South West Water Ltd

Restormel to Colliford Reservoir Abstraction Drought Permit

Environmental Assessment Report

APEM P000010095

September 2022

COMMERCIAL IN CONFIDENCE

Client: South West Water Ltd

Address: Peninsula House, Rydon Lane, Exeter, Devon EX2 7HR

Project reference: P000010095

Date of issue: September 2022

Project Director: David Bradley

Project Manager: François Edwards

Authors (alphabetical): Sarah Atkinson, Hannah Austin, Claire Barrett-Mold, Dan Cadman, Jonathan Cousins, Rebecca Davies, François Edwards, Fenchurch Hallatt, Sharon Mandipe, Rob Moore, Shervin Shahriari, James Smith, James Spencer, Paul Stebbing, Jennifer Wright

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APEM Ltd
Riverview
A17 Embankment Business Park
Heaton Mersey
Stockport
SK4 3GN

Tel: 0161 442 8938
Fax: 0161 432 6083

Registered in England No. 02530851

Report should be cited as:

"This is a draft document and should not be cited"

Revision and Amendment Register

Version Number	Date	Section(s)	Page(s)	Summary of Changes	Approved by
1.0	14/09/2022	all	all	Interim Draft report to SWW	HA
2.0	16/09/2022	all	all	Final draft report to SWW	DB
3.0	23/09/2022	all	all	Updated after SWW review	FE
3.1	23/09/2022	all	all	Minor revision	FE
3.2	06/10/2022	all	all	Updated after stakeholder fisheries review & SWW changes to DP application	FE
3.3	07/10/2022	all	all	Updated after further SWW review	FE
3.4	11/10/2022	all	all	Final report updated after EA comments hydrology & fisheries	FE

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Glossary

Term	Definition
ADVP	Acoustic Doppler Velocity Profiler
AONB	Area of Natural Beauty
ASPT	Average Score per Taxon
BOD	Biological oxygen demand
BTO	British Trust for Ornithology
BW	Bournemouth Water
CIEEM	Chartered Institute of Ecology and Environmental Management
DO	Dissolved oxygen
DP	Drought Plan
EA	Environment Agency
EAR	Environmental Assessment Report
EM	Electromagnetic
EMP	Environmental Management Plan
FFD	Freshwater Fish Directive
Fr	Froude Number
GBNNS	Great British Non-Native Species Secretariat
HoLL	Hands-off Lake Level
HRA	Habitat Regulations Assessment
INNS	Invasive non-native species
LIFE	Lotic invertebrate Index for Flow Evaluation
MCZ	Marine Conservation zone
Ml/d	Megalitres per day
NNR	National Nature Reserve
NRW	Natural Resources Wales
NTAXA	Number of Taxa
OS	Ordnance Survey
PTV	Pollution Tolerant Valves
RMHI	River Macrophyte Hydraulic Index

RMNI	River Macrophyte Nutrient Index
RNAG	Reason for Not Achieving Good Status
SAC	Special Area of Conservation
SPA	Special Protected Area
SSSI	Site of Special Scientific Interest
STW	Sewage Treatment Works
SWW	South West Water
TDI	Trophic Diatom Index
UKTAG	UK Technical Advisory Group
WCA	Water Countryside Act
WeBS	Wetland Bird Survey
WFD	Water Framework Directive
WHPT	Walley Hawkes Paisley Trigg metric
WTW	Water Treatment Works

Executive Summary

What is a drought order / drought permit?

In periods of unusually low rainfall, where water resources become scarce, powers are available to grant drought permits and ordinary and emergency drought orders under the Water Resources Act (WRA) 1991 (as amended). Drought permits are granted by the EA and drought orders and emergency drought orders are granted by the Secretary of State.

The water industry is required by the Government to demonstrate that it has adequate drought contingency plans, and there is a statutory duty for water companies to agree publicly available drought plans following consultation with the EA, the Secretary of State, the Water Services Regulation Authority (Ofwat) and other statutory bodies.

Drought order and drought permit options are identified in SWW's current drought plan (SWW & BW, 2022). 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.

Background

SWW abstract water on the River Fowey at Restormel Weir, close to the town of Lostwithiel, Cornwall. Water is abstracted for public water supply, feeding the Restormel WTW, but can also be pumped to Colliford Reservoir, approximately 12 km to the North East. The abstraction licence allows a daily abstraction volume of 110 Ml/day with a total of 28,900 Ml per year. Since 2017, daily abstraction to the WTW has varied between 54.9 and 101.2 Ml/day. Abstraction to Colliford Reservoir has been occasional since 2017, solely occurring in winter months (between October to April depending on the year) and ranging from 0.13 to 31.7 Ml/day. The abstraction licence runs on calendar years i.e. from 1st January to 31st December.

What will the drought permit entail?

SWW require to refill Colliford Reservoir over the winter 2022/2023, because of the period of extended dry weather and exceptional shortage of rain affecting the UK in 2022. To be able to do this, SWW will need to abstract the full licensed daily volume at Restormel, so that any water not required for public water supply will be pumped to Colliford Reservoir. This process would mean that SWW would exceed the 2022 licensed annual abstraction volume by 3300 Ml. For this reason, SWW need to apply for a drought permit. To be able to refill Colliford reservoir fully, the abstraction would need to continue under the 2023 licence until 31st March. The daily abstraction limit would not be exceeded in 2022 or 2023, however it is possible that this additional abstraction from January-March 2023 could cause the annual abstraction limit to be reached by the latter part of 2023. For this reason, SWW need to apply for a drought permit with respect to both the 2022 and the 2023 licences. The assessment

presented considers the impacts should a drought permit be implemented from December 2022 until March 2023 inclusive. This is referred to as the proposed drought permit in this report.

What does this environmental assessment cover?

An EAR, which includes a monitoring plan and mitigation measures, is required to support the drought permit application. This EAR provides details of baseline conditions, assesses impacts of potential changes to the hydrological regime due to implementation of the drought permit, and provides an EMP to support the requirement for baseline, during and post drought permit monitoring.

Following a 'source-pathway-receptor' approach, this environmental assessment focuses first on examining how the proposed drought permit at Restormel (the 'source') will affect the hydrological environment (the 'pathways'), and then considers how ecological and other features (the 'receptors') will respond to changes in those pathways.

What are the likely impacts of the drought permit on the environment?

A medium impact of the drought permit was predicted for the hydraulic pathway. The impacts on all other pathways were low or negligible.

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

Moderate impacts on receptors were only predicted for fish. The drought permit is predicted, due to the additional abstraction at Restormel, to have Moderate impacts on the Lower River Fowey water body (GB108048001420) in some months for upstream fish passage for Atlantic salmon, brown trout, adult eels and for habitat availability for the ammocoete life stage of lamprey in comparison with the baseline scenario.

In terms of the two periods of the drought permit these impacts can be summarised as follows:

- November – December 2022
    - Potential for a moderate impact on the migration of European eel.
    - Potential for a moderate impact on lamprey ammocoetes due to effects on habitat availability.
- January – March 2023
    - Potential for a moderate impact on the migration/movement of adult Atlantic salmon and brown/sea trout.
    - Potential for a moderate impact on migration/movement of Atlantic Salmon and brown/sea trout smolts, in March 2023 only.
    - Potential for a moderate impact on lamprey ammocoetes due to effects on habitat availability.

What monitoring will be carried out?

An EMP has been developed which includes pre-drought permit implementation, during-drought permit implementation and post-drought permit implementation monitoring.

This includes checking for signs of ecological stress, including: potential effects on inhibition of movement of fish past river structures or other barriers; and habitat availability for adult and juvenile life stages (including spawning / nursery areas).

It is important to note that the level of monitoring is risk-based. The environmental assessment indicates that the drought permit presents a low risk to the environment (only negligible or minor negative impacts are predicted for most receptors) with the exception of Moderate effects predicted on fish passage and habitat availability for juvenile lamprey. Given the uncertainties inherent in some of the assessments undertaken, monitoring has been recommended, to check the predicted degree of impact, and identify any unexpected impacts to trigger mitigation measures, if needed

What measures will be used to mitigate significant impacts?

Where significant negative impacts (defined for this report as those of moderate significance or greater) or significant uncertainty (defined in this report as medium or lesser) are identified during the environmental assessment process, there is a need to identify appropriate mitigation measures to avoid, reduce or remedy any impacts. Such measures may be implemented in advance of, during or after implementation of a drought permit.

It should be noted that not all 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 EA as a matter of urgency proportionate to the level of risk. Mitigation measures would be implemented to avoid, mitigate or compensate the impacts of the proposed drought permit and not the impacts of the drought itself.

Several additional mitigation measures could be implemented depending on feasibility, should monitoring during a drought permit indicate that significant impacts are occurring.

It may not be necessary to implement any of these mitigation measures if significant negative impacts are not observed to be occurring. Implementation of the mitigation measures will take place should monitoring during a drought permit indicate that significant impacts are being experienced.

1. Introduction

1.1 Background

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 orders and drought permits

In periods of exceptionally low rainfall, where water resources become scarce, powers are available to grant drought permits, ordinary drought orders and emergency drought 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 EA 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 EA. If objections are duly made and not withdrawn the EA will give the objector an opportunity to be heard at a hearing or cause a public inquiry to be held.

In the case of ordinary drought orders, the Secretary of State must be satisfied that either a serious deficiency of supplies of water in any area exists or is threatened, or that a deficiency in flow or level of water in any inland waterway sufficient to pose a threat to flora and fauna which depend on those waters, exists or is threatened. In either case the Secretary of State must also be satisfied that the reason for the deficiency is an exceptional shortage of rain.

Ordinary drought orders can be applied for under the Water Resources Act 1991 (Section 74) where there may be a change in terms of a variation of an abstraction licence condition, but additional changes may also be made, including discharging water to specified places and modifying or suspending discharges or the filtering/treating of water. Drought orders are authorised by the Secretary of State which can hold a public hearing to discuss the application if it deems one is necessary.

For emergency drought orders, the Secretary of State must be satisfied both that: by reason of an exceptional shortage of rain, a serious deficiency of supplies of water in any area exists or is threatened and that the deficiency is such as to be likely to impair the economic or social well-being of persons in the area.

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/drought order options are identified in SWW current Drought Plan (SWW & BW, 2022). 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 Drought Plan details the range of actions that SWW will consider implementing during drought conditions in order to maintain essential water supplies to its customers and minimise environmental impact.

The environmental assessment of drought permits and drought orders is undertaken in recognition of the guidance from the EA 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/order is not a statutory Environmental Impact Assessment (EIA), as would be required, 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 Aims and objectives

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 Restormel abstraction from the River Fowey, and to recommend monitoring and mitigation measures, if required.

1.4 Scope of the assessment

Following a 'source-pathway-receptor' approach, this environmental assessment focuses first on examining how the proposed drought permit (the 'source') will affect the hydrological, hydrogeological and geomorphological environment (the 'pathways'), and then considers how ecological and other features (the 'receptors') will respond to changes in those pathways.

As a preliminary screening step, the long list of pathways and receptors in Table 1-1 was reviewed to identify the environmental features of interest for inclusion in the environmental assessment. Features were excluded only if:

- the pathway or receptor is absent from the area of potential impact;
- there is no pathway by which the receptor could be impacted; or
- the receptor is not sensitive to changes in these pathways.

Table 1-1 Environmental features considered in this environmental assessment

Category	Environmental feature	Included?	Notes
Pathways	Hydrogeology (groundwater)	No	Not relevant
	Hydrology (surface water)	Yes	
	Water quality	Yes	
	Hydraulic habitat	Yes	
Ecological receptors	Water body WFD status	Yes	
	Macrophytes and diatoms	Yes	
	Phytoplankton	No	Not relevant
	Macroinvertebrates	Yes	
	Fish (including angling groups)	Yes	
	Birds	Yes	
	Protected species	Yes	
	Invasive non-native species	Yes	
Other receptors	Designated sites	Yes	
	Tourism and recreation	Yes	
	Other abstractors	Yes	Screened out at baseline stage
	Aesthetics and landscape	Yes	
	Archaeology and heritage	Yes	

It should be noted that the Duchy of Cornwall is one of the principle riparian land owners along the zone of influence on the river Fowey. They are currently entering a land management programme to slow run off of water from their land to the River Fowey. The programme includes river fencing, creating scrapes, ditch management and pond creation. The timescales of the work means that there is no interaction between the measures included in this programme and the proposed drought permit, so they have not been considered further in this EAR. However future applications for drought powers

and future EARs will need to consider how this programme of land management measures interacts with river management, for example how flood waters may affect the programme or how the programme may help maintain the river during droughts.

