M/NBLYFM/PTR/002

Farmpoint Ltd

Nobley Farm Borehole

Nobley Farm, Presteigne, Powys

Pump Test Report

Results of testing: January 2021

July 2021

Farmpoint Limited
Nobley
Walton
Presteigne
Powys
LD8 2NU

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1 INTRODUCTION

1.1 This Technical Note has been prepared to report on the testing of an existing abstraction borehole at Nobley Farm, Presteigne, Powys. The test was conducted in accordance with requirements set out in National Resources Wales (NRW) Consent No. PPN-00392, issued under Section 32 of the Water Resources Act 1991.

1.2 The Nobley Farm Borehole (the Borehole) was installed at National Grid Reference (NGR) SO 26150 61520 into the underlying Devensian Till in January 1988. A site location plan is provided at ***Figure 1*** and the drill record is attached to this report at ***Appendix 1***.

1.3 The purpose of the borehole installation is to provide a supply of water for agricultural purposes at the aforementioned site.

1.4 The purpose of the pump test was to enable assessment of the ongoing abstraction and to establish any impact/connection to local surface water features, notably the Knobley Brook (located some 90 m to the northeast of the borehole).

2 DETAILS OF TEST SOURCE

2.1 The borehole has been completed to a depth of 10.6 metres below ground level (mbgl). A summary of the borehole construction is given at ***Table 1***.

Table 1 Nobley Farm Abstraction Borehole construction details

Drilling		Completion details			
Depth below ground level (m)	Drill diameter (mm)	Casing material	Depth (m)	Casing diameter (mm)	Rest GWL (mbgl)
0 – 5.5	305	UPVC (plain)	0 – 5.5	152.4	-
5.5 – 10.7	305	UPVC (slotted)	5.5 – 10.7	152.4	-

2.2 A gravel pack was installed from 5.5 mbgl – 10.67 mbgl and grouted to seal the borehole from 5.5 mbgl to the surface. A pump house was constructed around the borehole to securely accommodate pumping equipment.

2.3 The pump was installed to a depth of some 5 mbgl on 3" flexible rising main. The headworks include a 19 mm plastic dip tube installed to the top of the pump.

3 GEOLOGY

3.1 The borehole has been installed entirely within superficial deposits (Devensian Till) consisting of grey soils, soft clays and gravels.

3.2 Drillers logs indicate soft grey soils and clay were encountered to 6.1 mbgl before hard gravels formed the majority of the screened section of the well to 10.67 mbgl.

4 TEST PUMPING DETAILS

4.1 Test Consent Summary

4.1 The borehole was tested under NRW consent no. PPN-00392. The consent specified a pump test to be undertaken on the borehole for a minimum period of 48-hours, or until water levels stabilised in the borehole. Monitoring of water levels was required post-test until full recovery.

4.2 The consent stated a maximum volume of 120 m^3 could be abstracted per day during the pump test.

4.3 The borehole is used to provide a drinking water supply to a series of sheds used for rearing chickens. As such the test needed to be accommodated within a period where the supply to the sheds could be temporarily suspended. Because of the restriction on time available for the test, it was agreed with NRW to extend the period of monitoring prior to commencement of the test, whilst accepting that abstraction would be continuing intermittently up to the start of the test.

4.4 On the above basis, 8 days of pre-test monitoring was conducted to enable a better understanding of water level trends at the site prior to the constant rate test.

4.5 The details of test pumping are provided at ***Table 2***.

Table 2 Details of test pumping – Nobley Farm Abstraction Borehole

Phase	Date of pumping	Monitoring period
Equipment Test	05/01/21	-
Constant Rate Test	13/01/21 – 15/01/21	05/01/21 - 18/01/21

4.6 Water was abstracted from the borehole using a submersible Godwin BC6 pump (the pump currently installed). The abstracted water was piped to the surface using 3-inch flexible rising main. The flow rate from the pump was measured using a 2.5-inch impellor flow meter ("Kent type"). Abstracted water was pumped to a water bowser before being discharged to the site surface water drainage system to prevent re-entry to the aquifer.

4.2 Monitoring Points

4.2.1 The EA Test Consent required assessment of a number of water features including the Knobley Brook and any other water features in the local area identified. Monitoring was undertaken at the Knobley Brook, the adjacent tributary watercourse to the Knobley Brook draining past the Borehole (the 'Adjacent Drain') and two groundwater monitoring points installed between the borehole and the Knobley Brook. These were monitored using a combination of datalogger and manual measurements.

4.2.2 The locations, method and frequency of monitoring is summarised in ***Table 3*** below.

Table 3 EA Consent Ref. PPN-00392 - Details of required monitoring locations

Identification	Monitoring method and frequency
Groundwater Monitoring Points	
Nobley Farm Borehole	Datalogger (15 minute pre-test, every minute thereafter)
Borehole P1 US	Manual dip (4 hrs)
Borehole P2 DS	Manual dip (4 hrs)
Surface water Monitoring Points	
Knobley Brook	Spot gauging (4hrs)
Adjacent Drain (GB1)	Datalogger (15 minute pre-test, every minute thereafter), Spot gauging (4hrs)

4.2.3 Dataloggers in the Borehole and Adjacent Drain (GB1) were set to record levels every 15 minutes prior to the pump test commencing, then at a 1-minute interval during and after the test to increase the resolution of the data. The Adjacent Drain was selected for more frequent monitoring in preference to Knobley Brook, due to the proximity to the Borehole (within 3m) and the significantly lower observed flows (less than 1l/s). These are features expected to make the watercourse more sensitive to the groundwater abstraction and hence would more readily highlight any connection between the surface water and groundwater environments.

