GEOSTOCK

INEOS

KEUPER GAS STORAGE PROJECT

PRELIMINARY STUDY OF GAS CAVERN STORAGE DESIGN CAPACITY

IEL/R/J/0002 (GK-INS41-SAL-RPT-0001-0)

MAIN PURPOSE OF THE REVISION AND TYPE OF MODIFICATIONS

Rev. B	Revised with Hydrogen Gas
Rev. A	Revised with 2021 Data / Updated Format
Rev. 0	Original Issue

REVISION **B** DATE **31 MAY 2021** STATUS **RFA** PAGES **24**

ISSUED (NAME, SIGNATURE)	**CHECKED** (NAME, SIGNATURE)	**APPROVED** (NAME, SIGNATURE)
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[redacted]

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1. Executive summary

Keuper Gas Storage Limited (KGSL), a wholly owned subsidiary of INEOS Enterprises Group Limited (INEOS), is looking to develop a new gas storage project (the Keuper Gas Storage Project, or 'KGSP') in the southern part the Holford Brinefields and the surrounding area to the north of Middlewich.

B Hydrogen is now considered as an option for the stored gas and the project design and engineering documents have been updated to reflect both natural gas and hydrogen use for the storage.

Cavern locations proposed by KGSL have been verified on the basis of preliminary geotechnical rules (pillar over diameter ratio).

Cavern geometry and, in particular, cavern height have been set up using geological data derived from the seismic campaign data shot by TESLA Exploration International Ltd (England) under the supervision of Geostock in November 2013 and Geostock standard practices on solution mining. The results of the seismic surveys are
A included in Geostock Report IEL/Y/J/0002-Rev. A issued in July 2014. These values have been updated in May 2021 with the latest data from the wells drilled on the brinefield.

Cavern operating parameters (pressure and temperature range) have been set on the basis of preliminary design rules and Geostock experiences.

Based on all the above assumptions, the working and cushion gas volume of the KGSP have been estimated.

At this stage of the KGSP, the gas volume estimates should be regarded as being accurate to within ±20 %.

The total working and cushion gas volume (19 new caverns) estimated in this study are listed in the following table:

Gas	Total gas capacity ($MMsm^3$)	Total working gas volume ($MMsm^3$)	Total cushion gas volume ($MMsm^3$)
A Natural gas	822	552	270
B Hydrogen	644	405	239

2. Introduction

KGSL requested Geostock to estimate the gas storage design capacity of up to 19 caverns for the KGSP in the southern part of the Holford Brinefield.

The proposed KGSP cavern implementation plan is presented in Appendix 1.

A The salt formation depth levels (top and bottom level) have been derived from the Seismic Campaign Interpretation Report prepared by Geostock (Report IEL/Y/J/0002-Rev. A). These values have been updated in May 2021 with the latest data from the wells drilled on the brinefield.

The following documents and data have been reviewed for this study:

- KGSP cavern's implementation plan,
- Geology of Byley,
- Seismic campaign interpretation,
- ELAN interpretation of well Drakelow 2A,
- A Wells drilled for brine production on the brinefield,
- A Wells drilled for the Holford and Stublach gas storage projects,
- A Caverns created for the Holford and Stublach gas storage projects.

3. Cavern layout

As presented in the map 13-03-01/HOL/60/228-P1, up to 19 caverns are proposed for the KGSP.

The minimum cavern spacing between these new caverns varies from 275 m to 534 m as presented in the following table:

Cavern	Adjacent cavern	Cavern spacing (m)	Cavern	Adjacent cavern	Cavern spacing (m)
H501	H510	315	H511	H509	275
H502	H406	289	H512	H504	277
H503	H517	276	H513	H512	300
H504	H505/H507	275	H514	H515	277
H505	H504	275	H515	H516	276
H506	H516	279	H516	H515	276
H507	H504	275	H517	H503	276
H508	H408	333	H518	H519	300
H509	H511	275	H519	H518	300
H510	H502	295			

The P/D ratio is calculated as follows:

- P: Minimum pillar width between two neighbouring caverns.
- D: average diameter of two neighbouring caverns.

A

At this stage of the KGSP, we consider that a minimum P/D of 1.70 (as for "Holford" gas storage caverns) is required. Holford project geotechnical models and simulations described in Geostock reports BYL/R/J/0003 and BYL/R/J/0005 have shown that caverns complying with this requirement and operated within allowable pressure range meet the main geotechnical stability criteria:

Criterion 1: the no-tension criterion

Although salt can sustain moderate tensile stresses (salt tensile strength is limited to 1.5 – 2 MPa), its behaviour becomes brittle under tension load and it is recognized that a sound design should not lead to its occurrence in the simulations. Cavern roof stability and integrity near the well cementation may particularly be challenged under this condition.

Tensile stresses can result from over pressurization of the cavern or from a thermal shock due to gas cooling during a production period. Another possible reason for the occurrence of tensile stresses would be the roof sagging as a result of excessively large cavern roof span.

For the sake of conservatism, no tensile stress is acceptable on the cavern wall.

Criterion 2: the creep strain criterion

The magnitude of the creep strain in the rock salt must not exceed a given limit in the long term. Laboratory experiments show that salt is highly ductile when submitted to compressive loading at slow strain rate and under lateral confinement. Samples can sustain large deformation without failure. However, for design purposes, it is recommended to limit the creep strain at the salt pillar in the range of 5 % to 10 %.

