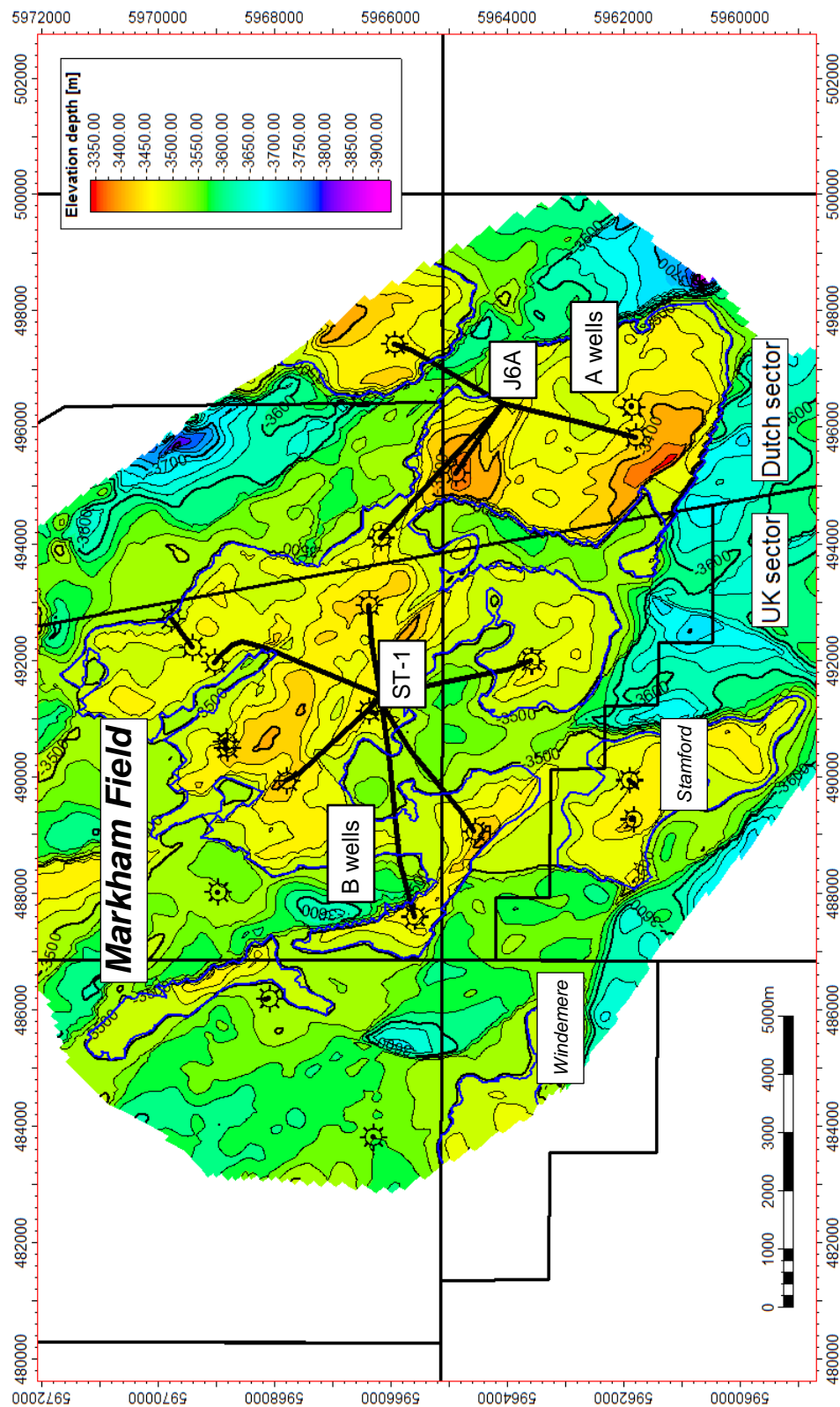
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