PUMPING TEST FACTUAL REPORT

Contract Name:	Llanelli Tunnel 48hr Constant Rate Groundwater Pumping Tests nr. Station Road, Llanelli
Client Name:	Morgan Sindall (MS)
Groundwater Pumping Test & Dewatering Specialist:	Stuart Wells Ltd (SWS)
Report No	SWC8129-PT

Revision	Date	Description	Prepared By (SWS)	Checked By (SWS)
1	27/09/2018	Submission	MW	DW

For:	Contact:
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By: Stuart Wells Ltd Hargham Road Shropham Norfolk NR17 1DT	**Contact:** Martin Welsford Contract Engineer Phone: 07971602952 Email: martin.welsford@stuartwells.co.uk

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1. Introduction

In September 2018 Stuart Wells Ltd was appointed by Morgan Sindall to undertake a pumping test in accordance with BS ISO 14686:2003 as part of Llanelli Tunnel Recovery works.

The pumping test comprised of pumping from a single pumping well while groundwater levels were monitored using 1no monitoring well.

The pumping test was undertaken with the following objectives in mind.

- Determine the hydraulic properties of the aquifer (permeability and boundary conditions, if possible).
- To generate information to confirm any additional dewatering requirements and design
- To generate information to enable robust assessment of dewatering impact for future application for dewatering abstraction and discharge permit requirements

This factual report details the activities and the results of the testing carried out.

Figure 1: Site Location Map

2. Summary of Ground Conditions

The ground conditions at PW1 are summarised as follows by the drillers borehole logs, as undertaken by DANBAR Drilling Services Ltd on behalf of Stuart Wells Ltd.

Stratum	Top level of stratum (mAOD)
Tarmac	0.00
Made Ground	0.26
Grey to yellow, sandy, CLAY	1.50
Weathered, grey, SANDSTONE	8.00
End of Borehole	14.00

Table 1: Summary of Pumping Well Ground Conditions

3. Field Work

The programme of works undertaken at site can be summarised as follows:

Date	Activity
14th September – 19th September 2018	Background monitoring
14th September 2018	Equipment Test
19th September – 21st September 2018	Constant Drawdown Test (48 hours)
21st September – 24th September 2018	Recovery Test

Table 2: Programme of works

Equipment used during testing is summarised as follows:

- A duty and standby CRI50/3(5.5kW) electrical submersible borehole pump was utilised for the testing after proving suitable during the equipment test on 14th September.
- A duty and standby Stuart Power 20kVA generator with automatic changeover panel were used to power the borehole pump.
- Electronic Dataloggers were used at each Well to record continuous water level readings for the duration of the testing period.
- Manual water level readings were recorded using a Manual Dip Tape.
- Flow rate was monitored using 2no mechanical flow meters.

The layout of the wells is shown in figure 2, and the well installation details provided in table 5.

4. Results

4.1. Background monitoring

Before undertaking the pumping test, the water level was monitored by Stuart Wells for a period of 5 days from 14th to 19rd September 2018 to observe any natural fluctuations in the water table. See as follows a summary of the data.

Well Name	Water Level (mAOD)
PW1	4.08 to 4.79
MW1	4.21 to 4.53

Table 3: Background monitoring data

4.4. Constant Rate Test

The result of the constant rate test can be summarised as follows pumping at a flow rate of approximately 0.83lts/sec.

	Start of Test	End of Test (48.5 hrs)		
Well Name	Water Level (mAOD)	Water Level (mAOD)	Drawdown (m)	Distance to PW1 (m)
PW1	4.75	-3.72	8.49	n/a
MW1	4.50	4.098	0.42	32.3

Table 4: Summary of constant rate test results

The results showing the response of the water table relative to the pumping rate, time of pumping and the radial distance away from the pumping well are presented in figures 3, 4 and 5. The full data set (table8) including all manual data is presented in excel format along with the report.

4.5. Other Groundwater Observations

On Thursday 20th September ~12:50 AM (approximately 28.5 hours into the constant rate test). Morgan Sindall operatives entered the tunnel and opened up bleed probes within the tunnel. Our understanding is that groundwater was not encounted until approximately 17.5m distance from Shaft S4. From this we would estimate a drawdown of ~4.7m to a level of -0.1m AOD was achieved at nominal 17.5m radial distance from the PW1 pumping well.

