South West Water Limited

Stannon Lake Drought Permit Environmental Assessment Report

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7.0	26/10/2022			Final draft. Final amendments to EMP table as per meeting with SWW 26.10.2022	RH/ HA

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1. Introduction

1.1 Background

South West Water (SWW) supplies water to the Isles of Scilly, Cornwall, Devon, Bournemouth and parts of Hampshire, Dorset, Somerset and Wiltshire. Water resource planning is based on five water resource zones (WRZ) – Colliford, Roadford, Wimbleball, Isles of Scilly and Bournemouth – with Devon and Cornwall supplied primarily by Colliford, Roadford and Wimbleball.

1.2 Drought permits and drought orders

In periods of exceptionally low rainfall, when water resources become scarce, powers are available to grant ordinary and emergency drought permits and orders under the Water Resources Act 1991 (as amended by the Environment Act 1995 and the Water Act 2003). Drought permits and drought orders are drought management actions that, if granted, can allow more flexibility to manage water resources and the effects of drought on public water supply and the environment (EA & Defra, 2019).

In the case of drought permits, the Environment Agency ('the Agency') must be satisfied that a serious deficiency of supplies of water in any area exists or is threatened and that the reason for the deficiency is an exceptional shortage of rain.

Drought permits can be applied for under the Water Resources Act 1991 (Section 79A) (as amended by the Environment Act 1995) to vary an abstraction licence condition, such as the maximum yearly allocation or a compensation flow or to allow water to be taken from another source. They are authorised by the Agency. If objections are duly made and not withdrawn the Agency will give the objector an opportunity to be heard at a hearing or cause a public inquiry to be held.

Following the severe drought in northern England in 1995/96, the Government set out a wide range of actions to be taken by the water industry, including the need for water companies to demonstrate that they have adequate drought contingency plans. As required under Sections 39B and 39C of the Water Industry Act 1991, as amended by the Water Act 2003 and in accordance with the Drought Plan Regulations 2005 the Drought Plan Direction 2020, water companies have a duty to prepare and maintain a Drought Plan.

Prospective drought permit options may be identified within Drought Plans. Over the last 12 months SWW's Drought Plan has been going through the routine statutory update process with DEFRA. The Drought Plan details the range of actions that SWW will consider implementing during drought conditions to maintain essential water supplies to its customers and minimise environmental impact. The environmental assessment of drought permits is undertaken in recognition of the guidance from the Agency and Defra, as contained in:

- EA Water Company Drought Plan Guideline (April 2020);

- EA and Defra Guidance on Drought Permits and Drought Orders (March 2021); and
- EA environmental assessment for water company drought planning supplementary guidance (July 2020).

The environmental assessment of a drought permit is not a statutory Environmental Impact Assessment (EIA), as recognised, for example, within the Town & Country Planning regime and its enabling regulations. However, this environmental assessment has been undertaken in accordance with best practice guidance wherever applicable.

An Environmental Assessment Report (EAR), which includes a monitoring plan and mitigation measures, is required to support each drought permit/order application. Each EAR should provide details of baseline flow conditions, assess impacts of potential changes to the flow regime due to implementation of the drought permit/order, and provide an EMP to support the requirement for baseline, during and post drought permit/order implementation monitoring.

1.3 Objectives and scope

The purpose of this EAR is to assess the potential environmental issues that may occur as a result of implementing a drought permit associated with the Stannon Lake abstraction and to recommend monitoring and mitigation measures, if required.

1.3.2 This report

Following the introduction, this report is structured as follows:

- Section 2 presents background information about the affected area and proposed drought permit;
- in Section 3 the impact assessment method is described;
- in Section 4 the Water Framework Directive (WFD) status and designated sites are described;
- in Section 5 the potential physical effects of the proposed drought permit are discussed, including likely effects on lake level and river flow;
- in Section 6 the ecological assessment is presented;
- in Section 7 the assessment for other receptors such as culture and heritage features is presented.
- a summary of the assessment is presented in Section 8;
- mitigation measures are discussed in Section 10;
- the EMP, including baseline, during drought permit and post drought permit monitoring plans are presented in Section 9;
- A concluding summary is provided in Section 10.

2. Description of proposal

2.1 Site setting

Stannon Lake is an important source of water supply in SWW's Colliford Water Resource Zone (WRZ) in South West England.

This EAR has been prepared to support a potential drought permit application that will involve an increase in abstraction from Stannon Lake. The objective of the permit sought is to increase available supply in the Colliford WRZ. By providing additional water from Stannon Lake, SWW will be able to preserve the water stored in Colliford Reservoir.

2.1.2 Stannon Lake historic use

Stannon Lake was created by flooding a decommissioned china clay extraction quarry pit, where mining ceased in 2002. The slopes of the lake are steep softened (kaolinised) granite. The mine operator Imerys undertook landscaping, geotechnical and drainage works to stabilise the pit slopes and spoil heaps. Abstraction licences were granted to SWW by the Agency following detailed hydrological and hydro-geological analysis by Hyder (Crisp, 2011).

2.1.3 Stannon Lake abstraction licence

A full licence to abstract water at Stannon Lake for public water supply was granted by the Agency in November 2016 (SW/049/0281/001/R01). The licence allows for abstraction of maximum quantities:

- 262.8 cubic metres per hour
- 4,000 cubic metres per day
- 1,464,000 cubic metres per year

At an instantaneous rate (as defined in the abstraction licence) not exceeding 73 litres per second.

There is a Hands off Level of 3 metres below the Stannon Lake outfall invert level. The Hands off Level is the reservoir level at which abstraction must cease (and the abstraction must not cause the level to fall below that point). The licence stipulates requirements for measuring abstracted water and monitoring Stannon Lake level, Stannon Lake outflow and Stannon Stream flow. There are further conditions relating to fish screening and investigation into the potential hydraulic interlinkage between Stannon Stream and Stannon Lake.

SWW also have an abstraction licence for Crowdy Reservoir, within the same WFD surface water body (Stannon Stream). Crowdy Reservoir flows into the Crowdy Stream, which joins the Stannon Stream at Allansford. There is a compensation flow requirement from Crowdy Reservoir of 0.016 cumecs (1.38 Ml/d), stipulated by the Crowdy abstraction licence.

2.1 Other catchment investigations

2.1.2 Investigations to comply with the abstraction licence

A condition of the Stannon Lake abstraction licence is for SWW to undertake a programme of investigation into the nature and characteristics of any potential hydraulic interlinkage between the Stannon Stream and the adjacent Stannon Lake. The EA has detailed that the investigation should include, but not be limited to:

- Gathering data on the local groundwater table conditions in the intervening area;
- Undertaking groundwater level logging over time;
- Carrying out seepage inspections during dry weather and under differing lake drawdown conditions and;
- Installing piezometers sets as required.

A Consent to investigate a Groundwater Source (GIC) was recently issued by the EA SWW to:

"*..abstract an additional 2000m^3/day of water (to that already authorised under Abstraction Licence: SW/049/0281/001/R01) from Stannon Lake for testing purposes at National Grid Reference: SX 12381 80929, subject to the further details and conditions set out in Schedules 1 and 2 of this consent*."

The Schedule 2 conditions (of the Consent) outlined a period of increased abstraction of no more than six weeks, at which point the abstraction should revert back to the maximum of 4000 m^3/day (4 Ml/d). Therefore the test ran for a period of six weeks between the 9/08/2022 and 20/09/2022.

The report from this pumping test is available in Appendix 2 , and will be referred to as part of the hydrology assessment within this report.

2.1.3 WINEP schemes

Consideration has given to the impact of the proposed Stannon Lake permit application in conjunction with a number of SWW WINEP schemes that have either been submitted or are still in development. In conclusion, it is not considered that the impact of the proposed additional abstraction from Stannon Lake will detrimentally impact the future proposals and recommendations outlined in the below WINEP schemes.

Fish passage and leat restoration

SWW commissioned Fishtek Consulting Ltd, supported by Thomas Mackay Ltd (hydraulic modelling) and Code 7 Consulting (ecological appraisal) to undertake investigations into the potential fish benefits and leat restoration options to mitigate the impacts of two man-made weirs on the leat referred to as the 'Dragons Teeth' leat. The aim of the investigation was to improve access for migratory species Atlantic salmon (*Salmo salar*), sea trout (*Salmo trutta*)

and European eel (*Anguilla anguilla*) beyond the structures and into the upper catchment, and to investigate wetland improvement opportunities upstream of the lake.

To support the study, data were gathered within the limits of SWW land ownership, including; walkover survey, flow gauging, preliminary ecological appraisal and topographic survey.

The preferred option to be taken forward is construction of a bypass channel to connect the lower leat to the upper leat, therefore bypassing the Dragon's Teeth structures and allowing fish passage. Proposals have also been made to remove two small weir structures on the lower leat and restore wetland habitat in the east/ north east of the site. These measures, which are upstream or off-line of the Stannon Lake outfall and would not be potentially impacted by the proposed drought permit, have been progressed to outline design and will progress as implementation schemes in AMP8.

The proposed drought permit will have no impact to the flows in the leats and, therefore, there will no impact to this WINEP scheme.

Woodland creation

The WINEP scope for Stannon Lake woodland creation is "*creation of a 10ha wet woodland/ willow carr on large geotechnical tip structure to reduce water run-off and improve biodiversity*". The target area is within SWW owned land surrounding Stannon Lake. The required actions to achieve this involve identification and control of invasive vegetation species, survey of nationally important plant populations with ongoing survey to ensure populations remain stable or increase, and woodland creation (non-native to native oak woodland). Whilst this study is still ongoing the abstraction from Stannon Lake should not impact either of the likely outputs from this scheme.

Camel flow investigations

The Agency assessed that Environmental Flow Indicators (EFI) and Common Standards Monitoring Guidance (CSMG) Targets were not being met across the River Camel and have required SWW to assess whether their abstractions are causing this failure, via a Water Industry National Environment Programme (WINEP) project. Two scenarios were modelled – fully licensed and recent actual, with a further three De Lank reach scenarios run to test options for future abstraction. The Fully licensed and Recent actual scenarios found non-compliance with CSMG targets in the De Lank River and non-compliance with EFI targets along Stannon Stream.

The selected option was to offset abstraction at De Lank by increasing abstraction at Stannon Lake, reduce De Lank licence to a sustainable level and provide additional compensation flow from Stannon Lake or Crowdy Reservoir. Further investigations have been recommended to determine the suitability of this option, including identification of habitat improvements that could reduce the sensitivity of the water body to abstraction, further investigation into

sediment transfer/ deposition impacts and investigation of changes to water quality and INNS risk associated with increased abstraction.

Although these studies are ongoing the short term drought permit abstraction from Stannon Lake will not detrimentally impact the investigations and may indeed provide further beneficial data.

2.1.4 Previous drought permits / orders

A drought permit has not previously been applied for in respect of Stannon Lake.

2.2 Drought permit proposal

The proposed drought permit scenario for Stannon Lake is:

- Current abstraction rate from Stannon Lake to be increased from 4 Ml/d to 6 Ml/d;
- Current annual abstraction limit to be increased from 1,464,000 m^3/ yr to 1,766,000 m^3/ yr;
- Duration: application for full 5 months initially (November 2022 to 1st April 2023).

Note that all other conditions of the Stannon Lake abstraction licence will continue to be adhered to, including the cessation of abstraction at 3 metres below outfall invert level.

A map of the Stannon Stream (GB108049007040) water body is presented in Figure 2.1, showing the location of Stannon Lake (Stannon Quarry) and Crowdy Reservoir water body.

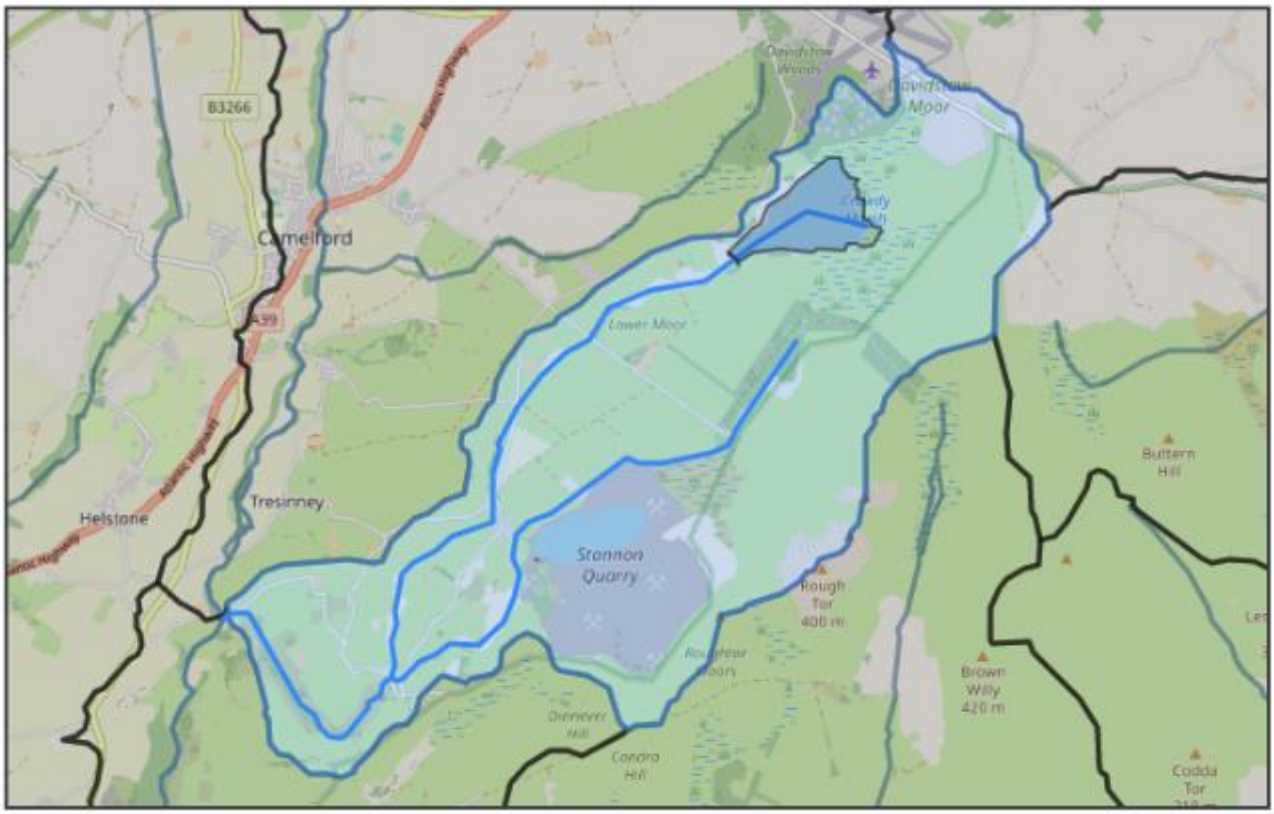


Figure 2.1 Map of the Stannon Stream (GB108049007040) water body

Source: https://environment.data.gov.uk/catchment-planning/WaterBody/GB108049007040 © Crown Copyright 2021

2.3 Need for the Drought permit

The National Drought Group, made up of senior decision makers from the Agency, government, water companies and key representative groups, joined by Water Minister Steve Double MP, met on Friday 12th August to discuss the response to the driest summer in fifty years and the continued action needed. The group discussed the current outlook and the associated risks and impacts and agreed to further collaborative work across sectors to balance water needs and conserve water.

At the meeting, the Agency confirmed that the drought trigger threshold had been met to move parts of the South West, parts of Southern and Central England, and the East of England into Drought.

The Agency confirmed Drought status in eight of its 14 areas, including that of Devon and Cornwall.

The triggers used to confirm the move to Drought status for Devon and Cornwall include the hydrological position (including rainfall, river flows, groundwater levels, reservoir levels, and the dryness of soils), as well as the impacts these conditions have on public water supply,

abstractors (including farmers) and the environment. This is determined by the Agency at a local level, rather than nationally.

Prolonged dry weather this year has led to exceptionally low river flows and reservoir levels falling across much of England. High temperatures continue to add additional pressures on the water environment and wildlife.

The Agency published its water situation national report[1] for July on 12th August 2022, providing a picture of the rainfall, soil moisture deficit, river flows, groundwater levels and reservoir levels over the last month. The report highlights that July was the driest July across England since 1935, with monthly rainfall totals for most river catchments classed as exceptionally low for the time of year.

There have been five consecutive months of below average rainfall across all geographic regions in England and above average temperatures. River flows, groundwater levels and reservoir stocks all decreased during July. Thirteen Agency monitored indicator rivers are at the lowest levels ever recorded and soil moisture deficit is comparable to that seen at the end of the 1976 drought.

1 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1097885/Water_Situation_Report_for_England_July_2022.pdf

3. Impact and risk pathways

Figure 3.1 summarises the process used to describe and categorise the impact of the drought permit on each receptor. The process is consistent with the latest Agency guidance on Environmental Assessment for Water Company Drought Planning (EA, 2019) and Environmental Assessment for Water Company Drought Planning Supplementary Guidance (July 2020) and draws on industry good practice for undertaking ecological impact assessments (CIEEM, 2018) and NRW technical guidance for Water Company Drought Plans (NRW, 2017).

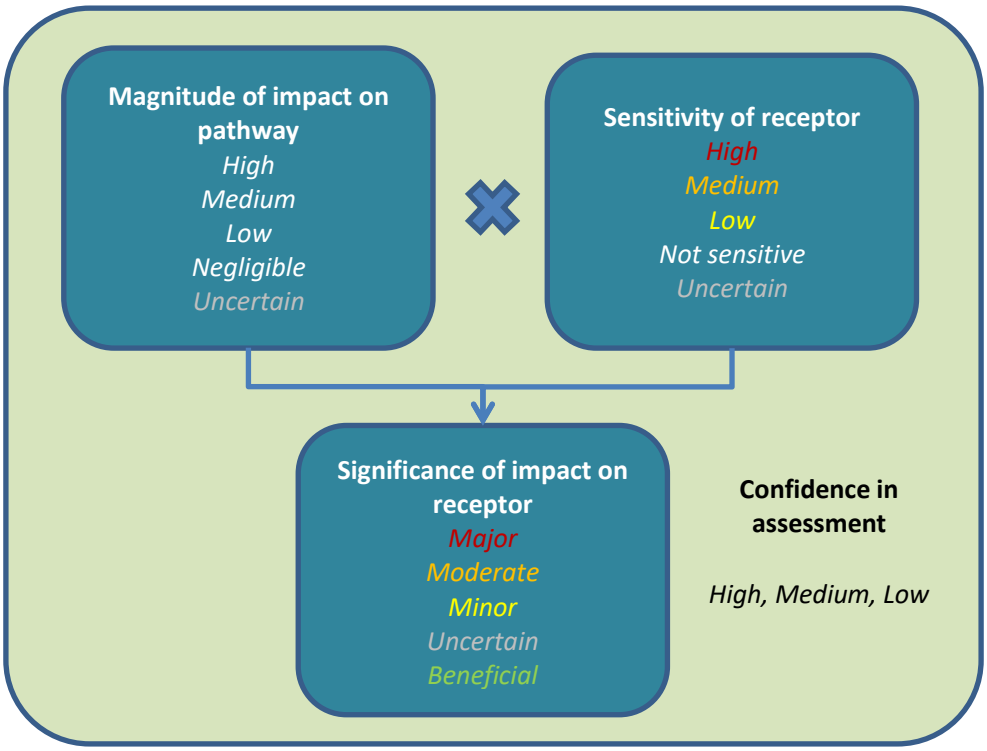


Figure 3.1 Flow chart outlining the environmental assessment process

The first step is to assess **magnitude of impact on each pathway**[2]. We have chosen to categorise these impacts on a five-point scale similar to that advocated by the Agency for assessing the sensitivity of receptors (EA, 2020): High, Medium, Low, Negligible, or Uncertain. These categories and associated definitions are provided in Table 3-1.

2 How the source (potential impact) can travel through the environment i.e. in this case the Stannon Stream and River Camel.

Table 3-1 Magnitude categories

Category	Definition
High	A large, extensive, long-term and/ or very frequent change.
Medium	A medium-sized, substantial, medium-term and/ or frequent change.
Low	A small, localised, short-term and/ or infrequent change.
Negligible	A change unlikely to be noticeable/ measurable.
Uncertain	Insufficient information is available to judge the magnitude of impact.

Following NRW (2017) and CIEEM (2018) guidance, the assessment of magnitude considers some or all of the following factors (as necessary to understand the resulting impact on receptors):

- severity – the degree of change, relative to the baseline (large, medium, small);
- extent – the area over which the impact occurs (extensive, substantial, localised);
- duration – the time for which the impact occurs (short-, medium-, long-term); and
- frequency – how often the impact may occur (very frequent, frequent, infrequent).

Where relevant, the specific location and timing of any impacts is also described. Impacts on pathways may translate into positive or negative impacts on receptors, so whilst the direction of change is important (e.g. increase or decrease), impacts on pathways are not described as being positive or negative.

Next, the **sensitivity of each receptor**[3] is categorised as High, Medium, Low, Not Sensitive, or Uncertain, in accordance with Agency guidance (EA, 2020). Definitions are provided in Table 3-2.

Table 3-2 Sensitivity categories

Category	Definition
High	Receptor is highly sensitive to changing environments due to inability to tolerate and recover from changes.
Medium	Receptor is sensitive to changing environments due to limited ability to tolerate and/or recover slowly from the environmental change.
Low	Receptor is relatively insensitive to changing environments due to ability to tolerate and/ or recover quickly from the environmental change.
Not sensitive	Receptor is not sensitive due to high tolerance to environmental change and/or ability to recover rapidly.
Uncertain	Insufficient information is available to judge the sensitivity of the receptor.

3 Who or what could be affected by the source/ action.

Sensitivity is a function of the receptor's capacity to accommodate change and its ability to recover if it is affected. A receptor may be more sensitive to changes in certain pathways than others. The assessment of sensitivity takes into account some or all of the following factors (adapted from NRW, 2017):

- adaptability – the degree to which a receptor can avoid or adapt to an impact;
- tolerance/ resistance – the ability of a receptor to accommodate change without a significant adverse impact; and
- recoverability/ resilience – the temporal scale over and extent to which a receptor will recover following an impact.

The magnitude of impact is combined with the sensitivity of receptor to assess the **significance of impact on each receptor**, as shown in Table 3-3 (adapted from NRW, 2017). In accordance with Agency guidance (EA, 2020), impacts on receptors are categorised as: Major, Moderate, Minor, Negligible[4], or Uncertain. Definitions, adapted from NRW (2017), are provided in Table 3-4.

Table 3-3 Determining the significance of impacts on receptors

Magnitude of impact on pathway	Sensitivity of receptor				
	High	Medium	Low	Not sensitive	Uncertain
High	Major	Major	Moderate	Minor	Uncertain
Medium	Major	Moderate	Minor	Negligible	Uncertain
Low	Moderate	Minor	Negligible	Negligible	Uncertain
Negligible	Minor	Negligible	Negligible	Negligible	Uncertain
Uncertain	Uncertain	Uncertain	Uncertain	Uncertain	Uncertain

[4] Whilst the Agency guidance does not provide a negligible category one has been used here to differentiate between minor and negligible impacts; the latter being considered unlikely to be noticeable.

Table 3-4 Significance categories

Category	Definition
Major	Very large or large change in environmental, ecological or socio-economic conditions, which, if lost, cannot be replaced or relocated. The impacts are generally, but not exclusively associated with features and sites of national to regional importance because they contribute to achieving national/ regional objectives. The impacts are likely to result in exceedance of statutory objectives and/or breaches of legislation (e.g. Likely Significant Effects or deterioration of WFD status).
Moderate	Intermediate change in environmental, ecological or socio-economic conditions. The impacts are likely to affect important considerations at a regional and local level. The impacts are unlikely to affect key decision-making processes (e.g. statutory objectives). Nevertheless, the cumulative effect of such impacts may lead to an increase of overall effect on a particular area or on particular features.
Minor	Small change in environmental, ecological or socio-economic conditions. These effects may be raised as local issues but are unlikely to be of importance in the decision-making process.
Negligible	Any change in in environmental, ecological or socio-economic conditions that is unlikely to be noticeable.
Uncertain	Insufficient information is available to judge the impact significance.

Impact significance provides a consistent means of expressing impacts which, in turn, informs the need for mitigation measures to offset the impacts. The determination of impact significance, both pre and post mitigation, also provides a transparent means for regulators to understand the impacts of a drought permit.

In practice, determining the significance of impact carries a degree of subjectivity and requires expert judgement. This may be because of limited evidence/ data on the sensitivity of the receptors and/ or the complexity of interactions that require assessment to determine the magnitude of change. For example, receptors may experience direct impacts as a result of changes in pathways, but also indirect impacts as a secondary response to changes in other receptors. If a receptor is subject to different impacts via different pathways, then the combined effect of the different pathways is integrated to assess the overall significance of impact.

Finally, in accordance with Agency guidance (EA, 2020), the **degree of confidence** in the assessment of impact significance is categorised as High, Medium or Low. Definitions are provided in Table 3-5. Key sources of uncertainty are identified and used to inform the design of the EMP.

Table 3-5 Confidence categories

Category	Definition
High	Judgments based on high-quality, robust information, and/ or the nature of the impact makes it possible to render a solid judgement.
Medium	Credibly sourced and plausible information, but not of sufficient quality or corroboration to warrant a higher level of confidence.
Low	The information available is too fragmented or poorly corroborated to make solid analytic inferences, or significant concerns or problems with information sources exist.

The assessment has also considered the legislative requirements of:

- Conservation of Habitats and Species Regulations 2017;
- fisheries legislation: Salmon and Freshwater Fisheries Act 1975 and the Eel (England and Wales) Regulations 2009;
- Water Environment (Water Framework Directive) Regulations 2017 including the objectives set out in river basin management plans;
- Section 40 of the Natural Environment and Rural Communities Act 2006 (NERC);
- legislation covering INNS;
- other non-statutory requirements (local wildlife sites etc.);
- protected areas designated under international agreements (incl. Ramsar & Natura 2000 sites);
- protected areas designated under national legislation (SSSIs), nationally protected species and habitats - Wildlife and Countryside Act 1981 and other locally important sites.

