Hatfield Road Quarry
Groundwater Quality Data - Bromide
August 2013 - February 2019

Borehole	Zone	Analysis	Aug-13	Nov-13	Feb-14	May-14	Jun-14	Jul-14	Oct-14	Jan-15	Apr-15	Jul-15	Oct-15	Jan-16	Apr-16	Aug-16	Nov-16	Feb-17	May-17	Nov-17	Feb-18	May-18	Aug-18	Nov-18	Feb-19
BHA	UMH	Bromide (mg/L)		0.100	0.210	<0.05						0.073	0.110				0.108					0.057	0.133	0.169	0.084
BHB	LMH	Bromide (mg/L)		0.350	0.300	0.390	0.325	0.310	0.400	0.326	0.418	0.384	0.364	0.359	0.366	0.347	0.404	0.235	0.352	0.352	0.302	0.326	0.331	0.242	0.263
BHC	UMH	Bromide (mg/L)		0.150	0.680	0.140						0.158	0.181				0.129					0.128			
BHD	UMH	Bromide (mg/L)		<0.05	0.280												0.260					0.189	0.189		
BHE	UMH	Bromide (mg/L)			<0.05	<0.05						0.073	0.081	0.111	0.110	0.098	0.088	0.075	0.074	0.082	0.009	0.125	0.091	0.065	0.068
BHF	UMH	Bromide (mg/L)			0.055	0.066						0.057	0.058				0.064								
BHG	LMH	Bromide (mg/L)			<0.05	0.110	0.118		0.088	0.064	0.139	0.150	0.132	0.094	0.072	0.143	0.207			0.166		0.102	0.086	0.087	0.130
BHH	UMH	Bromide (mg/L)			<0.05	<0.05						0.055	0.079												
BHJ	UMH	Bromide (mg/L)				0.150						0.126	<0.005		0.184	0.210	0.227	0.204							
BHK	UMH	Bromide (mg/L)				0.091						0.105	0.119	0.014											
BH101	UMH	Bromide (mg/L)	0.099	0.130	<0.05	0.150	0.203			0.080	0.077	0.105	0.113	0.093	0.098	0.112	0.121				0.086	0.072	0.120	0.093	0.086
BH101	LMH	Bromide (mg/L)	0.120	<0.05	<0.05	0.006	0.172	0.170	0.106	0.153	0.104	0.127	0.267	0.059	0.119	0.124	0.135		0.081	0.081	0.017	0.068	0.078	0.081	0.102
BH101	CHK	Bromide (mg/L)	0.120	0.110	0.098	0.066	0.158	0.150	0.148	0.064	0.142	0.136	0.145	0.136	0.135	0.124	0.134	0.105	0.145	0.145	0.171	0.144	0.152	0.138	0.149
BH102	UMH	Bromide (mg/L)	0.096	0.079	0.074	0.072	0.147			0.114	0.086	0.065	0.061	0.079	0.113	0.078	0.058	0.058	0.072	0.091	0.088	0.129		0.080	0.126
BH102	LMH	Bromide (mg/L)	0.090	0.100	0.062	0.130	0.130		0.117	0.091	0.118	0.120	0.097	0.130	0.140	0.144	0.140			0.128	0.151	0.186		0.118	0.165
BH102	CHK	Bromide (mg/L)	0.055	0.100	0.100	0.076	0.142		0.069	0.083	0.083	0.076	0.075	0.068	0.064	0.057	0.071			0.061	0.065	0.063		0.061	0.062
BH103	UMH	Bromide (mg/L)	0.053	<0.05	<0.05	<0.05	0.050			0.072	0.045	0.039	0.044	0.066	0.052	0.100	0.050				0.049	0.051	0.030	0.063	0.035
BH103	LMH	Bromide (mg/L)	1.200	0.370	0.350	0.380	0.294		0.930	1.002	0.884	0.832	0.771	0.837	0.548	0.685	0.970	0.919	0.638	0.810	1.046	0.966	<0.005	0.993	1.049
BH103	CHK	Bromide (mg/L)	0.440	0.380	0.340	0.380	0.397		0.070	0.411	0.405	0.372	0.394	0.412	0.149	0.342	0.047	0.343	0.099	0.393	0.369	0.372	0.393	0.332	0.411
BH104	UMH	Bromide (mg/L)	0.071	0.088	0.300	0.150	0.199			0.056	0.113	0.116	0.102	0.034	0.062	0.060	0.106				0.070	0.077	0.084	0.084	0.054
BH104	LMH	Bromide (mg/L)	0.210	0.110	0.051	0.110	0.146	0.150	0.257	0.220	0.271	0.247	0.251	0.096	0.112	0.243	0.166	0.172	0.241	0.090	0.097	0.106	0.145	0.204	0.122
BH104	CHK	Bromide (mg/L)	0.260	0.320	<0.05	0.180	0.180	0.190	0.352	0.371	0.340	0.296	0.344	0.083	0.330	0.314	0.112	0.322	0.146		0.365	0.354	0.334	0.350	0.354
BH105	UMH X	Bromide (mg/L)					0.202			0.161	0.169	0.590	0.140	0.185	0.194	0.344	0.138	0.126	0.156	0.115	0.096	0.161	0.112	0.152	0.088
BH105	LMH	Bromide (mg/L)	1.100	0.520	0.140	0.890	0.619	1.047	0.830	0.991	0.910	0.869	1.001	0.692	0.915	0.840	0.893		0.788	0.775	0.788	0.808	0.858	0.773	0.794
BH105	CHK	Bromide (mg/L)	0.610	0.100	0.400	0.380	0.480	0.465	0.218	0.499	0.566	0.456	0.538	0.170	0.599	0.666	0.710	0.484	0.710	0.655	0.651	0.669	0.162	0.605	0.665
BH106	UMH	Bromide (mg/L)	0.052	<0.05	0.063	0.062	0.170			0.074	0.071	0.059	0.063	0.042	0.096	0.076		0.057	0.069	0.064	0.102	0.035	0.056	0.046	0.057
BH106	LMH	Bromide (mg/L)	0.170	0.180	0.130	0.210	0.230		0.204	0.252	0.253	0.239	0.255	0.254	0.244	0.234	0.263	0.238	0.297	0.310	0.318	0.294	0.276	0.261	0.309
BH106	CHK	Bromide (mg/L)	0.064	0.059	<0.05	<0.05	0.050		0.054	0.062	0.055	0.049	0.050	0.028	0.054	0.051	0.047	0.044	0.044	0.039	0.261	0.060	0.055	0.033	0.036
BH107	UMH	Bromide (mg/L)					0.164			0.069	0.150	0.153	0.162												
BH107	LMH	Bromide (mg/L)					0.189	0.204	0.161	0.198	0.183	0.189													
BH107	CHK	Bromide (mg/L)					0.182		0.167	0.206	0.164	0.149	0.142												
BH108	UMH	Bromide (mg/L)					0.140			0.184	0.113	0.084	0.093	0.105	0.145	0.115	0.158	0.119	0.134	0.104	0.372	0.151	0.082	0.109	DRY
BH108	LMH	Bromide (mg/L)					0.200	0.160	0.188	0.337	0.360	0.110	0.265	0.104	0.357	0.287	0.300	0.204	0.240	0.217	0.408	0.128	0.127	0.157	0.168
BH108	CHK	Bromide (mg/L)					1.060	1.095	0.929	0.956	0.938	0.888	0.954	0.095	0.881	0.825	0.876	0.742	0.805	0.765	0.800	0.738	0.718	0.723	0.788
BH201 L (S)	LMH	Bromide (mg/L)					0.500	0.569	0.573	0.611	0.554	0.549	0.080	0.542	0.556	0.528	1.385	0.494	0.397	0.514	0.548	0.486	0.466	0.469	0.499
BH201 L (D)	LMH	Bromide (mg/L)					0.370	0.383	0.397	0.421	0.416	0.359	0.391	0.323	0.373	0.394	0.409					0.378	0.371		
FT101	UMH	Bromide (mg/L)	0.070									0.043					0.047					0.042	0.032		
FT102	UMH	Bromide (mg/L)	<0.05	<0.05	<0.05	<0.05			0.033			0.042	0.041	0.031	0.034	0.029									
FT103	UMH	Bromide (mg/L)	<0.05									0.047													
BH301	LMH	Bromide (mg/L)															0.450	0.446	0.452	0.490	0.319	0.272	0.453	0.410	0.215
BH301	CHK	Bromide (mg/L)															0.950	0.678	0.832	0.810	0.880	0.459	1.386	0.663	0.660
BH302	LMH	Bromide (mg/L)															1.794	0.087	1.079	1.478	1.875	1.963	1.821	1.976	2.280
BH302	CHK	Bromide (mg/L)															0.235	1.463	0.227	1.744	1.868	1.733	1.998	1.977	1.898
BH305	LMH	Bromide (mg/L)															1.538		1.437	1.396	1.581	1.346	1.389	1.338	1.397
BH305	CHK	Bromide (mg/L)															1.377		1.265	1.177	1.185	1.101	1.178	Well not operational	
BH306	UMH	Bromide (mg/L)															0.077	0.100	0.113	0.109		0.160	0.108	0.096	0.087
BH307	UMH	Bromide (mg/L)															0.133	0.128	0.131	0.138		0.162			

Units are mg/l. Multiply by 1,000 to convert to ug/l.
'<' means concentrations were below the method detection limit (MDL)
The MDL changed after May 2014 as a different laboratory was retained to improve the MDL

Hatfield Road Quarry
Groundwater Quality Data - Bromide
August 2013 - February 2019

Borehole	Zone	Analysis	Aug-13	Nov-13	Feb-14	May-14	Jun-14	Jul-14	Oct-14	Jan-15	Apr-15	Jul-15	Oct-15	Jan-16	Apr-16	Aug-16	Nov-16	Feb-17	May-17	Nov-17	Feb-18	May-18	Aug-18	Nov-18	Feb-19
GMW101	UMH	Bromide (mg/L)																				0.043			
GMW102	UMH	Bromide (mg/L)																				0.054			
GMW103	UMH	Bromide (mg/L)																				<0.005	2.097	1.038	1.400
GMW103 L	UMH	Bromide (mg/L)																				0.163	0.153	0.138	0.381
GMW104	UMH	Bromide (mg/L)															0.080		0.120	0.288		0.078	0.053		
GMW105	UMH	Bromide (mg/L)																				0.207	0.223	0.062	0.116
GMW106	UMH	Bromide (mg/L)																				0.080			
GMW107	UMH	Bromide (mg/L)															0.367		0.279			0.167	0.205	0.208	0.162
GMW108	UMH	Bromide (mg/L)																				0.116			
GMW109	UMH	Bromide (mg/L)															0.288		0.200			0.107	0.142	0.174	0.074
GMW110	UMH	Bromide (mg/L)																				0.059	0.063		
GMW111	UMH	Bromide (mg/L)																				0.067	0.054		
GMW112	UMH	Bromide (mg/L)																					0.028		
GMW113	UMH	Bromide (mg/L)															0.084					0.066	0.058		
GMW114	UMH	Bromide (mg/L)															0.040					0.010	0.077		

Units are mg/l. Multiply by 1,000 to convert to ug/l.
'<' means concentrations were below the method detection limit (MDL)
The MDL changed after May 2014 as a different laboratory was retained to improve the MDL

N

500

250

0

BH305L&C
563

BH105L&C
BH105U
233

BH108L&C
ND
BH108U

BH307U

BH201L
92.6

BH306U

SW3

SW11

GMW109

SW8

GMW108

GMW107

BH301 L&C
ND

GMW106

BH104L&C
BH104U
ND

BHD U

BHA U

SW2

BHJ U

SW1

GMW105

SW9

BHC U

BHB U
13.9

BHK U

SW12

GMW104

BH302 L&C
ND

GMW103

BHI L

FT102U

FT101U

SW4

SW5

GMW102

BH103L&C
BH103U
ND

FT103U

BHE U

GMW110

SW10

GMW101

BHH U

BHF U

BHG L
ND

BH106L&C
BH106U
ND

SW7A & SW7B

GMW111

BH107L&C
BH107U

GMW114

GMW112

BH101L&C
BH101U
ND

BH102L&C
BH102U
ND

GMW113

0 100 200 500
METERS

LEGEND

- SITE BOUNDARY
- PROPOSED MINERAL DEVELOPMENT SITE
- RIVER NAST CULVERT (ASSUMED ROUTE)
- NATIONAL GRID GAS PIPELINE (SURVEYED LOCATION)
- PRE BRETT WELLS

SLR BOREHOLES AND MONITORING POINTS

- SLR MONITORING WELLS
- SURFACE WATER MONITORING POINT
- PERIMETER GAS MONITORING WELLS (2016)

BROMATE CONCENTRATION (ug/l)

- 563 — BROMATE (ug/l)
- ND — NOT DETECTED
- > 500
- 250 - 500
- 0 - 250

BH101 - BH108 & FT = SERIES 1 BOREHOLES (2013 & 2014)
BH201 = SERIES 2 BOREHOLES (2014)
BH301 - BH302 BH305 - BH307 = SERIES 3 BOREHOLES (2016)

U = MONITORING WELL SCREENED ACROSS THE UPPER MINERAL HORIZON
L = MONITORING WELL SCREENED ACROSS THE LOWER MINERAL HORIZON
C = MONITORING WELL SCREENED ACROSS THE CHALK
FT = FIRE TRAINING AREA (UPPER MINERAL HORIZON)

SLR Ref	Stanger 2001 ref (NOT SHOWN ON PLAN)	BAE Systems, 2008 ref (NOT SHOWN ON PLAN)
BHA U	BHG	-
BHB U	-	BH15
BHC U	-	BH14
BHD U	-	BH13
BHE U	-	BH16
BHF U	-	BH18
BHG L	-	BH19
BHH U	BHC	-
BHI L	-	BH12
BHJ U	BHA	-
BHK U	-	BH3

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HATFIELD AERODROME

ENVIRONMENTAL BASELINE REPORT

FEBRUARY 2019 LMA BROMATE CONCENTRATIONS

DWG No. 2

Scale: NTS (A3)
Date: APRIL 2019

01009.00174.19.002.1_FEB-2019_BROMATE_CON.dwg

Hatfield Road Quarry
Groundwater Quality Data

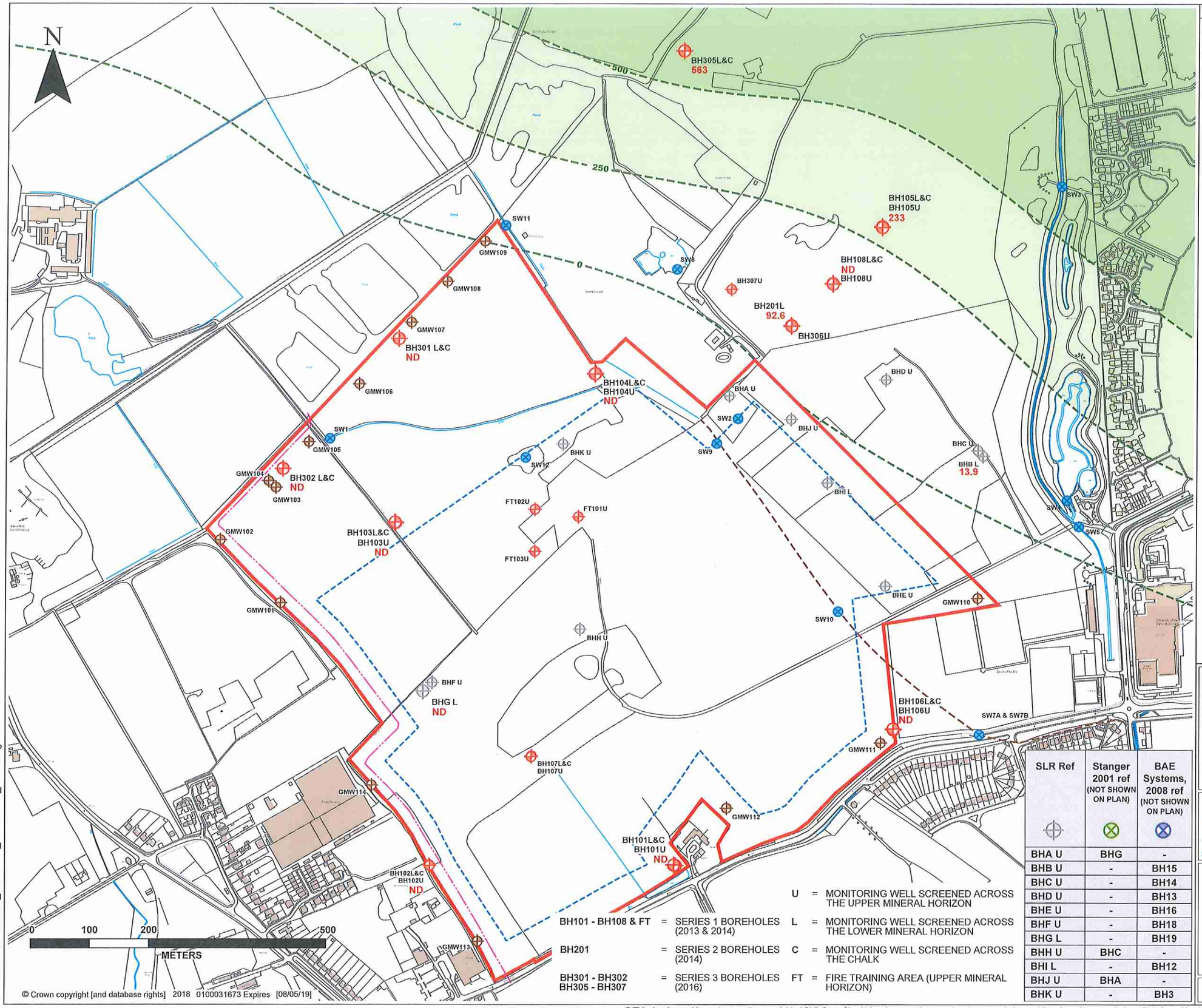
Borehole	Zone	Analysis	Aug-13	Nov-13	Feb-14	May-14	Jun-14	Jul-14	Oct-14	Jan-15	Apr-15	Jul-15	Oct-15	Jan-16	Apr-16	Aug-16	Nov-16	Feb-17	May-17	Nov-17	Feb-18	May-18	Aug-18	Nov-18	Feb-19
BHA	UMH	Bromate (mg/L)		<0.1	<0.1	<0.1						<0.0005	<0.0005				<0.0005					<0.0005	<0.0005	<0.0005	<0.0005
BHB	LMH	Bromate (mg/L)		<0.1	<0.1	<0.1	0.0072	0.0033	0.0133	0.0108	0.0162	0.0186	0.0150	0.0170	0.0168	0.0178	0.0253	<0.0005	0.0234	0.0293	0.0252	0.0280	0.0241	0.0101	0.0139
BHC	UMH	Bromate (mg/L)		<0.1	<0.1	<0.1						<0.0005	0.0006				<0.0005					<0.0005			
BHD	UMH	Bromate (mg/L)		<0.1	<0.1												<0.0005					<0.0005	<0.0005		
BHE	UMH	Bromate (mg/L)			<0.1	<0.1						<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BHF	UMH	Bromate (mg/L)			<0.1	<0.1						<0.0005	<0.0005				<0.0005								
BHG	LMH	Bromate (mg/L)			<0.1	<0.1	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	0.0024	<0.0005	<0.0005	<0.0005	<0.0005			<0.0005		<0.0005	<0.0005	<0.0005	<0.0005
BHH	UMH	Bromate (mg/L)			<0.1	<0.1						<0.0005	<0.0005												
BHJ	UMH	Bromate (mg/L)				<0.1						<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005							
BHK	UMH	Bromate (mg/L)				<0.1						<0.0005	<0.0005	<0.0005											
BH101	UMH	Bromate (mg/L)	<0.1	<0.1	<0.1	<0.1	<0.0005			<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005				<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BH101	LMH	Bromate (mg/L)	<0.1	<0.1	<0.1	<0.1	0.0047	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BH101	CHK	Bromate (mg/L)	<0.1	<0.1	<0.1	<0.1	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BH102	UMH	Bromate (mg/L)	<0.1	<0.1	<0.1	<0.1	<0.0005			<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005
BH102	LMH	Bromate (mg/L)	<0.1	<0.1	<0.1	<0.1	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005			<0.0005	<0.0005	<0.0005		<0.0005	<0.0005
BH102	CHK	Bromate (mg/L)	<0.1	<0.1	<0.1	<0.1	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	0.0006	<0.0005	<0.0005			<0.0005	0.0005	0.0005		<0.0005	0.0005
BH103	UMH	Bromate (mg/L)	<0.1	<0.1	<0.1	<0.1	<0.0005			<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005				<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BH103	LMH	Bromate (mg/L)	<0.1	<0.1	<0.1	<0.1	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BH103	CHK	Bromate (mg/L)	<0.1	<0.1	<0.1	<0.1	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BH104	UMH	Bromate (mg/L)	<0.1	<0.1	<0.1	<0.1	<0.0005			<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005				<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BH104	LMH	Bromate (mg/L)	<0.1	<0.1	<0.1	<0.1	<0.0005	<0.0005	0.0021	0.0018	0.0009	0.0019	0.0019	<0.0005	<0.0005	0.0015	0.0008	0.0001	<0.0005	<0.0005	<0.0005	<0.0005	0.0006	0.0008	<0.0005
BH104	CHK	Bromate (mg/L)	<0.1	<0.1	<0.1	<0.1	0.0011	0.0018	0.0039	0.0042	0.0031	0.0031	0.0032	<0.0005	0.0031	0.0027	<0.0005	0.0022	<0.0005		0.0029	0.0028	0.0026	0.0023	0.0025
BH105	UMH X	Bromate (mg/L)					<0.0005			<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0073	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BH105	LMH	Bromate (mg/L)	0.33	0.12	0.29	0.29	0.18	0.3106	0.2786	0.2997	0.3018	0.2654	0.3072	0.1999	0.2983	0.2769	0.2715	0.2649	0.2478	0.2380	0.2327	0.2359	0.1040	0.2403	0.2338
BH105	CHK	Bromate (mg/L)	<0.1	<0.1	<0.1	<0.1	0.13	0.1205	0.0243	0.1166	0.1541	0.1180	0.1383	0.0007	0.1631	0.1820	0.1965	0.1344	0.2077	0.1885	0.1737	0.2042	0.0066	0.1621	0.1786
BH106	UMH	Bromate (mg/L)	<0.1	<0.1	<0.1	<0.1	<0.0005			0.0021	0.0016	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	0.0054	0.0014	<0.0005	<0.0005	<0.0005
BH106	LMH	Bromate (mg/L)	<0.1	<0.1	<0.1	<0.1	<0.0005		<0.0005	<0.0005	0.0006	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0053	<0.0005	<0.0005	<0.0005	<0.0005
BH106	CHK	Bromate (mg/L)	<0.1	<0.1	<0.1	<0.1	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BH107	UMH	Bromate (mg/L)					<0.0005			<0.0005	<0.0005	<0.0005	<0.0005												
BH107	LMH	Bromate (mg/L)					<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005													
BH107	CHK	Bromate (mg/L)					<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005												
BH108	UMH	Bromate (mg/L)					<0.0005			0.0129	<0.0005	<0.0005	<0.0005	<0.0005	0.0025	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	DRY
BH108	LMH	Bromate (mg/L)					0.0073	0.0045	0.0048	0.0490	0.0657	0.0014	0.0374	<0.0005	0.0575	0.0414	0.0409	0.0204	0.0224	0.0192	<0.0005	<0.0005	<0.0005	0.0013	<0.0005
BH108	CHK	Bromate (mg/L)					0.2600	0.2826	0.2913	0.3222	0.3226	0.2846	0.3135	<0.0005	0.3027	0.2659	0.2758	0.2785	0.2746	0.2570	0.2493	0.235	0.2146	0.2299	0.2273
BH201 L (S)	LMH	Bromate (mg/L)					0.1100	0.1542	0.1200	0.1259	0.1309	0.1123	0.1220	0.1180	0.1299	0.1188	0.1163	0.1123	0.0782	0.1065	0.1032	0.1102	0.1702	0.0964	0.0926
BH201 L (D)	LMH	Bromate (mg/L)					0.0900	0.0863	0.0865	0.0860	0.0897	0.0761	0.0770	0.0650	0.0818	0.0769	0.0836					0.0762	0.0841		
FT101	UMH	Bromate (mg/L)	<0.1									<0.0005					<0.0005					<0.0005	<0.0005		
FT102	UMH	Bromate (mg/L)	<0.1	<0.1	<0.1	<0.1			<0.0005			<0.0005	<0.0005	<0.0005	<0.0005	<0.0005									
FT103	UMH	Bromate (mg/L)	<0.1									<0.0005													
BH301	LMH	Bromate (mg/L)															0.0033	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0007	<0.0005	<0.0005
BH301	CHK	Bromate (mg/L)															<0.0005	0.0012	0.0006	<0.0005	0.0025	0.0018	0.0007	0.0008	0.0029
BH302	LMH	Bromate (mg/L)															<0.0005	<0.0005	<0.0005	<0.0005	0.0035	<0.0005	<0.0005	<0.0005	<0.0005
BH302	CHK	Bromate (mg/L)															<0.0005	<0.0005	<0.0005	<0.0005	0.0040	<0.0005	<0.0005	<0.0005	<0.0005
BH305	LMH	Bromate (mg/L)															0.5574		0.5794	0.6231	0.6089	0.4543	0.5603	0.6026	0.5631
BH305	CHK	Bromate (mg/L)															0.4107		0.5198	0.5487	0.4892	0.4777	0.4387	Well not operational	

"<" = concentrations were below the analytical method detection limit (MDL)
The MDL changed after May 2014 as a different lab was retained to improve the MDL concentration.

Hatfield Road Quarry
Groundwater Quality Data

Borehole	Zone	Analysis	Aug-13	Nov-13	Feb-14	May-14	Jun-14	Jul-14	Oct-14	Jan-15	Apr-15	Jul-15	Oct-15	Jan-16	Apr-16	Aug-16	Nov-16	Feb-17	May-17	Nov-17	Feb-18	May-18	Aug-18	Nov-18	Feb-19
BH306	UMH	Bromate (mg/L)															<0.0005	<0.0005	0.0008	0.0007		<0.0005	<0.0005	<0.0005	<0.0005
BH307	UMH	Bromate (mg/L)															<0.0005	<0.0005	<0.0005	<0.0005		<0.0005			
GMW101	UMH	Bromate (mg/L)																				<0.0005			
GMW102	UMH	Bromate (mg/L)																				0.0068			
GMW103	UMH	Bromate (mg/L)																				<0.0005	<0.0005	<0.0005	<0.0005
GMW103 L	UMH	Bromate (mg/L)																				<0.0005	<0.0005	<0.0005	<0.0005
GMW104	UMH	Bromate (mg/L)															<0.0005		<0.0005	0.0052		<0.0005	<0.0005		
GMW105	UMH	Bromate (mg/L)																				<0.0005	<0.0005	<0.0005	<0.0005
GMW106	UMH	Bromate (mg/L)																				<0.0005			
GMW107	UMH	Bromate (mg/L)															<0.0005		<0.0005			<0.0005	<0.0005	<0.0005	<0.0005
GMW108	UMH	Bromate (mg/L)																				<0.0005			
GMW109	UMH	Bromate (mg/L)															<0.0005		<0.0005			<0.0005	<0.0005	<0.0005	<0.0005
GMW110	UMH	Bromate (mg/L)																				<0.0005	<0.0005		
GMW111	UMH	Bromate (mg/L)																				<0.0005	<0.0005		
GMW112	UMH	Bromate (mg/L)																					<0.0005		
GMW113	UMH	Bromate (mg/L)															<0.0005					<0.0005	<0.0005		
GMW114	UMH	Bromate (mg/L)															<0.0005					<0.0005	<0.0005		

"<" = concentrations were below the analytical method detection limit (MDL)
The MDL changed after May 2014 as a different lab was retained to improve the MDL concentration.



LEGEND

- SITE BOUNDARY
- PROPOSED MINERAL DEVELOPMENT SITE
- RIVER NAST CULVERT (ASSUMED ROUTE)
- NATIONAL GRID GAS PIPELINE (SURVEYED LOCATION)
- PRE BRETT WELLS

SLR BOREHOLES AND MONITORING POINTS

- SLR MONITORING WELLS
- SURFACE WATER MONITORING POINT
- PERIMETER GAS MONITORING WELLS (2016)

BROMATE CONCENTRATION (ug/l)

- 563 — BROMATE (ug/l)
- ND — NOT DETECTED
- > 500
- 250 - 500
- 0 - 250

BH101 - BH108 & FT = SERIES 1 BOREHOLES (2013 & 2014)
BH201 = SERIES 2 BOREHOLES (2014)
BH301 - BH302 BH305 - BH307 = SERIES 3 BOREHOLES (2016)

U = MONITORING WELL SCREENED ACROSS THE UPPER MINERAL HORIZON
L = MONITORING WELL SCREENED ACROSS THE LOWER MINERAL HORIZON
C = MONITORING WELL SCREENED ACROSS THE CHALK
FT = FIRE TRAINING AREA (UPPER MINERAL HORIZON)

SLR Ref	Stanger 2001 ref (NOT SHOWN ON PLAN)	BAE Systems, 2008 ref (NOT SHOWN ON PLAN)
BHA U	BHG	-
BHB U	-	BH15
BHC U	-	BH14
BHD U	-	BH13
BHE U	-	BH16
BHF U	-	BH18
BHG L	-	BH19
BHH U	BHC	-
BHI L	-	BH12
BHJ U	BHA	-
BHK U	-	BH3

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HATFIELD AERODROME
ENVIRONMENTAL BASELINE REPORT
FEBRUARY 2019 LMA BROMATE CONCENTRATIONS
DWG No. 2

Scale: NTS (A3)
Date: JULY 2019

01009.00174.19.002.2_FEB-2019_BROMATE_CON.dwg

Hatfield Road Quarry – Bromate and Bromide Groundwater Quality (Aug 2013 – Nov 2019)

Borehole	Zone	Analysis	DWS	Aug-13	Nov-13	Feb-14	May-14	Jun-14	Jul-14	Oct-14	Jan-15	Apr-15	Jul-15	Oct-15	Jan-16	Apr-16	Aug-16	Nov-16	Feb-17	May-17	Nov-17	Feb-18	May-18	Aug-18	Nov-18	Feb-19	May-19	Aug-19	Nov-19
BH101	CHK	Bromate (mg/L)	0.01	<0.1	<0.1	<0.1	<0.1	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BH102	CHK	Bromate (mg/L)	0.01	<0.1	<0.1	<0.1	<0.1	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	0.0006	<0.0005	<0.0005			<0.0005	0.0005	0.0005		<0.0005	0.0005	<0.0005	<0.0005	<0.0005
BH103	CHK	Bromate (mg/L)	0.01	<0.1	<0.1	<0.1	<0.1	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BH104	CHK	Bromate (mg/L)	0.01	0	0	0	0	0.0011	0.0018	0.0039	0.0042	0.0031	0.0031	0.0032	0	0.0031	0.0027	0	0.0022	0		0.0029	0.0028	0.0026	0.0023	0.0025	0.0025	0.0027	0.0025
BH105	CHK	Bromate (mg/L)	0.01	<0.1	<0.1	<0.1	<0.1	0.13	0.1205	0.0243	0.1166	0.1541	0.118	0.1383	0.0007	0.1631	0.182	0.1965	0.1344	0.2077	0.1885	0.1737	0.2042	0.0066	0.1621	0.1786	0.1751	0.0934	0.1774
BH106	CHK	Bromate (mg/L)	0.01	<0.1	<0.1	<0.1	<0.1	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BH107	CHK	Bromate (mg/L)	0.01					<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005															
BH108	CHK	Bromate (mg/L)	0.01					0.26	0.2826	0.2913	0.3222	0.3226	0.2846	0.3135	<0.0005	0.3027	0.2659	0.2758	0.2785	0.2746	0.257	0.2493	0.235	0.2146	0.2299	0.2273	0.194	0.1961	0.2149
BH301	CHK	Bromate (mg/L)	0.01															<0.0005	0.0012	0.0006	<0.0005	0.0025	0.0018	0.0007	0.0008	0.0029	<0.0005	0.0024	0.0014
BH302	CHK	Bromate (mg/L)	0.01															0.0005	0.0005	0.0005	0.0005	0.004	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
BH305	CHK	Bromate (mg/L)	0.01															0.4107		0.5198	0.5487	0.4892	0.4777	0.4387			0.3345	0.4774	0.5043

Borehole	Zone	Analysis	DWS	Aug-13	Nov-13	Feb-14	May-14	Jun-14	Jul-14	Oct-14	Jan-15	Apr-15	Jul-15	Oct-15	Jan-16	Apr-16	Aug-16	Nov-16	Feb-17	May-17	Nov-17	Feb-18	May-18	Aug-18	Nov-18	Feb-19	May-19	Aug-19	Nov-19
BHB	LMH	Bromate (mg/L)	0.01		<0.1	<0.1	<0.1	0.0072	0.0033	0.0133	0.0108	0.0162	0.0186	0.015	0.017	0.0168	0.0178	0.0253	<0.0005	0.0234	0.0293	0.0252	0.028	0.0241	0.0101	0.0139	0.0233	0.0231	0.0242
BHG	LMH	Bromate (mg/L)	0.01			<0.1	<0.1	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	0.0024	<0.0005	<0.0005	<0.0005	<0.0005			<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BH101	LMH	Bromate (mg/L)	0.01	<0.1	<0.1	<0.1	<0.1	0.0047	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BH102	LMH	Bromate (mg/L)	0.01	<0.1	<0.1	<0.1	<0.1	<0.0005		<0.0005	0	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005			<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BH103	LMH	Bromate (mg/L)	0.01	<0.1	<0.1	<0.1	<0.1	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BH104	LMH	Bromate (mg/L)	0.01	<0.1	<0.1	<0.1	<0.1	<0.0005	<0.0005	0.0021	0.0018	0.0009	0.0019	0.0019	<0.0005	<0.0005	0.0015	0.0008	0.0001	<0.0005	<0.0005	<0.0005	<0.0005	0.0006	0.0008	<0.0005	0.0011	0.0015	0.0012
BH105	LMH	Bromate (mg/L)	0.01	0.33	0.12	0.29	0.29	0.18	0.3106	0.2786	0.2997	0.3018	0.2654	0.3072	0.1999	0.2983	0.2769	0.2715		0.2478	0.238	0.2327	0.2359	0.104	0.2403	0.2338	0.2109	0.0745	0.1012
BH106	LMH	Bromate (mg/L)	0.01	<0.1	<0.1	<0.1	<0.1	<0.0005		<0.0005	<0.0005	0.0006	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0053	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BH107	LMH	Bromate (mg/L)	0.01					<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005																
BH108	LMH	Bromate (mg/L)	0.01					0.0073	0.0045	0.0048	0.049	0.0657	0.0014	0.0374	<0.0005	0.0575	0.0414	0.0409	0.0204	0.0224	0.0192	<0.0005	<0.0005	<0.0005	0.0013	<0.0005	0.0187	0.0209	0.0225
BH201 L (S)	LMH	Bromate (mg/L)	0.01					0.11	0.1542	0.12	0.1259	0.1309	0.1123	0.122	0.118	0.1299	0.1188	0.1163	0.1123	0.0782	0.1065	0.1032	0.1102	0.1702	0.0964	0.0926	0.0814	0.0408	0.0754
BH201 L (D)	LMH	Bromate (mg/L)	0.01					0.09	0.0863	0.0865	0.086	0.0897	0.0761	0.077	0.065	0.0818	0.0769	0.0836					0.0762	0.0841					
BH301	LMH	Bromate (mg/L)	0.01															0.0033	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0007	<0.0005	<0.0005	<0.0005	0.0011	<0.0005
BH302	LMH	Bromate (mg/L)	0.01															0.0005	0.0005	0.0005	0.0005	0.0035	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
BH305	LMH	Bromate (mg/L)	0.01															0.5574		0.5794	0.6231	0.6089	0.4543	0.5603	0.6026	0.5631	0.5313	0.4959	0.5168