The creep strain in the rock salt around the casing shoe should be limited to 0.3 %.

Criterion 3: the dilation/damage criterion

It is now widely accepted that rock dilation, i.e. an increase in the volume of rock submitted to deviatoric stresses, is an excellent indicator of damage. Onset of dilation is given by a stress criterion.

In general, the dilation criterion is expressed in terms of the second invariant of the deviatoric stress tensor and the first invariant of the stress tensor. As a simple criterion, deviatoric stresses in the salt pillar must be limited to approximately 20 MPa.

Criterion 4: Gas permeation

The risk of gas permeation into the rock mass is evaluated based on the value of the tangential stresses along the cavern wall during operation. It is generally admitted that the gas permeation can occur when the tangential stresses at the cavern wall are less compressive than the normal stress (equal in magnitude to the gas pressure) acting on the wall of the cavern.

Assuming a design diameter of 100 m, the minimum distance between cavern wellheads must be 275 m.

A The wellheads (or casing shoes if known) of the adjacent field caverns (Holford Gas Storage and Stublach Gas Storage) are above 275 m from the proposed KGSP caverns.

A Stublach Gas Storage caverns are located at a distance greater than 305 m from the proposed nearest KGSP caverns, and the Holford Gas Storage caverns are at least 282 m away.

A

Cavern	Adjacent cavern	Cavern spacing (m)
H502	H406	289
H509	H403	277
H509	H401	283
H511	H404	282

A In the current layout of the KGSP caverns, the smallest salt pillars are related to Holford gas storage caverns (H401, H403, H404 and H406).

A Assuming a design cavern diameter of 100 m for new KGSP caverns and considering the 'worst case' orientation of Holford caverns (i.e. the widest dimension of the Holford cavern is oriented towards the KGSP cavern), the minimum distance between cavern walls are satisfying the minimum required pillar to diameter ratio of 1.7:

Pillar	Pillar width	P/D	Safety factor (vs 1.7)
H502 - H406	188	1.87	1.10
H509 - H401	183	1.82	1.07
H509 – H403	176	1.73	1.02
H511 – H404	180	1.76	1.03

Thus, the proposed KGSP cavern layout complies with the geomechanical preliminary rules.

4. Cavern geometry

4.1. Leaching interval

As a general rule, the cavern roof depth is set about one cavern radius below the top salt level.

A The casing shoe of the KGSP caverns is set below the G_1 marl band (between 104 m and 147 m below the salt top). This is due to a number of factors, including the presence of marl layers in the upper salt and a limited free volume creation, if mined.

A minimum cavern neck height of 15 m is required between the casing shoe and the cavern roof.

A A minimum length of 5 m is required between the cavern bottom (leaching start depth) and the salt bottom level.

These design rules and the geometry of the cavity are summarized in Appendix 2.

Based on the seismic campaign results, the salt top and bottom depth and chosen leaching interval for each cavern are presented in Appendix 3.

A The location of the casing shoe and leaching start depth could vary up to 10 m for each cavern from current estimates. The exact depths will be confirmed during the drilling of the wells.

4.2. Cavern free volume

Based on site experience, the following assumptions have been made to estimate the cavern free volume:

- average insoluble content in the leaching interval: 26 %.
- insoluble bulking factor: 1.5.
- cavern roof angle: 20°.
- A cavern bottom angle (dissolution angle): 30°.
- A shape factor (irregular leached cavern volume over regular geometry envelope): 0.825.
- free volume ratio (Gas physical volume over free leached cavern volume including remained brine): 0.98.

Cavern estimated free volumes are presented in Appendix 3.

A Depending on geological conditions and the actual results of the solution mining phase, the caverns shape factors could vary from 0.75 to 0.85 but for the base case estimates, the value of 0.825 has been taken.

5. Caverns operating parameters

Based on Geostock standard practice and experience, at this preliminary stage of the KGSP, operating pressure limits of caverns are set as follows:

- The maximum cavern pressure is set to 0.185 bar/m x casing shoe depth limited to 75-80 % of the natural least compressive stress.
- The minimum cavern pressure is set to 0.052 bar/m x cavern 2/3 depth (at least 30 % of Pmax).

These figures have been used and validated in many projects and are consistent with the operating pressure limits currently in use at the Holford and Stublach gas storages, which are operated next to the KGSP location and has similar characteristics (same salt strata and same cavity design).

As a preliminary rule, gas operations must be within these pressure limits to satisfy the criteria set out in section 3.

The vertical stress at the casing shoe is calculated as the weight of the overlying rock column at the casing shoe depth. From the log density measurement performed in the Drakelow 2A well that is located within the cavern field area for KGSP (13-03-01/HOL/60/228-P1), the specific weight of the overburden and the salt layer were estimated at respectively 0.0244 MPa/m and 0.0216 MPa/m.

The maximum and minimum operating pressure of all KGSP caverns as a function of their depth is presented in Appendix 4. As shown in the appendix, the maximum pressure at casing shoe varies between 96 bar to 123 bar and the minimum pressure between 31 bar and 39 bar.

These pressure gradient limits will be validated by geomechanical modelling using updated data from laboratory tests in the later stage of the KGSP.

Based on experience, cavern maximum and minimum temperature are assumed to be as follows:

- Tmax = 40 °C,
- Tmin = 5 °C.

Simulation will be completed during the detailed design phase of the project.