3.1 Qualitative definitions of Water Framework Directive status classes

Potential impacts were also considered in the context of the WFD, which provides qualitative descriptions for each biological quality element in each surface water category (i.e. river, lake, transitional water or coastal water) and for each ecological status class. The different classes represent different degrees of disturbance to the quality elements relevant to the category of water concerned.

The degree of disturbance to each quality element is assessed against a 'reference value or set of values' for that element. A reference value for a biological quality element is a value identified from the typical range when the quality element is subject to no or only very minor alteration as a result of human disturbance (i.e. when it is in a reference, or high status, condition). UKTAG (the UK Technical Advisory Group for the WFD) recommends that reference conditions should reflect "*a state in the present or in the past corresponding to very low pressure, without the effects of major industrialisation, urbanisation and intensification of agriculture, and with only very minor modification of physico-chemistry, hydromorphology and biology*" (UKTAG, 2008).

The qualitative definitions of ecological status are as follows:

- Good: none of the biological quality elements can be more than slightly altered from their reference conditions;
- Moderate: one or more of the biological elements may be moderately altered;
- Poor: the alterations to one or more biological quality elements are major; and
- Bad: there are severe alterations such that a large proportion of the reference biological community is absent.

For the purposes of WFD classification, whether or not a particular element meets these definitions is assessed against various numerical metrics. For the purposes of this study, these metrics have not been re-calculated, rather, potential changes to WFD status have been assessed on a qualitative basis.

4. Water Framework Directive status and designated sites

4.1 Water Framework Directive classification status

The main WFD surface water bodies considered in this assessment are:

- GB108049007040 (Stannon Stream Water Body);
- GB108049006980 (Camel (De Lank to Stannon) Water Body).

Summaries of current WFD classification status are shown in Table 4-1 (based on the 2016 and 2019 Cycle 2 classification data (CDE, 2021)). Note that both the river water bodies are 'not designated artificial or heavily modified', and therefore need to achieve Good Ecological Status (GES).

The WFD requires 'no deterioration' in the ecological status of water bodies. Extreme natural events, such as drought, are recognised within the WFD, with temporary deterioration allowances covered by Article 4.6. This allows for temporary deterioration as a 'result of circumstances of natural cause which are exceptional or could not reasonably have been foreseen, in particular extreme floods and prolonged droughts.' This applies to situations where it is necessary to make use of the water environment in ways that result in a temporary deterioration of status (e.g., supplying the public with drinking water during prolonged drought).

When assessing impacts on WFD elements, it is necessary to consider whether the impacts are temporary, whether the water body will recover quickly and without the need for restoration measures, and the extent to which the impact is a result of natural causes versus anthropogenic management practices.

Table 4-1 Summary of the Stannon Stream Water Body (GB108049007040) and Camel (De Lank to Stannon) Water Body (GB108049006980)

Classification	Water Body ID	Water Body Name	Ecological Status	Invertebrates	Fish	Macrophytes & Phytobenthos*	Ammonia	Dissolved Oxygen	pH	Phosphate	Temperature	Hydrological regime	Morphology
2016 (Cycle 2)	GB108049007040	Stannon Stream	G	H	-	H	H	H	H	H	H	Supports Good	Supports Good
2019 (Cycle 2)	GB108049007040	Stannon Stream	G	H	G	H	H	H	H	H	H	Supports Good	Supports Good
Objectives	GB108049007040	Stannon Stream	G (2015)	G (2015)	G (2027)	G (2027)	G (2015)	G (2015)	G (2015)	G (2027)	G (2015)	G (2015)	G (2015)
2016 (Cycle 2)	GB108049006980	Camel (De Lank to Stannon)	G	H	-	G	H	H	H	G	H	Supports Good	Supports Good
2019 (Cycle 2)	GB108049006980	Camel (De Lank to Stannon)	G	H	-	G	H	H	H	G	H	Supports Good	Supports Good
Objectives	GB108049006980	Camel (De Lank to Stannon)	G (2015)	G (2015)	G (2015)	G (2015)	H (2015)	H (2015)	G (2015)	G (2015)	G (2015)	G (2015)	G (2015)

NB H=High, G=Good, M=Moderate, P=Poor, MEP=Moderate Ecological Potential
*The macrophytes and phytobenthos elements are combined for Cycle 2

4.2 Designated sites

The main statutory designated sites within the Stannon Stream and Camel (De Lank to Stannon) water bodies, which have hydrological connectivity to Stannon Lake, have been identified as:

- Bodmin Moor Site of Special Scientific Interest (SSSI);
- River Camel Special Area of Conservation (SAC);
- River Camel Valley and Tributaries SSSI.

Further details on these designations are provided in Section 7.4, and the spatial relationships to Stannon Lake are shown below in Figure 4.1.

4.1 Other Abstractors

There are no known third party abstractors within the Stannon Stream water body.

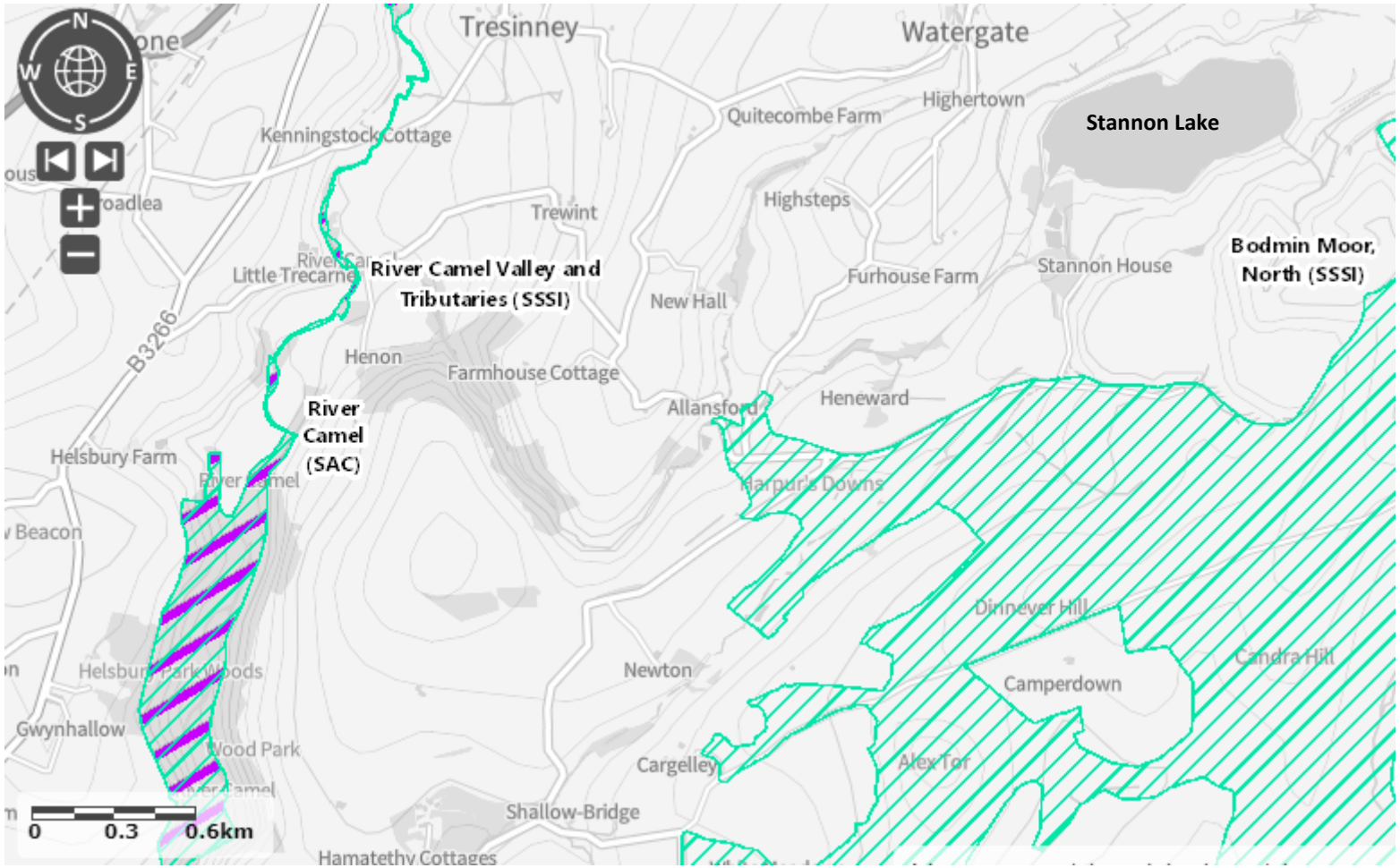


Figure 4.1 Designated sites in close to proximity to the proposed drought permit

Source: https://magic.defra.gov.uk/MagicMap.aspx (c) Crown Copyright and database rights 2022. Ordnance Survey 100022861

5. Assessment of physical effects and identification of geographical extent

5.1 Hydrology

5.1.1 Background

Stannon Lake is located in the upland headwaters of the River Camel (GB108049006980 Camel (De Lank to Stannon) Water Body) catchment and is fed by a combination of groundwater seepage and local surface water runoff. The natural surface water catchment directly draining to the lake has been heavily modified given the past use as a China Clay pit with much of the surface water runoff generated being intercepted by drainage channels – or leats - running around the lake perimeter. These leats were excavated historically during the operation of the pit to keep the working area dry, as such, the leats are elevated above the top water level (TWL) of the lake.

The natural surface water runoff and shallow groundwater catchment is generally open moorland and regenerating mining features i.e. reprofiled earthworks. The contributing surface water catchment is roughly 95ha. The catchment is underlain solid geology consisting of granite with several fault lines and fractures running throughout. The superficial geology consist of alluvial deposits of clays, gravels and sand, along with frequent patches of peat. The upper slopes often contain granite boulder fields. The quarried China Clay – Kaolin– is derived from the weathering process of granite and creates a fine low-permeability "liner" to the lake allowing slow groundwater seepage and recharge along with a potentially flashy catchment response to rainfall events.

Raw water abstracted from Stannon Lake is pumped into the De Lank > Lowermoor WTW raw water main. The TWL of the lake is controlled by an overflow structure to an elevation of 219.1m AOD (Above Ordnance Datum). The hands-off water level is set at 216.1m AOD, where by, if the water level in the lake reaches this, abstraction will cease. The open water surface area of the lake is 32ha. An unnamed actively eroding channel enters the lake on the southeast banks and has a contributing catchment of approximately 25ha.

The local hydrology and Stannon Stream (GB108049007040 Stannon Stream Water Body) catchment are shown in the following map. The lake overflows into Perimeter Leat that is joined by New North Leat from the north. Dragon's Teeth Leat also joins Perimeter Leat where it becomes Stannon Stream roughly 500m downstream of the lake outflow. Crowdy Stream joins Stannon Stream a further 1.8km downstream before joining River Camel roughly 4km downstream.

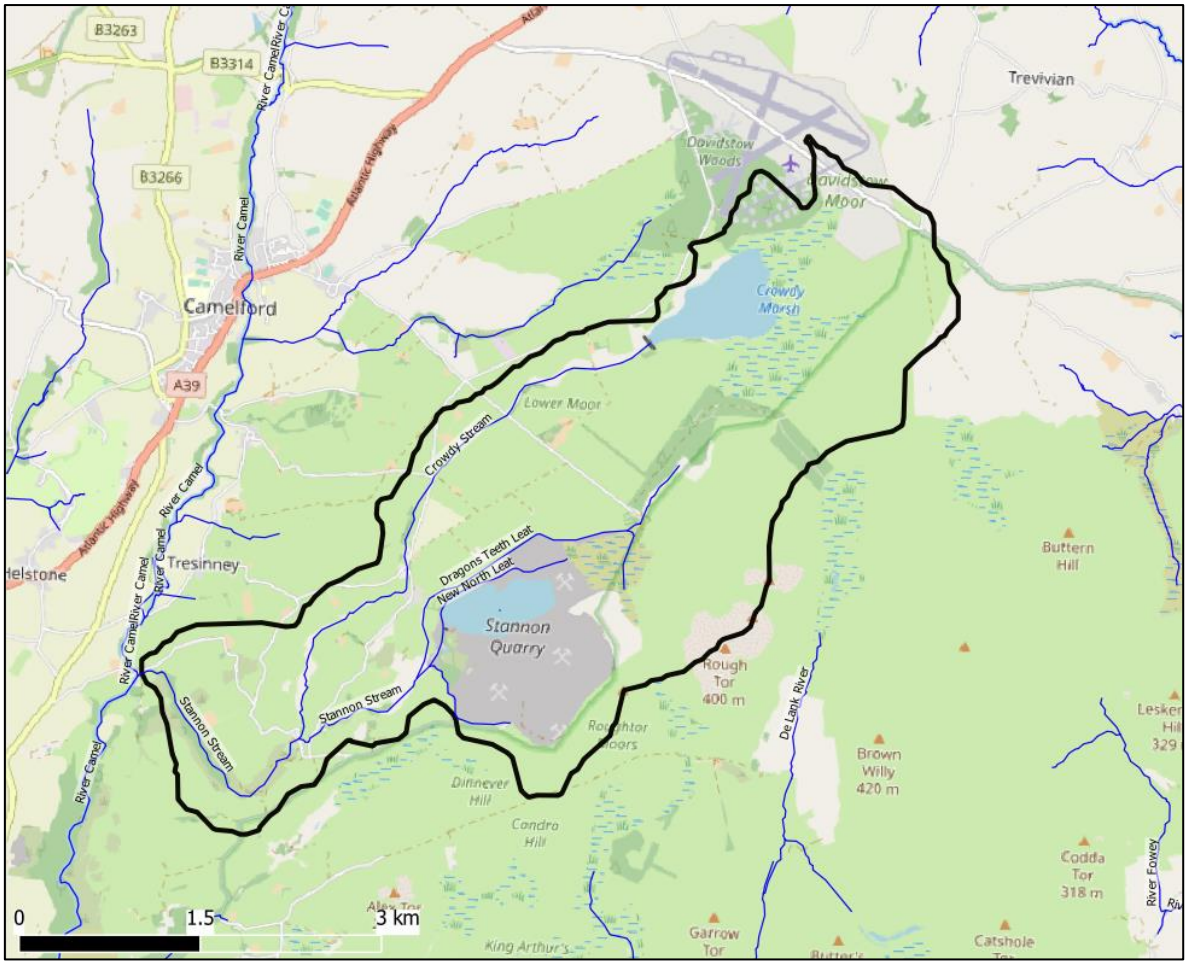


Figure 5.1 Stannon Stream water body catchment

5.1.2 Baseline

5.1.2.1 Potential Routes of Impact

Under the proposed drought permit, increased abstraction from Stannon Lake will reduce the volume of stored water within the lake thus decreasing lake water levels and potentially the spill frequency of the lake into downstream water bodies relative to the baseline condition.

Though a reduction in lake spill frequency under a drought permit would affect the whole flow regime, reductions will be most noticeable at low flows where these spills contribute a larger proportion of total flow than they would under higher rainfall periods, when flows in the leats would be relatively large. As can be seen in Figure 5.3 spills (overflow) can occur at any time of year from the lake but are more common during autumn - winter months when rainfall and direct groundwater recharge to the lake are highest.

Superficial geology within the catchment is generally impermeable and modified (clays, peat and past quarrying activities) providing both groundwater seepage and surface water runoff recharge. The nature of the superficial deposits and the drainage associated with the past

quarrying provide some degree of hydraulic disconnection between surface water and groundwater interactions.

Impacts on hydrogeology are expected to be minimal in the context of streamflow and are considered further within this assessment (Section 5.2) based on hydrological monitoring taking place within the catchment and pump tests.

5.1.2.2 Hydrological Zone of Influence

The zone of influence is intended to indicate how far downstream any changes in the flow released from Stannon Lake is a significant part of downstream flow. The guide thresholds for the zone of influence will vary and are site specific, depending on the extent of modifications and potential inflows from artificial sources.

Stantec undertook an assessment of the zone of influence during water balance modelling in March 2019 (*Report Ref: 64944.01 MA006: Stannon Lake: Updated assessment of effect on stream flow*) of the fully licenced abstraction rate of 4 Ml/d, along with the proposed 6 Ml/d pump test and abstraction rate. The model was calibrated against monitored hydrological data.

The modelling showed that:

- The effect of the Stannon Lake abstraction on outflows from the lake is fairly substantial relative to the estimated natural outflows, with outflows generally occurring 62% of the time under the recent actual scenario, compared to 100% of the time under the naturalised scenario (i.e., with no abstraction taking place);
- As a large portion of the summer abstraction is derived from lake storage, the actual reduction in summer flows downstream under the recent actual regime has been relatively small (1.73 Ml/d at Q70, 0.83 Ml/d at Q95) compared to typical summer abstraction rates of 2.5 to 4 Ml/d.
- Stannon Stream is a relatively small river and yet the effect of reductions in flow, for the increased abstraction to 6 Ml/d, is relatively small (3% at Q95 and 8% at Q50 for the 4 Ml/d scenario, and 9% at Q95 and 10% at Q50 for the 6 Ml/d scenario).

In addition to the above modelling, the zone of influence was further assessed based on contributing catchment areas at the fish easement (see Section 5.1.2.6 Fish Easement Hydraulics) and the low flows (Q95) estimations used in the design. Stannon Lake surface water catchment equates to less than 1% of the overall contributing catchment area at the easement and the reduction in flow would be insignificant to fish passage.

To conclude, the zone of influence would not extend to the River Camel waterbody and increased abstraction rates modelled would have a less than 10% impact on flow accretion downstream of the confluence with Crowdy Stream waterbody.

5.1.2.3 Hydrological Monitoring Review

Hydrological monitoring has been undertaken as a condition of the abstraction licence for Stannon Lake (SW/049/0281/001/R01 was issued to SWW on 26/01/2010 and was renewed on 20/11/2016 with an expiry date of 31/03/2028). Condition 9.6 stated that:

"The Licence Holder shall undertake a programme of investigation into the nature and characteristics of any potential hydraulic interlinkage between the Stannon Stream and the adjacent Stannon Lake. The programme content and the timing of provision of collected data and interpretive analysis of findings to the Agency, shall be agreed with the Agency to achieve a suitably targeted investigation.

The investigations should include, but not be limited to;

- *gathering data on the local groundwater table conditions in the intervening area,*
- *undertaking groundwater level logging over time,*
- *carrying out seepage inspections during dry weather and under differing lake drawdown conditions, and,*
- *installing piezometers sets as required".*

Data has been collected from instream loggers on local watercourses, an installed flume on Stannon Stream and three pairs of piezometers to monitor both shallow and deeper groundwater levels at strategic locations around the lake. The piezometers were installed with the knowledge that Stannon Lake would not be lowered greater than the 3m hands off water level. The Stannon Lake GIC Report is contained in Appendix 2 and the Options Appraisal for Meeting CSMG Targets Measure Specification report is contained in Appendix 3 . Monitoring data was reviewed and calibrated against long term rainfall data at De Lank rain gauge (Station Number: 49129, NGR: SX1326276556).

The monitored flows within the leats for 2022, Figure 5.2, indicate that the flows within leats have a flashy response to rainfall events i.e. the flow rate increases quickly after rainfall. This is expected given that the leats were historically excavated to intercept surface water runoff from the modified catchment and divert water around and away from the quarry. It is also expected based on the relatively impermeable superficial geology that consists of deposits of clays and peat within the upper catchment. Figure 5.7 spans the period of the pumped drawdown test which is covered in more detail later in this report. It is shown that during the pumping test with an increased abstraction rate up to 6 Ml/d, the response of flows in the leats to rainfall events was not significantly impacted. This indicates that the flow in the leats are not heavily dependent on the water resources contained in the lake or spill events.

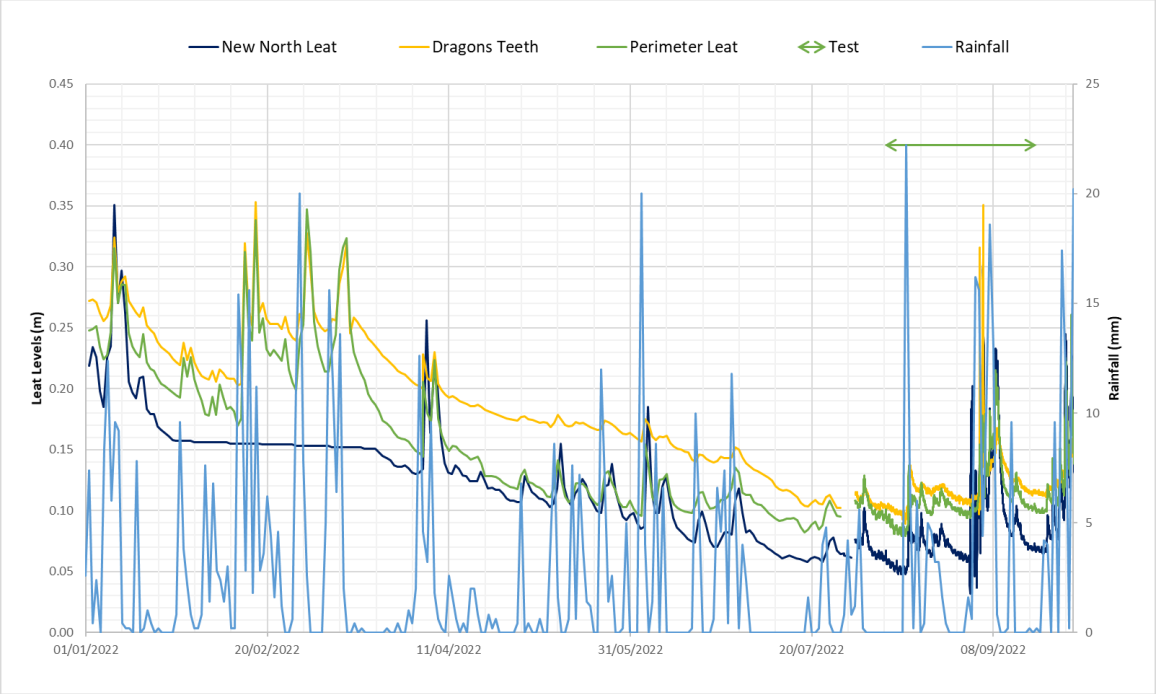


Figure 5.2 Stannon Stream water leat levels in 2022

Monitored data of Stannon Lake level recorded between April 2018 and September 2022 is presented in Figure 5.3 along with the actual abstraction rates, TWL and Hands Off Water Level. As is expected from the local geology and the catchment's hydrological response to rainfall events, the lake water level increases through periods of frequent rainfall events which typically coincide with reduced abstractions i.e. wetter months. The water level does not reduce by more than 0.5m in any given period including the drawdown test.

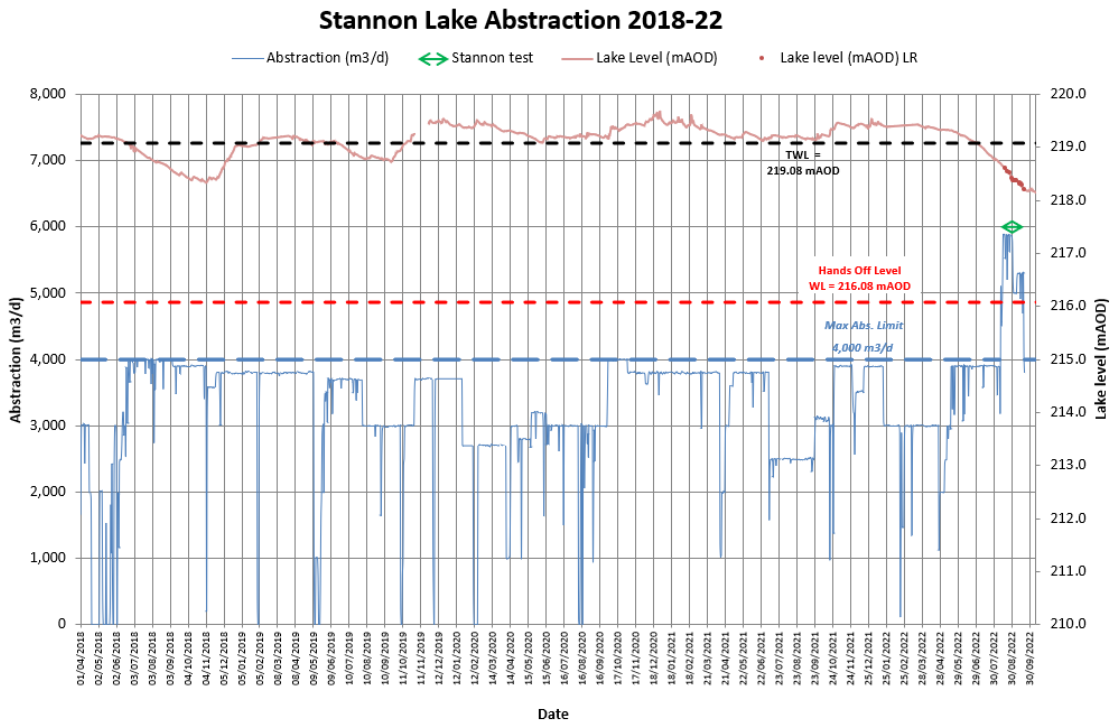


Figure 5.3 Stannon Lake levels 2018 to 2022

Attempts have been made to identify and quantify groundwater seepage in the past by visual inspection around the lake perimeter, however, these were to be reviewed when the lake TWL reduced by 3m to the hands-off water level – this significant reduction in level has not occurred to date. To make a meaningful estimation of lake recharge a comparison between the rate of abstraction minus the rate of drawdown during a period of zero or low rainfall was undertaken. This occurred within the operation range of the licenced 4 Ml/d abstraction rate during the only period of significant lake drawdown (at the time).

The period from 2/7/11 to 21/9/11 (83 days) when the rainfall was limited, a total of 310 Ml were abstracted compared to a fall in volume in the lake equivalent to 95 Ml. Thus the total recharge at this time was of the order of 2.65 Ml/d. Examining specific periods of zero rainfall between these two dates and the lake fall relative to abstraction which took place suggests that between 1.5 Ml/d and 2 Ml/d of recharge typically took place which is assumed to be groundwater recharge.