Borehole	Zone	Analysis	DWS	Aug-13	Nov-13	Feb-14	May-14	Jun-14	Jul-14	Oct-14	Jan-15	Apr-15	Jul-15	Oct-15	Jan-16	Apr-16	Aug-16	Nov-16	Feb-17	May-17	Nov-17	Feb-18	May-18	Aug-18	Nov-18	Feb-19	May-19	Aug-19	Nov-19
BH101	CHK	Bromide (mg/L)	-	0.12	0.11	0.098	0.066	0.158	0.15	0.148	0.064	0.142	0.136	0.145	0.136	0.135	0.124	0.134	0.105	0.145	0.145	0.171	0.144	0.152	0.138	0.149	0.135	0.137	0.157
BH102	CHK	Bromide (mg/L)	-	0.055	0.1	0.1	0.076	0.142		0.069	0.083	0.083	0.076	0.075	0.068	0.064	0.057	0.071			0.061	0.065	0.063		0.061	0.062	0.061	0.379	0.061
BH103	CHK	Bromide (mg/L)	-	0.44	0.38	0.34	0.38	0.397		0.07	0.411	0.405	0.372	0.394	0.412	0.149	0.342	0.047	0.343	0.099	0.393	0.369	0.372	0.393	0.332	0.411	0.408	0.054	0.442
BH104	CHK	Bromide (mg/L)	-	0.26	0.32	0	0.18	0.18	0.19	0.352	0.371	0.34	0.296	0.344	0.083	0.33	0.314	0.112	0.322	0.146		0.365	0.354	0.334	0.35	0.354	0.346	0.34	0.381
BH105	CHK	Bromide (mg/L)	-	0.61	0.1	0.4	0.38	0.48	0.465	0.218	0.499	0.566	0.456	0.538	0.17	0.599	0.666	0.71	0.484	0.71	0.655	0.651	0.669	0.162	0.605	0.665	0.654	0.376	0.632
BH106	CHK	Bromide (mg/L)	-	0.064	0.059	<0.05	<0.05	0.05		0.054	0.062	0.055	0.049	0.05	0.028	0.054	0.051	0.047	0.044	0.044	0.039	0.261	0.06	0.055	0.033	0.036	0.041	0.052	0.04
BH107	CHK	Bromide (mg/L)	-					0.182		0.167	0.206	0.164	0.149	0.142															
BH108	CHK	Bromide (mg/L)	-					1.06	1.095	0.929	0.956	0.938	0.888	0.954	0.095	0.881	0.825	0.876	0.742	0.805	0.765	0.8	0.738	0.718	0.723	0.788	0.715	0.626	0.68
BH301	CHK	Bromide (mg/L)	-															0.95	0.678	0.832	0.81	0.88	0.459	1.386	0.663	0.66	0.31	0.434	0.578
BH302	CHK	Bromide (mg/L)	-															0.235	1.463	0.227	1.744	1.868	1.733	1.998	1.977	1.898	1.717	1.658	1.716
BH305	CHK	Bromide (mg/L)	-															1.377		1.265	1.177	1.185	1.101	1.178			1.145	0.918	1.016

Borehole	Zone	Analysis	DWS	Aug-13	Nov-13	Feb-14	May-14	Jun-14	Jul-14	Oct-14	Jan-15	Apr-15	Jul-15	Oct-15	Jan-16	Apr-16	Aug-16	Nov-16	Feb-17	May-17	Nov-17	Feb-18	May-18	Aug-18	Nov-18	Feb-19	May-19	Aug-19	Nov-19
BHB	LMH	Bromide (mg/L)	-		0.35	0.3	0.39	0.325	0.31	0.4	0.326	0.418	0.384	0.364	0.359	0.366	0.347	0.404	0.235	0.352	0.352	0.302	0.326	0.331	0.242	0.263	0.359	0.357	0.404
BHG	LMH	Bromide (mg/L)	-			<0.05	0.11	0.118		0.088	0.064	0.139	0.15	0.132	0.094	0.072	0.143	0.207			0.166		0.102	0.086	0.087	0.13	0.143	0.179	0.187
BH101	LMH	Bromide (mg/L)	-	0.12	<0.05	<0.05	0.0059	0.172	0.17	0.106	0.153	0.104	0.127	0.267	0.059	0.119	0.124	0.135		0.081	0.081	0.0169	0.068	0.078	0.081	0.102	0.085	0.084	0.08
BH102	LMH	Bromide (mg/L)	-	0.09	0.1	0.062	0.13	0.13		0.117	0.091	0.118	0.12	0.097	0.13	0.14	0.144	0.14			0.128	0.151	0.186		0.118	0.165	0.153	0.139	0.133
BH103	LMH	Bromide (mg/L)	-	1.2	0.37	0.35	0.38	0.294		0.93	1.002	0.884	0.832	0.771	0.837	0.548	0.685	0.97	0.919	0.638	0.81	1.046	0.966	<0.005	0.993	1.049	1.058	1.003	0.987
BH104	LMH	Bromide (mg/L)	-	0.21	0.11	0.051	0.11	0.146	0.15	0.257	0.22	0.271	0.247	0.251	0.096	0.112	0.243	0.166	0.172	0.241	0.09	0.097	0.106	0.145	0.204	0.122	0.191	0.225	0.242
BH105	LMH	Bromide (mg/L)	-	1.1	0.52	0.14	0.89	0.619	1.047	0.83	0.991	0.91	0.869	1.001	0.692	0.915	0.84	0.893		0.788	0.775	0.788	0.808	0.858	0.773	0.794	0.778	0	0.484
BH106	LMH	Bromide (mg/L)	-	0.17	0.18	0.13	0.21	0.23		0.204	0.252	0.253	0.239	0.255	0.254	0.244	0.234	0.263	0.238	0.297	0.31	0.318	0.294	0.276	0.261	0.309	0.24	0.221	0.295
BH107	LMH	Bromide (mg/L)	-					0.189	0.204	0.161	0.198	0.183	0.189																
BH108	LMH	Bromide (mg/L)	-					0.2	0.16	0.188	0.337	0.36	0.11	0.265	0.104	0.357	0.287	0.3	0.204	0.24	0.217	0.408	0.128	0.127	0.157	0.168	0.187	0.219	0.251
BH201 L (S)	LMH	Bromide (mg/L)	-					0.5	0.569	0.573	0.611	0.554	0.549	0.08	0.542	0.556	0.528	1.385	0.494	0.397	0.514	0.548	0.486	0.466	0.469	0.499	0.475	0.254	0.483
BH201 L (D)	LMH	Bromide (mg/L)	-					0.37	0.383	0.397	0.421	0.416	0.359	0.391	0.323	0.373	0.394	0.409					0.378	0.371					
BH301	LMH	Bromide (mg/L)	-															0.45	0.446	0.452	0.49	0.319	0.272	0.453	0.41	0.215	0.16	0.188	0.283
BH302	LMH	Bromide (mg/L)	-															1.794	0.087	1.079	1.478	1.875	1.963	1.821	1.976	2.28	2.223	2.052	1.994
BH305	LMH	Bromide (mg/L)	-															1.538		1.437	1.396	1.581	1.346	1.389	1.338	1.397	1.364	1.223	1.279

Hatfield Road Quarry – Bromate and Bromide Groundwater Quality (Aug 2013 – Nov 2019)

Borehole	Zone	Analysis	DWS	Aug-13	Nov-13	Feb-14	May-14	Jun-14	Jul-14	Oct-14	Jan-15	Apr-15	Jul-15	Oct-15	Jan-16	Apr-16	Aug-16	Nov-16	Feb-17	May-17	Nov-17	Feb-18	May-18	Aug-18	Nov-18	Feb-19	May-19	Aug-19	Nov-19
BHA	UMH	Bromate (mg/L)	0.01		<0.1	<0.1	<0.1						<0.0005	<0.0005				<0.0005					<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BHC	UMH	Bromate (mg/L)	0.01		<0.1	<0.1	<0.1						<0.0005	0.0006				<0.0005					<0.0005							
BHD	UMH	Bromate (mg/L)	0.01		<0.1	<0.1												<0.0005					<0.0005	<0.0005					
BHE	UMH	Bromate (mg/L)	0.01			<0.1	<0.1						<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0112	<0.0005
BHF	UMH	Bromate (mg/L)	0.01			<0.1	<0.1						<0.0005	<0.0005				<0.0005											
BHH	UMH	Bromate (mg/L)	0.01			<0.1	<0.1						<0.0005	<0.0005															
BHJ	UMH	Bromate (mg/L)	0.01				<0.1						<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005										
BHK	UMH	Bromate (mg/L)	0.01				<0.1						<0.0005	<0.0005	<0.0005														
BH101	UMH	Bromate (mg/L)	0.01	<0.1	<0.1	<0.1	<0.1	<0.0005			<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005				<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BH102	UMH	Bromate (mg/L)	0.01	<0.1	<0.1	<0.1	<0.1	<0.0005			<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BH103	UMH	Bromate (mg/L)	0.01	<0.1	<0.1	<0.1	<0.1	<0.0005			<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005				<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BH104	UMH	Bromate (mg/L)	0.01	<0.1	<0.1	<0.1	<0.1	<0.0005			<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005				<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BH105	UMH X	Bromate (mg/L)	0.01					<0.0005			<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0073	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BH106	UMH	Bromate (mg/L)	0.01	<0.1	<0.1	<0.1	<0.1	<0.0005			0.0021	0.0016	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	0.0054	0.0014	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BH107	UMH	Bromate (mg/L)	0.01					<0.0005			<0.0005	<0.0005	<0.0005	<0.0005															
BH108	UMH	Bromate (mg/L)	0.01					<0.0005			0.0129	<0.0005	<0.0005	<0.0005	<0.0005	0.0025	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	DRY	<0.0005	0.0008	<0.0005
FT101	UMH	Bromate (mg/L)	0.01	<0.1									<0.0005					<0.0005					<0.0005	<0.0005					
FT102	UMH	Bromate (mg/L)	0.01	<0.1	<0.1	<0.1	<0.1			<0.0005			<0.0005	<0.0005	<0.0005	<0.0005	<0.0005												
FT103	UMH	Bromate (mg/L)	0.01	<0.1									<0.0005																
BH306	UMH	Bromate (mg/L)	0.01															<0.0005	<0.0005	0.0008	0.0007		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BH307	UMH	Bromate (mg/L)	0.01															<0.0005	<0.0005	<0.0005	<0.0005		<0.0005						
GMW101	UMH	Bromate (mg/L)	0.01																				<0.0005						
GMW102	UMH	Bromate (mg/L)	0.01																				0.0068						
GMW103	UMH	Bromate (mg/L)	0.01																				<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
GMW103 L	UMH	Bromate (mg/L)	0.01																				<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
GMW104	UMH	Bromate (mg/L)	0.01															<0.0005		<0.0005	0.0052		<0.0005	<0.0005					
GMW105	UMH	Bromate (mg/L)	0.01																				<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005
GMW106	UMH	Bromate (mg/L)	0.01																				<0.0005						
GMW107	UMH	Bromate (mg/L)	0.01															<0.0005		<0.0005			<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0008	<0.0005
GMW108	UMH	Bromate (mg/L)	0.01																				<0.0005						
GMW109	UMH	Bromate (mg/L)	0.01															<0.0005		<0.0005			<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
GMW110	UMH	Bromate (mg/L)	0.01																				<0.0005	<0.0005					<0.0005
GMW111	UMH	Bromate (mg/L)	0.01																				<0.0005	<0.0005					
GMW112	UMH	Bromate (mg/L)	0.01																					<0.0005					
GMW113	UMH	Bromate (mg/L)	0.01															<0.0005					<0.0005	<0.0005					
GMW114	UMH	Bromate (mg/L)	0.01															<0.0005					<0.0005	<0.0005					

Borehole	Zone	Analysis	DWS	Aug-13	Nov-13	Feb-14	May-14	Jun-14	Jul-14	Oct-14	Jan-15	Apr-15	Jul-15	Oct-15	Jan-16	Apr-16	Aug-16	Nov-16	Feb-17	May-17	Nov-17	Feb-18	May-18	Aug-18	Nov-18	Feb-19	May-19	Aug-19	Nov-19
BHA	UMH	Bromide (mg/L)	-		0.1	0.21	<0.05						0.073	0.11				0.108					0.057	0.133	0.169	0.084	0.091	0.084	0.091
BHC	UMH	Bromide (mg/L)	-		0.15	0.68	0.14						0.158	0.181				0.129					0.128						
BHD	UMH	Bromide (mg/L)	-		<0.05	0.28												0.26					0.189	0.189					
BHE	UMH	Bromide (mg/L)	-			<0.05	<0.05						0.073	0.081	0.111	0.11	0.098	0.088	0.075	0.074	0.082	0.0093	0.125	0.091	0.065	0.068	0.063	0.08	0.098
BHF	UMH	Bromide (mg/L)	-			0.055	0.066						0.057	0.058				0.064											
BHH	UMH	Bromide (mg/L)	-			<0.05	<0.05						0.055	0.079															
BHJ	UMH	Bromide (mg/L)	-				0.15						0.126	<0.005		0.184	0.21	0.227	0.204										
BHK	UMH	Bromide (mg/L)	-				0.091						0.105	0.119	0.014														
BH101	UMH	Bromide (mg/L)	-	0.099	0.13	<0.05	0.15	0.203			0.08	0.077	0.105	0.113	0.093	0.098	0.112	0.121				0.086	0.072	0.12	0.093	0.086	0.08	0.086	0.14
BH102	UMH	Bromide (mg/L)	-	0.096	0.079	0.074	0.072	0.147			0.114	0.086	0.065	0.061	0.079	0.113	0.078	0.058	0.058	0.072	0.091	0.088	0.129		0.08	0.126	0.118	0.107	0.132
BH103	UMH	Bromide (mg/L)	-	0.053	<0.05	<0.05	<0.05	0.05			0.072	0.045	0.039	0.044	0.066	0.052	0.1	0.05				0.049	0.051	0.03	0.063	0.035	0.038	1.019	0.041
BH104	UMH	Bromide (mg/L)	-	0.071	0.088	0.3	0.15	0.199			0.056	0.113	0.116	0.102	0.034	0.062	0.06	0.106				0.07	0.077	0.084	0.084	0.054	0.088	0.087	0.081
BH105	UMH X	Bromide (mg/L)	-					0.202			0.161	0.169	0.59	0.14	0.185	0.194	0.344	0.138	0.126	0.156	0.115	0.096	0.161	0.112	0.152	0.088	0.104	0.115	0.12
BH106	UMH	Bromide (mg/L)	-	0.052	<0.05	0.063	0.062	0.17			0.074	0.071	0.059	0.063	0.042	0.096	0.076		0.057	0.069	0.064	0.102	0.035	0.056	0.046	0.057	0.059	0.069	0.055
BH107	UMH	Bromide (mg/L)	-					0.164			0.069	0.15	0.153	0.162															
BH108	UMH	Bromide (mg/L)	-					0.14			0.184	0.113	0.084	0.093	0.105	0.145	0.115	0.158	0.119	0.134	0.104	0.372	0.151	0.082	0.109	DRY	0.099	0.1	0.136
FT101	UMH	Bromide (mg/L)	-	0.07									0.043					0.047					0.042	0.032					
FT102	UMH	Bromide (mg/L)	-	<0.05	<0.05	<0.05	<0.05			0.033			0.042	0.041	0.031	0.034	0.029												
FT103	UMH	Bromide (mg/L)	-	<0.05									0.047																
BH306	UMH	Bromide (mg/L)	-															0.077	0.1	0.113	0.109		0.16	0.108	0.096	0.087	0.081	0.091	0.087
BH307	UMH	Bromide (mg/L)	-															0.133	0.128	0.131	0.138		0.162						
GMW101	UMH	Bromide (mg/L)	-																				0.043						
GMW102	UMH	Bromide (mg/L)	-																				0.054						
GMW103	UMH	Bromide (mg/L)	-																				<0.005	2.097	1.038	1.4	1.155	0.094	1.176
GMW103 L	UMH	Bromide (mg/L)	-																				0.163	0.153	0.138	0.381	0.196	0.029	0.082
GMW104	UMH	Bromide (mg/L)	-															0.08		0.12	0.288		0.078	0.053					
GMW105	UMH	Bromide (mg/L)	-																				0.207	0.223	0.062	0.116	0.122		0.065
GMW106	UMH	Bromide (mg/L)	-																				0.08						
GMW107	UMH	Bromide (mg/L)	-															0.367		0.279			0.167	0.205	0.208	0.162	0.18	0.223	0.307
GMW108	UMH	Bromide (mg/L)	-																				0.116						
GMW109	UMH	Bromide (mg/L)	-															0.288		0.2			0.107	0.142	0.174	0.074	0.182	0.436	0.358
GMW110	UMH	Bromide (mg/L)	-																				0.059	0.063					0.079
GMW111	UMH	Bromide (mg/L)	-																				0.067	0.054					
GMW112	UMH	Bromide (mg/L)	-																					0.028					
GMW113	UMH	Bromide (mg/L)	-															0.084					0.066	0.058					
GMW114	UMH	Bromide (mg/L)	-															0.04					0.01	0.077					

HATFIELD ROAD QUARRY

Planning Permission [PL/0755/16]

Details required under Condition [26] and [30]

Groundwater and Water Management Plan

Final (Version 5)

Prepared for: Brett Aggregates Limited

SLR Ref: 403.01009.00190
Version No: FINAL V.5
January2020

BASIS OF REPORT

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CONTENTS

DOCUMENT REFERENCES

TABLES

DRAWINGS

APPENDICES

ABBREVIATIONS

UMH – Upper Mineral Horizon

LMH – Lower Mineral Horizon

UMA – Upper Mineral Aquifer

LMA – Lower Mineral Aquifer

UML – Upper Mineral Lagoon

LML – Lower Mineral Lagoon

Agency – The Environment Agency

Affinity – Affinity Water plc

Brett – Brett Aggregates Limited

CQA – Construction Quality Assurance

mAOD – metres above ordnance datum

1.0 INTRODUCTION

1.1 Overview

Brett Aggregates Limited (Brett) has applied for planning permission for the establishment of Hatfield Road Quarry, a new quarry on land at the former Hatfield Aerodrome. The proposals will involve the winning and working, together with processing for sale, of approximately 8Mt of sand and gravel over a period of around 30 years, and the manufacture of ready mixed concrete. In parallel with the extraction of minerals there will be the importation of low permeability inert material to infill the shallow mineral workings to facilitate the restoration of the site to a beneficial after use, combining recreation and nature consideration.

The draft planning conditions issued by Hertfordshire County Council (**Reference PL/0755/16**) includes several conditions requiring the submission of further information relating to the management of water. This report is submitted in advance of the planning determination to satisfy the following conditions:

- Condition 26 - Groundwater Management Plan, and
- Condition 30 - A Water Management Plan.

1.2 Requirements

1.2.1 Condition 26 Groundwater Management Plan

Draft Condition 26 of the planning permission relates to the management of groundwater and provides that:

26. Groundwater Management Plan

The development hereby permitted shall not commence until a Water Monitoring & Management Plan, including a timetable of monitoring and submission of reports to the local planning authority, has been submitted to, and approved in writing by, the local planning authority. Reports as specified in the approved plan, including details of any necessary contingency action arising from the monitoring, shall be submitted to, and approved in writing by, the local planning authority.

i. No mineral is extracted from within the existing plume of bromate and bromide groundwater pollution
ii. any activities close to the plume must not change the existing hydrogeological flow regime
iii. any activities close to the plume must not interfere with the remediation of the bromate and bromide

The Water Monitoring and Management Plan shall include:

1. details of construction and water management during construction of the two infiltration lagoons.

2. clarification of the restored site discharge point for the UML back-drain.

3. a long-term groundwater monitoring plan to continue during and post the operational phase.

4. a mechanism for periodic review.

The plan should include monitoring and reporting programs, location of monitoring points including additional monitoring boreholes particularly in the vicinity of the infiltration lagoons, analytical suites, limits of detection and groundwater level monitoring. Details of contingency actions in the event of impact shall also be included.

The two infiltration lagoons and back drain shall be constructed in accordance with the approved Groundwater Management Plan prior to the commencement of mineral extraction.

Groundwater monitoring shall be conducted by the Mineral Operator in accordance with the long-term groundwater monitoring plan for the lifetime of the development. Prior to mineral extraction in each Phase,

the Groundwater Management plan shall be reviewed, and an updated plan submitted and approved in writing by the Mineral Planning Authority.

The management of water shall be carried out in accordance with the approved Plan, or as otherwise agreed by the Mineral Planning Authority under the periodic review process, for the lifetime of the development.

Reasons:

To protect controlled waters throughout the mineral extraction phasing;

To ensure there is no deleterious impact to groundwater quality, in accordance with Policy 16 (Soil, Air and Water) of the Hertfordshire Waste Core Strategy 2012;

To prevent development that would have an unacceptable risk or adversely affect water pollution;

To minimise the risks associated the flow and quantity of surface and groundwater and migration of contamination from the site, in accordance with paragraph 143 of the NPPF.

1.2.2 Condition 30 A Water Management Plan

Draft Condition 30. requires that a water management plan is submitted and approved by the Mineral Planning Authority (Hertfordshire County Council, HCC). Details of Condition 30 and the reason for it are provided below.

30 Water Management Plan

Prior to the commencement of mineral extraction in each Phase, a water management plan shall be submitted and approved in writing by the Mineral Planning Authority. The water management plan shall detail measures to manage water from the lagoons, including an exceedance route for discharge of water from the lagoons as surface water under exceptional circumstances, and include a mechanism for periodic review. The management of water shall be carried out in accordance with the approved Plan, or as otherwise agreed by the Mineral Planning Authority under the periodic view process, for the lifetime of the development.

Reason:
To minimise the risk of surface water flooding and in the interests of water quality.

This is the initial water management plan and provides information relating to water management during development of the site. It is proposed that a phase specific water management plan will be prepared and submitted to the Mineral Planning Authority prior to the commencement of mineral extraction in each phase. This will allow specific conditions of each phase to be considered and for the management options to be revisited in the light of experience from previous phases and changes in background conditions

1.3 Response Structure

We have amalgamated our response to the two draft conditions into a single response because the topics as stated are related and overlap and one response will avoid repetition and possible confusion.

We have used this document to answer the specific points being raised within the context of the Sites Operational Plan for mineral extraction which sets the framework for the water management requirements.

The specific conditions require the preparation of a Water Management Plan to include the following:

- Details of the construction of the two infiltration lagoons and water management during their construction (addressed in Section 2);
- Clarification of the restored site discharge point for the back-drain in the Upper Mineral Horizon (addressed in Section 2).

- A long-term groundwater monitoring plan to continue during and post the operational phase (addressed in Section 3)
- A mechanism for periodic review (addressed in Section 2).

The requests listed above have been inserted into the relevant sections of this report where the topic is specifically discussed.

1.4 Groundwater Pumping Test

A groundwater pumping test has been carried out to support a licence application for groundwater abstraction for mineral washing and transfer from the Upper Mineral Aquifer (UMA) and to provide technical data for both the UMA and Lower Mineral Aquifer (LMA) in order to validate and refine previous assumptions and facilitate any future assessments. This pumping test has been reported separately (SLR report ref: 402.01009.00226.01_v2, Sept 2018) and is not reproduced within this management plan, however, the findings of the pumping test have informed the scope and content of this document.

2.0 OPERATIONAL PLAN

2.1 Site Geology and Groundwater Occurrence

The site is located within superficial Lowestoft Formation which overlies the Lewes Nodular Chalk. The superficial deposits comprise four units overlying the Chalk bedrock and there are groundwater aquifers in the two granular superficial horizons, as summarised in Table 2-1.

Table 2-1
Geology and Groundwater Occurrence

Geological Unit	Description	Thickness	Groundwater
Overburden	Predominantly clayey, silty sands	0m – 2m	Seasonally saturated by the underlying UMA
Upper Mineral Horizon (UMH)	Silty sands and gravels	4m – 6m	Upper Mineral Aquifer (LMA) (perched on aquitard below)
Interburden	Boulder Clay (Stiff glacial clay)	3m – 5m	Aquitard (Barrier to groundwater flow)
Lower Mineral Horizon (LMH)	Sands and gravels	5m – 7m	Lower Mineral Aquifer (hydraulically connected with the underlying Chalk aquifer)
Chalk Bedrock (Lewes Nodular Chalk)	Weathered at its surface increasing competency with depth	Unproven thickness on site	Chalk Aquifer

2.2 Mineral Development Plan

The quarry will work the two main superficial deposit horizons (UMH and LMH), which will be extracted and backfilled in Phases (Phase A through Phase G), in a staged approach. The Phase A operational plan is shown on Drawing HA-PCC-C9 in Appendix 01.

2.2.1 Upper Mineral Horizon

As the UMH is partially saturated it will be dewatered to allow the mineral to be worked dry. A 4m - 10m thick sidewall geological barrier will be keyed into the underlying interburden surface and will form a clay buttress around the perimeter of each phase (Drawing 018 in Appendix 01). The engineered geological barrier will allow isolation of the UMA within each phase in order that it can be dewatered without drawing in water from the wider UMA thus allowing the UMH to be worked dry. The sidewall geological barrier / clay buttress will be constructed using standard engineering practice and will be subject to Construction Quality Assurance (i.e. specification, CQA Plan, independent supervision and validation report).

Groundwater abstracted from the UMA during the construction of each Phase and its subsequent operation will be transferred to the silt lagoons in the processing plant area to provide mineral washing water (under licence issued by the Agency). Any water which is not required for mineral washing will be transferred into the Upper Mineral Lagoon (UML) and if required the Lower Mineral Lagoon (LML) where it will infiltrate back into the UMA or LMA, respectively, outside of the mineral working area. Separate and clearly labelled pipes will be used to transfer groundwater from the UMA and the LMA to its intended point of discharge, as detailed above.

UMH Perimeter Buttress

Each phase will be constructed with a perimeter buttress as described above and illustrated on Drawing 018 in Appendix 01. The perimeter buttress forming the outside perimeter of the mineral development site will remain in place in perpetuity, whereas internal buttresses will be progressively removed as the phases are sequentially developed.

UMH Back Drain

The back drain will be constructed to manage the water level and maintain the stability of the landfill perimeter buttress until site restoration. The drain as shown on drawing 'Infiltration Lagoons & Buttress Schematic Sections' comprises a collection pipe and a granular blanket across the cut face of the Upper Mineral Horizon and partially the Overburden.

The recorded UMA groundwater level will be reduced by c.1m by gravity flow and/or pumping and will be discharged to the silt lagoons to provide mineral washing water and any excess transferred to the UML and/or LML for recharge back into the respective aquifers. Section 2.3.4 presents estimates of water volumes calculated for the back-drain flow.

The drawing 'Infiltration Lagoons & Buttress Schematic Sections' does not at this stage refer to topographic levels in Ordnance Datum as they are intended only to show design principles and indeed the proportions of the different features are not to scale. Detailed construction drawings which reference Ordnance Datum will be prepared following granting of the planning permission.

2.2.2 Lower Mineral Horizon

Access to the LMH will be progressed once the UMH in each phase has been dewatered and the mineral excavated under dry conditions and the interburden surface is exposed.

The LMH is partially or fully saturated depending on the season and phase location and a methodology for mineral extraction has been devised for each of these scenarios and is described below. The extraction of the LMH will be undertaken on a 'wet' campaign basis during periods of the year when the LMA is at its seasonal low.

1. **LMA is Unconfined – piezometric surface is within the LMH (LMH excavated without pumping)**

- The clay interburden will be removed from above the LMH in small operating cells circa 100m x 30m in size;
- Interburden will be stored for re-use in backfilling / restoration;
- The exposed mineral will be excavated 'wet' using the dry surface of the mineral as an operating platform;
- This procedure is applicable to most of the phases and will not require pumping of groundwater from the LMA.

2. **LMA is Confined – piezometric surface rests within the Interburden horizon (LMH excavated WITHOUT pumping)**

- The surface level of the LMA will be confirmed by excavating a small test pit through the interburden to prove the top of the LMH and to confirm the on-site monitoring of the LMA piezometric surface;
- The interburden above the LMA piezometric surface, will be excavated and removed to stockpile for re-use in backfilling / restoration;

- With the equipment working from the remaining interburden bench the interburden above the LMH will be removed in strips and placed to stockpile for re-use in backfilling / restoration;
- Simultaneously, material from the LMH will be excavated and placed to form a raised working bench above the surface of the water which will be used as an operating platform for the wet extraction of the LMH.

The approach listed above will not require pumping of groundwater from the LMA.

3. **LMA is Confined – piezometric surface rests within the Interburden horizon (LMH excavated WITH pumping)**

The approach described below may be implemented if temporary lowering of the piezometric surface is selected to facilitate the removal of the interburden, after which pumping would cease:

- Key stakeholders (the Agency, Affinity, HCC) will be consulted in advance of pumping as part of the routine six monthly review meetings or during additional meetings as required (see Section 2.3.5);
- Pumping will only be undertaken with the written approval of Brett's Managing Director;
- Localised pumping of the LMA will be undertaken in small cells (up to 100m x 30m strips) to de-pressurise the interburden and facilitate its removal;
- Once the clay interburden has been removed, pumping will be stopped allowing the piezometric surface of the LMA to recover to its natural level;
- The mineral will then be removed 'wet' by excavators reaching below the water level from a gravel platform built up on the top of the mineral layer or on the adjacent interburden (depending on local conditions);
- Groundwater abstracted from the LMA will only be discharged into the Lower Mineral Lagoon (LML) and will infiltrate back into the LMA outside of the mineral working area.
- Pumping the LMA will only be undertaken when the LML has capacity to accept the water being transferred defined as at least 1m of water level head difference between the UML and the LML as measured in the lagoon by water level loggers.

4. **LMA is Confined – piezometric surface rests above the Interburden horizon.**

No removal of the interburden or extraction of the LMH will take place when these conditions exist within an operational phase.

2.2.3 LMH Backfilling

Backfilling of the LMH void will be undertaken using site won overburden and interburden material only. The LMH void will be filled concurrently with the mineral extraction process in small areas as defined above (c100m x 30m) and will self-consolidate when placed beneath the water. LMH mineral will be left in place if there is insufficient site won overburden and interburden to backfill all the phases of the LMH.

As the filling proceeds and given the permeability of the LMA, it is expected that any resulting mounding of the groundwater surface created by the infilling process will be slight and short-lived and the groundwater equilibrium will quickly re-establish itself because of the hydraulic connection between the chalk and the LMA.

Site won backfill will be placed in the LMH void until it is above the groundwater level or at the base of the interburden, at which point it will form the subgrade for construction of the basal geological barrier for the inert landfill. An assessment of the potential for basal heave was undertaken in association with the inert landfill

permit application (Ref: EPR/EB3808HD/A001). Calculations proved an acceptable factor of safety against basal heave.

2.2.4 Geological Barrier

The subgrade will be prepared, and the geological barrier constructed using standard engineering techniques and will be subject to Construction Quality Assurance (i.e. specification, CQA Plan, independent supervision and validation report). The basal and sidewall geological barriers will form a continuous engineered seal across the entire site. Once each area is lined, inert waste can then be placed into the void above the basal geological barrier and adjacent to the sidewall geological barrier/UMH perimeter buttresses. The site will be restored with subsoil and soil to a similar level as the unworked site in accordance with the approved restoration plan.

2.3 Infiltration Lagoons

Two water infiltration lagoons will be constructed on the hydraulically down gradient, northeast perimeter of the site (see Drawing HA-PCC-C9 in Appendix 01). One lagoon will only discharge water into the UMH and is referred to as the Upper Mineral Lagoon or UML. The second, referred to as the Lower Mineral Lagoon (LML) will only discharge into the LMH. The lagoon locations were specifically selected based on their suitability for infiltrating water into the aquifers, important factors being that:

- The LMH is interpreted as being unconfined for most of the previous 5 years with only a brief period of confinement (March – May 2014), which was a period of exceptionally high-water levels, and
- There is a significant 6m of hydraulic head between the UMA and the LMA meaning that the LML has significantly more storage capacity and hydraulic head to infiltrate water into the LMA.

The lagoons will be used to manage the discharge of groundwater and incident rainfall gathered during the operation of the Site as follows:

- As stated in Section 2.2.1, groundwater from the UMH which is not used to top up the mineral washing lagoons in the plant area will be discharged to the UML;
- Only in exceptional circumstances will UMH groundwater be discharged into the LML and then only following appropriate water quality analysis. As a matter of course, construction of the sidewall buttress will be scheduled for periods of lowest groundwater levels thereby reducing the amount of water to be managed;
- If water is pumped from the LMA it will only ever be discharged to the LML and under no circumstances will it be used for mineral processing or be discharged to the UML.

2.3.1 Lagoon Maintenance

It is appreciated that lagoon infiltration capacity will reduce due to gradual siltation. This will be managed by the physical removal of fines during planned periods of no groundwater discharge and will be possible because the LML will not be excavated beneath the base of the interburden meaning the surface of the LMH will provide a platform on which equipment can work. This will be a topic of the 6-monthly review meeting.

2.3.2 Lagoon Construction

Condition 26 (i) details of construction and water management during construction of the two infiltration lagoons.

Proposed excavation, engineering fill levels and schematic cross sections showing the construction of the infiltration lagoons are provided in Appendix 01. Precise details of the construction and water management are subject to the methodology provided by the successful contractor who will undertake the work, although the

proposed sequence of construction and an outline of the management of surface water and groundwater are given below.

The infiltration lagoons will be constructed in a similar manner to the Upper Mineral phase buttresses i.e. using standard engineering practices and subject to CQA.

Lower Mineral Lagoon

The LML will be constructed first and will be isolated from the surrounding UMH by the construction of an engineered clay buttress anchored into the interburden. This will involve local dewatering of the UMH to allow the clay buttress to be constructed in a dry excavation, with water being recharged back into the UMH in an adjacent temporary infiltration area on the location of the UML. The clay buttress will be constructed in relatively small sections to minimise the extent of dewatering of the UMA required to construct it and to manage the water volume being returned to the aquifer.

When the clay buttress is complete the UMH remaining within the perimeter of the clay buttress of the lagoon will be dewatered and the UMH extracted from the lagoon in a dry state.

The optimum seasonal period for working the UMH is June through November when natural UMA groundwater levels are at their lowest, which will further reduce the scale of dewatering work required during this commencement phase.

The interburden will then be excavated down to its base where the excavation will stop. We do not intend to excavate the LMH in the LML. Based on groundwater monitoring data, water levels in the LMA at the location of the LML are not routinely expected to be above the base of the interburden.

Upper Mineral Lagoon

The UMH lagoon will be constructed after the LMH Lagoon.

Construction of the clay buttress along the southern and western side of the UML will be undertaken in the same manner as described in Section 2.3.2 above. These buttresses will key into the interburden to provide a seal to prevent flow from the UML entering the future Phase B of the working site. There will be no buttresses along the north and east face of the UML because water will need to discharge from the lagoon into the UMA and down gradient towards the northeast in the direction of groundwater flow in the UMA.

A shallow engineered buttress will be installed from ground level to a depth of approximately 2m (74.5 mAOD) to prevent erosion of the overburden when the lagoon is operational. The UMH in the lagoon will be excavated to a depth of approximately 4.5m below the surface (72 mAOD) which approximates to the seasonal low groundwater level for the UMA at this location.

A plan showing the lagoon locations and cross sections showing the proposed construction of the infiltration lagoons are provided in Appendix 01.

2.3.3 Operational Water Management

Water Discharge Sources

The water sources to be managed on the site when the site is operational are listed in Table 2-2.

Table 2-2
Sources of Discharge

Source	Point of Discharge (UMA or LMA via lagoons)	
	UML	LML
1. Incident rainfall and runoff	Yes	Yes

Source	Point of Discharge (UMA or LMA via lagoons)	
	UML	LML
2. Dewatering discharge from the UMH (if not used for mineral processing)	Yes	Yes
3. Discharge from back drain behind UMH clay buttresses (if not used for mineral processing)	Yes	Yes
4. Groundwater lowering discharge from the LMH (only if LMH piezometric surface is reduced by pumping)	No	Yes
5. River Nast (Existing and Proposed)	No	No

1. *Incident rainfall and runoff*

Rainfall and runoff from the mineral processing area will predominantly infiltrate into the ground in which case it will be incorporated into shallow UMA groundwater that could ultimately recharge the River Nast although not significantly. When diverted the River Nast will flow through the site via open ditch and culvert and will by-pass the lagoons ultimately discharging into the Ellenbrook, as existing (see points 5 and 6 below).

Rainfall and runoff within each individual mineral development phase will be incorporated into the dewatering discharge from the UMH, which will be discharged to the UMA via the UML or into the LMA via the LML.

2. *Dewatering discharge from the UMH*

Groundwater pumped from the UMA during dewatering in each phase will be transferred by overland pipeline and discharged to the silt lagoons in the mineral processing area to provide mineral washing water and any excess to this requirement will be transferred to the UML and/or LML for recharge back into the respective aquifers.

3. *Discharge from back drain behind clay buttresses in UMH*

Groundwater captured by the perimeter back drain will be transferred from pumping stations by overland pipeline and discharged to the silt lagoons in the mineral processing area to provide mineral washing water; again, any excess to this requirement will be transferred to the UMA or the LMA via the UML and LML respectively.

4. *Groundwater lowering discharge from the LMH (if pumping from the LMA is undertaken)*

Groundwater pumped from the LMA during piezometric surface lowering in the operational phase, if undertaken, will only ever be returned to the LMA via the LML.