The natural gas composition considered for this study is as follows:

Compound	Methane	Ethane	Propane	Butane	Pentane	Hexane	CO_2	Nitrogen
Molar fraction (%)	87.22	5.66	1.73	0.61	0.17	0.08	1.4	3.13

For hydrogen storage, the stored gas is considered 100 % hydrogen in this study.

6. Working and cushion gas

The base case for the caverns physical free volume and working / cushion gas volume have been estimated using the above presented assumptions and parameters.

A The total usable volume of caverns is estimated at 6 747 000 m^3.

A The estimation of the maximum, minimum and working inventory are given in the following table, for natural gas and for hydrogen:

Gas	Total gas capacity ($MMsm^3$)	Total working gas volume ($MMsm^3$)	Total cushion gas volume ($MMsm^3$)
A Natural gas	822	552	270
B Hydrogen	644	405	239

At this stage of the project, the gas volume estimates should be regarded as being accurate to within ±20 %.

APPENDICES

APPENDIX 1

CAVERN IMPLEMENTATION PLAN

to display the document

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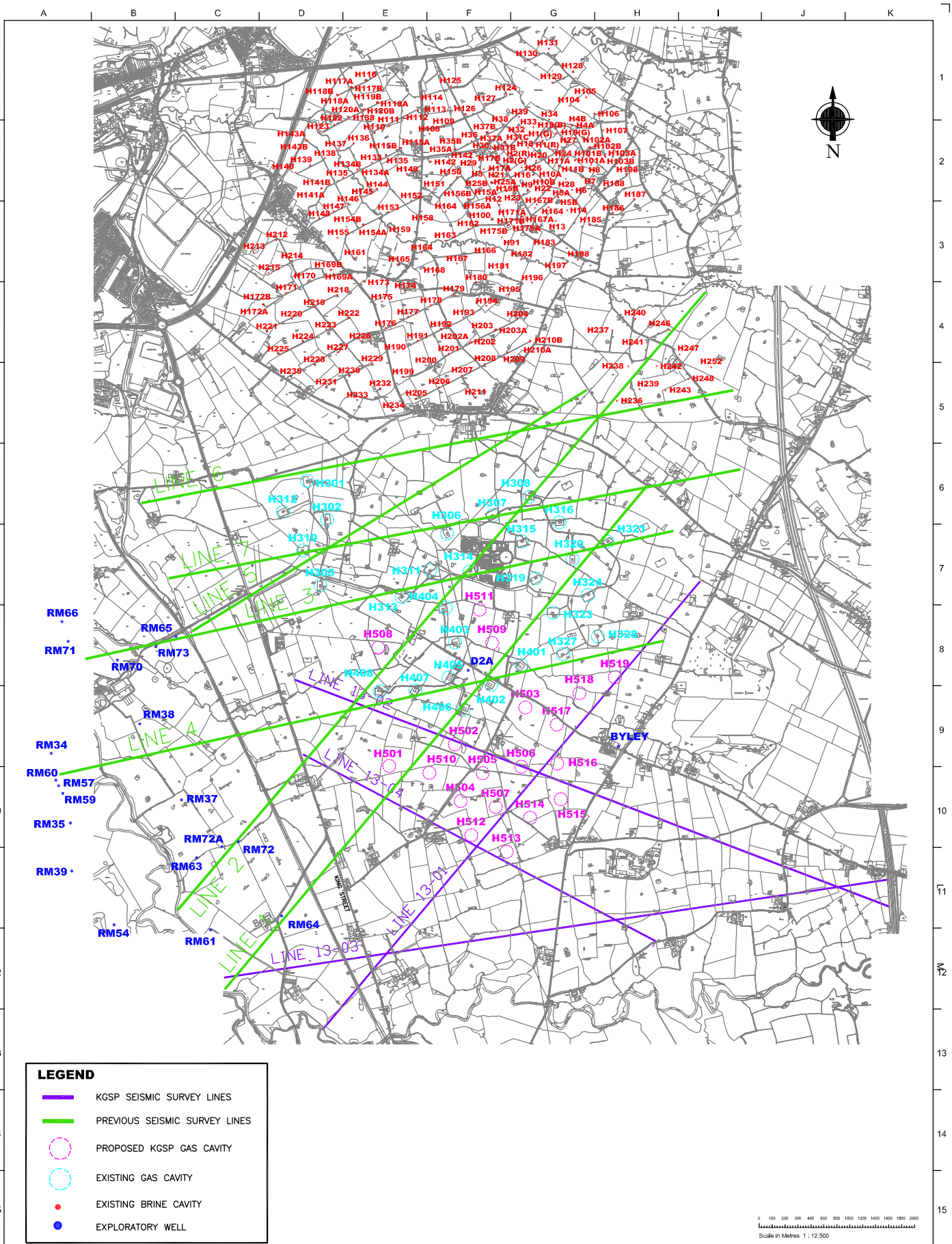

HOLFORD BRINEFIELD - KGSP PROJECT - GEOLOGICAL STUDY AREA

REV			
P1	DEVELOPMENT DRAWING	AS	18.06.2014
REV	ALTERATIONS	CHKD BY	DATE

KEUPER GAS STORAGE LIMITED
BRINE AND WATER SECTION, NORTHWICH SITES,
HOLFORD BRINEFIELD, LOSTOCK GRALAM,
NORTHWICH, CHESHIRE, CW9 7TD.

