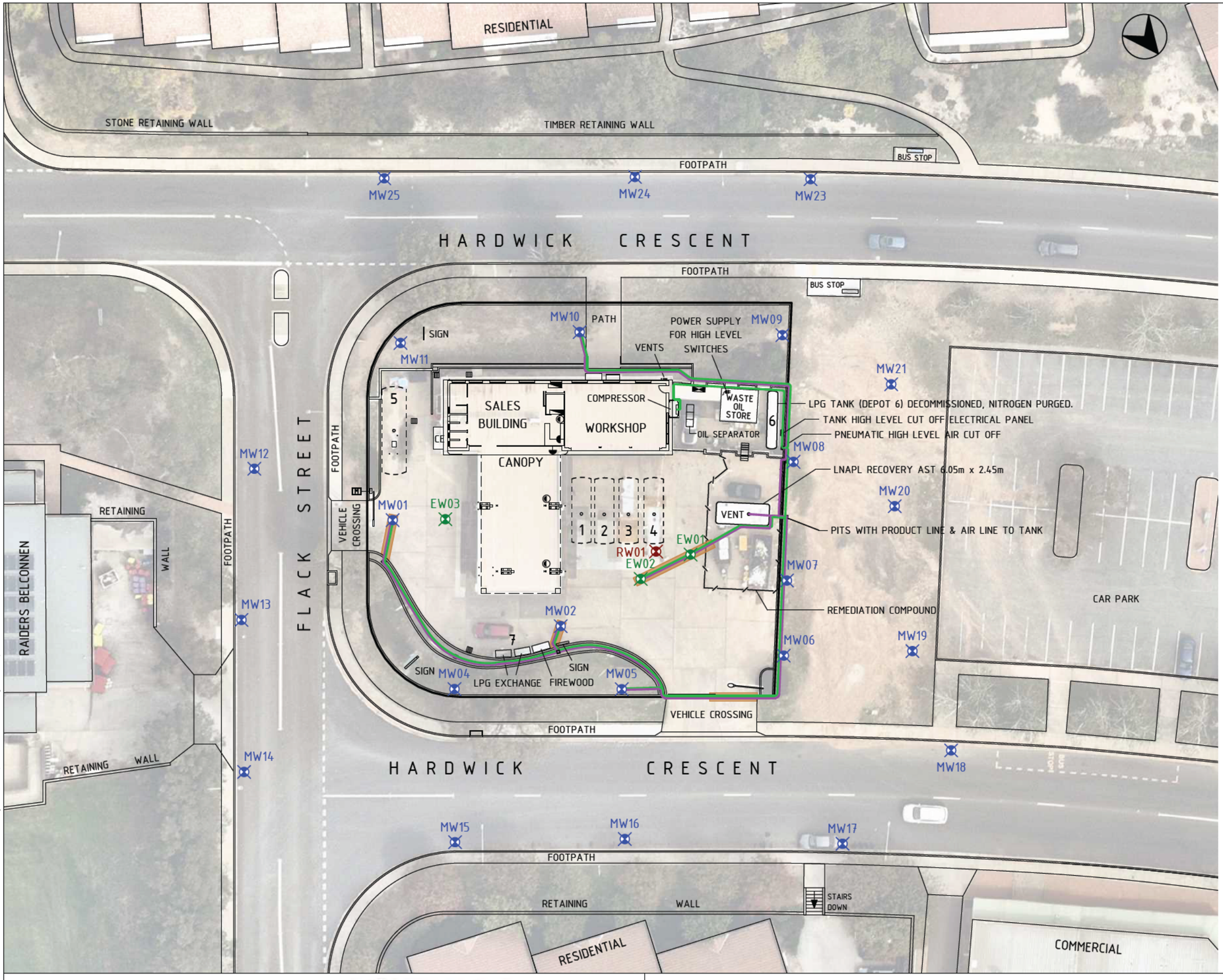


LEGEND

- SITE BOUNDARY
- EW# MW## GROUNDWATER MONITORING WELL
- RW## RECOVERY WELL
- SWITCHBOARD
- FIRE HOSE REEL
- MANIFEST BOX – CONTAINING ERP DOCUMENT
- EMERGENCY STOP BUTTON
- CO^2 FIRE EXTINGUISHER
- DRY CHEMICAL FIRE EXTINGUISHER
- FUEL DISPENSER
- GRATED DRAIN / GRATED PIT
- AIR PIPELINE
- PRODUCT PIPELINE
- PIT
- ROAD PLATE

DEPOT SCHEDULE

DEPOT	TYPE	PRODUCT	CLASS	CAPACITY	USAGE
1	UST	V95	3	27,400L	IN USE
2	UST	DIESEL	C1	27,400L	IN USE
3	UST	E10	3	27,400L	IN USE
4	UST	V98	3	28,600L	IN USE
5	UST	E10	3	59,400L	IN USE
6	AST	LPG	2.1	7,500L	NOT IN USE
7	LPG EXCHANGE		2.1	9x4kg, 42x9kg	IN USE

NOTE

LPG TANK (DEPOT 6) DECOMMISSIONED, NITROGEN PURGED.

0 10m

1:350 AT A3 APPROXIMATE

AERIAL IMAGE NEARMAP 13 APRIL 2020.

REFERENCE: CALTEX 'DANGEROUS GOODS PLAN' DRAWING NO. 22546-DG REV. B DATED 25/11/2011 SUPPLIED BY CLIENT.

InSite Remediation Services Pty Ltd
Unit 6 / 20 Templar Place
Bennetts Green, NSW, 2290 | Australia
www.insiteremediation.com.au

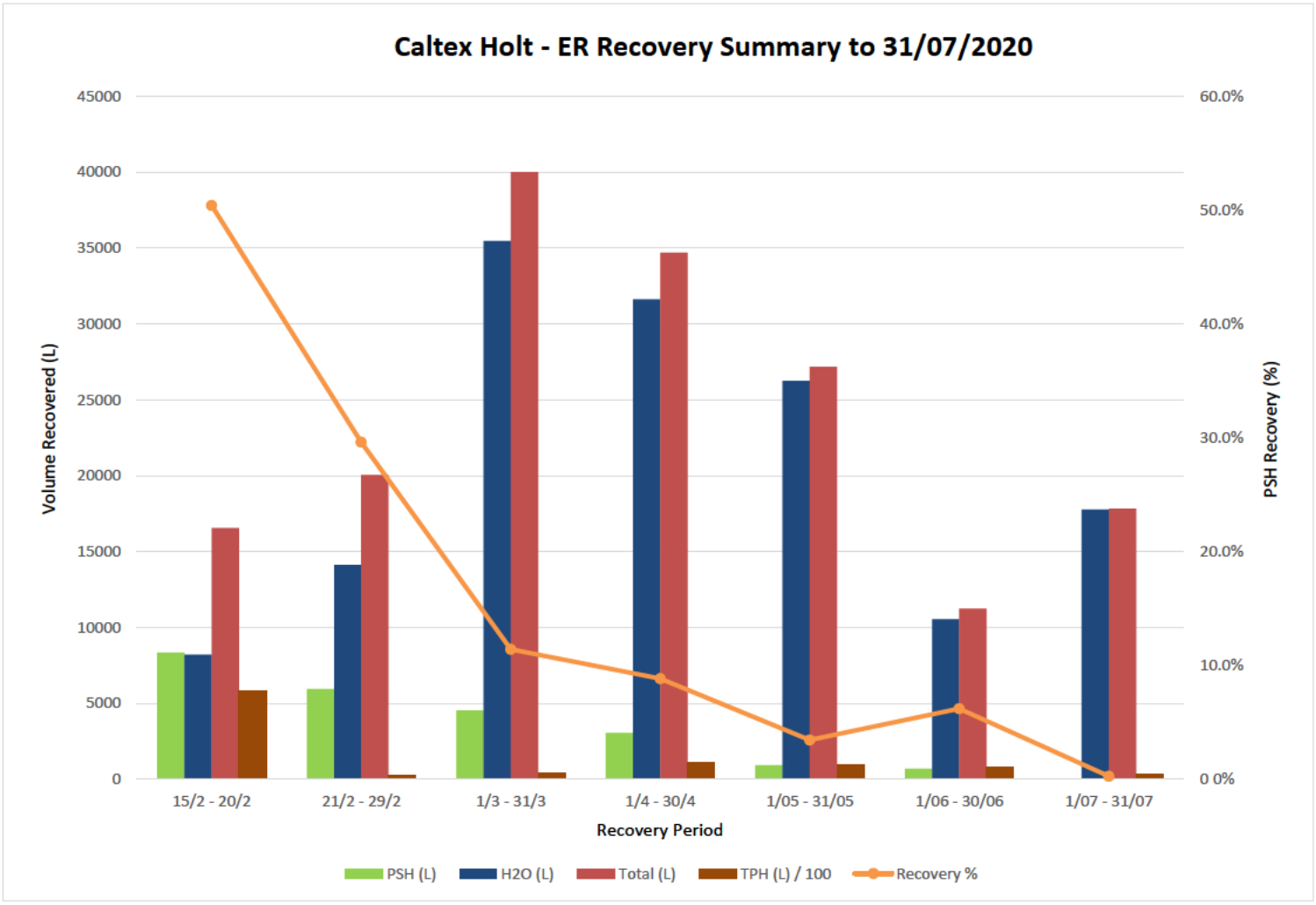
CATLEX HOLT SERVICE CENTRE
1 HARDWICK CRESCENT
HOLT ACT

FIGURE 3
PIPELINE NETWORK

D:\Google Drive\InSite Remediation\Holt\CALTEX HOLT INSITE PLANS MAR 2020 V6.vwx | Tue, 28 Apr 2020 11:27:47 AM | drawn by laurie white at www.reumad.com.au

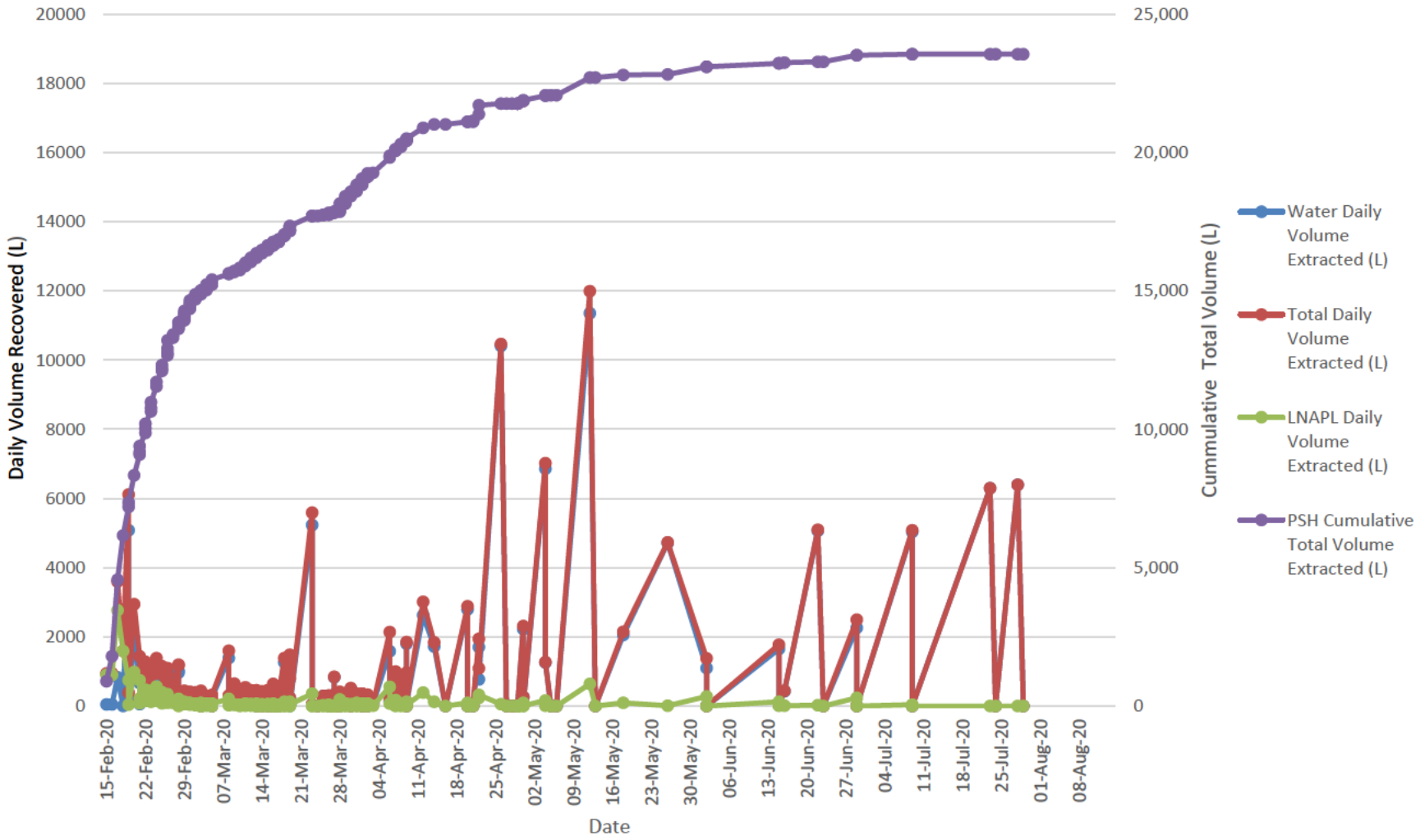
Attachment A – Total Fluids Extraction Data and Recovery Trends

Monthly Summary Report



	TPH (L)	PSH (L)	H2O (L)	Total (L)	Recovery %
Date Period /Totals	**43.7**	**23551**	**143993**	**167544**	**14.1%**
15/2 - 20/2	2.5	8341	8211	16552	50.4%
21/2 - 29/2	4.3	5938	14124	20062	29.6%
1/3 - 31/3	10.8	4553	35459	40012	11.4%
1/4 - 30/4	9.6	3055	31635	34690	8.8%
1/05 - 31/05	8.0	928	26243	27171	3.4%
1/06 - 30/06	3.2	694	10541	11235	6.2%
1/07 - 31/07	5.4	42	17780	17822	0.3%

Daily Liquids Recovery Trend



Notes: 1) Daily spikes between 4-8 March, 19-23 March, 3-6 April, 9-15 April, 15-21 April and 21-27 April are totals from multiple days of pumping (Typically over weekends).

2) Uptick in PSH recovery in late March Attributed to the expansion of the groundwater recovery wells.

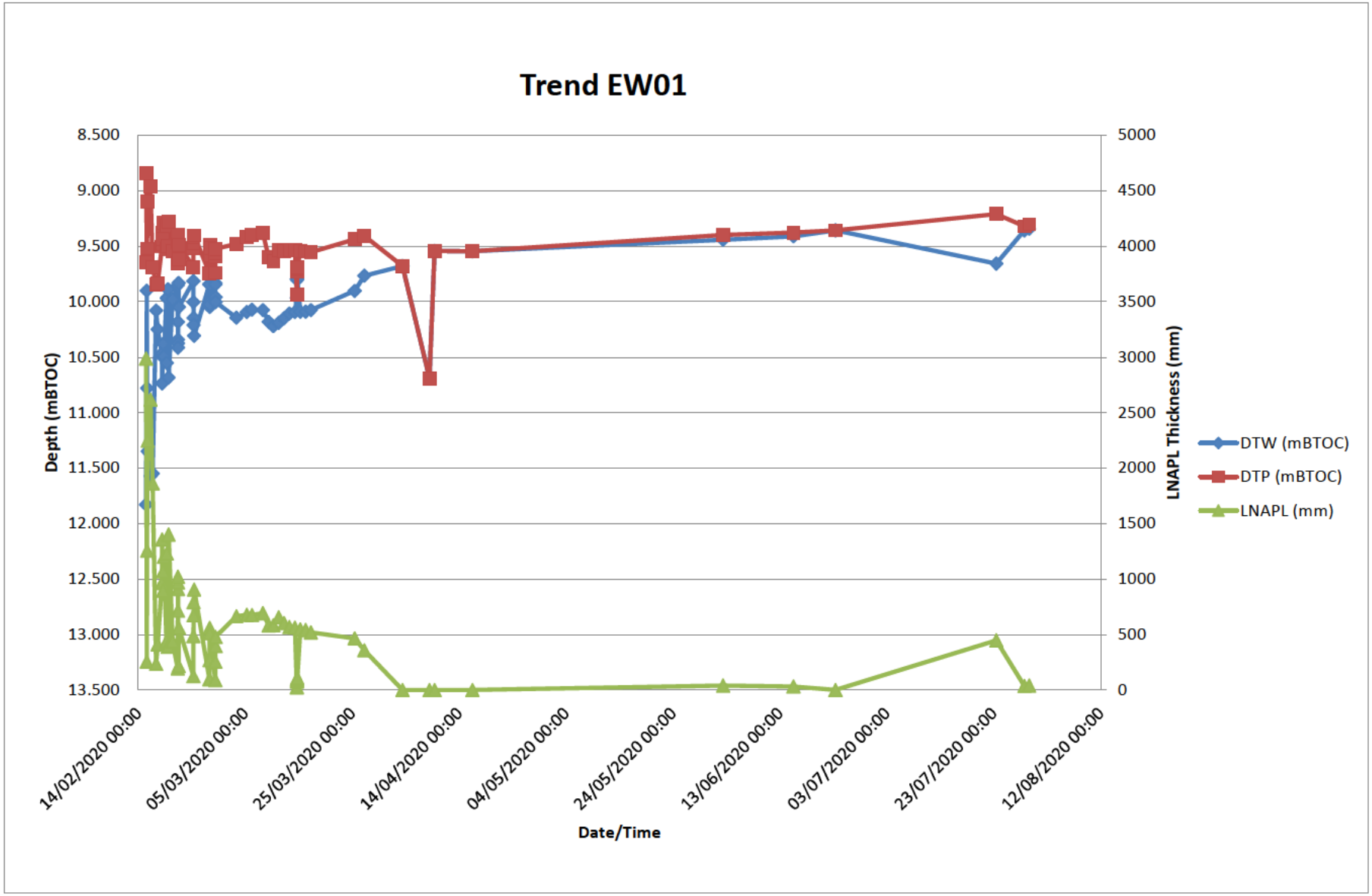
Date	Time	Extraction wells	LNAPL Daily Volume Extracted (L)			Water Daily Volume Extracted (L)			Total Daily Volume Extracted (L)	PSH Cumulative Total Volume Extracted (L)	Volume Disposed (L)	
											154,464	
			AP2	MPE	Total	AP2	MPE	Total			PSH	Water
Totals			**23151**	**400**	**23551**	**142677**	**1275**	**143952**	**167,503**		**19,444**	**135,019**
15-Feb-20	19 00	EW1	900	-	900	50	-	**50**	950	900		
16-Feb-20	13 00	EW1	900	-	900	50	-	**50**	950	1,800		1,900
17-Feb-20	12 20	EW1& MW2	2 770	-	2770	830	-	**830**	3 600	4,570		
18-Feb-20	11:11	EW1 & MW2,MW1	1,596		1596			**0**	1,596	6,166		
19-Feb-20	06 30	EW1 2 MW1 2	749	280	1029	4005	1 080	**5085**	6 114	7,195		
19-Feb-20	13:14	EW1 2 MW1 2	41	120	161	37	195	**232**	393	7,356		
20-Feb-20	12:12	EW1,2 MW1,2	985	-	985	1964	-	**1964**	2,949	8,341		10,527
21-Feb-20	06:40	EW1 2 MW1 2	750		750	687		**687**	1 437	9,091		
21-Feb-20	08 35	EW1 2 MW1 2	83		83	56		**56**	139	9,174	1,760	2,402
21-Feb-20	13 30	EW1,2 MW1,2	219		219	667		**667**	886	9,394		
22-Feb-20	07 30	EW1 2 MW1 2	472		472	805		**805**	1 277	9,866		
22-Feb-20	12:10	EW1 2 MW1 2	167		167	444		**444**	611	10,032		
22-Feb-20	17:10	EW1,2 MW1,2	167		167	361		**361**	527	10,199		
23-Feb-20	07 20	EW1 2 MW1 2	444		444	722		**722**	1 166	10,643		
23-Feb-20	12:40	EW1 2 MW1 2	125		125	361		**361**	486	10,768		
23-Feb-20	17 30	EW1,2 MW1,2	208		208	250		**250**	458	10,976		
24-Feb-20	07:10	EW1,2 MW1,2	569		569	819	-	**819**	1,388	11,545	2,250	4,026
24-Feb-20	16 00	EW1 2 MW1 2	167		167	777	-	**777**	944	11,712		
25-Feb-20	07 00	EW1 2 MW1 2	403		403	750	-	**750**	1 152	12,114		
25-Feb-20	11 00	EW1,2 MW1,2	83		83	403	-	**403**	486	12,197		
25-Feb-20	17 00	EW1,2 MW1,2	125		125	333	-	**333**	458	12,322		
26-Feb-20	07 00	EW1,2 MW1,2	347		347	597	-	**597**	944	12,669		
26-Feb-20	11 00	EW1,2 MW1,2	97		97	305	-	**305**	403	12,766		
26-Feb-20	17 00	EW1 2 MW1 2	153		153	500	-	**500**	652	12,919		
26-Feb-20	07 00	EW1 2 MW1 2	291		291	805	-	**805**	1 097	13,211		
27-Feb-20	11 00	EW1 2 MW1 2	97		97	250	-	**250**	347	13,308		
27-Feb-20	17 00	EW1,2 MW1,2	111		111	430	-	**430**	541	13,419		
28-Feb-20	07 30	EW1,2 MW1,2	208		208	972	-	**972**	1,180	13,627		
28-Feb-20	09 30	EW1,2 MW1,2	56		56	139	-	**139**	194	13,683	2,950	4,946
28-Feb-20	17 00	EW1 2 MW1 2	180		180	1013	-	**1013**	1 194	13,863		
28-Feb-20	22 00	EW1 2 MW1 2	0		0	389	-	**389**	389	13,863		
29-Feb-20	03 00	EW1 2 MW1 2	69		69	278	-	**278**	347	13,932		
29-Feb-20	07 00	EW1,2 MW1,2	125		125	319	-	**319**	444	14,057		
29-Feb-20	11 00	EW1,2 MW1,2	83		83	208	-	**208**	291	14,141		
29-Feb-20	17 00	EW1,2 MW1,2	56		56	347	-	**347**	403	14,196		
29-Feb-20	22 00	EW1 2 MW1 2	83		83	139	-	**139**	222	14,279		
01-Mar-20	03 00	EW1 2 MW1 2	69		69	236	-	**236**	305	14,349		
01-Mar-20	07 00	EW1 2 MW1 2	42		42	194	-	**194**	236	14,390		
01-Mar-20	11 00	EW1,2 MW1,2	83		83	153	-	**153**	236	14,474		
01-Mar-20	17 00	EW1,2 MW1,2	83		83	333	-	**333**	416	14,557		
01-Mar-20	22 00	EW1,2 MW1,2	97		97	291	-	**291**	389	14,654		
02-Mar-20	03 00	EW1,2 MW1,2	42		42	347	-	**347**	389	14,696		
02-Mar-20	07 00	EW1 2 MW1 2	42		42	361	-	**361**	403	14,737		
02-Mar-20	11 00	EW1 2 MW1 2	69		69	236	-	**236**	305	14,807		
02-Mar-20	13 00	EW1,2 MW1,2	28		28	208	-	**208**	236	14,835		
02-Mar-20	17 00	EW1,2 MW1,2	42		42	97	-	**97**	139	14,876		
03-Mar-20	07 35	EW1,2 MW1,2	0		0	0	-	**0**	0	14,876		
03-Mar-20	08:45	EW1,2 MW1,2	97		97	347	-	**347**	444	14,973	1,600	4,307
03-Mar-20	12 00	EW1 2 MW1 2	0		0	347	-	**347**	347	14,973		
03-Mar-20	14 00	EW1 2 MW1 2	28		28	194	-	**194**	222	15,001		
03-Mar-20	17 00	EW1,2 MW1,2	14		14	236	-	**236**	250	15,015		
04-Mar-20	07 00	EW1,2 MW1,2	14		14	236	-	**236**	250	15,029		
04-Mar-20	10 00	EW1,2 MW1,2	69		69	139	-	**139**	208	15,098		
04-Mar-20	12 00	EW1,2 MW1,2	28		28	153	-	**153**	180	15,126		
04-Mar-20	14 00	EW1 2 MW1 2	28		28	167	-	**167**	194	15,154		
04-Mar-20	17 00	EW1 2 MW1 2	69		69	222	-	**222**	291	15,223		
05-Mar-20	07 00	EW1 2 MW1 2	0		0	0	-	**0**	0	15,223		
05-Mar-20	10 00	EW1,2 MW1,2	28		28	278	-	**278**	305	15,251		
05-Mar-20	12 00	EW1,2 MW1,2	14		14	194	-	**194**	208	15,265		
05-Mar-20	14 00	EW1,2 MW1,2	69		69	208	-	**208**	278	15,334		
05-Mar-20	17 00	EW1 2 MW1 2	69		69	250	-	**250**	319	15,404		
08-Mar-20	07 00	EW1 2 MW1 2	208		208	1388	-	**1388**	1 596	15,612		
08-Mar-20	17 00	EW1 2 MW1 2	28		28	278	-	**278**	305	15,640		
09-Mar-20	12 00	EW1,2 MW1,2	42		42	611	-	**611**	652	15,681		5,531
09-Mar-20	14 00	EW1,2 MW1,2	42		42	305	-	**305**	347	15,723		
10-Mar-20	07 00	EW1,2 MW1,2	28		28	180	-	**180**	208	15,751		
10-Mar-20	09 00	EW1 2 MW1 2	42		42	430	-	**430**	472	15,792		
10-Mar-20	12 00	EW1 2 MW1 2	0		0	347	-	**347**	347	15,792		
10-Mar-20	14 00	EW1 2 MW1 2	42		42	236	-	**236**	278	15,834		
11-Mar-20	07 00	EW1,2 MW1,2	69		69	472	-	**472**	541	15,903		
11-Mar-20	09 00	EW1,2 MW1,2	14		14	278	-	**278**	291	15,917		
11-Mar-20	12 00	EW1,2 MW1,2	69		69	319	-	**319**	389	15,987		
11-Mar-20	14 00	EW1,2 MW1,2	28		28	264	-	**264**	291	16,014		
12-Mar-20	07 00	EW1 2 MW1 2	28		28	333	-	**333**	361	16,042		
12-Mar-20	09 00	EW1 2 MW1 2	56		56	333	-	**333**	389	16,098		
12-Mar-20	12 00	EW1,2 MW1,2	56		56	403	-	**403**	458	16,153		
12-Mar-20	14 00	EW1,2 MW1,2	14		14	305	-	**305**	319	16,167		
12-Mar-20	17 00	EW1,2 MW1,2	28		28	389	-	**389**	416	16,195		
13-Mar-20	07 00	EW1,2 MW1,2	0		0	0	-	**0**	0	16,195		
13-Mar-20	09 00	EW1 2 MW1 2	69		69	250	-	**250**	319	16,264		
13-Mar-20	12 00	EW1 2 MW1 2	28		28	430	-	**430**	458	16,292		
13-Mar-20	14 00	EW1,2 MW1,2	14		14	291	-	**291**	305	16,306		
13-Mar-20	16 00	EW1,2 MW1,2	56		56	305	-	**305**	361	16,361		

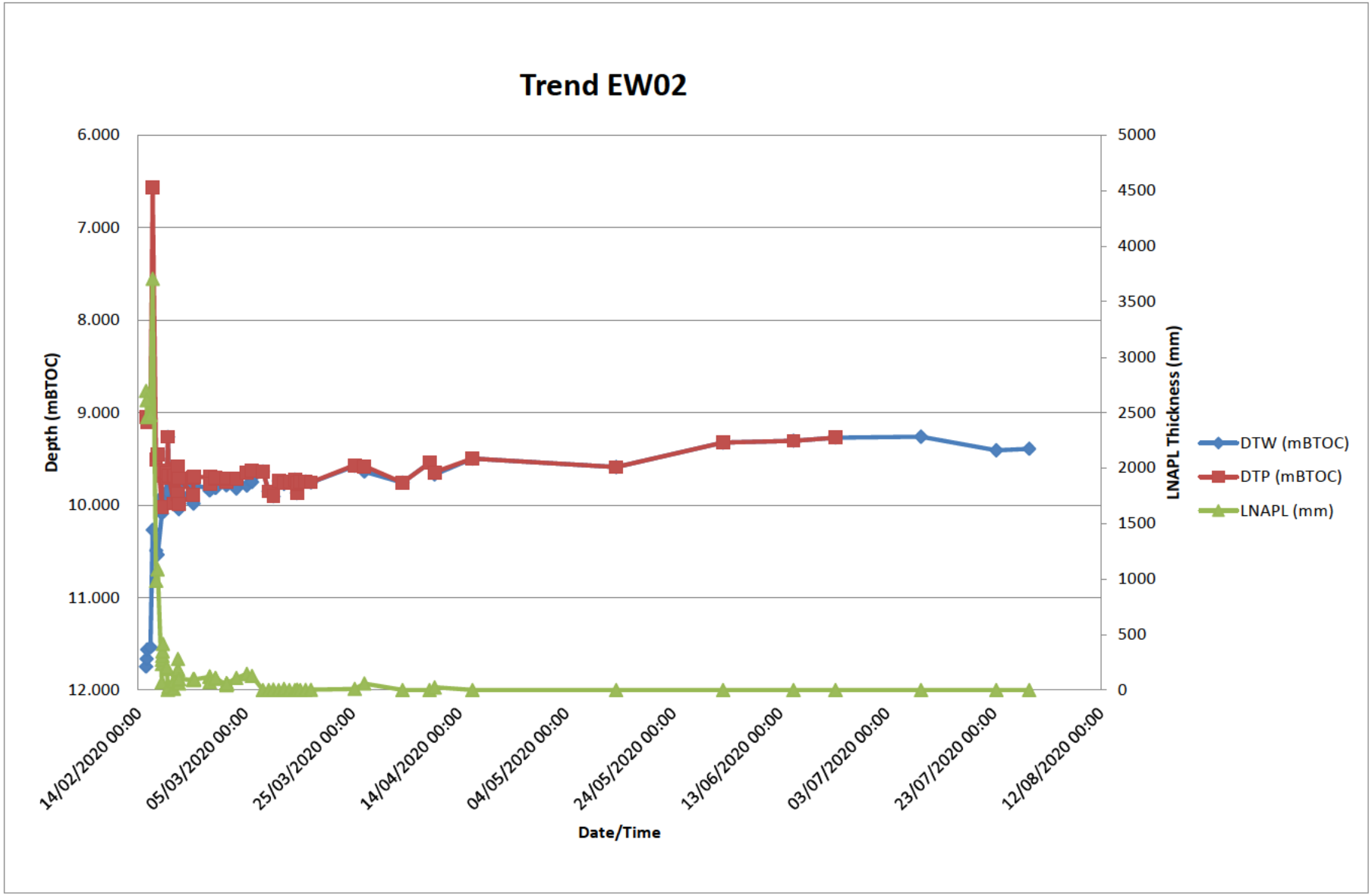
Date	Time	Extraction wells	LNAPL Daily Volume Extracted (L)			Water Daily Volume Extracted (L)			Total Daily Volume Extracted (L)	PSH Cumulative Total Volume Extracted (L)	Volume Disposed (L)	
14-Mar-20	07 00	EW1 2 MW1 2	0		0	0	-	**0**	0	16,361		
14-Mar-20	09 00	EW1 2 MW1 2	14		14	305	-	**305**	319	16,375		
14-Mar-20	12 00	EW1,2 MW1,2	28		28	250	-	**250**	278	16,403		
14-Mar-20	14 00	EW1,2 MW1,2	56		56	375	-	**375**	430	16,459		
14-Mar-20	16 00	EW1,2 MW1,2	14		14	250	-	**250**	264	16,472		
15-Mar-20	07 00	EW1,2 MW1,2	0		0	0	-	**0**	0	16,472		
15-Mar-20	09 00	EW1 2 MW1 2	56		56	291	-	**291**	347	16,528		
15-Mar-20	11 00	EW1 2 MW1 2	14		14	264	-	**264**	278	16,542		
15-Mar-20	14 00	EW1 2 MW1 2	56		56	403	-	**403**	458	16,597		
15-Mar-20	15 30	EW1,2 MW1,2	42		42	83	-	**83**	125	16,639		
16-Mar-20	07 00	EW1,2 MW1,2	0		0	0	-	**0**	0	16,639	2,550	6,815
16-Mar-20	09 00	EW1,2 MW1,2	0		0	0	-	**0**	0	16,639		
16-Mar-20	11 00	EW1 2 MW1 2	69		69	569	-	**569**	638	16,708		
16-Mar-20	14 00	EW1 2 MW1 2	56		56	500	-	**500**	555	16,764		
16-Mar-20	17 00	EW1 2 MW1 2	0		0	278	-	**278**	278	16,764		
17-Mar-20	07 00	EW1,2 MW1,2	0		0	0	-	**0**	0	16,764		
17-Mar-20	09 00	EW1,2 MW1,2	14		14	208	-	**208**	222	16,778		
17-Mar-20	11 00	EW1,2 MW1,2	28		28	236	-	**236**	264	16,806		
17-Mar-20	14 00	EW1 2 MW1 2	42		42	319	-	**319**	361	16,847		
17-Mar-20	17 00	EW1 2 MW1 2	14		14	305	-	**305**	319	16,861		
18-Mar-20	06 30	EW1 2 MW1 2	125		125	1263	-	**1263**	1 388	16,986		
18-Mar-20	09 00	EW1,2 MW1,2	0		0	278	-	**278**	278	16,986		
18-Mar-20	11 00	EW1,2 MW1,2	28		28	250	-	**250**	278	17,014		
18-Mar-20	14 00	EW1,2 MW1,2	0		0	319	-	**319**	319	17,014		
18-Mar-20	17 00	EW1,2 MW1,2	28		28	250	-	**250**	278	17,041		
19-Mar-20	06 30	EW1 2 MW1 2	125		125	1360	-	**1360**	1 485	17,166		
19-Mar-20	08 30	EW1 2 MW1 2	0		0	236	-	**236**	236	17,166		5,991
19-Mar-20	10 30	EW1,2 MW1,2	28		28	786	-	**786**	814	17,194		
19-Mar-20	11 00	EW1,2 MW1,2	14		14	69	-	**69**	83	17,208		
19-Mar-20	13 30	EW1,2 MW1,2	56		56	56	-	**56**	111	17,264		
19-Mar-20	15 00	EW1,2 MW1,2	42		42	28	-	**28**	69	17,305		
19-Mar-20	17 00	EW1 2 MW1 2	42		42	0	-	**0**	42	17,347		
23-Mar-20	13 00	EW1 2 MW1 2	361		361	5233		**5233**	5 594	17,708		
23-Mar-20	15 00	EW1,2 MW1,2	0		0	42		**42**	42	17,708		
23-Mar-20	16 30	EW1,2 MW1,2	0		0	42		**42**	42	17,708		
24-Mar-20	08 00	EW1,2 MW1,2	0		0	0	-	**0**	0	17,708		3,500
25-Mar-20	08 00	EW1,2 MW1,2	28		28	226	-	**226**	254	17,735		
25-Mar-20	13 00	EW1 2 MW1 2	0		0	291	-	**291**	291	17,735		
25-Mar-20	17:15	EW1 2 MW1 2	14		14	194	-	**194**	208	17,749		
26-Mar-20	07 30	EW1 2 MW1 2	0		0	0	-	**0**	0	17,749		
26-Mar-20	11 30	EW1,2 MW1,2	14		14	291	-	**291**	305	17,763		
26-Mar-20	15 00	EW1,2 MW1,2	14		14	264	-	**264**	278	17,777		
26-Mar-20	17 00	EW1,2 MW1,2	42		42	28	-	**28**	69	17,819		
27-Mar-20	07 30	EW1 2 MW1 2	0		0	0	-	**0**	0	17,819		
27-Mar-20	08:40	EW1 2 MW1 2	14		14	28	-	**28**	42	17,833		4,000
27-Mar-20	11 00	EW1 2 MW1 2	14		14	833	-	**833**	847	17,847		
27-Mar-20	13 00	EW1,2 MW1,2	0		0	333	-	**333**	333	17,847		
27-Mar-20	16 00	EW1,2 MW1,2	14		14	28	-	**28**	42	17,860		
27-Mar-20	17 00	EW1,2 MW1,2	0		0	0	-	**0**	0	17,860		
28-Mar-20	07 25	EW1 2 MW1 2	0		0	0	-	**0**	0	17,860		
28-Mar-20	10 00	EW1 2 MW1 2	28		28	389	-	**389**	416	17,888		
28-Mar-20	12 30	EW1 2 MW1 2	14		14	208	-	**208**	222	17,902		
28-Mar-20	14 30	EW1,2 MW1,2	56		56	208	-	**208**	264	17,958		
28-Mar-20	16 30	EW1,2 MW1,2	194		194	97	-	**97**	291	18,152		
29-Mar-20	07:10	EW1,2 MW1,2	0		0	125	-	**125**	125	18,152		
29-Mar-20	09 30	EW1 2 MW1 2	14		14	291	-	**291**	305	18,166		
29-Mar-20	11 30	EW1 2 MW1 2	69		69	291	-	**291**	361	18,235		
29-Mar-20	13 30	EW1 2 MW1 2	42		42	264	-	**264**	305	18,277		
29-Mar-20	15 30	EW1,2 MW1,2	69		69	194	-	**194**	264	18,346		
29-Mar-20	16:45	EW1,2 MW1,2	69		69	97	-	**97**	167	18,416		
30-Mar-20	07 30	EW1,2 MW1,2	0		0	0	-	**0**	0	18,416		
30-Mar-20	09 30	EW1,2 MW1,2	28		28	194	-	**194**	222	18,443		
30-Mar-20	11 30	EW1 2 MW1 2	56		56	291	-	**291**	347	18,499		
30-Mar-20	13 00	EW1 2 MW1 2	28		28	222	-	**222**	250	18,527		
30-Mar-20	14:15	EW1,2 MW1,2	28		28	496	-	**496**	524	18,554		3,550
30-Mar-20	16 30	EW1,2 MW1,2	28		28	28		**28**	56	18,582		
31-Mar-20	07 30	EW1,2 MW1,2	14		14	194	-	**194**	208	18,596		
31-Mar-20	09:40	EW1,2 MW1,2	97		97	42	-	**42**	139	18,693		
31-Mar-20	11:40	EW1 2 MW1 2	0		0	264	-	**264**	264	18,693		
31-Mar-20	13 30	EW1 2 MW1 2	14		14	278	-	**278**	291	18,707		
31-Mar-20	15 30	EW1 2 MW1 2	69		69	291	-	**291**	361	18,776		
31-Mar-20	16 00	EW1,2 MW1,2	56		56	56	-	**56**	111	18,832		
01-Apr-20	07 30	EW1,2 MW1,2	0		0	0	-	**0**	0	18,832		
01-Apr-20	09 30	EW1,2 MW1,2	28		28	208	-	**208**	236	18,860		
01-Apr-20	11 30	EW1 2 MW1 2	69		69	291	-	**291**	361	18,929		
01-Apr-20	13 30	EW1 2 MW1 2	28		28	305	-	**305**	333	18,957		
01-Apr-20	15 30	EW1 2 MW1 2	69		69	291	-	**291**	361	19,026		
01-Apr-20	17 00	EW1,2 MW1,2	28		28	194	-	**194**	222	19,054		
02-Apr-20	08 00	EW1,2 MW1,2,5,6,10	69		69	14	-	**14**	83	19,123		
02-Apr-20	09 30	EW1,2 MW1,2,5,6,10	0		0	0	-	**0**	0	19,123		2,000
02-Apr-20	11 30	EW1 2 MW1 2 5 6 10	42		42	236	-	**236**	278	19,165		
02-Apr-20	13 30	EW1 2 MW1 2 5 6 10	14		14	278	-	**278**	291	19,179		
02-Apr-20	16 00	EW1 2 MW1 2 5 6 10	69		69	264	-	**264**	333	19,248		
03-Apr-20	07 30	EW1,2 MW1,2,5,6,10	14		14	69	-	**69**	83	19,262		
06-Apr-20	09 30	EW1,2 MW1,2,5,6,10	555		555	1582	-	**1582**	2,138	19,817		

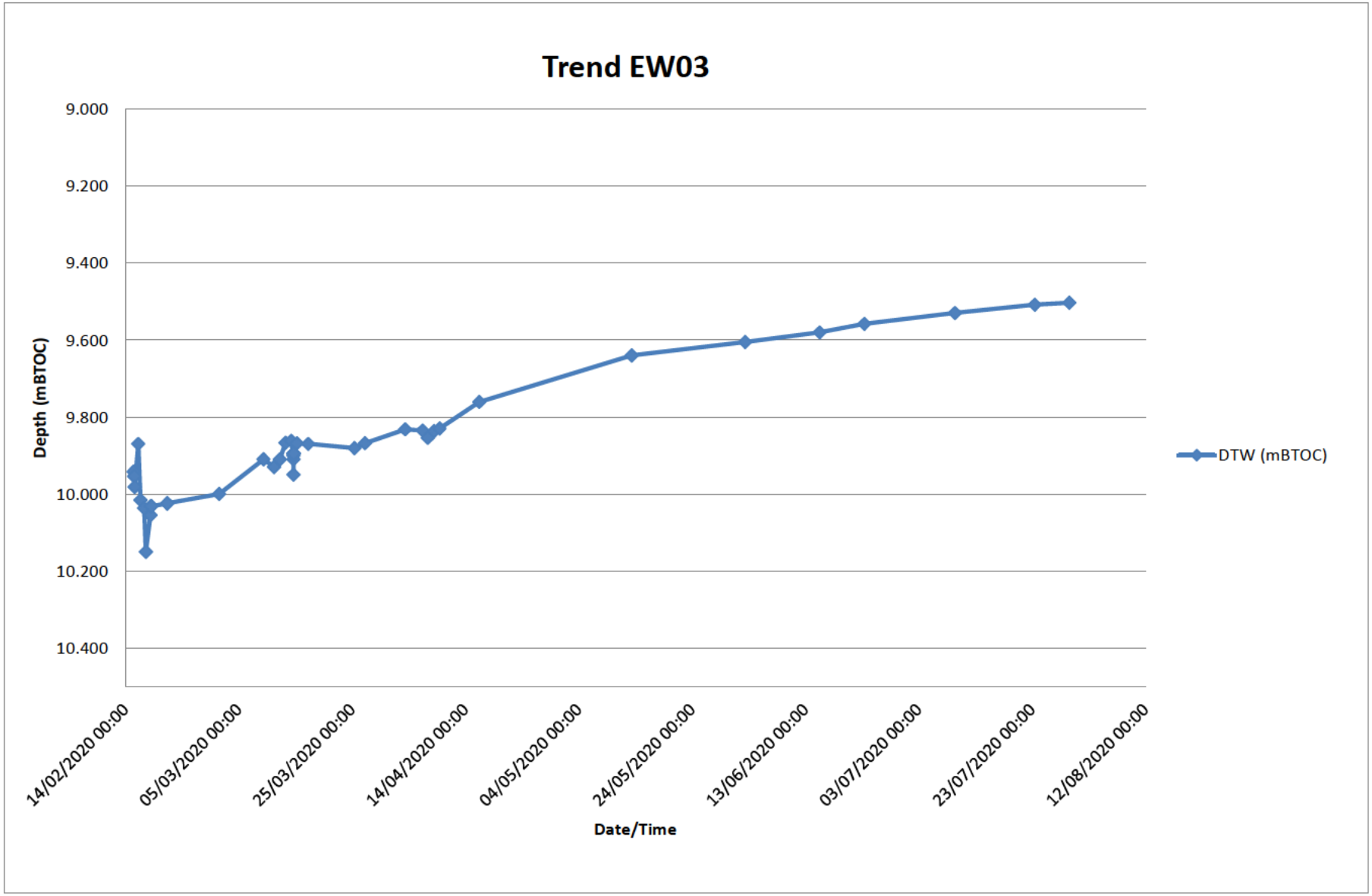
Date	Time	Extraction wells	LNAPL Daily Volume Extracted (L)			Water Daily Volume Extracted (L)			Total Daily Volume Extracted (L)	PSH Cumulative Total Volume Extracted (L)	Volume Disposed (L)	
06-Apr-20	14 20	EW1 2 MW1 2 5 6 10	69		69	139	-	**139**	208	19,887		2,000
07-Apr-20	06 55	EW1 2 MW1 2 5 6 10	180		180	820	-	**820**	1 001	20,067		
07-Apr-20	09 30	EW1,2 MW1,2,5,6,10	0		0	125	-	**125**	125	20,067		
07-Apr-20	14 00	EW1,2 MW1,2,5,6,10	28		28	180	-	**180**	208	20,095		
07-Apr-20	17 00	EW1,2 MW1,2,5,6,10	28		28	208	-	**208**	236	20,123		
08-Apr-20	07:10	EW1,2 MW1,2,5,6,10,12,15	83		83	652	-	**652**	736	20,206		
08-Apr-20	11 00	EW1,2 MW1,2,5,6,10,12,15	69		69	139	-	**139**	208	20,276		
08-Apr-20	14 00	EW1,2 MW1,2,5,6,10,12,15	28		28	28	-	**28**	56	20,303		
08-Apr-20	17 00	EW1,2 MW1,2,5,6,10,12,15	0		0	236	-	**236**	236	20,303		
09-Apr-20	08 00	EW1,2 MW1,2,5,6,10,12,15	125		125	847	-	**847**	972	20,428		
09-Apr-20	10 00	EW1,2 MW1,2,5,6,10,12,15	0		0	0	-	**0**	0	20,428	222	4,000
09-Apr-20	13 50	EW1,2 MW1,2,5,6,10,12,15	43		43	1804	-	**1804**	1,847	20,471		
09-Apr-20	14:40	EW1,2 MW1,2,5,6,10,12,15	28		28	97	-	**97**	125	20,499		
12-Apr-20	09 05	EW1,2 MW1,2,5,6,10,12,15	389		389	2623	-	**2623**	3,012	20,888		
14-Apr-20	07 50	EW1,2 MW1,2	125		125	1721	-	**1721**	1,846	21,013	5,450	4,700
16-Apr-20	07 35	EW1,2 MW1,2	0		0	0	-	**0**	0	21,013		
20-Apr-20	07:45	EW1,2 MW1,2	97		97	2790	-	**2790**	2,887	21,110		
20-Apr-20	16 20	EW1 2 MW1 2	0		0	0	-	**0**	0	21,110		
21-Apr-20	08 00	MW12 & MW15	0		0	0	-	**0**	0	21,110		
21-Apr-20	12 30	MW12 & MW15	42		42	28	-	**28**	69	21,151		
22-Apr-20	07 30	MW12 & MW15	236		236	1707	-	**1707**	1,943	21,387		
22-Apr-20	12:10	MW12 & MW15	319		319	770	-	**770**	1,089	21,707		6,100
26-Apr-20	12 55	Systen Shutdown (am)	56		56	10410	-	**10410**	10,466	21,762		
27-Apr-20	12 00	-	0		0	0	-	**0**	0	21,762	30	3,970
28-Apr-20	15 50	-	0		0	0	-	**0**	0	21,762		1,950
29-Apr-20	06 30	-	0		0	0	-	**0**	0	21,762		2,000
29-Apr-20	13 35	-	0		0	0	-	**0**	0	21,762	28	2,072
29-Apr-20	13 55	System re-start @ 14:00	0		0	0	-	**0**	0	21,762		
30-Apr-20	08:45	pre	97		97	2221	-	**2221**	2,318	21,859		1,900
30-Apr-20	09 30	Post	14		14	57	-	**57**	71	21,873		
30-Apr-20	11:45	pre	0		0	264	-	**264**	264	21,873		1,950
30-Apr-20	12:45	post	14		14	35	-	**35**	49	21,887		
04-May-20	09 00	EW1,2 MW1,2,5,6,10,12,15	167		167	6857	-	**6857**	7,023	22,054		
04-May-20	17:10	EW1,2 MW1,2,5,6,10,12,15	12		12	1261	-	**1261**	1,273	22,066		
05-May-20	14 00	EW1,2 MW1,2,5,6,10,12,15	0		0	0	-	**0**	0	22,066		2,000
06-May-20	17 00	EW1,2 MW1,2,5,6,10,12,15	0		0	0	-	**0**	0	22,066		6,000
12-May-20	17 00	EW1,2 MW1,2,5,6,10,12,15	638		638	11354	-	**11354**	11,992	22,704		500
13-May-20	17 00	EW1, MW1, MW2, MW5, MW8, MW10 (All Raised)	0		0	0	-	**0**	0	22,704	1,800	5,400
18-May-20	17 00	MW1, MW2, MW5, MW8, MW10	97		97	2052	-	**2052**	2,150	22,801		1,400
26-May-20	17 00	MW1, MW2, MW5, MW8, MW10	14		14	4719	-	**4719**	4,733	22,815		3,600
02-Jun-20	08 00	MW1, MW2, MW5, MW7, MW10	278		278	1102	-	**1102**	1,379	23,093		
02-Jun-20	10 00	MW1, MW2, MW5, MW7, MW10	0		0	0	-	**0**	0	23,093	28	1,372
15-Jun-20	10 00	MW1 MW2 MW5 MW10	125		125	1652	-	**1652**	1 777	23,218		2,000
15-Jun-20	13 00	MW1, MW2, MW5, MW10	14		14	29	-	**29**	43	23,232		
16-Jun-20	08 00	MW1, MW2, MW5, MW10	14		14	430	-	**430**	444	23,246		
22-Jun-20	07 00	MW1, MW2, MW5, MW10	28		28	5066	-	**5066**	5,094	23,273		
23-Jun-20	13 30	MW1 MW2 MW5 MW10	0		0	0	-	**0**	0	23,273	541	5,000
29-Jun-20	07 30	MW1 MW2 MW5 MW10	236		236	2262	-	**2262**	2 498	23,509		
29-Jun-20	12 00	MW1 MW2 MW5 MW10	0		0	0	-	**0**	0	23,509	236	4,164
09-Jul-20	08 00	MW1, MW2, MW5, MW10	42		42	5038	-	**5038**	5,080	23,551		
09-Jul-20	12 00	MW1, MW2, MW5, MW10	0		0	0	-	**0**	0	23,551		3,846
23-Jul-20	09 00	MW1, MW2, MW5, MW10	0		0	6302	-	**6302**	6,302	23,551		
24-Jul-20	10 00	MW1 MW2 MW5 MW10	0		0	0	-	**0**	0	23,551		4,000
28-Jul-20	18 00	EW01 MW01 MW10	0		0	6399	-	**6399**	6 399	23,551		
29-Jul-20	16 00	EW01 MW01 MW10	0		0	0	-	**0**	0	23,551		5,600

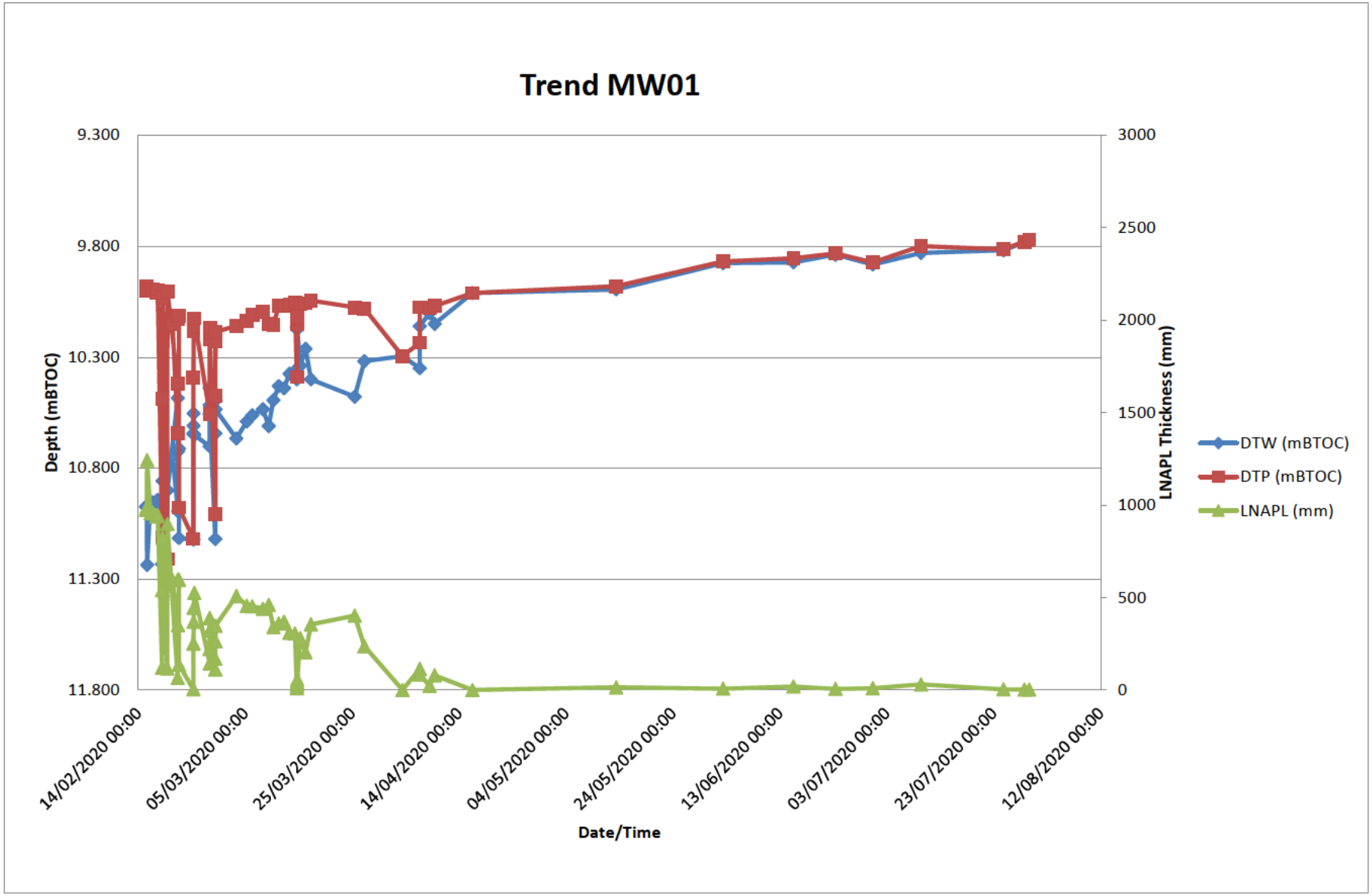
Attachment B – Groundwater Trends and Gauging Data

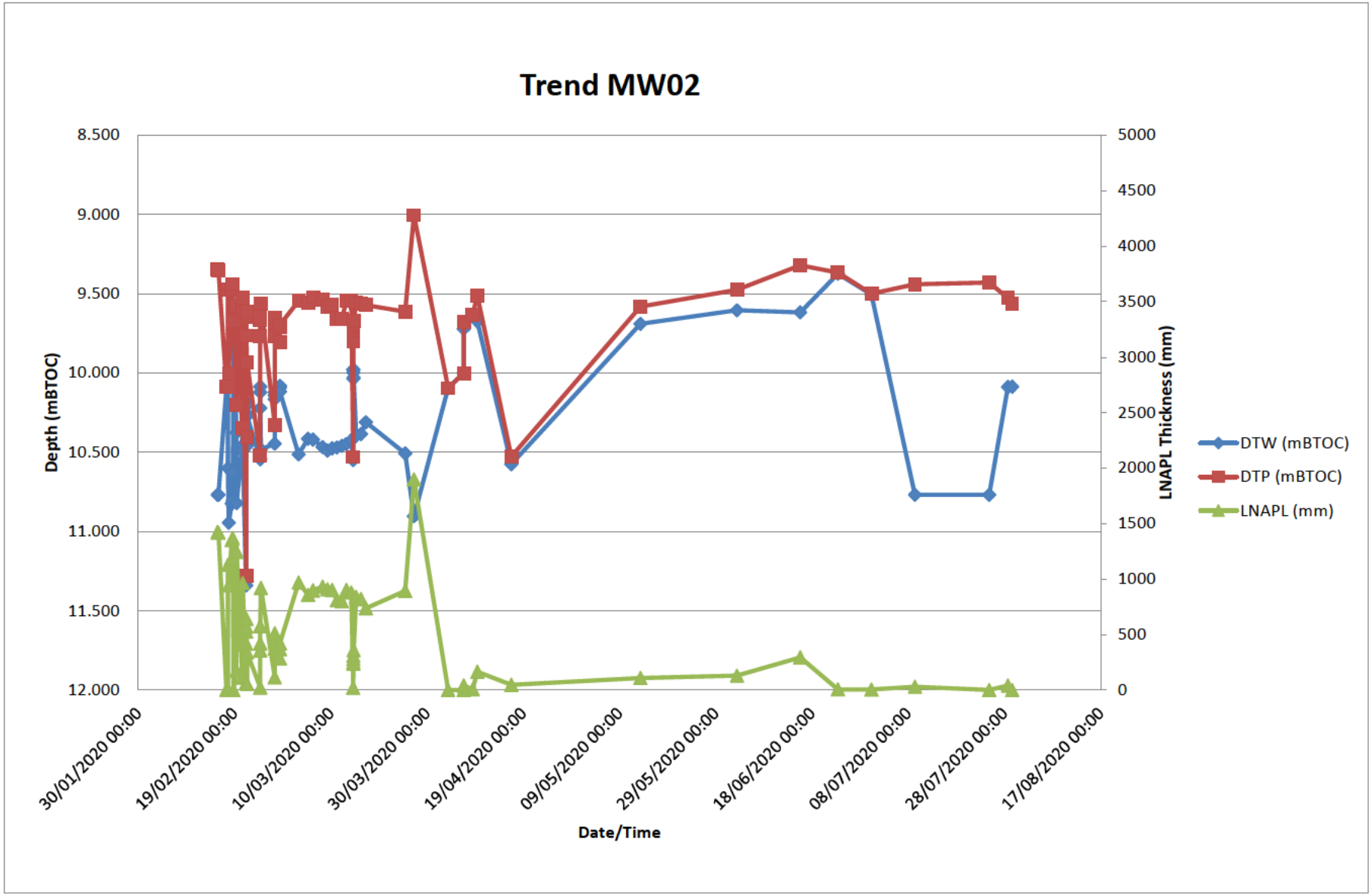
Monthly Summary Report

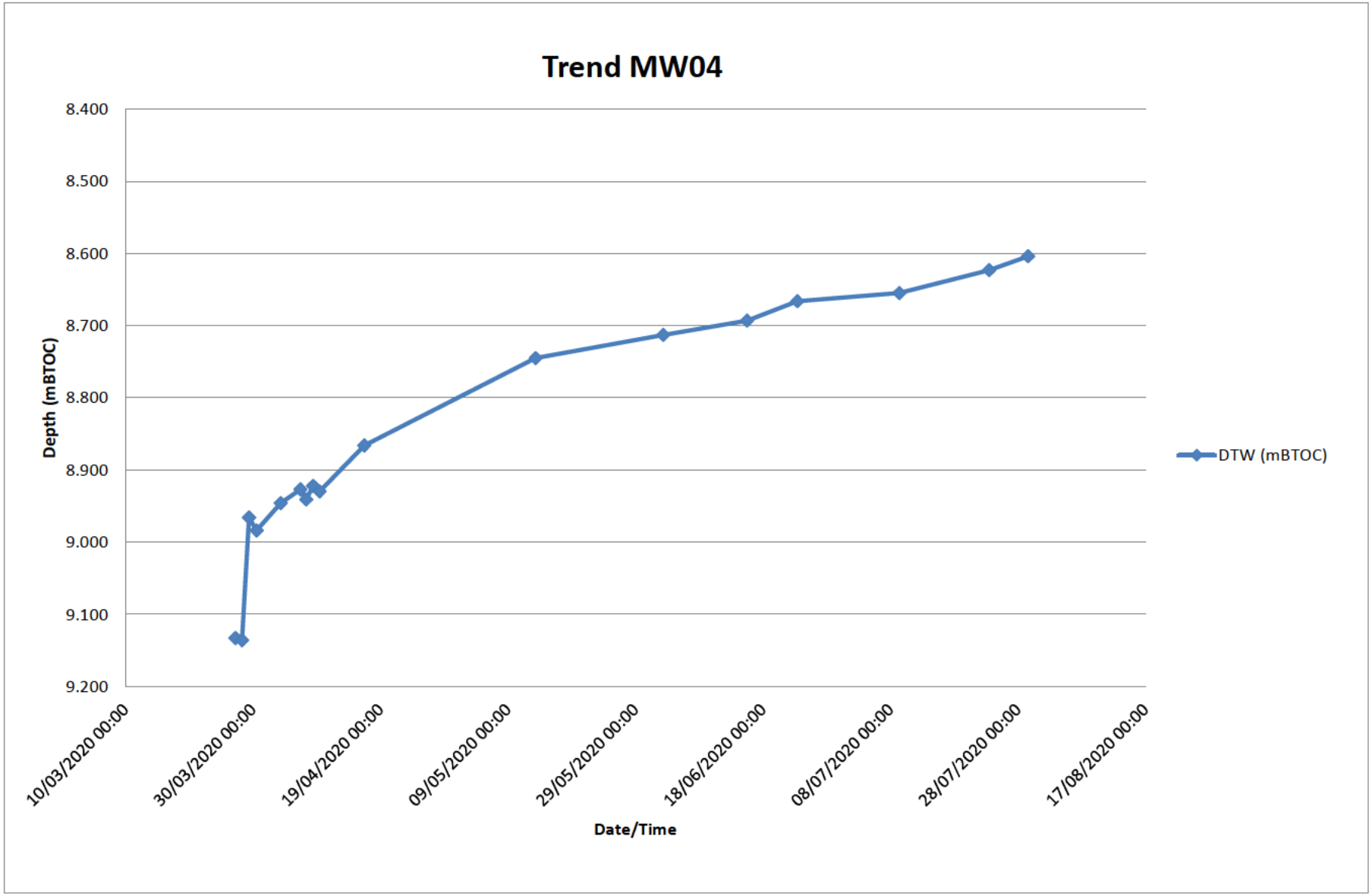

Trend EW01
Depth (mBTOC)
8.500
9.000
9.500
10.000
10.500
11.000
11.500
12.000
12.500
13.000
13.500
LNAPL Thickness (mm)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
14/02/2020 00:00
05/03/2020 00:00
25/03/2020 00:00
14/04/2020 00:00
04/05/2020 00:00
24/05/2020 00:00
13/06/2020 00:00
03/07/2020 00:00
23/07/2020 00:00
12/08/2020 00:00
Date/Time
DTW (mBTOC)
DTP (mBTOC)
LNAPL (mm)

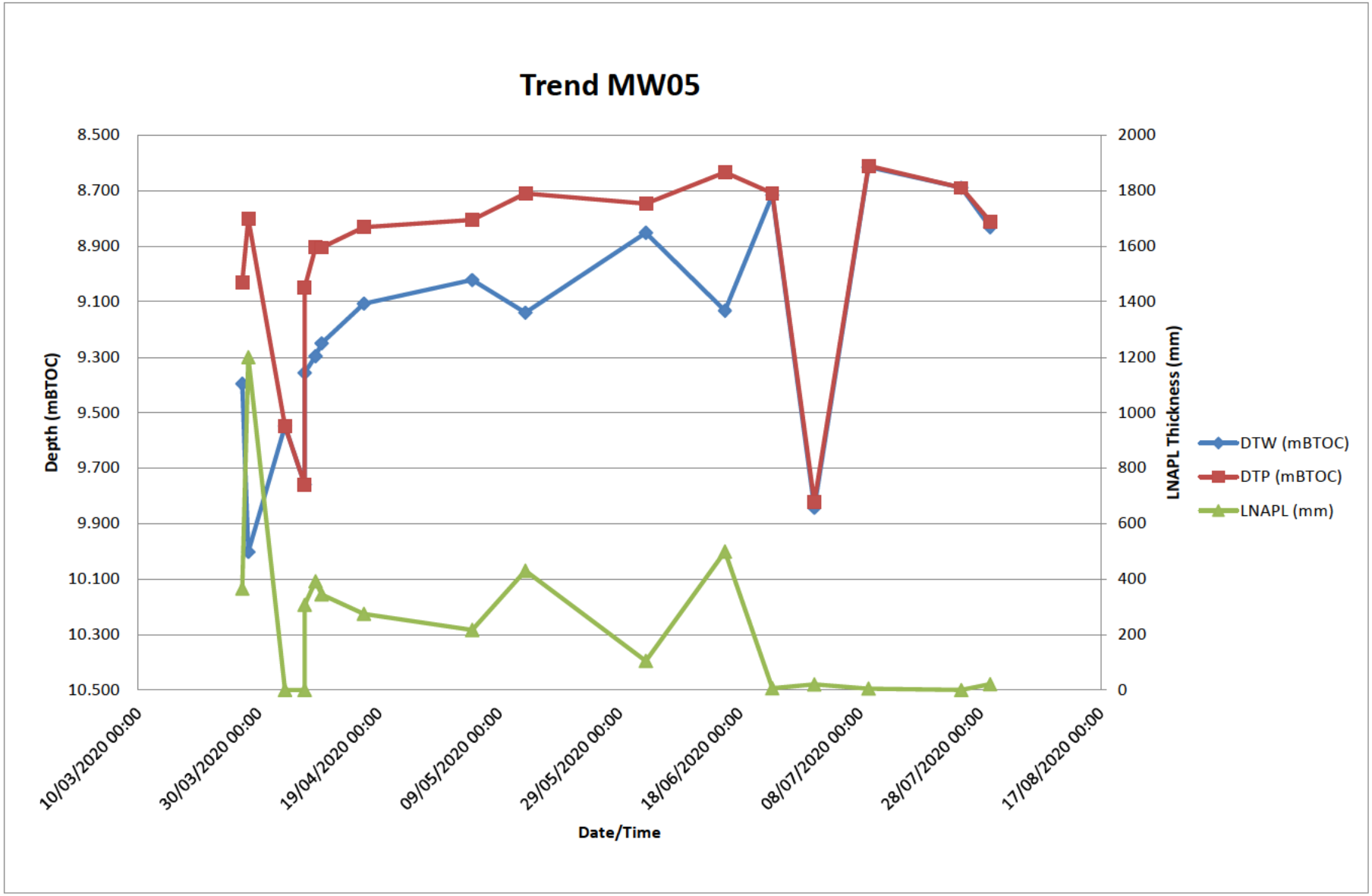

Trend EW02
6.000
7.000
8.000
9.000
10.000
11.000
12.000
Depth (mBTOC)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
LNAPL Thickness (mm)
14/02/2020 00:00
05/03/2020 00:00
25/03/2020 00:00
14/04/2020 00:00
04/05/2020 00:00
24/05/2020 00:00
13/06/2020 00:00
03/07/2020 00:00
23/07/2020 00:00
12/08/2020 00:00
Date/Time
DTW (mBTOC)
DTP (mBTOC)
LNAPL (mm)

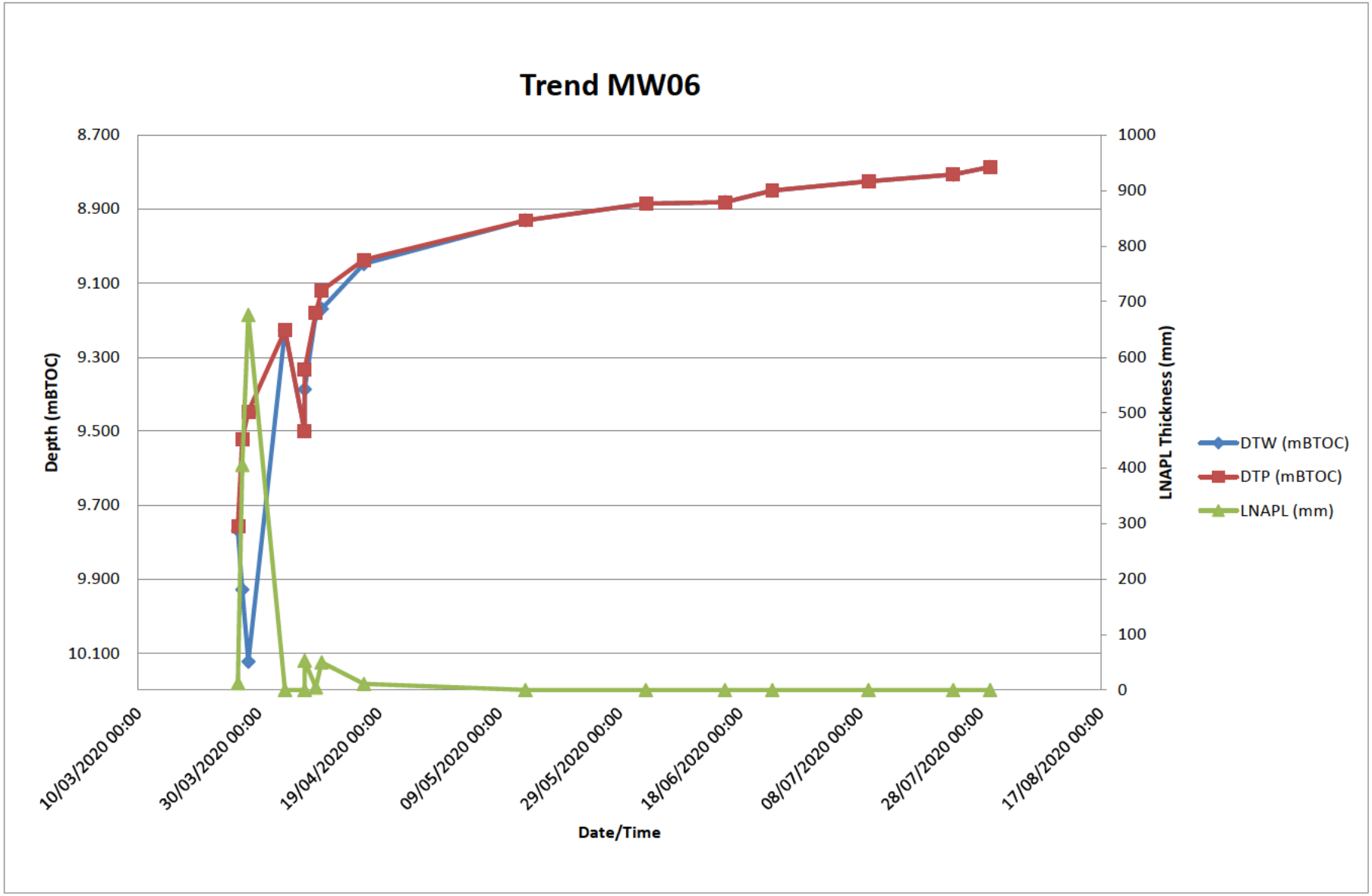

Trend EW03
9.000
9.200
9.400
9.600
9.800
10.000
10.200
10.400
Depth (mBTOC)
14/02/2020 00:00
05/03/2020 00:00
25/03/2020 00:00
14/04/2020 00:00
04/05/2020 00:00
24/05/2020 00:00
13/06/2020 00:00
03/07/2020 00:00
23/07/2020 00:00
12/08/2020 00:00
Date/Time
DTW (mBTOC)

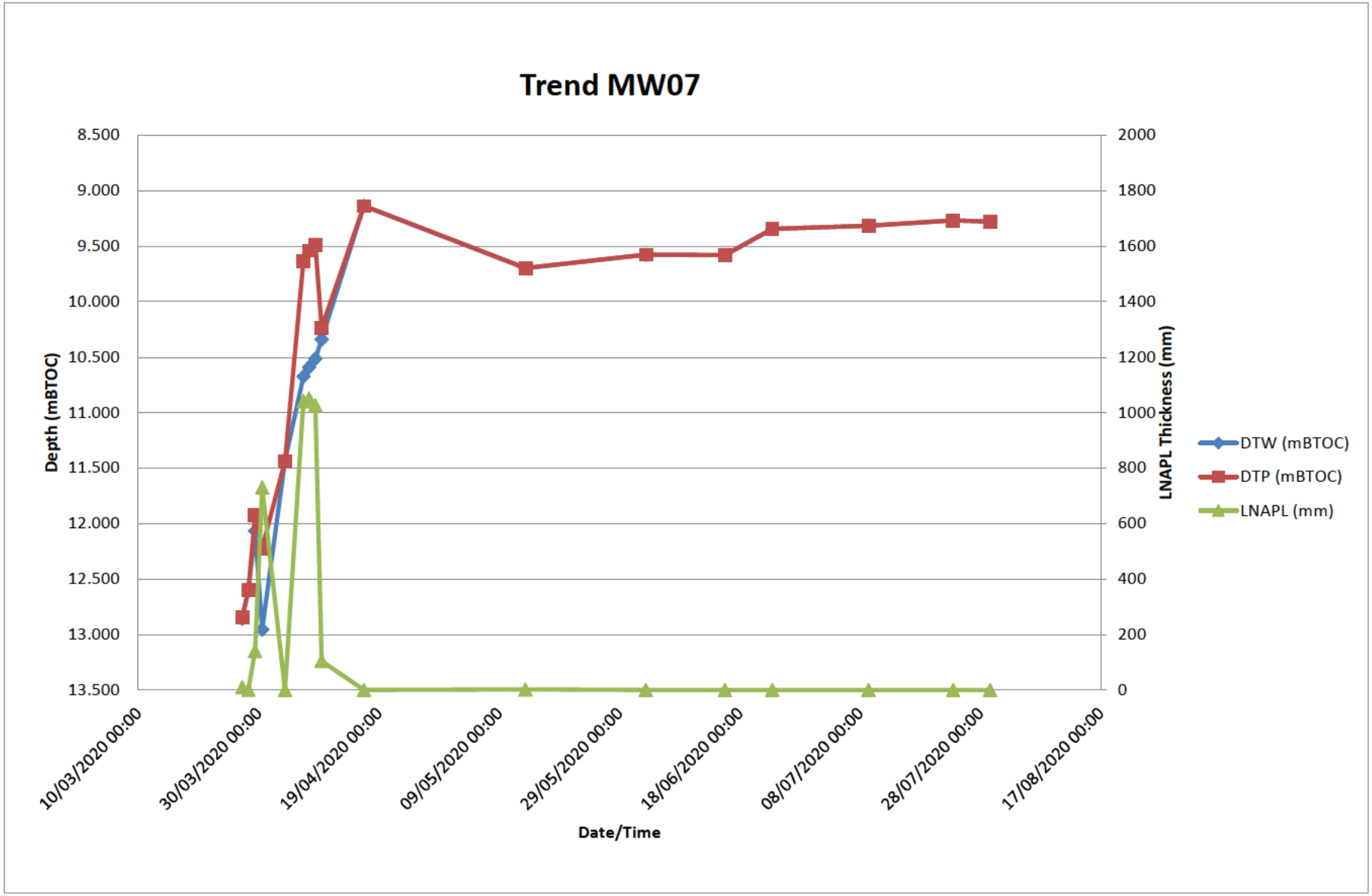

Trend MW01
9.300
9.800
10.300
10.800
11.300
11.800
Depth (mBTOC)
3000
2500
2000
1500
1000
500
0
LNAPL Thickness (mm)
14/02/2020 00:00
05/03/2020 00:00
25/03/2020 00:00
14/04/2020 00:00
04/05/2020 00:00
24/05/2020 00:00
13/06/2020 00:00
03/07/2020 00:00
23/07/2020 00:00
12/08/2020 00:00
Date/Time
DTW (mBTOC)
DTP (mBTOC)
LNAPL (mm)

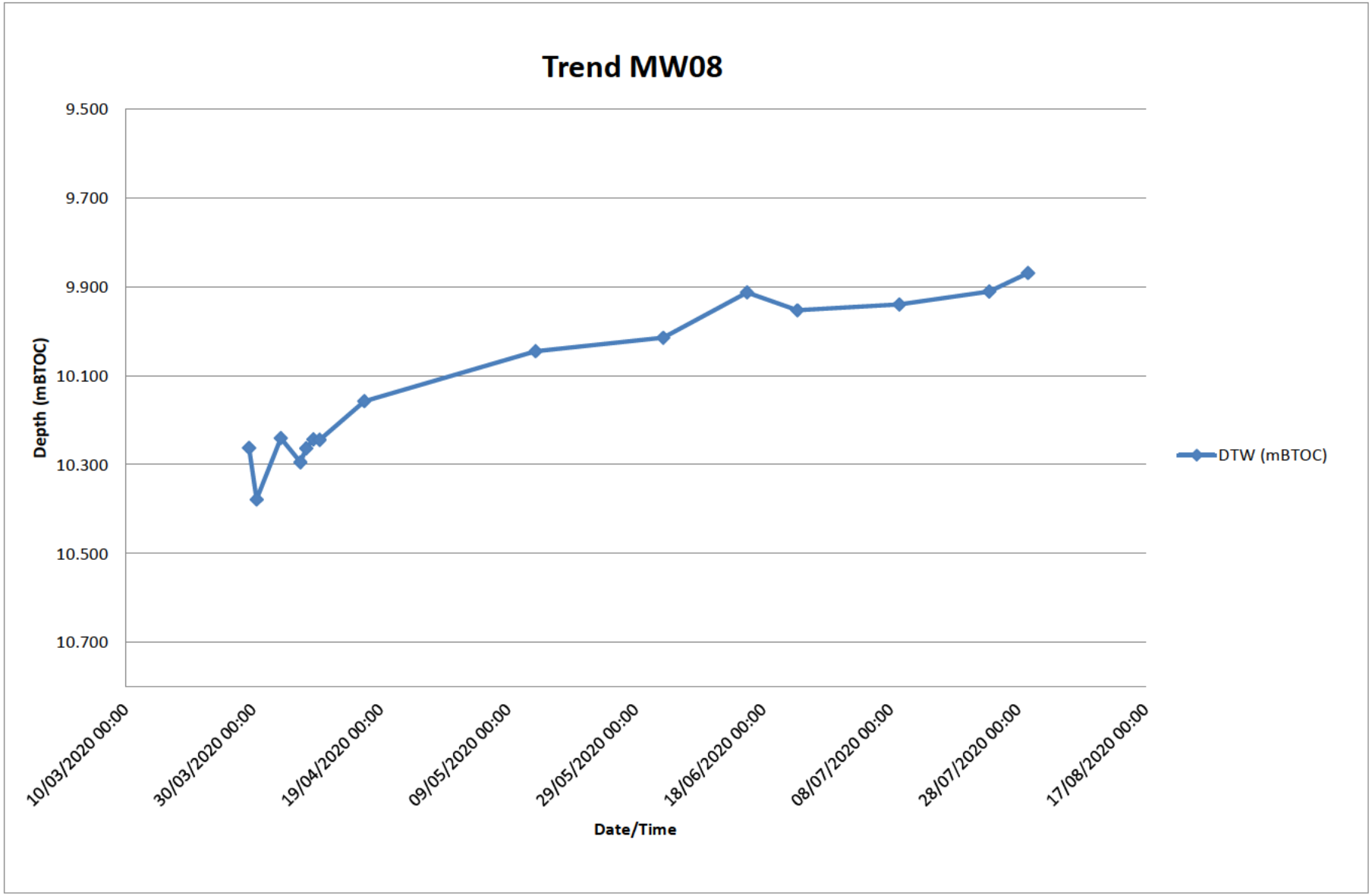

Trend MW02
Depth (mBTOC)
8.500
9.000
9.500
10.000
10.500
11.000
11.500
12.000
LNAPL Thickness (mm)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
30/01/2020 00:00
19/02/2020 00:00
10/03/2020 00:00
30/03/2020 00:00
19/04/2020 00:00
09/05/2020 00:00
29/05/2020 00:00
18/06/2020 00:00
08/07/2020 00:00
28/07/2020 00:00
17/08/2020 00:00
Date/Time
DTW (mBTOC)
DTP (mBTOC)
LNAPL (mm)

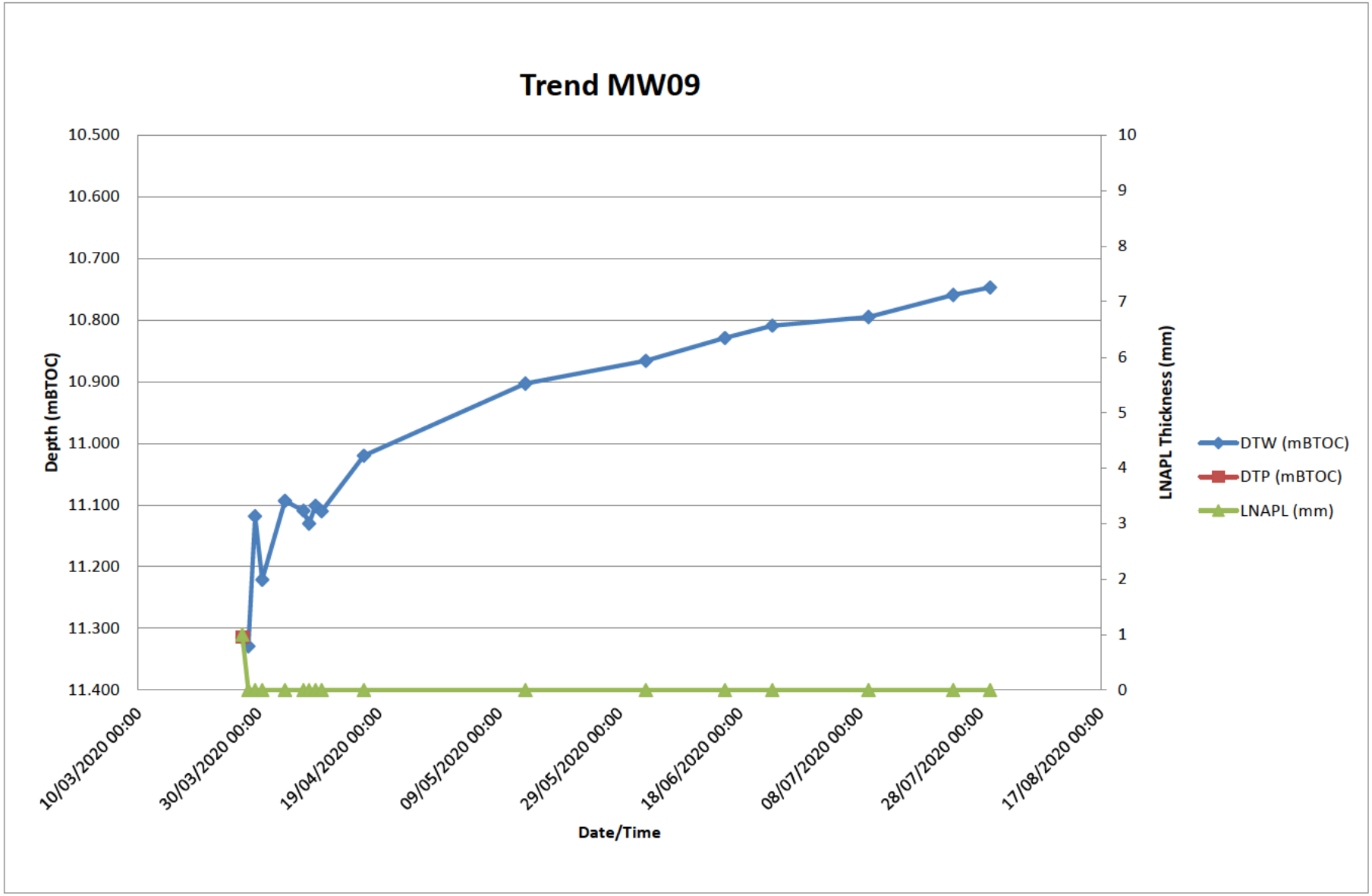

Trend MW04
8.400
8.500
8.600
8.700
8.800
8.900
9.000
9.100
9.200
Depth (mBTOC)
10/03/2020 00:00
30/03/2020 00:00
19/04/2020 00:00
09/05/2020 00:00
29/05/2020 00:00
18/06/2020 00:00
08/07/2020 00:00
28/07/2020 00:00
17/08/2020 00:00
Date/Time
DTW (mBTOC)

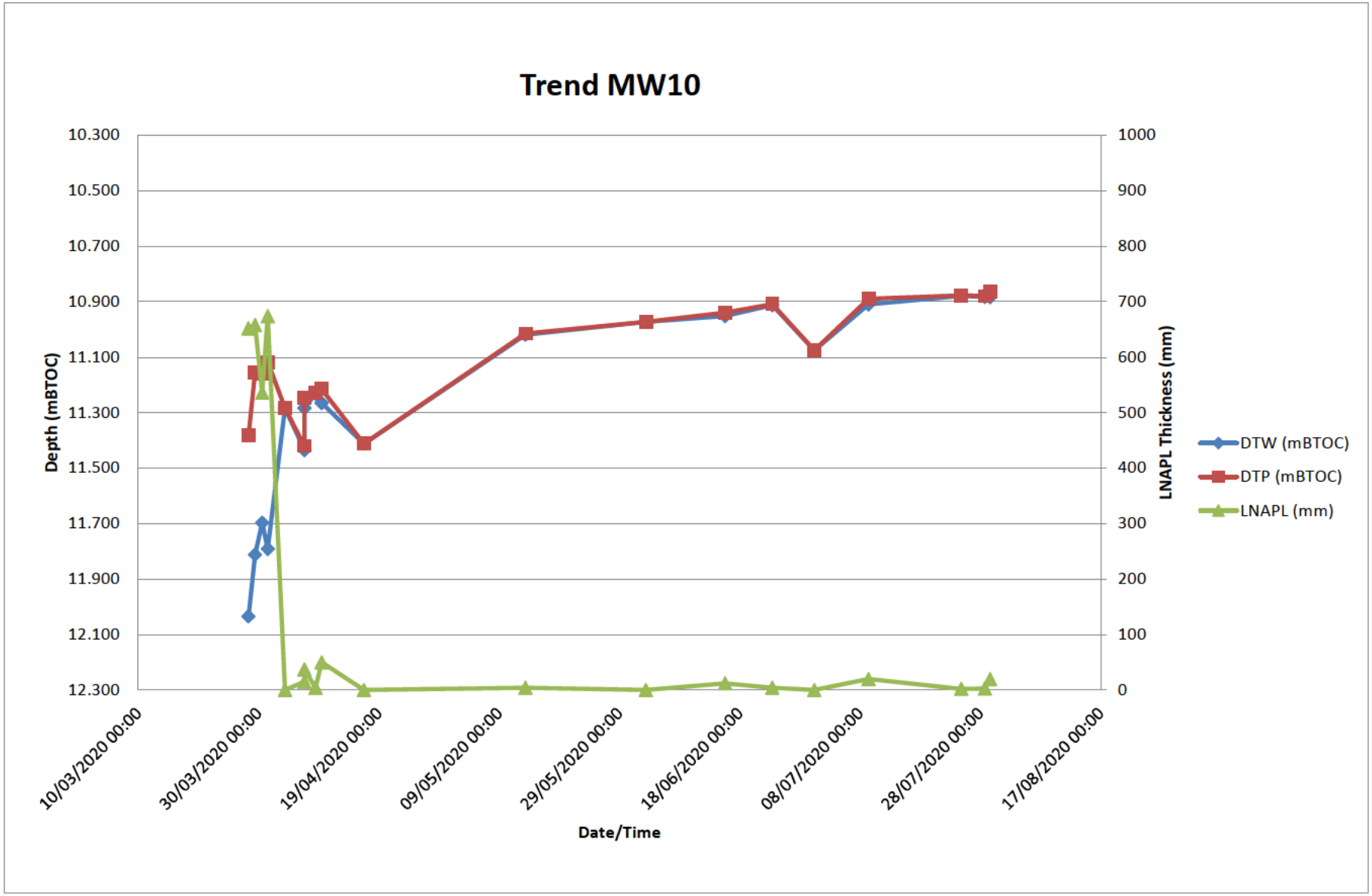

Trend MW05
Depth (mBTOC)
8.500
8.700
8.900
9.100
9.300
9.500
9.700
9.900
10.100
10.300
10.500
LNAPL Thickness (mm)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
10/03/2020 00:00
30/03/2020 00:00
19/04/2020 00:00
09/05/2020 00:00
29/05/2020 00:00
18/06/2020 00:00
08/07/2020 00:00
28/07/2020 00:00
17/08/2020 00:00
Date/Time
DTW (mBTOC)
DTP (mBTOC)
LNAPL (mm)

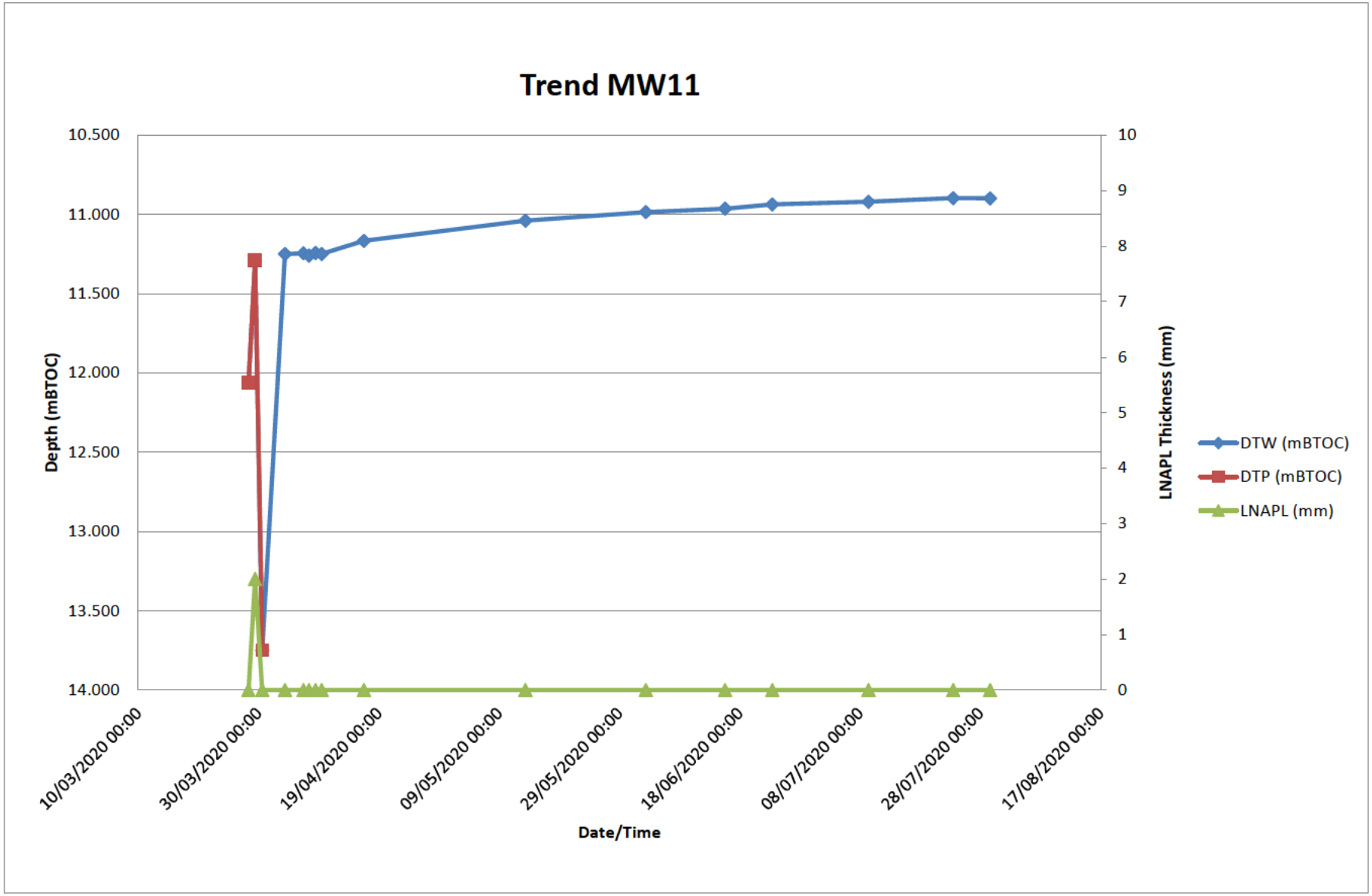

Trend MW06
Depth (mBTOC)
8.700
8.900
9.100
9.300
9.500
9.700
9.900
10.100
LNAPL Thickness (mm)
1000
900
800
700
600
500
400
300
200
100
0
10/03/2020 00:00
30/03/2020 00:00
19/04/2020 00:00
09/05/2020 00:00
29/05/2020 00:00
18/06/2020 00:00
08/07/2020 00:00
28/07/2020 00:00
17/08/2020 00:00
Date/Time
DTW (mBTOC)
DTP (mBTOC)
LNAPL (mm)

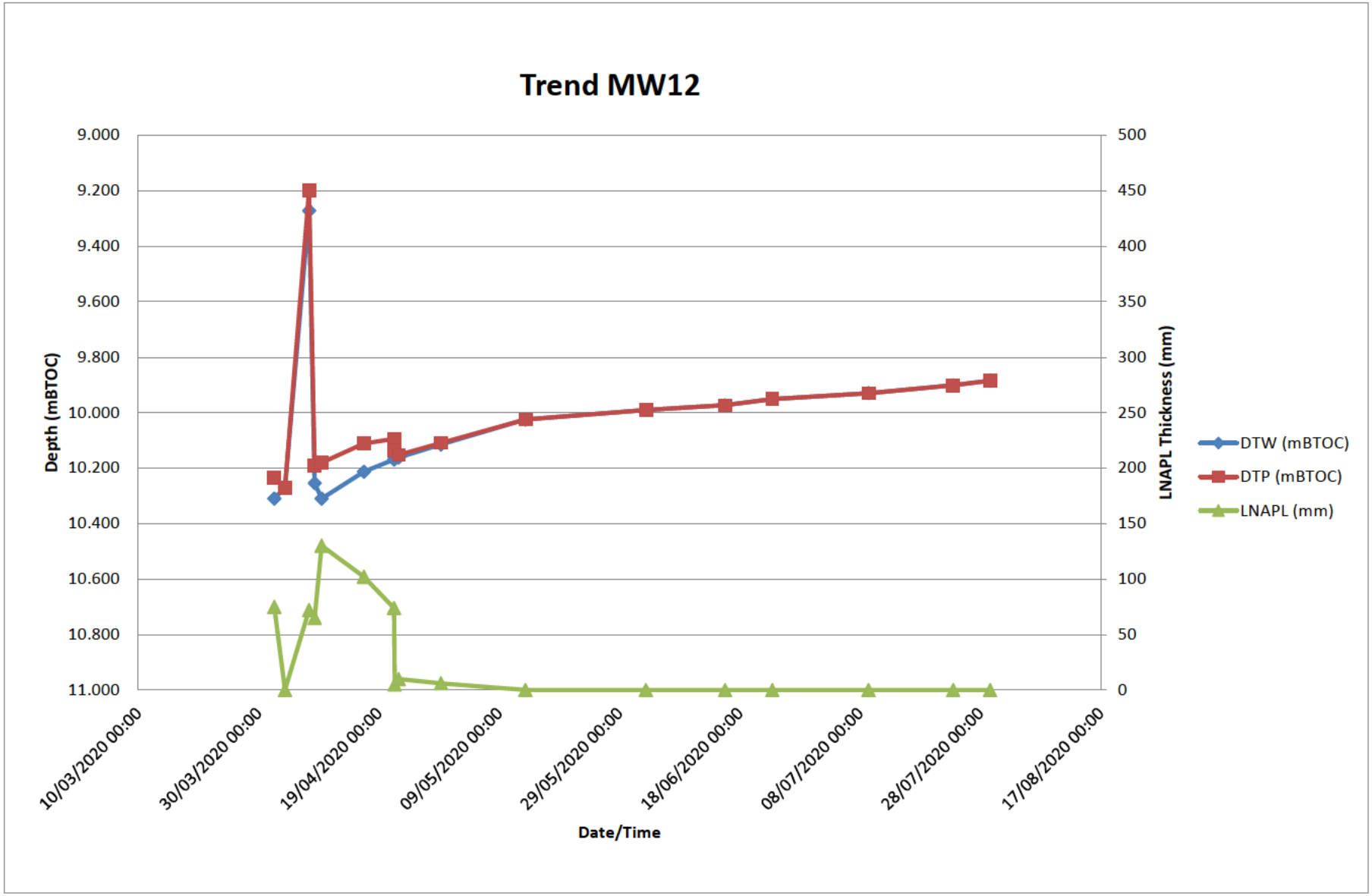

Trend MW07
8.500
9.000
9.500
10.000
10.500
11.000
11.500
12.000
12.500
13.000
13.500
Depth (mBTOC)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
LNAPL Thickness (mm)
10/03/2020 00:00
30/03/2020 00:00
19/04/2020 00:00
09/05/2020 00:00
29/05/2020 00:00
18/06/2020 00:00
08/07/2020 00:00
28/07/2020 00:00
17/08/2020 00:00
Date/Time
DTW (mBTOC)
DTP (mBTOC)
LNAPL (mm)

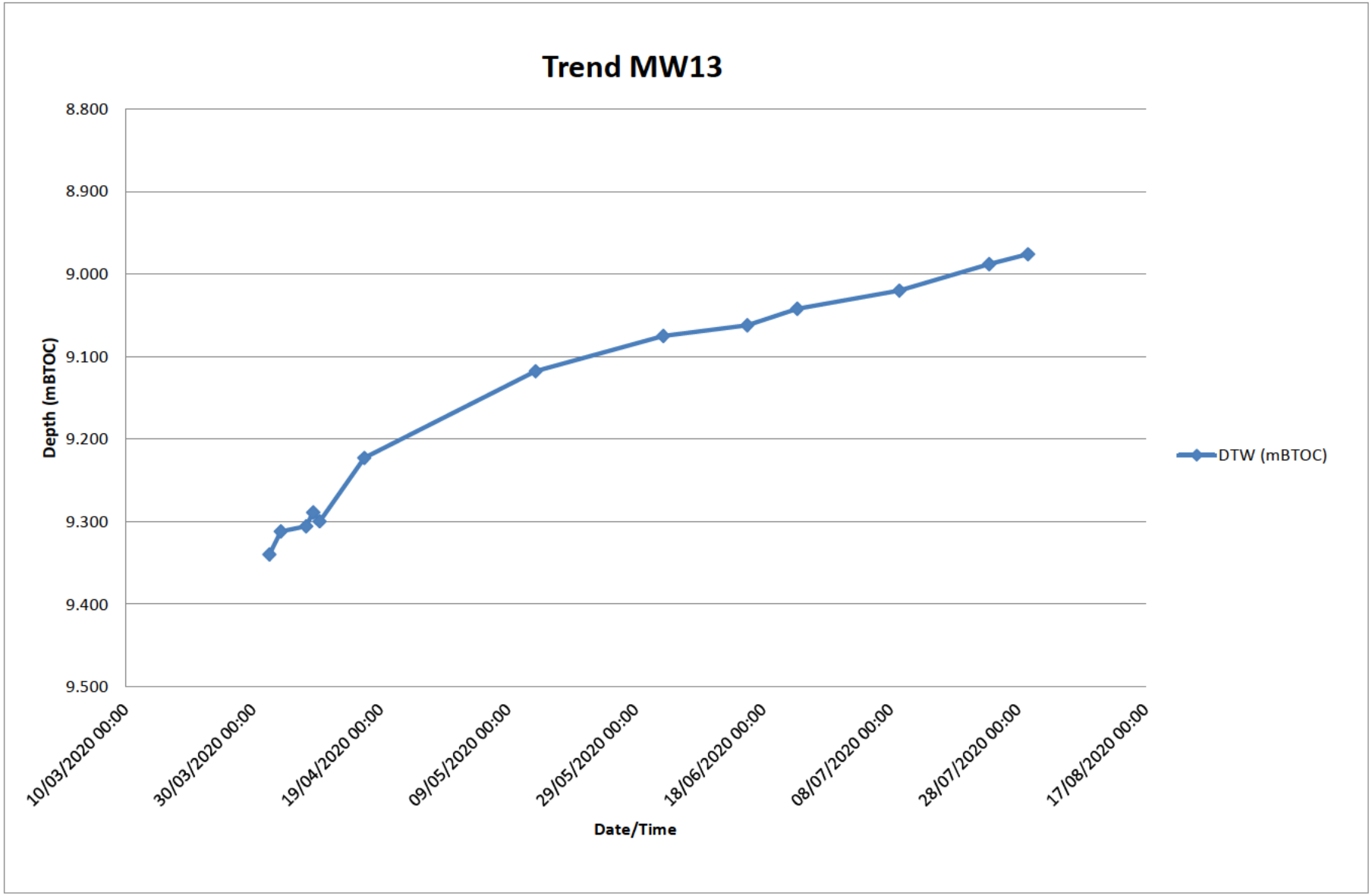

Trend MW08
9.500
9.700
9.900
10.100
10.300
10.500
10.700
Depth (mBTOC)
10/03/2020 00:00
30/03/2020 00:00
19/04/2020 00:00
09/05/2020 00:00
29/05/2020 00:00
18/06/2020 00:00
08/07/2020 00:00
28/07/2020 00:00
17/08/2020 00:00
Date/Time
DTW (mBTOC)