4.2.4 Manual measurements of stage and flow were made at the Knobley Brook and dip levels taken at the site piezometers, on a 4-hourly basis during the test.

4.3 Precipitation

4.3.1 Daily rainfall levels have been obtained from the 'Break Your Neck Falls' rain gauge located circa 8 km south-west of the Site and the 'Bleddfa' station located 8.5 km to the north-west. Rainfall levels from these two gauges are presented in ***Figure 4.***

4.3.2 The month of December was particularly wet which would have led to increased groundwater levels until rainfall began to ease at the start of January. This would result in a general declining trend in groundwater levels across the area for the month of January.

5 TEST PUMPING RESULTS

5.1 Constant Rate Test

5.1.1 The Constant Rate Test was performed between 13th February and 15th January 2021. The rest water level within the abstraction borehole prior to the test pump was measured at 3.10 mbd (datum being the top of the dip tube [estimated as 186 maOD]). Groundwater levels at the borehole were measured for the full duration of the test using a combination of both manual and datalogger readings.

5.1.2 Pre-test data (***Figure 1***) shows a gradual declining trend of some 0.1 m in water levels in the abstraction well over 8 days (the test period followed a very wet end to December). There were some brief instances of the pump switching on for supply to the poultry unit and farmhouse, however this does not change the overall trend of declining water levels in the abstraction borehole during the pre-test period.

5.1.3 Over the 48-hour test period, the borehole was pumped at an overall average of some 1.4 litres/second (120.9 m^3/d). This pumping rate resulted in a maximum drawdown of just 0.15 m. Plots of the water level within the abstraction well, along with the associated averaged pumping rate are presented at ***Figure 2***.

5.1.4 The test data record a rapid reduction in borehole water level within the first 45-minutes of the test (some 0.10 m drawdown). This level of drawdown remained stable for some 24-hours. Between 24-hours and 48-hours after commencement of the test, drawdown gradually increased by some 0.05 m (following the general pre-test declining water level trend).

5.1.5 ***Table 4*** presents stage data at GB1 as well as flows recorded upstream and downstream to the abstraction borehole within the Adjacent Drain. The data shows that flow downstream of the abstraction does not decline in relation to measured upstream flow, indicating that the abstraction made at the Borehole is not in direct hydraulic continuity with surface water features in the locality.

Table 4 Stage and flow rates within adjacent drain (GB1)

Time	GB1 Stage (m)	(GB1) Drain Upstream (l/s)	(GB1) Drain Downstream (l/s)	Flow into upstream Culvert (l/s)
13/01/21 15:30	0.059	0.45	0.45	8
14/01/21 09:00	0.06	0.5	0.54	8.2
14/01/21 16:45	0.06	0.56	0.58	8.4
15/01/21 09:00	0.059	0.38	0.4	7.2
15/01/21 10:50	0.059	0.38	0.4	7.2
15/01/21 12:40	0.058	0.3	0.32	7
18/01/21 11:00	0.061	0.36	0.36	7.65

5.1.6 *Figure 2* shows there was no significant reduction in water levels within the Knobley Brook during the Constant Rate Test. It is noteworthy that the magnitude of flow measured within the Knobley Brook (c.110 l/s) during the test pump period exceeded by almost two orders of magnitude, the rate of abstraction at the Borehole (1.4 l/s).

5.1.7 A small decline of 0.02 m was recorded in water levels in both P1 and P2, however this is more likely attributed to the declining water level trend observed in pre-test data.

5.1.8 The aforementioned details suggest there is no significant direct connection between the abstraction borehole and monitored surface water features.

5.1.9 Following completion of the Constant Rate Test, the pump was switched off and water level was allowed to recover. However, recovery data was affected by intermittent (low rate) pumping for supply to the farmhouse.

5.1.10 Examination of the post-test water level data shows water levels to have recovered within 19-hours of cessation of pumping. Note that the pre-test level was not fully attained at this point (water level returned to some 93% of full recovery) but allowing for the pattern of groundwater recession that was occurring in the locality during the test period, full recovery is expected to have occurred within the aforementioned timescale.

6 WATER USAGE AND STORAGE

6.1 Typical water consumption over a 40-day crop is presented in ***Table 5*** below.

Table 5 Typical water consumption over a 40-day crop

Days of Age	Litres Consumed (Accumulative Total)	Average daily usage (L)
1	6,900	6,900
5	34,983	8,746
10	42,435	8,487
15	47,858	9,572
20	68,685	13,737
25	81,620	16,324
30	86,153	17,231
35	79,253	15,851
40	83,524	16,705

6.2 After the 40 days there would be a wash down procedure over an additional 4 days requiring some 300,000 L in total (75,000 L/day), giving an average daily water consumption of 8.72 m^3/day (383.524 m^3 / 44 days) with maximum consumption of 75 m^3/d. The cropping cycle is based on 7.4 crops per annum.

