

Invicta Water Treatment

89 Castle Drive
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Email. sales@invictawatertreatment.co.uk www.invictawatertreatment.co.uk

Stuart Jolliff
Jolliff Developments Ltd

By email:
06/08/24

Dear Mr Jolliff,

Re: Private Water Supply at High Barn, Crays Lane Site – Raw Borehole Water Analyses (to date and inferences); Proposed Design and Compliance with PWS Regs 2016 Amended 2018 – Rev A

Further to the request that a raw borehole sample was taken by an accredited UKAS PWS Sampler, I can confirm that this was performed on 05/07/24 by Stefan Massingham. The borehole was allowed to flow for some 2 hours prior to sampling. It has been frequently flushed and allowed to develop during drilling prior to sampling. Visually, the water was turbid and grey in colour.

The samples were taken in accordance with DWI requirements (based on Group A & B Schedules PWS Regs 2016), with the correct bottles supplied by the UKAS Accredited lab, SE Water Scientific Services (SEWSS). and then duly transported to the lab thereafter, at the required transit temperatures (between 2°C and 8°C). Additional determinands were tested as it was highly likely that the raw water would require RO membrane treatment.



Signed acceptance of IWT Order by SEWSS

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Determinands to Date	Sample Number 1274019-2 Final, 01/08/24
Alkalinity, mg/l	435.0
Ammonium (Ammonia and Ammonium ions), mg/l	0.698
Chloride, mg/l	274.30
Nitrate, mg/l	<0.9
Nitrite, mg/l	<0.004
Nitrite/nitrate, mg/l	0.002
Sulphate, mg/l	2.0
Total Hardness, mg/l	<10.0
Odour – Qualitative	None
Odour – Quantitative	0
Colony Count 3 days at 22°C, cfu/ml	>300
Colony Count 2 days @ 37°C, cfu/ml	>300
E coli, mpn/100 ml	0
Total Coliforms, mpn/100 ml	15
Pseudomonas aeruginosa, cfu/100 ml	<10
Clostridium perfringens (including spore), cfu/100 ml	0
Colour, mg/l Pt/Co	5
Conductivity, uS/cm	1,462
Hydrogen ion, pH	8.4
Turbidity, NTU	296.000
Bromate, ug/l	Not tested, sample stability issue
Antimony, ug/l	0.4
Arsenic, ug/l	4.9
Selenium, ug/l	1.6
Boron, mg/l	1.577
Calcium, mg/l	6.2
Magnesium, mg/l	1.7
Sodium, mg/l	358.2
Fluoride, mg/l	1.920
Benzo(a)pyrene, ug/l	<0.003
Benzo(1,12)perylene, ug/l	<0.003
Benzo(11,12)fluoranthene, ug/l	<0.003
Benzo(3,4)fluoranthene, ug/l	<0.003
Indeno(1,2,3-cd)pyrene, ug/l	<0.003
PAH Total, ug/l	0.000
1,1,1 Trichloroethane, ug/l	<0.60
1,2-Dichloroethane, ug/l	<0.12
Benzene, ug/l	<0.02
Dibromochloromethane, ug/l	<0.50
Dichlorobromomethane, ug/l	<0.43
Tetrachloroethene	<0.15