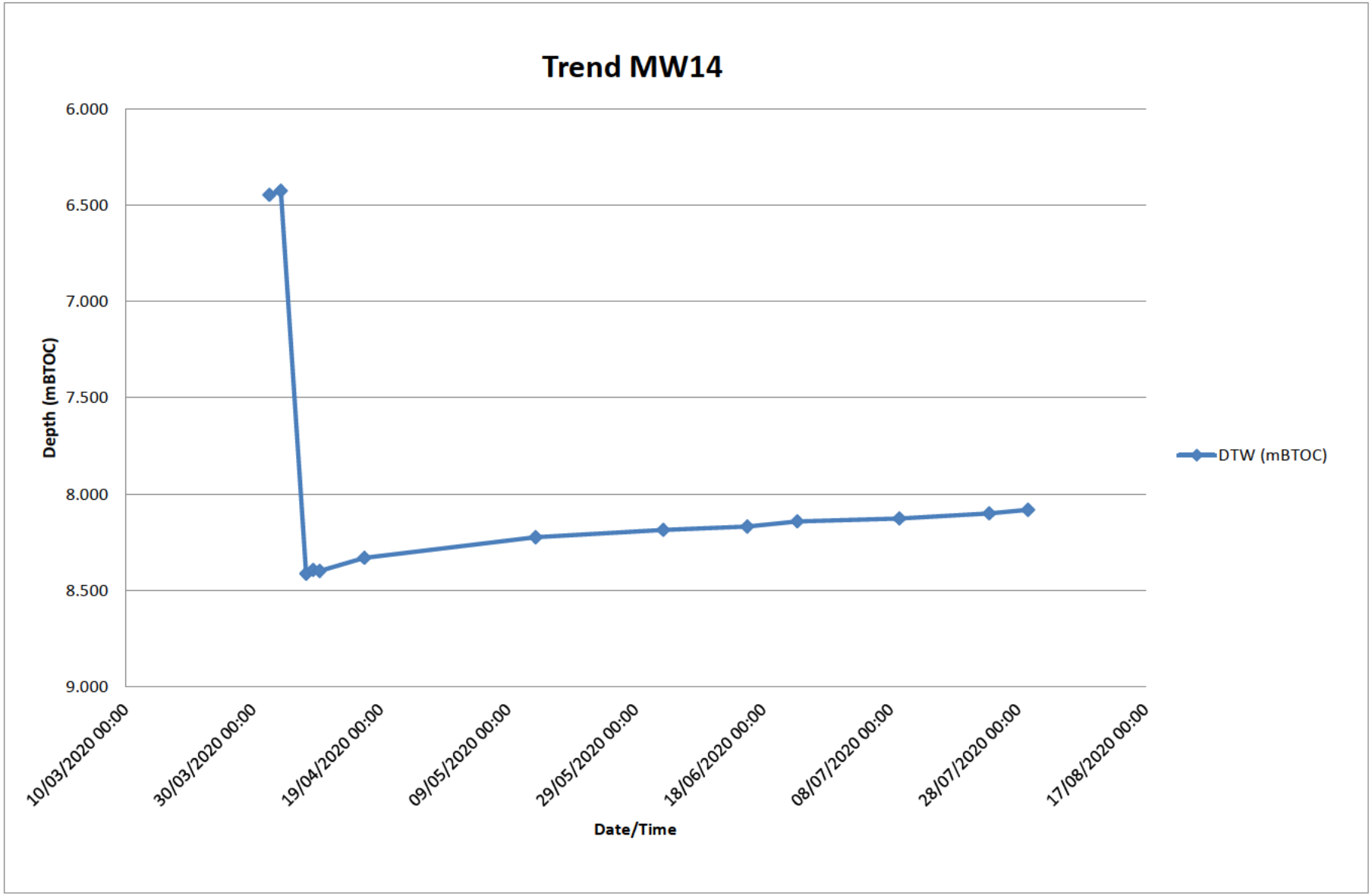

Trend MW09
Depth (mBTOC)
10.500
10.600
10.700
10.800
10.900
11.000
11.100
11.200
11.300
11.400
LNAPL Thickness (mm)
10
9
8
7
6
5
4
3
2
1
0
10/03/2020 00:00
30/03/2020 00:00
19/04/2020 00:00
09/05/2020 00:00
29/05/2020 00:00
18/06/2020 00:00
08/07/2020 00:00
28/07/2020 00:00
17/08/2020 00:00
Date/Time
DTW (mBTOC)
DTP (mBTOC)
LNAPL (mm)

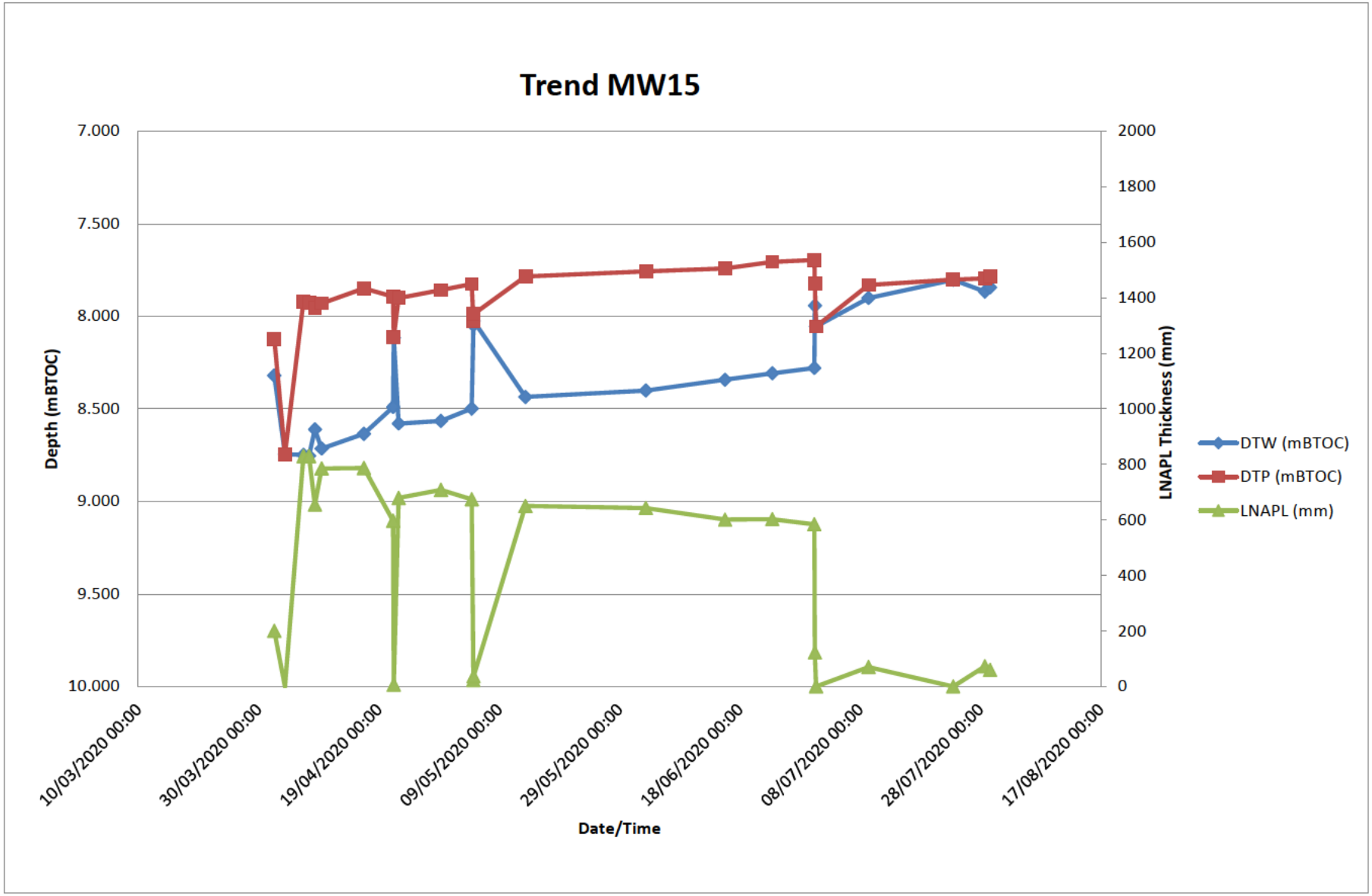

Trend MW10
Depth (mBTOC)
10.300
10.500
10.700
10.900
11.100
11.300
11.500
11.700
11.900
12.100
12.300
LNAPL Thickness (mm)
1000
900
800
700
600
500
400
300
200
100
0
10/03/2020 00:00
30/03/2020 00:00
19/04/2020 00:00
09/05/2020 00:00
29/05/2020 00:00
18/06/2020 00:00
08/07/2020 00:00
28/07/2020 00:00
17/08/2020 00:00
Date/Time
DTW (mBTOC)
DTP (mBTOC)
LNAPL (mm)

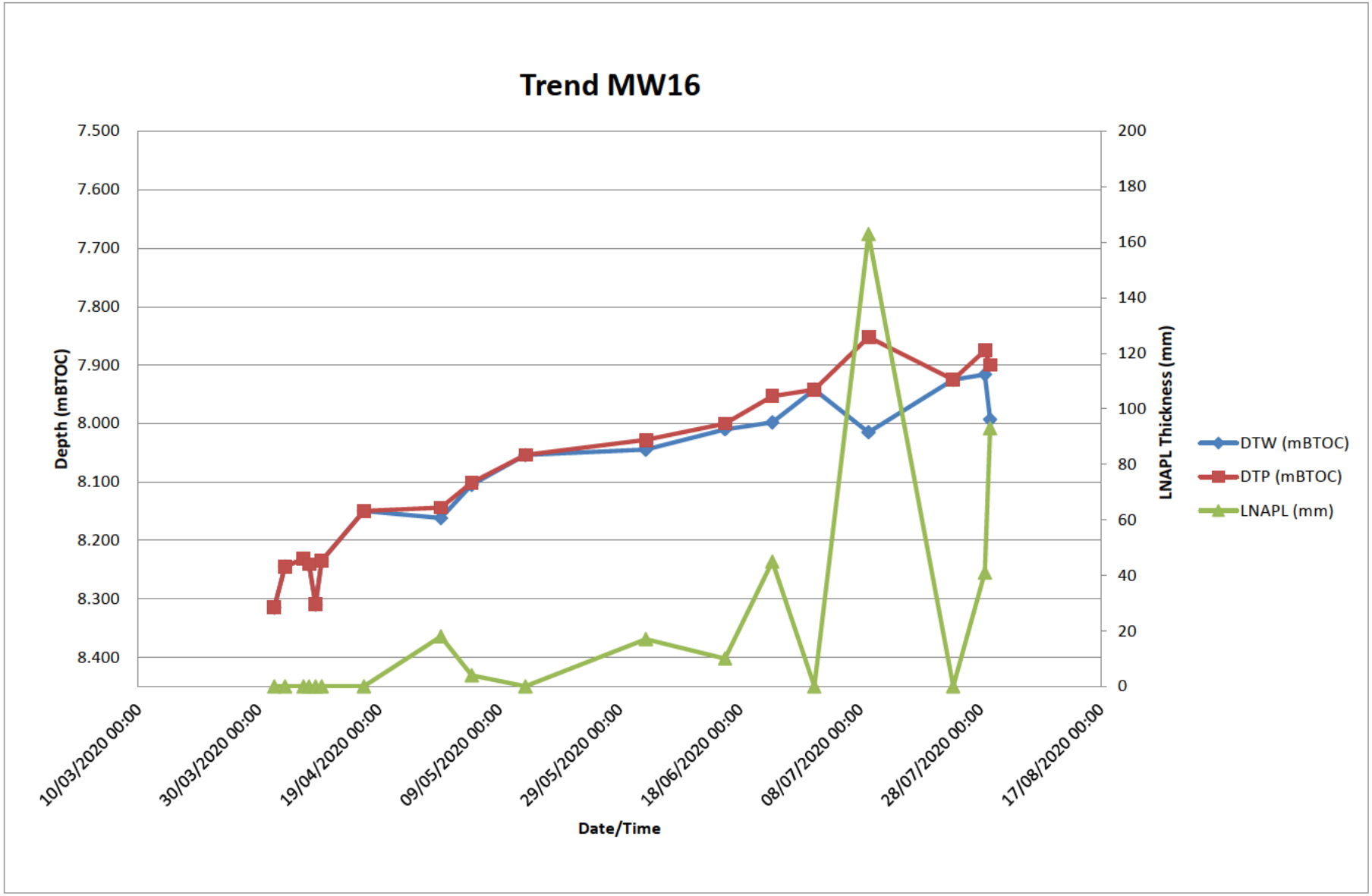

Trend MW11
Depth (mBTOC)
10.500
11.000
11.500
12.000
12.500
13.000
13.500
14.000
LNAPL Thickness (mm)
10
9
8
7
6
5
4
3
2
1
0
10/03/2020 00:00
30/03/2020 00:00
19/04/2020 00:00
09/05/2020 00:00
29/05/2020 00:00
18/06/2020 00:00
08/07/2020 00:00
28/07/2020 00:00
17/08/2020 00:00
Date/Time
DTW (mBTOC)
DTP (mBTOC)
LNAPL (mm)

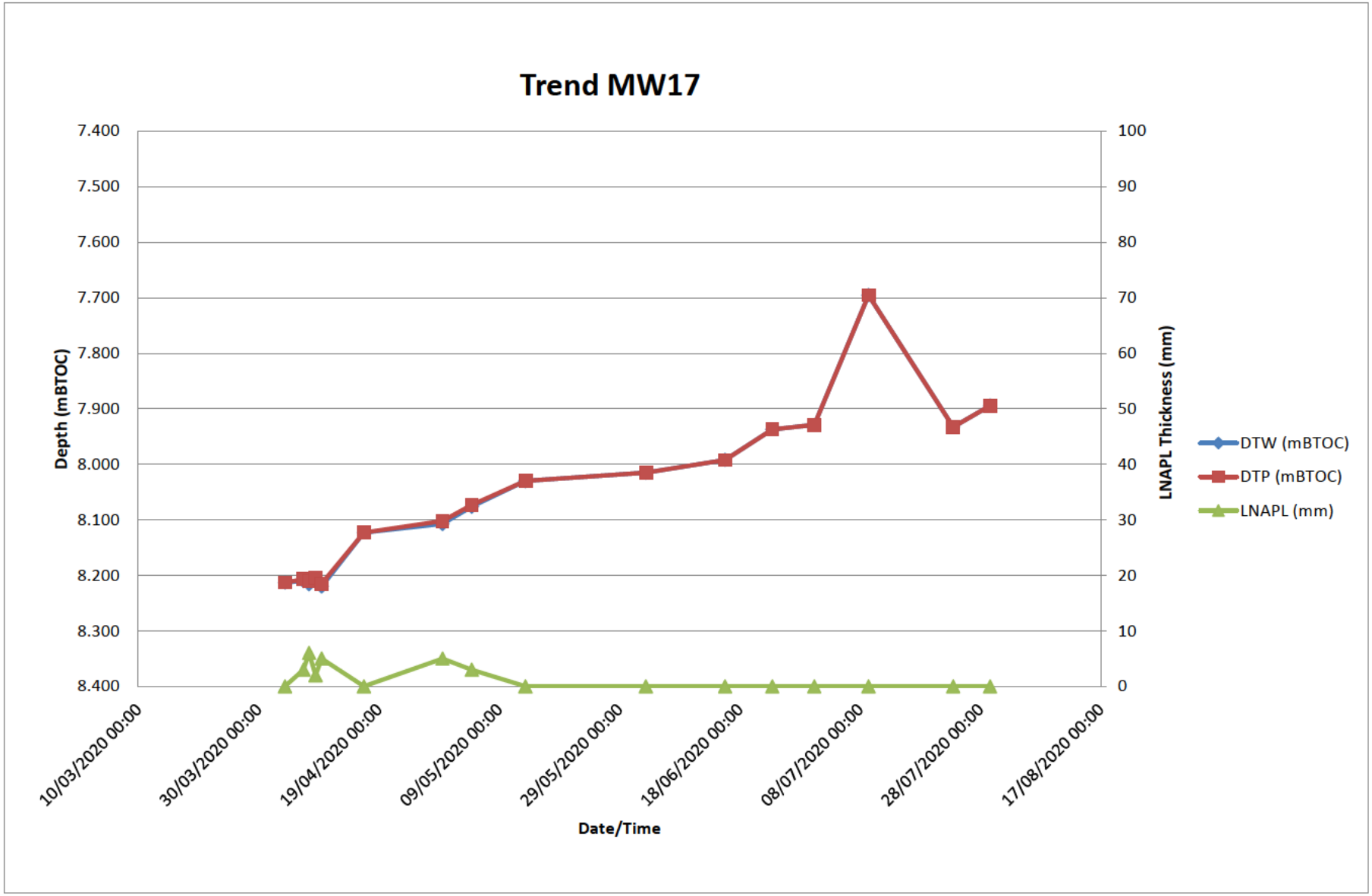

Trend MW12
Depth (mBTOC)
9.000
9.200
9.400
9.600
9.800
10.000
10.200
10.400
10.600
10.800
11.000
LNAPL Thickness (mm)
500
450
400
350
300
250
200
150
100
50
0
10/03/2020 00:00
30/03/2020 00:00
19/04/2020 00:00
09/05/2020 00:00
29/05/2020 00:00
18/06/2020 00:00
08/07/2020 00:00
28/07/2020 00:00
17/08/2020 00:00
Date/Time
DTW (mBTOC)
DTP (mBTOC)
LNAPL (mm)

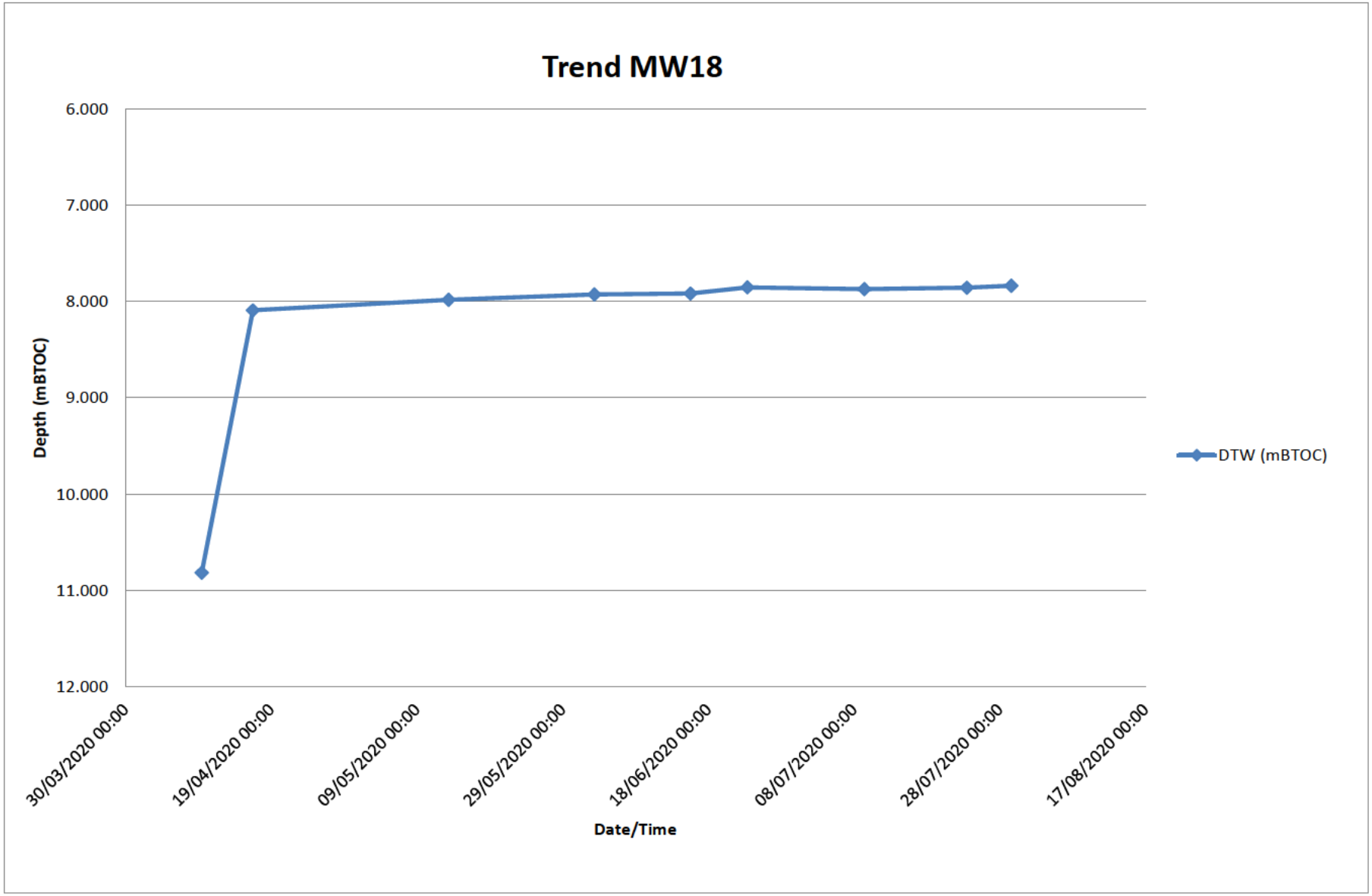

Trend MW13
8.800
8.900
9.000
9.100
9.200
9.300
9.400
9.500
Depth (mBTOC)
10/03/2020 00:00
30/03/2020 00:00
19/04/2020 00:00
09/05/2020 00:00
29/05/2020 00:00
18/06/2020 00:00
08/07/2020 00:00
28/07/2020 00:00
17/08/2020 00:00
Date/Time
DTW (mBTOC)

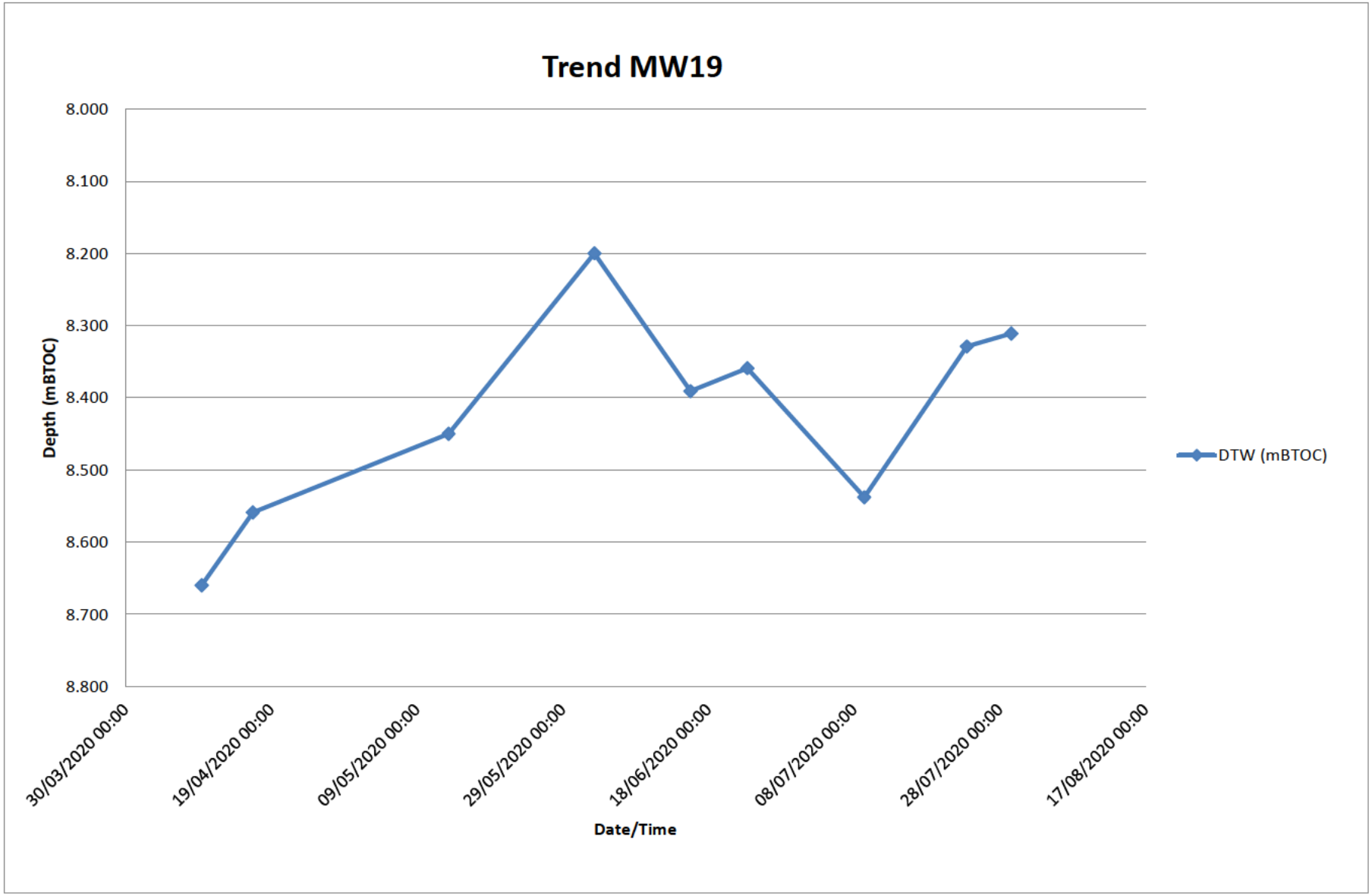

Trend MW14
6.000
6.500
7.000
7.500
8.000
8.500
9.000
Depth (mBTOC)
10/03/2020 00:00
30/03/2020 00:00
19/04/2020 00:00
09/05/2020 00:00
29/05/2020 00:00
18/06/2020 00:00
08/07/2020 00:00
28/07/2020 00:00
17/08/2020 00:00
Date/Time
DTW (mBTOC)

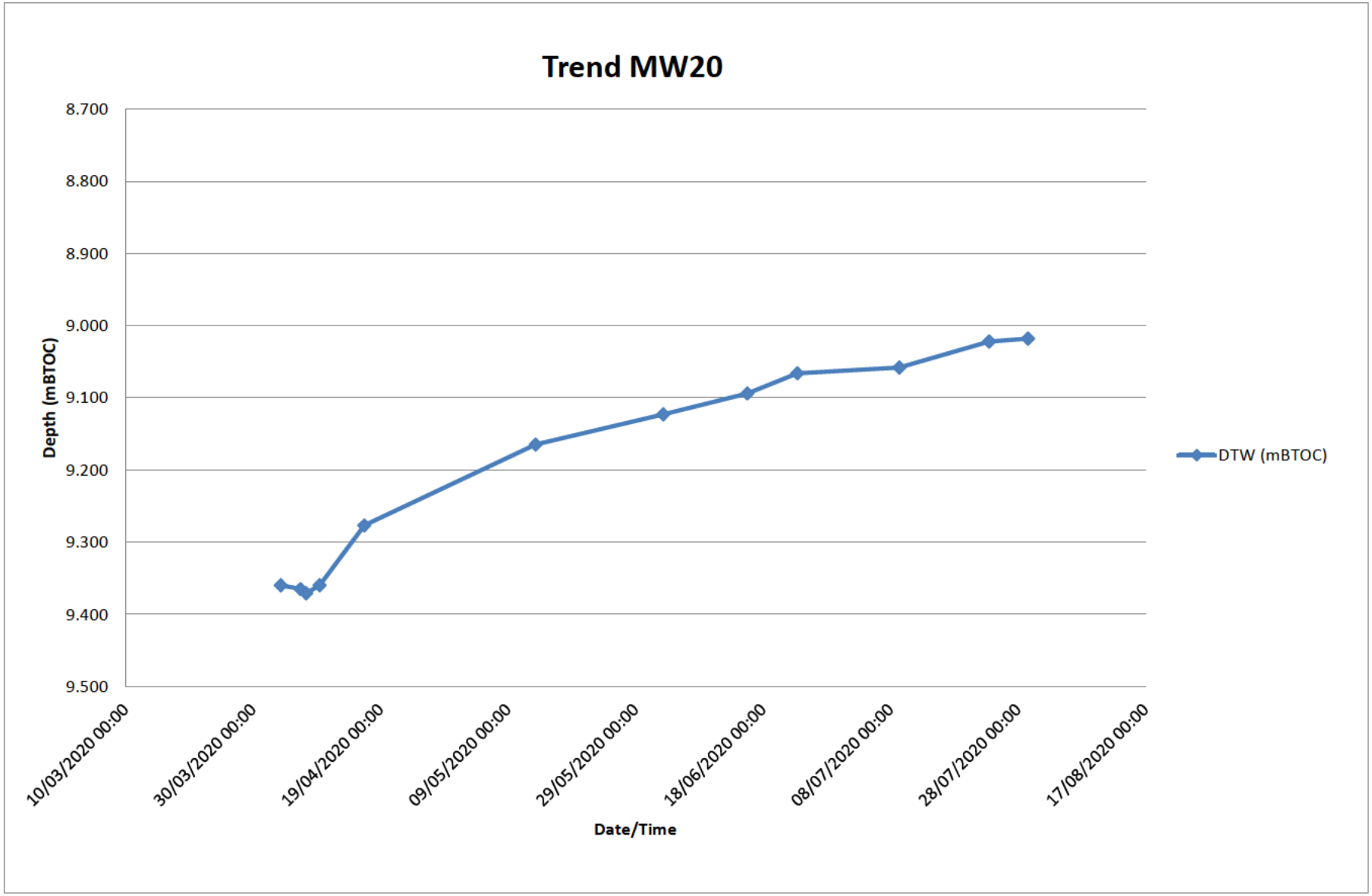

Trend MW15
7.000
7.500
8.000
8.500
9.000
9.500
10.000
Depth (mBTOC)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
LNAPL Thickness (mm)
10/03/2020 00:00
30/03/2020 00:00
19/04/2020 00:00
09/05/2020 00:00
29/05/2020 00:00
18/06/2020 00:00
08/07/2020 00:00
28/07/2020 00:00
17/08/2020 00:00
Date/Time
DTW (mBTOC)
DTP (mBTOC)
LNAPL (mm)

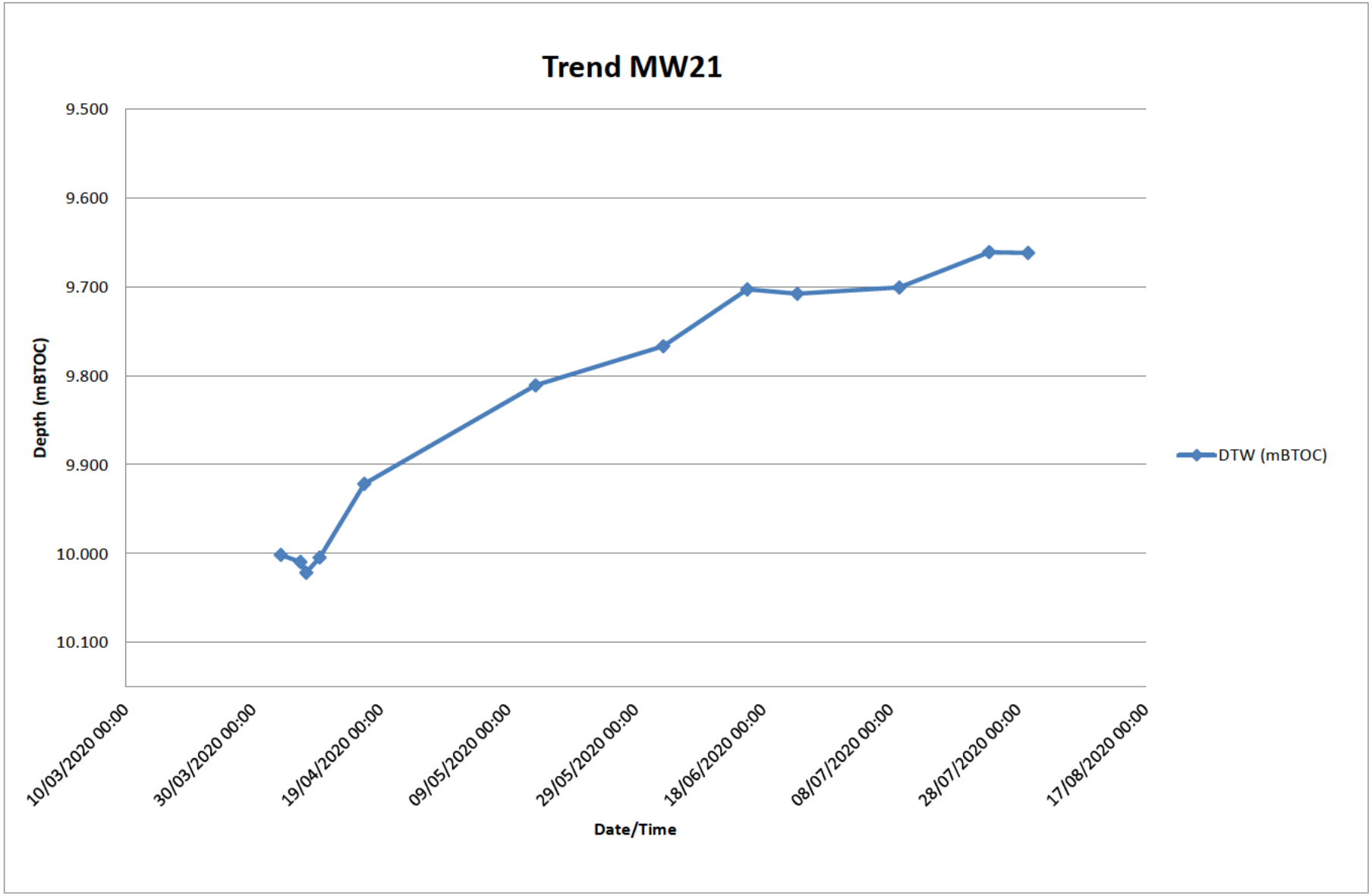

Trend MW16
Depth (mBTOC)
7.500
7.600
7.700
7.800
7.900
8.000
8.100
8.200
8.300
8.400
LNAPL Thickness (mm)
200
180
160
140
120
100
80
60
40
20
0
10/03/2020 00:00
30/03/2020 00:00
19/04/2020 00:00
09/05/2020 00:00
29/05/2020 00:00
18/06/2020 00:00
08/07/2020 00:00
28/07/2020 00:00
17/08/2020 00:00
Date/Time
DTW (mBTOC)
DTP (mBTOC)
LNAPL (mm)

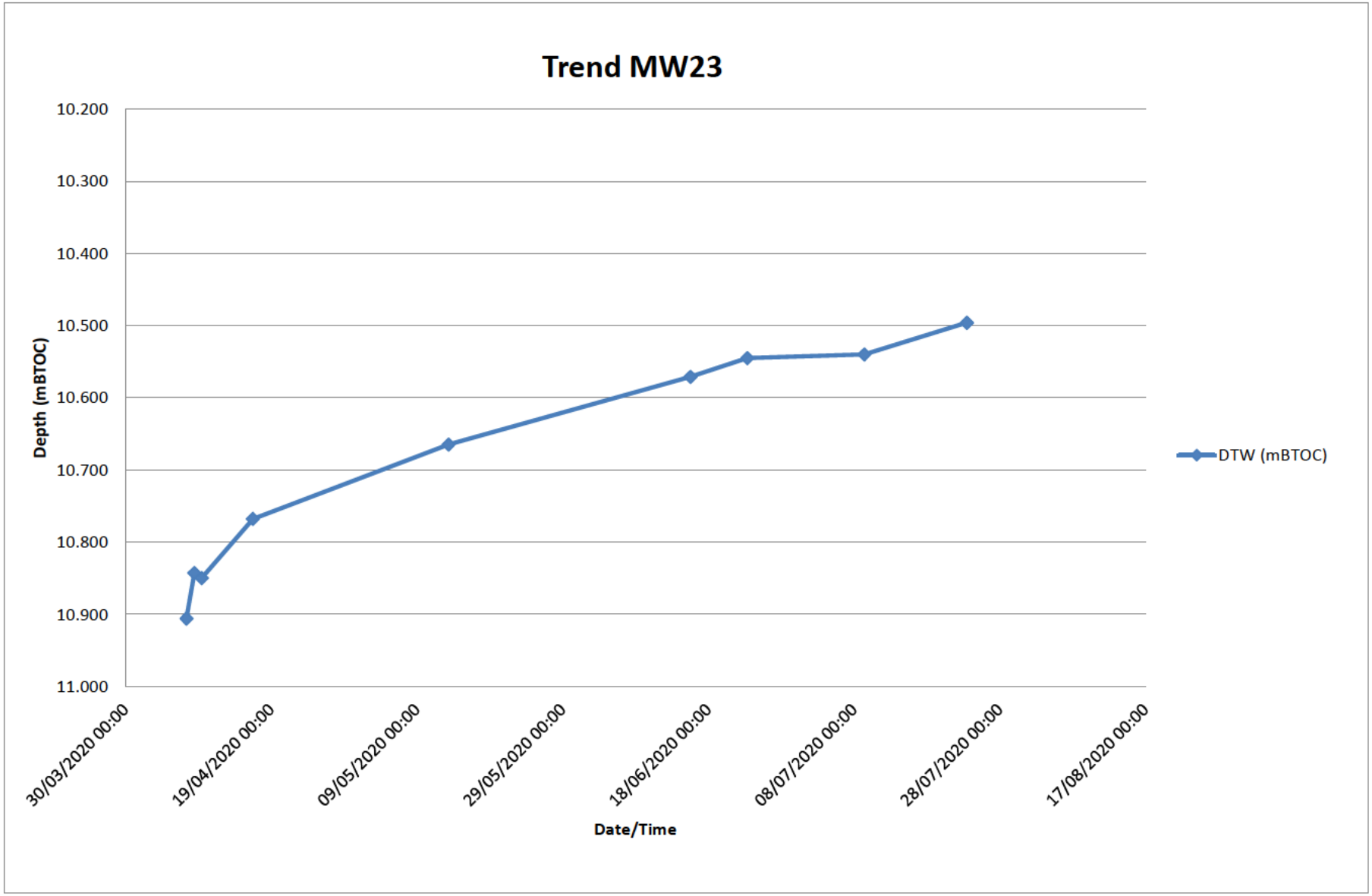

Trend MW17
Depth (mBTOC)
7.400
7.500
7.600
7.700
7.800
7.900
8.000
8.100
8.200
8.300
8.400
LNAPL Thickness (mm)
100
90
80
70
60
50
40
30
20
10
0
10/03/2020 00:00
30/03/2020 00:00
19/04/2020 00:00
09/05/2020 00:00
29/05/2020 00:00
18/06/2020 00:00
08/07/2020 00:00
28/07/2020 00:00
17/08/2020 00:00
Date/Time
DTW (mBTOC)
DTP (mBTOC)
LNAPL (mm)

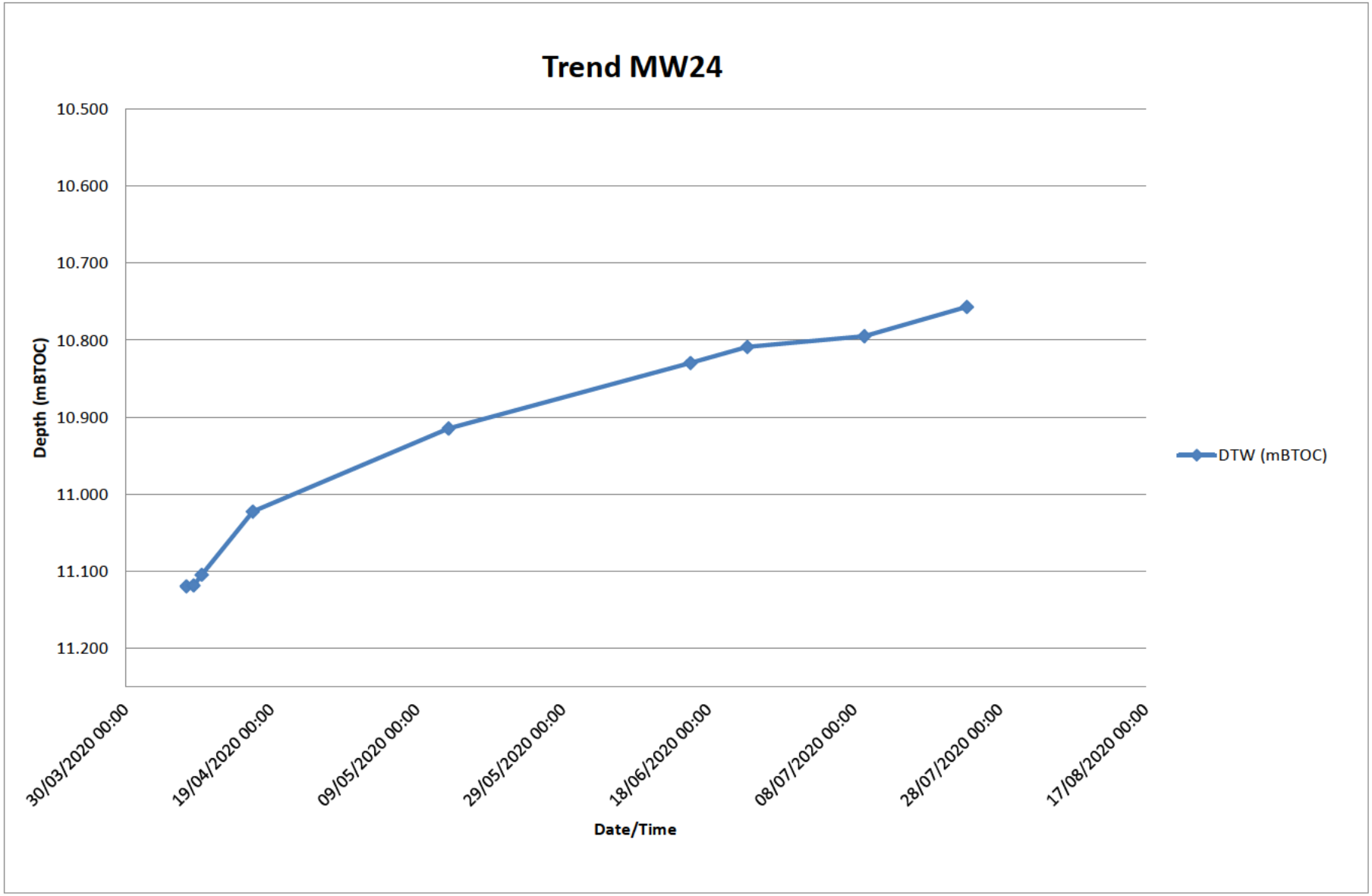

Trend MW18
6.000
7.000
8.000
9.000
10.000
11.000
12.000
Depth (mBTOC)
30/03/2020 00:00
19/04/2020 00:00
09/05/2020 00:00
29/05/2020 00:00
18/06/2020 00:00
08/07/2020 00:00
28/07/2020 00:00
17/08/2020 00:00
Date/Time
DTW (mBTOC)

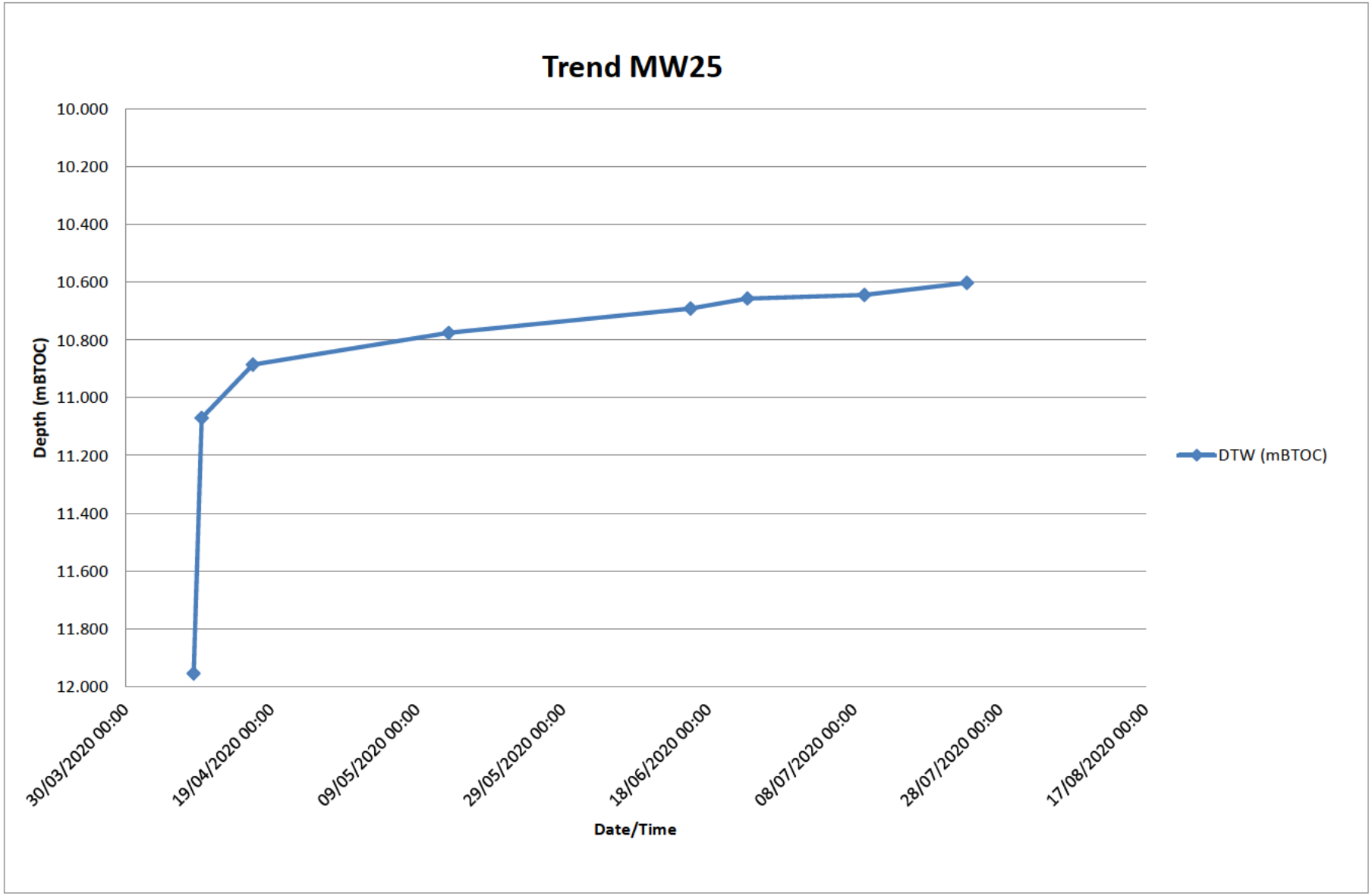

Trend MW19
8.000
8.100
8.200
8.300
8.400
8.500
8.600
8.700
8.800
Depth (mBTOC)
30/03/2020 00:00
19/04/2020 00:00
09/05/2020 00:00
29/05/2020 00:00
18/06/2020 00:00
08/07/2020 00:00
28/07/2020 00:00
17/08/2020 00:00
Date/Time
DTW (mBTOC)

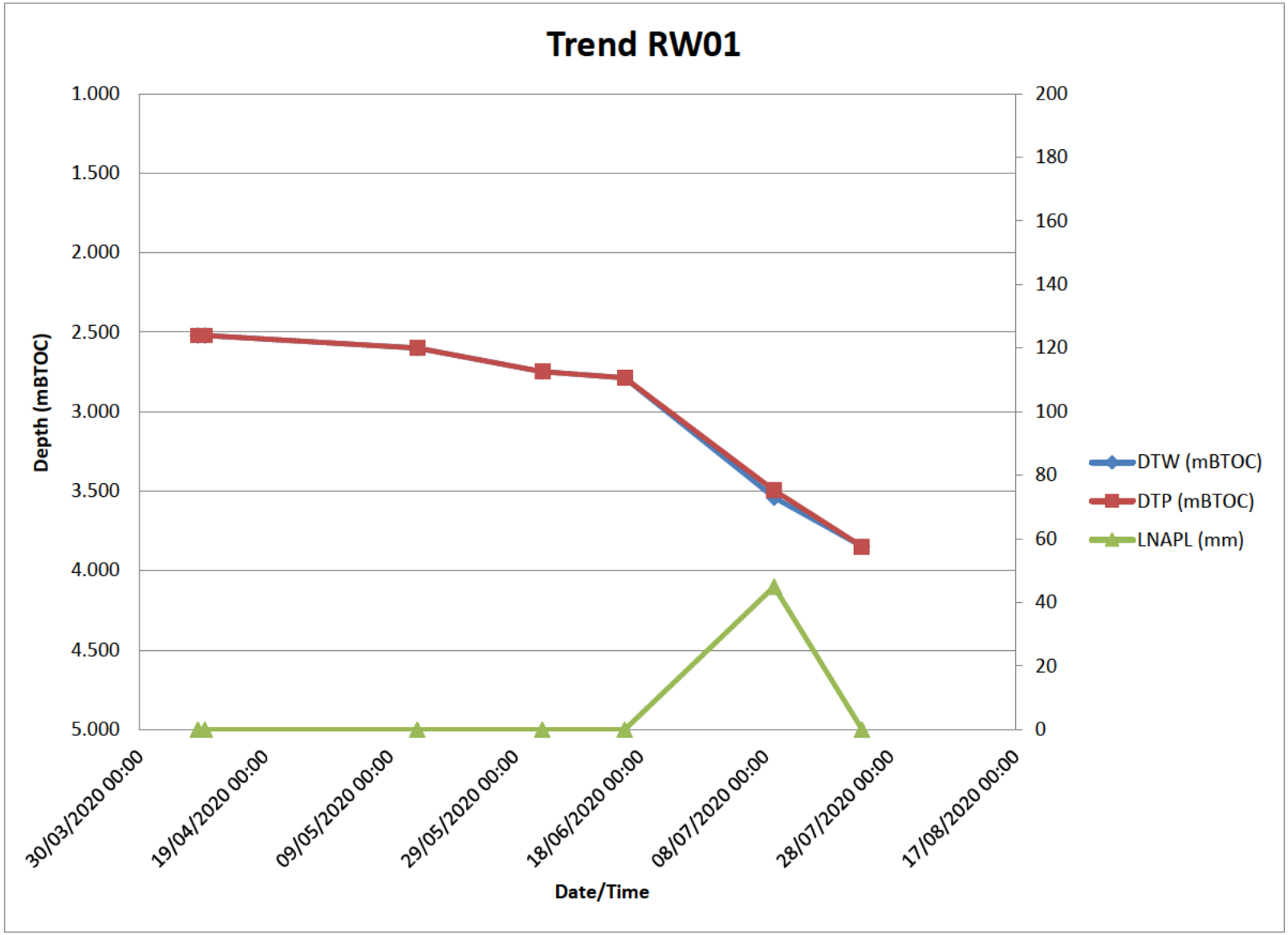

Trend MW20
8.700
8.800
8.900
9.000
9.100
9.200
9.300
9.400
9.500
Depth (mBTOC)
10/03/2020 00:00
30/03/2020 00:00
19/04/2020 00:00
09/05/2020 00:00
29/05/2020 00:00
18/06/2020 00:00
08/07/2020 00:00
28/07/2020 00:00
17/08/2020 00:00
Date/Time
DTW (mBTOC)


Trend MW21
9.500
9.600
9.700
9.800
9.900
10.000
10.100
Depth (mBTOC)
10/03/2020 00:00
30/03/2020 00:00
19/04/2020 00:00
09/05/2020 00:00
29/05/2020 00:00
18/06/2020 00:00
08/07/2020 00:00
28/07/2020 00:00
17/08/2020 00:00
Date/Time
DTW (mBTOC)


Trend MW23
10.200
10.300
10.400
10.500
10.600
10.700
10.800
10.900
11.000
Depth (mBTOC)
30/03/2020 00:00
19/04/2020 00:00
09/05/2020 00:00
29/05/2020 00:00
18/06/2020 00:00
08/07/2020 00:00
28/07/2020 00:00
17/08/2020 00:00
Date/Time
DTW (mBTOC)


Trend MW24
10.500
10.600
10.700
10.800
10.900
11.000
11.100
11.200
Depth (mBTOC)
30/03/2020 00:00
19/04/2020 00:00
09/05/2020 00:00
29/05/2020 00:00
18/06/2020 00:00
08/07/2020 00:00
28/07/2020 00:00
17/08/2020 00:00
Date/Time
DTW (mBTOC)


Trend MW25
10.000
10.200
10.400
10.600
10.800
11.000
11.200
11.400
11.600
11.800
12.000
Depth (mBTOC)
30/03/2020 00:00
19/04/2020 00:00
09/05/2020 00:00
29/05/2020 00:00
18/06/2020 00:00
08/07/2020 00:00
28/07/2020 00:00
17/08/2020 00:00
Date/Time
DTW (mBTOC)


Trend RW01
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
Depth (mBTOC)
200
180
160
140
120
100
80
60
40
20
0
DTW (mBTOC)
DTP (mBTOC)
LNAPL (mm)
30/03/2020 00:00
19/04/2020 00:00
09/05/2020 00:00
29/05/2020 00:00
18/06/2020 00:00
08/07/2020 00:00
28/07/2020 00:00
17/08/2020 00:00
Date/Time

Multi-Phase Extraction Monitoring - Radius of Influence and Gauging

Site Name: Caltex Holt Emergency Response

Date / Time	Well ID	DTW (mBTOC)	DTP (mBTOC)	LNAPL (mm)	Extraction Well ID	Droptube/Pump Depth (m)	Comments
15/02/2020 11 00	EW01	11.830	8.842	2988			
15/02/2020 13 30	EW01	9.900	9.643	257		9.9	Pump Set @ 9.9 m DTW
15/02/2020 15 40	EW01	10.780	9.523	1257		10.8	Lowered @ 15 32 DTW
15/02/2020 18 00	EW01	11.348	9.101	2247			
16/02/2020 07 00	EW01	11.572	8.956	2616			Start Pump @ 7 15am
16/02/2020 16 30	EW01	11.550	9.688	1862			
17/02/2020 07 47	EW01	10.080	9.845	235			DTW Top of pump
17/02/2020 15 15	EW01	10.250	9.838	412			DTW Top of pump
18/02/2020 10 12	EW01	10.467	9.503	964			
18/02/2020 10 36	EW01	10.737	9.379	1358		10.0	MPE Start @ 10 30
18/02/2020 14 53	EW01	10.379	9.482	897			
18/02/2020 15 00	EW01	10.503	9.433	1070			
18/02/2020 18 22	EW01	10.493	9.290	1203			
19/02/2020 06 55	EW01	9.967	9.528	439			
19/02/2020 07 27	EW01	10.552	9.319	1233			
19/02/2020 13 12	EW01	9.888	9.500	388			
19/02/2020 15 30	EW01	10.683	9.281	1402			
20/02/2020 10 01	EW01	9.982	9.542	440			
21/02/2020 09 30	EW01	9.852	9.657	195			
21/02/2020 09 45	EW01	10.182	9.468	714			
21/02/2020 10 00	EW01	10.341	9.431	910			
21/02/2020 10 15	EW01	10.376	9.408	968			
21/02/2020 10 30	EW01	10.414	9.393	1021			
21/02/2020 13 32	EW01	9.832	9.615	217			
21/02/2020 13 40	EW01	10.047	9.487	560			
24/02/2020 07 12	EW01	9.814	9.689	125			
24/02/2020 07 28	EW01	10.003	9.517	486			
24/02/2020 07 45	EW01	10.146	9.472	674			
24/02/2020 08 10	EW01	10.210	9.419	791			
24/02/2020 10 45	EW01	10.307	9.401	906			
27/02/2020 07 55	EW01	9.841	9.744	97			
27/02/2020 08 10	EW01	9.848	9.578	270			
27/02/2020 08 25	EW01	10.047	9.487	560			
27/02/2020 08 45	EW01	10.026	9.515	511			
28/02/2020 09 42	EW01	9.832	9.742	90			
28/02/2020 09 57	EW01	9.844	9.587	257			
28/02/2020 10 11	EW01	9.960	9.564	396			
28/02/2020 10 30	EW01	10.004	9.525	479			
03/03/2020 08 11	EW01	10.145	9.480	665			
05/03/2020 06 30	EW01	10.095	9.417	678			
06/03/2020 06 30	EW01	10.072	9.395	677			
08/03/2020 07 00	EW01	10.076	9.384	692			Started System @14 30 running on PLC control Automated - test with Text and email
09/03/2020 09 30	EW01	10.182	9.600	582			
10/03/2020 06 30	EW01	10.220	9.635	585			
11/03/2020 06 30	EW01	10.190	9.533	657			
12/03/2020 06 20	EW01	10.150	9.545	605		9.8	
13/03/2020 06 30	EW01	10.106	9.537	569		9.8	
14/03/2020 06 30	EW01	10.095	9.533	562		9.8	
14/03/2020 16 00	EW01	9.965	9.940	25			
14/03/2020 16 15	EW01	9.805	9.728	77			
14/03/2020 16 30	EW01	9.795	9.713	82			
14/03/2020 16 45	EW01	9.794	9.702	92			
14/03/2020 17 00	EW01	9.795	9.694	101			
14/03/2020 17 15	EW01	9.797	9.688	109			
15/03/2020 06 15	EW01	10.090	9.545	545		9.8	
16/03/2020 06 30	EW01	10.090	9.549	541			
17/03/2020 06 30	EW01	10.075	9.555	520		9.8	
25/03/2020 11 00	EW01	9.903	9.437	466			
27/03/2020 06 44	EW01	9.765	9.407	358		9.6	
03/04/2020 09 30	EW01	9.680	9.680	0		9.7	
08/04/2020 11 30	EW01	10.690	10.690	0			
09/04/2020 10 00	EW01	9.542	9.542	0			
16/04/2020 12 00	EW01	9.547	9.547	0			Meters Below Ground Level / Hydrocarbon Sheen
02/06/2020 09 30	EW01	9.441	9.400	41		Y	
15/06/2020 13 00	EW01	9.411	9.378	33	EW01, MW01, MW02, MW05, MW10	Y	Measured to Road Plate
23/06/2020 09 30	EW01	9.358	9.358	0	EW01, MW01, MW02, MW05, MW10		Confirmed with bailer
23/07/2020 12 00	EW01	9.658	9.210	448	MW01, MW02, MW05 and MW10		EW01 Re-installed on 24/07
28/07/2020 18 00	EW01	9.358	9.321	37	EW01, MW01, MW10		
29/07/2020 15 00	EW01	9.343	9.302	41	EW01, MW01, MW10		

Legend:
DTW = depth to water
DTP = depth to product
LNAPL = light non-aqueous phase liquid
mBTOC = meters below top of casing
kPa = kilopascals
Pa = pascals

Multi-Phase Extraction Monitoring - Radius of Influence and Gauging

Site Name: Caltex Holt Emergency Response

Date / Time	Well ID	DTW (mBTOC)	DTP (mBTOC)	LNAPL (mm)	Extraction Well ID	Droptube/Pump Depth (m)	Comments
15/02/2020 11 00	EW02	11.745	9.050	2695			
15/02/2020 13 30	EW02	11.661	9.049	2612	EW01		
15/02/2020 15 40	EW02	11.563	9.103	2460	EW01		
16/02/2020 07 00	EW02	11.538	9.058	2480			
16/02/2020 16 30	EW02	10.267	6.562	3705			
17/02/2020 07 47	EW02	10.492	9.507	985			
17/02/2020 15 15	EW02	10.536	9.448	1088			
18/02/2020 10 12	EW02	10.088	10.020	68			
18/02/2020 10 36	EW02	9.913	9.680	233			
18/02/2020 11 05	EW02	9.928	9.654	274			
18/02/2020 11 33	EW02	9.965	9.657	308	EW01		
18/02/2020 13 03	EW02	9.984	9.635	349	EW01		
18/02/2020 14 30	EW02	10.038	9.622	416	EW01		
19/02/2020 07 25	EW02	9.901	9.708	193			
19/02/2020 07 45	EW02	9.858	9.652	206			
19/02/2020 13 10	EW02	9.262	9.260	2			
19/02/2020 15 35	EW02	9.709	9.681	28			
20/02/2020 14 43	EW02	9.992	9.981	11			
20/02/2020 15 17	EW02	9.775	9.694	81			
20/02/2020 17 05	EW02	9.766	9.684	82			
21/02/2020 09 30	EW02	10.027	9.882	145			
21/02/2020 09 45	EW02	9.864	9.687	177			
21/02/2020 10 00	EW02	9.862	9.682	180			
21/02/2020 10 15	EW02	9.864	9.677	187			
21/02/2020 10 30	EW02	9.857	9.576	281			
21/02/2020 13 43	EW02	10.042	9.984	58			
21/02/2020 13 50	EW02	9.808	9.708	100			
24/02/2020 07 15	EW02	9.982	9.892	90			
24/02/2020 07 29	EW02	9.804	9.702	102			
24/02/2020 07 47	EW02	9.800	9.707	93			
24/02/2020 08 11	EW02	9.800	9.705	95			
24/02/2020 10 47	EW02	9.787	9.693	94			Pump set at 9.7m at 11 20 and lowered to 9.8m
27/02/2020 08 12	EW02	9.820	9.700	120			
27/02/2020 08 25	EW02	9.818	9.695	123			
27/02/2020 08 47	EW02	9.843	9.772	71			
28/02/2020 09 58	EW02	9.813	9.709	104			
28/02/2020 10 12	EW02	9.814	9.706	108			
28/02/2020 10 30	EW02	9.812	9.702	110			
01/03/2020 12 05	EW02	9.787	9.743	44			
01/03/2020 12 15	EW02	9.770	9.711	59			
01/03/2020 12 25	EW02	9.768	9.709	59			
01/03/2020 12 35	EW02	9.768	9.709	59			
01/03/2020 12 45	EW02	9.768	9.709	59			
01/03/2020 12 55	EW02	9.766	9.707	59			
01/03/2020 13 05	EW02	9.766	9.707	59			
03/03/2020 08 05	EW02	9.820	9.711	109			
05/03/2020 06 30	EW02	9.790	9.645	145			
06/03/2020 06 30	EW02	9.750	9.622	128			
08/03/2020 07 30	EW02	9.635	9.635	0			
09/03/2020 09 30	EW02	9.853	9.853	0			
10/03/2020 06 30	EW02	9.905	9.900	5			
11/03/2020 06 30	EW02	9.740	9.740	0			sheen
12/03/2020 06 20	EW02	9.770	9.760	10		9.8	
13/03/2020 06 30	EW02	9.747	9.747	0		9.8	
14/03/2020 06 30	EW02	9.725	9.725	0		9.8	
14/03/2020 16 00	EW02	9.870	9.870	0			
14/03/2020 16 15	EW02	9.771	9.771	0			
14/03/2020 16 30	EW02	9.765	9.765	0			
14/03/2020 16 45	EW02	9.763	9.763	0			
14/03/2020 17 00	EW02	9.763	9.763	0			
14/03/2020 17 15	EW02	9.758	9.758	0			
15/03/2020 06 15	EW02	9.744	9.744	0		9.8	
16/03/2020 06 30	EW02	9.747	9.745	2			
17/03/2020 06 30	EW02	9.755	9.753	2		9.8	
25/03/2020 11 00	EW02	9.578	9.568	10			
27/03/2020 06 44	EW02	9.638	9.580	58		9.6	
03/04/2020 09 30	EW02	9.755	9.755	0		9.7	
08/04/2020 11 30	EW02	9.543	9.543	0			
09/04/2020 10 00	EW02	9.668	9.644	24			
16/04/2020 12 00	EW02	9.498	9.498	0			Strong Hydrocarbon Odour

Legend:
DTW = depth to water
DTP = depth to product
LNAPL = light non-aqueous phase liquid
mBTOC = meters below top of casing
kPa = kilopascals
Pa = pascals

Multi-Phase Extraction Monitoring - Radius of Influence and Gauging

Site Name: Caltex Holt Emergency Response

Date / Time	Well ID	DTW (mBTOC)	DTP (mBTOC)	LNAPL (mm)	Extraction Well ID	Droptube/Pump Depth (m)	Comments
13/05/2020 08 50	EW02	9.590	9.590	0			
02/06/2020 09 30	EW02	9.324	9.324	0			
15/06/2020 13 00	EW02	9.304	9.304	0	EW01, MW01, MW02, MW05, MW10		
23/06/2020 09 30	EW02	9.270	9.270	0	EW01, MW01, MW02, MW05, MW10		
09/07/2020 10 15	EW02	9.260		0	MW01, MW02, MW05 and MW10		
23/07/2020 12 00	EW02	9.407		0	MW01, MW02, MW05 and MW10		
29/07/2020 15 00	EW02	9.392		0	EW01, MW01, MW10		
15/02/2020 11 00	EW03	9.942		0			
15/02/2020 13 30	EW03	9.954		0	EW01		Well Depth 15.150m
15/02/2020 15 40	EW03	9.982		0	EW01		
16/02/2020 07 00	EW03	9.870		0			
16/02/2020 16 30	EW03	10.016		0			
17/02/2020 07 47	EW03	10.037		0			
17/02/2020 15 15	EW03	10.150		0			
18/02/2020 10 23	EW03	10.055		0			Total Depth 15.150m
18/02/2020 13 03	EW03	10.032		0	EW01		
18/02/2020 14 30	EW03	10.032		0	EW01		
21/02/2020 09 30	EW03	10.025		0			
21/02/2020 09 45	EW03	10.024		0			
21/02/2020 10 00	EW03	10.024		0			
01/03/2020 13 05	EW03	10.000		0			
09/03/2020 09 30	EW03	9.910		0			
11/03/2020 06 30	EW03	9.930		0			
12/03/2020 06 20	EW03	9.910		0		-	
13/03/2020 06 30	EW03	9.867		0		-	
14/03/2020 06 30	EW03	9.862		0			
14/03/2020 16 00	EW03	9.910		0			
14/03/2020 16 15	EW03	9.950		0			
14/03/2020 16 30	EW03	9.900		0			
14/03/2020 16 45	EW03	9.895		0			
14/03/2020 17 00	EW03	9.895		0			
14/03/2020 17 15	EW03	9.895		0			
15/03/2020 06 15	EW03	9.868		0		-	
17/03/2020 06 30	EW03	9.870		0			
25/03/2020 11 00	EW03	9.881		0			
27/03/2020 06 44	EW03	9.868		0			
03/04/2020 09 30	EW03	9.832		0			
06/04/2020 11 30	EW03	9.835		0			
07/04/2020 09 30	EW03	9.854		0			
08/04/2020 11 30	EW03	9.837		0			
09/04/2020 11 30	EW03	9.830		0			
16/04/2020 12 00	EW03	9.761		0			No Hydrocarbon Odour
13/05/2020 08 50	EW03	9.640		0			
02/06/2020 09 30	EW03	9.605		0			
15/06/2020 13 00	EW03	9.580		0	EW01, MW01, MW02, MW05, MW10		
23/06/2020 09 30	EW03	9.558		0	EW01, MW01, MW02, MW05, MW10		
09/07/2020 10 15	EW03	9.530		0	MW01, MW02, MW05 and MW10		
23/07/2020 12 00	EW03	9.508		0	MW01, MW02, MW05 and MW10		
29/07/2020 15 00	EW03	9.503		0	EW01, MW01, MW10		
15/02/2020 11 00	MW01	10.975	10.000	975			
15/02/2020 13 30	MW01	10.971	9.983	988	EW01		
15/02/2020 15 40	MW01	11.236	9.993	1243	EW01		
16/02/2020 07 00	MW01	10.952	9.996	956			
16/02/2020 16 30	MW01	10.954	9.994	960			
17/02/2020 07 47	MW01	10.950	10.011	939			
17/02/2020 15 15	MW01	10.943	9.997	946			
18/02/2020 10 23	MW01	11.233	11.112	121			
18/02/2020 10 32	MW01	11.028	10.487	541			
18/02/2020 13 03	MW01	10.858	10.033	825	EW01		
19/02/2020 10 05	MW01	11.327	11.210	117			
19/02/2020 11 05	MW01	10.900	10.003	897			
21/02/2020 09 30	MW01	10.484	10.418	66			
21/02/2020 09 45	MW01	10.995	10.644	351			
20/02/2020 10 00	MW01	10.746	10.152	594			
21/02/2020 10 15	MW01	10.724	10.129	595			
21/02/2020 10 30	MW01	10.712	10.115	597			
21/02/2020 14 09	MW01	10.712	10.115	597			
21/02/2020 14 13	MW01	11.115	10.978	137			
24/02/2020 07 24	MW01	11.122	11.118	4			

Legend:
DTW = depth to water
DTP = depth to product
LNAPL = light non-aqueous phase liquid
mBTOC = meters below top of casing
kPa = kilopascals
Pa = pascals

Multi-Phase Extraction Monitoring - Radius of Influence and Gauging

Site Name: Caltex Holt Emergency Response

Date / Time	Well ID	DTW (mBTOC)	DTP (mBTOC)	LNAPL (mm)	Extraction Well ID	Droptube/Pump Depth (m)	Comments
24/02/2020 07 32	MW01	10.644	10.392	252			
24/02/2020 07 52	MW01	10.554	10.185	369			
24/02/2020 08 15	MW01	10.609	10.164	445			
24/02/2020 10 51	MW01	10.651	10.125	526			
27/02/2020 08 05	MW01	10.702	10.558	144			
27/02/2020 08 15	MW01	10.440	10.218	222			
27/02/2020 08 30	MW01	10.517	10.194	323			
27/02/2020 08 50	MW01	10.556	10.167	389			
28/02/2020 09 51	MW01	11.119	11.008	111			
28/02/2020 10 01	MW01	10.643	10.474	169			
28/02/2020 10 16	MW01	10.495	10.230	265			
28/02/2020 10 30	MW01	10.536	10.188	348			
03/03/2020 08 09	MW01	10.667	10.158	509			
05/03/2020 06 48	MW01	10.590	10.135	455			
06/03/2020 06 47	MW01	10.562	10.109	453			
08/03/2020 07 00	MW01	10.535	10.095	440			
09/03/2020 09 30	MW01	10.610	10.150	460			
10/03/2020 06 30	MW01	10.495	10.155	340			
11/03/2020 06 30	MW01	10.430	10.070	360			
12/03/2020 06 20	MW01	10.440	10.070	370		10.2	
13/03/2020 06 30	MW01	10.375	10.065	310		10.2	
14/03/2020 06 30	MW01	10.362	10.056	306		10.2	
14/03/2020 16 00	MW01	10.400	10.390	10			
14/03/2020 16 15	MW01	10.172	10.150	22			
14/03/2020 16 30	MW01	10.165	10.133	32			
14/03/2020 16 45	MW01	10.162	10.126	36			
14/03/2020 17 00	MW01	10.166	10.122	44			
14/03/2020 17 15	MW01	10.175	10.118	57			
15/03/2020 06 15	MW01	10.340	10.060	280		10.1	
16/03/2020 06 30	MW01	10.262	10.058	204			
17/03/2020 06 30	MW01	10.400	10.045	355		10.2	
25/03/2020 11 00	MW01	10.478	10.076	402			
27/03/2020 06 44	MW01	10.318	10.081	237		10.1	
03/04/2020 09 30	MW01	10.295	10.295	0		10.1	
06/04/2020 15 00	MW01	10.350	10.235	115			
06/04/2020 15 15	MW01	10.160	10.075	85		10.2	
08/04/2020 11 50	MW01	10.102	10.079	23			
09/04/2020 10 20	MW01	10.150	10.070	80			
16/04/2020 12 00	MW01	10.011	10.011	0			Heavy Hydrocarbon Sheen
13/05/2020 08 50	MW01	9.995	9.980	15		10.5	
02/06/2020 09 30	MW01	9.877	9.869	8		Y	
15/06/2020 13 00	MW01	9.873	9.854	19	EW01, MW01, MW02, MW05, MW10	Y	
23/06/2020 09 30	MW01	9.838	9.832	6	EW01, MW01, MW02, MW05, MW10		
30/06/2020 09 15	MW01	9.883	9.873	10			
09/07/2020 10 15	MW01	9.830	9.800	30	MW01, MW02, MW05 and MW10		
24/07/2020 20 00	MW01	9.818	9.814	4	MW01, MW02, MW05 and MW10		
28/07/2020 18 00	MW01	9.782	9.779	3	EW01, MW01, MW10		
29/07/2020 15 00	MW01	9.774	9.771	3	EW01, MW01, MW10		
15/02/2020 11 00	MW02	10.769	9.345	1424			
15/02/2020 13 30	MW02		9.347		EW01		Muddy
15/02/2020 15 40	MW02	10.768	9.351	1417	EW01		
16/02/2020 07 00	MW02		9.369				Muddy
17/02/2020 07 47	MW02	10.088	10.085	3			
17/02/2020 15 15	MW02	10.087	10.085	2			
17/02/2020 15 15	MW02	10.601	9.472	1129			
17/02/2020 18 29	MW02	10.945	10.000	945			
18/02/2020 10 12	MW02	10.824	9.472	1352			
18/02/2020 10 32	MW02		9.472				
18/02/2020 13 03	MW02	10.627	9.441	1186			
18/02/2020 14 30	MW02	10.807	9.438	1369			
18/02/2020 18 20	MW02	9.674	9.674	0			
19/02/2020 10 00	MW02	10.375	10.200	175			
19/02/2020 11 00	MW02	10.820	9.573	1247			
20/02/2020 14 47	MW02	10.457	10.345	112			
20/02/2020 15 18	MW02	10.203	9.615	588			
20/02/2020 17 05	MW02	10.492	9.527	965			
21/02/2020 09 30	MW02	11.340	11.278	62			
21/02/2020 09 45	MW02	10.184	9.764	420			
21/02/2020 10 00	MW02	10.178	9.650	528			
21/02/2020 10 15	MW02	10.207	9.635	572			

Legend:
DTW = depth to water
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kPa = kilopascals
Pa = pascals

Multi-Phase Extraction Monitoring - Radius of Influence and Gauging

Site Name: Caltex Holt Emergency Response

Date / Time	Well ID	DTW (mBTOC)	DTP (mBTOC)	LNAPL (mm)	Extraction Well ID	Droptube/Pump Depth (m)	Comments
21/02/2020 10 30	MW02	10.254	9.611	643			
21/02/2020 13 56	MW02	10.458	10.403	55			
21/02/2020 14 06	MW02	10.272	9.934	338			
24/02/2020 07 24	MW02	10.545	10.523	22			
24/02/2020 07 32	MW02	10.122	9.765	357			
24/02/2020 07 50	MW02	10.087	9.667	420			
24/02/2020 08 13	MW02	10.221	9.644	577			
24/02/2020 10 51	MW02	10.482	9.562	920			
27/02/2020 08 02	MW02	10.446	10.330	116			
27/02/2020 08 13	MW02	10.142	9.767	375			
27/02/2020 08 29	MW02	10.122	9.684	438			
27/02/2020 08 49	MW02	10.166	9.654	512			
28/02/2020 09 59	MW02	10.092	9.808	284			
28/02/2020 10 14	MW02	10.081	9.713	368			
28/02/2020 10 30	MW02	10.118	9.696	422			
03/03/2020 08 07	MW02	10.513	9.545	968			
05/03/2020 06 30	MW02	10.415	9.558	857			
06/03/2020 06 30	MW02	10.421	9.522	899			
08/03/2020 07 00	MW02	10.467	9.535	932			
09/03/2020 07 00	MW02	10.489	9.580	909			
10/03/2020 06 30	MW02	10.475	9.572	903			
11/03/2020 06 30	MW02	10.470	9.660	810			Pump on 6 55 and Pump Off 17 00
12/03/2020 06 20	MW02	10.460	9.658	802		10.0	
13/03/2020 06 30	MW02	10.447	9.545	902		10.1	
14/03/2020 06 30	MW02	10.425	9.545	880		10.1	
14/03/2020 16 00	MW02	10.550	10.530	20			
14/03/2020 16 15	MW02	10.035	9.800	235			
14/03/2020 16 30	MW02	9.980	9.730	250			
14/03/2020 16 45	MW02	9.980	9.702	278			
14/03/2020 17 00	MW02	9.997	9.689	308			
14/03/2020 17 15	MW02	10.030	9.671	359			
15/03/2020 06 15	MW02	10.395	9.555	840		10.2	
16/03/2020 06 30	MW02	10.385	9.565	820			
17/03/2020 06 30	MW02	10.310	9.572	738		10.0	
25/03/2020 11 00	MW02	10.508	9.613	895			
27/03/2020 06 44	MW02	10.903	9.004	1899		9.8	
03/04/2020 09 30	MW02	10.095	10.095	0		9.8	
06/04/2020 15 20	MW02	10.000	10.000	0			
06/04/2020 15 30	MW02	9.721	9.680	41		9.7	
08/04/2020 11 50	MW02	9.638	9.631	7			
09/04/2020 11 30	MW02	9.675	9.510	165			
16/04/2020 12 00	MW02	10.575	10.528	47			LNAPL
13/05/2020 08 50	MW02	9.690	9.580	110		9.6	
02/06/2020 09 30	MW02	9.604	9.475	129		Y	
15/06/2020 13 00	MW02	9.617	9.322	295	EW01, MW01, MW02, MW05, MW10	Y	
23/06/2020 09 30	MW02	9.374	9.367	7	EW01, MW01, MW02, MW05, MW10		Confirmed with bailer
30/06/2020 09 15	MW02	9.505	9.500	5			
09/07/2020 10 15	MW02	9.470	9.440	30	MW01, MW02, MW05 and MW10		
24/07/2020 20 00	MW02	9.430	9.430	0	MW01, MW02, MW05 and MW10		AP2 in Well But Turned Off on 24/07
28/07/2020 18 00	MW02	9.568	9.527	41	EW01, MW01, MW10		O g nally eco ded as EW02 gaug ng howeve was actually MW02
29/07/2020 15 00	MW02	9.564	9.564	0	EW01, MW01, MW10		
27/03/2020 06 44	MW04	9.133		0			
28/03/2020 07 25	MW04	9.136		0			
29/03/2020 09 30	MW04	8.966		0			
30/03/2020 14 42	MW04	8.984		0			
03/04/2020 09 30	MW04	8.946		0			
06/04/2020 11 30	MW04	8.927		0			
07/04/2020 09 30	MW04	8.941		0			
08/04/2020 11 30	MW04	8.922		0			
09/04/2020 11 30	MW04	8.930		0			
16/04/2020 12 00	MW04	8.866		0			No Hydrocarbon Odour
13/05/2020 08 50	MW04	8.745		0			
02/06/2020 09 30	MW04	8.713		0			
15/06/2020 13 00	MW04	8.693		0	EW01, MW01, MW02, MW05, MW10		
23/06/2020 09 30	MW04	8.666		0	EW01, MW01, MW02, MW05, MW10		
09/07/2020 10 15	MW04	8.655		0	MW01, MW02, MW05 and MW10		
23/07/2020 12 00	MW04	8.623		0	MW01, MW02, MW05 and MW10		
29/07/2020 15 00	MW04	8.604		0	EW01, MW01, MW10		
27/03/2020 06 44	MW05	9.396	9.030	366			

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Multi-Phase Extraction Monitoring - Radius of Influence and Gauging

Site Name: Caltex Holt Emergency Response

Date / Time	Well ID	DTW (mBTOC)	DTP (mBTOC)	LNAPL (mm)	Extraction Well ID	Droptube/Pump Depth (m)	Comments
28/03/2020 07 25	MW05	10.002	8.802	1200			
03/04/2020 09 30	MW05	9.548	9.548	0		9.2	
06/04/2020 15 30	MW05	9.759	9.759	0			
06/04/2020 15 45	MW05	9.357	9.050	307		9.2	
08/04/2020 11 50	MW05	9.296	8.904	392			
09/04/2020 11 30	MW05	9.250	8.905	345			
16/04/2020 12 00	MW05	9.107	8.832	275			LNAPL
04/05/2020 12 20	MW05	9.022	8.805	217		8.9	
13/05/2020 08 50	MW05	9.140	8.710	430		9.0	
02/06/2020 09 30	MW05	8.852	8.747	105		Y	
15/06/2020 13 00	MW05	9.133	8.634	499	EW01, MW01, MW02, MW05, MW10	Y	
23/06/2020 09 30	MW05	8.716	8.709	7	EW01, MW01, MW02, MW05, MW10		Confirmed with bailer
30/06/2020 09 15	MW05	9.843	9.823	20			
09/07/2020 10 15	MW05	8.615	8.610	5	MW01, MW02, MW05 and MW10		
24/07/2020 20 00	MW05	8.689	8.689	0	MW01, MW02, MW05 and MW10		AP2 in Well But Turned Off on 24/07
29/07/2020 15 00	MW05	8.832	8.811	21	EW01, MW01, MW10		
26/03/2020 13 40	MW06	9.768	9.756	12			
27/03/2020 06 44	MW06	9.929	9.523	406			
28/03/2020 07 25	MW06	10.123	9.447	676			
03/04/2020 09 30	MW06	9.228	9.228	0		9.2	
06/04/2020 15 45	MW06	9.500	9.500	0			
06/04/2020 16 00	MW06	9.387	9.334	53		9.4	
08/04/2020 12 30	MW06	9.185	9.180	5			
09/04/2020 11 30	MW06	9.170	9.120	50			
16/04/2020 12 00	MW06	9.048	9.037	11			LNAPL
13/05/2020 08 50	MW06	8.930	8.930	0			Heavy Sheen, Confirmed with Bailer
02/06/2020 09 30	MW06	8.885	8.885	0			
15/06/2020 13 00	MW06	8.881	8.881	0	EW01, MW01, MW02, MW05, MW10		
23/06/2020 09 30	MW06	8.850	8.850	0	EW01, MW01, MW02, MW05, MW10		
09/07/2020 10 15	MW06	8.825	8.825	0	MW01, MW02, MW05 and MW10		
23/07/2020 12 00	MW06	8.806	8.806	0	MW01, MW02, MW05 and MW10		
29/07/2020 15 00	MW06	8.786	8.786	0	EW01, MW01, MW10		
27/03/2020 06 44	MW07	12.856	12.845	11			
28/03/2020 07 25	MW07	12.602	12.601	1			
29/03/2020 09 30	MW07	12.066	11.925	141			
30/03/2020 14 42	MW07	12.954	12.224	730			
03/04/2020 09 30	MW07	11.435	11.435	0			
06/04/2020 11 30	MW07	10.674	9.633	1041			
07/04/2020 09 30	MW07	10.591	9.540	1051			
08/04/2020 10 15	MW07	10.514	9.487	1027			
09/04/2020 11 30	MW07	10.340	10.235	105			
16/04/2020 12 00	MW07	9.137	9.137	0			Hydrocarbon Sheen
13/05/2020 08 50	MW07	9.700	9.698	2		9.8	Confirmed with Bailer
02/06/2020 09 30	MW07	9.576	9.576	0		Y	
15/06/2020 13 00	MW07	9.580	9.580	0	EW01, MW01, MW02, MW05, MW10		
23/06/2020 09 30	MW07	9.343	9.343	0	EW01, MW01, MW02, MW05, MW10		
09/07/2020 10 15	MW07	9.315	9.315	0	MW01, MW02, MW05 and MW10		
23/07/2020 12 00	MW07	9.268	9.268	0	MW01, MW02, MW05 and MW10		
29/07/2020 15 00	MW07	9.278	9.278	0	EW01, MW01, MW10		
29/03/2020 09 30	MW08	10.263		0			
30/03/2020 14 42	MW08	10.379		0			
03/04/2020 09 30	MW08	10.241		0			
06/04/2020 11 30	MW08	10.295		0			
07/04/2020 09 30	MW08	10.264		0			
08/04/2020 11 50	MW08	10.244		0			
09/04/2020 11 30	MW08	10.245		0			
16/04/2020 12 00	MW08	10.158		0			No Hydrocarbon Odour
13/05/2020 08 50	MW08	10.045		0			
02/06/2020 09 30	MW08	10.015		0			
15/06/2020 13 00	MW08	9.913		0	EW01, MW01, MW02, MW05, MW10		
23/06/2020 09 30	MW08	9.953		0	EW01, MW01, MW02, MW05, MW10		
09/07/2020 10 15	MW08	9.940		0	MW01, MW02, MW05 and MW10		
23/07/2020 12 00	MW08	9.911		0	MW01, MW02, MW05 and MW10		
29/07/2020 15 00	MW08	9.869		0	EW01, MW01, MW10		
27/03/2020 06 44	MW09	11.315	11.314	1			
28/03/2020 07 25	MW09	11.329		0			
29/03/2020 09 30	MW09	11.118		0			

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Multi-Phase Extraction Monitoring - Radius of Influence and Gauging

Site Name: Caltex Holt Emergency Response

Date / Time	Well ID	DTW (mBTOC)	DTP (mBTOC)	LNAPL (mm)	Extraction Well ID	Droptube/Pump Depth (m)	Comments
30/03/2020 14 42	MW09	11.221		0			
03/04/2020 09 30	MW09	11.093		0			
06/04/2020 11 30	MW09	11.109		0			
07/04/2020 09 30	MW09	11.130		0			
08/04/2020 11 50	MW09	11.101		0			
09/04/2020 11 30	MW09	11.110		0			
16/04/2020 12 00	MW09	11.020		0			No Hydrocarbon Odour
13/05/2020 08 50	MW09	10.903		0			
02/06/2020 09 30	MW09	10.866		0			
15/06/2020 13 00	MW09	10.829		0	EW01, MW01, MW02, MW05, MW10		
23/06/2020 09 30	MW09	10.809		0	EW01, MW01, MW02, MW05, MW10		
09/07/2020 10 15	MW09	10.795		0	MW01, MW02, MW05 and MW10		
23/07/2020 12 00	MW09	10.759		0	MW01, MW02, MW05 and MW10		
29/07/2020 15 00	MW09	10.747		0	EW01, MW01, MW10		
28/03/2020 07 25	MW10	12.034	11.382	652			
29/03/2020 09 30	MW10	11.812	11.154	658			
30/03/2020 14 42	MW10	11.697	11.161	536			
31/03/2020 12 30	MW10	11.791	11.117	674			
03/04/2020 09 30	MW10	11.284	11.284	0		11.2	
06/04/2020 14 30	MW10	11.435	11.420	15			
06/04/2020 14 50	MW10	11.284	11.247	37		11.2	
08/04/2020 11 50	MW10	11.232	11.228	4			
09/04/2020 11 30	MW10	11.265	11.215	50			
16/04/2020 12 00	MW10	11.412	11.412	0			Strong Hydrocarbon Odour
13/05/2020 08 50	MW10	11.019	11.015	4		11.1	
02/06/2020 09 30	MW10	10.973	10.973	0		Y	
15/06/2020 13 38	MW10	10.952	10.940	12	EW01, MW01, MW02, MW05, MW10	Y	
23/06/2020 09 30	MW10	10.913	10.909	4	EW01, MW01, MW02, MW05, MW10		
30/06/2020 09 15	MW10	11.075	11.075	0			
09/07/2020 10 15	MW10	10.910	10.890	20	MW01, MW02, MW05 and MW10		
24/07/2020 20 00	MW10	10.879	10.877	2	MW01, MW02, MW05 and MW10		
28/07/2020 18 00	MW10	10.883	10.880	3	EW01, MW01, MW10		
29/07/2020 15 00	MW10	10.884	10.864	20	EW01, MW01, MW10		
28/03/2020 07 25	MW11	12.059	12.059	0			
29/03/2020 09 30	MW11	11.293	11.291	2			
30/03/2020 14 42	MW11	13.749	13.749	0			
03/04/2020 09 30	MW11	11.250		0			
06/04/2020 11 30	MW11	11.245		0			
07/04/2020 09 30	MW11	11.259		0			
08/04/2020 11 50	MW11	11.242		0			
09/04/2020 11 30	MW11	11.250		0			
16/04/2020 12 00	MW11	11.167		0			Weak Hydrocarbon Odour
13/05/2020 08 50	MW11	11.040		0			
02/06/2020 09 30	MW11	10.985		0			
15/06/2020 13 38	MW11	10.964		0	EW01, MW01, MW02, MW05, MW10		
23/06/2020 09 30	MW11	10.937		0	EW01, MW01, MW02, MW05, MW10		
09/07/2020 10 15	MW11	10.920		0	MW01, MW02, MW05 and MW10		
23/07/2020 12 00	MW11	10.897		0	MW01, MW02, MW05 and MW10		
29/07/2020 15 00	MW11	10.899		0	EW01, MW01, MW10		
01/04/2020 14 30	MW12	10.310	10.235	75			
03/04/2020 09 30	MW12	10.270	10.270	0			
07/04/2020 09 30	MW12	9.272	9.200	72			
08/04/2020 08 00	MW12	10.254	10.189	65			
09/04/2020 11 30	MW12	10.310	10.180	130			
16/04/2020 12 00	MW12	10.213	10.111	102			LNAPL
21/04/2020 12 00	MW12	10.169	10.095	74		10.3	
21/04/2020 15 20	MW12	10.142	10.137	5			
22/04/2020 07 30	MW12	10.162	10.152	10			
29/04/2020 07 20	MW12	10.115	10.109	6			
13/05/2020 08 50	MW12	10.025	10.025	0			
02/06/2020 09 30	MW12	9.990	9.990	0			
15/06/2020 13 38	MW12	9.973	9.973	0	EW01, MW01, MW02, MW05, MW10		
23/06/2020 09 30	MW12	9.951	9.951	0	EW01, MW01, MW02, MW05, MW10		
09/07/2020 10 15	MW12	9.930	9.930	0	MW01, MW02, MW05 and MW10		
23/07/2020 12 00	MW12	9.902	9.902	0	MW01, MW02, MW05 and MW10		
29/07/2020 15 00	MW12	9.885	9.885	0	EW01, MW01, MW10		
01/04/2020 14 30	MW13	9.340		0			

Legend:
DTW = depth to water
DTP = depth to product
LNAPL = light non-aqueous phase liquid
mBTOC = meters below top of casing
kPa = kilopascals
Pa = pascals

Multi-Phase Extraction Monitoring - Radius of Influence and Gauging

Site Name: Caltex Holt Emergency Response

Date / Time	Well ID	DTW (mBTOC)	DTP (mBTOC)	LNAPL (mm)	Extraction Well ID	Droptube/Pump Depth (m)	Comments
03/04/2020 09 30	MW13	9.312		0			
07/04/2020 09 30	MW13	9.306		0			
08/04/2020 11 15	MW13	9.289		0			
09/04/2020 11 30	MW13	9.300		0			
16/04/2020 12 00	MW13	9.223		0			No Hydrocarbon Odour
13/05/2020 08 50	MW13	9.118		0			
02/06/2020 09 30	MW13	9.075		0			
15/06/2020 13 38	MW13	9.062		0	EW01, MW01, MW02, MW05, MW10		
23/06/2020 09 30	MW13	9.042		0	EW01, MW01, MW02, MW05, MW10		
09/07/2020 10 15	MW13	9.020		0	MW01, MW02, MW05 and MW10		
23/07/2020 12 00	MW13	8.988		0	MW01, MW02, MW05 and MW10		
29/07/2020 15 00	MW13	8.976		0	EW01, MW01, MW10		
01/04/2020 14 30	MW14	6.445		0			
03/04/2020 09 30	MW14	6.424		0			
07/04/2020 09 30	MW14	8.414		0			
08/04/2020 11 15	MW14	8.394		0			
09/04/2020 11 30	MW14	8.400		0			
16/04/2020 12 00	MW14	8.332		0			No Hydrocarbon Odour
13/05/2020 08 50	MW14	8.225		0			
02/06/2020 09 30	MW14	8.187		0			
15/06/2020 13 38	MW14	8.169		0	EW01, MW01, MW02, MW05, MW10		
23/06/2020 09 30	MW14	8.143		0	EW01, MW01, MW02, MW05, MW10		
09/07/2020 10 15	MW14	8.128		0	MW01, MW02, MW05 and MW10		
23/07/2020 12 00	MW14	8.101		0	MW01, MW02, MW05 and MW10		
29/07/2020 15 00	MW14	8.082		0	EW01, MW01, MW10		
01/04/2020 14 30	MW15	8.320	8.120	200			
03/04/2020 09 30	MW15	8.745	8.745	0			
06/04/2020 11 30	MW15	8.748	7.918	830			
07/04/2020 09 30	MW15	8.754	7.924	830			
08/04/2020 08 40	MW15	8.610	7.955	655			
09/04/2020 11 30	MW15	8.715	7.930	785			
16/04/2020 12 00	MW15	8.635	7.848	787			LNAPL
21/04/2020 08 30	MW15	8.490	7.893	597		8.2	
21/04/2020 11 30	MW15	8.115	8.109	6			
22/04/2020 07 30	MW15	8.579	7.900	679			
29/04/2020 07 13	MW15	8.565	7.857	708			
04/05/2020 10 15	MW15	8.498	7.824	674			
04/05/2020 17 00	MW15	8.046	8.023	23			
04/05/2020 17 20	MW15	8.024	7.987	37			
13/05/2020 08 50	MW15	8.435	7.785	650			
02/06/2020 09 30	MW15	8.400	7.757	643			
15/06/2020 13 38	MW15	8.342	7.741	601	EW01, MW01, MW02, MW05, MW10		
23/06/2020 09 30	MW15	8.308	7.705	603	EW01, MW01, MW02, MW05, MW10		
30/06/2020 09 15	MW15	8.279	7.695	584			Pumped out with air bottle from 10 00 - 16 40. Periodically gauged.
30/06/2020 12 20	MW15	7.942	7.820	122			
30/06/2020 16 40	MW15	8.054	8.054	0			Sheen
09/07/2020 10 15	MW15	7.900	7.830	70	MW01, MW02, MW05 and MW10		
23/07/2020 12 00	MW15	7.802	7.802	0	MW01, MW02, MW05 and MW10		
28/07/2020 18 00	MW15	7.866	7.794	72	EW01, MW01, MW10		
29/07/2020 15 00	MW15	7.842	7.783	59	EW01, MW01, MW10		
01/04/2020 14 30	MW16	8.315	8.315	0			Sheen
03/04/2020 09 30	MW16	8.245	8.245	0			
06/04/2020 11 30	MW16	8.232	8.232	0			Odour
07/04/2020 09 30	MW16	8.241	8.241	0			
08/04/2020 11 15	MW16	8.310	8.310	0			
09/04/2020 11 30	MW16	8.235	8.235	0			
16/04/2020 12 00	MW16	8.150	8.150	0			Strong Hydrocarbon Odour
29/04/2020 07 10	MW16	8.162	8.144	18			
04/05/2020 10 12	MW16	8.105	8.101	4			
13/05/2020 08 50	MW16	8.054	8.054	0			Heavy Sheen
02/06/2020 09 30	MW16	8.045	8.028	17			
15/06/2020 13 38	MW16	8.010	8.000	10	EW01, MW01, MW02, MW05, MW10		
23/06/2020 09 30	MW16	7.998	7.953	45	EW01, MW01, MW02, MW05, MW10		
30/06/2020 09 15	MW16	7.942	7.942	0			.
09/07/2020 10 15	MW16	8.015	7.852	163	MW01, MW02, MW05 and MW10		
23/07/2020 12 00	MW16	7.925	7.925	0	MW01, MW02, MW05 and MW10		
28/07/2020 18 00	MW16	7.916	7.875	41	EW01, MW01, MW10		

Legend:
DTW = depth to water
DTP = depth to product
LNAPL = light non-aqueous phase liquid
mBTOC = meters below top of casing
kPa = kilopascals
Pa = pascals

Multi-Phase Extraction Monitoring - Radius of Influence and Gauging

Site Name: Caltex Holt Emergency Response

Date / Time	Well ID	DTW (mBTOC)	DTP (mBTOC)	LNAPL (mm)	Extraction Well ID	Droptube/Pump Depth (m)	Comments
29/07/2020 15 00	MW16	7.993	7.900	93	EW01, MW01, MW10		
03/04/2020 09 30	MW17	8.213	8.213	0			
06/04/2020 11 30	MW17	8.210	8.207	3			
07/04/2020 09 30	MW17	8.216	8.210	6			
08/04/2020 11 15	MW17	8.206	8.204	2			
09/04/2020 11 30	MW17	8.220	8.215	5			
16/04/2020 12 00	MW17	8.123	8.123	0			Strong Hydrocarbon Odour
29/04/2020 13 30	MW17	8.107	8.102	5			
04/05/2020 10 10	MW17	8.076	8.073	3			
13/05/2020 08 50	MW17	8.030	8.030	0			Odour
02/06/2020 09 30	MW17	8.015	8.015	0			
15/06/2020 13 38	MW17	7.992	7.992	0	EW01, MW01, MW02, MW05, MW10		Odour
23/06/2020 09 30	MW17	7.937	7.937	0	EW01, MW01, MW02, MW05, MW10		
30/06/2020 09 15	MW17	7.929	7.929	0			
09/07/2020 10 15	MW17	7.695	7.695	0	MW01, MW02, MW05 and MW10		
23/07/2020 12 00	MW17	7.933	7.933	0	MW01, MW02, MW05 and MW10		
29/07/2020 15 00	MW17	7.894	7.894	0	EW01, MW01, MW10		
09/04/2020 11 30	MW18	10.820		0			
16/04/2020 12 00	MW18	8.091		0			No Hydrocarbon Odour
13/05/2020 08 50	MW18	7.981		0			
02/06/2020 09 30	MW18	7.927		0			
15/06/2020 13 38	MW18	7.918		0	EW01, MW01, MW02, MW05, MW10		
23/06/2020 09 30	MW18	7.853		0	EW01, MW01, MW02, MW05, MW10		
09/07/2020 10 15	MW18	7.870		0	MW01, MW02, MW05 and MW10		
23/07/2020 12 00	MW18	7.856		0	MW01, MW02, MW05 and MW10		
29/07/2020 15 00	MW18	7.836		0	EW01, MW01, MW10		
09/04/2020 11 30	MW19	8.660		0			
16/04/2020 12 00	MW19	8.559		0			No Hydrocarbon Odour
13/05/2020 08 50	MW19	8.450		0			
02/06/2020 09 30	MW19	8.200		0			
15/06/2020 13 38	MW19	8.391		0	EW01, MW01, MW02, MW05, MW10		
23/06/2020 09 30	MW19	8.359		0	EW01, MW01, MW02, MW05, MW10		
09/07/2020 10 15	MW19	8.538		0	MW01, MW02, MW05 and MW10		
23/07/2020 12 00	MW19	8.329		0	MW01, MW02, MW05 and MW10		
29/07/2020 15 00	MW19	8.311		0	EW01, MW01, MW10		
03/04/2020 09 30	MW20	9.360		0			
06/04/2020 11 30	MW20	9.365		0			
07/04/2020 09 30	MW20	9.371		0			
09/04/2020 11 30	MW20	9.360		0			
16/04/2020 12 00	MW20	9.277		0			No Hydrocarbon Odour
13/05/2020 08 50	MW20	9.165		0			
02/06/2020 09 30	MW20	9.123		0			
15/06/2020 13 38	MW20	9.094		0	EW01, MW01, MW02, MW05, MW10		
23/06/2020 09 30	MW20	9.066		0	EW01, MW01, MW02, MW05, MW10		
09/07/2020 10 15	MW20	9.058		0	MW01, MW02, MW05 and MW10		
23/07/2020 12 00	MW20	9.022		0	MW01, MW02, MW05 and MW10		
29/07/2020 15 00	MW20	9.018		0	EW01, MW01, MW10		
03/04/2020 09 30	MW21	10.002		0			
06/04/2020 11 30	MW21	10.010		0			Pre-Developed
07/04/2020 09 30	MW21	10.022		0			
09/04/2020 11 30	MW21	10.005		0			
16/04/2020 12 00	MW21	9.922		0			No Hydrocarbon Odour
13/05/2020 08 50	MW21	9.811		0			
02/06/2020 09 30	MW21	9.767		0			
15/06/2020 13 38	MW21	9.703		0	EW01, MW01, MW02, MW05, MW10		
23/06/2020 09 30	MW21	9.708		0	EW01, MW01, MW02, MW05, MW10		
09/07/2020 10 15	MW21	9.701		0	MW01, MW02, MW05 and MW10		
23/07/2020 12 00	MW21	9.661		0	MW01, MW02, MW05 and MW10		
29/07/2020 15 00	MW21	9.662		0	EW01, MW01, MW10		
07/04/2020 09 30	MW23	10.906		0			
08/04/2020 11 15	MW23	10.843		0			
09/04/2020 11 30	MW23	10.850		0			
16/04/2020 12 00	MW23	10.768		0			No Hydrocarbon Odour
13/05/2020 08 50	MW23	10.665		0			
15/06/2020 13 38	MW23	10.571		0	EW01, MW01, MW02, MW05, MW10		

Legend:
DTW = depth to water
DTP = depth to product
LNAPL = light non-aqueous phase liquid
mBTOC = meters below top of casing
kPa = kilopascals
Pa = pascals

Multi-Phase Extraction Monitoring - Radius of Influence and Gauging

Site Name: Caltex Holt Emergency Response

Date / Time	Well ID	DTW (mBTOC)	DTP (mBTOC)	LNAPL (mm)	Extraction Well ID	Droptube/Pump Depth (m)	Comments
23/06/2020 09 30	MW23	10.545		0	EW01, MW01, MW02, MW05, MW10		
09/07/2020 10 15	MW23	10.540		0	MW01, MW02, MW05 and MW10		
23/07/2020 12 00	MW23	10.496		0	MW01, MW02, MW05 and MW10		
07/04/2020 09 30	MW24	11.120		0			
08/04/2020 08 58	MW24	11.119		0			
09/04/2020 11 30	MW24	11.105		0			
16/04/2020 12 00	MW24	11.023		0			Very Weak Hydrocarbon Odour
13/05/2020 08 50	MW24	10.915		0			
15/06/2020 13 38	MW24	10.830		0	EW01, MW01, MW02, MW05, MW10		
23/06/2020 09 30	MW24	10.809		0	EW01, MW01, MW02, MW05, MW10		
09/07/2020 10 15	MW24	10.795		0	MW01, MW02, MW05 and MW10		
23/07/2020 12 00	MW24	10.757		0	MW01, MW02, MW05 and MW10		
08/04/2020 08 55	MW25	11.955		0			
09/04/2020 11 30	MW25	11.070		0			
16/04/2020 12 00	MW25	10.885		0			No Hydrocarbon Odour
13/05/2020 08 50	MW25	10.775		0			
15/06/2020 13 38	MW25	10.691		0	EW01, MW01, MW02, MW05, MW10		
23/06/2020 09 30	MW25	10.656		0	EW01, MW01, MW02, MW05, MW10		
09/07/2020 10 15	MW25	10.644		0	MW01, MW02, MW05 and MW10		
23/07/2020 12 00	MW25	10.602		0	MW01, MW02, MW05 and MW10		
08/04/2020 07 25	RW01	2.520	2.520	0			Total Depth 3.915m
09/04/2020 10 15	RW01	2.521	2.521	0			
13/05/2020 08 50	RW01	2.600	2.600	0			
02/06/2020 09 30	RW01	2.749	2.749	0			
15/06/2020 13 00	RW01	2.787	2.787	0	EW01, MW01, MW02, MW05, MW10		
09/07/2020 10 15	RW01	3.540	3.495	45	MW01, MW02, MW05 and MW10		
23/07/2020 12 00	RW01	3.848	3.848	0	MW01, MW02, MW05 and MW10		
29/04/2020 14 10	TP01	2.653		0			
27/04/2020 13 10	UST	2.677		0			Total Depth 2.830m
29/04/2020 14 15	UST	2.798		0			Total Depth 2.830m

Legend:
DTW = depth to water
DTP = depth to product
LNAPL = light non-aqueous phase liquid
mBTOC = meters below top of casing
kPa = kilopascals
Pa = pascals

ATTACHMENT E
REGULATORY FRAMEWORK /
ASSESSMENT CRITERIA

E.1 STATUTORY REGULATION OF THE SITE

Following the formal notification of the product loss to the ACT EPA, on 3 March 2020 the EPA issued Environmental Protection Order (EPO) No: 50048. Amongst other actions relating to the management and mitigation of the suspected fuel loss, the order required Caltex to *"undertake an assessment of the risk to human health of the occupants and visitors of the site to demonstrate that the site is suitable to continue operating;"*. This assessment was conducted during mid to late March 2020 and a report was produced by WSP and was submitted to the EPA (Ref: PS118985-CLM-AVIR-8115 Rev2, dated 31 March 2020).

