SUFFICENCY OF PROPOSED BURN DERIVED PRIVATE WATER SUPPLY

2022/0213/DET : Erection of 7 Holiday Let Units, Drumore Cottage, Duchray Road, Aberfoyle, Stirling, FK8 3XL

Prepared for:

Peter Lawns

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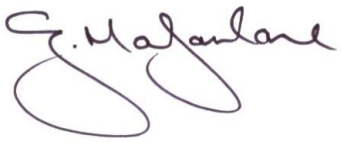
AE	Actual Evaporation (This is the same as annual evapotranspiration (evaporation from soils and plant/tree transpiration within the catchment) when an r value of 1.0 is applied as is recommended by IH108 for the subject catchment)
AREA	Catchment area
BFIHOST	Base Flow Index. This is derived from the delineation of UK soil types according to their hydrological properties to produce the 29-class Hydrology of Soil Types (HOST) classification
FEH	Flood Estimation Handbook
HACCP	Hazard Analysis and Critical Control Point
IH	Institute of Hydrology
$MAM_{(1)}$	Mean Annual 1-day Minimum flow
MF	Mean Flow
PE	Potential Evaporation
PROPWET	This catchment wetness index provides a measure of the proportion of time that catchment soils are defined as wet which in this context is when soil moisture deficits are less than 6 mm.
$Q_{95(1)}$	The 1 day mean flow exceeded by 95% of 1 day mean flows
r	Adjustment factor for average runoff depth which is a function of catchment rainfall
REHIS	The Royal Environmental Health Institute of Scotland
SAAR	Standard-period Average Annual Rainfall, 1961-1990. This is 1 km grid-based rainfall data provided by the Met Office for any location in the UK. The use of SAAR is a standard approach for flow calculation whether these be high flows (e.g., for flood risk assessment) or low flows (e.g., for water supplies)
UKCEH	United Kingdom Centre for Ecology and Hydrology

Quality Assurance

The data used in this document and their input and reporting have undergone a quality assurance review which follows established TransTech procedures. The information and results presented herein constitute an accurate representation of the data collected and analysed.

Document Details

Author: 

Garret Macfarlane, PhD, BSc (hons), REHIS Advanced HACCP

Issue Date: 28 February 2023

Disclaimer

All comments and opinions contained in this report, including any conclusions are based on information available to TransTech Environmental during our investigations. The conclusions drawn by TransTech could therefore differ if the information is found to be inaccurate, incomplete, or misleading. TransTech accepts no liability should this prove to be the case.

1. CATCHMENT

1.1. Predicted Catchment Area

The United Kingdom Centre for Hydrology and Ecology's predicted catchment boundary upstream of a potential location for the intake was obtained from the FEH Web Service(1) which in this instance also includes the catchment for the burn to the east. The digital terrain model used by the UKCEH to predict a catchment's extents has a 50 m grid resolution and as such the catchment's boundary often requires some amendment. Therefore, NextMap Britain 2 m contour data(2) was used to separate the catchment for the burn to the east and correctly delineate the catchment for the subject burn. This found its area to be 523,205 m^2 (figure 1).

Note that the potential location of the intake has been placed close to Drumore Cottage's southern boundary. Therefore, the calculated low flows will be unaffected if the intake is moved downstream. Indeed, the catchment and therefore the flows may increase very slightly.