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Tetrachloroethen/Trichloroethene- SUM, ug/l	0.00
Tetrachloromethane, ug/l	<0.11
Total Trihalomethane, ug/l	0.00
Tribromomethane, ug/l	<0.60
Trichloroethene, ug/l	<0.10
Trichloromethane, ug/l	<0.50
Aluminium, ug/l	7,346.0
Copper, mg/l	<0.009
Iron, ug/l	15,600.4
Iron (free), ug/l	270.8
Lead, mg/l	8.3
Manganese, ug/l	236.4
Nickel, ug/l	3.7
Cadmium, ug/l	<0.12
Chromium, ug/l	9.2
Calc Pesticides – Total Substances	0.000
Aldrin, ug/l	<0.007
Dichlobenil, ug/l	<0.006
Gamma-HCH (Lindane), ug/l	<0.005
Heptachlor, ug/l	<0.008
Heptachlor Epoxide, ug/l	<0.005
Propyzamide, ug/l	<0.005
Tri-allate, ug/l	<0.005
2,4,5-T, ug/l	<0.007
2,4-D, ug/l	<0.007
Bentazone, ug/l	<0.007
Bromoxynil, ug/l	<0.007
Dicamba, ug/l	<0.020
Dichlorprop, ug/l	<0.003
Fluroxypyrr, ug/l	<0.008
MCPA, ug/l	<0.008
MCPB, ug/l	<0.008
Mecoprop(MCPP), ug/l	<0.005
Triclopyr, ug/l	<0.015
Epichlorohydrin, ug/l	<0.1
Atrazine, ug/l	<0.002
Carbendazim, ug/l	<0.001
Carbetamide, ug/l	<0.002
Chlorotoluron, ug/l	<0.003
Diuron, ug/l	<0.004
Epoxiconazole, ug/l	<0.003
Flutriafol, ug/l	<0.003
Isoproturon, ug/l	<0.003

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Linuron, ug/l	<0.003
Oxadixyl, ug/l	<0.003
Pendimethalin, ug/l	<0.007
Prometryn, ug/l	<0.002
Simazine, ug/l	<0.003
Terbutryn, ug/l	<0.002
Trietazine, ug/l	<0.004
Mercury, ug/l	<0.04
% transmission	10.4
UV Abs (10 mm) @ 254 nm unfiltered	0.985 abs_unit
Bicarbonate Alkalinity, mg/l	424.19
Total Phosphate, ug/l	524
Total Organic Carbon, mg/l	1.5
Silica, mg/l	6.70
Suspended Solids, mg/l	151.6
Filtered Turbidity 0.45 um, NTU	2.01
Filtered Aluminium 0.45 um, ug/l	642.9

Treatment Prognosis

Based on the failures to date, the water treatment system will need to remove excess:

- iron (15,600.4 ug/l, maximum 200.0 ug/l)
- manganese (236.4 ug/l, maximum 50.0 ug/l)
- aluminium (7,346.0 ug/l, maximum 200.0 ug/l)
- sodium (358.2 mg/l, maximum 200.0 mg/l)
- chloride (274.30 mg/l, maximum 250.00 mg/l)
- fluoride (1.920 mg/l, maximum 1.5 mg/l)
- ammonium (0.698 mg/l, maximum 0.500 mg/l)
- turbidity (296.000 NTU, maximum 4.000 NTU)
- boron (1.577 mg/l, maximum 1.000 mg/l)
- suspended solids
- Bacteria – failures for Coliforms and general bacteria

The recommended treatment will be partial settlement; extensive particle filtration followed by a UF and RO unit (see emailed attachment for full RO design calculations) with remineralisation thereafter of the permeate. The treatment train will be similar to that for the Brook Hill Development, recently accepted by HDC and reported on by HDC consultant Dr. G. Pearce; and also, Lime Kiln Farm, Copsale.

We propose the following design:

- Borehole pump feeding
- 1350 litre raw water tank with level controls feeding

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- Booster pump feeding
- Automatic backwashable media filter for sediment removal to 5 um or lower feeding
- Automatic regenerating meter-controlled softener to remove residual iron, some organics and any hardness
- Bespoke UF unit (to remove colloidal clay)
- Bespoke RO unit (as per attached preliminary RO design)
- Remineralisation filter
- UV Unit to disinfect prior to storage
- 5,000 litre treated water tank with level controls
- Booster pump
- 5 um sediment filter cartridge
- UV disinfection unit with UV sensor and controls
- Control panel with level indicators
- PVC rigid solvent weld pipework, MDPE pipework
- High strength chlorination of all pipework prior to use
- UKAS sampling of treated water as per PWS Regs

We are not proposing chlorine dosing currently, as the supply is limited to a handful of new build properties.

The filtration equipment is modular in nature and so upgrades are quite straight forward. The treated water will meet the PWS Regs requirements.