In addition to the EPO, the EPA issued a notification that Caltex is required to commission an environmental audit of contaminated land for the site (letter file ref: 10/3998, dated 13 March 2020). A NSW EPA and ACT EPA approved contaminated land site auditor [redacted] GHD Pty Limited) has since been engaged by Caltex for the purpose of the audit. The audit is to address the following key requirements:

1. Determine the nature and extent of contamination both on and off-site from the identified release of petroleum product at the site.
2. Determine the appropriateness of all investigations and remedial actions undertaken to date and the appropriateness of any proposed assessment and management strategies for the site.
3. Provide commentary on the consultant's findings, past current and future, with respect to the level of risk the contamination posed to both on and off-site receptors.
4. Provide a conclusion as to the suitability of all impacted areas (both on and off-site) for their current permitted uses under the ACT Territory plan from a contamination perspective.
5. Be undertaken and submitted in accordance with the requirements of the Authority's Contaminated Sites Environment Protection Policy 2017 and the Authority's endorsed guidance.

E.2 TECHNICAL FRAMEWORK

The assessment works conducted at the site to date have been undertaken with reference to or consideration of the following regulations and guidelines:

- ACT EPA 2017, *Contaminated Sites Environment Protection Policy*.
- ACT EPA 2019, *Environmental Guidelines for Petroleum Storage in the ACT.*
- Environment ACT 2000, *ACT's Environmental Standards: Assessment & Classification of Liquid & Non-liquid Wastes*
- *Environmental Protection Act 1997.*
- *Environmental Protection Regulation 2005.*
- *National Environment Protection (Assessment of Site Contamination) Measure 1999* (NEPM; as amended 2013).
- NSW EPA 2014, *Technical Note: Investigation of Service Station Sites*.
- NSW EPA 2020, *Assessment and Management of Hazardous Ground Gases: Contaminated Land Guidelines.*
- NSW EPA 2020, *Guidelines for Consultants Reporting on Contaminated Land: Contaminated Land Guidelines.*
- *Work Health and Safety Act 2011* (NSW).

Further to the above, ACT Government provides a number of information sheets which outline some additional considerations relevant to the site. These include:

- ACT EPA 2019, Information Sheet 8 – *Requirements for the Classification and Reuse of Drilling Mud Waste in the ACT.*
- ACT EPA 2019, Information Sheet 9 – *Management of groundwater impacted by light non-aqueous phase liquids (LNAPL).*
- ACT EPA 2020, Information Sheet 11 – *Environment Protection Authority Report Submission Requirements.*

E.3 SITE ASSESSMENT CRITERIA

E.3.1 SOIL CRITERIA

To assess the presence and extent of soil contamination at a site, the ASC NEPM provides health investigation levels (HILs) and health screening levels (HSLs) for the assessment of impacted soil.

HILs provide an assessment of potential risk to human health from chronic exposure to contaminants and have been developed based on land use setting. None of the compounds analysed in soil have HILs, and therefore these have not been considered further.

HSLs have been developed for selected petroleum compounds and fractions and are applicable to assessing human health risk via the vapour intrusion and inhalation pathway. The HSLs depend on predominant soil physicochemical properties and land use scenarios which apply to different soil types and depths. As the geology encountered during drilling works comprised of weathered fractured rock with minimal overlying soil it is not possible to derive soil HSLs. The CRC CARE Technical Report No. 10 (Friebel and Nadebaum, 2011) specifies that the HSL for sand may be used when the lithology consists of fractured rock. For this investigation the HSL A (low density residential) and HSL D criteria (commercial/industrial) for a soil texture of sand was adopted. The NEPM 2013 lists HSLs for soil relating to open space exposures, all HSL values for soil, for open space are listed as “non limiting” as greater emphasis is placed on soil gas in assessing potential health risks from hydrocarbon sources and groundwater plumes under buildings.

It is noted that HSLs have not been developed for assessing vapour migration in bedrock, so for depths below approximately 7 mBGL the HSLs are not applicable and should be considered indicative only. The CRC CARE Technical Report No. 10 (Friebel and Nadebaum, 2011) provides HSLs for petroleum hydrocarbons specifically for vapour inhalation for intrusive maintenance workers in shallow trenches, and for direct contact. These have also been adopted. A summary of the adopted soil assessment criteria is outlined in Table E.1.

The NEPM 2013 also lists criteria (ecological screening levels) for the protection of plants from exposure to petroleum hydrocarbons in soils. The criteria and the influence of the contamination is limited to the top 2 m of the profile. Since the groundwater is, at all off-site well locations, 8 m or greater below ground level, the probability of effects on plant wellbeing is minimal. The ESLs have not been further considered.

Table E.1 Adopted soil assessment criteria

SOIL TEXTURE SAND

CHEMICALS	HSL A (mg/kg)					HSL D (mg/kg)					MAINTENANCE WORKERS (mg/kg) [2]			
	0 to <1 mBGL [1]	1 to <2 mBGL [1]	2 to <4 mBGL [1]	4+ mBGL [1]	Direct contact [2]	0 to <1 mBGL [1]	1 to <2 mBGL [1]	2 to <4 mBGL [1]	4+ mBGL [1]	Direct contact [2]	VAPOUR INHALATION			Direct contact
											0 to <2 mBGL	2 to <4 mBGL	4+ mBGL	
TRH F1 (C_6–C_{10} minus benzene)	45	70	110	200	4,400	260	370	630	NL	26,000	NL	NL	NL	82,000
TRH F2 (C_{10}–C_{16} minus naphthalene)	110	240	440	NL	3,300	NL	NL	NL	NL	20,000	NL	NL	NL	62,000
TRH C_{16}–C_{34}	-	-	-	-	4,500	–	–	–	–	27,000	–	–	–	85,000
TRH C_{34}–C_{40}	-	-	-	-	6,300	–	–	–	–	38,000	–	–	–	120,000
Benzene	0.5	0.5	0.5	0.5	100	3	3	3	3	430	77	160	NL	1,100
Toluene	160	220	310	540	14,000	NL	NL	NL	NL	99,000	NL	NL	NL	120,000
Ethylbenzene	55	NL	NL	NL	4,500	NL	NL	NL	NL	27,000	NL	NL	NL	85,000
Total xylene	40	60	95	170	12,000	230	NL	NL	NL	81,000	NL	NL	NL	130,000
Naphthalene	3	NL	NL	NL	1,400	3	NL	NL	NL	11,000	NL	NL	NL	29,000

Notes:
1. NEPM (2013) – Schedule B-1 Investigation Levels for Soil and Groundwater – Table 1A(3) Soil HSLs for vapour intrusion
2. CRC CARE (2011) Technical Report No. 10 – Table B1 Soil vapour health screening levels

E.3.2 GROUNDWATER CRITERIA

To assess the significance of contaminant concentrations in groundwater, results are compared to the NEPM (NEPC, 2013) guidelines, specifically Schedule B1 Guideline on Investigation Levels for Soil and Groundwater (Schedule B1), for assessment criteria, where available. Schedule B1 provides a framework for the use of investigation and screening levels based on human health and environmental risks. Schedule B1 of the NEPM (2013) defines groundwater investigation levels (GILs) that have been developed for a broad range of metals and organic contaminants in groundwater. GILs are based on the following guidelines:

- Australian and New Zealand Conservation Council/Agriculture, and Resource Management Council of Australia and New Zealand 2000, *National water quality management strategy. Australian and New Zealand guidelines for fresh and marine water quality*. This guideline has been superseded by an online resource prepared by the Australian and New Zealand and Australian State and Territory Governments (ANZG) in May 2018.
- National Health and Medical Research Council (NHMRC)/National Resource Management Ministerial Council (NRMMC) 2011, *Australian Drinking Water Guidelines 6*.

In the context of a contaminated site assessment, groundwater is considered to be contaminated when its quality is such that it is not suitable for the current or realistic future use or presents the likelihood of causing an unacceptable environmental or human health impact in the discharge environment.

For assessing groundwater quality, it is necessary to assess the potential uses of groundwater hydraulically downgradient of the site being investigated. The nearest surface water feature is a stormwater outlet, (that flows only during rain events) and is located approximately 580 m north-west of the site. That channel is understood to empty into Ginninderra Creek, approximately 870 m to the north of the site. Ginninderra Creek is a tributary of the Murrumbidgee River, which is a major water body located approximately 7.35 km west of the site. Ginninderra Creek is not considered likely to be used for recreational purposes and supports freshwater ecosystems. The unnamed channel is very unlikely to be used for recreational purposes but could potentially support a down-stream freshwater ecosystem. As these guidelines apply to receiving waters, it is generally conservative to apply these to groundwater discharging to receiving waters. It is considered that GILs for fresh water are applicable for investigating chemical concentrations in groundwater at the site because the possible receiving body is fresh water influenced.

It is important to note that these are not threshold values at which an environmental problem is likely to occur if exceeded. Rather, if the trigger values are exceeded then further action is required which may include either further site-specific investigations to assess whether there is an actual problem or management/remedial action should be undertaken. The groundwater reference criteria for ecological protection and drinking water resources, considered relevant to the current investigation of groundwater, are listed in Table E.2.

Table E.2 Groundwater reference criteria

ANALYTE	ECOLOGICAL PROTECTION CRITERIA- FRESHWATERS [1] (µg/L)	DRINKING WATER GUIDELINES [2] (µg/L)
Benzene	950	1
Toluene	180[2]	800
Ethylbenzene	80[2]	300
Total xylene	-	600

ANALYTE	ECOLOGICAL PROTECTION CRITERIA- FRESHWATERS [1] (µg/L)	DRINKING WATER GUIDELINES [2] (µg/L)
Xylene (o-)	350[2]	-
Xylene (m- and p-)	75[2]	-
Lead	3.4	10
Ethanol	1,400	-
Benzo(a)pyrene	0.2	0.01

Notes:

3. ANZAST (2018) – Water quality guidelines (95% trigger values for fresh water have been used)
4. National Health and Medical Research Council (NHMRC)/National Resource Management Ministerial Council (NRMMC) (2011) – Australian Drinking Water Guidelines 6.

Health Screening Levels (HSLs) are applicable to the assessment of vapour intrusion risks arising from petroleum hydrocarbons in contaminated groundwater. The adopted hydrocarbon fraction ranges for the HSLs are based on TRH concentrations after subtraction of BTEX compounds and naphthalene. HSLs do not apply to wells with LNAPL as it is assumed that the groundwater at those locations exceed the criteria.

These HSLs have been developed for sand, silt and clay soils based on soil texture classifications. Where there is reasonable doubt as to the appropriate soil texture to select, either a conservative selection should be made (i.e. select coarsest applicable grain size such as sand) or laboratory analysis carried out to determine particle size and hence soil texture sub-class. As particle size analysis could not be undertaken due to the drilling methodology employed (solid flight auger and air hammer, which pulverise the weathered and/or fresh rock into small fragments and dust), the most conservative option was selected, and the adopted assessment criteria was thus based on a subsurface profile comprising sand. This selection was on the basis that the profile consisted of highly weathered rock and not consistent in structure and type. The HSLs have been incorporated in Schedule B1 in the context of a wider site assessment framework for petroleum hydrocarbon contamination. They are intentionally conservative and are based on a reasonable worst-case scenario generic land use settings. For this assessment, both the HSL A/B (residential) and the HSL D (commercial/industrial setting) will be adopted, for a depth to groundwater of greater than 8 m. The adopted petroleum assessment criteria for groundwater have been provided in Table E.3. The NEPM 2013 lists HSLs for open space as well as for intrusion into buildings. All HSL values for open space are listed as "non limiting" meaning that the groundwater concentrations required to produce vapours that may present an exposure risk in open space, cannot be reached in the dissolved phase. Thus, dissolve phase hydrocarbons in groundwater cannot produce unacceptable vapour risks in open space atmospheres.

Table E.3 Groundwater health screening levels

CHEMICALS	HSL A/B: RESIDENTIAL – SAND – >8 m [1] (µg/L)	HSL D: COMMERCIAL/ INDUSTRIAL – SAND >8 m [1] (µg/L)
pH	–	–
TRH F1 (C_6-C_{10} minus BTEX)	1,000	7,000
TRH C_6-C_9	–	–
TRH F2 (>C_{10}-C_{16} minus naphthalene)	1,000	NL
TRH C_{10}-C_{40}	–	–

CHEMICALS	HSL A/B: RESIDENTIAL – SAND – >8 m [1] (µg/L)	HSL D: COMMERCIAL/ INDUSTRIAL – SAND >8 m [1] (µg/L)
Benzene	900	5,000
Toluene	NL	NL
Ethylbenzene	NL	NL
m- & p- xylene	–	–
o-xylene	–	–
Xylene	NL	NL
Naphthalene	NL	NL
Ethanol	–	–
Lead	–	–
Benzo(a)pyrene	–	–

Notes:

5. NEPM (2013) – Schedule B-1 Investigation Levels for Soil and Groundwater – Table 1A(4) Groundwater HSLs for vapour intrusion

NL not limiting i.e. the soil vapour source concentration for a petroleum mixture could not exceed a level that would result in the maximum allowable vapour risk for the given scenario

- No criteria available

For groundwater monitoring of a service station site in the ACT, monitoring should be undertaken in accordance with the specification outlined in the ACT EPA (2019) *Environmental Guidelines for Petroleum Storage in the ACT*. This guideline states that monitoring should be undertaken annually where groundwater monitoring wells are installed and should be analysed for the organic and inorganic substances outlines in Table 1 of the guideline. The groundwater monitoring parameters have been included for assessment during groundwater sampling and provided in Table E.4 below.

Table E.4 ACT EPA groundwater monitoring criteria

CHEMICALS	ACT EPA GROUNDWATER MONITORING CRITERIA (µg/L) [1]
pH	6.5-8.5
TRH C_6-C_9	-
TRH C_{10}-C_{40}	600
Benzene	950
Toluene	300
Ethylbenzene	140
m- & p- xylene	200
o-xylene	350
Ethanol	1,400
Lead	3.4

Notes:

1. As provided in the site's Environmental Authorisation (EA) No. 0749

- No criteria available

E.3.3 REFERENCE GUIDANCE FOR SOIL VAPOUR CONTAMINANT CONCENTRATIONS (ASSESSMENT CRITERIA)

Assessment criteria applying to soil vapour concentrations of the contaminants of concern, have been selected as the criteria to address one of the objectives of the investigation. That objective is to investigate potential vapour intrusion risks to residents and other occupants of properties off-site. The criteria, described below, will be used to evaluate whether or not there is a potential for occupants of the off-site properties to be affected by vapour intrusion. The chosen criteria are applicable as screening level values to indicate possible risks. However, an exceedance of the criteria would not necessarily indicate that a complete vapour intrusion pathway exists since the measurements are in the lithological profile and therefore are not necessarily indicative of conditions in the overlying buildings. An exceedance would be interpreted as an indication of a need for more targeted measurements such as flux and indoor air measurements. Criteria for protection of people using open space land have also been included as there is an area of open space to the west of the service station.

The selected criteria are sourced from Schedule B1 of the NEPM (2013) which presents human health screening level criteria describing acceptable soil vapour concentrations that would not present an unacceptable risk to building occupants, and open space receptors, through the pathway of vapour intrusion (from sub-floor soil vapour concentrations – to indoor air concentrations). The NEPM 2013 criteria listed in Table E.5 are relevant to soil vapour measurements – conservatively assuming a sandy soil or fill sub-surface profile and commercial/industrial land use, such as the leagues club to the east of the site. The analytical data will also be assessed against the criteria for low-density residential land use, to assess the vapour risk to adjacent site users to the north and south, as well as against the open space criteria for the current use of the unassigned block of land to the west. The results for the soil vapour testing in SV5, located in the unassigned block will also be compared against residential and commercial criteria, since the land may be developed for those uses as permitted in the ACT Territory Plan.

Criteria for sand have been used as there are no criteria for the specific profile encountered. The profile is volcanically sourced Tuff and soils formed from its weathering. The non-homogenous nature of the profile necessitates the selection of criteria for sand, which represents the most porous of the options – sand, silt and clay. Depths were chosen to coincide with the two depths of sampling, 2 m and 6 m.

Table E.5 Soil vapour health screening levels (HSLs) for petroleum hydrocarbons

CHEMICALS	HSL A: RESIDENTIAL – SAND 1 to <2m (µg/m^3) [1]	HSL A: LOW DENSITY RESIDENTIAL – SAND 4 to <8m (µg/m^3) [1]	HSL D: COMM / IND – SAND 1 to <2 m (µg/m^3) [1]	HSL D: COMM / IND – SAND 4 to <8m (µg/m^3) [1]	HSL C: PUBLIC OPEN SPACE SAND 1 to <2 m (µg/m^3) [1]	HSL C: PUBLIC OPEN SPACE SAND 4 to <8 m (µg/m^3) [1]	INTRUSIVE MAINETNCE WORKER 0 to <1 m (µg/m^3) [2]
Benzene	3,000	10,000	10,000	65,000	2,400,000	9,500,000	760,000
Toluene	3,800,000	15,000,000	16,000,000	84,000,000	NL	NL	NL
Ethylbenzene	1,100,000	4,300,000	4,600,000	25,000,000	NL	NL	NL
Total xylene	750,000	3,000,000	3,200,000	18,000,000	NL	NL	NL
Naphthalene	3,000	10,000	15,000	75,000	NL	NL	880,000
TRH F1	640,000	2,600,000	2,800,000	15,000,000	NL	NL	180,000,000
TRH F2	560,000	2,400,000	2,400,000	NL	NL	NL	NL

Notes:

1. NEPM (2013) – Schedule B-1 Investigation Levels for Soil and Groundwater
2. CRC CARE (2011) Technical Report No. 10 – Table B1 Soil vapour health screening levels

NL – Indicates that the unacceptable concentration (i.e., the HSL for the substance) cannot be reached by volatilisation from the pure substance

US EPA (May 2020) Vapor Intrusion Screening Levels (VISLs) have also been considered in the evaluation of the soil vapour data. The VISLs provide screening levels for some compounds for which there are no HSLs listed by the NEPM 2013. The VISLs have been incorporated the assessment of soil vapour at the site, however the VISLs are not necessarily applicable to the depths at which the soil vapour measurements were undertaken during previous assessment works.

ATTACHMENT F
REMEDIATION TECHNOLOGY SCREENING REVIEW

Remediation Technology Screening Matrix
LNAPL and Dissolved Hydrocarbon Remediation in a Weathered Fractured Rock Media

Technology Considered	Applicability & Permissibility to Site				Approx. Costs (C)	Treatment Time (T)	Sustainability (S)	Rating Summation	Ranking
	Discussion		Ratings		Total Cost as NPV				
			Applic. (A)	Permits (P)	High$ Low$	Slow Fast	Low High		
	Advantage	Disadvantage	0-5	0-3	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	A*P*(C+T+S)	
Air Sparging	l, me	ia, cnr, adtrt, smat, drsrl	1	2	3	1	3	14	**7**
Soil Vapour Extraction	dest, vred, perf, i, me	area, ci, adtrt, smat, drsl, igc	3	2	2	2	4	48	**4**
MPVE System	mred, dest, vred, perf, i, me	area, ci, adtrt, smat, drsl	4	2	2	4	3	72	**2**
Vacuum Truck Campaign	mred, dest, vred, perf, i, me	ci, adtrt, smat, drsl	3	3	2	3	2	63	**3**
Excavation	mred, dest, vred, perf,	area, ci, pal	1	0	1	5	1	0	**8**
In-Situ Chemical Oxidation	mred, dest, vred, me	cnr, area, adtrt, smat, pni, drsl, pal	4	3	2	3	4	108	**1**
Pump & Treat / Hydraulic Control	mred, dest, vred, perf, i, me	area, ci, adtrt, drsl,	2	3	3	2	3	48	**4**
Enhanced Natural Attenuation	dest, vred, perf, l, me'	area, cnr, adtrt, pni, drsl, pal	1	3	2	1	5	24	**6**

Remediation Technology Screening Matrix
LNAPL and Dissolved Hydrocarbon Remediation in a Weathered Fractured Rock Media

Technical Applicability		Relative Applicability & Permissibility		Relative NPV Costs	Sustainability	Treatment Time Acceptability
Advantages	**Disadvantages**	**Applicability Score**	**Permissibility Score**			
mred - Mobility Reduction	et – Emerging Technology	0 = not applicable	0 = Not Permissible	1 = Very High (>$1.5M)	1 = Very High Energy Consumption/ Waste Generation	1 = Very High (>10 yrs)
dest - Destruction	ia – Inappropriate Technology nperm – Not Permittable	1 = unlikely to be applicable	1 = Probably not Permissible	2 = High ($0.75M - $1.5M)	2 = High Energy Consumption/ Waste Generation	2 = High (5 – 10 yrs)
vred - Volume Reduction	cnr – Contaminant Not Removed area – Area Required	2 = possibly applicable – untested	2 = Probably Permissible	3 = Medium ($500k – $750K)	3 = Moderate Energy Consumption/ Waste Generation	3 = Moderate (2 – 5 yr)
perf - Performance & Reliable	ci – Community Impact adtrt – Additional Treatment Required	3 = application at other sites – mixed results	3 = No Permitting Problems	4 = Low ($250K - $500K)	4 = Low Energy Consumption/ Waste Generation	4 = Low (1 – 2 yrs)
i – Implementability	smat = Potential inappropriate soil material dtw = Depth to water	4 = some successful application at similar sites		5 = Very Low (<$250K)	5 = Very Low Energy Consumption/ Waste Generation	5 = Very Low (< 1 yr)
me - Exposure Minimisation	pni = Potential negative interaction	5 = proven technology at similar sites				
	drsrl = Does not reach site remediation level					
	pal = Potential additional liability					
	igc = Inappropriate for groundwater contaminant					

Scoring

Applicability to Site (A)

The applicability of a technology to remediate contaminants at any specific site is evaluated with regard to the specific advantages and disadvantages listed below. Those that are applicable are recorded on the Technology Screening Matrix.

Advantages

Mobility reduction	mred	is listed as an advantage when the technology significantly reduces the potential for contaminant migration.
Destruction	dest	is listed as an advantage when the technology destroys, degrades or otherwise transforms the contaminant to a non-toxic form.
Volume Reduction	vred	is listed as an advantage when the technology significantly reduces the amount of contamination in the contaminated matrix.
Performance and Reliable	perf	is listed as an advantage if the technology has a proven track record for treating the given waste in a similar site setting.
Implementability	I	is listed as an advantage when the logistics of designing, obtaining, installing, and operating the technology at the given site appear to be straightforward
Exposure Minimisation	me	is listed if the treatment reduces human exposure to the contaminant.

Disadvantages

Emerging Technology	et	is listed as a disadvantage when a technology is not fully developed. Reliability of the technology is questionable for the specific site.
Inappropriate Technology	ia	is listed as a disadvantage when site conditions are not technically suitable for the application of the technology.
Not Permissible	nperm	is listed as a disadvantage if permitting of the technology of the site is very difficult or impossible to obtain.
Contaminant Not Removed	cnr	is listed as a disadvantage if significant contamination remains on-site after application of the technology. This may require health risk assessment
Area Required	area	is listed as a disadvantage if application of the technology would require a large area of the site surface
Community Impact	ci	is listed as a disadvantage if the technology could be perceived as negatively impacting the local community or environment
Additional Treatment required	adtrt	is listed if technology requires additional equipment or processes to handle contaminant (e.g. off-gas control, carbon polish, etc.).
Inappropriate Soil Material	smat	is listed if the soil structure is incompatible with treatment process
Depth to Water	dtw	listed if depth to groundwater is inappropriate for the treatment alternative
Potential Negative Interaction	pni	is listed if the treatment alternative may somehow react with cons ituents at the site producing a negative effect
Does Not Reach Site Remediation Level	drs	is listed if the technology is not capable of achieving the clean-up objectives in an acceptable amount of time
Potential Addi ional Liability	pal	is listed if the treatment technology may add additional liability
Inappropriate Groundwater contaminant	igc	is listed if the treatment technology does not address he groundwater contaminant of concern

Permissibility (P)

Permissibility is linked to the aspects related to the disadvantages linked with the assessment of Applicability (see above). It also direc ly relates to the willingness of third party regulators and other parties to allow he planned treatment to proceed and what control measures and monitoring would be required.

Relative Costs (C)

This rating gives a numerical value to the estimated combined relative capital and operating costs (as a Net Present Value combined cost) that is likely to be incurred in implementing the technology.

Capital Costs. Relative cost of obtaining and installing the technology at a specific site; combined with

Operating Costs. Relative cost of operating and maintaining the treatment system at the specific site.

Treatment Time (T)

This rating gives a numerical value to the potential of the treatment technology to perform the desired site remediation wi hin an acceptable time frame. With the review of source reduction measures, treatment times of greater than 3 years are assigned a low score, while more aggressive treatment that can close a site within a year are given a high score.

Sustainability (S)

This rating gives a numerical value to the potential environmental effects of remedy implementation and whether the chosen technology maximises net environmental benefit of cleanup actions. Solutions which generate large amounts of waste, consume large amounts of energy, leave long term liabili ies unmanaged, or produce large amounts of greenhouse emissions will be allocated low scores. Technologies which produce better outcomes with respect to these factors will score higher results.

ATTACHMENT G
REMEDIATION PILOT TRIALS WORK PLAN

Our ref: PS118985-REM-LTR-001 Rev2

By email
[redacted]

14 September 2020

[redacted]
Senior Envrionmental Specialist - Eastern Region
Caltex Australia Petroleum Pty Limited
2 Market Street
Sydney, NSW, 2000

Dear [redacted]

Remediation Pilot Trials Work Plan - Caltex Holt

1. INTRODUCTION

On 14 February 2020, in response to a suspected loss of fuel at the Caltex Holt service station, 1 Hardwick Crescent, Holt, ACT, Caltex Australia Petroleum Pty Limited (Caltex) engaged WSP Australia Pty Limited (WSP) to assist in the spill response investigations and works to mitigate the loss of product at the service station (site location presented in Figure 1).

Following the information gained from the initial spill response works (including the light non-aqueous phase liquid (LNAPL) recovery efforts to date), as well as additional vapour, groundwater and LNAPL assessment, WSP proposes a pilot trial program for the site.

The pilot study will aim to evaluate the effectiveness of remedial technologies that are considered to be potential options for achieving likely remedial objectives for the site, and to provide specific design parameters for the remediation approach implemented in the future.

At sites where there is significant LNAPL contamination, and therefore bulk hydrocarbon removal is required, high-vacuum fluid and vapour extraction and/or In-situ Chemical Oxidation (ISCO) technologies are considered the most appropriate remediation approaches with this type of lithology (volcanic tuff).

The remediation approaches that are considered the most appropriate for the Holt site include:

- Multi-Phase Vacuum Extraction (MPVE) – vacuum extraction of vapours and liquid
- Soil Vapour Extraction (SVE) – vacuum extraction of vapours only
- SVE + pumping – combined SVE and liquid pumping
- In-situ Chemical Oxidation (ISCO) – injection of oxidising reagent chemical (persulfate)

Based on previous experiences at similar sites, the pneumatic and hydraulic radius of influence (ROI) from the point of the liquid/vapour extraction / injection can vary significantly in a fractured rock setting. To determine this, we propose to install eight new wells (1 x 100mm central extraction well, 4 x 50mm monitoring wells and 3 x 50mm injection wells – see Figure 2) to measure the ROI and allow for ISCO solution injection during the pilot trials. The wells have been placed at varying distances and directions from the extraction / injection points to accurately assess the ROI. The table in Attachment B provides a summary of the well names, purpose, selected location, and the proposed monitoring.

2. SCOPE OF WORK

The proposed pilot trial program would consist of the following:

- Well installation – WSP propose the installation of eight additional wells onsite:
  - 1 x 100mm central extraction well – PRW1 (green dot on Figure 2);
  - 4 x 50mm monitoring wells – PMW1 to PMW4 (purple dots on Figure 2); and
  - 3 x 50mm injection wells – IW1 to IW3 (red dots on Figure 2).
- A series of rising head slug tests across the study area to estimate the aquifer hydraulic parameters. The potential locations of the rising head slug tests are marked with orange circles on Figure 2.
- A series of LNAPL baildown tests across the study area to estimate the LNAPL transmissivity. The potential locations of the rising head slug tests are marked with orange circles on Figure 2.
- MPVE test to estimate the mass removal rates, and pneumatic and hydraulic ROI in the saturated and unsaturated formations for this remediation technology.
- SVE test to estimate the mass removal rates, and pneumatic ROI in the unsaturated formations for this remediation technology.
- SVE + pumping test to estimate the mass removal rates, and pneumatic and hydraulic ROI in the saturated and unsaturated formations for this remediation technology.
- ISCO injection of chemical oxidising reagent (persulfate) into the four proposed 50mm injection wells. The injection wells will consist of IW1 to IW3 and one of PMW1 to PMW4.

The proposed pilot trial would provide data on the following.

- Hydraulic conductivity (K) to provide data for plume modelling associated with future remedial system design and / or risk assessment.
- Drawdowns in pumping and monitoring wells and associated ROI of liquid extraction from various liquid extraction tests.
- The pneumatic flow characteristics of the vadose zone, including effective ROI from various vacuum extraction tests.
- The extracted air quality from various vacuum extraction tests.
- The air flow and vacuum requirements for effective capture and treatment of contaminated fluids.
- The expected treatment required prior to the discharge of the extracted air and liquids.
- Oxidising characteristics of the ISCO reagent.

Based on the outcomes of the trials, a comparison will be made between the four remediation technologies (MPVE, SVE, SVE + pumping and ISCO) to determine the most appropriate, efficient and cost-effective technology(ies) for the site.

2.1 RISING HEAD TESTS / LNAPL TRANSMISSIVITY

2.1.1 RISING HEAD TESTS

A maximum of eight rising head tests ('slug tests') will be conducted in wells that do not contain LNAPL, in order to assess the hydraulic characteristics in the underlying aquifer. The hydraulic

conductivity data may be then used for plume modelling associated with any required injection technology, fate and transport assessment and / or risk assessment (as required).

The slug test is one of a number of different methods that are used to evaluate the hydraulic conductivity of an aquifer. The procedure will involve removing a measured quantity of water (i.e. a 'slug') from the wells rapidly, followed by making a series of rapid water-level measurements (using down-hole data loggers) to assess the rate of water-level recovery.

Slug tests are the preferred technique to obtain hydraulic conductivity data at this site, as there is likely to be measurable LNAPL in the pilot test area, making the conduct and interpretation of an aquifer pumping test data complicated. Conducting a number of slug tests across the study area will also provide a range of values for the hydraulic conductivity, which may be important at this site where there appears to be some differences in the aquifer lithology leading to preferential groundwater and contaminant flow.

2.1.2 LNAPL TRANSMISSIVITY

LNAPL bail down / transmissivity testing has previously been conducted on MW15 on 21 May 2020, which reported an LNAPL transmissivity of 0.076 m^2/day (WSP, 2020).

To supplement the previous transmissivity testing at MW15, we propose to conduct an additional three tests at EW1, MW16 and one the new pilot trial wells, assuming there is sufficient LNAPL present for bail down testing (noting that meaningful LNAPL bail down / transmissivity testing is difficult to achieve with small LNAPL thicknesses (e.g. <0.1m thick).

The bail down testing procedure will involve removing the LNAPL from the well until no more can be removed, while minimising the volume of water removed, followed by making a series of depth to water and depth to LNAPL measurements (using an interface probe-hole data loggers) to assess the rate of LNAPL recovery over time. The data will be analysed using the American Petroleum Institute (API) LNAPL Transmissivity Workbook (2016) to estimate the LNAPL transmissivity.

We also note that LNAPL behaviour and multiphase flow is complex in fractured rock with the LNAPL mobility governed by the geometry and interconnection of the fracture network. As the available transmissivity models assume a porous homogenous media with two-dimensional flow, the transmissivity values that will be calculated will be considered indicative only.

2.2 SOIL VAPOUR EXTRACTION (SVE) TEST

The SVE test will be conducted at the extraction well (proposed 100mm central well) using a truck mounted vacuum/separation system, where air is extracted under monitored conditions with vapour flow and well head vacuums measured. The vacuum line will be connected directly to the top of the extraction well head, with no installation of a drop tube / stinger into the well. A range of flow rates and wellhead vacuums will be applied during the trial. The water level and vacuum response at the other 50mm surrounding wells will also be monitored.

During the SVE tests the following data will be collected:

- Flow rate of vapour from the extraction well.
- Applied wellhead vacuum pressure.
- Induced vacuums and hydraulic drawdowns at the extraction wellhead and surrounding monitoring wells.
- Contaminant concentrations in the discharged air, using a PID, explosimeter and one carbon tube to validate the PID / LEL readings).

2.3 SOIL VAPOUR EXTRACTION (SVE) AND PUMPING TEST

The SVE – pumping test will be conducted at the extraction well (proposed 100mm central well) using a truck mounted vacuum/separation system, where air is extracted under monitored conditions with vapour flow and well head vacuums measured. The vacuum line will be connected directly to the top of the extraction well head, with no installation of a drop tube / stinger into the well. A range of flow rates and wellhead vacuums will be applied during the trial. The water level and vacuum response at the other 50mm surrounding wells will also be monitored.

In order to maximise the efficiency of the hydrocarbon mass removal via the SVE, the trial will be conducted with a down-hole pneumatic pump operating in the extraction well concurrently with the application of SVE. The concurrent dewatering will ensure that the smear zone is further exposed, which may enable a larger effective ROI and more efficient hydrocarbon removal.

During the SVE – pumping tests the following data will be collected:

- Flow rate of vapour from the extraction well.
- Flowrates and volumes of liquids from the extraction well.
- Applied wellhead vacuum pressure.
- Induced vacuums and hydraulic drawdowns at the extraction wellhead and surrounding monitoring wells.
- Contaminant concentrations in the discharged air, using a PID, explosimeter and one carbon tube to validate the PID / LEL readings.

2.4 MULTI-PHASE VACUUM EXTRACTION (MPVE) TEST

MPVE, also known as Dual Phase Extraction (DPE) and vacuum-enhanced extraction, is a technology that employs a high vacuum to remove various combinations of contaminated groundwater, LNAPL, and volatile organic vapours from the subsurface matrix.

A truck mounted vacuum/separation system would be used to conduct the MPVE pilot trial. The system will be capable of applying a vacuum up to 75 kPa at the well head of the extraction point (proposed 100mm central well). A drop tube (stinger) will be inserted to variable depths in the extraction well. The MPVE pilot trial system will be used to apply a vacuum to the well head of the extraction well in increasing steps.

During the MPVE events the following data will be collected:

- The total extracted volume of NAPL and contaminated groundwater.
- The pneumatic flow characteristics of the unsaturated soil, including effective ROI. This will be achieved by installing regular vacuum gauging of the surrounding 50mm monitoring wells.
- The hydraulic flow characteristics of the unsaturated soil, including effective ROI. This will be achieved by regular gauging of the surrounding 50mm monitoring wells.
- The extracted air quality from the vacuum extraction test (using a photoionization detector (PID), explosimeter (Lower Explosion Limit (LEL) meter) and one carbon tube (laboratory analysis) to validate the PID / LEL readings).
- The air flow and vacuum requirements for effective capture of contaminated materials.
- The key specifications for MPVE remedial system design for full-scale remediation of the site.

2.5 IN-SITU CHEMCIAL OXIDATION (ISCO) INJECTION

ISCO is a technique used to remediate subsurface contaminants using strong chemical oxidants, in this case persulfate, to breakdown the contaminant into innocuous products such as water and carbon dioxide. The effectiveness of ISCO depends on the geology, the residence time of the oxidant, the amount of oxidant used, and the effective contact the oxidant has with the contaminant.

The injection method proposed for the site is direct injection, via positive injection of the reagent using pumps. The persulfate solution will be pumped into four 50mm injection wells (See Figure 2 – IW1 – IW3 and one of PMW1 to PMW4). Each injection well will have 500 L of persulfate solution pumped into the well, displacing groundwater corresponding to the volume of reagent injected. This will enable the contact between the reagents and the contaminants within the soil/rock pores and allow oxidisation and subsequent contaminant breakdown to occur.

During the ISCO tests the following data will be collected:

- Volume (and flow rates) of injected persulfate solution measured.
- Water levels and water quality parameters in surrounding wells.

2.6 PILOT TRIAL SUMMARY

Table 2.1 below shows the summary of the wells, expected duration, and performance metrics of the pilot trials.

Table 2.1 Summary Pilot Trial Parameters

TRIAL	EXTRACTION / INJECTION WELLS	MONITORING WELLS	EXPECTED TRIAL DURATION	PERFORMANCE METRICS
Rising Head Tests (Day 1 - morning)	MW04, MW06, MW07, MW09 – MW11, MW15, and EW03 (assumes LNAPL not present – may need to change wells if LNAPL present)	N/A	Likely to vary: 15 mins – 120 mins / well	Hydraulic conductivity
LNAPL Bail Down Tests (TBC)	EW1, MW16 and one pf the new wells (PMW1 to PMW4 or PEW1)	N/A	~3 hours / well	LNAPL transmissivity > 0.009–0.07 m^2/day (ITRC, 2009)
SVE Trial (Day 1 – late morning / afternoon)	PEW1	PMW1 to PMW4, MW02, MW05, MW06, MW15	~5 hours	ROI – Monitoring well vacuum response >100 Pa Mass recovery rates > 1 kg/hr
SVE + Pumping Trial (Day 2)	PEW1	PMW1 to PMW4, MW02, MW05, MW06, MW15	~8 hours	ROI – Monitoring well vacuum response >100 Pa ROI – Monitoring well drawdown of > 0.1m Mass recovery rates > 1 kg/hr
MPVE Trial (Day 3)	PEW1	PMW1 to PMW4, MW02, MW05, MW06, MW15	~8 hours	ROI – Monitoring well vacuum response >100 Pa ROI – Monitoring well drawdown of > 0.1m Mass recovery rates > 1 kg/hr
Injection Trials (Days 4 and 5)	IW1	MW06, MW07	~4 hours / well	Injection flow rate Noticeable changes in water level and water quality parameters in the monitoring wells Hydrocarbon concentrations in monitoring wells before and (approximately 1-2 weeks) after injection
	IW2	MW01, EW03		
	IW3	MW10		
	One of PMW1 to PMW4	PMW1 to PMW4, MW02, MW05		

3. PILOT TRIAL REPORTING

Reporting of the pilot trials assumes that both a draft (for review by Caltex, Norton Rose Fulbright and the Auditor) and final report will be produced providing the following:

- Results of the rising head slug tests, including the hydraulic conductivity calculated at each of the test locations.
- Assessment of the pneumatic ROI achieved at various vacuums for the various vacuum extraction tests.
- Assessment and comments on the response of surrounding wells to the rate of fluid and vapour extraction and changing water levels and pressures at surrounding wells.
- Liquid recovery rates.
- Vapour recovery rates and contaminant concentrations.
- Estimate of mass of hydrocarbon removed during the various pilot tests.
- Reagent injection volumes, rates, and solution concentrations.
- Estimate of mass of hydrocarbon removed / broken down during the ISCO pilot test.
- Response in nearby monitoring wells to the injection trial
- The key system design specifications for full-scale remediation of the site.
- A comparison of the remediation technologies tested.

4. CLOSING

We trust that the work plan outlined above is satisfactory. Please contact the undersigned if you would like any clarification on the above proposal.

Yours sincerely

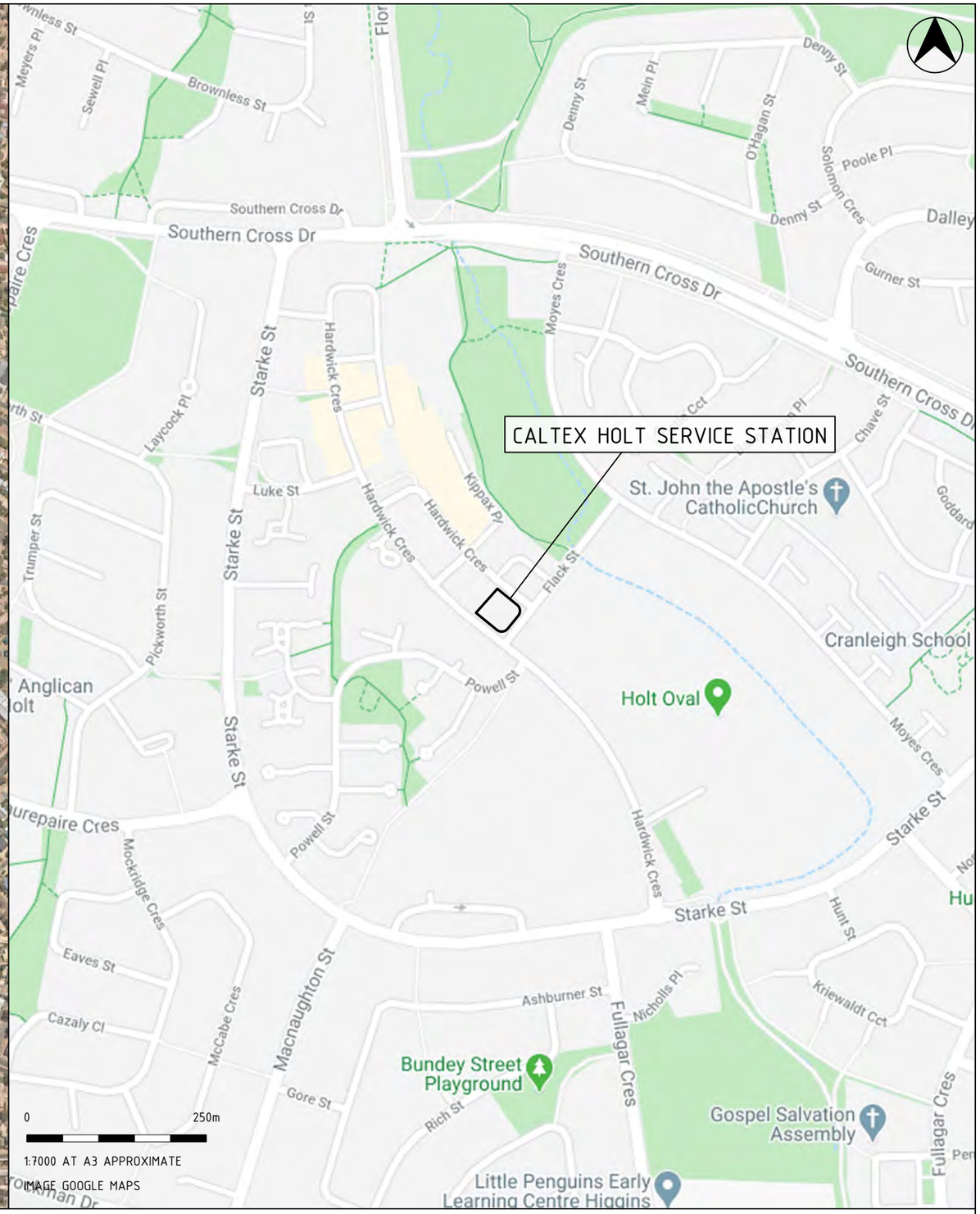
[redacted]
Environmental Consultant

[redacted]
Principal Engineer, Remediation

Encl: Figures
Well Installation Summary

Attachments
Figure 1 – Site Location Plan
Figure 2 – Trial Layout Plan

ATTACHMENT A
FIGURES



REMAD technical services
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InSite Remediation Services

Figure prepared for WSP by
InSite Remediation Services Pty Ltd

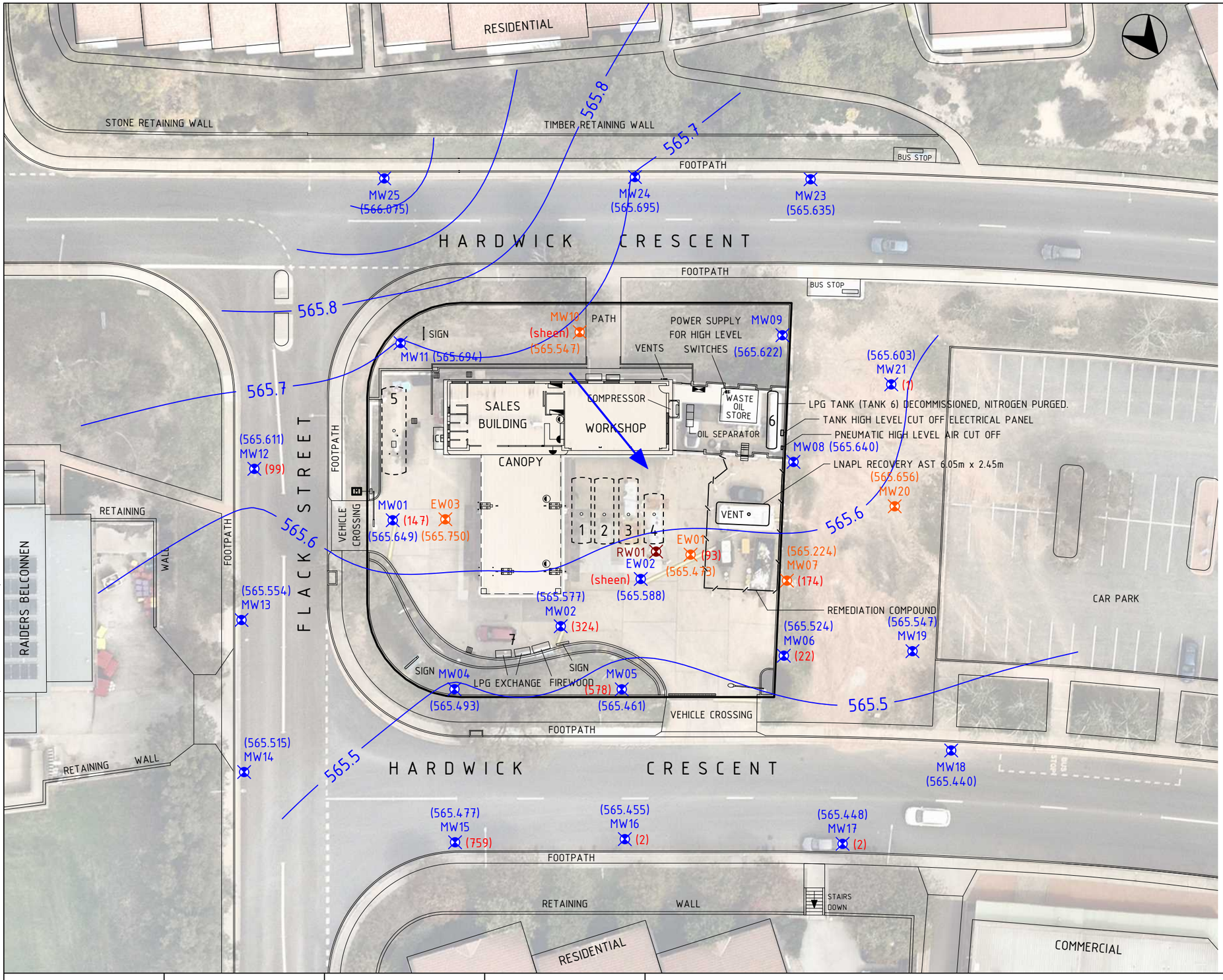
CALTEX

wsp

CALTEX HOLT SERVICE STATION
1 HARDWICK CRESCENT
HOLT ACT

FIGURE 1
SITE LOCATION

D:\Google Drive\InSite Remediation\Holt\FIGURES\FIGURES V14 ESA\CALTEX HOLT ESA F01 SITE LOCATION V14.wwx | Thu, 2 Jul 2020 8:24:44 AM | drawn by laurie white at www.reumad.com.au



LEGEND

- SITE BOUNDARY
- EW# MW## — GROUNDWATER MONITORING WELL INCLUDED IN GROUNDWATER CONTOUR CREATION
- EW# MW## — GROUNDWATER MONITORING WELL OMITTED FROM GROUNDWATER CONTOUR CREATION
- RW## — RECOVERY WELL OMITTED FROM GROUNDWATER CONTOUR CREATION
- SWITCHBOARD
- FIRE HOSE REEL
- MANIFEST BOX - CONTAINING ERP DOCUMENT
- EMERGENCY STOP BUTTON
- CO^2 FIRE EXTINGUISHER
- DRY CHEMICAL FIRE EXTINGUISHER
- FUEL DISPENSER
- GRATED DRAIN / GRATED PIT
- #.# — GROUNDWATER ELEVATION CONTOUR IN 0.1m INTERVALS (mAHD)
- (###.###) — GROUNDWATER ELEVATION LEVEL IN MONITORING WELL (mAHD)
- (###.###) — GROUNDWATER ELEVATION LEVEL IN MONITORING WELL (mAHD) OMITTED FROM GROUNDWATER CONTOUR CREATION
- INFERRED DIRECTION OF GROUNDWATER FLOW
- (###) — APPARENT LNAPL THICKNESS (mm) 20 APRIL 2020

TANK SCHEDULE

TANK	TYPE	PRODUCT	CLASS	CAPACITY	USAGE
1	UST	V95	3	27,400L	IN USE
2	UST	DIESEL	C1	27,400L	IN USE
3	UST	E10	3	27,400L	IN USE
4	UST	V98	3	20,000L	NOT IN USE
5	UST	ULP	3	59,400L	IN USE
6	AST	LPG	2.1	7,500L	NOT IN USE
7	LPG EXCHANGE		2.1	9x4kg, 42x9kg	IN USE

NOTE

LPG TANK (TANK 6) DECOMMISSIONED, NITROGEN PURGED.
EW01, EW03, MW07, MW10, MW20 & RW01 WERE OMITTED FROM THE 'SURFER' GROUNDWATER CONTOUR CREATION TO PRODUCE AN INTERPRETED CONTOUR ABSENT OF POTENTIAL LNAPL PRESENCE RECOVERY EFFECTS.

0 15m

1:460 AT A3 APPROXIMATE

AERIAL IMAGE NEARMAP 13 APRIL 2020.

REFERENCE: CALTEX 'DANGEROUS GOODS PLAN' DRAWING NO. 22546-DG REV. B DATED 25/11/2011 SUPPLIED BY CLIENT.

REMMAD technical services geotechnical & environmental drafting support

InSite REMEDIATION SERVICES

Figure prepared for WSP by InSite Remediation Services Pty Ltd

CALTEX

wsp

CALTEX HOLT SERVICE STATION
1 HARDWICK CRESCENT
HOLT ACT

FIGURE 8
GROUNDWATER CONTOUR PLAN
20 APRIL 2020

D:\Google Drive\InSite Remediation\Holt\GWCONTOUR\CALTEX HOLT F06a GWC AND LNAPL THICKNESS 2020APR20 V11.vwx | Fri, 5 Jun 2020 2:21:25 PM | drawn by laurie white at www.reumad.com.au

ATTACHMENT B
WELL SUMMARY

Level 27, 680 George Street
Sydney NSW 2000
GPO Box 5394
Sydney NSW 2001

Tel: +61 2 9272 5100
Fax: +61 2 9272 5101
www.wsp.com

WSP Australia Pty Limited ABN 80 078 004 798

WELL ID	CURRENT STATUS	PURPOSE	RATIONALE	MONITORING PARAMETERS
PEW1	Proposed 100mm well	Pilot Trial Extraction Well for MPVE / SVE / Pumping	Located on site, in area where existing LNAPL-impacted wells (e.g. MW02 and MW05) can be used as monitoring wells for the MPVE / SVE / SVE + Pumping trials	Vacuum, depth to LNAPL / water, flow rates
PMW1 to PMW4	Proposed 50mm well	Pilot Trial Monitoring Well for MPVE / SVE / Pumping	Located on in the vicinity of PEW1 and / or in the direction of the possible fracture(s) (e.g. MW15) – to be used as monitoring wells for the MPVE / SVE / SVE + Pumping trials. Enables monitoring to be conducted in different directions and distances from the extraction point, and thus allowing for the ROI to be determined.	Vacuum, depth to LNAPL / water
MW02, MW05, MW06, MW15	Current 50mm well			
IW1 TO IW3	Proposed 50mm well	Injection Well for ISCO Trial (one of PMW1 to PMW4 will be used as an injection well too)	Located in different areas to help determine differences in response to injection across the site.	Injection rates / pressure Monitoring to be conducted in nearby wells (water quality parameters, depth to LNAPL / water): IW1 – MW06, MW07 IW2 - MW01, EW03 IW3 - MW10 PMW1 – PEW1, PMW2 to PMW4, MW2
MW04, MW06, MW07, MW09 – MW11, MW15, EW03	Current 50mm wells	Rising head tests. (assumes LNAPL not present – may need to change wells if LNAPL present)	Propose to use up to eight wells that do not contain LNAPL, are located in different areas, and have a range of different levels of impacts (e.g. <LOR up to previously containing LNAPL) to help determine differences in hydraulic across the site. The wells used will be dependant on the absence of LNAPL.	Depth to water (versus time)

APPENDIX E

REMEDIATION TRIAL REPORT

CALTEX AUSTRALIA PETROLEUM PTY LTD

DECEMBER 2020

REMEDIATION PILOT TRIAL REPORT

CALTEX HOLT SERVICE STATION (SITE ID: 22546), 1 HARDWICK CRESCENT HOLT ACT

Remediation Pilot Trial Report
Caltex Holt service station (Site ID: 22546), 1 Hardwick Crescent Holt ACT

Caltex Australia Petroleum Pty Ltd

WSP
Level 27, 680 George Street
Sydney NSW 2000
GPO Box 5394
Sydney NSW 2001

Tel: +61 2 9272 5100
Fax: +61 2 9272 5101
wsp.com

REV	DATE	DETAILS
1	14/10/2020	Initial draft report for review
2	05/11/2020	Revision after comments
3	03/12/2020	Final

	NAME	DATE	SIGNATURE
Prepared by:	[redacted]	03/12/2020	[redacted]
Reviewed by:		03/12/2020	
Approved by:		03/12/2020	

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LIST OF APPENDICES

ABBREVIATIONS

ACT	Australian Capital Territory
BTEX	Benzene, toluene, ethyl benzene, xylene
°C	Degrees Celsius
C6–C10	Light hydrocarbon chain groups (for example, petrol)
C10–C16	Medium hydrocarbon chain groups (for example, kerosene)
C16–C34	Heavy hydrocarbon chain groups (for example, diesel)
C34–C40	Heavy hydrocarbon chain groups (for example, lube oil)
CSM	Conceptual site model
EA	Environmental authorisation
EPA	Environment Protection Authority
ESA	Environmental Site Assessment
GAC	Granulated activated carbon
GME	Groundwater monitoring event
Hr	Hour
IBC	Intermediate bulk container
HSL	Health screening level
ISCO	In Situ Chemical Oxidation
K	Hydraulic Conductivity
kg	Kilogram
kg/hr	Kilograms per hour
kPa	Kilopascal
L	Litre
LCSM	LNAPL conceptual site model
LNAPL	Light non-aqueous phase liquid
LOR	Limit of reporting
LPG	Liquid Petroleum Gas
L/s	Litres per Second
L/min	Litres per minute
mAHD	Metres Australian Height Datum
mBGL	Metres below ground level
mBTOC	Metres below top of casing
mg/L	Milligrams per Litre
min	Minute
m	Metres
mm	Millimetre
mV	Millivolt
m^3/h	Metres cubed per hour
mg/m^3	Milligrams per metres cubed

$Na_2S_2O_8$	Sodium persulfate
NATA	National Association of Testing Authorities
NSW	New South Wales
Pa	Pascal
PAH	Polycyclic aromatic hydrocarbon
pH	Potential of hydrogen
PID	Photo-ionisation detector
ppm	Parts per million
ppm_v	Parts per million by volume
PULP	Premium unleaded petrol
PVC	Polyvinyl chloride
ROI	Radius of influence
SAC	Site Assessment Criteria
SOP	Standard operating procedure
SWL	Standing water level
SVE	Soil Vapour Extraction
TDS	Total Dissolved Solids
TPH	Total petroleum hydrocarbons
TRH	Total recoverable hydrocarbons
µg/L	Micrograms per litre
µS/cm	Millisiemens per centimetre
UPSS	Underground petroleum storage system
UST	Underground storage tank
VOC	Volatile organic compounds
WSP	WSP Australia Pty Limited

EXECUTIVE SUMMARY

Caltex Australia Petroleum Pty Ltd (Caltex) engaged WSP Australia Pty Limited (WSP) to undertake Remediation Pilot Trials at the Caltex Holt service station located at 1 Hardwick Crescent, Holt, ACT (the site).

The pilot trial works were conducted as part of the staged remediation program in response to a reported loss of fuel at the service station. The objectives of the trials were to:

- Determine an appropriate remediation technology for the future implementation at the site
- Evaluate the mass recovery rates
- Determine key design parameters (e.g. radius of influence (ROI), hydrocarbon mass recovery rates, well vacuums, flow rates, etc.) for the application of the future remediation strategy, and
- Provide data to better assess the hydraulic characteristics of the underlying aquifer within the fractured rock.

The pilot trial program commenced in September 2020 consisted of the following works:

- Installation of eight additional wells onsite:
  - 1 x 100mm central extraction well – PEW1;
  - 4 x 50mm monitoring wells – PMW1 to PMW4; and
  - 3 x 50mm injection wells – IW01 to IW03.
- A series of rising head slug tests at well locations MW04, MW09, MW10 MW11, MW15, and EW03 to estimate the aquifer hydraulic parameters.
- A series of LNAPL bail down tests across the study area to estimate the LNAPL transmissivity were planned, but due to the small LNAPL thicknesses present in wells, these tests were not able to be conducted.
- Soil Vapour Extraction (SVE) test to estimate the mass removal rates, and pneumatic ROI in the unsaturated formations for this remediation technology.
- SVE + pumping test to estimate the mass removal rates, and pneumatic and hydraulic ROI in the saturated and unsaturated formations for this remediation technology.
- Multi-Phase Vacuum Extraction (MPVE) test to estimate the mass removal rates, and pneumatic and hydraulic ROI in the saturated and unsaturated formations for this remediation technology.
- In-situ Chemical Oxidation (ISCO) injection of chemical oxidising reagent (persulfate) into the three 50mm injection wells (IW01 to IW03) to determine the flow rates achievable and the response in surrounding monitoring wells.

The rising head tests were conducted on wells MW04, MW09, MW10, MW11, MW15 and EW03. The hydraulic conductivity, calculated using Bouwer-Rice and Hvorslev methods, were found to range between 0.0017 m/day and 0.65 m/day using the Bouwer-Rice method, and between 0.0025 m/day and 1.0 m/day using the Hvorslev method.

The results of the hydraulic conductivity tests performed on wells MW04, MW09, MW10, MW11, MW15 and EW03 are consistent with the variable lithology identified beneath the site (clay and fractured rock (tuff)).

The pilot trial results for the various remediation approaches indicate that the extraction and injection approaches trialled would be effective in reducing hydrocarbon mass.

As there has been off-site light non-aqueous phase liquid (LNAPL) impact noted, it is expected that off-site extraction points will be required in a full scale remediation system, hence transferring fluids over some distance will be required (e.g. to the south, across Hardwick Crescent). It is considered that SVE + Pumping and MPVE will be more effective than SVE and more efficient than chemical injection in the short to medium term in reducing the bulk of the hydrocarbon mass.

SVE + Pumping can achieve similar mass recovery and ROI as MPVE, with lower applied vacuum (and accordingly lower energy requirements), and with more efficient transfer and treatment of fluids, and therefore SVE + Pumping is considered to be most appropriate extraction remediation technology for the site.

Based on the overall results of the SVE + Pumping pilot trial conducted at PEW1, the expected operational parameters for any further SVE + Pumping works at the site are as follows:

- **Applied wellhead vacuum** -10 to -20 kPa
- **Groundwater extraction rate** up to 2.5 L/min
- **Extraction wellhead flow** 40 - 55 m^3/hr
- **Hydrocarbon mass removal rate** 1 to 3 kg/hr per well
- **Pneumatic ROI** 18 m (conservatively, assume 10-15 m for remediation design)

A suitable location for the installation of a remediation system was identified in the north-western portion of the site, where the current groundwater/LNAPL collection tank is located. The absence of residential properties immediately adjacent to the remediation system should minimise potential issues related to the noise of the operation of a remediation system at the site.

The discharge of water to sewer may be a limiting factor for the implementation of an SVE + Pumping system. Preliminary discussions with the water authority (Icon Water) have indicated that they do not normally accept groundwater within trade waste. Discussions are ongoing, and we expect that they will accept the treated water as trade waste if we can demonstrate that there is no other viable option and appropriate reduction in contaminants within the effluent water can be achieved.

The findings of this report should be read in the context of the statement of limitations outlined the end of this report.

1 INTRODUCTION

1.1 BACKGROUND

Caltex Australia Petroleum Pty Ltd (Caltex) engaged WSP Australia Pty Limited (WSP) to undertake Remediation Pilot Trials at the Caltex Holt service station located at 1 Hardwick Crescent, Holt, ACT (the site). A site locality plan is presented in Figure 1 of Appendix A.

1.2 PURPOSE AND OBJECTIVES

The pilot trial works were conducted as part of the staged remediation program in response to a reported loss of fuel at the service station.

In accordance with the WSP "*Remediation Option Assessment*" (Report Reference PS118985-LTR-REM-5502 Rev2, dated 14th September 2020) and the associated attachment "*Remediation Pilot Trials Work Plan*" (Report Reference PS118985-REM-LTR-001 Rev2, dated 14th September 2020), the remediation approaches that are considered the most appropriate for the Holt site include:

- Soil Vapour Extraction (SVE) – vacuum extraction of vapours only
- SVE + Pumping – combined SVE and liquid pumping
- Multi-Phase Vacuum Extraction (MPVE) – vacuum extraction of vapours and liquid
- In-situ Chemical Oxidation (ISCO) – injection of oxidising reagent chemical (persulfate)

The objectives of the trials were to:

- Determine an appropriate remediation technology for the future implementation at the site
- Evaluate the mass recovery rates
- Determine key design parameters (e.g. radius of influence (ROI), hydrocarbon mass recovery rates, well vacuums, flow rates, etc.) for the application of the future remediation strategy, and
- Provide data to better assess the hydraulic characteristics of the underlying aquifer within the fractured rock.

1.3 SCOPE OF WORK

The pilot trial program commenced in September 2020 consisted of the following works:

- Well installation – WSP proposed the installation of eight additional wells onsite:
  - 1 x 100mm central extraction well – PEW1;
  - 4 x 50mm monitoring wells – PMW1 to PMW4; and
  - 3 x 50mm injection wells – IW01 to IW03.
- A series of rising head slug tests at well locations MW04, MW09, MW10 MW11, MW15, and EW03 to estimate the aquifer hydraulic parameters.
- A series of LNAPL bail down tests across the study area to estimate the LNAPL transmissivity were planned, but due to the small LNAPL thicknesses present in wells, these tests were not able to be conducted.
- SVE test to estimate the mass removal rates, and pneumatic ROI in the unsaturated formations for this remediation technology.

- SVE + pumping test to estimate the mass removal rates, and pneumatic and hydraulic ROI in the saturated and unsaturated formations for this remediation technology.
- MPVE test to estimate the mass removal rates, and pneumatic and hydraulic ROI in the saturated and unsaturated formations for this remediation technology.
- ISCO injection of chemical oxidising reagent (persulfate) into the three 50mm injection wells (IW01 to IW03) to determine the flow rates achievable and the response in surrounding monitoring wells.

A copy of the site plan for the well locations over the project area and those well locations accessed during the pilot trial program can be found in Figures 2 and 3 respectively (Appendix A).

The pilot trial was aimed at providing the following data.

- Hydraulic conductivity (K) to provide data for plume modelling associated with future remedial system design.
- The pneumatic flow characteristics of the unsaturated zone, including effective ROI from various vacuum extraction tests.
- Drawdowns in pumping and monitoring wells and associated ROI of liquid extraction from various liquid extraction tests.
- The extracted air quality from various vacuum extraction tests.
- The air flow and vacuum requirements for effective capture and treatment of contaminated fluids.
- The expected treatment required prior to the discharge of the extracted air and liquids.
- Oxidising characteristics of the ISCO reagent.

Based on the outcomes of the trials, an informed comparison is then able be made between the four potential remediation technologies (MPVE, SVE, SVE + Pumping and ISCO) to determine an appropriate, efficient and cost-effective technology(ies) for the site.

1.4 TECHNICAL FRAMEWORK

This Remediation Pilot Trail was undertaken with reference to or consideration of the following regulations and guidelines:

- ACT EPA 2017, *Contaminated Sites Environment Protection Policy.*
- ACT EPA 2019, *Environmental Guidelines for Petroleum Storage in the ACT.*
- Environment ACT 2000, *ACT's Environmental Standards: Assessment & Classification of Liquid & Non-liquid Wastes*
- *Environmental Protection Act 1997.*
- *Environmental Protection Regulation 2005.*
- *National Environment Protection (Assessment of Site Contamination) Measure 1999* (NEPM; as amended 2013).
- NSW EPA 2014, *Technical Note: Investigation of Service Station Sites*.
- NSW EPA 2020, *Assessment and Management of Hazardous Ground Gases: Contaminated Land Guidelines.*
- NSW EPA 2020, *Guidelines for Consultants Reporting on Contaminated Land: Contaminated Land Guidelines.*
- *Work Health and Safety Act 2011* (NSW).

Further to the above, ACT Government provides a number of information sheets which outline some additional considerations relevant to the site. These include:

- ACT EPA 2019, Information Sheet 8 – *Requirements for the Classification and Reuse of Drilling Mud Waste in the ACT.*
- ACT EPA 2019, Information Sheet 9 – *Management of groundwater impacted by light non-aqueous phase liquids (LNAPL).*
- ACT EPA 2020, Information Sheet 11 – *Environment Protection Authority Report Submission Requirements.*

2 SITE INFORMATION

2.1 SITE IDENTIFICATION

The site is located within a mixed commercial and residential area in Holt, ACT. Figure 1 shows the regional site location and setting. General site details are summarised below in Table 2.1. The site layout is shown in Figure 2 of Appendix A.

Table 2.1 Summary of general information

SITE NAME	CALTEX KIPPAX HOLT SERVICE STATION
Site address	1 Hardwick Crescent, Holt ACT 2615
Caltex site identification	22546
Legal identification	Block 1, Section 53, Holt
Local government area	ACT Government
Zoning	CZ2: Business Zone
Current land use	Service station with on-site retail shop and mechanic workshop

2.2 FUEL STORAGE INFRASTRUCTURE

There are five known underground storage tanks (USTs) and one decommissioned aboveground former liquefied petroleum gas (LPG) storage tank at the site. The location of the USTs is shown in Figure 2. The storage information is given below in Table 2.2, based on the information provided from Caltex. There are no records for other storage tanks outside of the current tank farm other than an above ground waste oil tank behind (to the south-west) the mechanical workshop building.

Table 2.2 Petroleum storage information

TANK NUMBER	PRODUCT	SIZE (L)
T1 UST	Vortex 95 premium unleaded petrol (PULP)	27,400
T2 UST	Diesel	27,400
T3 UST	Unleaded petrol with 10% ethanol (E10)	27,400
T4 UST	Former Vortex 98 PULP (out of service from 14 February 2020 and temporarily abandoned from 1 April 2020)	20,000
T5 UST	Unleaded petrol with 10% ethanol (E10)	59,400
T6 AST	Decommissioned (formerly LPG)	7,500

2.3 SURROUNDING LAND USE

Surrounding land uses include:

- **North:** Hardwick Crescent with residential properties (Zara Gardens) to the north-east (approximately 22 m from the site boundary) and commercial properties (Scott Chambers Building) north (approximately 29 m from the site boundary)
- **East:** Flack Street with the Raiders Belconnen and open-air recreation sports field beyond to the north-east (approximately 20 m from the site boundary)
- **South:** Hardwick Crescent with residential properties (Canberra Masonic Homes) beyond to the south-west (approximately 21 m from the site boundary)
- **West:** open-air bitumen carpark (immediately adjacent to the site boundary).

Utility facilities including maintenance pits, drains and inspection covers relating to electrical, communications, water, sewer and stormwater infrastructure are located in all cardinal directions surrounding the site.

2.4 GEOLOGY AND HYDROGEOLOGY

2.4.1 GEOLOGY

Based on a review of Abell 1992, *Canberra 1: 100,000 scale geological map*, the site is underlain by the Late Silurian Deakin Volcanics, which is predominantly comprised of rhyodacitic ignimbrite with minor volcaniclastic and sedimentary units. Further, the 1:50,000 Geology of Canberra, Queanbeyan, and Environs (1980) geological map also indicates that the site is underlain by the Deakin Volcanics. The geological legend indicates that volcanic bedrock comprises Tuff and Tuffaceous Shale. Structurally, there are a number of major faults that have displaced the bedrock in close proximity of the site. A north-north west splay of the Deakin Fault having an orientation of approximate 165° crosses through the site. Although this fault is the dominant fault in the area there is likely to be a number of structures/joints that would be subparallel to the fault, and also conjugate joint sets which would strike approximately 45° to the main fault direction (Abell, 1992).

The subsurface conditions at the site observed in the monitoring well boreholes drilled during previous assessment works comprised a thin layer of Gravelly Silt Topsoil to approximately 0.2 mBGL in the grassed areas adjacent to the site, to a Sandy Gravel Road base to approximately 0.3m below the bitumen in the roads. At some locations the bedrock was exposed at the surface. The upper part of the bedrock comprised a yellow orange, highly to moderately weathered Tuff with alternating bands of harder and softer rock. Below approximately 8 m the profile continued as moderately to slightly weathered, grey brown Tuff. The Tuff comprises coarse phenocrysts in a finer grained matrix. At two locations MW07 and MW19 the bedrock has been recrystalised and fragmented and is likely to be the result of heating of the bedrock during faulting and these locations are likely to have been drilled into the fault zone.

Overall, it appears that the geology encountered at the site is consistent with the geological desktop study.

2.4.2 HYDROGEOLOGY

The 1:100,000 Hydrogeology of the Australian Capital Territory and Environs (1984) map indicates that groundwater is anticipated to be hosted in layers of dacitic, rhyodacitic, ignimbrite and bedded tuffs with minor shale, sandstone, limestone and ashstone of the Late Silurian era. The hydrogeological units are fractured with higher yielding zones associated with the upper and lower portions of the individual ash-flow tuffs and interbedded sediments. Groundwater quality tends to be variable with an estimated yield > 1.0 litres per second (L/s) and a total dissolved solid (TDS) concentration between 500-1000 milligrams per litre (mg/L). During previous assessment works (prior to the pilot trial in September 2020), 21 new groundwater wells were installed that target the shallow aquifer with groundwater

intersected at 8 mBGL to 10 mBGL with groundwater inferred to flow in a north-east direction. Yields were noted to be variable when developing the wells ranging from <0.1 L/minute to 4.5 L/minute.

A search of ACT EPA records for groundwater monitoring bores associated with potential contaminated sites within a 1 km radius of the site was requested by WSP on 4 June 2020. The ACT EPA provided the following information on 5 June 2020:

> *"Office of the Environment Protection Authority records indicate that there are environmental monitoring bores at the 7 Eleven service station located at Block 1 Section 52 Holt. These bores are associated with environmental monitoring required under the site's environmental authorisation (EA) under the Environment Protection Act 1997.*
>
> *Dissolved phase hydrocarbon impacts have been detected in groundwater samples at the site in perched groundwater and a shallow aquifer (at depths of between 6.0 and 10.0 mBGL). Groundwater flow has been found to be to the north-northeast."*

Block 1 Section 52 Holt is located approximately 400 m north of the ESA investigation area. Potential off-site dissolved phase hydrocarbon impacts associated with Block 1 Section 52 Holt are unlikely to have impacted the site and nearby surrounding properties, as the ESA investigation area being approximately 400 m upgradient from Block 1 Section 52 Holt.

A review of the ACTmapi Cadastre and imagery water bore layer and the Bureau of Meteorology Australian Groundwater Explorer portal (which references the National Groundwater Information System) both undertaken on 23 April 2020 indicated that there are no registered bores within a 500 m radius of the site. To confirm that no potential unregistered groundwater abstraction bores were located within the near vicinity of the site, WSP performed a desktop survey of the area by review of aerial photographs from December 2019 (a period where Canberra was in drought and any significant water usage on gardens would be highlighted) and a walkover of the nominated area looking for evidence of possible groundwater bores (well covers, signs and pumps). The result of the desktop survey and walkover by WSP of nominated area surrounding the site undertaken on 4 June 2020 provided no visual evidence of potential unregistered groundwater abstraction bores in those areas mentioned.

The nearest surface water feature is an unnamed water body, a stormwater outlet and creek line, located approximately 580 m north of the site that empties into Ginninderra Creek, approximately 870 m to the north of the site. The stormwater outlet diverts water flow captured from runoff in the Holt area with a number of stormwater drains marked in the area that the stormwater flows directly into Ginninderra Creek. Ginninderra Creek is a tributary of the Murrumbidgee River, which is a major water body located approximately 7.35 km west of the site.

2.5 LOCAL LITHOLOGY

The subsurface lithology profile at the site and immediately surrounding areas has previously been observed to generally comprise of a red brown sandy clay with minor gravels to a depth of approximately 1.5 mBGL, which is underlain by red brown gravelly sand with minor clays to the maximum depth of the investigation, 15 mBGL (GHD, 2010).

Drilling of groundwater monitoring wells on the service station and in surrounding roads during previous WSP investigations has shown most locations are characterised by shallow soil horizons grading into weathered rock with refusal of solid flight augers at depths ranging from 1.5 m to 12 m. Pneumatic hammer drilling (or sonic drilling and coring more recently) was required beyond the depths of auger refusal.

The use of pneumatic hammer drilling does not allow identification of the intricacies of the geology being drilled through, especially important features like fractures, and minor changes in density and moisture. However, some observations of the characteristics of the geology are possible from the air hammer cuttings. Drilling showed lenses or bands of more weathered and softer material alternating with harder bands, which occurred at various depths.

Indications of the Deakin Fault structure were identified during the drilling of boreholes MW07 and MW19 with large crystalized quartzite rocks encountered between approximately 5.0 to 7.0 mBGL. It is considered that this structure may

form a significant preferential pathway of migration of hydrocarbon impact and result in a wide distribution of impact across the site and site boundaries.

Sonic drilling and coring have been conducted recently (yet to be interpreted / reported), which will provide further information regarding the local lithology at the site.

2.6 TOPOGRAPHY

Regionally, there is an elevated land area to the south of the site and the overall regional fall is to the north. Surveyed heights of the ground surface show the highest elevation for the well located on Powell Street, south-west of the site (S2-C10: 582.239 mAHD), and lowest for wells in the park area on the northern side of Zara Gardens (S2-P6: 568.819 mAHD; S2-P7: 566.881 mAHD) (refer to Appendix B for surveyed plan of the site area). Thus, the current investigation area shows a topographical fall of approximately 15 m, from south to north over a distance of 250m, which equates to an average topographical gradient of approximately 6 % (16:1).

3 PREVIOUS ENVIRONMENTAL / REMEDIATION WORKS

3.1 SUMMARY OF PREVIOUS INVESTIGATIONS

The known environmental reports, management plans and authorisations for the site are listed below in chronological order. A summary of the scope or outcome of each is presented in this section.

- GHD 2010, *Report for Holt Caltex Service Station, 1 Hardwick Crescent, Phase 2 Environmental site assessment*.
- AECOM 2011, *Groundwater Monitoring Well Report, Caltex Holt (22546), Corner Hardwick Crescent and Flack Street, Holt, ACT*.
- Caltex Australia 2013, *Environmental management plan Caltex Holt (22546)*.
- WSP (formerly Parsons Brinckerhoff) 2013, *2013 Round 1 – ACT Groundwater monitoring event*.
- WSP 2014, *2013 Round 4 – ACT Groundwater monitoring event*.
- WSP 2015, *Classification of stockpiled material at Caltex Holt Service Station (22546) Corner Hardwick Crescent and Flack Street, Holt, ACT*.
- URS Australia 2015, *Final Groundwater Data Memo – Kippax service station (22546).*
- ACT EPA 2016, *Environmental authorisation letter*.
- GHD 2017, *22546 – Caltex Kippax Service Station, 1 Hardwick Crescent, Holt, ACT, 2615 Groundwater monitoring event – September 2016*.
- WSP 2017, *Caltex Kippax Holt service station (Site ID: 22546), 1 Hardwick Crescent, Holt ACT 2615: Groundwater monitoring event*.
- WSP 2018, *Caltex Kippax Holt service station (Site ID: 22546), 1 Hardwick Crescent, Holt ACT 2615: Groundwater monitoring event*.
- WSP 2019, *Caltex Kippax Holt service station (Site ID: 22546), 1 Hardwick Crescent, Holt ACT 2615: Groundwater monitoring event*.
- WSP March 2020a, *Caltex Kippax Holt service station (Site ID: 22546), 1 Hardwick Crescent, Holt ACT 2615: Assessment of Vapour Risks*.
- WSP May 2020b, *Tier 1 Risk Assessment (Off-site), Caltex Holt Service Station, 1 Hardwick Crescent Holt, ACT, Site ID: 22546 (Rev0 – Draft)*.
- WSP August 2020c, *Environmental Site Assessment Report, Caltex Holt service station (Site ID: 22546), 1 Hardwick Crescent Holt ACT (Rev 4).*
- WSP October 2020d, *Vapour Risk Assessment (Off-Site), Caltex Holt Service Station, 1 Hardwick Crescent Holt, ACT, Site ID: 22546 (Rev0 Draft)*.

At the time of reporting, WSP were in the process of completing the fieldworks and / or reporting for delineation drilling and groundwater assessment and off-site vapour assessment.

GHD 2010, Phase 2 Environmental Site Assessment

GHD were commissioned by Caltex to undertake contamination assessment at the site, with the objective to assess the status of soil and groundwater contamination at the site and if identified how potential contamination may affect the site's ongoing use as a service station facility. The scope of works included:

- A limited desktop-based assessment of the site
- Drilling of six soil sampling boreholes (CH1 to CH6) to a depth of 4 mBGL and the collection of soil samples
- Conversion of three borehole into groundwater monitoring wells (CH1, CH4 and CH5) in a triangulated pattern around the underground petroleum storage system (UPSS) and the collection of groundwater samples
- Laboratory analysis of the soil and groundwater samples for total petroleum hydrocarbons (TPH), benzene, toluene, ethylene and xylene (BTEX), polycyclic aromatic hydrocarbons (PAHs) and lead

Results of the GHD (2010) Phase 2 environmental assessment found that standing water levels for groundwater were measured between 10.190 m below top of casing (mBTOC) and 10.570 mBTOC with a groundwater flow in a north and north-west direction. Soil and groundwater analytical results were below the laboratory limit of reporting (LOR) for TPH, BTEX and PAH, while concentrations of lead were found to be below the site assessment criteria (SAC).

GHD concluded that there was no evidence that would suggest the site has been impacted by hydrocarbon contamination.

AECOM 2011, Groundwater Monitoring Well Report

AECOM were commissioned by Caltex to install groundwater monitoring wells and undertake a GME at the site. The objective of the investigation was to assess the groundwater conditions at the site with respect to potential hydrocarbon impacts from the UPSS infrastructure. The scope of works included:

- Drilling of two soil boreholes (BH01 and BH02) to a depth of approximately 12 mBGL and the collection of soil samples
- Installation of two groundwater monitoring wells (MW01 and MW02) at the borehole locations and the collection of groundwater samples
- Collection of groundwater samples from the three existing groundwater monitoring wells installed by GHD. These well were renamed from CH1, CH4 and CH5 to EW1 to EW3
- Laboratory analysis of the soil and groundwater samples for TPH, BTEX and lead

Results of the AECOM (2011) GME found that standing water levels for all the groundwater monitoring wells were measured between 8.588 mBTOC and 9.230 mBTOC, with a groundwater flow direction to the north and north-east. Soil analytical results recorded concentrations below the laboratory LOR for TPH and BTEX and below the SAC for lead. A slight hydrocarbon odour and sheen was observed in MW02 and BTEX compounds were detected in EW02, but all groundwater results were less than the adopted groundwater assessment criteria.

AECOM concluded that the investigation adequately assessed the groundwater conditions at the site within the vicinity of the UPSS infrastructure.

Caltex 2013, Environmental Management Plan

The Caltex (2013) environmental management plan outlines the procedures for loss monitoring, incident management, maintenance schedule and groundwater monitoring.

WSP 2013, Groundwater Monitoring Event

WSP (as Parsons Brinckerhoff) undertook a GME of four groundwater monitoring wells (EW1 to EW3 and MW02; MW01 was not sampled) in May 2013. The scope of works involved the sampling of the groundwater monitoring wells on site and laboratory analysis of the groundwater samples for TRH, BTEX and lead. The results of GME reported the following:

- Concentrations of TRH C_6-C_{10} and TRH >C_{10}-C_{16} in wells MW02 and EW2 and concentrations of TRH C_{15}-C_{28} in well MW02 were identified
- Concentrations of BTEX compounds that were reported in the AECOM 2011 GME in well EW2 were no longer present
- All groundwater results were below the adopted SAC
- Standing water levels for the groundwater monitoring wells were measured between 8.809 mBTOC and 9.486 mBTOC, with a groundwater flow direction inferred to the north and north-west; based on the AECOM 2011 GME.

WSP 2014, Groundwater Monitoring Event

WSP (as Parsons Brinckerhoff) undertook a GME of four groundwater monitoring wells (EW1 to EW3 and MW02; MW01 was not sampled) in November 2014. The scope of works involved the sampling of the groundwater monitoring wells on site and laboratory analysis of the groundwater samples for TRH, BTEX, ethanol and lead. The results of GME reported the following:

- Concentrations of TRH C_6-C_{10} in wells MW02 and EW2 and concentrations of TRH >C_{10}-C_{16} well MW02 were identified. MW02 recorded a TRH C_{10}-C_{40} of 740 µg/L which exceeded the SAC
- Concentrations of BTEX compounds in well EW2 and MW02 were identified. Concentrations of toluene (1,400 µg/L), ethylbenzene (585 µg/L) and xylenes (3,370 µg/L) recorded in well MW02 exceeded the SAC
- Concentrations of lead were below the SAC in most samples with the exception of well EW1 which recorded a lead concertation of 9 µg/L which exceeded the adopted SAC
- Concentrations of ethanol were below the laboratory LOR in all samples
- Standing water levels for the groundwater monitoring wells were measured between 8.560 mBTOC and 8.918 mBTOC, with a groundwater flow direction inferred to the north-east.

WSP 2015, Classification of Stockpiled Material

WSP (as Parsons Brinckerhoff) were commissioned by Caltex to prepare a waste classification of 4 cubic metres (m^3) of soil excavated during sign replacement works at the site. The objective of the works was to classify the excavated soils for disposal at an appropriate facility in accordance with ACT EPA guidelines. The scope of works involved the collection of soil samples from the stockpile which were analysed for TRH, BTEX, PAH, heavy metals and asbestos. The results of the waste classification reported the following:

- Concentrations of TRH, BTEX and PAH were reported to be below the laboratory LOR
- No asbestos was detected in the samples
- Concentrations of heavy metals were reported to be below the general solid waste contaminant threshold values
- The stockpiled material was classified as general solid waste (non-putrescible)

URS 2015, Groundwater Monitoring Event

URS undertook a GME of three groundwater monitoring wells (EW2, EW3 and MW02; EW1 and MW01 were not sampled) in September 2015. The scope of works involved the sampling of the groundwater monitoring wells on site and laboratory analysis of the groundwater samples for TRH, BTEX and PAH; lead was considered to not be a contaminant of concern. The results of GME reported the following:

- Groundwater was observed to be slightly turbid with no sheens or odours
- Concentrations of TRH C_6-C_{10} in wells MW02 and EW2, concentrations of TRH >C_{10}-C_{16} in well MW02 and concentrations of TRH >C_{16}-C_{34} in wells MW01 and MW02 were identified
- Concentrations of BTEX compounds or PAHs were reported to be below the laboratory LOR in all samples

- All groundwater results were below the adopted SAC. It is noted that the groundwater samples were not assessed against the assessment criteria outlined in the site's EA.
- Standing water levels for all the groundwater monitoring wells were measured between 8.549 mBTOC and 9.100 mBTOC, with a groundwater flow direction inferred to the north and north-east; based on the regional topography and hydrology.

URS concluded that any potential risks from groundwater petroleum hydrocarbon impacts to onsite and nearby off-site receptors are low and acceptable.

ACT EPA 2016, Environmental Authorisation Letter

The ACT EPA (2016) Environmental Authorisation letter is a variation to the EA that was granted on 19 October 2011. The notable variation to the 2011 EA is the inclusion of ethanol as a groundwater parameter as well as adjustments to the criteria values for other groundwater parameters.

GHD 2017, Groundwater Monitoring Event

GHD undertook a GME of five groundwater monitoring wells (EW1 to EW3, MW01 and MW02) in September 2016. The scope of works involved the sampling of the groundwater monitoring wells on site and laboratory analysis of the groundwater samples for TRH, BTEXN, ethanol and lead. The results of GME reported the following:

- LNAPL was not recorded in any wells on site, however slight hydrocarbon odours were noted in wells EW1, EW2, MW01 and MW02
- Concentrations of TRH and BTEXN were below the laboratory LOR in most samples with the exception of minor concentrations of TRH F1 in well EW2
- Concentrations of ethanol and lead were below the laboratory LOR in all samples
- Standing water levels for all the groundwater monitoring wells were measured between 7.918 mBTOC and 8.530 mBTOC. Groundwater flow direction was not conclusive due to the uncertainty surrounding the previously surveyed relative levels.

GHD concluded that complete or potentially complete exposure pathways between groundwater impact and identified receptors are unlikely to be present.

WSP 2017, Groundwater Monitoring Event

WSP undertook a GME of five groundwater monitoring wells (EW1 to EW3, MW01 and MW02) in July 2017. The scope of works involved the sampling of the groundwater monitoring wells on site and laboratory analysis of the groundwater samples for TRH, BTEX, ethanol and lead. The results of GME reported the following:

- All hydrocarbon results were either below the laboratory LORs or below the adopted assessment criteria.
- Minor concentrations of ethanol were detected below the adopted assessment criteria in monitoring well MW01
- The field measured pH in monitoring well MW02 fell outside of the acceptable criteria stipulated in the EA but was within the historical range and was considered to be the result of natural groundwater conditions.
- All groundwater results were below the adopted SAC
- Standing water levels for the groundwater monitoring wells were measured between 8.618 mBTOC and 9.282 mBTOC. The groundwater was inferred to flow towards the north to north-east; however, there was still uncertainty regarding flow direction of groundwater due to the location of the monitoring wells.

WSP 2018, Groundwater Monitoring Event

WSP undertook a GME of five groundwater monitoring wells (EW1 to EW3, MW01 and MW02) in July 2018. The scope of works involved the sampling of the groundwater monitoring wells on site and laboratory analysis of the groundwater samples for TRH, BTEX, ethanol and lead. The results of GME reported the following:

- All hydrocarbon results were either below the laboratory LORs or below the adopted assessment criteria, however, minor detections of medium fraction hydrocarbon chains (TRH C_{10}-C_{16}) were present in monitoring wells EW2 and MW02, located in the central northern portion of the site
- Minor concentrations of benzene were recorded in EW2
- Minor concentrations of lead were recorded in EW1, MW01 and MW02
- Concentrations of ethanol were below the laboratory LOR in all samples
- The field measured pH ranged from 6.58 to 6.82, indicating circumneutral conditions and were within the acceptable criteria
- All groundwater results were below the adopted SAC
- Standing water levels for the groundwater monitoring wells were measured between 9.072 mBTOC and 9.737 mBTOC. There was still uncertainty regarding flow direction of groundwater due to the location of the monitoring wells.

WSP 2019, Groundwater Monitoring Event

WSP undertook a GME of five groundwater monitoring wells (EW1 to EW3, MW01 and MW02) in September 2019. The scope of works involved the sampling of the groundwater monitoring wells on site and laboratory analysis of the groundwater samples for TRH, BTEX, ethanol and lead. The results of GME reported the following:

- All hydrocarbon results were either below the laboratory LORs or below the adopted assessment criteria, however, low concentrations of TRH C_6-C_{10} were present in monitoring well EW2, located in the central northern portion of the site.
- Minor concentrations of benzene and total BTEX and were recorded in EW2
- Concentrations of ethanol and lead were below the laboratory LOR in all samples
- The field measured pH ranged from 7.01 to 7.71, indicating circumneutral conditions and were within the acceptable criteria
- All groundwater results were below the adopted SAC
- Standing water levels for the groundwater monitoring wells were measured between 8.490 mBTOC and 10.081 mBTOC. The groundwater was inferred to flow towards the north to north-east; however, there was still uncertainty regarding flow direction of groundwater due to the location of the monitoring wells.

WSP 2020a, Assessment of Vapour Risks

In March 2020 following a confirmed loss of fuel, WSP conducted an investigation of potential vapour intrusion risks to occupants and visitors to the service station. The vapour investigation comprised four elements of measurement:

- Measurement of soil vapour concentrations beneath the forecourt pavement
- Measurement of soil vapour fluxes diffusing through the floor slab of the sales building and the workshop
- Measurement of ambient air concentrations of volatile organic compounds (VOCs) (targeting petrol vapours) in the buildings and outside on the forecourt
- Continuous measurement of photo-ionisation detector (PID) readings within the sales building – to look for evidence of possible advective flows into the sales building

Sub-slab soil vapour concentrations were measured at three locations outside the workshop and the sales building. VOCs characteristic of petrol vapour were detected at all three locations but at low concentrations. The low concentrations, all well below the adopted assessment criteria, indicated that an unacceptable vapour intrusion risk to occupants and visitors to the buildings was unlikely.

Surface flux was measured on the floors of the workshop and sales building at a total of six locations. The results show that all flux rates were trace or low. All the BTEX compounds had very minor flux strengths which would not contribute significantly to indoor air concentrations.

Ambient air concentrations of VOCs relating to petrol vapours for the measured indoor and outdoor locations were typical of Australian service stations. With the exception of benzene, the concentrations of all VOCs of concern were either greatly less than the risk-based criteria or were not detected.

The continuous recording of VOCs using a PID instrument showed no evidence of advective pressure driven flows of soil vapours into the building. It was concluded from this record that advective vapour intrusion was not occurring at levels of concern.

The four measured elements demonstrated that there is no evidence of unacceptable human health risk from the intrusion of vapours from the sub-floor. Vapours emanating from the ground through the surfaces outside the buildings were not considered to be a potential health risk for site workers or site visitors due to the very substantial rates of dispersion of vapours diffusing from the ground surface when emitted into unconfined spaces. The assessment found that soil vapours were not causing an unacceptable health risk to site occupants and visitors and therefore, with respect to soil vapours, the site was suitable to continue operating as a service station.

WSP 2020b, Tier 1 Risk Assessment

In May 2020, WSP prepared a draft preliminary Tier 1 Risk Assessment to identify the pathways and potential receptors arising from the identified hydrocarbon impacts in groundwater that had extended beyond the boundaries of the service station. It was the intent that if source-pathway-receptor linkages were indicated by the assessment, further assessment works would be planned. The evaluation of potential off-site risks was based on the data collected after the installation and sampling of 13 groundwater monitoring wells located around the circumference of the service station. The wells were installed in March 2020, the results of which are presented in this current document. The Tier 1 Risk Assessment used the groundwater analytical data to evaluate possible risks by comparing measured hydrocarbon impacts with criteria published in the National Environment Protection (Assessment of Site Contamination) Measure 1999 (amended 2013).

Identified source-pathways-receptors were:

- Vapour intrusion from contaminated groundwater into residential buildings on Hardwick Crescent (north and south of the service station)
- Vapour intrusion from contaminated groundwater into commercial buildings on Flack Street (east of the service station)
- Intrusive maintenance workers in trenches and services trenches in locations over contaminated groundwater
- Human consumption of groundwater if abstraction bores are installed in areas affected by the hydrocarbon contamination
- Dermal contact with extracted groundwater.

The Tier 1 Risk Assessment identified two source-pathway-receptor linkages considered to be possibly complete and to potentially present unacceptable risks. Those linkages were, firstly, risks from possible vapour intrusion into buildings, residential and commercial, present on three sides of the service station; and secondly, ingestion and dermal contact with groundwater if the groundwater were to be extracted and used. A third possible pathway, though unlikely to be complete, was vapour exposure for intrusive maintenance workers.

The Tier 1 Risk Assessment identified a need, with a high level of certainty, for follow-up measurements of soil vapour to ascertain whether the vapour intrusion pathway-receptor linkage is complete and to quantify the risk if the pathway were shown to be complete.

WSP 2020c, Environmental Site Assessment

In response to a reported loss of fuel at the Caltex Holt service station, Caltex engaged WSP to conduct a program of ESA works to investigate possible risks to human health and to the environment caused by hydrocarbon impacts to the soil and groundwater resulting from the fuel loss.

The results of the WSP ESA revealed the following:

- Soil matrix sampling confirmed that the vadose zone of the profile has not been impacted by fuel spills, with no detections of hydrocarbons in soil above the saturated zone. The shallowest depth at which an impacted soil sample was detected was 9 m at MW15. Samples that had detections of any hydrocarbon analytes were in the saturated zone.
- The installation and monitoring of two concentric rings of groundwater wells around the service station determined that hydrocarbon impacts in groundwater have migrated in all four cardinal directions from the service station source. LNAPL or saturation level dissolved phase hydrocarbons were present in groundwater on all four sides of the service station. The extent of the impacts has not been delineated in any direction. The major migration direction appears to be to the north and north-east.
- Soil vapour measurements showed hydrocarbon vapours to be present at the 6 m depth in all six locations off-site around the service station. Lower concentrations were measured at the 2 m sample depth indicating that attenuation of the hydrocarbon vapours with decreasing depth is occurring. Relevant screening level criteria (HSLs) were exceeded at the 2 m depths at one bore on the northern side of the site, adjacent to residential properties. The soil vapour data was interpreted to show that there is a potentially unacceptable vapour intrusion risk to one or more of the residential properties on the northern side of Hardwick Crescent (Zara Gardens), and possibly to the commercial units also on the northern side of Hardwick Crescent further westward (Scott Chambers Building). As for the commercial property (Raiders Belconnen) to the east, an unacceptable risk is unlikely to exist, but confirmation was required through further vapour testing. Unacceptable risks relate to long term exposure to the contaminants. The potential risks are of a chronic nature rather than an imminent or acute risk. The screening level criteria relate to long term exposures and not to short term risks.

WSP 2020d, Vapour Intrusion Assessment

Based on the outcomes of the ESA above (WSP, 2020d), further vapour intrusion assessment (a mix of soil vapour and indoor air investigations) was undertaken by WSP at the residential complex to the north (Zara Gardens), and in the commercial properties to the east (Raiders Belconnen) and north (Scott Chambers Commercial Complex). The vapour risk assessment concluded the following:

- The primary line of evidence for the determination of vapour intrusion risk for occupiers of residential units at Zara Gardens and commercial shops at Scott Chambers was indoor air measurements of VOCs. Secondary lines of evidence, soil vapour and surface vapour flux, were used to assist in the interpretation of the ambient air data. All the lines of evidence supported the conclusion that at those two properties (Zara Gardens and Scott Chambers) there was no unacceptable vapour intrusion risk at the time (during the season) of testing. There remains uncertainty as to the possible influence of warmer weather on the risk. Limited and targeted re-testing in warm weather would likely resolve the uncertainty of seasonal effect on risk level.
- For the Raiders Belconnen property, screening level risk indicators – from sub-slab soil vapour measurements, were sufficient evidence on which to conclude that indoor air sampling was not required to confirm the absence of unacceptable vapour intrusion risk. However, the same caveat over seasonal effects applies.
- A further consideration concerning uncertainty is the possibility of an increasing degree of soil vapour impacts affecting the targeted properties. It is possible that the vapour intrusion risk level may increase if contaminant migration in groundwater increases in the form of an expansion of phase separated hydrocarbons, or other changes to the vadose zone occur having an effect on vapour generation and diffusion. Such uncertainty can be examined through seasonal re-testing.

WSP 2020e, Groundwater Delineation Assessment

To delineate the groundwater impacts identified in the ESA above (WSP, 2020c), two further concentric rings of groundwater wells were installed in a variety of locations, including:

- Kippax Place
- Flack Street
- Hardwick Crescent (both to the north / north west and south of the Caltex site)
- Powell Street
- In the park to the north of Zara Gardens
- Within the Scott Chambers Building
- Within the car parking area to the north west of the Caltex site

At the time of writing, these works were yet to be reported, however the field observations and analytical results to date show that the gross impacts were largely delineated, with the hydrocarbon concentrations detected in the outer wells below or only marginally above the laboratory limit of reporting. There was one exception, with well S2-P2 located on Flack Street immediately adjacent the Raiders Belconnen playing field, reporting hydrocarbon impacts and possible presence of LNAPL.