6.3 On-site water storage options are limited and would likely equate to only one day's worth of water for emergencies.

6.4 There is no mains water immediately available with the closest point being approximately 1 mile away in the village of Evenjobb, however water pressure is low and there is not adequate surplus quantity to supply the needs of the operation at the Site.

7 CONCLUSIONS

7.1 A pumping test has been conducted on an existing borehole installed at Nobley Farm, Presteigne, in accordance with NRW consent ref. PPN-00392. A Constant Rate Test was undertaken over 48-hours to assess impacts on watercourses and surface water features within the locality.

7.2 The test results and conclusions are summarised as follows:

- Pumping at an average rate of 1.4 l/s over the 48-hour period resulted in a drawdown of some 0.15 m within the test borehole.
- Spot flow gauging and water level monitoring within the adjacent surface watercourse (Adjacent Drain) during the test found no reduction in water level or flow resultant from the pumping exercise.
- No significant impacts to the Knobley Brook or groundwater levels within the nearest piezometers were recorded for the duration of the test.
- The test pumping results show the borehole is sustainable and fit for ongoing supply at Nobley Farm, at a pumping rate of 1.4 l/s (120m3/d), without causing significant impact to water features within the locality.

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Hydrogeologist
<u>BCL Consultant Hydrogeologists Limited</u>
July 2021

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Figures

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BCL Consultant Hydrogeologists Limited

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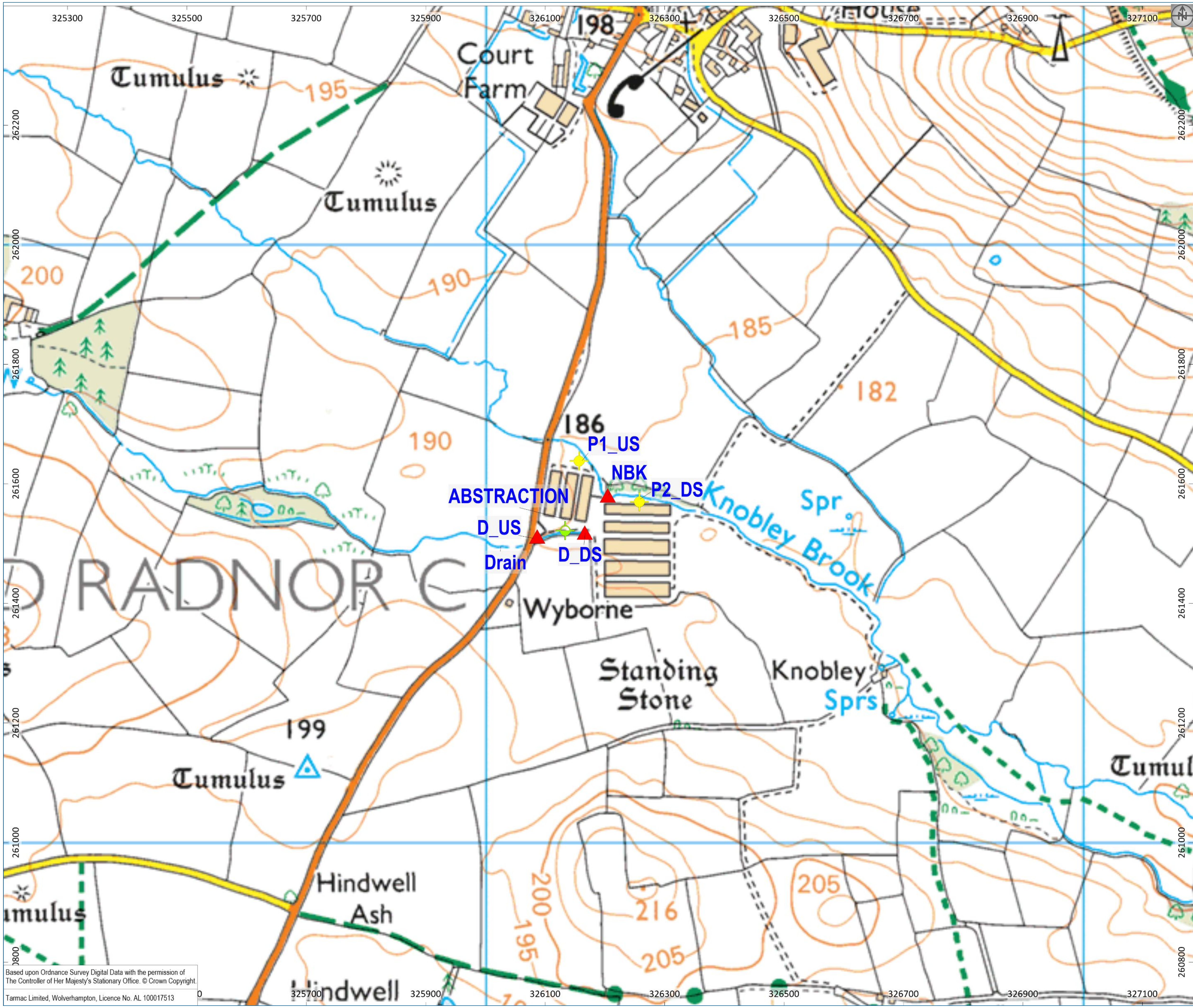
email: info@bclhydro.co.uk, web: http://www.bclhydro.co.uk
Registered Office: 33, Wolverhampton Road, Cannock, West Midlands, WV11 1AP
Registered in England & Wales. Company Registration Number: 4043373