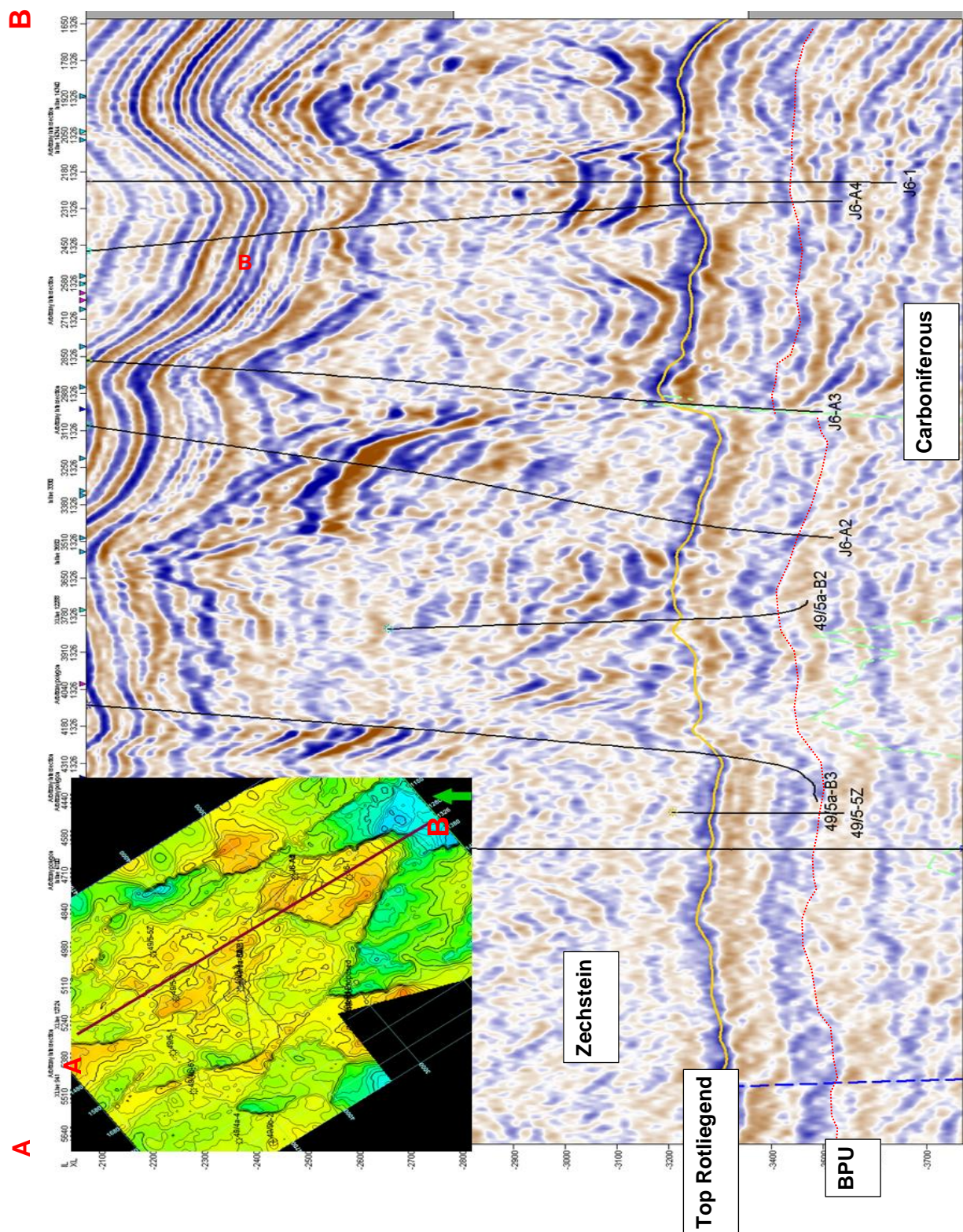
Appendix I Location Map