3.2 SUMMARY OF REMEDIATION WORKS

3.2.1 ACTIVE REMEDIATION / RECOVERY

In addition to the assessment activities outlined above, active remediation / recovery of the LNAPL has been undertaken at the site since the fuel loss was identified.

Initial spill response efforts commenced on 15 February 2020, with contractors (InSite) mobilising to site to remove LNAPL from on-site groundwater monitoring wells using (mobile) pneumatically-driven, down hole pumps. The recovery was initially conducted from EW01 on 15 February 2020, with the pumping works were progressively expanded to include EW02, MW01 and MW02 in the following days. The recovered liquids were initially stored in (bunded) 1000L intermediate bulk containers (IBCs) prior to off-site disposal.

A (semi-) permanent system was also progressively installed at the site. A storage tank (supplementing the on-site IBCs) was installed at the site in the week commencing 17 February 2020, and permanent air and liquids recovery lines initially run to EW01, EW02, MW01 and MW02 through a combination of trenches in unpaved areas and heavy duty, rubber speed humps (with cable channels) in paved areas.

Initial pumping efforts on 15 February 2020 were conducted during the day. However, pumping was quickly extended to include extraction throughout the night from 16 February 2020 and continuous pumping (24 hours/day) was conducted up until 2 March 2020, at which point pumping reverted to day time pumping.

The operation of the system was initially manned while the high level and high-high level switches were installed, commissioned and confirmed to be operating properly within the tank. On 10 April 2020 the system commenced operation in auto mode (unmanned), and thus this system was able to be operated 24 hours/day (whenever the site air compressor is on). Due to the operations of the on-site mechanics workshop, the site air compressor is only operational during normal working hours, and thus the system is accordingly only operational during these hours too.

The system (and / or mobile pumping) has been progressively expanded to include recovery from wells EW01, EW02, MW01, MW02, MW05, MW06, MW07, MW08, MW10, MW12, MW15 at various stages of operation. As of 20 August 2020, the system was pumping from wells MW01, MW02, MW05 and MW10.

MPVE was also conducted at EW01 and EW02 as part of these initial emergency response works on 18-19 February 2020.

Table 3.1 below provides a summary of all the liquids recovered up until 31 September 2020.

Table 3.1 LNAPL / Water Recovery Summary

EXTRACTION PERIOD	LNAPL RECOVERED* (L)	WATER RECOVERED (L)	TOTAL LIQUIDS RECOVERED (L)	% LNAPL RECOVERED
February (15/02 - 20/02)	8,341	8,211	16,552	50.4
February (21/02 – 28/02)	5,938	14,124	20,062	29.6
March (1/03 – 31/03)	4,553	35,459	40,012	11.4
April (1/04 – 30/04)	3,055	31,635	34,690	8.8
May (1/05 – 31/05)	928	26,243	27,171	3.4
June (1/06 – 30/06)	694	10,541	11,235	6.2
July (1/07 – 31/07)	194	18,752	18,946	1.1
August (1/08 – 31/08)	167	21,805	21,972	0.8
September (1/09 – 31/09)	0	7620	7620	0.0
Totals (15/02 – 31/09)	**23,870**	**174,390**	**198,260**	**12.04**

* *LNAPL Recovered* includes LNAPL liquid and hydrocarbon (TRH) volume removed in 'dissolved phase'

As can be seen in the above summary of the liquids recovered to date, a total of 23,870 L of LNAPL has been recovered up until 31 August 2020. Approximately 60% of the LNAPL recovered to date was recovered in the first two weeks of extraction (15 – 28 February 2020), with LNAPL recovery rates progressively reducing over time. The most recent reported data, for September 2020, indicates 0 L was recovered. This was due to the active recovery system being shut down in preparation for this remediation trial covered within this report.

3.2.2 REMEDIATION OPTIONS ASSESSMENT

In September 2020, WSP conducted a desktop assessment of the options for the remediation and management of the gross impacts sourced from the site. A wide range of remediation technologies were assessed taking into consideration factors such as the reasons for the remediation work and any constraints on it, risk management, technical suitability and feasibility, stakeholders' views, cost/benefit ratio and wider environmental, social and economic impacts (i.e. waste generation, sustainable development, etc.).

Based on the nature and extent of impacts, the geology / hydrogeology, site setting, and the ability for the remediation technologies to remove / reduce / transform contaminant mass, costs and treatment time of implementation, the initial remediation screening process prepared for the site showed that the remediation technologies that are retained for further consideration are:

- SVE (with / without pumping)
- MPVE
- ISCO
- (Continued) pumping

4 EXTENT OF IMPACTS

As noted in Section 3.1, the environmental assessment works at the site are ongoing and the understanding of the extent of impacts is being continually developed as more data are gathered. The information below presents the understand of the extent of impacts based on information available at the time of the pilot trials (i.e. up until 18 September 2020).

Up until September 2020, the investigations of the impact of the fuel loss have consisted of the installation of 22 new groundwater wells (located on-site around the perimeter of the service station and off-site on the surrounding roads and open space) and monitoring of those wells and the five pre-existing on-site groundwater wells. The 22 groundwater monitoring wells installed in the first half of 2020 essentially formed two concentric rings of wells around the fuel leak source on the service station. Monitoring results showed the presence of LNAPL in six on-site wells and seven off-site wells, with LNAPL detected off site to the north, east and west of the site. As noted in Section 3.1, a further 22 wells have been installed at the site forming a further two concentric rings of wells aimed at delineating the groundwater impacts – the results of these delineation works are yet to be reported.

Based on the most recent gauging event (28 September 2020)[1], LNAPL was detected in the following three locations:

- MW02 (3 mm)
- PMW01 (4 mm)
- MW15 (61 mm)
- MW16 (50 mm)

Although we note that active LNAPL recovery has been occurring in a number of on-site wells since February 2020 (See Section 3.2.1), and the groundwater has risen by between 0.5m and 1.0m since February, which may be masking the presence of LNAPL at some locations.

Further works have been recently completed to delineate the LNAPL and dissolved phase impacts off site. At the time of writing, these works were yet to be reported, however the field observations and analytical results to date show that the gross impacts were largely delineated, with the hydrocarbon concentrations detected in the outer wells below or only marginally above the laboratory limit of reporting. There was one exception, with well S2-P2 located on Flack Street immediately adjacent the Raiders Belconnen playing field, reporting hydrocarbon impacts and possible presence of LNAPL.

Investigations to date into the possible risk from vapour intrusion into the service station buildings – the sales building and mechanic workshop – comprised the testing of soil vapour beneath the forecourt at three locations outside the buildings and the measurement of surface floor fluxes and indoor air concentrations in the buildings. The on-site vapour testing showed low and acceptable vapour intrusion risks to the commercial occupants of the on-site buildings.

Initial off-site soil vapour investigations have showed hydrocarbon vapours to be present at the 6 m depth in six off-site soil vapour bores located on the surrounding roads and open space. Lower concentrations were measured at the 2 m sample depth indicating that attenuation of the hydrocarbon vapours with decreasing depth is occurring.

The initial soil vapour data indicated that there is a potentially unacceptable vapour intrusion risk to the residential properties on the northern side of Hardwick Crescent (Zara Gardens), and possibly to the commercial units also on the northern side of Hardwick Crescent further westward (Scott Chambers Commercial Complex). While it was considered that an unacceptable risk was unlikely to exist to the commercial property to the east (Raiders Belconnen), confirmation was required through further vapour testing.

[1] A recent GME, including gauging, was completed on 28-29 September 2020 - these results have not been reported at the time of writing.

Further soil vapour intrusion assessment (a mix of soil vapour and indoor air investigations) was undertaken by WSP at the residential complex to the north (Zara Gardens), and in the commercial properties to the east (Raiders Belconnen) and north (Scott Chambers Commercial Complex), which was reported in the recent vapour risk assessment report. The vapour risk assessment concluded the following:

- The primary line of evidence for the determination of vapour intrusion risk for occupiers of residential units at Zara Gardens and commercial shops at Scott Chambers was indoor air measurements of VOCs. Secondary lines of evidence, soil vapour and surface vapour flux, were used to assist in the interpretation of the ambient air data. All the lines of evidence supported the conclusion that at those two properties (Zara Gardens and Scott Chambers) there was no unacceptable vapour intrusion risk at the time (during the season) of testing. There remains uncertainty as to the possible influence of warmer weather on the risk. Limited and targeted re-testing in warm weather would likely resolve the uncertainty of seasonal effect on risk level.
- For the Raiders Belconnen property, screening level risk indicators – from sub-slab soil vapour measurements, were sufficient evidence on which to conclude that indoor air sampling was not required to confirm the absence of unacceptable vapour intrusion risk. However, the same caveat over seasonal effects applies.
- A further consideration concerning uncertainty is the possibility of an increasing degree of soil vapour impacts affecting the targeted properties. It is possible that the vapour intrusion risk level may increase if contaminant migration in groundwater increases in the form of an expansion of phase separated hydrocarbons, or other changes to the vadose zone occur having an effect on vapour generation and diffusion. Such uncertainty can be examined through seasonal re-testing.

In addition to the vapour risks outlined above, consideration has been given to the following potential source-pathway-receptor (SPR) linkages:

- It appears probable that environmental risk pathways are incomplete (i.e. receiving waters are too far distant and the groundwater is too deep to affect nearby surface water bodies).
- Extraction of groundwater for use for domestic or irrigation use, may be possible, but is improbable.

Works are ongoing to delineate the full extent of the groundwater impacts and to determine the vapour inhalation risks to off-site receptors. We also note that the off-site delineation and vapour intrusion risk assessment should be completed (work is currently ongoing) before the scope and design of the additional remediation is finalised.

5 UPDATED CONCEPTUAL SITE MODEL

The environmental assessment works at the site are ongoing and the conceptual site model (CSM) is being continually developed as more data are gathered. The sections below present a preliminary CSM, and four cross sections (A-A' to D-D') are provided as Figures 4 to 7 (Appendix A).

5.1 CONTAMINANTS OF CONCERN AND SOURCES

The analytical results from the groundwater monitoring conducted in 2020 have provided clear evidence that the contaminants in groundwater are sourced from petrol. LNAPL samples sent to the laboratory for fingerprinting identified the LNAPL as premium unleaded petrol (PULP) having been in the environment for between three and seven years. However, we note that the fuel loss was confirmed to have occurred in February 2020; approximately 3 months prior to LNAPL sampling. The results of the fingerprinting analysis identified the source of the LNAPL to be premium unleaded petrol the same as what was released from former Depot 4.

The contaminants of concern are therefore the compounds comprising PULP, largely characterised by benzene, toluene, ethylbenzene and xylene (BTEX) plus the fractions C_6-C_{10} and >C_{10}-C_{16} as indicators of petrol. Naphthalene is also included in the contaminants characterising petrol.

Chlorinated solvents are not expected to be present, however, the vapour analytical suite to be used for vapour sample analyses included a range of chlorinated VOCs. Chlorinated solvents were not identified in the soil vapour results and are therefore not considered contaminants of concern.

5.2 RECEPTORS AND CONTAMINANT MIGRATION PATHWAYS

The nearest surface water feature is an unnamed channel, a stormwater outlet, that flows only during rain events, located approximately 580 m north-west of the site. The unnamed channel is very unlikely to be used for recreational purposes but could potentially support a down-stream freshwater ecosystem. However, it is too far distant to have any reasonable probability of being a receptor of the hydrocarbons in groundwater. Furthermore, the groundwater depth at the site, and most probably, at the stormwater drain, is too deep to discharge into the drain. The more substantial surface body, Ginninderra Creek, is more distant from the service station, at 870 m and is thus out of reach of the hydrocarbon plume. On this basis, the ecological receptor risk pathway is considered incomplete.

The area is served with reticulated town water and a review of the ACTMapi (www.actmapi.act.gov.au) groundwater database conducted on 23 April 2020 indicated that there are no registered groundwater boreholes within a 500 m radius of the site. Observations conducted during assessment works conducted on nearby properties, Zara Gardens and Scott Chambers Building, did not identify any groundwater bores, and Raiders Belconnen confirmed that there are no groundwater abstraction bores on their property. While it is not possible to rule out the potential for unregistered bores to exist nearby, based on available data and evidence the probability of people (both residents and/or workers) having exposure to impacted groundwater (sourced from the site) via vapour inhalation, dermal contact or ingestion is low.

A further possible exposure pathway is the intrusion of vapours arising from the LNAPL, hydrocarbon impacted groundwater and the smear zone created by fluctuations in levels of impacted groundwater. Potentially affected buildings include the service station sales building and the workshop, however investigations of those potential vapour intrusion risks were completed and it was concluded that there was no evidence for unacceptable vapour intrusion risks (WSP, 2020a). The other buildings and properties potentially affected by vapour intrusion are those surrounding the site in all directions. To the north east and south are residences, to the east is a commercial property (Raiders Belconnen), to

north is a commercial property (Scott Chambers Building) and to the west is an unassigned, vacant open space property and a car park and shopping centre beyond. This pathway consists of the molecular diffusion (mass flux) of hydrocarbon vapours from the saturated and smear zones, upwards through the lithological profile to the surface or to the underside of building floor slabs. The pathway may continue through the diffusive mass flux of hydrocarbon vapours (if not completely attenuated by processes of dispersion and biodegradation) through the floor structures and into the indoor enclosures. Vapours may also possibly enter the indoor enclosures by means of pressure driven advective flows through gaps in the floor structures. At the time of writing, the vapour intrusion assessment works for the nearby residential and commercial properties were not complete and yet to be reported, however the analytical results to date show that there are no unacceptable vapour intrusion risks to the occupants of these residential and commercial properties.

Persons crossing the open space to the west of the service station may theoretically be affected through inhalation of vapours. This risk is considered unlikely due to great dilution rates occurring in the open atmosphere, but the risk pathway was considered. The current soil vapour measurements allowed the open space vapour risk to be screened out as the measured soil vapour concentrations were greatly less than the screening level criteria.

The risk of exposure to hydrocarbons in groundwater by on-site and off-site workers, including intrusive (trench) maintenance workers by means of vapour inhalation, dermal contact and ingestion is unlikely. Firstly, vapour intrusion into the sales building and workshop has already been assessed and deemed acceptable (WSP, 2020a). Secondly, utility pits surrounding the site have been routinely monitored with a photo-ionisation detector (PID) since the project commenced and no elevated vapour concentrations have been detected. Soil vapour testing in the previous assessment works showed that concentrations were less than screening level criteria (CRC Care Technical Report No 10) for maintenance workers' vapour exposure in shallow trenches. This risk-receptor pathway is therefore considered incomplete.

Groundwater is not abstracted at the site for any other purpose than remediation/recovery and monitoring, and the depth to groundwater (at a minimum greater than 4 metres in all areas except for the park to the north of Zara Gardens (where impacts have not been detected)) means that the probability of incidental intersection of the impacted groundwater during routine intrusive maintenance works is very low to nil. Where workers are potentially in contact with the water or are performing the remediation and groundwater monitoring activities, those workers follow the appropriate WHS guidelines to mitigate their exposure risks.

Groundwater is known to be impacted by phase separated hydrocarbons (i.e., LNAPL) and as such is unsuitable for human consumption and presents a risk if used for any purpose. Although there is no known abstraction of groundwater within at least 500 m of the service station, it is possible that the contaminated water could be used now or in the future. Abstraction of off-site impacted groundwater remains a possible risk.

Current assessment works (yet to be reported) are aiming to close out the existing data gaps regarding the nature and extent of the contamination, and while the results are yet to be reported, it is understood that the delineation of the plume has been achieved in all directions except for to the east (towards Raiders Belconnen). Due to the presence of the Raiders Belconnen building and playing field, delineation of the plume to the east is not possible for well over 100m. As noted above, vapour intrusion assessment works on the Raiders Belconnen site show that there are no unacceptable vapour intrusion risks to the occupants of this building.

A summary of potential risk pathways and receptors is presented in Table 5.1 below.

Table 5.1 Risk level assessment for relevant source-pathway-receptor linkages

Potential Receptor	Potential Exposure Pathway	Risk from Exposure Through the Pathway (Is the Linkage Complete & is there a Risk?)
OFF-SITE		
Ecological: Surface water bodies	Discharge of groundwater into surface water bodies – stormwater channel or creek	Considered to be an incomplete pathway, therefore no unacceptable risk
Users of groundwater bores registered for water supply	Abstraction of groundwater for beneficial purpose	There are currently no known users of groundwater within 500 m of the service station. Possible exposure pathways if water is accessed and used are: ingestion; dermal contact; contamination of soil if groundwater is used for irrigation. There are currently no known groundwater extraction bores. Thus, the risk pathways are currently believed to be incomplete.
Residents and occupiers of commercial buildings	Vapour intrusion	At the time of writing, the vapour intrusion assessment works were not complete and yet to be reported, however the analytical results to date show that there are no unacceptable vapour intrusion risks to the occupants of these residential and commercial properties.
Human receptors on open space land	Vapour inhalation	Due to considerable atmospheric dispersion above unconfined open space (the car parking), an unacceptable level of risk is unlikely. Current soil vapour measurements confirmed that the risk is improbable. The pathway can thus be considered incomplete.
Sub-surface maintenance workers (intrusive trench workers)	Inhalation of vapour in shallow excavation trenches,	Soil vapour testing in the current works showed that concentrations were less than screening level criteria (CRC Care Technical Report No 10) for workers' vapour exposure in shallow trenches. This risk-receptor pathway is therefore considered incomplete.
Sub-surface maintenance workers (intrusive trench workers)	Ingestion and direct contact with impacted groundwater or soil	Considered an incomplete pathway. The groundwater is too deep for excavation workers to come into contact with and the soil contamination is believed to be confined to the service station.

5.3 LNAPL CONCEPTUAL SITE MODEL

In response to the requirements of ACT EPA (2019) *Information Sheet 9* and in light of the presence of LNAPL detected at a thickness greater than 3 mm at the site (and also off-site) an LNAPL CSM (LCSM) is required to be developed and presented as part of the site assessment process.

A summary of the potential receptors of the LNAPL impact detected on and off-site, the potential exposure pathways and an assessment of the likelihood of risk from exposure to the LNAPL through the potential pathway is presented in Table 5.2.

Table 5.2 Risk level assessment for relevant source-pathway-receptor linkages related to LNAPL

Potential Receptor	Potential Exposure Pathway	Risk from Exposure Through the Pathway (Is The Linkage Complete & Is There A Risk?)
Ecological: Surface water bodies (nearest located 580 metres north-west of the site)	Discharge of LNAPL into surface water bodies – stormwater channel or creek 580 metres to the north	Considered to be an incomplete pathway, therefore no unacceptable risk.
Users of groundwater bores registered for water supply	Abstraction of groundwater impacted with LNAPL for beneficial purpose	There are currently no known users of groundwater within 500 m of the service station. Possible exposure pathways if water is accessed and used are: ingestion; dermal contact; contamination of soil if groundwater is used for irrigation. There are currently no known groundwater extraction bores. Thus, the risk pathways are currently believed to be incomplete.
Residents and occupiers of commercial buildings	Vapour arising from the LNAPL intrudes and accumulates in buildings	At the time of writing, the vapour intrusion assessment works were not complete and yet to be reported, however the analytical results to date show that there are no unacceptable vapour intrusion risks to the occupants of these residential and commercial properties.
Human receptors on open space land	Vapour arising from the LNAPL is inhaled	Due to considerable atmospheric dispersion above unconfined open space (the car parking), an unacceptable level of risk is unlikely. Current soil vapour measurements confirmed that the risk is improbable. The pathway can thus be considered incomplete.
Sub-surface maintenance workers (intrusive trench workers)	Vapour arising from the LNAPL enters shallow excavation trenches and is then inhaled	Soil vapour testing in the current works showed that concentrations were substantially less than screening level criteria (CRC Care Technical Report No 10) for workers' vapour exposure in shallow trenches. This risk-receptor pathway is therefore considered incomplete.
Sub-surface maintenance workers (intrusive trench workers)	Ingestion and direct contact with LNAPL impacted groundwater or soil	Considered an incomplete pathway. The LNAPL impacted groundwater is too deep for excavation workers to come into contact with and the soil contamination is believed to be confined to the service station.

6 REMEDIATION PILOT TRIAL PROGRAM

6.1 WELL DESIGN RATIONALE

Based on previous experiences at similar sites, the pneumatic and hydraulic radius of influence (ROI) from the point of the liquid/vapour extraction / injection can vary significantly in a fractured rock setting. To determine this, eight new wells (1 x 100mm central extraction well, 4 x 50mm monitoring wells and 3 x 50mm injection wells – see Figure 3 of Appendix A) were installed to measure the ROI and allow for ISCO solution injection during the pilot trials. The wells have been placed at varying distances and directions from the extraction / injection points to accurately assess the ROI.

Table 6.1 below provides a summary of the well names, purpose, selected location, and the proposed monitoring.

Table 6.1 Well locations and rationale

WELL ID/s	CURRENT STATUS	PURPOSE	RATIONALE	MONITORING PARAMETERS
PEW1	Installed 100mm well	Pilot Trial Extraction Well for MPVE / SVE / Pumping	Located on site, in area where existing LNAPL-impacted wells (e.g. MW02 and MW05) can be used as monitoring wells for the MPVE / SVE / SVE + Pumping trials	Vacuum, depth to LNAPL / water, flow rates
PMW1 to PMW4	Installed 50mm well	Pilot Trial Monitoring Well for MPVE / SVE / Pumping	Located on in the vicinity of PEW1 and / or in the direction of the possible fracture(s) (e.g. MW15) – to be used as monitoring wells for the MPVE / SVE / SVE + Pumping trials. Enables monitoring to be conducted in different directions and distances from the extraction point, and thus allowing for the ROI to be determined.	Vacuum, depth to LNAPL / water
MW02, MW05, MW06, MW15	Current 50mm well			
IW01 to IW03	Installed 50mm well	Injection Well for ISCO Trial	Located in different areas to help determine differences in response to injection across the site.	Injection rates / pressure Monitoring to be conducted in nearby wells (water quality parameters, depth to LNAPL / water): IW01 – MW06, MW07 IW02 - MW01, EW03 IW03 - MW10

WELL ID/s	CURRENT STATUS	PURPOSE	RATIONALE	MONITORING PARAMETERS
MW04, MW09, MW10, MW11, MW15, EW03	Current 50mm wells	Rising head tests. (assumes LNAPL not present – may need to change wells if LNAPL present)	Propose to use up to six wells that do not contain LNAPL, are located in different areas, and have a range of different levels of impacts (e.g. <LOR up to previously containing LNAPL) to help determine differences in hydraulic across the site. The wells used will be dependent on the absence of LNAPL.	Depth to water (versus time)

6.2 REMEDIATION PILOT TRIAL PROGRAM

From the proposed new wells and the selected existing groundwater wells listed above, the trials were undertaken in the order detailed in Table 6.2 below.

Table 6.2 Summary of Pilot Trial Program

DATE	WORKS / PILOT TRIAL CONDUCTED	EXTRACTION / INJECTION LOCATION(S)
14th September 2020	Rising Head (Slug) Tests Trial setup	MW04, MW09, MW10, MW11, MW15, and EW03
15th September 2020	SVE Trial	PEW1
	SVE + Pumping Trial	PEW1
16th September 2020	SVE + Pumping Trial	PEW1
17th September 2020	MPVE Trial	PEW1
	Injection Trials	IW01 and IW03
18th September 2020	Injection Trials	IW01 and IW02

7 RISING HEAD TESTING

7.1 METHODOLOGY

Rising head testing (slug testing) was conducted to estimate the hydraulic conductivity at the site following standard industry procedures and WSP's standard operating procedure for slug testing (SOP 3.4), attached in Appendix H.

Rising-head tests were conducted in six groundwater monitoring wells, including: MW04, MW09, MW10, MW11, MW15 and EW03 on 14 September 2020.

Rising-head tests were conducted in each well using a bailer to generate an instantaneous change in head. Groundwater recovery was monitored using a groundwater lever logger (pressure logger), recording groundwater levels every second. Manual groundwater levels were also recorded prior, during and after the test using a water level meter.

7.2 RESULTS

Rising-head test results from the six wells were pre-processed in excel and analysed within the analytical package AQTESOLV Pro© by a qualified hydrogeologist to estimate the hydraulic conductivity (k) of the aquifer in the vicinity of each well. K values were estimated adopting both Bouwer-Rice (1976) and Hvorselv (1951) analytical solutions.

It should be noted that measurable thicknesses of LNAPL was observed in MW10 (5mm of LNAPL), and MW15 (68mm of LNAPL). Slug testing are usually not conducted on wells containing LNAPL due to complications with the flow of LNAPL in the soil profile, the viscosity of LNAPL, and the inability to convert the recovery curve pressures to volumes, where fluids with differing densities are present within the well. However, given the relatively small thickness of LNAPL (relative to the head displacement during rising -head tests), and the purpose of these test (i.e. to inform LNAPL recovery and remediation options at the site), these complications have been assumed negligible for the purpose of this assessment.

The results of the rising-head test rising-head tests are summarised in Table 7.1. AQTESOLV outputs are provided in Appendix C.

Table 7.1 Summary of rising-head test results.

MONITORING WELL	RISING-HEAD TEST RESULT		ADOPTED K VALUE (m/day)
	Bouwer-Rice	Hvorslev	
MW04	0.32	0.50	0.41
MW09	0.027	0.037	0.032
MW10*	0.18	0.25	0.21
MW11	0.0017	0.0025	0.0021
MW15*	0.65	1.0	0.82
EW03	0.19	0.23	0.21

** measurable thickness of LNAPL was recorded in MW10 and MW15.*

8 SOIL VAPOUR EXTRACTION (SVE) TEST

8.1 METHODOLOGY

The SVE test was conducted on 15 September 2020 at the central extraction well (PEW1) using a truck mounted vacuum/separation system (Figure 1 below - left), where air was extracted under monitored conditions with vapour flow and well head vacuums measured. The vacuum line was connected directly to the top of the extraction well head, with no installation of a drop tube / stinger into the well (Figure 1 below - right). A range of flow rates and wellhead vacuums were applied during the trial. The water level and vacuum response at several 50mm surrounding observation wells was also monitored throughout the trial.

Figure 1 Truck mounted vacuum separation system (left) and extraction well head setup for SVE trial (right).

During the SVE tests the following data were collected:

- Flow rate of vapour from the extraction well.
- Applied wellhead vacuum pressure.
- Induced vacuums at the extraction wellhead and surrounding monitoring wells.
- Contaminant concentrations in the discharged air, using a PID, infra-red gas analyser (hexane) and one carbon tube (to validate the PID / hexane readings).

The recovered vapour was discharged to the atmosphere after passing through a granular activated carbon (GAC) filter to remove the VOCs.

8.2 RESULTS

The tabulated data of the monitoring well response to the SVE that was recorded by WSP is attached in Appendix E-1, and the Insite Remediation trial report is attached in Appendix D.

The SVE trial was conducted at well PEW1 for approximately 3.45 hours on 15 September 2020. Using the vacuum control valve on the vacuum truck unit, the applied vacuum (measured at the wellhead of PEW1) ranged between -3.5 kPa and -12 kPa at the extraction well. Each step in the applied vacuum was maintained for a duration that would allow the formation to reach equilibrium, both in terms of vacuum response (manually gauged at monitoring wells) and vapour

recovery (measured at the SVE unit). The applied wellhead vacuums generated air flow at the wellhead of the extraction well in the range of 12.0 m^3/h to 38.2 m^3/h (Figure 2 below).

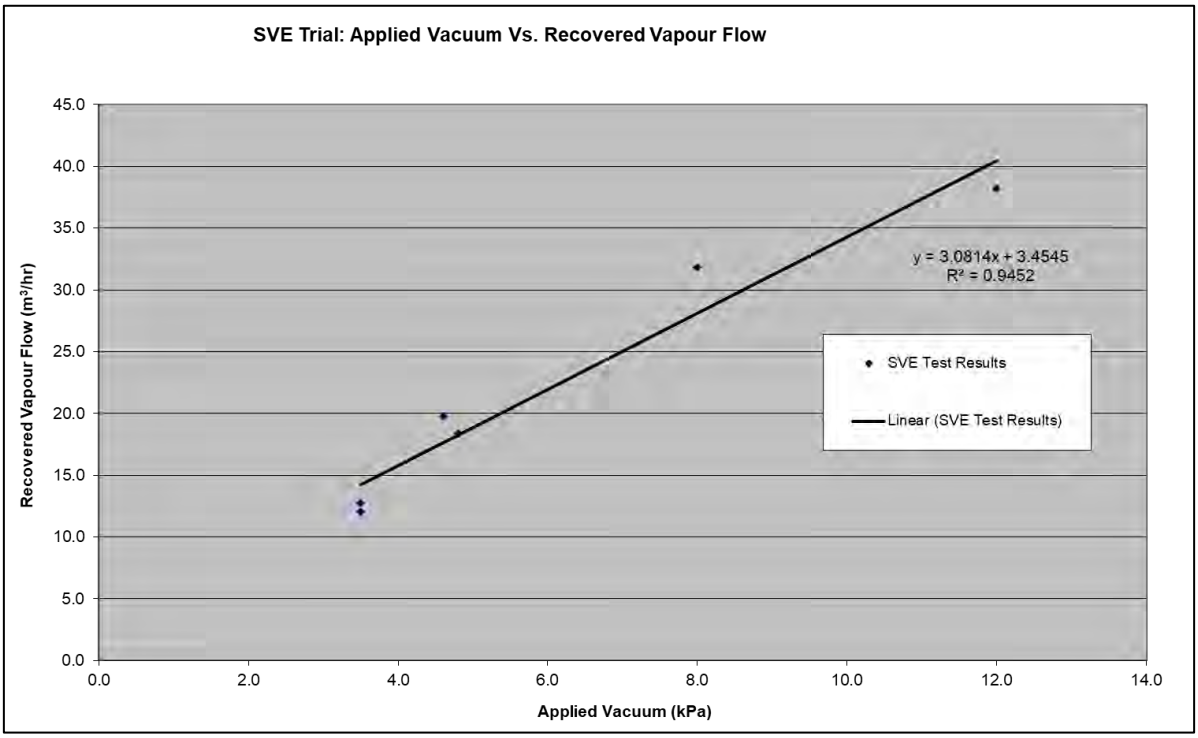

Figure 2 SVE trial applied vacuum vs. recovered vapour flow.

During the trial, the vacuum response was measured at several observation wells surrounding the extraction well. For the purpose of analysing and graphing this data, the wells assessed, including the measured vacuums and distance from extraction well, are presented in Table 8.1. The complete data set from all observation wells monitored during the SVE trial is presented in Appendix E-1.

Table 8.1 SVE Trial observation wells, distance from extraction well, and measured vacuum data.

Vacuum Applied at Extraction Well (kPa)	Observation Well ID (Distance from Extraction Wells (m)) Vacuum Measurements (Pa)										
	PMW1 (2.90)	MW05 (3.30)	PMW4 (5.20)	MW2 (7.10)	PMW2 (8.50)	PMW3 (10.30)	MW4 (17.99)	SV3-6M (19.87)	SV3-2M (19.87)	MW16 (19.88)	MW15 (27.95)
-3.5	-110	-260	-410	-220	-320	-150	-30	-25	-15	-20	-10
-4.8	-370	-390	-500	-250	-410	-180	-45	-20	-15	-10	-5
-8.0	-950	-600	-900	-300	-700	-350	-100	-50	-40	-45	-5
-12.0	-500	-700	-900	-600	-850	-440	-130	-60	-50	-60	-20

Figure 3 below presents the graphed data of Table 8.1. Adopting -100 Pa as an indication of effective vacuum response (based on previous experience), the pneumatic ROI for SVE in isolation was estimated to be effective for all applied vacuums at the extraction well of up to a distance of 13m. At distances further than 13m, an applied vacuum of -3.5 kPa did not stimulate effective vacuum response of greater than -100 Pa in the surrounding observations wells. An applied extraction well vacuum of -4.8 kPa had an effective vacuum response of 14.9 m; -8.0 kPa had an effective vacuum response of 18 m; and -12.0 kPa had an effective vacuum response of 18.8m.

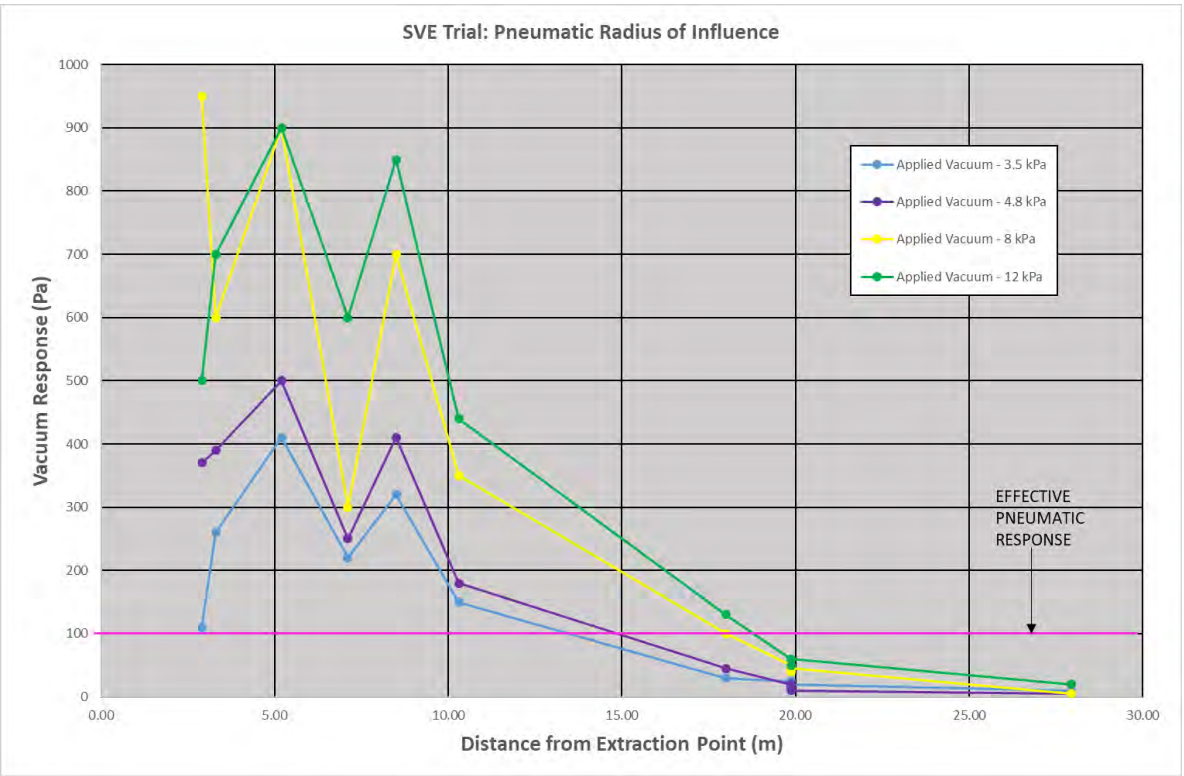

Figure 3 SVE trial pneumatic radius of influence.

Instantaneous PID measurements of the soil vapour recovered during the test at PEW1 ranged between 405 ppm_v and 1,210 ppm_v, and infra-red gas analyser measurements of VOCs as hexane ranged between 60,000 and >110,000 ppm_v. The meter used to measure hexane VOC's had a maximum upper range of 110,000 ppm_v, and hence why higher concentrations were not recorded.

PID and hexane readings obtained were averaged for each particular vacuum applied at PEW1. Hydrocarbon recovery rates are also summarised in Table 8.2 below.

Table 8.2 VOC Readings and Mass Extraction Rates (SVE at PEW1)

Applied Extraction Well Head Vacuum (kPa)	Approximate Extracted Air Flow Rate (m^3/hr)	Average Meter Readings / Sample Results			Calculated Mass Extraction Rate		
		PID (ppm_v)	Hexane (ppm_v)	Carbon Tube Total VOCs (mg/m^3)	PID (kg/hr)	Hexane (kg/hr)	Carbon Tube (kg/hr)
-3.5	12.4	1075	>110,000*	-	0.050	>4.815	-
-4.8	19.1	1080	62,000	-	0.078	4.180	-
-8.0	31.8	785	>110,000*	-	0.094	>12.348	-
-12.0	38.2	405	52,000	38,000	0.058	7.012	1.452

* Above maximum range of measuring device.

A carbon tube sample was obtained and analysed during the SVE trial (sample ID "SVE Single Tube", within the Insite Report in Appendix D). The calculated results for the hydrocarbon mass extraction rate, when the applied vacuum was - 12 kPa, was 1.452 kg/hr. The calculated mass extraction rates using the PID concentrations ranged between 0.050 – 0.094 kg/hr, which was considerably lower than the calculated carbon tube results. The calculated hexane meter results, ranging between 4.180 – >12.348 kg/hr, were higher than the calculated carbon tube results. The carbon tube result is considered to be a reliable method for calculating mass extraction rates, due to the methods capturing and accurately

analytically identifying a large range of volatile compounds, and the mass reported is considered to be the minimum hydrocarbon recovery rate. Based on the three carbon tube results (over the course of the pilot trials), it is considered that the PID readings underestimated the hydrocarbon recovery rates (by a factor of between 5 and 25) and the hexane meter overestimated the hydrocarbon recovery rates (by a factor of between 5 and 10).

Based on the hydrocarbon recovery rates reported by the carbon tube (1.452 kg/hr) and the high pneumatic radius of influence (>10 m) SVE could be effective remediation approach at the site.

9 SOIL VAPOUR EXTRACTION (SVE) AND PUMPING TEST

9.1 METHODOLOGY

The SVE + pumping test was conducted on 16 September 2020 at the central extraction well (PEW1) using a truck mounted vacuum/separation system, where air is extracted under monitored conditions with vapour flow and well head vacuums measured. The vacuum line was connected directly to the top of the extraction well head, with no installation of a drop tube / stinger into the well. A range of flow rates and wellhead vacuums were applied during the trial. The water level and vacuum response at several 50mm surrounding observation wells were also monitored.

In order to maximise the efficiency of the hydrocarbon mass removal via the SVE, the trial was conducted with a down-hole pneumatic pump operating in the extraction well concurrently with the application of SVE (Figure 4 below). The concurrent dewatering aimed to ensure that the smear zone is further exposed, which could enable a larger effective ROI and more efficient hydrocarbon removal.

Figure 4 SVE + pumping trial showing the vacuum hose and pneumatic pump tubes connected to the extraction well head.

During the SVE – pumping tests the following data was collected:

- Flow rate of vapour from the extraction well.
- Flowrates and volumes of liquids from the extraction well.
- Applied wellhead vacuum pressure.
- Induced vacuums and hydraulic drawdowns at the extraction wellhead and surrounding monitoring wells.
- Contaminant concentrations in the discharged air, using a PID, infra-red gas analyser (hexane) and one carbon tube (to validate and compare to the PID / hexane readings).

The recovered vapour was discharged to the atmosphere after passing through a GAC filter to remove the VOCs, and recovered liquids were discharged to InSite recovery tank located in the north-western portion of the site for future off-site disposal.

9.2 RESULTS

The tabulated data of the monitoring well response to the SVE + Pumping that was recorded by the WSP is attached in Appendix E-2, and the Insite Remediation trial report is attached in Appendix D,

The SVE trial was conducted at well PEW1 for approximately 5.08 hours on 16 September 2020. Using the vacuum control valve on the vacuum truck unit, a vacuum (measured at the wellhead of PEW1) of between -3 kPa and -20 kPa was applied at the extraction well. Each step in the applied vacuum was maintained for a duration that would allow the formation to reach equilibrium, both in terms of vacuum response (manually gauged at monitoring wells) and vapour recovery (measured at the SVE unit). The applied wellhead vacuums generated air flow at the wellhead of the extraction well in the range of 14.1 m^3/h to 55.8 m^3/h (Figure 5 below).

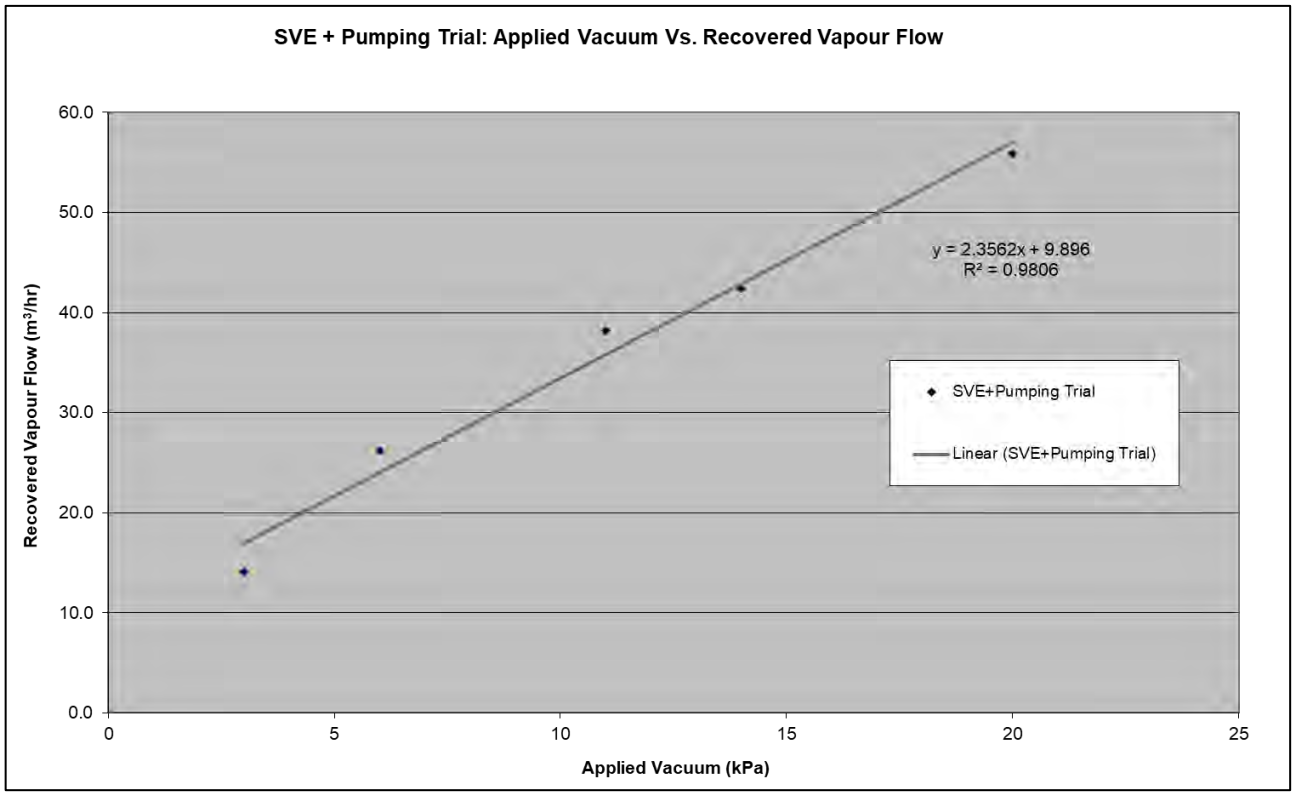

Figure 5 SVE + Pumping trial applied vacuum vs. recovered vapour flow.

The pneumatic groundwater pump was installed within the extraction PEW1 so as the inlet to the pump was at 10.705 mBGL. The SWL in the extraction well before the trial started was 8.770 mBGL, which meant that there was a head of 1.935 m of groundwater above the pump inlet before pumping started. Depending on the pumping flow rate and the recharge efficiency of the well, this 1.935 m was the potential groundwater draw down of the extraction well.

Table 9.1 presents the average liquid flow rate, total extracted liquid volume, expected total TPH concentration and the estimated total dissolved phase hydrocarbons removed during the SVE + Pumping trial.

Table 9.1 Total liquid volumes, TPH concentration and estimated dissolved phase hydrocarbons removed during the MPVE trial.

Trial	Average Flow Rate (L/min)	Volume of Liquid Extracted (L)	TPH Concentration* (mg/L)	Dissolved Phase Hydrocarbon Recovery Rate (kg/hr)	Estimated Total Hydrocarbon Removed (dissolved phase) (kg)
SVE + Pumping	2.31	638	405.07	0.056	0.2584

* Total TPH concentration measured at PEW1 on 29 September 2020.

Throughout the SVE + Pumping trial, and once the pump flow had stabilised, the average flow rate was 2.31 L/min. There were two occasions where the trial had to be paused due to the pump malfunctioning from sand/sediment blockage (outlined within the comments section the data tables in Appendix E-2). A total of approximately 638 L of liquid was pumped out of the extraction well during the trial. This was measured by dipping the liquid storage tank onsite at regular intervals. There was no measurable LNAPL that was pumped out of the extraction well, although due to the short length of the trial, as well as the procedure used to gauge the tank, this was to be expected.

The flow rates were also confirmed by using the timed known volume fill test method ('bucket test'), which is done by filling a bucket at the pump outlet and timing how long it takes to fill a specified volume. By using the total TPH concentration measured at the extraction well at the most recent GME (405.07 mg/L), an estimated 0.2584 kg of dissolved phase hydrocarbons was removed during the SVE + Pumping trial, at a rate of 0.056 kg/hr.

Figure 6 below presents the groundwater level changes measured in the surrounding observation wells graphed against the distance these observation wells were from the extraction well. The largest observed change in water level in the surrounding observation wells was a decrease of 78mm in PMW1 (2.9m from extraction well). This decrease in water level gradually decreased the further the observation well was from the extraction well. In the wells approximately >20m away from the extraction well, a slight increase in water level was observed, ranging from 2 – 9 mm. These observed increases in water levels in these wells is likely attributed to changes in the atmospheric pressure and/or slight errors in the manual dipping of the well using the interface probe.

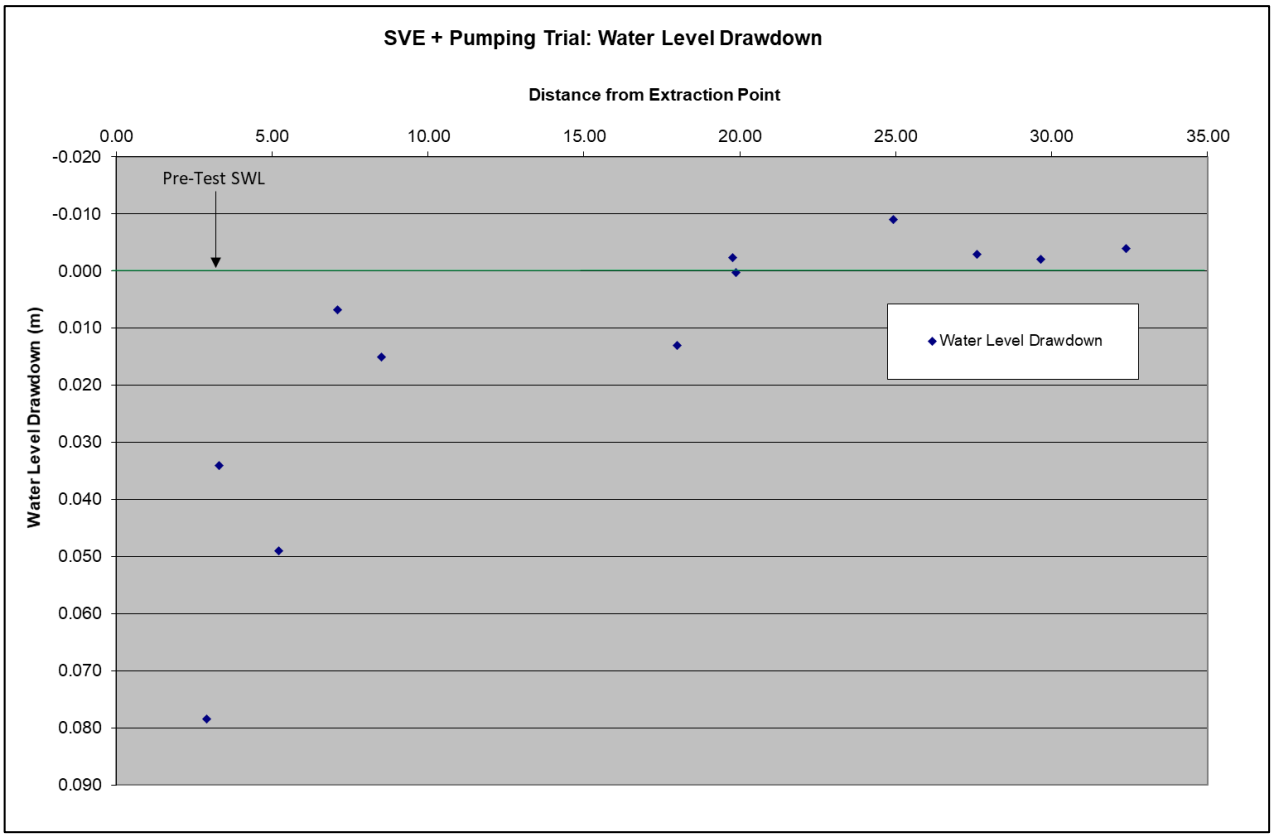

Figure 6 SVE + Pumping Trial water drawdown.

During the SVE + Pumping trial, vacuum pressures were measured at several observation wells surrounding the extraction well. For the purpose of analysing and graphing this data, the wells assessed, including the measured vacuums and distance from extraction well, are presented in Table 9.2. The complete data set from all observation wells monitored during the SVE + Pumping trial is presented in Appendix E-2.

Table 9.2 SVE + pumping trial observation wells, distance from extraction well, and measured vacuum data.

Vacuum Applied at Extraction Well (kPa)	Observation Well ID (Distance from Extraction Wells (m)) Vacuum Measurements (Pa)											
	PMW1 (2.90)	MW05 (3.30)	PMW4 (5.20)	MW2 (7.10)	PMW2 (8.50)	PMW3 (10.30)	MW4 (17.99)	SV3-2M (19.87)	SV3-6M (19.87)	MW16 (19.88)	MW7 (22.11)	EW3 (24.92)
- 3	-125	-125	-250	-70	-200	-80	-	-	-	-5	-	-
- 6	-160	-340	-480	-240	-350	-120	-20	-15	-15	-10	-	-20
- 11	-550	-550	-950	-550	-550	-400	-75	-35	-50	-35	-	-55
- 15	-500	-900	-1400	-600	-1000	-500	-150	-70	-100	-100	-180	-125
- 20	-1050	-900	-1500	-550	-800	-600	-	-	-	-110	-	-

Note: "-" no vacuum measurement was taken, usually due to other works or an obstruction, such as a parked car, at the observation well location.

Figure 7 below presents the graphed data contained in Table 9.2. Adopting 100 Pa as an indication of effective vacuum response (based on previous experience), the pneumatic ROI for SVE + pumping was estimated to be effective for all applied vacuums at the extraction well of up to a distance of 10m. There was a single exception to this, with an applied

vacuum of -3 kPa, observation well MW02 had a measured vacuum of 70 Pa, which is below the effective vacuum response of 100 Pa. Each of the differing vacuums applied resulted in lower responses at this location, which suggests that there is less pneumatic connection between the extraction well PEW1 and MW02, when compared to other observation well locations.

An applied extraction well vacuum of -6 kPa had an effective vacuum response of 11.5 m; -11.0 kPa had an effective vacuum response of 17.3 m; -15.0 kPa had an effective vacuum response of 19.1 m and -20.0 kPa had an effective vacuum response of at least 20.0 m.

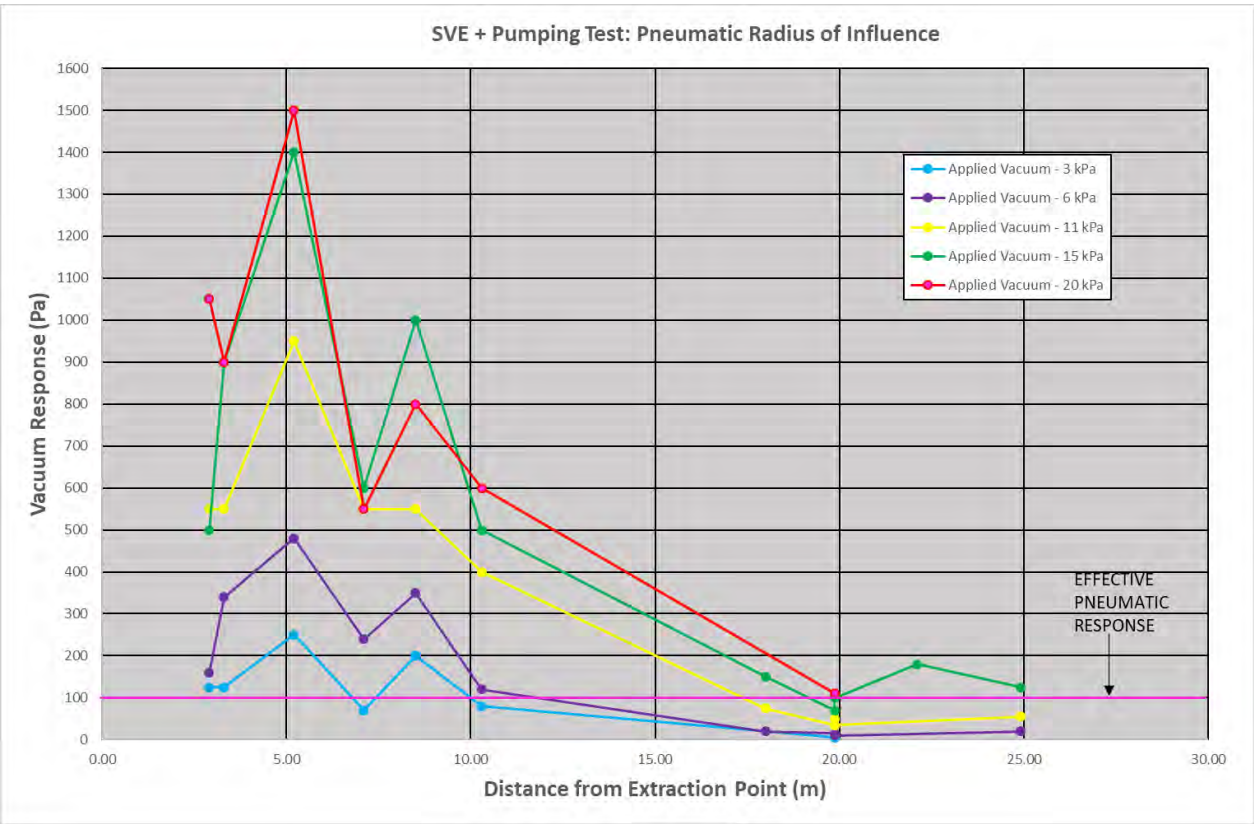

Figure 7 SVE + pumping trial pneumatic radius of influence.

Instantaneous PID measurements of the soil vapour recovered during the test at PEW1 ranged between 880 ppm_v and 7180 ppm_v, and infra-red gas analyser measurements of VOCs as hexane ranged between 45,000 and >110,000 ppm_v. The meter used to measure hexane VOC's had a maximum upper range of 110,000 ppm_v, and hence why higher concentrations were not recorded.

PID and hexane readings obtained were averaged for each particular vacuum applied at PEW1 and presented in Table 9.3. Hydrocarbon recovery rates are also summarised in Table 9.3 below.

Table 9.3 VOC readings, vapour flowrates and mass extraction rates (SVE + pumping at PEW1)

Applied Extraction Well Head Vacuum (kPa)	Approximate Extracted Air Flow Rate (m^3/hr)	Average Meter Readings / Sample Results			Calculated Mass Extraction Rate		
		PID (ppm_v)	Hexane (ppm_v)	Carbon Tube Total VOCs (mg/m^3)	PID (kg/hr)	Hexane (kg/hr)	Carbon Tube (kg/hr)
-3	14.1	1000	45,000	-	0.053	2.240	-
-6	18.7	4090	>110,000*	-	0.288	>7.261	-

Applied Extraction Well Head Vacuum (kPa)	Approximate Extracted Air Flow Rate (m^3/hr)	Average Meter Readings / Sample Results			Calculated Mass Extraction Rate		
		PID (ppm_v)	Hexane (ppm_v)	Carbon Tube Total VOCs (mg/m^3)	PID (kg/hr)	Hexane (kg/hr)	Carbon Tube (kg/hr)
-11	38.2	880	>110,000*	-	0.127	>14.833	-
-15	42.4	980	>110,000*	43,000	0.157	>16.464	1.823
-20	55.8	1100	>110,000*	-	0.231	>21.667	-

* Above maximum range of measuring device.

A carbon tube sample was obtained and analysed during the SVE + Pumping trial (sample ID "SVE + Pumping Dual Tubes in Series", within the Insite Report in Appendix D). The calculated results for the hydrocarbon mass extraction rate, when the applied vacuum was - 15 kPa, was 1.823 kg/hr. The calculated mass extraction rates using the PID concentrations ranged between 0.053 – 0.288 kg/hr, which was considerably lower than the calculated carbon tube results. The calculated hexane meter results, ranging between 2.240 – >21.667 kg/hr, were higher than the calculated carbon tube results.

As per the SVE test, the carbon tube result is considered to be a reliable method for calculating mass extraction rates, due to the methods capturing and accurately analytically identifying a large range of volatile compounds, and the mass reported is considered to be the minimum hydrocarbon recovery rate.

Based on the high hydrocarbon recovery rates (1.823 kg/hr) and the high radius of influence (>10 m) SVE + pumping could be effective remediation approach at the site.

10 MULTI-PHASE VACUUM EXTRACTION (MPVE) TRIAL

10.1 METHODOLOGY

The MPVE trial conducted at the site were undertaken by InSite Remediation Services Pty Ltd and supervised by a WSP environmental scientist. MPVE was conducted using the truck-mounted MPVE system that utilises GAC to treat the recovered hydrocarbons in the vapour. The system applied staged vacuum pressure up to 47 kPa at the well head of the central extraction well PEW1.

The vacuum was applied to the extraction well via an anti-static hose between the vacuum unit and the extraction well to extract water, vapour and LNAPL. The hosing was connected to a 25 mm in-well drop tube (stinger) which extended into the groundwater through a purpose built MPVE well head (Figure 8 below). An adjustable air dilution valve was used at the well head to introduce some entrainment air into the well to help convey liquids to the surface. The inlet of the drop tube (stinger) was placed below the depth of the LNAPL / groundwater interface (stinger inlet = 10.7 mBGL or 1.9 m below SWL), in order to draw down the groundwater level. Using a control valve on the vacuum truck, a range of vacuums up to 47 kPa were applied at the extraction well head.

Figure 8 MPVE trail setup showing the stinger entering the extraction well head.

During the application of MPVE, vacuum gauges were attached to several observation wells at the site to detect the pneumatic ROI and gauging was conducted to measure changes in SWL. The air flow rates, temperatures, applied vacuum, hydrocarbon concentrations in the vapour of the extracted air and liquid flow rates was measured using the MPVE unit gauges.

During the MPVE events the following data were collected:

- The total extracted volume of NAPL and contaminated groundwater.
- The pneumatic flow characteristics of the unsaturated soil, including effective ROI. This was achieved vacuum gauging of the surrounding 50mm monitoring wells.
- The hydraulic flow characteristics of the unsaturated soil, including effective ROI. This was achieved by gauging the SWL of the surrounding 50mm monitoring wells at the start and end of the trial.

- Contaminant concentrations in the discharged air, using a PID, infra-red gas analyser (hexane) and one carbon tube (to validate and compare to the PID / hexane readings).
- The air flow and vacuum requirements for effective capture of contaminated materials.

The recovered vapour from the extraction event was treated by activated carbon canisters to adsorb the VOCs from the recovered vapour. The recovered liquids were stored within the (dangerous goods rated) truck for off-site disposal (waste disposal receipts are presented in the Insite Remediation report - Appendix D).

10.2 RESULTS

The tabulated data of the monitoring well response to the MPVE trial that was recorded by the WSP Environmental Scientist is attached in Appendix E-3, and the Insite Remediation trial report is attached in Appendix D.

The MPVE trial was conducted at well PEW1 for approximately 7.1 hours on 17 September 2020. Using the vacuum control valve on the vacuum truck unit, a vacuum (measured at the wellhead of PEW1) of between -40 kPa and -47 kPa was applied at the extraction well. Each step in the applied vacuum was maintained for a duration that would allow the formation to reach equilibrium, both in terms of vacuum response (manually gauged at monitoring wells) and vapour recovery (measured at the MPVE unit). The applied wellhead vacuums generated air flow at the wellhead of the extraction well in the range of 14.1 m^3/h to 55.8 m^3/h (Figure 9 below).

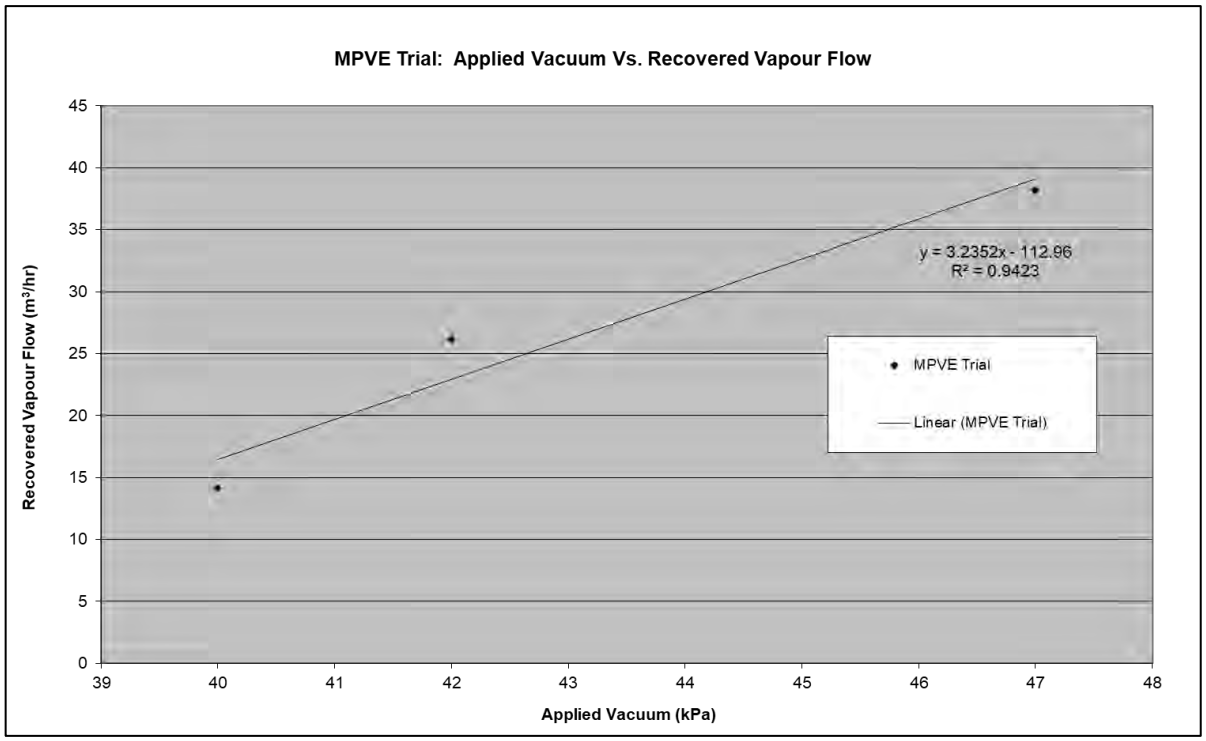

Figure 9 MPVE trial applied vacuum Vs. recovered vapour flow.

The MPVE system stinger tube was installed within the extraction PEW1 so as the inlet was at 10.7 mBGL. The SWL in the extraction well before the trial started was 8.784 mBGL, which meant that there was a head of 1.916 m of groundwater above the stinger inlet before the vacuum extraction started. Depending on the vacuum liquid flow rate and the recharge efficiency of the well, this 1.916m was the potential groundwater draw down of the extraction well.

Table 10.1 presents the average liquid flow rate, total extracted liquid volume, expected total TPH concentration and the estimated total dissolved phase hydrocarbons removed during the MVPE trial.

Table 10.1 Total liquid volumes, TPH concentration and estimated dissolved phase hydrocarbons removed during the MPVE trial.

Trial	Average Flow Rate (L/min)	Volume of Liquid Extracted (L)	TPH Concentration * (mg/L)	Dissolved Phase Hydrocarbon Recovery Rate (kg/hr)	Estimated Total Hydrocarbon Removed (dissolved phase) (kg)
MPVE	2.7	876	405.07	0.066	0.3548

* Total TPH concentration measured at PEW1 on 29 September 2020.

Throughout the MPVE trial and once the liquid flow rate had stabilised, the average flow rate of liquid being extracted from the well was 2.70 L/min. A total of 876 L of liquid was extracted from the extraction well during the trial. By using the total TPH concentration measured at the extraction well at the most recent GME (405.07 mg/L), an estimated 0.3548 kg of dissolved phase hydrocarbons was removed during the MPVE trial, at a rate of 0.066 kg/hr.

Figure 10 below presents the groundwater level changes measured in the surrounding observation wells graphed against the distance these observation wells were from the extraction well. This largest observed change in water level in the surrounding observation wells was a decrease of 0.425m in PMW1 (2.9m from extraction well). This well is considered an outlier, as all the other observed locations ranged between 0.1 – 0.022 m decrease in water level.

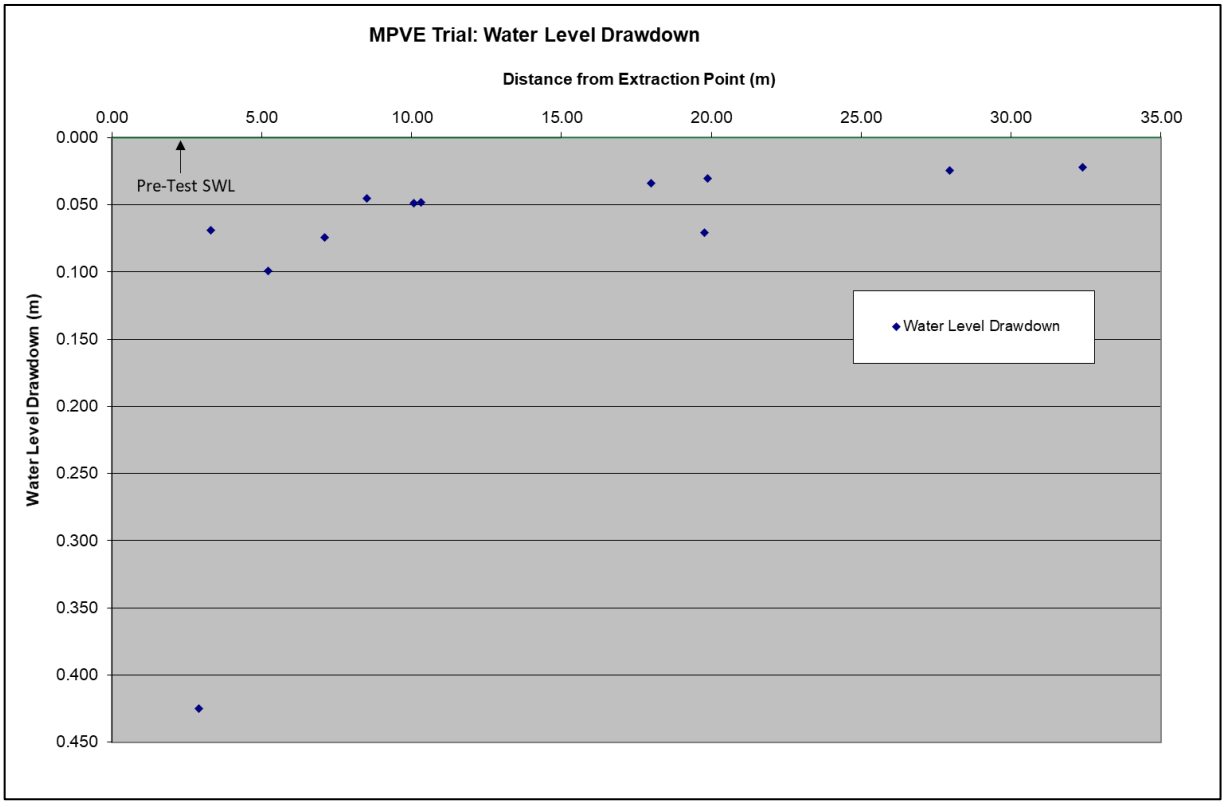

Figure 10 MPVE trial water level drawdown graph.

During the MPVE trial, vacuum pressures were measured at several observation wells surrounding the extraction well. For the purpose of analysing and graphing this data, the wells assessed, including the measured vacuums and distance from extraction well, are presented in Table 10.2. The complete data set from all observation wells monitored during the MPVE trial is presented in Appendix E-3.

Table 10.2 MPVE trial observation wells, distance from extraction well and measured vacuum data.

Vacuum Applied at Extraction Well (kPa)	Observation Well ID (Distance from Extraction Wells (m)) Pressure Measurements (Pa)											
	PMW1 (2.90)	MW05 (3.30)	PMW4 (5.20)	MW2 (7.10)	PMW2 (8.50)	PMW3 (10.30)	MW4 (17.99)	SV3-6M (19.87)	SV3-2M (19.87)	MW16 (19.88)	MW7 (22.11)	MW15 (27.95)
- 40	-1600	-850	-1100	-550	-850	-450	-120	-90	-65	-80	-150	-11
- 42	-900	-700	-950	-450	-750	-390	-109	-70	-36	-60	-180	-8
- 47	-550	-700	-900	-500	-550	-400	-110	-90	-55	-70	-100	-20

Figure 11 below presents the graphed data contained in Table 10.2. Adopting 100 Pa as an indication of effective vacuum response (based on previous experience), the pneumatic ROI for MPVE trial was estimated to be effective for all applied vacuums at the extraction well of up to a distance of 18.5m.

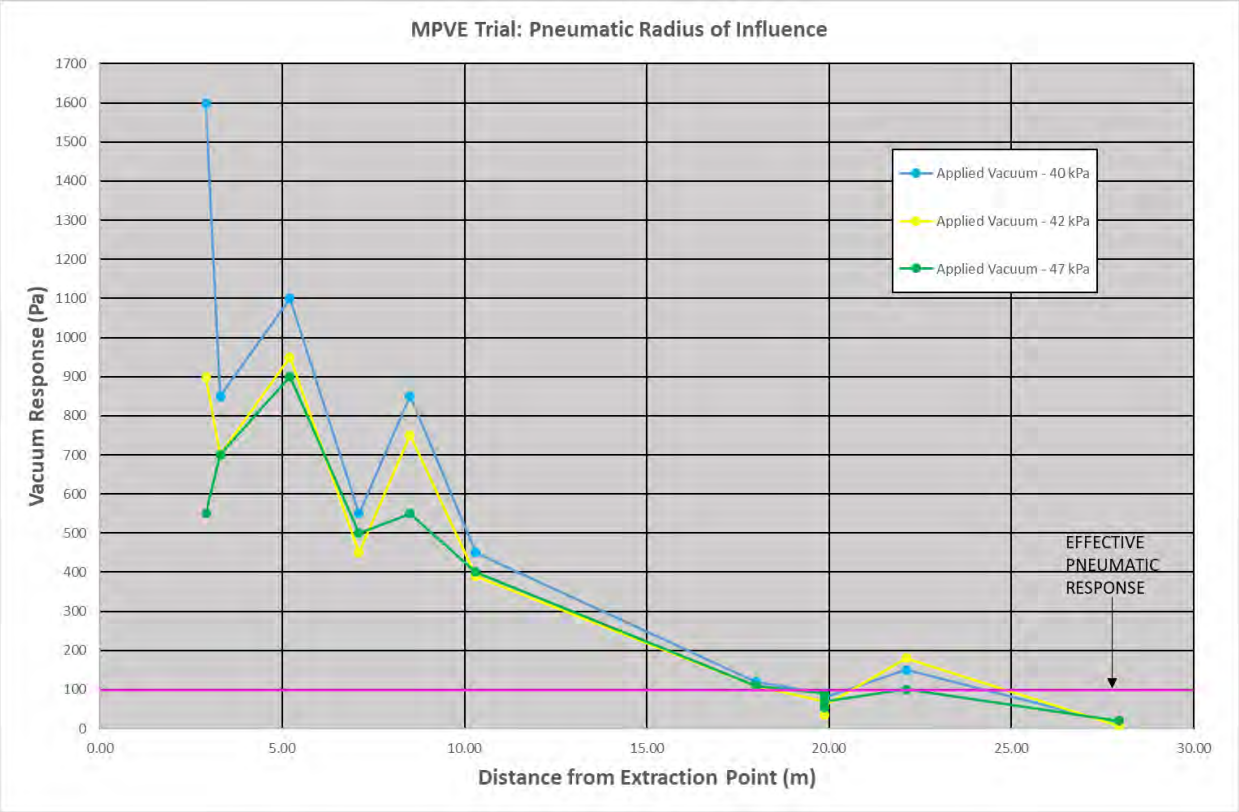

Figure 11 MPVE trial pneumatic radius of influence.

Instantaneous PID measurements of the soil vapour recovered during the test at PEW1 ranged between 725 ppm_v and 1272 ppm_v, and infra-red gas analyser measurements of VOCs as hexane ranged between 44,000 and 50,956 ppm_v.

PID and hexane readings obtained were averaged for each particular vacuum applied at PEW1 and presented Table 10.3. Hydrocarbon recovery rates are also summarised in Table 10.3 below.

Table 10.3 VOC readings, vapour flowrates and mass extraction rates (MPVE at PEW1)

Applied Extraction Well Head Vacuum (kPa)	Approximate Extracted Air Flow Rate (m^3/hr)	Average Meter Readings / Sample Results			Calculated Mass Extraction Rate		
		PID (ppm_v)	Hexane (ppm_v)	Carbon Tube Total VOCs (mg/m^3)	PID (kg/hr)	Hexane (kg/hr)	Carbon Tube (kg/hr)
-40	111.4	802	47,451	17,000	0.337	18.660	1.894
-42	139.6	1076	45,000	-	0.566	22.175	-
-47	120.2	980	44,000	-	0.444	18.669	-

A carbon tube sample was obtained and analysed during the MPVE trial (sample ID "MPE Dual Tubes in Series", within the Insite Report in Appendix D). The calculated results for the hydrocarbon mass extraction rate using the carbon tube results, when the applied vacuum was - 40 kPa, was 1.894 kg/hr. The calculated mass extraction rates using the PID concentrations ranged between 0.337 – 0.566 kg/hr, which was lower than the calculated carbon tube results. The calculated hexane meter results, ranging between 18.660 – 22.175 kg/hr, were higher than the calculated carbon tube results.

As per the previous tests above, the carbon tube result is considered to be a reliable method for calculating mass extraction rates, due to the methods capturing and accurately analytically identifying a large range of volatile compounds, and the mass reported is considered to be the minimum hydrocarbon recovery rate.

Based on the high hydrocarbon recovery rates (1.894 kg/hr) and the high radius of influence (18.5 m) MPVE could be effective remediation approach at the site.

11 IN-SITU CHEMICAL OXIDATION (ISCO) INJECTION TRIAL

11.1 METHODOLOGY

The direct injection method was utilised for the site on the 17 and 18 September 2020. The sodium persulfate ($Na_2S_2O_8$) solution was pumped into three 50mm injection wells (IW01, IW02 and IW03) using a trailer-mounted storage/mixing tank and pump. Persulfate solution was pumped into each of the injection wells, displacing groundwater corresponding to the volume of reagent injected. This enables contact between the reagents and the contaminants within the soil/rock pores and allow oxidisation and subsequent contaminant breakdown to occur.

The sodium persulfate chemical comes in 25 kg bags of granular material, which is mixed with water, to achieve the desired concentration of solution (recommended starting concentration of 25% weight/volume). For the purposes of this trial, a trailer mounted IBC was filled with 500L of tap water at each injection location. 125 kg of the granulated sodium persulfate is slowly added to the water. A recirculating pump and mixing paddle were used to ensure the sodium persulfate was sufficiently dissolved before injection commenced.

Once the solution was sufficiently mixed, the pump was connected to the injection well head using hose and threaded PVC fittings. The wellhead inlet line had a valve, pressure gauge and inline flow meter to sufficiently monitor and control the injection fluid entering the well.

Figure 12 Chemical injection point at well head IW02

During the ISCO tests the following data was collected:

- Volume (and flow rates) of injected persulfate solution measured.
- Water levels and water quality parameters in surrounding wells.

In addition, groundwater samples were collected prior to the ISCO injection on the 17 September 2020 and after injection on the 28 and 29 September 2020, within the three injection wells (IW01 to IW03) and five surrounding wells (MW01,

MW06, MW07, MW10, and EW03). The groundwater samples were submitted to a NATA accredited laboratory (SGS Environmental Sydney) and analysed for TRH and BTEX. The pre-injection sample analysis serves to provide the baseline data for comparison to the post-injection results, which will provide bases for the assessment on the effectiveness of the ISCO injection.

11.2 RESULTS

The Insite Remediation trial report is attached in Appendix D, and the tabulated data of the monitoring well response to the ISCO trial that was recorded by the WSP Environmental Scientist is attached in Appendix E-4.

11.2.1 INJECTION INTO IW01

The ISCO trial was conducted at injection well IW01 for approximately 3.6 hours in total, over two days (17 and 18 September 2020). Table 11.1 presents a summary of the results of the trial at this location.

Table 11.1 Total quantities of water and sodium persulfate injected at IW01.

Batch No. (Date)	Water volume (L)	Sodium Persulfate Weight (kg)	% Sodium Persulfate Concentration (weight/volume)	Sodium Persulfate Concentration (mg/L)	Average Liquid Flow Rate & Injection Pressure	Comment
1 (17/09/20)	220	55	25%	250,000	2.8 L/min at 40.5 kPa	Batch left over from injection into IW03
2 (18/09/20)	200	75	37.5%	375,000	1.5 L/min at 50 kPa	Batch left over from Batch 1 on 17/09/20. An additional bag 25kg of sodium persulfate was added to this batch.
Total Injected	420	130				

The trial at IW01 was conducted over two days, with 220L of solution pumped into IW01 on the first day (55 kg of sodium persulfate at 25% weight/volume solution) and 200 L on the second day (75 kg of sodium persulfate at 37.5% weight/volume solution), equating to a total of 420L of solution (130 kg of sodium persulfate in total) that was injected into IW01 over the two days of the injection trial.

The flowrates measured on the inline flowmeter fluctuated considerably throughout the trial (1.3 - 5.3 L/min). For this reason, the flowrates within the above table are calculated using the total volume of liquid injected and total time of injection. The average flowrate of the Batch 1 solution was calculated as 2.8 L/min at 40.5 kPa and the Batch 2 was calculated as 1.5 L/min at 50 kPa.

Water level data loggers were installed in two wells in close proximity to injection IW01, EW01 (9.83 m south-east from IW01) and MW06 (6.57 m north of IW01), for the second day of monitoring (18/09/2020). The graphed data from these loggers is presented in Figure 13, below.

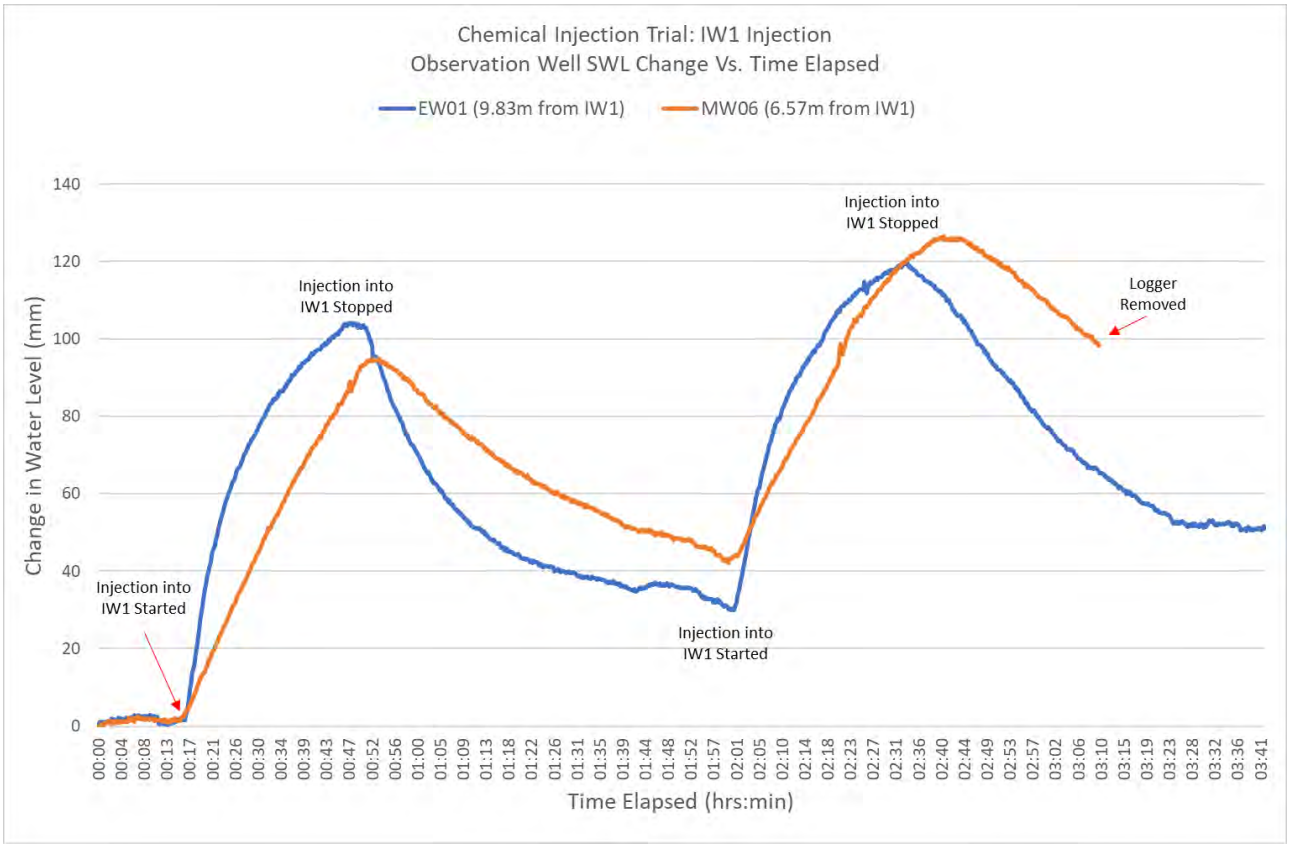

Figure 13 ISCO trial at IW01 - Observation wells (EW01 & MW06) standing water level change Vs. time elapsed.

The data presented in Figure 13 above shows a clear correlation between the injection of chemical solution into IW01 and the increase in water level within EW01 and MW06. At approximately 43 minutes into the trial, the injection of chemical solution was paused, and there is a clear response of water level decrease in both EW01 and MW06. The injection was restarted, with the surrounding wells responding with a water level increase.

Table 11.2 presents the water quality field measurements (pH, temperature, electrical conductivity, redox potential and dissolved oxygen) of the injection solution, at the injection well IW01 and the surrounding observation wells, MW06 and MW07, before and after the injection.

Table 11.2 Water quality field parameters of IW01, MW6 and MW7 (pre and post injection).

Analyte Name	Units	Injection Solution	Pre-Injection (17/09/20)			Post-Injection (18/09/20)			Change Between Pre and Post Injection		
			IW01	MW06	MW07	IW01	MW06	MW07	IW01	MW06	MW07
pH	-	3.2	7.39	7.11	6.91	3.3	7.01	6.94	-4.09	-0.10	0.03
Temp.	°C	13.1	19.7	19.4	19.3	17.7	18.9	18.8	-2.0	-0.5	-0.5
EC	µS/cm	87063	1300	1360	1577	105013	1429	1853	103713	69	276
ORP	mV	554.6	91.7	95.7	26.1	532.9	260	136.8	441.2	164.3	110.7
DO	mg/L	3.81	5.83	4.04	1.41	3.27	1.22	1.35	-2.56	-2.82	-0.06

Note:

Decrease between pre and post injection sampling.

Increase between pre and post injection sampling.

While there is little (or no) change in pH and temperature in the monitoring wells (MW06 and MW07), MW06 and MW07 reported changes in the following parameters between the pre- and post- injection measurements:

- Increase in electrical conductivity: +69 µS/cm in MW06 and +276 µS/cm in MW07.
- Increase in redox potential: +164.3 mV in MW06 and +110.7 mV in MW07.
- Decrease in dissolved oxygen: -2.82 mg/L in MW06 and -0.06 mg/L in MW07.

Table 11.3 presents the laboratory analytical results of the hydrocarbon concentrations in the samples collected from the injection well IW01 and the surrounding observation wells, MW06 and MW07, before and after the injection, as well as the change in concentrations.

Table 11.3 Hydrocarbon concentration of IW01, MW6 and MW7, and change in concentration (pre and post injection).

Analyte Name	Units	Pre-Injection (17/09/20)			Post-Injection (28-29/09/20)			Change Between Pre and Post Injection*		
		IW01	MW06	MW07	IW01	MW06	MW07	IW01	MW06	MW07
Benzene	µg/L	16000	3600	10000	7900	14000	10000	-8100	+10400	0
Toluene	µg/L	180000	88000	100000	94000	160000	88000	-86000	+72000	-12000
Ethylbenzene	µg/L	3500	3100	3400	1700	3900	2000	-1800	+800	-1400
Total Xylenes	µg/L	17000	20000	21000	8200	20000	13000	-8800	0	-8000
Total BTEX	µg/L	210000	110000	140000	110000	200000	110000	-100000	+90000	-30000
Naphthalene	µg/L	<2500	<1000	<2500	<1000	<2500	<1000	-1500	+1500	-1500
TRH C_6-C_9	µg/L	330000	180000	210000	240000	<200000	100000	-90000	+20000	-110000
TRH C_6-C_{10}	µg/L	340000	200000	<250000	250000	<250000	120000	-90000	+50000	-130000
TRH C_{10}-C_{40}	µg/L	6100	20000	39000	12000	14000	27000	+5900	-6000	-12000

Note:

Decrease in concentration between pre and post injection sampling.

Increase in concentration between pre and post injection sampling.

* For the purpose of calculating change in concentration, in cases where the concentration was < the LOR, the LOR has been used as the concentration (e.g. if the original value was <500 µg/L, then 500 µg/L has been used as the concentration for calculating the change between pre and post injection.

11.2.2 INJECTION INTO IW02

The ISCO trial was conducted at injection well IW02 for approximately 1.1 hours in total, on 18 September 2020. Table 11.4 presents a summary of the results of the trial at this location.

Table 11.4 Total quantities of water and sodium persulfate injected at IW02.

Batch No. (Date)	Water volume (L)	Sodium Persulfate Weight (kg)	% Sodium Persulfate Concentration (weight/volume)	Sodium Persulfate Concentration (mg/L)	Average Liquid Flow Rate & Injection Pressure	Comment
1 (18/09/20)	200	75	37.5%	375,000	7.7 L/min at 40 kPa	-
2 (18/09/20)	400	150	37.5%	375,000	10.0 L/min at 80 kPa	-
Total Injected	600	225				

During the injection trial at IW02, two separate batches of solution were injected into the ground. The first batch consisted of 200L of solution (75kg of sodium persulfate at a 37.5% weight/volume solution) and the second batch

consisted of 400L of solution (150kg of sodium persulfate at a 37.5% weight/volume solution). This equates to a total of 600L of solution (225 kg of sodium persulfate in total) being injected into the IW02 injection well during the trial.

The flowrates measured on the inline flowmeter fluctuated considerably throughout the trial (5.3 – 7.9 L/min). For this reason, the flowrates within the above table are calculated using the total volume of liquid injected and total time of injection. The average flowrate of the Batch 1 solution was calculated as 7.7 L/min at 40 kPa and the Batch 2 was calculated as 10.0 L/min at 80 kPa.

Water level data loggers were installed in two wells in close proximity to injection IW02, EW03 (3.13 m east from IW02) and MW01 (2.85 m west of IW02). The graphed data from these loggers is presented in Figure 14, below.

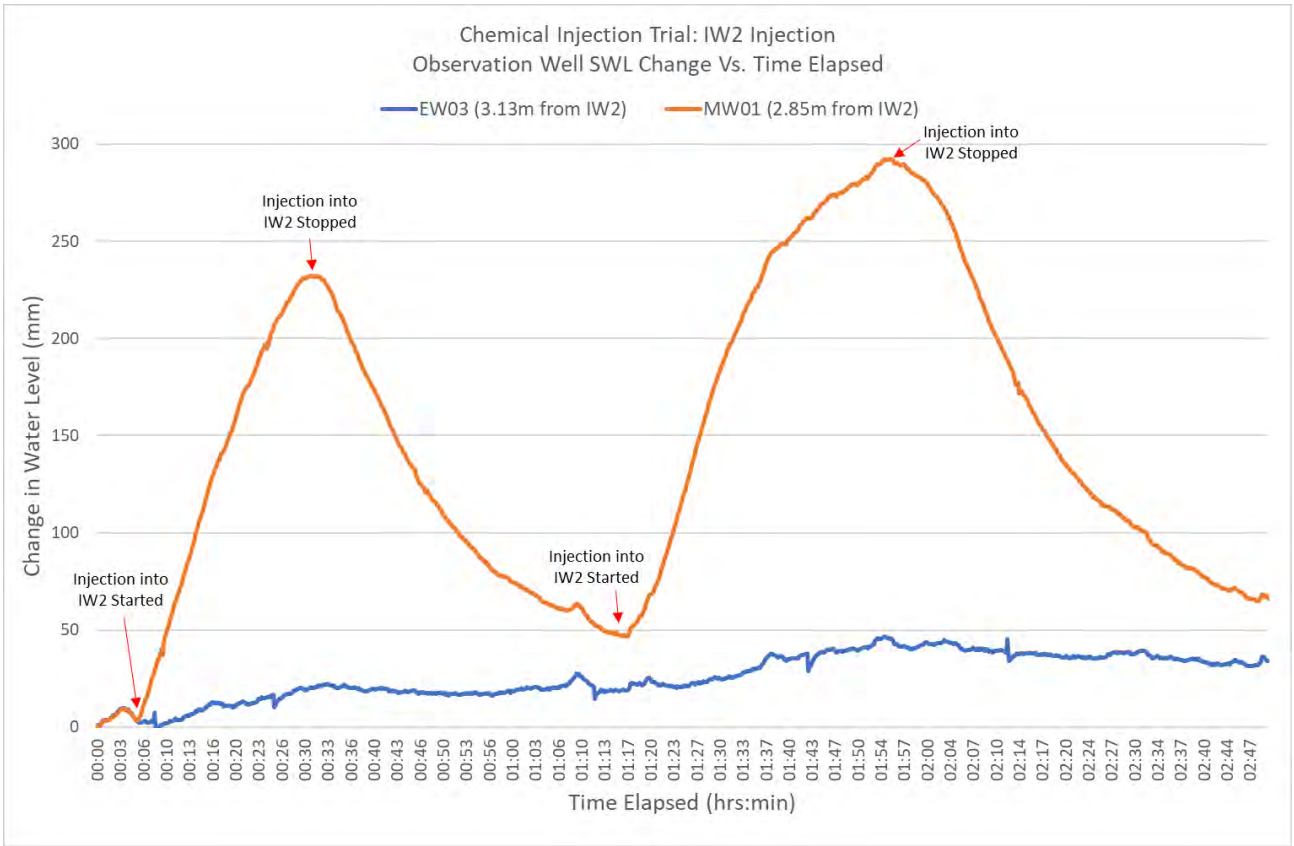

Figure 14 ISCO trial at IW02 - Observation wells (EW03 & MW01) standing water level change Vs. time elapsed.

The data presented in Figure 14 above shows a clear correlation between the injection of chemical solution into IW02 and the increase in water level within MW01. This same correlation was not evident in EW03, even though it was a similar distance from the injection well. At approximately 30 minutes into the trial, the injection of chemical solution was paused, and there is a clear response of water level decrease in MW01, but still no response in EW03. The injection was restarted at approximately 67 minutes into the trial, with the surrounding the same response in MW01 and no obvious response in EW03. This minimal response in EW03 suggests that there is very little hydraulic connection between the injection well IW02 and the observation well EW03.

This is consistent with the reported hydrocarbon impacts in the three wells, where MW01 and IW02 have significant hydrocarbon concentrations in groundwater (e.g. benzene > 1 mg/L) and indicative of good hydraulic connectivity between these wells and the secondary source zones within the plume, whereas the hydrocarbon concentrations in EW03 are lower, and indicative of reduced hydraulic connectivity between EW03 and the secondary source zones within the plume.

Table 11.5 presents the water quality field measurements (pH, temperature, electrical conductivity, redox potential and dissolved oxygen) in the injection solution, at the injection well IW02 and the surrounding observation wells, MW01 and EW03, before and after the injection.

Table 11.5 Water quality field parameters of IW02, MW01 and EW03 (pre and post injection).

Analyte Name	Units	Injection Solution	Pre-Injection			Post-Injection			Change Between Pre and Post Injection		
			IW02	MW01	EW03	IW02	MW01	EW03	IW02	MW01	EW03
pH	-	5.58	7.21	6.96	6.94	-	7.00	6.84	-	0.04	-0.10
Temp.	°C	8.8	19.4	19.0	19.1	-	19.1	18.5	-	0.1	-0.6
EC	µS/cm	76404	1253	1172	1099	-	1294	1168	-	122	69
ORP	mV	492.6	147.3	80.1	-34.3	-	108.7	115.5	-	28.6	149.8
DO	mg/L	7.62	4.60	3.18	1.87	-	1.37	0.52	-	-1.81	-1.35

Note:

Decrease between pre and post injection sampling.

Increase between pre and post injection sampling.

While there is little (or no) change in pH, electrical conductivity and temperature in the monitoring wells (MW01 and EW03), MW01 and EW03 reported changes in the following parameters between the pre- and post- injection measurements:

- Increase in redox potential: +28.6 mV in MW01 and +149.8 mV in EW03.
- Decrease in dissolved oxygen: -1.81 mg/L in MW01 and -1.35 mg/L in EW03.

Table 11.6 presents the laboratory analytical results of the hydrocarbon concentrations in the samples collected from the injection well (IW02) and the surrounding observation wells (MW01 and EW03), before and after the injection, as well as the change in concentrations.

Table 11.6 Hydrocarbon concentration of IW02, MW01 and EW03, and change in concentration (pre and post injection).

Analyte Name	Units	Pre-Injection (17/09/20)			Post-Injection (28-29/09/20)			Change Between Pre and Post Injection*		
		IW02	MW01	EW03	IW02	MW01	EW03	IW02	MW01	EW03
Benzene	µg/L	6700	4200	52	7600	3500	3.8	+900	-700	-48
Toluene	µg/L	130000	100000	3300	75000	78000	46	-55000	-22000	-3254
Ethylbenzene	µg/L	4300	3800	230	2400	9600	25	-1900	+5800	-205
Total Xylenes	µg/L	22000	23000	1500	11000	20000	55	-11000	-3000	-1445
Total BTEX	µg/L	160000	140000	5000	97000	110000	130	-63000	-30000	-4870
Naphthalene	µg/L	2600	<2500	58	<1000	<1000	<0.5	-1600	-1500	-58
TRH C_6-C_9	µg/L	260000	200000	8900	170000	240000	200	-90000	+40000	-8700
TRH C_6-C_{10}	µg/L	280000	<250000	10000	180000	250000	260	-100000	0	-9740
TRH C_{10}-C_{40}	µg/L	12000	28000	1600	14000	22000	<320	+2000	-6000	-1280

Note:

Decrease in concentration between pre and post injection sampling.

Increase in concentration between pre and post injection sampling.

* For the purpose of calculating change in concentration, in cases where the concentration was < the LOR, the LOR has been used as the concentration (e.g. if the original value was <500 µg/L, then 500 µg/L has been used as the concentration for calculating the change between pre and post injection.

11.2.3 INJECTION INTO IW03

The ISCO trial was conducted at injection well IW03 for approximately 1.0 hour in total, on 17 September 2020. Table 11.7 presents a summary of the results of the trial at this location.

Table 11.7 Total quantities of water and sodium persulfate injected at IW03.

Batch No. (Date)	Water volume (L)	Sodium Persulfate Weight (kg)	% Sodium Persulfate Concentration (weight/volume)	Sodium Persulfate Concentration (mg/L)	Average Liquid Flow Rate & Injection Pressure	Comment
1 (17/09/20)	80	20	25%	250,000	1.3 L/min at 75 kPa	Injection stopped after 80L injected over 1 hour, due to the slow injection rate.
Total Injected	80	20				

During the injection trial at IW03, a single batch of solution was injected into the ground. This consisted of 80L of solution (20kg of sodium persulfate at a 25% weight/volume solution). It was originally planned to inject 500L of solution into the injection well at this location, but due to the slow injection flow rates and the high pressures (>> 50 kPa) required to inject the solution into, it was decided to cease the injection.

The flowrates measured on the inline flowmeter fluctuated throughout the trial (1.3 – 2.2 L/min). For this reason, the flowrates within the above table are calculated using the total volume of liquid injected and total time of injection. The average flowrate of the injection was calculated as 1.3 L/min at 75 kPa.

Water level data loggers were installed in a single well near injection IW03, MW10 (2.91 m east from IW03). The graphed data from this logger is presented in Figure 15, below.

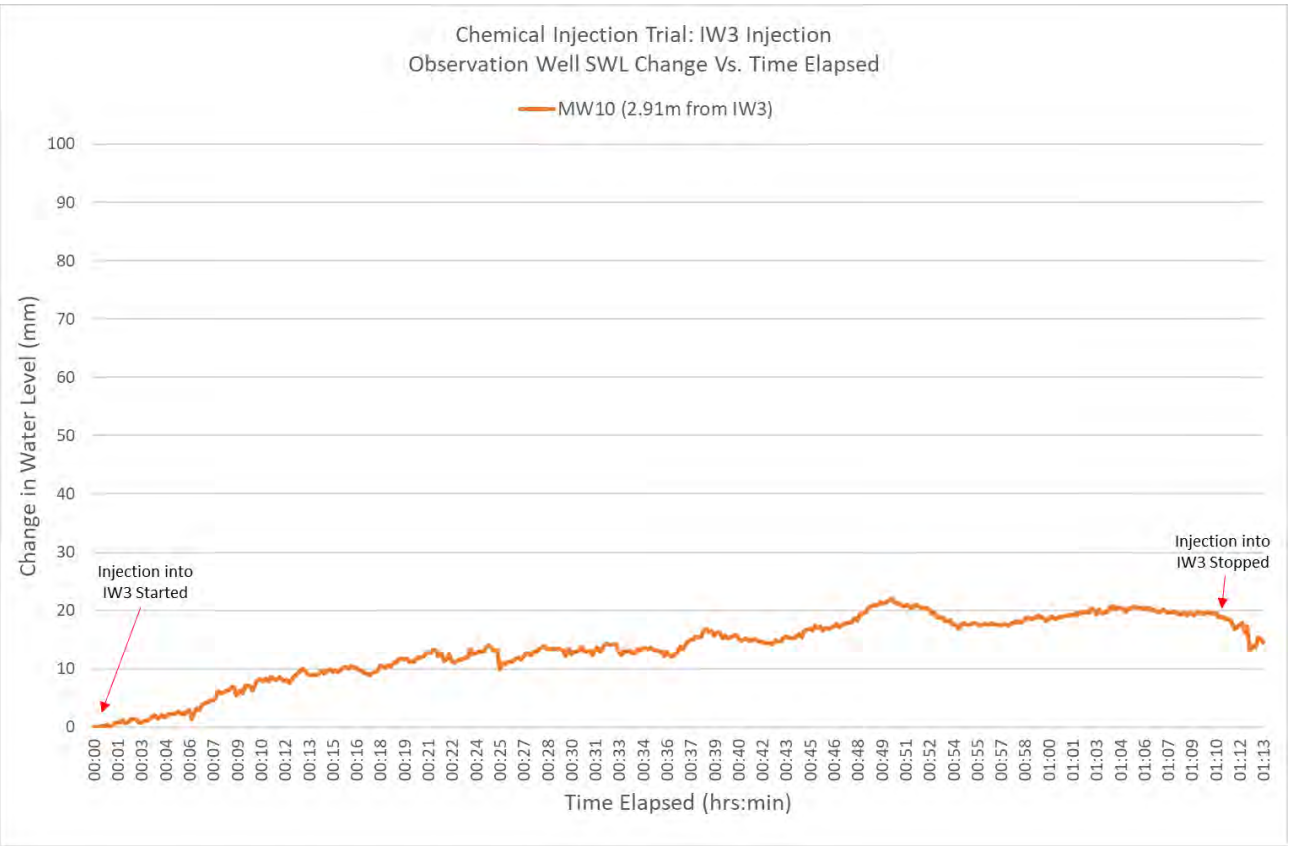

Figure 15 ISCO trial at IW03 - Observation well (MW10) standing water level change Vs. time elapsed.