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Integrated Membranes Solutions Design Software

Created on: 30/07/2024 04:47:09



Permeate Throttling (Variable), Concentrate Recirculation

Project name Cray Barn Page : 1/3

Calculated by	Stefan	Permeate flow/train	0.40 m3/h
HP Pump flow	Massingham	Raw water flow/train	0.57 m3/h
Feed pressure	3.07 m3/h	Permeate recovery	13.03 %
Feed temperature	5.5 bar	Total system recovery	70.00 %
Concentrate recirculation	25.0 °C(77.0°F)	Element age	0.0 years
Feed water pH	2.50 m3/h	Flux decline %, per year	5.0
Chem dose, mg/l, -	8.40	Fouling factor	1.00
Specific energy	H2SO4	SP increase, per year	7.0 %
Pass NDP	1.47 kWh/m3		
Average flux rate	2.3 bar		
	17.9 lmh		

Feed type Brackish Well Non-Fouling

Pass -	Perm.	Flow / Vessel	Flux	DP	Flux	Beta	Stagewise Pressure	Perm.	Element	Element	PV# x	
Stage	Flow	Feed	Conc	lmh	bar	lmh	Perm.	Boost	Conc	TDS	Quantity	Elem #
1-1	0.4	1	0.9	18	0.1	18	1.13	1	0	5.4	120.1	ESPA4-LD-4040

Ion (mg/l)	Raw Water	Feed Water	Permeate Water	Concentrate 1
Hardness, as CaCO ₃	0.00	0.00	0.000	0.0
Ca	0.00	0.00	0.000	0.0
Mg	0.00	0.00	0.000	0.0
Na	380.00	1018.82	46.386	1164.5
K	0.00	0.00	0.000	0.0
NH4	0.70	1.08	0.079	1.2
Ba	0.000	0.000	0.000	0.0
Sr	0.000	0.000	0.000	0.0
H	0.00	0.00	0.000	0.0
CO ₃	0.00	0.02	0.000	0.0
HCO ₃	0.10	0.26	0.012	0.3
SO ₄	2.00	5.78	0.026	6.6
Cl	585.45	1571.37	71.619	1796.1
F	0.00	0.00	0.000	0.0
NO ₃	0.00	0.00	0.000	0.0
PO ₄	0.00	0.00	0.000	0.0
OH	0.04	0.10	0.005	0.1
SiO ₂	6.70	18.69	0.444	21.4
B	1.58	1.58	1.581	1.6
CO ₂	0.00	0.00	0.00	0.00
NH ₃	0.10	0.36	0.36	0.36
TDS	976.53	2617.59	129.15	2991.78
PH	8.40	8.78	7.50	8.83

Saturations	Raw Water	Feed Water	Concentrate	Limits
CaSO ₄ / ksp * 100, %	0	0	0	400
SrSO ₄ / ksp * 100, %	0	0	0	1200
BaSO ₄ / ksp * 100, %	0	0	0	10000
SiO ₂ saturation, %	4	10	11	140
CaF ₂ / ksp * 100, %	0	0	0	50000
Ca ₃ (PO ₄) ₂ saturation index	0.0	0.0	0.0	2.4
CCPP, mg/l	0.00	0.00	0.00	850
Langlier saturation index	0.00	0.00	0.00	2.8
Ionic strength	0.02	0.04	0.05	
Osmotic pressure, bar	0.8	2.1	2.3	

Product performance calculations are based on nominal element performance when operated on a feed water of acceptable quality. The results shown on the printouts produced by this program are estimates of product performance. No guarantee of product or system performance is expressed or implied unless provided in a separate warranty statement signed by an authorized Hydranautics representative. Calculations for chemical consumption are provided for convenience and are based on various assumptions concerning water quality and composition. As the actual amount of chemical needed for pH adjustment is feedwater dependent and not membrane dependent, Hydranautics does not warrant chemical consumption. If a product or system warranty is required, please contact your Hydranautics representative. Non-standard or extended warranties may result in different pricing than previously quoted. Version : 2.231.90 %

Email : lmsd-support@hydranauticsprojections.net

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RO Design Calculations (see email attachment for full set)

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Compliance

With reference to the PWS Regs 2016 and amended 2018, this supply will be classified as Reg 9. We have allowed for a DWI risk assessment on the completed system by David Clapham (RIAMS independent consultant) along with the required sampling by a UKAS accredited sampler. We understand, under PWS Regs section 6 & 7, the duties of the council. We look for the council to provide clarity on this.