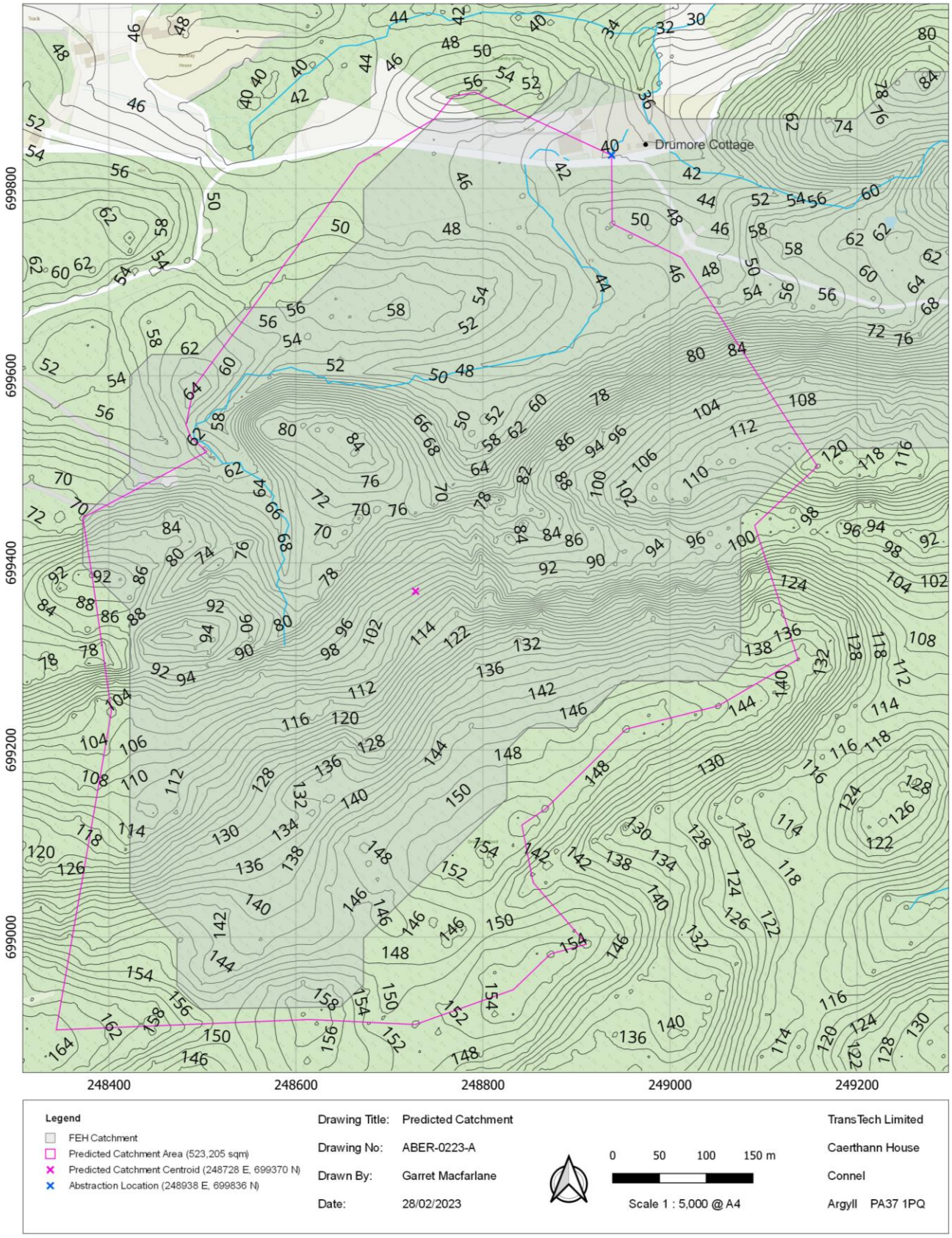


Figure 1. Supply catchment upstream of the potential abstraction location.

1.2. Catchment Descriptors

To calculate the low flows at the supply's intake site-specific catchment descriptors were obtained from the FEH Web Service(1) along with evaporation data from the UKCEH(3). A screenshot of the catchment's standard-period average annual rainfall (SAAR) and base flow index for the hydrology of its soil type (BFIHOST) is provided in figure 2.