The data presented in Figure 15 above shows no clear connection between IW03 and MW10, which is consistent with the high pressures (and corresponding low injection flow rates) required to inject into IW03.

Table 11.8 presents the water quality field measurements (pH, temperature, electrical conductivity, redox potential and dissolved oxygen) of the injection solution, at the injection well IW03 and the close proximity observation well, MW10, before and after the injection.

Table 11.8 Water quality field parameters of IW03 and MW10 (pre and post injection).

Analyte Name	Units	Injection Solution	Pre-Injection (18/09/20)		Post-Injection (18/09/20)		Change Between Pre and Post Injection	
			IW03	MW10	IW03	MW10	IW03	MW10
pH	-	5.9	7.11	6.92	-	6.85	-	-0.07
Temp.	°C	15.6	19.0	19.6	-	19.3	-	-0.3
EC	µS/cm	70172	1143	1238	-	1312	-	74
ORP	mV	549	46.3	86.5	-	92.6	-	6.1
DO	mg/L	5.44	5.00	2.01	-	0.47	-	-1.54

Note:

Decrease between pre and post injection sampling.

Increase between pre and post injection sampling.

While there is little (or no) change in pH, electrical conductivity, redox potential and temperature in MW10, however a decrease was noted in dissolved oxygen (-1.54 mg/L).

Table 11.9 presents the laboratory analytical results of the hydrocarbon concentrations in the samples collected from the injection well IW03 and the close proximity observation well, MW10, before and after the injection, as well as the change in concentrations.

Table 11.9 Hydrocarbon concentration of IW03 MW10 and change in concentration (pre and post injection).

Analyte Name	Units	Pre-Injection (17/09/20)		Post-Injection (28/09/20)		Change Between Pre and Post Injection*	
		IW03	MW10	IW03	MW10	IW03	MW10
Benzene	µg/L	4000	9300	<0.5	11000	-4000	+1700
Toluene	µg/L	25000	120000	<0.5	140000	-25000	+20000
Ethylbenzene	µg/L	780	3300	<0.5	3600	-780	+300
Total Xylenes	µg/L	5900	16000	<1.5	19000	-5899	+3000
Total BTEX	µg/L	36000	150000	<3	180000	-35997	+30000
Naphthalene	µg/L	1300	<2500	<0.5	<2500	-1300	0
TRH C_6-C_9	µg/L	57000	230000	<40	410000	-56960	+180000
TRH C_6-C_{10}	µg/L	62000	<250000	<50	440000	-61950	+190000
TRH C_{10}-C_{40}	µg/L	1600	7900	<320	7700	-1280	-200

Note:

Decrease in concentration between pre and post injection sampling.

Increase in concentration between pre and post injection sampling.

* For the purpose of calculating change in concentration, in cases where the concentration was < the LOR, the LOR has been used as the concentration (e.g. if the original value was <500 µg/L, then 500 µg/L has been used as the concentration for calculating the change between pre and post injection.

12 DISCUSSION

12.1 HYDROCARBON MASS EXTRACTION

A summary of the total mass of hydrocarbon extracted during the pilot trial is presented in Table 12.1.

Table 12.1 Summary of hydrocarbon vapour mass extraction rates calculated from carbon tube results

Trial	Applied Vacuum (kPa)	Vapour Recovery Rate (m^3/hr)	Hydrocarbon Vapour Mass Recovery Rate (kg/hr)
SVE	-12.0	38.2	1.452
SVE + Pumping	-15.0	42.4	1.823
MPVE	-40.0	111.4	1.894

The above hydrocarbon mass recovery rates are based off the laboratory results for the carbon tube sampling. It is recognised that the carbon tube sample only captured a "snapshot" of the concentration of total VOCs within the extracted vapour for each trial and that there were fluctuations in concentrations through the trials. These fluctuations were seen in the large range of PID and hexane concentrations observed.

The carbon tube results are considered to be a reliable method for calculating mass extraction rates, due to the methods capturing and accurately analytically identifying a large range of volatile compounds, and the mass reported is considered to be the minimum hydrocarbon recovery rate. Based on the three carbon tube results (over the course of the pilot trials), it is considered that the PID readings underestimated the hydrocarbon recovery rates (by a factor of between 5 and 25) and the hexane meter overestimated the hydrocarbon recovery rates (by a factor of between 5 and 10).

The hydrocarbon recovery rates of the extraction trials were above 1 kg/hr, and thus each extraction technology is considered to be suitable remediation technology at the site. The above results suggest that drawing down the water level within the extraction well (SVE + Pumping and MPVE), increases the hydrocarbon recovery rates. This is achieved by exposing the hydrocarbon impact in the 'smear zone' to SVE / MPVE via dewatering and is the most efficient way to maximise the long-term hydrocarbon recovery rates, which will minimise the period of remediation.

Table 12.2 presents the average liquid flow rate, total extracted liquid volume, expected total TPH concentration and the estimated total dissolved phase hydrocarbons removed during both the SVE + Pumping and MVPE trial.

Table 12.2 Summary of liquid extraction volumes & hydrocarbon removal rates at both the SVE + Pumping & MPVE trials.

Trial	Average Flow Rate (L/min)	Volume of Liquid Extracted (L)	TPH Concentration* (mg/L)	Dissolved Phase Hydrocarbon Recovery Rate (kg/hr)	Estimated Total Hydrocarbon Removed (dissolved phase) (kg)
SVE + Pumping	2.31	638	405.07	0.056	0.2584
MPVE	2.70	876	405.07	0.066	0.3548
Total	**-**	**1514**	**-**	**-**	**0.6132**

* Total TPH concentration measured at PEW1 on 29 September 2020.

The mass of dissolved hydrocarbons extracted during the SVE + Pumping and MPVE trial was based on an assumed dissolved hydrocarbon concentration (~ 405.07 mg/L) in impacted groundwater. The mass of dissolved hydrocarbons

extracted (<< 0.1 kg/hr) is negligible compared to the mass of VOCs extracted during the SVE / SVE + Pumping / MPVE trials (>>1 kg/hr).

12.2 RADIUS OF INFLUENCE

A summary of the pneumatic ROI measured for the SVE, SVE + pumping and MPVE techniques tested during the pilot trial is presented in Table 12.3, below.

Table 12.3 Summary of Pneumatic Radius of Influence.

Trial type	Applied Vacuum (kPa)	Vadose Air Recovery Rate (m^3/hr)	Effective Pneumatic ROI (m)
SVE	-3.5	12.4	13
	-4.8	19.1	14.9
	-8	31.8	18
	-12	38.2	18.8
SVE + Pumping	-3	14.1	6.8
	-6	18.7	11.5
	-11	38.2	17.3
	-15	42.4	19.1
	-20	55.8	20.0
MPVE	-40	111.4	19.0
	-42	139.6	18.5
	-47	120.2	18.5

When comparing the ROI achieved between the different remediation methods, all vacuums achieved at least 10m ROI (pneumatic response above 100 Pa), with the exception of SVE + Pumping at a vacuum of – 3.0 kPa. Most methods and applied vacuums exceeded this, with some observation wells reporting effective vacuum responses up to 20 m away from the extraction well.

12.3 HYDRAULIC CONDUCTIVITY / CONNECTIVITY

Rising-head tests were conducted in six groundwater monitoring wells, including: MW04, MW09, MW10, MW11, MW15 and EW03. It should be noted that measurable thicknesses of LNAPL was observed in MW10 (5mm of LNAPL), and MW15 (68mm of LNAPL). Slug testing are usually not conducted on wells containing LNAPL but for the purpose of these test (i.e. to inform LNAPL recovery and remediation options at the site), these complications have been assumed negligible for the purpose of the assessment.

The results show that the effective hydraulic conductivity for the aquifer material at the test sites range from 0.0021m/day (MW11) to 0.82 m/day (MW15). The results showed significant variability in the hydraulic conductivity, which is expected, given the fractured rock geology and the inconsistent hydrocarbon impacts noted at the site. There was some correlation between the hydraulic conductivity and the reported impacts, with wells that have a higher degree of hydrocarbon impact (e.g. MW15) more likely to have a higher hydraulic conductivity than wells that have very little / no hydrocarbon impacts (e.g. MW10 and MW11).

During the ISCO injection trial, a number of observation wells in close proximity to injection wells had water level loggers installed during the trial. Some of these wells had a notable response in water level increase, once the injection of the solution had begun, and subsequent decrease when the injection was stopped (e.g. MW01, MW06 and MW07). The reported response to injection suggests that there is generally good hydraulic connectivity between wells that have significant hydrocarbon concentrations in groundwater (e.g. benzene > 1 mg/L) and much lower hydraulic connectivity in wells that are not as heavily impacted.

The above results, in regard to both the range of calculated hydraulic conductivity values and the varied results in response at the observation wells during the ISCO injection trial, suggests that there is large variation in hydraulic connection at the site. This confirms that the site is underlain with geology that contains uneven fracturing within the saturated rock matrix and that the flow pathways for the contaminated groundwater may not be direct straight-line pathways, as would be expected in sands, but rather follows the fractures within the rock.

12.4 EXTRACTION TRIALS

Based on the results of the three extraction trials (SVE, SVE + Pumping, and MPVE), each technology could be effectively applied at the site. The pneumatic and hydraulic radius of influence for technologies was at least 10 m, and the hydrocarbon mass removal rate (based on carbon tube results) was well above 1 kg/hr. Although the remediation technologies trialled use very similar techniques to recover/destroy the hydrocarbon impact, the MPVE approach utilises greater applied wellhead vacuum, which can result in greater hydrocarbon mass removal rates.

Generally, the main advantage of MPVE over the concurrent down-hole pumping and SVE approach is that a higher vacuum is able to be applied to the extraction points via MPVE, and consequently it is more suited to relatively impermeable formations, such as clays and fractured rock.

However, an advantage of the concurrent down-hole pumping and SVE approach over MPVE is that generally the transfer of fluids (liquids and vapour) is more efficient. The concurrent down-hole pumping and SVE approach transfers the liquids and vapour separately back to the remediation compound, which requires less energy than transferring the liquids and vapour together (as per a MPVE system) from the extraction points to the remediation plant.

Additionally, greater hydraulic control of the plume is able to be maintained through the application of down-hole pumping and SVE. However, the volume of water able to be pumped, and therefore the hydraulic control of the plume, may be limited by the maximum volume of water able to be discharged under a (likely) trade waste agreement.

As there has been off-site LNAPL impact noted, it is expected that off-site extraction points will be required in a full scale remediation system, hence transferring fluids over some distance will be required (e.g. to the south, across Hardwick Crescent). It is considered that SVE + Pumping can achieve similar mass recovery and ROI as MPVE, with lower applied vacuum (and accordingly lower energy requirements), and with more efficient transfer and treatment of fluids, and therefore SVE + Pumping is considered to be most appropriate extraction remediation technology for the site.

12.5 ISCO INJECTION

During the ISCO trial, a total of 1100 L of sodium persulfate solution (375 kg of sodium persulfate) was injected into the ground between three locations (IW01, IW02 and IW03).

The results suggest that there is sufficient connectivity to ensure chemical injection will be an effective remediation technique where impacts are present (e.g. IW01 and IW02). However, given the likely chemical oxidant demand (typically 20:1), it is considered that chemical injection will be more suitable once the bulk of the hydrocarbon removal has been conducted through one of the other proposed remediation techniques (e.g. SVE + Pumping). This would mean that less chemicals would be required for injection, which would save on costs of chemical product, less infrastructure requirements (pumps, mixing containers, dosing equipment) and minimise the storage of potentially hazardous chemicals on the site.

13 CONCLUSIONS

The objectives of the pilot trial, which were conducted from 14 to 18 September 2020, were the following.

- Determine the most appropriate remediation technology for the site;
- Evaluate the mass recovery rates;
- Determine key design parameters (e.g. radius of influence (ROI), hydrocarbon mass recovery rates, well vacuums, flow rates, etc.) for the application of the future remediation strategy; and
- Provide data to better assess the hydraulic characteristics of the underlying aquifer within the fractured rock.

The rising head tests were conducted on wells MW04, MW09, MW10, MW11, MW15 and EW03. The hydraulic conductivity, calculated using Bouwer-Rice and Hvorslev methods, were found to range between 0.0017 m/day and 0.65 m/day using the Bouwer-Rice method, and between 0.0025 m/day and 1.0 m/day using the Hvorslev method.

The results of the hydraulic conductivity tests performed on wells MW04, MW09, MW10, MW11, MW15 and EW05 are consistent with the variable lithology identified beneath the site (clay and fractured rock (tuff)).

The pilot trial results for the various remediation approaches indicate that the extraction and injection approaches trialled would be effective in reducing hydrocarbon mass.

As there has been off-site LNAPL impact noted, it is expected that off-site extraction points will be required in a full scale remediation system, hence transferring fluids over some distance will be required (e.g. to the south, across Hardwick Crescent). It is considered that SVE + Pumping and MPVE will be more effective than SVE and more efficient than chemical injection in the short to medium term in reducing the bulk of the hydrocarbon mass.

SVE + Pumping can achieve similar mass recovery and ROI as MPVE, with lower applied vacuum (and accordingly lower energy requirements), and with more efficient transfer and treatment of fluids, and therefore SVE + Pumping is considered to be most appropriate extraction remediation technology for the site.

Based on the overall results of the SVE + Pumping pilot trial conducted at PEW1, the expected operational parameters for any further SVE + Pumping works at the site are as follows:

- **Applied wellhead vacuum** -10 to -20 kPa
- **Groundwater extraction rate** up to 2.5 L/min
- **Extraction wellhead flow** 40 - 55 m^3/hr
- **Hydrocarbon mass removal rate** 1 to 3 kg/hr per well
- **Pneumatic ROI** 18 m (conservatively, assume 10-15 m for remediation design)

A suitable location for the installation of a remediation system was identified in the north-western portion of the site, where the current groundwater/LNAPL collection tank is located. The absence of residential properties immediately adjacent to the remediation system should minimise potential issues related to the noise of the operation of a remediation system at the site.

The discharge of water to sewer may be a limiting factor for the implementation of an SVE + Pumping system. Preliminary discussions with the water authority (Icon Water) have indicated that they do not normally accept groundwater within trade waste. Discussions are ongoing, and we expect that they will accept the treated water as trade waste if we can demonstrate that there is no other viable option and appropriate reduction in contaminants within the effluent water can be achieved.

The findings of this report should be read in the context of the statement of limitations outlined the end of this report.

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LIMITATIONS

1 This Report has been prepared by WSP Pty Limited ("WSP") for the benefit of Caltex Australia Petroleum Pty Ltd ("Caltex"), the registered proprietor or tenant of the site requested to be investigated by WSP ("Site") under its agreement with Caltex dated 21 March 2018 ("Agreement").

2 The nature and extent of the environmental consulting and remediation works at the Site detailed in the Report reflects the scope of the Services set out in the Request for Proposal under the Agreement and the Scope of Works set out in Schedule 1 of the Agreement ("Scope of Works").

3 A potential purchaser (but not including a purchaser's successor in title) of the Site may rely on the findings contained in the Report for the purpose of considering the possible (but not actual) level of contamination of or at that Site at the time of the contamination assessment of the Site was undertaken ("Permitted Purpose").

4 The registered proprietor of the land to which the report relates at the time of writing the report (but not including any proprietor's successor in title) may rely on the findings contained in the Report for the purpose of assessing the possible level of contamination of that Site ("Permitted Purpose") and subject to the limitations set out in the Scope of Works.

5 The findings contained in the Report are subject to the qualifications, assumptions and limitations set out in the Report or otherwise communicated to, or by, Caltex. To the extent of any inconsistency between this Limitation Statement and the qualifications, assumptions and limitations in the Report, this Limitation Statement shall prevail.

6 The Report may contain information provided by others. Except as otherwise stated in the Report, WSP has not verified the accuracy or completeness of this information. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the Report ("Conclusions") are based in whole or in part on this information, those Conclusions are contingent upon the accuracy and completeness of that information. WSP accepts no responsibility for the reliability, accuracy, completeness or adequacy of information provided by others.

7 WSP has prepared the Report without regard to any special or particular interest of any person (including that of a potential purchaser), other than Caltex when undertaking the Services or setting out its findings in the Report.

8 The Report can only be relied upon for the Permitted Purpose and may not be relied upon for any other purpose and does not purport to recommend or induce a decision to make (or not make) any purchase, disposal, investment, divestment, financial commitment or otherwise in relation to the Site ("Investment Decision").

9 Matters material to a potential purchaser, may have been omitted from the Report, or may not have been investigated because of the scope of the Services. It follows that a potential purchaser should be cognisant of the restrictions inherent in or otherwise set out in the Report and should commission the preparation of a contamination assessment of the Site that caters for its own interests and scope of services, and which will provide findings in relation to the level of contamination of or at the Site at the time the potential purchaser is making an Investment Decision.

10 The Report has not and will not be updated for events occurring after the date of the Report or any other matter which may have a material effect on its contents which come to light after the date of the Report. WSP will not be obliged to inform a potential purchaser of any matter arising or coming to its attention after the date of the Report, which may affect or qualify the Report.

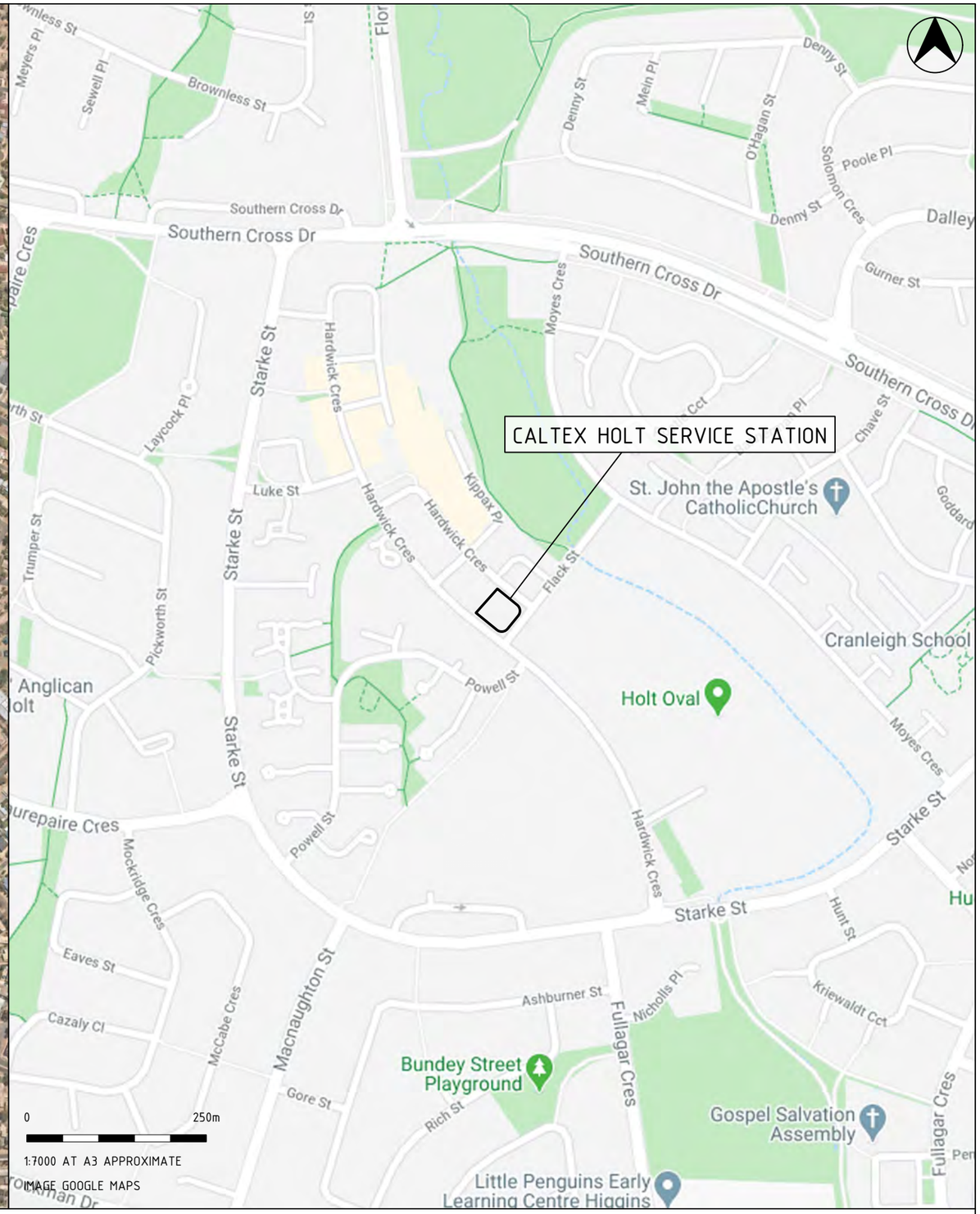
11 WSP is not liable to a potential purchaser in respect of errors or omissions in the Report which a potential purchaser knows of, or ought to be aware of, from:

- **a** its own actual knowledge and inquiries
- **b** inquiries made by its advisers; or
- **c** matters which a potential purchaser should have been aware of by making reasonable inquiry (including the inquiries recommended at Item 9 above).

12 To the fullest extent permitted at law, WSP, its related bodies corporate, its officers, employees and agents assume no liability and will not be liable to any potential purchaser for, or in relation to, any losses, damages or expenses (including any indirect, consequential or punitive losses or damages or any amounts for loss of income or profit, revenue or loss of opportunity to earn profit, loss of production, loss of contract, increased operational costs, loss of business opportunity, business interruption and pure economic loss) of any kind (and whether arising in contract, tort (including negligence), under statute, in equity or otherwise, suffered or incurred by a potential purchaser (or any other third party) arising out of or in connection with any matter outside the ambit of the Permitted Purpose in relation to the Report or findings expressed in the Report.

APPENDIX A

FIGURES & PLANS



REMAD technical services
geotechnical & environmental drafting support

InSite Remediation Services

Figure prepared for WSP by
InSite Remediation Services Pty Ltd

CALTEX

wsp

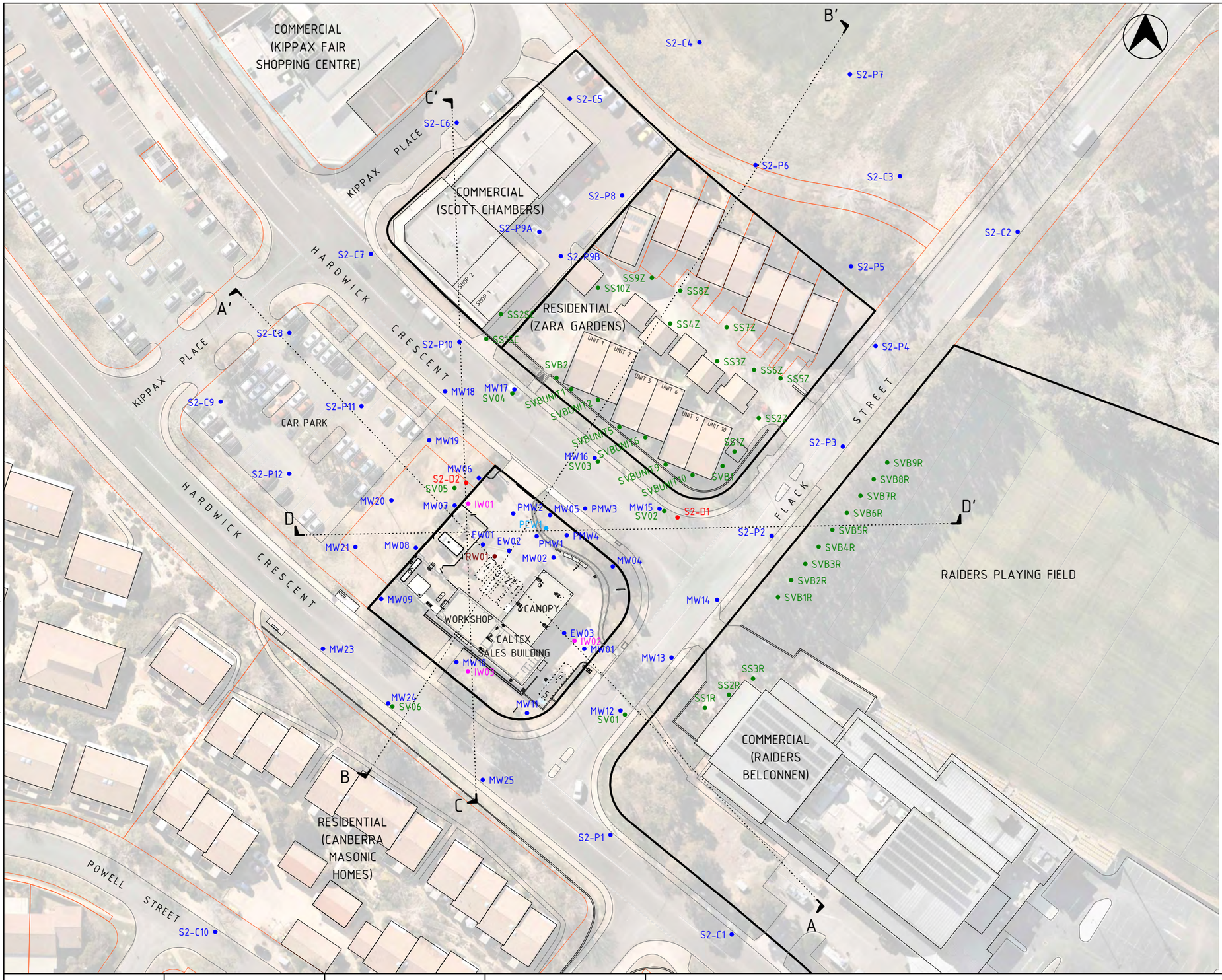
CALTEX HOLT SERVICE STATION
1 HARDWICK CRESCENT
HOLT ACT

FIGURE 1
SITE LOCATION

D:\Google Drive\InSite Remediation\Holt\FIGURES\FIGURES V14 ESA\CALTEX HOLT ESA F01 SITE LOCATION V14.wwx | Thu, 2 Jul 2020 8:24:44 AM | drawn by laurie white at www.reumad.com.au

aerial image nearmap august 2020
block & section data from http://www.actmapi.act.gov.au

drawn by laurie white at www.reumad.com.au | Thu, 8 Oct 2020 5:28:33 PM | D:\Google Drive\InSite Remediation\Holt\FIGURES 2020 SEPT\CALTEX HOLT ENTIRE WELL NETWORK V3.vwx



LEGEND

- PROPERTY BOUNDARY
- BLOCK / SECTION BOUNDARY
- #.....#' SECTION LOCATION & ID
- MW## GROUNDWATER MONITORING WELL
- EW## GROUNDWATER MONITORING WELL
- PMW## GROUNDWATER MONITORING WELL
- S2-P# GROUNDWATER MONITORING WELL
- S2-C# GROUNDWATER MONITORING WELL
- PEW## EXTRACTION WELL
- IW## INJECTION WELL
- RW## RECOVERY WELL
- SV# SOIL VAPOUR BORE
- SS# SUB SLAB SOIL VAPOUR PIN
- S2-D# CORED BOREHOLE

TANK SCHEDULE

TANK	TYPE	PRODUCT	CLASS	CAPACITY	USAGE
1	UST	V95	3	27,400L	IN USE
2	UST	DIESEL	C1	27,400L	IN USE
3	UST	E10	3	27,400L	IN USE
4	UST	V98	3	20,000L	NOT IN USE
5	UST	ULP	3	59,400L	IN USE
6	AST	LPG	2.1	7,500L	NOT IN USE
7	LPG EXCHANGE		2.1	9x4kg, 42x9kg	IN USE

NOTE

LPG TANK (TANK 6) DECOMMISSIONED, NITROGEN PURGED.

0 25m

1:950 AT A3 APPROXIMATE

REFERENCE: CALTEX 'DANGEROUS GOODS PLAN' DRAWING NO. 22546-DG REV. B DATED 25/11/2011 AND VERIS SURVEY 217267.01 DATED 02/10/2020 SUPPLIED BY CLIENT.

REUMAD technical services geotechnical & environmental drafting support

InSite Remediation Services

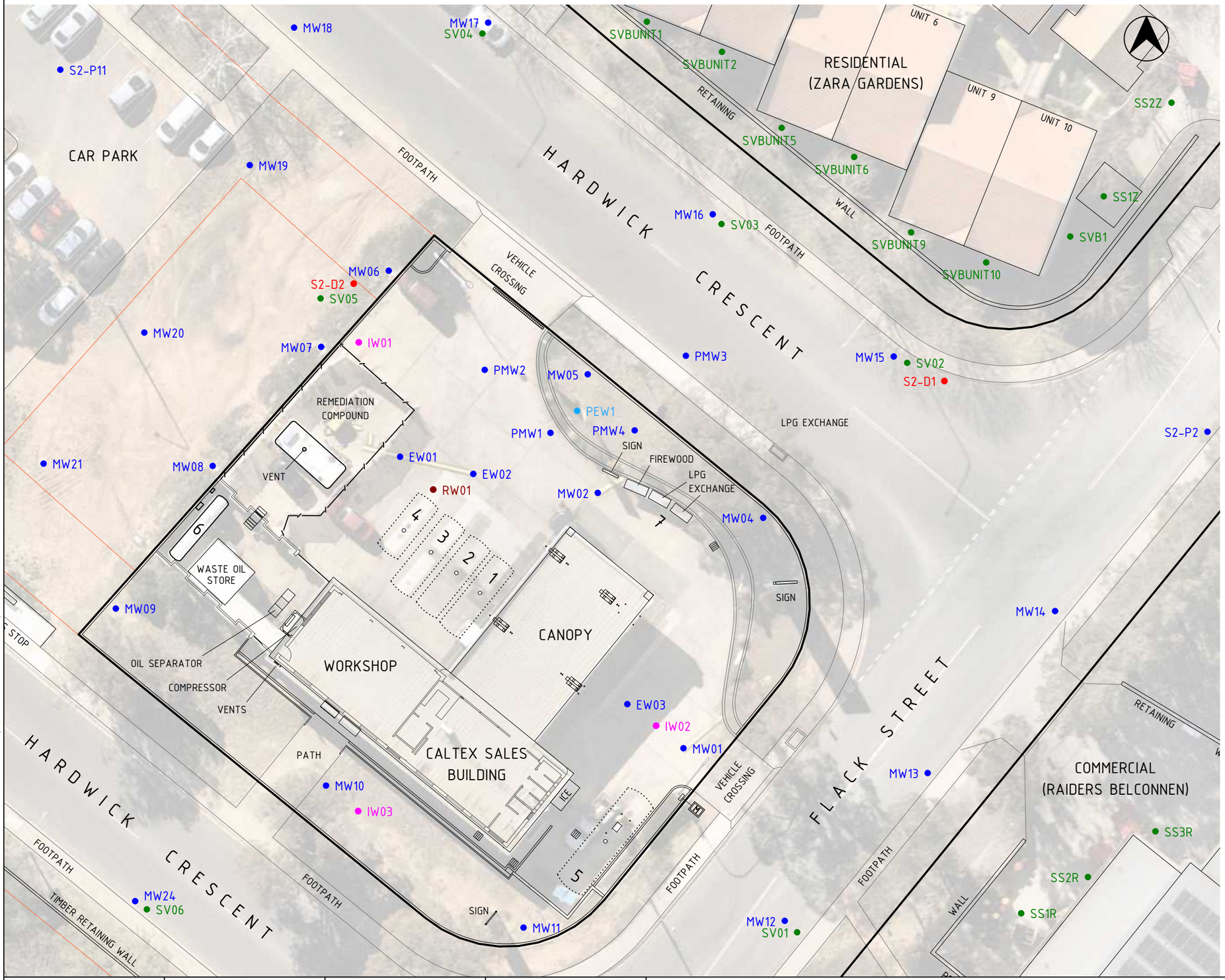
Figure prepared for WSP by InSite Remediation Services Pty Ltd

CALTEX

WSP

CALTEX HOLT SERVICE STATION
1 HARDWICK CRESCENT
HOLT ACT

FIGURE 2
ENTIRE WELL NETWORK



LEGEND

- PROPERTY BOUNDARY
- BLOCK / SECTION BOUNDARY
- MW## GROUNDWATER MONITORING WELL
- EW## GROUNDWATER MONITORING WELL
- PMW## GROUNDWATER MONITORING WELL
- S2-P# GROUNDWATER MONITORING WELL
- S2-C# GROUNDWATER MONITORING WELL
- PEW## EXTRACTION WELL
- IW## INJECTION WELL
- RW## RECOVERY WELL
- SV# SOIL VAPOUR BORE
- SS# SUB SLAB SOIL VAPOUR PIN
- S2-D# CORED BOREHOLE

TANK SCHEDULE

TANK	TYPE	PRODUCT	CLASS	CAPACITY	USAGE
1	UST	V95	3	27,400L	IN USE
2	UST	DIESEL	C1	27,400L	IN USE
3	UST	E10	3	27,400L	IN USE
4	UST	V98	3	20,000L	NOT IN USE
5	UST	ULP	3	59,400L	IN USE
6	AST	LPG	2.1	7,500L	NOT IN USE
7	LPG EXCHANGE		2.1	9x4kg, 42x9kg	IN USE

NOTE

LPG TANK (TANK 6) DECOMMISSIONED, NITROGEN PURGED.

0 10m

1:340 AT A3 APPROXIMATE

REFERENCE: CALTEX 'DANGEROUS GOODS PLAN' DRAWING NO. 22546-DG REV. B DATED 25/11/2011 AND VERIS SURVEY 217267.01 DATED 02/10/2020 SUPPLIED BY CLIENT.

REUMAD technical services geotechnical & environmental drafting support

InSite REMEDIATION SERVICES

Figure prepared for WSP by InSite Remediation Services Pty Ltd

CALTEX

wsp

CALTEX HOLT SERVICE STATION
1 HARDWICK CRESCENT
HOLT ACT

FIGURE 3
SITE PLAN

aerial image nearmap august 2020
block & section data from http://www.actmapi.act.gov.au
drawn by laurie white at www.reumad.com.au | Tue, 13 Oct 2020 7:54:23 AM | D:\Google Drive\InSite Remediation\Holt\FIGURES\FIGURES SVR 2020 SEPT\V3\CALTEX HOLT SVR F02a V3.vwx

A

South East

A'

North West

585 mAHD

580

575

570

565

560

550

Raiders Driveway

S2-C1 (WSP September 2020)

Raiders Belconnen

S2-P1 (WSP September 2020)

Footpath

Fence

Flack Street

SV1 (WSP September 2020)

MW12 (WSP March 2020)

Vehicle Crossing

Site Boundary

MW01 (AECOM March 2011)

EW03 (GHD February 2010)

Caltex Holt Service Station

Canopy

Fuel Dispensers

Dip & Fill Points

TANK PIT

T1 T2 T3 T4

RW01 (WSP April 2020)

EW01 (GHD February 2010)

Remediation Compound

Site Boundary

MW07 (WSP March 2020)

SV5 (WSP September 2020)

Open Space / Vacant Lot (unsealed area)

S2-P11 (WSP September 2020)

Car Park

S2-C8 (WSP September 2020)

Kippax Place

Tuff, orange / brown, moderately to highly weathered

Tuff, grey / brown, slightly weathered to fresh rock

Tuff, yellow / orange, highly weathered

Tuff / Quartzite Fault Zone

Tuff, grey / brown, moderately weathered to fresh rock

Tuff, orange / brown, moderately to highly weathered

Tuff, grey / brown, slightly weathered to fresh rock

5600

3555

EOH 4m

EOH 13m

EOH 13.1m

EOH 12m

EOH 12m

EOH 15m

EOH 14m

EOH 13.1m

EOH 12m

EOH 10.5m

VI:HE = 1:2.7778

0m 20m 40m 60m 80m 100m 120m 140m 160m 180m 200m

LEGEND

- MW## — MONITORING WELL ID
- MONITORING WELL CASING
- SCREENED INTERVAL OF MONITORING WELL
- SV# — SOIL VAPOUR BORE ID
- TEFLON TUBE
- SOIL VAPOUR IMPLANT
- TEFLON TUBE
- SOIL VAPOUR IMPLANT
- SS# — SUB SLAB SOIL VAPOUR PIN ID
- SUB SLAB SOIL VAPOUR PIN
- ### — PID < 100ppm
- ### — PID > 100ppm
- ##m ▽ — GROUNDWATER ENCOUNTERED LEVEL (mBGL)
- ##m ▼ — GROUNDWATER STABILISED LEVEL (mBGL)
- GRASS SURFACE
- INFERRED GEOLOGICAL CONTACT
- INFERRED GROUNDWATER LEVEL
- CONCRETE
- BITUMEN
- TANK PIT
- TUFF, YELLOW / ORANGE OR ORANGE / BROWN.
- TUFF, GREY / BROWN
- TUFF / QUARTZITE FAULT ZONE

NOTE

GROUNDWATER LEVELS GAUGED BETWEEN 22 & 29 SEPTEMBER 2020. EW01 & EW03 INSTALLED BY GHD FEBRUARY 2010, MW01 INSTALLED BY AECOM MARCH 2011, MW07 & MW12 INSTALLED BY WSP MARCH 2020, RW01 INSTALLED BY WSP APRIL 2020 AND SV1, SV5, S2-P1, S2-P11, S2-C1 & S2-C8 INSTALLED BY WSP SEPTEMBER 2020.

REMMAD technical services — geotechnical & environmental drafting support

InSite Remediation Services

Figure prepared for WSP by InSite Remediation Services Pty Ltd

CALTEX

wsp

CALTEX HOLT SERVICE STATION
1 HARDWICK CRESCENT
HOLT ACT

FIGURE 4
CROSS SECTION A-A'

D:\Google Drive\InSite Remediation\Holt\FIGURES\FIGURES SVR 2020 SEPT\V3\CALTEX HOLT SVR F04 SECTION AA V3.vwx | Thu, 8 Oct 2020 5:25:54 PM | drawn by laurie white at www.reumad.com.au

B

South West

B'

North East

585 mAHD

580

575

570

565

560

555

Residential (Canberra Masonic Homes)

Footpath

Retaining Wall

Foot path

Hardwick Crescent

Site Boundary

Caltex Holt Service Station

Foot path

Concrete Ramp

Workshop

Site Boundary

Dip & Fill Point

TANK PIT

T3

Hardwick Crescent

Foot path

Retaining Wall

Residential (Zara Gardens)

Carport

Fence

Footpath

MW24 (WSP April 2020)

SV6 (WSP September 2020)

MW10 (WSP March 2020)

RW01 (WSP April 2020)

EW02 (GHD February 2010)

MW05 (WSP March 2020)

SV3 (WSP September 2020)

MW16 (WSP April 2020)

SVBUNIT5 (WSP September 2020)

SS4Z (WSP September 2020)

SS8Z (WSP September 2020)

S2-P6 (WSP September 2020)

S2-P7 (WSP September 2020)

0.5 2 2 2 2 3 2 3 2 8 163 3782 3866 2632

10.4m

13.5m

EOH 15m

0.2 0.6 0.9 0.8 0 0 0 0 0 218 659 975

10.54m

EOH 14.5m

Tuff, yellow / orange, highly weathered

5600

EOH 4m

8.93m

13m

EOH 14m

Tuff, grey / brown, moderately weathered to fresh rock

0.4 0.3 0.2 0.1 0.5 0.6 63 82 83 990 820 170

8.5m

11m

EOH 12m

6 2 2 6 31 67 562 153

7.6m

8.5m

EOH 10.5m

Tuff, orange / brown, moderately to highly weathered

Tuff, grey / brown, slightly weathered to fresh rock

0 0 0 5.2 33 5.7 3 0 0.2 0 0.3

2.95m

7.5m

EOH 9.3m

0 0 0 0.6 0.7 1.2 2.1 3 1.3 2.1 -

2.2m

6m

EOH 8.5m

VI:HE = 1:2.94

0m 20m 40m 60m 80m 100m 120m 140m 160m 180m 200m 210m

LEGEND

MW## MONITORING WELL ID

MONITORING WELL CASING

SCREENED INTERVAL OF MONITORING WELL

SV# SOIL VAPOUR BORE ID

TEFLON TUBE

SOIL VAPOUR IMPLANT

TEFLON TUBE

SOIL VAPOUR IMPLANT

SS# SUB SLAB SOIL VAPOUR PIN ID

SUB SLAB SOIL VAPOUR PIN

PID < 100ppm

PID > 100ppm

##m ▽ GROUNDWATER ENCOUNTERED LEVEL

##m ▼ GROUNDWATER STABILISED LEVEL

GRASS SURFACE

INFERRED GEOLOGICAL CONTACT

INFERRED GROUNDWATER LEVEL

CONCRETE

BITUMEN

TANK PIT

TUFF, YELLOW / ORANGE OR ORANGE / BROWN.

TUFF, GREY / BROWN

NOTE

GROUNDWATER LEVELS GAUGED BETWEEN 22 & 29 SEPTEMBER 2020. EW02 INSTALLED BY GHD FEBRUARY 2010, MW05 & MW10 INSTALLED BY WSP MARCH 2020, RW01, MW16 & MW25 INSTALLED BY WSP APRIL 2020, SV3, SV6, SVBUNIT5, SS4Z, SS8Z, S2-P6 & S2-P7 INSTALLED BY WSP SEPTEMBER 2020.

CALTEX HOLT SERVICE STATION
1 HARDWICK CRESCENT
HOLT ACT

FIGURE 5
CROSS SECTION B-B'

D:\Google Drive\InSite Remediation\Holt\FIGURES\FIGURES SVR 2020 SEPT\V3\CALTEX HOLT SVR F05 SECTION BB V3.vwx | Thu, 8 Oct 2020 5:26:24 PM | drawn by laurie white at www.reumad.com.au

C

South

C'

North

585 mAHD

580

575

570

565

560

555

Foot path

MW25 (WSP April 2020)

Hardwick Crescent

Footpath

Site Boundary

MW10 (WSP March 2020)

Caltex Holt Service Station

Workshop

Dip & Fill Points

TANK PIT 1 2 3 4

Site Boundary

MW06 (WSP March 2020)

Footpath

Hardwick Crescent

MW17 (projected)

MW17 (WSP April 2020)

Footpath

Scott Chambers

Kippax Place

S2-C6 (WSP September 2020)

Tuff, orange / brown, moderately to highly weathered

Tuff, grey / brown, slightly weathered to fresh rock

	MW25	MW10	MW06	MW17	S2-C6
	-	0.2	0.3	-	0
	-	0.6	0	-	0
	1	0.9	1.2	7	1.6
	2	0.8	0	6	1.8
	0	0	0.1	11	2
	0	0	4.5	17	1.8
	0	0	158	7	1.8
	0	0	135	25	1.8
	-	0	547	359	2.2
	-	218	879	600	2.1
	-	659	889		1.9
	-	975	1040		
	EOH 15m	EOH 14.5m	EOH 13.5m	EOH 10.4m	EOH 10m

10.4m 10.5m 9m 12m 8.5m 8.5m 5.8m 8m

VI:HE = 1:2.31

0m 20m 40m 60m 80m 100m 120m 140m 160m 165m

LEGEND

MW## MONITORING WELL ID

MONITORING WELL CASING

SCREENED INTERVAL OF MONITORING WELL

PID < 100ppm

PID > 100ppm

##m ▽ GROUNDWATER STABILISED LEVEL (mBGL)

##m ▼ GROUNDWATER STABILISED LEVEL (mBGL)

GRASS SURFACE

INFERRED GEOLOGICAL CONTACT

INFERRED GROUNDWATER LEVEL

CONCRETE

BITUMEN

TANK PIT

TUFF, YELLOW / ORANGE OR ORANGE / BROWN.

TUFF, GREY / BROWN

NOTE

GROUNDWATER LEVELS GAUGED 22 SEPTEMBER 2020.
MW06 & MW10 INSTALLED BY WSP MARCH 2020, MW17 & MW25 INSTALLED BY WSP APRIL 2020 AND S2-C6 INSTALLED BY WSP SEPTEMBER 2020.

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InSite Remediation Services

Figure prepared for WSP by InSite Remediation Services Pty Ltd

CALTEX

wsp

CALTEX HOLT SERVICE STATION
1 HARDWICK CRESCENT
HOLT ACT

FIGURE 6
CROSS SECTION C-C'

D:\Google Drive\InSite Remediation\Holt\FIGURES\FIGURES SVR 2020 SEP TV3\CALTEX HOLT SVR F06 SECTION CC V3.vwx | Thu, 8 Oct 2020 5:26:52 PM | drawn by laurie white at www.reumad.com.au

D

West

D'

East

585 mAHD
580
575
570
565
560
550

Site Boundary
Caltex Holt Service Station
Site Boundary
Car Park
Open Space / Vacant Lot (unsealed area)
Garden
Footpath
Hardwick Crescent
Cnr of Hardwick Cr & Flack St
Flack Street
Footpath
Fence
Raiders Playing Fields

MW21 (WSP April 2020)
MW08 (WSP March 2020)
EW01 (GHD February 2010)
MW05 (WSP March 2020)
MW15 (WSP March 2020)
S2-P2 (WSP September 2020)
SVB5R (WSP 2020)

Tuff, orange / brown, moderately to highly weathered

Tuff, grey / brown, slightly weathered to fresh rock

	MW21	MW08	EW01	MW05	MW15	S2-P2	SVB5R
	4		9	0.4	0.3	1.3	
	10		1.6	0.3	0.4	0.4	
	8		4	0.2	0.5	0.5	
	7		3.2	0.1	3	2.1	
	7			0.5	13	5.6	
	7			0.6	63	4.8	
	6			63	82	3.7	
	7			82	249	726	
	2			83	700	1,159	
	2			990	400	1,679	
	4			820	1,100	1,270	
				170		10.5	
	9.33m	9.56m	8.8m	8.33m	7.51m	6.91m	
	10.5m		12m	11m	8.5m	8.6m	
	EOH 12m	EOH 15m	EOH 14m	EOH 12m	EOH 11m	EOH 10.1m	EOH 5m

1.47m

VI:HE = 1:1.944

0m 20m 40m 60m 80m 100m 120m 140m 156m

LEGEND

- MW## — MONITORING WELL ID
- MONITORING WELL CASING
- SCREENED INTERVAL OF MONITORING WELL
- SV# — SOIL VAPOUR BORE ID
- TEFLON TUBE
- SOIL VAPOUR IMPLANT
- TEFLON TUBE
- SOIL VAPOUR IMPLANT

- ### — PID < 100ppm
- ### — PID > 100ppm
- ##m ▽ — GROUNDWATER ENCOUNTERED LEVEL (mBGL)
- ##m ▼ — GROUNDWATER STABILISED LEVEL (mBGL)
- ▼ — GAUGED LNAPL LEVEL
- GRASS SURFACE
- INFERRED GEOLOGICAL CONTACT
- INFERRED GROUNDWATER LEVEL

- CONCRETE
- BITUMEN
- TUFF, YELLOW / ORANGE OR ORANGE / BROWN.
- TUFF, GREY / BROWN

NOTE

GROUNDWATER & LNAPL LEVELS GAUGED 22 SEPTEMBER 2020.
EW01 INSTALLED BY GHD FEBRUARY 2010, MW05, MW08 & MW15 INSTALLED BY WSP MARCH 2020, MW21 INSTALLED BY WSP APRIL 2020 AND S2-P2 & SVB5R INSTALLED BY WSP SEPTEMBER 2020.

REMMAD technical services geotechnical & environmental drafting support

InSite Remediation Services

Figure prepared for WSP by InSite Remediation Services Pty Ltd

CALTEX

wsp

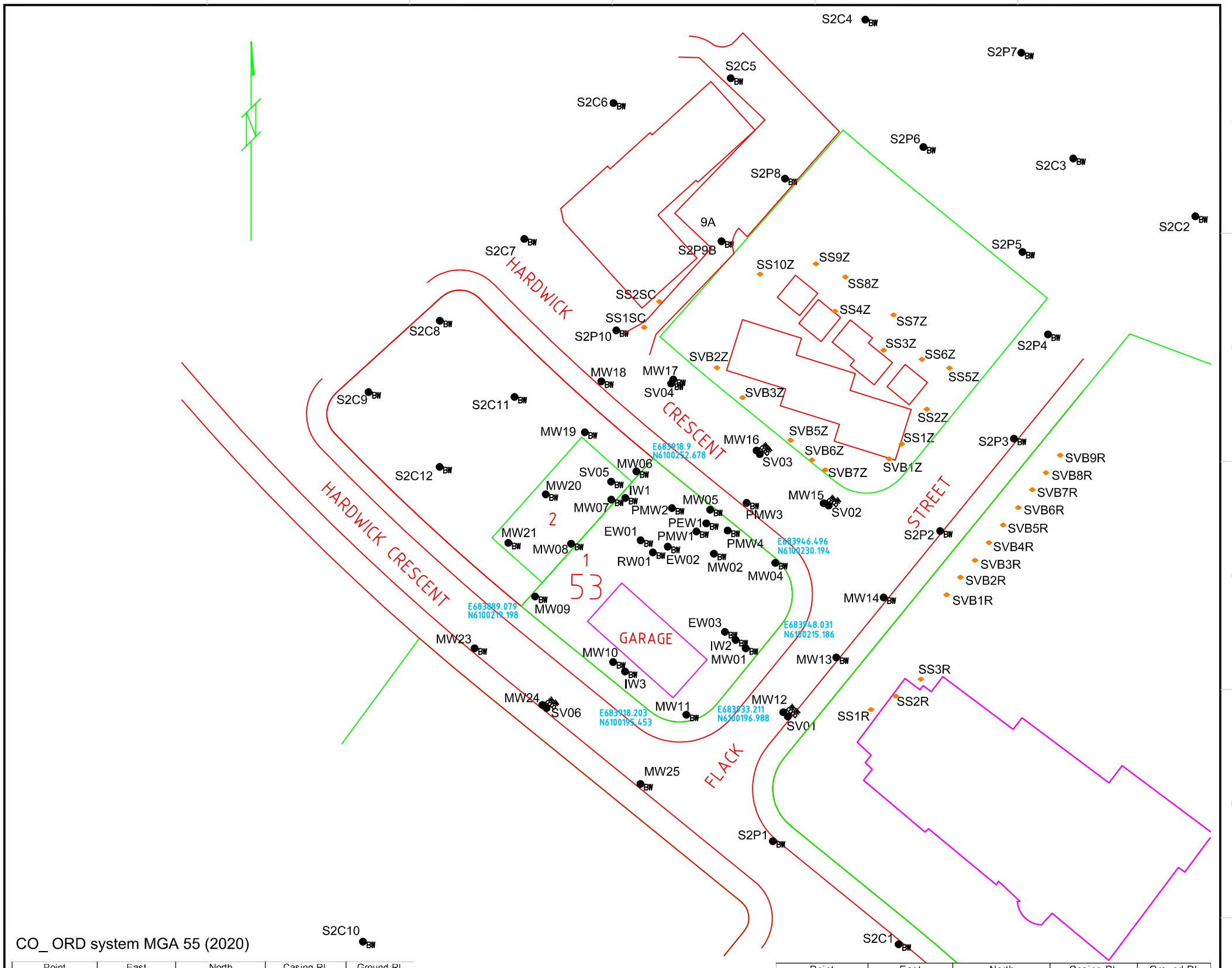
CALTEX HOLT SERVICE STATION
1 HARDWICK CRESCENT
HOLT ACT

FIGURE 7
CROSS SECTION D-D'

D:\Google Drive\InSite Remediation\Holt\FIGURES\FIGURES SVR 2020 SEPT\V3\CALTEX HOLT SVR F07 SECTION DD V3.vwx | Thu, 8 Oct 2020 5:27:25 PM | drawn by laurie white at www.reumad.com.au

APPENDIX B

SITE SURVEY



CO_ ORD system MGA 55 (2020)

Point	East	North	Casing RL	Ground RL
EW1	683916.084	6100234.125	575.016	575.179
EW2	683922.221	6100232.688	575.035	575.171
EW3	683935.146	6100213.392	575.494	575.636
IW1	683912.615	6100243.717	574.858	574.903
IW2	683937.559	6100211.582	575.584	575.615
IW3	683912.564	6100204.426	596.073	596.123
MW1	683939.852	6100209.694	575.656	575.722
MW2	683932.664	6100231.098	575.119	575.213
MW4	683946.542	6100229.006	574.34	574.405
MW5	683931.82	6100241.039	574.364	574.411
MW6	683915.127	6100249.725	574.541	574.599
MW7	683909.459	6100243.34	575.065	575.123
MW8	683900.36	6100233.357	575.783	575.93
MW9	683892.235	6100221.403	576.63	576.694
MW10	683909.869	6100206.565	576.66	576.741
MW11	683926.437	6100194.657	576.83	576.916
MW12	683948.349	6100195.224	575.736	575.821
MW13	683960.337	6100207.615	574.771	574.862
MW14	683971.026	6100221.192	573.838	573.938
MW15	683957.49	6100242.53	573.518	573.645
MW16	683942.309	6100254.452	573.61	573.702
MW17	683923.468	6100270.515	573.581	573.655
MW18	683907.191	6100270.098	573.52	573.72
MW19	683903.473	6100258.57	574.102	574.356
MW20	683894.627	6100244.535	574.919	575.015
MW21	683886.177	6100233.55	575.515	575.655
MW23	683878.551	6100209.692	576.391	576.517
MW24	683893.86	6100196.875	576.706	576.776
MW25	683916.039	6100178.985	576.938	577.079
PMW1	683928.699	6100236.129	574.804	574.924
PMW2	683923.18	6100241.41	574.499	574.61
PMW3	683940.055	6100242.592	573.785	573.868
PMW4	683935.76	6100236.336	574.576	574.589
S2P1	683946.003	6100166.043	577.142	577.253
S2P2	683983.811	6100236.223	572.976	573.111
S2P3	684000.518	6100257.119	572.297	572.363
S2C11	683887.581	6100266.572	573.588	573.678
S2C12	683870.633	6100250.734	574.49	574.553
PEW1	683930.933	6100237.974	574.814	574.812
S2C1	683974.44	6100142.698	577.536	577.635
S2C2	684041.525	6100307.448	571.152	571.321
S2C3	684013.906	6100320.534	567.357	567.419
S2C4	683966.889	6100351.948	567.174	567.269
S2C5	683936.459	6100338.686	571.168	571.261
S2C6	683909.942	6100333.085	571.702	571.803
S2C7	683889.791	6100302.322	572.669	572.756
S2C8	683870.695	6100283.802	573.074	573.141
S2C9	683854.558	6100267.656	574.135	574.209
S2C10	683853.298	6100143.291	582.161	582.239

Point	East	North	Casing RL	Ground RL
RW01	683918.863	6100231.377	575.061	575.221
S2P4	684008.192	6100280.709	571.941	572.032
S2P5	684002.438	6100299.37	570.151	570.198
S2P6	683980.033	6100323.115	568.759	568.819
S2P7	684002.184	6100344.449	566.756	566.881
S2P8	683948.732	6100315.978	570.842	570.92
9A	683929.323	6100307.452		571.822
S2P9B	683934.371	6100301.799	571.83	571.897
S2P10	683910.581	6100281.631	573.36	573.42
SS1R	683968.183	6100195.859		
SS1SC	683916.876	6100282.344		573.471
SS1Z	683975.108	6100255.955		
SS2R	683973.783	6100198.897		
SS2SC	683920.298	6100288.175		572.928
SS2Z	683980.791	6100263.808		572.055
SS3R	683979.443	6100202.727		
SS3Z	683971.036	6100277.174		
SS4Z	683960.021	6100285.984		
SS5	683985.914	6100273.124		573.506
SS6	683979.689	6100275.098		573.3
SS7	683973.277	6100285.149		571.311
SS8	683962.373	6100293.727		571.288
SS9	683955.715	6100296.712		571.435
SS10	683943.085	6100294.377		571.549
SV1	683949.388	6100194.268	575.686	575.836
SV2	683958.618	6100242	573.464	573.629
SV3	683943.043	6100253.634	573.59	573.714
SV4	683922.99	6100269.602	573.519	573.689
SV5	683909.411	6100247.4	574.718	574.878
SV6	683894.839	6100196.188	576.691	576.794
SVB1Z	683972.296	6100252.588		
SVB2Z	683933.348	6100273.2		
SVB3	683939.113	6100266.449		
SVB5	683949.998	6100256.799		
SVB6	683954.828	6100252.326		
SVB7	683957.827	6100250.087		
SVB1R	683985.296	6100221.814		573.252
SVB2R	683988.383	6100225.78		572.997
SVB3R	683991.695	6100229.622		572.759
SVB4R	683994.841	6100233.606		572.547
SVB5R	683998.053	6100237.611		572.322
SVB6R	684001.472	6100241.55		572.009
SVB7R	684004.66	6100245.603		571.891
SVB8R	684007.748	6100249.449		571.849
SVB9R	684010.943	6100253.414		571.637

Contour Interval

Datum A.H.D

BM KBM2647

RL 575.281

Scale 1:300 0 5 10

Surveyed 29/09/2020

Drawn 1/10/2020

Checked 2/10/2020

Approved .....[redacted]...

Surveyor, Registered under the Surveyors Act 2007.

veris

CANBERRA
11-13 Lawry Place,
Macquarie, ACT, 2614
Phone 02 6202 7600

CALTEX KIPPAX

MONITORING WELLS

BLOCK 1, SECTION 53

DIVISION OF HOLT

ACT

Proj No. 217267.01 **Rev G**

Sheet No. 1 of 1 17267.001

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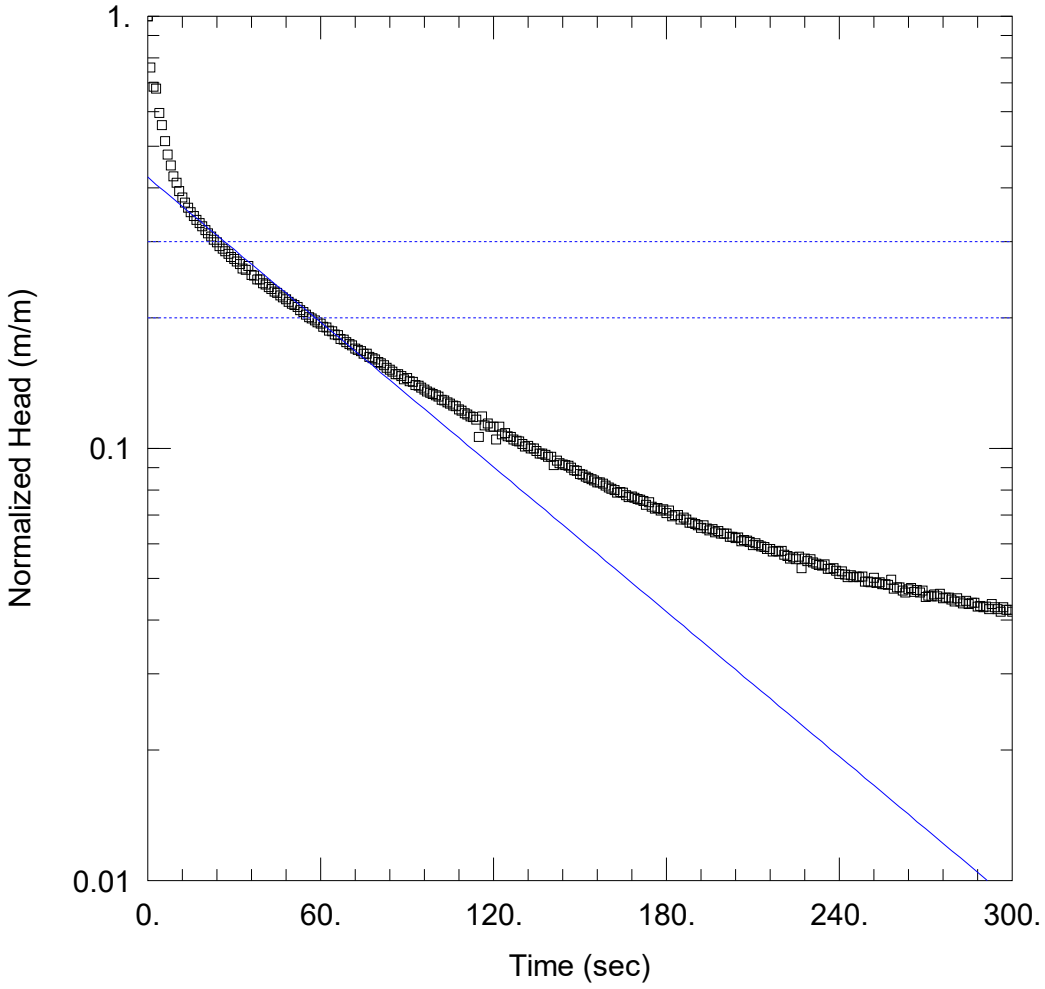
APPENDIX C

RISING HEAD SLUG TEST RESULTS



RISING-HEAD TEST

Data Set: C:\...\EW03_RH_BR.aqt
Date: 09/30/20 Time: 12:09:28

PROJECT INFORMATION

Company: WSP
Client: CALTEX
Project: PS121949
Location: HOLT, ACT
Test Well: EW03
Test Date: 14.09.20

AQUIFER DATA

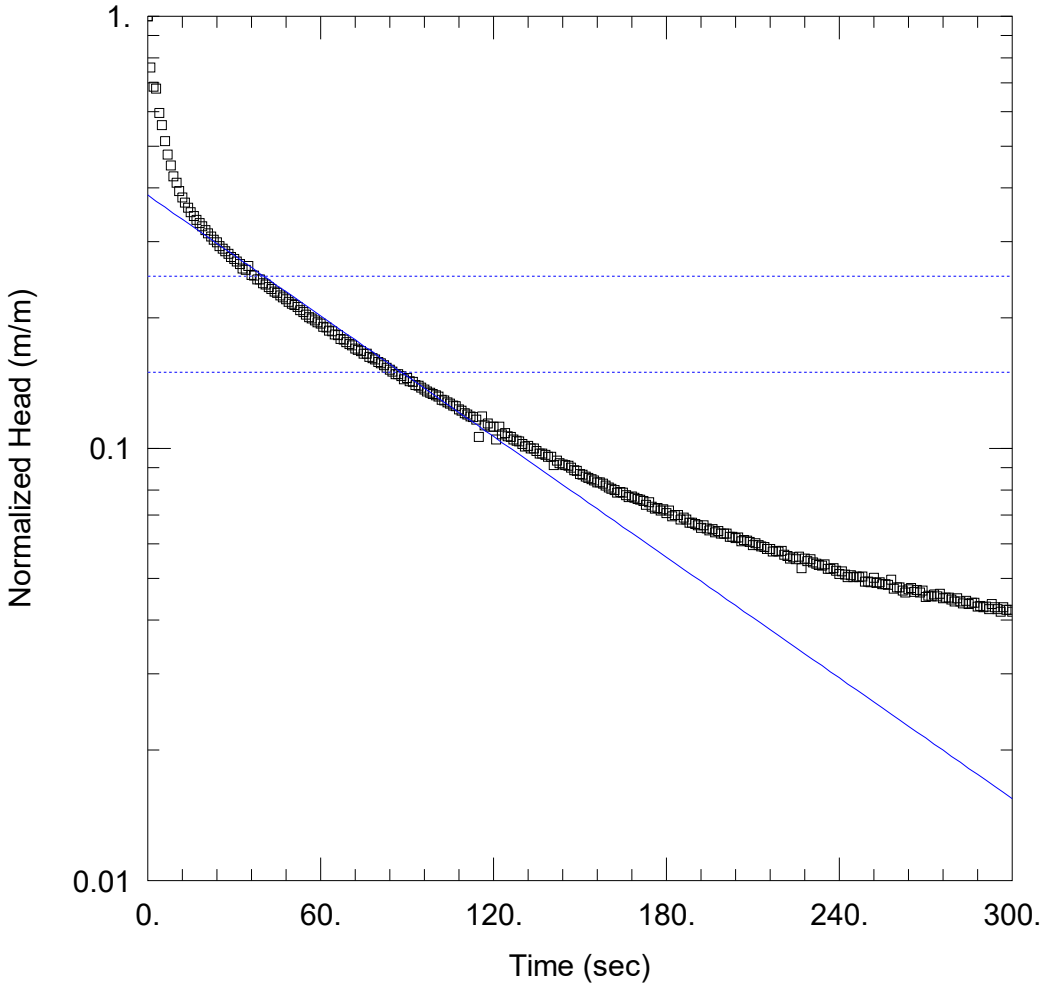
Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (EW03)

Initial Displacement: 0.5348 m
Total Well Penetration Depth: 5.632 m
Casing Radius: 0.025 m
Static Water Column Height: 5.632 m
Screen Length: 5.632 m
Well Radius: 0.0625 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.191 m/day
y0 = 0.2265 m



RISING-HEAD TEST

Data Set: C:\...\EW03_RH_Hv.aqt
Date: 09/30/20 Time: 12:09:27

PROJECT INFORMATION

Company: WSP
Client: CALTEX
Project: PS121949
Location: HOLT, ACT
Test Well: EW03
Test Date: 14.09.20

AQUIFER DATA

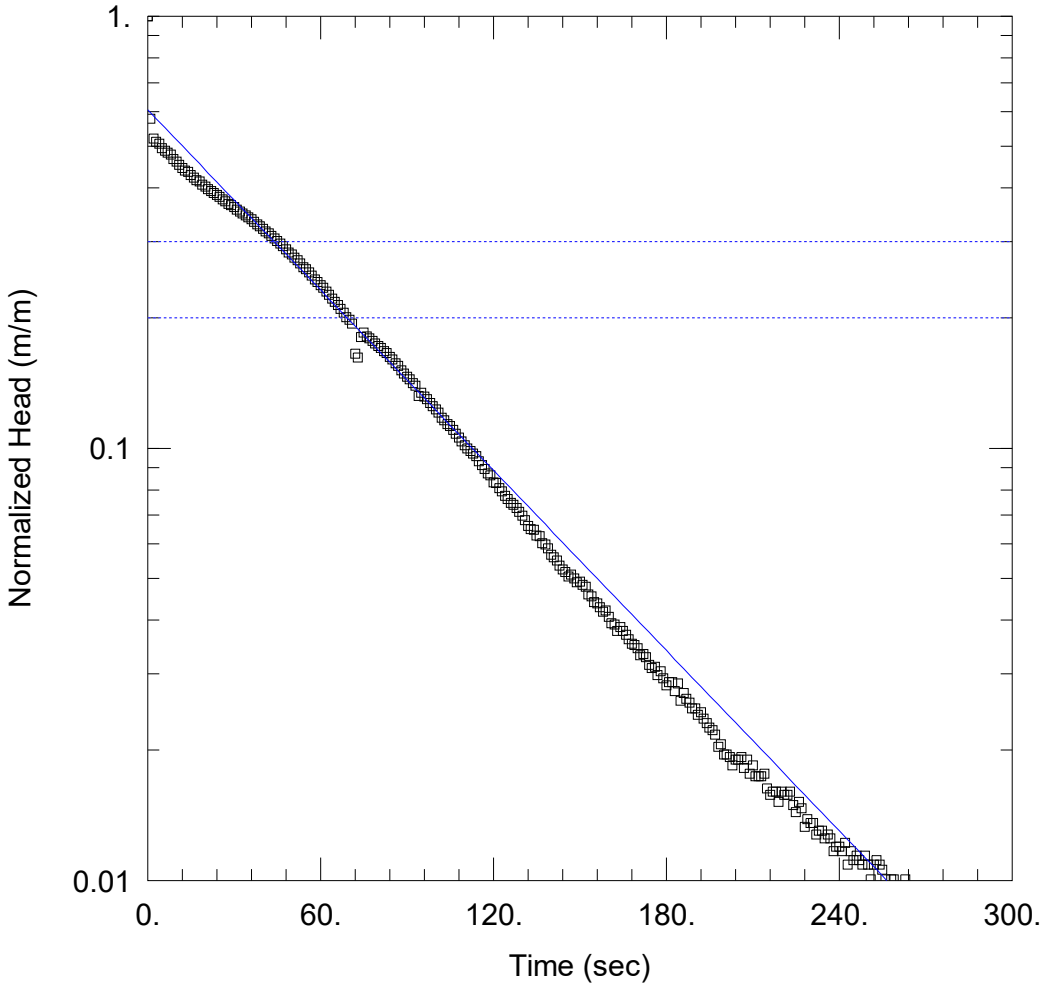
Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (EW03)

Initial Displacement: 0.5348 m
Total Well Penetration Depth: 5.632 m
Casing Radius: 0.025 m
Static Water Column Height: 5.632 m
Screen Length: 5.632 m
Well Radius: 0.0625 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.2312 m/day
y0 = 0.206 m



RISING-HEAD TEST

Data Set: C:\...\MW04_RH_BR.aqt
Date: 09/30/20 Time: 09:04:25

PROJECT INFORMATION

Company: WSP
Client: CALTEX
Project: PS121949
Location: HOLT, ACT
Test Well: MW04
Test Date: 14.09.20

AQUIFER DATA

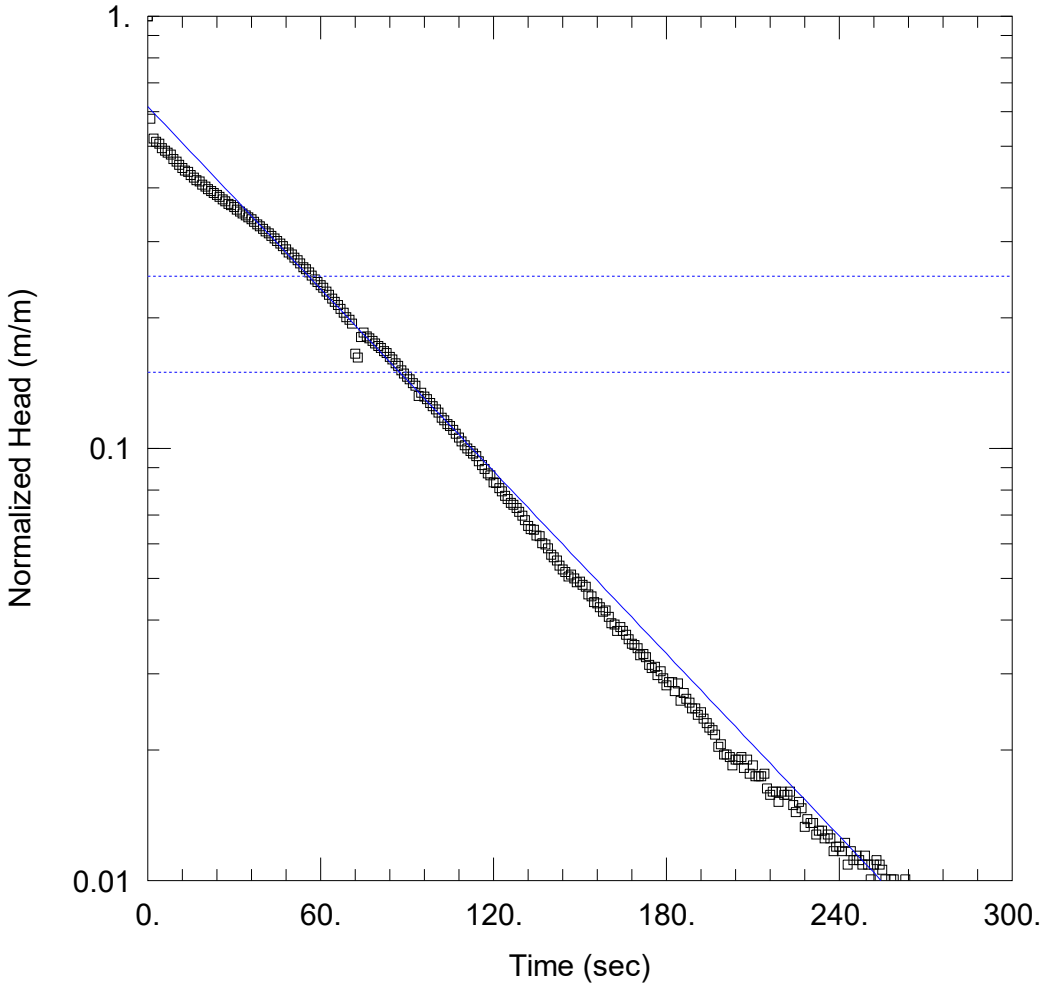
Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW04)

Initial Displacement: 0.3682 m
Total Well Penetration Depth: 3.56 m
Casing Radius: 0.025 m
Static Water Column Height: 3.56 m
Screen Length: 3.56 m
Well Radius: 0.0625 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.3258 m/day
y0 = 0.2234 m



RISING-HEAD TEST

Data Set: C:\...\MW04_RH_Hv.aqt
Date: 09/30/20 Time: 09:04:25

PROJECT INFORMATION

Company: WSP
Client: CALTEX
Project: PS121949
Location: HOLT, ACT
Test Well: MW04
Test Date: 14.09.20

AQUIFER DATA

Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

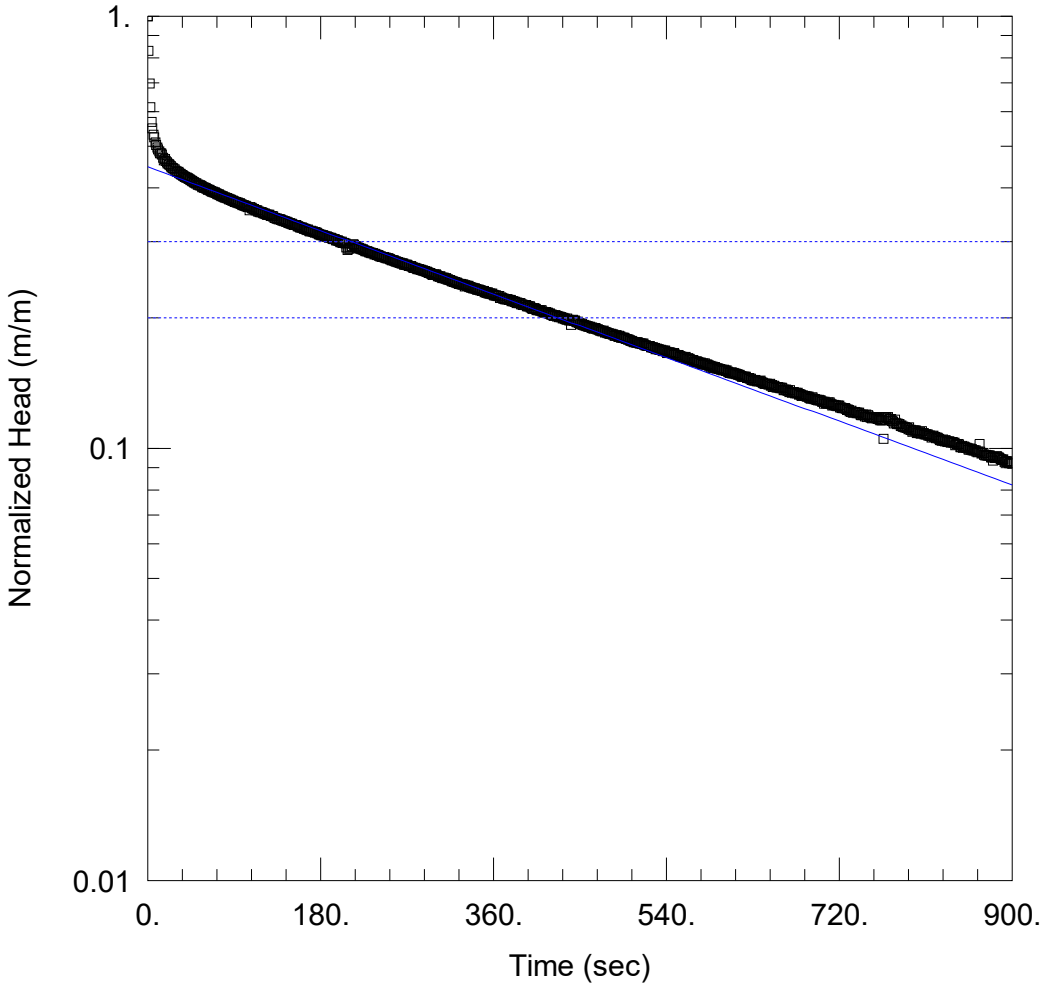
WELL DATA (MW04)

Initial Displacement: 0.3682 m
Total Well Penetration Depth: 3.56 m
Casing Radius: 0.025 m
Static Water Column Height: 3.56 m
Screen Length: 3.56 m
Well Radius: 0.0625 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.4966 m/day y0 = 0.2274 m



RISING-HEAD TEST

Data Set: C:\...\MW09_RH_BR.aqt
Date: 09/30/20 Time: 09:04:25

PROJECT INFORMATION

Company: WSP
Client: CALTEX
Project: PS121949
Location: HOLT, ACT
Test Well: MW09
Test Date: 14.09.20

AQUIFER DATA

Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

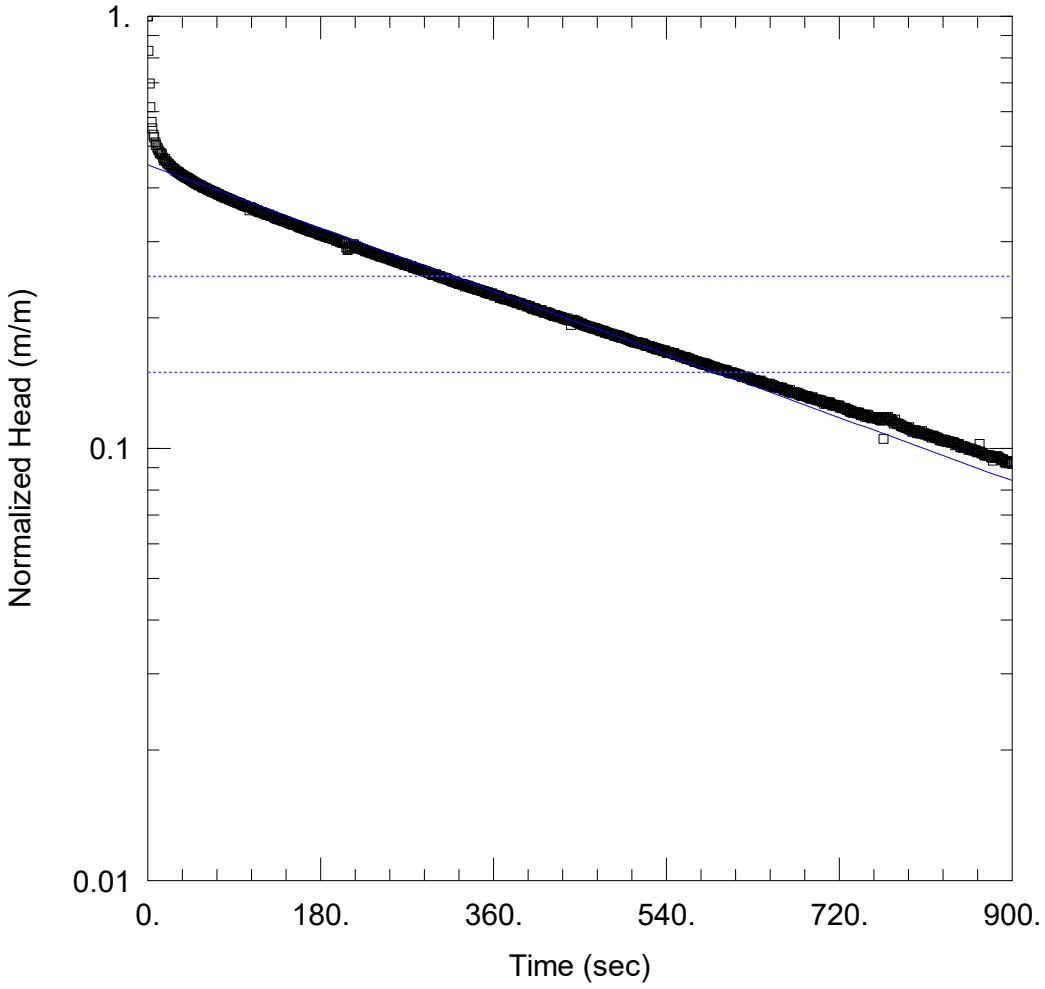
WELL DATA (MW09)

Initial Displacement: 0.4133 m
Total Well Penetration Depth: 5.939 m
Casing Radius: 0.025 m
Static Water Column Height: 5.939 m
Screen Length: 5.939 m
Well Radius: 0.0625 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.02694 m/day y0 = 0.1849 m



RISING-HEAD TEST

Data Set: C:\...\MW09_RH_Hv.aqt
Date: 09/30/20 Time: 09:04:24

PROJECT INFORMATION

Company: WSP
Client: CALTEX
Project: PS121949
Location: HOLT, ACT
Test Well: MW09
Test Date: 14.09.20

AQUIFER DATA

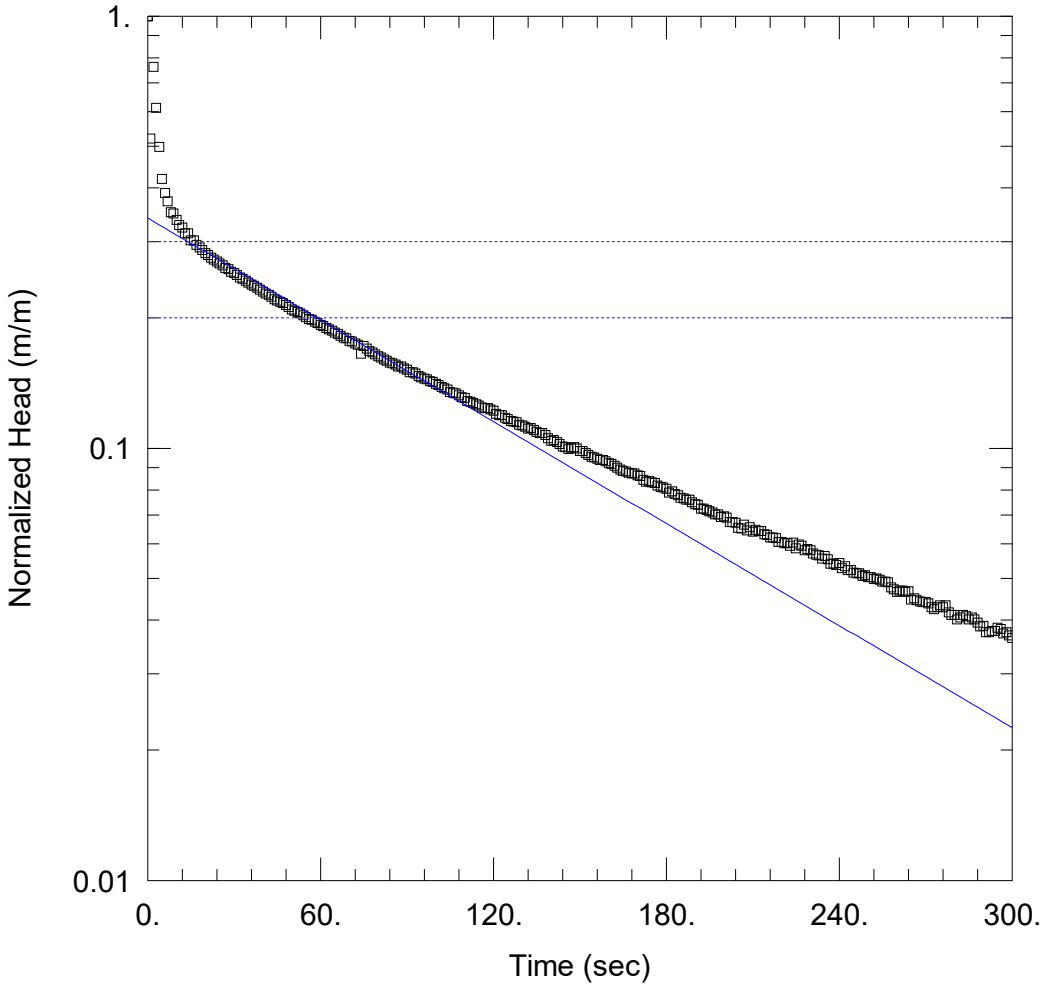
Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW09)

Initial Displacement: 0.4133 m
Total Well Penetration Depth: 5.939 m
Casing Radius: 0.025 m
Static Water Column Height: 5.939 m
Screen Length: 5.939 m
Well Radius: 0.0625 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.03873 m/day
y0 = 0.1871 m



RISING-HEAD TEST

Data Set: C:\...\MW10_RH_BR.aqt
Date: 09/30/20 Time: 09:04:24

PROJECT INFORMATION

Company: WSP
Client: CALTEX
Project: PS121949
Location: HOLT, ACT
Test Well: MW10
Test Date: 14.09.20

AQUIFER DATA

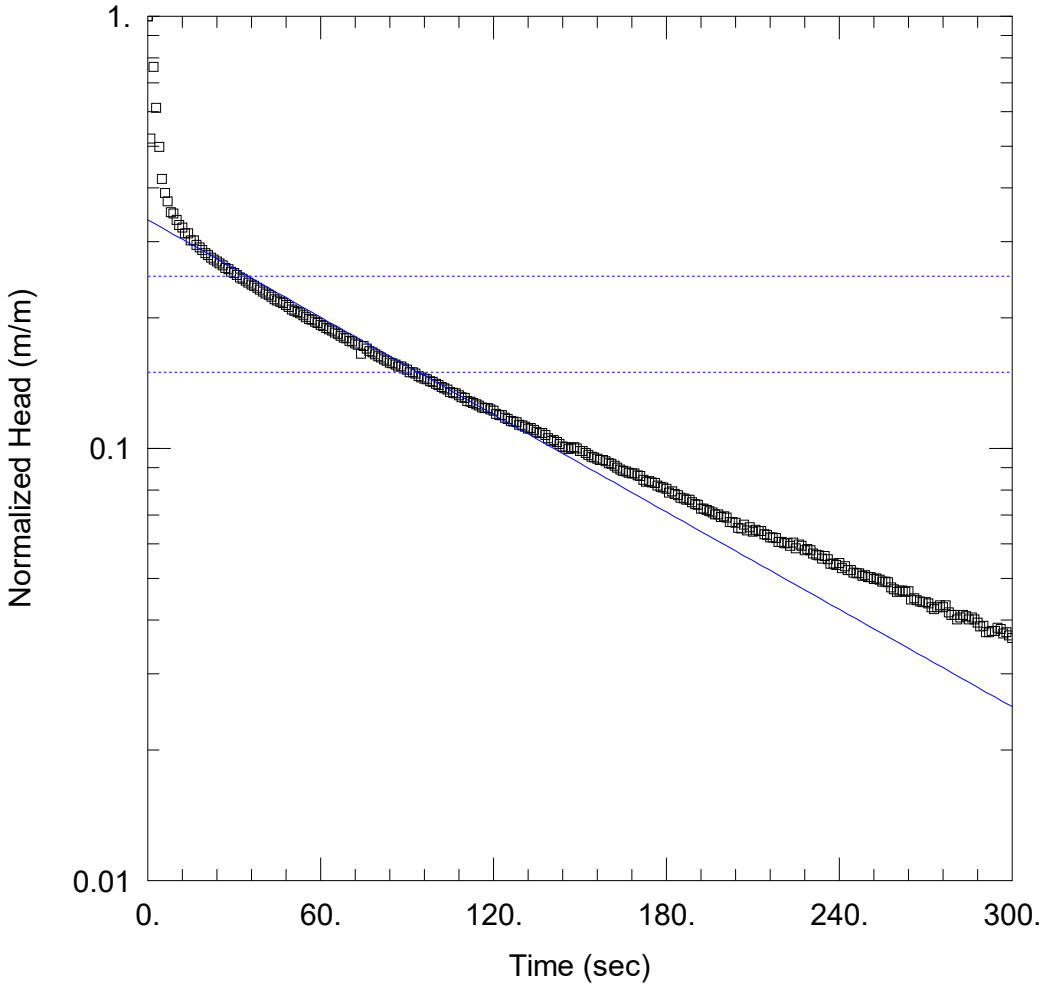
Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW10)

Initial Displacement: 0.448 m
Total Well Penetration Depth: 3.785 m
Casing Radius: 0.025 m
Static Water Column Height: 3.785 m
Screen Length: 3.785 m
Well Radius: 0.0625 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.1768 m/day
y0 = 0.1528 m



RISING-HEAD TEST

Data Set: C:\...\MW10_RH_Hv.aqt
Date: 09/30/20 Time: 09:04:23

PROJECT INFORMATION

Company: WSP
Client: CALTEX
Project: PS121949
Location: HOLT, ACT
Test Well: MW10
Test Date: 14.09.20

AQUIFER DATA

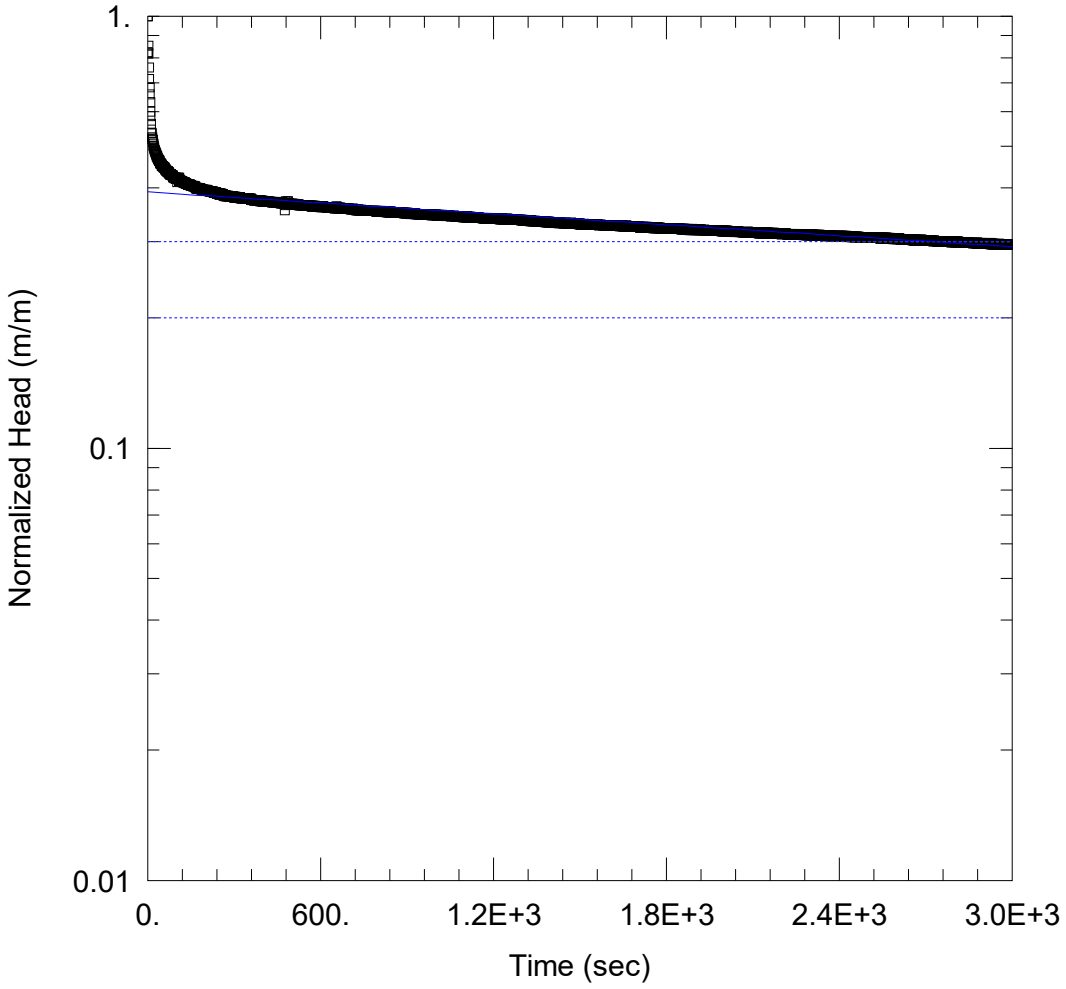
Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW10)

Initial Displacement: 0.448 m
Total Well Penetration Depth: 3.785 m
Casing Radius: 0.025 m
Static Water Column Height: 3.785 m
Screen Length: 3.785 m
Well Radius: 0.0625 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.2532 m/day
y0 = 0.1513 m



RISING-HEAD TEST

Data Set: C:\...\MW11_RH_BR.aqt
Date: 09/30/20 Time: 09:04:23

PROJECT INFORMATION

Company: WSP
Client: CALTEX
Project: PS121949
Location: HOLT, ACT
Test Well: MW11
Test Date: 14.09.20

AQUIFER DATA

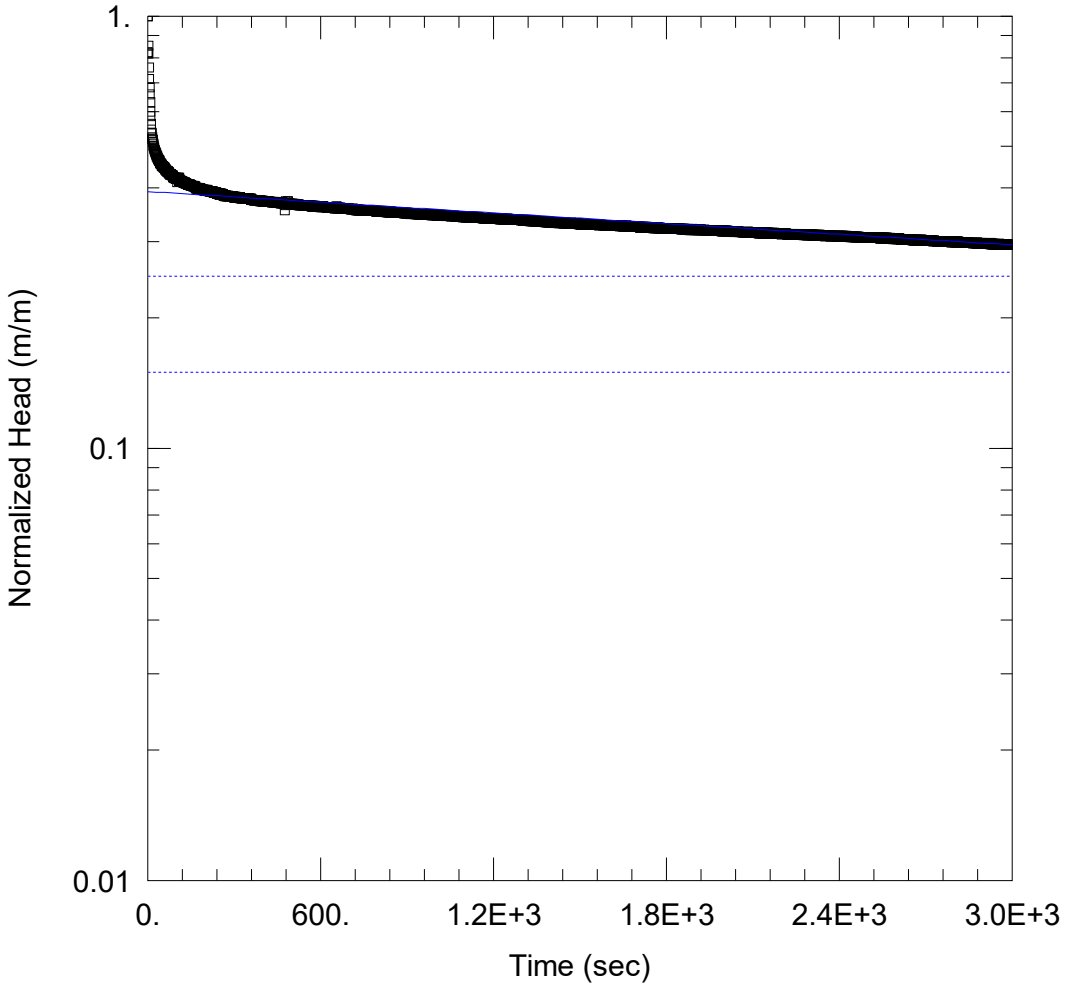
Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW11)

Initial Displacement: 0.4794 m
Total Well Penetration Depth: 4.3 m
Casing Radius: 0.025 m
Static Water Column Height: 4.3 m
Screen Length: 4.3 m
Well Radius: 0.0625 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.001738 m/day
y0 = 0.1877 m



RISING-HEAD TEST

Data Set: C:\...\MW11_RH_Hv.aqt
Date: 09/30/20 Time: 09:04:22

PROJECT INFORMATION

Company: WSP
Client: CALTEX
Project: PS121949
Location: HOLT, ACT
Test Well: MW11
Test Date: 14.09.20

AQUIFER DATA

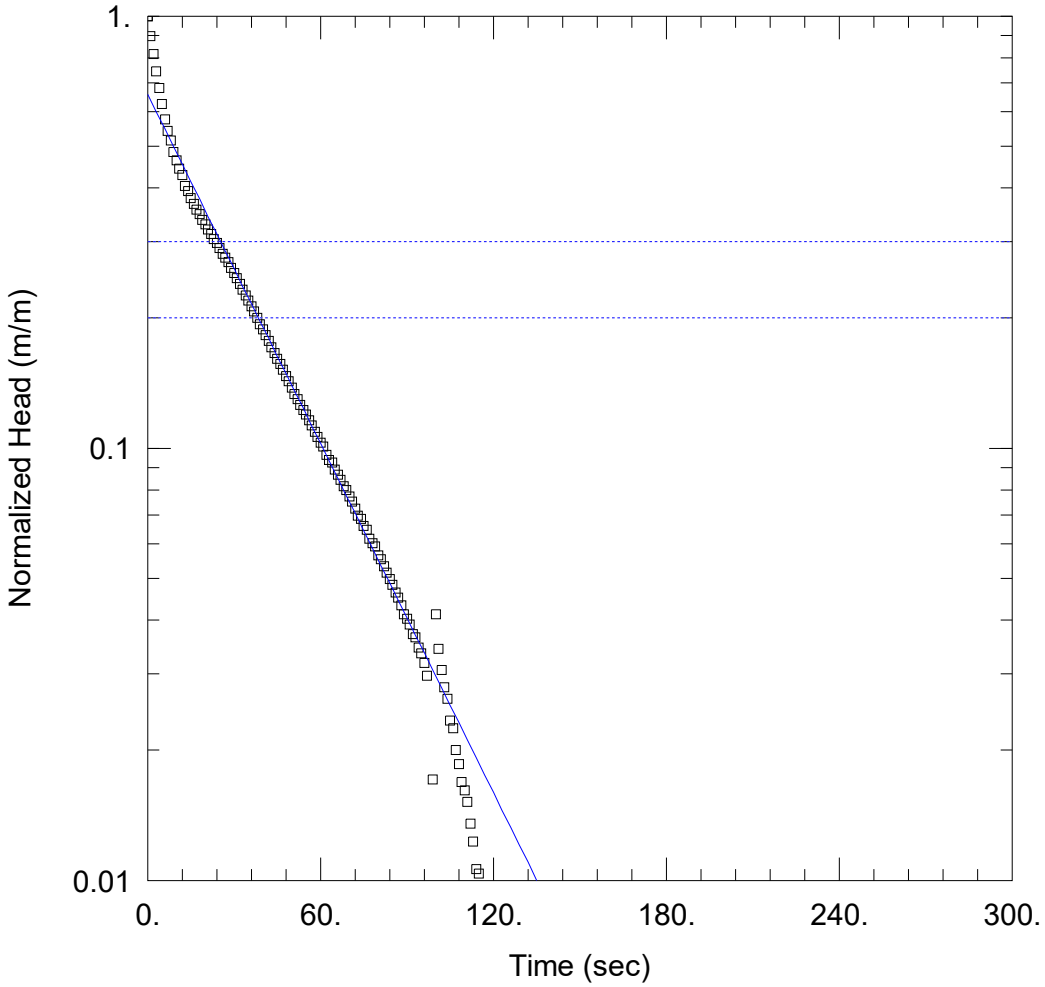
Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW11)

Initial Displacement: 0.4794 m
Total Well Penetration Depth: 4.3 m
Casing Radius: 0.025 m
Static Water Column Height: 4.3 m
Screen Length: 4.3 m
Well Radius: 0.0625 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.002515 m/day
y0 = 0.1881 m



RISING-HEAD TEST

Data Set: C:\...\MW15_RH_BR.aqt
Date: 09/30/20 Time: 09:04:21

PROJECT INFORMATION

Company: WSP
Client: CALTEX
Project: PS121949
Location: HOLT, ACT
Test Well: MW04
Test Date: 14.09.20

AQUIFER DATA

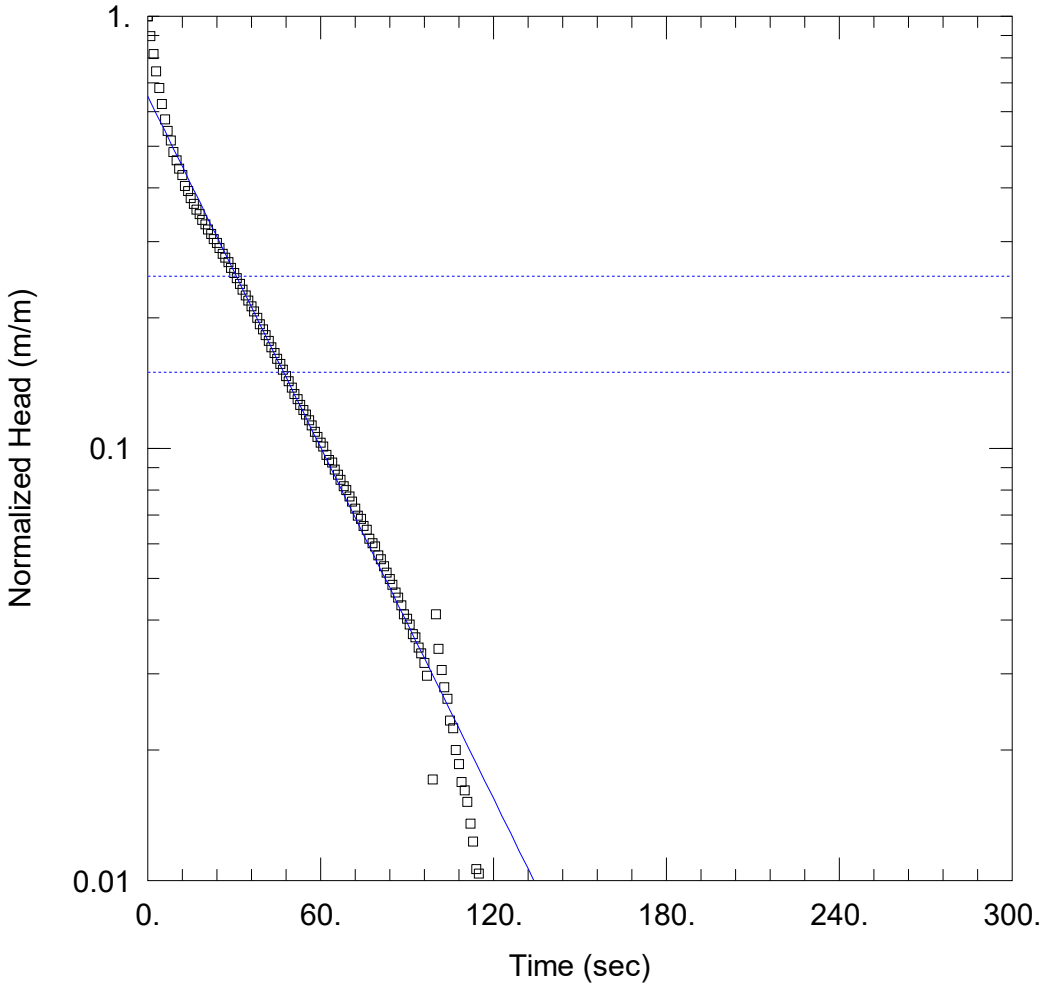
Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW15)

Initial Displacement: 0.4142 m
Total Well Penetration Depth: 3.37 m
Casing Radius: 0.025 m
Static Water Column Height: 3.37 m
Screen Length: 3.37 m
Well Radius: 0.0625 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.6547 m/day
y0 = 0.273 m



RISING-HEAD TEST

Data Set: C:\...\MW15_RH_Hv.aqt
Date: 09/30/20 Time: 09:04:20

PROJECT INFORMATION

Company: WSP
Client: CALTEX
Project: PS121949
Location: HOLT, ACT
Test Well: MW04
Test Date: 14.09.20

AQUIFER DATA

Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW15)

Initial Displacement: 0.4142 m
Total Well Penetration Depth: 3.37 m
Casing Radius: 0.025 m
Static Water Column Height: 3.37 m
Screen Length: 3.37 m
Well Radius: 0.0625 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.9961 m/day y0 = 0.2703 m

APPENDIX D

INSITE REMEDIATION REPORT

InSite Remediation Services Pty Ltd
ABN 83 705 183 104

Unit 10, 3 Box Road
Caringbah NSW 2229

Phone: 02 9525 7543

info@insiteremediation.com.au

8 October 2020

WSP Australia Pty LTD
Level 15, 28 Freshwater Place
Southbank, VIC
3006 Australia

Attention: [redacted]

Via email

Dear [redacted]

Re: Caltex Holt Remediation Trial Summary Report (September,2020)

1.0 Background and Objectives

InSite Remediation Services Pty Ltd (InSite) were engaged by WSP Australia Pty Ltd (WSP) to undertake a four day remediation trial from 15 to 18 September 2020 at the Caltex Holt located at 1 Hardwick Crescent, Holt ACT 2615 ("the Site") (see **Figure 1** for detailed site map).