Abstraction borehole

Piezometer

Surface Water Monitoring

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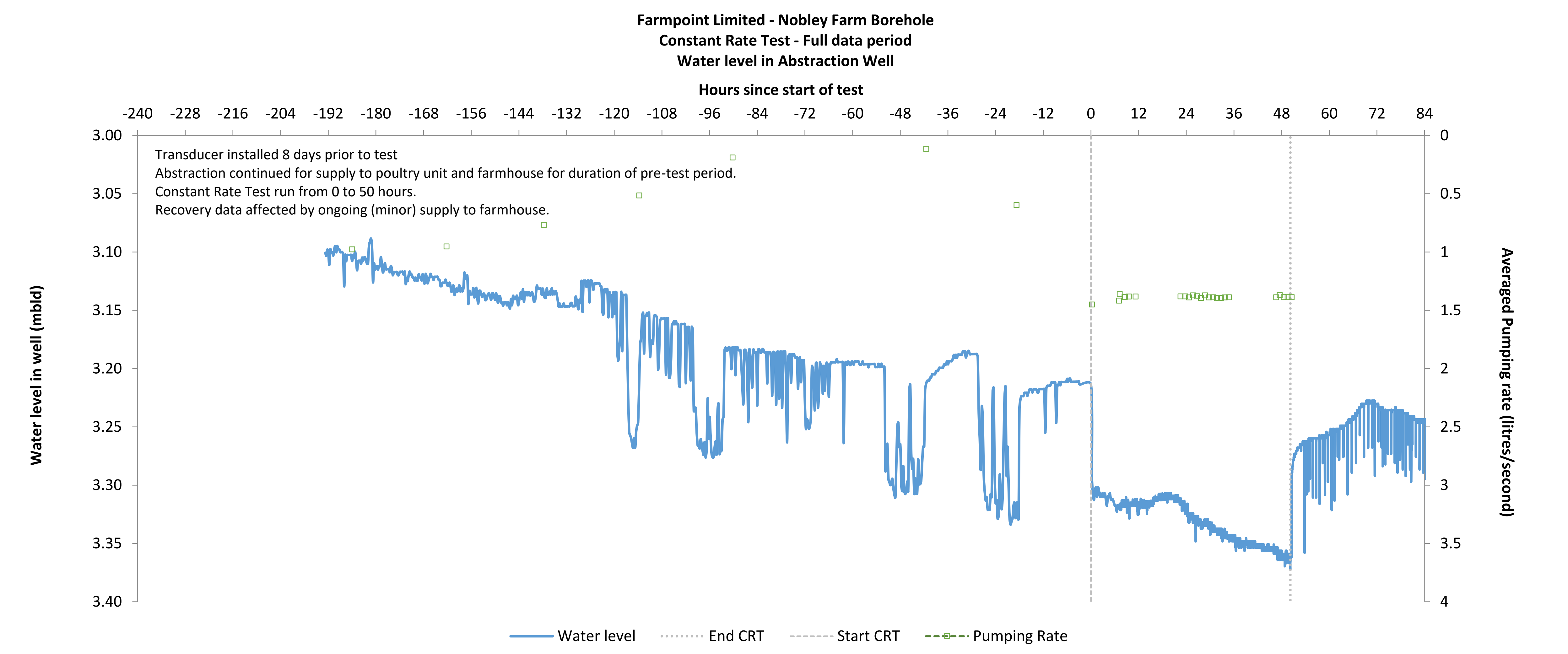
Figure 1 Site Location, monitoring points and Whitehole Springs schematic layout