DRAWN BY	DATE	SCALE
A Skelhorn	18.06.14	1:12,500
CHECKED BY	DATE	SIZE
DP	18.06.14	A1
DWG No.		REV
13-03-01/HOL/60/228		P1

APPENDIX 2

DESIGN RULES AND GEOMETRY OF THE CAVERN

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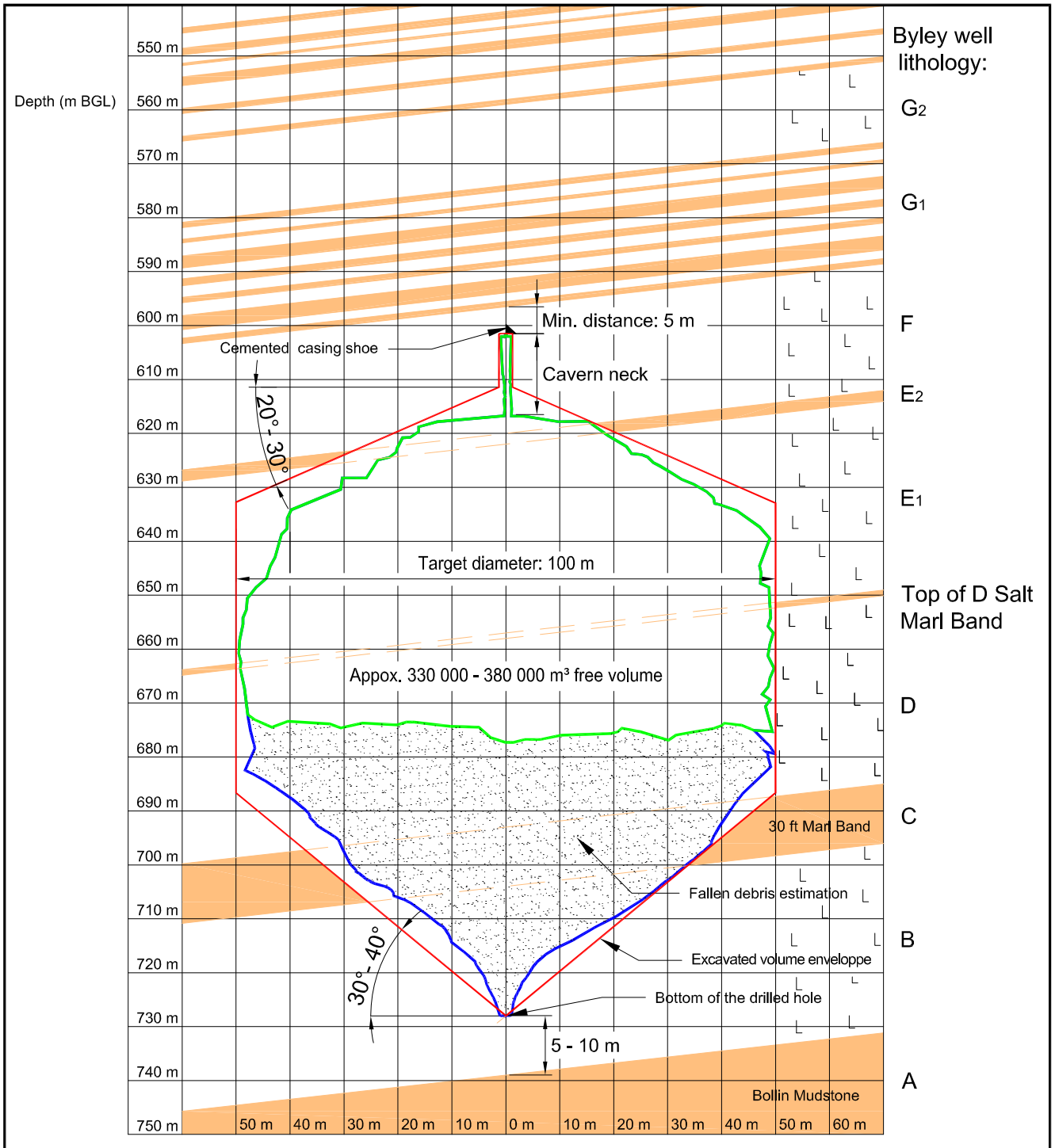

PROJECT MANAGEMENT: GEOSTOCK
PROJECT MANAGEMENT ASSISTANT: | CONTRACTOR:

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GK	0	17/03/14	FIRST ISSUE	JGA	ARE	BCO	ARE	PREL	OWNER	