1.5 Structure of this report

Figure 1-1 shows how the EA's requirements for environmental assessments of drought permits/orders are satisfied by this report.

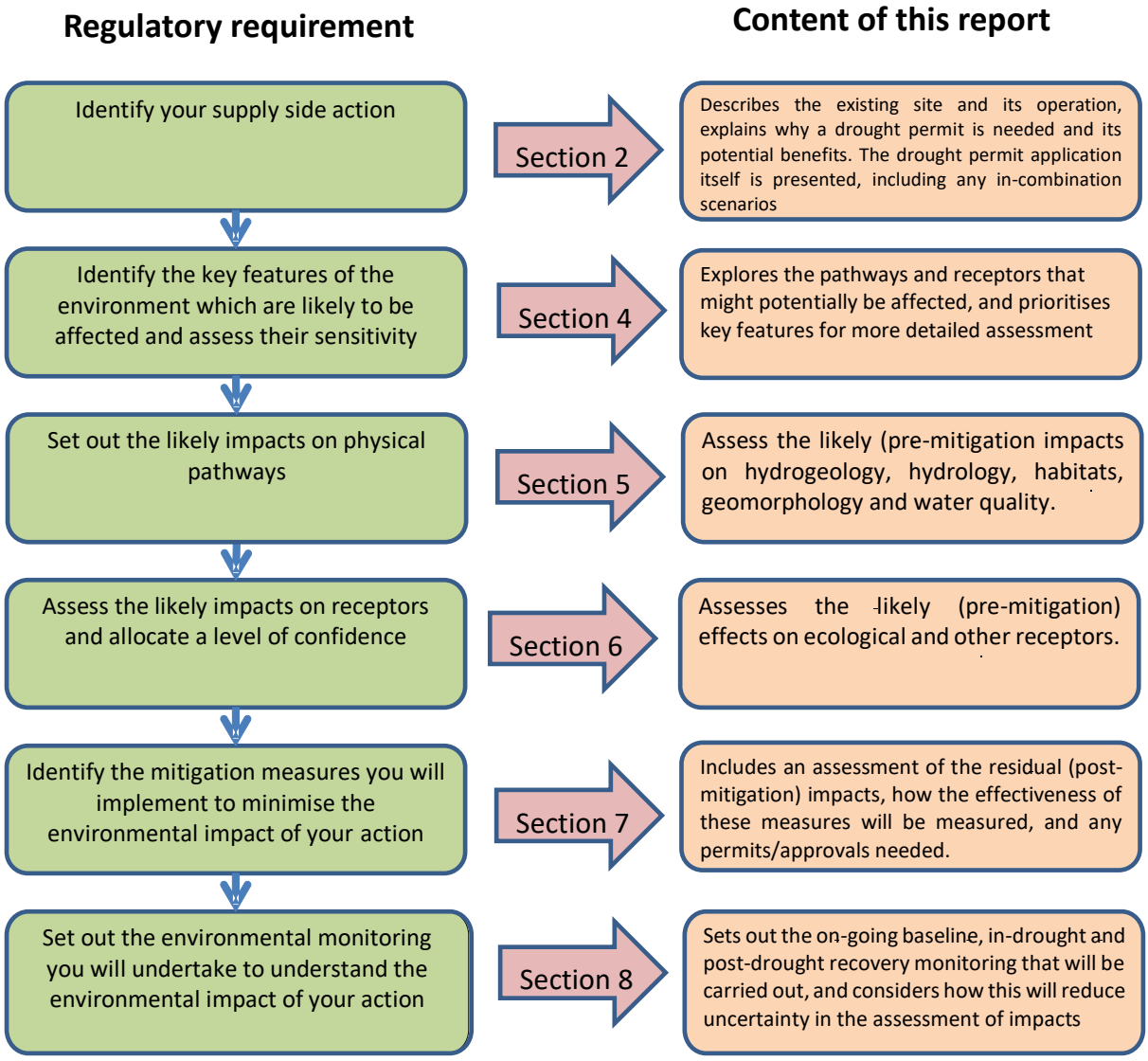


Figure 1-1 Flow chart detailing how the EA's requirements for drought permits/orders are satisfied by this report

2. Description of proposal

2.1 Site setting and background

The Restormel abstraction and associated WTW are located on the River Fowey northeast of Sweetshouse village, Bodmin within the ward of Lostwithiel & Lanreath (Figure 2-1).

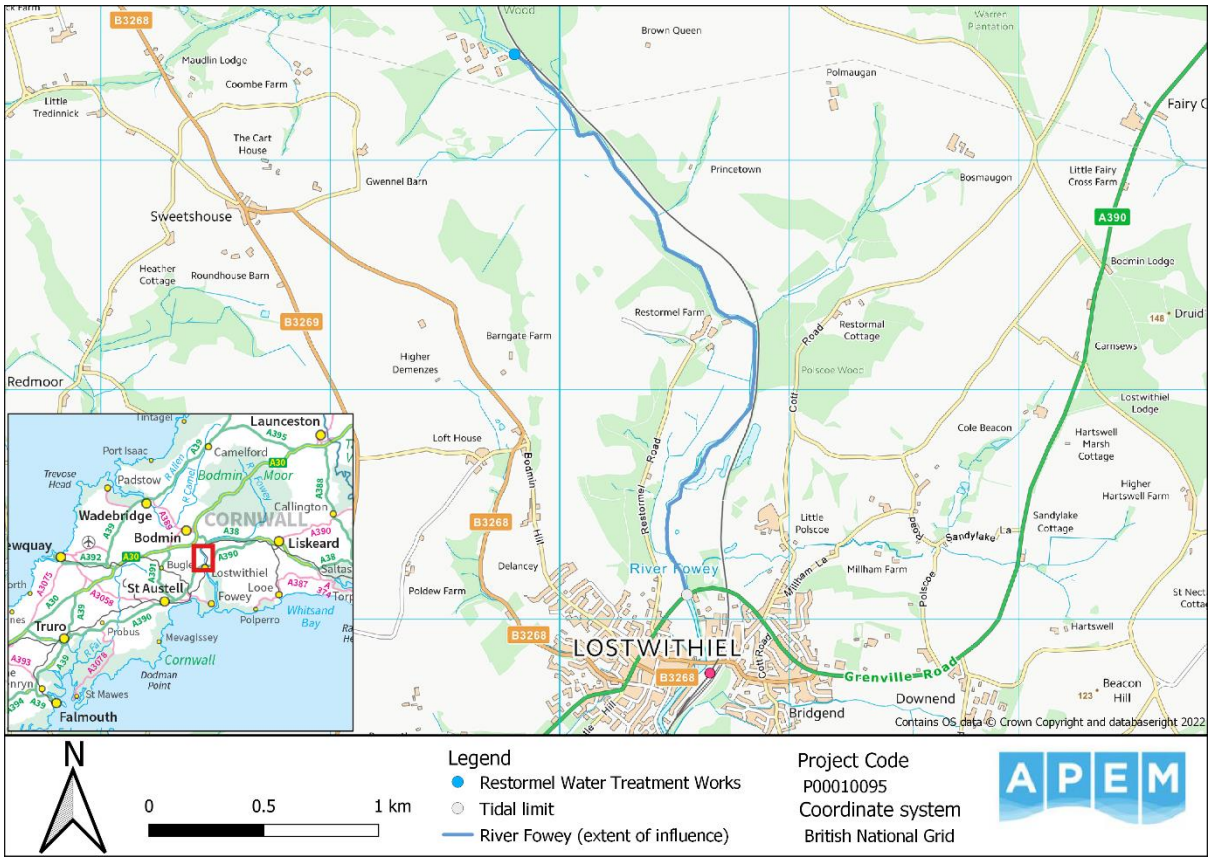


Figure 2-1 Map of Lower River Fowey from Restormel to tidal limit. Blue dot indicates Restormel Weir.

2.2 Current operation and abstraction regime

The Restormel abstraction is operated under licence 15/48/18/s/40, in place since 1987. Water is abstracted for public water supply, feeding Restormel WTW, but can also be pumped to Colliford Reservoir, approximately 12 km to the north east. The abstraction licence allows a daily abstraction volume of 110 Ml/day with a total of 28,900 Ml per year. The licence is based on calendar years. Since 2017, daily abstraction to the WTW has varied between 54.9 and 101.2 Ml/day. Abstraction for pumping to Colliford Reservoir has been occasional since

2017, solely occurring in winter months (between October to April depending on the year) and ranging from 0.13 to 31.7 Ml/day (Figure 2-2).

No abstraction can take place if the flow in the River Fowey is below 104.28 Ml/day, unless a simultaneous discharge is released from Colliford and/or Siblyback reservoirs. When the flow in the River Fowey is above 104.28 Ml/day, no more than half the additional flow may be abstracted unless a simultaneous discharge is released from Colliford and/or Siblyback reservoirs.

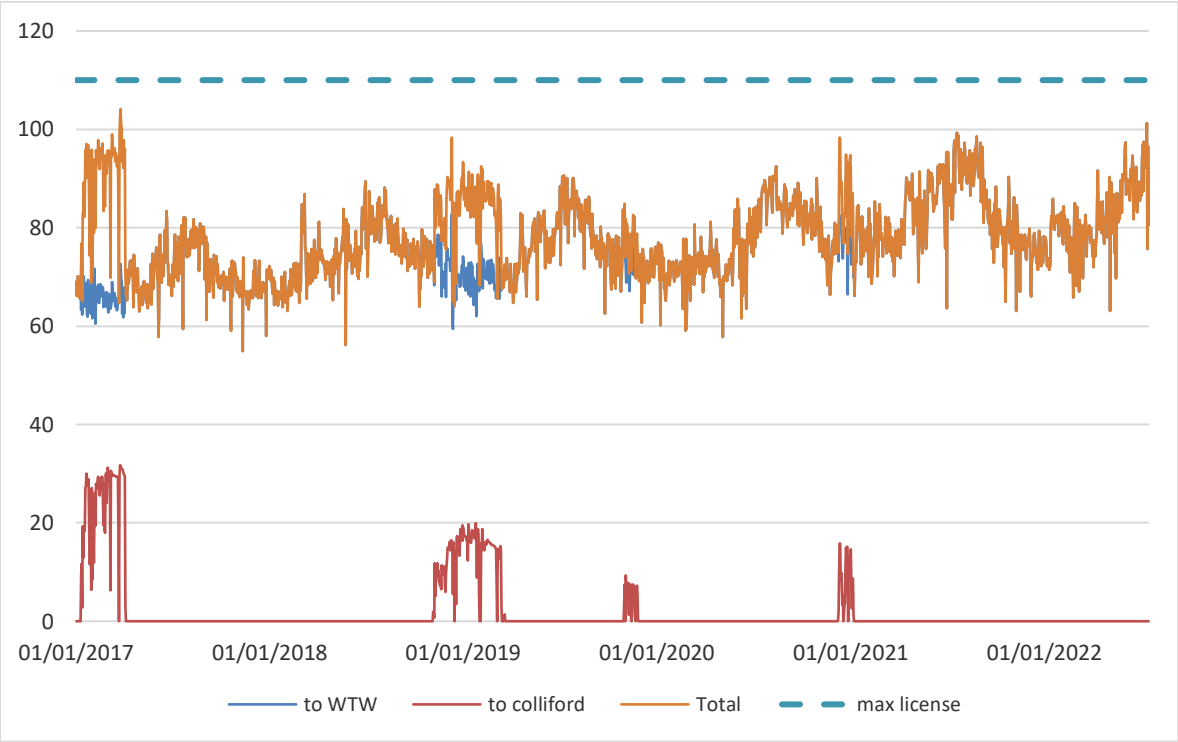


Figure 2-2: Abstraction from Restormel in Ml/day

If SWW wishes to use the Restormel abstraction to aid refill of Colliford Reservoir during late 2022 and early 2023, it will require additional licence capacity under both the 2022 and the 2023 licences. The annual licence at Restormel is not large enough to mitigate the loss in natural recharge that has resulted from the exceptional shortage of rainfall.