Ongoing Maintenance & Sampling

The water treatment system will require maintenance. We will provide a bespoke O&M manual, with specific procedures for your system along with the manufacturer's documentation. We will issue a line drawing of the water treatment process and provide hands-on training during the commissioning phase. Critical spares will be left on site and these are: spare UV lamp, quartz sleeve and sediment filters.

Regarding headings 3,4,5 in HDC Water Neutrality Compliance requirements. Please note 3 and 4 will be detailed at contract phase in the O&M manual. The manual will also cover recording. We have other applications/systems passed based on the same wording as in this report. With regard to recording: the designated maintenance contractor/owner/agent looking after the system will take necessary samples and record in the site log book, which forms part of the O&M manual. Until the system is commissioned, we cannot say which determinands need to be tracked but it is highly likely it is those which have failed and highlighted below. Specific SOPs, contained in the O&M, will be written once the system has been commissioned and will cover inspection, cleaning and maintenance. We will comply with PWS Regs 2016 amended 2018.

Sampling the raw borehole as well as the treated water is important to understand how the ground water is changing over time and how it reacts to weather events. We will only test pertinent process determinands and those required under the Schedules (see PWS Regs). If the council requires regulatory samples, we assume we will be instructed accordingly.

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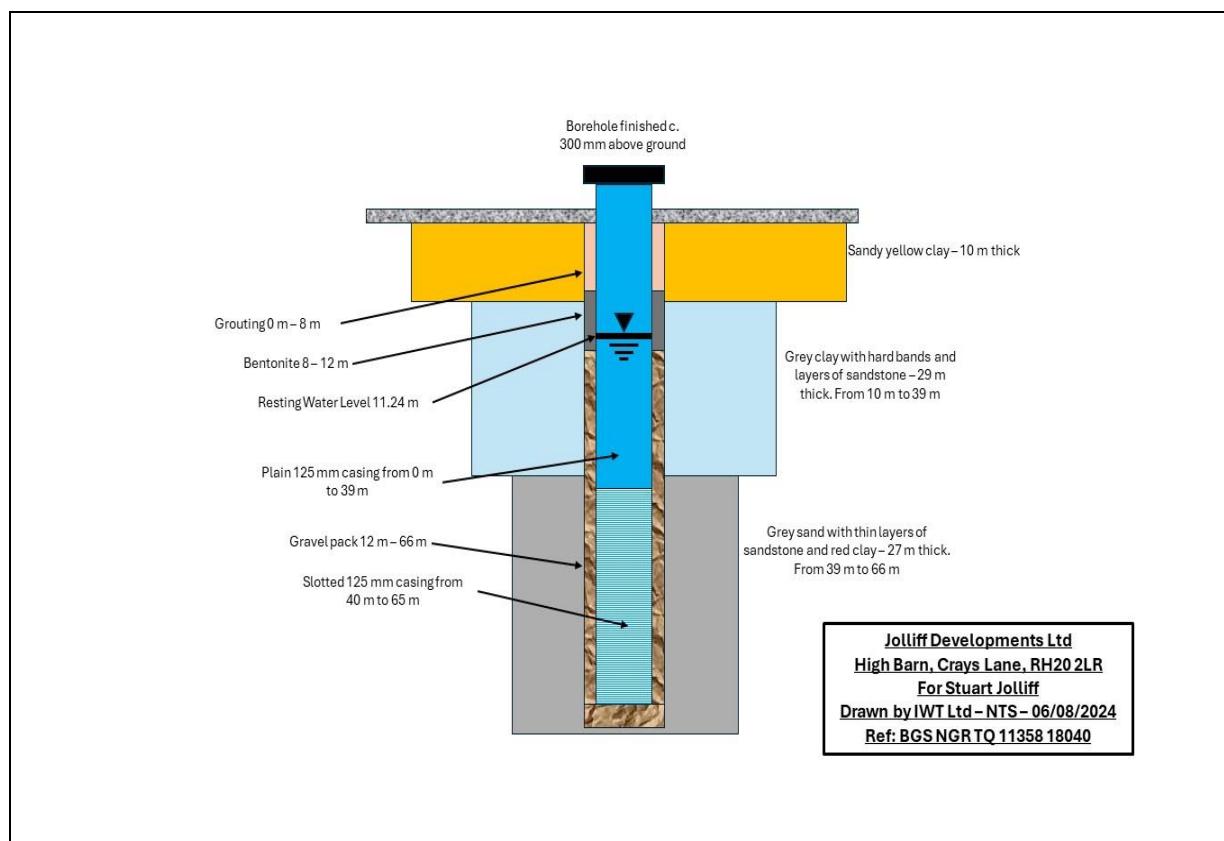
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Borehole Design As Drilled On Site