OWNER: INEOS

INEOS
KGSP PROJECTED CAVITY GEOMETRY

ORIGIN DRAUGHTSMAN	ORG DATE :	GK NUM :		
JGA	17/03/14	IEL/F/S/0001		
COMPANY ORIGIN:	SHEET :	SIZE :	SCALE :	REV.
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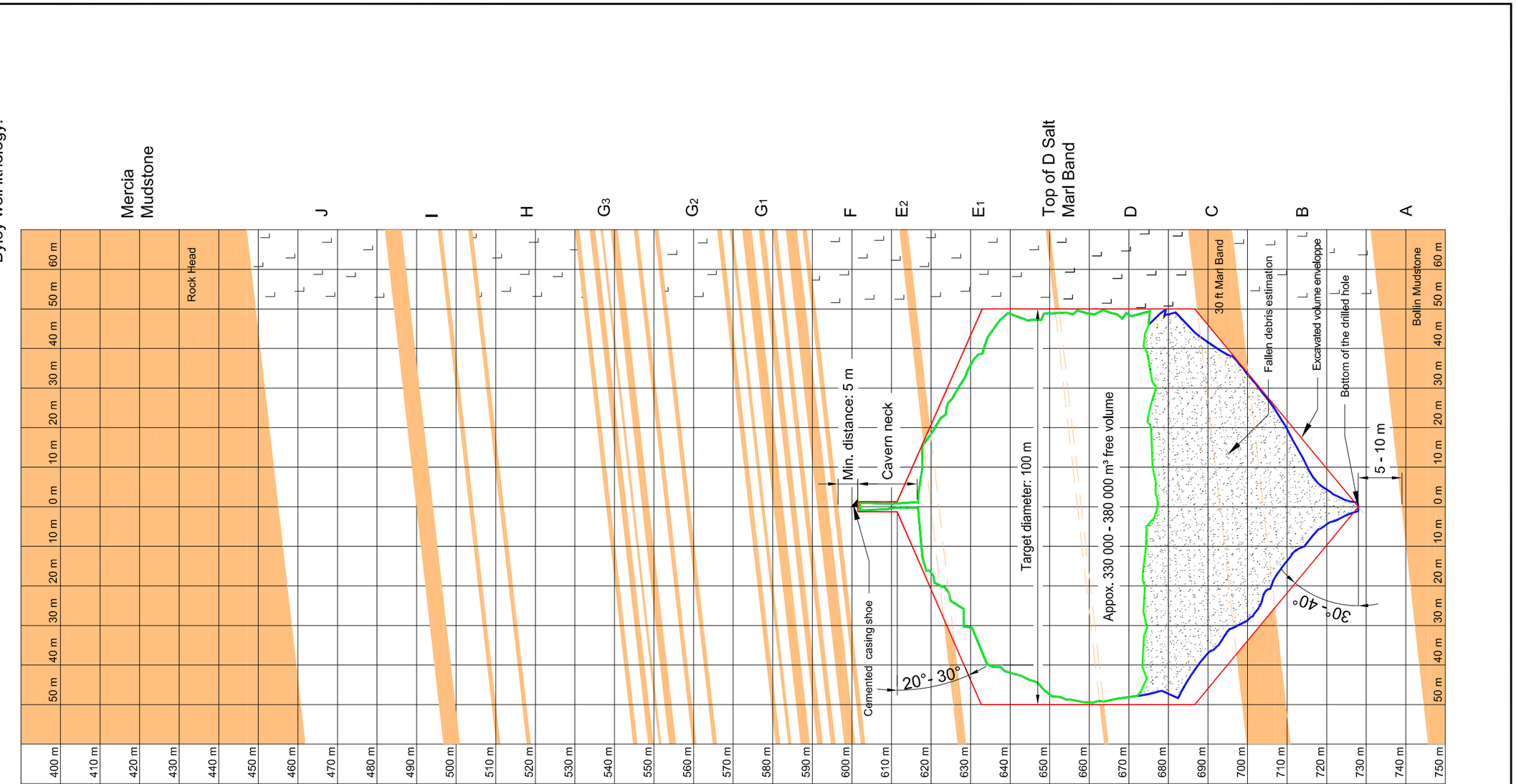

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Company code	REV.	DATE	OBJECT	DRAU	ISSUED	CHECK	APPRO	STAT	OWNER	

PROJECT MANAGEMENT: GEOSTOCK

PROJECT MANAGEMENT ASSISTANT: | CONTRACTOR:

OWNER: INEOS

INEOS

KGSP PROJECTED CAVITY GEOMETRY
FULL SALT UNIT

ORIGIN DRAUGHTSMAN	ORG DATE :	GK NUM :		
JGA	18/03/14	IEL/F/S/0001		
COMPANY ORIGIN:	SHEET :	SIZE :	SCALE :	REV.
GK	2/2	A3	1/1000	A