Taking the lower, more conservative figure of 1.5 Ml/d implies that at a maximum abstraction rate of 4 Ml/d this would generate an impact on lake storage equivalent to 2.5 Ml/d. Thus, from a full storage position (840 Ml available storage) it would require a minimum of 336 days abstraction to drawdown the lake by the maximum 3m. Under this scenario, at the proposed drought permit rate of 6 Ml/d, the impact on lake storage would be equivalent to 4.5 M/d and it would require a minimum of 186 days abstraction to drawdown the lake by the maximum 3m. To re-iterate this assumes a period of no rainfall.

5.1.2.4 Pump Test

During the summer of 2022, between 9th August and 20th September, SWW commissioned a pump test to assess the effects of increasing the maximum abstraction rate to 6 Ml/d on the lake drawdown, flows in the adjacent watercourses and local groundwater levels as required by the licence (ref. SW/049/0281/001/R01).

The Agency requested consideration that a trigger level be included on flow rates in the New North Leat as a condition of the consent to undertake the drawdown test to safeguard downstream ecology. The trigger level was set as 0.005 m^3/s in the New North Leat based on analysis of the recent available flow record from the leat with rainfall influenced peak flows removed to show the base flow recession. The analysis indicates that in an extreme scenario with no further rainfall over three months, base flows in the leat would decline to approximately 0.005 m^3/s.

It was observed that Stannon Lake water level went below the TWL (219.08 mAOD) 33 days prior to test commencing reflecting the lack of rainfall in the preceding months and the ongoing drought conditions. Due to operation constraints during the pumping test, the abstraction rate fluctuated and averaged at 5.2 Ml/d over the test duration.

Monitored lake levels during the pump test are provided in Figure 5.4 along with the water levels recorded in the New North Leat along with both abstraction and rainfall data. The graph shows that as abstraction increases, lake water level drops accordingly whilst the water level in leats remains relatively reflective of the rainfall events. As both the leat and lake water levels are represented in mAOD, it can be assumed that as the New Northern Leat is elevated more than a meter above the TWL, that there is limited hydraulic connectivity between the two.

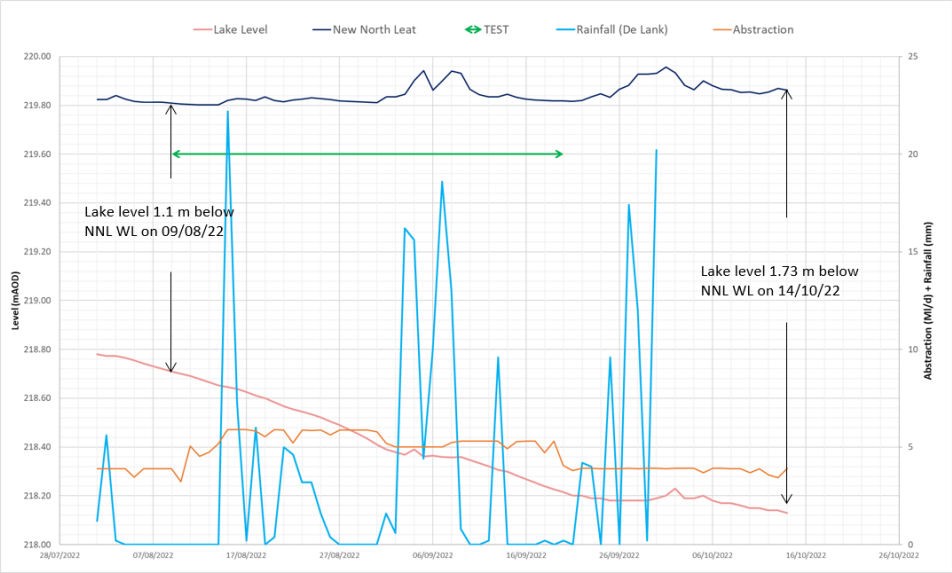


Figure 5.4 Stannon Lake levels August 2022 to October 2022

The monitored flow rates in each of the local watercourses is provided in Figure 5.5 along with the De Lank rain gauge date through the pumping test and also show little response of the flows to the increased abstraction.

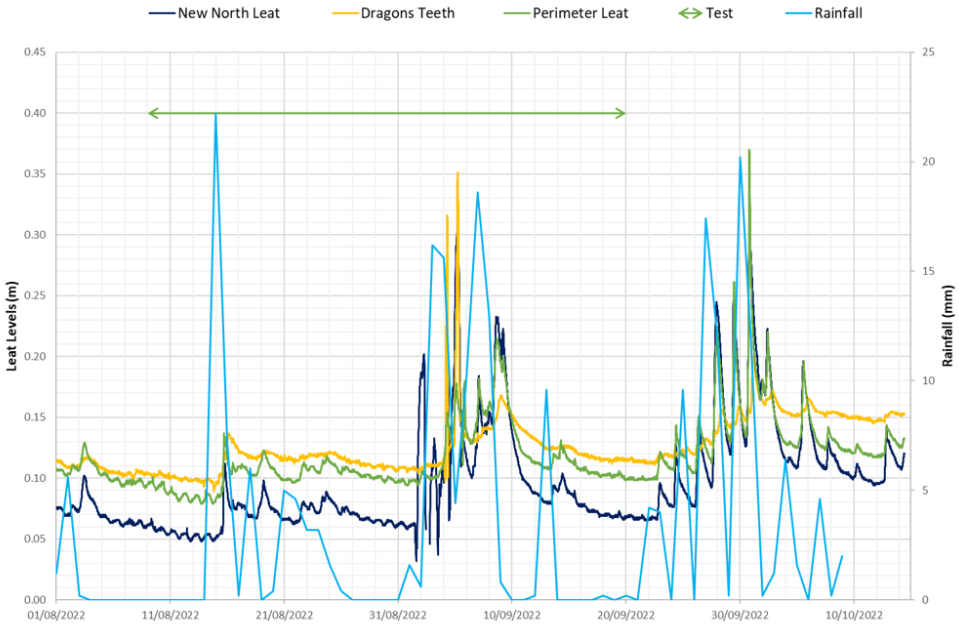


Figure 5.5 Stannon Lake leats levels August 2022 to October 2022

Recharge by rainfall and groundwater seepage have been further assessed, see Figure 5.6, based on the De Lank rain gauge data, local runoff characteristics of soil types within the surface water catchment area and Penman-Monteith estimated rates of evapotranspiration. The graphed recharge includes the previously reported 1.2 Ml/d groundwater seepage rate estimated in studies by Stantec along with the actual abstraction rates. The complete dataset was only available for this assessment for 2020 – 2022, however, it captures the pumped drawdown test and the lake water level response.

As was noted earlier, the lake's water level had dropped below the TWL 33 days prior to the commencement of the test as a response to the reduced rainfall input in the preceding months. Upon completion of the test abstraction reverted back to the licensed 4 Ml/d and there was a levelling off of the water level and slight increase in water depth following minor rainfall events and seepage. This suggests that rainfall and shallow groundwater seepage form a large portion of the lake's recharge as anticipated from previous studies. As the increased abstraction due to the proposed drought permit will be from November to 1st April 2023, the lake level is predicted to be above the TWL by 1st April 2023, based on the below graph data (e.g. rainfall and lake catchment recharge characteristics). The increased abstraction aligns with periods of more frequent rainfall and, therefore, increased recharge. However, review of the data in Figure 5.6 showed that the average monthly recharge is around 76 Ml/month.

The increased abstraction rate to 6 Ml/d would increase monthly abstraction by approximately 60 Ml. In terms of the overall volume of the upper 3m of the lake, this would equate to an additional drawdown of roughly 0.2m than is occurring under the current licence.

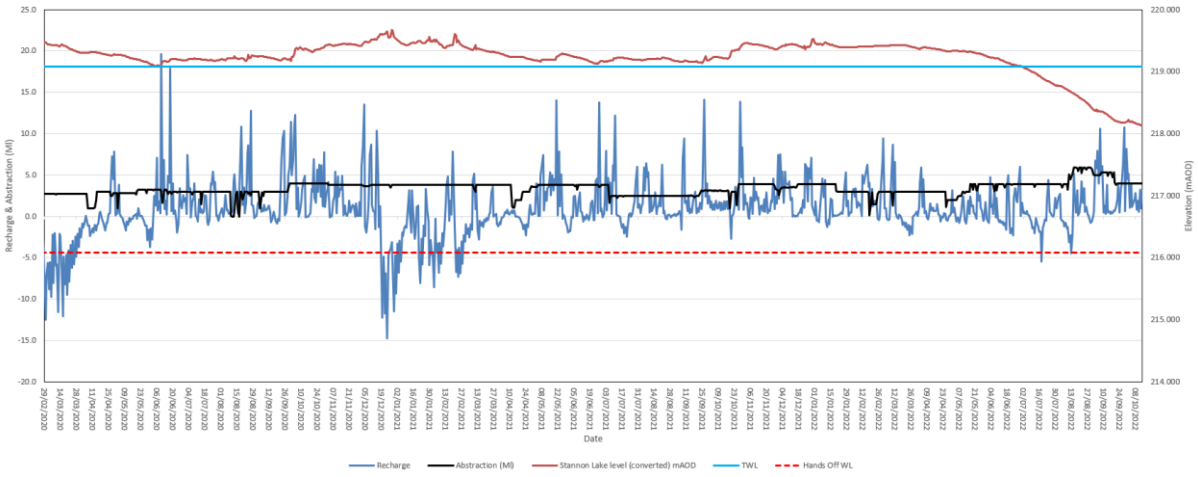


Figure 5.6 Recharge estimation for Stannon Lake 2020 to 2022

5.1.2.5 Compensation Flow Release & Storage

The abstraction licence states no requirement to release compensatory flow from Stannon Lake. The total available storage was estimated in the 2017 Stannon Lake Monitoring Report to be 8020 Ml. It has been derived by SWW that the upper 3m of storage in the lake i.e. the maximum allowable drawdown, has 840 Ml of available water for abstraction. This would provide 148 and 99 days of pumping at 4 Ml/d and 6 Ml/d respectively - not accounting for any recharge from rainfall and groundwater seepage or evaporation.

5.1.2.6 Fish Easement Hydraulics

During June 2018, the West Country Rivers Trust commissioned a hydrological and hydraulic assessment of fish passage easement design for a weir on Stannon Stream watercourse at Allensford, Cornwall (SX 11035 79982), roughly 1.8km downstream of Stannon Lake outfall. The proposed adjustments to the weir included the lowering of the mid-section of the weir and additional notch cut from the existing weir that is located just downstream of the confluence between the New North Leat & Dragon's Teeth Leat watercourses.

The hydraulic design incorporated the minimum Q95 low flows of 0.068m³/s and Qmean of 0.462 m³/s.

5.1.3 Impact Assessment

The aim of the Stannon Lake drought permit is to provide additional water resources to ensure availability of public water supply.

5.1.3.1 *Stannon Stream (GB108049007040) water body*

The drought permit generally has little impact on Stannon Lake as all conditions of the current abstraction licence will remain in place i.e. the maximum 3m drawdown to a hands-off level; however, the consequence is reduced spill frequency and flow in Stannon Stream.

The magnitude of impact of increased Stannon Lake abstraction on the Stannon Stream water body is considered to be **Low**. Stannon Stream has a **Medium** sensitivity to the estimated change and therefore the impact is considered as **Minor**. Given that the full results of pump test do not show full lake recharge curve, the level of uncertainty is also **Medium**.

5.1.3.2 *Camel (De Lank to Stannon) (GB108049006980) water body*

The hydrological zone of influence has been estimated to not extend to the confluence with River Camel under the proposed drought permit i.e. the rate of abstraction increased to 6 Ml/d. The magnitude of impact of increased Stannon Lake abstraction on the River Camel is considered to be **Negligible** and the River Camel has a **Medium** sensitivity to the estimated change. The proposed drought permit will therefore have a **negligible** impact on the hydrological regime of the river as the flows will be maintained above the natural Q95 during periods of drought by the remaining Stannon Stream catchment, which includes flows from the leats and the licensed compensation release from Crowdy Lake. The level of confidence in this assessment is **High**.

5.2 Habitat and geomorphology

5.2.2 *Background*

This part of the assessment reviews the effects of the proposed drought permit on the habitat and geomorphology of the Stannon Stream.

As outlined in Section 5.1 (Hydrology), impacts of the proposed drought permit on downstream flow are generally limited. The proposed conditions of the permit would result in a reduction in flow in the downstream Stannon Stream of 3% during Q95 events and 8% during Q50 events in the 4Ml/d scenario, and, 9% and 10% reductions respectively in the 6Ml/d scenario. These impacts have an effect as far downstream as the Crowdy Stream but do not impact the downstream River Camel.

This section will review the consequence of the hydrological change as it pertains to the geomorphology and the physical habitat availability for aquatic biota of the Stannon Stream. Impacts as a consequence of water quality changes are assessed separately in Section 5.3.4.

As a high level summary of potential effects, consideration of changes to habitat availability through changes in flow depth, wetted width and wetted perimeter, and changes to habitat type as a result of altered hydraulic parameters such as flow velocity will be assessed.

As a high level summary, the potential effects caused by hydrological changes on rates of sediment erosion, transport and deposition caused by changes to the competence of the flow to entrain and transport sediment are assessed. Alterations of these processes due to hydrological changes can lead to changes in habitat type and availability, through changes in flow depth and width which can drive changes in channel geometry, morphology and bed substrate composition.

5.2.2 Baseline

No historic baseline data were identified for characterisation of the geomorphology and habitat of the Stannon Stream downstream of Stannon Lake.

A preliminary ecological appraisal report for Allensford Weir fish pass was undertaken by Westcountry Rivers Trust. The report highlights that the Stannon Stream was characterised as having a meandering planform with a cross sectional width of 1.5m to 2m. The channel is described as having gravel bed substrate suitable for salmonid spawning, a variety of in-channel habitats including glide sequences and extensive macrophyte vegetation. The river-banks are described as being tall but typically stable with one length showing signs of erosion and slumping, with evidence of poaching present. Whilst this description only outlines the characteristics of less than 200m of the Stannon Stream at the confluence with Crowdy Stream it is assumed that these characteristics are typical for the Stannon Stream downstream of the Stannon Lake.

5.2.2 Impact assessment

Reduction of lake levels caused by the increase in abstraction outlined in the proposed drought permit will result in a reduced number of spills from the Stannon Lake to the Stannon Stream. When spills do occur, these will typically occur later in the year (during the higher rainfall periods of the autumn and winter months) as levels in the lake would require a greater time of rainfall to recharge to levels at which spills occur. It is also likely that the volume of spills would also be reduced and would be expected to last a shorter duration during the drought permit operation. As outlined, this would result in as little as a 9% reduction during Q95 flow events up to a maximum 10% reduction during Q50 events. The majority of flow within the Stannon Stream is supplied by perimeter drains which circumvent the lake. As these flow paths would still respond to seasonal variations in flow and maintain connectivity with the Stannon Stream downstream of the Stannon Lake the impacts from reduction in flows are heavily moderated.

Possible effects of the reduction in flow from Stannon Lake include:

- A reduction in the rate and incidence of erosion due to reduced flow velocity and discharge during implementation of the proposed drought permit. This would result in more stable channel banks which would be more likely to be colonised with vegetation, protecting the banks further from fluvial erosion processes as well as from

mechanical (poaching) and sub-aerial erosion processes. This could support marginal habitats, providing refuge, shading and a supply of organic matter to the channel.

- A reduction in the sediment transport competence of the Stannon Stream. This would have two effects, 1) the grain size of sediment mobilised by flow in a given event would be reduced after implementation of the drought permit; and, 2) there would be a slight increase in grain size of sediment being deposited during implementation of the drought permit. Should deposition of fine sediments supplied by perimeter drains that circumvent the Stannon Lake increase due to reduction in competence and occur at a significant enough rate, this could have detrimental effects on aquatic habitat as fine sediment could begin to occupy interstitial spaces between coarser sediment grains in the river-bed. This would reduce the flow of water through the spaces and the availability of oxygen. However, much of this fine sediment would be anticipated to be washed out during higher flows resulting in short term impacts during drier periods of the year.
- A reduction in the duration that a given sediment size would be mobile, as spills would occur later in the year and would become less frequent earlier in the year. This would result in a less active fluvial environment.
- A reduction in the sediment yield of the Stannon Stream as an input to the Crowdy Stream and the River Camel as less sediment would be transported by the Stannon Stream, potentially resulting in further downstream impacts upon substrate.
- Reduced water levels and increased exposure of shallow gravels and depositional features (if present) altering local flow dynamics. These could also be colonised by terrestrial vegetation if exposed for long periods of time.

The impacts identified above that could occur following implementation of the proposed drought permit are likely to be of **Medium** magnitude between the Stannon Lake and the Crowdy Stream, resulting in a **Moderate** effect significance. Between the Crowdy Stream and the River Camel the supply of flow and sediment by the Crowdy Stream, which contributes a comparable flow to the Stannon Stream downstream of the confluence would reduce the magnitude of impact to **Low** resulting in a **Minor** effect significance. At the River Camel the magnitude of effect and significance would be **Negligible**.

As such, it is recommended that due to the risk of habitat and/ or geomorphological changes in the reach between the Stannon Lake and the Crowdy Stream, that walkovers are completed for the baseline/ pre-drought permit period and the during the drought permit period; see Table 9-1.

5.3 Water quality

This section presents the water quality baseline of the study area for the proposed drought permit.

5.3.2 Background

5.3.2.1 Potential routes of impact

The proposed drought permit will increase the quantity of water abstracted from Stannon Lake. This could affect water quality in Stannon Stream water body and the River Camel water bodies downstream via reduced dilution of point source and diffuse inputs.

There is one sewage treatment works (STW) that discharges into the River Camel within the water bodies of interest. This is located downstream and it is the St Breward STW. Reduced dilution of the point source discharge could result in an increase in biochemical oxygen demand (BOD), suspended solids, total ammonia and orthophosphate concentrations; it could also result in an increase in concentrations of WFD chemicals (specific pollutants, priority hazardous substances and priority substances), or could affect physico-chemical parameters such as dissolved oxygen (DO), temperature and pH.

5.3.2.2 Sources of information and methods

The WFD water bodies of interest for this assessment are as follows (from upstream to downstream): the Upper River Camel (GB108049007060), Stannon Stream (GB 108049007040), Camel (De Lank to Stannon) (GB108049006980) and the Lower River Camel (GB108049000190).

The water quality baseline presented, in Table 5-1 in order from upstream to downstream and in Figure 5.7, is based on monthly monitoring data collected by the Agency (2017-2022). There was a gap in the monitoring data period from 2020 to 2021 due to implications of the COVID-19 pandemic.

A total of seven Agency locations within four water bodies were reviewed for water quality characterisation.

Baseline characterisation included monitoring locations upstream and downstream of Stannon Stream water body.

Table 5-1 Water quality monitoring data

Water body	EA Location Name/ID	NGR	Frequency	Duration presented here	Max no. parameters	Comments
Upper River Camel GB108049 007060	RIVER CAMEL AT SLAUGHTERBRIDGE, SW-82528159	SX 10930 85550	Monthly from 2019	2017-2022	8	No BOD data available
	RIVER CAMEL AT CAMELFORD BRIDGE, SW-82528154	SX 10670 83830	Monthly	2017-2022	8	No BOD data available

Stannon Stream GB108049 007040	RIVER CAMEL AT TRECARNE BRIDGE, SW-82528110	SX 09723 80545	Monthly	2017-2022	7	No BOD or suspended solids data available
	STANNON STREAM AT TRECARNE, SW-82522304	SX 09750 80530	Monthly from 2019	2017-2022	8	No BOD data available
Camel (De Lank to Stannon) GB108049 006980	ST BREWARD STW EFFLUENT, SW-82528090	SX 09100 76200	Only 4 data points collected	2017-2022	9	
	RIVER CAMEL AT WENFORD, SW-82528082	SX 08500 75180	Monthly	2017-2022	8	No BOD data available
Lower River Camel GB108049 000190	RIVER CAMEL AT HELLANDBRIDGE, SW-82528060	SX 06550 71500	Monthly	2017-2022	8	No BOD data available

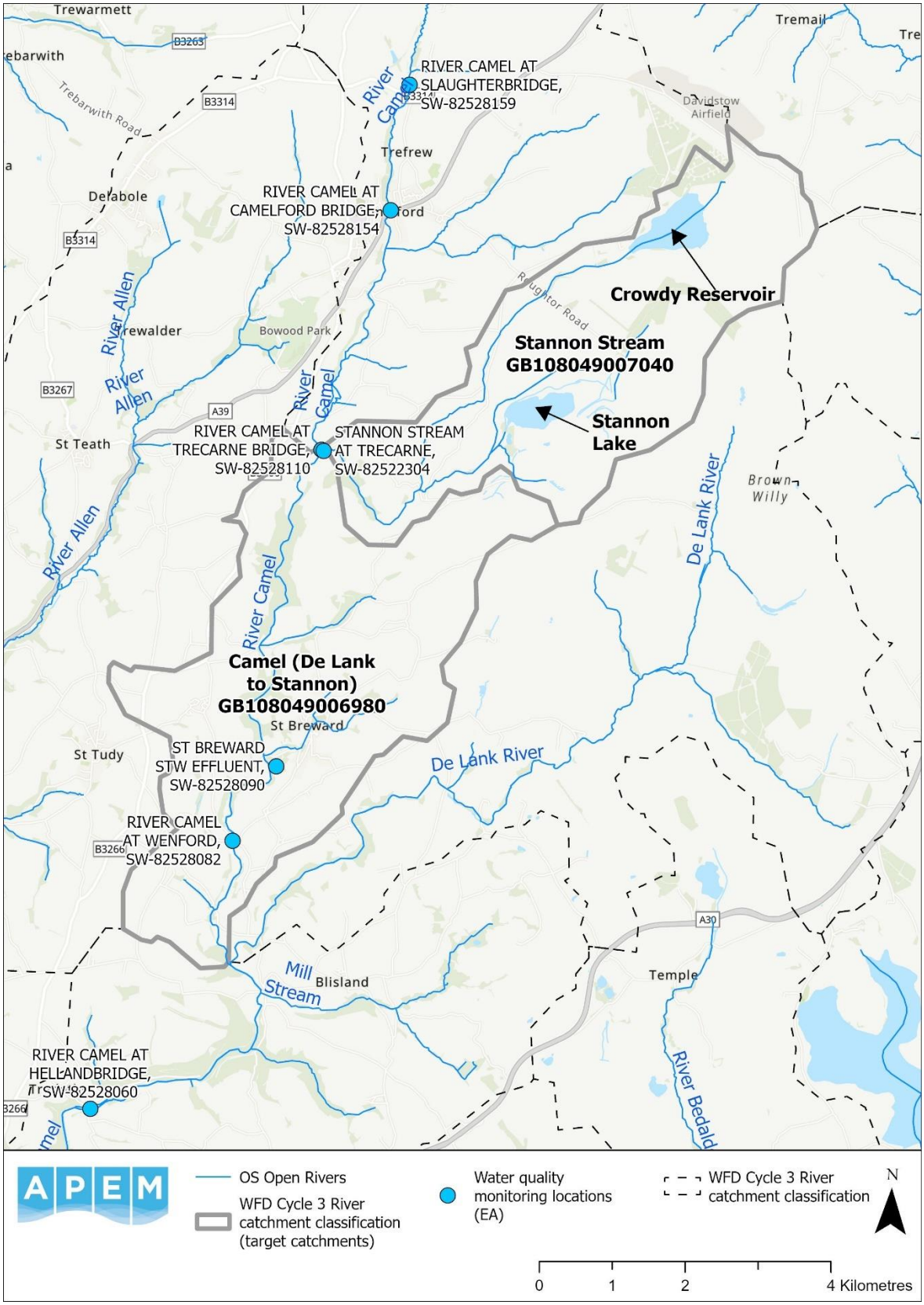


Figure 5.7 Environment Agency Water quality monitoring locations

5.3.2.3 Assessment period

The assessment period was defined by the availability of Agency water quality data, which are readily available from 01/01/2000 onwards. Water quality data were obtained for the years 2017 to 2022 for baseline characterisation as data before 2017 would not be relevant to characterise the most recent water quality that would be affected by the proposed drought permit. This provides a sufficient background on the water quality over the last five-year period.

5.3.2.4 Stannon Stream data

Water quality data for WFD physico-chemical elements i.e., dissolved oxygen (DO), biochemical oxygen demand (BOD), total ammonia (as N), orthophosphate (as P), water temperature and pH were analysed in the context of WFD classification thresholds.

The water quality data were compared against the relevant WFD United Kingdom Technical Advisory Group (UKTAG) EQS for each parameter.

The EQS for DO, BOD and total ammonia are based on river typology. In accordance with Annex II of the WFD, UK rivers (and other water bodies) have been grouped based on natural characteristics that might influence ecological communities (UKTAG, 2008). The method by which waters of similar ecological sensitivity are grouped into types for the WFD is referred to as typology and UK rivers have been grouped based on a typology of altitude and alkalinity (see Table 5-2 and Table 5-3).

Table 5-2 Basic typology for rivers

Site altitude	Alkalinity (as mg/l $CaCO_3$)				
	Less than 10	10 to 50	50 to 100	100 to 200	Over 200
Under 80m	Type 1	Type 2	Type 3	Type 5	Type 7
Over 80m			Type 4	Type 6	

Table 5-3 Final typology for oxygen (inc. BOD) and total ammonia for rivers

Description	Typology
Upland and low alkalinity (UpLA)	Types 1, 2, 4 and 6
Lowland and high alkalinity (LowHA)	Types 3, 5 and 7

The typology of the water bodies assessed for the baseline for this study is Type 1 and 2: upland and low alkalinity (UpLA).

Orthophosphate standards are calculated for each specific water quality monitoring location based on altitude and alkalinity at that location, according to the approach set out in the UKTAG River Assessment Method for Phosphorus (UKTAG, 2014). Alkalinity data were used from the period 2017-2022, for the purpose of calculating orthophosphate standards along with altitude (elevation) data obtained from Grid Reference Finder. The most stringent standards of the water body sites were used for this assessment.