There is also a fisheries water bank at Colliford. A fisheries water bank is a stored volume of water that is set aside to maintain fisheries and cannot be used for other purposes. At Colliford Reservoir, 909.2 Ml is reserved (over a 3 year rolling period) to be released as

needed via an increase in compensation flow for the purpose of maintaining fisheries for use. The operating agreement notes that:

- The EA is responsible for determining the use of the volume specified; the Undertaker (SWW) will implement the release patterns based on volumes and timings as reasonably specified by the EA unless unforeseen operational difficulties relating to the making of these releases occur.

- No more than 909.2 Ml is available in any twelve-month period.

- The Fisheries Water Bank three-year cycles (the prescribed volume is allocated for 3 years at a time) restart when the Colliford Reservoir storage has refilled, taking into account specific releases made for hydro-generation.

- Nothing in the Agreement shall give the EA power to require a Fisheries Water Bank volume greater than the volume specified above.

- The notification procedures for the use of the Fisheries Water Bank will be specified by the EA in the Operating Manual.

- Water will be taken with a preference to minimise any water quality concerns in the reservoir.

It is not anticipated that the water bank would be amended by the proposed drought permit.

2.3 Historic drought powers

There have been no applications for drought powers at the Restormel abstraction since 1995. Details of historical drought powers prior to this are not available (communication by SWW 12/09/2022).

2.4 Proposed drought powers

Due to the period of extended dry weather and exceptional shortage of rain affecting the UK in 2022, SWW is seeking a DP to aid refill of Colliford Reservoir over the winter of late 2022 and early 2023.

The proposed drought permit scenario at Restormel is to:

- Maintain the current daily abstraction limit of 110 Ml/day. The volume (up to 40Ml/d) not needed for PWS supply would be pumped to Colliford Reservoir to aid winter refill. The daily abstraction limit would not be increased under the drought permit.

- From 1st November 2022 to 31st December 2022: Increase the annual abstraction limit for the calendar year January to December 2022 from 28,900 to 32,200 Ml. This requires an annual limit increase of the 2022 licence of 3300 Ml (11.4% of current annual licensed volume).
- From 1st January 2023 to 31st March 2023: Abstract an additional 3600 Ml of water supply, the volume of which shall not be included for the purposes of calculating the maximum annual abstraction allowance of 28,900 Ml.
- No abstraction will take place if the flow in the River Fowey is below 104.28 Ml/day, unless a simultaneous discharge is released from Colliford and/or Siblyback reservoirs.
- When the flow in the River Fowey is above 104.28 Ml/day, no more than half the additional flow may be abstracted unless a simultaneous discharge is released from Colliford and/or Siblyback reservoirs.

This would allow SWW to abstract additional water to that which would normally have been possible between December 2022 to March 2023 whilst not increasing the daily abstraction limit. The water will be used to maintain public water supply and to replenish Colliford Reservoir over the winter months of late 2022 and early 2023. The drought permit could be implemented for a period of up to six months. The assessment presented considers the impacts should a drought permit be implemented from December 2022 until March 2023, inclusive. This is referred to as the proposed drought permit in this report.

2.5 Geographical extent of the study

The geographical extent of this study consists of a reach of the River Fowey (the zone of influence, see Figure 2-1), from Restormel Weir (SX 09803 62462) to the tidal limit, considered to be at the A390 road bridge in Lostwithiel (SX 10555 60108). This study does not consider Colliford Reservoir, as no changes in compensation flows are expected there. However, this study does consider the risk of INNS transfer from the Restormel abstraction to Colliford Reservoir.

3. Environmental assessment methodology

Figure 3-1 summarises the process used to describe and categorise the impact of the drought permit/order on each receptor. The process is consistent with the latest EA guidance on environmental assessment for water company drought planning (EA, 2020a&b) and draws on industry good practice for undertaking ecological impact assessments (CIEEM, 2018) and on NRW technical guidance for water company Drought Plans (NRW, 2017).

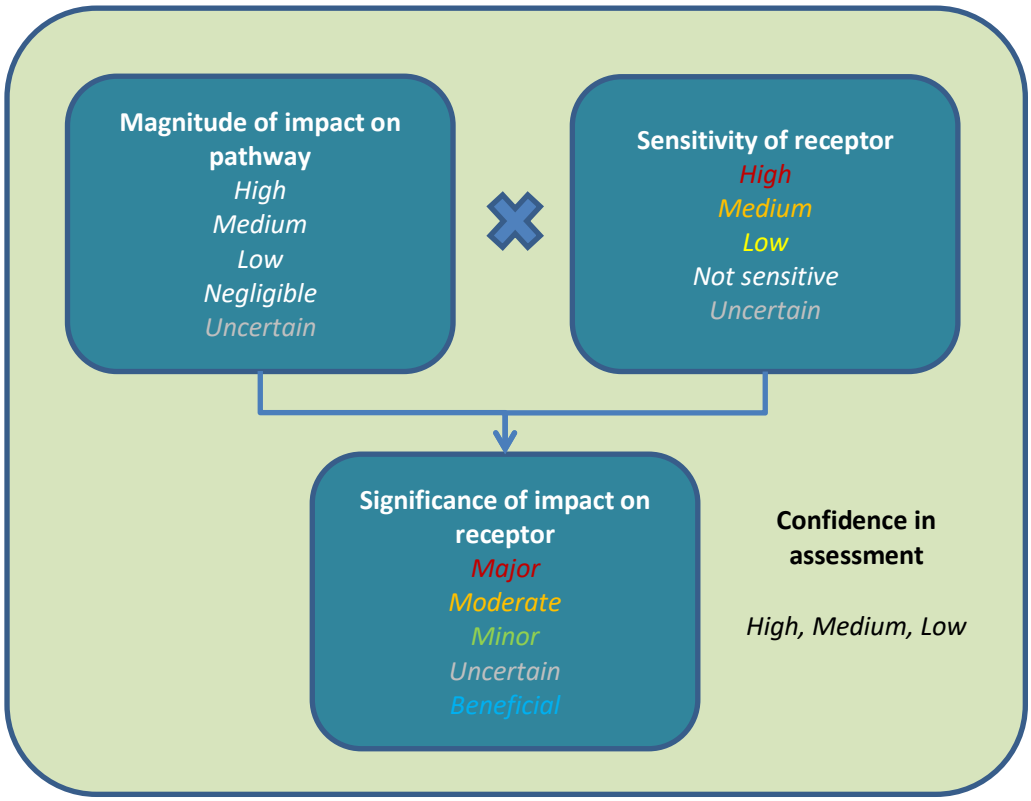


Figure 3-1 Flow chart outlining the environmental assessment process

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

Table 3-1.

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 takes into account 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** is categorised as High, Medium, Low, Not Sensitive, or Uncertain, in accordance with EA Water Company Drought Plan guidance (EA, 2020b). 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.

Category	Definition
Uncertain	Insufficient information is available to judge the sensitivity of the receptor.

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 – the ability of a receptor to accommodate change without a significant adverse impact; and
- recoverability – 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 EA guidance (EA, 2020b), impacts on receptors are categorised as: Major, Moderate, Minor, or Uncertain. Impacts on receptors can be positive as well as negative, however, so we have included a fifth category – Beneficial – to identify any positive impacts. 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	Minor	Uncertain
Low	Moderate	Minor	Minor	Minor	Uncertain
Negligible	Minor	Minor	Minor	Minor	Uncertain
Uncertain	Uncertain	Uncertain	Uncertain	Uncertain	Uncertain

Table 3-4 Significance categories

Category	Definition
Major	Very large or large change in environmental 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 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 a particular feature.
Minor	Small or negligible change in environmental or socio-economic conditions. These effects may be raised as local issues but are unlikely to be of importance in the decision-making process.
Uncertain	Insufficient information is available to judge the impact significance.
Beneficial	Any significant, moderate or minor change predicted to have a net positive effect on environmental or socio-economic conditions.

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/order.

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 EA guidance (EA, 2020b), 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 the following:

- 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 (The Wildlife and Countryside Act (1981);
- Other non-statutory requirements (local wildlife sites etc.);
- Protected areas designated under international agreements (incl. Ramsar & Natura 2000 sites); and
- Protected areas designated under national legislation (SSSIs), nationally protected species and habitats covered under the Wildlife and Countryside Act 1981 and Countryside and Rights of Way Act 2000 and other locally important sites.

4. Baseline

4.1 Designated sites

A search was conducted for statutory designated sites[1] 1) within a 2km distance of the study area (i.e. River Fowey from Restormel to the tidal limit at A390 road bridge in Lostwithiel), 2) the downstream reaches of the River Fowey to the estuary, and 3) the Fowey Estuary itself. These included Area Of Natural Beauty (AONB), Sites of Special Scientific Interest (SSSI), Special Areas of Conservation (SAC), Special Protected Areas (SPA), Ramsar sites, National Nature Reserves (NNR), Moorland line, World Heritage sites and Biosphere reserves.

There are no SAC, SPA, Ramsar and SSSI sites in the zone of influence.

There is an AONB which encompasses the Fowey estuary but not the river itself.

The Fowey estuary and the tidal River Fowey up to the A390 road bridge are part of a designated Marine Conservation Zone (MCZ). The Upper Fowey and Pont Pill MCZ consists of two spatially separate areas and protects the total area of 205ha making it one of the smallest MCZ's designated in England. The largest area of the site protects the upper tidal reaches of the Fowey estuary from south of Golant extending upstream to Lostwithiel and includes the River Lerryn, Penpoll Creek and Bodmin Pill. The smaller area protects Pont Pill, a tributary estuary flowing into the Fowey on the eastern side near the town of Polruan. The Upper Fowey and Pont Pill MCZ includes areas of estuarine rocky habitat. These are important as they contribute to the richness of life within estuaries by providing an alternative habitat which can support different species to the sediment habitat which usually characterise estuarine environments.

There are two protected areas linked to the Lower River Fowey water body; a Drinking Water Protected Area and a Safeguard Zone.

4.2 Water Framework Directive (WFD)

The Lower River Fowey water body (GB108048001420) is one of several water bodies in the Fowley Operational Catchment [2]. The zone of influence (i.e. study area) considered in this

[1] MAGIC (defra.gov.uk), last accessed 09/09/2022

Site Search (naturalengland.org.uk), last accessed 09/09/2022

[2] England | Catchment Data Explorer, last accessed 09/09/2022

report is wholly included in this waterbody. The Lower River Fowey is not classified as a heavily modified water body and is currently of Good ecological status overall (Table 4-1).

Table 4-1: Cycle 2 WFD Ecological Status classification (overall) and breakdown by elements (green = Good, blue = High)

Classification item	2013	2014	2015	2016	2019
Ecological (overall)					
Biological quality elements					
Fish					
Invertebrates					
Macrophytes & phytobenthos					
Physicochemical Quality elements					
Hydromorphological Supporting elements					
Specific Pollutants					

Chemical status has been more variable, classified as a Fail in 2013 and 2014 and Good in 2015 and 2016 (Table 4-2). The most recent 2019 chemical status is Fail, due to two chemical classification elements (priority hazardous substances):

Chemical: Mercury and Its Compounds (Fail).

Chemical: Polybrominated diphenyl ethers (PBDE) (Fail).

However, the change in Chemical status in 2019 is most likely due to these hazardous substances being added to the chemicals being monitored, rather than an actual change of Water Quality in 2019.

Table 4-2: Cycle 2 WFD Chemical Status classification (overall) and breakdown by elements (green = Good, red = Fail)

Classification item	2013	2014	2015	2016	2019
Chemical (overall)					
Priority hazardous substances					
Priority substances					
Other pollutants					

4.3 Hydrology

Restormel WTW is located on the River Fowey. The upstream catchment at the WTW is 167 km² and includes flow contributions from several large tributaries including St Neots River, Warleggan River and Cardinham Water, along with several minor unnamed tributaries. The Warleggan River and Cardinham Water are not materially affected by direct artificial influences on the flow regime (abstraction and effluent discharges) but the flow regimes of the River Fowey and the St Neot River are substantially altered by abstraction for public water supply (and to a lesser extent by other abstractions):

- Abstraction at Restormel is part of a 'put and take' scheme whereby water stored in Colliford Reservoir and Siblyback Reservoir can be released to the River Fowey to support abstraction at Restormel. This release is made via the St Neot River in the case of Colliford Reservoir.
- Water abstracted at Restormel can also be put back into storage at Colliford, although operationally this is only undertaken when flows are sufficiently high to support this without releases.