APPENDIX 3

CAVERNS FREE VOLUME ESTIMATE

Keuper Gas Storage **Cavity geometry and volume estimates**

Cavity	Easting	Northing	Elevation	**Top salt**	Base Salt	Salt Interval	Top Salt to Casing Shoe	**Casing Shoe**	Cavern neck length	Top cavern	Base Cavern	Bottom margin	**Start Leaching Depth**	Leaching interval	**Max diam.**	Max radius	Roof Angle	Bottom angle	Ratio Gross / Net	Insol. (%)	Bulking Factor	**Cavern Volume**
	m	m	mOD	**mGL**	mGL	m	m	**mGL**	m	mGL	mGL	m	**mGL**	m	**m**	m				%		**m^3**
H501	370 280	369 293	36.6	**484**	768	283	125	**609**	15	624	694	13	**754**	130	**100**	50.0	20	30	0.825	26.0	1.5	**382 000**
H502	370 788	369 460	37.8	**488**	769	281	136	**623**	15	638	708	5	**764**	125	**100**	50.0	20	30	0.825	26.0	1.5	**363 000**
H503	371 332	369 744	41.5	**450**	704	254	119	**569**	15	584	654	5	**699**	115	**100**	50.0	20	30	0.825	26.0	1.5	**323 000**
H504	370 832	369 022	38.2	**526**	816	290	134	**660**	15	675	745	11	**805**	130	**100**	50.0	20	30	0.825	26.0	1.5	**382 000**
H505	371 003	369 238	39.1	**497**	782	285	135	**632**	15	647	717	5	**777**	130	**100**	50.0	20	30	0.825	26.0	1.5	**382 000**
H506	371 300	369 287	41.0	**484**	753	270	124	**607**	15	622	692	5	**748**	126	**100**	50.0	20	30	0.825	26.0	1.5	**365 000**
H507	371 103	368 977	39.6	**509**	787	278	129	**638**	15	653	723	5	**782**	129	**100**	50.0	20	30	0.825	26.0	1.5	**377 000**
H508	370 196	370 207	33.0	**417**	697	280	127	**544**	15	559	629	8	**689**	130	**100**	50.0	20	30	0.825	26.0	1.5	**382 000**
H509	371 075	370 242	36.0	**425**	667	242	114	**538**	15	553	623	5	**662**	108	**100**	50.0	20	30	0.825	26.0	1.5	**298 000**
H510	370 590	369 240	34.5	**517**	808	291	133	**650**	15	665	735	13	**795**	130	**100**	50.0	20	30	0.825	26.0	1.5	**382 000**
H511	370 978	370 500	38.0	**408**	669	261	127	**535**	15	550	620	5	**664**	114	**100**	50.0	20	30	0.825	26.0	1.5	**318 000**
H512	370 915	368 758	36.0	**533**	806	273	118	**651**	15	666	736	10	**796**	130	**100**	50.0	20	30	0.825	26.0	1.5	**382 000**
H513	371 187	368 631	36.0	**510**	770	259	104	**614**	15	629	699	10	**759**	130	**100**	50.0	20	30	0.825	26.0	1.5	**382 000**
H514	371 368	368 893	36.0	**493**	752	259	113	**606**	15	621	691	5	**747**	126	**100**	50.0	20	30	0.825	26.0	1.5	**365 000**
H515	371 605	369 036	36.0	**483**	751	268	128	**611**	15	626	696	5	**746**	119	**100**	50.0	20	30	0.825	26.0	1.5	**341 000**
H516	371 578	369 311	40.0	**474**	750	277	140	**614**	15	629	699	5	**745**	116	**100**	50.0	20	30	0.825	26.0	1.5	**330 000**
H517	371 575	369 612	41.5	**450**	712	262	131	**581**	15	596	666	5	**707**	111	**100**	50.0	20	30	0.825	26.0	1.5	**309 000**
H518	371 750	369 856	42.0	**417**	674	257	125	**542**	15	557	627	5	**669**	112	**100**	50.0	20	30	0.825	26.0	1.5	**313 000**
H519	372 024	369 978	43.2	**368**	662	294	147	**515**	15	530	600	5	**657**	127	**100**	50.0	20	30	0.825	26.0	1.5	**371 000**
																						6 747 000
Average			38.2	**470**	742	272	127	**597**	15	612	682	7	**735**	123	**100**	50.0	20	30	0.825	26.0	1.5	**355 105**
Min			33.0	**368**	662	242	104	**515**	15	530	600	5	**657**	108	**100**	50.0	20	30	0.825	26.0	1.5	**298 000**
Max			43.2	**533**	816	294	147	**660**	15	675	745	13	**805**	130	**100**	50.0	20	30	0.825	26.0	1.5	**382 000**