There are no WFD standards for suspended solids or nitrate concentrations so the (now repealed) Freshwater Fish Directive (FFD) mandatory limit for suspended solids and the Nitrates Directive threshold for nitrates were used for assessment purposes.

Where water quality data are presented against long term thresholds (e.g., status classification boundaries) these thresholds are provided for indicative comparison only, given that classification status is generally determined by relevant statistical analyses undertaken by the EA.

5.3.3 River Camel/ Stannon Stream baseline

Water quality data collected by the Agency provides additional detail over and above that offered in the WFD status classification set out in Section 4. This allows an assessment showing any intermittent water quality issues which could be significant as a result of the flow change.

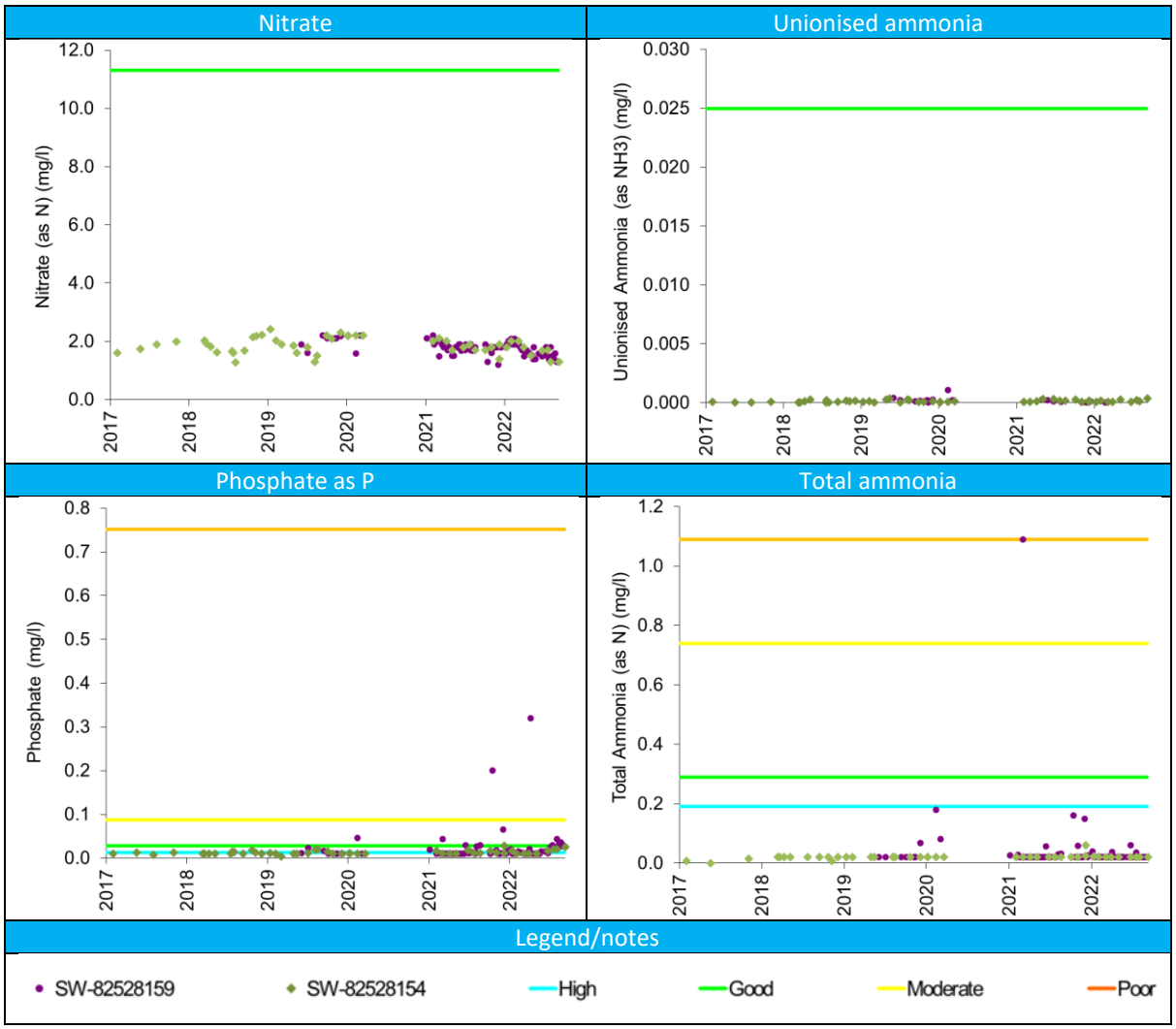
Physico-chemical and nutrient parameters for the two locations in the Upper River Camel water body are presented in Table 5-4 and Table 5-5. The main observations are as follows.

Table 5-4 shows water temperature, DO and pH were consistently indicative of High status at all sites. SW-82528159 was not measured for these parameters until 2019. Both sites showed clear seasonal variation in temperature. Suspended solids concentrations were mostly below the (now repealed) FFD limit at both sites. However, there were occasional fluctuations above the limit for suspended solids at both sites after 2021 reaching as high as 190 mg/l in 2022. Suspended solids concentrations were not measured at SW-82528159 until 2019.

Recent nitrate concentrations as shown in Table 5-5 were below the NVZ limit at both sites. Additionally, a seasonal trend in the data can be observed in all years (apart from 2020-2021 due to COVID-19) where the highest nitrate concentrations were recorded in the winter months. For unionised ammonia (UIA), concentrations were consistently below the (now repealed) FFD limit at both sites. Concentrations at both sites were very low (below 0.005 mg/l), with many concentrations reported at the limit of detection. Phosphate concentrations were mainly indicative of at least Good status with some concentrations at SW-82528159 indicative of Moderate and Poor status between 2021 and 2022. In terms of total ammonia, concentrations were consistently indicative of High status apart from one reading at SW-82528159 indicative of Poor status.

Table 5-4 Physico-chemical parameters recorded at Agency monitoring locations within the Upper River Camel (GB108049007060) water body

Table 5-5 Nutrient parameters recorded at Agency monitoring locations within Upper River Camel (GB108049007060) water body



Physico-chemical and nutrient parameters for the two locations in the Stannon Stream water body are presented in Table 5-6 and Table 5-7. The main observations are as follows.

Table 5-6 shows water temperature, DO and pH were consistently indicative of High status at all sites. Both sites showed clear seasonal variation in temperature. Suspended solids concentrations were consistently below the (now repealed) FFD limit at SW-82528110 apart from one reading above the limit at 160 mg/l. There was no suspended solids data present for SW-82522304.

Recent nitrate concentrations as shown in Table 5-7 were below the NVZ limit at both sites. For unionised ammonia (UIA), concentrations were consistently below the (now repealed) FFD limit at both sites. Concentrations at both sites were very low (below 0.005 mg/l), with

many concentrations reported at the limit of detection. Phosphate concentrations were mainly indicative of at least Good status with occasional concentrations at both sites indicative of Moderate status. In terms of total ammonia, concentrations were consistently indicative of High status apart from one reading at SW-82528110 indicative of Moderate status.

Table 5-6 Physico-chemical parameters recorded at EA monitoring locations within the Stannon Stream (GB108049007040) water body

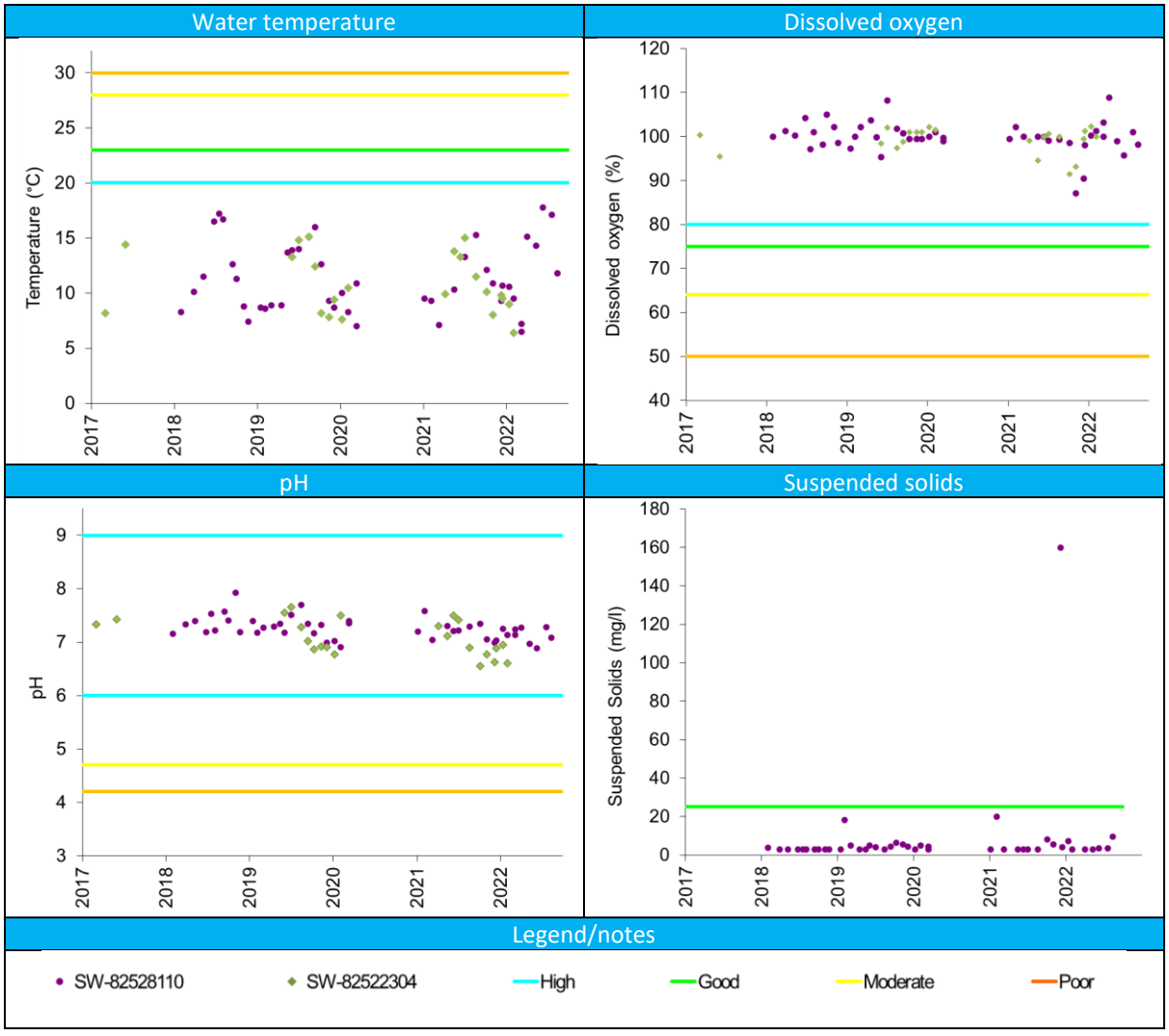
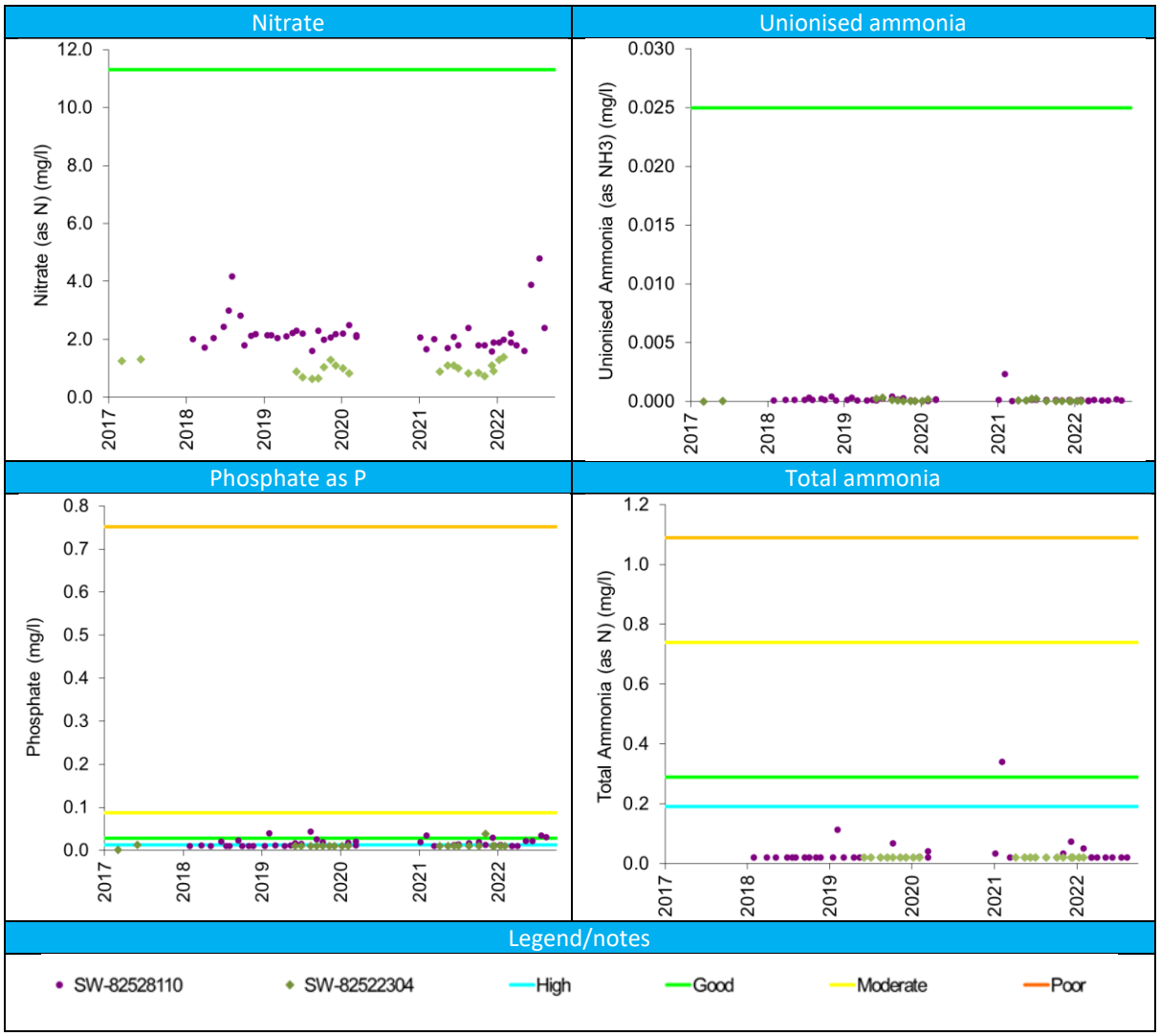


Table 5-7 Nutrient parameters recorded at Agency monitoring locations within the Stannon Stream (GB108049007040) water body



Physico-chemical and nutrient parameters for the two locations in the Camel (De Lank to Stannon) water body are presented in Table 5-8 and Table 5-9. The main observations are as follows.

Table 5-8 shows water temperature, DO and pH were consistently indicative of High status at all sites. Site SW-82528082 showed clear seasonal variation in temperature. There were only four data points available for these parameters at Site SW-82528090. Suspended solids concentrations were consistently below the (now repealed) FFD limit at both sites. BOD concentrations were only available at Site SW-82528090 and were consistently indicative of a less than Good status with occasional readings indicative of Poor and Bad status.

Recent nitrate concentrations as shown in Table 5-9 were below the NVZ limit at both sites. For unionised ammonia (UIA), concentrations were consistently below the (now repealed) FFD limit at both sites. Concentrations at both sites were very low (below 0.005 mg/l), with many concentrations reported at the limit of detection. There were only four data points available for nitrate and UIA parameters at Site SW-82528090. Phosphate concentrations were mainly indicative of at least Good status with occasional concentrations at Site SW-82528082 indicative of Moderate status. In terms of total ammonia, concentrations were consistently indicative of High status at SW-82528082. However, at Site SW-82528090 concentrations were consistently indicative of Poor and Bad status.

Table 5-8 Physico-chemical parameters recorded at Agency monitoring locations within the Camel (De Lank to Stannon) (GB108049006980) water body

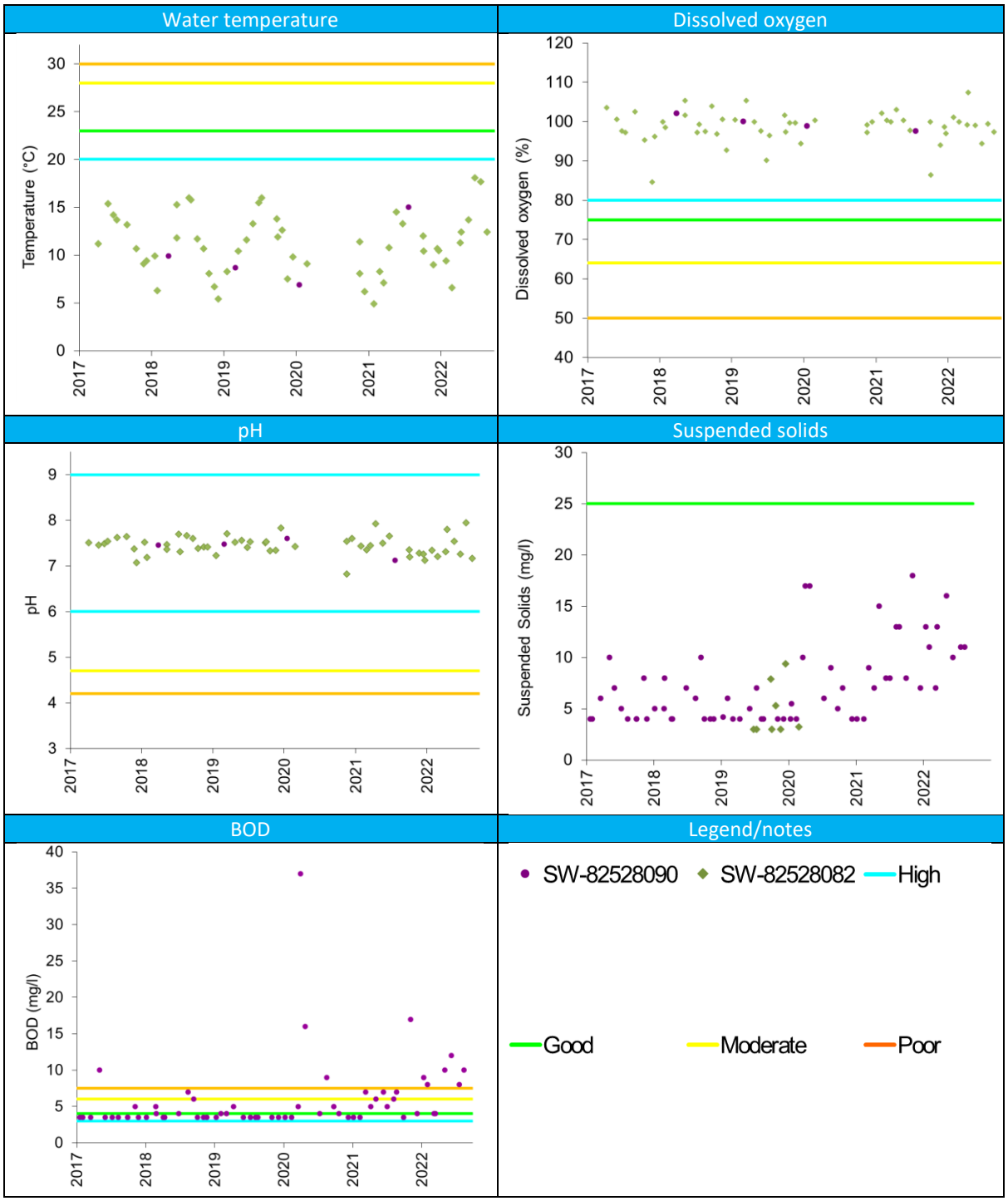


Table 5-9 Nutrient parameters recorded at Agency monitoring locations within the Camel (De Lank to Stannon) (GB108049006980) water body

Physico-chemical and nutrient parameters for the two locations in the Lower River Camel water body are presented in Table 5-10 and Table 5-11. The main observations are as follows.

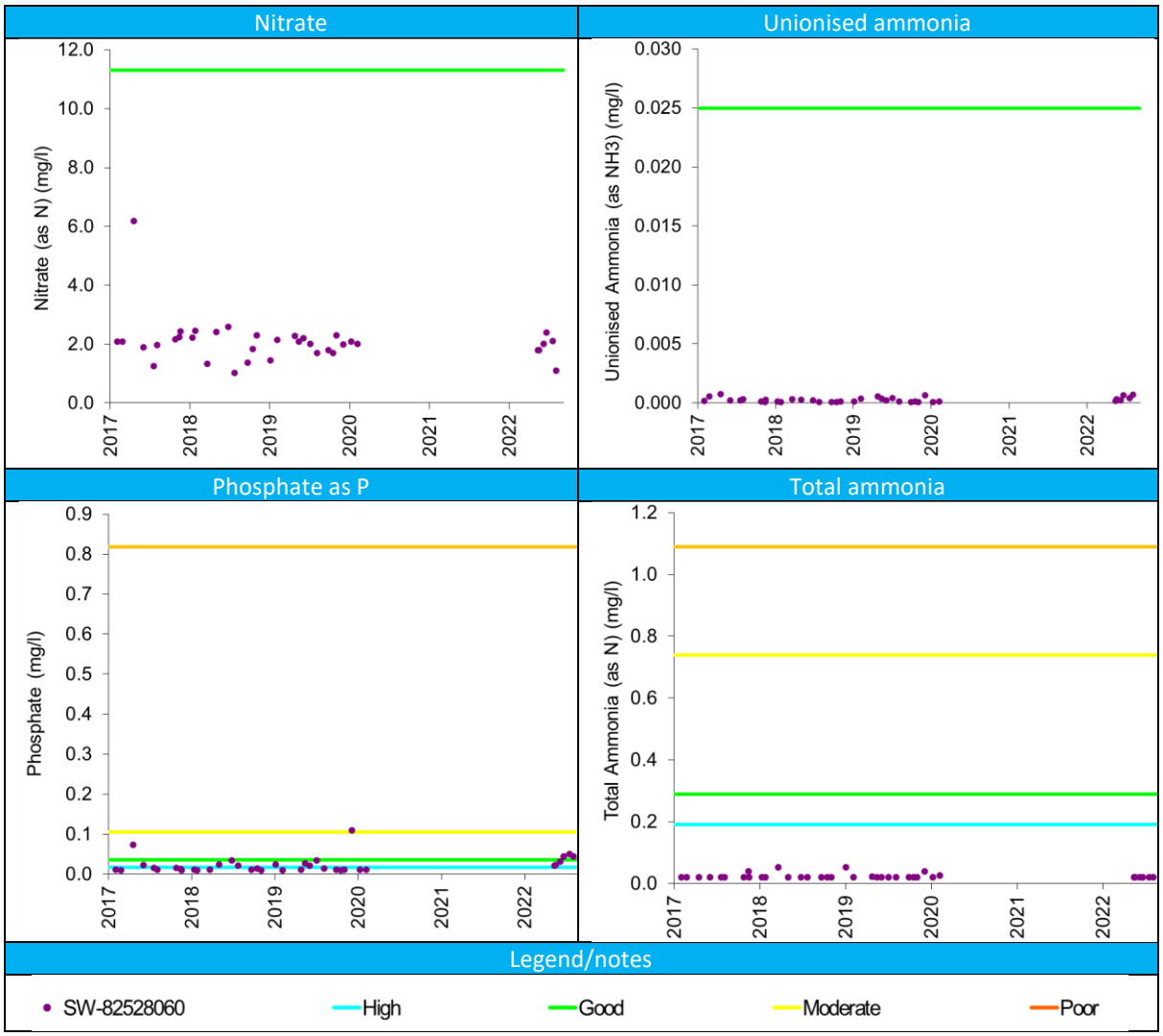
Table 5-10 shows water temperature, DO and pH were consistently indicative of High status at SW-82528060 and showed clear seasonal variation in temperature. Suspended solids concentrations were consistently below the (now repealed) FFD limit but were only available between 2019 and 2020.

Recent nitrate concentrations as shown in Table 5-11 were below the NVZ limit. For unionised ammonia (UIA), concentrations were consistently below the (now repealed) FFD

limit. Concentrations at SW-82528060 were very low (below 0.005 mg/l), with many concentrations reported at the limit of detection. Phosphate concentrations were mainly indicative of at least Good status with occasional concentrations indicative of Moderate status. In terms of total ammonia, concentrations were consistently indicative of High status.

Table 5-10 Physico-chemical parameters recorded at Agency monitoring locations within the Lower River Camel (GB108049000190) water body

Table 5-11 Nutrient parameters recorded at Agency monitoring locations within the Lower River Camel (GB108049000190) water body



In summary, the water quality data for the four water bodies upstream and downstream of Stannon Stream from 2017 to 2022 show that the water quality was consistently indicative of High WFD status for DO, pH, temperature and below nitrate and UIA limits. Suspended solids were mainly below their (now repealed) FFD limit at all water bodies with a few exceedances. Phosphate concentrations were largely indicative of at least Good status with exceptions of concentrations indicative of Moderate and Poor status at Lower and Upper River Camel respectively. Finally, total ammonia concentrations were also mainly indictive of at least Good status with exceptions of concentrations indicative of Poor and Bad status at Upper River Camel and Camel (De Lank to Stannon) respectively.

5.3.4 Impact assessment

The impact assessment was carried out using the Agency Simcat water quality model for PR24. The assessment investigated the impact in the Stannon Stream just upstream of the confluence with Crowdy Stream.

5.3.4.1 Stannon Stream (GB108049007040) water body

The drought permit impact on water quality in Stannon Stream is summarised in Table 5-12. The results show there would be very little or no change for total ammonia and BOD, but a minor increase for concentrations of nitrate and phosphorus as a consequence of a reduced flow downstream of Stannon Lake.