Drawn By: GM	Scale: 1:6000
Date: Feb 21	Format: A3L



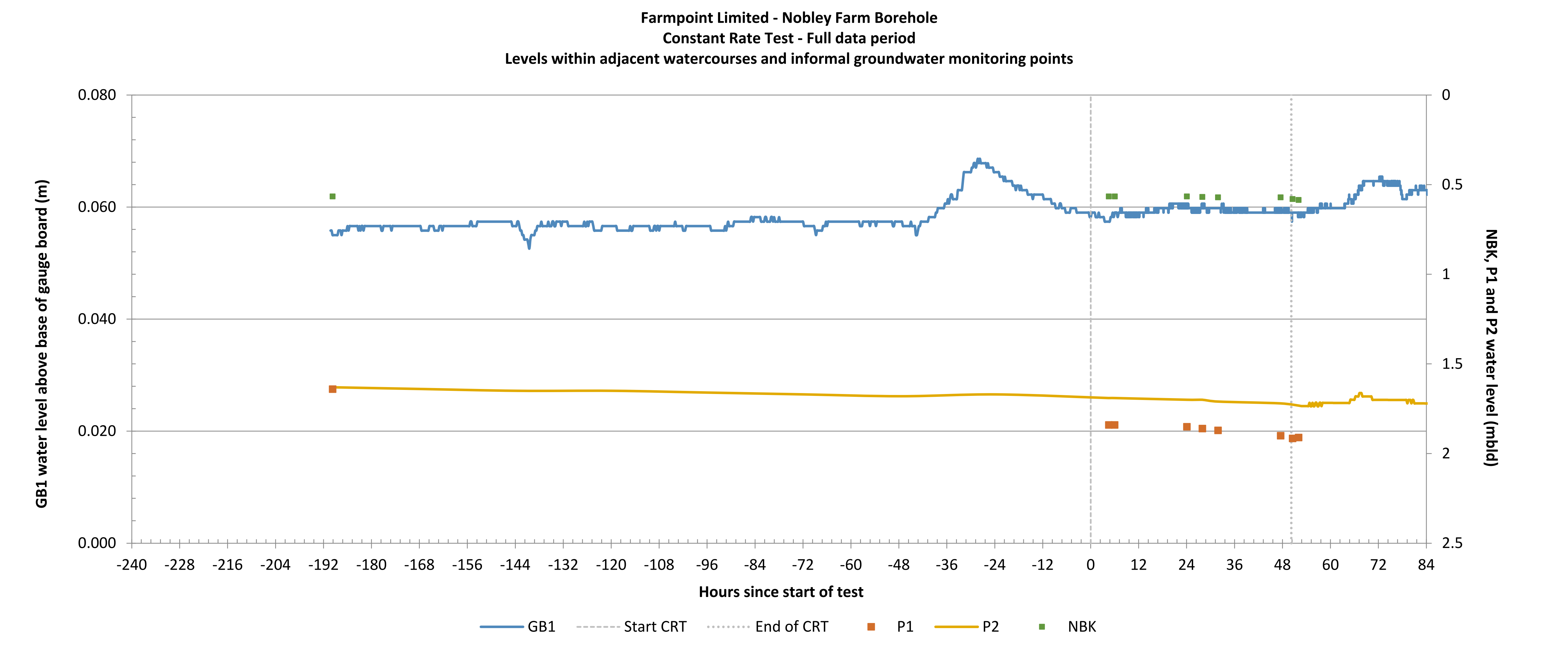


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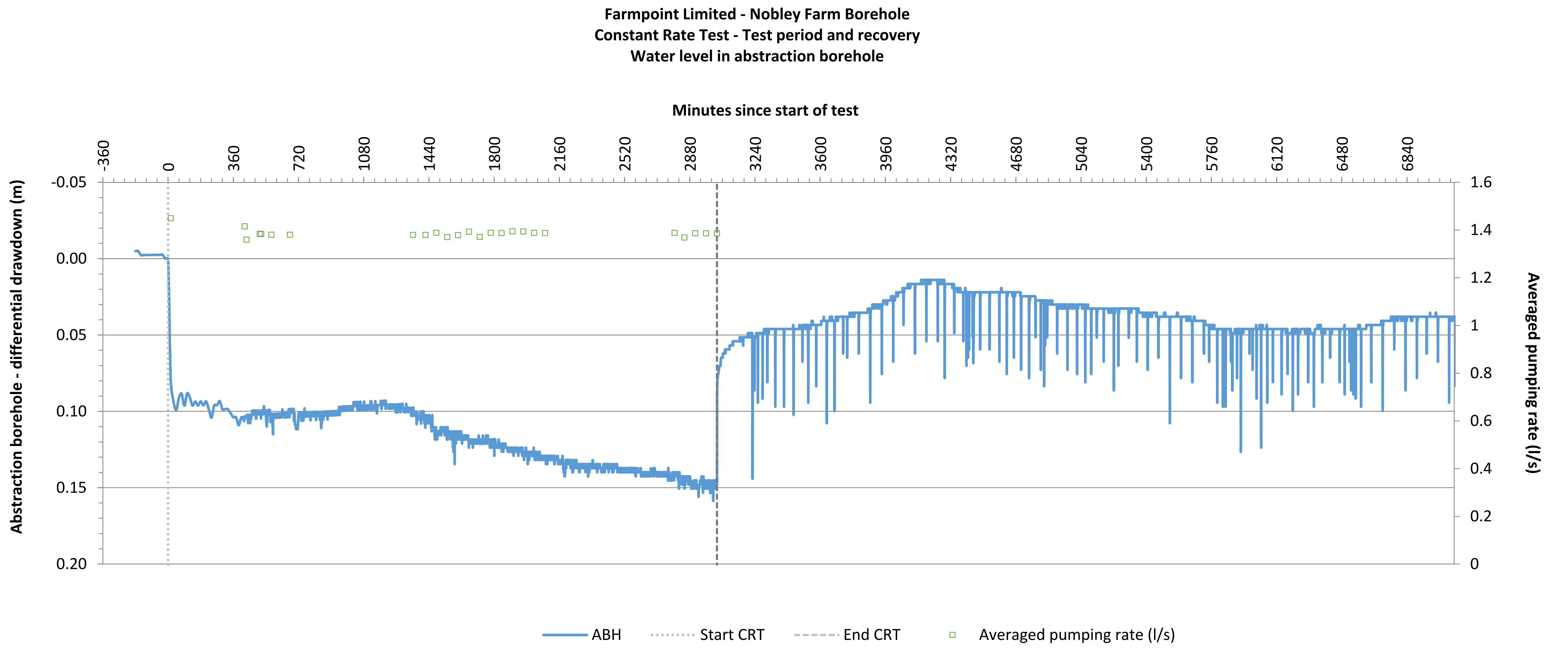
Figure 2 Constant Rate Test – Abstraction well and monitoring point hydrographs