Yours faithfully,

Martin Welsford
Contracts Engineer
For & behalf of **Stuart Well Services Limited**

David Wright CGeol
Director & Principal Groundwater Engineer
For & behalf of **Stuart Well Services Limited**

Figure 2: Well location plan

				Screened Sections				
	Easting	Northing	Ground Level	Top	Bottom	Borehole Size	Liner Size	Distance from Pumping Well ABH1
Well Name	m	m	mAOD	mAOD	mAOD	mm	mm	m
PW1 (Pumping Well)	250719	199436	6.4	6.67	-7.6	250mm	165 x 155	n/a
MW1	250739	199413	6.4	6.57	-7.6	250mm	165 x 155	32.3

Table 5: Well Detail

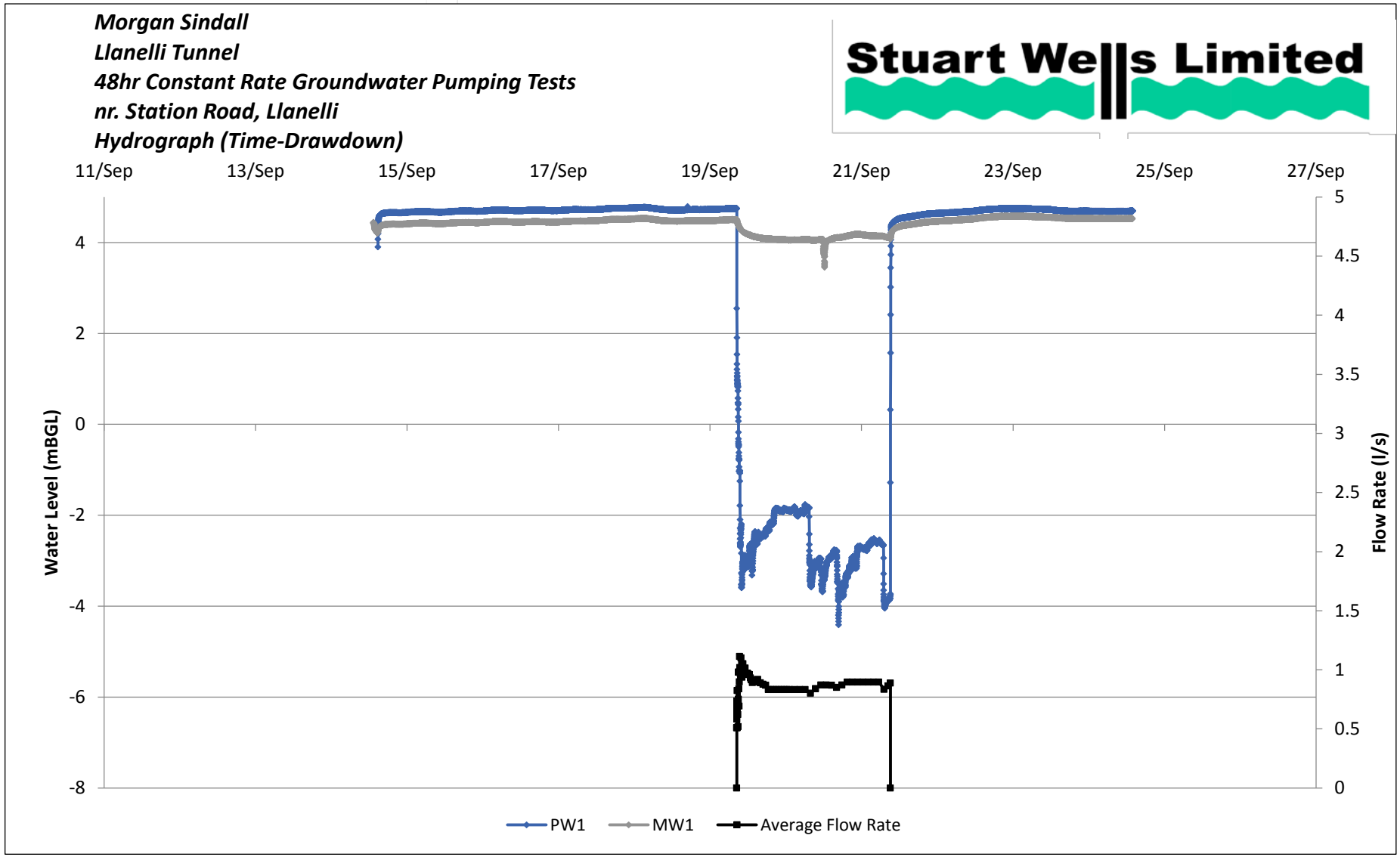

Figure 3: Time-water level

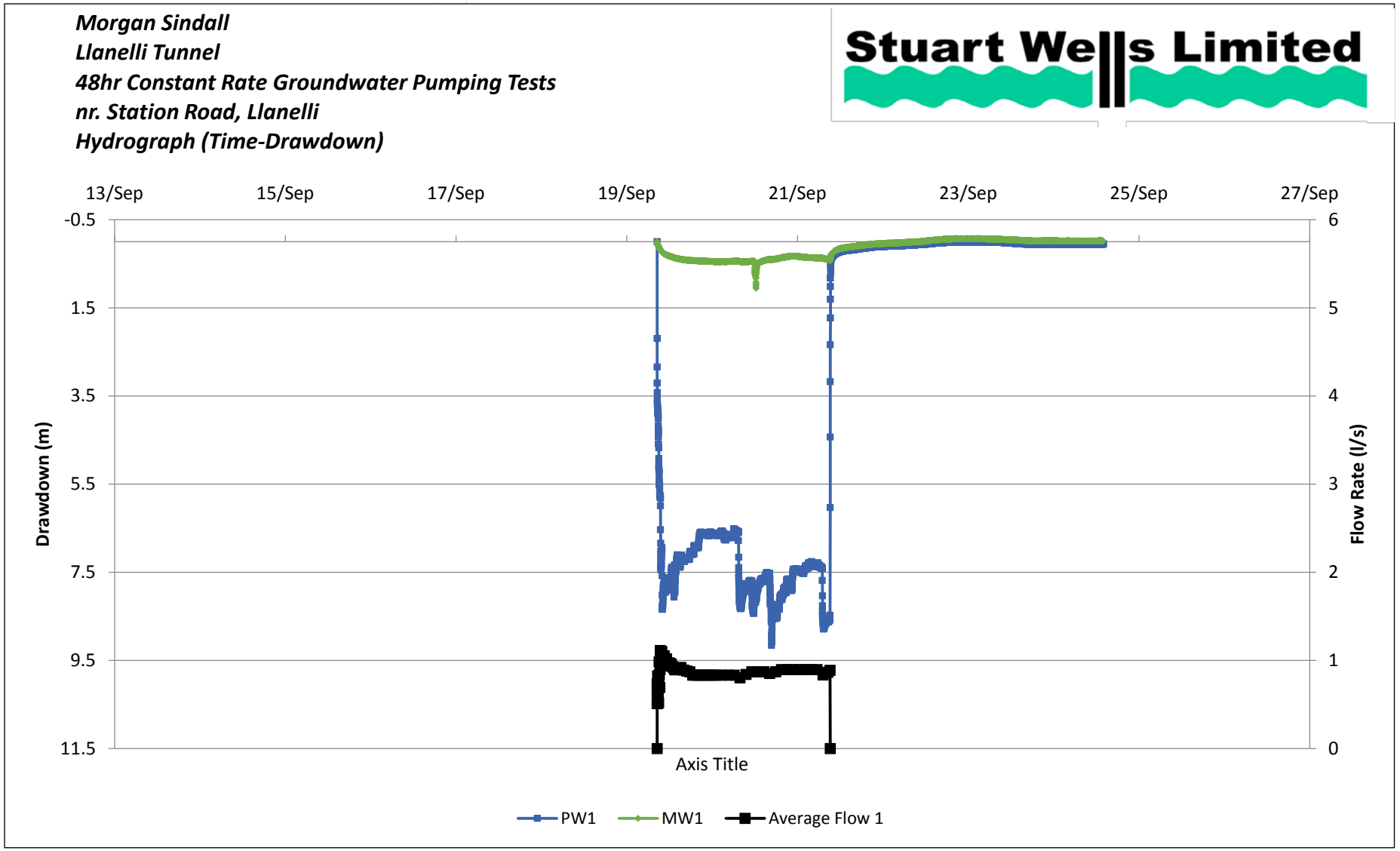