APPENDIX 4

TOTAL WORKING GAS VOLUME ESTIMATE

Keuper Gas Storage			Working gas estimates			Hydrogen			kg	m3 (std)																
			T_ref	P_ref	m3 (std)	kg		kJ	141 860	12 087																
			15	1.01325	1	0.0852		kWhr	39.41	3.36																
Project	Well	Total Cavity Vol	Casing Shoe Depth	Cavity Roof Depth	Cavern Bottom Depth	Mid-Cavity Depth Inventory Calc.	2/3 cav-height depth	80% of geostatic stress	Max Gradient @ Casing Shoe	Max. Pressure @ Casing Shoe	Max. Cavern Pressure Inventory	Cavern Temperature @ Max Inventory	Mean Z factor at Max Inventory	Max. Inventory	Max inventory (GWhr)	Min Gradient @ 2/3 cav-height	Min Pressure @ 2/3 cav-height	Min. Pressure @ Mid Cavern Inventory	Cavern Temp. @ Min. Inventory	Z factor at Min Inventory	Min. Inventory (cushion gas)	Min inventory (GWhr)	Working Gas	Working Gas (GWhr)	Number of Caverns	Total Site Working Gas	Total Site Working Gas (GWhr)
Unit		m3	mGL	mGL	mGL	mGL	mGL	bar	bar/m	bara	bara	°C		MMm3(st)	GWhr	bar/m	bara	bara	°C		MMm3(st)	GWhr	MMm3(st)	GWhr		MMm3(st)	GWhr
Keuper	**H501**	382 000	609	624	694	659	671	116	0.185	113.7	113.8	40	1.066	37.0	124	0.052	35.9	35.9	5	1.022	13.7	46	23.3	78	1	23	78
Keuper	**H502**	363 000	623	638	708	673	685	119	0.185	116.4	116.4	40	1.068	35.9	121	0.052	36.6	36.6	5	1.022	13.3	45	22.6	76	2	46	154
Keuper	**H503**	323 000	569	584	654	619	631	108	0.185	106.4	106.4	40	1.062	29.4	99	0.052	33.8	33.8	5	1.021	11.0	37	18.5	62	3	64	216
Keuper	**H504**	382 000	660	675	745	710	722	126	0.185	123.2	123.2	40	1.072	39.9	134	0.052	38.6	38.6	5	1.024	14.7	49	25.2	85	4	90	301
Keuper	**H505**	382 000	632	647	717	682	694	120	0.185	117.9	118.0	40	1.069	38.3	129	0.052	37.1	37.1	5	1.023	14.2	48	24.1	81	5	114	382
Keuper	**H506**	365 000	607	622	692	657	669	116	0.185	113.4	113.4	40	1.066	35.3	118	0.052	35.8	35.8	5	1.022	13.1	44	22.2	75	6	136	456
Keuper	**H507**	377 000	638	653	723	688	700	122	0.185	119.0	119.0	40	1.069	38.1	128	0.052	37.4	37.4	5	1.023	14.1	47	24.0	81	7	160	537
Keuper	**H508**	382 000	544	559	629	594	606	103	0.185	101.7	101.7	40	1.059	33.3	112	0.052	32.5	32.5	5	1.020	12.5	42	20.9	70	8	181	607
Keuper	**H509**	298 000	538	553	623	588	600	103	0.185	100.6	100.6	40	1.058	25.7	86	0.052	32.2	32.2	5	1.020	9.6	32	16.1	54	9	197	661
Keuper	**H510**	382 000	650	665	735	700	711	124	0.185	121.2	121.2	40	1.071	39.3	132	0.052	38.0	38.0	5	1.023	14.5	49	24.8	83	10	222	745
Keuper	**H511**	318 000	535	550	620	585	597	102	0.185	100.0	100.0	40	1.058	27.3	92	0.052	32.0	32.0	5	1.020	10.2	34	17.1	57	11	239	802
Keuper	**H512**	382 000	651	666	736	701	712	124	0.185	121.4	121.4	40	1.071	39.3	132	0.052	38.0	38.0	5	1.023	14.5	49	24.8	83	12	264	885
Keuper	**H513**	382 000	614	629	699	664	676	118	0.185	114.7	114.7	40	1.067	37.3	125	0.052	36.2	36.2	5	1.022	13.8	46	23.5	79	13	287	964
Keuper	**H514**	365 000	606	621	691	656	668	116	0.185	113.1	113.2	40	1.066	35.2	118	0.052	35.7	35.7	5	1.022	13.1	44	22.2	74	14	309	1 039
Keuper	**H515**	341 000	611	626	696	661	673	116	0.185	114.1	114.1	40	1.066	33.2	111	0.052	36.0	36.0	5	1.022	12.3	41	20.9	70	15	330	1 109
Keuper	**H516**	330 000	614	629	699	664	675	117	0.185	114.5	114.6	40	1.067	32.2	108	0.052	36.1	36.1	5	1.022	11.9	40	20.3	68	16	350	1 177
Keuper	**H517**	309 000	581	596	666	631	642	110	0.185	108.4	108.5	40	1.063	28.6	96	0.052	34.4	34.4	5	1.021	10.7	36	18.0	60	17	368	1 237
Keuper	**H518**	313 000	542	557	627	592	603	103	0.185	101.2	101.2	40	1.059	27.2	91	0.052	32.4	32.4	5	1.020	10.2	34	17.0	57	18	385	1 294
Keuper	**H519**	371 000	515	530	600	565	577	97	0.185	96.3	96.3	40	1.056	30.7	103	0.052	31.0	31.0	5	1.019	11.5	39	19.2	64	19	405	1 359
Total		**6 747 000**												**644**	**2 161**						**239**	**802**	**405**	**1 359**			
Average		355 105	597	612	682	647	659	114	0.185	111.4	111.5	40	1.065	33.9	114	0.052	35.3	35.3	5	1.022	12.6	42	21.3	72		219.5	737
Min		298 000	515	530	600	565	577	97	0.185	96.3	96.3	40	1.056	25.7	86	0.052	31.0	31.0	5	1.019	9.6	32	16.1	54		23.3	78
Max		382 000	660	675	745	710	722	126	0.185	123.2	123.2	40	1.072	39.9	134	0.052	38.6	38.6	5	1.024	14.7	49	25.2	85		404.7	1 359