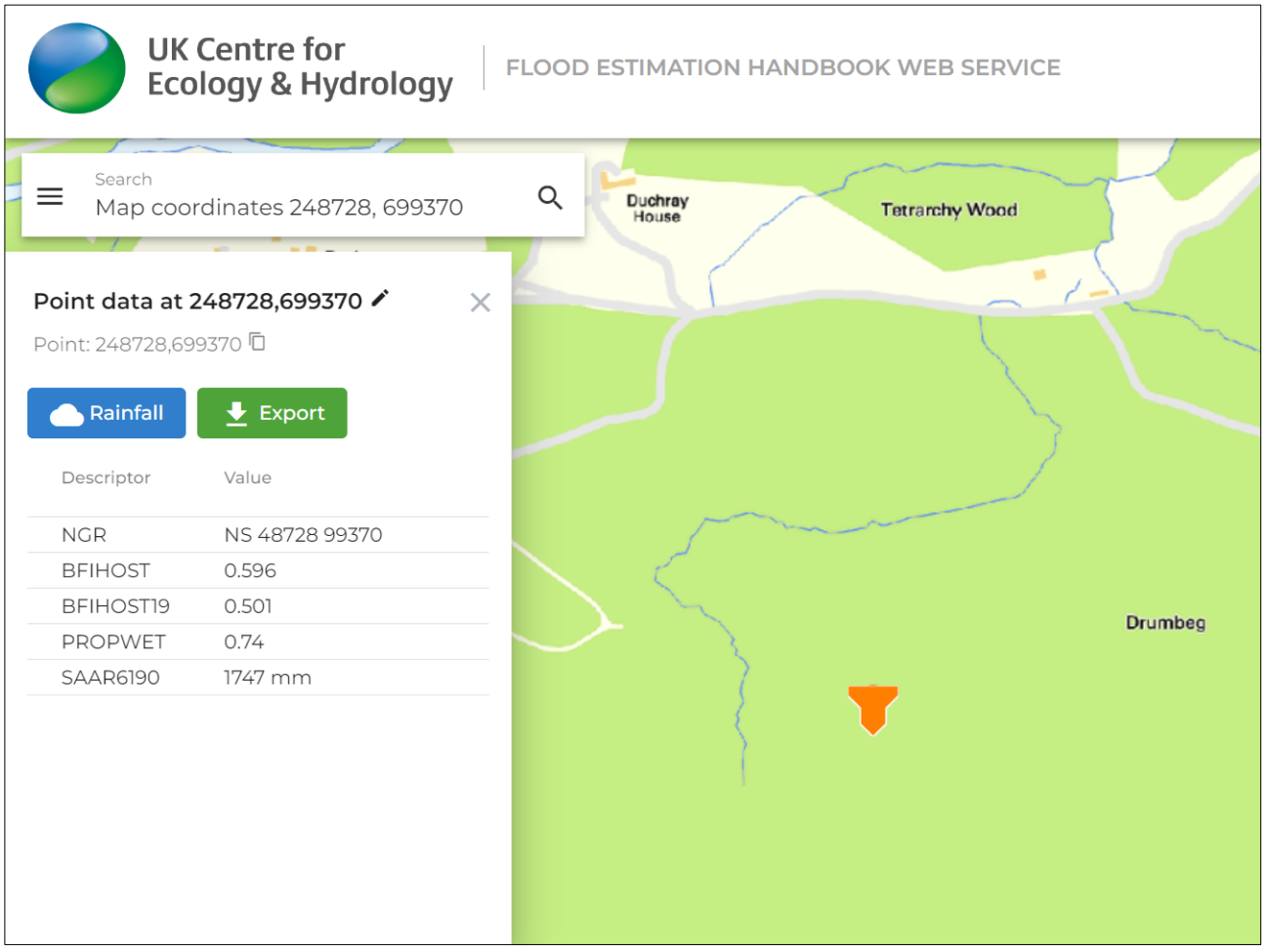


Figure 2. SAAR and BFIHOST descriptors for the burn's catchment above the potential abstraction location.

The site-specific point source descriptors for the catchment indicate that the soils within it are extremely wet throughout the year with the 1 km^2 grid within which it lies having a proportion of time the soil is wet (PROPWET) value of 0.74 (i.e., 74%). This signifies that the water table remains high even during drought conditions. Likewise, the BFIHOST descriptor is also high at 0.596 which indicates a strong baseflow within the burn.

The catchment falls within one 5 km^2 UKCEH potential evaporation area for which historical data is available(3). Table 1 below provides the values for this. Note that potential evaporation is the same as actual evaporation (AE) because SAAR is >1,100 mm/year (figure 2), thus no adjustment for average runoff depth (r) is necessary.

Table 1. Historic actual evaporation for burn's catchment above the potential abstraction location.