5. *Existing River Nast*

The River Nast is an ephemeral stream which has been recorded to flow between approximately January and April although only three times in the last 6 years (2014, 15 and 16 with no-flow in 2017, 18 and 19). It is approximately 1.5m wide and 0.4m deep and flow is only recorded when the UMA water table reaches the invert level of the ditch i.e. c. 0.4mbgl.

The ephemeral river rises near the northern site boundary with Hatfield Quarry and flows along a straightened route towards the south-east end of Home Covert Wood where it enters a culvert that passes beneath the former Hatfield Aerodrome runway and the University playing fields. The culvert discharges to a road ditch on the northern side of the Hatfield-St Albans Road and subsequently into the Ellenbrook on Ellenbrook Lane.

6. Diverted River Nast

The current route of the Nast passes through the proposed mineral processing area for the site, so to facilitate plant construction it will be re-routed along the northern site boundary towards Home Covert Wood and then south along the Wood's western side.

The diverted Nast will then discharge into a new sealed culvert constructed along the engineered buttress between the infiltration lagoons and operational Phase B and A. It then follows its existing route under the University playing fields to the ditch on the Hatfield – St Albans Road as illustrated on Drawing HA-PCC-C9 in Appendix 01. This diverted route for the River Nast is not substantially different to that existing today and as experienced in the past, we expect flow in the Nast to be seasonal.

The infrastructure built for the Nast diversion will not be used for transfer of pumped UMA or LMA groundwater.

2.3.4 Estimated Water Discharge Volumes

Detailed design of the lagoons will ensure they have capacity to manage the predicted volumes of water and to recharge water back into the respective aquifers. Details of the predicted water volumes were presented in Appendix 6/10 of the Environmental Statement (ES) that accompanied the planning application (summary table included in Appendix 02). Since then, Brett has undertaken a pumping test in the UMA and LMA, so we have used the data to refine the conceptual model input parameters for the predictions of flow. These revised estimates are presented in Table 2-3.

Table 2-3
Summary of Predicted Volumes of Water to be Managed

Source of Water	Potential Volume (m3/day)	Discharge Location
Dewatering discharge for UMH clay buttress construction	750-1000	Mineral Washing Lagoon or UMH Lagoon (LMH if required)
Back drain	225-645	Mineral Washing Lagoon or UMH Lagoon (LMH if required)
UMH groundwater and rainfall in each phase	122-164	Mineral Washing Lagoon or UMH Lagoon (LMH if required)
LMH groundwater if above interburden base (If pumping undertaken)	2,500-4,500	LMH Lagoon
Back-drain discharge from restored site (open ditch along western site boundary)	134 – 269	UMH Lagoon (enlarged to include footprint of LMH Lagoon)
Restored site runoff	41,000	UMH Lagoons
Total estimated discharge to Mineral Washing Lagoon or UMH Lagoon	1,097-1,809	Mineral Washing Lagoon or UMH Lagoon
Total estimated discharge to LMH Lagoon (If pumping undertaken)	2,500-4,500	LMH Lagoon
Total estimated discharge to Mineral Washing Lagoon, UMH & LMH Lagoon	3,597-6,309	Mineral Washing Lagoon, LMH and UMH Lagoon
UMH Lagoon Infiltration Capacity	1,100 - 2,300 m3/day A	
LMH Lagoon Infiltration Capacity	7,260 - 14,500 m3/day B	
UMH Restoration Lagoon Storage Capacity	93,000 - 167,000m3	

Notes:

[A] Assumes 3m of driving head above static water table
[B] Assumes 6m of driving head above static water table

Operational Volumes

The summary presented in Table 2-3 demonstrates that during the operational phase of the site the combined infiltration capacity of the lagoons exceeds the predicted water discharges. This does not include the UMH water transferred to the silt lagoons in the mineral processing area or the static storage capacity of the infiltration Lagoons that will provide an additional management option if required.

2.3.5 Lagoon Discharge Management

Condition 30 The water management plan shall detail measures to manage water from the lagoons, including an exceedance route for discharge of water from the lagoons as surface water under exceptional circumstances, and include a mechanism for periodic review

As described in Section 2.3.3 the UML and LML are designed to accept pumped groundwater from a variety of water discharge sources. The following principles (to be under constant review) will manage the lagoon discharge:

1. The three water discharge sources (Back drain, dewatering for buttress construction, UMH groundwater control in operational phase) are all manually controlled by pumps; there will be no automatic or uncontrolled discharges into the UML;
2. Groundwater from the UMH will be discharged to the silt lagoons in the mineral processing area, and into the UML.
3. In exceptional circumstances groundwater from the UMA may be discharged into the LML but only following appropriate water quality analysis, and discussion within the 6-monthly review meetings or through on-line discussion depending on urgency. Approval to discharge will be provided by the Brett Managing Director;
4. A manually operated spillway will be installed between the UML and LML at an elevation of 75.5m AOD to allow water to discharge from the UML to the LML. The spillway will be locked in the closed position when not in use and will only be opened and used upon completion of the procedure described in item 3 above;
5. Groundwater pumped from the LMH will only ever be discharged to the LML;
6. Water levels will be continuously monitored in both recharge lagoons using a pressure transducer and data logger system. The system will include telemetry and automatic alarms which will notify operational staff when pre-set maximum levels are reached;
7. The elevation of water in the UML will always be maintained at least 1m above that in the LML to ensure there is no hydraulic gradient from the LML into the UML. Gauge boards will also be installed in the recharge lagoons so relative water levels can be readily observed by site staff;
8. If the pre-determined maximum water level in the LML is reached all pumping will stop until water levels fall;
9. A comprehensive programme of water level monitoring and water quality sampling is being implemented at the site. Further details are presented in Section 3.0 of this document.

2.3.6 Performance Reviews and Progress Meetings

Careful management of any water discharge is fundamental to the successful operation of the site and will require the understanding and integration of many environmental and operational factors. Examples include:

- Developing a seasonally controlled operating plan that avoids, as far as reasonably possible, the need to pump and discharge water;

- Seasonal changes in groundwater levels and its impact on water discharge volumes from back drain flow and dewatering requirements;
- Avoiding the mixing of UMA groundwater with LMA groundwater via the lagoon discharge pathway whenever possible;
- Third party influences such as Affinity pumping rates;
- Lagoon performance with water level changes;
- Operational factors such as siltation of lagoons;
- Water discharge changes due to product demand changes; and
- Bromate and Bromide

For all these reasons and more, the water management plan is unlikely to be static and therefore will be under constant internal review.

There will be 6 monthly review meetings for the duration of the development to:

- Share operational statistics about the guiding principles listed above, and to
- Monitor system performance:
    - water level changes;
    - volumes pumped and discharged;
    - lagoon performance
    - flow in the Nast;
    - flow from back drains;
    - water quality data; and
    - any local concerns or other environmental issues

It is proposed that these meetings are attended by the Environment Agency, Herts CC and Affinity Water. The frequency of these meetings will not be reduced unless all parties agree and additional meetings or sharing of data will occur as and when required to discuss any issues that arise, significant changes in monitoring results, or proposed significant changes to operational practice.

2.3.7 Restoration Phase Water Management

Details of the restored landform are shown on Drawing HA-PCC-C55-REST in Appendix 03. The landform comprises a gentle easterly sloping surface with surface water ditch and pond features including the retained infiltration lagoon (enlarged UMH only).

Water Discharge Sources

Once the site is restored no pumping of groundwater in either the UMH or LMH will take place, the dewatering discharge from the UMH will stop and back drains on the outside of the clay buttresses will no longer be required although will remain in situ.

Water sources to be managed on the restored site include:

1. Shallow UMA groundwater from the west and northwest of the site which will be diverted around the site due to the nature of geological barrier and inert material used to fill the site
2. Incident rainfall and runoff
3. River Nast

Western Back Drain

Condition 26 (ii) Clarification of the restored site discharge point for the UMA back-drain

A back-drain comprising a 500mm deep open channel will be constructed on the western margin of the Phase E and G perimeter buttress (Drawing HA-PCC-C55-REST in Appendix 03). The function of this 'western back drain' is to intercept shallow groundwater during exceptionally wet periods when UMA groundwater levels have historically risen to near ground level (for example February 2014).

The western back drain will slope north and south from its mid-point directing any flow along the outside of the northern and southern perimeter buttress. The northern and southern perimeter parts of the western back drain will extend east to the location where the restored ground elevation is 76mAOD at which point the back-drain channels will direct flow into swales leading to the interior of the site and onward to the enlarged recharge lagoon in the UMH. Runoff will then be re-infiltrated into the UMA.

Surface Water Runoff

The greatest increase in surface water runoff from the proposed development will be during the restored phase as this will comprise the largest area of less permeable surface due to the underlying fill and restoration soils. Runoff will be directed to a network of swales, ditches and pond features towards the enlarged UMLs where the water will be re-infiltrated into the UMA.

The likely volume of runoff has been estimated with reference to the Flood Estimation Handbook Depth Duration Frequency model data. This was presented in the environmental statement that accompanied the planning application. A 1% AEP 1-hour storm duration results in a rainfall intensity of 48.89mm/hr, or 68.45mm/hr inclusive of climate change. A conservative approach was adopted that assumed all rainfall onto the proposed extraction and processing areas will result in surface water runoff. Over the proposed extraction works area of 53.4ha, 36,550m^3 of surface water runoff will potentially result from the restored phase.

This volume is greater than the daily infiltration volumes for both lagoons but is less than the storage capacity of the lagoons which indicates that they are adequate to manage the potential surface water flows from the restored site.

River Nast

The alignment of River Nast will not fundamentally change around the mineral processing site following restoration. The Nast will remain in its diverted form and will continue to be ultimately discharged to the Ellenbrook.

2.3.8 UMA Infiltration Lagoons (enlarged)

Two UMA infiltration lagoons will be constructed in the location of the existing UMA and LMA infiltration lagoons for discharge of runoff on the restored site.

The existing UML will fundamentally remain in its pre-existing operational form apart from landscaping. For the LML, site restoration will include sealing the base of the proposed UML at the level of the interburden with site won, low permeability backfill material. UMH perimeter buttresses adjacent to the eastern and southern side of the former LML will be removed to allow lateral migration into the UMA. These works will be subject to CQA.

Surface water runoff generated by the western back drain and from incident rainfall will be directed to the enlarged onsite UML's where all water will be re-infiltrated into the UMA. Water levels in the lagoons can be expected to rise and fall with seasonal fluctuations in the UMA groundwater level.

River Nast Exceedance Outfall

An outfall will be provided from the enlarged and restored UML into the Nast at the south east boundary of the site to allow for management of groundwater and surface water during an exceedance event i.e. an event greater

than the design event of the 1 in 100 years plus climate change. The discharge occurs at an invert level of 75.5m AOD to a drain connecting to the diverted Nast culvert (see Appendix 03)

2.4 Phase Specific Water Management Plan

In addition to the specific questions raised and addressed in previous sections of this document, Condition 30 requires that a phase specific water management plan be produced in advance of the excavation of each phase. The wording of the requirement is presented below.

Condition 30 ***Prior to the commencement of mineral extraction in each Phase, a water management plan shall be submitted and approved in writing by the Mineral Planning Authority. The water management plan shall detail measures to manage water from the lagoons, including an exceedance route for discharge of water from the lagoons as surface water under exceptional circumstances, and include a mechanism for periodic review. The management of water shall be carried out in accordance with the approved Plan, or as otherwise agreed by the Mineral Planning Authority under the periodic view process, for the lifetime of the development.***

Planning a new phase of development will start at least 1 year in advance of the works and they will be planned in a manner that takes advantage of seasonal conditions, changes created by the preceding phase of work, types and quantities of available stockpiled materials and the commercial objectives for the site. Fundamental differences in the approach between phases are not expected but physical conditions will change, and this will require planning and adapting the method to fit the new situation.

Each phase of the site will undergo a detailed evaluation of ground and groundwater conditions based on previous investigations and the most current hydrogeological data including that of water levels, water quality, and lagoon performance data gathered from preceding phase of work, plus the time taken to achieve certain milestones in the development of each phase in the past. The time taken to prepare a new phase will require starting preparations while the previous phase is still being worked.

Brett will prepare a phase specific Water Management Plan for the MPA's review and would expect the Performance Review meetings described in Section 2.3.4 to be the forum for discussion and presenting the future development plans, followed by submission in writing.

3.0 Monitoring Plan

This section describes the proposed groundwater and surface water monitoring plan for the site. This encompasses monitoring being proposed under Planning Conditions 26 and 30, itself reflecting the requirements of key stakeholders, but also

- the requirements associated with the Environmental Permit (EB3808HD) for inert landfilling in the UMH, and
- some additional monitoring, principally off site, volunteered by Brett in support of the wider Operational Plan

3.1 Monitoring Purpose and Objectives

The purpose of monitoring links to several statutory and planning requirements including:

- Protecting controlled waters throughout the mineral extraction and the landfilling phases to ensure there is no deleterious impact to groundwater quality in accordance with Policy 16 (Soil, Air and Water) of the Hertfordshire Waste Core Strategy 2012.
- Meeting requirements of the National Planning Policy Framework1 (NPPF, Paragraph 143) to ensure that the development will not have an unacceptable impact on flood risk or on the flow and quality of surface water and groundwater.
- Demonstrating that the site will be compliant with the Environmental Permitting Regulations 2016 which require that certain substances (Hazardous Substances) are not discharged to groundwater such that they are discernible, and that the discharge of other substances (Non-Hazardous Pollutants) is limited "so as to prevent pollution". A hydrogeological risk assessment (HRA) was undertaken to accompany an application for an environmental permit for the site2 which included 'requisite surveillance', i.e. proposals for the monitoring of groundwater and surface water level and quality.

It is also the objective of this plan to provide data to Affinity who are actively capturing the bromate plume by pumping from a scavenging well.

This Monitoring Plan is based upon the monitoring proposals presented in the HRA, but the proposals have also been extended to include:

- Monitoring of impact during the extraction phase, including the construction and operation of the infiltration lagoons, and
- Monitoring of pre-existing contaminants including bromate, bromide and other compounds not related to the mineral development.

3.2 Monitoring Locations and Sampling Schedule

The locations of the monitoring points and their respective monitoring zones (UMA, LMA, Chalk, Surface Water, Lagoons) are shown on Drawings 01, 02 and 03. The drawings also show the March 2018 groundwater piezometric surface level contours for each respective aquifer unit, so the reader can determine whether the well is up, -cross or down-gradient relative to the site.

[1] Department for Communities and Local Government 2012). National Planning Policy Framework.
[2] SLR (2016). Hatfield Inert Landfill Environmental Permit Application Hydrogeological Risk Assessment

Each monitoring well and geological zone, and surface water monitoring point is summarised in

Table 3-1 together with the proposed laboratory analysis suite to be undertaken, the sampling frequency (monthly, quarterly, other) and the frequency and method of water level recording (monthly or quarterly by the default manual dip method or hourly by dedicated logger).

Borehole logs for each of the monitoring wells are provided in Appendix 05. Boreholes BH303, BH304 and BH401 are due to be installed in the first half of 2020.

3.2.1 Water Level Monitoring

The method and frequency of water level monitoring depends on the location and purpose of the well. The default regime applicable to most boreholes is that water levels are dipped manually on a quarterly basis and the borehole base dipped annually.

Groundwater levels in monitoring wells being sampled monthly will also be dipped at the time of sampling.

Several boreholes are fitted with data loggers set to record water levels on an hourly basis that is subsequently validated by manual monitoring. The data will be downloaded monthly.

The infiltration lagoons (UML and LML) will also have water level loggers installed and these will be provided with telemetry.

Table 3-1
Groundwater and Surface Water Monitoring Plan

MONITORING WELL	PERMIT	ADDITIONAL	LOCATION RELATIVE TO GROUNDWATER FLOW DIRECTION	WATER LEVEL MONITORING REGIME[2]					WATER SAMPLING & ANALYSIS					
				WATER	WATER	BASE	BASE	LOGGER	SUITE 1		SUITE 2	SUITE 3	SUITE 4	SUITE 5
				M	Q	A	M	H	M	Q	M	Q	Q	Q or 6M
UMA[1]														
BHA			Down gradient of lagoons and extraction area		✓	✓				✓		✓		✓ VOCs
BHE*[a]			Down gradient of extraction area		✓	✓						✓		
BHJ*[b]			Down gradient of extraction area		✓	✓						✓		
BH101U			Down gradient of extraction area	✓		✓					✓		✓	
BH102U			Up gradient of extraction area	✓		✓		✓			✓	✓		
BH103U			Cross-gradient of extraction area		✓	✓				✓		✓		
BH104U			Cross-gradient of extraction area		✓	✓		✓		✓		✓		
BH105UX			Cross gradient		✓	✓				✓				✓ VOCs, Metals, Bromate
BH106U			Down gradient of extraction area	✓		✓		✓			✓		✓	
BH108U			Cross gradient		✓	✓				✓				✓ VOCs, Metals, Bromate
BH306U			Cross gradient		✓	✓				✓				✓ VOCs, Metals, Bromate
BH307U			Cross gradient		✓	✓				✓				✓ VOCs, Metals, Bromate
BH303U[3]			Down gradient of UML	✓		✓		✓	✓			✓		
BH304U[3]			Down gradient of UML	✓		✓			✓			✓		
BH401U[3]			Up gradient		✓	✓					✓		✓	
GMW102			Up gradient											
GMW103			Up gradient	✓		✓					✓		✓	
GMW103L			Up gradient		✓	✓							✓	✓ Metals
GMW104			Up gradient		✓	✓								
GMW105			Up gradient		✓	✓							✓	✓ Metals
GMW106			Up gradient											
GMW107			Up gradient		✓	✓							✓	✓ Metals
GMW108			Up gradient											
GMW109			Up gradient		✓	✓							✓	✓ Metals
UML			Infiltration lagoon					✓	✓			✓		

LMA[1]													
BHB			Down gradient of extraction area		✓	✓							✓ Bromate
BHG			Up gradient of extraction area		✓	✓				✓			
BH101L			Down gradient of extraction area	✓		✓		✓			✓	✓	
BH102L			Up gradient of extraction area	✓		✓		✓			✓		✓
BH103L			Up gradient of extraction area		✓	✓				✓		✓	
BH104L			Up gradient of extraction area		✓	✓			✓			✓	
BH106L			Down gradient of extraction area	✓		✓		✓	✓			✓	
BH303L[5]			Down gradient of UM Lagoon	✓		✓			✓			✓	
BH304L[5]			Down gradient of LM Lagoon	✓		✓		✓	✓			✓	
BH105L			Off site		✓	✓							✓ VOCs, Metals, Bromate
BH108L			Off site		✓	✓							✓ VOCs, Metals, Bromate
BH201L(u)[4]			Off site		✓	✓							✓ VOCs, Metals, Bromate
BH201L(l)[4]			Off site		✓	✓							
BH301L			Up gradient of mineral processing area		✓	✓			✓			✓	✓ Metals
BH302L			Up gradient of mineral processing area	✓		✓		✓			✓	✓	
BH305L			Off site		✓	✓						✓	✓ Metals
BH401L[3]			Up gradient	✓			✓	✓		✓		✓	
LML			Infiltration lagoon					✓	✓		✓		
CHALK[1]													
BH101C			Down gradient of extraction area	✓			✓	✓			✓	✓	
BH102C			Up gradient of extraction area	✓			✓	✓			✓		✓
BH103C			Up gradient of extraction area		✓	✓				✓			✓ Metals
BH104C			Up gradient of extraction area		✓	✓		✓	✓			✓	
BH106C			Down gradient of extraction area	✓			✓	✓			✓	✓	
BH105C			Off site		✓	✓							✓ VOCs, Metals, Bromate
BH108C			Off site		✓	✓							✓ VOCs, Metals, Bromate
BH301C			Up gradient of mineral processing area		✓	✓			✓			✓	✓ Metals
BH302C			Up gradient of mineral processing area	✓			✓	✓			✓	✓	
BH303C[3]			Side gradient of mineral extraction area	✓		✓			✓		✓		
BH304C[3]			Down gradient of LML	✓		✓		✓	✓		✓		
BH305C			Off site		✓	✓						✓	✓ Metals
BH401C[3]			Up gradient of extraction area	✓			✓	✓		✓		✓	
SURFACE WATERS													
SW1			R. Nast (up gradient)	✓		✓			✓			✓	
SW7a			R. Nast (down gradient) – Hatfield Road	✓		✓			✓			✓	
SW11			Discharge into site from Hatfield Quarry	✓		✓			✓			✓	

*a – BHE is in footprint of the perimeter bund and will be re-drilled to the south east by the site boundary – landfill permit to be varied to reflect this
*b – BHJ is in the footprint of the perimeter bund and will be replaced by existing BHA – landfill permit to be varied to reflect this
[1] Flow direction in the UMH is west/northwest to east/southeast, and in the LMH & chalk is northwest to southeast (See Drawings 01, 02, 03)
[2]Basic water level monitoring regimes: quarterly manual dip to water level plus annual dip to base of borehole.
[3] To be installed 2019
[4]BH201 has 2 well screens installed in the LMA, they are separated by a clay horizon, but the purpose of screening was to assess whether there is a vertical concentration gradient for bromate in the granular aquifer

P – Permit
M – Monthly
Q – Quarterly
A – Annual
H – Hourly
6M – Semi Annual (some shallow monitoring wells contain no groundwater during late Spring and Summer, so the decision to sample alternative locations is made locally by the Brett environmental team)

Permit Wells/Surface Water
✓ Data logger installed since 2013
✓ Data Logger to be installed in 2019
Additional voluntary monitoring wells

3.3 Laboratory Analysis

Table 3-2 describes the proposed laboratory testing rationale that has been built around the specific analyses referenced in Permit EB3808HD, Planning Condition 26 and 30, site specific conditions such as the regional bromate plume and other local offsite issues. Five suites have been devised to simplify the implementation of the sampling programme.

Table 3-2
Groundwater and Surface Water Analysis Suites

Name	Description
SUITE 1	Watching brief on Bromate and Bromide undertaken on a monthly or quarterly basis depending on monitoring location
SUITE 2	Based on stakeholder consultation and to be undertaken monthly at key locations
SUITE 3	Comprehensive Permit testing suite, although excludes bromate and bromide (not associated with inert waste which the Permit regulates). As a minimum this suite of analysis will be undertaken on samples from the Permit wells.
SUITE 4	Subset of the Permit suite with the addition of bromate and bromide for general groundwater quality surveillance.
SUITE 5	Selected offsite wells northeast of the site where certain compounds have previously been detected

Table 3-3 lists the analyses proposed and indicates the testing proposed for each of the suites.

This sampling and testing pattern ensure a broad testing suite for Permit monitoring wells, as well as good site-wide testing outside of Permit requirements. There is complete cover for bromate and bromide in all LMA and Chalk aquifer monitoring wells, including offsite wells and a significant proportion of UMA monitoring wells. Any monitoring location where more than one suite is indicated means that the cumulative analysis is undertaken, however no parameter is duplicated.

Table 3-3
Groundwater and Surface Water Analysis Suites

PARAMETER	SUITE 1	SUITE 2	SUITE 3	SUITE 4	SUITE 5
Bromate & Bromide	✓	✓		✓	✓
Conductivity			✓	✓	
pH			✓	✓	
Ionic Balance			✓	✓	
Alkalinity			✓	✓	
Chloride			✓	✓	
Sulphate			✓	✓	
Nitrate			✓	✓	

PARAMETER	SUITE 1	SUITE 2	SUITE 3	SUITE 4	SUITE 5
Calcium			✓	✓	
Sodium			✓	✓	
Potassium			✓	✓	
Magnesium			✓	✓	
Fluoride			✓		
Ammoniacal Nitrogen			✓	✓	
TON			✓		
TOC			✓		
COD			✓		
BOD			✓		
Cadmium		✓	✓		✓[2]
Chromium		✓	✓		✓[2]
Copper		✓	✓		✓[2]
Iron		✓	✓		✓[2]
Lead		✓	✓		✓[2]
Manganese		✓	✓		✓[2]
Mercury		✓	✓		✓[2]
Nickel		✓	✓		✓[2]
Selenium		✓	✓		✓[2]
Zinc		✓	✓		✓[2]
Naphthalene			✓		
Phenol			✓		
TPH (DRO, GRO)		✓	✓[1]	✓	
VOCs					✓[2]
SS (Surface Water only)			✓	✓	

Notes

1 Not specified in Permit but suggested addition
2 May only be tested in selected monitoring wells based on previous results

Laboratory limits of detection for all quality parameters are given in Table 3-4.

Table 3-4
Water Quality Laboratory Limits of Detection

Determinant	Units	Limit of Detection
Bromate/Bromide	mg/l	0.0005 (Bromate) & 0.005 (Bromide)
TPH (GRO/DRO)	ug/l	10
Chloride	mg/l	0.3
Sulphate	mg/l	0.5
Ammoniacal Nitrogen	mg/l	0.03 (accredited) 0.01 (Low level)
Total Alkalinity	mg/l	1
Magnesium	mg/l	0.1
Manganese	ug/l	2 (1.5 Low level method)
Potassium	mg/l	0.1
Iron	ug/l	20 (4.7 Low level method)
Chromium	ug/l	1.5 (0.2 Low level method)
Calcium	mg/l	0.1
Sodium	mg/l	0.1
Electrical Conductivity	uS/cm	2
pH	pH Units	0.01
Fluoride	mg/l	0.3
Phenol	mg/l	0.01
TON	mg/l	0.2
TOC	mg/l	2
COD	mg/l	7
BOD	mg/l	1
Lead	ug/l	0.4
Zinc	ug/l	1.5
Copper	ug/l	3
Cadmium	ug/l	0.03
Mercury	ug/l	0.5
Nickel	ug/l	1.3
Selenium	ug/l	1.2
Nitrate	mg/l	0.2
Naphthalene	ug/l	0.1
VOCs (GC/MS)	ug/l	0.1 to 3 (compound specific)
Suspended Solids	mg/l	20

Note: Detection limits are those from laboratories currently used: Affinity Water for bromate and bromide and Exova Jones for all other determinants.

3.4 Monitoring and Reporting Programme

The above programme of monitoring and analysis will continue throughout the operational life of the site and for at least 3 years post closure or until all parties are satisfied that it may cease e.g. surrender of the landfill permit.

The scope of monitoring will be reviewed periodically and is likely to be much simplified following formal closure of the landfill and restoration of the whole quarry site. However, provision is made to continue the approved monitoring (i.e. permit requirements and this GWMP) for a period of 10 years post closure.

A baseline monitoring report will be submitted to the Hertfordshire County Councils (HCC) after 12 months of sampling. This report will review the initial rounds of results and propose management control levels for bromate/bromide and TPH. Note, boreholes BH401, BH303 and BH304 will be installed in 2020 and the baseline report will be available 12 months after the boreholes have been installed.

In addition, an annual interpretive monitoring report as required under Planning Conditions 26 & 30 will be submitted to HCC. Both the baseline and annual reports will be copied to the Agency and Affinity.

In accordance with the landfill permit an annual report will be submitted to the Agency presenting the data required by the permit and assessing compliance with the permit.

Field, logger and laboratory data arising from this monitoring programme will be submitted to HCC, the Agency and Affinity on a quarterly basis in line with the permit reporting timescales.

3.5 Contingency Actions

Any action required by the inert landfill permit e.g. in response to a breach of a permit compliance limit, will be undertaken in accordance with the permit. It is therefore proposed to only consider contingency actions as part of this monitoring plan for the non-landfill related determinants.

Given the setting and the proposed operations at the site, bromate and bromide will be the key compounds to monitor and track. TPH is included because it comprises a suite of compounds that relate to petroleum hydrocarbons and could therefore be traced to site operations (trucks, excavators, generators, pumps, fuel storage etc.).

- We propose setting management control levels for bromate/bromide and TPH. These are an internal management tool and are not used as regulatory compliance concentrations. The control levels will be borehole specific and will apply to key groundwater monitoring points of those listed in
- Table 3-1 and will be based on the results from previous rounds of sampling, plus 20% to account for natural variation (water level change, season etc.). Control levels will be reviewed in the annual monitoring reports to ensure they consider current background conditions.
- If following the start of the development results exceed the control levels, additional validation samples will be taken from the affected borehole and may be extended to adjacent locations to determine if the detections are localised or more widespread.
- A review of operations in the period prior to the exceedance will be made and an assessment of the likely cause identified, and appropriate mitigation measures implemented. Notification of the exceedance will be provided to the Agency, HCC and Affinity within one week of the exceedance. Detailed analytical results, an assessment of the cause of the exceedance and mitigation measures implemented will be sent to the Agency, HCC and Affinity within six weeks of the initial exceedance being recorded. Any changes to operational practice will be agreed with these parties should the nature and source of the contamination relate to on-site operations.
- If visible oils and grease are observed at any of the surface water monitoring locations an investigation will be undertaken immediately to identify the cause. If the cause is related to operations at the site

corrective actions will be undertaken to stop the release. Measures will also be undertaken to contain the extent of the spill using absorbent booms and similar equipment and to remove any free product from the surface water and dispose of it to a suitably permitted waste facility.

- The procedures outlined in the QHEST management system (Appendix 04) for the reporting accidents, incidents and complaints and taking corrective actions will be complied with.

DRAWINGS

Borehole Location Plan and UMA, LMA, Chalk Aquifer Piezometric Surface

N

SW11
GMW10□
GMW108
GMW10□
GMW10□
BH10□L&C
BH10□U
GMW105
SW1
GMW10□
GMW10□
GMW10□
BH10□L&C
BH10□U
BH□01L&C
BH10□L&C
BH10□U
BH101L&C
BH101U
BH105U
BH□0□U
BH108U
BH□0□U
BHA U
BH□0□L&C
BH□0□U
BH□U
UM LAGOON
BH□0□L&C
BH□0□U
BHE U
BH10□L&C
BH10□U
SW□A

0 100 □00 500
METERS

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LEGEND

- SITE BOUNDARY
- PROPOSED MINERAL DEVELOPMENT SITE
- RIVER NAST CULVERT (ASSUMED ROUTE)
- NATIONAL GRID GAS PIPELINE (SURVEYED LOCATION)

PIEZOMETRIC SURFACE

- □5 PIEZOMETRIC SURFACE ELEVATION (mAOD)

BOREHOLE MONITORING RATIONALE

- SLR WELLS
- SURFACE WATER MONITORING POINT
- PRE BRETT WELLS

BOREHOLE STAGE

- PERMIT
- ADDITIONAL

BH101□BH108 & FT	SERIES 1 BOREHOLES (2013 & 2014)
BH□01	SERIES 2 BOREHOLES (2014)
BH□01□BH□0□ BH□05□BH□0□	SERIES 3 BOREHOLES (2016)

U □ MONITORING WELL SCREENED ACROSS THE UPPER MINERAL HORIZON

L □ MONITORING WELL SCREENED ACROSS THE LOWER MINERAL HORIZON

C □ MONITORING WELL SCREENED ACROSS THE CHALK

NOTE

BH□0□ULC
BH□0□ULC
BAE U
BHA TO REPLACE BH□
BHE □R□ TO REPLACE BHE U
BH□01C

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HATFIELD QUARRY

GROUNDWATER MANAGEMENT PLAN

MONITORING WELL LOCATIONS □UPPER MINERAL HORI□ON□ LAGOONS AND SURFACE WATER

DWG N□□01

Scale	Date
NTS (A3)	OCTOBER 2018

N

BH□05L&C

SW11

BH□01L&C

BH10□L&C
BH10□U

SW1

BH□0□L&C

BH10□L&C
BH10□U

BH105L&C
BH105U

BH108L&C
BH108U

BH□01L
BH□0□U

BH□0□L&C
BH□0□U

BHB L

BH□0□L&C
BH□0□U

LM LAGOON

BH□01L&C

BHG L

BH10□L&C
BH10□U

SW□A

BH10□L&C
BH10□U

BH101L&C
BH101U

0 100 □00 500
METERS

LEGEND

SITE BOUNDARY

PROPOSED MINERAL DEVELOPMENT SITE

RIVER NAST CULVERT (ASSUMED ROUTE)

NATIONAL GRID GAS PIPELINE (SURVEYED LOCATION)

PIEZOMETRIC SURFACE

□5 PIEZOMETRIC SURFACE ELEVATION (mAOD)

SLR BOREHOLES AND MONITORING POINTS

SLR WELLS

SURFACE WATER MONITORING POINT

PRE BRETT WELLS

BOREHOLE STAGE

PERMIT

ADDITIONAL

BH101□BH108 & FT SERIES 1 BOREHOLES (2013 & 2014)

BH□01 SERIES 2 BOREHOLES (2014)

BH□01□BH□0□ BH□05□BH□0□ SERIES 3 BOREHOLES (2016)

U □ MONITORING WELL SCREENED ACROSS THE UPPER MINERAL HORIZON

L □ MONITORING WELL SCREENED ACROSS THE LOWER MINERAL HORIZON

C □ MONITORING WELL SCREENED ACROSS THE CHALK

NOTE

BH□0□ULC
BH□0□ULC
BAE U
BHA TO REPLACE BH□
BHE □R□TO REPLACE BHE U
BH□01C

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HATFIELD QUARRY

GROUNDWATER MANAGEMENT PLAN

MONITORING WELL LOCATIONS □LOWER MINERAL HORI□ON

DWG N□□0□

Scale: NTS (A3)

Date: OCTOBER 2018

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N

BH□05L&C

SW11

BH□01L&C

BH10□L&C
BH10□U

SW1

BH□0□L&C

BH10□L&C
BH10□U

BH105L&C
BH105U

BH108L&C
BH108U

BH□0□L&C
BH□0□U

BH□0□L&C
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BH□01L&C

BH10□L&C
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SW□A

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BH10□U

BH101L&C
BH101U

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METERS

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LEGEND

SITE BOUNDARY

PROPOSED MINERAL DEVELOPMENT SITE

RIVER NAST CULVERT (ASSUMED ROUTE)

NATIONAL GRID GAS PIPELINE (SURVEYED LOCATION)

PIEZOMETRIC SURFACE

□5 PIEZOMETRIC SURFACE ELEVATION (mAOD)

SLR BOREHOLES AND MONITORING POINTS

SLR WELLS

SURFACE WATER MONITORING POINT

BOREHOLE MONITORING RATIONALE

PERMIT

ADDITIONAL

BH101□BH108 & FT SERIES 1 BOREHOLES (2013 & 2014)

BH□01 SERIES 2 BOREHOLES (2014)

BH□01□BH□0□
BH□05□BH□0□ SERIES 3 BOREHOLES (2016)

U □ MONITORING WELL SCREENED ACROSS THE UPPER MINERAL HORIZON

L □ MONITORING WELL SCREENED ACROSS THE LOWER MINERAL HORIZON

C □ MONITORING WELL SCREENED ACROSS THE CHALK

NOTE

BH□0□ULC
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BHA TO REPLACE BH□
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BH□01C

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HATFIELD QUARRY

GROUNDWATER MANAGEMENT PLAN

MONITORING WELL LOCATIONS □CHAL□

DWG N□□0□

Scale: NTS (A3)

Date: OCTOBER 2018

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APPENDIX 01

Phase A Layout and Lagoon Construction Drawings

LEGEND

- CONTOURS
- DIVERTED / EXISTING PUBLIC RIGHT OF WAY
- PERMISSIVE FOOTPATH
- EXISTING WATERCOURSE
- RETAINED BOREHOLES
- PROPOSED WATERCOURSE OPEN CHANNEL
- PROPOSED RIVER NAST DIVERSION (PERFORATED PIPE)
- PROPOSED RIVER NAST DIVERSION (SOLID PIPE)
- NAST CULVERT AND SURFACE WATER MONITORING POINT
- EXISTING PONDS
- PROPOSED GREAT CRESTED NEWT PONDS
- GAS PIPELINE ROUTE TAKEN FROM NATIONAL GRID DRAWING EA_TE_Z6_2S_16351
- PROPOSED ACOUSTIC FENCING
- PROPOSED STOCK PROOF FENCING
- MINERAL EXTRACTION AREA
- PROPOSED HAUL ROAD
- PROPOSED INTERPRETATION BOARD
- PROPOSED SIGNAGE
- EXISTING VEGETATION
- PROPOSED ADVANCED PLANTING
- PROPOSED ADVANCED HEDGEROW PLANTING
- PROPOSED AREA OF DISTURBANCE FROM SITE PREPARATION WORKS
- PROPOSED PERIMETER SCREENING/STORAGE BUNDS
- PROPOSED PERIMETER SEALS
- TS TOPSOIL STORAGE MOUND
- SS SUBSOIL STORAGE MOUND

PHASE A

TO BE STRIPPED OF TOPSOIL AND SUBSOIL TO A DEPTH OF 1.2m AND PLACED INTO TEMPORARY STORAGE AROUND PERIMETER.

VOLUMES
TOPSOIL 19,100m³
SUBSOIL 57,500m³

TO BE STRIPPED OF OVERBURDEN AND USED TO FORM PERIMETER SEALS AROUND PHASE, WITH SURPLUS PLACED INTO WORKED OUT VOID. SUITABLE IMPORTED MATERIALS MAY BE USED TO FORM THE PERIMETER SEALS.