Keuper Gas Storage			Working gas estimates			Natural gas			kg	m3 (std)																
			T_ref	P_ref	m3 (std)	kg		kJ	49 735	39 000																
			15	1.01325	1	0.7842		kWhr	13.815	10.83																
Project	Well	Total Cavity Vol	Casing Shoe Depth	Cavity Roof Depth	Cavern Bottom Depth	Mid-Cavity Depth Inventory Calc.	2/3 cav-height depth	80% of geostatic stress	Max Gradient @ Casing Shoe	Max. Pressure @ Casing Shoe	Max. Cavern Pressure Inventory	Cavern Temperature @ Max Inventory	Mean Z factor at Max Inventory	Max. Inventory	Max inventory (GWhr)	Min Gradient @ 2/3 cav-height	Min Pressure @ 2/3 cav-height	Min. Pressure @ Mid Cavern Inventory	Cavern Temp. @ Min. Inventory	Z factor at Min Inventory	Min. Inventory (cushion gas)	Min inventory (GWhr)	Working Gas	Working Gas (GWhr)	Number of Caverns	Total Site Working Gas	Total Site Working Gas (GWhr)
Unit		m3	mGL	mGL	mGL	mGL	mGL	bar	bar/m	bara	bara	°C		MMm3(st)	GWhr	bar/m	bara	bara	°C		MMm3(st)	GWhr	MMm3(st)	GWhr		MMm3(st)	GWhr
Keuper	**H501**	382 000	609	624	694	659	671	116	0.185	113.7	114.0	40	0.8321	47.4	514	0.052	35.9	35.9	5	0.9013	15.5	168	31.9	346	1	32	346
Keuper	**H502**	363 000	623	638	708	673	685	119	0.185	116.4	116.6	40	0.8299	46.2	501	0.052	36.6	36.6	5	0.8993	15.1	163	31.1	337	2	63	683
Keuper	**H503**	323 000	569	584	654	619	631	108	0.185	106.4	106.6	40	0.8389	37.2	403	0.052	33.8	33.8	5	0.9070	12.3	133	24.9	270	3	88	953
Keuper	**H504**	382 000	660	675	745	710	722	126	0.185	123.2	123.5	40	0.8247	51.8	561	0.052	38.6	38.5	5	0.8940	16.8	182	35.0	379	4	123	1 332
Keuper	**H505**	382 000	632	647	717	682	694	120	0.185	117.9	118.2	40	0.8286	49.4	535	0.052	37.1	37.1	5	0.8980	16.1	174	33.3	361	5	156	1 692
Keuper	**H506**	365 000	607	622	692	657	669	116	0.185	113.4	113.6	40	0.8324	45.1	489	0.052	35.8	35.8	5	0.9016	14.8	160	30.4	329	6	187	2 021
Keuper	**H507**	377 000	638	653	723	688	700	122	0.185	119.0	119.3	40	0.8278	49.2	533	0.052	37.4	37.4	5	0.8972	16.0	174	33.2	360	7	220	2 381
Keuper	**H508**	382 000	544	559	629	594	606	103	0.185	101.7	101.9	40	0.8436	41.8	453	0.052	32.5	32.5	5	0.9106	13.9	151	27.9	302	8	248	2 683
Keuper	**H509**	298 000	538	553	623	588	600	103	0.185	100.6	100.8	40	0.8448	32.2	349	0.052	32.2	32.2	5	0.9115	10.7	116	21.5	233	9	269	2 916
Keuper	**H510**	382 000	650	665	735	700	711	124	0.185	121.2	121.5	40	0.8261	50.9	551	0.052	38.0	38.0	5	0.8955	16.5	179	34.4	372	10	304	3 288
Keuper	**H511**	318 000	535	550	620	585	597	102	0.185	100.0	100.2	40	0.8455	34.1	370	0.052	32.0	32.0	5	0.9119	11.4	123	22.8	247	11	326	3 535
Keuper	**H512**	382 000	651	666	736	701	712	124	0.185	121.4	121.6	40	0.8260	51.0	552	0.052	38.0	38.0	5	0.8954	16.5	179	34.4	373	12	361	3 908
Keuper	**H513**	382 000	614	629	699	664	676	118	0.185	114.7	115.0	40	0.8313	47.9	518	0.052	36.2	36.2	5	0.9005	15.6	169	32.2	349	13	393	4 257
Keuper	**H514**	365 000	606	621	691	656	668	116	0.185	113.1	113.4	40	0.8326	45.0	488	0.052	35.7	35.7	5	0.9017	14.7	160	30.3	328	14	423	4 585
Keuper	**H515**	341 000	611	626	696	661	673	116	0.185	114.1	114.3	40	0.8318	42.5	460	0.052	36.0	36.0	5	0.9010	13.9	150	28.6	310	15	452	4 894
Keuper	**H516**	330 000	614	629	699	664	675	117	0.185	114.5	114.8	40	0.8314	41.3	447	0.052	36.1	36.1	5	0.9007	13.5	146	27.8	301	16	480	5 195
Keuper	**H517**	309 000	581	596	666	631	642	110	0.185	108.4	108.7	40	0.8369	36.3	394	0.052	34.4	34.4	5	0.9054	12.0	130	24.4	264	17	504	5 459
Keuper	**H518**	313 000	542	557	627	592	603	103	0.185	101.2	101.4	40	0.8442	34.1	369	0.052	32.4	32.4	5	0.9110	11.3	123	22.7	246	18	527	5 706
Keuper	**H519**	371 000	515	530	600	565	577	97	0.185	96.3	96.5	40	0.8495	38.2	414	0.052	31.0	31.0	5	0.9148	12.8	139	25.4	275	19	552	5 980
Total		**6 747 000**												**822**	**8 901**						**270**	**2 920**	**552**	**5 980**			
Average		355 105	597	612	682	647	659	114	0.185	111.4	111.7	40	0.835	43.2	468	0.052	35.3	35.2	5	0.903	14.2	154	29.1	315		300.3	3 253
Min		298 000	515	530	600	565	577	97	0.185	96.3	96.5	40	0.825	32.2	349	0.052	31.0	31.0	5	0.894	10.7	116	21.5	233		31.9	346
Max		382 000	660	675	745	710	722	126	0.185	123.2	123.5	40	0.850	51.8	561	0.052	38.6	38.5	5	0.915	16.8	182	35.0	379		552.0	5 980

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2021-165