Year	AE for Catchment (mm/year)
2001	448.5
2002	455.1
2003	464.5
2004	461.0
2005	458.4
2006	461.8
2007	457.7
2008	454.7
2009	459.4
2010	448.5
2011	453.1
2012	445.2
2013	450.9
2014	466.7
2015	439.9
AVERAGE:	455.0
MINIMUM:	439.9
MAXIMUM:	466.7

The annual maximum of 466.7 mm/year has been used in this appraisal along with sensitivity analysis on this (§2.2.4.) which provides precautionary low flow values which are predicted to encompass future increases in AE because of climate change.

2. SUFFICIENCY OF SUPPLY

2.1 Calculation of the Flow Regime at the Supply's Intake

The $Q_{95(1)}$ and $MAM_{(1)}$ flows in the burn have been estimated using the methods described in the Institute of Hydrology's Report 101 "Low Flow Estimation in Scotland"[4] and Report 108 "Low Flow Estimation in the UK"[5].

These reports describe the derivation of the flows at an ungauged site using the following input parameters:

- Base Flow Index
- Standard Average Annual Rainfall
- Catchment Area

An outline of the methods is given in §2.1.1. to §2.1.3.

2.1.1. Calculation of Mean Flow

The mean flow is derived from the catchment water balance equation below:

$$\mathrm{MF} = \frac{(SAAR - AE) \times AREA}{3600 \times 24 \times 365.25}$$

Where,

MF = Mean flow (m^3/s)
SAAR = Standard average annual rainfall (m/yr)
AE = Actual evaporation (m/yr)

2.1.2. Calculation of $Q_{95(1)}$ Flow

The $Q_{95(1)}$ is estimated from the equation provided in section 6 of IH108[5]. This method uses catchment geology, represented by an estimate of the Base Flow Index (BFIHOST), to estimate $Q_{95(1)}$ values as follows:

$$Q_{95(1)} \text{ as \% of MF} = 44.1 \times \mathrm{BFIHOST}^{1.43} \times \mathrm{SAAR}^{-0.033} \times \mathrm{AREA}^{0.0342}$$

Where,

MF = Mean flow (m^3/s)
$Q_{95(1)}$ = 1 day mean flow exceeded by 95% of 1 day mean flows
BFIHOST = Base flow index for the catchment
SAAR = Standard average annual rainfall (mm)
AREA = Catchment area (km^2)

The $Q_{95(1)}$ in units of m^3/s is obtained as follows:

$$Q_{95(1)} = \frac{Q_{95(1)} \text{ as \% of MF}}{100} \times MF$$

2.1.3. Calculation of $MAM_{(1)}$ Flow

For this assessment, the predicted Mean Annual 1-day Minimum flow ($MAM_{(1)}$) has also been determined.

The first step in its calculation is to convert the $Q_{95(1)}$ as a percentage of MF to the Mean Annual 7-day Minimum flow ($MAM_{(7)}$) as a percentage of Mean Flow (MF). The formula for this is:

$$MAM_{(7)} \text{ as \% of MF} = 6.4 \times \mathrm{SAAR}^{-0.238} \times Q_{95(1)} \text{ as \% of MF}^{0.953}$$

The next step is to convert the $MAM_{(7)}$ as a percentage of MF to the $MAM_{(1)}$ flow as a percentage of MF. The formula for this is:

$$MAM_{(7)} \text{ as \% of MF} \times (1 + (1 - 7) \times 0.00212 \times MAM_{(7)} \text{ as \% of MF}^{-1.02} \times SAAR^{0.629})$$

The last step is to calculate the $MAM_{(1)}$ flow as follows:

$$MAM_{(1)} = \frac{MAM_{(1)} \text{ as \% of MF}}{100} \times MF$$

2.2. Flow Calculations

2.2.1. Predicted Mean Flow

The values required to calculate the mean flow are:

SAAR = 1.747 m/yr
AE = 0.4667 m/yr
AREA = 523,205 m^2

Using the equations and parameters above the predicted mean flow in the burn at the potential abstraction location is 21.2266 litres/second.