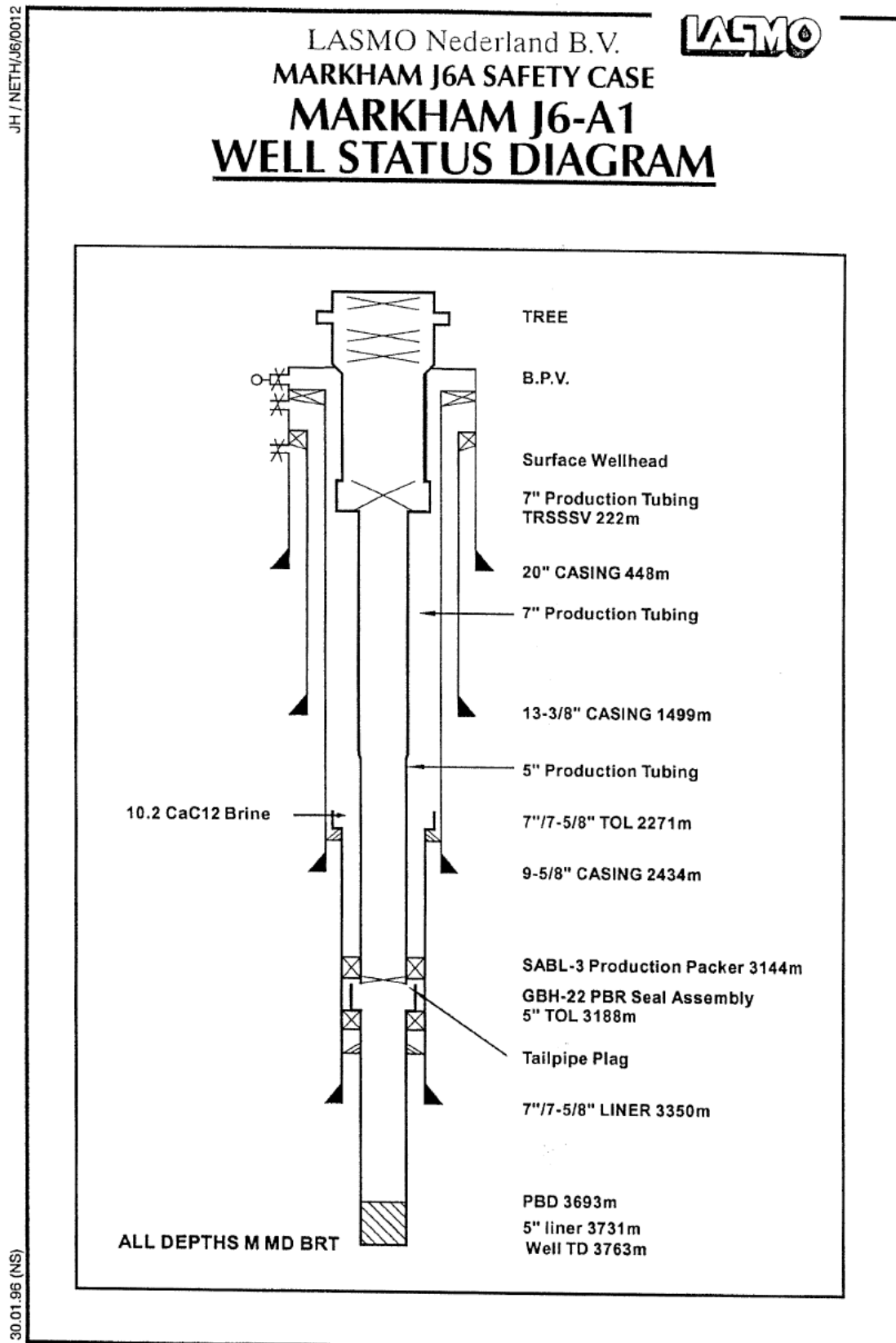
Appendix II Top Reservoir Map (Lower Lemn Sst)