Table 5-12 Stannon Stream water quality changes due to the flow reduction at location upstream of Crowdy Stream confluence (NGR SX 11059 79991)

Stannon Stream	Determinands				
	Total ammonia (mg/l)	BOD (mg/l)	Nitrate (mg/l)	Orthophosphate (mg/l)	Total phosphorus (mg/l)
At the baseline flow	0.0154	1.09	1.73	0.0118	0.0128
At the reduced flow	0.0155	1.09	1.80	0.0125	0.0134
Percentage change	0.6%	0%	4%	5.9%	4.7%

The magnitude of impact of increased Stannon Lake abstraction on the water quality in /Stannon Stream water body is considered to be **Low**. Stannon Stream has a **Medium** sensitivity to the estimated flow change and therefore the impact is considered as **Minor**.

Therefore, there is no requirement for water quality monitoring for the during drought permit period. However, as shown in Table 9-1 in situ water quality monitoring is proposed along side spot flow gauging.

5.3.4.2 Camel (De Lank to Stannon) (GB108049006980) water body

The hydrological zone of influence has been estimated to not extend to the confluence with River Camel under the proposed drought permit. The magnitude of impact of increased Stannon Lake abstraction on the River Camel is considered to be **Negligible** and the River Camel has a **Medium** sensitivity to the estimated change. The proposed drought permit will therefore have a **Negligible** impact.

6. Ecological assessment

6.1 Macrophytes and phytobenthos

6.1.2 Background

This section assesses the potential impacts on the macrophyte and phytobenthos (diatom) communities of the rivers potentially affected by the proposed drought permit. The assessment is based on a review of the existing data and the results of other areas of the environmental assessment (predominantly hydromorphology and water quality, Section 5).

The WFD combined macrophyte and phytobenthos element is intended to reflect the ecological significance of nutrient status of a given water body. Under low alkalinity conditions macrophytes provide an unreliable assessment of eutrophication pressure and phytobenthic communities (diatoms) are used instead. The Stannon Stream and Camel (De Lank to Stannon) water bodies are of low alkalinity, with river mean alkalinity values of 17.0 mg/l and 18.9 mg/l CaCO3 respectively. Current Agency WFD classifications are therefore based on diatom data.

The macrophyte and phytobenthos combined biological element of the Stannon Stream waterbody (GB108049007040) is classified as High status. The classification for the downstream waterbody, Camel (De Lank to Stannon) (GB108049006980), is Good status.

6.1.3 Potential routes of impact

Potential effects on macrophytes and phytobenthos can arise from changes in flow, wetted width and water quality. Lower flow velocities can alter the macrophyte and diatom community directly or indirectly, for example, siltation increases and smothers benthic species. Siltation can also impact nutrient availability, resulting in increased algal growth. Macrophyte groups with different ecological niches can then become established. A reduced wetted width can expose marginal plants and reduce overall habitat area, with changes in water depth potentially resulting in increased light penetration, impacting algal growth. Any increase in nutrients resulting from reduced flows, attributable to a change in dilution, might also indirectly lead to modification of macrophyte/ phytobenthos communities.

6.1.4 Baseline

The Agency undertook monitoring of diatoms (a major component of phytobenthos) on Stannon Stream between 2013 and 2015 and on the River Camel between 2002 and 2019. Agency monitoring of macrophytes has been conducted on the River Camel downstream of Stannon Lake between 1995 and 2015. The closest downstream diatom monitoring location to Stannon Lake on the River Camel is 3.27km, and for macrophytes is 5.23km, with the most recent samples from 2015 and 2011 respectively. A macrophyte survey of the North Perimeter Leat and diverted catchment stream was commissioned by SWW in 2007. No data exist for Stannon Lake.

Diatom indices for Stannon Stream are presented in Table 6-2. The macrophyte survey data provided by SWW for the Stannon Stream water body have not been reviewed as they are over 10 years old and, as described above, would not produce reliable WFD classifications.

6.1.4.1 Stannon Stream

The latest diatom data for Stannon Stream are from 2015 and are therefore not considered ideal for this assessment but will be reviewed to provide historical context to the site. The metric used to classify phytobenthos in rivers is the trophic diatom index (TDI). Diatom taxa are each assigned a score from 1 (nutrient sensitive) to 5 (nutrient tolerant) and the computed total TDI scores range from 0 (very low nutrients) to 100 (very high nutrients). Two samples were collected in 2013 and one sample in 2015. The diatom community in Stannon Stream was indicative of a community unimpacted by nutrient enrichment in the 2013 and 2015 samples with TDI scores of 32, 11 and 31 (Table 6-2). None of the species recorded were notable or protected. No macrophyte data exist for Stannon Stream.

6.1.4.2 River Camel

Diatom data exist on the River Camel approximately 0.08km upstream of Stannon Stream (10071) from 2019 and 3.27km downstream (10070) from 2013 and 2015. Macrophyte data are available for the River Camel 0.57km upstream of the confluence with Stannon Stream (10123) from 2010 and 5.2km downstream (156644) from 2011 (Table 6-1). The zone of influence does not extend to the River Camel therefore the baseline data will not be reviewed.

Table 6-1 Baseline macrophyte and phytobenthos data (1995 onwards)

Element	Location name	NGR	Record duration	Number of samples	Location	Record Holder
Stannon Lake						
No data						
Stannon Stream water body						
Macrophytes	N/A	SX12548137	2007	3	Catchment stream	SWW
Macrophytes	N/A	SX12558137	2007	3	North Perimeter Leat	SWW
Macrophytes	N/A	SX13378145	2007	1	Unnamed ditch	SWW
Macrophytes	N/A	SX13238146	2007	1	Unnamed stream	SWW
Diatoms	10072	SX0979080550	2013 –2015	3	Stannon Stream	EA
Camel (De Lank to Stannon) water body						
Diatoms	10071	SX0968080570	2019 – 2019	2	80m upstream of Stannon Stream	EA
Diatoms	10070	SX0890077900	2013 – 2015	3	3.27km downstream of Stannon Stream	EA
Diatoms	156644	SX0895876273	2011 –2011	2	Downstream 2	EA
Diatoms	10069	SX0849075190	2011 – 2019	5	Downstream 3	EA
Diatoms	10068	SX0882073170	2011 – 2011	2	Downstream 4	EA
Diatoms	10067	SX0658071500	2009 – 2019	9	Downstream 5	EA

Element	Location name	NGR	Record duration	Number of samples	Location	Record Holder
Diatoms	10058	SX0484067800	2002 – 2018	10	Downstream 6	EA
Diatoms	80920	SX0447067500	2002 –2011	6	Downstream 7	EA
Diatoms	10160	SX0410067340	2002 – 2010	6	Downstream 8	EA
Diatoms	10065	SX0140068600	2009 – 2019	12	Downstream 9	EA
Diatoms	10073	SX0145069400	2002 – 2003	4	Downstream 10	EA
Macrophytes	10123	SX0975080950	2010	1	575m upstream Stannon Stream	EA
Macrophytes	156644	SX0895876273	2011	1	5232m downstream Stannon Stream	EA
Macrophytes	10069	SX0849075190	2011 –2011	1	Downstream 2	EA
Macrophytes	10068	SX0882073170	2011 –2011	1	Downstream 3	EA
Macrophytes	10067	SX0658071500	2009 –2015	5	Downstream 4	EA
Macrophytes	80920	SX0447067500	2002 – 2011	6	Downstream 5	EA
Macrophytes	92587	SX0450067400	1995 – 1996	4	Downstream 6	EA
Macrophytes	10160	SX0410067340	2002 – 2010	5	Downstream 7	EA
Macrophytes	10065	SX0140068600	2007 – 2015	7	Downstream 8	EA

Table 6-2 Diatom Trophic Diatom Index (TDI5) scores

Location ID	Date	NGR	TDI5	% Planktonic	% Motile	% PTV	% Salinity
Stannon Stream water body							
10072	04/04/2013	SX0979080550	32.11	0.89	1.48	40.65	0.3
10072	19/11/2013	SX0979080550	11.31	1.95	5.86	6.51	0.33
10072	01/05/2015	SX0979080550	21.13	0	8.95	6.39	0.32

6.1.5 Impact assessment

Changes in the hydrological regime as a result of the drought permit on Stannon Stream may result in increased fine sediment deposition, reduced fluvial scour, decreased spills from Stannon Lake and reduced water levels. Water quality impacts are predicted to be minor, with minor increases in concentrations of nitrate and phosphates. The drought permit is predicted to have little impact on Stannon Lake as described in Section 5.1.3.1.

6.1.5.1 Stannon Stream

The diatom community in the zone of influence (Stannon Stream) has historically indicated the site is not impacted by nutrient enrichment. Despite the lack of recent data, the historical diatom community was indicative of relatively high-water quality and this will form the basis of a precautionary approach to assessment of impact. Diatoms are photosynthetic, benthic organisms and are therefore susceptible to increases in fine sediment deposition; therefore,

the sensitivity of the diatom community to the drought permit scenario is determined to be **Medium**. Based on the predicted changes to habitat and geomorphology from increased abstraction from Stannon Lake the magnitude of impact on the Stannon Stream water body is considered to be **Low** for the reach to the Crowdy confluence. Therefore, the significance of impacts is determined to be **Minor.** Confidence in this assessment is **Low.**

There are no macrophyte data for Stannon Stream. However, as a low alakalinity and upland site, the macrophyte community is expected to show **Low** sensitivity as a receptor. The magnitude of impact on the Stannon Stream water body is considered to be **Low** for the reach to the Crowdy confluence, therefore potential impacts of the drought permit are determined to be of **Negligible** significance. In the absence of survey data, confidence in this assessment is **Low**.

Therefore, there is no requirement for during drought permit monitoring of macrophytes and phytobenthos (the recommended monitoring is covered in Section 9).

6.1.5.2 Stannon Lake

There are no macrophyte or phytobenthos data for Stannon Lake, therefore a precautionary approach has been taken when assessing the impact on this receptor. In the absence of survey data, the macrophyte or phytobenthos community has been determined as a **Medium** sensitivity receptor. The magnitude of impact on Stannon Lake is predicted to be **Negligible**, therefore potential impacts of the drought permit were determined to be of **Negligible** significance. Confidence in this assessment is **Low**.

Therefore, there is no requirement for during drought permit monitoring of macrophytes and phytobenthos (see Section 10); however, see Section 6.1.6.

6.1.6 Uncertainties

Further diatom and macrophyte surveys are recommended on Stannon Lake and Stannon Stream to understand the current macrophyte and diatom community and monitor any changes that may occur following implementation of the drought permit; however, the restrictions on sampling periods, below, should be noted.

Diatom sampling should be undertaken to assess potential changes to WFD status. The Stannon Stream water body is low alkalinity and under these conditions macrophytes provide an unreliable assessment of eutrophication pressures; however, macrophyte surveys will provide information on any protected species, or species of interest that may be impacted by changes in flow regime or water quality.

Diatom sampling should be undertaken in spring (March - May) and autumn (September to November) and macrophyte surveys undertaken July to September. Diatom sampling should be carried out at Stannon Lake and two locations on Stannon Stream (one upstream and one downstream of the Crowdy confluence).

6.2 Macroinvertebrates

6.2.2 Background

This assessment focusses on potential effects of implementation of a drought permit on macroinvertebrate communities associated within Stannon Stream and Camel (De Lank to Stannon) downstream of Stannon Lake, including consideration of potential effects on WFD status and identification of notable species.

The macroinvertebrate biological element of the Stannon Stream waterbody (GB108049007040) is classified as High status. The macroinvertebrate biological element for the Camel (De Lank to Stannon) waterbody (GB108049006980) is also at High status.

6.2.3 Potential routes of impact

Macroinvertebrates could be impacted by a reduction in discharge through a loss of wetted area and a reduction in flow velocity. A reduced wetted area would decrease the area of habitat available for macroinvertebrates and could also lead to a decrease in food availability and habitat. As well as direct effects, reduced flow velocities could lead to increased sediment deposition which can smother gravels and alter habitat suitability, including if increased sediment deposition should lead to an increase in vegetative cover. Some macroinvertebrate groups are sensitive to changes in sediment conditions. Changes in flow velocity can also alter the habitat types present, i.e. should the velocity of water decrease and result in loss of riffle and run habitat.

6.2.4 Baseline

The Agency have undertaken macroinvertebrate monitoring on the Northern Perimeter Leat between 1995 and 2000, Stannon Stream between 1990 and 2015 and on the River Camel, upstream and downstream of Stannon Stream between 1991 and 2019 (Table 6-3). There are no macroinvertebrate data for Stannon Lake.

6.2.4.1 Stannon Stream

The most recent data for Stannon Stream (location 10072) are from 2015 and are no longer considered up to date for the purpose of this assessment. However, to provide context to the site, the macroinvertebrate indices have been reviewed. Lotic-invertebrate index for flow evaluation (LIFE) scores for Stannon Stream ranged between 7.52 – 8.14 which indicate a macroinvertebrate community associated with fast flows. The Proportion of Sediment-sensitive Invertebrates (PSI) scores for Stannon Stream were indicative of minimally sedimented/ unsedimented to slightly sedimented conditions. The Average Score Per Taxon (ASPT) was between 6.9 and 7.76 and the NTAXA was 24 – 35 which is indicative of a moderately high to highly diverse community, comprising taxa that are not tolerant of pollution. One non-native species was recorded at the site in 2015, the freshwater shrimp *Crangonyx pseudogracilis/floridanus*. No other species of interest were recorded.

6.2.4.2 *North Perimeter Leat*

The data that exist for the North Perimeter Leat are upstream of the zone of influence and over 10 years old so have not been reviewed.

6.2.4.3 *River Camel*

Macroinvertebrate data exist in River Camel 70m upstream of Stannon Stream (location 10071) and 3.34km downstream (location 10070). The zone of influence does not extend to the River Camel therefore the baseline data have not been reviewed.

Table 6-3 Baseline macroinvertebrate data (1990 onwards)

Location ID	NGR	Record duration	Number of samples	Location
Stannon Lake				
No data.				
Stannon Stream water body				
10159	SX1240081170	1995 – 2000	5	North Perimeter Leat (upstream of Stannon Stream)
10072	SX0979080550	1990 – 2015	19	Downstream of Stannon Lake
Camel (De Lank to Stannon) water body				
10071	SX0968080570	1991 – 2019	8	0.07m upstream Stannon Stream
10070	SX0890077900	1991 – 2005	14	3.34km downstream Stannon Stream
10069	SX0849075190	1991 – 2022	18	Downstream 2
10054	SX0164072020	1990 – 2015	18	Downstream 3
10068	SX0882073170	1991 – 1992	6	Downstream 4
10067	SX0658071500	1991 – 2019	13	Downstream 5
10058	SX0484067800	1991 – 2000	11	Downstream 6
10061	SX0433067270	1991 – 2015	17	Downstream 7
10160	SX0410067340	1995 – 2006	9	Downstream 8
10090	SX0354067410	1990 – 1992	6	Downstream 9
10065	SX0140068600	1991 – 2022	24	Downstream 10
10073	SX0145069400	1991 – 2004	13	Downstream 11

Table 6-4 Macroinvertebrate monitoring results

Site ID	NGR	Sample Date	WHPT NTAXA	WHPT ASPT	LIFE Family Index	PSI Family Score	CCI
Stannon Stream water body							
10159	SX1240081170	14/03/1997	24	7.19	7.9	67.39	-

Site ID	NGR	Sample Date	WHPT NTAXA	WHPT ASPT	LIFE Family Index	PSI Family Score	CCI
		04/04/1995	30	6.45	7.28	56.52	-
		15/09/1995	33	6.12	6.86	49.06	-
		16/03/2000	24	7.26	7.8	70.45	-
		03/10/2000	35	6.71	7.48	60.87	-
10072	SX0979080550	21/06/1990	27	7.64	7.84	74	-
		02/04/1990	27	7.47	7.52	72.55	-
		07/07/1992	28	7.69	7.8	73.47	-
		25/09/1992	19	7.28	8.06	83.33	-
		17/03/1997	22	6.99	7.67	70	-
		15/09/1995	28	7.2	7.57	68.09	-
		15/04/1992	26	7.47	7.7	73.81	-
		02/10/1990	24	7.48	7.91	86.05	-
		31/03/1995	22	7.63	8	83.72	-
		16/03/2000	25	7.5	7.95	73.47	-
		03/10/2000	29	7.8	7.88	73.68	-
		25/04/2002	31	7.4	7.64	78.43	-
		12/09/2002	33	7.63	7.71	79.03	-
		09/05/2005	26	7.34	7.74	72.22	-
		06/09/2005	28	7.12	7.64	76.6	-
		04/04/2013	30	7.48	7.85	77.19	-
		07/11/2013	29	7.47	7.75	79.59	-
		01/05/2015	33	7.51	7.67	71.67	21.85
		24/09/2015	25	7.57	8.14	80.43	12.95

6.2.5 Impact assessment

Changes in the hydrological regime as a result of the drought permit on Stannon Stream may result in increased fine sediment deposition, reduced fluvial scour, decreased spills from Stannon Lake and reduced water levels. Water quality impacts are predicted to be minor, with minor increases in concentrations of nitrate and phosphates. The drought permit is predicted to have little impact on Stannon Lake as described in Section 5.1.3.1.

The macroinvertebrate community in the zone of influence (Stannon Stream) has historically been adapted to moderately fast to fast flows, low sediment conditions and was not considered impacted by nutrient enrichment. Therefore, the sensitivity of macroinvertebrates to the drought permit scenario are determined to be **Medium**. Based on the predicted changes to habitat and geomorphology from increased abstraction from Stannon Lake, the magnitude of impact of on the Stannon Stream water body is considered to be **Low**, for the reach to the Crowdy confluence. Therefore, the significance of impact is determined to be **Minor.** Confidence in this assessment is **Low.**

There are no macroinvertebrate data for Stannon Lake, therefore a precautionary approach has been taken when assessing the impact on this receptor. In the absence of survey data, the macroinvertebrate community has been determined as a **Medium** sensitivity receptor. The magnitude of impact on Stannon Lake is predicted to be **Negligible**, therefore potential impacts of the drought permit were determined to be of **Negligible** significance. Confidence in this assessment is **Medium.**

Therefore, there is no requirement for during drought permit monitoring of macroinvertebrates (the recommended monitoring is covered in Section 9); however, see Section 6.2.6.

6.2.6 Uncertainties

There are a lack of recent data for the zone of influence; therefore, further macroinvertebrate surveys are recommended on Stannon Stream to understand the current macroinvertebrate community and monitor any changes that may occur due to the proposed drought permit, should it be implemented; however, the restrictions on sampling periods, below, should be noted.

Macroinvertebrate surveys should be undertaken in spring (March to May) and autumn (September to November). Samples should be collected prior to implementation of the drought permit. Two samples should be collected from Stannon Stream using standard 3-minute kick sampling (one upstream and one downstream of the Crowdy confluence).

6.3 Fish

6.3.2 Background

The following section provides an overview of fish communities present within waterbodies in the study area downstream of Stannon Lake, to inform the focus for the assessment. The assessment compares modelled changes to hydraulic parameters and predicted changes to water quality parameters during the proposed drought permit to baseline conditions, to consider how implementation of the drought permit may impact on habitat availability and migration for individual life stages and species of fish, in addition to angling activity.

6.3.3 Potential routes of impact

Potential impacts to fish and fisheries during implementation of the drought permit may occur via a number of routes, including:

- Modification of habitat (through changes in wetted area, flow characteristics, temperature, water quality, fine sediment deposition and production; with consequences for fish distribution, feeding, predation, growth and survival of juvenile and resident brown trout and coarse fish species);
- Disruption of migration in rivers downstream of Stannon Lake (salmonids and migratory coarse fish species);

- Disruption of spawning activity in rivers downstream of Stannon Lake (salmonids and coarse fish species); and
- Disruption of angling quality and value in the rivers downstream of Stannon Lake (through changes in availability or accessibility of fish, flow changes and resultant fishing opportunity and demand).

Given that fish populations exhibit naturally large variation in size and structure, quantitatively predicting the impact of seasonal changes in flow using fish density data would require an extensive and long-term fish survey programme. Consequently, the potential effects of the drought permit on fish populations have been assessed by considering the combined outputs from pathways assessment – principally in relation to changes in hydromorphology and water quality. The habitat analysis approach focusses on targeted hydraulic assessment to predict changes in physical habitat parameters (e.g. wetted width, velocity and depth) under alternative flow scenarios. These physical parameters are key determinants of habitat suitability, functionality and typology for the fish species present within the affected reaches.

Referring to the magnitude and duration of changes predicted to impact pathways in Section 5, potential impacts on relevant fish species were qualitatively assessed based on habitat requirements and known periods of sensitivity for key species and life stages recorded in the study area, in addition to expert judgement. Potential additive effects of other environmental variables such as water temperature and low dissolved oxygen concentration were also considered, together with potential disruption to fish migration due to changes in the volume of river flows.

6.3.4 Baseline

To assess the impact of the proposed drought permit, it is necessary to establish a baseline of the fish community, which either resides within the impacted reach or uses the habitat within it as a migratory conduit, or to fulfil certain life stage requirements such as spawning, nursery and feeding habitats. The approach taken here has been to examine existing fisheries data pertaining to sites, ideally within the reaches where cross-section data have been collected, or failing this, from surrogate sites which are considered to best represent the fish communities within the area of study.

The two downstream waterbodies which may be impacted by the proposed drought permit (and are therefore included within this assessment) are 'Stannon Stream' (GB108049007040) and 'Camel (De Lank to Stannon)' (GB108049006980). The fish element of the Stannon Stream water body was classified as Good during the 2019 WFD Cycle 2 assessment, whilst the fish element of the Camel (De Lank to Stannon) water body was not classified, the water body achieved Good ecological quality overall. Camel (De Lank to Stannon) is part of the River Camel Special Area of Conservation (SAC), which is designated for bullhead (*Cottus gobio*) and Atlantic salmon (*Salmo salar*), whilst the River Camel is also designated as a principal salmon river (Cefas/EA/NRW 2021).

Monitoring for fish has been carried out by the Agency on both Stannon Stream and Camel (De Lank to Stannon); survey data from the most recent 5-year period (2017 – 2022) have been incorporated into this assessment. A total of five Agency monitoring locations were identified across the two river waterbodies between 2017 – 2022 (Figure 6.1, Table 6-5).

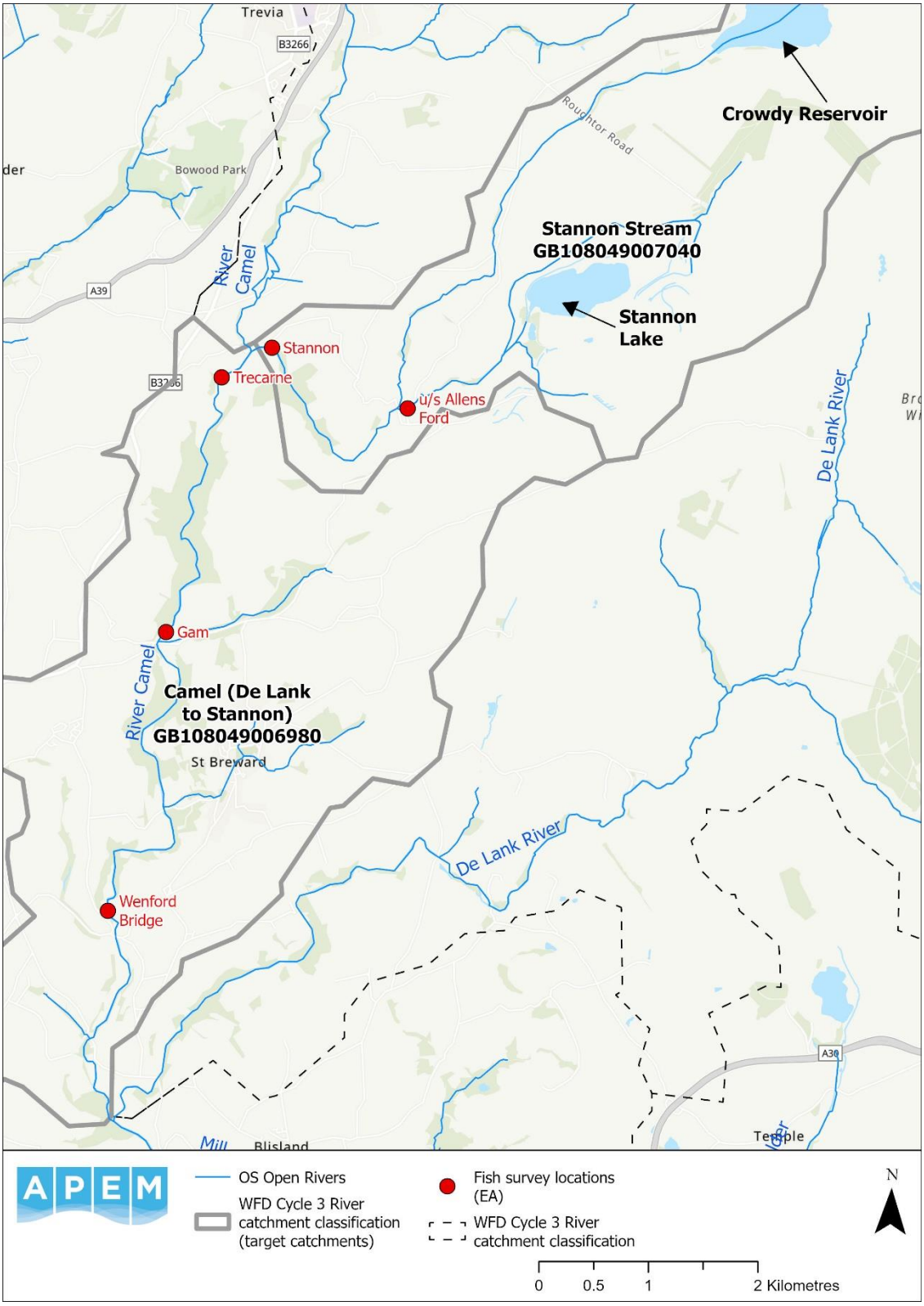


Figure 6.1 An overview of the historic Agency fish survey locations on Stannon Stream and Camel (De Lank to Stannon), 2017 – 2022

Table 6-5 Summary data for Agency electric fishing surveys, 2017 – 2022

Site name	NGR	Survey years	Species recorded
Stannon Lake (GB30846165)			
Stannon Lake	SX1271481056	N/A	N/A
Stannon Stream (GB108049007040)			
u/s Allens Ford	SX1115879995	2017	Brown/ sea trout, European eel, minnow.
Stannon	SX0988080500	2017-2019, 2021	Atlantic salmon, brown/ sea trout, bullhead, European eel, minnow, ruffe.
Camel (De Lank to Stannon) (GB108049006980)			
Gam	SX0895077950	2017-2018	Atlantic salmon, brown/ sea trout, bullhead, European eel.
Trecarne	SX0946080280	2017	Atlantic salmon, brook lamprey, brown/ sea trout, bullhead, European eel, minnow.
Wenford Bridge	SX0842075400	2017	Atlantic salmon, brook lamprey, brown/ sea trout, bullhead, European eel, stone loach.