Abstraction at Restormel is licenced to a maximum quantity of 110,000 cubic metres per day (110 Ml/d), capped to an annual limit of 28,900,000 cubic metres per annum (calendar year).

Further provisions in the abstraction licence (15/48/18/S40) stipulate that:

- No abstraction may take place when the flow in the river (Fowey) is below the intake 1.207 cumecs (22.93 million gallons per day) except to the extent that additional water is released from Colliford and/ or Siblyback Reservoirs.
- When the flow in the river is above 1.207 cumecs (22.93 million gallons per day) then no more than half the additional flow may be abstracted, except to the extent that water is released from Colliford and/ or Siblyback Reservoirs.

The proposed drought permit (DP) is intended to facilitate refill of Colliford Reservoir using the abstraction at Restormel. It is assumed that any such abstraction would not be supported by releases from Colliford or Siblyback Reservoirs.

4.3.1 Extent of effect

Given that abstraction at Restormel in accordance with the DP would not be supported by releases from Colliford or Siblyback Reservoirs, flows upstream of the abstraction point at Restormel are only likely to be affected if DP operation enables earlier releases from Colliford or Siblyback Reservoirs than would otherwise be the case, or should DP operation allow earlier spills. These, if they occur, are taken to benefit these reaches and have therefore not been a focus of investigation.

As the abstraction point is located approximately 2km upstream of the tidal limit, it is assumed that the flows within the entire stretch between the abstraction point and the tidal limit will be impacted to some degree. It is further assumed that flows in the tidal reaches are dominated by saltwater.

4.3.2 Flow monitoring

Flows are gauged at:

- 48001 Fowey at Trekeivesteps, located a short distance downstream of the inflow from Siblyback Reservoir (and therefore influenced by storage at and releases from Siblyback Reservoir).
- 48004 Warleggan at Trengoffe, a tributary recorded by the National River Flow Archive as natural to within 10% at the 95-percentile flow.
- 48009 St Neot at Craigshill Wood, which is substantially affected by storage at and releases from Colliford Reservoir, and
- 48011 - Fowey at Restormel, located a short distance upstream of the Restormel WTW abstraction.

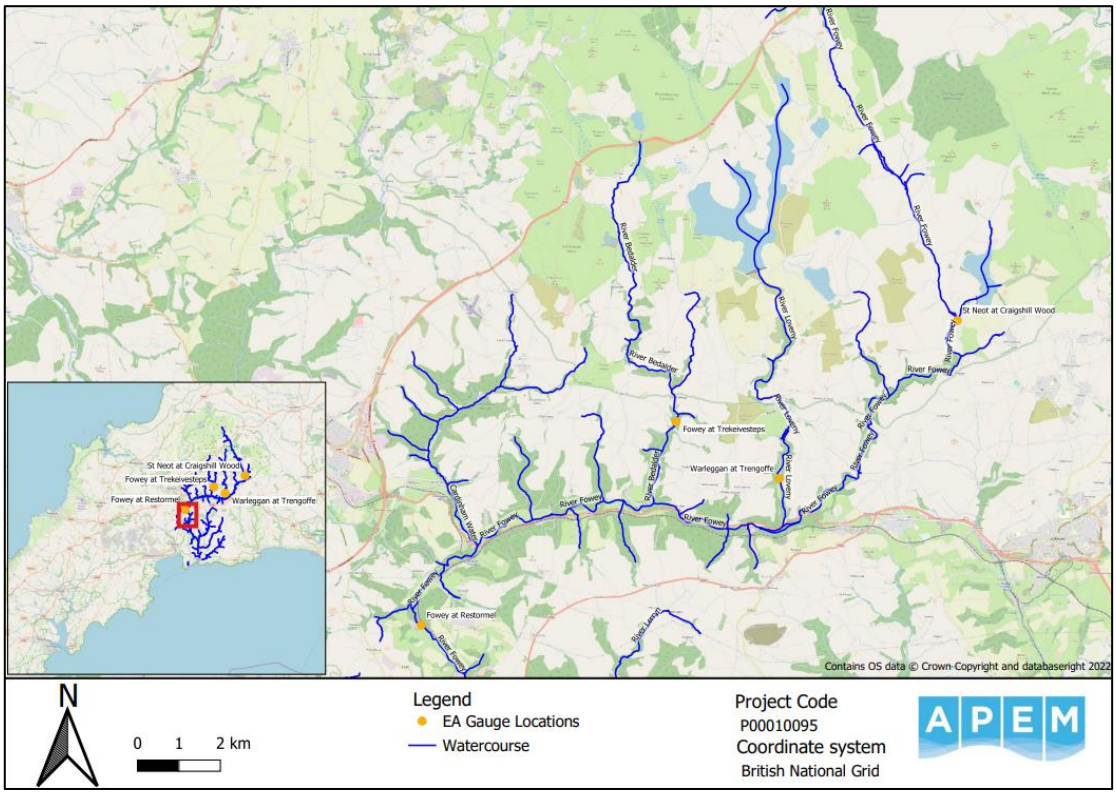


Figure 4-1 Gauging stations associated with the Restormel abstraction

A naturalised flow series at Restormel was also made available by SWW. This is understood to be an agreed flow series between the EA and SWW and for the period since 1st July 1983 is calculated without lags at a daily timestep, using Equation 1:

$$Q_{nat}^{Restormel} = Q_{gauged}^{Restormel} + Q_{abstraction}^{Restormel} + Q_{abstraction}^{Trekeivesteps} + (Q_{nat}^{Siblyback} - Q_{gauged}^{Siblyback}) + (Q_{nat}^{Colliford} - Q_{gauged}^{Colliford})$$

Eqn1

4.3.3 Baseline

Baseline operation is illustrated for 2018 using the four gauging station records listed above and by the naturalised Restormel flow series (Figure 4-2). Abstraction over the same period is illustrated in Figure 4-3:

- The natural flow regime is described by the Restormel naturalised flows and by the Warleggan at Trengoffe. The general pattern this is typical of a largely impermeable rural upland catchment - in all but the most exceptional years, there is a reliable trend of spring recession and autumn rise, with a summer or early autumn minimum. This annual trend is punctuated by episodic, rapidly rising spate runoff during rainstorms (snowmelt is only occasionally important), which produce a late autumn or winter maximum in most years. Flows are therefore naturally very variable. However, baseflow for the Warleggan at Trengoffe is high for an upland catchment due to storage in the granite: a Base Flow Index of 0.69 (NRFA, accessed September 2022) suggesting substantial groundwater storage and by extension, some moderation of the low flow and runoff response found in many upland areas in the UK.

- The neighbouring St Neot at Craigshill Wood illustrates the effect of Colliford Reservoir, which impounds roughly half the catchment to the gauging station. The variability in autumn and winter flows demonstrates some spate response, but despite the similarity of catchment size and character, these events are smaller than on the neighbouring Warleggan; even when Collliford Reservoir is full, attenuation is likely to reduce spate response. The most notable effect is, however during the late spring to mid-autumn period, during which, in baseline dry years, long-duration releases are made from Colliford to support abstraction at Restormel. As a result, baseflows are higher during the summer than the winter and variability is suppressed, although flows often decline during spate events, during which regulation releases are curtailed.

- The Fowey at Restormel (Colliford and Siblyback) and Fowey at Trekeivesteps (Siblyback) are both affected by reservoir regulation, but the proportion of catchment impounded is much lower than at Craigshill Wood (12% and 22% respectively, rather than 55%). As such, reservoir effects remain present, but are less obvious; as on the Warleggan the seasonal pattern of spring recession and autumn rise is evident, and spates occur even in the summer months. Flow variability is not obviously suppressed, although at Restormel, summer low flows are supported by the long duration support from Colliford.

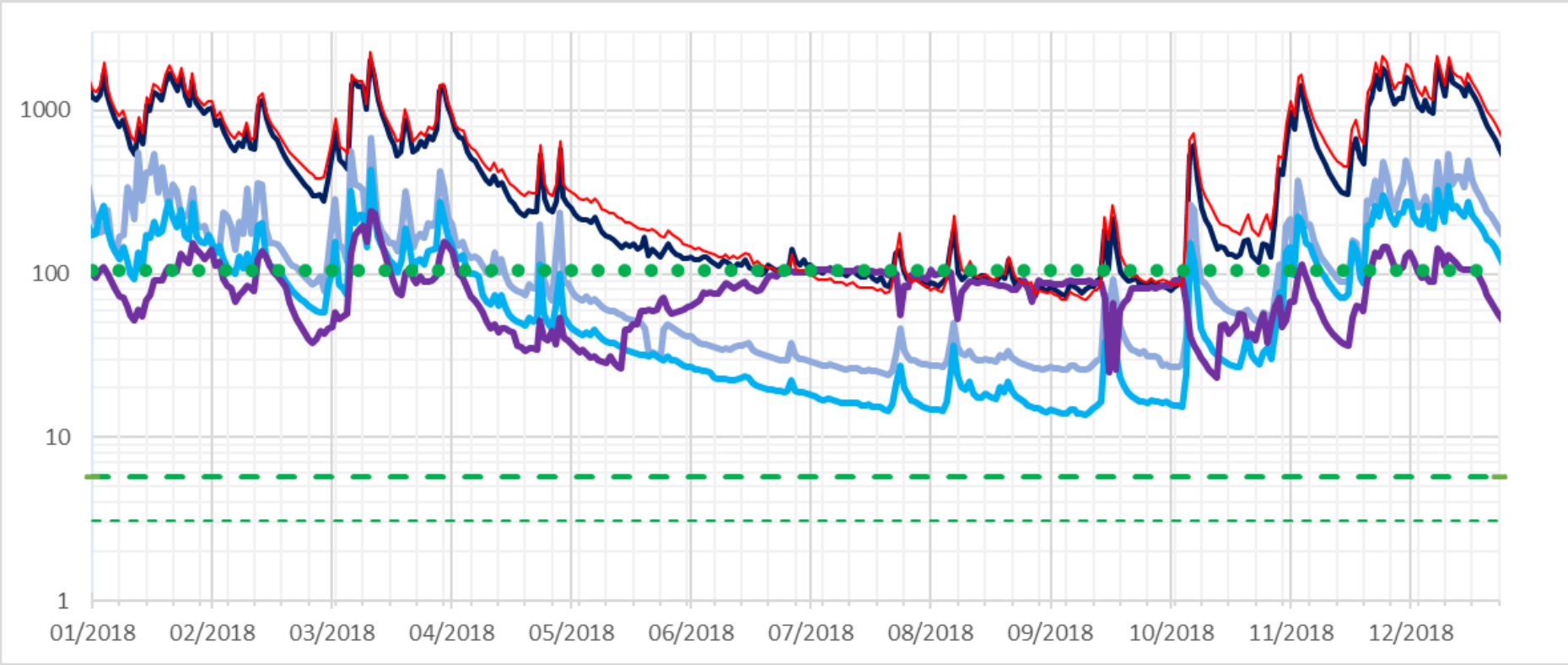


Figure 4-2 2018 Fowey flows in Ml/d, illustrating baseline dry weather flows.