Appendix III NW-SE Cross Section



Appendix IV Well Casing Design (J6-A1)



Appendix V Well Completion Design (J6-A1)

JH / NETH/J6/0018

LASMO Nederland B.V. MARKHAM J6A SAFETY CASE MARKHAM COMPLETION SCHEMATIC WELL J6-A1					
NO	DESCRIPTION	ID (INS)	OD (INS)	LENGTH (M)	DEPTH (M)
5	TOP OF SWAB			1.150	0
1	CAMERON TUBING HANGER	8.312		0.255	1.150
2	PUP JOINT 7" FOX	8.184	7.656	1.475	1.405
3	PUP JOINT 7" FOX	8.184	7.656	1.809	2.880
4	PUP JOINT 7" FOX	8.184	7.656	5.980	4.689
5	PUP JOINT 7" FOX	8.184	7.656	2.330	10.649
6	PUP JOINT 7" FOX	8.184	7.656	1.480	12.979
7	PUP JOINT 7" FOX	8.184	7.656	1.240	14.459
8	TUBING JOINT 7" FOX (14 JOINTS)	8.184	7.656	189.638	15.899
9	PUP JOINT 7" FOX	8.185	7.800	1.880	185.337
10	BAKER FLOW COUPLING 7" FOX	8.175	7.810	1.950	187.217
11	BAKER 'L' SV NIPPLE 7" FOX	5.750	8.230	1.100	189.087
12	FLOW COUPLING 7" FOX	8.178	7.800	1.850	190.187
13	PUP JOINT 7" FOX	8.195	7.815	1.280	192.017
14	TUBING JOINT 7" FOX (1)	8.184	7.656	12.112	193.297
15	PUP JOINT 7" FOX	8.190	7.805	1.895	205.409
16	FLOW COUPLING CROSSOVER 7" x 5 1/2" FOX 20"	4.777	7.821	1.865	207.104
17	BAKER FVLE TR55SV 5 1/2" FOX 20"	4.581	8.391	3.170	208.989
18	FLOW COUPLING CROSSOVER 7" x 5 1/2" FOX 20"	4.911	7.820	1.855	212.139
19	PUP JOINT 7" FOX	8.190	7.804	1.270	213.994
20	TUBING JOINTS 7" FOX (166 JOINTS)	8.184	7.656	2009.455	215.264
21	PUP JOINT 7" FOX	8.165	7.816	1.890	2224.719
22	CROSSOVER SUB 7" FOX x 5" FOX	4.415	7.830	0.340	2228.809
23	PUP JOINT 5" FOX	4.420	6.485	1.280	2228.949
24	TUBING JOINTS 5" FOX (74 JOINTS)	4.408	5.563	897.050	2228.209
25	PUP JOINT 5" FOX	4.401	5.420	1.800	3125.250
26	BAKER FLOW COUPLING 5" FOX	4.420	5.421	1.280	3127.050
27	BAKER 'AOF' NIPPLE 5" FOX	4.125	5.622	0.680	3128.319
28	PUP JOINT 5" FOX	4.408	5.422	1.280	3128.979
29	PUP JOINT 5" FOX	4.408	5.563	1.870	3130.239
30	BAKER KC-225 ANCHOR 5" FOX BOX UP	3.875	5.563	0.820	3132.109
31	BAKER SABL-3 PACKER 85-47X38	3.875	5.875	1.400	3132.929
32	BAKER PACKER MILLOUT EXTENSION 5" FOX FIN/PIN	4.408	5.000	1.900	3134.329
33	BAKER CROSSOVER SUB 5" FOX x 4 1/2" FOX	3.943	5.444	0.290	3138.229
34	PUP JOINT 4 1/2" FOX	3.931	4.926	1.280	3138.519
35	TUBING JOINT 4 1/2" FOX	3.920	5.000	12.180	3137.799
36	PUP JOINT 4 1/2" FOX	3.930	4.931	1.855	3149.959
37	BAKER FLOW COUPLING 4 1/2" FOX	3.900	4.980	1.255	3151.814
38	BAKER 'OAR' NIPPLE 4 1/2" FOX	3.625	5.253	0.820	3152.089
39	TUBING JOINT 4 1/2" FOX	3.930	4.930	1.190	3153.889
40	TUBING JOINT 4 1/2" FOX	3.920	5.000	12.000	3154.879
41	PUP JOINT 4 1/2" FOX	3.931	4.936	1.840	3168.879
42	BAKER FLOW COUPLING 4 1/2" FOX	3.911	4.980	1.260	3168.719
43	BAKER 'AOF' NIPPLE	3.312	4.929	0.680	3169.979
44	PUP JOINT 4 1/2" FOX	3.930	4.933	1.270	3170.659
45	BAKER GBH-22 WDC SEAL 4 1/2" FOX BOX UP	3.988	5.847	1.720	3171.929
46	5" LINER 15# FL45 CR				3173.849

PERFORATED INTERVAL: 3637M - 3651M MD

REF LOG: LOG/ENL GR OF 1501.89

ALL DETAILS ARE REFERENCED TO SWAB VALVE

NB: 7" FOX TBG - 20LBS/FT L80 13CR
 5" FOX TBG - 15LBS/FT L80 13CR
 4 1/2" FOX TBG - 12LBS/FT L80 13CR
 (18 CONTROL LINE PROTECTOR CLAMPS USED)

PACKER PRE-SET HIGH WHEN UNABLE TO ENTER 5" PBR WITH BAKER GBH-22 SEAL ASSY LOG,
 SEAL ASSY IS THEREFORE ABOVE 5" PBR - LENGTH OF SEAL ASSY IS FULL LENGTH NOT EFFECTIVE LENGTH

(5" LINER DEPTHS 3175M BSV TO 3681M BSV)

18.01.96 (NS)

Appendix VI Markham Field Well Status