Figure 4: Time-drawdown graph

Figure 5 Distance Drawdown graph

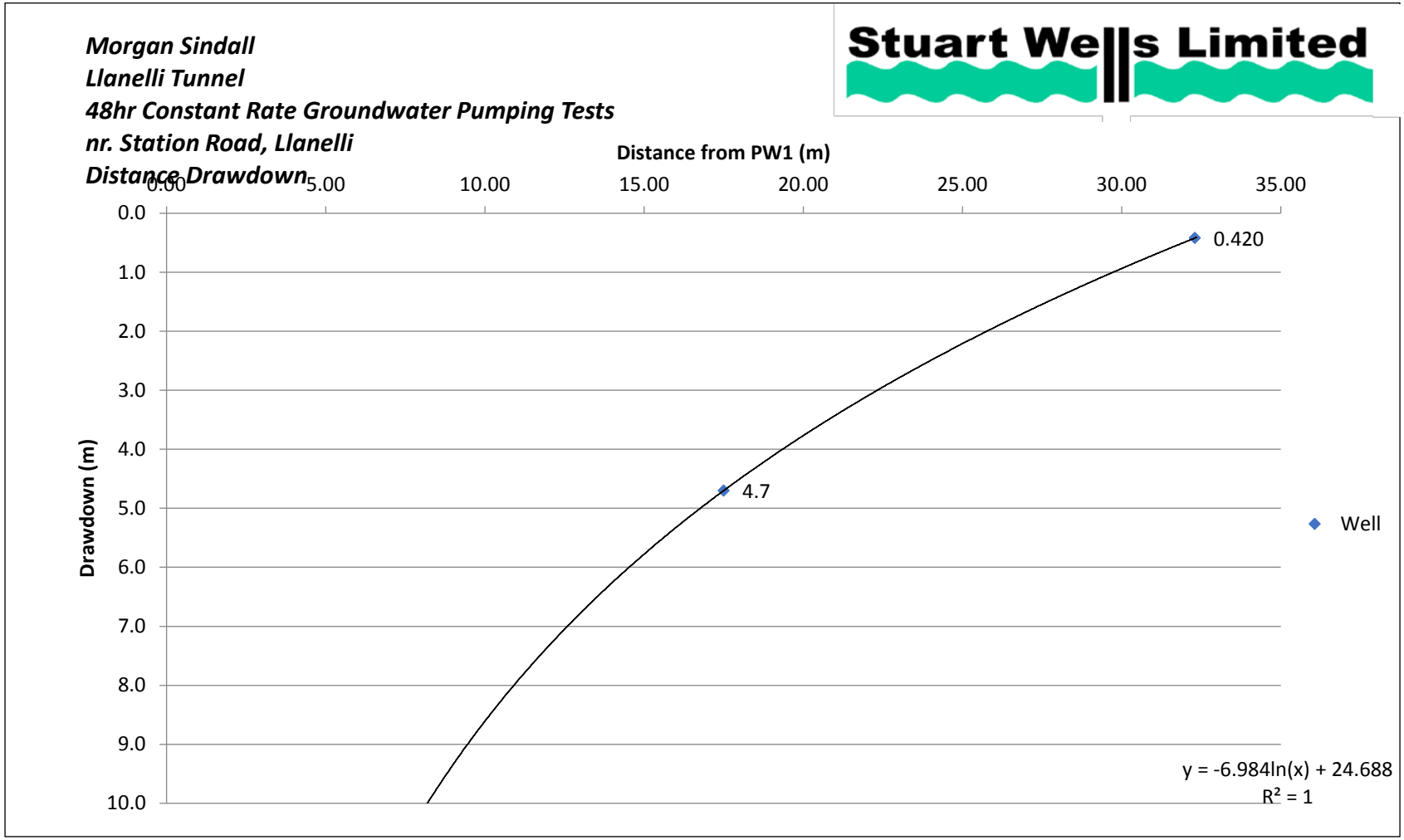

Table 4: Table of Pump Test Data

Appendix – Drillers BH Logs (Description Only)

DANBAR Drilling Services Ltd	5 Leopold Street Lamberhead Ind Estate Pemberton Wigan WN5 8DH	Telephone: 01942 216924 www.danbardrilling.com	**DAILY DAYWORKS & STANDING TIME**	SITE: Station Road, Llanelli	JOB NO:
				DATE: 4.9.A	BOREHOLE NO: PW1

TYPE	TIME FROM	TIME TO	REASON
			on Site 7.45AM
Dw	9.00	10.00	Retrieve Skip Fish up
Dw	2.30	3.30	Flush Hole
Dw	3.30	7.30 pm	Install
			GL Tarmac
			0.26 Tarmac/Hardcore
			1.50 Grey Yellow Sandy Clay
			4.00 Weathered grey Sandstone
			14.m Gradual Bit
			9m Plain
			6m Slotted

	DW = DAYWORKS	ST = STANDING TIME	DRILLER	Rhian
			CLIENT	SWS

DANBAR Drilling Services Ltd	5 Leopold Street Lamberhead Ind Estate Pemberton Wigan WN5 8DH	Telephone: 01942 216924 www.danbardrilling.com	**DAILY DAYWORKS & STANDING TIME**	SITE: Station Road, Ulnes Walton	JOB NO:
				DATE: 6.9.18	BOREHOLE NO: MW1

TYPE	TIME FROM	TIME TO	REASON
			On Site @ 8.00
DW	8.00	10:00	Fill up Water
	4.50	5.00	Pump Down off site getting tools
			6L Tarmac
			0.2m Iron Stag Fell
			1.20 Grey Clay
			5m Weathed Sandstone

	DW = DAYWORKS	ST = STANDING TIME	DRILLER	Kieran
			CLIENT	SWS