INTERBURDEN TO BE PROGRESSIVELY STRIPPED AND PLACED BACK INTO VOID.

UMH AND LMH TO BE PROGRESSIVELY TAKEN TO PLANT SITE.

PROPOSED PERIMETER BUND

BUND EXTENDED ALONG HATFIELD ROAD AND AROUND POPEFIELD FARM.

BUND'S HAVE AN ADDITIONAL CAPACITY OF 77,200m³, TOPSOIL BUNDS ARE 3M HIGH AND SUBSOIL BUNDS ARE 5M HIGH EXCEPT ALONG HATFIELD ROAD WHERE THE BUND HEIGHT IS LIMITED TO 4M WITH 1:2 SIDE SLOPES. 5M STAND OFF FROM TOE OF BUND TO EXTRACTION AREA AND SITE BOUNDARY.

TOPSOIL TO BE STRIPPED FROM BENEATH SUBSOIL STORAGE IN ADVANCE. ALL BUNDS TO BE GRASS SEEDED. CONTRASTING UNITS TO BE SEPARATED BY GEOTEXTILE

WOODLAND/SCRUB PLANTING

Tree/Shrub species		Form/habit	Root condition	Minimum no. of Breaks	Age/Condition or Number of Times Transplanted	minimum size of container	Overall Height (cm)	Planting Block	WP2
								m²	3494
								mix	Total Plant No s (@ 2m centres)
Acer campestre	Field Maple	Transplant - seed raised	Bagged/Bareroot		1+1 or 1/1		60-80	5%	45
Corylus avellana	Hazel	Branched	Bagged/Bareroot	3	1+2 or 1/2		60 - 80	10%	85
Crataegus monogyna	Hawthorn	Transplant - seed raised	Bagged/Bareroot		1+1 or 1/1		60 - 80	10%	85
Ilex aquifolium	Holly	Leaders and Laterals	Container			3L	60-80	2.5%	20
Malus sylvestris	Crab apple	Transplant - seed raised	Bagged/Bareroot		1+1 or 1/1		60-80	2.5%	20
Prunus avium	Wild Cherry	Transplant - seed raised	Bagged/Bareroot		1+1 or 1/1		60-80	5%	45
Prunus spinosa	Blackthorn	Transplant - seed raised	Bagged/Bareroot		1+1 or 1/1		60-80	2.5%	20
Quercus robur	Pedunculate oak	Transplant - seed raised	Bagged/Bareroot		1+1 or 1/1		60-80	35%	305
Rosa canina	Dog rose	Branched	Bagged/Bareroot	3	1+1 or 1/1		60-80	2.5%	20
Sorbus aria	Whitebeam	Transplant - seed raised	Bagged/Bareroot		1+1 or 1/1		60-80	15%	130
Viburnum opulus	Guelder rose	Branched	Bagged/Bareroot	3	1+2 or 1/2		60-80	10%	85
							Total	100%	860

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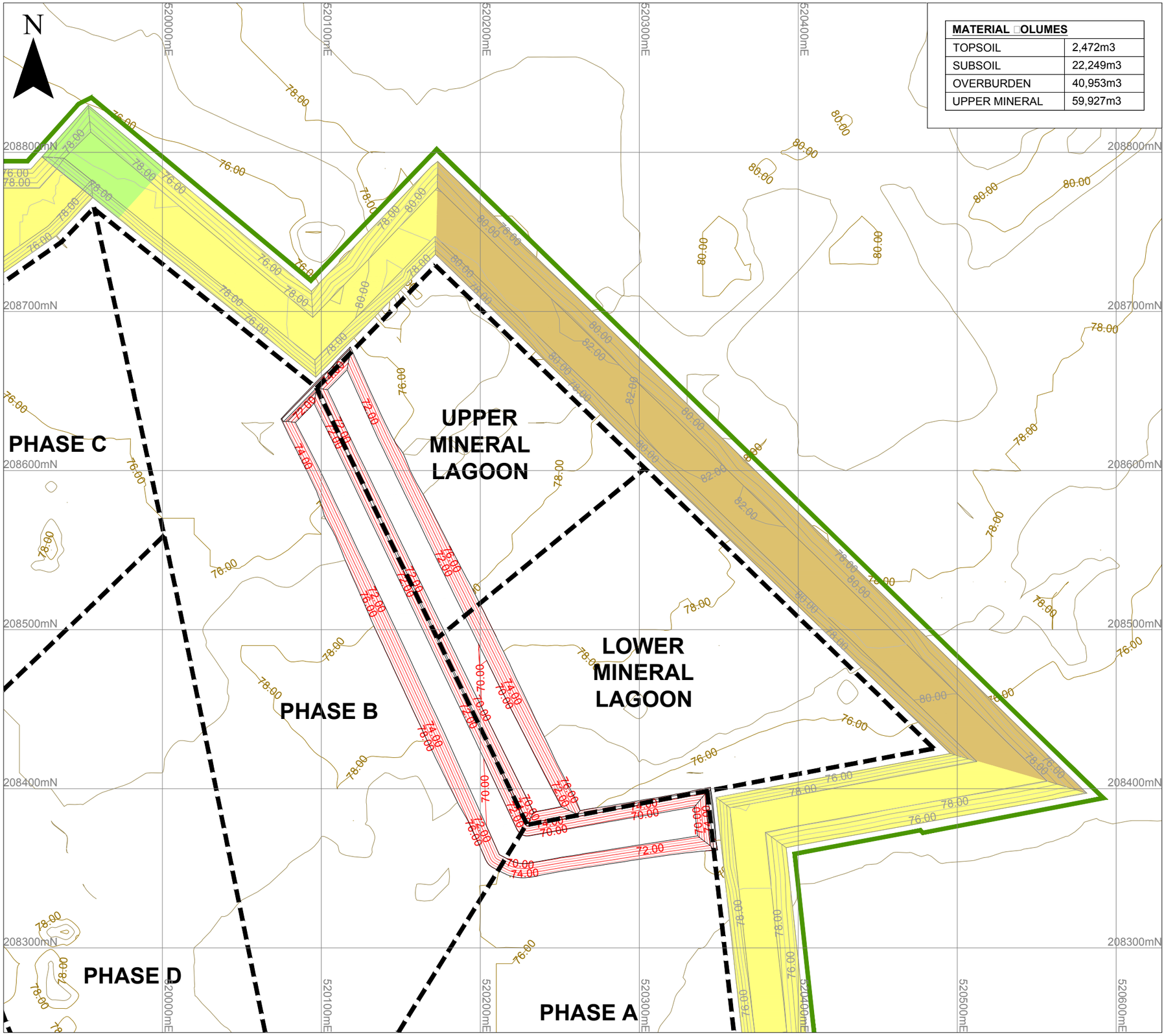
HATFIELD AERODROME
DISCHARGE OF CONDITIONS
PHASE A
HA - PCC - C9

Scale 1:2,500 @ A1 | Date MAY 2018

180511_01009.00190.29.HA-PCC-C9_PHASE_A_SM.dwg



MATERIAL VOLUMES	
TOPSOIL	2,472m3
SUBSOIL	22,249m3
OVERBURDEN	40,953m3
UPPER MINERAL	59,927m3

EXCAVATION OF OVERBURDEN & UPPER MINERAL FROM WESTERN PERIMETER OF LAGOONS

LEGEND

- ENVIRONMENTAL PERMIT BOUNDARY
- PHASE BOUNDARY
- 80.00 TOPOGRAPHIC SURVEY LEVEL CONTOURS (mAOD)
- 70.00 PROPOSED EXCAVATION LEVEL CONTOURS (mAOD)
- 70.00 PREVIOUS EXCAVATION STAGE LEVEL CONTOURS (mAOD)
- 70.00 PROPOSED ENGINEERED FILL LEVEL CONTOURS (mAOD)
- 70.00 PREVIOUS ENGINEERED FILL STAGE LEVEL CONTOURS (mAOD)
- 80.00 PROPOSED SCREENING BUND LEVEL CONTOURS (mAOD)
- PROPOSED TOPSOIL STORAGE AREA
- PROPOSED OVERBURDEN STORAGE AREA
- PROPOSED INTERBURDEN STORAGE AREA
- PROPOSED STORAGE AREA VOID

PT0	KW	JP	01/18	
Revision	By	Chk'd By	Date	Comments

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Site
HATFIELD QUARRY

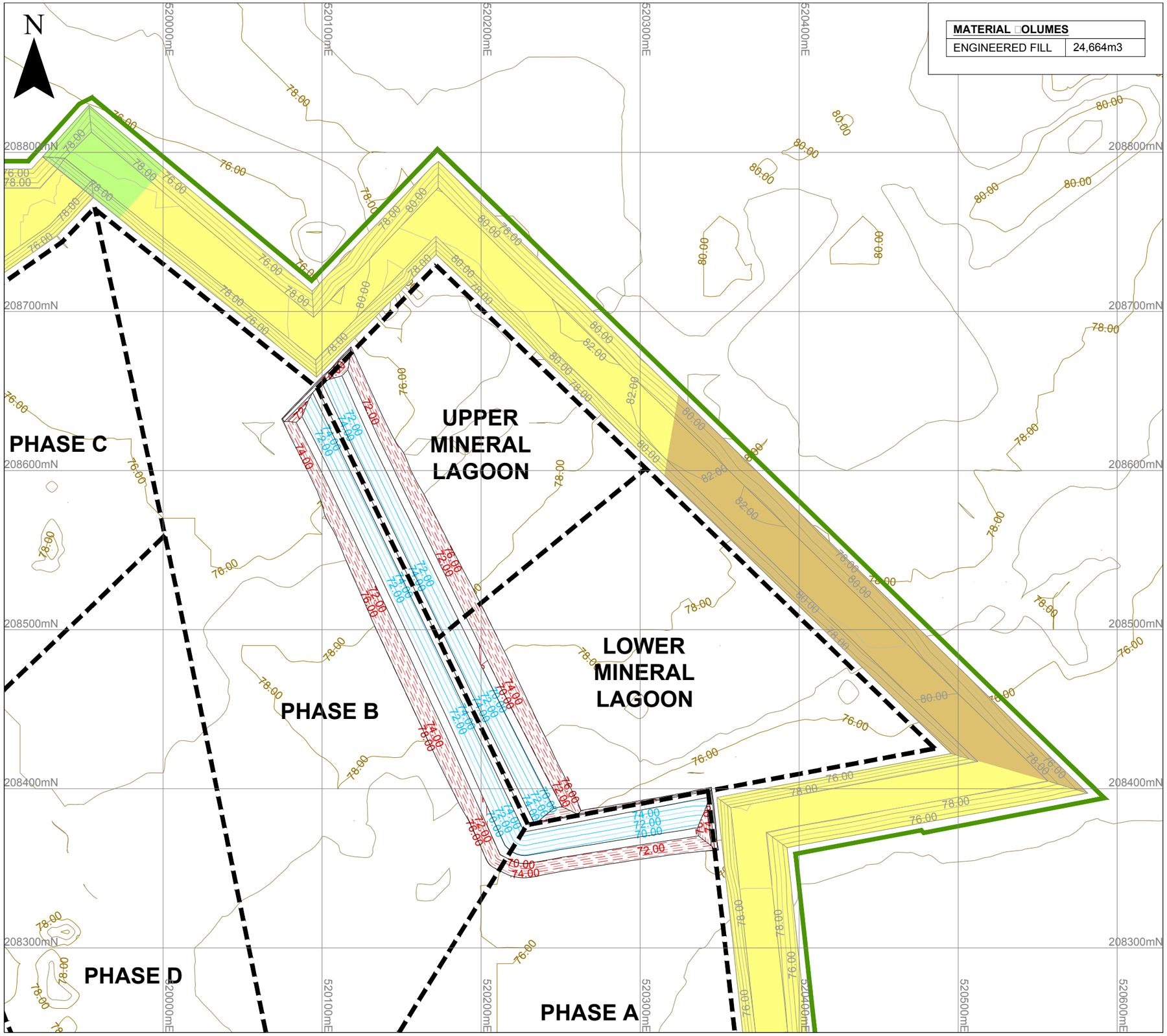
Project
HATFIELD EARTHWORKS - INFILTRATION LAGOONS & PHASE A

Drawing Title
STAGE 1A
PROPOSED E□CA□ATION LE□ELS

Scale	Date	Drawing Number	Revision
1:2500 @ A3	JANUARY 2018	00□	PT0

PRELIMINARY TENDER

01009.00177.07.003.PT0_Stage1A.dwg



FILLING OF ENGINEERED BUTTRESS TO WESTERN PERIMETER OF LAGOONS

LEGEND

- ENVIRONMENTAL PERMIT BOUNDARY
- PHASE BOUNDARY
- 80.00 TOPOGRAPHIC SURVEY LEVEL CONTOURS (mAOD)
- 70.00 PROPOSED EXCAVATION LEVEL CONTOURS (mAOD)
- 70.00 PREVIOUS EXCAVATION STAGE LEVEL CONTOURS (mAOD)
- 70.00 PROPOSED ENGINEERED FILL LEVEL CONTOURS (mAOD)
- 70.00 PREVIOUS ENGINEERED FILL STAGE LEVEL CONTOURS (mAOD)
- 80.00 PROPOSED SCREENING BUND LEVEL CONTOURS (mAOD)
- PROPOSED TOPSOIL STORAGE AREA
- PROPOSED OVERBURDEN STORAGE AREA
- PROPOSED INTERBURDEN STORAGE AREA
- PROPOSED STORAGE AREA VOID

PT0	KW	JP	01/18	
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Drawing Title
STAGE 1B
PROPOSED ENGINEERED FILL LEVELS

Scale	Date	Drawing Number	Revision
1:2500 @ A3	JANUARY 2018	00	PT0

PRELIMINARY TENDER

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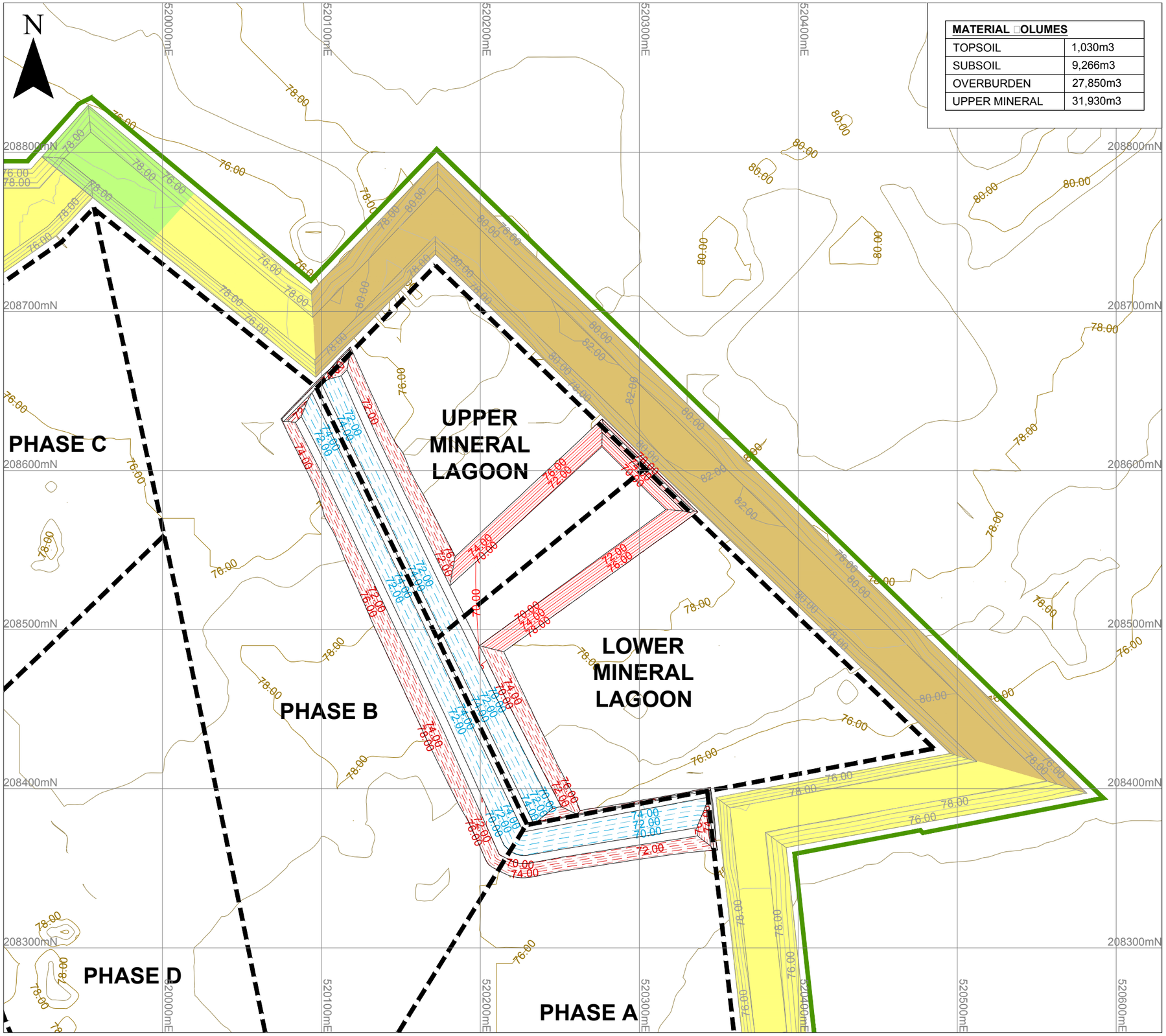

MATERIAL VOLUMES	
TOPSOIL	1,030m3
SUBSOIL	9,266m3
OVERBURDEN	27,850m3
UPPER MINERAL	31,930m3

EXCAVATION OF OVERBURDEN & UPPER MINERAL FROM SEPARATION BUND OF LAGOONS

LEGEND

- ENVIRONMENTAL PERMIT BOUNDARY
- PHASE BOUNDARY
- TOPOGRAPHIC SURVEY LEVEL CONTOURS (mAOD) (80.00)
- PROPOSED EXCAVATION LEVEL CONTOURS (mAOD) (70.00)
- PREVIOUS EXCAVATION STAGE LEVEL CONTOURS (mAOD) (70.00)
- PROPOSED ENGINEERED FILL LEVEL CONTOURS (mAOD) (70.00)
- PREVIOUS ENGINEERED FILL STAGE LEVEL CONTOURS (mAOD) (70.00)
- PROPOSED SCREENING BUND LEVEL CONTOURS (mAOD) (80.00)
- PROPOSED TOPSOIL STORAGE AREA
- PROPOSED OVERBURDEN STORAGE AREA
- PROPOSED INTERBURDEN STORAGE AREA
- PROPOSED STORAGE AREA VOID

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Drawing Title
STAGE A
PROPOSED EXCAVATION LEVELS

Scale	Date
1:2500 @ A3	JANUARY 2018

Drawing Number	Revision
005	PT0

PRELIMINARY TENDER

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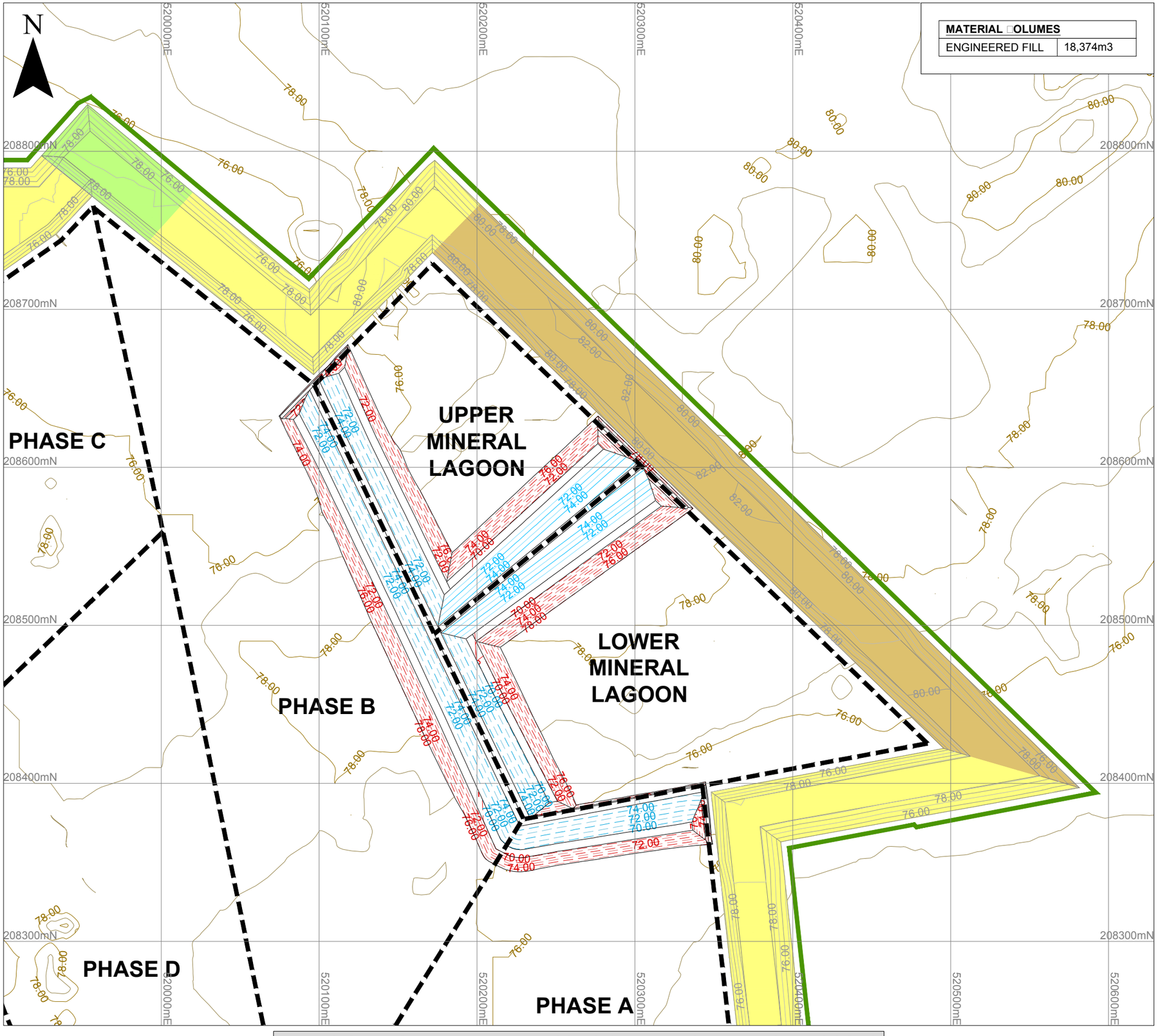

FILLING OF ENGINEERED BUTTRESS TO SEPARATION BUND OF LAGOONS

LEGEND

- ENVIRONMENTAL PERMIT BOUNDARY
- PHASE BOUNDARY
- 80.00 TOPOGRAPHIC SURVEY LEVEL CONTOURS (mAOD)
- 70.00 PROPOSED EXCAVATION LEVEL CONTOURS (mAOD)
- 70.00 PREVIOUS EXCAVATION STAGE LEVEL CONTOURS (mAOD)
- 70.00 PROPOSED ENGINEERED FILL LEVEL CONTOURS (mAOD)
- 70.00 PREVIOUS ENGINEERED FILL STAGE LEVEL CONTOURS (mAOD)
- 80.00 PROPOSED SCREENING BUND LEVEL CONTOURS (mAOD)
- PROPOSED TOPSOIL STORAGE AREA
- PROPOSED OVERBURDEN STORAGE AREA
- PROPOSED INTERBURDEN STORAGE AREA
- PROPOSED STORAGE AREA VOID

Revision	By	Chk'd By	Date	Comments
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Project
HATFIELD EARTHWORKS - INFILTRATION LAGOONS & PHASE A

Drawing Title
STAGE B
PROPOSED ENGINEERED FILL LEVELS

Scale
1:2500 @ A3

Date
JANUARY 2018

Drawing Number
00

Revision
PT0

PRELIMINARY TENDER

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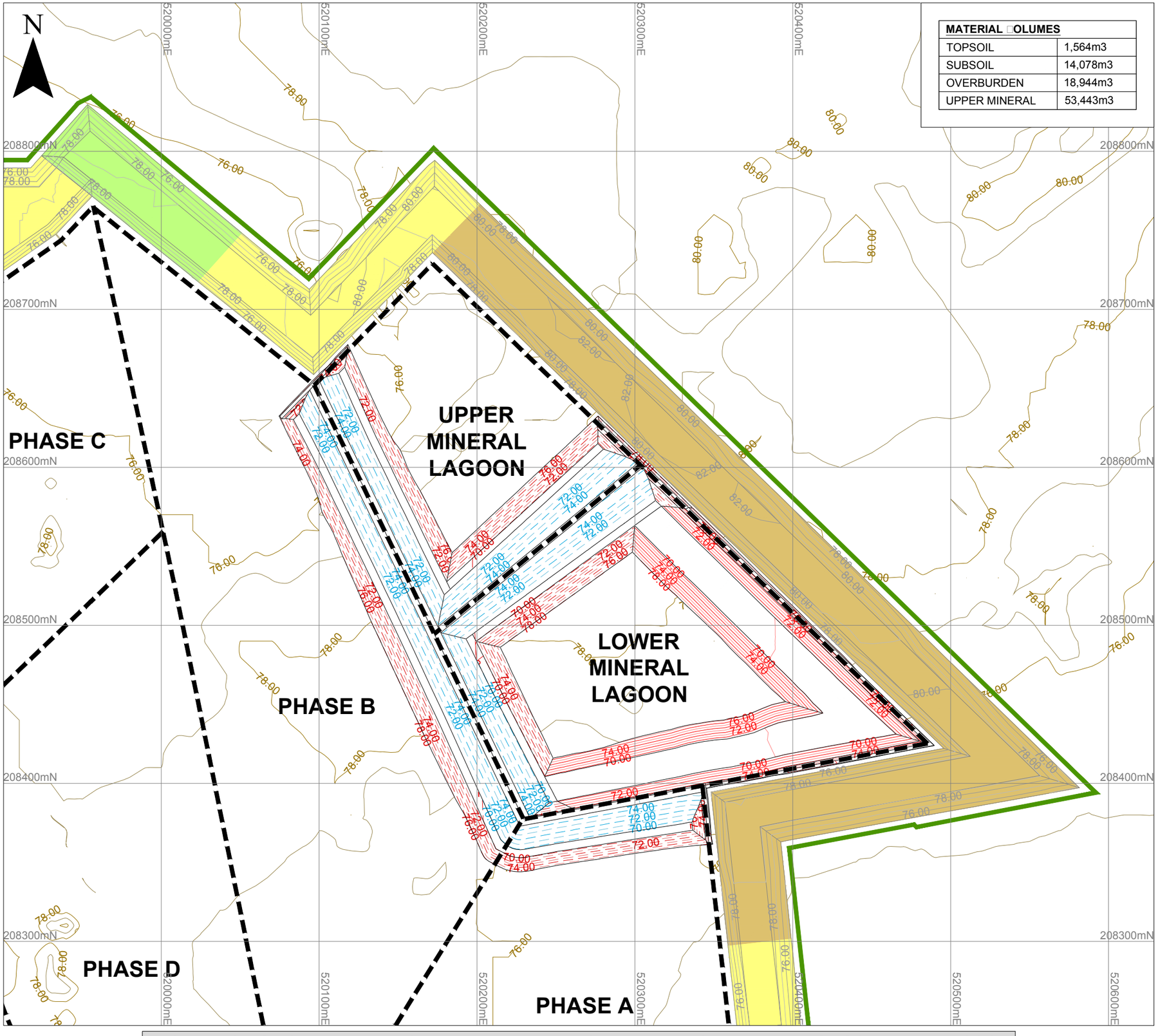

LEGEND

- ENVIRONMENTAL PERMIT BOUNDARY
- PHASE BOUNDARY
- 80.00 TOPOGRAPHIC SURVEY LEVEL CONTOURS (mAOD)
- 70.00 PROPOSED EXCAVATION LEVEL CONTOURS (mAOD)
- 70.00 PREVIOUS EXCAVATION STAGE LEVEL CONTOURS (mAOD)
- 70.00 PROPOSED ENGINEERED FILL LEVEL CONTOURS (mAOD)
- 70.00 PREVIOUS ENGINEERED FILL STAGE LEVEL CONTOURS (mAOD)
- 80.00 PROPOSED SCREENING BUND LEVEL CONTOURS (mAOD)
- PROPOSED TOPSOIL STORAGE AREA
- PROPOSED OVERBURDEN STORAGE AREA
- PROPOSED INTERBURDEN STORAGE AREA
- PROPOSED STORAGE AREA VOID

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Project
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Drawing Title
STAGE □A
PROPOSED E□CA□ATION LE□ELS

Scale
1:2500 @ A3

Date
JANUARY 2018

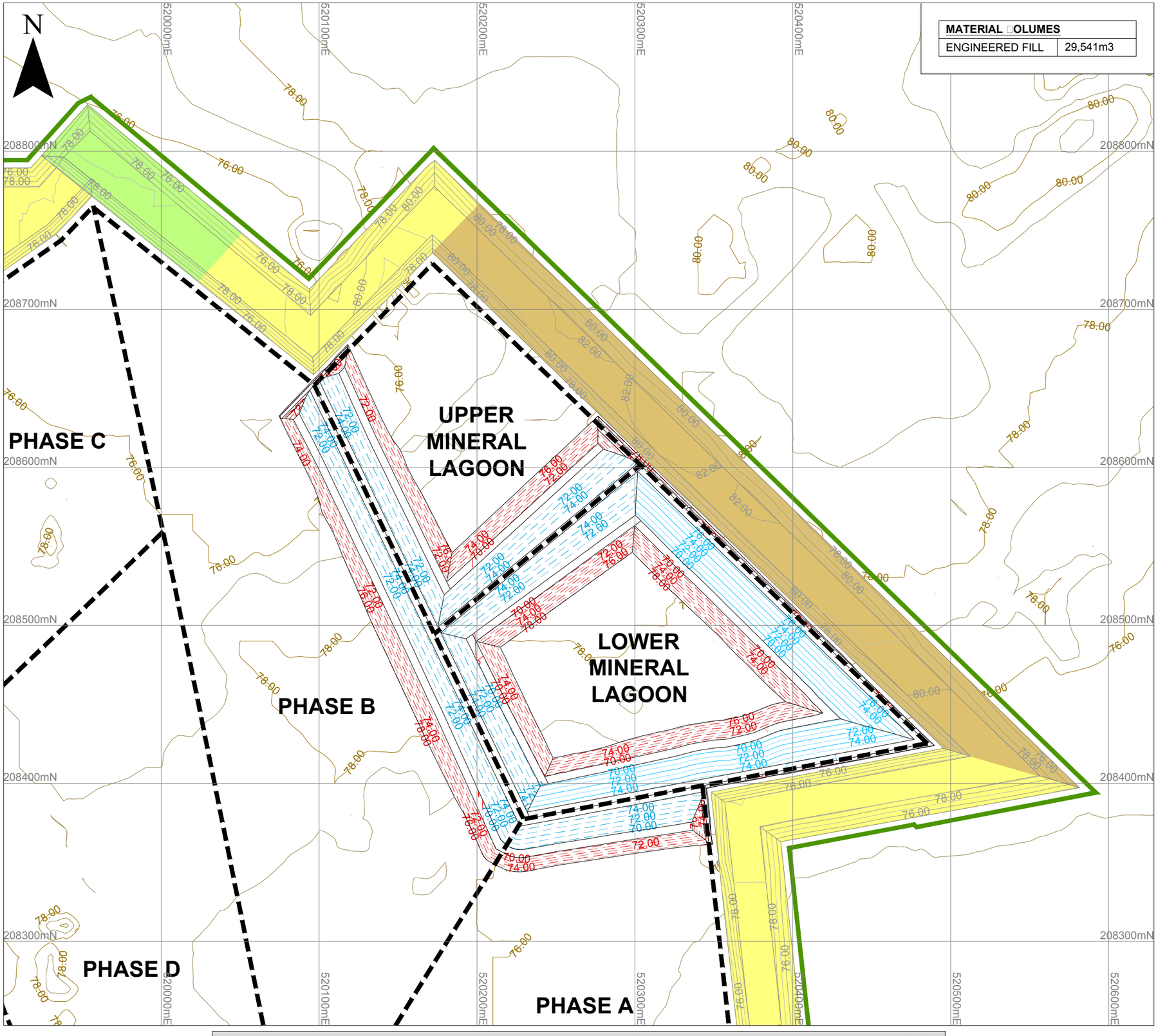
Drawing Number
00□

Revision
PT0

PRELIMINARY TENDER

EXCAVATION OF OVERBURDEN & UPPER MINERAL FROM REMAINING PERIMETER OF SOUTHERN LAGOON

01009.00177.07.007.PT0_Stage3A.dwg



FILLING OF ENGINEERED BUTTRESS TO REMAINING PERIMETER OF SOUTHERN LAGOON

LEGEND

- ENVIRONMENTAL PERMIT BOUNDARY
- PHASE BOUNDARY
- 80.00 TOPOGRAPHIC SURVEY LEVEL CONTOURS (mAOD)
- 70.00 PROPOSED EXCAVATION LEVEL CONTOURS (mAOD)
- 70.00 PREVIOUS EXCAVATION STAGE LEVEL CONTOURS (mAOD)
- 70.00 PROPOSED ENGINEERED FILL LEVEL CONTOURS (mAOD)
- 70.00 PREVIOUS ENGINEERED FILL STAGE LEVEL CONTOURS (mAOD)
- 80.00 PROPOSED SCREENING BUND LEVEL CONTOURS (mAOD)
- PROPOSED TOPSOIL STORAGE AREA
- PROPOSED OVERBURDEN STORAGE AREA
- PROPOSED INTERBURDEN STORAGE AREA
- PROPOSED STORAGE AREA VOID

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Drawing Title
STAGE B
PROPOSED ENGINEERED FILL LEVELS

Scale
1:2500 @ A3

Date
JANUARY 2018

Drawing Number
008

Revision
PT0

PRELIMINARY TENDER

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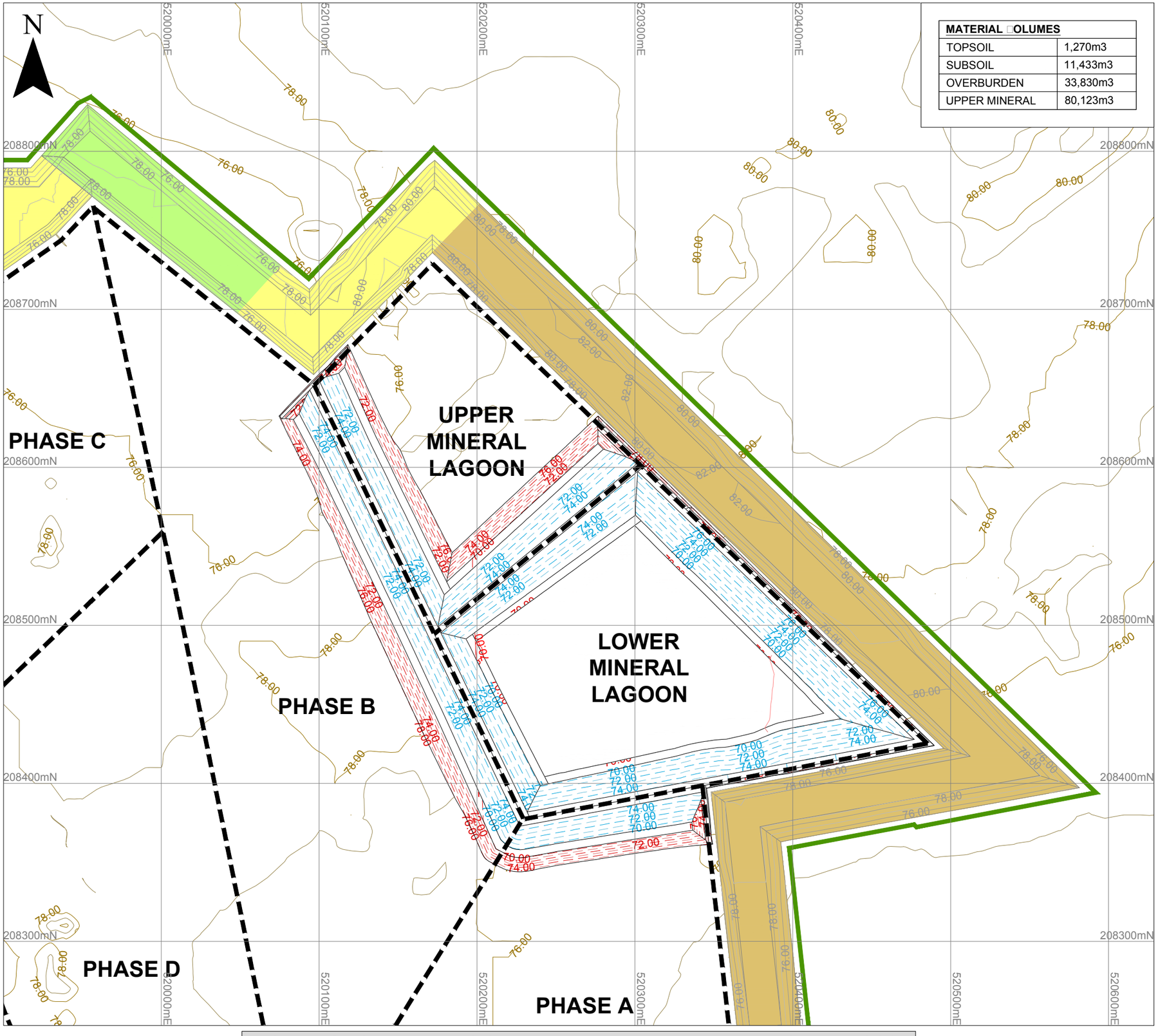