2.2.2. Predicted $Q_{95(1)}$ Flow

The values required to calculate $Q_{95(1)}$ flow (the mean 1 day flow exceeded by 95% of mean 1 day flows) are:

BFIHOST = 0.596
SAAR = 1,747 mm/yr
AREA = 0.523205 km^2

The predicted $Q_{95(1)}$ is 3.4143 litres/second (294,996 litres/day).

2.2.3. Predicted $MAM_{(1)}$ Flow

The $MAM_{(1)}$ flow is 2.9643 litres/second which amounts 256,116 litres/day.

2.2.4. Sensitivity Analysis

To provide a robust assessment of low flows, we have conducted sensitivity analysis for the parameters that the calculations are based on i.e., Standard-period Average Annual Rainfall, the Base Flow Index HOST descriptor, Actual Evaporation and catchment AREA. The analysis involved reducing SAAR, BFIHOST and AREA by 20% and increasing AE by 20%. The effects of this are provided in table 2.

Table 2. Sensitivity analysis on SAAR, BFIHOST, AREA and AE for the calculated $Q_{95(1)}$ flow.

	No Sensitivity	20% Decrease in SAAR Only	20% Decrease in BFIHOST Only	20% Decrease in AREA Only	20% Increase in AE Only	20% Decrease in SAAR, BFIHOST & AREA and 20% Increase in AE
$Q_{95(1)}$ (litres/second)	3.4143	2.5009	2.4815	2.7107	3.1654	1.2984
$Q_{95(1)}$ (litres/day)	294,996	216,078	214,402	234,204	273,491	112,182

For a low flow prediction, it can be acceptable to use the minimum $Q_{95(1)}$ value of 1.2984 litres/second to determine the sufficiency of supply from the burn. However, we have also conducted sensitivity analysis on the Mean Annual 1 day Minimum ($MAM_{(1)}$) flow given in §2.2.3. (table 3).

Table 3. Sensitivity analysis on SAAR, BFIHOST, AREA and AE for the calculated $MAM_{(1)}$ flow.

	No Sensitivity	20% Decrease in SAAR Only	20% Decrease in BFIHOST Only	20% Decrease in AREA Only	20% Increase in AE Only	20% Decrease in SAAR, BFIHOST & AREA and 20% Increase in AE
$MAM_{(1)}$ (litres/second)	2.9643	2.3284	2.1119	2.3526	2.7482	1.1927
$MAM_{(1)}$ (litres/day)	256,116	201,174	182,468	203,265	237,444	103,049

The lowest $MAM_{(1)}$ flow is **1.1927 litres/second** and it is this precautionary low flow that has been used to calculate sufficiency of supply. This flow rate amounts to a daily discharge volume from the burn at the potential abstraction location of **103,049 litres/day**.

3. CONCLUSIONS

We have used site specific rainfall and catchment characteristics to determine the Mean Annual 1-day Minimum flow for the burn supply. A conservatively low/precautionary estimate of this, i.e., post sensitivity analysis, is 103,049 litres/day. Given that the peak demand will be 2,800 litres/day (i.e., 14 bedspaces x Environmental Health's required demand figure of 200 litres/bedspace/day), the supply is predicted to comfortably meet the needs of the development proposal.

REFERENCES

(1) Wallingford HydroSolutions Flood Estimation Handbook Web Service. Launched November 2015.
Website link

(2) NextMap Britain 2 m Contours. Downloaded from emapsite, February 2023.
Website link

(3) Historic 5 km^2 Gridded Annual Potential Evaporation. This data is provided in netCDF files for use in GIS software. UK Centre for Ecology and Hydrology Environmental Information Data Centre. Natural Environment Research Council. 16 February 2023.
Website link

(4) Gustard, A. et al. IH Report 101. Low Flow Estimation in Scotland. Institute of Hydrology, Wallingford, UK. 1987.
Website link

(5) Gustard, A. et al. IH Report 108. Low Flow Estimation in the United Kingdom. Institute of Hydrology, Wallingford, UK. 1992.
Website link

From: XXXXX@stirling.gov.uk>
Sent: 08 August 2025 13:01
To: XXXXX
Subject: RE: Planning Permission 2022/0213/DET - Drumore Cottage, Duchray Road, Aberfoyle, Stirling, FK8 3XL

XXXXX,

My apologies. I did contact you when the consultation on 23/06/25 to question it.