The objective of the trial event was to ascertain a suitable remediation technique for the removal of recoverable Light Non-Aqueous Phase Liquid (LNAPL), dissolved phase impacted groundwater and Volatile Organic Compound (VOC) vapour from the sites subsurface soils. The trial included; Soil Vapour Extraction (SVE), SVE and incorporating liquid removal using a down well AP2 pump, Multi-Phase Extraction (MPE) and Chemical Injection or In-situ Chemical Oxidisation (ISCO) using Sodium Persulphate. This report details continuous monitoring results and recovery rates for the removal of sub-surface LNAPL and associated hydrocarbon vapours from the Site.

2.0 Scope of Works

The scope of works undertaken is as follows:

- Site safety briefing – all personnel were inducted onto the InSite site safety plan and onto the InSite Job Safety Analyses (JSAs).
- Establish work area;
- Conduct trial event with all relevant monitoring and methods outlined in Section 3.5 and
- Prepare a letter report detailing the trial.

3.0 Method

3.1 General

InSite conducted a four day Remediation Trial from 15 to 18 September, 2020 at the Site. **Table 3.1** represents the key details for each day of extraction.

Table 3.1 – Key details of the event

Date	Extraction / Injection Well(s)	Remediation Technique(s)
15 September 2020	PEW01 (10:39 - 14:41)	SVE
	PEW01 (15:21 – 16:16)	SVE + AP2 Pumping
16 September 2020	PEW01	SVE + AP2 Pumping
17 September 2020	PEW01 (8:35 – 16:45)	MPE
	IW03 (15:24 – 16:25)	Chemical Injection
	IW01 (16:55 – 18:00)	
18 September 2020	IW01 (8:56 – 11:12)	Chemical Injection
	IW02 (12:45 – 14:45)	

3.2 SVE Procedure

The SVE system utilised a combination of a mobile truck-mounted SVE system and existing recovery wells on site. Well heads were placed onto nominated extraction wells and were put under vacuum pressures of -3.5, -5, -8 and -12KPa. The vacuum created by the liquid ring pump creates negative pressure in the well, which promotes the flow of vapour towards the well.

3.3 SVE + Pumping Procedure

The SVE system was configured as per Section 3.1. In addition, an AP2 down well pump was placed into the well at a nominated depth of two meters below the initial standing water level. While the well was under vacuum. Vapour and liquids recovered where monitored during the trial. See Appendix A for detailed extraction data.

Liquids removed as part of the process are contained within a holding tank mounted on the vacuum truck. The vacuum truck was used to transport recovered liquid for treatment and disposal to the licensed liquid waste treatment facility. Waste dockets are contained in **Attachment D.** Note, only 1500L of the 3300L disposed of was from the trial works, the remaining 1800L was liquids from an existing LNAPL recovery system.

3.4 MPE Procedure

The MPE system utilised a combination of a mobile truck-mounted MPE system and existing recovery wells on site. Drop-tubes (spears) were inserted into nominated extraction wells at the required depth for extraction at the LNAPL/groundwater interface. Each targeted extraction well was pumped under vacuum at pressures of up to -70KPa to remove LNAPL, dissolved phase impacted groundwater and vapours from the sites subsurface.

The vacuum created by the liquid ring pump creates negative pressure in the well, which promotes the flow of groundwater and vapour towards the well.

Liquids removed as part of the process are contained within a holding tank mounted on the vacuum truck. The vacuum truck was used to transport recovered liquid for treatment and disposal to the licensed liquid waste treatment facility. Waste dockets are contained in **Attachment D.**

3.5 Chemical Injection Procedure

Sodium Persulphate was mixed onsite using and Injected into selected injection wells. It was originally planned to inject 500L of 25% into each well but due to location specific conditions, this varied in volume and sodium persulfate concentrations. Injection wellheads were fixed to the well, a delivery hose from the mixing unit was connected to the wellhead. System is pressure tested to 75-100kPa with water to ensure the system is sealed. Variable speed drive pumps were used to increase the injection pressure when required. Water level and water quality readings were monitored during the injection by WSP to ascertain the ability of the formation to accept the mixed solution and the effectiveness of the injection in reducing the hydrocarbon contamination at the Site.

3.6 Equipment

The Trial utilised the following equipment to perform each of the remediation techniques:

- InSite's mobile truck-mounted MPE/SVE unit was utilised as the source of the vacuum for the SVE & MPE trial works. The liquid ring pump on the dangerous goods rated truck is capable of a maximum air flow rate of 800m^3/hour. The 8,000L tank mounted on the rear of the truck was used to store recovered hydrocarbon product and associated liquids;
- 25mm diameter copper drop tubes/stingers and well head assemblies in extraction wells listed in **Table 3.1**;
- Well heads used to create a vacuum seal between the well casing and the stingers (see **Figure 2** for typical well head set up);
- Fuel or static rated code 1000 hoses to allow the transfer of potentially contaminated groundwater and associated vapours between the nominated extraction wells and vacuum truck; and
- A knockout pot used to gather individual well data.
- AP2 Pumps for SVE + Pumping Trial.
- 1,000L IBC's for mixing Sodium Persulphate solution.

3.7 Monitoring Equipment

Monitoring equipment used is outlined in **Table 3.2**.

Table 3.2 – Monitoring Equipment Used

Item	Purpose
Impact pro gas meter	Measurement of ambient air quality for safety purposes (%LEL, O_2, H_2S and CO)
FCI FT51 air flow / temp	Measurement of air / vapour velocities / temperature
Infra-red gas analyser	Measurement of vapour concentrations (in ppm of hexane) within the vapour stream
Photoionization detector (PID)	Measurement of VOC concentrations within the vapour stream
Small vacuum pump	Extracts vapours from the inlet vapour stream to the infra-red gas analyser for measurement
Small Calibrated flow vacuum pump	Extracts vapours from the inlet vapour stream through the carbon tube validation samples.
Interface probe	Gauging of extraction and observation wells for depth to LNAPL and depth to groundwater.
Magnehelic differential pressure gauges	Monitoring of vacuum on observation wells (vacuum radius of influence).
Vacuum gauge	Monitoring of vacuum applied to the well head, extraction well casing (head and well vacuum readings) and the plant vacuum.
Temperature gauge	Monitoring of air temperature
Knockout pot (individual well)	Measurement of groundwater recovery rates, flow velocity and hydrocarbon vapours being extracted from individual well/s.

3.5 Monitoring Procedure

The following sections detail the monitoring procedures that were undertaken by qualified InSite personnel during the course of the trial. Gauging and monitoring data is included as **Attachment A**.

3.5.1 Pre- SVE / MPE

- Relevant extraction well(s) on site were initially opened and allowed to equilibrate and then gauged, using an interface probe, prior to the drop tube (MPE only) and well head assembly being set up. The readings are recorded in **Attachment A** and were used to determine the initial drop tube depths; and
- Relevant observation wells on site were gauged, using an interface probe, for depth to water and LNAPL thickness (where present). The interface probe was decontaminated using Decon 90 prior to use at each subsequent well.

3.5.2 During- SVE / MPE

- Observation wells were periodically gauged for depth to water and depth to product with the use of an interface probe. These readings were used to indicate potential for water and product flow through the formation and the distance that the vacuum extraction influence may extend within the formation (hydraulic drawdown radius of influence);
- Observation wells were assessed for induced pressure radius or vacuum influence using magnehelic gauges (vacuum radius of influence);
- The concentration of hydrocarbon vapours (ppm of hexane), air velocity (metres per second) and temperature (degrees Celsius) at the outlet of the vacuum truck (between the tank and carbon vessels) was monitored at regular intervals. These values were used to determine the

mass of hydrocarbon vapour removed from the sub-surface. The same location was monitored with a PID to determine if VOC vapours were being recovered.

- Carbon Tube samples were collected to validate the Infra-Red Hexane meter readings during the SVE, SVE + Pumping and MPE trial – 1 sample per day of operation.
- The outlet from the carbon vessels was also monitored for hydrocarbon vapours (ppm of hexane) and VOCs to determine when breakthrough of the carbon vessels occurs.
- AP2 pump flow rates were monitored to monitor well recovery and LNAPL removal by gauging the holding tank.
- A knockout pot was used during the event to gather individual monitoring well data sets. The data includes groundwater recovery rates, flow velocity and hydrocarbon vapours being extracted from the well.

3.5.3 Post- SVE / MPE

- All extraction wells were gauged for depth to water and LNAPL thickness (where present) immediately as the applied vacuum was stopped. The wells were gauged again a short time later to determine groundwater and LNAPL (where present) rebound in the well;
- Storage tank on the MPE truck was dipped using an interface probe to measure total quantity of liquid recovered and LNAPL thickness (if present).

3.5.5 Pre - Injection

- Relevant injection and observation wells on site were gauged, using an interface probe, for depth to water and LNAPL thickness (where present). The interface probe was decontaminated using Decon 90 prior to use at each subsequent well.

3.5.4 During Injection

- Injection flow rates were monitored during injection.
- Injection pressures were monitored
- Observation wells were gauged for depth to water and LNAPL thickness (where present)
- Water quality meter readings recorded on selected observation wells (WSP).
- Groundwater samples collected for TPH/BTEX analysis from selected observation wells (WSP).

3.5.5 Post Injection

- Injection well was gauged regularly over an approximately 30 minute period to ascertain the fall of the liquid levels in the injection well.

4.0 Calculations

4.1 Hydrocarbon Mass Recovery

Hydrocarbon mass recovery was determined from three phases: liquid, dissolved and vapour. Each phase is listed below and the associated calculations explained in each section.

4.1.1 Vapour Phase

Flow rate, temperature and Hexane concentration (ppm) measurements were collected at regular intervals from the inlet point of the vacuum truck. Hexane concentrations are converted from parts per million (ppm) to milligrams per cubic metre (mg/m^3). This provides the volume of Hexane required when calculating the total mass removed using ideal gas law ($pV = nRT$)[1].

Monitoring sheets detailing measurements of flow rate, temperature, pressure and concentration of hydrocarbon vapours are provided in **Attachment A**. Based on these measurements the mass of hydrocarbon vapours removed during the MPE event was calculated.

Carbon tube samples provide a mass emission rate (kg/hr). This is multiplied by the extraction time to give a total mass removed.

[1] (P is the pressure of the gas, V is the volume of the gas, n is the amount of substance of gas (also known as number of moles), T is the temperature of the gas and R is the ideal, or universal, gas constant.)

4.1.2 Liquid Phase

The volume of hydrocarbon recovered as liquid phase was determined by gauging the storage tank on the truck at the end of each day of the MPE event. The estimated volume of LNAPL in litres was calculated by the thickness of product in the tank and tank specific dimensions. The volume in litres was converted to kilograms by using the specific gravity of the product being extracted.

4.2 Groundwater Recovery

Temporary storage tank on the vacuum truck was empty at the start of the event. It was then dipped at the completion of the event. Groundwater recovery was calculated from dividing the total quantity recovered by the run time of the event.

5.0 Results

5.1 Radius of Influence

5.1.1 Vacuum Radius of Influence

In order to evaluate the radius of influence of vapour extraction, measurements of induced vacuum were undertaken at all relevant monitoring wells not included as extraction wells during the course of the MPE event. Details of measurements have been provided in the monitoring sheets included as **Attachments A**. Vacuum radius of influence is summarised in **Table 5.1.**

Table 5.1 – Vacuum radius of influence

Date	Trial Type	Extraction Well(s)	Well(s) with Vacuum ROI
15 September 2020	SVE	PEW01	MW01 (Slight), MW02, MW04, MW05, MW07, PMW01, PMW02, PMW03, PMW04
	SVE + Pumping	PEW01	MW02, MW05, PMW01, PMW02, PMW03, PMW04
16 September 2020	SVE + Pumping	PEW01	MW01, MW02, MW04, MW05, MW07, PMW01, PMW02, PMW03, PMW04, EW03
17 September 2020	MPE	PEW01	MW01, MW02, MW04, MW05, MW07, MW16, PMW01, PMW02, PMW03, PMW04, EW03
18 September 2020	ISCO	N/A	N/A

5.1.2 Groundwater Radius of Influence (Drawdown)

In order to evaluate the radius of influence of groundwater movement (and associated recovery of dissolved phase impacted groundwater) measurements of depth to water prior to and during the SVE/SVE + Pumping/MPE Trial were undertaken at selected observation wells. Details of depth to water measurements are included in the monitoring sheets and charts provided in **Attachment A**. Groundwater drawdown (radius of influence) is summarised in **Table 5.2**.

Table 5.2 – Groundwater Drawdown

Date	Trial Type	Extraction Well(s)	Well(s) with Groundwater Drawdown
15 September 2020	SVE	PEW01	MW04
	SVE + Pumping	PEW01	MW04
16 September 2020	SVE + Pumping	PEW01	MW01, MW02, MW04, MW05, MW06, PMW04
17 September 2020	MPE	PEW01	MW01, MW02, MW04, MW05, MW06, MW07, MW16, PMW01, PMW02, PMW03, PMW04
18 September 2020	ISCO	N/A	N/A

5.2 Hydrocarbon Mass Recovery

Hydrocarbon mass recovery was determined from two phases: liquid and vapour phases. Each phase is listed below and the associated calculations explained in each section.

5.2.1 Vapour Phase – Infra-Red Gas Analyser and PID

The following table (**Table 5.3**) represents the daily mass of hydrocarbons in vapour phase (as Hexane) recovered during the event and recovery rates based on measurements collected from the Infra-Red gas analyser. The table also represents daily mass recovery of VOC's and VOC recovery rates as measured by the vacuum trucks on board PID.

Table 5.3 – Hydrocarbon Mass Removal (Vapour Phase) (IR Analyser)

Date	Trial Type	Stack Discharge Flux (m^3/hr)	Run Time (hr)	HC (as Hexane) Vapour Recovery Rates (kg/hour)	HC Vapour (as Hexane) Recovered (kg)	VOC Recovery Rates (kg/hour)	VOC's Recovered (kg)
15 September 2020	SVE	23.50	3.45	6.39	22.0	0.07	0.2
	SVE + Pumping	6.72	0.92	2.09	1.9	0.05	0.04
16 September 2020	SVE + Pumping	43.61	5.08	14.91	75.7	0.18	0.9
17 September 2020	MPE	1654.56	7.10	103.17	732.5	2.14	15.2
18 September 2020	ISCO	N/A	N/A	N/A	N/A	N/A	N/A
Total					**832.1**		**16.34**

5.2.2 Vapour Phase – Carbon Tube Samples

The following table (**Table 5.3**) represents the daily mass of hydrocarbons in vapour phase recovered during the event and recovery rates based on results from carbon tube analysis. Carbon tube analysis can be found in **Attachment C**.

Table 5.4 – Hydrocarbon Mass Removal (Vapour Phase) (Carbon Tube)

Date	Trial Type	Run Time (hr)	Discharge Flux (m^3/hr)	Total Speciated VOC's Vapour Recovery Rates (mg/m^3)	Hexane Vapour Recovery Rates (mg/m^3)
15 September 2020	SVE	3.45	23.50	*38000	2200
	SVE + Pumping	0.92	No Sample	No Sample	No Sample
16 September 2020	SVE + Pumping	5.08	43.61	43000	2500
17 September 2020	MPE	7.10	1654.56	17000	890
18 September 2020	ISCO	N/A	N/A	N/A	N/A

* Value was measured with single tube only and tube was saturated so decision was made to sample with two tubes in series on 16/09/2020 for more accurate measurement.

5.2.3 Liquid Phase (LNAPL)

The following table (**Table 5.6**) represents the estimated daily mass of hydrocarbons in liquid phase (LNAPL) recovered during the event.

Table 5.6 – Hydrocarbon Mass Removal (Liquid Phase)

Date	LNAPL Thickness in tank (m)	Liquid Phase Removed (L)	Liquid Phase Removed (kg)
15 September 2020	0	0	0
16 September 2020	0	0	0
17 September 2020	0	0	0
18 September 2020	N/A	N/A	N/A
Totals	***0**	***0**	***0**

***Due to short duration of the trial, and therefore relatively small volumes of liquid extracted, it is difficult to accurately quantify the total amount of LNAPL extracted over the trial period. Therefore, the volumes presented below are conservative, and are likely less than the actual volumes extracted.**

5.4 Groundwater Recovery

The following table (**Table 5.7**) represents groundwater recovered, recovery rates and event run times. These groundwater recovery rates are based on the change in water level within the holding tank and the time elapsed of each trial.

Table 5.7 – Groundwater Recovery

Date	Groundwater Recovered (L)	Groundwater Recovery Rate (L/min)	Run Time (hrs)
15 September 2020 SVE	0	0	3.45
15 September 2020 SVE + Pumping	14	0.3	0.92
16 September 2020 SVE + Pumping	624	2.1	5.08
17 September 2020 MPE	876	2.1	7.10
18 September 2020 Chemical Injection	N/A	N/A	N/A
Totals	**1500**	**1.5***	**16.55**

* Average recovery rate for event

5.5 Individual Well Data

Attachment B presents individual well data collected during the event using a knockout pot, including measurement of groundwater recovery rates, flow velocity and hydrocarbon vapours being extracted from individual wells.

5.6 ISCO Results

The injection flow rates, volumes and injection pressures for each of the three injection wells is detailed in **Table 5.8**.

Table 5.8 – ISCO Summary

Chemical Injection Data						
Date	**Well ID**	**Time**	**Flow rates (L/min)**	**Injection Pressures (kPa)**	**Injection Volume (L)**	**Comments**
17/09/2020	IW03	15:24	1.3	0	0	Commence by Gravity Feed
		15:27	2.0	10	-	
		16:00	1.3	50	-	
		16:20	2.2	100	-	
		16:25	-	-	**80**	Stop Injection
	IW01	16:55	2.6	10	0	Start Injection
		17:06	1.3-2.6	10	-	
		17:15	-	-	88	
		17:22	2.6-3.9	50	100	
		17:30	-	-	132	
		17:36	3.9-5.3	92	159	
		18:00	-	-	250	Stop Injection
18/09/2020	IW01	8:56	2.6-3.9	50	250	Start Injection
		9:18	2.6	50	300	
		9:30	-	-	-	Stop Injection - Tank Pressure Alarm
		10:42	2.6	50	-	Re-Start Injection
		11:12	-	-	**472**	Stop Injection
	IW02	12:45	5.3-6.6	30	0	Start Injection - Batch 1
		13:00	5.8	30	87	
		13:02	6.6-7.6	50	-	
		13:20	-	-	223	Stop Injection - Batch 1
		14:05	6.7-7.9	8	223	Start Injection - Batch 2
		14:41	6.6-7.9	8	520	
		14:45	-	-	**560**	Stop Injection - Batch 2

6.0 Conclusions

Based on the four day remediation trial undertaken at the Site from 15 to 18 September, 2020 InSite concludes the following:

- The estimated total mass of hydrocarbons removed over the trial was 832.1kg. This is broken down into vapour and liquid phases:
  - The total detectable mass hydrocarbons removed in vapour phase was 832.1kg;
  - The estimated total mass hydrocarbon reported to be removed in liquid phase was 0kg although due to short length of trial and small liquid volumes, this not be and actual representation of the true volume recovered.
- The total runtime of the SVE trial was 3.85hrs;
- The total runtime of the SVE + Pumping trial was 6hrs over two days;
- The total runtime of the MPE trial was 7.10hrs;
- Based on waste disposal documentation, a total of 1500L of hydrocarbon-contaminated water was recovered from the event;
- For vacuum radius of influence refer to **Table 5.1**;
- For groundwater depression (drawdown) refer to **Table 5.2**;
- A total of 1,112L of sodium persulphate solution was injected into three separate injection wells with varying success as outlined below:
  - IW01 = 472 over 3.35hrs;
  - IW02 = 560L over 2hrs; and
  - IW03 = 80L over 1.02hrs

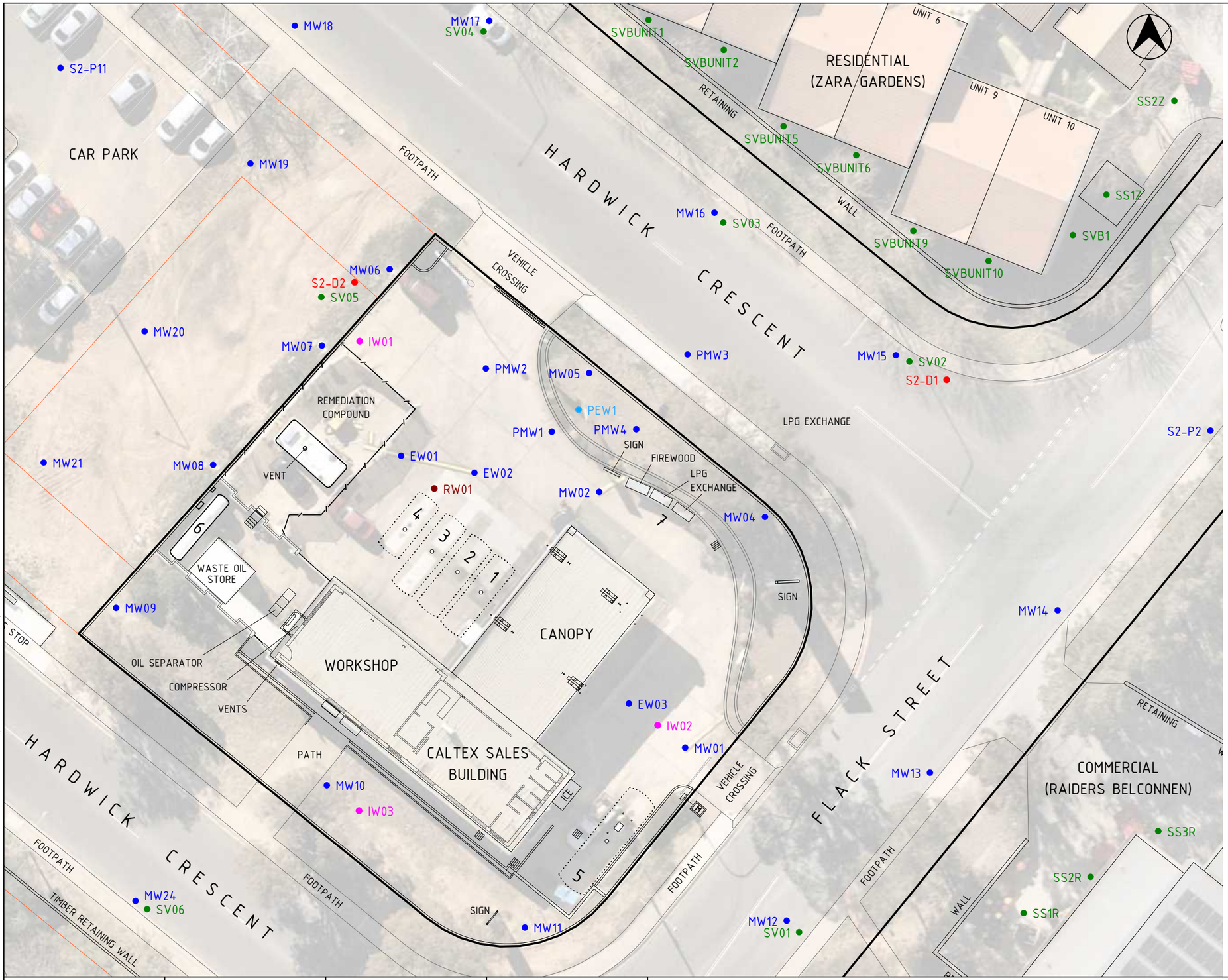
If you have any further questions, please don't hesitate to contact us on (02) 9525 7543.

List of Attachments

Figure 1	Site Map
Figure 2	Typical well head set up
Attachment A	Extraction Data and Graphs
Attachment B	Individual Well Data
Attachment C	Laboratory Certificate of Analysis – Carbon Tubes (Ektimo)
Attachment D	Waste Disposal Documentation

Figure 1 - Site Map

Remediation Trial Summary Report



LEGEND

- PROPERTY BOUNDARY
- BLOCK / SECTION BOUNDARY
- MW## GROUNDWATER MONITORING WELL
- EW## GROUNDWATER MONITORING WELL
- PMW## GROUNDWATER MONITORING WELL
- S2-P# GROUNDWATER MONITORING WELL
- S2-C# GROUNDWATER MONITORING WELL
- PEW## EXTRACTION WELL
- IW## INJECTION WELL
- RW## RECOVERY WELL
- SV# SOIL VAPOUR BORE
- SS# SUB SLAB SOIL VAPOUR PIN
- S2-D# CORED BOREHOLE

TANK SCHEDULE

TANK	TYPE	PRODUCT	CLASS	CAPACITY	USAGE
1	UST	V95	3	27,400L	IN USE
2	UST	DIESEL	C1	27,400L	IN USE
3	UST	E10	3	27,400L	IN USE
4	UST	V98	3	20,000L	NOT IN USE
5	UST	ULP	3	59,400L	IN USE
6	AST	LPG	2.1	7,500L	NOT IN USE
7	LPG EXCHANGE		2.1	9x4kg, 42x9kg	IN USE

NOTE

LPG TANK (TANK 6) DECOMMISSIONED, NITROGEN PURGED.

0 10m

1:340 AT A3 APPROXIMATE

REFERENCE: CALTEX 'DANGEROUS GOODS PLAN' DRAWING NO. 22546-DG REV. B DATED 25/11/2011 AND VERIS SURVEY 217267.01 DATED 02/10/2020 SUPPLIED BY CLIENT.

REUMAD technical services geotechnical & environmental drafting support

InSite Remediation Services

Figure prepared for WSP by InSite Remediation Services Pty Ltd

CALTEX

wsp

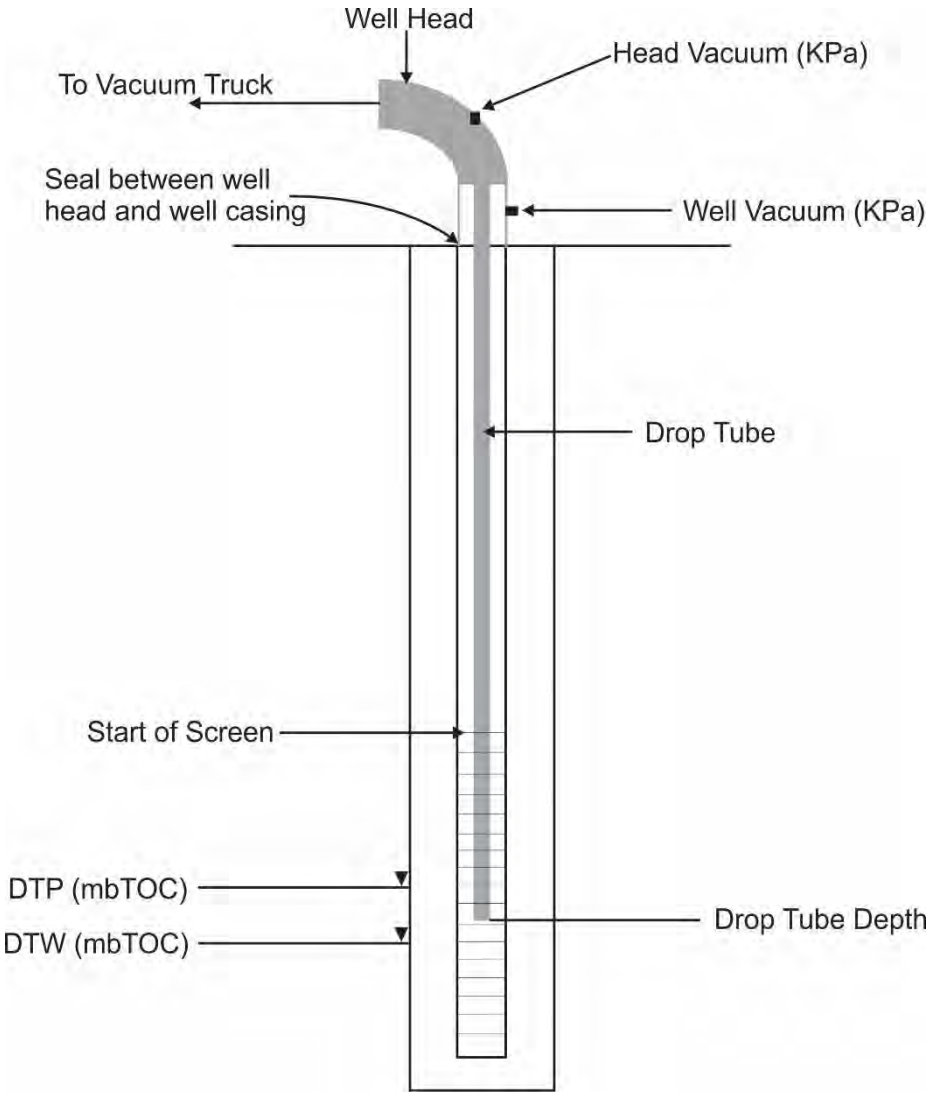
CALTEX HOLT SERVICE STATION
1 HARDWICK CRESCENT
HOLT ACT

FIGURE 1
SITE PLAN

aerial image nearmap august 2020
block & section data from http://www.actmapi.act.gov.au

D:\Google Drive\InSite Remediation\Holt\FIGURES\FIGURES SVR 2020 SEPT\V3\CALTEX HOLT SVR F02a V3.vwx | Tue, 13 Oct 2020 7:54:23 AM | drawn by laurie white at www.reumad.com.au

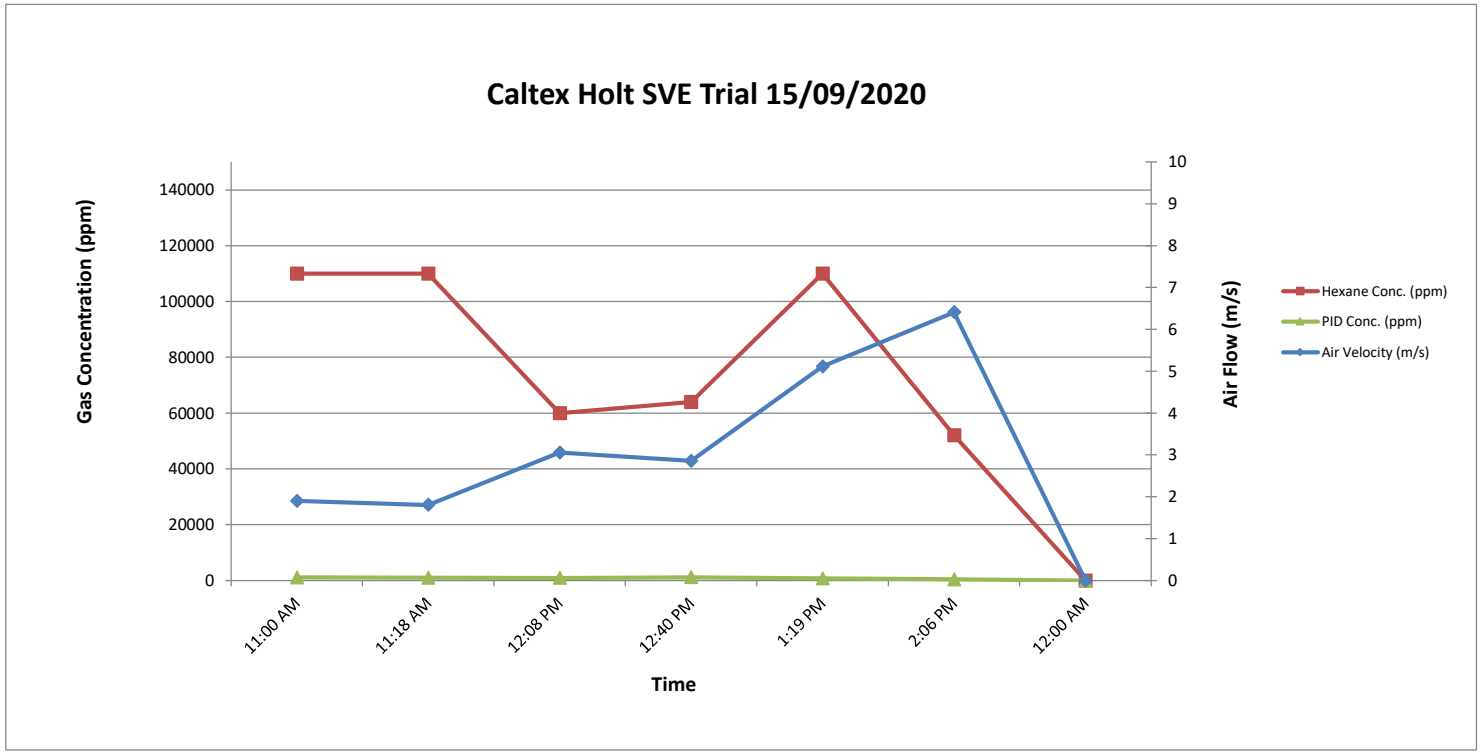
Figure 2 - Typical Well Head Assembly



Typical extraction / pumping well set up

Attachment A – Multi-Phase Extraction Data / Trends

Remediation Trial Summary Report



Time:	11:00 AM	11:18 AM	12:08 PM	12:40 PM	1:19 PM	2:06 PM	12:00 AM
Air Velocity (m/s)	1.90	1.81	3.06	2.86	5.11	6.41	0.00
Hexane Conc. (ppm)	110000	110000	60000	64000	110000	52000	0
PID Conc. (ppm)	1150	1000	950	1210	785	405	0

Time	Wells Extracting From	Wells Stopped	Comments
10:39	PEW01		Start Extraction @ -3.5kPa
11:45	PEW01		Increaded Vacuum to -5kPa
12:59	PEW01		Increaded Vacuum to -8kPa
13:41	PEW01		Increaded Vacuum to -12kPa
14:41		PEW01	Stop SVE Test
15:21	PEW01		Start SVE + Pump Test
16:16		PEW01	Stop SVE + Pump Test

Soil Vapour Extraction Trial Monitoring - Hydrocarbon Vapour Mass Removal

Site Name: Caltex Holt
Date: 15/09/2020
Operator: AR SH GD

Truck Vent Diameter: 0.050 m

		Time									
Location	**Unit**	**10:39**	**11:00**	**11:18**	**12:08**	**12:40**	**13:19**	**14:06**			
Ambient Air Test Location 1	%LEL	0	0	0	0	0	0	0			
Concentration	Hexane (ppm)	0	110000	110000	60000	64000	110000	52000			
Concentration	PID (ppm)	0	1150	1000	950	1210	785	405			
Truck Vacuum	KPa	-	3.5	3.5	4.6	4.8	8	12			
Standardised Air Velocity	SMPS	0	1.8	1.7	2.8	2.6	4.5	5.4			
Actual Air Velocity	ms^{-1}	0	1.9	1.8	3.1	2.9	5.1	6.4			
Temperature (Air Flow Sample Point)	^{o}C	-	20.8	22.5	27.0	28.4	28.4	28.4			

Estimated Hydrocarbon Vapour Removed: 22.0 kg
6.39 kg/hr

Estimated VOC Vapour Removed: 0.2 kg
0.07 kg/hr

Pump Test Data

Tank Dip - Time	DTP (m)	DTW (m)	LNAPL (mm)	
Tank Dip at Start:	0.850	0.874	24	
Tank Dip at Finish:	0.850	0.874	24	
Total Recovered:	PSH	0	L	
	Water	0	L	
	Total	0	L	

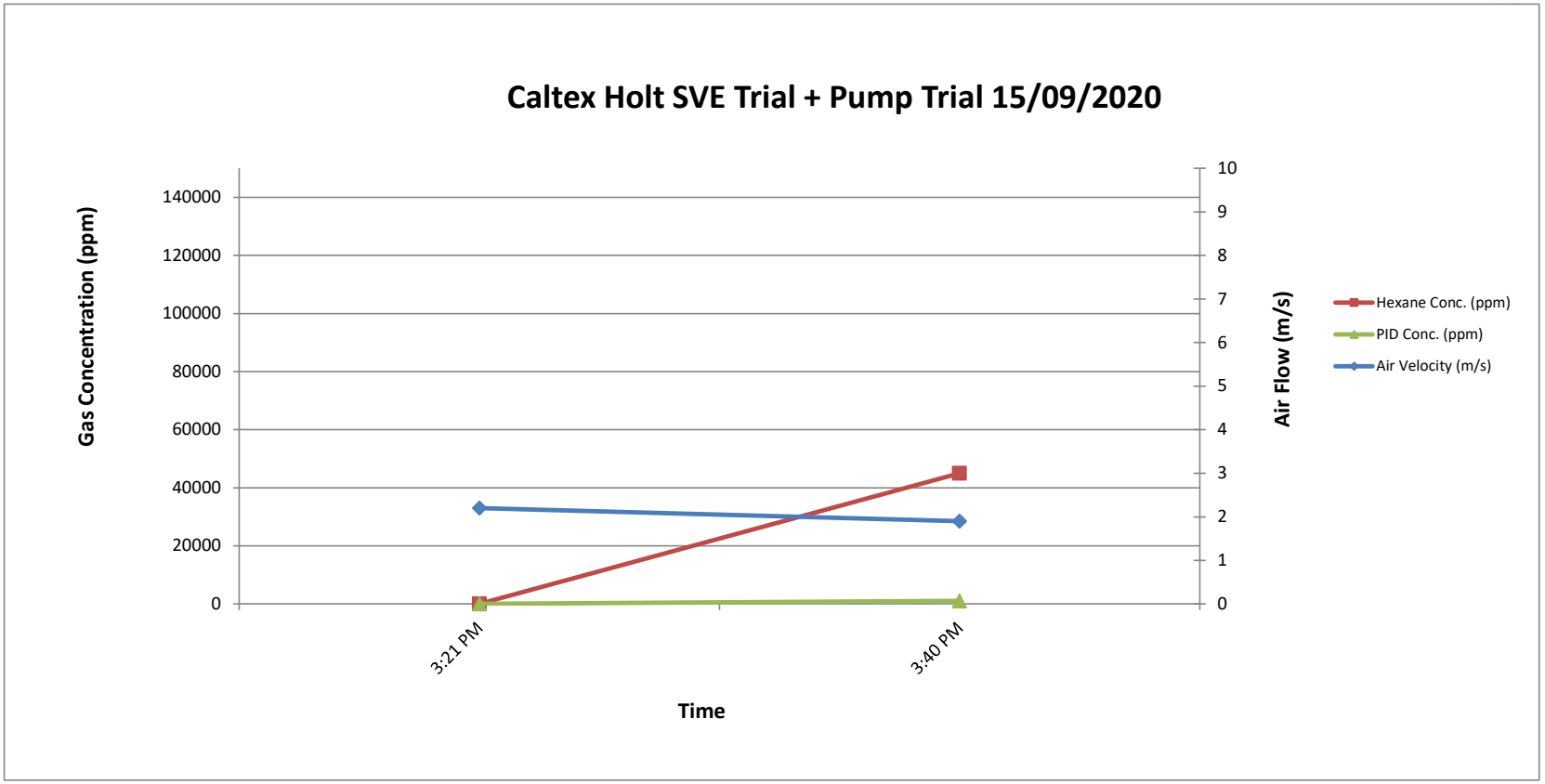
Post Extraction Truck Dip
DTW (m): 0.000
DTP (m): 0.000
DTB (m): 1.800
LNAPL Thickness (mm): 0.000
Free Phase Removed (L): 0.00
Free Phase Removed (kg): 0.00

Comments:

Total Run Time: 3.45 hrs

Time Weighted Average Conc.: 77643 ppm
Time Weighted Average PID Conc.: 860 ppm
Average Temperature : 25.9 °C

Average Velocity : 3.52 m/s
Average Flow : 24.91 m^3/hr
Average Truck Vacuum: 6.1 kPa



Time:	3:21 PM	3:40 PM
Air Velocity (m/s)	2.20	1.90
Hexane Conc. (ppm)	0	45000
PID Conc. (ppm)	0	1000

Time	Wells Extracting From	Wells Stopped	Comments
15:21	PEW01		Start Extraction @ -3.5kPa
16:16		PEW01	Stop Extraction

Soil Vapour Extraction + Pump Trial Monitoring - Hydrocarbon Vapour Mass Removal

Site Name: Caltex Holt
Date: 15/09/2020
Operator: AR SH GD

Truck Vent Diameter: 0.050 m

		Time									
Location	**Unit**	**15:21**	**15:40**								
Ambient Air Test Location 1	%LEL	0	0								
Concentration	Hexane (ppm)	0	45000								
Concentration	PID (ppm)	0	1000								
Truck Vacuum	KPa	3.4	3.5								
Standardised Air Velocity	SMPS	2	1.8								
Actual Air Velocity	ms^{-1}	2.2	1.9								
Temperature (Air Flow Sample Point)	^{o}C	31.7	20.8								

Estimated Hydrocarbon Vapour Removed: 1.9 kg
2.09 kg/hr

Estimated VOC Vapour Removed: 0.04 kg
0.05 kg/hr

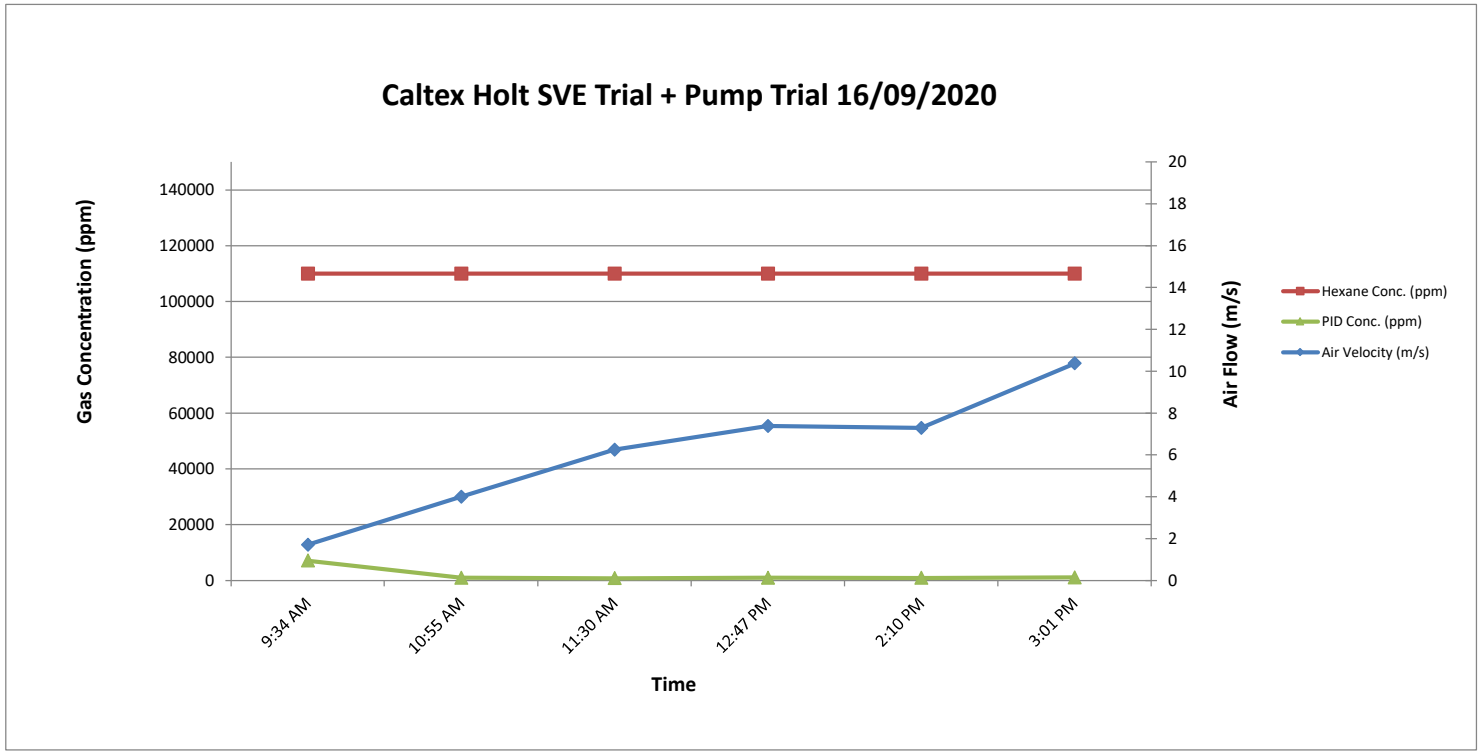
Pump Test Data

Tank Dip - Time	**DTP (m)**	**DTW (m)**	**LNAPL (mm)**
Tank Dip at Start:	**0.850**	**0.874**	**24**
Tank Dip at Finish:	**0.850**	**0.873**	**23**
Total Recovered:	**PSH**	**0**	**L**
	Water	**14**	**L**
	Total	**14**	**L**

Post Extraction Truck Dip
DTW (m): 0.000
DTP (m): 0.000
DTB (m): 1.800
LNAPL Thickness (mm): 0.000
Free Phase Removed (L): 0.00
Free Phase Removed (kg): 0.00

Comments:

Total Run Time: 0.92 hrs
Time Weighted Average Conc.: 45000 ppm
Time Weighted Average PID Conc.: 1000 ppm
Average Temperature : 20.8 °C
Average Velocity : 1.90 m/s
Average Flow : 13.44 m^3/hr
Average Truck Vacuum: 3.5 kPa



Time:	9:34 AM	10:55 AM	11:30 AM	12:47 PM	2:10 PM	3:01 PM
Air Velocity (m/s)	1.71	4.00	6.26	7.38	7.30	10.37
Hexane Conc. (ppm)	110000	110000	110000	110000	110000	110000
PID Conc. (ppm)	7180	1000	880	1010	950	1100

Time	Wells Extracting From	Wells Stopped	Comments
9:16	PEW01		Start Extraction + Pump Test @ -6kPa
11:45	PEW01		
12:59	PEW01		
13:41	PEW01		
14:41		PEW01	
15:21	PEW01		Start SVE + Pump Test
16:16		PEW01	Stop SVE + Pump Test

Soil Vapour Extraction + Pump Trial Monitoring - Hydrocarbon Vapour Mass Removal

Site Name: Caltex Holt
Date: 16/09/2020
Operator: AR SH GD

Truck Vent Diameter: 0.050 m

		Time									
Location	**Unit**	**9:16**	**9:34**	**10:55**	**11:30**	**12:47**	**14:10**	**15:01**			
Ambient Air Test Location 1	%LEL	0	0	0	0	0	0	0			
Concentration	Hexane (ppm)	0	110000	110000	110000	110000	110000	110000			
Concentration	PID (ppm)	0	7180	1000	880	1010	950	1100			
Truck Vacuum	KPa	-	6	6	11	15	14	20			
Standardised Air Velocity	SMPS	0	1.6	3.7	5.4	6.0	6.0	7.9			
Actual Air Velocity	ms^{-1}	0	1.7	4.0	6.3	7.4	7.3	10.4			
Temperature (Air Flow Sample Point)	^{o}C	-	16.7	20	24.5	28.8	28.8	30.5			

Estimated Hydrocarbon Vapour Removed: 75.7 kg
14.91 kg/hr

Estimated VOC Vapour Removed: 0.9 kg
0.18 kg/hr

Pump Test Data

Tank Dip - Time	DTP (m)	DTW (m)	LNAPL (mm)
Tank Dip at Start:	0.850	0.873	23
Tank Dip at Finish:	0.805	0.827	22
Total Recovered:	PSH	0	L
	Water	638	L
	Total	638	L

Post Extraction Truck Dip

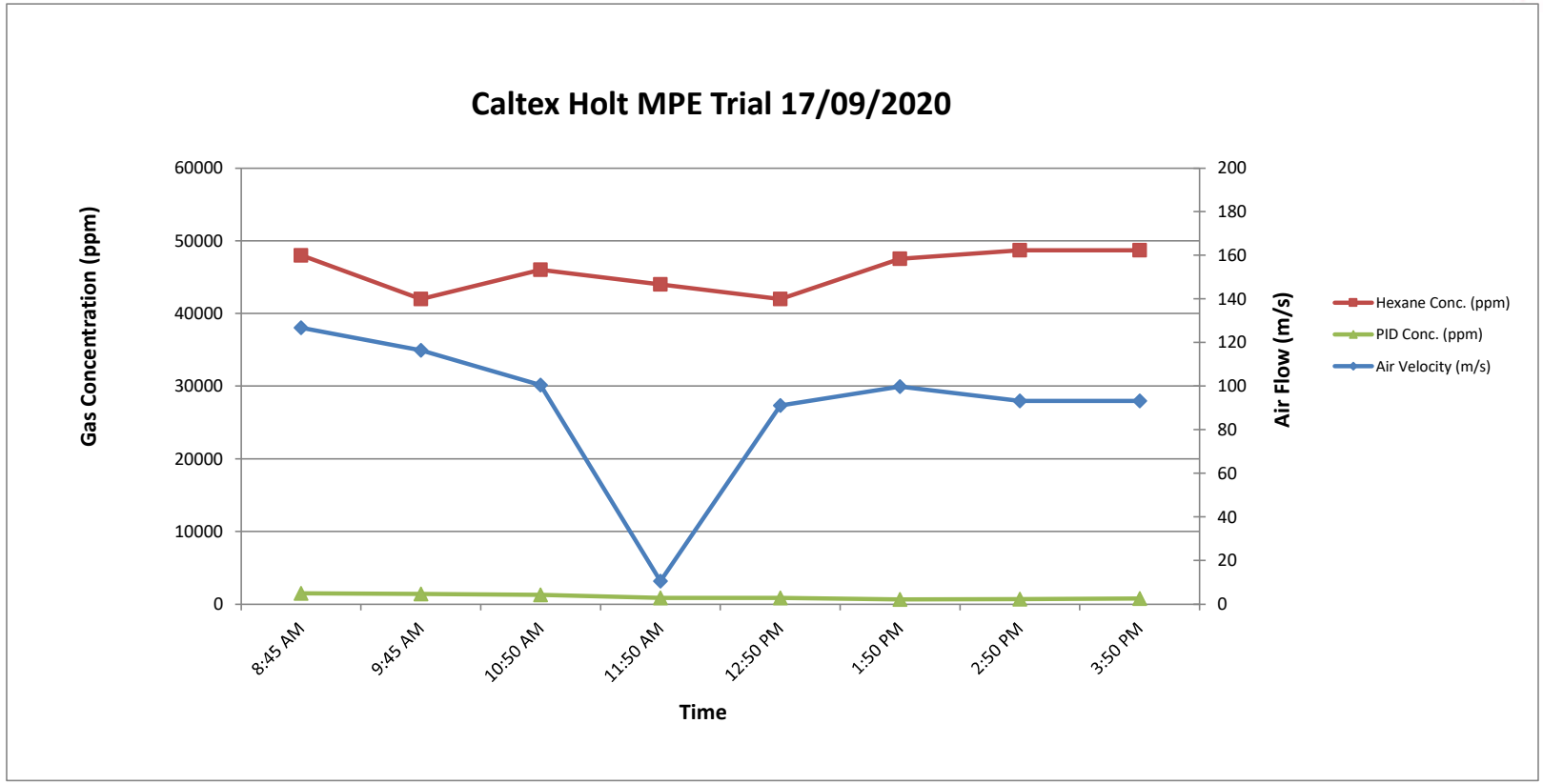
DTW (m):	0.000
DTP (m):	0.000
DTB (m):	1.800
LNAPL Thickness (mm):	0
Free Phase Removed (L):	0.00
Free Phase Removed (kg):	0.00

Comments:

Total Run Time: 5.08 hrs

Time Weighted Average Conc.: 110000 ppm
Time Weighted Average PID Conc.: 1315 ppm
Average Temperature : 24.9 °C

Average Velocity : 6.17 m/s
Average Flow : 43.61 m^3/hr
Average Truck Vacuum: 12.0 kPa



Time:	8:45 AM	9:45 AM	10:50 AM	11:50 AM	12:50 PM	1:50 PM	2:50 PM	3:50 PM
Air Velocity (m/s)	126.76	116.46	100.46	10.54	91.09	99.79	93.19	93.19
Hexane Conc. (ppm)	48000	42000	46000	44000	42000	47500	48688	48688
PID Conc. (ppm)	1512	1400	1272	850	850	649	705	770

Time	Wells Extracting From	Wells Stopped	Comments
8:35	PEW01		Start Extraction
13:00	PEW01		Increased Vacuum
16:45		PEW01	Stop Extraction

Multi-Phase Extraction Trial Monitoring - Hydrocarbon Vapour Mass Removal

Site Name: Caltex Holt
Date: 17/09/2020
Operator: AR SH GD

Truck Vent Diameter: 0.080 m

		Time									
Location	**Unit**	**8:35**	**8:45**	**9:45**	**10:50**	**11:50**	**12:50**	**13:50**	**14:50**	**15:50**	
Ambient Air Test Location 1	%LEL	0	0	0	0	0	0	0	0	0	
Concentration	Hexane (ppm)	0	48000	42000	46000	44000	42000	47500	48688	48688	
Concentration	PID (ppm)	0	1512	1400	1272	850	850	649	705	770	
Truck Vacuum	KPa	-	70	67	61	61	57	61	58	58	
Standardised Air Velocity	SMPS	0	38.0	38.0	38.0	4.0	38.0	38.0	38.0	38.0	
Actual Air Velocity	ms^{-1}	0	126.8	116.5	100.5	10.5	91.1	99.8	93.2	93.2	
Temperature (Air Flow Sample Point)	^{o}C	-	24	26	30	29	29	28	29	29	

Estimated Hydrocarbon Vapour Removed:	**732.5 kg**
	103.17 kg/hr
Estimated VOC Vapour Removed:	**15.2 kg**
	2.14 kg/hr
Tank Dip at Start:	**0 L**
Tank Dip at Finish:	**1500 L**
Total Recovered:	**1500 L**
Total Disposed:	**1500 L**
	211.3 L/hr
	3.5 L/min

Post Extraction Tank Dip	
DTW (m):	**1.482**
DTP (m):	**0.000**
DTB (m):	**1.800**
LNAPL Thickness (mm):	**0**
Free Phase Removed (L):	**0.00**
Free Phase Removed (kg):	**0.00**

Comments:

Total Run Time:	**7.1 hrs**	**Time Weighted Average Conc.:**	**45615 ppm**	**Average Velocity :**	**91.43 m/s**
		Time Weighted Average PID Conc.:	**945 ppm**	**Average Flow :**	**1654.56 m^3/hr**
		Average Temperature :	**28.0 ^{o}C**	**Average Truck Vacuum:**	**61.6 kPa**

Soil Vapour / Multi-Phase Extraction Trial Monitoring - Radius of Influence and Gauging

Site Name: Caltex Holt

Date / Time	Well ID	DTW (mBTOC)	DTP (mBTOC)	LNAPL (mm)	Vacuum (Pa)	Extraction Well ID	Droptube Depth (m)	Head Vac (kPa)	Well Vac (kPa)	Comments
17/09/2020 17:15	Core 1	8.507		0						Chemical Injection
17/09/2020 17:30	Core 1	8.482		0						Chemical Injection
17/09/2020 17:55	Core 1	8.440		0						Chemical Injection
15/09/2020 8:06	EW01	8.865	8.862	3						Total Depth = 13.970 m
16/09/2020 7:30	EW01	8.838		0						
16/09/2020 11:30	EW01	8.824		0		PEW01				
16/09/2020 15:30	EW01	8.820		0		PEW01				
17/09/2020 7:30	EW01	8.843		0						
17/09/2020 9:50	EW01	8.881		0		PEW01				
17/09/2020 16:00	EW01	8.845		0		PEW01				
17/09/2020 16:55	EW01	8.787		0						
17/09/2020 17:15	EW01	8.765		0						
17/09/2020 17:30	EW01	8.730		0						
17/09/2020 17:55	EW01	8.688		0						Chemical Injection
18/09/2020 7:28	EW01	8.880		0						Chemical Injection
18/09/2020 9:29	EW01	8.787		0						Chemical Injection
18/09/2020 11:03	EW01	8.770		0						Chemical Injection
15/09/2020 8:06	EW02	8.965		0						Total Depth = 11.740 m
16/09/2020 7:30	EW02	8.945		0						
16/09/2020 9:34	EW02	-		0	0	PEW01				
16/09/2020 10:55	EW02	-			0	PEW01				
16/09/2020 11:30	EW02	8.957		0	0	PEW01				
16/09/2020 12:47	EW02	-			0	PEW01				
16/09/2020 15:30	EW02	8.960		0		PEW01				
17/09/2020 7:30	EW02	8.946		0						
17/09/2020 9:04	EW02	-			0	PEW01				
17/09/2020 9:50	EW02	9.000		0		PEW01				
17/09/2020 10:02	EW02	-			0	PEW01				
17/09/2020 11:12	EW02	-			0	PEW01				
17/09/2020 12:13	EW02	-			0	PEW01				
17/09/2020 13:45	EW02	-			0	PEW01				
17/09/2020 15:38	EW02	-			0	PEW01				
17/09/2020 16:00	EW02	8.995		0		PEW01				
15/09/2020 8:06	EW03	9.238		0						
15/09/2020 11:00	EW03	-			0	PEW01				
15/09/2020 12:08	EW03	-			25	PEW01				
15/09/2020 13:19	EW03	-			55	PEW01				

Legend:
DTW = depth to water
DTP = depth to product
LNAPL = light non-aqueous phase liquid
mBTOC = meters below top of casing
kPa = kilopascals
Pa = pascals

Soil Vapour / Multi-Phase Extraction Trial Monitoring - Radius of Influence and Gauging

Site Name: Caltex Holt

Date / Time	Well ID	DTW (mBTOC)	DTP (mBTOC)	LNAPL (mm)	Vacuum (Pa)	Extraction Well ID	Droptube Depth (m)	Head Vac (kPa)	Well Vac (kPa)	Comments
15/09/2020 14:06	EW03	-			0	PEW01				
16/09/2020 7:30	EW03	9.204		0						
16/09/2020 11:30	EW03	9.194		0		PEW01				
16/09/2020 15:30	EW03	9.195		0		PEW01				
17/09/2020 7:30	EW03	9.220		0						
17/09/2020 9:04	EW03	-			50	PEW01				
17/09/2020 9:50	EW03	9.233		0		PEW01				
17/09/2020 10:02	EW03	-			82	PEW01				
17/09/2020 11:12	EW03	-			95	PEW01				
17/09/2020 12:13	EW03	-			90	PEW01				
17/09/2020 13:45	EW03	-			100	PEW01				
17/09/2020 15:38	EW03	-			110	PEW01				
18/09/2020 7:28	EW03	9.256		0						Chemical Injection
18/09/2020 11:32	EW03	9.222		0						Chemical Injection
18/09/2020 12:57	EW03	9.223		0						Chemical Injection
18/09/2020 13:15	EW03	9.213		0						Chemical Injection
18/09/2020 14:01	EW03	9.206		0						Chemical Injection
18/09/2020 14:31	EW03	9.195		0						Chemical Injection
18/09/2020 15:00	EW03	9.184		0						Chemical Injection
16/09/2020 9:34	IW01	-		0	0	PEW01				
16/09/2020 10:55	IW01	-			0	PEW01				
16/09/2020 11:30	IW01	-			0	PEW01				
16/09/2020 12:47	IW01	-			0	PEW01				
16/09/2020 15:30	IW01	8.650		0		PEW01				
17/09/2020 7:30	IW01	8.666		0						Heavy Sheen
17/09/2020 9:50	IW01					PEW01				Being Sampled
17/09/2020 16:00	IW01	8.685		0		PEW01				Well purged earlier
17/09/2020 16:55	IW01	8.845		0						
17/09/2020 18:07	IW01	2.060		0						
17/09/2020 18:12	IW01	5.900		0						
18/09/2020 7:28	IW01	9.081	9.079	2						
18/09/2020 11:12	IW01	3.800		0						
18/09/2020 11:12	IW01	4.060		0						
18/09/2020 11:13	IW01	4.250		0						
18/09/2020 11:13	IW01	4.400		0						
18/09/2020 11:14	IW01	4.660		0						
18/09/2020 11:14	IW01	4.860		0						
18/09/2020 11:15	IW01	5.060		0						
18/09/2020 11:15	IW01	5.220		0						

Legend:
DTW = depth to water
DTP = depth to product
LNAPL = light non-aqueous phase liquid
mBTOC = meters below top of casing
kPa = kilopascals
Pa = pascals

Soil Vapour / Multi-Phase Extraction Trial Monitoring - Radius of Influence and Gauging

Site Name: Caltex Holt

Date / Time	Well ID	DTW (mBTOC)	DTP (mBTOC)	LNAPL (mm)	Vacuum (Pa)	Extraction Well ID	Droptube Depth (m)	Head Vac (kPa)	Well Vac (kPa)	Comments
18/09/2020 11:16	IW01	5.390		0						
18/09/2020 11:16	IW01	5.550		0						
18/09/2020 11:17	IW01	5.710		0						
18/09/2020 11:17	IW01	5.870		0						
18/09/2020 11:18	IW01	6.000		0						
18/09/2020 11:18	IW01	6.130		0						
15/09/2020 8:06	IW02	9.406		0						
16/09/2020 7:30	IW02	9.393		0						Odour
16/09/2020 11:30	IW02	9.385		0	0	PEW01				Odour
16/09/2020 12:47	IW02	-			10	PEW01				
16/09/2020 14:10	IW02	-			20	PEW01				
16/09/2020 15:30	IW02	9.390		0		PEW01				
17/09/2020 7:30	IW02	9.395		0						
17/09/2020 9:04	IW02	-			5	PEW01				
17/09/2020 9:50	IW02	9.408		0		PEW01				
17/09/2020 10:02	IW02	-				PEW01				
18/09/2020 7:28	IW02	9.439		0						Chemical Injection
18/09/2020 11:32	IW02	9.424		0						Chemical Injection
18/09/2020 15:00	IW02	7.210		0						Chemical Injection
15/09/2020 8:06	IW03	10.587		0						Total Depth = 14.300 m
15/09/2020 11:00	IW03	-			0	PEW01				
15/09/2020 12:08	IW03	-			0	PEW01				
15/09/2020 13:19	IW03	-			0	PEW01				
15/09/2020 14:06	IW03	-			0	PEW01				
16/09/2020 11:30	IW03	-			55	PEW01				
16/09/2020 12:47	IW03	-			100	PEW01				
16/09/2020 12:47	IW03	-			0	PEW01				
16/09/2020 14:10	IW03	-			125	PEW01				
17/09/2020 7:30	IW03	10.564		0						
17/09/2020 9:50	IW03	10.563		0		PEW01				
17/09/2020 12:30	IW03	13.010		0		PEW01				Well had been bailed
17/09/2020 16:30	IW03	0.854		0						Chemical Injection
17/09/2020 16:35	IW03	2.115		0						Chemical Injection
17/09/2020 18:07	IW03	8.912		0						Chemical Injection
18/09/2020 7:28	IW03	10.494		0						Chemical Injection
15/09/2020 8:06	MW01	9.503		0						
15/09/2020 11:00	MW01	-			0	PEW01				

Legend:
DTW = depth to water
DTP = depth to product
LNAPL = light non-aqueous phase liquid
mBTOC = meters below top of casing
kPa = kilopascals
Pa = pascals

Soil Vapour / Multi-Phase Extraction Trial Monitoring - Radius of Influence and Gauging

Site Name: Caltex Holt

Date / Time	Well ID	DTW (mBTOC)	DTP (mBTOC)	LNAPL (mm)	Vacuum (Pa)	Extraction Well ID	Droptube Depth (m)	Head Vac (kPa)	Well Vac (kPa)	Comments
15/09/2020 12:08	MW01	-			5	PEW01				
15/09/2020 13:19	MW01	-			15	PEW01				
15/09/2020 14:06	MW01	-			20	PEW01				
16/09/2020 7:30	MW01	9.492		0						
16/09/2020 11:30	MW01	9.483		0	15	PEW01				
16/09/2020 12:47	MW01	-			30	PEW01				
16/09/2020 14:10	MW01	-			50	PEW01				
16/09/2020 15:30	MW01	9.490		0		PEW01				
17/09/2020 9:04	MW01	-			15	PEW01				
17/09/2020 10:02	MW01	-			35	PEW01				
17/09/2020 11:12	MW01	-			25	PEW01				
17/09/2020 12:13	MW01	-			25	PEW01				
17/09/2020 13:45	MW01	-			35	PEW01				
17/09/2020 15:38	MW01	-			60	PEW01				
17/09/2020 16:00	MW01	9.513		0		PEW01				
18/09/2020 7:28	MW01	9.527		0						Chemical Injection
18/09/2020 11:32	MW01	9.522		0						Chemical Injection
18/09/2020 12:57	MW01	9.472		0						Chemical Injection
18/09/2020 13:15	MW01	9.316		0						Chemical Injection
18/09/2020 14:01	MW01	9.472		0						Chemical Injection
18/09/2020 14:31	MW01	9.254		0						Chemical Injection
18/09/2020 15:00	MW01	9.334		0						Chemical Injection
15/09/2020 8:06	MW02	9.064	9.043	21						Total Depth = 10.845 m
15/09/2020 14:28	MW02	9.056	9.035	21		PEW01				
15/09/2020 15:49	MW02	9.045	9.030	15		PEW01				
16/09/2020 9:34	MW02	-			210	PEW01				
16/09/2020 10:55	MW02	-			240	PEW01				
16/09/2020 11:30	MW02	9.069	9.051	18	550	PEW01				
16/09/2020 12:47	MW02	-			650	PEW01				
16/09/2020 14:10	MW02	-			600	PEW01				
16/09/2020 15:01	MW02	-			550	PEW01				
16/09/2020 15:30	MW02	9.070	9.050	20		PEW01				
17/09/2020 7:30	MW02	9.040	9.026	14						
17/09/2020 9:04	MW02	-			450	PEW01				
17/09/2020 9:50	MW02	9.115	9.095	20		PEW01				
17/09/2020 9:50	MW02	9.505		0		PEW01				
17/09/2020 10:02	MW02	-			450	PEW01				
17/09/2020 11:12	MW02	-			500	PEW01				
17/09/2020 12:13	MW02	-			340	PEW01				

Legend:
DTW = depth to water
DTP = depth to product
LNAPL = light non-aqueous phase liquid
mBTOC = meters below top of casing
kPa = kilopascals
Pa = pascals

Soil Vapour / Multi-Phase Extraction Trial Monitoring - Radius of Influence and Gauging

Site Name: Caltex Holt

Date / Time	Well ID	DTW (mBTOC)	DTP (mBTOC)	LNAPL (mm)	Vacuum (Pa)	Extraction Well ID	Droptube Depth (m)	Head Vac (kPa)	Well Vac (kPa)	Comments
17/09/2020 13:45	MW02	-			390	PEW01				
17/09/2020 15:38	MW02	-			550	PEW01				
17/09/2020 16:00	MW02	9.117	9.100	17		PEW01				
15/09/2020 8:06	MW04	8.334		0						
15/09/2020 11:00	MW04	-			20	PEW01				
15/09/2020 11:18	MW04	-			0	PEW01				
15/09/2020 12:08	MW04	-			40	PEW01				
15/09/2020 12:40	MW04	-			45	PEW01				
15/09/2020 13:19	MW04	-			100	PEW01				
15/09/2020 14:06	MW04	-			130	PEW01				
16/09/2020 7:30	MW04	8.547		0						
16/09/2020 7:30	MW04	8.317		0						
16/09/2020 9:34	MW04	-		0	30	PEW01				
16/09/2020 10:55	MW04	-			20	PEW01				
16/09/2020 11:30	MW04	8.603		0	75	PEW01				Heavy Sheen
16/09/2020 11:30	MW04	8.318		0	75	PEW01				
16/09/2020 12:47	MW04	-			140	PEW01				
16/09/2020 14:10	MW04	-			150	PEW01				
16/09/2020 15:30	MW04	8.330		0		PEW01				
17/09/2020 7:30	MW04	8.324		0						
17/09/2020 9:04	MW04	-			85	PEW01				
17/09/2020 9:50	MW04	8.348		0		PEW01				
17/09/2020 10:02	MW04	-			109	PEW01				
17/09/2020 11:12	MW04	-			110	PEW01				
17/09/2020 12:13	MW04	-			110	PEW01				
17/09/2020 13:45	MW04	-			130	PEW01				
17/09/2020 15:38	MW04	-			120	PEW01				
17/09/2020 16:00	MW04	8.358		0		PEW01				
18/09/2020 7:28	MW04	8.364		0						Chemical Injection
15/09/2020 8:06	MW05	8.412		0						Total Depth = 11.740 m
15/09/2020 14:25	MW05	8.398		0		PEW01				
15/09/2020 15:44	MW05	8.387		0		PEW01				
16/09/2020 7:30	MW05	8.386		0						
16/09/2020 9:34	MW05	-		0	260	PEW01				
16/09/2020 10:55	MW05	-			340	PEW01				
16/09/2020 11:30	MW05	8.427		0	550	PEW01				
16/09/2020 12:47	MW05	-			1000	PEW01				
16/09/2020 14:10	MW05	-			900	PEW01				

Legend:
DTW = depth to water
DTP = depth to product
LNAPL = light non-aqueous phase liquid
mBTOC = meters below top of casing
kPa = kilopascals
Pa = pascals

Soil Vapour / Multi-Phase Extraction Trial Monitoring - Radius of Influence and Gauging

Site Name: Caltex Holt

Date / Time	Well ID	DTW (mBTOC)	DTP (mBTOC)	LNAPL (mm)	Vacuum (Pa)	Extraction Well ID	Droptube Depth (m)	Head Vac (kPa)	Well Vac (kPa)	Comments
16/09/2020 15:01	MW05	-			900	PEW01				
16/09/2020 15:30	MW05	8.420		0		PEW01				
17/09/2020 7:30	MW05	8.388		0						
17/09/2020 9:04	MW05	-			550	PEW01				
17/09/2020 9:50	MW05	8.475		0		PEW01				
17/09/2020 10:02	MW05	-			700	PEW01				
17/09/2020 11:12	MW05	-			700	PEW01				
17/09/2020 12:13	MW05	-			800	PEW01				
17/09/2020 13:45	MW05	-			1000	PEW01				
17/09/2020 15:38	MW05	-			850	PEW01				
17/09/2020 16:00	MW05	8.457		0		PEW01				
15/09/2020 8:06	MW06	8.572	8.529	43						Total Depth = 13.300 m
15/09/2020 15:56	MW06	8.526	8.482	44		PEW01				
16/09/2020 7:30	MW06	8.527	8.490	37						
16/09/2020 9:34	MW06	-		0	0	PEW01				
16/09/2020 10:55	MW06	-			0	PEW01				
16/09/2020 11:30	MW06	8.522	8.482	40	0	PEW01				
16/09/2020 12:47	MW06	-			0	PEW01				
16/09/2020 14:10	MW06	-			0	PEW01				
16/09/2020 15:01	MW06	-			0	PEW01				
16/09/2020 15:30	MW06	8.575	8.475	100		PEW01				
17/09/2020 7:30	MW06	8.528	8.491	37						
17/09/2020 9:50	MW06	8.568	8.530	38		PEW01				
17/09/2020 16:00	MW06	8.569		0		PEW01				Well Sampled Earlier
17/09/2020 16:55	MW06	8.498		0						Chemical Injection
17/09/2020 17:15	MW06	8.463		0						Chemical Injection
17/09/2020 17:30	MW06	8.425		0						Chemical Injection
17/09/2020 17:55	MW06	8.372		0						Chemical Injection
18/09/2020 7:28	MW06	8.544	8.541	3						Chemical Injection
18/09/2020 9:29	MW06	8.457		0						Chemical Injection
18/09/2020 11:03	MW06	8.452		0						Chemical Injection
15/09/2020 8:06	MW07	9.006		0						Total Depth = 13.510 m
15/09/2020 11:00	MW07	-			0	PEW01				
15/09/2020 12:08	MW07	-			40	PEW01				
15/09/2020 13:19	MW07	-			130	PEW01				
15/09/2020 14:06	MW07	-			140	PEW01				
16/09/2020 12:47	MW07	-			140	PEW01				
16/09/2020 14:10	MW07	-			180	PEW01				

Legend:
DTW = depth to water
DTP = depth to product
LNAPL = light non-aqueous phase liquid
mBTOC = meters below top of casing
kPa = kilopascals
Pa = pascals

Soil Vapour / Multi-Phase Extraction Trial Monitoring - Radius of Influence and Gauging

Site Name: Caltex Holt

Date / Time	Well ID	DTW (mBTOC)	DTP (mBTOC)	LNAPL (mm)	Vacuum (Pa)	Extraction Well ID	Droptube Depth (m)	Head Vac (kPa)	Well Vac (kPa)	Comments
16/09/2020 15:30	MW07	8.965		0		PEW01				
17/09/2020 7:30	MW07	8.985		0						
17/09/2020 9:04	MW07	-			110	PEW01				
17/09/2020 10:02	MW07	-			180	PEW01				
17/09/2020 11:12	MW07	-			100	PEW01				
17/09/2020 12:13	MW07	-			130	PEW01				
17/09/2020 13:45	MW07	-			170	PEW01				
17/09/2020 15:38	MW07	-			150	PEW01				
17/09/2020 16:00	MW07	9.432		0		PEW01				Well Sampled Earlier
17/09/2020 16:55	MW07	9.417		0						Chemical Injection
17/09/2020 17:15	MW07	9.410		0						Chemical Injection
17/09/2020 17:30	MW07	9.405		0						Chemical Injection
17/09/2020 17:55	MW07	9.395		0						Chemical Injection
18/09/2020 7:28	MW07	9.203		0	Sheen					Chemical Injection
18/09/2020 9:29	MW07	9.233		0						Chemical Injection
18/09/2020 11:03	MW07	9.207		0						Chemical Injection
15/09/2020 8:06	MW08	9.640		0						
15/09/2020 11:00	MW08	-			0	PEW01				
15/09/2020 12:08	MW08	-			0	PEW01				
15/09/2020 13:19	MW08	-			0	PEW01				
15/09/2020 14:06	MW08	-			0	PEW01				
16/09/2020 12:47	MW08	-			0	PEW01				
17/09/2020 9:04	MW08	-			0	PEW01				
17/09/2020 10:02	MW08	-			0	PEW01				
17/09/2020 11:12	MW08	-			0	PEW01				
17/09/2020 12:13	MW08	-			0	PEW01				
17/09/2020 13:45	MW08	-			0	PEW01				
17/09/2020 15:38	MW08	-			0	PEW01				
15/09/2020 8:06	MW09	10.492		0						
15/09/2020 11:00	MW09	-			0	PEW01				
15/09/2020 12:08	MW09	-			0	PEW01				
15/09/2020 13:19	MW09	-			0	PEW01				
15/09/2020 14:06	MW09	-			0	PEW01				
16/09/2020 12:47	MW09	-			0	PEW01				
17/09/2020 9:04	MW09	-			0	PEW01				
17/09/2020 10:02	MW09	-			0	PEW01				
17/09/2020 11:12	MW09	-			0	PEW01				
17/09/2020 12:13	MW09	-			0	PEW01				

Legend:
DTW = depth to water
DTP = depth to product
LNAPL = light non-aqueous phase liquid
mBTOC = meters below top of casing
kPa = kilopascals
Pa = pascals

Soil Vapour / Multi-Phase Extraction Trial Monitoring - Radius of Influence and Gauging

Site Name: Caltex Holt

Date / Time	Well ID	DTW (mBTOC)	DTP (mBTOC)	LNAPL (mm)	Vacuum (Pa)	Extraction Well ID	Droptube Depth (m)	Head Vac (kPa)	Well Vac (kPa)	Comments
17/09/2020 12:30	MW09	10.473		0		PEW01				
17/09/2020 13:45	MW09	-			0	PEW01				
17/09/2020 15:38	MW09	-			0	PEW01				
15/09/2020 8:06	MW10	10.605	10.600	5						
15/09/2020 11:00	MW10	-			0	PEW01				
15/09/2020 12:08	MW10	-			0	PEW01				
15/09/2020 13:19	MW10	-			0	PEW01				
15/09/2020 14:06	MW10	-			0	PEW01				
16/09/2020 12:47	MW10	-			0	PEW01				
17/09/2020 7:30	MW10	10.588	10.580	8						
17/09/2020 9:04	MW10	-			0	PEW01				
17/09/2020 9:50	MW10	10.597	10.586	11		PEW01				
17/09/2020 10:02	MW10	-			0	PEW01				
17/09/2020 11:12	MW10	-			0	PEW01				
17/09/2020 12:13	MW10	-			0	PEW01				
17/09/2020 12:30	MW10	10.588	10.580	8		PEW01				
17/09/2020 13:45	MW10	-			0	PEW01				
17/09/2020 15:38	MW10	-			0	PEW01				
17/09/2020 16:00	MW10			#N/A		PEW01				
18/09/2020 8:05	MW10	10.612	10.607	5						Chemical Injection
15/09/2020 8:06	MW11	10.602		0						
15/09/2020 11:00	MW11	-			0	PEW01				
15/09/2020 12:08	MW11	-			0	PEW01				
15/09/2020 13:19	MW11	-			0	PEW01				
15/09/2020 14:06	MW11	-			0	PEW01				
16/09/2020 12:47	MW11	-			0	PEW01				
17/09/2020 7:30	MW11	10.575		0						
17/09/2020 9:04	MW11	-			0	PEW01				
17/09/2020 9:50	MW11	10.581		0		PEW01				
17/09/2020 10:02	MW11	-			0	PEW01				
17/09/2020 11:12	MW11	-			0	PEW01				
17/09/2020 12:13	MW11	-			0	PEW01				
17/09/2020 12:30	MW11	10.600		0		PEW01				
17/09/2020 13:45	MW11	-			0	PEW01				
17/09/2020 15:38	MW11	-			0	PEW01				
17/09/2020 16:00	MW11	10.580		0		PEW01				
15/09/2020 8:06	MW12	9.611		0						

Legend:
DTW = depth to water
DTP = depth to product
LNAPL = light non-aqueous phase liquid
mBTOC = meters below top of casing
kPa = kilopascals
Pa = pascals

Soil Vapour / Multi-Phase Extraction Trial Monitoring - Radius of Influence and Gauging

Site Name: Caltex Holt

Date / Time	Well ID	DTW (mBTOC)	DTP (mBTOC)	LNAPL (mm)	Vacuum (Pa)	Extraction Well ID	Droptube Depth (m)	Head Vac (kPa)	Well Vac (kPa)	Comments
15/09/2020 8:06	MW13	8.702		0						
15/09/2020 8:06	MW14	7.815		0						
15/09/2020 8:06	MW15	7.594	7.526	68						Total Depth = 10.900 m
15/09/2020 14:37	MW15	7.569	7.510	59		PEW01				
15/09/2020 15:45	MW15	7.565	7.510	55		PEW01				
16/09/2020 7:30	MW15	7.560	7.505	55						
16/09/2020 9:34	MW15	-		0	0	PEW01				
17/09/2020 7:30	MW15	7.565	7.507	58						
17/09/2020 9:04	MW15	-			10	PEW01				
17/09/2020 9:50	MW15	7.590	7.525	65		PEW01				
17/09/2020 10:02	MW15	-			8	PEW01				
17/09/2020 11:12	MW15	-			20	PEW01				
17/09/2020 12:13	MW15	-			5	PEW01				
17/09/2020 13:45	MW15	-			10	PEW01				
17/09/2020 15:38	MW15	-			11	PEW01				
17/09/2020 16:00	MW15	7.599	7.529	70		PEW01				
18/09/2020 7:28	MW15	7.617	7.546	71						Chemical injection
15/09/2020 11:00	MW15-1	-			0	PEW01				
15/09/2020 12:08	MW15-1	-			0	PEW01				
15/09/2020 12:40	MW15-1	-			0	PEW01				
15/09/2020 13:19	MW15-1	-			0	PEW01				
15/09/2020 14:06	MW15-1	-			0	PEW01				
15/09/2020 11:00	MW15-2	-			0	PEW01				
15/09/2020 12:08	MW15-2	-			0	PEW01				
15/09/2020 12:40	MW15-2	-			0	PEW01				
15/09/2020 13:19	MW15-2	-			7	PEW01				
15/09/2020 14:06	MW15-2	-			5	PEW01				
16/09/2020 9:34	MW15-L	-		0	0	PEW01				
17/09/2020 9:04	MW15-L	-			5	PEW01				
17/09/2020 10:02	MW15-L	-			4	PEW01				
17/09/2020 11:12	MW15-L	-			10	PEW01				
17/09/2020 12:13	MW15-L	-			10	PEW01				
17/09/2020 13:45	MW15-L	-			10	PEW01				
17/09/2020 15:38	MW15-L	-			11	PEW01				

Legend:
DTW = depth to water
DTP = depth to product
LNAPL = light non-aqueous phase liquid
mBTOC = meters below top of casing
kPa = kilopascals
Pa = pascals

Soil Vapour / Multi-Phase Extraction Trial Monitoring - Radius of Influence and Gauging

Site Name: Caltex Holt

Date / Time	Well ID	DTW (mBTOC)	DTP (mBTOC)	LNAPL (mm)	Vacuum (Pa)	Extraction Well ID	Droptube Depth (m)	Head Vac (kPa)	Well Vac (kPa)	Comments
16/09/2020 9:34	MW15-S	-		0	0	PEW01				
17/09/2020 9:04	MW15-S	-			0	PEW01				
17/09/2020 10:02	MW15-S	-			0	PEW01				
17/09/2020 11:12	MW15-S	-			10	PEW01				
17/09/2020 12:13	MW15-S	-			10	PEW01				
17/09/2020 13:45	MW15-S	-			10	PEW01				
17/09/2020 15:38	MW15-S	-			6	PEW01				
15/09/2020 8:06	MW16	7.726	7.646	80						Total Depth = 10.415 m
15/09/2020 14:35	MW16	7.690	7.630	60		PEW01				
15/09/2020 15:46	MW16	7.688	7.630	58		PEW01				
16/09/2020 7:30	MW16	7.688	7.629	59						
16/09/2020 9:34	MW16	-		0	15	PEW01				
16/09/2020 10:55	MW16	-			10	PEW01				
16/09/2020 11:30	MW16	7.688	7.628	60	35	PEW01				
16/09/2020 12:47	MW16	-			65	PEW01				
16/09/2020 14:10	MW16	-			100	PEW01				
16/09/2020 15:30	MW16	7.685	7.630	55		PEW01				
17/09/2020 7:30	MW16	7.690	7.634	56						
17/09/2020 9:04	MW16	-			25	PEW01				
17/09/2020 9:50	MW16	7.733	7.655	78		PEW01				
17/09/2020 10:02	MW16	-			60	PEW01				
17/09/2020 11:12	MW16	-			70	PEW01				
17/09/2020 12:13	MW16	-			30	PEW01				
17/09/2020 13:45	MW16	-			40	PEW01				
17/09/2020 15:38	MW16	-			80	PEW01				
17/09/2020 16:00	MW16	7.745	7.658	87		PEW01				
18/09/2020 7:28	MW16	7.768	7.667	101						
15/09/2020 11:18	MW16-1	-			25	PEW01				
15/09/2020 12:08	MW16-1	-			30	PEW01				
15/09/2020 12:40	MW16-1	-			20	PEW01				
15/09/2020 13:19	MW16-1	-			50	PEW01				
15/09/2020 14:06	MW16-1	-			60	PEW01				
15/09/2020 11:18	MW16-2	-			15	PEW01				
15/09/2020 12:08	MW16-2	-			20	PEW01				
15/09/2020 12:40	MW16-2	-			15	PEW01				
15/09/2020 13:19	MW16-2	-			40	PEW01				

Legend:
DTW = depth to water
DTP = depth to product
LNAPL = light non-aqueous phase liquid
mBTOC = meters below top of casing
kPa = kilopascals
Pa = pascals

Soil Vapour / Multi-Phase Extraction Trial Monitoring - Radius of Influence and Gauging

Site Name: Caltex Holt

Date / Time	Well ID	DTW (mBTOC)	DTP (mBTOC)	LNAPL (mm)	Vacuum (Pa)	Extraction Well ID	Droptube Depth (m)	Head Vac (kPa)	Well Vac (kPa)	Comments
15/09/2020 14:06	MW16-2	-			50	PEW01				
16/09/2020 9:34	MW16-L	-			10	PEW01				
16/09/2020 10:55	MW16-L	-			15	PEW01				
16/09/2020 11:30	MW16-L	-			50	PEW01				
16/09/2020 12:47	MW16-L	-			80	PEW01				
16/09/2020 14:10	MW16-L	-			100	PEW01				
17/09/2020 9:04	MW16-L	-			0	PEW01				
17/09/2020 10:02	MW16-L	-			70	PEW01				
17/09/2020 11:12	MW16-L	-			90	PEW01				
17/09/2020 12:13	MW16-L	-			70	PEW01				
17/09/2020 13:45	MW16-L	-			70	PEW01				
17/09/2020 15:38	MW16-L	-			90	PEW01				
16/09/2020 9:34	MW16-S	-			10	PEW01				
16/09/2020 10:55	MW16-S	-			15	PEW01				
16/09/2020 11:30	MW16-S	-			35	PEW01				
16/09/2020 12:47	MW16-S	-			55	PEW01				
16/09/2020 14:10	MW16-S	-			70	PEW01				
17/09/2020 9:04	MW16-S	-			40	PEW01				
17/09/2020 10:02	MW16-S	-			36	PEW01				
17/09/2020 11:12	MW16-S	-			55	PEW01				
17/09/2020 12:13	MW16-S	-			45	PEW01				
17/09/2020 13:45	MW16-S	-			40	PEW01				
17/09/2020 15:38	MW16-S	-			65	PEW01				
16/09/2020 7:30	MW17	7.624		0						
16/09/2020 9:34	MW17	-		0	0	PEW01				
16/09/2020 10:55	MW17	-			0	PEW01				
16/09/2020 11:30	MW17	7.619		0	0	PEW01				Odour
16/09/2020 12:47	MW17	-			3	PEW01				
16/09/2020 14:10	MW17	-			0	PEW01				
16/09/2020 15:30	MW17	7.620		0		PEW01				
17/09/2020 7:30	MW17	7.632		0						
17/09/2020 9:04	MW17	-			0	PEW01				
17/09/2020 9:50	MW17	7.650		0		PEW01				
17/09/2020 10:02	MW17	-			0	PEW01				
17/09/2020 11:12	MW17	-			5	PEW01				
17/09/2020 12:13	MW17	-			0	PEW01				
17/09/2020 13:45	MW17	-			0	PEW01				

Legend:
DTW = depth to water
DTP = depth to product
LNAPL = light non-aqueous phase liquid
mBTOC = meters below top of casing
kPa = kilopascals
Pa = pascals

Soil Vapour / Multi-Phase Extraction Trial Monitoring - Radius of Influence and Gauging

Site Name: Caltex Holt

Date / Time	Well ID	DTW (mBTOC)	DTP (mBTOC)	LNAPL (mm)	Vacuum (Pa)	Extraction Well ID	Droptube Depth (m)	Head Vac (kPa)	Well Vac (kPa)	Comments
17/09/2020 15:38	MW17	-			0	PEW01				
17/09/2020 16:00	MW17	7.654		0		PEW01				
18/09/2020 7:28	MW17	7.670		0						
16/09/2020 9:34	MW17-L	-			0	PEW01				
16/09/2020 10:55	MW17-L	-			0	PEW01				
16/09/2020 11:30	MW17-L	-			2	PEW01				
16/09/2020 12:47	MW17-L	-			5	PEW01				
16/09/2020 14:10	MW17-L	-			0	PEW01				
17/09/2020 9:04	MW17-L	-			0	PEW01				
17/09/2020 10:02	MW17-L	-			9	PEW01				
17/09/2020 11:12	MW17-L	-			5	PEW01				
17/09/2020 12:13	MW17-L	-			10	PEW01				
17/09/2020 13:45	MW17-L	-			5	PEW01				
17/09/2020 15:38	MW17-L	-			5	PEW01				
16/09/2020 9:34	MW17-S	-			0	PEW01				
16/09/2020 10:55	MW17-S	-			0	PEW01				
16/09/2020 11:30	MW17-S	-			2	PEW01				
16/09/2020 12:47	MW17-S	-			0	PEW01				
16/09/2020 14:10	MW17-S	-			5	PEW01				
17/09/2020 9:04	MW17-S	-			3	PEW01				
17/09/2020 10:02	MW17-S	-			3	PEW01				
17/09/2020 11:12	MW17-S	-			5	PEW01				
17/09/2020 12:13	MW17-S	-			3	PEW01				
17/09/2020 13:45	MW17-S	-			5	PEW01				
17/09/2020 15:38	MW17-S	-			5	PEW01				
15/09/2020 8:06	PEW01	8.814		0						Total Depth = 11.975 m
15/09/2020 10:00	PEW01	9.503		0						Post Pump Removal
15/09/2020 14:43	PEW01	8.260		0		PEW01				Stick-up Added
16/09/2020 7:30	PEW01	8.770		0						
17/09/2020 7:30	PEW01	8.784		0			10.7			
17/09/2020 16:45	PEW01	10.445		0						
17/09/2020 17:08	PEW01	8.850		0						Chemical Injection
18/09/2020 7:28	PEW01	8.826		0						Chemical Injection
18/09/2020 9:29	PEW01	8.828		0						Chemical Injection
18/09/2020 11:03	PEW01	8.821		0						Chemical Injection
15/09/2020 8:06	PMW01	8.797	8.793	4						Total Depth = 11.760 m

Legend:
DTW = depth to water
DTP = depth to product
LNAPL = light non-aqueous phase liquid
mBTOC = meters below top of casing
kPa = kilopascals
Pa = pascals

Soil Vapour / Multi-Phase Extraction Trial Monitoring - Radius of Influence and Gauging

Site Name: Caltex Holt

Date / Time	Well ID	DTW (mBTOC)	DTP (mBTOC)	LNAPL (mm)	Vacuum (Pa)	Extraction Well ID	Droptube Depth (m)	Head Vac (kPa)	Well Vac (kPa)	Comments
15/09/2020 11:50	PMW01	8.787	8.784	3						
15/09/2020 15:50	PMW01	8.777	8.774	3		PEW01				
16/09/2020 7:30	PMW01	8.773	8.770	3						
16/09/2020 9:34	PMW01	-		0	200	PEW01				
16/09/2020 10:55	PMW01	-			160	PEW01				
16/09/2020 11:30	PMW01	8.858	8.854	4	550	PEW01				
16/09/2020 12:47	PMW01	-			900	PEW01				
16/09/2020 14:10	PMW01	-			500	PEW01				
16/09/2020 15:01	PMW01	-			1050	PEW01				
16/09/2020 15:30	PMW01	8.850	8.845	5		PEW01				
17/09/2020 7:30	PMW01	8.773	8.769	4						
17/09/2020 9:04	PMW01	-			465	PEW01				
17/09/2020 9:50	PMW01	8.934	8.930	4		PEW01				
17/09/2020 10:02	PMW01	-			900	PEW01				
17/09/2020 11:12	PMW01	-			550	PEW01				
17/09/2020 12:13	PMW01	-			1100	PEW01				
17/09/2020 13:45	PMW01	-			1400	PEW01				
17/09/2020 15:38	PMW01	-			1600	PEW01				
17/09/2020 16:00	PMW01	8.199	8.194	5		PEW01				
15/09/2020 8:06	PMW02	8.505		0						Total Depth = 11.755 m
15/09/2020 14:32	PMW02	8.499		0		PEW01				
15/09/2020 15:53	PMW02	8.487		0		PEW01				
16/09/2020 7:30	PMW02	8.485		0						
16/09/2020 9:34	PMW02	-		0	320	PEW01				
16/09/2020 10:55	PMW02	-			350	PEW01				
16/09/2020 11:30	PMW02	8.489		0	550	PEW01				
16/09/2020 12:47	PMW02	-			900	PEW01				
16/09/2020 14:10	PMW02	-			1000	PEW01				
16/09/2020 15:01	PMW02	-			800	PEW01				
16/09/2020 15:30	PMW02	8.500		0		PEW01				
17/09/2020 7:30	PMW02	8.484		0						
17/09/2020 9:04	PMW02	-			600	PEW01				
17/09/2020 9:50	PMW02	8.531		0		PEW01				
17/09/2020 10:02	PMW02	-			750	PEW01				
17/09/2020 11:12	PMW02	-			550	PEW01				
17/09/2020 12:13	PMW02	-			550	PEW01				
17/09/2020 13:45	PMW02	-			700	PEW01				
17/09/2020 15:38	PMW02	-			850	PEW01				
17/09/2020 16:00	PMW02	8.530		0		PEW01				

Legend:
DTW = depth to water
DTP = depth to product
LNAPL = light non-aqueous phase liquid
mBTOC = meters below top of casing
kPa = kilopascals
Pa = pascals

Soil Vapour / Multi-Phase Extraction Trial Monitoring - Radius of Influence and Gauging

Site Name: Caltex Holt

Date / Time	Well ID	DTW (mBTOC)	DTP (mBTOC)	LNAPL (mm)	Vacuum (Pa)	Extraction Well ID	Droptube Depth (m)	Head Vac (kPa)	Well Vac (kPa)	Comments
17/09/2020 16:55	PMW02	8.526		0						Chemical Injection
17/09/2020 17:15	PMW02	8.515		0						Chemical Injection
17/09/2020 17:30	PMW02	8.505		0						Chemical Injection
17/09/2020 17:55	PMW02	8.495		0						Chemical Injection
18/09/2020 7:28	PMW02	8.526		0						Chemical Injection
18/09/2020 9:29	PMW02	8.515		0						Chemical Injection
18/09/2020 11:03	PMW02	8.507		0						Chemical Injection
15/09/2020 8:06	PMW03	7.788		0						Total Depth = 11.640 m
15/09/2020 14:33	PMW03	7.775		0		PEW01				
15/09/2020 15:57	PMW03	7.769		0		PEW01				
16/09/2020 7:30	PMW03	7.767		0						
16/09/2020 9:34	PMW03	-		0	150	PEW01				
16/09/2020 10:55	PMW03	-			120	PEW01				
16/09/2020 11:30	PMW03	7.781		0	400	PEW01				
16/09/2020 12:47	PMW03	-			500	PEW01				
16/09/2020 14:10	PMW03	-			500	PEW01				
17/09/2020 7:30	PMW03	7.771		0						
17/09/2020 9:04	PMW03	-			320	PEW01				
17/09/2020 9:50	PMW03	7.815		0		PEW01				
17/09/2020 10:02	PMW03	-			390	PEW01				
17/09/2020 11:12	PMW03	-			400	PEW01				
17/09/2020 12:13	PMW03	-			375	PEW01				
17/09/2020 13:45	PMW03	-			410	PEW01				
17/09/2020 15:38	PMW03	-			450	PEW01				
17/09/2020 16:00	PMW03	7.819		0		PEW01				
18/09/2020 7:28	PMW03	7.809		0						
15/09/2020 8:06	PMW04	8.568		0						Total Depth = 10.164 m
15/09/2020 14:25	PMW04	8.564		0		PEW01				
15/09/2020 15:47	PMW04	8.552	8.550	2		PEW01				
16/09/2020 7:30	PMW04	8.547		0						
16/09/2020 9:34	PMW04	-		0	450	PEW01				
16/09/2020 10:55	PMW04	-			480	PEW01				
16/09/2020 11:30	PMW04	8.603			950	PEW01				
16/09/2020 12:47	PMW04	-			1200	PEW01				
16/09/2020 14:10	PMW04	-			1400	PEW01				
16/09/2020 15:30	PMW04	8.596		0		PEW01				
17/09/2020 7:30	PMW04	8.550		0						
17/09/2020 9:04	PMW04	-			900	PEW01				

Legend:
DTW = depth to water
DTP = depth to product
LNAPL = light non-aqueous phase liquid
mBTOC = meters below top of casing
kPa = kilopascals
Pa = pascals

Soil Vapour / Multi-Phase Extraction Trial Monitoring - Radius of Influence and Gauging