Dark blue = Fowey at Restormel. Pale Blue = Fowey at Trekeivesteps. Light blue = Warleggan at Trengoffe. Purple = St Neot at Craigshill Wood. Red = Restormel naturalised series. Green dots = Restormel abstraction HOF. Thick green dashed line = Colliford Reservoir compensation flow. Thin green dashed line = Siblyback Reservoir compensation flow. Note log scale used (Y axis). Source of gauging station data: National River Flow Archive, September 2022. Naturalised Restormel series supplied by SWW

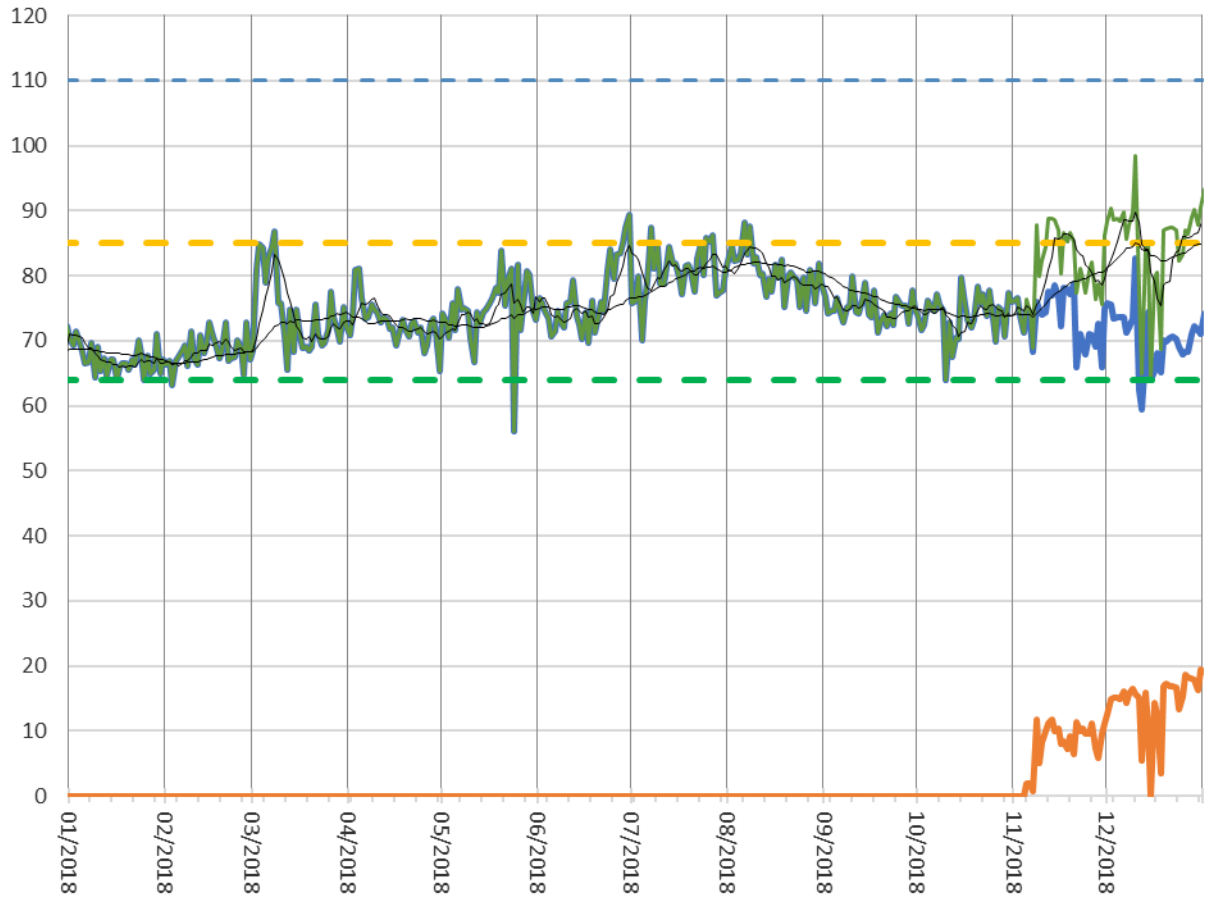


Figure 4-3 2018 abstraction in Ml/d, illustrating baseline operation.

Blue = abstraction to supply. Orange = abstraction to Colliford. Green = total abstraction. Blue dashed line = max licensed take. Green dashed line = abstraction under the Sustained case. Yellow dashed line = abstraction at last recorded rate. Black lines denote 30 and 7-day moving averages of total abstraction.

4.4 Hydraulics

As abstraction is most important as a proportion of flow when flows downstream of Restormel are reduced to the HOF, habitat differences for the 'max rate', 'sustained' and 'continue at last recorded rate' cases have been considered for the DP and non DP scenarios as below:

- For the 'max rate' case, habitat character for a flow of 214 Ml/d under the Non-DP scenario has been compared to habitat character for flows of 104 Ml/d (the Restormel HOF) for the DP. Any such differences are considered to take effect for c. 50 days in November – December.

- For the 'sustained' case, habitat character for a flow of 150 Ml/d under the Non-DP scenario has been compared to habitat character for flows of 104 Ml/d (the Restormel HOF) for the DP. This difference is considered to occur throughout the autumn and early winter.

- For the 'continue at last recorded rate' case, habitat character for a flow of 190 Ml/d under the Non-DP scenario has been compared to habitat character for flows of 104 Ml/d (the Restormel HOF) for the DP. Any such differences are considered to take effect for c. 20 days in December.

Effects have been considered at 4 locations in the reach between the Restormel abstraction and the tidal limit of the River Fowey at the A390 Road Bridge. As no existing data were available for that reach of the River Fowey, field data (depth and flow measurements at the cross sections) were collected on the 07/09/2022 at the 4 locations indicated in Table 4-3 and Figure 4-4. The locations have been selected in way to represent the reach in terms of habitat sensitivity. Location 1 is in the downstream area of Restormel weir and location 4 is in the upstream area of Lostwithiel with locations 2 and 3 in between.

APEM undertook the survey to determine hydraulic parameters at these locations in a relatively low flow condition. Depending on water depth, Acoustic Doppler velocity profiler (ADVP) or Electromagnetic (EM) Flowmeter kits were used to measure flow parameters. Base on this survey, a hydraulic study was carried out for the DP and non-DP scenarios. Channel slope at each location were estimated from LiDAR data. Manning roughness values were then calibrated based on the observed flow parameters (e.g., depth and discharge).

Effects have been considered at 4 locations in the reach between the Restormel abstraction and the tidal limit of the River Fowey at the A390 Road Bridge. As no existing data were available for that reach of the River Fowey, field data (depth and flow measurements at the cross sections) were collected on the 07/09/2022 at the 4 locations indicated in Table 4-3.

Survey results and impact assessment are presented in Section 5.2

Table 4-3: Locations of cross sectional surveys September 2022

Location	Method	Notes
SX 209873 062390	EM flow meter- Valeport Model 801 (flat type). 37 Verticals.	Downstream of weir. Located on riffle. Too low to gauge with ADVP.
SX 210432 061699	Acoustic Doppler velocity profiler (ADVP)	
SX 210843 061206	EM flow meter - Valeport Model 801 (flat type). 28 verticals.	Too low to gauge with ADVP.
SX 210596 060677	ADVP	Series of islands. Survey to bank-full width included other channels. Gauging located between two riffles.

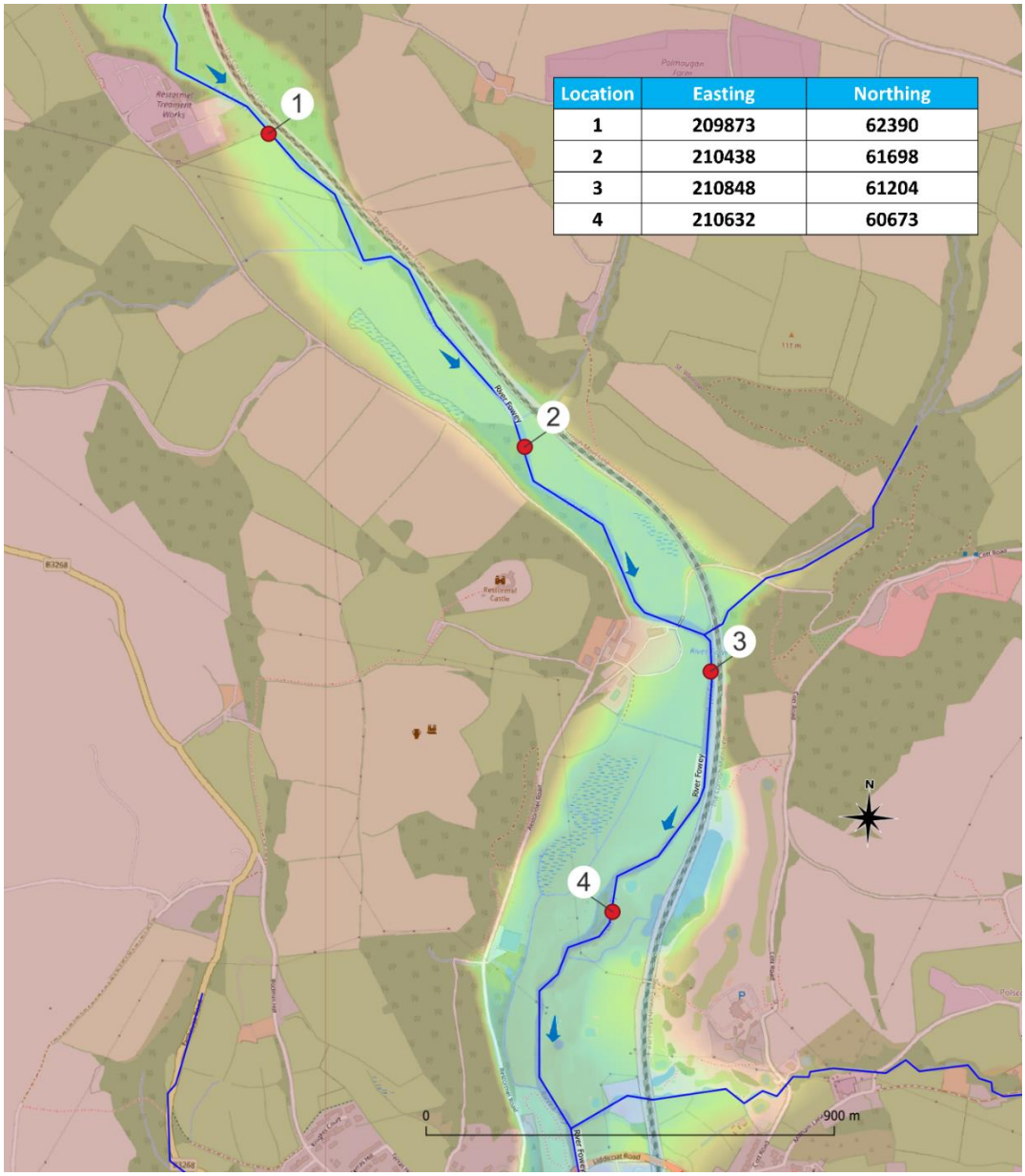


Figure 4-4: Hydraulic assessment Locations

4.5 Water Quality

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

4.5.1 Potential routes of impact

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

Several sewage treatment works (STW) discharge directly into the River Fowey. The STW are located several kilometres upstream of the abstraction at Restormel and include Common Moor STW, St Neot STW and East Taphouse STW. There are no STW downstream of the abstraction and within the Lower Fowey water body. Reduced dilution of these point sources 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.

The possible risks of deterioration in water quality are reviewed in section 5.3.

4.5.2 Sources of information and methods

The WFD water body of interest for this assessment is the Lower River Fowey, GB108048001420.

The River Fowey water quality baseline presented below is based on recent monitoring data collected by the Environment Agency (2017-2022). The data have been collated for monitoring locations show in Figure 4-5**Error! Reference source not found.** presented in order, upstream to downstream.

Baseline characterisation has only included monitoring locations downstream of the three STW discharges to the River Fowey (Common Moor STW, St Neot STW and East Taphouse STW) which may be at risk of causing an impact on water quality if flows in this water body were reduced during a proposed drought permit. A total of four EA locations were reviewed for water quality characterisation (Figure 4-6). Of these four, two were selected for water quality characterisation (Table 4-4). The two downstream monitoring sites located in Lostwithiel were not included in the assessment because one is not on the main channel of the River Fowey and so would not be influenced by any changes arising from implementation of the drought permit, and the other is part of the transitional water body and would therefore have tidal influences that could not be used in the SIMCAT assessment;

furthermore, the tidal influence would affect water volumes and has not been modelled as part of this study .

EA water quality monitoring locations were reviewed using the EA's water quality data archive website[3]. These locations were generally monitored on a monthly or quarterly frequency between 2017 and 2022. However, there was a gap in the monitoring data period from March 2020 to November 2020 (SW-81520166) and March 2020 to April 2021 (SW-81520205) due to the implications of the COVID-19 pandemic.