EXCAVATION OF REMAINING OVERBURDEN / UPPER MINERAL IN LOWER LAGOON

LEGEND

- ENVIRONMENTAL PERMIT BOUNDARY
- PHASE BOUNDARY
- TOPOGRAPHIC SURVEY LEVEL CONTOURS (mAOD)
- PROPOSED EXCAVATION LEVEL CONTOURS (mAOD)
- PREVIOUS EXCAVATION STAGE LEVEL CONTOURS (mAOD)
- PROPOSED ENGINEERED FILL LEVEL CONTOURS (mAOD)
- PREVIOUS ENGINEERED FILL STAGE LEVEL CONTOURS (mAOD)
- PROPOSED SCREENING BUND LEVEL CONTOURS (mAOD)
- PROPOSED TOPSOIL STORAGE AREA
- PROPOSED OVERBURDEN STORAGE AREA
- PROPOSED INTERBURDEN STORAGE AREA
- PROPOSED STORAGE AREA VOID

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Project
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Drawing Title
STAGE A
PROPOSED EXCAVATION LEVELS

Scale
1:2500 @ A3

Date
JANUARY 2018

Drawing Number
00

Revision
PT0

PRELIMINARY TENDER

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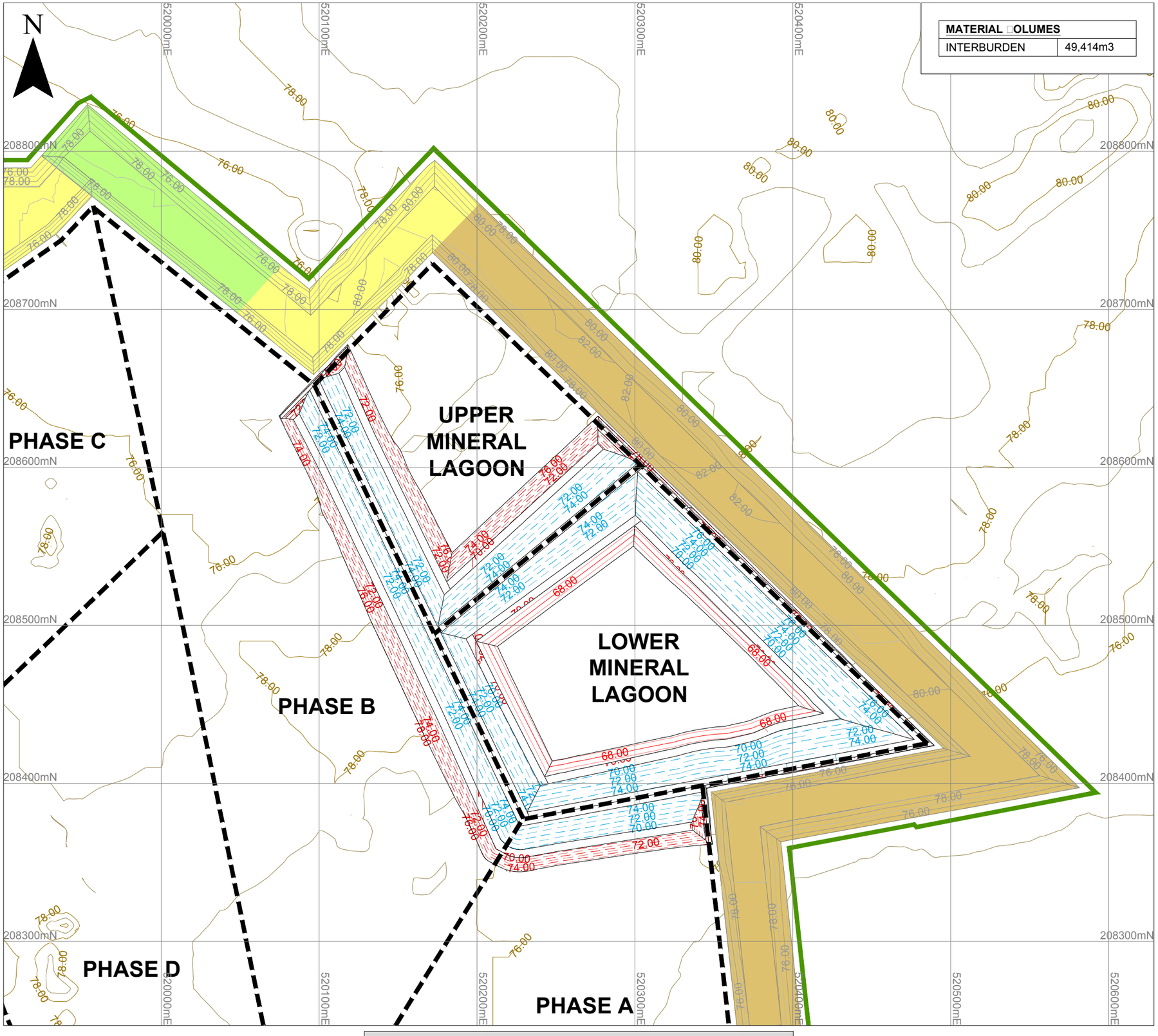

EXCAVATION OF INTERBURDEN IN LOWER LAGOON

LEGEND

- ENVIRONMENTAL PERMIT BOUNDARY
- PHASE BOUNDARY
- TOPOGRAPHIC SURVEY LEVEL CONTOURS (mAOD) (80.00)
- PROPOSED EXCAVATION LEVEL CONTOURS (mAOD) (70.00)
- PREVIOUS EXCAVATION STAGE LEVEL CONTOURS (mAOD) (70.00)
- PROPOSED ENGINEERED FILL LEVEL CONTOURS (mAOD) (70.00)
- PREVIOUS ENGINEERED FILL STAGE LEVEL CONTOURS (mAOD) (70.00)
- PROPOSED SCREENING BUND LEVEL CONTOURS (mAOD) (80.00)
- PROPOSED TOPSOIL STORAGE AREA
- PROPOSED OVERBURDEN STORAGE AREA
- PROPOSED INTERBURDEN STORAGE AREA
- PROPOSED STORAGE AREA VOID

PT0	KW	JP	01/18	
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Project
HATFIELD EARTHWORKS - INFILTRATION LAGOONS & PHASE A

Drawing Title
STAGE B
PROPOSED EXCAVATION LEVELS

Scale
1:2500 @ A3

Date
JANUARY 2018

Drawing Number
010

Revision
PT0

PRELIMINARY TENDER

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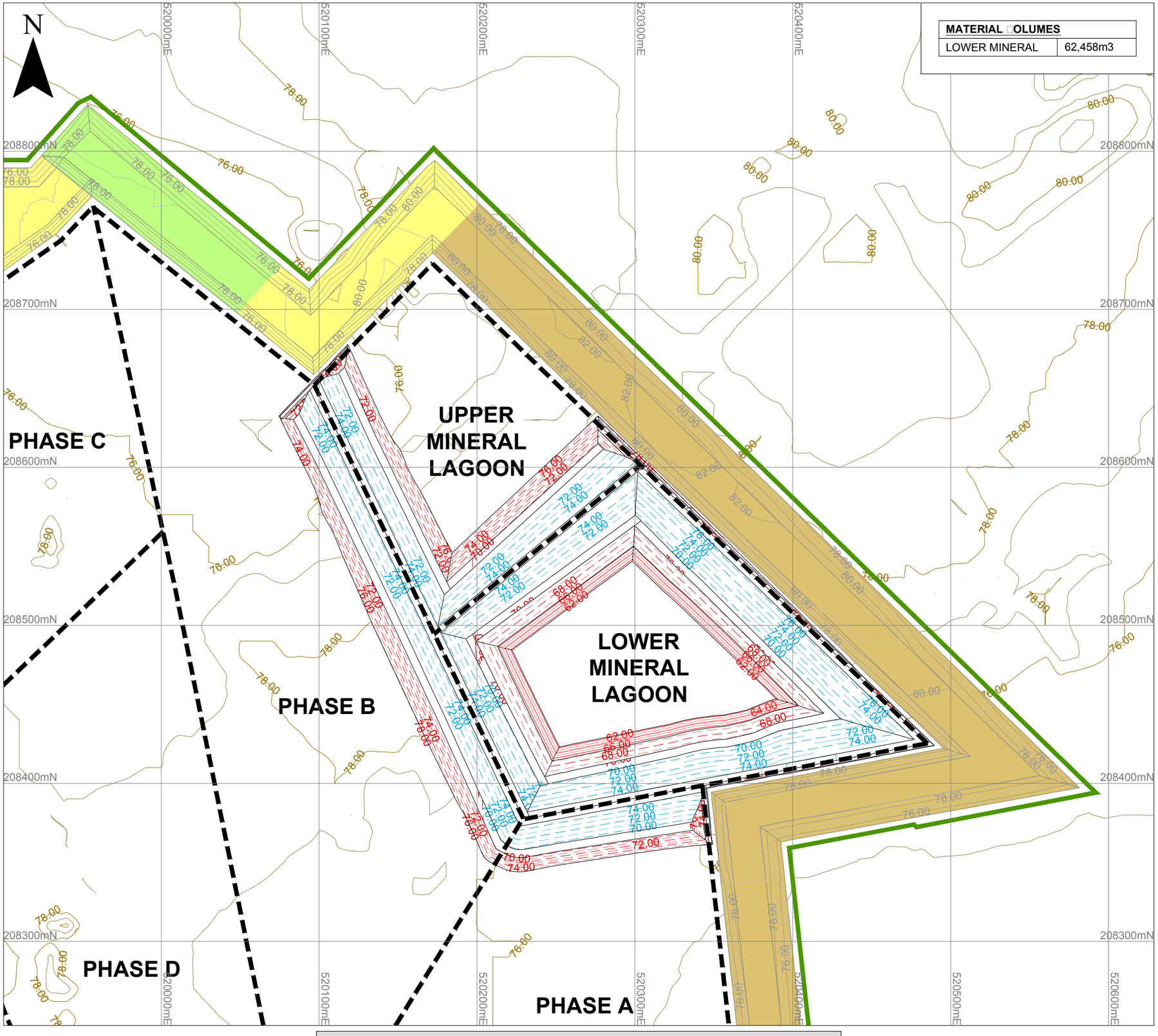

EXCAVATION TO REMOVE LOWER MINERAL IN LOWER LAGOON

LEGEND

- ENVIRONMENTAL PERMIT BOUNDARY
- PHASE BOUNDARY
- TOPOGRAPHIC SURVEY LEVEL CONTOURS (mAOD) (80.00)
- PROPOSED EXCAVATION LEVEL CONTOURS (mAOD) (70.00)
- PREVIOUS EXCAVATION STAGE LEVEL CONTOURS (mAOD) (70.00)
- PROPOSED ENGINEERED FILL LEVEL CONTOURS (mAOD) (70.00)
- PREVIOUS ENGINEERED FILL STAGE LEVEL CONTOURS (mAOD) (70.00)
- PROPOSED SCREENING BUND LEVEL CONTOURS (mAOD) (80.00)
- PROPOSED TOPSOIL STORAGE AREA
- PROPOSED OVERBURDEN STORAGE AREA
- PROPOSED INTERBURDEN STORAGE AREA
- PROPOSED STORAGE AREA VOID

Revision	By	Chk'd By	Date	Comments
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Project
HATFIELD EARTHWORKS - INFILTRATION LAGOONS & PHASE A

Drawing Title
STAGE C
PROPOSED EXCAVATION LEVELS

Scale
1:2500 @ A3

Date
JANUARY 2018

Drawing Number
011

Revision
PT0

PRELIMINARY TENDER

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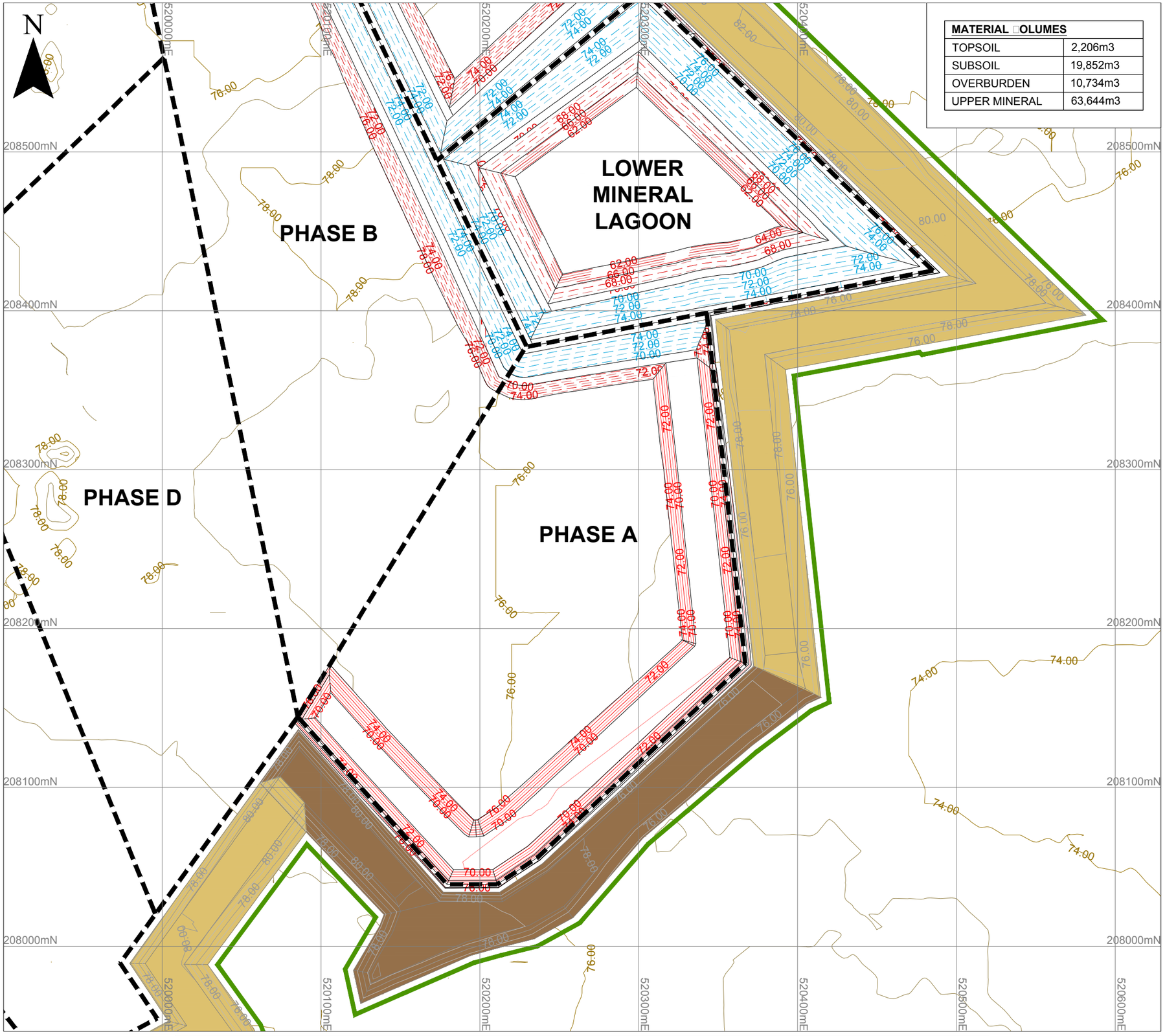

MATERIAL VOLUMES	
TOPSOIL	2,206m3
SUBSOIL	19,852m3
OVERBURDEN	10,734m3
UPPER MINERAL	63,644m3

EXCAVATION OF OVERBURDEN & UPPER MINERAL IN PHASE A SOUTHERN / EASTERN PERIMETER

LEGEND

- ENVIRONMENTAL PERMIT BOUNDARY
- PHASE BOUNDARY
- 80.00 TOPOGRAPHIC SURVEY LEVEL CONTOURS (mAOD)
- 70.00 PROPOSED EXCAVATION LEVEL CONTOURS (mAOD)
- 70.00 PREVIOUS EXCAVATION STAGE LEVEL CONTOURS (mAOD)
- 70.00 PROPOSED ENGINEERED FILL LEVEL CONTOURS (mAOD)
- 70.00 PREVIOUS ENGINEERED FILL STAGE LEVEL CONTOURS (mAOD)
- 80.00 PROPOSED SCREENING BUND LEVEL CONTOURS (mAOD)
- PROPOSED TOPSOIL STORAGE AREA
- PROPOSED OVERBURDEN STORAGE AREA
- PROPOSED INTERBURDEN STORAGE AREA
- PROPOSED STORAGE AREA VOID

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HATFIELD EARTHWORKS - INFILTRATION LAGOONS & PHASE A

Drawing Title
STAGE 5A
PROPOSED EXCAVATION LEVELS

Scale	Date	Revision
1:2500 @ A3	JANUARY 2018	PT0

Drawing Number
01

PRELIMINARY TENDER

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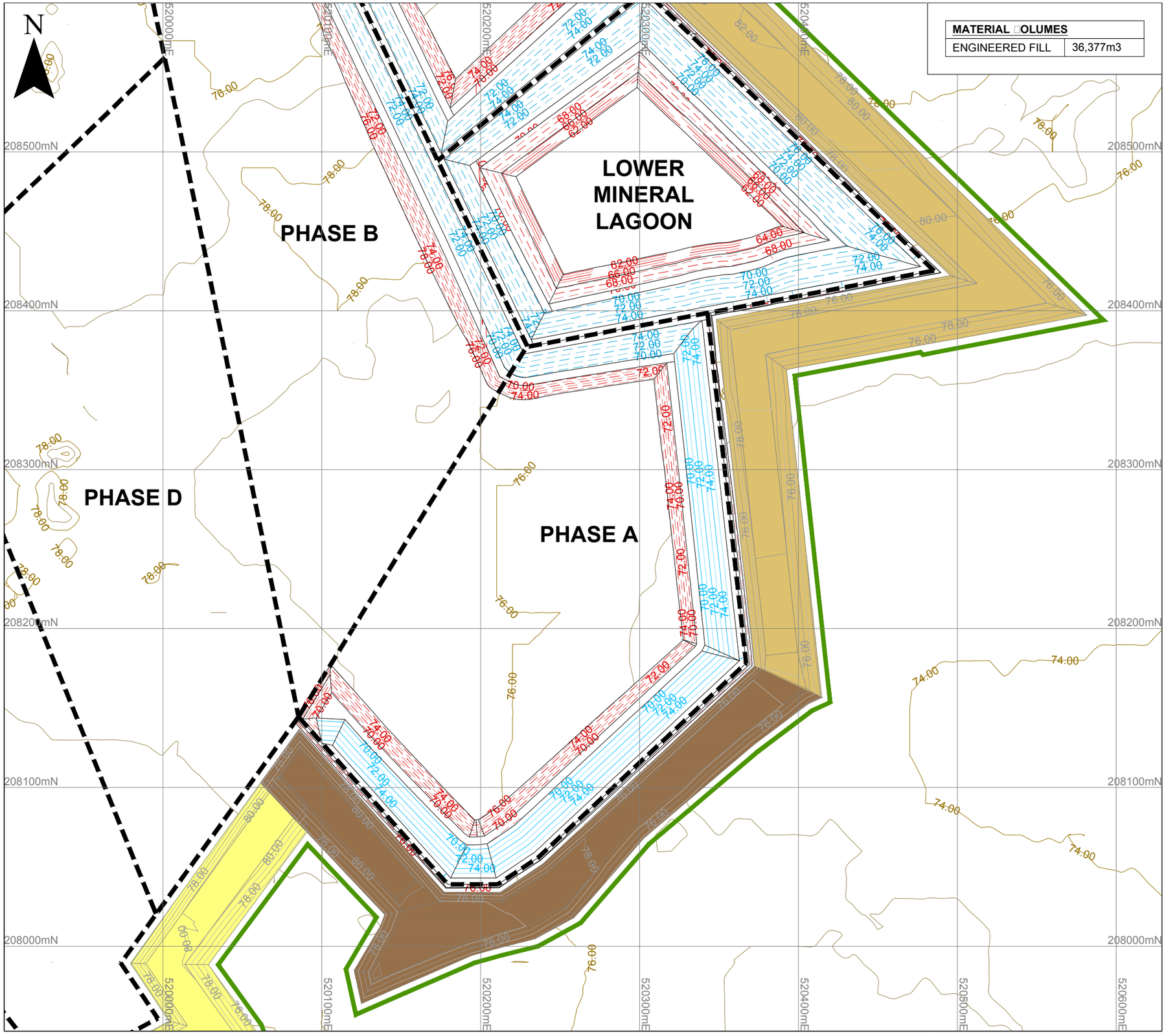

FILLING OF ENGINEERED BUTTRESS IN PHASE A SOUTHERN / EASTERN PERIMETER

LEGEND

- ENVIRONMENTAL PERMIT BOUNDARY
- PHASE BOUNDARY
- TOPOGRAPHIC SURVEY LEVEL CONTOURS (mAOD)
- PROPOSED EXCAVATION LEVEL CONTOURS (mAOD)
- PREVIOUS EXCAVATION STAGE LEVEL CONTOURS (mAOD)
- PROPOSED ENGINEERED FILL LEVEL CONTOURS (mAOD)
- PREVIOUS ENGINEERED FILL STAGE LEVEL CONTOURS (mAOD)
- PROPOSED SCREENING BUND LEVEL CONTOURS (mAOD)
- PROPOSED TOPSOIL STORAGE AREA
- PROPOSED OVERBURDEN STORAGE AREA
- PROPOSED INTERBURDEN STORAGE AREA
- PROPOSED STORAGE AREA VOID

Revision	By	Chk'd By	Date	Comments
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Project
HATFIELD EARTHWORKS - INFILTRATION LAGOONS & PHASE A

Drawing Title
STAGE 5B
PROPOSED ENGINEERED FILL LEVELS

Scale
1:2500 @ A3

Date
JANUARY 2018

Drawing Number
01

Revision
PT0

PRELIMINARY TENDER

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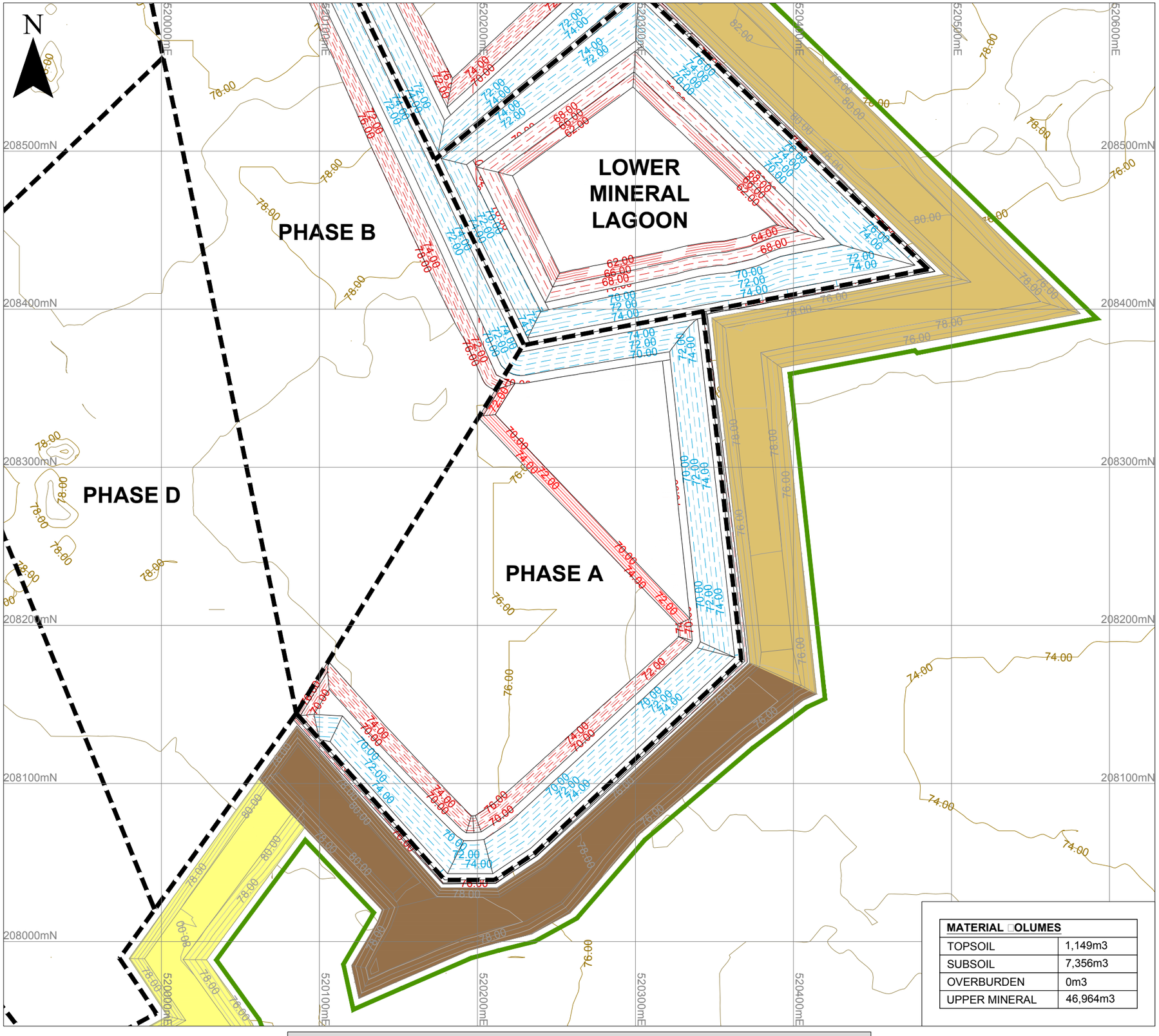

MATERIAL VOLUMES	
TOPSOIL	1,149m3
SUBSOIL	7,356m3
OVERBURDEN	0m3
UPPER MINERAL	46,964m3

EXCAVATION OF OVERBURDEN / UPPER MINERAL IN PHASE A - AREA 1

LEGEND

- ENVIRONMENTAL PERMIT BOUNDARY
- PHASE BOUNDARY
- TOPOGRAPHIC SURVEY LEVEL CONTOURS (mAOD)
- PROPOSED EXCAVATION LEVEL CONTOURS (mAOD)
- PREVIOUS EXCAVATION STAGE LEVEL CONTOURS (mAOD)
- PROPOSED ENGINEERED FILL LEVEL CONTOURS (mAOD)
- PREVIOUS ENGINEERED FILL STAGE LEVEL CONTOURS (mAOD)
- PROPOSED SCREENING BUND LEVEL CONTOURS (mAOD)
- PROPOSED TOPSOIL STORAGE AREA
- PROPOSED OVERBURDEN STORAGE AREA
- PROPOSED INTERBURDEN STORAGE AREA
- PROPOSED STORAGE AREA VOID

Revision	By	Chk'd By	Date	Comments
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Project
HATFIELD EARTHWORKS - INFILTRATION LAGOONS & PHASE A

Drawing Title
STAGE A
PROPOSED EXCAVATION LEVELS

Scale
1:2500 @ A3

Date
JANUARY 2018

Drawing Number
01

Revision
PT0

PRELIMINARY TENDER

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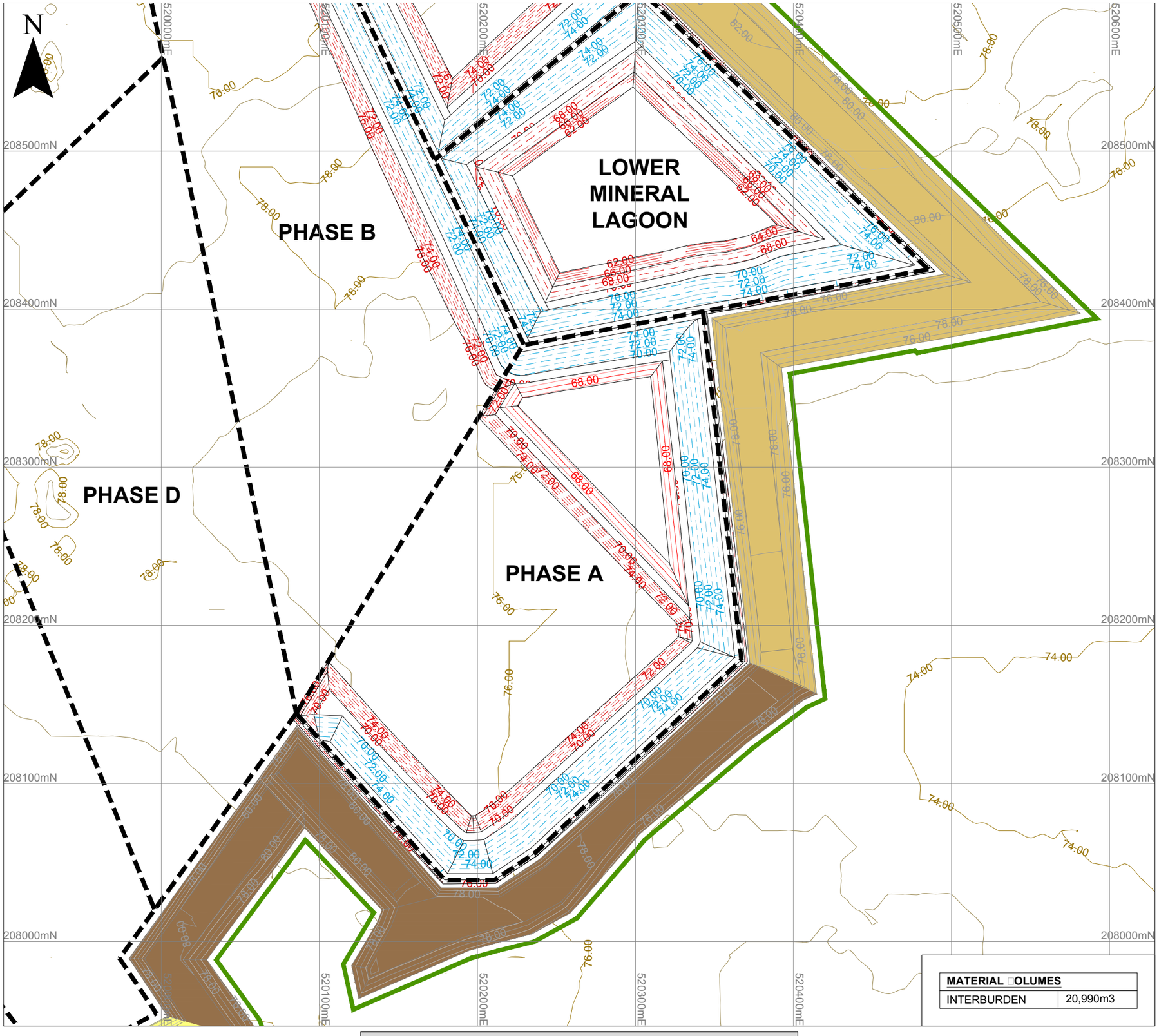

MATERIAL VOLUMES	
INTERBURDEN	20,990m3

EXCAVATION OF INTERBURDEN IN PHASE A - AREA 1

LEGEND

- ENVIRONMENTAL PERMIT BOUNDARY
- PHASE BOUNDARY
- TOPOGRAPHIC SURVEY LEVEL CONTOURS (mAOD)
- PROPOSED EXCAVATION LEVEL CONTOURS (mAOD)
- PREVIOUS EXCAVATION STAGE LEVEL CONTOURS (mAOD)
- PROPOSED ENGINEERED FILL LEVEL CONTOURS (mAOD)
- PREVIOUS ENGINEERED FILL STAGE LEVEL CONTOURS (mAOD)
- PROPOSED SCREENING BUND LEVEL CONTOURS (mAOD)
- PROPOSED TOPSOIL STORAGE AREA
- PROPOSED OVERBURDEN STORAGE AREA
- PROPOSED INTERBURDEN STORAGE AREA
- PROPOSED STORAGE AREA VOID

Revision	By	Chk'd By	Date	Comments
PT0	KW	JP	01/18	

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Site
HATFIELD QUARRY

Project
HATFIELD EARTHWORKS - INFILTRATION LAGOONS & PHASE A

Drawing Title
STAGE □B
PROPOSED E□CA□ATION LE□ELS

Scale
1:2500 @ A3

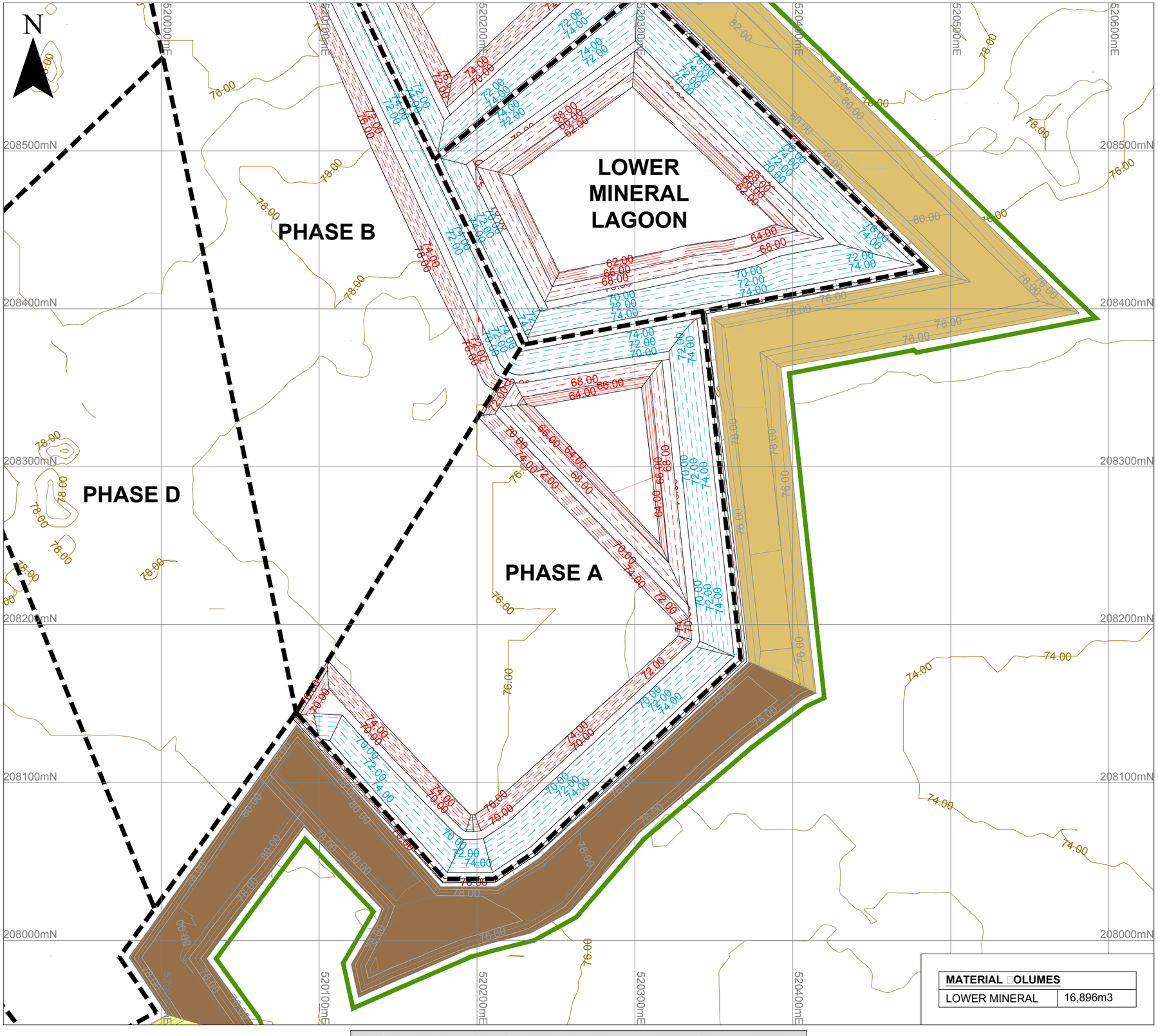
Date
JANUARY 2018

Drawing Number
015

Revision
PT0

PRELIMINARY TENDER

01009.00177.07.015.PT0_Stage6B.dwg



MATERIAL VOLUMES	
LOWER MINERAL	16,896m3

EXCAVATION OF LOWER MINERAL IN PHASE A - AREA 1

LEGEND

- ENVIRONMENTAL PERMIT BOUNDARY
- PHASE BOUNDARY
- TOPOGRAPHIC SURVEY LEVEL CONTOURS (mAOD)
- PROPOSED EXCAVATION LEVEL CONTOURS (mAOD)
- PREVIOUS EXCAVATION STAGE LEVEL CONTOURS (mAOD)
- PROPOSED ENGINEERED FILL LEVEL CONTOURS (mAOD)
- PREVIOUS ENGINEERED FILL STAGE LEVEL CONTOURS (mAOD)
- PROPOSED SCREENING BUND LEVEL CONTOURS (mAOD)
- PROPOSED TOPSOIL STORAGE AREA
- PROPOSED OVERBURDEN STORAGE AREA
- PROPOSED INTERBURDEN STORAGE AREA
- PROPOSED STORAGE AREA VOID