6.3.4.1 Summary

Based on the data from historic Agency surveys summarised in Table 6-5, a total of eight fish species have been recorded across the study area. These data form the baseline information on fish populations used to assess the potential impacts resulting from the proposed drought permit.

A number of the fish species display very similar ecological requirements and life history characteristics and can therefore be grouped into distinct 'functional guilds' for the purpose of ecological assessment. With regards to coarse fish, the majority of species can be defined as either rheophilic or eurytopic in nature. Rheophilic fish display a preference for areas of moderate to fast flowing water; spawning habitat for these species is therefore typically associated with coarse gravel and cobble substrate. In contrast, eurytopic fish species display a much wider preference range with regards to habitat requirements, although optimal habitat is typically characterised by areas of static or low velocity water with a greater mean depth. The majority of coarse fish species have been assigned to one of these functional guilds on the basis of information provided in Agency (2004) and Fieseler and Wolter (2006).

There are a number of species which could be categorised within one of these two assessment groups that have instead been considered separately due, for example, to an increased receptor value. Bullhead, for example, is typically defined as a rheophilic species, although it has been assessed separately due to its high sensitivity to environmental change, whilst the same also applies to Atlantic salmon.

Abundant and widespread species such as stone loach, bullhead, minnow, stickleback were grouped into a 'minor coarse fish species' assessment group, which is consistent with the

approach taken to define these species within the EA's FCS2 assessment model (and ultimately WFD Fish status outputs).

The final fish species assessment list is therefore as follows:

- Atlantic salmon;
- Brook lamprey (*Lampetra planeri*);
- Brown / sea trout;
- Bullhead;
- European eel (*Anguilla anguilla*);
- Rheophilic coarse fish (Stone loach (*Barbatula barbatula*));
- Eurytopic coarse fish (Ruffe (*Gymnocephalus cernua*)), and;
- Minor coarse fish (Minnow (*Phoxinus phoxinus*)).

6.3.5 Fish habitat requirements

Impacts on fish population identified in this section vary in accordance with the life history characteristics of individual species. Accordingly, impacts of a drought period are considered against the temporal periods of sensitivity for each species/ species group under assessment, presented in Table 6-6.

Similarly, it is necessary to establish the ecological requirements of individual species/ species groups to determine whether any changes arising from the proposed drought permit (e.g. hydraulic changes in depth or velocity in the channels) are likely to result in an adverse impact on fish populations. An overview of preference ranges for each species/ species group is provided in Table 6-7.

Table 6-6 Overview of key seasonal sensitivity periods for individual fish species/ life stages

Species	Life stage	J	F	M	A	M	J	J	A	S	O	N	D
Atlantic salmon	Spawning & egg incubation	■	■								■	■	■
	Juvenile	■	■	■	■	■	■	■	■	■	■	■	■
	Adults	■	■							■	■	■	■
Brook lamprey	Spawning & egg incubation			■	■	■	■	■					
	Ammocoetes	■	■	■	■	■	■	■	■	■	■	■	■
Brown / sea trout	Spawning & egg incubation	■	■								■	■	■
	Juvenile	■	■	■	■	■	■	■	■	■	■	■	■
	Adults	■	■	■	■	■	■	■	■	■	■	■	■
Bullhead	Spawning & egg incubation			■	■	■	■						
	Juvenile	■	■	■	■	■	■	■	■	■	■	■	■
	Adults	■	■	■	■	■	■	■	■	■	■	■	■
European eel	Elver U/S migration				■	■	■	■	■	■			
	Adult D/S migration									■	■	■	
	Adults	■	■	■	■	■	■	■	■	■	■	■	■
All coarse fish species groups	Spawning & egg incubation			■	■	■	■	■					
	Juvenile	■	■	■	■	■	■	■	■	■	■	■	■
	Adults	■	■	■	■	■	■	■	■	■	■	■	■

Note: Shaded cells indicate a period of sensitivity for a particular species and/ or life stage.

Table 6-7 Water depth and velocity requirements of key and sensitive species

Species	Life stage	Water depth requirements	Velocity requirements
Atlantic salmon	Fry	<10 – 40 cm (=20 cm preferred)	5 - 65 cms^{-1}
	Parr	>10 - <100 cm (~25 – 60 cm preferred)	4 - <120 cms^{-1} (~10 - 60 cms^{-1} preferred)
	Adult	40 - 75 cm	~25 cm
	Spawning	15 – 91 cm (~25 – 50 cm preferred)	>15 - 90 cms^{-1} ~20 - 50 cms^{-1} preferred)
Brook lamprey	Spawning	3 - 150 cm	30 - 50 cms^{-1}
	Juvenile	<50 cm	8 - 10 cms^{-1}
Brown / sea trout	Fry	<60 cm	0 - <30 cms^{-1}
	Parr	<5.1 - 300 cm (40 - 75 cm preferred)	0 - 65 cms^{-1} (~20 - 30 cms^{-1} preferred)
	Adult	9 - 305 cm (40 - 75 cm preferred)	0 - 142 cms^{-1} (~25 cms^{-1} preferred)
	Spawning	6 - 91 cm (25 - 50 cm preferred)	10.8 - 81 cms^{-1} (~20 - 50 cms^{-1} preferred)
Bullhead	Juvenile	Shallow	Elevated
	Adult	>5 - 40 cm	10 - >40 cms^{-1}
	Spawning	>5 cm	N/A
European eel	Resident freshwater	< 600 cm	< 600 cm
Rheophilic coarse fish	Larvae	0 – 50 cm	<20 cms^{-1}
	Juvenile	<20 - 100 cm	Still – Elevated
	Adult	17 – 113 cm	0 – 100 cms^{-1}
	Spawning	15 - 40 cm	20 - 50 cms^{-1}
Eurytopic coarse fish	Larvae	20 - <150 cm	<5 cm/s
	Juvenile	<20 - 175 cm	0 - 40 cm/s
	Adult	N/A	N/A
	Spawning	15 – 45 cm	<20 - >20 cm/s
Minor coarse fish	Larvae	2 – 50 cm	<5 cms^{-1}
	Juvenile	<50 cm	Still – elevated
	Adult	20 – 100 cm	10 – 50 cms^{-1}
	Spawning	10 – 25 cm	20 – 30 cms^{-1}

Source: Cowx et al. (2004).

6.3.6 Fishing/ angling groups

Although no Agency monitoring locations were identified for fish in Stannon Lake, the nearby Crowdy Reservoir is used for recreational angling (fishing rights owned by South West Lakes Game and Coarse Fisheries), and is described as a wilderness trout fishery, offering wild brown trout (*Salmo trutta*) fly fishing only. No angling club waters exist elsewhere in the Stannon Stream water body. Fishing rights are owned by Tresarrett Fishery (0.75 miles on the Camel near Tresarrett) and the Westcountry Rivers Trust (Westcountry angling passport (Camel)). The exact start and finish coordinates are unknown but the reaches are in the vicinity of the De Lank confluence, at the downstream end of this water body.

6.3.7 Impact assessment

6.3.7.1 Stannon Lake (GB30846165)

There are no fisheries data for Stannon Lake, and therefore a precautionary approach has been taken when assessing the impact on this receptor. The nearby Crowdy Reservoir (GB30846131) is a wild brown trout fishery which also connects to the Stannon Stream waterbody, and it is therefore reasonable to assume that Stannon Lake and its tributaries may also offer suitable habitat for this species. In the absence of survey data, the fisheries community of Stannon Lake has been determined as a **Medium** sensitivity receptor. As a **Negligible** impact magnitude is predicted for Stannon Lake, equating to a **Negligible** impact significance overall. Confidence in this assessment is **Low**.

Therefore, there is no requirement for during drought permit monitoring of fish and supporting habitats (the recommended monitoring is covered in Section 9).

6.3.7.2 Stannon Stream (GB108049007040)

Under the proposed drought permit scenario, reductions in flow velocity, water depth and wetted width may occur and are predicted to be of **Low** impact magnitude.

Spawning life stages of Atlantic salmon, brown/ sea trout and bullhead may all be impacted by reductions in flow velocity and the potential exposure of suitable spawning gravels, in addition to the potential deterioration of spawning habitat due to increased sediment deposition in areas of lower flow. Whilst the proposed drought permit implementation period only partially coincides with the bullhead spawning window (March to June), it completely overlaps the spawning window for both Atlantic salmon and brown/ sea trout (October to February). However, impacts would be lessened below the confluence with the Crowdy stream, with additional mitigation in the form of elevated winter flows. A **Low** impact magnitude is therefore anticipated for the spawning life stages of Atlantic salmon, brown/ sea trout and bullhead, equating to a **Moderate** impact significance overall. Similarly, a **Low** impact magnitude is anticipated for the spawning life stages of eurytopic and minor coarse fish species, equating to a **Minor** impact significance overall.

Whilst juvenile and adult coarse fish and bullhead may be present year-round, the proposed drought permit implementation period falls mainly within the winter and spring months and will likely be mitigated by elevated flows during this period. Consequently, losses to habitat for these species and life stages are likely to be relatively small, and a **Low** impact magnitude is therefore anticipated, equating to a **Minor** impact significance overall (**Negligible** for adult eurytopic coarse fish). Similarly, juvenile Atlantic salmon, brown trout and bullhead may be present year-round, and a **Low** impact magnitude is also anticipated for these species and life stages, equating to a **Minor** impact significance overall.

Atlantic salmon and sea trout migrating through the River Camel (and Stannon Stream, assuming suitable connectivity and flows) are likely to be the later phases of migration, during which fish may move almost continuously upstream, holding for periods of time at key holding

locations, before moving rapidly upstream to spawn (Milner *et al*. 2012)[5]. As the hydrological zone of influence of the proposed drought permit is confined to the Stannon Stream waterbody and therefore does not extend into the River Camel, it is anticipated that any impacts on migratory movements of Atlantic salmon or sea trout would be of **Negligible** magnitude, equating to a **Minor** impact significance overall.

Eels are relatively flexible in terms of their habitat requirements in freshwater, occupying a wide range of habitats from productive deep lowland rivers through to steeper upland streams. Evidence suggests that juvenile eel tend to utilise shallower habitats characterised by a greater proportion of fine sediments, with a trend towards colonisation of deeper habitats with coarser substrate (cobble and boulder) with increasing age and body size (Degerman *et al*. 2019)[6]. Based on the Low magnitude of impacts anticipated on the Stannon Stream waterbody, a **Low** magnitude impact is anticipated for all eel life stages, equating to a **Minor** impact significance overall.

A **Low** impact magnitude is predicted on water quality, which equates to a **Negligible** to **Moderate** impact significance on fish. A **Moderate** impact significance would be limited to the spawning life stages of Atlantic salmon, brown trout and bullhead, with a **Negligible** impact significance for adult eurytopic coarse fish, and a **Minor** impact significance for all other species and life stages.

Specifically related to the Moderate impact significance for the spawning life stages of Atlantic salmon, brown trout and bullhead, in the reach between Stannon Lake outflow and the confluence with the Crowdy Stream, is recommended that baseline/ pre-drought permit and during drought permit monitoring (geomorphology and habitat walkovers) is completed; see Table 9-1.

6.3.7.3 Camel (De Lank to Stannon) (GB108049006980)

As the hydrological zone of influence has been estimated to not extend to the confluence with the River Camel under the proposed drought permit, the magnitude of impact on the Camel (De Lank to Stannon) waterbody is predicted to be **Negligible**, equating to a **Negligible** impact significance overall for all fish species and life stages. Confidence in this assessment is **Medium**.

Therefore, there is no requirement for during drought permit monitoring of fish and supporting habitats (the recommended monitoring is covered in Section 9).

5 Milner, N.J., Solomon, D.J. and Smith, G.W. (2012). The role of river flow in the migration of adult Atlantic salmon, Salmo salar, through estuaries and rivers. Fisheries Management and Ecology, 2012, 19, 537–547.

6 Degerman, E., Tomario, C., Watz, J., Nilsson, P.A. and Calles, O. (2019). Occurrence and habitat use of European eel (Anguilla anguilla) in running waters: lessons for improved monitoring, habitat restoration and stocking. Aquatic Ecology, 1 – 12.

6.3.8 Summary

In the absence of any survey data, a **Negligible** impact magnitude is predicted for Stannon Lake, equating to a **Negligible** impact significance overall. Impacts on fish species and life stages in the Stannon Stream waterbody range from **Negligible** to **Moderate** significance overall and are summarised in Table 6-8. Impacts on all fish species and life stages in the Camel (De Lank to Stannon) waterbody are anticipated to be of **Negligible** significance due to the waterbody's location outwith the hydrological zone of influence of the drought permit.

Table 6-8 Summary of impacts on fish within the Stannon Stream (GB108049007040) waterbody

Species	Life stage	Impact magnitude	Receptor sensitivity	Impact significance	Confidence level
Atlantic salmon	Spawning	Low	High	Moderate	Medium
	Juvenile	Low	Medium	Minor	Medium
	Adults	Negligible	Medium	Minor	Medium
Brown / sea trout	Spawning	Low	High	Moderate	Medium
	Juvenile	Low	Medium	Minor	Medium
	Adults	Negligible	Medium	Minor	Medium
Bullhead	Spawning	Low	High	Moderate	Medium
	Juvenile	Low	Medium	Minor	Medium
	Adults	Low	Medium	Minor	Medium
European eel	Elver U/S migration	Low	Medium	Minor	Medium
	Adult D/S migration	Low	Medium	Minor	Medium
	Adults	Low	Medium	Minor	Medium
Eurytopic coarse fish	Spawning	Low	Medium	Minor	Medium
	Juvenile	Low	Medium	Minor	Medium
	Adults	Low	Low	Negligible	Medium
Minor coarse fish	Spawning	Low	Medium	Minor	Medium
	Juvenile	Low	Medium	Minor	Medium
	Adults	Low	Medium	Minor	Medium
Angling groups	-	Negligible	Low	Negligible	Medium

6.3.9 Uncertainties

Whilst the fish assemblages of the Stannon Stream and Camel (De Lank to Stannon) waterbodies are well understood from historical data and key species-specific habitat requirements are documented in literature, there are inherently some difficulties in

confidently predicting how changes in hydromorphology or water quality will translate through to impacts at the population level, due to the complexity of biotic and abiotic interactions. As such, the assessment is considered to have a medium confidence level.

There is an absence of data for the Stannon Lake waterbody, fisheries surveys may therefore be useful on Stannon Lake to understand the current fisheries community and to monitor any changes that may occur during the proposed drought permit, should it be implemented. Although it should be noted that the water level in Stannon Lake is protected from significant drawdown by the hands-off level condition in the abstraction licence.

6.4 Birds

6.4.2 Background

This section assesses the potential impacts on the bird species associated with the water bodies potentially affected by the proposed drought permit. The assessment is based on a review of the existing data and the results of other areas of the environmental assessment (predominantly macrophytes, fish and macroinvertebrates).

6.4.3 Potential routes of impact

The main potential effects of the proposed drought permit are reduced water levels within Stannon Lake as well as altered flow downstream of the abstraction site. The impacts on bird species would be mediated via potential changes to the availability of suitable habitats for foraging and refuge and potential changes to the availability (access to and quantity) of food sources. At a receptor-specific level the following pathways for potential impacts are as follows:

- For piscivorous waterbirds, predation of fish may be more effective under low water level and/ or low flow conditions, as both juvenile and adult fish may become more visible in shallower water in areas below the abstraction point;
- For herbivorous waterbirds, lowered water levels below the abstraction point could make aquatic macrophytes more accessible initially, but were the water level to fall below the zone of macrophyte growth, this could subsequently deplete food resources; and
- For insectivorous birds, such as dippers and grey wagtails, impacts may be confined to changes in the total abundance and species composition of macroinvertebrates.

6.4.4 Baseline

Ornithological surveys have not been undertaken to inform this report. However, a desk-based review of the Site was completed using the Cornwall Bird Atlas (Cornwall Bird Watching & Preservation Society, 2018) and results from the Wetland Bird Survey (WeBS) organised by the British Trust for Ornithology (BTO).

A total of 26 bird species were recorded as being present in the 1 km grid square for Stannon Lake in the Cornwall Bird Atlas (2018) during the winter, including seven species of greater conservation sensitivity being recorded within the 10 km square which covers the extent of Stannon Lake. Wetland bird species recorded during the winter within this grid square were golden plover, lapwing, lesser black-backed gull, herring gull, grey wagtail, and tufted duck.

A total of 51 bird species were recorded as being present in the 1 km grid square for Stannon Lake in the Cornwall Bird Atlas (2018) during the breeding season, including 11 species of greater conservation sensitivity being recorded within the 10 km square which covers the extent of Stannon Lake. Wetland bird species recorded during the breeding season within this grid square were mallard, teal, herring gull, great black-backed gull, and reed bunting.

There are no WeBS data recorded for Stannon Lake but Crowdy Reservoir, to the north of Stannon Lake is likely to hold a similar avifauna to the area of study. During the previous five years (2015/ 16 to 2019/ 20) 43 species of waterfowl were recorded on the Crowdy Reservoir WeBS sector, as shown in Table 6-9. The most commonly occurring species (peak counts of over 100 individuals) were Canada goose, teal, lapwing, golden plover, black-headed gull, herring gull, and lesser black-backed gull.

Table 6-9 Bird Species recorded during WeBS counts in the Crowdy Reservoir sector (2015-16 to 2019-20)

Species	Peak Count	Average Count	Species	Peak Count	Average Count
Canada goose	323	240	**Kingfisher**	1	1
Barnacle goose	2	0	**Coot**	1	0
Pink-footed goose	1	0	**Lapwing**	600	321
Gadwall	1	0	**Golden plover**	2000	480
Wigeon	24	6	**Grey plover**	1	0
Mallard	79	47	**Ringed plover**	7	2
Pintail	1	0	**Whimbrel**	1	0
Teal	112	73	**Curlew**	2	0

Species	Peak Count	Average Count	Species	Peak Count	Average Count
Tufted duck	15	10	**Ruff**	1	0
Scaup	1	0	**Dunlin**	5	1
Goldeneye	2	1	**Little stint**	1	0
Goosander	5+	2	**Snipe**	5	1
Great northern diver	1	0	**Common sandpiper**	7	4
Little grebe	2	1	**Greenshank**	1	0
Great crested grebe	8	7	**Black-headed gull**	1000	496
Grey heron	4	3	**Common gull**	1	0
Little egret	1	0	**Great black-backed gull**	7	5
Cormorant	6	4	**Glaucous gull**	1	0
Moorhen	2	0	**Herring gull**	291	185
Lesser black-backed gull	1000	340	**Yellow-legged gull**	1	0

There is one statutory designated site with ornithological receptors listed within its citation located within 2 km of the study area, the Bodmin Moor SSSI, c. 270 m to the east of the site at its closest point. The SSSI has dunlin, lapwing, snipe, redstart, stonechat, black-headed gull, wheatear, curlew and whinchat listed within its citation as breeding species of interest with wheatear, curlew and whinchat highlighted as particularly important. In winter the SSSI supports a number of migrant and wintering bird species, with hen harrier, merlin, peregrine, red kite, snipe, short-eared owl and golden plover listed within its citation as being of particular importance.

6.4.5 Impact assessment

Impacts upon birds present at Stannon Lake due to the temporary artificial lowering of the water level are likely to occur only for those species which are reliant upon the waterbody and associated vegetation for foraging, refuge and breeding.

During the breeding season there may be a risk of stranding of waterbird nests located in shallow water along the reservoir shoreline if water levels decline substantially, making them vulnerable to predators. However, it is not anticipated that significant numbers of birds nest along the margins of Stannon Lake and the water level changes predicted are unlikely to occur at a rate to affect nest stranding prior to fledging. During the winter, predicted changes to water levels would not adversely affect access by diving waterbirds to their prey of small fish and large invertebrates. Decreased flow in the downstream waterbodies of Stannon Lake would not adversely affect foraging or breeding of birds, as it will come into place prior to the breeding season commencing, and whilst minor dilatation of prey species within the waterbodies may occur, this would be mitigated by the flexibility in the bird species foraging, utilising different areas of the waterbodies. The water level changes are predicted to have minor effects on macrophyte communities, macroinvertebrates, and fish within Stannon Lake and negligible effects on macrophyte communities, negligible effects on macroinvertebrates, and minor/ negligible effects on fish within streams with connectivity to Stannon Lake. Therefore, waterbird communities would be resilient to the identified changes in water levels in the study area both directly and indirectly at any time of the year.

6.4.5.1 Wading birds

The greater exposure of margins may be of benefit as a temporary reduction in water levels may expose greater areas of shoreline and offer additional foraging opportunities for wading bird species.

There are no breeding records of waders at Stannon Lake from the available data. Outside of the main breeding season the sensitivity of wading birds is also considered to be **Low** from any changes in water levels and any potential impacts can also be excluded as being of **Minor** as these birds migrate. It is also more likely that exposure of additional bottom sediments would offer wading birds additional foraging areas, so may lead to a minor beneficial impact.

In summary, the impact significance on wading birds is considered to be **Negligible** should the proposed drought permit be implemented during the non-breeding and non-breeding periods.

Therefore, there is no requirement for during drought permit monitoring of wading birds (the recommended monitoring is covered in Section 9).

There are no WeBS datasets available for within Stannon Lake, although WeBS data for the nearby Crowdy Reservoir are available for all waterbird species, including those listed as protected species. Data confidence is corroborated by species accounts and sightings

reported in the Cornwall Bird Atlas (2018) and the ERCCIS. As such, confidence in the assessment is considered of a **Medium** level.

6.4.5.2 Wildfowl

Breeding wildfowl, including Canada goose, teal, and mallard, often seek breeding sites on the edge of reservoirs. However, as for waders, the predicted change in water levels is unlikely to increase the risk of nest exposure during the breeding season. Canada goose, teal, and mallard nest beside waterbodies but due to the timing and extent of the predicted changes in water level, it is unlikely that there would be an increased risk of nest exposure during the breeding season and as such these species would have a low sensitivity to this. As such, these three species are considered to have a **Low** or **No sensitivity** during the breeding season to the potential changes in water level estimated for this drought permit and the proposed drought permit is not anticipated to cause any significant loss of macrophytes as the magnitude of any impact is minor within Stannon Lake and negligible within streams with connectivity to the lake. The impact significance has been categorised as **Negligible**.

The wintering waterfowl population confirmed to be present within the vicinity of Stannon Lake through the Cornwall Bird Atlas (2018) is comprised of tufted duck only. However, a larger array of waterfowl species have been reported in the WeBS data from nearby Crowdy Reservoir and from the ERCCIS data from the Stannon Stream and Camel (De Lank to Stannon) WFD catchment areas, although the time of year for the majority of these records is not stated. These data include records of coot, mallard, great crested grebe, wigeon, gadwall, pintail, and goosander, among other species with similar environmental requirements. For these species the sensitivity to the predicted changes in water levels are considered to be **Low**. Many species of wildfowl feed on aquatic plants. Lowered water levels as a result of a drought can be beneficial to feeding wildfowl as the plants can become more accessible. However, if drought conditions are prolonged, plants can become exposed and dry out and die, which could lead to a reduction in food availability. However, as wildfowl are considered to have a **Low** sensitivity to the potential changes in water level estimated for this drought permit and the proposed drought permit is not anticipated to cause any significant loss of macrophytes the magnitude of any impact is **Negligible**.

Goosander and other piscivorous species including cormorant and grey heron are considered to have a **Low** sensitivity to the potential changes in water level estimated for this drought permit. Considering the impact on fish considered to be minor/ negligible then it is likely that there would be a negligible impact on food availability for these birds. The impact significance has been categorised as **Negligible**.

Therefore, there is no requirement for during drought permit monitoring of wildfowl species (the recommended monitoring is covered in Section 9).

As above, the confidence in the assessment is considered of a **Medium** level.

6.4.5.3 Passerine birds

The breeding and non-breeding passerines (e.g., reed bunting, dipper, and grey wagtail) that feed on invertebrates have a **Low** sensitivity to small changes in water levels and are likely to remain present in in all but the most extreme drought situations when the waterbody more or less dries up. This type of situation is not predicted to occur under the proposed drought permit as there is a 3m hands-off level that would cause abstraction to cease, and therefore the impact magnitude is considered to be Negligible. Considering the low sensitivity of all passerines during the breeding and non-breeding season and a negligible impact magnitude, the resultant significance of impacts on passerine birds is considered to be **Negligible** significance.

Therefore, there is no requirement for during drought permit monitoring of passerine species (the recommended monitoring is covered in Section 9).

Passerine data for Stannon Lake are available from the Cornwall Bird Atlas (2018) in addition to records presented within the ERCCIS data from the Stannon Stream and Camel (De Lank to Stannon) WFD catchment areas. Impacts upon passerines are considered to be negligible, regardless of the baseline data availability. As such, confidence in the assessment is considered of a **High** level.

6.5 Protected species

6.5.2 Background

A desk study was undertaken to identify any protected and/ or notable species within the extent of the 'Stannon Stream' (GB108049007040) and 'Camel (De Lank to Stannon)' (GB108049006980) water body catchment areas as defined by the Water Framework Directive (WFD). Species records were provided by The Environmental Records Centre for Cornwall and the Isles of Scilly (ERCCIS). Any records pre 2012 have been scoped out of this report as they are not deemed relevant for this assessment.