Table 4-4 Water quality monitoring data

Water body	EA Location Name/ID	NGR	Frequency	Duration presented here	Max no. surveys	Max no. parameters	Comments
Lower River Fowey GB10804800 1420	RIVER FOWEY AT RESPRYN BRIDGE, SW-81520205	SX 09940 63530	Monthly and Quarterly	2017-2022	59	8	No BOD data available
	RIVER FOWEY AT RESTORMEL, SW-81520166	SX 10800 61300	Monthly and Quarterly	2017-2022	62	8	No BOD data available

[3] Environment Agency water quality data archive, available online at http://environment.data.gov.uk/water-quality/index.html

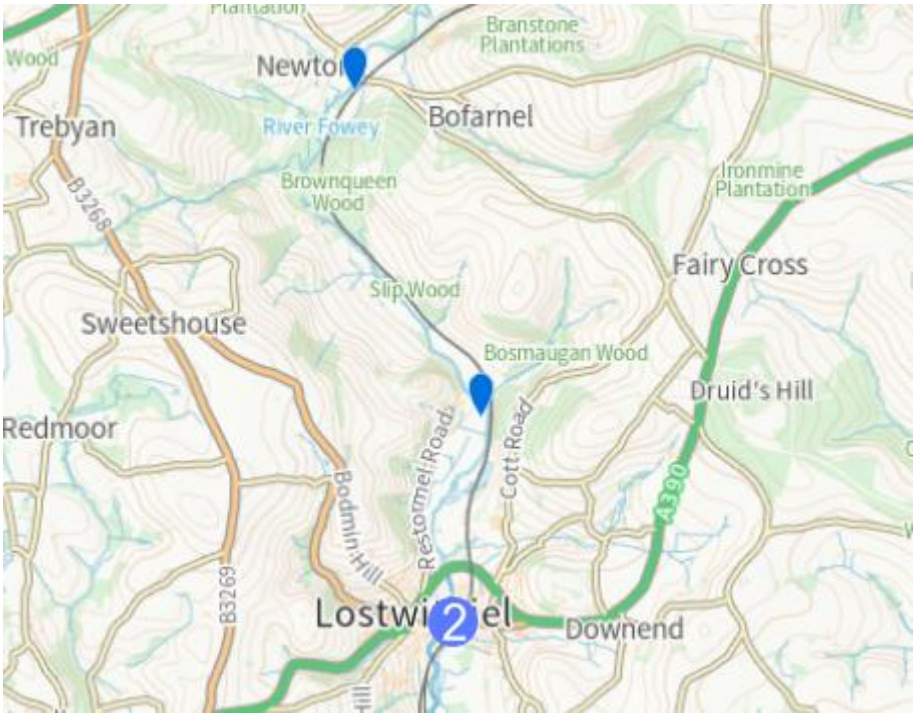


Figure 4-5 EA water quality monitoring locations

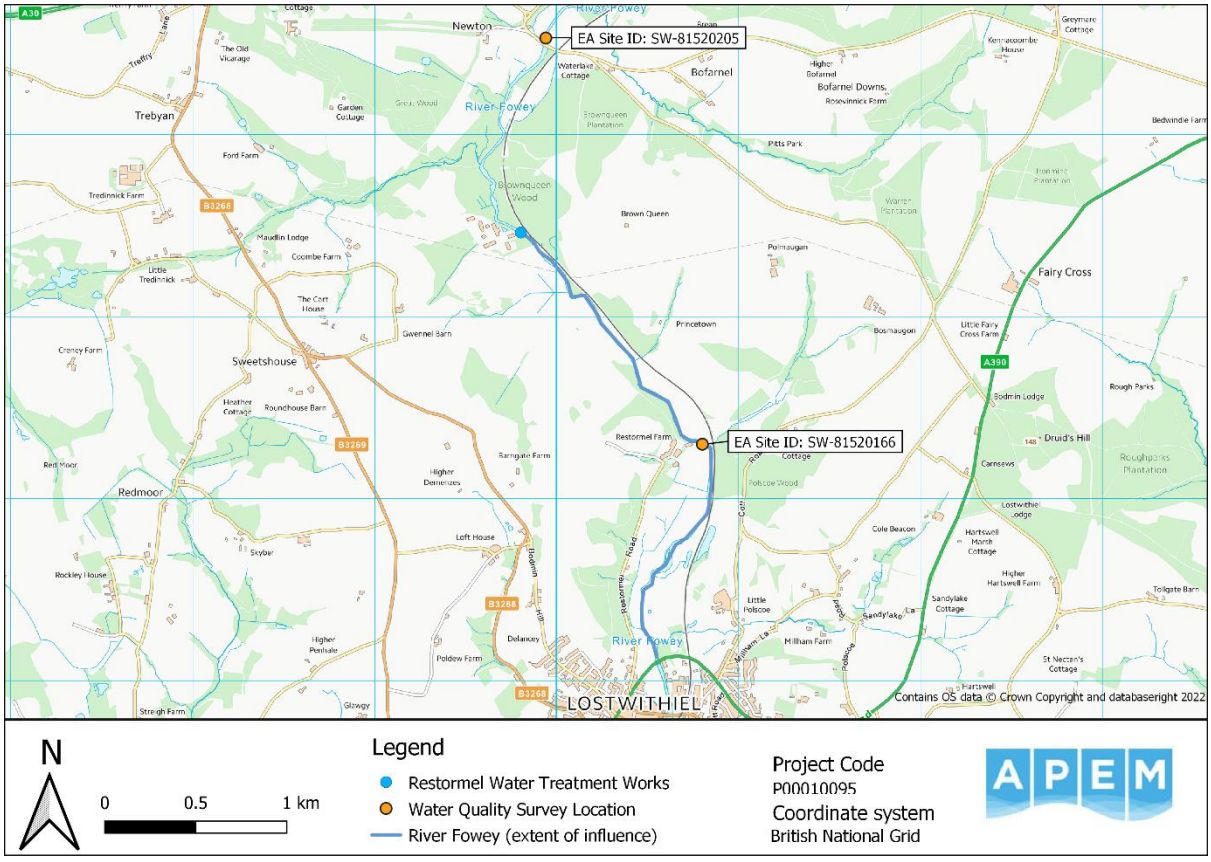


Figure 4-6 Water quality survey locations

Assessment period

The assessment period was defined by the availability of EA 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, but gives sufficient background on the water quality over the last five-year period.

River Fowey data

Water quality data for WFD physico-chemical elements i.e., dissolved oxygen, total ammonia (as N), orthophosphate, 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 (WFD UK TAG) 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 4-5 and Table 4-6).

Table 4-5 Basic typology for rivers

<table>
<tr><th rowspan="2">Site altitude</th><th colspan="5">Alkalinity (as mg/l $CaCO_3$)</th></tr>
<tr><th>Less than 10</th><th>10 to 50</th><th>50 to 100</th><th>100 to 200</th><th>Over 200</th></tr>
<tr><td>Under 80m</td><td rowspan="2">Type 1</td><td rowspan="2">Type 2</td><td>Type 3</td><td>Type 5</td><td rowspan="2">Type 7</td></tr>
<tr><td>Over 80m</td><td>Type 4</td><td>Type 6</td></tr>
</table>

Table 4-6 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 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 two sites were used for this assessment.

There are no WFD standards for suspended solids and nitrate concentrations and 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.

4.5.3 River Fowey Baseline

Water quality data collected by the EA provides additional detail over and above that offered in the WFD status classifications set out in section 4.2. This allows, for example to distinguish between chronic and intermittent water quality issues.

Physico-chemical and nutrient parameters for the two locations in the Lower River Fowey water body are presented from Table 4-7 to

Table 4-8. The main observations are as follows.

Table 4-7 shows temperature and pH were consistently indicative of High status at both sites. Both SW-81520166 and SW-81520205 showed clear seasonal variation in temperature. The pH at both sites also varied somewhat by season (though less consistently than temperature), with higher values of pH mainly occurring in summer. In terms of dissolved oxygen, saturations were consistently indicative of High status at both sites. Suspended solids concentrations were consistently below the (now repealed) FFD limit at both sites, with many samples reported at the limit of detection. The majority of samples measured between <3 and 5 mg/l however there were occasional fluctuations above 5 mg/l at both sites. Suspended solids concentrations were not measured at SW-81520205 until 2019.

Recent nitrate concentrations as shown in

Table 4-8 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 0.0015 mg/l), with many concentrations reported at the limit of detection. Phosphate concentrations were mainly indicative of High status however there were occasional concentrations at both sites indicative of Moderate or Poor status. In terms of total ammonia, concentrations were consistently indictive of High status. There was a considerable gap in the data at site SW-81520205 between the period 2019 and 2022, where only five total ammonia concentrations were reported.

In summary, the water quality data for the Lower River Fowey from 2017 to 2022 show that at both monitoring sites within this water body, the water quality was consistently indicative of High WFD status for all parameters reported above except phosphate, for which concentrations were largely indicative of High status with occasional exceptions where elevated concentrations were recorded.

Table 4-7 Physico-chemical parameters recorded at EA monitoring locations within Lower River Fowey (GB108048001420) water body