Revision	By	Chk'd By	Date	Comments
PT0	KW	JP	01/18	

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HATFIELD QUARRY

Project
HATFIELD EARTHWORKS - INFILTRATION LAGOONS & PHASE A

Drawing Title
STAGE C
PROPOSED EXCAVATION LEVELS

Scale
1:2500 @ A3

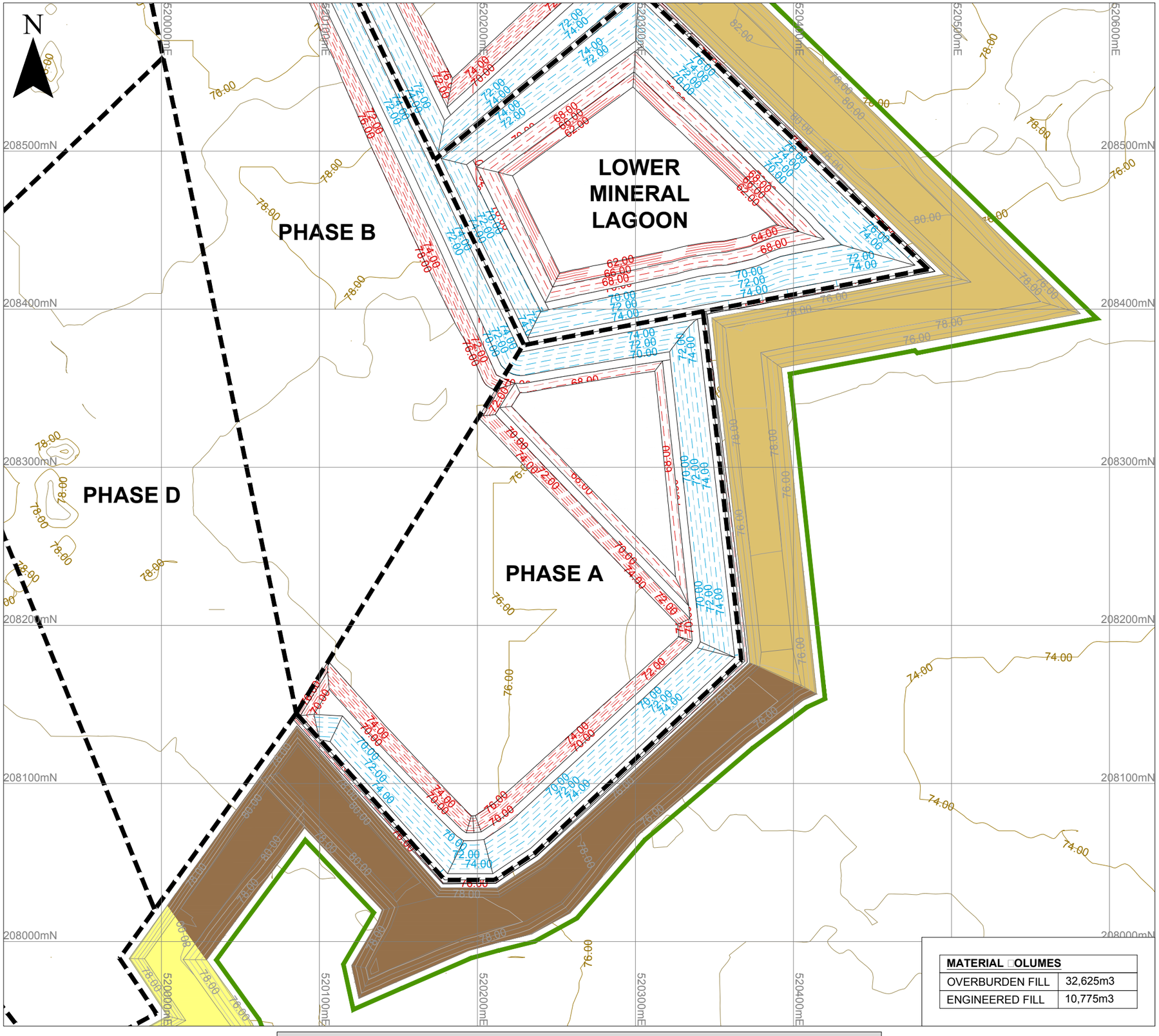
Date
JANUARY 2018

Drawing Number
01

Revision
PT0

PRELIMINARY TENDER

01009.00177.07.016.PT0_Stage6C.dwg



MATERIAL VOLUMES	
OVERBURDEN FILL	32,625m3
ENGINEERED FILL	10,775m3

FILLING OF RAFT MATERIAL / GEOLOGICAL BARRIER IN PHASE A - AREA 1

LEGEND

- ENVIRONMENTAL PERMIT BOUNDARY
- PHASE BOUNDARY
- TOPOGRAPHIC SURVEY LEVEL CONTOURS (mAOD)
- PROPOSED EXCAVATION LEVEL CONTOURS (mAOD)
- PREVIOUS EXCAVATION STAGE LEVEL CONTOURS (mAOD)
- PROPOSED ENGINEERED FILL LEVEL CONTOURS (mAOD)
- PREVIOUS ENGINEERED FILL STAGE LEVEL CONTOURS (mAOD)
- PROPOSED SCREENING BUND LEVEL CONTOURS (mAOD)
- PROPOSED TOPSOIL STORAGE AREA
- PROPOSED OVERBURDEN STORAGE AREA
- PROPOSED INTERBURDEN STORAGE AREA
- PROPOSED STORAGE AREA VOID

Revision	By	Chk'd By	Date	Comments
PT0	KW	JP	01/18	

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Site
HATFIELD INERT LANDFILL

Project
HATFIELD EARTHWORKS - INFILTRATION LAGOONS & PHASE A

Drawing Title
STAGE D
PROPOSED ENGINEERED FILL LEVELS

Scale
1:2500 @ A3

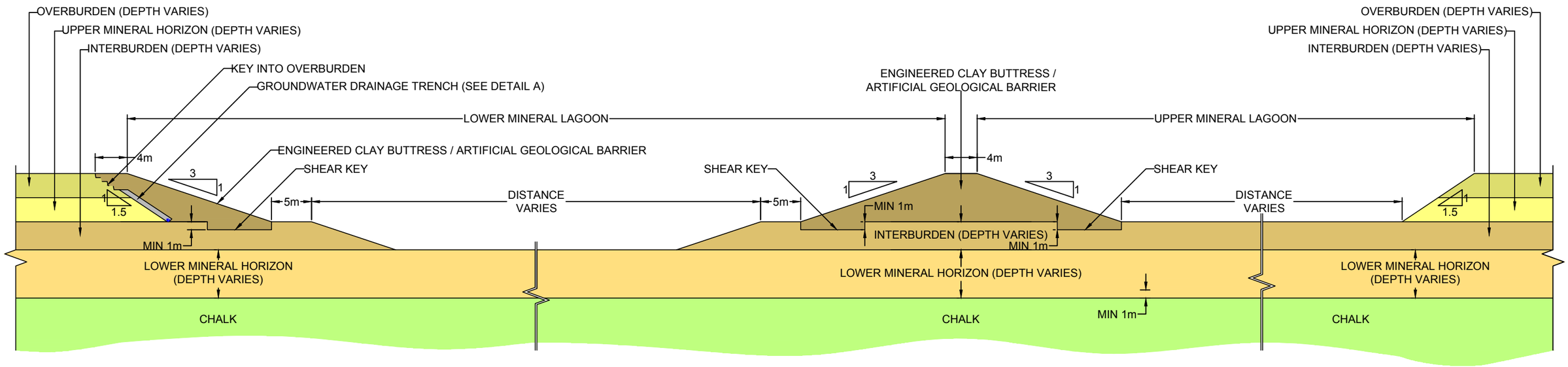
Date
JANUARY 2018

Drawing Number
01

Revision
PT0

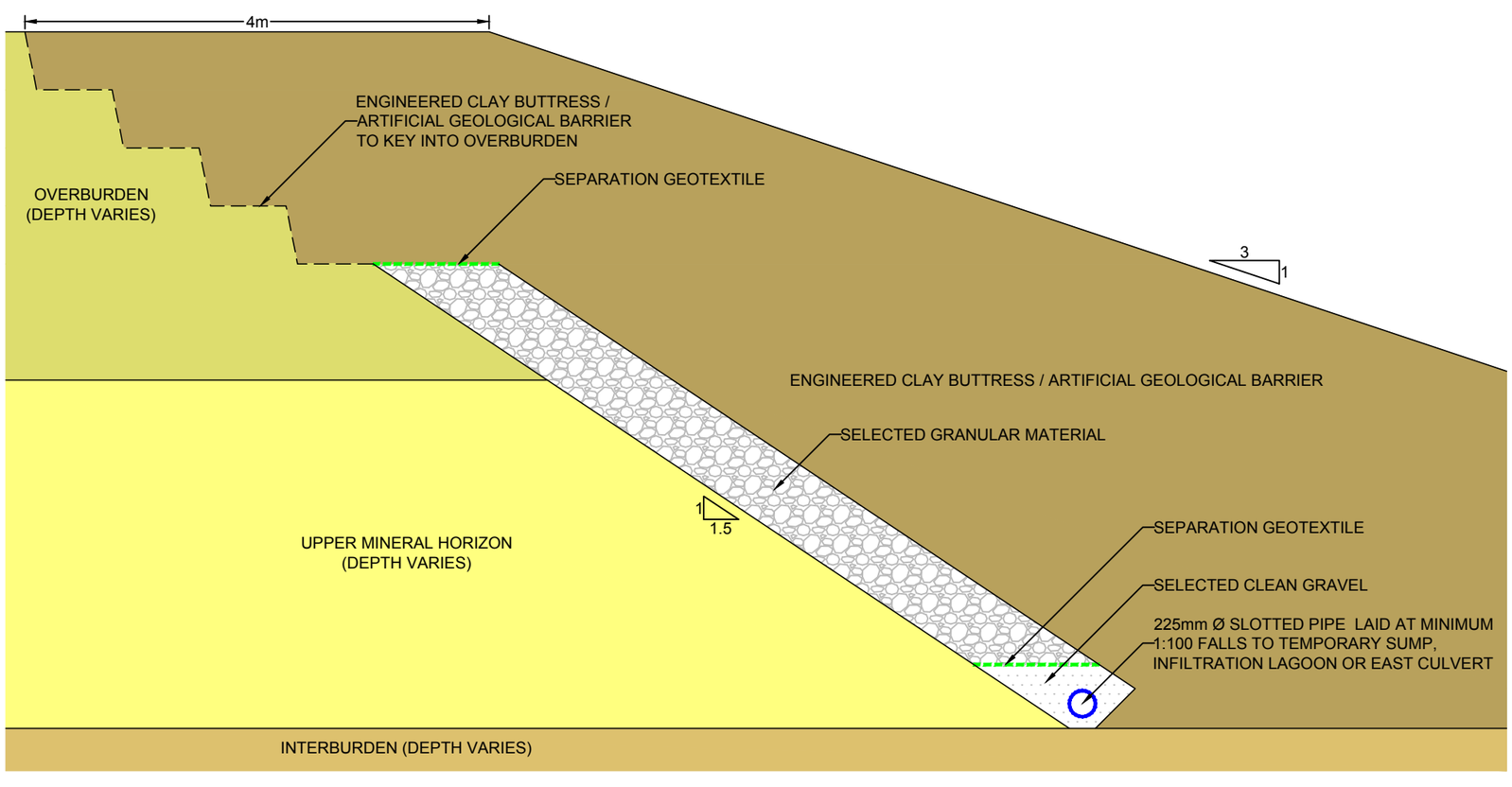
PRELIMINARY TENDER

01009.00177.07.017.PT0_Stage6D.dwg



SCHEMATIC DETAIL THROUGH LMA AND UMA INFILTRATION LAGOONS

SCALE 1:500



DETAIL A: GROUNDWATER CONTROL DRAIN

SCALE 1:50

PT1	KW	JP	05/18	
Revision	By	Chk'd By	Date	Comments

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Site
HATFIELD QUARRY

Project
HATFIELD EARTHWORKS - INFILTRATION LAGOONS & PHASE A

Drawing Title
INFILTRATION LAGOONS & BUTTRESS SCHEMATIC SECTIONS

Scale	Date
AS SHOWN @ A3	MAY 2018

Drawing Number	Revision
018	PT1

PRELIMINARY TENDER

01009.00177.07.018.PT1A_Schematic_Sections.dwg

APPENDIX 02

Water Operating Plan (Appendix 6/10 from ES)

<table>
<tr><th>Objective</th><th>Task</th><th>Description</th><th>Mineral Management</th><th>Water Management Control Process</th><th>Water Volume</th></tr>
<tr><td>Isolate UMH aquifer within each 4 Year Operational Phase (Phase A through G).</td><td>1(a)</td><td>Excavate overburden and UMH around the perimeter of the mineral excavation phase down to a depth equal to the water saturated mineral. The depth will vary by season and phase.</td><td rowspan="4">Segregate mineral from overburden and stockpile and/or process accordingly</td><td>None required</td><td></td></tr>
<tr><td rowspan="3">Install UMH Perimeter Bund Wall.</td><td>1(b)</td><td>Install well points and/or sumps along the perimeter of each phase to selectively dewater the UMH along the phase perimeter. Excavate UMH down to the upper surface of the Interburden in suitable section lengths (20m wide x 65m length) to allow for installation of the perimeter bund and back drain. Allow for a 1:4 grade haul road down to the upper surface of the interburden.</td><td>Actively dewater the UMH aquifer at a rate to allow placement of the perimeter bund keyed into the interburden. Depending on suspended load groundwater from the UMH will be discharged into a settlement lagoon followed by the UMH Recharge Lagoon, or directly to the UMH Recharge Lagoon.</td><td>
<table>
<tr><th>Confined m³/day</th><th>Unconfined[1] m³/day</th></tr>
<tr><td colspan="2">Ro=200</td></tr>
<tr><td>59 – 149</td><td>72 - 144</td></tr>
<tr><td colspan="2">Ro=100</td></tr>
<tr><td>149 - 299</td><td>92 - 288</td></tr>
</table>
</td></tr>
<tr><td>1(c)</td><td>Install UMH perimeter clay bund with a back drain, keying the bund into the overburden surface. Bund crest elevations will be as detailed below, which are above the highest UMH groundwater levels (AOD) recorded on the site (March 2014):
<table>
<tr><th>Phase</th><th>Bund Crest (AOD)</th><th>Bund Length (m)[2]</th></tr>
<tr><td>A</td><td>76m</td><td>770</td></tr>
<tr><td>B</td><td>76m</td><td>760</td></tr>
<tr><td>C</td><td>77m (west), 76m (east)</td><td>780</td></tr>
<tr><td>D</td><td>77m (west), 76m (east)</td><td>570</td></tr>
<tr><td>E</td><td>78m (west), 77m (east)</td><td>900</td></tr>
<tr><td>F</td><td>78m (west), 77m (east)</td><td>560</td></tr>
<tr><td>G</td><td>78m</td><td>620</td></tr>
</table>
</td><td>The back drain will control the maximum groundwater head outside of the Phase bund. Drain invert elevations (AOD, listed below) will vary for each Phase, but the intention is to manage the groundwater head at 1m below the maximum recorded water level for that Phase.
<table>
<tr><th>Phase</th><th>Back Drain IL (mAOD)</th><th>Groundwater Level in the UMH (mAOD)[3]</th></tr>
<tr><td>A</td><td>74m</td><td>75.5 – 74</td></tr>
<tr><td>B</td><td>74.5</td><td>75.5 – 74</td></tr>
<tr><td>C</td><td>76m</td><td>76.8 – 74.5</td></tr>
<tr><td>D</td><td>76m</td><td>76.7 – 75.5</td></tr>
<tr><td>E</td><td>76.5m</td><td>77.6 – 77.0</td></tr>
<tr><td>F</td><td>76.5m</td><td>77.0 – 76.0</td></tr>
<tr><td>G</td><td>76.5m</td><td>77.5 – 76.0</td></tr>
</table>
</td><td>
<table>
<tr><th colspan="3">Back Drain Flow (m³/day and L/sec)[4]</th></tr>
<tr><td>A</td><td>97-193[5]</td><td>1.1-2.2</td></tr>
<tr><td>B</td><td>59-118</td><td>0.7-1.4</td></tr>
<tr><td>C</td><td>64-128</td><td>0.7-1.5</td></tr>
<tr><td>D</td><td>38-75</td><td>0.4-0.9</td></tr>
<tr><td>E</td><td>85-169</td><td>1.0-2.0</td></tr>
<tr><td>F</td><td>28-55</td><td>0.3-0.6</td></tr>
<tr><td>G</td><td>66-133</td><td>0.8-1.5</td></tr>
</table>
</td></tr>
<tr><td>1(d)</td><td>Repeat Tasks 1(a-c) for the remaining perimeter sections of each phase until a continuous clay bund has been constructed around the perimeter of the site.

This scenario corresponds with the final reinstated site condition.</td><td>The perimeter back drains will control UMH groundwater levels during the site restoration stage to a maximum elevation of 76.5mAOD. The reinstatement back drain will be constructed in 2 halves with flow around the north and the south sides of the site to where ground levels will fall below 76.5mAOD. This approximates to the lateral extent of Phase E and G.
It should be recognised that for the period of monitoring UMH groundwater only exceeded 76.5mAOD during the months of January to mid-March in 2014 following an extremely wet winter period. Water levels did not reach this elevation in 2015, which means that the E and G back drains would not have captured groundwater.</td><td>
<table>
<tr><th colspan="3">Back Drain Flow (m³/day and L/sec)[6]</th></tr>
<tr><td>E</td><td>73-147</td><td>0.8-1.7</td></tr>
<tr><td>G</td><td>61-122[7]</td><td>0.7-1.4</td></tr>
<tr><td>E+G</td><td>134-269</td><td>1.6-3.1</td></tr>
</table>
</td></tr>
</table>

[1] Calculated using Tab12. Well Points (UC) in 'Assessing the impacts of dewatering on water resources', Tier 1 Analytical Tools, Version 1.6; Environment Agency
[2] Length excludes the shared internal bund if it is to be removed (See Task 6)
[3] Seasonal high water level (March 2014)
[4] Calculations are based upon highest recorded groundwater level using March 2014 data (worse case). For significant period of the year there will be very little to no flow from the back drain.
[5] Calculated using Tab 8. Trench with Flow One Side (UC) in 'Assessing the impacts of dewatering on water resources', Tier 1 Analytical Tools, Version 1.6; Environment Agency
[6] As footnote 5 above.
[7] As footnote 1 above

<table>
<tr><th>Objective</th><th>Task</th><th>Description</th><th>Mineral Management</th><th>Water Management Control Process</th><th colspan="4">Water Volume</th></tr>
<tr><td rowspan="3">Excavate Overburden and UMH for storage, blending and processing.</td><td rowspan="3">2</td><td rowspan="3">Overburden and UMH within the bunded area of each phase will be excavated down to the Interburden surface in areas equivalent to an annual operating period</td><td rowspan="3"></td><td rowspan="3">Reduce and maintain groundwater levels in the UMH inside the Phase using ditches, and sump pumps to control water levels.

Maintenance pumping will also be required to capture and discharge flow generated by precipitation.

Each Phase will be dewatered at a sustainable rate equal to recharge plus the volume held in storage. Discharge rates will be managed according to the available recharge lagoon infiltration capacity, supplemented by recharge into the LMH aquifer within the confines of each phase as its worked.</td><td>Phase</td><td>Water in Storage (m^3/day)</td><td>Precipitation Recharge (m^3/day)</td><td>Combined Discharge Requirement (m^3/day)</td></tr>
<tr><td>A
B
C
D
E
F
G</td><td>51
53
45
50
63
63
69</td><td>73
83
66
91
82
82
79</td><td>125
136
111
141
145
146
147</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td rowspan="2">Preparation for extraction of LMH mineral beneath the interburden.

It is advantageous if the interburden can be removed without a positive upward pressure from groundwater below.</td><td>3a</td><td>For site phases where the LMH groundwater levels are below the base of the Interburden for a significant seasonal period (unconfined aquifer conditions), then the interburden will be excavated from suitably sized working ‘cells’ with an approximate dimension of 75m x 75m.</td><td rowspan="2">Cohesive material from the interburden will be stockpiled for future bund construction, backfilling of the LMH excavation, or will be placed directly into previously excavated LMH ‘cells’.</td><td>Monitoring of groundwater levels indicates that no active groundwater pumping will be required from the LMH for Phase A and B (and possibly C, D and F, depending on seasonal conditions). This conclusion is drawn from Drawings B through K that illustrates geological cross sections for each Phase with the maximum and minimum seasonal water levels in both the UMH and the LMH aquifers). The maximum and minimum water levels are based upon the groundwater hydrographs in Appendix 6/3 of the Environmental Statement.</td><td colspan="4">No water generating activities required</td></tr>
<tr><td>3b</td><td>For site phases where the LMH groundwater levels are above the base of the Interburden for a significant seasonal period (confined aquifer conditions), then the interburden will be excavated from suitably sized working ‘cells’.</td><td>Monitoring of groundwater levels indicates that active groundwater pumping will be required from the LMH aquifer during extraction of the interburden in Phase E and G (Phase c, D and F may or may not require active lowering of the water table – this will be determined at the time of working). For these 2 phases the working ‘cells’ will be reduced to a size of approximately 30m x 100m (3,000m^2)to limit the volume of water being pumped and recharged into the LMH Recharge Lagoon. Once the interburden has been removed from each ‘cell’ then pumping will be stopped and LMH aquifer water levels will be allowed to recover and re-equilibrate.
The volume calculations are sensitive to a number of assumptions, e.g., permeability and hydraulic connection with the Chalk being important.</td><td colspan="2">Phase</td><td colspan="2">Pumping rate to lower water level to the base of the interburden[8]</td></tr>
<tr><td colspan="4"></td><td colspan="2">A
B
C
D
E
F
G</td><td colspan="2">Not required
Not required
155 – 310
215 – 431
278 – 558
472 – 945
405 – 811</td></tr>
<tr><td>Extraction of LMH mineral.</td><td>4</td><td>‘Wet excavation’ of the LMH will occur once the interburden has been removed from the working ‘cell’.</td><td>LMH mineral will be excavated ‘wet’ from the working ‘cell’ for stockpiling and processing using long reach excavators</td><td>No active groundwater management is anticipated during the LMH mineral extraction operation.</td><td colspan="4">No water generating activities required</td></tr>
</table>

[8] Calculated using Tab 1. Thiem (C) in ‘Assessing the impacts of dewatering on water resources’, Tier 1 Analytical Tools, Version 1.6; Environment Agency

Objective	Task	Description	Mineral Management	Water Management Control Process	Water Volume	
Recharge into UMH aquifer	5a	Water generated by the following tasks will be discharged to the UMH recharge lagoon: • Task 1 (b) Dewatering UMH during placement of perimeter bunds • Task 1 (c) Back drain discharge once UMH perimeter bunds are in place • Task 2 Maintenance water management (storage in UMH and precipitation) during all excavations	None required associated with this stage. Care will be taken to ensure both lagoons do not accumulate silt with the potential for decreasing infiltration rates	Lagoon recharge capacity is controlled by the physical properties of the aquifer, as well as with season due to changes in the water level at the time of discharge. A range of potential recharge values have been calculated using the Theim equation and the following assumptions: K = 4m to 8m/d (from piezometer test data) Ro = 200m, acting as a locally confined aquifer by the overburden Minimum head change in lagoon 2m (winter conditions) Maximum head change in lagoon 2.7m (summer conditions)	K = 4m/d 160 – 289m^3/day	K = 8m/d 322 – 579m^3/day
Recharge into LMH aquifer	5b	Water generated by the following task will be discharged to the LMH recharge lagoon. • Task 3 (b) Lowering of the piezometric surface of the LMH aquifer to the base of the interburden • Tasks 1(b), (c), 2, if required		The Theim equation has also been used to calculate the recharge capacity for the LMH lagoon with the following assumptions: K = 10m to 20m/d (from piezometer tests) Ro = 1000m Maximum available head change in the LMH lagoon is 6m	K = 10m/d 1,158m^3/day	K = 20m/d 2,316m^3/day
Removal of internal bund walls in neighbouring Phases.	6	Internal bund walls will be removed during construction of neighbouring phases that share a bund. Clay material won from the bund will be reused for subsequent bund preparation works.	Mineral will be excavated beneath the former bund for processing	Once the internal perimeter bund has been removed there may be groundwater seepage from the adjacent reinstated UMH in the adjacent phase.	Negligible quantity assumed	
Final Restoration	7	Perimeter bund drainage	None	The perimeter drain for Phase E and G will remain in place during the restoration stage and discharge into the interior of the restored site within shallow swales and hedgerow boundary ditches that will eventually discharge into the combined UMH recharge lagoon (see Task 8 below). Following a period of water level review, the perimeter drain around Phase A, B, C (part of), D and F will be removed.	136m^3/d – 269m3/d[9]	
Combined Lagoons	8	Create a pathway for surface water (comprising a) Rainfall runoff b) Groundwater fed runoff (Phase E and G) All to be recharged into the UMH and LMH lagoons (combined as a single UMH lagoon).	None	The LMH lagoon will be reinstated to the upper surface of the interburden. The bund between the the UMH and LMH lagoon will be removed so forming a single UMH lagoon. a) RW runoff for the reinstated site will be at the greenfield rate b) The Phase E & G drain will be set at 76.5mAOD and is designed to capture rising groundwater, if any c) Combined lagoon recharge capacity	The combined flow to the infiltration lagoon will comprise:	
					a) RW runoff b) E & G GW runoff	36 – 41,000m^3 134 – 269m^3/day
					Combined lagoon recharge capacity	
					K = 4m/d 370 – 666m^3/day	K = 8m/d 740 – 1,333m^3/day
				The combined lagoon will have a storage capacity equal to its area X the available rise in water head from the static water level up to the spill point at 75.5mAOD The static water level recorded at the lagoon area ranges seasonally from 72.8m to 74mAOD so a rise in available head of 2.7m to 1.5m.	167,000m^3 to 93,000m^3	

[9] Refer back to task 1(d)

APPENDIX 03

Illustrative Restoration Concept

PLANT SITE AND STOCKING AREA TO BE RESTORED TO ACID GRASSLAND AND MOSAIC USING RESIDUAL MINERAL LEFT OVER AT END OF SITE CLEARANCE, WITH RIDGE AND FURROW, MICRO-TOPOGRAPHICAL VARIATION AND MANAGED AS TRANQUIL AREA FOR NATURE CONSERVATION.

TWO EXISTING GREAT CRESTED NEWT PONDS ON MARGIN OF SITE RETAINED

SEMI-NATURAL SPECIES, RICH GRASSLAND TO INCLUDE RIDGE AND FURROW, MICROTOPOGRAPHICAL AND SUBSTRATE VARIATION TO MAXIMISE OVERALL POTENTIAL HABITAT VALUE AND INTEREST

FRESHWATER AND SILT LAGOONS RETAINED AS PERMANENT WATERBODIES AS PART OF RESTORATION

THE TWO RECHARGE LAGOONS TO BE RETAINED AS PERMANENT WATERBODIES, BUT PARTIALLY BACKFILLED TO TOP OF INTERBURDEN USING SITE DERIVED AND IMPORTED MATERIAL

PILLBOX RETAINED

OVERFLOW/OUTFALL FROM RESTORED WATERBODY AS DITCH/PIPE AT 75.5m AOD TO DRAIN TO DIVERTED NAST CULVERT

INVERT OF EXISTING NAST CULVERT ALONG THE SIDE OF THE ROAD AT 71.78m AOD.

SW7A & SW7B
(71.788) (71.896)

PARTS OF PERIMETER SOIL BUND TO BE RETAINED AS A LOW BERM AROUND THE SITE FOR RECREATIONAL ACCESS AND VIEWS

CAR PARKING AND SITE OFFICES TO BE RETAINED FOR RECREATIONAL USE

ACCESS ROAD RETAINED

N

LEGEND

- SITE BOUNDARY
- PROPOSED CONTOURS (2m INTERVALS)
- PROPOSED NAST DIVERSION (PERFORATED PIPE)
- PROPOSED NAST DIVERSION (SOLID PIPE)
- GAS PIPELINE ROUTE TAKEN FROM NATIONAL GRID DRAWING EA_TE_Z6_2S_16351
- PUBLIC RIGHT OF WAY
- BRIDLEWAY TO BE DEDICATED
- PERMISSIVE RIGHT OF WAY
- MINERAL EXTRACTION AREA
- NAST CULVERT AND SURFACE WATER MONITORING POINT
- RETAINED BOREHOLES
- RETAINED ACCESS ROAD
- POTENTIAL INDICATIVE LOCATION OF BACK DRAIN
- PROPOSED OPEN DITCH/SWALE
- ADVANCE HEDGEROW AND TREE PLANTING
- EXISTING TREES AND SHRUBS
- PROPOSED HEDGROW
- PROPOSED SCRUB
- PROPOSED MARGINAL VEGETATION/REEDBED
- WATER BODY / PONDS
- UNIMPROVED NEUTRAL-ACIDIC GRASSLAND
- CALCAREOUS GRASSLAND
- PROPOSED RIDGE AND FURROW

0 80m 200
Metres 1:2500

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HATFIELD AERODROME

DISCHARGE OF CONDITIONS

RESTORATION PLAN

HA - PCC - C55 - REST

Scale 1:2,500 @ A1

Date MAY 2018

160522_01009.00190.29.HA-PCC-C55-PR_REST_SM.dwg

APPENDIX 04

QHEST Management System

1.0 Q H E S T MANAGEMENT SYSTEM

1.1 Management System

The activities to be carried out at Hatfield Road Quarry will be managed and operated in accordance with the Brett Integrated Management System (IMS) known as QHEST (Quality, Health, Environment, Safety Together) which combines the requirements for quality, occupational health, environment and safety into one comprehensive set of procedures. The management system is certified to the following standards:

BS EN ISO14001:2015, Environmental management systems;
BS EN ISO9001:2015, Quality management systems;
BS OHSAS18001, Occupational health and safety management systems – Specification; and
BES 6001 Issue 3, Responsible Sourcing of Construction Products;
QSRMC Quality and Product Conformity Regulations 2003 (EN 206-1).

The management systems will therefore ensure that:

the risks that the activities pose to the environment are identified;
the measures that are required to minimise the risks are identified;
the activities are managed in accordance with the management system; and
performance against the management system is audited at regular intervals; and

The QHEST management system comprises:

Brett Group Sustainability and Responsible Sourcing Policy;
- Brett Group Safety, Health and Environment Policy;
- Brett Group Quality Policy;
- Brett Group Ethical Policy;
- Brett Group Energy, Water, Waste and Resource Management Policy;
- Brett Group Employee Training and Competency Policy;
- Brett Group Community Liaison, Consultation and Complaints Policy;
- Brett Group Transport Policy;

Introduction to the QHEST system;
Brett Group Procedures;
Brett Aggregates Procedures; and
QHEST Guidance Notes.

The QHEST IMS is subject to continual review in response to significant changes to the activities, accidents or non-compliance. A copy of the QHEST IMS will be available for inspection on site.

1.1.1 Management Structure and Responsibilities

Structure, responsibilities and resources will be in accordance with the following QHEST procedure:

BG2.1 Structure, Responsibilities and Resources.

1.1.2 Technical Competence and Training

The site will be managed by sufficient staff that are competent to operate the site without causing pollution.

Operations at the site will be under the control of a technically competent person who has received relevant training and has appropriate experience.

Training will be undertaken in accordance with the following QHEST procedures and forms:

BG2.2 Training, Awareness and Competence;
Form BG2.2a Training Evaluation Form;
Form BG2.2b Training Request Form; and
Form BG2.2e Training Course Attendance Form.

1.1.3 Managing Documentation and Records

Controls will be in place to ensure that all documents are issued, revised and maintained in a consistent fashion in accordance with the following QHEST procedure and forms:

BG2.4 Document Control;
Form BG2.4a Site-Specific Procedures List; and
Form BG2.4b Site Specific Controlled Documents List.

Records will be maintained in accordance with the following QHEST procedure and related forms:

BG2.5 Records and Records Management;
Form BG2.5a QHEST forms; and
Form BG2.5b Site Specific Forms.

1.1.4 Reporting Non-Compliance and Taking Corrective Action

Procedures will ensure appropriate corrective action is taken in response to problems identified at the site. The procedures will ensure that non-conformances are reported, investigated and rectified, and that failures and weaknesses are prevented.

A number of QHEST procedures will be in place to implement the necessary action including:

BG4.1 Monitoring and Inspection;
BG6.2 Non Conformance, Corrective and Preventative Action;
Form BG6.2a Corrective Action Report Form;

BA 1 WI 01 Geotechnical Assessment, Appraisal and Inspection; and,
Form BA1i Site Inspection Checklist including Lagoons.

1.1.5 Auditing and Legal Compliance

There will be a formalised internal auditing procedure to ensure the facility is audited at defined intervals and that the progress of corrective and preventative action is monitored in accordance with the following QHEST procedures and forms:

BG6.1 Audit and Inspection Procedure;
Form BG6.1a QHEST Audit Report;
Form BG6.1b Audit Checklist;
Form BG6.1e Checklist for Oil Storage Tanks; and
BG6.4 Procedure for Submitting Completed Audit Actions.

1.1.6 Monitoring, Measuring and Reviewing Environmental Performance

A formalised management structure will review environmental performance, and ensure any necessary actions are taken in accordance with:

BG4.1 Monitoring and Inspection;
BG4.6 Measuring Up; and
BG6.3 Management Review.

1.1.7 Operational Control, Preventative Maintenance and Calibration

The QHEST IMS will ensure effective control of operations, the use of approved suppliers and contract services, the maintenance of operational equipment and the calibration of monitoring equipment.

All plant and equipment will be subject to a programme of Planned Preventative Maintenance (PPM) which will follow the inspection and maintenance schedule recommended by the manufacturer.

Relevant procedures and forms include:

BG1.9 Control of Purchasing;
BG3.1 Permit to Work and Permission to Proceed;
BG3.46 Control of Contractors
Form BG3.2a Contractors Inspection Form;
BG3.46 WI 01 Checking/Searching for Brett preferred or Avelta Approved Contractor;
BG3.46 WI 02 Adding New Contractors to the Avelta Approved Scheme; and
BG3.46 WI 03 Authorisation of Non- Avelta Approved Contractors.
BG4.2 Plant and Equipment Maintenance;
BG4.3 Instrument and Equipment Calibration;

1.2 Accident Management Plan

Brett recognises the importance of the prevention of accidents that may have environmental consequences and that it is crucial to limit those consequences. As part of the QHEST IMS Brett has developed a system to identify, assess and minimise the environmental risks and hazards of accidents and their consequences in accordance with:

BG1.3 QHEST Risk Assessment;
BG1.4 Hazardous Substances Risk Assessment;
BG5.1 Emergency Preparedness and Response;
BG5.2 Reporting and Investigation of Accident, Incident and Complaint;
Form BG5.2a Group Incident Report Form;
BG5.3 Near Miss Reporting; and
Form BG5.3a Near Miss Report.

The following environmental hazards have been identified:

fire;
loss of containment - spillage and leakage;
security and vandalism; and,
flooding.

Actions that will be taken to minimise specific risks are detailed below.

2.2.1 Fire

As part of the QHEST IMS a number of procedures have been developed to prevent and minimise the potential impact of fire.