I have reviewed the documentation and, as before, I am satisfied that the proposals will satisfy the condition, provided there is no deviation from the plans.

The applicant should register the private water supply with Environmental Health and sample to confirm compliance before use.

Thereafter, the treatment system will require to be maintained.

Regards,

XXXXX **– Public Health and Pollution**

Regulatory Services | Stirling Council | Endrick House | Kerse Road | Stirling FK7 7SZ
Tel XXXXX | **Email:** XXXXX @stirling.gov.uk | **Web:** stirling.gov.uk

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From: XXXXX @lochlomond-trossachs.org>
Sent: 08 August 2025 09:53
To: XXXXX @stirling.gov.uk>
Cc: EHplanningconsultations <EHplanningconsultations@stirling.gov.uk>; Planning Monitoring <planning.monitoring@lochlomond-trossachs.org>; XXXXX @lochlomond- trossachs.org>
Subject: [External] Planning Permission 2022/0213/DET - Drumore Cottage, Duchray Road, Aberfoyle, Stirling, FK8 3XL

XXXXX,

I refer to our telephone conversation yesterday, in relation to Condition 13 of Planning Permission 2022/0213/DET - Drumore Cottage, Duchray Road, Aberfoyle, Stirling, FK8 3XL.

Following our conversation I have re-checked the document log for the application, and in particular, Condition Thirteen, and note the following: -

- **24/01/2025 – Applicant submitted initial documents in relation to the Condition to the National Park.**
- **17/02/2025 – Consultation issued to Environmental Health at Stirling Council.**
- **03/06/2025 – Response received from Environmental Health at Stirling Council.**
- **04/06/2025 – Reminder issued to Environmental Health at Stirling Council – this would appear to have crossed over with your response.**
- **22/06/2025 – Agent submitted a further proposal in relation to Condition 13 to the National Park.**
- **23/06/2025 - Consultation issued to Environmental Health at Stirling Council.**

- **07/08/2025 - Reminder issued to Environmental Health at Stirling Council.**

Having reviewed the document log, the response received from EH 03/06/2025 was in relation to the version submitted by the applicant 24/01/2025.
I would be grateful if you could review the most recent version of the submission forwarded to the Council 23/06/2025, and advise if these proposals will satisfy the requirements of the condition?

I hope the above will assist in identifying the appropriate version and thank you for your assistance.

Kindest regards,

XXXXX
Loch Lomond & The Trossachs National Park
Direct: XXXXX
Email: XXXXX @lochlomond-trossachs.org
View planning applications online at: www.lochlomond-trossachs.org/planning
Information on how to respect, protect and enjoy the National Park can be found in our latest advice to visitors

CDM REGULATIONS:
ALL CONSTRUCTION PROJECTS LARGE & SMALL ARE SUBJECT TO THE CDM REGULATIONS (2015). IF THE DEVELOPMENT WILL BE FOR A DOMESTIC CLIENT OR LESS THAN 30 DAYS IN DURATION THEN THE RESPONSIBILITY FOR HEALTH & SAFETY IS THEN PASSED ONTO THE MAIN CONTRACTOR. IN ALL CASES THE CLIENT MAY DEVOLVE THE RESPONSIBILITY TO A PRINCIPAL DESIGNER, WHO WILL ACT ON THE CLIENTS' BEHALF. PLEASE REFER TO PRINCIPAL DESIGNER FOR ADVICE.

EXISTING BUILDINGS:
BEFORE STARTING WORK IT IS THE CONTRACTORS RESPONSIBILITY TO CHECK IF ANY ASBESTOS IS PRESENT, IN COMMERCIAL PROPERTIES THERE SHOULD BE A PLAN/REGISTER=ASK TO SEE IT. YOU NEED TO CHECK THAT THE PLAN COVERS THE AREA OF THE BUILDING THAT YOU WILL BE WORKING IN AND IF YOU ARE DOING REFURBISHMENT WORK THAT IT INCLUDES A SURVEY THAT TELLS YOU WHAT TYPES OF ASBESTOS IS PRESENT AND ITS CONDITION. IF THERE IS NO REGISTER OR SURVEY OR THE REPORT IS NOT CLEAR-DO NOT START WORK.