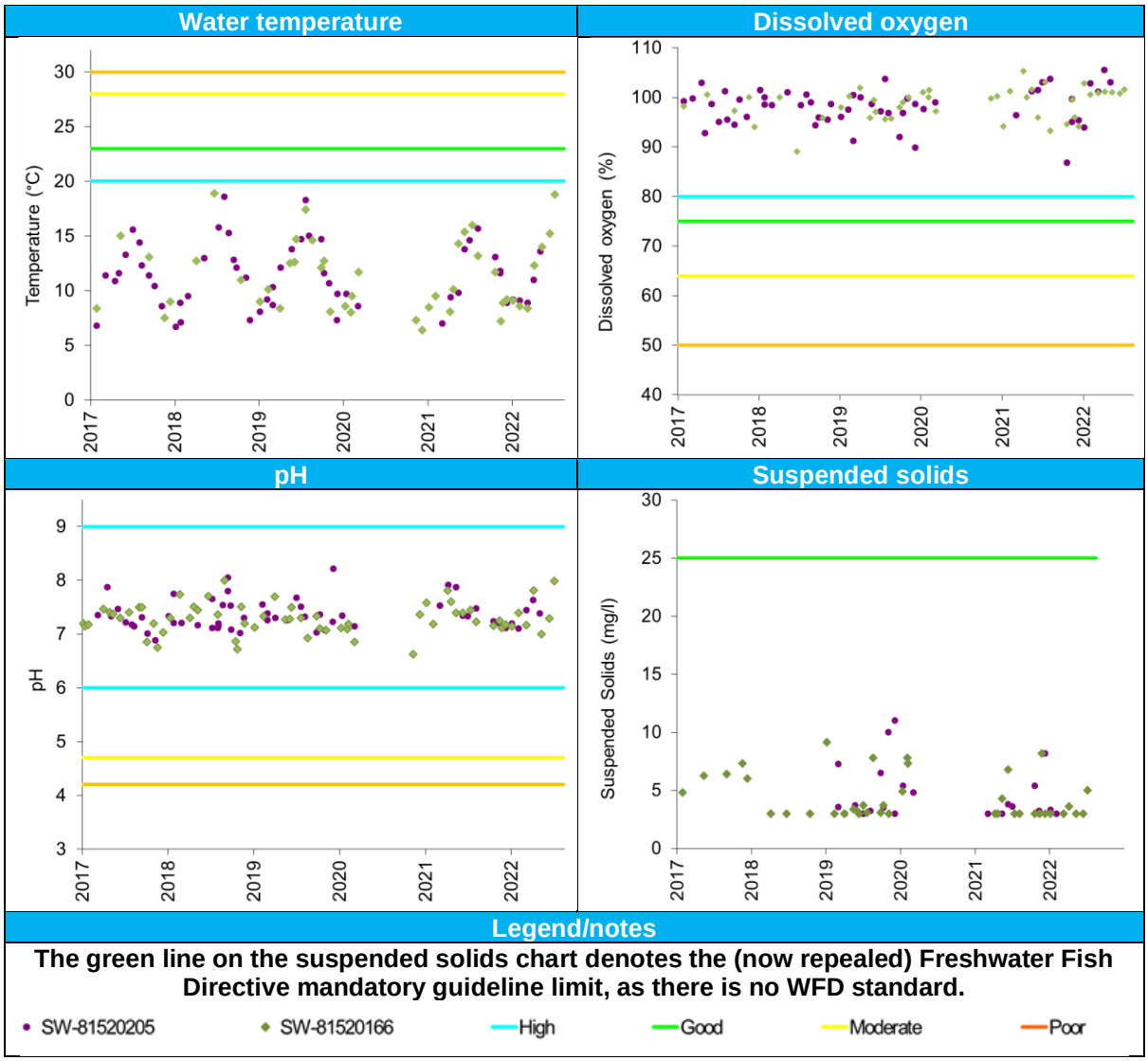
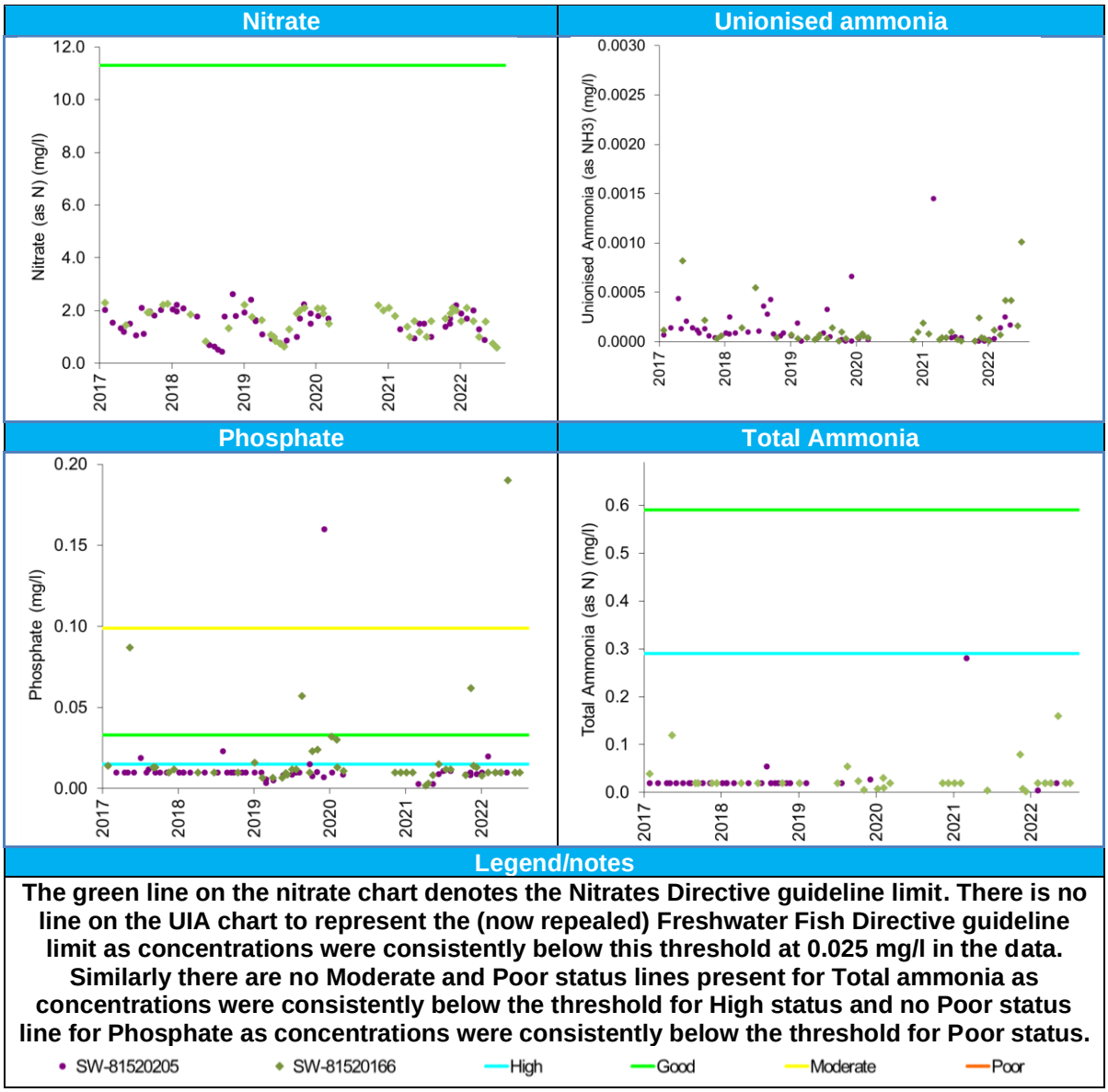


Table 4-8 Nutrient parameters recorded at EA monitoring locations within Lower River Fowey (GB108048001420) water body



4.5.4 Modelling impact assessment

Water quality modelling for the Lower River Fowey water body was carried out using a SIMCAT model, which was provided by SWW. The Environment Agency monitoring locations used were the same as the water quality baseline undertaken above, which include SW-81520166 and SW-81520205.

Water quality data for the two locations in the Lower River Fowey water body are presented from Table 4-9 to Table 4-12 for the following parameters: total ammonia, BOD, nitrate,

orthophosphate and total phosphorus. The baseline data represent the normal rate of abstraction and the adjusted flows represent an increased rate of abstraction under the DP conditions.

Table 4-9 SIMCAT results for water quality at monitoring location SW-81520166

Mean value	Ammonia mg/l	BOD mg/l	Nitrate mg/l	Orthophosphate mg/l	Total phosphorus mg/l
Baseline	0.0163	0.917	2.60	0.0136	0.0342
Adjusted flows	0.0164	0.917	2.61	0.0137	0.0343

Table 4-10 SIMCAT results for water quality at monitoring location SW-81520166

90th percentile value	Ammonia mg/l	BOD mg/l	Nitrate mg/l	Orthophosphate mg/l	Total phosphorus mg/l
Baseline	0.0250	1.39	6.05	0.0288	0.0724
Adjusted flows	0.0251	1.39	6.06	0.0290	0.0728

Table 4-11 SIMCAT results for water quality at monitoring location SW-81520205

Mean value	Ammonia mg/l	BOD mg/l	Nitrate mg/l	Orthophosphate mg/l	Total phosphorus mg/l
Baseline	0.0156	0.973	2.55	0.013	0.0327
Adjusted flows	0.0156	0.973	2.55	0.013	0.0327

Table 4-12 SIMCAT results for water quality at monitoring location SW-81520205

90th percentile value	Ammonia mg/l	BOD mg/l	Nitrate mg/l	Orthophosphate mg/l	Total phosphorus mg/l
Baseline	0.0237	1.45	5.94	0.0274	0.0697
Adjusted flows	0.0237	1.45	5.94	0.0274	0.0697

The data for SW-81520166 and SW-81520205 indicate that there would be only either a slight increase in mean concentrations or no change for ammonia, nitrate, orthophosphate and total phosphorus with the adjusted flows within the water body. Likewise, for the 90th

percentile, concentrations will slightly increase or will not increase for the same parameters as the mean concentrations. Therefore, this assessment shows that the adjusted flows due to the increased rate of abstraction within the Lower Fowey water body will not have any negative impact on water quality.

4.6 Macrophytes and diatoms

4.6.1 Background

Monitoring for macrophytes and phytobenthos (diatoms) has been carried out by the EA on the river Fowey watercourse, upstream and downstream of the Restormel WTW, since August 2007 (Table 4-13,Figure 4-7).

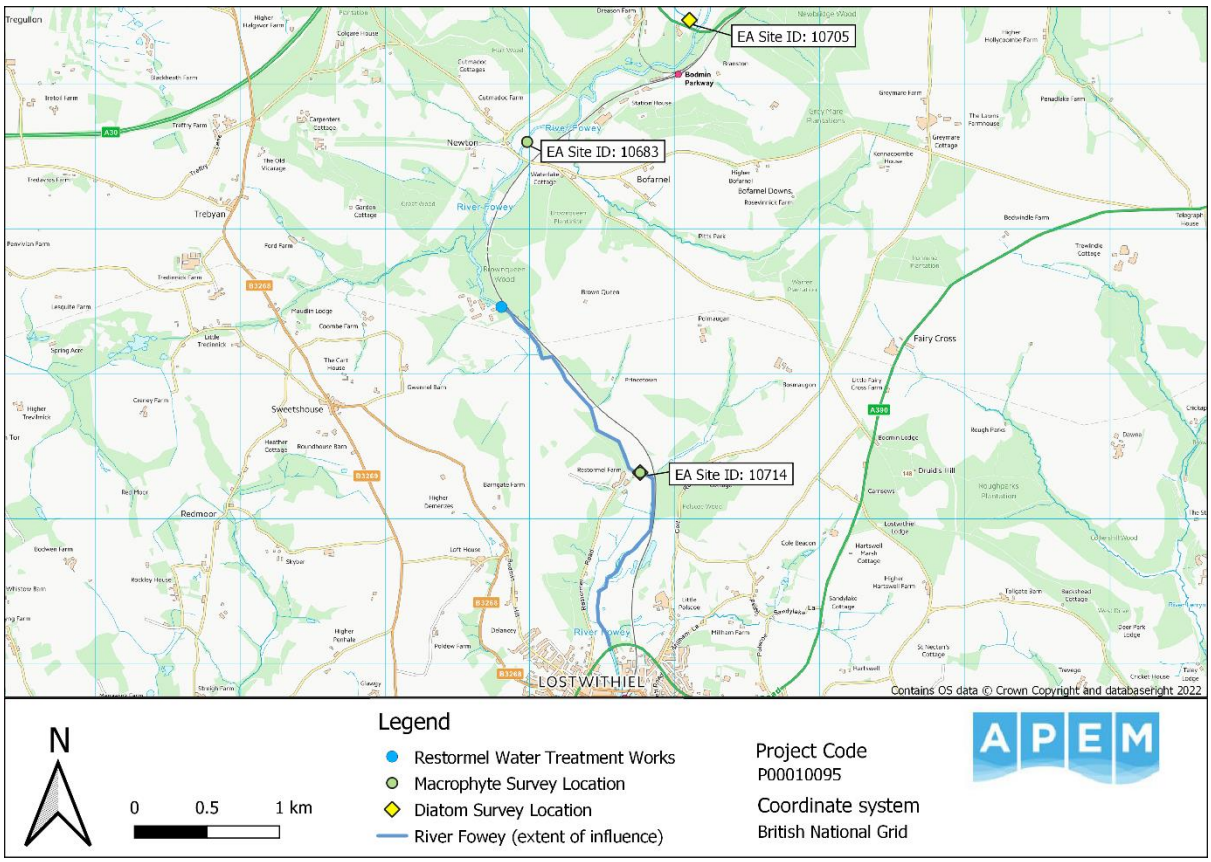


Figure 4-7 Macrophyte and diatom survey locations map

The macrophyte and diatom combined biological element of the Lower River Fowey water body (GB108048001420) is classified as Good WFD status. This in accordance with the most recent Phosphate classification, indicative of High status. The only EA macrophyte and diatom monitoring site on the River Fowey, within the hydrological zone of influence, is located 1.6 km downstream of the Restormel WTW (Site ID: 10714). During the last macrophyte survey at the site in July 2015, River Macrophyte Nutrient Index (RMNI) was recorded to be 4.81 (out of a maximum of 10) and filamentous green algae (*Cladophora glomerata/Rhizoclonium*

hieroglyphicum) was not observed. This is indicative of a macrophyte community that is not heavily influenced by nutrient enrichment. The vegetation recorded during this most recent macrophyte survey was dominated by moss species such as Alpine Water-moss (*Fontinalis squamosa)* and Pleurocarpous moss (*Hygrohypnum ochraceum)*. The River Macrophyte Hydraulic Index (RMHI) was recorded as 5.58 in July 2015, consistent with the high energy environment and indicative of a plant community adapted to high flows (high water velocity).

The phytobenthos scores for the sampling location within the zone of influence (10714) from the last 10 years (Table A-2) indicate a diatom community which is not impacted by either siltation or nutrient enrichment.

Upstream of the Restormel WTW, the closest EA macrophyte and diatom monitoring site is located 1.4 km to the northeast (Site ID: 10683). The most recent macrophyte survey for the site was conducted in September 2008, when RMNI was 4.85 and blue/green algae (*Cyanophyta* spp) had a percentage cover of 0.5%. (Table A-1)

Table 4-13 Details of macrophytes and diatoms monitoring locations

Element	Site Name	EA Location ID	NGR	Record Duration	No. of samples	Location
Macrophytes	Respryn Bridge	10683	SX0998063600	2007 - 2008	2	U/s zone of influence
	Restormel	10714	SX1076061320	2007 - 2015	4	Within zone of influence
Diatoms	Glynn Mill	10705	SX1110064440	2008 - 2018	10	U/s zone of influence
	Restormel	10714	SX1076061320	2008 - 2018	10	Within zone of influence

4.6.2 Potential pathways of impact

Macrophytes and phytobenthos can be affected by a reduction in discharge in two ways. Firstly, a reduction in wetted width can expose marginal emergent and submerged plants leading to desiccation. Secondly changes in water depth affect light penetration potentially increasing the growth rate of filamentous algae, as well as epilithic and epiphytic algae. Reductions in water velocity can also favour the growth rate of attached algae. The RMHI is indicative of a plant community adapted to high flows and therefore a sustained reduction in discharge could cause a shift in community composition.