The proposed drought permit includes increasing the abstraction rate from the lake from 4 Mld to 6 Mld. All infrastructure is already in place to facilitate the proposed works and no vegetation clearance is anticipated during the works. Any species with a direct dependence on the hydrological network were therefore scoped into the assessment. Adverse effects on other protected and/ or notable species are not anticipated as a result of the increased abstraction rates.

The following species have been scoped into the assessment for further consideration:

- Great crested newt *Triturus cristatus;*
- Common toad *Bufo Bufo*;
- Otter *Lutra Lutra;*
- Beaver *Castor fiber;*

- Water vole *Arvicola amphibious.*

Great crested newts (GCN), otters, and beavers are European protected species and are legally protected under Schedule 2 of the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019.

The Wildlife and Countryside Act 1981 affords legal protection to GCN, otters, beavers and water voles under Schedule 5.

Common toads, otters, and water voles are listed as a species of principal importance under Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006.

6.5.3 Potential routes of impact

All species scoped into the report could be impacted by a reduction in discharge through a loss of wet areas.

GCN and common toad

A change in water level in Stannon Lake and water catchment areas may decrease the suitability of the habitats for GCN and common toad. This could also increase predation on these animals.

Otters, water voles and beaver

A reduction of flow into the connecting rivers has the potential to decrease habitat suitability by exposing burrow, holt and lodge entrances that may be underwater. This could disturb the animals in their resting places and places of shelter, which may cause them to disperse. Increased predation on water vole could arise as a result of exposed burrows.

Changes to fish populations as a result of the abstraction within Stannon Lake may have an impact on food availability for otters within the lake and within the water catchment areas.

6.5.4 Baseline

A full species list is provided in Appendix 1 . Relevant species data returned from the ERCCIS has been summarised in Table 6-10 below.

GCN and common toad

Twenty-nine records of common toad were returned from the data search, with the closest record located 100m southeast of the site.

The desk study did not return any records of GCN within the two catchment areas.

Other common amphibian records including common frog *Rana temporaria* and palmate newt *Lissotriton helveticus* were returned in the data search (Appendix 1).

Otters, water voles and beaver

Four records of otter have been returned in the desk study, with the closest record located approximately 900m northeast of Stannon Quarry Lake. No otter holts were returned by the data search and all four records were of otter spraints.

North Bodmin Moor and Wenfordbridge to Helsbury Park Country Wildlife Sites (CWS) both support otters. These sites are located within the Stannon Stream and the Camel (De Lank to Stannon) catchment areas respectively.

The desk study did not return any records of water vole within the two catchment areas. In 2002 water vole were considered extinct in Cornwall however several reintroduction programmes have taken place in recent years. Water voles were reintroduced to Bude in 2013.

The desk study did not return any records of beaver within the two catchment areas. Beavers have been reintroduced to Cornwall in recent years and are known to be living within the Tamar catchment area which is located adjacent to the Stannon Stream catchment area.

Table 6-10 Baseline protected and/ or notable species data (year 2012 onwards)

Species	NGR	Location	Number of Records	Record Duration	Distance to Stannon Lake
Common toad	SX129808 SX120810 SX110820	St Breward Harpurs Down Crowdy marsh	29	2014 – 2020	100 m SE 250 m W 1.6 km NW
Eurasian otter	SX139818 SX09227855 SX08867785	Rough Tor Hamatethy Gam bridge	4	2016 – 2022	900 m NE 3.8 km SW 4.6 km SW

6.5.5 Impact assessment

GCN and common toad

It is unlikely that Stannon Lake supports a population of GCN due to several different factors. Great crested newts are sparsely found in the southwest of England and the lake itself has a large surface area of approximately 0.32km². It is likely that the lake supports large numbers of waterfowl and fish, which will predate on GCN. Due to an absence of records and the sub-optimal habitat in the lake, the abstraction of water within Stannon Lakes is not likely to adversely affect GCN.

Rivers are not suitable habitat to support GCN and act as a major barrier to movement/ dispersal. It is therefore considered that the Camel River does not support a population of GCN.

The habitat within the catchment area supports common toads and common amphibian species. It is unlikely that these species will be significantly impacted as a result of the abstraction of water from Stannon Lake as amphibians are resilient to water level changes. Should the abstraction result in significant changes in the water table, this may impact the habitat suitability for common toads in respect to marshlands, rough grasslands and wetlands. However, as detailed in Section 5.1.2.1, the nature of the superficial deposits and the drainage associated with the past quarrying provide some degree of hydraulic disconnection between surface water and groundwater interactions. It is therefore unlikely that the proposed drought permit would affect the water table (and, furthermore, the maximum drawdown condition already specified within the licence would be maintained).

Otters, water voles and beaver

It is likely that Stannon Lake supports foraging otters, and it is possible that the surrounding area supports holts. The abstraction of water from Stannon Lake is considered unlikely to impact the population size and/ or the location availability of fish during implementation of the proposed drought permit. Immediate effects of a Moderate significance are limited to possible impacts on spawning, not on adult fish, and within a short reach of stream (Section 6.3.7.2). Whilst fish are a staple food source for otter it is unlikely that the proposed drought permit will have a significant impact on foraging as otter are a highly mobile species, with large territories and multiple prey sources.

Holts located above the ground level within the two water bodies are likely to be undisturbed by the abstraction of water. Should there be a significant reduction of the water level in the surrounding rivers, underwater holt entrances may be exposed. However, the hydrological pathway assessment predicts a Low impact on flows in the Stannon Stream. The abstraction works are therefore considered to have a **Minor** adverse significance of impacts on otters as a result of likely disturbance to their foraging resources and possible reduction in water level, which could expose holt entrances.

Therefore, there is no requirement for during drought permit monitoring of otter, water vole and beaver (the recommended monitoring is covered in Section 9).

Water vole have been reintroduced in Bude in 2013, which is located approximately 25 km from Stannon Lake. It is unlikely that a water vole population has established in the Stannon Stream and Camel (De Lank to Stannon) catchment areas due to the large distance between the two sites and an absence of records. Adverse effects to water vole are therefore not anticipated as a result of the works.

In 2017 beavers were reintroduced to Woodland Valley Farm near Ladock and more recently, in 2020, have been introduced to Bodmin Moor. These two reintroduction locations are

located approximately 40 km and 12 km from Stannon Lake. The two beavers introduced at Bodmin Moor have remained in the Tamar catchment area and are considered likely absent from the 'Stannon Stream' (GB108049007040) and 'Camel (De Lank to Stannon)' (GB108049006980) water body catchment areas. Adverse effects to beaver are therefore not anticipated as a result of the works.

6.6 Invasive Non-Native Species

6.6.2 Background

The latest drought planning guidance recommends that the associated environmental assessment explicitly addresses potential impacts of the proposed drought permit on the risk of spreading invasive non-native species (INNS). Within this assessment a species-based approach is taken to examine how potential pathways of impact resulting from the proposed drought permit may affect the potential for aquatic and riparian INNS to spread. As other INNS may enter the relevant water bodies at any point (temporally and geographically) the species included in this assessment should be treated as indicative of how others may respond to the proposed drought permit.

This assessment focusses on potential effects of the proposed drought permit on INNS from Stannon Lake and waterbody. This drought permit is intended to be in effect from November 2022 to 1st April 2023. The impact (either negative or positive) of the proposed drought permit on the potential of INNS to spread is considered for species in the study area that listed under Schedule 9 of the Wildlife and Countryside Act 1981 (WCA) and the Invasive Alien Species Order 2019 (species of Union Concern). All species designated as "High", "Moderate" or "Unknown" Impact on the WFD UKTAG Aquatic Alien Species List were also included.

To identify which INNS are present in the study area, data was downloaded from the National Biodiversity Network (NBN) Atlas and only records with an open general licence or a creative commons attribution licence were used (downloaded October 2022).

6.6.3 Potential routes of impact

The proposed drought permit could potentially affect the spread of INNS in several ways, including:

i) A reduction in river wetted area, leading to an increase in relative density of INNS present within the river channel and the exposure of bankside habitat presenting opportunities for temporary colonisation by riparian INNS;

ii) Changes in river flow rates. Reduced flows may decrease the potential for certain INNS (e.g., plant propagules) to be dispersed downstream but could also increase the potential for other species (e.g. crayfish) to migrate upstream. Alternatively, increased flows could increase the potential for certain INNS to be spread downstream but also reduce the chance for upstream migration of others; and

iii) Changes in water quality in the affected rivers, which may influence the establishment success and/ or dispersal potential of some aquatic animal INNS.

6.6.4 Baseline

From Stannon Lake to the confluence with the River Camel, no INNS were recorded based on open-source data. On the River Camel, within the proximity of the confluence with Stannon Lake, Himalayan balsam (*Impatiens glandulifera*), Japanese knotweed (*Fallopia japonica*), American mink (*Neovison vison*) and New Zealand mud snail (*Potamopyrgus antipodarum*) were recorded (Table 6-11 and Figure 6.2). Mink, which have large home ranges, have been recorded approximately 300m upstream, but included here for completeness. Other INNS may be present which have yet to be detected or recorded on NBN.

Table 6-11 INNS recorded within close proximity of the zone of influence

Species	Categorisation
American mink (*Neovison vison*)	Wildlife and Countryside Act Schedule 9
Himalayan balsam (*Impatiens glandulifera*)	WFD UKTAG **High Impact,** Invasive Alien Species of Union Concern, Wildlife and Countryside Act Schedule 9
Japanese knotweed (*Fallopia japonica*)	WFD UKTAG **High Impact,** Wildlife and Countryside Act Schedule 9
New Zealand mud snail (*Potamopyrgus antipodarum*)	WFD UKTAG **Moderate Impact**

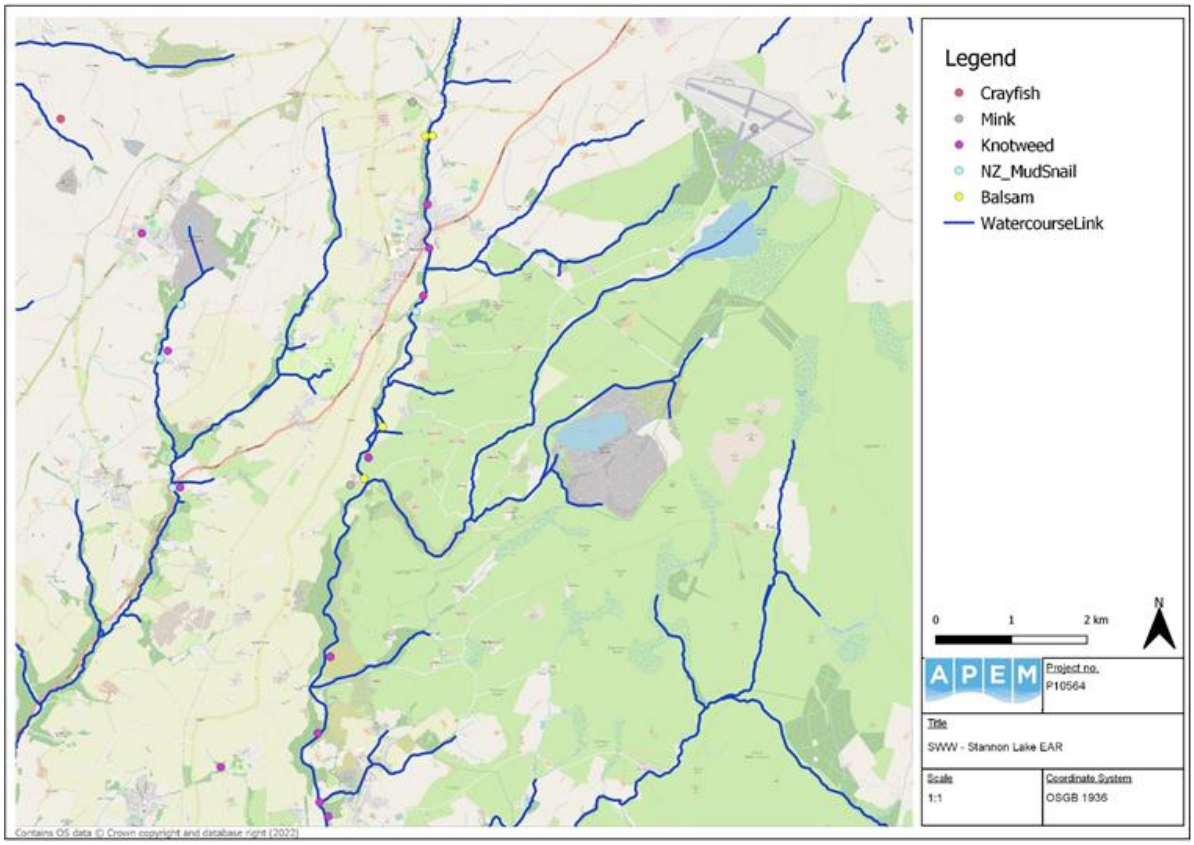


Figure 6.2 INNS in the zone of influence and in the upstream River Camel

For info. Crayfish are in the adjacent catchment.

6.6.5 Impact assessment

A decrease in water level below baseline conditions

A reduction in wetted area in Stannon Lake could increase the area available for colonisation by high-risk riparian plant INNS, depending on the season/ time of year. A reduction in wetted area would lead to more exposed bankside which can be quickly colonised by species such as Himalayan balsam. This could cause an overall increase in the density of INNS macrophytes along the river, and therefore propagule loading into the system, depending on the season. This may result in an increase in competition with native macrophyte communities. However, as this drought permit would be in effect between November and 1st April 2023, many species such as Himalayan balsam will have already set seed and died back for winter. As such, additional growth on exposed bankside is very unlikely during this time period. However, a reduction in wetted area may extend the riparian zone and therefore increase the amount exposed seedbank (present in the riverbanks) to favourable conditions for germination in Spring. Additionally, the decrease in wetted area is likely to result in American mink adapting to more terrestrial prey and prolong a behaviour naturally observed during summer.

Under the drought permit scenario effects on wetted habitat space is predicted to be between **Negligible** and **Minor** (depending on the section of river being assessed). There will therefore be a minor increase in the area of exposed inundation zone which may allow minor increases in distribution and spread of INNS. Therefore, the overall significance of impact has been categorised as **Negligible**.

Flow changes

The flow of Stannon Lake within the zone of impact will be reduced relative to baseline conditions and previous years. During winter months, the macrophyte species mentioned often rely on flood flows to erode riverbanks and disperse seeds from bankside seedbanks. Therefore, decreased water levels and flow changes may decrease the dispersal distance of some INNS macrophytes downstream. This reduction in propagule pressure may be compensated by the increased population density within the zone of influence, owing to the decreased water levels. However, the reduction in propagule pressure for INNS macrophytes such as Himalayan balsam may be compensated by the lateness in season of this flow reduction, as many macrophyte species have already set seed and died back in preparation for winter. Decreased flow is unlikely to cause any impact on American mink. Therefore, the net effect of the flow rate changes on the spread of these species can be expected to be **Negligible**. The significance of their impact would be categorised as **Negligible**.

Water quality changes

Changes in water quality parameters because of the drought permit may alter the suitability of the habitat for some INNS. For instance, elevated levels of ammonia can be toxic to aquatic invertebrates. Under the drought permit scenario, effects on water quality are predicted to be between **Low** and **Minor** (depending on the parameter being assessed) in the Stannon Lake water body. The risk in terms of the drought permit affecting INNS spread/ impact is considered to be negligible because of the absence on INNS in the zone of influence and low sensitivity, or absence of sensitivity, of the INNS species recorded close to the zone of influence. The significance of impact has been categorised as **Negligible**.

Therefore, there is no requirement for during drought permit monitoring of INNS (the recommended monitoring is covered in Section 9).

6.6.6 Summary

Species that are adaptable to a wide range of environmental conditions and tolerant to (or may even benefit from) habitat disturbances (e.g., fire, mutilation, grazing pressure, cultivation) were classed as Not Sensitive. Species that are considered to be more sensitive but still able to adapt and survive in a range of conditions were considered as of Low sensitivity. Any species not thought to be tolerant to environmental change were classed as Medium or High sensitivity on a case-specific basis. A general trait of INNS is that they are tolerant of and able to adapt to a wide range of environmental conditions, therefore generally fall into the Not Sensitive or Low Sensitivity categories. Results are summarised in Table 6-12

Table 6-12 Summary of predicted impacts of drought permit on INNS recorded in the proximity of the zone of influence

Species	Sensitivity	Significance of impact	Confidence level
Japanese knotweed (*Fallopia japonica*)	Not sensitive	Negligible	High
Himalayan balsam (*Impatiens glandulifera*)	Low	Negligible	High
American mink (*Neovison vison*)	Not sensitive	Negligible	Medium

7. Assessment of other receptors

7.1 Socio-economics, tourism and recreation

7.1.2 Baseline

Stannon Stream water body

Stannon Lake itself is not open to the public for any form of tourist or recreational activity. There are no footpaths or cycleways that exist within the immediate vicinity of the lake. The upper catchment to the east of Stannon Lake is registered common land; the boundary of which largely coincides with Bodmin Moor SSSI. National cycle network route 3 (on road) crosses the Stannon Stream just upstream of the confluence with the Crowdy stream (Figure 7.1). Two public footpaths also cross the watercourse within the Stannon Stream water body, but none run adjacent.

Figure 7.1 Map of access in the vicinity of Stannon Lake

Stannon Stone circle is located in close proximity to Stannon Lake (Section 7.3). The site is considered a tourist attraction but would draw limited footfall and is not hydrologically sensitive.

South West Lakes Game and Coarse Fisheries own fishing rights to Crowdy Reservoir, which is described as a wilderness trout fishery (115 acres), wild brown trout (*Salmo trutta*), fly fishing only. No angling club waters exist elsewhere in the Stannon Stream water body[7].

Camel (De Lank to Stannon) water body

Within the Camel (De Lank to Stannon) water body, there are no major tourist attractions or recreational spaces within close proximity to the river. The Camel Trail (National Cycle Network, route 3) is set back from the river along much of its length within this water body, following directly adjacent only in the small reach between Wenfordbridge and the confluence with the De Lank.

Fishing rights are owned by Tresarrett Fishery (0.75 miles on the Camel near Tresarrett) and Westcountry Rivers Trust (Westcountry angling passport (Camel)). The exact start and finish coordinates are unknown but the reaches are in the vicinity of the De Lank confluence, at the downstream end of this water body. Fisheries present within the Camel (De Lank to Stannon) water body also include Hengar Manor Holiday Park and Prince Park Lake, but these are unconnected stillwater course lakes.

7.1.3 Impact assessment

The sensitivity of the receptor is considered **Low**. However, the magnitude of impact to socio-economics, tourism and recreation within the Stannon Stream water body is considered **Negligible**. Therefore, the overall assessment for this receptor is **Negligible**.

Therefore, there is no requirement for during drought permit monitoring of socio-economics, tourism and recreation (the recommended monitoring is covered in Section 9).

7.2 Aesthetics and landscape

7.2.2 Baseline

Stannon Stream water body

The area surrounding Stannon Lake itself comprises the old China Clay quarry site, now scrub/ grassland. The area is rural and only a few properties (<10) overlook Stannon Lake within a few hundred metres of the lake. These include a holiday cottage Moor View Chapel in the hamlet of Highertown. Cornwall Area of Outstanding Natural Beauty (AONB) approximately follows the boundary of Bodmin Moor SSSI at a distance of ~300-500m to the east and south of the lake. There are views from the outskirts of the AONB over Stannon Lake.

7 https://www.gethooked.co.uk/fishing/where-to-fish

Downstream of Stannon lake to the confluence with the River Camel, the watercourse has wooded riparian margins and only a single property, at the confluence with the Crowdy Stream, is anticipated to have views over the watercourse. As described in Section 7.1, opportunities for public access, and therefore views over the watercourse, are limited.

Camel (De Lank to Stannon) water body

The River Camel immediately downstream of the Stannon Stream confluence, is bounded by agricultural fields with narrow wooded margins. After a few hundred metres, the river enters an area of dense deciduous woodland which persists down to the Coombe Road crossing at the village of Row. The downstream portion of the water body is again, mainly agricultural, with narrow riparian margins and a spattering of properties, including holiday cottages over-looking the river at Coombe Mill. The River Camel within this water body does not fall within Cornwall AONB.

7.2.3 Impact assessment

The sensitivity of the receptor is considered **Low**. However, the magnitude of impact to aesthetics and landscape within the Stannon Stream water body is considered **Negligible**. Therefore, the overall assessment for this receptor is **Negligible**.

Therefore, there is no requirement for during drought permit monitoring of aesthetics and landscape (the recommended monitoring is covered in Section 9).

7.3 Archaeology and cultural heritage

7.3.2 Baseline

Stannon Stream water body

There are no scheduled monuments or listed buildings within the immediate vicinity of Stannon Lake.

Between Stannon Lake and the River Camel confluence, there are two scheduled monuments and five grade II listed buildings within ~200m of the watercourse. These are detailed in Table 7-1. Of these, two are directly located on the Stannon stream; Clapper bridges at Allansford and Trecarne.

The theoretical pathway of impact on the Clapper bridges relate to drops in water level that would temporarily expose previously submerged stonework, which could potentially be damaged by a cycle of drying and rewetting.

Camel (De Lank to Stannon) water body

There are nine grade II listed buildings and one scheduled monument within ~200m of the watercourse in the Camel (De Lank to Stannon) water body. These are detailed in Table 7-1.

Of these, three are directly located on the Stannon stream; Gam bridge, roadbridge north east of Coombe Millhouse and bridge at Wenfordbridge.

The theoretical pathway of impact on the bridges relate to drops in water level that would temporarily expose previously submerged stonework, which could potentially be damaged by a cycle of drying and rewetting.

Table 7-1 Baseline archaeology and cultural heritage data (listed upstream to downstream)

Name	NGR	Type	Details
Stannon Stream water body			
Whitewalls Farmhouse	SX 11914 80684	Grade II listed	Outbuildings and garden wall
Disused Farmhouse at Heneward	SX 11616 80059	Grade II listed	n/a
Two hut circles 400m WSW of Furhouse	SX 11437 80423	Scheduled monument	n/a
Hut circles 330yds (300m) SW of Henneward	SX 11398 79976	Scheduled monument	Stone hut circles were the dwelling places of prehistoric farmers on the Moor, mostly dating from the Bronze Age (c.2000-700 BC).
Clapperbridge 100 m to south east of Allansford	SX 11066 79993	Grade II listed	Image available at https://historicengland.org.uk /listing/the-list/list-entry/1328107
Allansford	SX 11042 80041	Grade II listed	Allansford is a particularly picturesque small house of a type which is rapidly disappearing from Cornwall (Historic England)
Clapper bridge 150 m to east of Trecarne	SX 09753 80533	Grade II listed	Image available at: https://historicengland.org.uk /listing/the-list/list-entry/1142752
Camel (De Lank to Stannon) water body			
Gam Bridge	SX 08875 77861	Grade II listed	Road bridge over Rivers Allan and Camel. Mid C19. Stone rubble and granite. Seven span bridge with unmoulded granite lintels and crude cutwaters.
Holy well near St James' Chapel	SX 09054 76891	Scheduled monument and Grade II	Holy well dedicated to St James. Late medieval. Well sump now dry.
Roadbridge 70 m to north east of Coombe Millhouse	SX 08931 76332	Grade II listed	Road bridge over River Camel. Circa C19. Granite. 3-span bridge with granite rubble piers and large monolithic granite lintels.
Small footbridge and stile 100 m to north east of Coombe	SX 09003 76370	Grade II listed	Circa C19. Small footbridge over tributary of River Camel. Granite and slate.

Name	NGR	Type	Details
Millhouse			
Coombe Millhouse	SX 08869 76308	Grade II listed	Millhouse. Circa late C16 or early C17. Stone rubble. Rag slate roof with gable ends.
Bridge at Wenfordbridge	SX 08496 75165	Grade II listed	GV II Road bridge over River Camel. C19 with earlier origins, partly rebuilt after flood of 1847. Local stone and granite rubble with ashlar granite dressings.
Wenford Bridge House and the Brewhouse	SX 08556 75163	Grade II listed	A C19 former public house converted into a house and workshops by the potter Michael Cardew in 1939. Listed for architectural and historic interest
Guidepost at Wenfordbridge	SX 08555 75145	Grade II listed	Circa late C18. Granite monolith of rectangular section with round head.
Wenford Dries	SX 08494 74476	Grade II listed	China Clay Dry built early C20 by the Stannon China Clay Company. Series of conjoined buildings. his example is unusual in that it consists of a series of conjoined dries. Such buildings are highly unusual, and very much a Cornwall and West Devon speciality.

7.3.3 Impact assessment

The sensitivity of the receptor (in-channel features) is considered **Low**. The magnitude of impact to archaeology and cultural heritage within the Stannon Stream water body is considered **Low**. Therefore, the overall assessment for this receptor is **Negligible**.

Therefore, there is no requirement for during drought permit monitoring of archaeology and cultural heritage (the recommended monitoring is covered in Section 9).

7.4 Designated sites

7.4.2 Baseline

Stannon Lake itself is covered by no statutory designations. The Stannon stream downstream of Stannon Lake is skirted by Bodmin Moor (SSSI) which overlaps the stream for a short stretch (~200 m) at Allanford. Cornwall AONB follows the left bank of the Stannon stream for approximately 1.5km. Further details on these designated sites are presented in Table 7-2.

The Camel (De Lank to Stannon) is covered by two designations for its entire length within the waterbody; River Camel Valley and Tributaries SSSI and River Camel (SAC). The SAC is designated as a primary reason for Bullhead *Cottus gobio* and Otter *Lutra lutra,* with qualifying species Atlantic salmon *Salmo salar*. In addition to these species, the SSSI designation lists sea trout *Salmo trutta* and sea lamprey *Petromyzon marinus,* mammals greater and lesser horseshoe bats *Rhinolophus ferrumequinum* and *R. hipposideros* and water vole *Arvicola terrestris,* and a number of bird species. Further details on these designated sites are presented in Table 7-2.