BG1.3 QHEST Risk Assessment;
BG1.15 Fire and Explosion Management;
BG3.1 Permit to Work and Permission to Proceed;
BG3.19 Inspection, Testing and Maintenance of Electrical Equipment;
BG4.2 Plant and Equipment Maintenance;

Form BA1i Site Inspection Checklist including Lagoons;
Form BG1.15a Fire Safety Risk Assessment Proforma;

GN8 Hot Work; and
GN21 Working with Electricity.

2.2.2 Loss of Containment - Spillage and Leakage

Loss of containment could lead to spillage and leakage of potentially contaminating liquids. To prevent loss of containment and minimise the risk and impact of releases a number of QHEST IMS Procedures have been developed as follows:

BG3.3 Control of Gas Oil Deliveries;
BG3.4 Fuel and Oil Storage;
BG3.5 Refuelling of Plant / Vehicles on Site;
BG4.2 Plant and Equipment Maintenance; and

GN29 Guidelines for Oil Storage.

2.2.3 Security and Vandalism

To maintain security at the site the following QHEST procedures will be followed:

BG1.13 Design Security into Buildings and Plant;
BG3.34 Brett Site Security;

BG3.46 WI 01 Checking/Searching for Brett preferred or Avelta Approved Contractor;
BG3.46 WI 02 Adding New Contractors to the Avelta Approved Scheme; and
BG3.46 WI 03 Authorisation of Non- Avelta Approved Contractors.

BA1 Design and Operation of a Quarry;
Form BA1i Inspection Checklist including Lagoons;

GN42 Guidelines for Employees Encountering Unauthorised Individuals on Site;
GN43 Guidelines for Vacant Property Security;
GN44 Guidelines for CCTV Selection and Management.

APPENDIX 05

Borehole Logs and Monitoring Well Construction Details

BOREHOLE LOG

BOREHOLE No. **BH101S**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	13/08/13	75.74maOD	E520037.814 N207951.650

Project: **HATFIELD AERODROME**

Sheet: 1 of 1

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							75.34		0.40	Grass onto: Firm orange-brown sandy CLAY.	
1.10-1.50	B1						74.44		(0.90) 1.30	Orange brown silty very sandy GRAVEL. Gravel is medium to coarse rounded to subangular flint.	
							73.94		(0.50) 1.80	Stiff black grey orange mottled gravelly CLAY. Gravel is fine to medium angular flint.	
3.10-3.50	B2						71.44		(2.50) 4.30	Orange brown slightly silty very sandy GRAVEL. Gravel is medium to coarse rounded to subangular flint.	
							69.44		(2.00) 6.30	Yellow brown slightly gravelly fine to coarse SAND. Gravel is medium to coarse subrounded flint.	
							69.04		6.70	Stiff grey slightly gravelly CLAY. Gravel is fine to medium subangular flint and rare chalk.	
										Borehole complete at 6.70m	

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	1) Hand dug inspection pit to 1.2m. 2) Bored 200mm to 6.7m. 3) 50mm well installed, screened from 2.1-6.1m.

All dimensions in metres Scale 1:62.5	Contractor: Endeavour Ltd Plant: Dando 3000	Method: Cable Percussion Hole Size: 200	Logged By: DH	Approved By: PW

SLR Consulting Ltd, 8 Stow Court, Stow-Cum-Quy, Cambridge, CB25 9AS, , Tel: 01223 813805, Fax: 01223 813783

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

BOREHOLE LOG

BOREHOLE No. **BH101D**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	12/08/13	75.75maOD	E520040.513 N207950.805

Project: **HATFIELD AERODROME**

Sheet: 1 of 2

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							75.35		0.40	Grass onto: Firm orange-brown sandy CLAY.	
0.60-0.90	B1						74.45	(0.90)	1.30	Orange brown sandy fine to coarse GRAVEL. Gravel is fine to coarse rounded to subangular flint.	
							73.95	(0.50)	1.80	Stiff black grey orange mottled gravelly CLAY. Gravel is fine to medium angular flint.	
1.90-2.20	B2									Orange brown sandy fine to coarse sandy GRAVEL. Gravel is fine to coarse rounded to subangular flint.	
							71.25	(2.70)	4.50	3.90 ...becoming very sandy...	
3.90-4.20	B3						71.05		4.70	Yellow brown slightly gravelly fine to coarse SAND. Gravel is medium to coarse subrounded flint.	
										Yellow brown silty medium to coarse SAND.	
5.90-6.20	B4						69.15	(1.90)	6.60		
7.00-7.50	U100						66.45	(2.70)	9.30	Stiff grey slightly gravelly CLAY. Gravel is fine to medium subangular flint and rare chalk.	
9.50-10.00	B5							(1.00)		Orange brown slightly sandy GRAVEL. Gravel is fine to coarse rounded to subrounded flint.	

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	1) Hand dug inspection pit to 1.2m. 2) Bored 250mm casing to 8.9m, 200mm casing to 19m, bentonite seal from 7.9-8.9m. 3) Two 50mm wells installed, screen from 10.0-14.3m and 16.0-19.0m.

All dimensions in metres Scale 1:62.5	Contractor: Endeavour Ltd Plant: Dando 3000	Method: Cable Percussion Hole Size: 250/200	Logged By: DH	Approved By: PW

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LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

BOREHOLE LOG

BOREHOLE No. **BH101D**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	12/08/13	75.75maOD	E520040.513 N207950.805

Project: **HATFIELD AERODROME**

Sheet: 2 of 2

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							65.45		10.30		
							65.25		10.50	Firm brown sandy CLAY.	
11										Orange brown slightly sandy GRAVEL. Gravel is fine to coarse angular to rounded flint.	
11.90-12.40	B6									11.90 ...very sandy..	
12									(4.00)		
13											
13.90-14.40	B7										
14							61.25		14.50		
15										White grey CHALK. (recovered as very soft gravelly chalk silt. Gravel is angular flint, chert and chalk)	
16											
17									(4.50)		
18											
19							56.75		19.00		
										Borehole complete at 19.00m	

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	1) Hand dug inspection pit to 1.2m. 2) Bored 250mm casing to 8.9m, 200mm casing to 19m, bentonite seal from 7.9-8.9m. 3) Two 50mm wells installed, screen from 10.0-14.3m and 16.0-19.0m.

All dimensions in metres Scale 1:62.5	Contractor: Endeavour Ltd Plant: Dando 3000	Method: Cable Percussion Hole Size: 250/200	Logged By: DH	Approved By: PW

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LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

BOREHOLE LOG

BOREHOLE No. **BH102S**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	23/08/13	77.94maOD	E519624.815 N207951.093

Project: **HATFIELD AERODROME**

Sheet: 1 of 1

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							77.64		0.30	Grass onto: Firm orange brown sandy CLAY.	
							76.24		(1.40) 1.70	Firm orange brown sandy CLAY.	
							75.94		2.00	Soft orange brown gravelly CLAY. Gravel is rounded fine to coarse flint and quartz.	
4.00-4.40	B1						72.74		(3.20) 5.20	Soft orange brown very sandy gravelly CLAY. Gravel is fine to medium with occasional coarse, rounded to subrounded flint and quartz.	
6.00-6.40	B2						71.24		(1.50) 6.70	Orange brown very sandy GRAVEL. Gravel is medium to coarse rounded to subangular flint, chert and quartz.	
							70.94		7.00	Stiff grey slightly gravelly CLAY. Gravel is fine to medium subangular flint and rare chalk.	
										Borehole complete at 7.00m	

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	1) Hand dug inspection pit to 1.2m. 2) Bored 200mm casing to 7M. 3) 50mm well installed, screened from 2.5-6.5m.

All dimensions in metres Scale 1:62.5	Contractor: Endeavour Ltd Plant: Dando 3000	Method: Cable Percussion Hole Size: 200	Logged By: DH	Approved By: PW

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LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

BOREHOLE LOG

BOREHOLE No. **BH102D**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	22/08/13	77.99maOD	E519623.953 N207952.320

Project: **HATFIELD AERODROME**

Sheet: 1 of 2

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							77.69		0.30	Grass onto: Firm orange-brown sandy CLAY.	
							76.29		(1.40) 1.70	Firm orange brown sandy CLAY.	
							75.99		2.00	Soft orange brown gravelly CLAY. Gravel is fine to coarse rounded flint and quartz.	
3.00-3.40	B1								(3.20)	Soft orange brown very sandy gravelly CLAY. Gravel is fine to medium with occasional coarse rounded to subrounded flint and quartz.	
5.00-5.40	B2						72.79		5.20		
							71.29		(1.50) 6.70	Orange brown silty very sandy GRAVEL. Gravel is medium to coarse rounded to subangular flint / chert and quartz.	
									(3.90)	Stiff grey slightly gravelly CLAY. Gravel is fine to medium subangular flint and rare chalk.	

Boring Progress and Water Observations				Casing		Chiselling			Water Added	
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To

General Remarks

1) Hand dug inspection pit to 1.2m.
2) Bored 250mm casing to 7.5m, 200mm casing to 18m, bentonite seal from 6.5-7.5m.
3) Two 50mm wells installed, screened from 11.4-13.4m & 15.0-18.0m.

All dimensions in metres	Contractor: Endeavour Ltd	Method: Cable Percussion	Logged By:	Approved By:
Scale 1:62.5	Plant: Dando 3000	Hole Size: 250/200	DH	PW

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LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

BOREHOLE LOG

BOREHOLE No. **BH102D**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	22/08/13	77.99maOD	E519623.953 N207952.320

Project: **HATFIELD AERODROME**

Sheet: 2 of 2

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							67.39		10.60	Stiff grey slightly gravelly CLAY. Gravel is fine to medium subangular flint and rare chalk. *(continued)*	
							66.99		11.00	Stiff Orange brown slightly sandy CLAY.	
12.00-12.40	B3								(3.10)	Orange brown very sandy GRAVEL. Gravel is medium to coarse rounded to subangular flint / chert and quartz.	
							63.89		14.10		
							59.99		18.00	White grey CHALK. (recovered as very soft gravelly chalk silt. Gravel is angular, fine to coarse flint / chert and chalk).	
										Borehole complete at 18.00m	

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	1) Hand dug inspection pit to 1.2m. 2) Bored 250mm casing to 7.5m, 200mm casing to 18m, bentonite seal from 6.5-7.5m. 3) Two 50mm wells installed, screened from 11.4-13.4m & 15.0-18.0m.

All dimensions in metres Scale 1:62.5	Contractor: Endeavour Ltd Plant: Dando 3000	Method: Cable Percussion Hole Size: 250/200	Logged By: DH	Approved By: PW

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LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

BOREHOLE LOG

BOREHOLE No. **BH103S**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	06/08/13	77.23maOD	E519564.713 N208526.769

Project: **HATFIELD AERODROME**

Sheet: 1 of 1

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							77.13		0.10	Grass onto: Brown gravelly medium to coarse SAND. Gravel is fine to medium, rarely coarse, rounded to very rounded flint.	
							76.43		(0.70) 0.80	Soft brown gravelly CLAY. Gravel is fine to medium angular slightly tabular flint.	
1							75.83		(0.60) 1.40	Soft brown gravelly slightly sandy CLAY. Gravel is fine to medium angular slightly tabular flint and subangular chert and chalk.	
2 2.00-2.00	B1						74.33		(1.50) 2.90	Brown gravelly coarse SAND with rare clay. Gravel is fine to coarse angular to rounded flint and chert	
3							73.83		(0.50) 3.40	Soft brown slightly gravelly CLAY. Gravel is fine to medium subrounded to subangular chert.	
3.40-3.85	U100						72.53		(1.30) 4.70	Firm grey slightly gravelly CLAY. Gravel is fine to medium subangular to subrounded chert and rare chalk.	
4							71.23		(1.30) 6.00	No recovery.	
5							69.73		(1.50) 7.50	Stiff to very stiff grey slightly gravelly CLAY. Gravel is fine to medium subangular to subrounded chert and rare chalk.	
6										Borehole complete at 7.50m	
7											
8											
9											

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	1) Hand dug inspection pit to 1.2m. 2) Bored 200mm casing to 7.5m. 3) 50mm well installed. screened from 3.0-6.0m.

All dimensions in metres Scale 1:62.5	Contractor: Endeavour Ltd Plant: Dando 3000	Method: Cable Percussion Hole Size: 250/200	Logged By: CS	Approved By: PW

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LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

BOREHOLE LOG

BOREHOLE No. **BH103D**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	09/08/13	77.27maOD	E519565.451 N208525.664

Project: **HATFIELD AERODROME**

Sheet: 1 of 2

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							77.17		0.10	Grass onto: Brown gravelly medium to coarse SAND. Gravels are fine to medium, rarely coarse, rounded to very rounded chert.	
							76.47		(0.70) 0.80	Soft brown gravelly CLAY. Gravel is fine to medium angular flint and rare chalk.	
1							75.87		(0.60) 1.40	Soft to firm brown gravelly slightly sandy CLAY. Gravel is fine to medium angular slightly tabular flint and subangular chert and chalk.	
2 2.00-2.00	B1						74.37		(1.50) 2.90	Brown silty very gravelly fine to coarse SAND with rare clay. Gravel is fine to coarse angular to rounded flint and chert. 1.80 ...becoming increasingly gravelly...	
3							73.87		(0.50) 3.40	Soft brown slightly gravelly CLAY. Gravel is fine subrounded to subangular chert.	
4							72.57		(1.30) 4.70	Firm becoming soft grey slightly gravelly CLAY. Gravel is fine to medium subangular to subrounded chert and rare chalk.	
5 5.00-5.00	B2						71.27		(1.30) 6.00	Brown slightly gravelly fine to coarse SAND. Gravel is fine, occasionally medium, angular to subrounded chert.	
6							70.77		(0.50) 6.50	Soft grey slightly gravelly CLAY. Gravel is fine, occasionally medium, subrouded to subangular chert.	
7									(4.20)	Stiff locally very stiff grey slightly gravelly CLAY. Gravel is fine to medium subangular to subrounded chert and chalk.	
8 8.00-8.45	U100										
9											

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	1) Hand dug inspection pit to 1.2m. 2) Bored 250mm casing to 7.0, 200mm casing to 19.5m, bentonite seal from 6.0-7.0m. 3) Two 50mm wells installed. screened from 16.3-19.5m and 11.0-14.7m.

All dimensions in metres	Contractor: Endeavour Ltd	Method: Cable Percussion	Logged By:	Approved By:
Scale 1:62.5	Plant: Dando 3000	Hole Size: 250/200	CS	PW

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LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

BOREHOLE LOG

BOREHOLE No. **BH103D**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	09/08/13	77.27maOD	E519565.451 N208525.664

Project: **HATFIELD AERODROME**

Sheet: 2 of 2

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							66.57		10.70	Stiff locally very stiff grey slightly gravelly CLAY. Gravel is fine to medium subangular to subrounded chert and chalk. *(continued)*	
11							66.27		11.00	Stiff locally very stiff brown slightly gravelly CLAY. Gravel is fine to medium subangular to subrounded chert and chalk	
12.00-12.00	B3						64.27	(2.00)	13.00	Brown and grey slightly sandy GRAVEL. Gravel is fine to coarse angular to rounded mixed lithologies.	
13							63.47	(0.80)	13.80	Brown occasionally grey gravelly coarse SAND. Gravel is fine to medium angular to subrounded quartz and chalk.	
14.00-14.00	B4						61.87	(1.60)	15.40	Brown and grey very sandy GRAVEL. Gravel is fine to coarse angular to rounded chalk and mixed lithologies.	
15							60.47	(1.40)	16.80	White CHALK (recovered as slightly cobbly gravel. Gravel is medium to coarse, occasionally fine, angular to subrounded chalk with occasional black, very angular to angular, medium to coarse flint clasts).	
16.00-16.00	B5						57.77	(2.70)	19.50	White grey CHALK (recovered as slightly silty gravel. Gravel is medium to coarse, occasionally fine, angular to subrounded chalk with rare black angular medium to coarse flint).	
17											
18											
19										Borehole complete at 19.50m	

Boring Progress and Water Observations				Casing		Chiselling			Water Added	
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To

General Remarks

1) Hand dug inspection pit to 1.2m.
2) Bored 250mm casing to 7.0, 200mm casing to 19.5m, bentonite seal from 6.0-7.0m.
3) Two 50mm wells installed. screened from 16.3-19.5m and 11.0-14.7m.

All dimensions in metres	Contractor: Endeavour Ltd	Method: Cable Percussion	Logged By:	Approved By:
Scale 1:62.5	Plant: Dando 3000	Hole Size: 250/200	CS	PW

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LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

BOREHOLE LOG

BOREHOLE No. **BH104S**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	19/08/13	75.05maOD	E519901.770 N208775.531

Project: **HATFIELD AERODROME**

Sheet: 1 of 1

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							74.75		0.30	Grass onto: Firm orange-brown sandy CLAY.	
							74.05		(0.70) 1.00	Firm orange brown gravelly CLAY. Gravel is medium to coarse rounded to subrounded flint.	
1.50-1.70	B1						72.75		(1.30) 2.30	Orange brown very sandy GRAVEL. Gravel is medium to coarse rounded to subrounded flint.	
3.50-3.70	B2						71.15		(1.60) 3.90	Yellow brown gravelly fine to coarse SAND. Gravel is medium to coarse round to subrounded flint.	
							70.55		(0.60) 4.50	Stiff grey slightly gravelly CLAY. Gravel is fine to medium subangular flint and rare chalk.	
										Borehole complete at 4.50m	

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	1) Hand dug inspection pit to 1.2m. 2) Bored 200mm to 4.5m. 3) 50mm well installed, screened from 1.4-3.9m.

All dimensions in metres Scale 1:62.5	Contractor: Endeavour Ltd Plant: Dando 3000	Method: Cable Percussion Hole Size: 200	Logged By: DH	Approved By: PW

SLR Consulting Ltd, 8 Stow Court, Stow-Cum-Quy, Cambridge, CB25 9AS, , Tel: 01223 813805, Fax: 01223 813783

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

BOREHOLE LOG

BOREHOLE No. **BH104D**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	14/08/13	75.06maOD	E519902.757 N208776.232

Project: **HATFIELD AERODROME**

Sheet: 1 of 2

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							74.76		0.30	Grass onto: Very stiff slightly sandy CLAY.	
							74.06		(0.70) 1.00	Firm to stiff grey and grey brown gravelly CLAY. Gravel is angular to subangular, medium to coarse flint and rare chert.	
2.00-2.00	B1						72.76		(1.30) 2.30	Brown and grey sandy GRAVEL with rare cobbles. Gravel is fine, occasionally medium, rarely coarse, angular to rounded flint and mixed lithologies. Cobbles are subangular to rounded mixed lithologies.	
							71.16		(1.60) 3.90	Brown occasionally orange-brown gravelly coarse SAND. Gravel are fine to medium angular to rounded mixed lithologies.	
							68.46		(2.70) 6.60	Stiff to very stiff grey slightly gravelly CLAY. Gravel is fine to medium, rarely coarse, subangular to rounded chert and chalk.	
7.00-7.45	U100						67.66		(0.80) 7.40	Stiff to very stiff brown slightly gravelly CLAY. Gravel is fine to medium, rarely coarse, subangular to rounded chert and chalk.	
8.00-8.00	B2									Brown and grey slightly to very sandy GRAVEL. Gravel is fine to coarse angular to rounded mixed lithologies.	

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	1) Hand dug inspection pit to 1.2m. 2) Bored 250mm casing to 7.0, 200mm casing to 18.5m, bentonite seal from 6.0-7.0m. 3) Two 50mm wells installed. screened from 14.5-18.5m and 8.5-13.5m.

All dimensions in metres	Contractor: Endeavour Ltd	Method: Cable Percussion	Logged By:	Approved By:
Scale 1:62.5	Plant: Dando 3000	Hole Size: 250/200	CS	PW

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LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

BOREHOLE LOG

BOREHOLE No. **BH104D**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	14/08/13	75.06maOD	E519902.757 N208776.232

Project: **HATFIELD AERODROME**

Sheet: 2 of 2

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
10.00-10.00	B3									Brown and grey slightly to very sandy GRAVEL. Gravel is fine to coarse angular to rounded mixed lithologies. *(continued)*	
12.00-12.00	B4						58.66		(9.00) 16.40		
							56.46		(2.20) 18.60	White CHALK (recovered as cobbly gravels in a chalk silt matrix. Gravel is rounded to subround chalk and angular flint. Cobbles ae rounded to subrounded chalk)	
										Borehole complete at 18.60m	

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	1) Hand dug inspection pit to 1.2m. 2) Bored 250mm casing to 7.0, 200mm casing to 18.5m, bentonite seal from 6.0-7.0m. 3) Two 50mm wells installed. screened from 14.5-18.5m and 8.5-13.5m.

All dimensions in metres Scale 1:62.5	Contractor: Endeavour Ltd Plant: Dando 3000	Method: Cable Percussion Hole Size: 250/200	Logged By: CS	Approved By: PW

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LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

BOREHOLE LOG

BOREHOLE No. **BH105S**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	14/08/13	79.87maOD	E520387.082 N209021.113

Project: **HATFIELD AERODROME**

Sheet: 1 of 2

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							78.87		(1.00) 1.00	MADE GROUND - Very stiff brown slightly gravelly CLAY. Gravel is medium to coarse angular flint and chert.	
							78.77		1.10	MADE GROUND - Red COBBLES. Cobbles are angular brick.	
									(2.50) 3.60	Soft to stiff brown slightly gravelly CLAY. Gravel is medium to coarse angular flint and chert.	
							76.27		(1.10) 4.70	Soft to stiff brown slightly gravelly CLAY. Gravel is medium to coarse subangular chert and chalk.	
4.70-5.00	B1	0					75.17		5.10	Very soft brown to orange brown mottled grey very sandy CLAY.	
6.00-6.00	B2	0					74.77		(5.40)	Brown to orange brown slightly slity/clayey slightly gravelly fine to coarse SAND. Gravel is fine to medium subangular to subrounded flint and chalk.	
8.00-8.00	B3	0									

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	1) Hand dug inspection pit to 1.2m. 2) Bored 200mm casing to 11m. 3) 50mm well installed. screened from 4.5-10.5m.

All dimensions in metres	Contractor: Endeavour Ltd	Method: Cable Percussion	Logged By:	Approved By:
Scale 1:62.5	Plant: Dando 3000	Hole Size: 250/200	CS	PW

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LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

BOREHOLE LOG

BOREHOLE No. **BH105S**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	14/08/13	79.87maOD	E520387.082 N209021.113

Project: **HATFIELD AERODROME**

Sheet: 2 of 2

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							69.37		10.50	Brown to orange brown slightly slity/clayey slightly gravelly fine to coarse SAND. Gravel is fine to medium subangular to subrounded flint and chalk. *(continued)*	
							68.87		(0.50) 11.00	Firm to stiff grey CLAY.	
										Borehole complete at 11.00m	

11 12 13 14 15 16 17 18 19

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	1) Hand dug inspection pit to 1.2m. 2) Bored 200mm casing to 11m. 3) 50mm well installed. screened from 4.5-10.5m.

All dimensions in metres Scale 1:62.5	Contractor: Endeavour Ltd Plant: Dando 3000	Method: Cable Percussion Hole Size: 250/200	Logged By: CS	Approved By: PW

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LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

BOREHOLE LOG

BOREHOLE No. **BH105SX**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	20/05/14	80.04maOD	E520385 N209021

Project: **HATFIELD AERODROME**

Sheet: 1 of 2

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							79.94		0.10	Grass onto TOPSOIL (Brown sandy CLAY containing rootlets occasional coarse flinty gravel).	
									(1.10)	Soft orange brown slightly sandy slightly gravelly CLAY. Gravel is fine with rare coarse chert.	
1							78.84		1.20		
									(1.60)	Soft to firm orange brown and grey mottled slightly gravelly CLAY. Gravel comprises medium subangular flint.	
2							77.24		2.80		
									(1.90)	Stiff to very stiff light brown sandy gravelly CLAY. Gravel is fine chalk and fine to coarse subangular to subrounded flint, quartz and chert.	
3							75.34		4.70		
4							75.24		4.80	Orange to pale yellow slightly clayey fine SAND.	
									(5.70)	Orange to pale yellow brown gravelly fine to medium becoming coarse SAND. Gravel is fine to coarse subangular to rounded flint.	
5											
6											
7											
8											
9											

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	1) Hand dug inspection pit to 1.20m. 2) 50mm well installed, screened 4.5-10.5m.

All dimensions in metres Scale 1:62.5	Contractor: SLR Consulting Plant: Dando	Method: Cable Percussion Hole Size: 200mm	Logged By: DH	Approved By: PW

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LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

BOREHOLE LOG

BOREHOLE No. **BH105SX**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	20/05/14	80.04maOD	E520385 N209021

Project: **HATFIELD AERODROME**

Sheet: 2 of 2

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							69.54		10.50	Orange to pale yellow brown gravelly fine to medium becoming coarse SAND. Gravel is fine to coarse subangular to rounded flint. *(continued)*	
							68.94		(0.60) 11.10	Firm grey brown slightly sandy CLAY with flecks of chalk and fine to medium flint gravel.	
										Borehole complete at 11.10m	

11 12 13 14 15 16 17 18 19

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	1) Hand dug inspection pit to 1.20m. 2) 50mm well installed, screened 4.5-10.5m.

All dimensions in metres Scale 1:62.5	Contractor: SLR Consulting Plant: Dando	Method: Cable Percussion Hole Size: 200mm	Logged By: DH	Approved By: PW

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LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

BOREHOLE LOG

BOREHOLE No. **BH105D**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	13/08/13	79.86maOD	E520386.899 N209022.845

Project: **HATFIELD AERODROME**

Sheet: 1 of 3

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							78.86		(1.00) 1.00	MADE GROUND - Very stiff brown slightly sandy slightly gravelly CLAY. Gravel is medium to coarse angular flint and subangular chert.	
							78.85		1.01	MADE GROUND - Black plastic membrane.	
							78.66		1.20	MADE GROUND - Red COBBLES. Cobbles are angular brick.	
									(2.40)	Soft to stiff brown slightly gravelly CLAY. Gravel is medium to coarse angular flint and chert.	
							76.26		3.60		
							75.16		(1.10) 4.70	Soft to stiff brown slightly gravelly CLAY. Gravel is medium to coarse subangular chert.	
4.70-5.00	B1						74.76		5.10	Brown to orange brown slightly clayey slightly gravelly coarse SAND. Gravel is fine occasionally medium, subangular to subrounded flint.	
									(5.40)	Brown slightly silty to very silty/clayey gravelly fine to coarse SAND. Gravel is fine to medium angular to subrounded flint and chalk.	
6.50-7.00	B2										
8.50-9.00	B3										

Boring Progress and Water Observations				Casing		Chiselling			Water Added	
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To

General Remarks

1) Hand dug inspection pit to 1.2m.
2) Bored 250mm casing to 11.5, 200mm casing to 21m, bentonite seal from 10.5-11.5m.
3) Two 50mm wells installed. screened from 17.7-21.0m and 13.7-16.3m.

All dimensions in metres	Contractor: Endeavour Ltd	Method: Cable Percussion	Logged By:	Approved By:
Scale 1:62.5	Plant: Dando 3000	Hole Size: 250/200	CS	PW

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LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

BOREHOLE LOG

BOREHOLE No. **BH105D**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	13/08/13	79.86maOD	E520386.899 N209022.845

Project: **HATFIELD AERODROME**

Sheet: 2 of 3

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							69.36		10.50	Brown slightly silty to very silty/clayey gravelly fine to coarse SAND. Gravel is fine to medium angular to subrounded flint and chalk. *(continued)*	
							68.36		(1.00) 11.50	Stiff grey slightly gravelly CLAY. Gravel is fine to coarse angular to subrounded chalk and rare flint.	
12.00-12.45	U100						66.26		(2.10) 13.60	Stiff brown sandy slightly gravelly CLAY. Gravel is medium to coarse angular flint.	
							65.36		(0.90) 14.50	Brown and grey slightly sandy GRAVEL. Gravel is fine to coarse angular to rounded mixed lithologies.	
							64.86		(0.50) 15.00	Stiff brown CLAY.	
15.50-16.00	B4						63.46		(1.40) 16.40	Brown and grey slightly sandy GRAVEL. Gravel is fine to coarse angular to rounded mixed lithologies.	
							61.86		(1.60) 18.00	White CHALK (recovered as slightly cobbly gravel. Gravel is coarse to medium subangular to subrounded chalk with rare black angular medium to coarse flint. Cobbles are subangular to subrounded chalk).	
									(3.00)	White CHALK (recovered as silty gravel. Gravel is medium to coarse subangular to subrounded chalk with rare black angular medium to coarse flint).	

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	1) Hand dug inspection pit to 1.2m. 2) Bored 250mm casing to 11.5, 200mm casing to 21m, bentonite seal from 10.5-11.5m. 3) Two 50mm wells installed. screened from 17.7-21.0m and 13.7-16.3m.

All dimensions in metres Scale 1:62.5	Contractor: Endeavour Ltd Plant: Dando 3000	Method: Cable Percussion Hole Size: 250/200	Logged By: CS	Approved By: PW

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LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

BOREHOLE LOG

BOREHOLE No. **BH105D**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	13/08/13	79.86maOD	E520386.899 N209022.845

Project: **HATFIELD AERODROME**

Sheet: 3 of 3

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							58.86		21.00	White CHALK (recovered as silty gravel. Gravel is medium to coarse subangular to subrounded chalk with rare black angular medium to coarse flint). *(continued)*	
										Borehole complete at 21.00m	

21 22 23 24 25 26 27 28 29

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	1) Hand dug inspection pit to 1.2m. 2) Bored 250mm casing to 11.5, 200mm casing to 21m, bentonite seal from 10.5-11.5m. 3) Two 50mm wells installed. screened from 17.7-21.0m and 13.7-16.3m.

All dimensions in metres Scale 1:62.5	Contractor: Endeavour Ltd Plant: Dando 3000	Method: Cable Percussion Hole Size: 250/200	Logged By: CS	Approved By: PW

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LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

BOREHOLE LOG

BOREHOLE No. **BH106S**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	08/08/13	73.82maOD	E520409.017 N208180.311

Project: **HATFIELD AERODROME**

Sheet: 1 of 1

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							73.52		0.30	Grass onto: Firm orange brown sandy CLAY.	
							72.92		(0.60) 0.90	Brown slightly sandy CLAY.	
1.30-1.50	B1						71.32		(1.60) 2.50	Orange brown sandy GRAVEL. Gravel is fine to coarse rounded to subangular flint.	
3.30-3.50	B2						68.62		(2.70) 5.20	Yellow brown gravelly fine to coarse SAND. Gravel is fine to coarse rounded to subrounded flint.	
							68.32		5.50	Stiff grey slightly gravelly CLAY. Gravel is fine to medium subangular flint and rare chalk.	
										Borehole complete at 5.50m	

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	1) Hand dug inspection pit to 1.2m. 2) Bored 200mm to 5.5m. 3) 50mm well installed, creened from 2.3-5.3m.

All dimensions in metres Scale 1:62.5	Contractor: Endeavour Ltd Plant: Dando 3000	Method: Cable Percussion Hole Size: 200	Logged By: DH	Approved By: PW

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LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

BOREHOLE LOG

BOREHOLE No. **BH106D**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	07/08/13	73.82maOD	E520409.292 N208178.906

Project: **HATFIELD AERODROME**

Sheet: 1 of 2

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							73.52		0.30	Grass onto: Firm orange brown sandy CLAY.	
							72.92		(0.60) 0.90	Brown slightly sandy CLAY.	
0.90-1.20	B1								(1.60)	Orange brown very sandy GRAVEL. Gravel is medium to coarse rounded to subangular flint.	
							71.32		2.50		
2.50-2.70	B2								(2.70)	Yellow brown gravelly coarse SAND. Gravel is medium to coarse rounded to subround flint.	
4.50-4.70	B3						68.62		5.20		
6.00-6.50	U100								(3.30)	Stiff grey slightly gravelly CLAY. Gravel is fine to medium subangular flint and rare chalk.	
							65.32		8.50		
8.60-8.90	B4								(2.10)	Orange brown sandy GRAVEL. Gravel is medium to coarse rounded to subrounded flint.	

Boring Progress and Water Observations				Casing		Chiselling			Water Added	
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To

General Remarks

1) Hand dug inspection pit to 1.2m.
2) Bored 250mm casing to 7.5m, 200mm casing to 19m, bentonite seal from 6.5-7.5m.
3) Two 50mm wells installed, screened from 9.0-12.0m & 15.0-19.0m.

All dimensions in metres	Contractor: Endeavour Ltd	Method: Cable Percussion	Logged By:	Approved By:
Scale 1:62.5	Plant: Dando 3000	Hole Size: 250/200	DH	PW

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LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

BOREHOLE LOG

BOREHOLE No. **BH106D**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	07/08/13	73.82maOD	E520409.292 N208178.906

Project: **HATFIELD AERODROME**

Sheet: 2 of 2

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							63.22		10.60	Orange brown sandy GRAVEL. Gravel is medium to coarse rounded to subrounded flint. *(continued)*	
							62.72	(0.50)	11.10	Soft yellow brown slightly gravelly CLAY. Gravel is fine rounded to subrounded flint and rare chalk.	
11.10-11.30	B5						62.22	(0.50)	11.60	Orange brown sandy GRAVEL. Gravel is fine to coarse rounded to subrounded flint.	
							61.92		11.90	Soft yellow brown sandy CLAY.	
							60.32	(1.60)	13.50	Orange brown slightly to very sandy fne to coarse GRAVEL. Gravel is rounded to subrounded flint.	
13.10-13.30	B6						58.82	(1.50)	15.00	White CHALK. (recovered silty gravel and cobbles. Gravel is angular medium flint and chalk. Cobbles are angular chalk).	
							54.82	(4.00)	19.00	White CHALK (recovered soft chalk silt)	
										Borehole complete at 19.00m	

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	1) Hand dug inspection pit to 1.2m. 2) Bored 250mm casing to 7.5m, 200mm casing to 19m, bentonite seal from 6.5-7.5m. 3) Two 50mm wells installed, screened from 9.0-12.0m & 15.0-19.0m.

All dimensions in metres Scale 1:62.5	Contractor: Endeavour Ltd Plant: Dando 3000	Method: Cable Percussion Hole Size: 250/200	Logged By: DH	Approved By: PW

SLR Consulting Ltd, 8 Stow Court, Stow-Cum-Quy, Cambridge, CB25 9AS, , Tel: 01223 813805, Fax: 01223 813783

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

BOREHOLE LOG

BOREHOLE No. **BH108S**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	08/05/14	79.71maOD	E520303 N208927

Project: **HATFIELD AERODROME**

Sheet: 1 of 2

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							79.31		0.40	Grass onto TOPSOIL (Brown clayey SAND containing rootlets).	
									(4.30)	Stiff orange grey brown mottled sandy slightly gravelly CLAY. Gravel comprises fine to medium rounded to subrounded flint.	
							75.01		4.70		
4.70-5.70	B1	<5							(5.80)	Orange to pale yellow slightly gravelly fine to medium grading into coarse SAND. Gravel comprises rounded to subrounded flint and occasional quartz with occasional pockets of clay at 10.1m.	
5.70-6.70	B2	<5									
6.70-7.70	B3	<5									
7.70-8.70	B4	<5									
8.70-9.70	B5	<5									
9.70-10.50	B6	<5									

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	1) Hand dug inspection pit to 1.20m. 2) 50mm well installed, screened 4.5 to 10.5m.

All dimensions in metres Scale 1:62.5	Contractor: SLR Consulting Plant: Dando	Method: Cable Percussion Hole Size: 200mm	Logged By: DH	Approved By: PW

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LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

BOREHOLE LOG

BOREHOLE No. **BH108S**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	08/05/14	79.71maOD	E520303 N208927

Project: **HATFIELD AERODROME**

Sheet: 2 of 2

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							69.21		10.50		
							68.71		(0.50) 11.00	Very stiff grey brown sandy gravelly CLAY. Gravel is fine rounded to subrounded flint and flecks of chalk.	
										Borehole complete at 11.00m	

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	1) Hand dug inspection pit to 1.20m. 2) 50mm well installed, screened 4.5 to 10.5m.

All dimensions in metres	Contractor: SLR Consulting	Method: Cable Percussion	Logged By:	Approved By:
Scale 1:62.5	Plant: Dando	Hole Size: 200mm	DH	PW

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LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

BOREHOLE LOG

BOREHOLE No. **BH108D**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	19/05/14	79.71maOD	E520303 N208926

Project: **HATFIELD AERODROME**

Sheet: 1 of 3

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							79.31		0.40	Turf onto TOPSOIL (Brown sandy CLAY containing rootlets).	
									(4.30)	Soft to firm becoming stiff to very stiff orange brown and grey mottled slightly sandy slightly gravelly CLAY. Gravel is fine to medium rounded to subrounded flint with occasional coarse subrounded gravel.	
							75.01		4.70		
4.70-5.70	B1	<5							(5.90)	Orange yellow brown slightly gravelly fine to medium SAND. Gravel is fine to coarse rounded to subrounded flint and quartz, becoming more gravelly at 6.5m with clay pockets near base.	
5.70-6.70	B2	<5									
6.70-7.70	B3	<5									
7.70-8.70	B4	<5									
8.70-9.70	B5	<5									
9.70-10.50	B6	<5									

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	1) Hand dug inspection pit to 1.20m. 2) Bored 250mm to 11.9m and 200mm to base. 3) 50mm wells installed, screened 14.0-15.5m and 18.5-21.5m.