Drawn By: PB	Scale: n/a
Date: Feb 21	Format: A3L



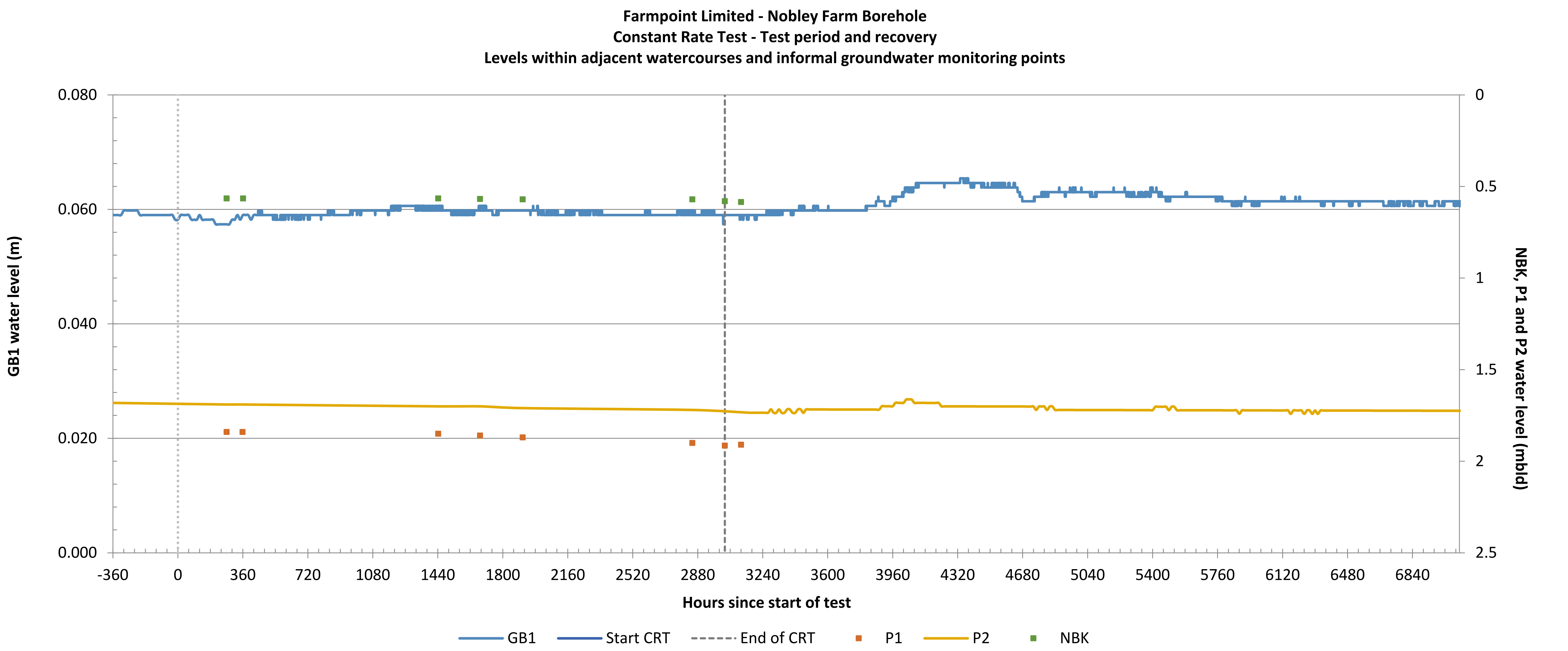


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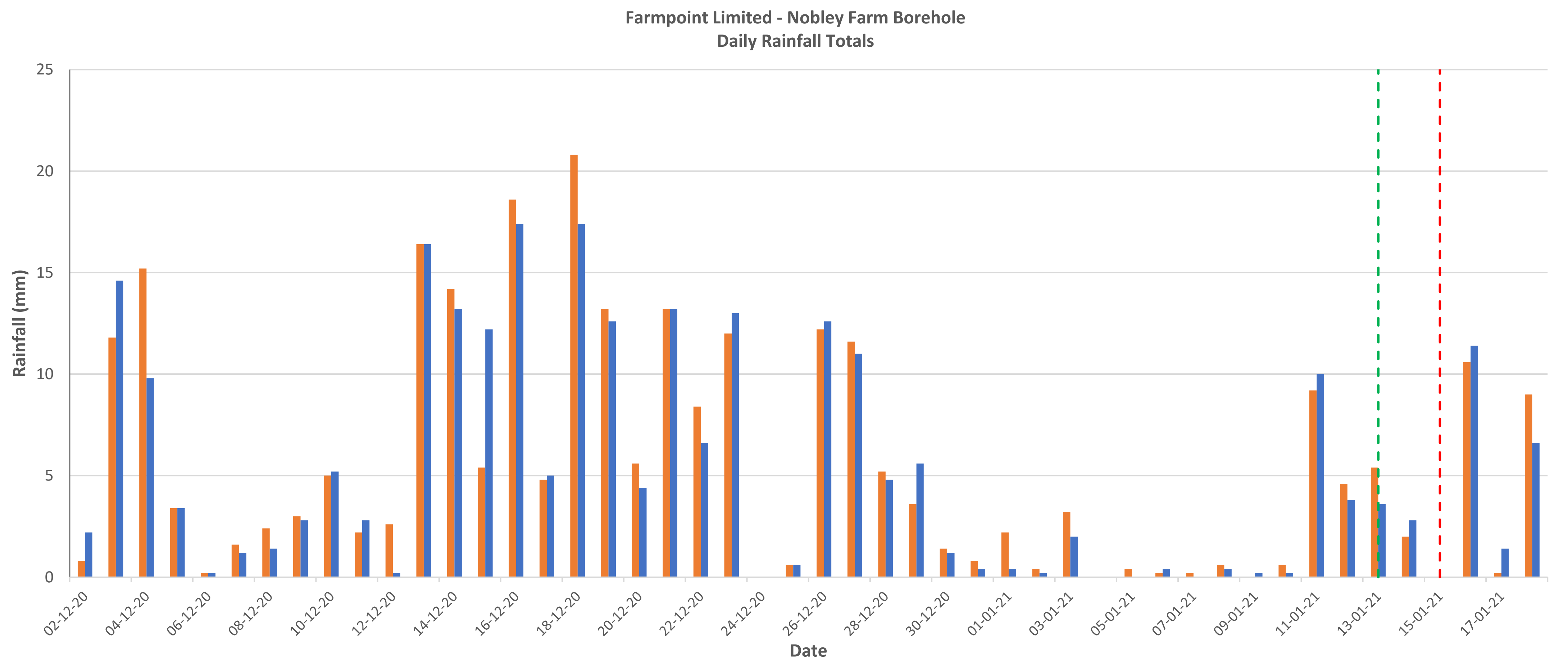
Figure 3 Constant Rate Test – Recovery.