The borehole has been drilled as per the drill log attached to the email and as below (page 1 of log). The borehole produces water from the grey sands/sandstone and red clay. The borehole has been finished above ground. There are no known sewage systems or ground contamination sources nearby.

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WR38: Borehole record form

Borehole record form



Water Resources Act 1991 (as amended by the Water Act 2003)

A Site details

Borehole drilled for Jolliff Developments Ltd

Location High Barn Crays Lane Goose Green Pulborough RH20 2LR

NGR (ten digits) TQ 11358 18040 Please attach site plan

Ground level (if known) 30 metres Above Ordnance Datum

Drilling company SussexBoreholes

Date drilling commenced 15/03/2024 (DD/MM/YYYY) Completed 22/03/2024 (DD/MM/YYYY)

B Construction details

Borehole datum (if not ground level) 30 metres (m). Please tick if this is above or below ground level. (point from which all measurements of depth are taken, for example, flange, edge of chamber)

Borehole drilled diameter 225 mm from 0 to 86 m/depth

 mm from to m/depth

 mm from to m/depth

 mm from to m/depth

Casing material upvc diameter 125 mm from 0 to 85 m/depth and type (for example, if plain steel, plastic slotted). Please record permanent casing details, not temporary casing.

Casing material plain diameter 125 mm from 0 to 39 m/depth

Casing material slotted diameter 125 mm from 40 to 85 m/depth

Casing material diameter mm from to m/depth

Grouting details gravel pack, bentonite pellets at 12.8 meters and cement grout to surface

Water struck at 1. m (depth below datum – mbd) 2. m (mbd)

3. m (mbd) 4. m (mbd)

C Test pumping summary (Please supply full details on form WR39)

Test pumping datum 11.24 m. Please tick if this is above or below ground level. (if different from borehole datum)

Pump suction depth 40 mbd

Water level (start of test) 11.24 mbd

Water level (end of test) mbd

Type of test (for example, bailer, step, constant rate)

Pumping rate 1.4 m³/hour or litres/second Please tick as appropriate.
for 1 days, 2 hours, 0 mins

Recovery to mbd in days, hours, mins
(from end of pumping)

Date(s) of measurements Pump started 27/03/2024 (DD/MM/YYYY)

Pump stopped (DD/MM/YYYY)

Please supply chemical analysis if available. If you have included this please tick this box

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Summary

We trust that there is enough information herein for HDC. Please keep us informed of your progress. HDC can contact me directly if they wish.

Please feel free to call on 07970 154529 if you need any parts of the report clarifying.

Regards

Stefan Massingham BSc (Hons Chem.) MSc (Cran) MWMSoc
Director - Invicta Water Treatment Limited
Qualified UKAS Private Water Supply Sampler

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Disclaimer

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