All dimensions in metres	Contractor: SLR Consulting	Method: Cable Percussion	Logged By:	Approved By:
Scale 1:62.5	Plant: Dando	Hole Size: 250/200mm	DH	PW

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LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

BOREHOLE LOG

BOREHOLE No. **BH108D**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	19/05/14	79.71maOD	E520303 N208926

Project: **HATFIELD AERODROME**

Sheet: 2 of 3

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							69.11		10.60	Orange yellow brown slightly gravelly fine to medium SAND. Gravel is fine to coarse rounded to subrounded flint and quartz, becoming more gravelly at 6.5m with clay pockets near base. *(continued)*	
							68.51	(0.60)	11.20	Very stiff grey brown sandy gravelly CLAY. Gravel is fine rounded to subrounded flint and flecks of chalk.	
							65.91	(2.60)	13.80	Stiff to very stiff brown sandy gravelly CLAY. Gravel is fine to medium rounded to subrounded flint, quartz and scattered fine chalk. With occasional rounded to subrounded flint cobbles.	
14.00-15.00	B7	<5					65.71		14.00	Firm to stiff becoming soft brown sandy gravelly CLAY with frequent coarse subangular to subrounded gravel and flint, chert and quartz cobbles.	
							65.01	(0.70)	14.70	Brown slightly sandy GRAVEL becoming clayey at base. Gravel is fine to coarse angular to rounded flint and chert with occasional rounded flint cobbles.	
15.00-16.00	B8	<5					64.61		15.10	Brown gravelly medium to coarse SAND. Gravel is fine to coarse subangular to rounded flint, chert and quartz.	
16.00-16.50	B9	<5					63.21	(1.40)	16.50	Brown slightly sandy GRAVEL. Gravel is fine to coarse angular to rounded flint, chert and quartz with occasional rounded to subrounded flint cobbles.	
							63.11		16.60	Gey white gravelly chalky CLAY. Gravel is coarse chalk and flint.	
							61.71	(1.40)	18.00	Grey white CHALK (Recovered as coarse gravel to cobble sized fragments of chalk with rare flint cobbles).	
							61.31		18.40	Flint GRAVEL and COBBLES	
										White CHALK. (Recovered as coarse gravel to cobble sized fragments of chalk).	

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	1) Hand dug inspection pit to 1.20m. 2) Bored 250mm to 11.9m and 200mm to base. 3) 50mm wells installed, screened 14.0-15.5m and 18.5-21.5m.

All dimensions in metres Scale 1:62.5	Contractor: SLR Consulting Plant: Dando	Method: Cable Percussion Hole Size: 250/200mm	Logged By: DH	Approved By: PW

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LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

BOREHOLE LOG

BOREHOLE No. **BH108D**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	19/05/14	79.71maOD	E520303 N208926

Project: **HATFIELD AERODROME**

Sheet: 3 of 3

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
									(3.10)	White CHALK. (Recovered as coarse gravel to cobble sized fragments of chalk). *(continued)*	
21							58.21		21.50		
										Borehole complete at 21.50m	
22											
23											
24											
25											
26											
27											
28											
29											

Boring Progress and Water Observations				Casing		Chiselling			Water Added	
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To

General Remarks

1) Hand dug inspection pit to 1.20m.
2) Bored 250mm to 11.9m and 200mm to base.
3) 50mm wells installed, screened 14.0-15.5m and 18.5-21.5m.

All dimensions in metres	Contractor: SLR Consulting	Method: Cable Percussion	Logged By:	Approved By:
Scale 1:62.5	Plant: Dando	Hole Size: 250/200mm	DH	PW

SLR Consulting Ltd, 8 Stow Court, Stow-Cum-Quy, Cambridge, CB25 9AS, , Tel: 01223 813805, Fax: 01223 813783

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

Project Name:	Hatfield Greenbelt	Stanger
Project No: 04507-01-01	Client: Arlington Property Developments Limited	Science and Environment

Co-ordinates (National):	Ground level (m AOD):	Method:		Record of Borehole No:
E 520,133.0 N 208,725.0	76.41	Shell and Auger Rig		BHA ~~BH G~~
Date:	**Depth of Hole:**	**Hole dia. (mm):**	**Casing dia. (mm):**	**Sheet:**
29/01/2001	8	150	150	1 of 2

Sample & Tests				Strata		Description of Strata	Legend	Geology	Water	Piezo Backfill
Depth (m)	No.	Type	SPT CPT N' Value	Depth (Thick.) (m)	Reduced Level (m)					
0.20		D		0.4	76.01	MADE GROUND: Brown and orange brown CLAY with fragments of brick and flint gravel				
0.40		D		0.7	75.71	Firm orange brown and blue-grey CLAY with a little flint gravel				
0.70		D		1.1	75.31	Soft black and grey very silty sandy CLAY				
1.10		D		(1.30)		Firm orange brown silty CLAY				
2.00		D		2.4	74.01					
2.40		D		2.7	73.71	Orange brown clayey SAND and fine to coarse flint GRAVEL				
2.70		B		(1.50)		Orange brown SAND and GRAVEL		Upper Glacial Deposits		
4.20		D		4.2	72.21	Green grey and orange brown SAND with a little fine flint gravel				
5.20		D		(1.90)						
6.10		D		6.1	70.31	Orange and yellow brown SAND				
7.00		D		(1.00)						
7.10		D		7.1	69.31	Stiff grey silty CLAY with a little fine flint gravel		Anglian Till		
				(0.90)						
				8	68.41					

Boring Progress & Water Obs.

Date/Time	Depth	Casing	Water	Rose	Sealed

Remarks

Groundwater encountered at 2.4m. Water added from 2.5m to 4.5m

For abbreviations & symbols see keysheet.

Scale	Logged in accordance with BS5930	Processed by:	Logged by:
1:50 All dimension in metres	Stanlog	E.Rogerson	L.A.Bond

Project Name:	Hatfield Greenbelt	Stanger Science and Environment
Project No: 04507-01-01	Client: Arlington Property Developments Limited	

Co-ordinates (National):	Ground level (m AOD):	Method:			Record of Borehole No:
E 520,133.0 N 208,725.0	76.41	Shell and Auger Rig			BHA ~~BH G~~
Date:	**Depth of Hole:**	**Hole dia. (mm):**	**Casing dia. (mm):**	**Sheet:**	
29/01/2001	8	150	150	2 of 2	

Sample & Tests				Strata		Description of Strata	Legend	Geology	Water	Piezo Backfill
Depth (m)	No.	Type	SPT CPT 'N' Value	Depth (Thick.) (m)	Reduced Level (m)					
7.90		D								

Boring Progress & Water Obs.					
Date/Time	Depth	Casing	Water	Rose	Sealed

Remarks

Groundwater encountered at 2.4m. Water added from 2.5m to 4.5m

For abbreviations & symbols see keysheet.

Scale	Logged in accordance with BS5930	Processed by:	Logged by:
1:50 All dimension in metres	Stanlog	E.Rogerson	L.A.Bond

BAE SYSTEMS

BAE Systems Environmental

Site	Borehole Number
Hatfield Green BHB L	~~BH15~~

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150 mm to m	77.70	Arlington Business Parks Partnership	A814/00
	Location	**Dates**	**Engineer**	**Sheet**
	520561 E 208637. N	05/03/2008-06/03/2008	Adam Williams	1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
						(0.60)	MADE GROUND: Sandy topsoil with coarse angular gravel of brick			
0.60	B				77.10	0.60	Firm to moderately stiff brown sandy CLAY with fine to coarse angular to subangular gravel of flint (Upper Glacial Deposit)			
						(0.90)				
1.50	B				76.20	1.50	Orange brown fine to coarse SAND with some to occasional fine to coarse angular to subangular gravel of flint and quartz (Upper Glacial Deposit)			
3.50	B								▼1	
5.50	B			Water strike(1) at 5.50m, rose to 4.80m in 20 mins.		(7.80)			▽1	
									▼2	
7.50	B									
9.50	B				68.40	9.30	Soft to moderately firm blue grey sandy CLAY with some to occasional fine rounded gravel of chalk (Anglian Till)			

Remarks

Scale (approx)	Logged By
1:50	AW

Figure No. A814/00.BH15

BAE SYSTEMS

BAE Systems Environmental

Site	Borehole Number
Hatfield Green BHB L	~~BH15~~

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150 mm to m	77.70	Arlington Business Parks Partnership	A814/00
	Location	**Dates**	**Engineer**	**Sheet**
	520561 E 208637. N	05/03/2008-06/03/2008	Adam Williams	2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
						(3.70)				
11.50	B									
13.00	B				64.70	13.00	Orange brown sandy fine to coarse subangular to rounded GRAVEL of mixed lithology (Proto-Thames Gravels)			
						(3.00)				
15.00	B			Water strike(2) at 15.00m, rose to 6.00m in 20 mins.					▽2	
16.00	B				61.70	16.00	Soft to moderately firm greyi brown sandy CLAY with much fine gravel of mixed lithology (Proto-Thames Gravels)		▼3	
						(0.50)				
16.50	B				61.20	16.50	Orange brown fine to coarse SAND with much fine to coarse angular to rounded gravel of mixed lithology (Proto-Thames Gravels)			
						(3.10)				
18.50	B									
19.60	B				58.10	19.60	Highly weatherd CHALK recovered as sandy clayey fine to coarse gravel (Middle Chalk Formation)			
					57.70	(0.40) 20.00				

Remarks

Scale (approx)	Logged By
1:50	AW

Figure No. A814/00.BH15

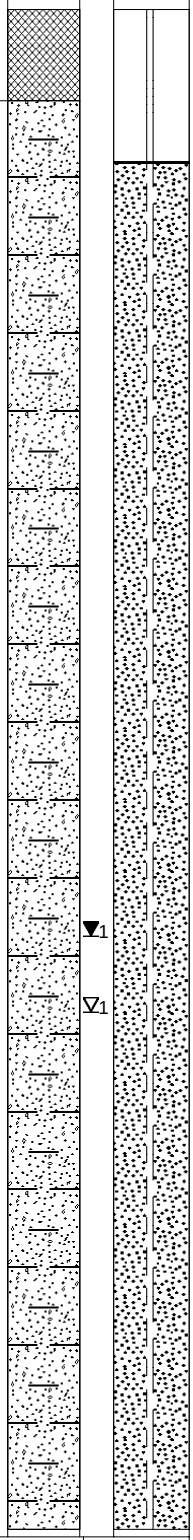
BAE SYSTEMS

BAE Systems Environmental

Site	Borehole Number
Hatfield Green BHC U	~~BH14~~

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150 mm to m	77.92	Arlington Business Parks Partnership	A814/00
	Location 520529 E 208617 N	**Dates** 06/03/2008	**Engineer** Adam Williams	**Sheet** 1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
						(0.60)	MADE GROUND: Sandy topsoil with coarse angular gravel of brick			
0.60	B				77.32	0.60	Orange brown slightly clayey SAND with very occasional angular to rounded gravel of flint and quartz (Upper Glacial Deposit)			
2.50	B									
4.50	B									
6.50	B			Water strike(1) at 6.50m, rose to 6.00m in 20 mins.					▼1 ▽1	
8.50	B									



Remarks

Scale (approx)	Logged By
1:50	AW

Figure No. A814/00.BH14

BAE SYSTEMS

BAE Systems Environmental

Site	Borehole Number
Hatfield Green BHC U	~~BH14~~

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150 mm to m	77.92	Arlington Business Parks Partnership	A814/00
	Location 520529 E 208617 N	**Dates** 06/03/2008	**Engineer** Adam Williams	**Sheet** 2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
						(9.90)				
10.50	B				67.42	10.50	Moderatley firm grey blue CLAY with some fine rounded gravel of chalk (Anglian Till)			
						(0.50)				
					66.92	11.00	Complete at 11.00m			

Remarks

Scale (approx)	Logged By
1:50	AW

Figure No. A814/00.BH14

BAE SYSTEMS

BAE Systems Environmental

Site	Borehole Number
Hatfield Green BHD U	~~BH13~~

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150 mm to m	78.59	Arlington Business Parks Partnership	A814/00
	Location 520394 E 208765 N	**Dates** 10/03/2008	**Engineer** Adam Williams	**Sheet** 1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
					78.39	0.20	TOPSOIL			
						(1.30)	Soft to firm orange brown sandy CLAY (Upper Glacial Deposit)			
1.50	B				77.09	1.50	Firm brown sandy CLAY with some to occasional fine to coarse angular to subangular gravel of flint and quartz (Upper Glacial Deposit)			
3.50	B					(3.80)				
5.30	B				73.29	5.30	Yellow brown fine to coarse SAND (Upper Glacial Deposit)		▼1	
7.30	B			Water strike(1) at 7.00m, rose to 6.30m in 20 mins.		(4.30)			▽1	
9.30	B									
9.60	B				68.99	9.60	Firm blue sandy CLAY (Anglian Till)			
					68.59	(0.40) 10.00				

Remarks

Scale (approx)	Logged By
1:50	AW

Figure No. A814/00.BH13

BAE SYSTEMS

BAE Systems Environmental

Site	Borehole Number
Hatfield Green BHE U	~~BH16~~

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion		75.40	Arlington Business Parks Partnership	A814/00
	Location 520394 E 208419. N	**Dates** 05/03/2008-06/03/2008	**Engineer** Adam Williams	**Sheet** 1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
						(0.50)	MADE GROUND: Sandy topsoil with coarse angular gravel of brick			
					74.90	0.50	Firm to moderately stiff brown sandy CLAY with fine to coarse angular to subangular gravel of flint (Upper Glacial Deposit)			
						(1.00)				
					73.90	1.50	Soft brown clayey very sandy fine to coarse angular to subrounded GRAVEL of flint and quartz (Upper Glacial Deposit)			
						(0.50)				
2.00	B				73.40	2.00	Orange brown fine to coarse SAND with very occasional fine angular to rounded gravel of flint. Gravel content increases with depth (Upper Glacial Deposit)			
2.50	B									
									▼1	
4.50	B			Water strike(1) at 4.50m, rose to 4.00m in 20 mins.		(5.00)			▽1	
6.50	B									
7.00	B				68.40	7.00	Firm blue grey sandy CLAY with some to occasional fine subangular gravel of chalk (Anglian Till)			
						(1.00)				
					67.40	8.00				
							Complete at 8.00m			

Remarks

Scale (approx)	Logged By
1:50	AW

Figure No. A814/00.BH16

Project Name:	Hatfield Greenbelt	Stanger Science and Environment
Project No: 04507-01-01	Client: Arlington Property Developments Limited	

Co-ordinates (National):	Ground level (m AOD):	Method:		Record of Borehole No:
E 520,276.0 N 208,648.0	76.78	Shell and Auger Rig		BHJ ~~BH A~~
Date:	**Depth of Hole:**	**Hole dia. (mm):**	**Casing dia. (mm):**	**Sheet:**
23/01/2001	10.5	150	150	1 of 2

Sample & Tests				Strata		Description of Strata	Legend	Geology	Water	Piezo Backfill
Depth (m)	No.	Type	SPT CPT 'N' Value	Depth (Thick.) (m)	Reduced Level (m)					
0.20		B		(0.70) 0.7	76.08	MADE GROUND: Brown and dark brown sandy clay with brick and concrete fragments				
0.70		D		(0.90) 1.6	75.18	Firm brown and grey mottled silty CLAY				
1.60		D		(2.00) 3.6	73.18	Firm to stiff orange brown very sandy CLAY with a little fine flint gravel				
2.60		D								
3.60		D		(4.60)		Orange brown SAND with a little to some fine to medium flint gravel		Upper Glacial Deposits		
4.50		D								
5.50		D								
6.50		D								
7.50		D								

Boring Progress & Water Obs.

Date/Time	Depth	Casing	Water	Rose	Sealed

Remarks

No Groundwater Encountered. water added friom 5.0m to 7.5m

For abbreviations & symbols see keysheet.

Scale	Logged in accordance with BS5930	Processed by:	Logged by:
1:50 All dimension in metres	Stanlog	E.Rogerson	L.A.Bond

Project Name:	Hatfield Greenbelt	Stanger
Project No: 04507-01-01	Client: Arlington Property Developments Limited	Science and Environment

Co-ordinates (National):	Ground level (m AOD):	Method:		Record of Borehole No:
E 520,276.0 N 208,648.0	76.78	Shell and Auger Rig		BHJ ~~BH A~~
Date:	**Depth of Hole:**	**Hole dia. (mm):**	**Casing dia. (mm):**	**Sheet:**
23/01/2001	10.5	150	150	2 of 2

Sample & Tests				Strata						
Depth (m)	No.	Type	SPT CPT 'N' Value	Depth (Thick.) (m)	Reduced Level (m)	Description of Strata	Legend	Geology	Water	Piezo Backfill
				8.2	68.58					
8.20		D		(1.30)		Firm grey silty CLAY		Anglian Till		
9.20		D		9.5	67.28					
9.50		D		(1.00)		Firm to stiff brown grey silty CLAY with a little to some fine to coarse flint gravel				
10.50		D		10.5	66.28					

Boring Progress & Water Obs.

Date/Time	Depth	Casing	Water	Rose	Sealed

Remarks

No Groundwater Encountered. water added friom 5.0m to 7.5m

For abbreviations & symbols see keysheet.

Scale	Logged in accordance with BS5930	Processed by:	Logged by:
1:50 All dimension in metres	Stanlog	E.Rogerson	L.A.Bond

BOREHOLE LOG

BOREHOLE No.
BH201

Client:
BRETT AGGREGATES LTD

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	14/05/14	79.00maOD	E520233 N208856

Project:
HATFIELD AERODROME

Sheet:
1 of 2

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							78.50		(0.50) 0.50	Grass onto TOPSOIL (Brown sandy CLAY containing rootlets).	
							74.70		(3.80) 4.30	Firm to stiff orange grey slightly sandy slightly gravelly CLAY. Gravel is fine flint with rare coarse fragments.	
							73.50		(1.20) 5.50	Stiff to very stiff brown grey gravelly CLAY. Gravel is fine to medium rounded to subrounded chalk with occasional fine to medium flint and occasional chalk cobbles.	
5.50-6.50	B1	<5					69.30		(4.20) 9.70	Orange brown fine to medium becoming coarse SAND.	
6.50-7.50	B2	<5									
7.50-8.50	B3	<5									
8.50-9.50	B4	<5									

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	1) Hand dug inspection pit to 1.20m. 2) Bored 250mm to 11.0m, 200mm to 15.5m, 150mm to base. 3) 50mm wells installed, screened 12.9-13.9m and 15.0-18.3m.

All dimensions in metres Scale 1:62.5	Contractor: SLR Consulting Plant: Dando	Method: Cable Percussion Hole Size: 250/200/150mm	Logged By: DH	Approved By: PW

Form SLR AGS3 UK BH File 140703_402.01009.00064_BH107TOBH201_2014_LCP_LOGS_PW.GPJ 07-07-14

BOREHOLE LOG

BOREHOLE No. **BH201**

Client: **BRETT AGGREGATES LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00064	14/05/14	79.00maOD	E520233 N208856

Project: **HATFIELD AERODROME**

Sheet: 2 of 2

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							67.40		(1.90) 11.60	Stiff to very stiff grey to dark grey slightly sandy gravelly CLAY. Gravel is fine to coarse subangular to rounded chalk and rare flint. *(continued)*	
							66.10		(1.30) 12.90	Firm brown sandy gravelly CLAY. Gravel is medium to coarse rounded to subrounded flint with scattered fine chalk and occasional flint cobbles.	
12.90-13.90	B5	<5					65.10		(1.00) 13.90	Orange brown sandy coarse GRAVEL. Gravel is fine to coarse angular to rounded flint with occasional cobbles.	
							64.80		14.20	Firm to stiff orange brown slightly sandy slightly gravelly CLAY. Gravel is coarse subangular flint.	
							63.50		(1.30) 15.50	Soft orange brown grey mottled slightly gravelly CLAY. Gravel is medium to coarse subangular to rounded flint.	
15.50-16.50	B6	<5					61.60		(1.90) 17.40	Grey slightly clayey sandy GRAVEL. Gravel is fine to coarse angular to rounded flint and quartz with occasional flint cobbles.	
16.50-17.40	B7	<5					60.90		(0.70) 18.10	Soft brown slightly sandy slightly gravelly CLAY. Gravel is fine to medium subangular to subrounded flint and quartz.	
							60.70		18.30	Brown coarse sandy GRAVEL with pockets of chalky clay. Gravel is subangular to subrounded flint with occasional cobbles.	
							60.40		18.60	Stiff light brown to white slightly gravelly CLAY. Gravel is fine chalk and coarse rounded to subangular flint.	
							60.10		18.90	Grey white CHALK. (Recovered as coarse gravel to cobble sized fragments of chalk).	
										Borehole complete at 18.90m	

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	1) Hand dug inspection pit to 1.20m. 2) Bored 250mm to 11.0m, 200mm to 15.5m, 150mm to base. 3) 50mm wells installed, screened 12.9-13.9m and 15.0-18.3m.

All dimensions in metres	Contractor: SLR Consulting	Method: Cable Percussion	Logged By:	Approved By:
Scale 1:62.5	Plant: Dando	Hole Size: 250/200/150mm	DH	PW

SLR Consulting Ltd, 8 Stow Court, Stow-Cum-Quy, Cambridge, CB25 9AS, , Tel: 01223 813805, Fax: 01223 813783

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH BS5930+A2

BOREHOLE LOG

BOREHOLE No.
BH 301 L&C

Client:
ROBERT BRETT & SONS LTD

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00174	27/09/16	76.67maOD	E519569.963 N208834.843

Project:
HATFIELD AERODROME

Sheet:
1 of 2

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
0.50	E	<1							(0.80)	MADE GROUND: Light brown slightly gravelly SAND. Gravel is subangular to subrounded fine to coarse flint.	
0.80	E	<1					75.87		0.80	0.60 - 0.70 2" clay pipe, dry. NW-SE orientation.	
1 1.50	E	1							(0.80)	Light brown slightly clayey gravelly SAND. Gravel is fine to medium angular to subrounded flint, with localised pockets of firm light grey gravelly CLAY. Gravel is fine to medium angular to subrounded flint.	
2 2.00	E	1					75.07		1.60	Light brown fine GRAVEL of sub angular to angular flint and quartz, rare medium gravel.	
3 3.00	E	<1					73.87		(1.20) 2.80	Stiff brown slightly sandy slightly gravelly CLAY. Gravel is fine subangular to angular flint.	
4 4.00	E	2									
5 5.00	E	<1							(4.20)	5.00 - 7.00 Becoming Stiff dark grey brown slightly gravelly CLAY. Gravel is fine rounded chalk.	
6 6.00	E	<1									
7 7.00	E	<1					69.67		7.00	Light brown/yellow fine SAND with occasional gravel. Gravel is fine to medium subangular to subrounded flint.	
8 8.00	E	<1					68.67		(1.00) 8.00	Light brown/orange sandy GRAVEL. Gravel is fine to medium angular to rounded flint and occasional flint cobbles with dark grey clay pockets (undefined layers).	
9 9.00	E	<1					67.07		(1.60) 9.60	Yellow/ light brown CHALK recovered as chalk silt with gravel of angular fine to medium flint, sub rounded medium off-white chalk gravel and occasional flint cobbles.	
10 10.00	E	<1									
11 11.00	E	<1									

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	Hand dug pit to 1.2m. Headspace measurements using a PID. Dual well installed, screened 7.3m to 9.3m and 12.0 - 15.0m.

All dimensions in metres Scale 1:71.875	Contractor: Endeavour Plant: Dando 2000	Method: Cable Percussion Hole Size: 200mm	Logged By: CC	Approved By: JH

BOREHOLE LOG

BOREHOLE No.
BH 301 L&C

Client:
ROBERT BRETT & SONS LTD

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00174	27/09/16	76.67maOD	E519569.963 N208834.843

Project:
HATFIELD AERODROME

Sheet:
2 of 2

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
12 12.00	E	<1								Yellow/ light brown CHALK recovered as chalk silt with gravel of angular fine to medium flint, sub rounded medium off-white chalk gravel and occasional flint cobbles. *(continued)*	
13 13.00	E	<1							(5.40)		
14 14.00	E	<1									
15							61.67		15.00		
										Borehole complete at 15.00m	
16											
17											
18											
19											
20											
21											
22											

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	Hand dug pit to 1.2m. Headspace measurements using a PID. Dual well installed, screened 7.3m to 9.3m and 12.0 - 15.0m.

All dimensions in metres	Contractor: Endeavour	Method: Cable Percussion	Logged By:	Approved By:
Scale 1:71.875	Plant: Dando 2000	Hole Size: 200mm	CC	JH

BOREHOLE LOG

BOREHOLE No.
BH302 L&C

Client:
ROBERT BRETT & SONS LTD

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00174	06/10/16	76.27maOD	E519374.23 N208616.749

Project:
HATFIELD AERODROME

Sheet:
1 of 2

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
0.50	HS	<1					75.67		(0.60) 0.60	MADE GROUND: Light brown gravelly SAND. Gravel is angular to subangular fine to coarse flint, brick and concrete.	
1 1.00	HS	<1								Light brown sandy clayey GRAVEL. Gravel is subangular to rounded, fine to medium flint with occasional cobbles.	
										1.50 - 4.00 No longer clayey.	
2 2.00	HS	<1							(3.40)		
3 3.00	HS	<1									
4 4.00	HS	<1					72.27		4.00		
							71.77		4.50	Light brown slightly gravelly SAND. Gravel is angular to subangular fine flint.	
							71.67		4.60	Firm light brown mottled light grey slightly sandy CLAY.	
5 5.00	HS	<1							(1.60)	Firm dark grey CLAY. 5.00 rare gravels.	
6 6.00	HS	<1					70.07		6.20		
7 7.00	HS	<1								Light orange brown sandy GRAVEL. Gravel is rounded to angular fine to coarse flint, sandstone and quartz with occasional cobbles.	
8 8.00	HS	<1							(4.80)		
9 9.00	HS	<1									
10 10.00	HS	<1									
11 11.00	HS	<1					65.27		11.00		
										Firm brown grey slightly sandy slightly gravelly CLAY. Gravel is subrounded fine to medium flint.	

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	Hand dug pit to 1.2m. Headspace measurements using a PID. Dual well installed, screened 15.3m to 16.0m and 18.0 - 22.0m.

All dimensions in metres Scale 1:71.875	Contractor: Endeavour Plant: Dando 2000	Method: Cable Percussion Hole Size: 200mm	Logged By: CC	Approved By: JH

Form SLR AGS3 UK BH File 161014_402.01009.00174_BH_LOGS_TW.GPJ 23-03-17

BOREHOLE LOG

BOREHOLE No. **BH302 L&C**

Client: **ROBERT BRETT & SONS LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00174	06/10/16	76.27maOD	E519374.23 N208616.749

Project: **HATFIELD AERODROME**

Sheet: 2 of 2

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
									(1.00)	Firm brown grey slightly sandy slightly gravelly CLAY. Gravel is subrounded fine to medium flint. *(continued)*	
12 12.00	HS	<1					64.27		12.00	Stiff dark grey brown slightly gravelly CLAY. Gravel is subrounded to rounded fine chalk and subangular to subrounded fine to medium flint and siltstone.	
13 13.00	HS	<1							(3.00)		
14 14.00	HS	<1									
15 15.00	HS	<1					61.27		15.00		
							60.97		15.30	Stiff orange brown slightly gravelly CLAY. Gravel is subrounded to subangular fine to medium flint, quartz and siltstone.	
							60.27		(0.70) 16.00	Light brown sandy GRAVEL. Gravel is rounded to subangular fine to course flint, sandstone and quartz with occasional cobbles.	
16 16.00	HS	<1					59.97		16.30	Stiff orange brown slightly gravelly slightly sandy CLAY. Gravel is subrounded to angular fine to medium flint, sandstone and chalk.	
17 17.00	HS	<1								Yellow white CHALK recovered as weathered chalk silt with sub rounded to rounded fine to medium chalk gravel and fine to medium angular flint. 16.30 Recovered chalk gravel. 17.00 Sample recovered as chalk gravel.	
18 18.00	HS	<1								18.00 First sign of weathered chalk.	
19 19.00	HS	<1							(5.70)		
20 20.00	HS	<1									
21 21.00	HS	<1								21.00 Sample recovered as chalk gravel.	
22 22.00	HS	<1					54.27		22.00		
										Borehole complete at 22.00m	

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	Hand dug pit to 1.2m. Headspace measurements using a PID. Dual well installed, screened 15.3m to 16.0m and 18.0 - 22.0m.

All dimensions in metres	Contractor: Endeavour	Method: Cable Percussion	Logged By:	Approved By:
Scale 1:71.875	Plant: Dando 2000	Hole Size: 200mm	CC	JH

BOREHOLE LOG

BOREHOLE No.
BH305 L&C

Client:
ROBERT BRETT & SONS LTD

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00174	13/10/16	79.05maOD	E520049.621 N209317.092

Project:
HATFIELD AERODROME

Sheet:
1 of 2

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
							78.65		0.40	MADE GROUND: Grass over brown slightly gravelly slightly sandy SILT. Gravel comprises fine to coarse angular to rounded flint, brick and ceramic with frequent rootlets.	
0.50		<1								Firm orange brown slightly gravelly slightly sandy CLAY. Gravel comprises subangular to subrounded fine to coarse flint and chalk, sand is fine to coarse.	
1 1.20		<1							(2.40)		
2 2.00		<1					76.25		2.80		
2.80		<1								Firm to stiff brown mottled grey and white slightly sandy gravelly CLAY. Gravel comprises fine to medium subrounded to rounded chalk and flint, sand is fine to coarse. 3.00 - 4.80 Becoming stiff clay 3.50 - 4.80 No longer mottled grey and with fine to coarse gravel	
3 4 4.00		<1							(2.00)		
4.80		<1					74.25		4.80		
5 6 6.00		<1								Orange brown slightly gravelly SAND. Gravel comprises fine to coarse subrounded to rounded flint, sand is medium to coarse.	
7 7.20		<1							(2.40)		
8							71.85		7.20		
9 9.00		<1								Stiff dark brown mottled grey slightly sandy gravelly CLAY. Gravel comprises fine to coarse subangular to rounded flint, sand is fine to coarse. 7.40 - 10.50 Becoming dark grey	
10 10.00		<1							(3.80)		
										10.50 - 11.00 Becoming brown mottled grey	
11 11.00		<1					68.05		11.00		
										Firm soft orange brown sandy very gravelly CLAY. Gravel comprises fine to coarse subrounded to rounded flint, sand is fine to coarse.	

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	Hand dug pit to 1.2m. Headspace measurements using a PID. Dual well installed, screened 14.0-16.9m and 19.5-22.5m.

All dimensions in metres	Contractor: Endeavour	Method: Cable Percussion	Logged By:	Approved By:
Scale 1:71.875	Plant: Dando 2000	Hole Size: 200mm	FC	JH

BOREHOLE LOG

BOREHOLE No. **BH305 L&C**

Client: **ROBERT BRETT & SONS LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00174	13/10/16	79.05maOD	E520049.621 N209317.092

Project: **HATFIELD AERODROME**

Sheet: 2 of 2

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
									(1.00)	Firm soft orange brown sandy very gravelly CLAY. Gravel comprises fine to coarse subrounded to rounded flint, sand is fine to coarse. *(continued)*	
12 12.00		<1					67.05		12.00		
									(0.60)	Orange brown slightly gravelly clayey SAND. Gravel comprised fine to coarse subangular to rounded flint, sand is fine to coarse.	
12.60		<1					66.45		12.60	12.20 - 12.60 Becoming very gravelly	
13										Orange brown sandy GRAVEL. Gravel comprises fine to coarse subangular to rounded, sand is fine to coarse.	
13.50		2							(2.40)		
14										14.00 - 15.00 Becoming very sandy	
14.50	E	3									
15 15.00		1					64.05		15.00		
							63.95		15.10	Soft orange brown sandy CLAY. Sand is fine to coarse.	
15.50		1								Orange brown sandy GRAVEL. Gravel comprises fine to coarse subangular to rounded, sand is fine to coarse.	
16 16.00		1							(2.40)		
16.50		2									
17							61.55		17.50		
17.50		2								Soft white mottled brown slightly gravelly CLAY. Gravel is subangular/subrounded of chalk.	
18											
18.50		3							(2.00)		
19 19.00		3					59.55		19.50		
										Silty GRAVEL and COBBLES. Gravel and cobbles comprise subrounded to rounded flint within a silty chalk matrix.	
20											
21									(3.00)		
22											
							56.55		22.50		
										Borehole complete at 22.50m	

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	Hand dug pit to 1.2m. Headspace measurements using a PID. Dual well installed, screened 14.0-16.9m and 19.5-22.5m.

All dimensions in metres	Contractor: Endeavour	Method: Cable Percussion	Logged By:	Approved By:
Scale 1:71.875	Plant: Dando 2000	Hole Size: 200mm	FC	JH

BOREHOLE LOG

BOREHOLE No. **BH306U**

Client: **ROBERT BRETT & SONS LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00174	17/10/16	79.01maOD	E520234.233 N208855.845

Project: **HATFIELD AERODROME**

Sheet: 1 of 1

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
0.40	HS	<1					78.51		0.50	Grass over brown very sandy CLAY containing rootlets and occasional sub angular to sub rounded fine to medium flint.	
1.00	HS	<1								Firm to stiff orange mottled grey CLAY with rare fine sub angular flint gravel.	
1.50	HS	<1									
2.00	HS	<1							(3.70)		
3.00	HS	<1									
4.00	HS	<1					74.81		4.20		
4.50	HS	<1								Stiff brown gravelly CLAY. Gravel comprises sub angular to sub rounded fine to medium off-white chalk, rare chalk cobbles and occasional sub angular to sub rounded fine to medium flint.	
5.00	HS	<1							(1.30)		
							73.51		5.50		
6.00	HS	<1								Orange brown fine to medium SAND.	
7.00	HS	<1									
8.00	HS	<1							(4.40)		
9.00	HS	<1									
							69.11		9.90		
10.00	HS	<1							(0.80)	Stiff to very stiff dark grey slightly gravelly CLAY. Gravel comprises angular to sub rounded fine to medium flint and chalk.	
							68.31		10.70		
										Borehole complete at 10.70m	

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	Hand dug pit to 1.2m. Headspace measurements using a PID. Well installed, screened 4.6m to 9.9m

All dimensions in metres Scale 1:71.875	Contractor: Endeavour Plant: Dando 3000	Method: Cable Percussion Hole Size: 200mm	Logged By: CB	Approved By: JH

Form SLR AGS3 UK BH File 161014_402.01009.00174_BH_LOGS_TW.GPJ 23-03-17

BOREHOLE LOG

BOREHOLE No. **BH307U**

Client: **ROBERT BRETT & SONS LTD**

Project No:	Date:	Ground Level:	Co-ordinates:
402.01009.00174	14/10/16	79.69maOD	E520132.067 N208917.503

Project: **HATFIELD AERODROME**

Sheet: 1 of 1

SAMPLES & TESTS							STRATA				
Depth	Type No	HS(ppm)	HV(kPa)	PP(kPa)	SPT-N	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
0.20	HS	<1					79.29		0.40	MADE GROUND: Brown clayey gravelly SAND. Gravel comprises fine to coarse angular to sub rounded flint and occasional fine red brick fragments. Sand is fine.	
1.00	HS	<1								Firm orange brown mottled grey gravelly CLAY. Gravel comprises fine to coarse angular to rounded flint and off-white chalk fragments.	
2.00	HS	<1							(3.20)		
3.00	HS	<1					76.09		3.60		
4.00	HS	<1								Firm orange brown mottled grey, slightly gravelly CLAY. Gravel comprises fine to medium sub angular to sub rounded flint.	
5.00	HS	<1									
6.00	HS	<1							(5.10)		
8.00	HS	<1									
8.50	HS	<1					70.99		8.70		
							70.49		9.20	Stiff dark grey slightly gravelly CLAY. Gravel comprises angular to sub rounded fine to medium flint and chalk.	
										Borehole complete at 9.20m	

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	Hand dug pit to 1.2m. Headspace measurements using a PID. Well installed, screened 3.6m to 8.6m.

All dimensions in metres Scale 1:71.875	Contractor: Endeavour Plant: Dando 3000	Method: Cable Percussion Hole Size: 200mm	Logged By: CB	Approved By: JH

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