Drawn By: PB	Scale: n/a
Date: Feb 21	Format: A3L



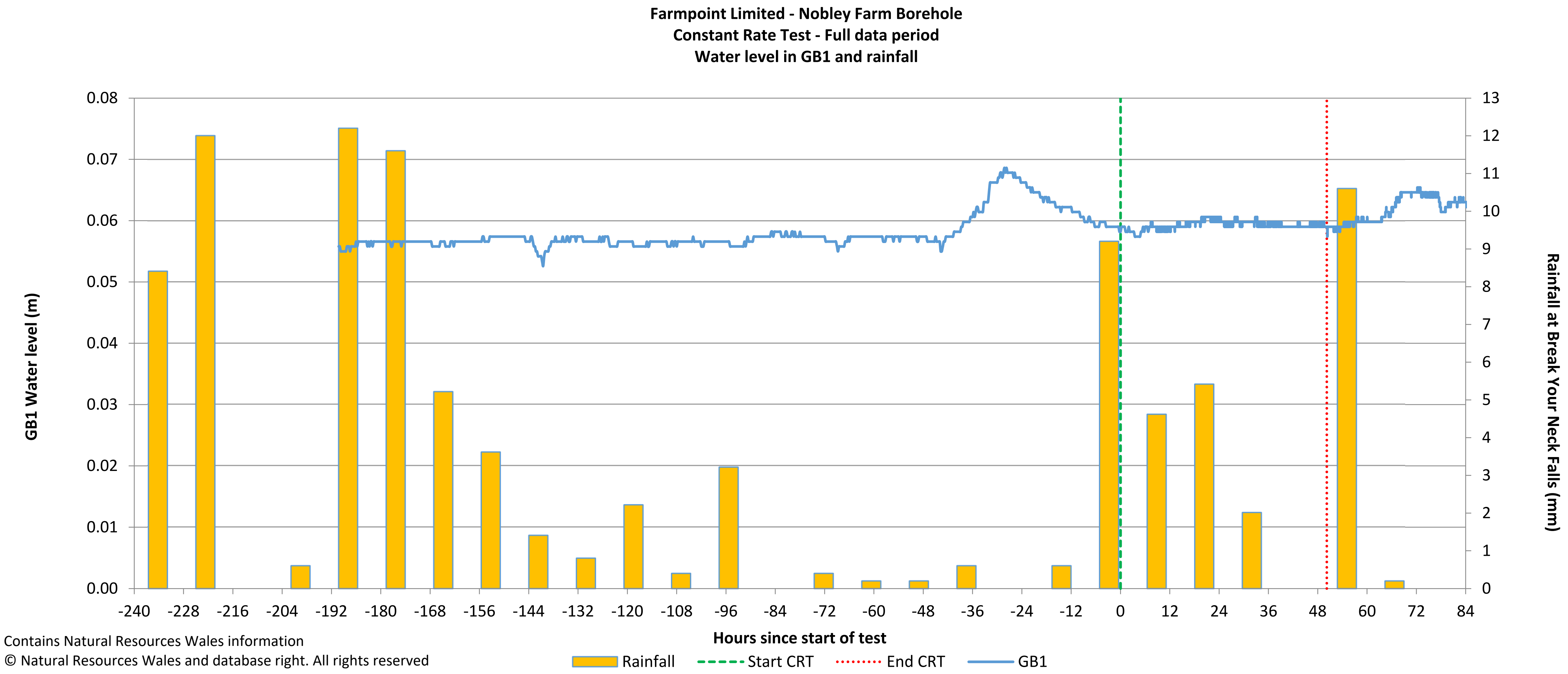


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Figure 4 Constant Rate Test – Water levels in drain

Drawn By: GM	Scale: n/a
Date: Jul 21	Format: A3L

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Appendix 1 Drill Record

BCL HYDRO
BCL Consultant Hydrogeologists Limited

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email: info@bclhydro.co.uk, web: http://www.bclhydro.co.uk
Registered Office: 33, Wolverhampton Road, Cannock, West Midlands, WV11 1AP
Registered in England & Wales. Company Registration Number: 4043373

WELSH NRA WELSH LS. WELL AND PUMP DATA SO26SE/4 TC. No Abs.

WB & AD Morgan

Electrical Engineers and Pumping Specialists
The Old Vicarage Lyonshall
Kington Herefordshire HR5 3LN
Telephone LYONSHALL (054 48) 297

ACCESSION NUMBER WN 22790

RECEIVED N.G.D.C.
DATE: 7-11-95
SIG: S. Roach

2817 6151

Property owner's name and address: 180 MR. PHILIP DAVIES, EVANJOB, POWYS. SO26/11 053 SO26SE 180 24995 / 25643

Well depth: 35'
Datum point from which all measurements are taken: SURFACE

Method of Drilling: ☐ Cable tool ☐ Direct rotary ☐ Reverse rotary ☐ Hollow rod ☑ Air rotary ☐ Jetted ☑ Driven ☐ Bucket auger ☐ Flight auger ☐ Dug ☐ ____

Use: ☐ Domestic ☐ Irrigation ☐ Test Well ☐ Public supply ☐ Municipal ☐ Heating or cooling ☐ Industrial ☐ Commercial ☐ Monitoring ☑ FARM.

Casing Type: ☐ Steel ☐ Galv. ☑ PVC ☐ SS ☐ Threaded ☐ Welded ☐ Solvent welded
Height above/below surface ____ Drive shoe? Yes ___ No ___
Hole diameter: 4 in to 15 ft; 4 in to 35 ft

Remarks, Elevation, Source of Data, etc.

Borehole data