Table 7-2 Designated sites

Name	Designation	Description of interaction	Designation details
Stannon Lake			
There are no designated sites which intersect Stannon Lake itself			
Stannon Stream water body			
Bodmin Moor	SSSI	The SSSI extends at a distance of ~300-500m around the east and south side of Stannon Lake and overlaps the Stannon stream for a short stretch (~200 m) at Allanford.	Range of upland plant communities: wet heath, dry grassland, valley bogs, blanket bogs and crags. Major importance for both nesting and wintering birds. The Moor is one of the best dragonfly and damselfly sites in the County and also supports nationally scarce butterfly species. Noted also for Otters *Lutra lutra* along watercourses and records of Harvest Mouse *Micromys minutus.*
Cornwall	AONB	Similar extent to Bodmin Moor SSSI. However, AONB borders Stannon Stream to south for a longer distance ~ 1.5 km.	Cornwall AONB covers approximately 27% of the county. At this location, the AONB covers Bodmin Moor, described as 'the only extensive upland area in Cornwall and is dominated by granite outcrops with characteristic stone tors and clitter slopes, a wealth of mineral deposits and unusual river profiles'[8].
Camel (De Lank to Stannon) water body			
River Camel	SAC	Camel itself and riparian margins.	Primary reasons for site selection: • Bullhead *Cottus gobio* • Otter *Lutra lutra* Qualifing species: • Atlantic salmon *Salmo salar*

8 https://landscapesforlife.org.uk/about-aonbs/aonbs/cornwall

Name	Designation	Description of interaction	Designation details
			Qualifying habitats: • European dry heaths • Old sessile oak woods with *Ilex* and *Blechnum* • Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*
River Camel Valley and Tributaries	SSSI	Camel itself and riparian margins.	System is particularly important for otters *Lutra lutra,* fish such as the Atlantic salmon *Salmo salar*, bullhead *Cottus gobio*, sea trout *Salmo trutta* and sea lamprey *Petromyzon marinus*. Rare greater and lesser horseshoe bats *Rhinolophus ferrumequinum* and *R. hipposideros* feed along the watercourses along with the kingfisher *Alcedo atthis*, dipper Cinclus cinclus, grey wagtail *Motacilla cinerea* and water vole *Arvicola terrestris* which also breed[9].

7.4.3 Impact assessment

For consideration of impact to the River Camel SAC see separate HRA report.

Bodmin Moor SSSI impact assessment takes conclusions from assessment sections Macroinvertebrates (Section 6.2), Birds (Section 6.4) and Protected species (Section 6.5), and with consideration of the minimal overlap (~200m) with the SSSI site. The sensitivity of the receptor is considered **Medium**. The magnitude of impact to the SSSI within the Stannon Stream water body is considered **Negligible**. Therefore, the overall assessment for this receptor is **Negligible**. Therefore, there is no requirement for during drought permit monitoring specifically related to Bodmin SSSI (the recommended monitoring is covered in Section 10).

With consideration of Cornwall AONB, the sensitivity of the receptor is considered **Low**. The magnitude of impact to the AONB within the Stannon Stream water body is considered **Negligible**. Therefore, the overall assessment for this receptor is **Negligible**. Therefore, there

9 https://designatedsites.naturalengland.org.uk/PDFsForWeb/Citation/2000151.pdf

is no requirement for during drought permit monitoring specifically related to Cornwall AONB (the recommended monitoring is covered in Section 9).

River Camel Valley and Tributaries SSSI impact assessment takes conclusions from assessment sections Macroinvertebrates (Section 6.2), Fish (Section 6.3), Birds (Section 6.4) and Protected species (Section 6.5). The sensitivity of the receptor is considered **High**. The magnitude of impact to the SSSI within the River Camel (Camel (De Lank to Stannon)) Water Body is considered **Negligible**. Therefore, the overall assessment for this receptor is **Minor**. Therefore, there is no requirement for during drought permit monitoring specifically related to the SSSI (the recommended monitoring is covered in Section 10).

However, as stated in Section 6.3.7, the impact assessment for Fish concluded that baseline/ pre-drought permit and during drought permit monitoring (geomorphology and habitat walkovers, see Table 9-1) was recommended specifically related to the Moderate impact significance for the spawning life stages of Atlantic salmon, brown trout and bullhead, in the reach between Stannon Lake outflow and the confluence with the Crowdy Stream. As this reach of Stannon Stream (Stannon Lake outflow to the confluence with the Crowdy Stream) could be considered functional habitat of the River Camel Valley and Tributaries SSSI, effectively monitoring is recommended to take place for the SSSI.

8. Summary

The data collation and overview of the likely potential impacts has taken place for the following features:

- River flow and level;
- Habitat and geomorphology;
- Water quality;
- Macrophytes and phytobenthos;
- Macroinvertebrates;
- Fish;
- Birds;
- Protected species;
- The risk of spread of INNS;
- Socio-economics, tourism and recreation;
- Aesthetics and landscape;
- Archaeology and cultural heritage; and
- Designated sites.

The predicted impacts (arranged by season, receptor and drought permit scenario) are summarised in Table 8-1.

Table 8-1 Summary of predicted impacts. Note that the proposed implementation of the drought permit is from November to April

		Sensitivity of receptor	S	O	N	D	J	F	M	A	M	J	J	A	Level of Confidence
Pathways	**Hydrology**														
	Stannon Stream (GB108049007040)				L	L	L	L	L	L					Medium
	Camel (De Lank to Stannon) (GB108049006980)				N	N	N	N	N	N					High
	Habitat and geomorphology														
	Stannon Stream (GB108049007040)				Mo	Mo	Mo	Mo	Mo	Mo					Medium
	Camel (De Lank to Stannon) (GB108049006980)				N	N	N	N	N	N					Medium
	Water Quality														
	Stannon Stream (GB108049007040)				Mi	Mi	Mi	Mi	Mi	Mi					Medium
	Camel (De Lank to Stannon) (GB108049006980)				N	N	N	N	N	N					High
Receptors	**Phytobenthos and macrophytes**														
	Stannon Stream (GB108049007040)	Medium			Mi	Mi	Mi	Mi	Mi	Mi					Medium
	Camel (De Lank to Stannon) (GB108049006980)	Low			N	N	N	N	N	N					Low
	Macroinvertebrates														
	Stannon Stream (GB108049007040)	Medium			Mi	Mi	Mi	Mi	Mi	Mi					Low
	Camel (De Lank to Stannon) (GB108049006980)	Medium			N	N	N	N	N	N					Medium
	Fish														
	Stannon Stream (GB108049007040)	High			Mo	Mo	Mo	Mo	Mo	Mo					Medium
	Camel (De Lank to Stannon) (GB108049006980)	High			N	N	N	N	N	N					Medium
	Protected species (incl. birds)														
	Stannon Stream (GB108049007040)	Low			Mi	Mi	Mi	Mi	Mi	Mi					Medium
	Camel (De Lank to Stannon) (GB108049006980)	Low			Mi	Mi	Mi	Mi	Mi	Mi					Medium
	Non-native species														
	Stannon Stream (GB108049007040)	Low			N	N	N	N	N	N					High
	Camel (De Lank to Stannon) (GB108049006980)	Low			N	N	N	N	N	N					High
	Socio-economics, tourism and recreation														
	Stannon Stream (GB108049007040)	Low			N	N	N	N	N	N					High
	Camel (De Lank to Stannon) (GB108049006980)	Low			N	N	N	N	N	N					High
	Aesthetics and landscape														

		Sensitivity of receptor	S	O	N	D	J	F	M	A	M	J	J	A	Level of Confidence
	Stannon Stream (GB108049007040)	Low			N	N	N	N	N	N					High
	Camel (De Lank to Stannon) (GB108049006980)	Low			N	N	N	N	N	N					High
	Archaeology and cultural heritage														
	Stannon Stream (GB108049007040)	Low			N	N	N	N	N	N					High
	Camel (De Lank to Stannon) (GB108049006980)	Low			N	N	N	N	N	N					High
	Designated sites														
	Stannon Stream (GB108049007040)	Medium			N	N	N	N	N	N					High
	Camel (De Lank to Stannon) (GB108049006980)	Medium			N	N	N	N	N	N					High

Key

Magnitude of impact on pathway		Significance of impact on receptor	
H	High		Major
M	Medium		Moderate
L	Low		Minor
N	Negligible		Negligible
U	Uncertain		Uncertain
NA	Not assessed	NA	Not assessed

9. Monitoring plan

9.1 EMP introduction

An Environmental Monitoring Plan (EMP) has been developed which includes baseline, pre-drought permit implementation, during-drought permit implementation and post-drought permit implementation monitoring. The receptors to be monitored are detailed in Table 9-1, together with the agreed monitoring locations.

It is important to note that the level of monitoring is risk-based. The environmental assessment indicates that the proposed drought permit presents a low risk to the environment (negligible or minor negative impacts are predicted for most receptors) with the exception of spawning life stages of Atlantic salmon, brown trout and bullhead but only between Stannon Lake outflow to the confluence with the Crowdy Stream (GB108049007040 (Stannon Stream Water Body)), where moderate impacts are possible. Given the latter moderate effects, and uncertainties inherent in some of the assessments, monitoring has been recommended, to check the predicted degree of impact, and identify any unexpected impacts to trigger mitigation measures, if needed.

Baseline

Baseline monitoring is required to formulate a description of the existing ecological conditions, from which the impacts of drought permit operations over and above the effects of other pressures, such as natural drought, can be identified. Baseline monitoring can also help to establish the sensitivity of the environment to changes in flow and improve the level of confidence in the assessment of likely impacts. Due to the short timeline to apply for and implement the drought permit, in this case baseline monitoring can be merged with pre-drought permit monitoring.

Pre-drought permit monitoring

Pre-implementation monitoring should be triggered by SSW drought permit preparations and undertaken prior to implementation of a Stannon Lake drought permit. Pre-implementation data can be important to demonstrate the precise baseline conditions ahead of the proposed changes to the flow regime.

During Drought Permit Monitoring

In-drought monitoring is required to assess any impacts from the implementation of the drought management action and for the management of mitigation measures during a drought. It is recommended that during drought permit monitoring continue as per the pre-implementation period, except where, in consultation with the regulator, it is deemed that such monitoring may be environmentally damaging.

Post Drought Permit Monitoring

Post-drought permit monitoring aims to assess a site's recovery and to check that there are no long-term effects on any environmental features. This is important as results are needed to assess the success of mitigation measures. It can also feed back into the assessment of sensitivity and likely impact and inform the management of future drought actions. The duration of post drought permit monitoring will depend upon the severity of the natural drought but will cover the period of recovery and will be carried out in consultation with the regulator.

A summary of the EMP for the Stannon Lake drought permit is provided in Table 9-1.

Table 9-1 Summary of the Environmental Monitoring Plan for the Stannon Lake drought permit

Parameter	Locations	By whom	Scope & Why	Baseline/ Pre-drought permit	During drought permit	Post drought permit
Flow (downstream Stannon Lake)	x2 on the Stannon stream upstream and downstream of the Crowdy Brook confluence.	SWW	Spot flow gauging to monitor flows.	Once	X1 fortnightly, and the later installation of water loggers if viable.	n/a
Stannon Lake and leat hydrology	At existing New North Leat location (see the Stannon Lake GIC Report in Appendix 2)	SWW	Download of flow logger and visual inspections of Stannon Lake, Stannon stream outlet and New North Leat.	Once	Monthly	n/a
	At existing locations	SWW	Download of level loggers (as above)	Once	Monthly	n/a
	At existing locations	SWW	Download of piezometer data (as above)	Once	Monthly	n/a
Geomorphology and habitat	Habitat with specific focus on protected fish species habitat mapping.	SWW	Walkover of Stannon Lake and the Stannon Stream (to conf. with Crowdy Stream) where access permits, following the method outlined in Hendry and Cragg-Hine (1997) on stream sections.	A pre-implementation baseline walkover, as close to drought permit implementation as possible, is recommended to establish baseline conditions.	X1 fortnightly	Once post end of drought permit.

Parameter	Locations	By whom	Scope & Why	Baseline/ Pre-drought permit	During drought permit	Post drought permit
Water quality	In situ monitoring to be completed when completing flow gauging at two spot flow gauging locations on the Stannon Stream (one upstream and one downstream of Crowdy confluence)	SWW	To inform baseline, and update for current conditions.	Pre-implementation surveys, as close to drought permit implementation as possible, is also recommended to establish baseline conditions.	Fortnightly	n/a
Macrophytes & phytobenthos	Stannon Lake (x1) and Stannon Stream (x2).	SWW	Diatom sampling (spring: March until May inclusive; autumn: September to November inclusive) and macrophyte surveys (June until September inclusive), to understand baseline and impact of drought permit.	Optional. Dependent on time of year – to implement when feasible	Optional. Dependent on time of year – to implement when feasible	Optional. Dependent on time of year – to implement when feasible

Parameter	Locations	By whom	Scope & Why	Baseline/ Pre-drought permit	During drought permit	Post drought permit
Macroinvertebrates	Stannon Lake (x1) and Stannon Stream (x2).	SWW	Macroinvertebrate samples using PSYM methodology (Stannon Lake) (June to August inclusive) and 3-minute kick sampling (Stannon Stream) (spring: March until May inclusive; autumn: September to November inclusive), to understand baseline and impact of drought permit.	Optional. Dependent on time of year – to implement when feasible	Optional. Dependent on time of year – to implement when feasible	Optional. Dependent on time of year – to implement when feasible

10. Mitigation measures

10.1 Mitigation measures introduction

Mitigation measures are proposed to avoid, reduce or remedy those impacts which are considered likely to occur and sufficiently significant to warrant them, or where there is particular uncertainty about an impact. Mitigation measures are proposed to cover eventualities that may occur during drought permit operation and may not be required in every period of drought permit operation. Note also that mitigation measures are proposed to reduce the impact of drought permit operation and not the impacts of the drought itself.

The only potential impact associated with Stannon Lake drought permit which is predicted to be of Moderate significance or greater, even prior to mitigation, is that related to the spawning life stages of Atlantic salmon, brown trout and bullhead, in the reach between Stannon Lake outflow and the confluence with the Crowdy Stream (in the Stannon Stream Water Body).

Should monitoring during the drought permit indicate significant impacts to ecological receptors (e.g. signs of ecological stress, salmonid redds at risk of exposure, etc) or other river users, potential mitigation measures could include:

- Additional releases from Stannon Lake to the New North Leat via temporary augmentation; this will be achieved through the installation of temporary pumps and pipework between Stannon lake and New North Leat;
- Additional releases from Crowdy Reservoir compensation release as either a freshet or longer-term temporary discharge, to supplement the Stannon stream reach downstream of the Crowdy Brook confluence;
- All other conditions associated with the licensed Crowdy Reservoir compensation flow will remain unchanged;
- To align with the Consent to Investigate a groundwater source SWW will ensure the flow in the New North Leat at SX 12248 80927 does not fall below 5 l/s. SWW will instigate a trigger for enhanced monitoring if the flow in new North Leat falls below 10 l/s to ensure preparation and early intervention of mitigation measures.
- In the event of a pollution incident, if there is evidence of ecological distress, and/ or if reduced flows are considered to be having serious detrimental environmental consequences on downstream waterbodies then additional releases either from Stannon Lake to the New North Leat via temporary augmentation and/ or from Crowdy Reservoir compensation release;

- During the salmonid spawning season if pre-implementation walkover survey identifies the presence of salmonid redds potentially at risk of exposure, then additional releases either from Stannon Lake to the New North Leat via temporary augmentation and/ or from Crowdy Reservoir compensation release; such releases should be preventative as opposed to restorative to avoid the loss of spawning gravels and/ or desiccation of eggs.

- To facilitate movement of fish past any river structures or other barriers identified during the pre-implementation walkover survey, excluding barriers which are already known to be largely impassable to upstream and downstream movements of migratory fish, then additional releases either from Stannon Lake to the New North Leat via temporary augmentation and/ or from Crowdy Reservoir compensation release.

10.2 Additional measures

A number of additional mitigation measures could be implemented should monitoring during a drought permit indicate that significant impacts to ecological receptors, or other river users, are occurring. It may not be necessary to implement all these mitigation measures to reduce the observed impacts. Any such implementation of mitigation measures would be undertaken in consultation with the Agency:

- If fish are observed to be trapped, or in distress, during the proposed drought permit a number of measures could be taken. The decision on which method to deploy should be taken in discussion with the Agency, and according to the specific nature of the problem. Options may include:
    a. Deployment of localised aeration;
    b. Installation of fish refugia in spatially limited areas;
    c. Fish rescue and relocation if no other suitable alternative is available.

- Funding of appropriate reasonable measures (e.g. habitat restoration) could be made in mitigation of ecological damage occurring in reaches affected by reduced flows in the longer term.

11. Summary

The drought permit is predicted to have the following Moderate impacts on the Stannon Stream (GB108049007040), ONLY from the outflow from Stannon Lake to the confluence with the Crowdy Stream, in comparison with the baseline scenario:

- November 2022 – February 2023
    - Potential for a moderate impact on the spawning life stages of Atlantic salmon, brown/ sea trout and bullhead.

The effect of the drought permit is predicted to be minor or negligible on all other receptors in comparison with the baseline.

Where significant negative impacts are identified during the environmental assessment process, there is a need to identify appropriate mitigation measures to avoid, reduce or remedy any impacts.

Based on the assessment and given the uncertainties inherent in some of the assessments undertaken, a range of mitigation measures have been developed, in the event that environmental monitoring during drought permit implementation identifies that unexpected impacts are occurring.

Monitoring has been recommended to capture any changes during and after drought permit implementation. This includes checking for signs of ecological stress including potential effects on habitat availability and passability of barriers for fish.

It should be noted that not all of the mitigation measures described may be required or appropriate. If unexpected impacts are found to be occurring, potential mitigation measures should be discussed and agreed with the Agency. Mitigation measures would be implemented to reduce the impacts of the proposed drought permit and not the impacts of the drought itself.

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Appendix 1 Protected species list (ERCCIS)

Species	Latin Name	NGR	Location	Number of Records	Record Duration
Amphibians					
Common frog	*Rana temporaria*	SX115795 SX097763 SX146840	Various	57	2012 – 2022
Palmate newt	*Lissotriton helveticus*	SX15208415	Crowdy marsh	4	2018-2019
Bats					
Lesser horseshoe bat	*Rhinolophus hipposideros*	SX09057784 SX09127528	St Breward	>1000	2012 – 2018
Greater horseshoe bat	*Rhinolophus ferrumequinum*	SX09127528	St Breward	1	2018
Brown long-eared bat	*Plecotus auritus*	SX09127528	St Breward	1	2018
Invertebrates					
Black-tailed skimmer	*Orthetrum cancellatum*	SX15218402 SX15098347	Crowdy marsh Crowdy reservoir St Breward	15	2018 – 2020
Blood-vein	*Timandra comae*	SX089778	Tuckingmill	25	2014 – 2018
Bright neb	*Argolamprotes micella*	SX087772	Shell wood	1	2014
Broom moth	*Ceramica pisi*	SX097777 SX139818 SX089778	Various	33	2014 – 2018
Buff ermie	*Spilosoma lutea*	SX087772 SX089778 SX139818	Shell wood Tuckingmill Rough Tor	111	2014 – 2018
Buff-tailed mining bee	*Andrena humilis*	SX1280	Stannon Lake	1	2019
Catsear nomad bee	*Nomada integra*	SX1280	Stannon Lake	1	2019
Cinnabar	*Tyria jacobaeae*	SX089778	Tuckingmill	2	2014 & 2016
Deronectes latus	*Deronectes latus*	SX1110080160	Crowdy stream	1	2016
Dot moth	*Melanchra persicariae*	SX097777 SX139818	Rough Tor Tuckingmill	3	2014
Dusky brocade	*Apamea remissa*	SX139818	Rough Tor	41	2014
Erigonella ignobilis	*Erigonella ignobilis*	SX139818	Rough Tor	4	2020
Garden tiger	*Arctia caja*	SX102769 SX087772	Church Hay Downs Shell wood	4	2014 – 2018
Golden horsefly	*Atylotus fulvus*	SX150840	Crowdy marsh	1	2018
Gwynne's mining bee	*Andrena bicolor*	SX1280	Stannon Lake	3	2016 – 2019
Heath bumblebee	*Bombus jonellus*	SX1581 SX1582 SX1683	Rough Tor Lanlavery rock Trevillians gate	3	2013
Hot bot fly	*Gasterophilus intestinalis*	SX149813	Showery Tor	5	2014

Species	Latin Name	NGR	Location	Number of Records	Record Duration
Hydatophylax infumatus	*Hydatophylax infumatus*	SX0849075190	Camel	1	2020
Knot grass	*Acronicta rumicis*	SX082740 SX089778	Polyes bridge Tuckingmill	3	2014 & 2016
Lathbury's nomad bee	*Nomada lathburiana*	SX1076 SX1280	St Breward Stannon Lake	2	2013 & 2016
Marsh fritillary	*Euphydryas aurinia*	SX1078 SX1179 SX10857702	Treswallock Harpus Down Irish Farm	126	2018
Migrant hawker	*Aeshna mixta*	SX123806 SX08277401	Stannon clay pit Poley bridge	2	2014 – 2022
Oblique carpet	*Orthonama vittata*	SX089778 SX141824	Tuckingmill Lower moor plantation	10	2014 – 2018
Pearl-bordered fritillary	*Boloria euphrosyne*	SX09307753 SX09197733 SX0918277361	Various	182	2012 – 2019
Perkin's mining bee	*Andrena rosae*	SX1280	Stannon Lake	2	2016
Pied grey	*Eudonia delunella*	SX15218402 SX087772	Crowdy marsh Shell wood	3	2014 – 2018
Pirata piscatorius	*Pirata piscatorius*	SX15338425 SX15298422	Crowdy marsh	6	2019
Red-veined darter	*Sympetrum fonscolombii*	SX15218402	Crowdy marsh	1	2019
Rhagonycha translucida	*Rhagonycha translucida*	SX102770	Church hay down	1	2018

Species	Latin Name	NGR	Location	Number of Records	Record Duration
River skater	*Aquarius najas*	SX1383 SX1110080160	Crowdy dam Crowdy stream	2	2013 – 2016
Rosy rustic	*Hydraecia micacea*	SX082740 SX087772	Poleys bridge Shell wood	6	2014
Scarce blue-tailed damselfly	*Ischnura pumilio*	SX15158348 SX145842	Crowdy marsh Davidstow	7	2014 – 2019
Small heath	*Coenonympha pamphilus*	SX097762 SX154840 SX116789	Various	21	2013 – 2022
Small pearl-bordered fritillary	*Boloria selene*	SX108772 SX09307753	Irish farm Fellover brake	2	2018 – 2020
Small phoenix	*Ecliptopera silaceata*	SX089778 SX082740 SX087772	Tuckingmill Poleys bridge Shell wood	11	2014 – 2018
Small red damselfly	*Ceriagrion tenellum*	SX150834	Crowdy marsh	1	2014
Small square-spot	*Diarsia rubi*	SX089778 SX139818 SX082740	Tuckingmill Rough Tor Poleys bridge	42	2014 – 2018
Tormentil mining bee	*Andrena tarsata*	SX1280 SX1382	Stannon Lake Rough Tor	2	2014 & 2019
Tormentil nomad bee	*Nomada roberjeotiana*	SX1280	Stannon Lake	1	2019
Trichopternoides thorelli	*Trichopternoides thorelli*	SX139818	Rough Tor	1	2020
Violet oil-beetle	*Meloe violaceus*	SX096760	St Breward	1	2019
Wall	*Lasiommata megera*	SX09687622 SX125812 SX1683	Various including Stannon pit	11	2013 – 2020
White ermine	*Spilosoma lubricipeda*	SX089778 SX108770 SX139818	Tuckingmill Irish farm Rough Tor	57	2014 - 2018
Woundwort pearl	*Anania stachydalis*	SX089778	Tuckingmill	1	2018
Reptiles					
Adder	*Vipera berus*	SX110783	Treswallock Downs	1	2018

Species	Latin Name	NGR	Location	Number of Records	Record Duration
Common lizard	*Zootoca vivipara*	SX14718409 SX113794	Crowdy marsh Harpus Downs	7	2014 – 2019
Grass snake	*Natrix helvetica*	SX152841	Crowdy marsh	1	2018
Slow worm	*Anguis fragilis*	SX09697631 SX09597626	St Breward	2	2020
Mammals					
Brown hare	*Lepus europaeus*	SX1683 SX148823 SX15258409	Davidstow moor Crowdy reservoir	4	2012 – 2020
Eurasian badger	*Meles meles*	SX092763 SX089778 SX0978	Darryname Wood park Tuckingmill	4	2012 - 2022
Eurasian common shrew	*Sorex araneus*	SX09637617 SX09677618 SX09677618	High View Farm - St Breward	8	2018 – 2020
Fallow deer	*Dama dama*	SX0964177990	Mine hill St Breward	1	2012
Harvest mouse	*Micromys minutus*	SX100794 SX135821 SX151841	Carweather Roughtor Crowdy reservoir	3	2022
Polecat	*Mustela putorius*	SX0975 SX09907718	Somerville – St Breward	2	2016
Red deer	*Cervus elaphus*	SX0978 SX092789 SX093785	St Breward Hamatethy	4	2017 – 2022
Roe deer	*Capreolus capreolus*	SX092763 SX09647610 SX0974	Darrynane St Breward Pendrift Downs	9	2012 – 2021
Stoat	*Capreolus capreolus*	SX11408027	Watergate	1	2015
Weasel	*Mustela nivalis*	SX096761 SX090749	St Breward Lank	3	2016 – 2020
West European hedgehog	*Erinaceus europaeus*	SX0795276998 SX095763 SX0673	Hengar St Breward Longstone	8	2014 – 2021

Appendix 2 Stannon Lake GIC Report

Stannon Lake GIC Report.docx

Appendix 3 Options Appraisal for Meeting CSMG Targets Measure Specification Monitoring Report