STATUTORY APPROVALS:
NO WORKS ARE TO START ON SITE PRIOR TO DISCHARGE OF ANY / ALL PRE-START PLANNING CONDITIONS.
THE CLIENT IS AT RISK IF ANY WORKS ARE STARTED PRIOR TO APPROVAL BY APPOINTED BUILDING CONTROL BODY.

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REVISION NOTE	ISSUE	DATE

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A1

Date 14/11/2022

Project: **Little Duchray**

Usage	Number	Rev
	PL_005A	B

Drawing: **Eastern Site Plan**

Purpose of Issue	Project No.	Scale:
	096	1:300

Drumore Cottage
Duchray Road
Aberfoyle
Stirling
FK8 3XL

23rd January 2025

Dear XXXXX

Application Number 2022/0213/DET
This letter provides the information and supporting documentation to discharge Planning Condition 13 (Private Water Supply):

Private Water Supply: Prior to the development commencing a report by a suitably qualified and competent person shall be submitted to and approved in writing by the planning authority in consultation with Stirling Council Environmental Health. The report shall:
a. Identify the source of the private water supply,
b. Demonstrate sufficient capacity (including in times of prolonged dry weather),
c. Detail the proposed treatment system/process(es),
d. Demonstrate the capability of the treatment system to achieve a sufficient and wholesome supply of water that meets the standards for both microbiological and chemical parameters as set out in Private Water Supplies (Scotland) 2006.

The summary below provides some background, together with the steps that we have taken to discharge this planning condition.

I trust that all is in order, and I would be grateful for you confirmation of the same.

Please don't hesitate to get in touch if you require any further information to discharge this condition.