Site Name: Caltex Holt

Date / Time	Well ID	DTW (mBTOC)	DTP (mBTOC)	LNAPL (mm)	Vacuum (Pa)	Extraction Well ID	Droptube Depth (m)	Head Vac (kPa)	Well Vac (kPa)	Comments
17/09/2020 9:50	PMW04	8.650		0		PEW01				
17/09/2020 10:02	PMW04	-			950	PEW01				
17/09/2020 11:12	PMW04	-			900	PEW01				
17/09/2020 12:13	PMW04	-			1000	PEW01				
17/09/2020 13:45	PMW04	-			1100	PEW01				
17/09/2020 15:38	PMW04	-			1100	PEW01				
17/09/2020 16:00	PMW04	8.650	8.649	1		PEW01				
17/09/2020 9:04	PMW06	-			0	PEW01				
17/09/2020 10:02	PMW06	-			0	PEW01				
17/09/2020 11:12	PMW06	-			0	PEW01				
17/09/2020 12:13	PMW06	-			0	PEW01				
17/09/2020 13:45	PMW06	-			0	PEW01				
17/09/2020 15:38	PMW06	-			0	PEW01				
15/09/2020 11:18	RW01	-			0	PEW01				
17/09/2020 9:50	RW01	2.745		0		PEW01				No Vac Influence
18/09/2020 9:50	RW01	2.752		0						
15/09/2020 8:06	S2P02	6.969		0						
15/09/2020 8:06	S2P03	6.359		0						
15/09/2020 8:06	S2P04	6.072		0						
16/09/2020 12:47	V01	-			0	PEW01				
17/09/2020 10:02	V01	-			0	PEW01				
17/09/2020 11:12	V01	-			0	PEW01				
17/09/2020 12:13	V01	-			0	PEW01				
17/09/2020 13:45	V01	-			0	PEW01				
17/09/2020 15:38	V01	-			0	PEW01				
16/09/2020 12:47	V02	-			0	PEW01				
17/09/2020 10:02	V02	-			0	PEW01				
17/09/2020 11:12	V02	-			0	PEW01				
17/09/2020 12:13	V02	-			0	PEW01				
17/09/2020 13:45	V02	-			0	PEW01				
17/09/2020 15:38	V02	-			0	PEW01				
16/09/2020 12:47	V03	-			0	PEW01				

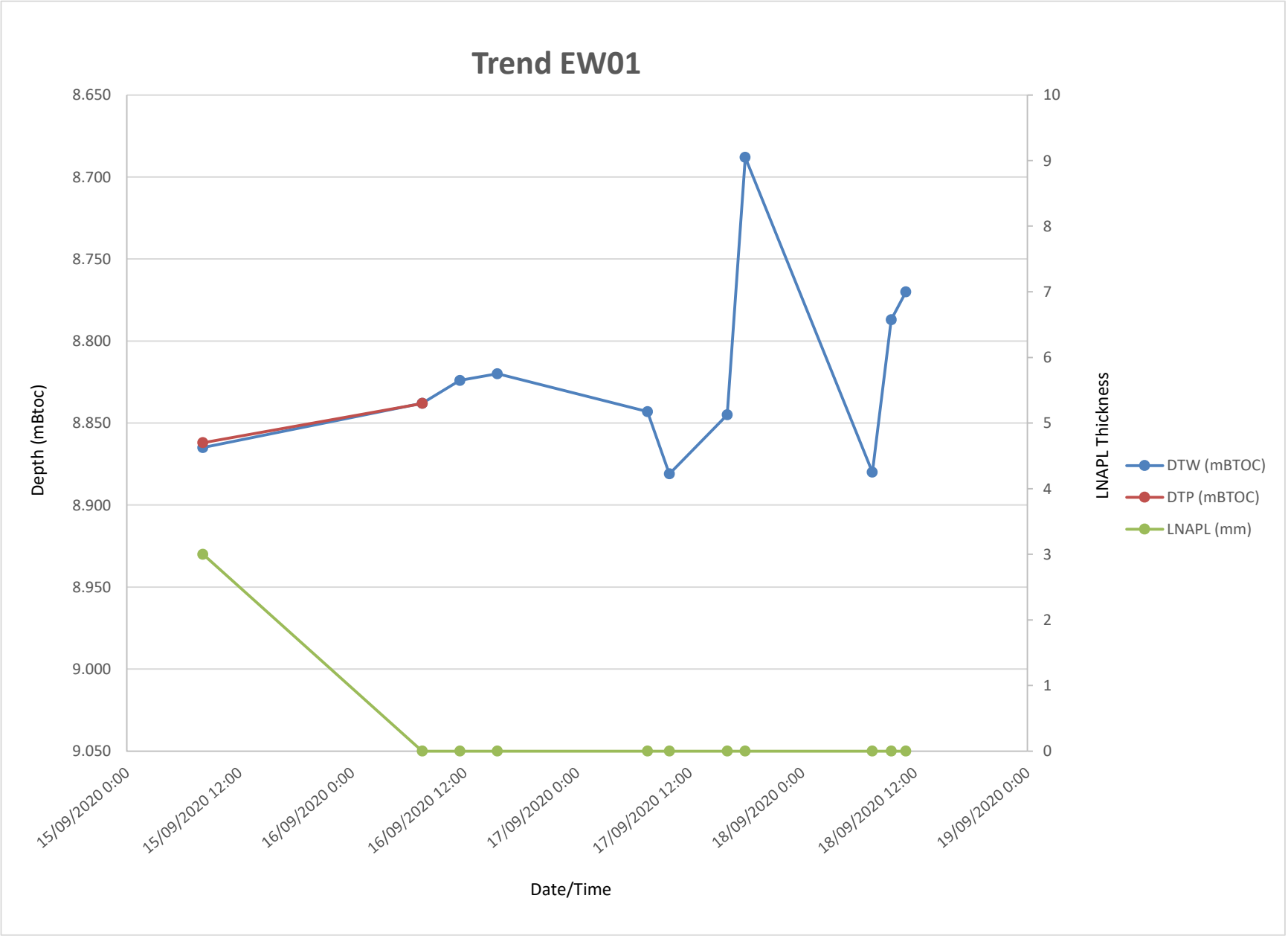
Legend:
DTW = depth to water
DTP = depth to product
LNAPL = light non-aqueous phase liquid
mBTOC = meters below top of casing
kPa = kilopascals
Pa = pascals

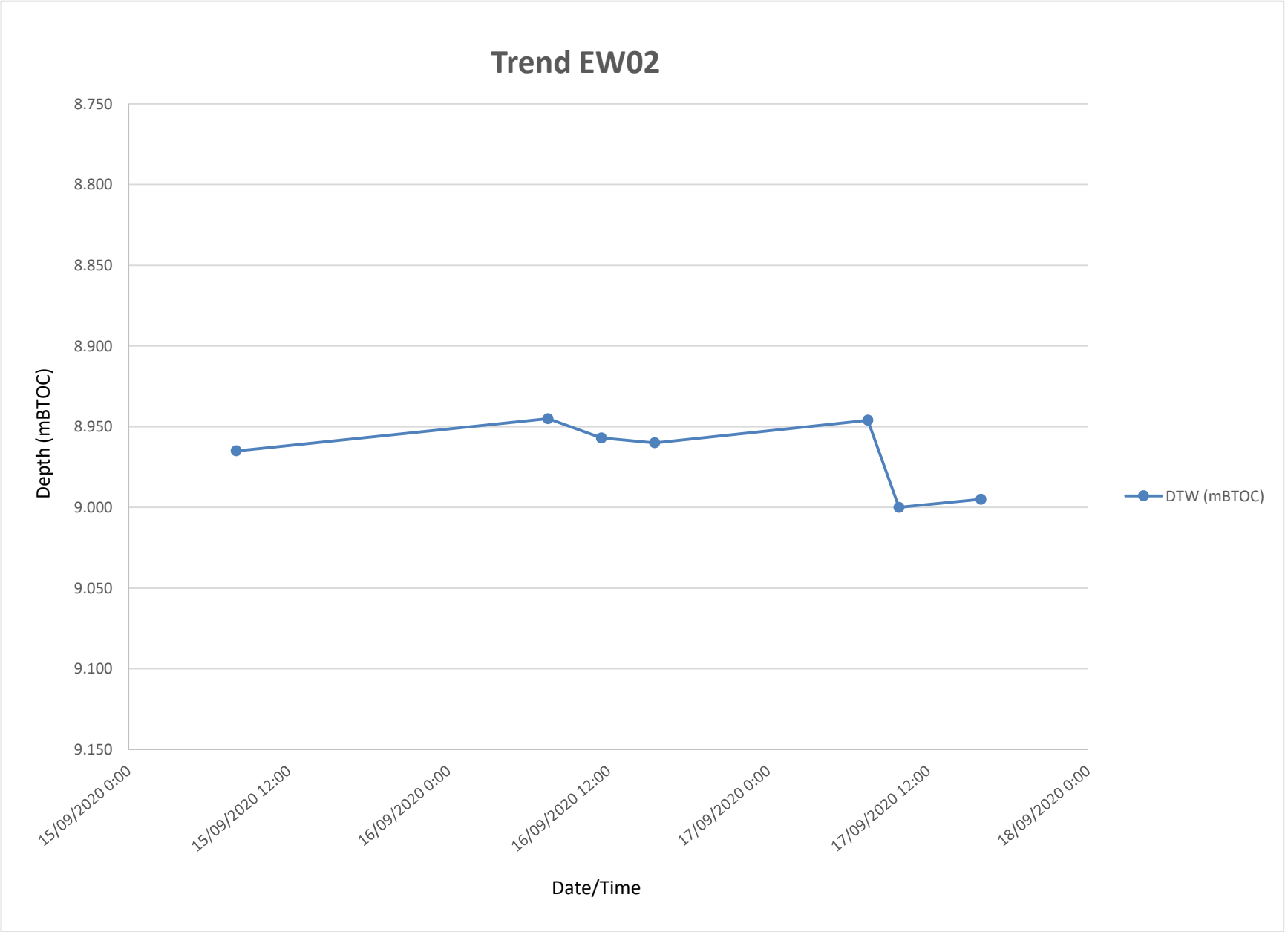
Soil Vapour / Multi-Phase Extraction Trial Monitoring - Radius of Influence and Gauging

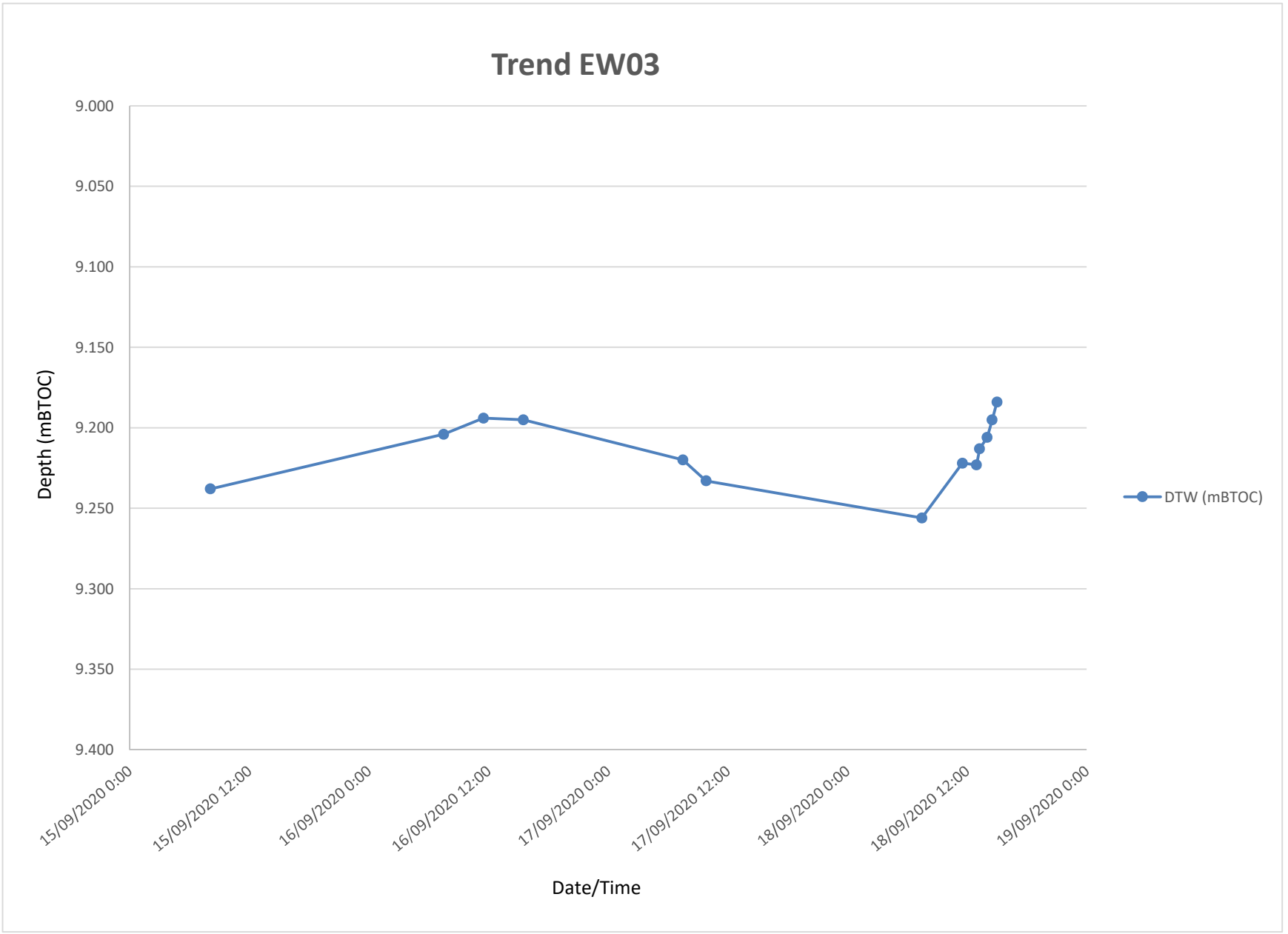
Site Name: Caltex Holt

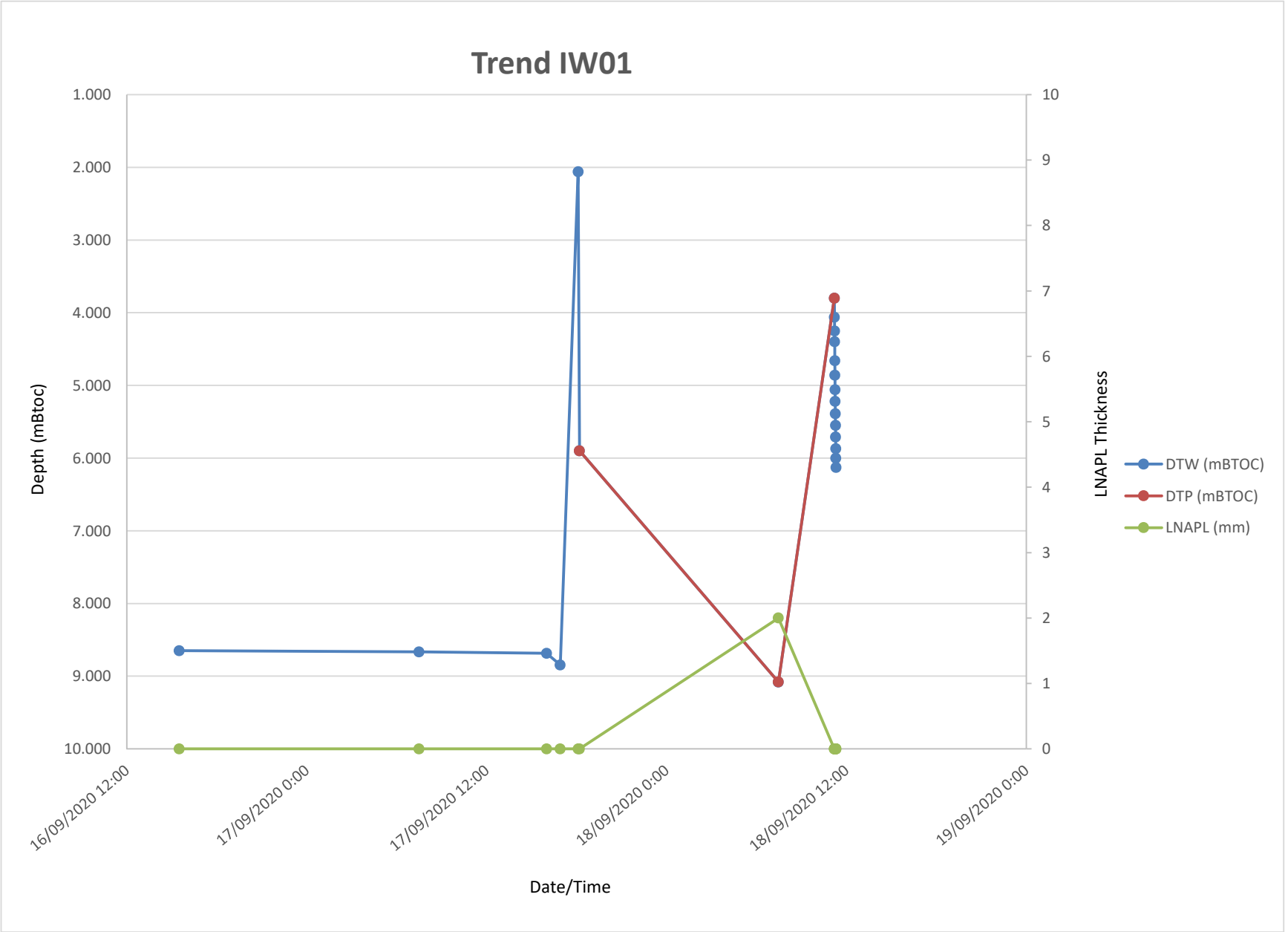
Date / Time	Well ID	DTW (mBTOC)	DTP (mBTOC)	LNAPL (mm)	Vacuum (Pa)	Extraction Well ID	Droptube Depth (m)	Head Vac (kPa)	Well Vac (kPa)	Comments
17/09/2020 10:02	V03	-			0	PEW01				
17/09/2020 11:12	V03	-			0	PEW01				
17/09/2020 12:13	V03	-			0	PEW01				
17/09/2020 13:45	V03	-			0	PEW01				
17/09/2020 15:38	V03	-			0	PEW01				
16/09/2020 12:47	V04	-			0	PEW01				
17/09/2020 10:02	V04	-			0	PEW01				
17/09/2020 11:12	V04	-			0	PEW01				
17/09/2020 12:13	V04	-			0	PEW01				
17/09/2020 13:45	V04	-			0	PEW01				
17/09/2020 15:38	V04	-			0	PEW01				
16/09/2020 12:47	V05	-			0	PEW01				
16/09/2020 12:47	V06	-			0	PEW01				
				#N/A						
				#N/A						
				#N/A						
				#N/A						
				#N/A						
				#N/A						
				#N/A						
				#N/A						
				#N/A						
				#N/A						
				#N/A						
				#N/A						
				#N/A						
				#N/A						
				#N/A						
				#N/A						
				#N/A						

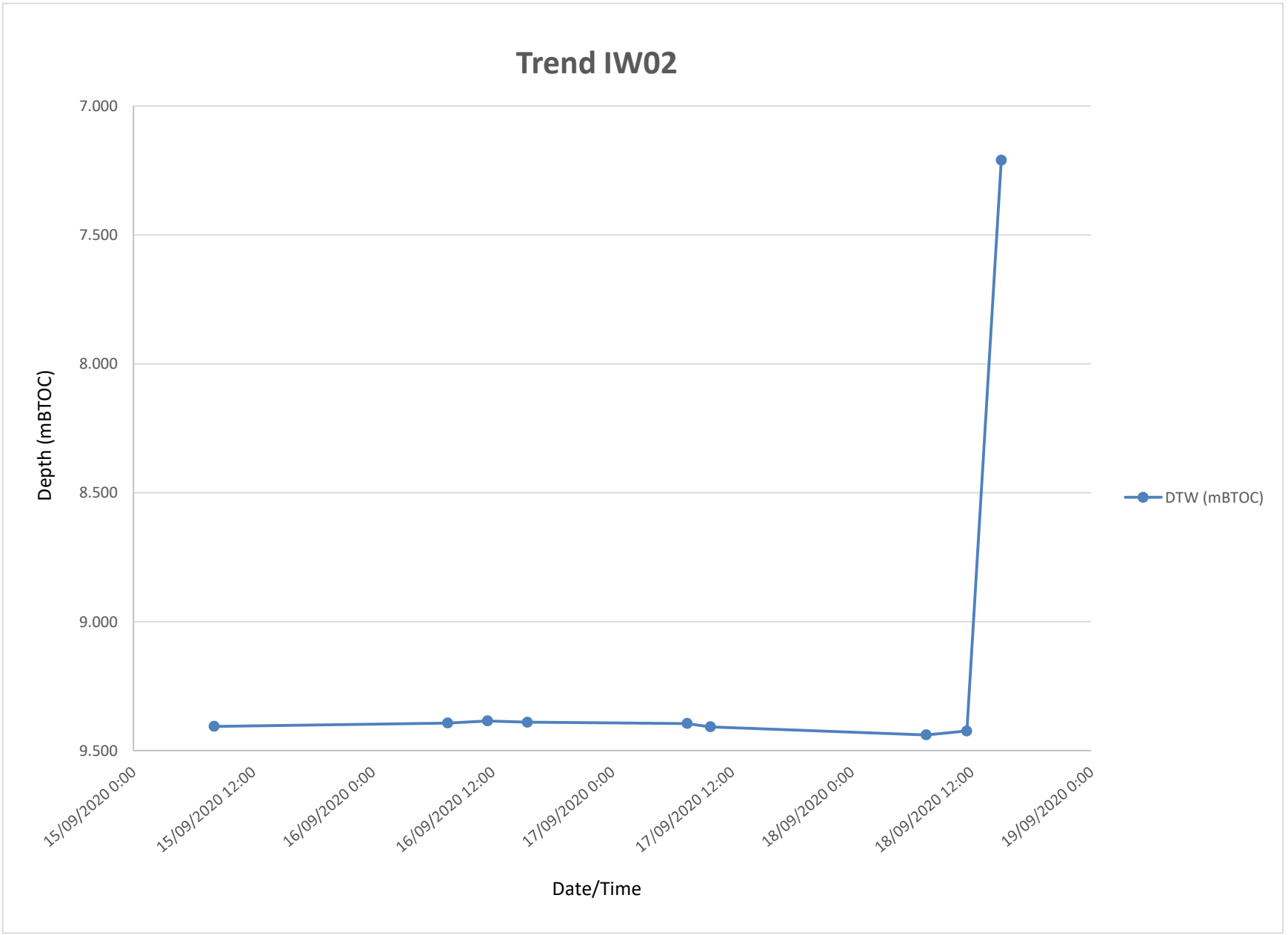
Legend:
DTW = depth to water
DTP = depth to product
LNAPL = light non-aqueous phase liquid
mBTOC = meters below top of casing
kPa = kilopascals
Pa = pascals

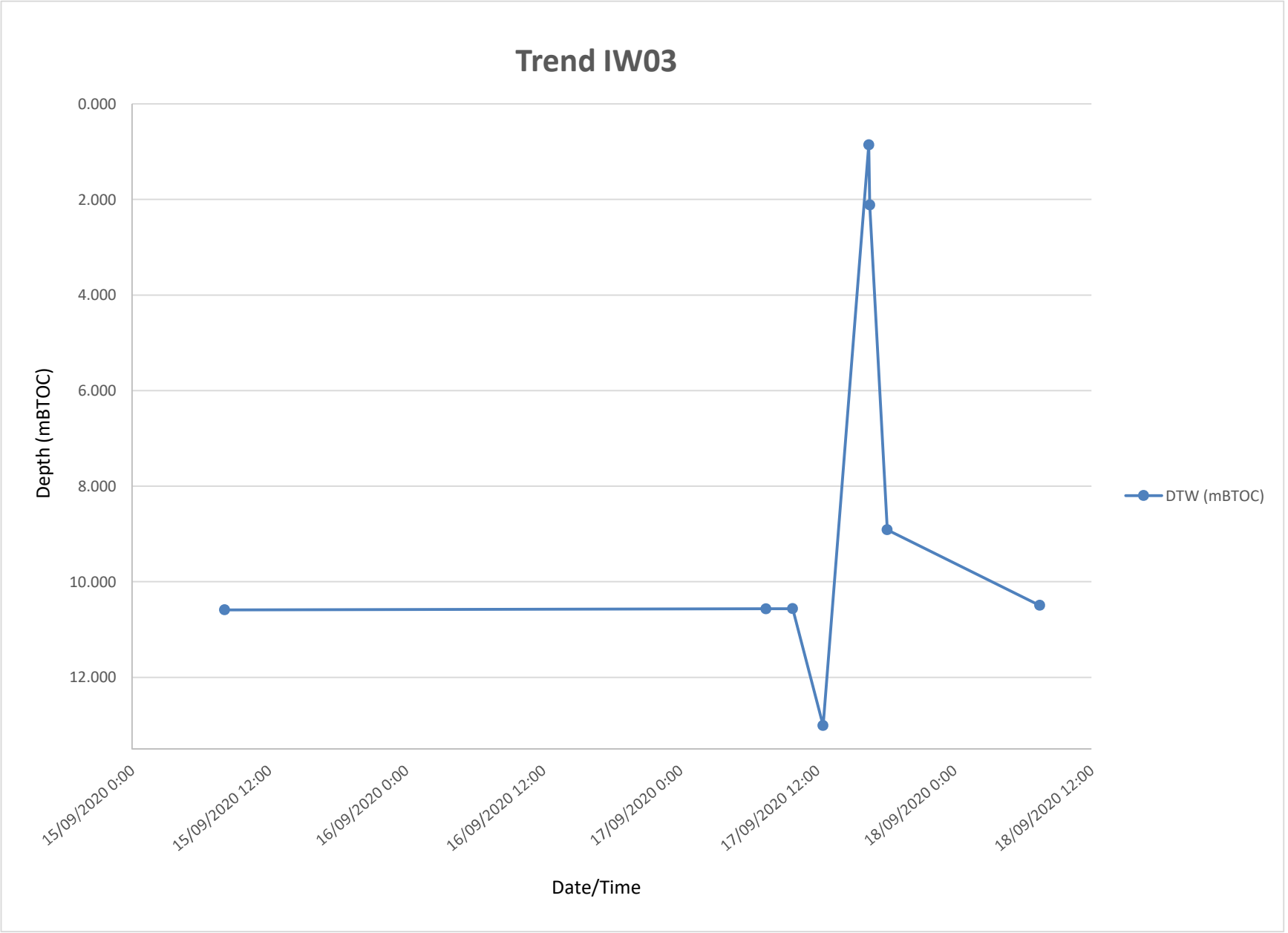

Trend EW01
8.650
8.700
8.750
8.800
8.850
8.900
8.950
9.000
9.050
Depth (mBtoc)
10
9
8
7
6
5
4
3
2
1
0
LNAPL Thickness
15/09/2020 0:00
15/09/2020 12:00
16/09/2020 0:00
16/09/2020 12:00
17/09/2020 0:00
17/09/2020 12:00
18/09/2020 0:00
18/09/2020 12:00
19/09/2020 0:00
Date/Time
DTW (mBTOC)
DTP (mBTOC)
LNAPL (mm)

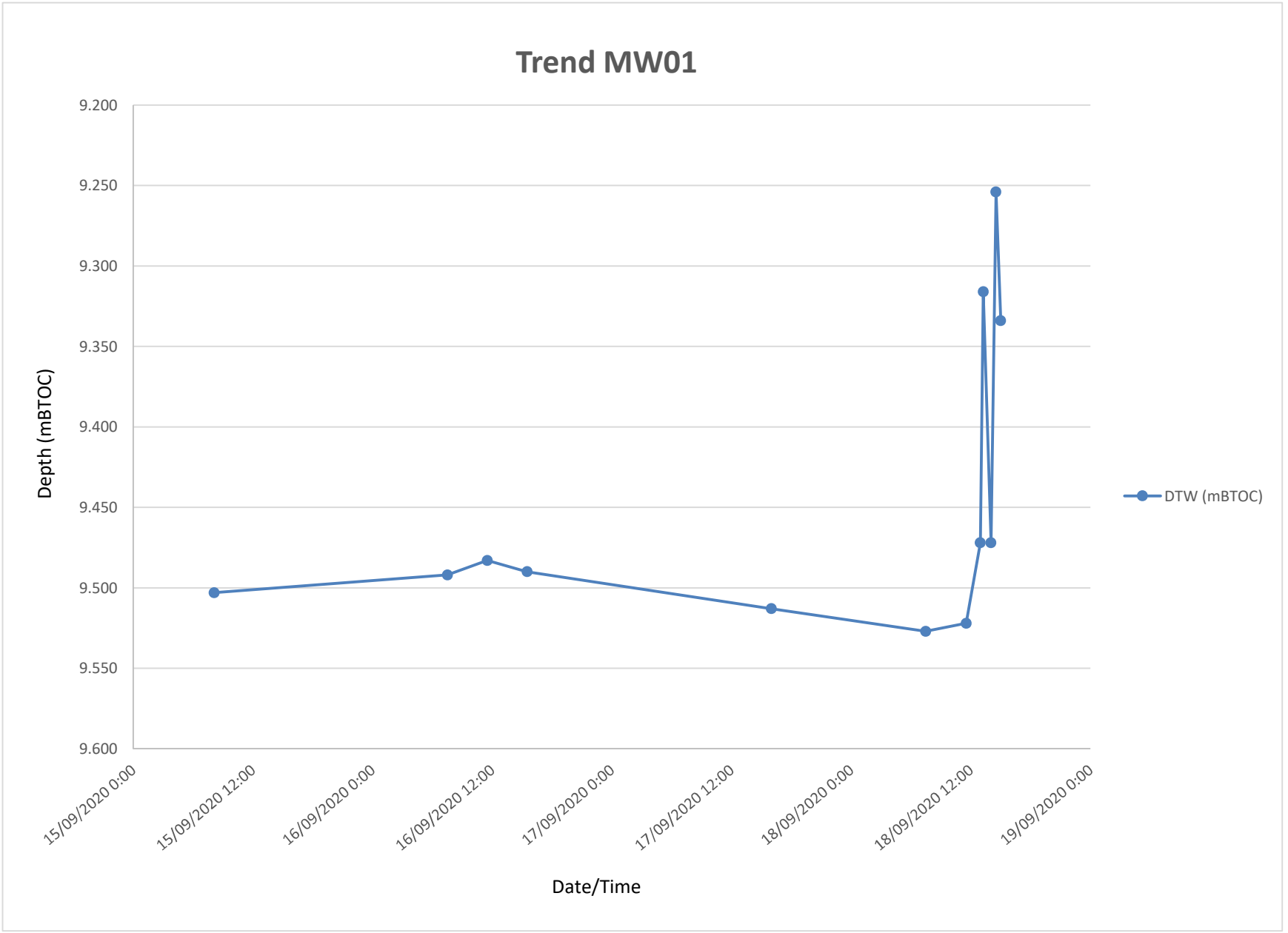

Trend EW02
8.750
8.800
8.850
8.900
8.950
9.000
9.050
9.100
9.150
Depth (mBTOC)
15/09/2020 0:00
15/09/2020 12:00
16/09/2020 0:00
16/09/2020 12:00
17/09/2020 0:00
17/09/2020 12:00
18/09/2020 0:00
Date/Time
DTW (mBTOC)

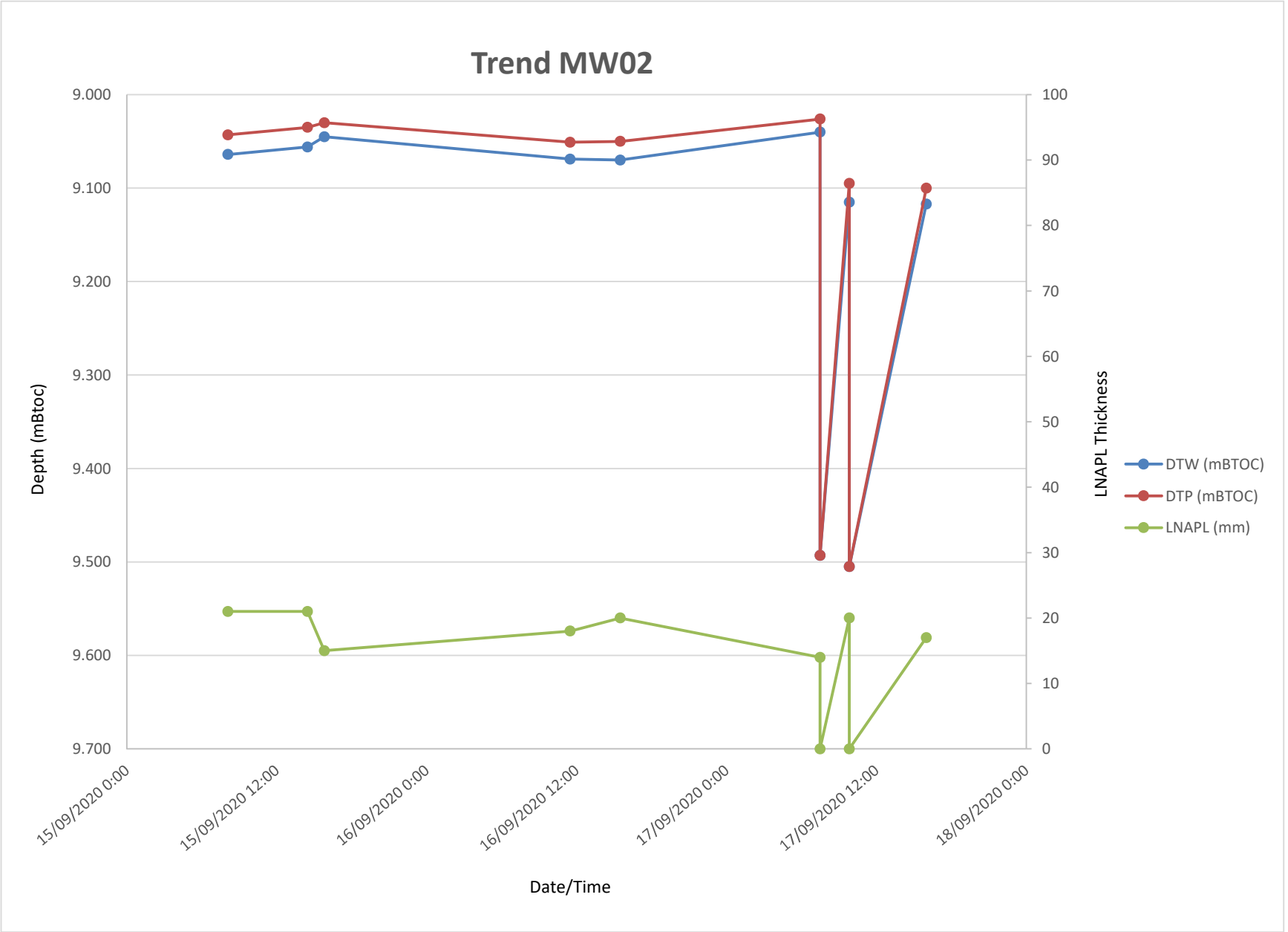

Trend EW03
9.000
9.050
9.100
9.150
9.200
9.250
9.300
9.350
9.400
Depth (mBTOC)
15/09/2020 0:00
15/09/2020 12:00
16/09/2020 0:00
16/09/2020 12:00
17/09/2020 0:00
17/09/2020 12:00
18/09/2020 0:00
18/09/2020 12:00
19/09/2020 0:00
Date/Time
DTW (mBTOC)

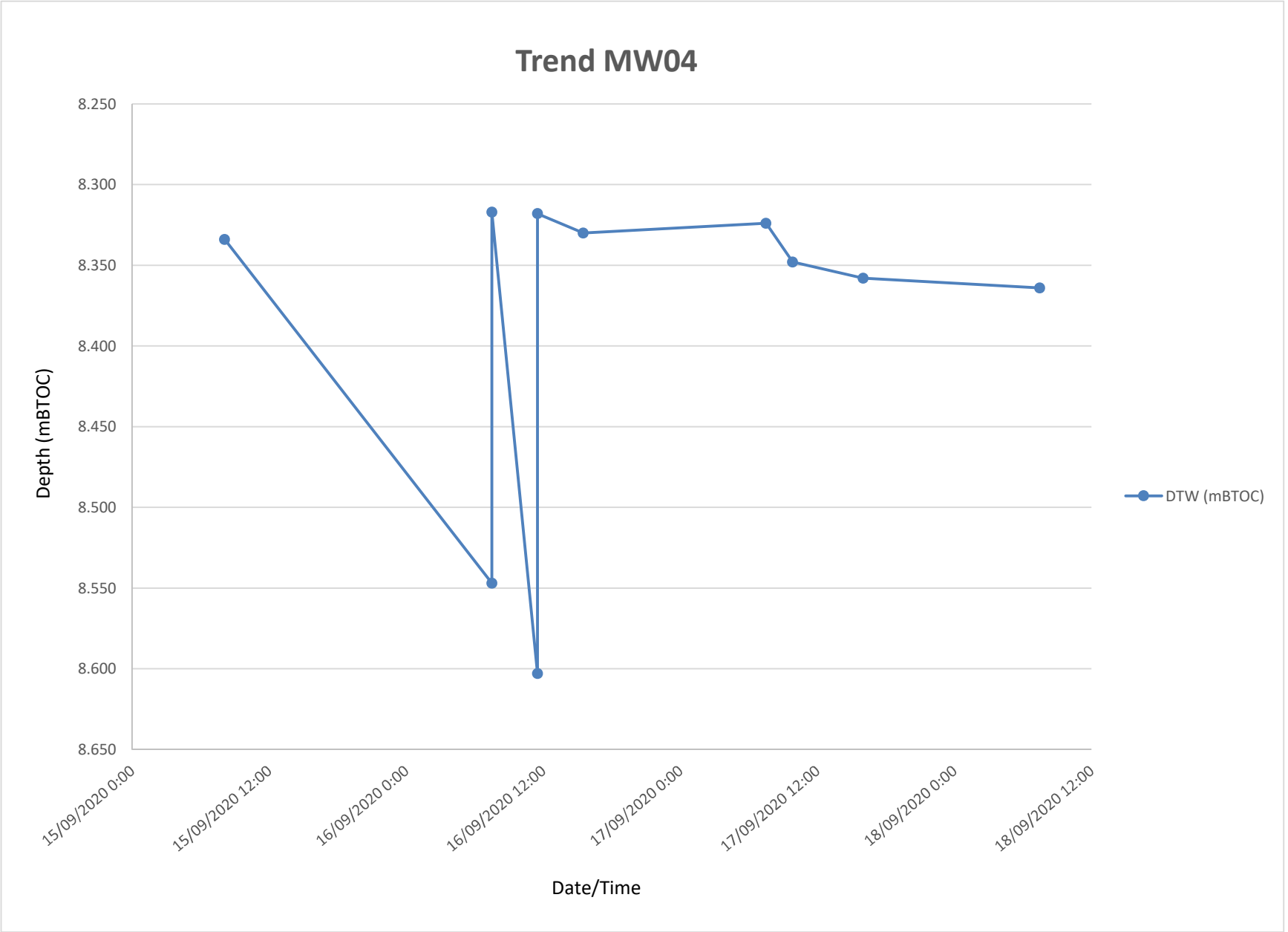

Trend IW01
1.000
2.000
3.000
4.000
5.000
6.000
7.000
8.000
9.000
10.000
Depth (mBtoc)
10
9
8
7
6
5
4
3
2
1
0
LNAPL Thickness
16/09/2020 12:00
17/09/2020 0:00
17/09/2020 12:00
18/09/2020 0:00
18/09/2020 12:00
19/09/2020 0:00
Date/Time
DTW (mBTOC)
DTP (mBTOC)
LNAPL (mm)

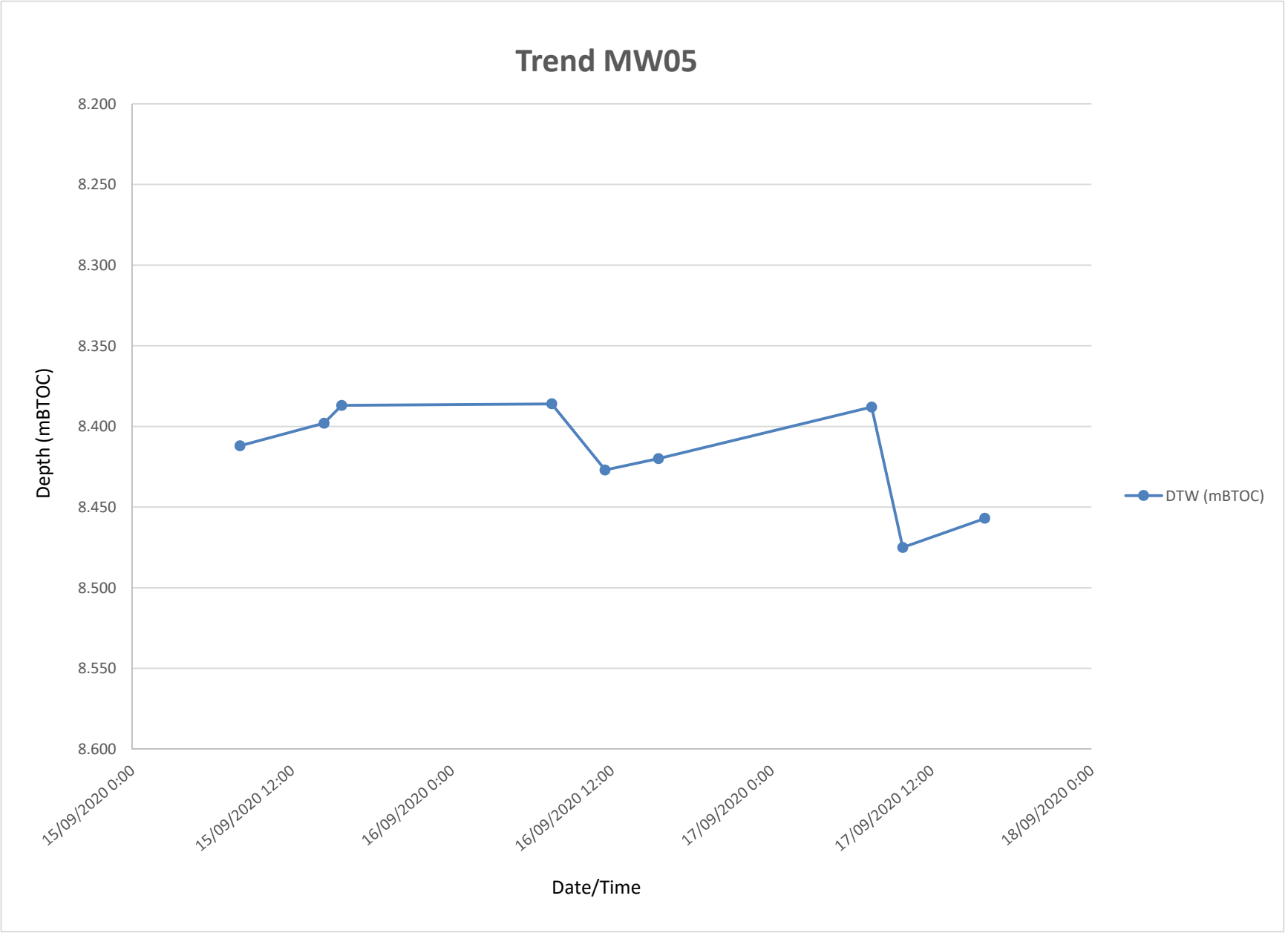

Trend IW02
7.000
7.500
8.000
8.500
9.000
9.500
Depth (mBTOC)
15/09/2020 0:00
15/09/2020 12:00
16/09/2020 0:00
16/09/2020 12:00
17/09/2020 0:00
17/09/2020 12:00
18/09/2020 0:00
18/09/2020 12:00
19/09/2020 0:00
Date/Time
DTW (mBTOC)

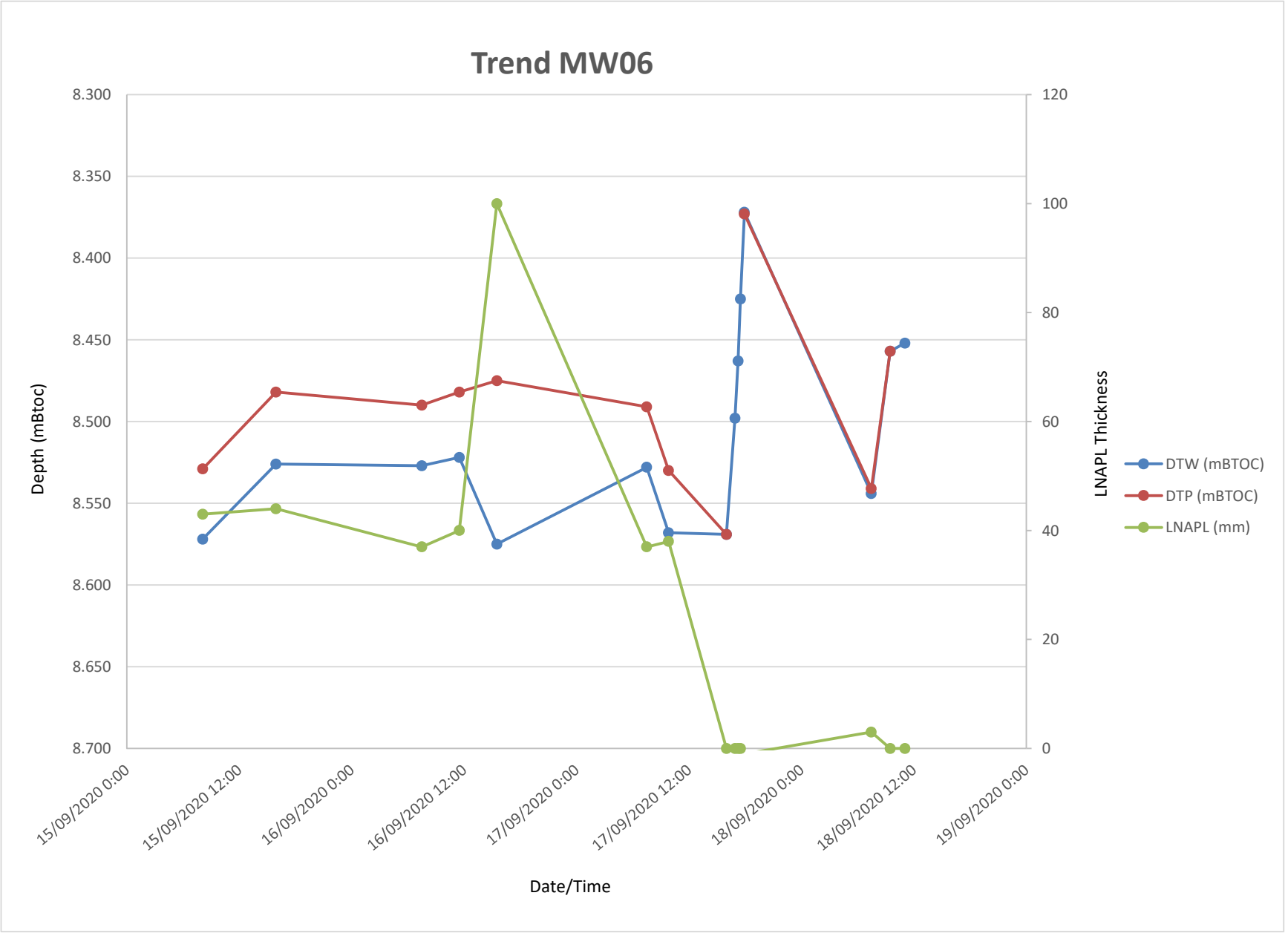

Trend IW03
0.000
2.000
4.000
6.000
8.000
10.000
12.000
Depth (mBTOC)
15/09/2020 0:00
15/09/2020 12:00
16/09/2020 0:00
16/09/2020 12:00
17/09/2020 0:00
17/09/2020 12:00
18/09/2020 0:00
18/09/2020 12:00
Date/Time
DTW (mBTOC)

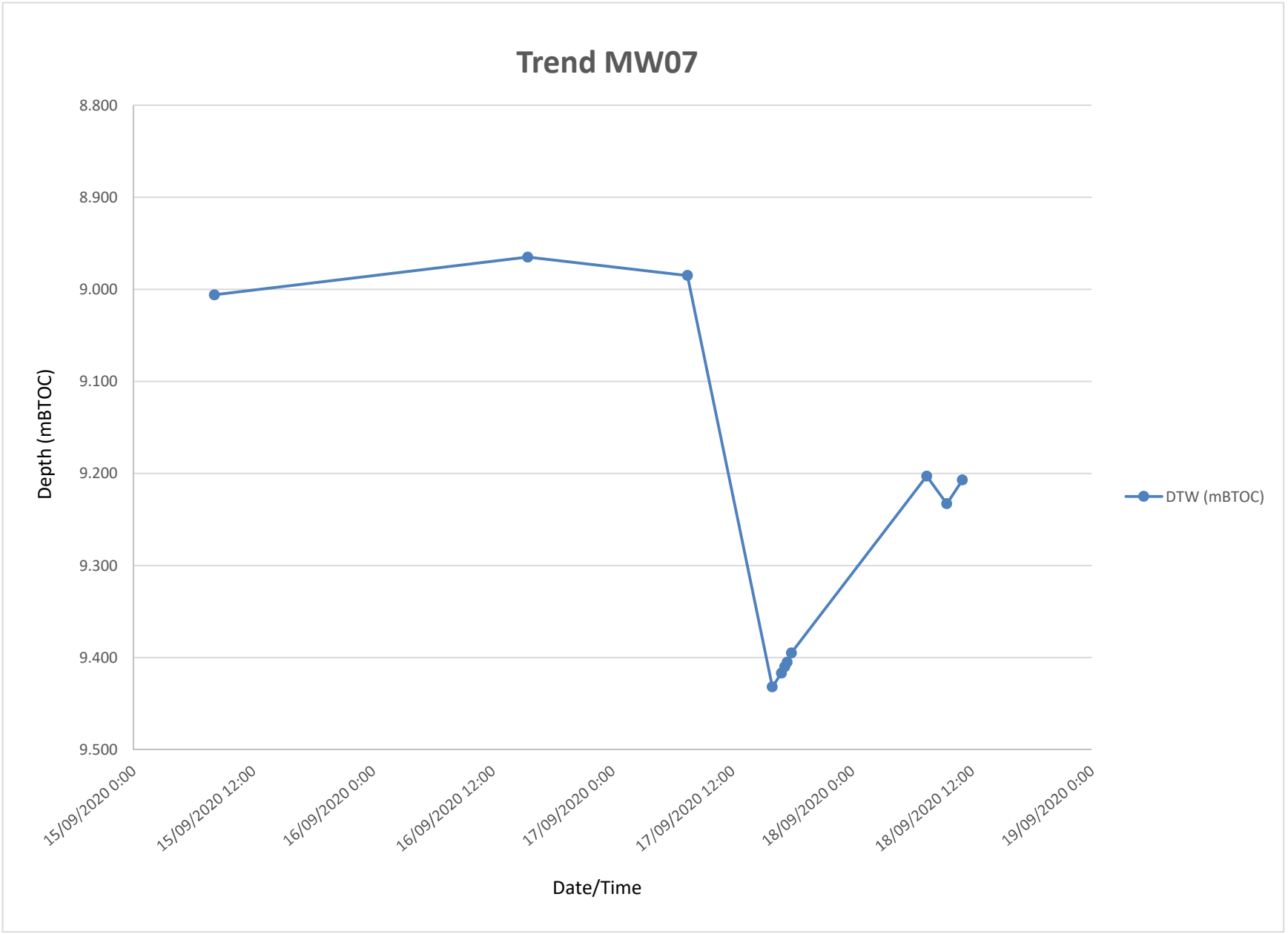

Trend MW01
9.200
9.250
9.300
9.350
9.400
9.450
9.500
9.550
9.600
Depth (mBTOC)
15/09/2020 0:00
15/09/2020 12:00
16/09/2020 0:00
16/09/2020 12:00
17/09/2020 0:00
17/09/2020 12:00
18/09/2020 0:00
18/09/2020 12:00
19/09/2020 0:00
Date/Time
DTW (mBTOC)

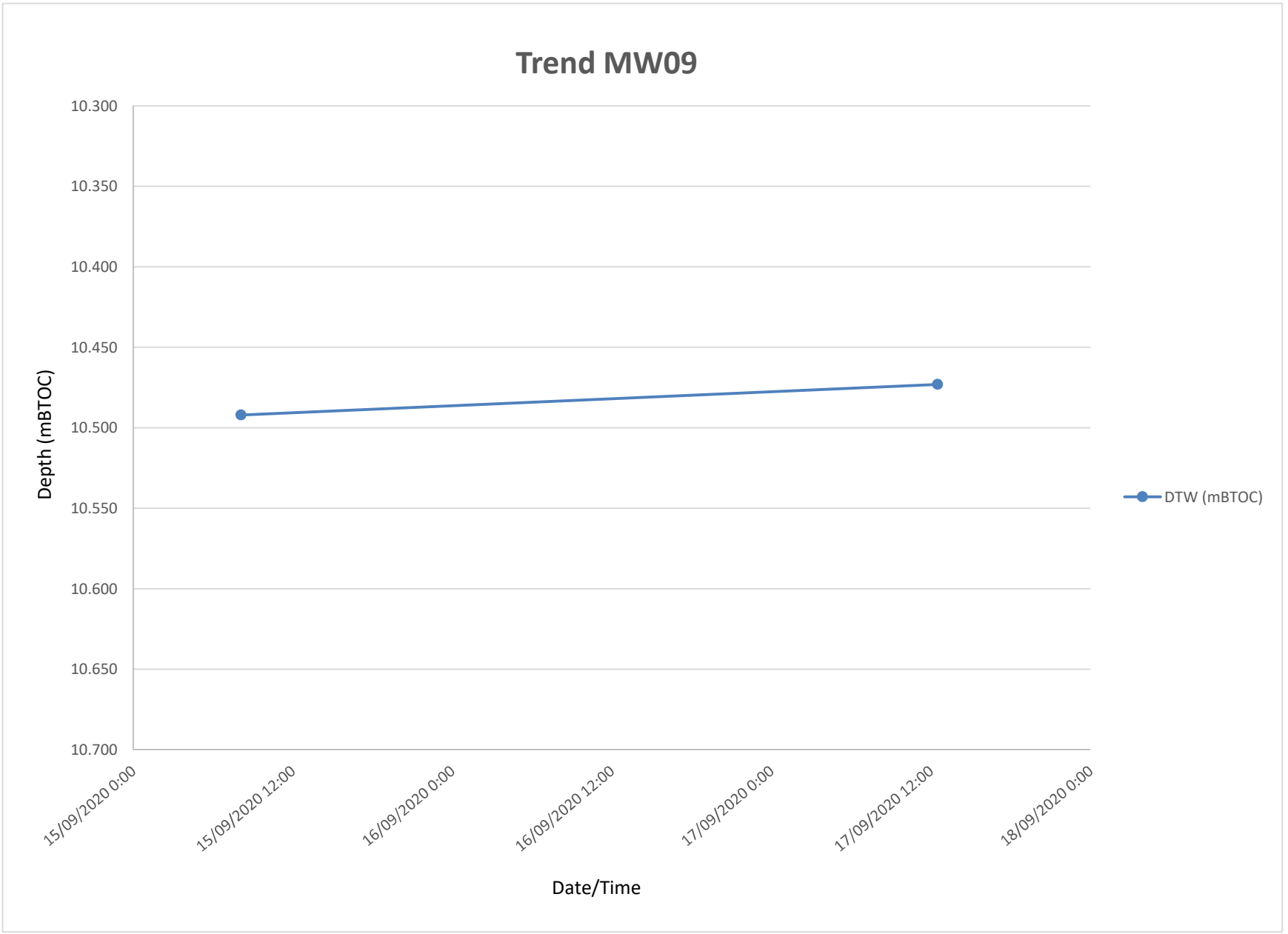

Trend MW02
9.000
9.100
9.200
9.300
9.400
9.500
9.600
9.700
Depth (mBtoc)
100
90
80
70
60
50
40
30
20
10
0
LNAPL Thickness
15/09/2020 0:00
15/09/2020 12:00
16/09/2020 0:00
16/09/2020 12:00
17/09/2020 0:00
17/09/2020 12:00
18/09/2020 0:00
Date/Time
DTW (mBTOC)
DTP (mBTOC)
LNAPL (mm)

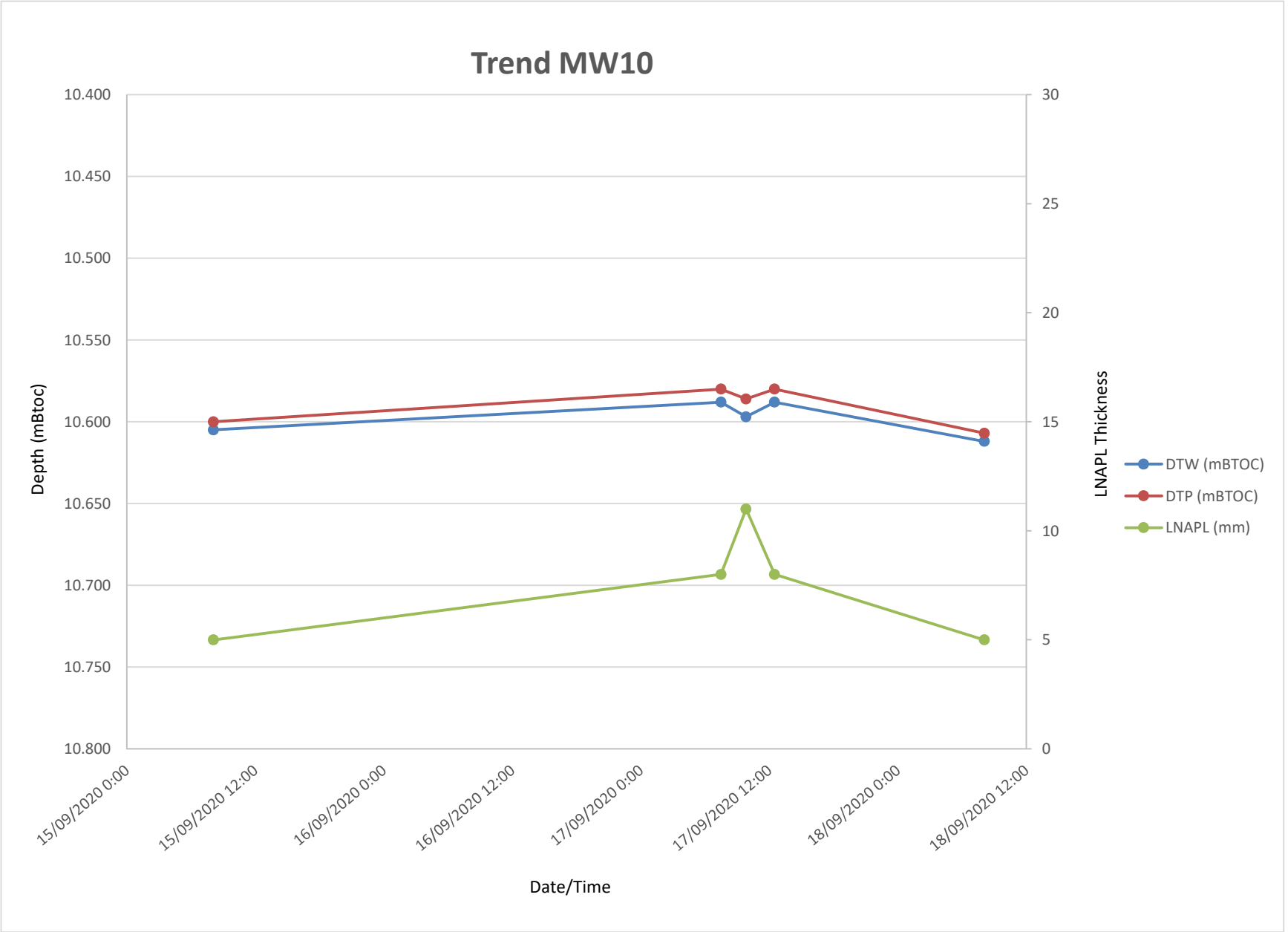

Trend MW04
8.250
8.300
8.350
8.400
8.450
8.500
8.550
8.600
8.650
Depth (mBTOC)
15/09/2020 0:00
15/09/2020 12:00
16/09/2020 0:00
16/09/2020 12:00
17/09/2020 0:00
17/09/2020 12:00
18/09/2020 0:00
18/09/2020 12:00
Date/Time
DTW (mBTOC)

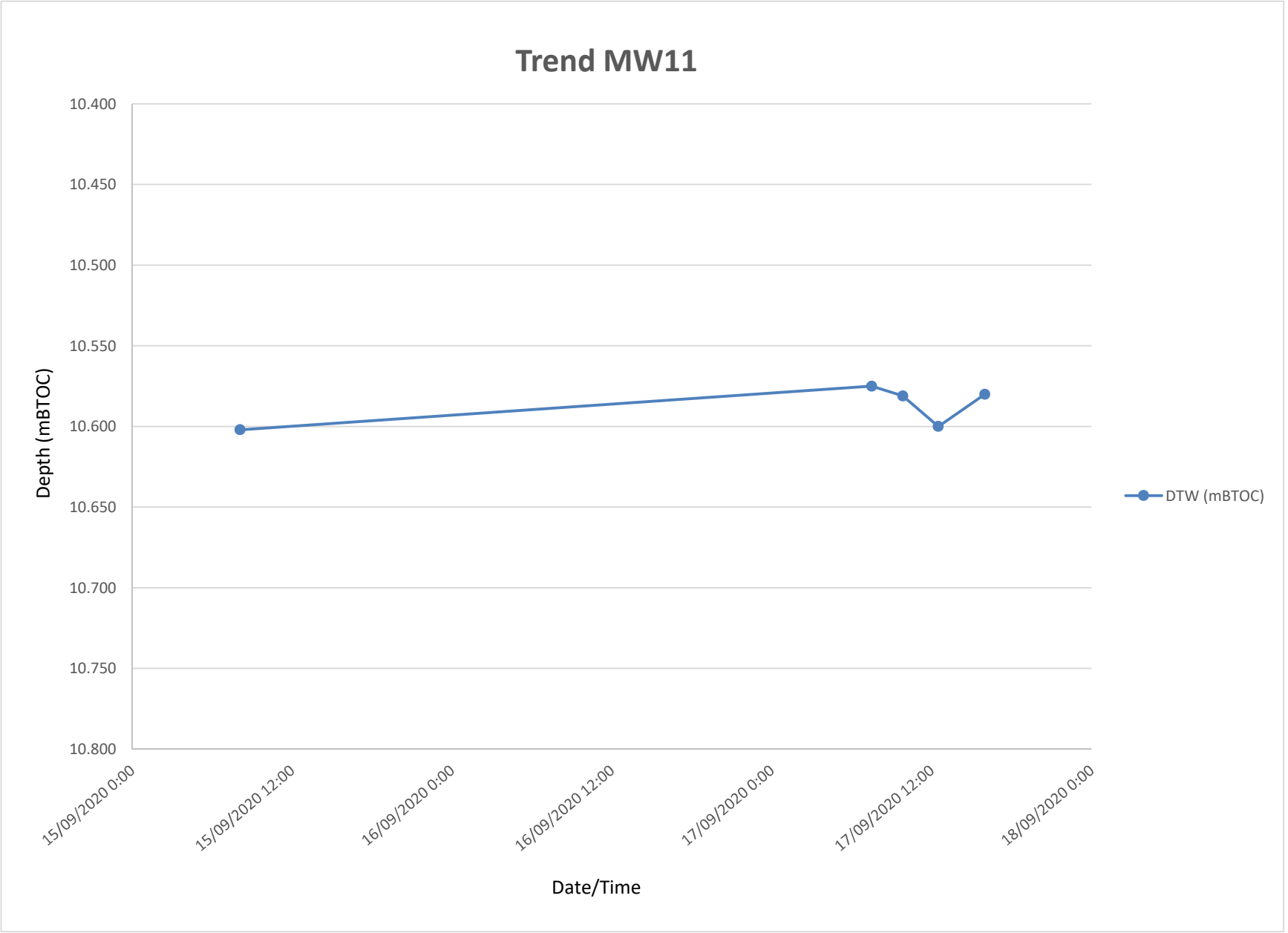

Trend MW05
8.200
8.250
8.300
8.350
8.400
8.450
8.500
8.550
8.600
Depth (mBTOC)
15/09/2020 0:00
15/09/2020 12:00
16/09/2020 0:00
16/09/2020 12:00
17/09/2020 0:00
17/09/2020 12:00
18/09/2020 0:00
Date/Time
DTW (mBTOC)

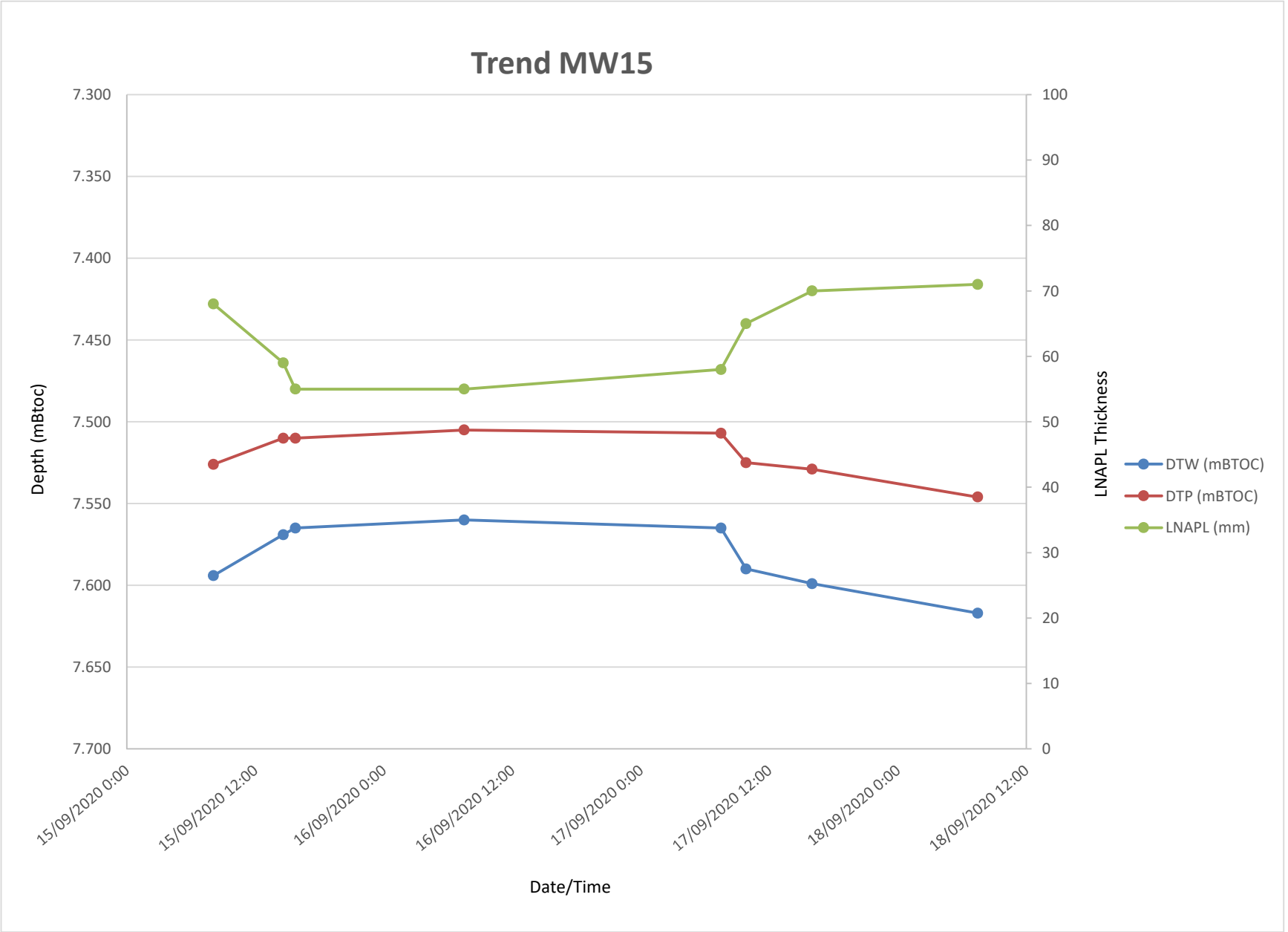

Trend MW06
8.300
8.350
8.400
8.450
8.500
8.550
8.600
8.650
8.700
Depth (mBtoc)
120
100
80
60
40
20
0
LNAPL Thickness
15/09/2020 0:00
15/09/2020 12:00
16/09/2020 0:00
16/09/2020 12:00
17/09/2020 0:00
17/09/2020 12:00
18/09/2020 0:00
18/09/2020 12:00
19/09/2020 0:00
Date/Time
DTW (mBTOC)
DTP (mBTOC)
LNAPL (mm)

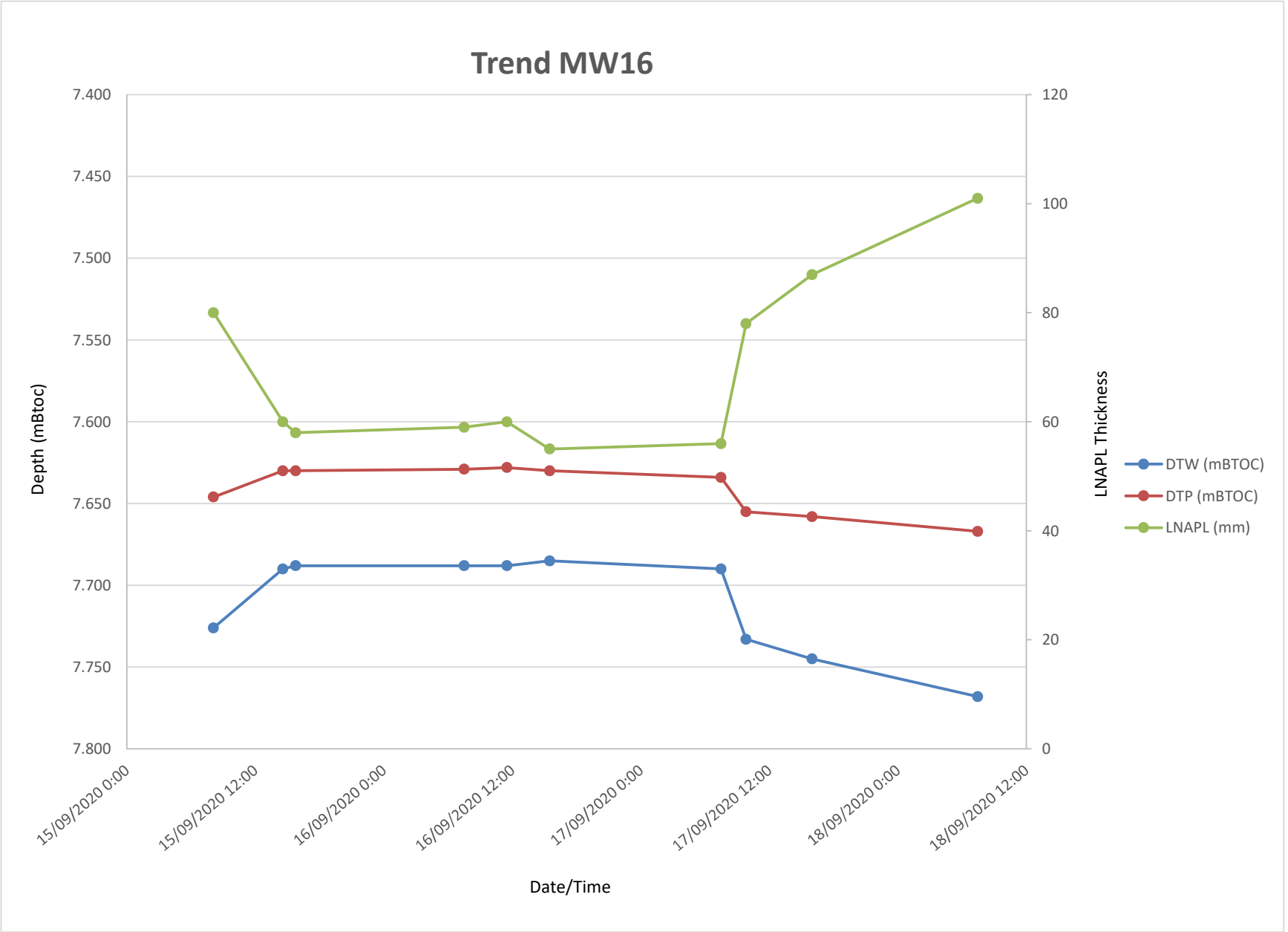

Trend MW07
8.800
8.900
9.000
9.100
9.200
9.300
9.400
9.500
Depth (mBTOC)
15/09/2020 0:00
15/09/2020 12:00
16/09/2020 0:00
16/09/2020 12:00
17/09/2020 0:00
17/09/2020 12:00
18/09/2020 0:00
18/09/2020 12:00
19/09/2020 0:00
Date/Time
DTW (mBTOC)

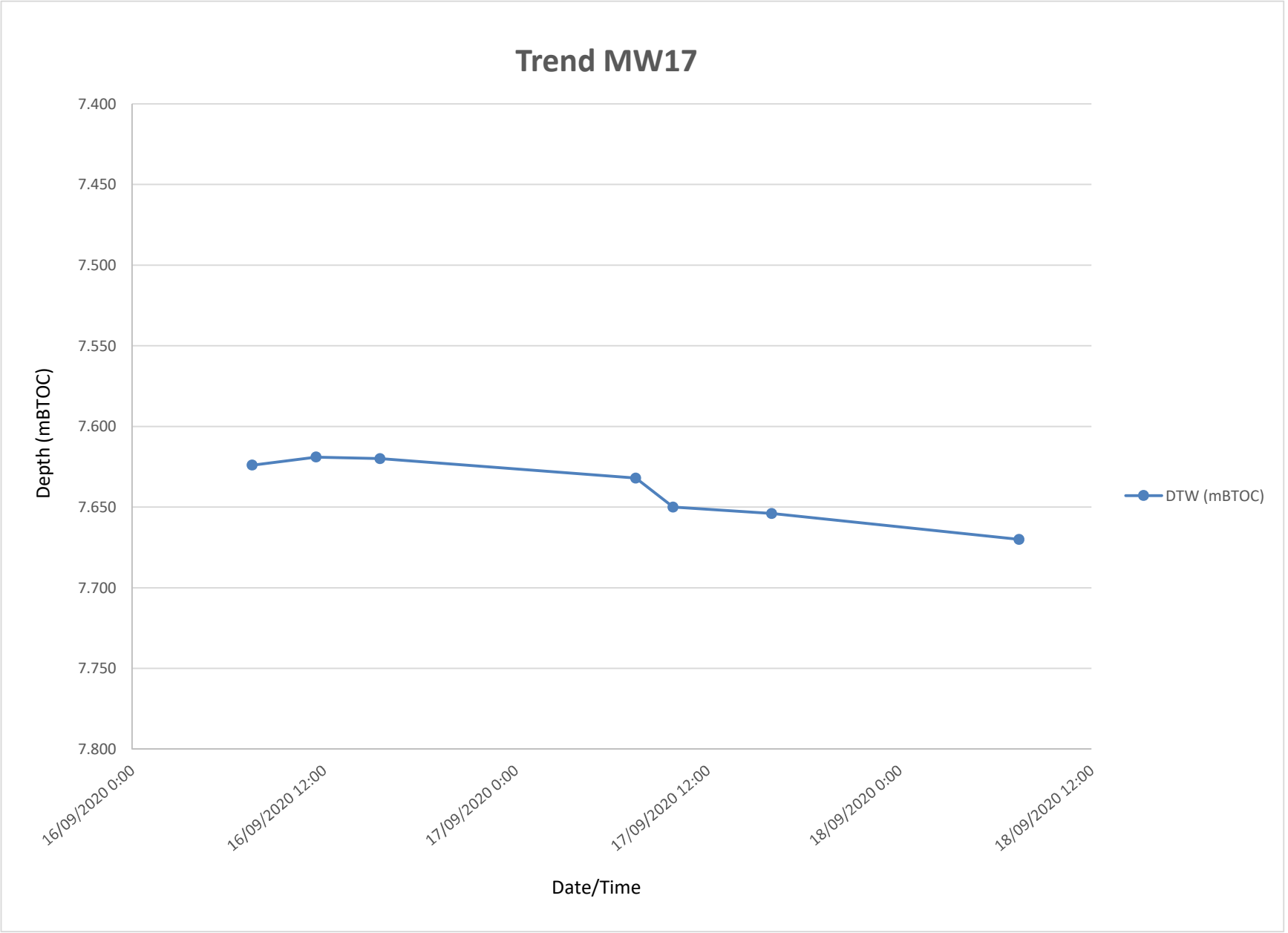

Trend MW09
10.300
10.350
10.400
10.450
10.500
10.550
10.600
10.650
10.700
Depth (mBTOC)
15/09/2020 0:00
15/09/2020 12:00
16/09/2020 0:00
16/09/2020 12:00
17/09/2020 0:00
17/09/2020 12:00
18/09/2020 0:00
Date/Time
DTW (mBTOC)

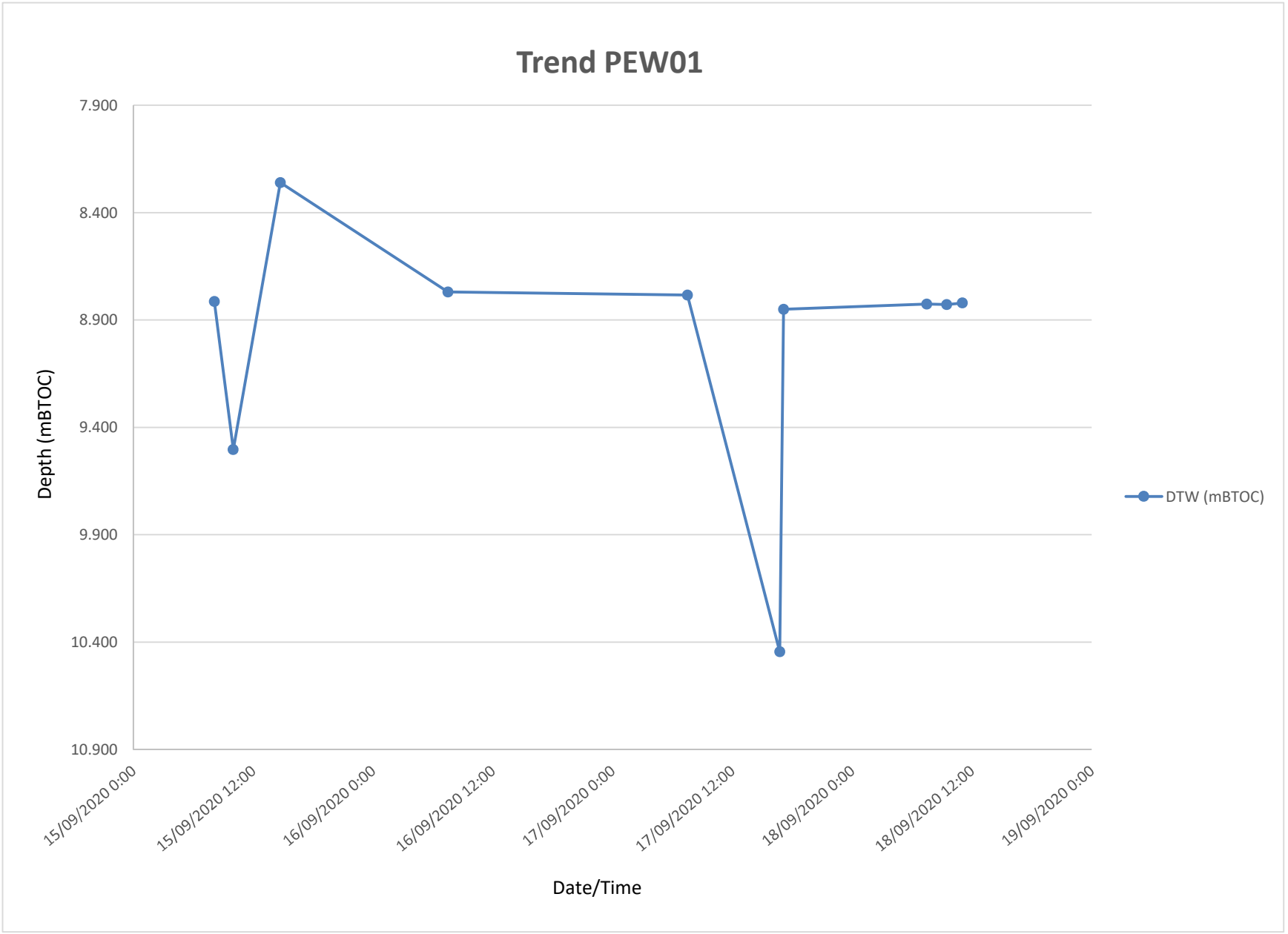

Trend MW10
10.400
10.450
10.500
10.550
10.600
10.650
10.700
10.750
10.800
Depth (mBtoc)
30
25
20
15
10
5
0
LNAPL Thickness
15/09/2020 0:00
15/09/2020 12:00
16/09/2020 0:00
16/09/2020 12:00
17/09/2020 0:00
17/09/2020 12:00
18/09/2020 0:00
18/09/2020 12:00
Date/Time
DTW (mBTOC)
DTP (mBTOC)
LNAPL (mm)

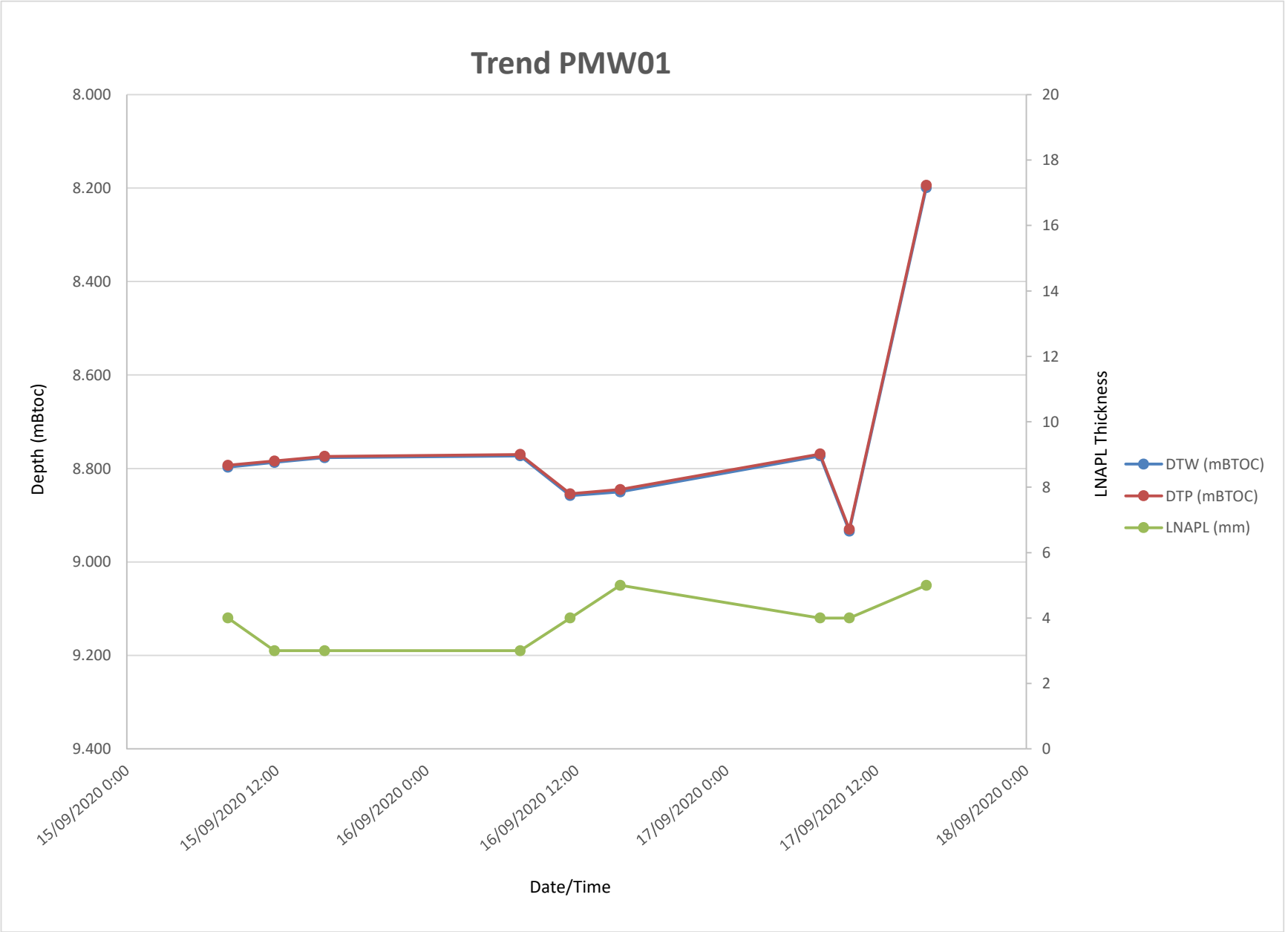

Trend MW11
10.400
10.450
10.500
10.550
10.600
10.650
10.700
10.750
10.800
Depth (mBTOC)
15/09/2020 0:00
15/09/2020 12:00
16/09/2020 0:00
16/09/2020 12:00
17/09/2020 0:00
17/09/2020 12:00
18/09/2020 0:00
Date/Time
DTW (mBTOC)

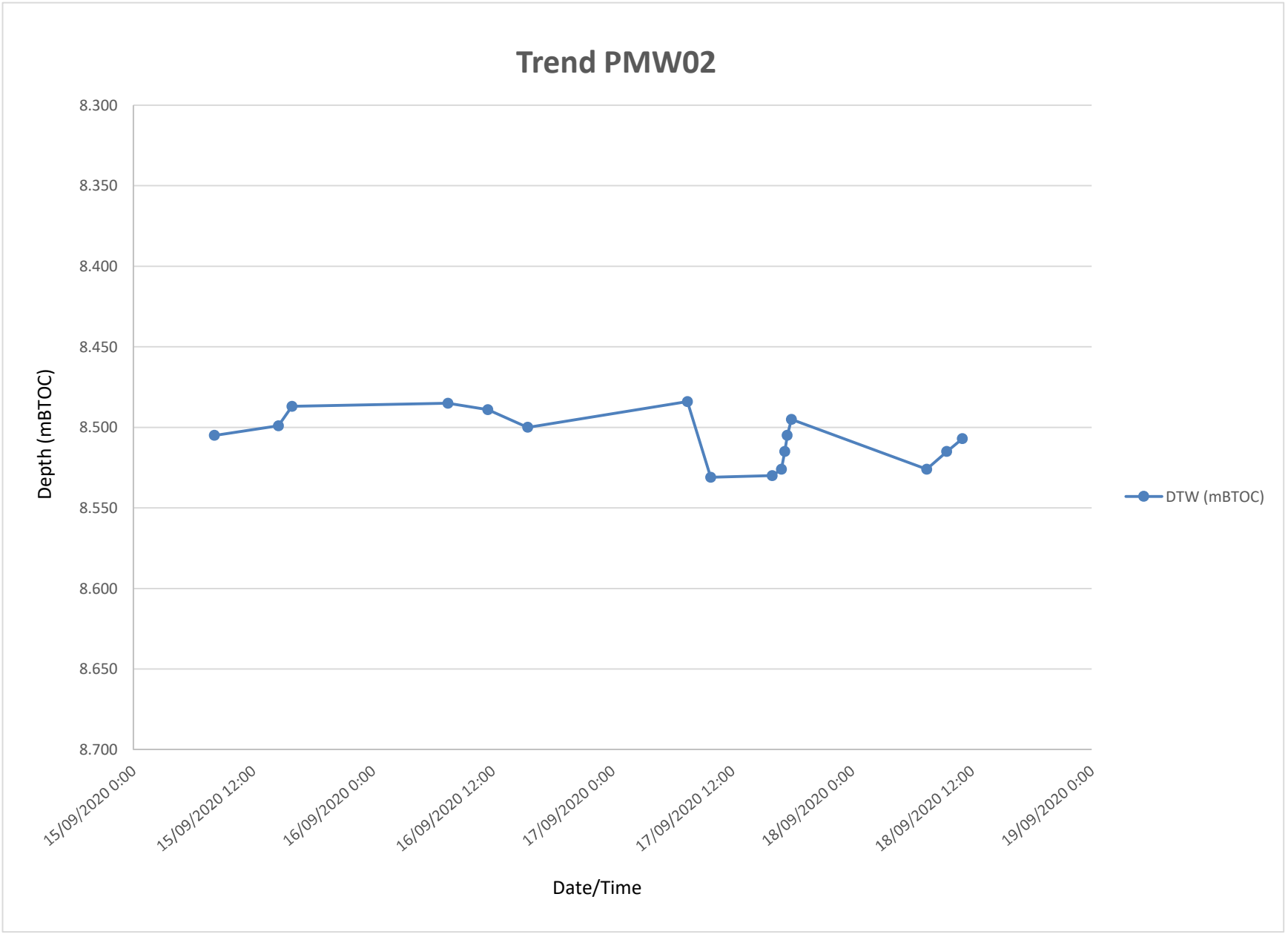

Trend MW15
7.300
7.350
7.400
7.450
7.500
7.550
7.600
7.650
7.700
Depth (mBtoc)
100
90
80
70
60
50
40
30
20
10
0
LNAPL Thickness
15/09/2020 0:00
15/09/2020 12:00
16/09/2020 0:00
16/09/2020 12:00
17/09/2020 0:00
17/09/2020 12:00
18/09/2020 0:00
18/09/2020 12:00
Date/Time
DTW (mBTOC)
DTP (mBTOC)
LNAPL (mm)

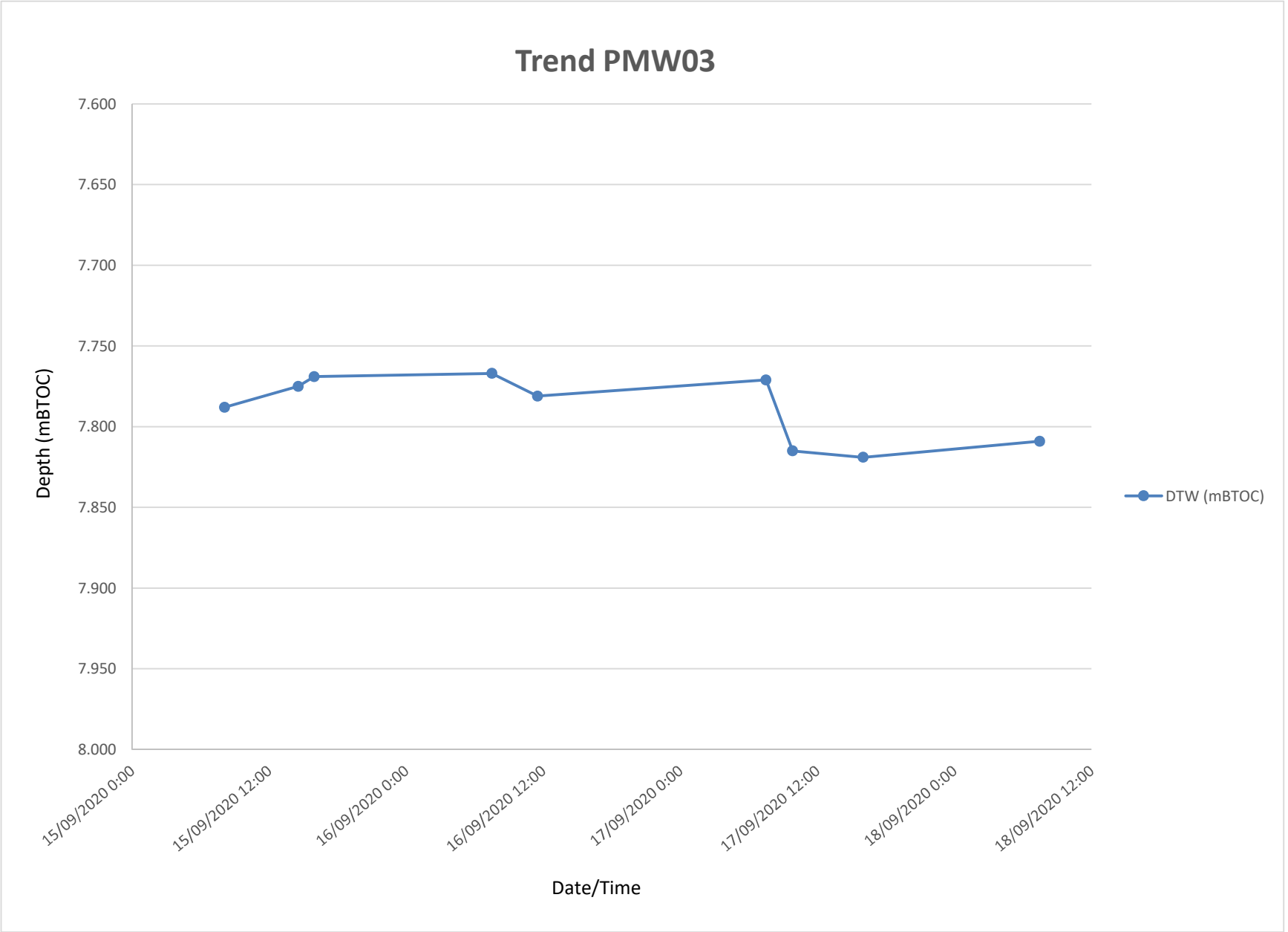

Trend MW16
7.400
7.450
7.500
7.550
7.600
7.650
7.700
7.750
7.800
Depth (mBtoc)
120
100
80
60
40
20
0
LNAPL Thickness
15/09/2020 0:00
15/09/2020 12:00
16/09/2020 0:00
16/09/2020 12:00
17/09/2020 0:00
17/09/2020 12:00
18/09/2020 0:00
18/09/2020 12:00
Date/Time
DTW (mBTOC)
DTP (mBTOC)
LNAPL (mm)

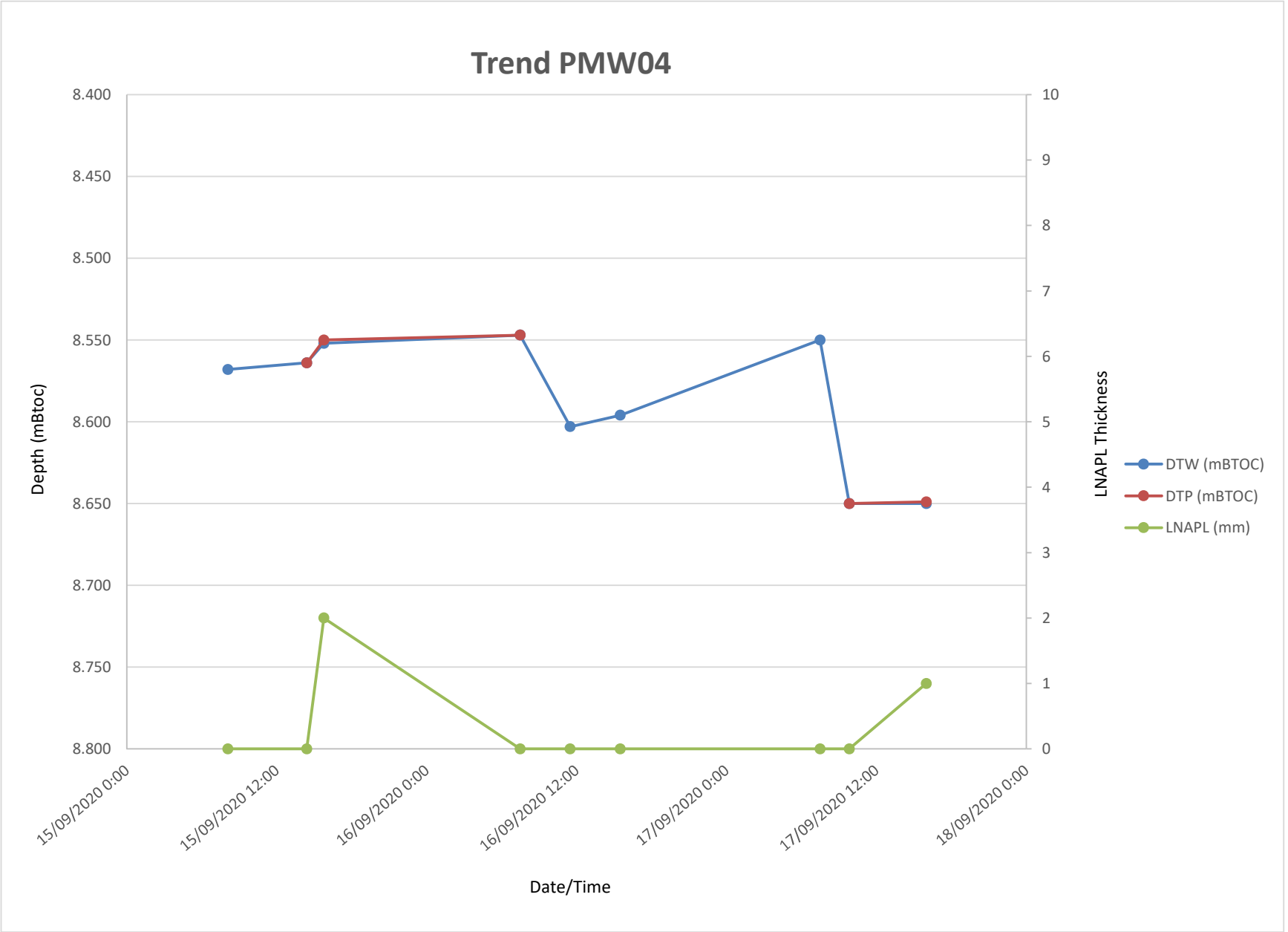

Trend MW17
7.400
7.450
7.500
7.550
7.600
7.650
7.700
7.750
7.800
Depth (mBTOC)
16/09/2020 0:00
16/09/2020 12:00
17/09/2020 0:00
17/09/2020 12:00
18/09/2020 0:00
18/09/2020 12:00
Date/Time
DTW (mBTOC)

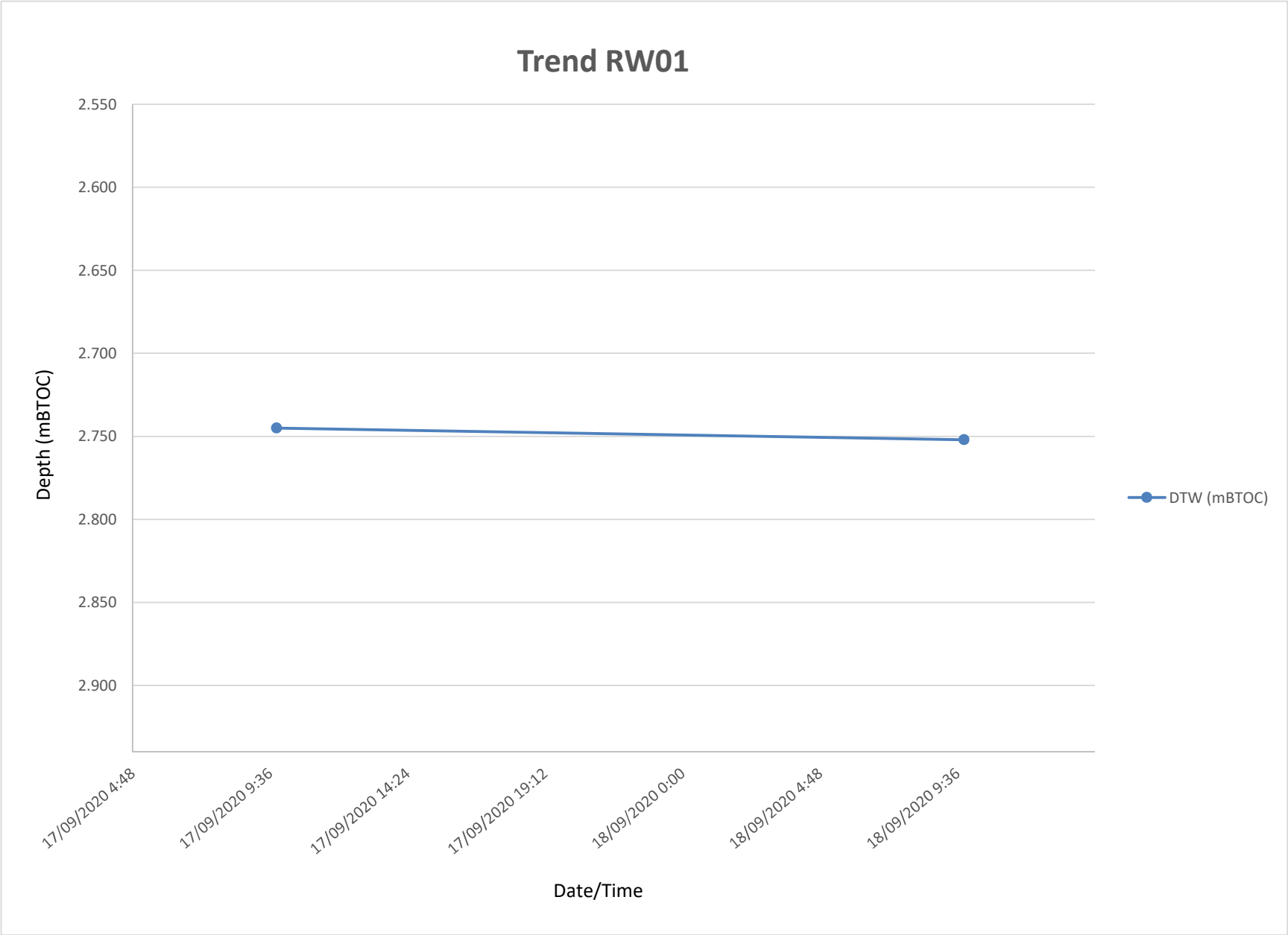

Trend PEW01
7.900
8.400
8.900
9.400
9.900
10.400
10.900
Depth (mBTOC)
15/09/2020 0:00
15/09/2020 12:00
16/09/2020 0:00
16/09/2020 12:00
17/09/2020 0:00
17/09/2020 12:00
18/09/2020 0:00
18/09/2020 12:00
19/09/2020 0:00
Date/Time
DTW (mBTOC)


Trend PMW01
8.000
8.200
8.400
8.600
8.800
9.000
9.200
9.400
Depth (mBtoc)
20
18
16
14
12
10
8
6
4
2
0
LNAPL Thickness
15/09/2020 0:00
15/09/2020 12:00
16/09/2020 0:00
16/09/2020 12:00
17/09/2020 0:00
17/09/2020 12:00
18/09/2020 0:00
Date/Time
DTW (mBTOC)
DTP (mBTOC)
LNAPL (mm)


Trend PMW02
8.300
8.350
8.400
8.450
8.500
8.550
8.600
8.650
8.700
Depth (mBTOC)
15/09/2020 0:00
15/09/2020 12:00
16/09/2020 0:00
16/09/2020 12:00
17/09/2020 0:00
17/09/2020 12:00
18/09/2020 0:00
18/09/2020 12:00
19/09/2020 0:00
Date/Time
DTW (mBTOC)


Trend PMW03
7.600
7.650
7.700
7.750
7.800
7.850
7.900
7.950
8.000
Depth (mBTOC)
15/09/2020 0:00
15/09/2020 12:00
16/09/2020 0:00
16/09/2020 12:00
17/09/2020 0:00
17/09/2020 12:00
18/09/2020 0:00
18/09/2020 12:00
Date/Time
DTW (mBTOC)


Trend PMW04
8.400
8.450
8.500
8.550
8.600
8.650
8.700
8.750
8.800
Depth (mBtoc)
10
9
8
7
6
5
4
3
2
1
0
LNAPL Thickness
15/09/2020 0:00
15/09/2020 12:00
16/09/2020 0:00
16/09/2020 12:00
17/09/2020 0:00
17/09/2020 12:00
18/09/2020 0:00
Date/Time
DTW (mBTOC)
DTP (mBTOC)
LNAPL (mm)


Trend RW01
2.550
2.600
2.650
2.700
2.750
2.800
2.850
2.900
Depth (mBTOC)
17/09/2020 4:48
17/09/2020 9:36
17/09/2020 14:24
17/09/2020 19:12
18/09/2020 0:00
18/09/2020 4:48
18/09/2020 9:36
Date/Time
DTW (mBTOC)

Attachment B – Individual Well Data

Remediation Trial Summary Report

Individual Well Data Sheet

Site Name: **Caltex Holt**

Date	Time	Well ID	GW Recovery (L/min)	Air Flow (m/s)	Hexane (ppm)	VOC's (ppm)	Head Vac (KPa)	Well Vac (KPa)	Temp (^{o}C)	Spear Depth (m)	COMMENTS (open/closed spear, bleed open/closed etc)
17/09/2020	9:00	PEW01	3.6	19.1	39200	1276	42	5	16.4	10.7	Open Ended Spear, Bleed Valve Closed
17/09/2020	9:45	PEW01	3.3	20.4	38300	1250	42	5	16.3	10.7	Open Ended Spear, Bleed Valve Closed
17/09/2020	10:55	PEW01	2.8	15.7	46000	1272	43	8	18	10.7	Open Ended Spear, Bleed Valve Closed
17/09/2020	11:40	PEW01	2.7	17	44000	880	47	10	18.4	10.7	Open Ended Spear, Bleed Valve Closed
17/09/2020	12:45	PEW01	2.6	15.4	44000	980	40	10	18.7	10.7	Open Ended Spear, Bleed Valve Closed
17/09/2020	13:45	PEW01	3.0	16.2	45140	782	40	10	19	10.7	Open Ended Spear, Bleed Valve Closed
17/09/2020	14:45	PEW01	2.6	16	46256	899	40	10	18.8	10.7	Open Ended Spear, Bleed Valve Closed
17/09/2020	15:45	PEW01	2.5	15.7	50956	725	40	10	18	10.7	Open Ended Spear, Bleed Valve Closed

Attachment C – Laboratory Certificate of Analysis

Remediation Trial Summary Report

Ektimo

REPORT NUMBER R009779

Laboratory Analysis Report

VOC analysis - Holt ACT September 2020

InSite Remediation Services Pty Ltd

Document Information

Template Version; 030620

Client Name:	InSite Remediation Services Pty Ltd
Report Number:	R009779
Date of Issue:	6 October 2020
Attention:	Sam Greig
Address:	Unit 10, 3 Box Road Caringbah NSW 2229
Testing Laboratory:	Ektimo Pty Ltd, ABN 86 600 381 413

Report Authorisation

NATA Accredited Laboratory
No. 14601

[redacted]
Client Manager

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports.