Formation Log	Color	Hardness	From	To
SOILS & CLAY	GREY	SOFT	0'	20'
GRAVELS		HARD	20'	35'

→ Superficial Drift deposits?

JHPare 24/8/94

Intake Portion of Well
Screen type: Linear VERTICAL or open hole from ___ ft to ___ ft
Manufacturer: EUROPE
Material: PVC Dia: 6"
Fittings ____ Length: 19'
Set between 16 ft and 35 ft Slot ____
Method of installation ____

Filter Pack
Source ____ Gradation ____
Method of installation ____ Composition ____
Volume used ____ Depth to top of f.p. ____

Grout
Used? ☑ Yes ☐ No Volume used: 15 BAGS.
☑ Neat Cement ☐ Bentonite ☐ ____
Method of installation ____
Depth: from 15 ft to SURFACE ft

Development
Method ____ Duration ____
Dates ____ Sand content after ___ hrs ____
Chemicals used ____

Static Water Level
____ ft ☐ below ☐ above grade
Date measured ____

Pumping Water Level
____ ft ☐ below ☐ above grade Date ____
After ____ hrs pumping at ____ gpm

Specific Capacity
____ gpm/ft of drawdown at ____ hours
Date ____

Pump
Date installed ____ Type: SC 6
Manufacturer: GRUNDFOS Model No. ____
H.P. ____ Volts ____ Capacity ____
Depth of pump intake setting ____ No. of stages ____
☐ Oil ☐ Water lubrication Power source ____
Material of drop pipe ____ bowls ____
shafting ____ impellers ____ Bowl dia. ____
Column pipe dia. ____ Length ____ Modifications ____

Well Head Completion
☐ Pitless adaptor ☐ Basement offset Distance above grade ____

Nearest Sources of Possible Contamination
____ ft Direction ____ Type ____
Well disinfected upon completion? ☐ Yes ☐ No

Geophysical Logs Run

Water Quality
Sample taken? ☐ Yes ☐ No
Where analyzed ____

Name of Driller: B.A. MORGAN.

Date well completed: JAN 88