Kind regards, Pete and Debbie Lawns

Surface Water Supply – Location and Sufficiency of Supply

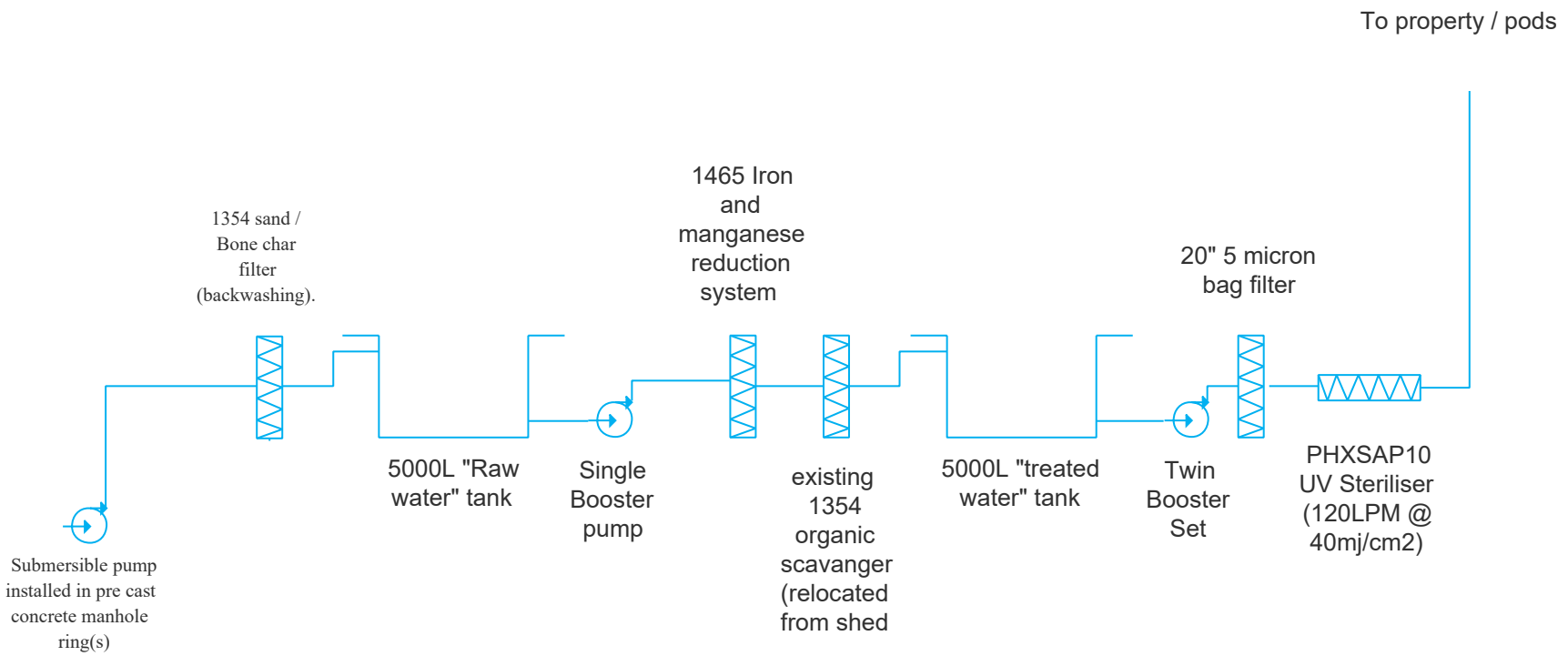
1. Given the only viable option was to use a surface water supply, we identified the stream on our southern boundary next to the barn as a potential water source.
2. [Insert map showing extraction point]
3. We engaged TransTech Environmental (Environmental Consultancy | TransTech) to carry out a hydrological assessment to evaluate the sufficiency of supply to service the development.
4. The detailed report from TransTech Environmental is set out in **Attachment 1**. It confirms that "A conservatively low/precautionary estimate of the minimum flow for the burn supply, i.e., post sensitivity analysis, is **103,049 litres/day**. Given that the peak demand [in the unlikely event that we decide to build all 7 cabins would be] **2,800 litres/day** (i.e., 14 bedspaces x Environmental Health's required demand figure of 200 litres/bedspace/day), **the supply is predicted to comfortably meet the needs of the development proposal**."
5. **We would like to propose that the information set out in 6 to 9 above satisfies the requirements of Planning Condition 13(a) and (b).**

Surface Water Supply – Location and Sufficiency of Supply

6. With the extraction point and sufficiency of supply established, we engaged separately with HighWater Ltd and PHX Water Ltd (specialist in the design, installation and maintenance of private water supplies) and obtained consultancy on how best approach, extract and treat the identified surface water supply.
7. A water sample from the proposed extraction site was taken on 14 December 2023 and sent for laboratory analysis of bacterial and chemical contaminants. The result of the water sample

are set out in **Attachments 2 and 3**, and the output was assessed against the regulatory limits for private water supplies in Scotland as set out in **Attachment 4**.

8. Given the output from the water sample, and to ensure that we had a robust water treatment system for the development, we formally engaged PHx Limited (PHX Water | Home) to design a treatment facility to remediate the bacterial and chemical issue
9. The quote for the works is set out in **Attachment 5** and a Schematic of Treatment System is set out in the **Attachment 6**. The key features are as follows:
    a. Concrete extraction chamber located adjacent to burn, surrounded in pea gravel and complete with manhole cover. A submersible pump extracts water and sends this to the plant room in the barn, via a 32 MDPE pipe.
    b. Sand and bone char filter
    c. 5000 litre raw water storage tank
    d. Iron and manganese reduction system.
    e. Organic scavenger
    f. 5000 litre treater water storage tank
    g. 5 micro filter
    h. UV sterilisation
10. **We would like to propose that the information set out in 11 to 14 above satisfies the requirements of Planning Condition 13(c) and (d).**



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PHX Water Engineer	
Site	Drumore
Date	27.02.24

LEGEND

	Hot Pipe
	Cold Pipe
	Cold Main
EV	Expansion Vessel
	Secondary Return Pump
	Booster Pump Set
	Cold Water Storage Tank
	Hot Water Storage
	Boiler
HW	Point of Use
	Vent Pipe
	Water Filter