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Please note that only numerical results pertaining to measurements conducted directly by Ektimo are covered by Ektimo's terms of NATA accreditation. This does not include comments, conclusions or recommendations based upon the results. Refer to 'Test Methods' for full details of testing covered by NATA accreditation.

Table of Contents

1 BACKGROUND

Five (5) tubes were received at our laboratory on 28 September 2020 and analysed at the request of InSite Remediation as detailed below.

Sample ID	Sample Matrix	Sampling Date	Sampling Time (min) [1]	Sampling Rate (l/min) [1]	Date Received	Date Analysed	Test Parameters
SVE single tube	SKC Activated Charcoal Tubes cat no.226-09	15/9/20, 13:45	1	0.2	28/9/20	5/10/20	Speciated volatile organic compounds
MPE series (front)		17/9/29, 16:16	1	0.2			
MPE series (back)		17/9/20, 16:16	1	0.2			
SVE + pumping series (front)		16/9/20, 13:28	1	0.2			
SVE + pumping series (back)		16/9/20, 13:28	1	0.2			

1. As supplied by Insite Remediation to Ektimo Pty Ltd

All Results reported at STP

2 RESULTS (µg)

Compound	µg				
	SVE single tube	MPE series (front)	MPE series (back)	SVE + pumping series (front)	SVE + pumping series (back)
Ethanol	<2	<2	<2	<2	<2
Isopropanol	<2	<2	<2	<2	<2
1,1-Dichloroethene	<2	<2	<2	<2	<2
Dichloromethane	<2	<2	<2	<2	<2
trans-1,2-Dichloroethene	<2	<2	<2	<2	<2
cis-1,2-Dichloroethene	<2	<2	<2	<2	<2
Chloroform	<2	<2	<2	<2	<2
1,1,1-Trichloroethane	<2	<2	<2	<2	<2
1,2-Dichloroethane	<2	<2	<2	<2	<2
Benzene	**78**	**52**	<2	**124**	<2
Carbon tetrachloride	<2	<2	<2	<2	<2
Butanol	<2	<2	<2	<2	<2
1-Methoxy-2-propanol	<2	<2	<2	<2	<2
Trichloroethylene	<2	<2	<2	<2	<2
Toluene	**478**	**393**	<2	**930**	<2
1,1,2-Trichloroethane	<2	<2	<2	<2	<2
Tetrachloroethene	<2	<2	<2	<2	<2
Chlorobenzene	<2	<2	<2	<2	<2
Ethylbenzene	**34**	**19**	<2	49	<2
m + p-Xylene	**74**	**43**	<2	114	<2
Styrene	<2	<2	<2	<2	<2
o-Xylene	**21**	**12**	<2	**32**	<2
2-Butoxyethanol	<2	<2	<2	<2	<2
1,1,2,2-Tetrachloroethane	<2	<2	<2	<2	<2
Isopropylbenzene	**3**	<2	<2	**4**	<2
Propylbenzene	**9**	4	<2	**12**	<2
1,3,5-Trimethylbenzene	**10**	5	<2	**15**	<2
tert-Butylbenzene	<2	<2	<2	<2	<2
1,2,4-Trimethylbenzene	**28**	**15**	<2	**41**	<2
1,2,3-Trimethylbenzene	**4**	**2**	<2	**6**	<2
Acetone	<2	<2	<2	<2	<2
Pentane	**1051**	**412**	<2	**1026**	<2
Acrylonitrile	<2	<2	<2	<2	<2
Methyl ethyl ketone	<2	<2	<2	<2	<2
n-Hexane	**409**	**166**	<2	**473**	<2
Ethyl acetate	<2	<2	<2	<2	<2
Cyclohexane	**62**	**26**	<2	**78**	<2
2-Methylhexane	**77**	**32**	<2	**97**	<2
Isopropyl acetate	<2	<2	<2	<2	<2
2,3-Dimethylpentane	**94**	**40**	<2	**119**	<2
3-Methylhexane	**228**	**97**	<2	**289**	<2
Heptane	**128**	**57**	<2	**170**	<2
Ethyl acrylate	<2	<2	<2	<2	<2
Methyl methacrylate	<2	<2	<2	<2	<2
Propyl acetate	<2	<2	<2	<2	<2
Methylcyclohexane	**68**	**28**	<2	**83**	<2
Methyl Isobutyl Ketone	<2	<2	<2	<2	<2
2-Hexanone	<2	<2	<2	<2	<2
Octane	**52**	**21**	<2	**67**	<2
Butyl acetate	<2	<2	<2	<2	<2
1-Methoxy-2-propyl acetate	<2	<2	<2	<2	<2
Butyl acrylate	<2	<2	<2	<2	<2
Nonane	**21**	**10**	<2	**30**	<2
Cellosolve acetate	<2	<2	<2	<2	<2
α-Pinene	<2	<2	<2	<2	<2
β-Pinene	<2	<2	<2	<2	<2
Decane	**5**	<2	<2	**6**	<2
3-Carene	<2	<2	<2	<2	<2
D-Limonene	<2	<2	<2	<2	<2
Undecane	<2	<2	<2	<2	<2
Dodecane	<2	<2	<2	<2	<2
Tridecane	<2	<2	<2	<2	<2
Tetradecane	<2	<2	<2	<2	<2
Residuals as Toluene	**4299**	**1744**	<2	**4391**	<2
C6-C9 as Heptane	**2189**	**1055**	<2	**3011**	<2
C10-C19 as Decane	**18**	**2**	<2	**30**	<2

3 RESULTS (CONCENTRATIONS)

3.1 SVE Trial (Single Tube)

Date	15/09/2020	**Client**	InSite Remediation
Report	R009779		
Licence No.	-	**Location**	Holt
Sampling Staff	[redacted] InSite Remediation	**State**	ACT
Process Conditions	SVE Trial single tube		

Total Speciated VOCs	Results
	Concentration mg/m³
Total	38000

VOC's C5-C20	Results
Sampling time	1345-1346
	Concentration mg/m³
Detection limit[1]	<10
Benzene	410
Toluene	2500
Ethylbenzene	180
m + p-Xylene	390
o-Xylene	110
Isopropylbenzene	17
Propylbenzene	46
1,3,5-Trimethylbenzene	54
1,2,4-Trimethylbenzene	150
1,2,3-Trimethylbenzene	21
Pentane	5600
n-Hexane	2200
Cyclohexane	330
2-Methylhexane	410
2,3-Dimethylpentane	500
3-Methylhexane	1200
Heptane	680
Methylcyclohexane	360
Octane	270
Nonane	110
Decane	26
Residuals as Toluene	23000
C6-C9 as Heptane	12000
C10-C19 as Decane	96

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Styrene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, tert-Butylbenzene, Acetone, Acrylonitrile, Methyl ethyl ketone, Ethyl acetate, Isopropyl acetate, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methyl Isobutyl Ketone, 2-Hexanone, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Cellosolve acetate, α-Pinene, β-Pinene, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane

3 RESULTS (CONCENTRATIONS)

3.1 SVE Trial (Single Tube)

Date	15/09/2020	**Client**	InSite Remediation
Report	R009779		
Licence No.	-	**Location**	Holt
Sampling Staff	[redacted] InSite Remediation	**State**	ACT
Process Conditions	SVE Trial single tube		

Total Speciated VOCs	Results
	Concentration mg/m³
Total	38000

VOC's C5-C20	Results
Sampling time	1345-1346
	Concentration mg/m³
Detection limit[1]	<10
Benzene	410
Toluene	2500
Ethylbenzene	180
m + p-Xylene	390
o-Xylene	110
Isopropylbenzene	17
Propylbenzene	46
1,3,5-Trimethylbenzene	54
1,2,4-Trimethylbenzene	150
1,2,3-Trimethylbenzene	21
Pentane	5600
n-Hexane	2200
Cyclohexane	330
2-Methylhexane	410
2,3-Dimethylpentane	500
3-Methylhexane	1200
Heptane	680
Methylcyclohexane	360
Octane	270
Nonane	110
Decane	26
Residuals as Toluene	23000
C6-C9 as Heptane	12000
C10-C19 as Decane	96

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Styrene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, tert-Butylbenzene, Acetone, Acrylonitrile, Methyl ethyl ketone, Ethyl acetate, Isopropyl acetate, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methyl Isobutyl Ketone, 2-Hexanone, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Cellosolve acetate, α-Pinene, β-Pinene, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane

3.2 MPE Trial (Dual Tubes in Series)

Date	17/09/2020	**Client**	InSite Remediation
Report	R009779		
Licence No.	-	**Location**	Holt
Sampling Staff	[redacted] InSite Remediation	**State**	ACT
Process Conditions	MPE Trial dual tubes in series		

Total Speciated VOCs	Results
	Concentration mg/m³
Total	17000

VOC's C5-C20	Results
Sampling time	1616-1617
	Concentration mg/m³
Detection limit[1]	<20
Benzene	280
Toluene	2100
Ethylbenzene	100
m + p-Xylene	230
o-Xylene	65
Propylbenzene	23
1,3,5-Trimethylbenzene	29
1,2,4-Trimethylbenzene	81
1,2,3-Trimethylbenzene	<20
Pentane	2200
n-Hexane	890
Cyclohexane	140
2-Methylhexane	170
2,3-Dimethylpentane	210
3-Methylhexane	520
Heptane	310
Methylcyclohexane	150
Octane	110
Nonane	55
Residuals as Toluene	9400
C6-C9 as Heptane	5700
C10-C19 as Decane	13

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Styrene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, tert-Butylbenzene, Acetone, Acrylonitrile, Methyl ethyl ketone, Ethyl acetate, Isopropyl acetate, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methyl Isobutyl Ketone, 2-Hexanone, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Cellosolve acetate, α-Pinene, β-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane

3.3 SVE & Pumping Trial (Dual Tubes in Series)

Date	16/09/2020	**Client**	InSite Remediation
Report	R009779		
Licence No.	-	**Location**	Holt
Sampling Staff	[redacted] InSite Remediation	**State**	ACT
Process Conditions	SVE + pumping Trial dual tubes in series		

Total Speciated VOCs	Results
	Concentration mg/m³
Total	43000

VOC's C5-C20	Results
Sampling time	1328-1329
	Concentration mg/m³
Detection limit[1]	<20
Benzene	660
Toluene	4900
Ethylbenzene	260
m + p-Xylene	610
o-Xylene	170
Isopropylbenzene	23
Propylbenzene	66
1,3,5-Trimethylbenzene	79
1,2,4-Trimethylbenzene	220
1,2,3-Trimethylbenzene	30
Pentane	5500
n-Hexane	2500
Cyclohexane	410
2-Methylhexane	520
2,3-Dimethylpentane	630
3-Methylhexane	1500
Heptane	900
Methylcyclohexane	440
Octane	360
Nonane	160
Decane	33
Residuals as Toluene	23000
C6-C9 as Heptane	16000
C10-C19 as Decane	160

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Styrene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, tert-Butylbenzene, Acetone, Acrylonitrile, Methyl ethyl ketone, Ethyl acetate, Isopropyl acetate, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methyl Isobutyl Ketone, 2-Hexanone, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Cellosolve acetate, α-Pinene, β-Pinene, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane

4 TEST METHODS

All analysis performed by Ektimo unless otherwise specified. Specific details of the methods are available upon request.

Parameter	Analysis Method	NATA Accredited	
		Sampling	Analysis
Speciated volatile organic compounds (VOC's)	Ektimo 344	NA	✓†

200708

* Uncertainty values cited in this table are calculated at the 95% confidence level (coverage factor = 2)

† Analysis conducted at the Ektimo Mitcham, VIC laboratory, NATA accreditation number 14601.
Results were reported on 5 October 2020 in report number LV-000482

5 QUALITY ASSURANCE/QUALITY CONTROL INFORMATION

Ektimo is accredited by the National Association of Testing Authorities (NATA) for the sampling and analysis of air pollutants from industrial sources. Unless otherwise stated test methods used are accredited with the National Association of Testing Authorities. For full details, search for Ektimo at NATA's website www.nata.com.au.

Ektimo is accredited by NATA (National Association of Testing Authorities) to ISO/IEC 17025 - Testing. ISO/IEC 17025 - Testing requires that a laboratory have adequate equipment to perform the testing, as well as laboratory personnel with the competence to perform the testing. This quality assurance system is administered and maintained by the Quality Director.

NATA is a member of APLAC (Asia Pacific Laboratory Accreditation Co-operation) and of ILAC (International Laboratory Accreditation Co-operation). Through the mutual recognition arrangements with both of these organisations, NATA accreditation is recognised worldwide.

6 DEFINITIONS

The following symbols and abbreviations may be used in this test report:

<	Less than
>	Greater than
EPA	Environment Protection Authority
NA	Not applicable
NATA	National Association of Testing Authorities
STP	Standard temperature and pressure. Gas volumes and concentrations are expressed on a dry basis at 0°C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa, unless otherwise specified.
VOC	Any chemical compound based on carbon with a vapour pressure of at least 0.010 kPa at 25°C or having a corresponding volatility under the particular conditions of use. These compounds may contain oxygen, nitrogen and other elements, but specifically excluded are carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonate salts.
95% confidence interval	Range of values that contains the true result with 95% certainty. This means there is a 5% risk that the true result is outside this range.

Address (Head Office)
7 Redland Drive
Mitcham VIC 3132

Postal Address
52 Cooper Road
Cockburn Central WA 6164

Office Locations
VIC NSW WA QLD

Freecall: 1300 364 005
www.ektimo.com.au
ABN 86 600 381 413

Attachment D – Waste Documentation

Remediation Trial Summary Report

NSW Environment Protection Authority - Online Waste Tracking System

TRANSPORT CERTIFICATE - No. 2T01112536

Created by : [redacted] 7-Sep-2020 12:54 pm **Status:** Created

CA no: 2C00162070 **CA start date:** 18-Mar-2020 **CA end date:** 17-Mar-2021

PART 1 (this part to be completed by consignor at pickup)

CONSIGNOR

Caltex - Holt
1 Hardwick Crescent
Holt, ACT 2615

Contact: [redacted] **Role:** Producer
Phone: [redacted] **Email:** N/A
ABN: 85 005 632 860 **Fax:** N/A **Emergency:** [redacted]
ANZSIC code: 0 **Licence no.:** N/A

Pickup details: As above

WASTE

Waste code: J120 - Waste oil/hydrocarbons mixtures/emulsions in water
Description: Oil/hydrocarbon mixed with water nos
Form: Liquid **Liquid waste levy applies:** Yes
Proposed treatment: Storage **Classification:** Liquid
Contaminants: Oily Water
Dangerous goods class: N/A **Subsidiary risk class:** N/A **UN no.:** N/A
Packaging type: N/A **Packing group no:** N/A **No. package:** N/A

PICKUP

Waste amount at pickup: 3 3500 (required - Yes)
I declare that to the best of my knowledge [redacted] mation is true and correct.
Name and [redacted]
Signature ..... Date 13-9-20

PART 2 - TRANSPORTER (this part to be completed by the transporter at pickup)

INSITE REMEDIATION SERVICES PTY LTD
UNIT 10, 3 BOX ROAD
CARINGBAH, NSW 2229

Contact: [redacted] **Email:** [redacted]
Phone: [redacted] **Fax :** N/A
Licence no.: 20200 **Vehicle reg:** TBA **Transit state:** NSW
Transport type: Road

I decl[redacted] wledge [redacted] formation is true and correct.
Name [redacted]
Signa[redacted] Date 18-9-20

PART 3 - RECEIVING FACILITY (this part to be completed by the receiving facility)

ENVIRONMENTAL TREATMENT SOLUTIONS PTY LTD - MINTO
WAREHOUSE B, 7 PEMBURY ROAD
MINTO, NSW 2566

Contact: [redacted] **Email:** [redacted]
Phone: [redacted] **Fax:**
Licence no.: 20696

Receiving facility ref no.: N/A
Waste amount at arrival: ..... Date waste arrived at the facility : .....

ACCEPT / REJECT THE WASTE

☐ The receiving facility accepted the waste - Date accepted: ..... Date Processed: ..... Treatment: .....
☐ The receiving facility rejected the waste (complete section below)
Reason for rejection: .....
Rejected waste sent to - Name: .....
Address: .....
I declare that to the best of my knowledge and belief the above information is true and correct - complete if accepted or rejected:
Name and Position (Block letters) .....
Signature ..... Date .....

NOTE

APPENDIX E

ANALYTICAL DATA TABLES

APPENDIX E-1
SVE TRIAL DATA

SVE Trial Results

CLIENT:	Caltex
SITE:	Holt - Canberra

ACTIVITY:	SVE Trial
DATE:	15/09/2020

TESTERS:	[redacted]
TRIAL:	SVE Trail

Extraction Well	Approx timeframes			Observation wells - pressure measurements (Pa) -- and -- Distance from extraction wells (m)																						BLOWER / EXTRACTION UNIT / VAC TRUCK						Comments
PEW1	Start time	Finish time	Time (hours)	MW2	PMW1	PMW2	MW05	PMW3	PMW4	MW6	MW16	SV3-6m	SV3-2m	MW15	SV2-6m	SV2-2m	EW2	MW4	EW3	MW1	MW11	MW10	IW3	MW9	MW8	MW7	Vacuum	Air Velocity	Air Flow	VOCs (PID)	VOCs (LEL / HEX)	Temp	
Ext. well Vac (kPa)				7.10	2.90	8.50	3.30	10.30	5.20	19.76	19.88	19.87	19.87	27.95	28.20	28.20	10.08	17.99	24.92	29.65	43.42	37.48	37.58	42.07	30.89	22.11	kPa	m/s	m^3/hr	ppm_v	ppm_v	°C	
0	10:39:00	-	00:00:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0	0.0	0.0	-	Trial Start @ 10:39
-3.5	11:00:00	11:13:00	00:21:00	-140	-70	-260	-180	-120	-380	0	-15	-	-	-10	0	0	0	-20	0	0	0	0	0	0	0	0	-3.5	1.8	12.7	1150	>110000	20.8	
-3.5	11:18:00	11:42:00	00:39:00	-220	-110	-320	-260	-150	-410	0	-20	-25	-15	-10	0	0	0	-30	-	-	-	-	-	-	-	-	-3.5	1.7	12.0	1000	>110000	22.5	
-4.6	12:08:00	12:23:00	01:29:00	-280	-210	-350	-340	-150	-500	0	-15	-30	-20	-5	0	0	0	-40	-25	-5	0	0	0	0	0	40	-4.6	2.8	19.8	950	60000	27	Increased vac. To -5kpa @ 11:45
-4.8	12:40:00	12:58:00	02:01:00	-250	-370	-410	-390	-180	-500	0	-10	-20	-15	-5	-7	0	0	-45	-	-	-	-	-	-	-	-	-4.8	2.6	18.4	1210	64000	28.4	
-8.0	13:19:00	12:37:00	02:40:00	-300	-950	-700	-600	-350	-900	0	-45	-50	-40	-5	-5	0	0	-100	-55	-15	0	0	0	0	0	130	-8	4.5	31.8	785	>110000	28.4	Increased vac. To -8kpa @ 12:59
-12.0	14:06:00	14:31:00	03:27:00	-600	-500	-850	-700	-440	-900	0	-60	-60	-50	-20	0	0	0	-130	0	-20	0	0	0	0	0	140	-12	5.4	38.2	405	52000	28.4	Increased vac. To -12kpa @ 13:41

SVE Trial Results

CLIENT:	Caltex
SITE:	Holt - Canberra

ACTIVITY:	SVE Trial
DATE:	15/09/2020

TESTERS:	[redacted]
TRIAL:	SVE Trail

Extraction Well	Approx timeframes			Extraction Well(s)		Observation wells - standing water levels (mBTOC) -- and -- Distance from extraction well(s) (m)																																	
PEW1	Start time	Finish time	Time (hours)	DTP	DTW	MW2		PMW1		PMW2		MW05		PMW3		PMW4		MW6		MW16		MW15		EW2		MW4		EW3		MW1		MW11		MW10		IW3		MW9	
Ext. well Vac (kPa)						7.1		2.9		8.5		3.3		10.3		5.2		18.77		20.1		26.68		12.72		19.11		27.96		32.31		46.67		40.62		40.51		44.2	
						DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW
0	10:39:00	-	00:00:00	-	8.814	9.043	9.064	8.793	8.797	-	8.505	-	8.412	-	7.788	-	8.568	8.529	8.572	7.646	7.729	7.526	7.594	-	8.965	-	8.334	-	9.238	-	9.503	-	10.602	10.600	10.605	-	10.587	-	10.492
-3.5	11:00:00	11:13:00	00:21:00																																				
-3.5	11:18:00	11:42:00	00:39:00																																				
-4.6	12:08:00	12:23:00	01:29:00																																				
-4.8	12:40:00	12:58:00	02:01:00																																				
-8.0	13:19:00	12:37:00	02:40:00																																				
-12.0	14:06:00	14:31:00	03:27:00																																				

SVE Trial Results

CLIENT:	Caltex
SITE:	Holt - Canberra

ACTIVITY:	SVE Trial
DATE:	15/09/2020

Extraction Well	Approx timeframes								Comments
PEW1	Start time	Finish time	Time (hours)	MW8		MW7		Approx Litres	
Ext. well Vac (kPa)				32.38		22.45			
				DTP	DTW	DTP	DTW		
0	10:39:00	-	00:00:00	-	9.640	-	9.006	-	
-3.5	11:00:00	11:13:00	00:21:00						
-3.5	11:18:00	11:42:00	00:39:00						
-4.6	12:08:00	12:23:00	01:29:00						
-4.8	12:40:00	12:58:00	02:01:00						
-8.0	13:19:00	12:37:00	02:40:00						
-12.0	14:06:00	14:31:00	03:27:00						

APPENDIX E-2
SVE + PUMPING TRIAL DATA

SVE + Pumping Trial Results

CLIENT:	Caltex
SITE:	Holt - Canberra

ACTIVITY:	SVE+Pumping Trial
DATE:	15/09/20 & 16/09/20

TESTERS:	[redacted]
TRIAL:	SVE+Pumping Trail

Extraction Well	Approx timeframes			Observation wells - pressure measurements (Pa) -- and -- Distance from extraction wells (m)																						BLOWER / EXTRACTION UNIT / VAC TRUCK							Comments
PEW1	Start time	Finish time	Time (hours)	MW2	PMW1	PMW2	MW05	PMW3	PMW4	MW6	MW16	SV3-2m	SV3-6m	MW15	SV2-2m	SV2-6m	EW2	MW4	EW3	MW1	MW7	IW1	IW2	MW17	SV4-2m	SV4-6m	Vacuum	Air Velocity	Air Flow	Pumped Water Flow	VOCs (PID)	VOCs (LEL / HEX)	Temp	
Ext. well Vac (kPa)				7.10	2.90	8.50	3.30	10.30	5.20	19.76	19.88	19.87	19.87	27.95	28.20	28.20	10.08	17.99	24.92	29.65	22.11	18.98	27.60	32.39	32.85	32.85	kPa	m/s	m^3/hr	L/min	ppm,	ppm,	°C	
0	15/09/20 15:21	-	00:00:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0.0	0	1.06	0.0	0.0	-	Trial Start @ 15:21 on 15.9.20 Pump inlet @ 8.53 mbgl
-3	15/09/20 15:40	16:00:00	00:19:00	-70	-125	-200	-125	-80	-250	0	-5			0	0	0	0										-3	2.0	14.1	0.23	1000	45000	30.6	Trial paused @ 16:16 due to end of work day
0	16/09/20 09:16	09:22:00	00:19:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0.0	0.0	3.09	0	0	-	Trial restarted @ 09:16 on 16.9.20 Pump inlet @ 10.493 mbgl
-6	16/09/20 09:34	09:59:00	00:37:00	-210	-200	-320	-260	-150	-450	0	-15	-10	-10	0	0	0	0	-30	-15	-5		0	0	0	0	0	-6	1.6	11.3	2.35	7180	>110,000*	16.7	Trial paused - malfunctioning pump @ 10:00
0	16/09/20 10:33	10:40:00	00:37:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0.0	0.0	2.35	0	0	-	Trial restarted @ 10:33
-6	16/09/20 10:55	11:06:00	00:59:00	-240	-160	-350	-340	-120	-480	0	-10	-15	-15				0	-20	-20	-5		0	0	0	0	0	-6	3.7	26.2	2.33	1000	>110,000*	20	Starting vacuum @ -6 kpa
-11	16/09/20 11:30	11:41:00	01:34:00	-550	-550	-550	-550	-400	-950	0	-35	-35	-50				0	-75	-55	-15		0	0	0	0	0	-11	5.4	38.2	2.16	880	>110,000*	24.5	Increased vacuum -10kpa @ 11:15
-15	16/09/20 12:47	13:11:00	02:51:00	-650	-900	-900	-1000	-500	-1200	0	-65	-55	-80				0	-140	-100	-30	-140	0	-10	0	-2	-2	-15	6.0	42.4	2.07	1010	>110,000*	28.8	Increased vacuum -15kpa @ 12:05
-14	16/09/20 14:10	14:27:00	04:14:00	-600	-500	-1000	-900	-500	-1400	0	-100	-70	-100				0	-150	-125	-50	-180	0	-20	-3	0	-5	-14	6.0	42.4	2.06	950	>110,000*	28.8	Carbon tube vapour sample taken in series: Sample 1 ID: V32961; Sample 2 ID: V32962
-20	16/09/20 15:01	15:11:00	05:05:00	-550	-1050	-800	-900	-600	-1500	0	-110						0					0		0	-5	0	-20	7.9	55.8	2.07	1100	>110,000*	30.5	Increased vacuum -20kpa @ 14:32
																																		Trial commenced / shutdown @ 16:03

Note:
* Hexane VOC meter above maximum limit of detection (<110,000 ppm hexane)
Blank cell means no measurement taken.
Drillers/car has moved to this position, so no measurements possible.
Trial paused

SVE + Pumping Trial Results

CLIENT:	Caltex
SITE:	Holt - Canberra

Extraction Well	Approx timeframes			Extraction Well		Observation wells - standing water levels (mBTOC) -- and -- Distance from extraction well(s) (m)																														Extracted Volumes			
PEW1	Start time	Finish time	Time (hours)	PEW1		MW2		PMW1		PMW2		MW05		PMW3		PMW4		MW6		MW16		MW15		EW2		MW4		EW3		MW1		MW7		IW2		MW17		Liquid Storage Tank			Liquid Recovery Rate
Ext. well Vac (kPa)				DTP	DTW	7.10		2.90		8.50		3.30		10.30		5.20		19.76		19.88		27.95		10.08		17.99		24.92		29.65		22.11		27.60		32.39					
						DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	Liters of Liquid Extracted	L/min
0	15/09/20 15:21	-	00:00:00	-	8.814	9.043	9.064	8.793	8.797	-	8.505	-	8.412	-	7.788	-	8.568	8.529	8.572	7.646	7.729	7.526	7.594	-	8.965	-	8.334	-	9.238	-	9.503	-	9.006	-	9.406			0.850	0.873	0.0	1.06
-3	15/09/20 15:40	16:00:00	00:19:00			9.035	9.056	8.784	8.787	-	8.499	-	8.398	-	7.775	-	8.564			7.630	7.690	7.510	7.569			-	8.320														0.23
0	16/09/20 09:16	09:22:00	00:19:00	-	8.770	9.043	9.064	8.770	8.773	-	8.485	-	8.386	-	7.767	-	8.547	8.490	8.527	7.629	7.688	7.505	7.560	-	8.945	-	8.317	-	9.204	-	9.492			-	9.393	-	7.624				
-6	16/09/20 09:34	09:59:00	00:37:00																																						2.45
0	16/09/20 10:33	10:40:00	00:37:00																																						2.35
-6	16/09/20 10:55	11:06:00	00:59:00																																			0.834	0.859		2.35
-11	16/09/20 11:30	11:41:00	01:34:00			9.051	9.069	8.854	8.858	-	8.489	-	8.427	-	7.781	-	8.603	8.482	8.522	7.628	7.688			-	8.957	-	8.318	-	9.194	-	9.483			-	9.385	-	7.619				2.33
-15	16/09/20 12:47	13:11:00	02:51:00																																			0.814	0.837		2.06
-14	16/09/20 14:10	14:27:00	04:14:00																																						2.07
-20	16/09/20 15:01	15:11:00	05:05:00			9.050	9.070	8.850	8.845	-	8.500	-	8.420			-	8.596	8.475	8.575	7.630	7.685			-	8.960	-	8.330	-	9.195	-	9.490	-	8.965	-	9.390	-	7.620	0.803	0.825	691.2	

Note: * Hexane VOC meter above

Blank cell means no meas

Drillers/car has moved to

Trial paused

SVE + Pumping Trial Results

CLIENT:	**Caltex**
SITE:	**Holt - Canberra**

Extraction Well	**Approx timeframes**			**Comments**
PEW1				
Ext. well Vac (kPa)	**Start time**	**Finish time**	**Time (hours)**	
0	15/09/20 15:21	-	00:00:00	Water level gauging measurement from 15/9/20 @ 08:06
-3	15/09/20 15:40	16:00:00	00:19:00	Water level gauging measurement from 15/9/20 @ 14:25
0	16/09/20 09:16	09:22:00	00:19:00	Water level gauging measurement from 16/9/20 @ 07:30
-6	16/09/20 09:34	09:59:00	00:37:00	
0	16/09/20 10:33	10:40:00	00:37:00	
-6	16/09/20 10:55	11:06:00	00:59:00	
-11	16/09/20 11:30	11:41:00	01:34:00	Water level gauging measurement from 16/9/20 @ 11:30
-15	16/09/20 12:47	13:11:00	02:51:00	
-14	16/09/20 14:10	14:27:00	04:14:00	
-20	16/09/20 15:01	15:11:00	05:05:00	Water level gauging measurement from 16/9/20 @ 15:30

Note: * Hexane VOC meter above
Blank cell means no meas
Drillers/car has moved to
Trial paused

APPENDIX E-3
MPVE TRIAL DATA

MPVE Trial Results

CLIENT:	Caltex
SITE:	Holt - Canberra

ACTIVITY:	MPVE Trial
DATE:	17/09/2020

TESTERS:	[redacted]
TRIAL:	MPVE Trial

Extraction Well		Approx timeframes			Observation wells - pressure measurements (Pa) -- and -- Distance from extraction wells (m)																										BLOWER / EXTRACTION UNIT / VAC TRUCK							Comments
PEW1		Start time	Finish time	Time (hours)	MW2	PMW1	PMW2	MW05	PMW3	PMW4	MW6	MW16	SV3-2m	SV3-6m	MW15	SV2-2m	SV2-6m	EW2	MW4	EW3	MW1	MW11	MW10	MW9	MW8	MW7	MW17	SV4-2m	SV4-6m	Vacuum	Air Velocity	Air Flow	Liquid Water Flow	VOCs (PID)	VOCs (LEL / HEX)	Temp	
Ext. well Vac (kPa)	Spear Depth (mbgl)				7.10	2.90	8.50	3.30	10.30	5.20	19.76	19.88	19.87	19.87	27.95	28.20	28.20	10.08	17.99	24.92	29.65	43.42	37.48	42.07	30.89	22.11	32.39	32.85	32.85	kPa	m/s	m^3/hr	L/min	ppm_v	ppm_v	°C	
0	10.7	08:33	-	00:00:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.00	-	-	-	Trial started at 08:33 Open spear & bleed closed
-42	10.7	09:04	-	00:31:00	-450	-465	-600	-550	-320	-900	0	-25	-40	0	-10	0	-5	0	-85	-50	-15	0	0	0	0	-110	0	-3	0	-70	19.1	135.0	2.76	1272	46000	18	
-42	10.7	10:02	-	01:29:00	-450	-900	-750	-700	-390	-950	0	-60	-36	-70	-8	0	-4	0	-109	-82	-35	0	0	0	0	-180	0	-3	-9	-67	20.4	144.2	2.73	880	44000	18.4	
-47	10.7	11:12	-	02:39:00	-500	-550	-550	-700	-400	-900	0	-70	-55	-90	-20	-10	-10	0	-110	-95	-25	0	0	0	0	-100	-5	-5	-5	-62	17.0	120.2	2.61	980	44000	18.7	
-40	10.7	12:13	-	03:40:00	-340	-1100	-550	-800	-375	-1000	0	-30	-45	-70	-5	-10	-10	0	-110	-90	-25	0	0	0	0	-1330	0	-3	-10	-62	15.4	108.9	3.00	782	45140	19	
-40	10.7	13:45	-	05:12:00	-390	-1400	-700	-1000	-410	-1100	0	-40	-40	-70	-10	-10	-10	0	-130	-10	-35	0	0	0	0	-170	0	-5	-5	-61	16.2	114.5	2.61	899	46256	18.8	
-40	10.7	15:38	16:45:00	07:05:00	-550	-1600	-850	-850	-450	-1100	0	-80	-65	-90	-11	-6	-11	0	-120	-110	-60	0	0	0	0	-150	0	-5	-5	-58	15.7	111.0	2.50	725	50956	18	Carbon tube sampling at 16:16 in series: Sample 1 ID: V32957; Sample 2 ID: V32958

Note:

*	Hexane VOC meter above maximum limit of detection (<110,000 ppm hexane)
	Blank cell means no measurement taken.
	Drillers/car has moved to this position, so no measurements possible.
	Trial paused

CLIENT:	Caltex
SITE:	Holt - Canberra

ACTIVITY:	MPVE Trial
DATE:	17/09/2020

TESTERS:	[redacted]
TRIAL:	MPVE Trial

Extraction Well		Approx timeframes			Extraction Well		Observation wells - standing water levels (mBTOC) -- and -- Distance from extraction well(s) (m)																								Extracted volumes	Comments
PEW1		Start time	Finish time	Time (hours)	PEW1		MW2		PMW1		PMW2		MW05		PMW3		PMW4		MW6		MW16		MW15		EW2		MW4		MW7		MW17		Approx Litres	
Ext. well Vac (kPa)	Spear Depth (mbgl)				DTP	DTW	7.10		2.90		8.50		3.30		10.30		5.20		19.76		19.88		27.95		10.08		17.99		22.11		32.39			
							DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW	DTP	DTW		
0	10.7	08:33	-	00:00:00	-	8.784	9.026	9.040	8.769	8.773	-	8.485	-	8.388	-	7.771	-	8.550	8.491	8.528	7.634	7.690	7.507	7.565	-	8.946	-	8.324	-	8.985	-	7.632		Wells gauged at 07:30
-42	10.7	09:04	-	00:31:00																														
-42	10.7	10:02	-	01:29:00																														
-47	10.7	11:12	-	02:39:00																														
-40	10.7	12:13	-	03:40:00																														
-40	10.7	13:45	-	05:12:00																														
-40	10.7	15:38	16:45:00	07:05:00			9.100	9.117	8.194	8.199	-	8.530	-	8.457	-	7.819	8.649	8.650	-	8.569	7.658	7.745	7.529	7.599	-	8.995	-	8.358	-	9.432	-	7.654		Wells gauged at 16:00

Note:

*	Hexane VOC meter above
	Blank cell means no meas
	Drillers/car has moved to
	Trial paused

APPENDIX E-4
CHEMICAL INJECTION TRIAL DATA

Chemical Injection Results

Project: Caltex Holt, ACT
Project No: PS121494

IW1 Chemical Injection

Batch (Date)	Start Time	Finish Time	Time Elapsed (hr:min)	Injection Pressure (kPa)	Injection Flowrate Range from Flowmeter* (L/min)	Total Fluid Injected (L)	Calculated Average Flowrate (L/min)	Calculated Average Injection Pressure (kPa)	Comment
1 (17/09/2020)	16:41		0:00	0	0.0	0	2.8	40.5	Injection started by gravity flow
	16:55		0:14	10	2.6				Pump started at 16:55
	17:06		0:25	10	1.3 - 2.6				
	17:22		0:41	50	2.6 - 3.9				
	17:36		0:55	92	3.9 - 5.3				
		18:00	1:19			220			Finished Injection for the day.
2 (18/09/2020)	8:56		1:19	50	2.6 - 3.9	220	1.5	50.0	Started Injection on second day at IW1
	9:18		1:41	50	2.6				Injection stopped at 9:30
	10:42		3:05	50	2.6				Injection restarted at 10:42
		11:12	3:35	50	2.6	420			Injection at IW1 complete.

Note: * In some cases the fluid flowrate is given as a range, as there was a high fluctuation output on flow meter

Trial stopped / paused

IW2 Chemical Injection

Batch (Date)	Start Time	Finish Time	Time Elapsed (hr:min)	Injection Pressure (kPa)	Injection Flowrate Range from Flowmeter* (L/min)	Total Fluid Injected (L)	Calculated Average Flowrate (L/min)	Calculated Average Injection Pressure (kPa)	Comment
1 (18/09/2020)	12:54		0:00	30	5.3 - 6.6	0	7.7	40	Started injection of batch 1 at 12:54
	13:02		0:08	50	6.6 - 7.6				
		13:20	0:26			200			Finished injection of batch 1 at 13:20
2 (18/09/2020)	14:05		0:26	80	6.7 - 7.9	200	10.0	80	Started injection of batch 2 at 14:05
	14:41		1:02	80	6.6 - 7.9				
		14:45	1:06			600			Injection at IW2 complete.

Note: * In some cases the fluid flowrate is given as a range, as there was a high fluctuation output on flow meter

Trial stopped / paused

IW3 Chemical Injection

Batch (Date)	Start Time	Finish Time	Time Elapsed (hr:min)	Injection Pressure (kPa)	Injection Flowrate Range from Flowmeter* (L/min)	Total Fluid Injected (L)	Calculated Average Flowrate (L/min)	Calculated Average Injection Pressure (kPa)	Comment
1 (17/09/2020)	15:24		0:00	10	2.0	0	1.3	75	Started injection of batch 1 at 15:24
	16:00		0:36	50	1.3				
	16:20		0:56	100	1.3 - 2.2				
		16:25	1:01			80			Stopped injection at IW3 due to slow infiltration rate

Note: * In some cases the fluid flowrate is given as a range, as there was a high fluctuation output on flow meter

APPENDIX F

LABORATORY REPORTS

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	[redacted]
Client	WSP AUSTRALIA PTY LIMITED
Address	GPO Box 5394 NSW 2001
Telephone	02 9272 5100
Facsimile	02 9272 5101
Email	[redacted]
Project	**PS121494**
Order Number	**PS121494**
Samples	10

LABORATORY DETAILS

Manager	[redacted]
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	**SE211389 R0**
Date Received	21/9/2020
Date Reported	30/9/2020

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(4354).

VOC/VPH - The Limit of Reporting (LOR) has been raised due to interferences from the sample matrix.

SIGNATORIES

[redacted]

Organic Section Head

VOCs in Water [AN433] Tested: 24/9/2020

PARAMETER	UOM	LOR	IN1 WATER - 17/9/2020 SE211389.001	IN2 WATER - 17/9/2020 SE211389.002	IN3 WATER - 17/9/2020 SE211389.003	MW01 WATER - 17/9/2020 SE211389.004	MW06 WATER - 17/9/2020 SE211389.005
Benzene	µg/L	0.5	16000	6700	4000	4200	3600
Toluene	µg/L	0.5	180000	130000	25000	100000	88000
Ethylbenzene	µg/L	0.5	3500	4300	780	3800	3100
m/p-xylene	µg/L	1	12000	15000	4000	16000	14000
o-xylene	µg/L	0.5	5000	6600	1900	6800	5900
Total Xylenes	µg/L	1.5	17000	22000	5900	23000	20000
Total BTEX	µg/L	3	210000	160000	36000	140000	110000
Naphthalene	µg/L	0.5	<2500↑	2600	1300	<2500↑	<1000↑

PARAMETER	UOM	LOR	MW07 WATER - 17/9/2020 SE211389.006	MW10 WATER - 17/9/2020 SE211389.007	EW03 WATER - 17/9/2020 SE211389.008	MW-QC1 WATER - 17/9/2020 SE211389.009	RN1 WATER - 17/9/2020 SE211389.010
Benzene	µg/L	0.5	10000	9300	52	15000	1.6
Toluene	µg/L	0.5	100000	120000	3300	160000	32
Ethylbenzene	µg/L	0.5	3400	3300	230	3200	1.0
m/p-xylene	µg/L	1	15000	12000	930	11000	3
o-xylene	µg/L	0.5	6300	5000	540	4400	1.4
Total Xylenes	µg/L	1.5	21000	16000	1500	15000	4.7
Total BTEX	µg/L	3	140000	150000	5000	190000	39
Naphthalene	µg/L	0.5	<2500↑	<2500↑	58	<2500↑	<0.5

Volatile Petroleum Hydrocarbons in Water [AN433] Tested: 24/9/2020

PARAMETER	UOM	LOR	IN1 WATER - 17/9/2020 SE211389.001	IN2 WATER - 17/9/2020 SE211389.002	IN3 WATER - 17/9/2020 SE211389.003	MW01 WATER - 17/9/2020 SE211389.004	MW06 WATER - 17/9/2020 SE211389.005
TRH C6-C9	µg/L	40	330000	260000	57000	200000	180000
Benzene (F0)	µg/L	0.5	16000	6700	4000	4200	3600
TRH C6-C10	µg/L	50	340000	280000	62000	<250000↑	200000
TRH C6-C10 minus BTEX (F1)	µg/L	50	<250000↑	<250000↑	<50000↑	<250000↑	<100000↑

PARAMETER	UOM	LOR	MW07 WATER - 17/9/2020 SE211389.006	MW10 WATER - 17/9/2020 SE211389.007	EW03 WATER - 17/9/2020 SE211389.008	MW-QC1 WATER - 17/9/2020 SE211389.009	RN1 WATER - 17/9/2020 SE211389.010
TRH C6-C9	µg/L	40	210000	230000	8900	290000	54
Benzene (F0)	µg/L	0.5	10000	9300	52	15000	1.6
TRH C6-C10	µg/L	50	<250000↑	<250000↑	10000	310000	58
TRH C6-C10 minus BTEX (F1)	µg/L	50	<250000↑	<250000↑	5400	<250000↑	<50

TRH (Total Recoverable Hydrocarbons) in Water [AN403] Tested: 22/9/2020

PARAMETER	UOM	LOR	IN1 WATER - 17/9/2020 SE211389.001	IN2 WATER - 17/9/2020 SE211389.002	IN3 WATER - 17/9/2020 SE211389.003	MW01 WATER - 17/9/2020 SE211389.004	MW06 WATER - 17/9/2020 SE211389.005
TRH C10-C14	µg/L	50	5800	11000	1600	20000	9700
TRH C15-C28	µg/L	200	300	540	<200	8700	10000
TRH C29-C36	µg/L	200	<200	<200	<200	<200	<200
TRH C37-C40	µg/L	200	<200	<200	<200	<200	<200
TRH >C10-C16	µg/L	60	2900	6000	980	11000	5200
TRH >C10-C16 - Naphthalene (F2)	µg/L	60	2600	5600	890	10000	4900
TRH >C16-C34 (F3)	µg/L	500	<500	<500	<500	8400	9800
TRH >C34-C40 (F4)	µg/L	500	<500	<500	<500	<500	<500
TRH C10-C40	µg/L	320	6100	12000	1600	28000	20000

PARAMETER	UOM	LOR	MW07 WATER - 17/9/2020 SE211389.006	MW10 WATER - 17/9/2020 SE211389.007	EW03 WATER - 17/9/2020 SE211389.008	MW-QC1 WATER - 17/9/2020 SE211389.009	RN1 WATER - 17/9/2020 SE211389.010
TRH C10-C14	µg/L	50	19000	6700	1400	4800	<50
TRH C15-C28	µg/L	200	19000	1200	<200	220	<200
TRH C29-C36	µg/L	200	450	<200	<200	<200	<200
TRH C37-C40	µg/L	200	<200	<200	<200	<200	<200
TRH >C10-C16	µg/L	60	13000	3400	760	2300	<60
TRH >C10-C16 - Naphthalene (F2)	µg/L	60	11000	3000	660	2000	<60
TRH >C16-C34 (F3)	µg/L	500	18000	1100	<500	<500	<500
TRH >C34-C40 (F4)	µg/L	500	<500	<500	<500	<500	<500
TRH C10-C40	µg/L	320	39000	7900	1600	5000	<320

METHOD	METHODOLOGY SUMMARY
AN403	Total Recoverable Hydrocarbons: Determination of Hydrocarbons by gas chromatography after a solvent extraction. Detection is by flame ionisation detector (FID) that produces an electronic signal in proportion to the combustible matter passing through it. Total Recoverable Hydrocarbons (TRH) are routinely reported as four alkane groupings based on the carbon chain length of the compounds: C6-C9, C10-C14, C15-C28 and C29-C36 and in recognition of the NEPM 1999 (2013), >C10-C16 (F2), >C16-C34 (F3) and >C34-C40 (F4). Where F2 is corrected for Naphthalene, the VOC data for Naphthalene is used.
AN403	Additionally, the volatile C6-C9/C6-C10 fractions may be determined by a purge and trap technique and GC/MS because of the potential for volatiles loss. Total Recoveerable Hydrocarbons - Silica (TRH-Silica) follows the same method of analysis after silica gel cleanup of the solvent extract. Aliphatic/Aromatic Speciation follows the same method of analysis after fractionation of the solvent extract over silica with differential polarity of the eluent solvents.
AN403	The GC/FID method is not well suited to the analysis of refined high boiling point materials (ie lubricating oils or greases) but is particularly suited for measuring diesel, kerosene and petrol if care to control volatility is taken. This method will detect naturally occurring hydrocarbons, lipids, animal fats, phenols and PAHs if they are present at sufficient levels, dependent on the use of specific cleanup/fractionation techniques. Reference USEPA 3510B, 8015B.
AN433	VOCs and C6-C9 Hydrocarbons by GC-MS P&T: VOC`s are volatile organic compounds. The sample is presented to a gas chromatograph via a purge and trap (P&T) concentrator and autosampler and is detected with a Mass Spectrometer (MSD). Solid samples are initially extracted with methanol whilst liquid samples are processed directly. References: USEPA 5030B, 8020A, 8260.

FOOTNOTES

*	NATA accreditation does not cover the performance of this service.	-	Not analysed.	UOM	Unit of Measure.
**	Indicative data, theoretical holding time exceeded.	NVL	Not validated.	LOR	Limit of Reporting.
***	Indicates that both * and ** apply.	IS	Insufficient sample for analysis.	↑↓	Raised/lowered Limit of Reporting.
		LNR	Sample listed, but not received.		

Unless it is reported that sampling has been performed by SGS, the samples have been analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the " Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.
Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC and MU criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here: www.sgs.com.au/en-gb/environment-health-and-safety.

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ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	[redacted]
Client	WSP AUSTRALIA PTY LIMITED
Address	Level 27, 680 George St NSW 2000
Telephone	02 9272 5689
Facsimile	02 9272 5101
Email	[redacted]
Project	**Caltex Holt - Stage 2 GME (Sept 2020)**
Order Number	**PS121494-111**
Samples	69

LABORATORY DETAILS

Manager	[redacted]
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	**SE211730 R0**
Date Received	29/9/2020
Date Reported	2/10/2020

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(4354).

Ethanol subcontracted to SGS Special Projects Division-Unit 16, 33 Maddox Street Alexandria NSW 2015. Job SP032512
VOC/VPH - The Limit of Reporting (LOR) has been raised due to interferences from the sample matrix.

SIGNATORIES

[redacted]

Metals/Inorganics Team Leader | Senior Chemist | Organic Section Head

VOCs in Water [AN433] Tested: 29/9/2020

PARAMETER	UOM	LOR	EW01 WATER - 28/9/2020 SE211730.001	EW02 WATER - 28/9/2020 SE211730.002	EW03 WATER - 28/9/2020 SE211730.003	RW01 WATER - 28/9/2020 SE211730.004	MW01 WATER - 28/9/2020 SE211730.005
Benzene	µg/L	0.5	15000	17000	3.8	20000	3500
Toluene	µg/L	0.5	130000	130000	46	170000	78000
Ethylbenzene	µg/L	0.5	3200	<2500↑	25	4000	9600
m/p-xylene	µg/L	1	9600	8300	32	12000	14000
o-xylene	µg/L	0.5	3900	3600	23	5000	6100
Total Xylenes	µg/L	1.5	13000	12000	55	17000	20000
Total BTEX	µg/L	3	160000	160000	130	210000	110000
Naphthalene	µg/L	0.5	<2500↑	<2500↑	<0.5	<2500↑	<1000↑

PARAMETER	UOM	LOR	MW02 WATER - 28/9/2020 SE211730.006	MW04 WATER - 28/9/2020 SE211730.007	MW05 WATER - 28/9/2020 SE211730.008	MW06 WATER - 28/9/2020 SE211730.009	MW07 WATER - 28/9/2020 SE211730.010
Benzene	µg/L	0.5	13000	620	11000	14000	10000
Toluene	µg/L	0.5	170000	140	140000	160000	88000
Ethylbenzene	µg/L	0.5	3400	<25↑	3400	3900	2000
m/p-xylene	µg/L	1	13000	50	13000	14000	9200
o-xylene	µg/L	0.5	5600	27	5200	5800	4100
Total Xylenes	µg/L	1.5	19000	78	18000	20000	13000
Total BTEX	µg/L	3	200000	840	170000	200000	110000
Naphthalene	µg/L	0.5	<2500↑	<25↑	<2500↑	<2500↑	<1000↑

PARAMETER	UOM	LOR	MW08 WATER - 28/9/2020 SE211730.011	MW09 WATER - 28/9/2020 SE211730.012	MW10 WATER - 28/9/2020 SE211730.013	MW11 WATER - 28/9/2020 SE211730.014	MW12 WATER - 28/9/2020 SE211730.015
Benzene	µg/L	0.5	<0.5	<0.5	11000	22	970
Toluene	µg/L	0.5	<0.5	<0.5	140000	2.4	29000
Ethylbenzene	µg/L	0.5	<0.5	<0.5	3600	4.3	1300
m/p-xylene	µg/L	1	<1	<1	13000	5	6800
o-xylene	µg/L	0.5	<0.5	<0.5	5600	2.1	2700
Total Xylenes	µg/L	1.5	<1.5	<1.5	19000	7.6	9500
Total BTEX	µg/L	3	<3	<3	180000	37	41000
Naphthalene	µg/L	0.5	<0.5	<0.5	<2500↑	<0.5	<500↑

PARAMETER	UOM	LOR	MW13 WATER - 28/9/2020 SE211730.016	MW14 WATER - 28/9/2020 SE211730.017	MW15 WATER - 28/9/2020 SE211730.018	MW16 WATER - 28/9/2020 SE211730.019	MW17 WATER - 28/9/2020 SE211730.020
Benzene	µg/L	0.5	<0.5	<0.5	12000	13000	6500
Toluene	µg/L	0.5	<0.5	<0.5	130000	150000	69000
Ethylbenzene	µg/L	0.5	<0.5	<0.5	3500	3100	1600
m/p-xylene	µg/L	1	<1	<1	12000	12000	5700
o-xylene	µg/L	0.5	<0.5	<0.5	5100	4800	2200
Total Xylenes	µg/L	1.5	<1.5	<1.5	17000	17000	7900
Total BTEX	µg/L	3	<3	<3	170000	190000	85000
Naphthalene	µg/L	0.5	<0.5	<0.5	<2500↑	<2500↑	<1000↑

VOCs in Water [AN433] Tested: 29/9/2020 (continued)

PARAMETER	UOM	LOR	MW18 WATER - 28/9/2020 SE211730.021	MW19 WATER - 28/9/2020 SE211730.022	MW20 WATER - 28/9/2020 SE211730.023	MW21 WATER - 28/9/2020 SE211730.024	MW23 WATER - 28/9/2020 SE211730.025
Benzene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	2.3
Ethylbenzene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
m/p-xylene	µg/L	1	<1	<1	<1	<1	<1
o-xylene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Xylenes	µg/L	1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Total BTEX	µg/L	3	<3	<3	<3	<3	<3
Naphthalene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5

PARAMETER	UOM	LOR	MW24 WATER - 28/9/2020 SE211730.026	MW25 WATER - 28/9/2020 SE211730.027	S2-P1 WATER - 28/9/2020 SE211730.028	S2-P2 WATER - 28/9/2020 SE211730.029	S2-P3 WATER - 28/9/2020 SE211730.030
Benzene	µg/L	0.5	3700	<0.5	<0.5	110	2.5
Toluene	µg/L	0.5	35000	2.0	<0.5	2800	3.9
Ethylbenzene	µg/L	0.5	740	<0.5	<0.5	76	1.2
m/p-xylene	µg/L	1	4600	<1	<1	810	2
o-xylene	µg/L	0.5	1800	<0.5	<0.5	310	1.6
Total Xylenes	µg/L	1.5	6400	<1.5	<1.5	1100	3.8
Total BTEX	µg/L	3	46000	<3	<3	4100	11
Naphthalene	µg/L	0.5	<500↑	<0.5	<0.5	45	0.5

PARAMETER	UOM	LOR	S2-P4 WATER - 28/9/2020 SE211730.031	S2-P5 WATER - 28/9/2020 SE211730.032	S2-P6 WATER - 28/9/2020 SE211730.033	S2-P7 WATER - 28/9/2020 SE211730.034	S2-P8 WATER - 28/9/2020 SE211730.035
Benzene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	8.2
Toluene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	7.1
Ethylbenzene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
m/p-xylene	µg/L	1	<1	<1	<1	<1	2
o-xylene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	2.8
Total Xylenes	µg/L	1.5	<1.5	<1.5	<1.5	<1.5	5.1
Total BTEX	µg/L	3	<3	<3	<3	<3	21
Naphthalene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	0.7

PARAMETER	UOM	LOR	S2-P9B WATER - 28/9/2020 SE211730.036	S2-P10 WATER - 28/9/2020 SE211730.037	S2-P11 WATER - 28/9/2020 SE211730.038	S2-P12 WATER - 28/9/2020 SE211730.039	S2-C1 WATER - 28/9/2020 SE211730.040
Benzene	µg/L	0.5	9.1	200	<0.5	1.0	<0.5
Toluene	µg/L	0.5	<0.5	210	0.9	12	<0.5
Ethylbenzene	µg/L	0.5	<0.5	22	<0.5	<0.5	<0.5
m/p-xylene	µg/L	1	<1	170	<1	<1	<1
o-xylene	µg/L	0.5	<0.5	85	0.8	0.6	<0.5
Total Xylenes	µg/L	1.5	<1.5	260	<1.5	<1.5	<1.5
Total BTEX	µg/L	3	9	690	<3	13	<3
Naphthalene	µg/L	0.5	<0.5	8.2	<0.5	<0.5	<0.5

VOCs in Water [AN433] Tested: 29/9/2020 (continued)

PARAMETER	UOM	LOR	S2-C2 WATER - 28/9/2020 SE211730.041	S2-C3 WATER - 28/9/2020 SE211730.042	S2-C4 WATER - 28/9/2020 SE211730.043	S2-C5 WATER - 28/9/2020 SE211730.044	S2-C6 WATER - 28/9/2020 SE211730.045
Benzene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
m/p-xylene	µg/L	1	<1	<1	<1	<1	<1
o-xylene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Xylenes	µg/L	1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Total BTEX	µg/L	3	<3	<3	<3	<3	<3
Naphthalene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5

PARAMETER	UOM	LOR	S2-C7 WATER - 28/9/2020 SE211730.046	S2-C8 WATER - 28/9/2020 SE211730.047	S2-C9 WATER - 28/9/2020 SE211730.048	S2-C10 WATER - 28/9/2020 SE211730.049	GW_QA01 WATER - 28/9/2020 SE211730.050
Benzene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	**230**
Toluene	µg/L	0.5	**0.9**	<0.5	<0.5	<0.5	**230**
Ethylbenzene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	**17**
m/p-xylene	µg/L	1	<1	<1	<1	<1	**180**
o-xylene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	**89**
Total Xylenes	µg/L	1.5	<1.5	<1.5	<1.5	<1.5	**270**
Total BTEX	µg/L	3	<3	<3	<3	<3	**740**
Naphthalene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<2.5↑

PARAMETER	UOM	LOR	GW_QA02 WATER - 28/9/2020 SE211730.051	GW_QA03 WATER - 28/9/2020 SE211730.052	GW_QA04 WATER - 28/9/2020 SE211730.053	GW_RB01 WATER - 28/9/2020 SE211730.054	GW_RB02 WATER - 29/9/2020 SE211730.055
Benzene	µg/L	0.5	<0.5	**720**	<0.5	<0.5	<0.5
Toluene	µg/L	0.5	<0.5	**78**	<0.5	<0.5	**2.8**
Ethylbenzene	µg/L	0.5	<0.5	<10↑	<0.5	<0.5	<0.5
m/p-xylene	µg/L	1	<1	**39**	<1	<1	<1
o-xylene	µg/L	0.5	<0.5	**24**	<0.5	<0.5	<0.5
Total Xylenes	µg/L	1.5	<1.5	**63**	<1.5	<1.5	<1.5
Total BTEX	µg/L	3	<3	**860**	<3	<3	<3
Naphthalene	µg/L	0.5	<0.5	<10↑	<0.5	<0.5	<0.5

PARAMETER	UOM	LOR	GW_TB01 WATER - 28/9/2020 SE211730.056	GW_TS01 WATER - 28/9/2020 SE211730.057	IW1 WATER - 29/9/2020 SE211730.058	IW2 WATER - 29/9/2020 SE211730.059	IW3 WATER - 28/9/2020 SE211730.060
Benzene	µg/L	0.5	<0.5	[103%]	**7900**	**7600**	<0.5
Toluene	µg/L	0.5	<0.5	[103%]	**94000**	**75000**	<0.5
Ethylbenzene	µg/L	0.5	<0.5	[103%]	**1700**	**2400**	<0.5
m/p-xylene	µg/L	1	<1	[103%]	**5800**	**8200**	<1
o-xylene	µg/L	0.5	<0.5	[103%]	**2400**	**3300**	<0.5
Total Xylenes	µg/L	1.5	<1.5	-	**8200**	**11000**	<1.5
Total BTEX	µg/L	3	<3	-	**110000**	**97000**	<3
Naphthalene	µg/L	0.5	<0.5	-	<1000↑	<1000↑	<0.5

VOCs in Water [AN433] Tested: 29/9/2020 (continued)

PARAMETER	UOM	LOR	PMW1 WATER - 28/9/2020 SE211730.061	PMW2 WATER - 29/9/2020 SE211730.062	PMW3 WATER - 28/9/2020 SE211730.063	PMW4 WATER - 28/9/2020 SE211730.064	PEW1 WATER - 29/9/2020 SE211730.065
Benzene	µg/L	0.5	10000	17000	11000	12000	20000
Toluene	µg/L	0.5	130000	140000	110000	150000	180000
Ethylbenzene	µg/L	0.5	3900	3400	2100	3300	4800
m/p-xylene	µg/L	1	11000	9400	6500	9800	13000
o-xylene	µg/L	0.5	4800	4000	2700	4200	5300
Total Xylenes	µg/L	1.5	16000	13000	9200	14000	18000
Total BTEX	µg/L	3	160000	170000	130000	180000	230000
Naphthalene	µg/L	0.5	<2500↑	<2500↑	<500↑	<500↑	<2500↑

PARAMETER	UOM	LOR	S2-P9 SHALLOW WATER - 29/9/2020 SE211730.066	S2-P9 DEEP WATER - 29/9/2020 SE211730.067	S2-D1 WATER - 28/9/2020 SE211730.068	S2-D2 WATER - 29/9/2020 SE211730.069
Benzene	µg/L	0.5	23	41	3100	160
Toluene	µg/L	0.5	1.2	<0.5	35000	1700
Ethylbenzene	µg/L	0.5	<0.5	<0.5	610	45
m/p-xylene	µg/L	1	<1	<1	2000	160
o-xylene	µg/L	0.5	<0.5	<0.5	840	66
Total Xylenes	µg/L	1.5	<1.5	<1.5	2800	230
Total BTEX	µg/L	3	24	41	42000	2100
Naphthalene	µg/L	0.5	<0.5	<0.5	<500↑	<25↑

Volatile Petroleum Hydrocarbons in Water [AN433] Tested: 29/9/2020

PARAMETER	UOM	LOR	EW01 WATER - 28/9/2020 SE211730.001	EW02 WATER - 28/9/2020 SE211730.002	EW03 WATER - 28/9/2020 SE211730.003	RW01 WATER - 28/9/2020 SE211730.004	MW01 WATER - 28/9/2020 SE211730.005
TRH C6-C9	µg/L	40	<200000↑	<200000↑	200	<200000↑	240000
Benzene (F0)	µg/L	0.5	15000	17000	3.8	20000	3500
TRH C6-C10	µg/L	50	<250000↑	<250000↑	260	<250000↑	250000
TRH C6-C10 minus BTEX (F1)	µg/L	50	<250000↑	<250000↑	130	<250000↑	130000

PARAMETER	UOM	LOR	MW02 WATER - 28/9/2020 SE211730.006	MW04 WATER - 28/9/2020 SE211730.007	MW05 WATER - 28/9/2020 SE211730.008	MW06 WATER - 28/9/2020 SE211730.009	MW07 WATER - 28/9/2020 SE211730.010
TRH C6-C9	µg/L	40	<200000↑	<2000↑	<200000↑	<200000↑	100000
Benzene (F0)	µg/L	0.5	13000	620	11000	14000	10000
TRH C6-C10	µg/L	50	<250000↑	<2500↑	<250000↑	<250000↑	120000
TRH C6-C10 minus BTEX (F1)	µg/L	50	<250000↑	<2500↑	<250000↑	<250000↑	<100000↑

PARAMETER	UOM	LOR	MW08 WATER - 28/9/2020 SE211730.011	MW09 WATER - 28/9/2020 SE211730.012	MW10 WATER - 28/9/2020 SE211730.013	MW11 WATER - 28/9/2020 SE211730.014	MW12 WATER - 28/9/2020 SE211730.015
TRH C6-C9	µg/L	40	<40	<40	410000	52	44000
Benzene (F0)	µg/L	0.5	<0.5	<0.5	11000	22	970
TRH C6-C10	µg/L	50	<50	<50	440000	60	<50000↑
TRH C6-C10 minus BTEX (F1)	µg/L	50	<50	<50	270000	<50	<50000↑

PARAMETER	UOM	LOR	MW13 WATER - 28/9/2020 SE211730.016	MW14 WATER - 28/9/2020 SE211730.017	MW15 WATER - 28/9/2020 SE211730.018	MW16 WATER - 28/9/2020 SE211730.019	MW17 WATER - 28/9/2020 SE211730.020
TRH C6-C9	µg/L	40	<40	<40	410000	<200000↑	<80000↑
Benzene (F0)	µg/L	0.5	<0.5	<0.5	12000	13000	6500
TRH C6-C10	µg/L	50	<50	<50	420000	<250000↑	<100000↑
TRH C6-C10 minus BTEX (F1)	µg/L	50	<50	<50	250000	<250000↑	<100000↑

PARAMETER	UOM	LOR	MW18 WATER - 28/9/2020 SE211730.021	MW19 WATER - 28/9/2020 SE211730.022	MW20 WATER - 28/9/2020 SE211730.023	MW21 WATER - 28/9/2020 SE211730.024	MW23 WATER - 28/9/2020 SE211730.025
TRH C6-C9	µg/L	40	<40	<40	<40	<40	<40
Benzene (F0)	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
TRH C6-C10	µg/L	50	<50	<50	<50	<50	<50
TRH C6-C10 minus BTEX (F1)	µg/L	50	<50	<50	<50	<50	<50

PARAMETER	UOM	LOR	MW24 WATER - 28/9/2020 SE211730.026	MW25 WATER - 28/9/2020 SE211730.027	S2-P1 WATER - 28/9/2020 SE211730.028	S2-P2 WATER - 28/9/2020 SE211730.029	S2-P3 WATER - 28/9/2020 SE211730.030
TRH C6-C9	µg/L	40	41000	<40	<40	8600	<40
Benzene (F0)	µg/L	0.5	3700	<0.5	<0.5	110	2.5
TRH C6-C10	µg/L	50	<50000↑	<50	<50	11000	<50
TRH C6-C10 minus BTEX (F1)	µg/L	50	<50000↑	<50	<50	6500	<50

Volatile Petroleum Hydrocarbons in Water [AN433] Tested: 29/9/2020 (continued)

PARAMETER	UOM	LOR	S2-P4 WATER - 28/9/2020 SE211730.031	S2-P5 WATER - 28/9/2020 SE211730.032	S2-P6 WATER - 28/9/2020 SE211730.033	S2-P7 WATER - 28/9/2020 SE211730.034	S2-P8 WATER - 28/9/2020 SE211730.035
TRH C6-C9	µg/L	40	<40	<40	<40	<40	**46**
Benzene (F0)	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	**8.2**
TRH C6-C10	µg/L	50	<50	<50	<50	<50	**54**
TRH C6-C10 minus BTEX (F1)	µg/L	50	<50	<50	<50	<50	<50

PARAMETER	UOM	LOR	S2-P9B WATER - 28/9/2020 SE211730.036	S2-P10 WATER - 28/9/2020 SE211730.037	S2-P11 WATER - 28/9/2020 SE211730.038	S2-P12 WATER - 28/9/2020 SE211730.039	S2-C1 WATER - 28/9/2020 SE211730.040
TRH C6-C9	µg/L	40	<40	**1300**	<40	<40	<40
Benzene (F0)	µg/L	0.5	**9.1**	**200**	<0.5	**1.0**	<0.5
TRH C6-C10	µg/L	50	<50	**1500**	<50	<50	<50
TRH C6-C10 minus BTEX (F1)	µg/L	50	<50	**860**	<50	<50	<50

PARAMETER	UOM	LOR	S2-C2 WATER - 28/9/2020 SE211730.041	S2-C3 WATER - 28/9/2020 SE211730.042	S2-C4 WATER - 28/9/2020 SE211730.043	S2-C5 WATER - 28/9/2020 SE211730.044	S2-C6 WATER - 28/9/2020 SE211730.045
TRH C6-C9	µg/L	40	<40	<40	<40	<40	<40
Benzene (F0)	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
TRH C6-C10	µg/L	50	<50	<50	<50	<50	<50
TRH C6-C10 minus BTEX (F1)	µg/L	50	<50	<50	<50	<50	<50

PARAMETER	UOM	LOR	S2-C7 WATER - 28/9/2020 SE211730.046	S2-C8 WATER - 28/9/2020 SE211730.047	S2-C9 WATER - 28/9/2020 SE211730.048	S2-C10 WATER - 28/9/2020 SE211730.049	GW_QA01 WATER - 28/9/2020 SE211730.050
TRH C6-C9	µg/L	40	<40	<40	<40	<40	**1000**
Benzene (F0)	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	**230**
TRH C6-C10	µg/L	50	<50	<50	<50	<50	**1100**
TRH C6-C10 minus BTEX (F1)	µg/L	50	<50	<50	<50	<50	**310**

PARAMETER	UOM	LOR	GW_QA02 WATER - 28/9/2020 SE211730.051	GW_QA03 WATER - 28/9/2020 SE211730.052	GW_QA04 WATER - 28/9/2020 SE211730.053	GW_RB01 WATER - 28/9/2020 SE211730.054	GW_RB02 WATER - 29/9/2020 SE211730.055
TRH C6-C9	µg/L	40	<40	<800↑	<40	<40	<40
Benzene (F0)	µg/L	0.5	<0.5	**720**	<0.5	<0.5	<0.5
TRH C6-C10	µg/L	50	<50	<1000↑	<50	<50	<50
TRH C6-C10 minus BTEX (F1)	µg/L	50	<50	<1000↑	<50	<50	<50

PARAMETER	UOM	LOR	GW_TB01 WATER - 28/9/2020 SE211730.056	IW1 WATER - 29/9/2020 SE211730.058	IW2 WATER - 29/9/2020 SE211730.059	IW3 WATER - 28/9/2020 SE211730.060	PMW1 WATER - 28/9/2020 SE211730.061
TRH C6-C9	µg/L	40	<40	**240000**	**170000**	<40	**260000**
Benzene (F0)	µg/L	0.5	<0.5	**7900**	**7600**	<0.5	**10000**
TRH C6-C10	µg/L	50	<50	**250000**	**180000**	<50	**290000**
TRH C6-C10 minus BTEX (F1)	µg/L	50	<50	**140000**	<100000↑	<50	<250000↑

Volatile Petroleum Hydrocarbons in Water [AN433] Tested: 29/9/2020 (continued)

PARAMETER	UOM	LOR	PMW2 WATER - 29/9/2020 SE211730.062	PMW3 WATER - 28/9/2020 SE211730.063	PMW4 WATER - 28/9/2020 SE211730.064	PEW1 WATER - 29/9/2020 SE211730.065	S2-P9 SHALLOW WATER - 29/9/2020 SE211730.066
TRH C6-C9	µg/L	40	**280000**	**190000**	**260000**	**400000**	<40
Benzene (F0)	µg/L	0.5	**17000**	**11000**	**12000**	**20000**	**23**
TRH C6-C10	µg/L	50	**310000**	**200000**	**280000**	**440000**	<50
TRH C6-C10 minus BTEX (F1)	µg/L	50	<250000↑	<100000↑	**100000**	<250000↑	<50

PARAMETER	UOM	LOR	S2-P9 DEEP WATER - 29/9/2020 SE211730.067	S2-D1 WATER - 28/9/2020 SE211730.068	S2-D2 WATER - 29/9/2020 SE211730.069
TRH C6-C9	µg/L	40	<40	**71000**	**2400**
Benzene (F0)	µg/L	0.5	**41**	**3100**	**160**
TRH C6-C10	µg/L	50	<50	**78000**	**2700**
TRH C6-C10 minus BTEX (F1)	µg/L	50	<50	<50000↑	<2500↑

TRH (Total Recoverable Hydrocarbons) in Water [AN403] Tested: 29/9/2020

PARAMETER	UOM	LOR	EW01 WATER - 28/9/2020 SE211730.001	EW02 WATER - 28/9/2020 SE211730.002	EW03 WATER - 28/9/2020 SE211730.003	RW01 WATER - 28/9/2020 SE211730.004	MW01 WATER - 28/9/2020 SE211730.005
TRH C10-C14	µg/L	50	3800	2700	<50	6100	12000
TRH C15-C28	µg/L	200	770	4900	<200	840	10000
TRH C29-C36	µg/L	200	<200	<200	<200	230	210
TRH C37-C40	µg/L	200	<200	<200	<200	<200	<200
TRH >C10-C16	µg/L	60	2000	1600	<60	4000	8500
TRH >C10-C16 - Naphthalene (F2)	µg/L	60	1800	1400	<60	3600	8000
TRH >C16-C34 (F3)	µg/L	500	850	4900	<500	860	10000
TRH >C34-C40 (F4)	µg/L	500	<500	<500	<500	<500	<500
TRH C10-C40	µg/L	320	4500	7600	<320	7100	22000

PARAMETER	UOM	LOR	MW02 WATER - 28/9/2020 SE211730.006	MW04 WATER - 28/9/2020 SE211730.007	MW05 WATER - 28/9/2020 SE211730.008	MW06 WATER - 28/9/2020 SE211730.009	MW07 WATER - 28/9/2020 SE211730.010
TRH C10-C14	µg/L	50	6900	<50	6400	8200	7000
TRH C15-C28	µg/L	200	2400	<200	2800	5700	19000
TRH C29-C36	µg/L	200	<200	<200	340	220	480
TRH C37-C40	µg/L	200	<200	<200	<200	<200	<200
TRH >C10-C16	µg/L	60	4700	<60	3800	4500	5000
TRH >C10-C16 - Naphthalene (F2)	µg/L	60	4400	<60	3300	4200	4000
TRH >C16-C34 (F3)	µg/L	500	2200	<500	2900	5700	19000
TRH >C34-C40 (F4)	µg/L	500	<500	<500	<500	<500	<500
TRH C10-C40	µg/L	320	9300	<320	9600	14000	27000

PARAMETER	UOM	LOR	MW08 WATER - 28/9/2020 SE211730.011	MW09 WATER - 28/9/2020 SE211730.012	MW10 WATER - 28/9/2020 SE211730.013	MW11 WATER - 28/9/2020 SE211730.014	MW12 WATER - 28/9/2020 SE211730.015
TRH C10-C14	µg/L	50	<50	<50	6600	<50	4200
TRH C15-C28	µg/L	200	<200	<200	1000	<200	<200
TRH C29-C36	µg/L	200	<200	<200	<200	<200	<200
TRH C37-C40	µg/L	200	<200	<200	<200	<200	<200
TRH >C10-C16	µg/L	60	<60	<60	3700	<60	2200
TRH >C10-C16 - Naphthalene (F2)	µg/L	60	<60	<60	3200	<60	2000
TRH >C16-C34 (F3)	µg/L	500	<500	<500	990	<500	<500
TRH >C34-C40 (F4)	µg/L	500	<500	<500	<500	<500	<500
TRH C10-C40	µg/L	320	<320	<320	7700	<320	4200

PARAMETER	UOM	LOR	MW13 WATER - 28/9/2020 SE211730.016	MW14 WATER - 28/9/2020 SE211730.017	MW15 WATER - 28/9/2020 SE211730.018	MW16 WATER - 28/9/2020 SE211730.019	MW17 WATER - 28/9/2020 SE211730.020
TRH C10-C14	µg/L	50	<50	71	7700	37000	1700
TRH C15-C28	µg/L	200	<200	360	420	2700	220
TRH C29-C36	µg/L	200	<200	<200	<200	830	<200
TRH C37-C40	µg/L	200	<200	<200	<200	<200	<200
TRH >C10-C16	µg/L	60	<60	99	4100	22000	850
TRH >C10-C16 - Naphthalene (F2)	µg/L	60	<60	96	3700	21000	780
TRH >C16-C34 (F3)	µg/L	500	<500	<500	<500	2300	<500
TRH >C34-C40 (F4)	µg/L	500	<500	<500	<500	570	<500
TRH C10-C40	µg/L	320	<320	430	8100	40000	1900

TRH (Total Recoverable Hydrocarbons) in Water [AN403] Tested: 29/9/2020 (continued)

PARAMETER	UOM	LOR	MW18 WATER - 28/9/2020 SE211730.021	MW19 WATER - 28/9/2020 SE211730.022	MW20 WATER - 28/9/2020 SE211730.023	MW21 WATER - 28/9/2020 SE211730.024	MW23 WATER - 28/9/2020 SE211730.025
TRH C10-C14	µg/L	50	<50	<50	<50	<50	<50
TRH C15-C28	µg/L	200	**480**	<200	<200	<200	<200
TRH C29-C36	µg/L	200	<200	<200	<200	<200	<200
TRH C37-C40	µg/L	200	<200	<200	<200	<200	<200
TRH >C10-C16	µg/L	60	<60	<60	<60	<60	<60
TRH >C10-C16 - Naphthalene (F2)	µg/L	60	<60	<60	<60	<60	<60
TRH >C16-C34 (F3)	µg/L	500	<500	<500	<500	<500	<500
TRH >C34-C40 (F4)	µg/L	500	<500	<500	<500	<500	<500
TRH C10-C40	µg/L	320	**480**	<320	<320	<320	<320

PARAMETER	UOM	LOR	MW24 WATER - 28/9/2020 SE211730.026	MW25 WATER - 28/9/2020 SE211730.027	S2-P1 WATER - 28/9/2020 SE211730.028	S2-P2 WATER - 28/9/2020 SE211730.029	S2-P3 WATER - 28/9/2020 SE211730.030
TRH C10-C14	µg/L	50	**1500**	<50	<50	**950**	<50
TRH C15-C28	µg/L	200	<200	<200	<200	<200	<200
TRH C29-C36	µg/L	200	<200	<200	<200	<200	<200
TRH C37-C40	µg/L	200	<200	<200	<200	<200	<200
TRH >C10-C16	µg/L	60	**560**	<60	<60	**560**	<60
TRH >C10-C16 - Naphthalene (F2)	µg/L	60	**460**	<60	<60	**510**	<60
TRH >C16-C34 (F3)	µg/L	500	<500	<500	<500	<500	<500
TRH >C34-C40 (F4)	µg/L	500	<500	<500	<500	<500	<500
TRH C10-C40	µg/L	320	**1500**	<320	<320	**950**	<320

PARAMETER	UOM	LOR	S2-P4 WATER - 28/9/2020 SE211730.031	S2-P5 WATER - 28/9/2020 SE211730.032	S2-P6 WATER - 28/9/2020 SE211730.033	S2-P7 WATER - 28/9/2020 SE211730.034	S2-P8 WATER - 28/9/2020 SE211730.035
TRH C10-C14	µg/L	50	<50	<50	<50	<50	<50
TRH C15-C28	µg/L	200	<200	<200	<200	<200	<200
TRH C29-C36	µg/L	200	<200	<200	<200	<200	<200
TRH C37-C40	µg/L	200	<200	<200	<200	<200	<200
TRH >C10-C16	µg/L	60	<60	<60	<60	<60	<60
TRH >C10-C16 - Naphthalene (F2)	µg/L	60	<60	<60	<60	<60	<60
TRH >C16-C34 (F3)	µg/L	500	<500	<500	<500	<500	<500
TRH >C34-C40 (F4)	µg/L	500	<500	<500	<500	<500	<500
TRH C10-C40	µg/L	320	<320	<320	<320	<320	<320

PARAMETER	UOM	LOR	S2-P9B WATER - 28/9/2020 SE211730.036	S2-P10 WATER - 28/9/2020 SE211730.037	S2-P11 WATER - 28/9/2020 SE211730.038	S2-P12 WATER - 28/9/2020 SE211730.039	S2-C1 WATER - 28/9/2020 SE211730.040
TRH C10-C14	µg/L	50	<50	**110**	<50	<50	<50
TRH C15-C28	µg/L	200	<200	<200	<200	<200	<200
TRH C29-C36	µg/L	200	<200	<200	<200	<200	<200
TRH C37-C40	µg/L	200	<200	<200	<200	<200	<200
TRH >C10-C16	µg/L	60	<60	**85**	<60	<60	<60
TRH >C10-C16 - Naphthalene (F2)	µg/L	60	<60	**84**	<60	<60	<60
TRH >C16-C34 (F3)	µg/L	500	<500	<500	<500	<500	<500
TRH >C34-C40 (F4)	µg/L	500	<500	<500	<500	<500	<500
TRH C10-C40	µg/L	320	<320	<320	<320	<320	<320

TRH (Total Recoverable Hydrocarbons) in Water [AN403] Tested: 29/9/2020 (continued)

PARAMETER	UOM	LOR	S2-C2 WATER - 28/9/2020 SE211730.041	S2-C3 WATER - 28/9/2020 SE211730.042	S2-C4 WATER - 28/9/2020 SE211730.043	S2-C5 WATER - 28/9/2020 SE211730.044	S2-C6 WATER - 28/9/2020 SE211730.045
TRH C10-C14	µg/L	50	<50	<50	<50	<50	<50
TRH C15-C28	µg/L	200	<200	<200	<200	<200	<200
TRH C29-C36	µg/L	200	<200	<200	<200	<200	<200
TRH C37-C40	µg/L	200	<200	<200	<200	<200	<200
TRH >C10-C16	µg/L	60	<60	<60	<60	<60	<60
TRH >C10-C16 - Naphthalene (F2)	µg/L	60	<60	<60	<60	<60	<60
TRH >C16-C34 (F3)	µg/L	500	<500	<500	<500	<500	<500
TRH >C34-C40 (F4)	µg/L	500	<500	<500	<500	<500	<500
TRH C10-C40	µg/L	320	<320	<320	<320	<320	<320

PARAMETER	UOM	LOR	S2-C7 WATER - 28/9/2020 SE211730.046	S2-C8 WATER - 28/9/2020 SE211730.047	S2-C9 WATER - 28/9/2020 SE211730.048	S2-C10 WATER - 28/9/2020 SE211730.049	GW_QA01 WATER - 28/9/2020 SE211730.050
TRH C10-C14	µg/L	50	<50	<50	<50	<50	**110**
TRH C15-C28	µg/L	200	<200	<200	<200	<200	<200
TRH C29-C36	µg/L	200	<200	<200	<200	<200	<200
TRH C37-C40	µg/L	200	<200	<200	<200	<200	<200
TRH >C10-C16	µg/L	60	<60	<60	<60	<60	**70**
TRH >C10-C16 - Naphthalene (F2)	µg/L	60	<60	<60	<60	<60	**68**
TRH >C16-C34 (F3)	µg/L	500	<500	<500	<500	<500	<500
TRH >C34-C40 (F4)	µg/L	500	<500	<500	<500	<500	<500
TRH C10-C40	µg/L	320	<320	<320	<320	<320	<320

PARAMETER	UOM	LOR	GW_QA02 WATER - 28/9/2020 SE211730.051	GW_QA03 WATER - 28/9/2020 SE211730.052	GW_QA04 WATER - 28/9/2020 SE211730.053	GW_RB01 WATER - 28/9/2020 SE211730.054	GW_RB02 WATER - 29/9/2020 SE211730.055
TRH C10-C14	µg/L	50	<50	<50	<50	<50	<50
TRH C15-C28	µg/L	200	<200	<200	<200	<200	<200
TRH C29-C36	µg/L	200	<200	<200	<200	<200	<200
TRH C37-C40	µg/L	200	<200	<200	<200	<200	<200
TRH >C10-C16	µg/L	60	<60	<60	<60	<60	<60
TRH >C10-C16 - Naphthalene (F2)	µg/L	60	<60	<60	<60	<60	<60
TRH >C16-C34 (F3)	µg/L	500	<500	<500	<500	<500	<500
TRH >C34-C40 (F4)	µg/L	500	<500	<500	<500	<500	<500
TRH C10-C40	µg/L	320	<320	<320	<320	<320	<320

PARAMETER	UOM	LOR	IW1 WATER - 29/9/2020 SE211730.058	IW2 WATER - 29/9/2020 SE211730.059	IW3 WATER - 28/9/2020 SE211730.060	PMW1 WATER - 28/9/2020 SE211730.061	PMW2 WATER - 29/9/2020 SE211730.062
TRH C10-C14	µg/L	50	**9400**	**12000**	**110**	**4300**	**2900**
TRH C15-C28	µg/L	200	**2000**	**1600**	<200	**320**	**250**
TRH C29-C36	µg/L	200	**210**	<200	<200	<200	<200
TRH C37-C40	µg/L	200	<200	<200	<200	<200	<200
TRH >C10-C16	µg/L	60	**8700**	**10000**	**100**	**2400**	**1500**
TRH >C10-C16 - Naphthalene (F2)	µg/L	60	**8500**	**9900**	**100**	**1900**	**1300**
TRH >C16-C34 (F3)	µg/L	500	**1800**	**1500**	<500	<500	<500
TRH >C34-C40 (F4)	µg/L	500	<500	<500	<500	<500	<500
TRH C10-C40	µg/L	320	**12000**	**14000**	<320	**4600**	**3100**

TRH (Total Recoverable Hydrocarbons) in Water [AN403] Tested: 29/9/2020 (continued)

PARAMETER	UOM	LOR	PMW3 WATER - 28/9/2020 SE211730.063	PMW4 WATER - 28/9/2020 SE211730.064	PEW1 WATER - 29/9/2020 SE211730.065	S2-P9 SHALLOW WATER - 29/9/2020 SE211730.066	S2-P9 DEEP WATER - 29/9/2020 SE211730.067
TRH C10-C14	µg/L	50	**3000**	**3500**	**4300**	<50	<50
TRH C15-C28	µg/L	200	<200	**250**	**450**	<200	<200
TRH C29-C36	µg/L	200	<200	<200	**320**	<200	<200
TRH C37-C40	µg/L	200	<200	<200	<200	<200	<200
TRH >C10-C16	µg/L	60	**1600**	**1900**	**2400**	<60	<60
TRH >C10-C16 - Naphthalene (F2)	µg/L	60	**1400**	**1600**	**2000**	<60	<60
TRH >C16-C34 (F3)	µg/L	500	<500	<500	**630**	<500	<500
TRH >C34-C40 (F4)	µg/L	500	<500	<500	<500	<500	<500
TRH C10-C40	µg/L	320	**3000**	**3800**	**5100**	<320	<320

PARAMETER	UOM	LOR	S2-D1 WATER - 28/9/2020 SE211730.068	S2-D2 WATER - 29/9/2020 SE211730.069
TRH C10-C14	µg/L	50	**700**	**130**
TRH C15-C28	µg/L	200	**800**	**340**
TRH C29-C36	µg/L	200	<200	<200
TRH C37-C40	µg/L	200	<200	<200
TRH >C10-C16	µg/L	60	**400**	**160**
TRH >C10-C16 - Naphthalene (F2)	µg/L	60	**350**	**150**
TRH >C16-C34 (F3)	µg/L	500	**840**	<500
TRH >C34-C40 (F4)	µg/L	500	<500	<500
TRH C10-C40	µg/L	320	**1500**	**470**

Trace Metals (Dissolved) in Water by ICPMS [AN318] Tested: 29/9/2020

PARAMETER	UOM	LOR	S2-P1 WATER - 28/9/2020 SE211730.028	S2-P2 WATER - 28/9/2020 SE211730.029	S2-P3 WATER - 28/9/2020 SE211730.030	S2-P4 WATER - 28/9/2020 SE211730.031	S2-P5 WATER - 28/9/2020 SE211730.032
Lead, Pb	µg/L	1	<1	<1	<1	<1	<1

PARAMETER	UOM	LOR	S2-P6 WATER - 28/9/2020 SE211730.033	S2-P7 WATER - 28/9/2020 SE211730.034	S2-P8 WATER - 28/9/2020 SE211730.035	S2-P9B WATER - 28/9/2020 SE211730.036	S2-P10 WATER - 28/9/2020 SE211730.037
Lead, Pb	µg/L	1	<1	<1	<1	<1	<1

PARAMETER	UOM	LOR	S2-P11 WATER - 28/9/2020 SE211730.038	S2-P12 WATER - 28/9/2020 SE211730.039	S2-C1 WATER - 28/9/2020 SE211730.040	S2-C2 WATER - 28/9/2020 SE211730.041	S2-C3 WATER - 28/9/2020 SE211730.042
Lead, Pb	µg/L	1	<1	<1	<1	<1	<1

PARAMETER	UOM	LOR	S2-C4 WATER - 28/9/2020 SE211730.043	S2-C5 WATER - 28/9/2020 SE211730.044	S2-C6 WATER - 28/9/2020 SE211730.045	S2-C7 WATER - 28/9/2020 SE211730.046	S2-C8 WATER - 28/9/2020 SE211730.047
Lead, Pb	µg/L	1	<1	<1	<1	<1	<1

PARAMETER	UOM	LOR	S2-C9 WATER - 28/9/2020 SE211730.048	S2-C10 WATER - 28/9/2020 SE211730.049	GW_QA01 WATER - 28/9/2020 SE211730.050	GW_QA02 WATER - 28/9/2020 SE211730.051	GW_RB01 WATER - 28/9/2020 SE211730.054
Lead, Pb	µg/L	1	<1	<1	<1	<1	<1

PARAMETER	UOM	LOR	GW_RB02 WATER - 29/9/2020 SE211730.055
Lead, Pb	µg/L	1	<1

Alcohols in Water [AN478] Tested: 30/9/2020

PARAMETER	UOM	LOR	S2-P1 WATER - 28/9/2020 SE211730.028	S2-P2 WATER - 28/9/2020 SE211730.029	S2-P3 WATER - 28/9/2020 SE211730.030	S2-P4 WATER - 28/9/2020 SE211730.031	S2-P5 WATER - 28/9/2020 SE211730.032
ethanol*	mg/L	1	<1	<1	<1	<1	<1

PARAMETER	UOM	LOR	S2-P6 WATER - 28/9/2020 SE211730.033	S2-P7 WATER - 28/9/2020 SE211730.034	S2-P8 WATER - 28/9/2020 SE211730.035	S2-P9B WATER - 28/9/2020 SE211730.036	S2-P10 WATER - 28/9/2020 SE211730.037
ethanol*	mg/L	1	<1	<1	<1	<1	<1

PARAMETER	UOM	LOR	S2-P11 WATER - 28/9/2020 SE211730.038	S2-P12 WATER - 28/9/2020 SE211730.039	S2-C1 WATER - 28/9/2020 SE211730.040	S2-C2 WATER - 28/9/2020 SE211730.041	S2-C3 WATER - 28/9/2020 SE211730.042
ethanol*	mg/L	1	<1	<1	<1	<1	<1

PARAMETER	UOM	LOR	S2-C4 WATER - 28/9/2020 SE211730.043	S2-C5 WATER - 28/9/2020 SE211730.044	S2-C6 WATER - 28/9/2020 SE211730.045	S2-C7 WATER - 28/9/2020 SE211730.046	S2-C8 WATER - 28/9/2020 SE211730.047
ethanol*	mg/L	1	<1	<1	<1	<1	<1

PARAMETER	UOM	LOR	S2-C9 WATER - 28/9/2020 SE211730.048	S2-C10 WATER - 28/9/2020 SE211730.049	GW_QA01 WATER - 28/9/2020 SE211730.050	GW_QA02 WATER - 28/9/2020 SE211730.051	GW_RB01 WATER - 28/9/2020 SE211730.054
ethanol*	mg/L	1	<1	<1	<1	<1	<1

PARAMETER	UOM	LOR	GW_RB02 WATER - 29/9/2020 SE211730.055
ethanol*	mg/L	1	<1

METHOD	METHODOLOGY SUMMARY
AN020	Unpreserved water sample is filtered through a 0.45µm membrane filter and acidified with nitric acid similar to APHA3030B.
AN318	Determination of elements at trace level in waters by ICP-MS technique,, referenced to USEPA 6020B and USEPA 200.8 (5.4).
AN403	Total Recoverable Hydrocarbons: Determination of Hydrocarbons by gas chromatography after a solvent extraction. Detection is by flame ionisation detector (FID) that produces an electronic signal in proportion to the combustible matter passing through it. Total Recoverable Hydrocarbons (TRH) are routinely reported as four alkane groupings based on the carbon chain length of the compounds: C6-C9, C10-C14, C15-C28 and C29-C36 and in recognition of the NEPM 1999 (2013), >C10-C16 (F2), >C16-C34 (F3) and >C34-C40 (F4). Where F2 is corrected for Naphthalene, the VOC data for Naphthalene is used.
AN403	Additionally, the volatile C6-C9/C6-C10 fractions may be determined by a purge and trap technique and GC/MS because of the potential for volatiles loss. Total Recoveerable Hydrocarbons - Silica (TRH-Silica) follows the same method of analysis after silica gel cleanup of the solvent extract. Aliphatic/Aromatic Speciation follows the same method of analysis after fractionation of the solvent extract over silica with differential polarity of the eluent solvents.
AN403	The GC/FID method is not well suited to the analysis of refined high boiling point materials (ie lubricating oils or greases) but is particularly suited for measuring diesel, kerosene and petrol if care to control volatility is taken. This method will detect naturally occurring hydrocarbons, lipids, animal fats, phenols and PAHs if they are present at sufficient levels, dependent on the use of specific cleanup/fractionation techniques. Reference USEPA 3510B, 8015B.
AN433	VOCs and C6-C9 Hydrocarbons by GC-MS P&T: VOC`s are volatile organic compounds. The sample is presented to a gas chromatograph via a purge and trap (P&T) concentrator and autosampler and is detected with a Mass Spectrometer (MSD). Solid samples are initially extracted with methanol whilst liquid samples are processed directly. References: USEPA 5030B, 8020A, 8260.
AN478	Aqueous samples are filtered into 2mL vials for GC/MS analysis. Soil samples are extracted in water, filtered into 2mL vials ready for GC/MS analysis.

FOOTNOTES

*	NATA accreditation does not cover the performance of this service.	-	Not analysed.	UOM	Unit of Measure.
**	Indicative data, theoretical holding time exceeded.	NVL	Not validated.	LOR	Limit of Reporting.
***	Indicates that both * and ** apply.	IS	Insufficient sample for analysis.	↑↓	Raised/lowered Limit of Reporting.
		LNR	Sample listed, but not received.		

Unless it is reported that sampling has been performed by SGS, the samples have been analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the " Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.
Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC and MU criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here: www.sgs.com.au/en-gb/environment-health-and-safety.

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APPENDIX G

CALIBRATION CERTIFICATES

Booking

HydroTerra
Environmental Monitoring Specialists

Booking #: 16947
Booking Date: 07/09/2020
Customer PO#: PO PS121494-115

ABN 58 154 889 559
42/328 Reserve Road
Cheltenham VIC 3192
Phone: (03) 8683 0091
Email: rentals@hydroterra.com.au

Invoice To:

WSP Australia Pty Limited

GPO Box 5394
Sydney NSW 2001

Phone: 02 9272 1422

Delivery/Pickup:

WSP [redacted]

Level 27, 680 George Street
Sydney NSW 2000

Phone: [redacted]

TASK:

Delivery Date/Time From:
Estimated Hire Date/Time From: 9/09/2020 2:01PM
Staff: [redacted]

Collection Date/Time To:
Estimated Hire Date/Time To: 21/09/2020 12:01PM

For HydroTerra Terms & Conditions, please refer to the hire page on the HydroTerra website
SDS available on request

Item Code	Description	Quantity	Unit	Unit Price (ex GST)	Disc%	Total (ex GST)
MLL-7658	3001 LT Levelogger Edge, M10/F30	1	Week	$115.00		$115.00
MLL-0930	3001 LT Levelogger Edge, M10/F30	1	Week	$115.00		$115.00
MLL-4784	3001 LT Levelogger Edge, M10/F30	1	Week	$115.00		$115.00
MBL-7459	3001 LT Barologger Edge, M1.5/F5	1	Week	$90.00		$90.00
MOR-2985	3001 Optical Reader (USB) for the Levelogger	1	Week	$35.00		$35.00
Freight	Freight - Delivery by TNT O/N Express on connote# 126216829	1		$30.00		$30.00

Payment Terms:
30 Days Net

Cancellation of confirmed bookings may incur a 30% cancellation fee. Goods must be paid for in full within the payment terms.

Hydroterra Bank Details for EFT Payment:
Account Name: HydroTerra Pty Ltd
Bank: ANZ Bank
BSB: 013 395
Acct: 1852 78892
Visa & MasterCard are accepted: 1.5% Surcharge applies
Please email remittance advice to accounts@hydroterra.com.au
For all account enquiries, please contact the head office on 03 8683 0091

Subtotal (ex GST):	$500.00
GST:	$50.00
Total (inc GST):	**$550.00**
Amount Paid:	$0.00
Balance Due:	**$550.00**

Thank you for choosing HydroTerra, we appreciate your business!