4.7 Macroinvertebrates

4.7.1 Background

Monitoring for macroinvertebrates has been carried out by the EA both upstream and downstream of Restormel WTW since March 1990 (Table 4-14, Figure 4-8).

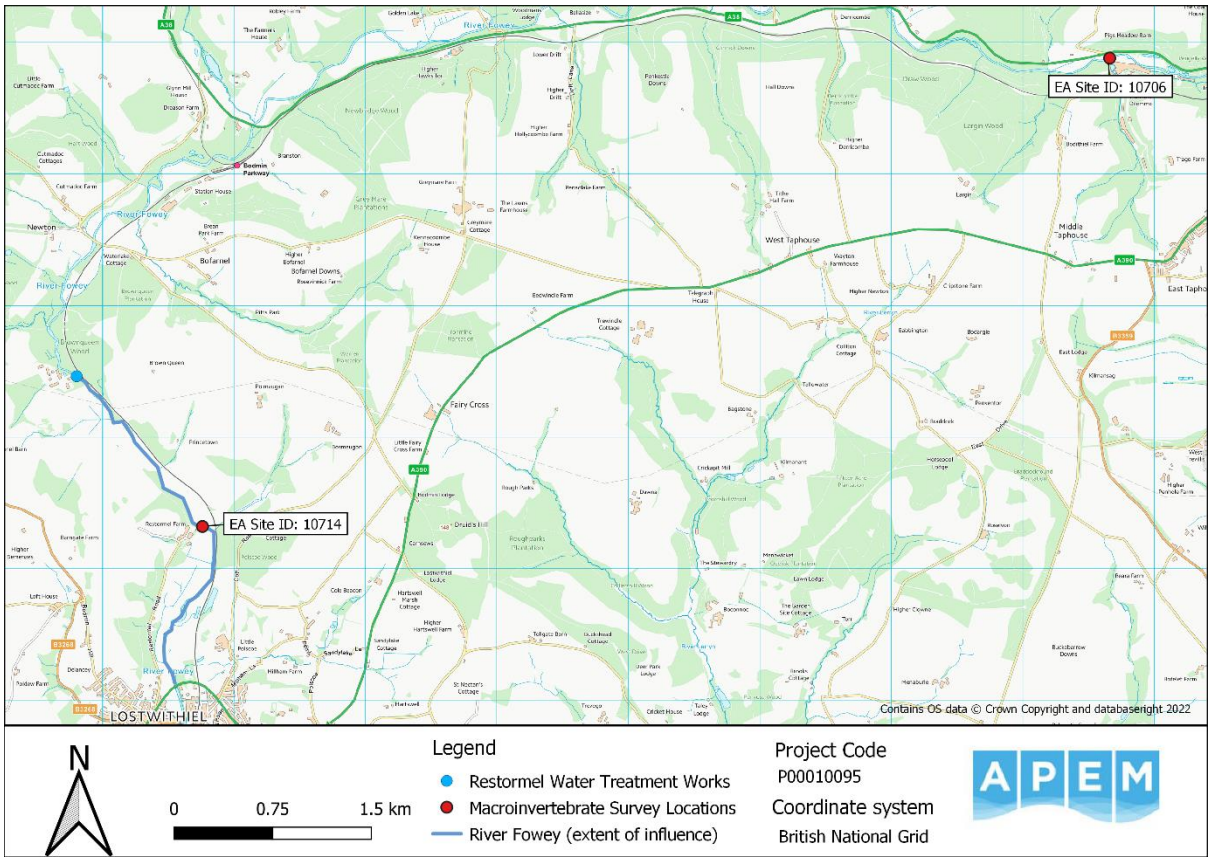


Figure 4-8 Macroinvertebrate survey locations map

The invertebrate element of the Lower River Fowey water body (GB108048001420) is classified at High WFD status. The only EA invertebrate monitoring site on the River Fowey, within the hydrological zone of influence, is located 1.6 km downstream of the Restormel WTW (Site ID: 10714). At this site, two surveys were undertaken between March and October in 2021 (Table B-1). The Whalley, Hawkes, Paisley and Trigg (WHPT) Average Score per Taxon (ASPT) was recorded as 7.44 and 7.26 in spring and autumn respectively. This is indicative of high water quality typical of communities containing a high proportion of species with low tolerances to organic pollution. Species richness at the site is thought to be high, with the WHPT Number of Scoring Taxa (NTAXA) recorded as 30 and 31 in spring and autumn respectively. The Lotic-invertebrate Index for Flow Evaluation (species LIFE) scores averaged 8.32 and are indicative of an invertebrate community with a potentially high sensitivity to reduction in flow velocity. Thus, the community is not considered to be experiencing flow stress at the time of the survey.

Upstream of the Restormel WTW, the closest EA invertebrate monitoring site is located approximately 11 km to the northeast (Site ID: 10706). In 2021, WHPT ASPT averaged 7.2, indicating an invertebrate community which contains several species with low tolerances to organic pollution. Species richness at the site varies from moderate to high, with WHPT NTAXA averaging 29.5.

Table 4-14 Details of macroinvertebrate monitoring locations

Location Name	EA Location ID	NGR	Record Duration	No. of samples	Location
Bodithiel Bridge	10706	SX1766064880	1991 – 2021	28	U/s zone of influence
Restormel	10714	SX1076061320	1991 – 2021	50	Within zone of influence

4.7.2 Potential pathways of impact

Macroinvertebrates can be affected by a reduction in discharge through loss of wetted habitat which at some locations could increase predation pressure by fish. Macroinvertebrates could also be affected by changes in water quality, in this case reduced dilution of pollutants with reduced discharge. A decrease in water velocity can also affect flow-sensitive macroinvertebrates as the wetted habitat becomes suboptimal.

4.8 Fish

Monitoring for fish has been carried out by the EA on the river Fowey watercourse, upstream and downstream of the Restormel WTW, since August 1994 (Table 4-15, Figure 4-9).

The fish element of the Lower River Fowey water body (GB108048001420) is classified at High WFD status. The only EA fish monitoring site on the River Fowey, within the hydrological zone of influence, is located 1.74 km downstream of the Restormel WTW (Site ID: 15902). At this site, five surveys have been undertaken between 1944 and 2008 (See Table 4-15). The last survey identified the migratory and protected species Atlantic salmon (*Salmo salar*), brown / sea trout (*Salmo trutta*) and European eel (*Anguilla anguilla*). In addition, the protected species bullhead (*Cottus gobio*) were also recorded (Table 4-16). These species are WFD indicator species suggesting that the river at this location has minimal impacts which effect fish directly. The presence of a single Flounder (*Platichthys flesus*) suggests that this site is near the tidal limit.

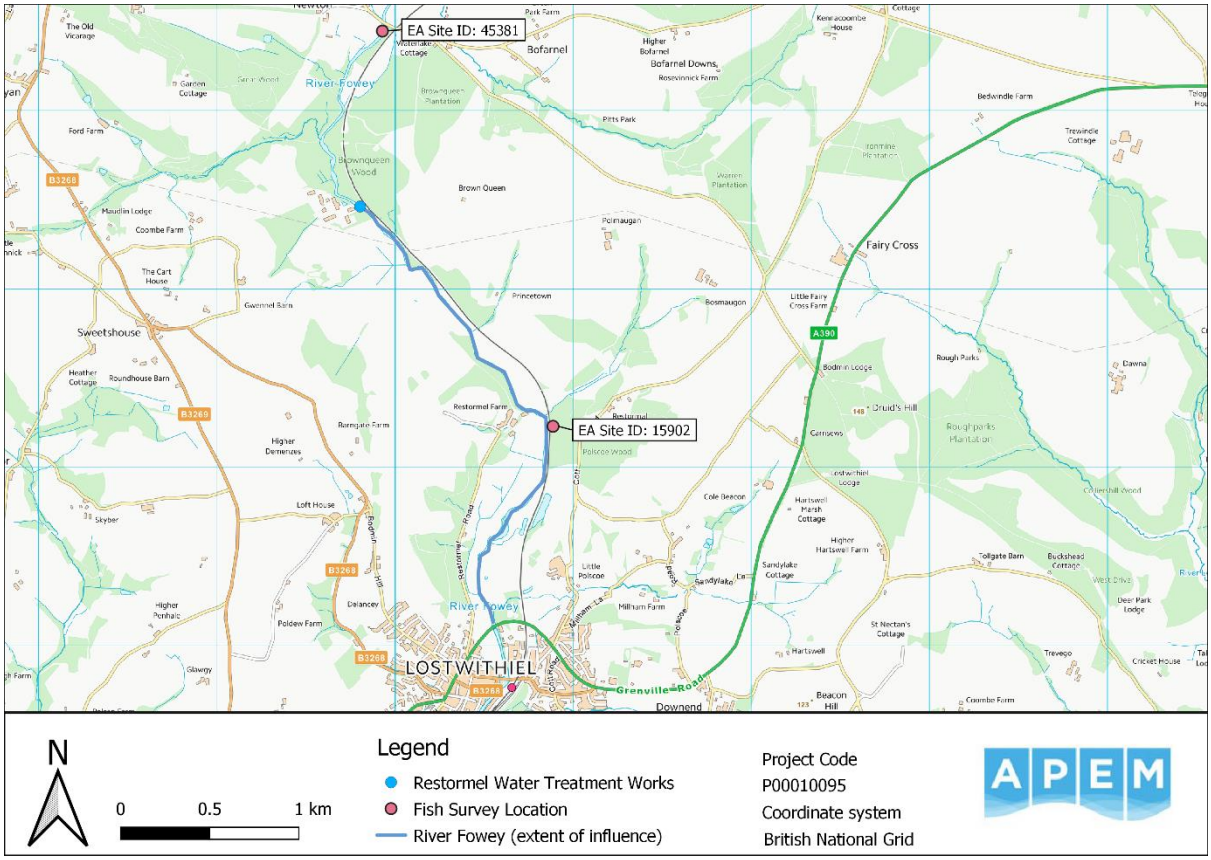


Figure 4-9 Fish survey locations map

Upstream of Restormel WTW, the closest EA fish monitoring site is located approximately 1.42 km to the northwest at Respryn Bridge (Site ID: 15901). Here, the same species as Restormel were identified apart from the inclusion of brook lamprey (*Lampetra planeri*; see Table 4-16). Importantly, the present of migratory fish at this site suggests that Restormel weir is not a complete barrier to their migration.

Table 4-15 Details of fish monitoring locations

Location Name	EA Location ID	NGR	Record Duration	No. of samples	Location
Cardinham	8442	SX1110064460	1979 - 2004	10	U/s zone of influence
Glynn	15900	SX1139064560	1979 - 2005	4	U/s zone of influence
Newbridge	15899	SX1286065100	1994 - 2005	4	U/s zone of influence
Respryn Bridge	15901	SX0997563629	1979 - 2011	6	U/s zone of influence
Restormel	15902	SX1080061200	1994 - 2008	5	Within zone of influence

Table 4-16: The total number of each fish species identified from the fish monitoring sites located on the Lower River Fowey Water Body (GB108048001420).

Species	Cardinham (Site ID: 8442)	Glynn (Site ID: 15900)	Newbridge (Site ID: 15899)	Respryn Bridge (Site ID: 15901)	Restormel (Site ID: 15902)
Atlantic salmon (*Salmo salar*)	489	313	241	345	211
Brook lamprey (*Lampetra planeri*)				13	
Brown / sea trout (*Salmo trutta*)	738	154	17	147	36
Bullhead (*Cottus gobio*)	221	159	90	296	86
European eel (*Anguilla anguilla*)	238	121	3	76	18
Flounder (*Platichthys flesus*)					1
Lamprey sp. (*Petromyzontidae*)	13	9		7	

In addition to the fish monitoring sites, the EA also has a current resistivity-based fish counter system (Logie C) manufactured by Aquantic Ltd that covers all three channels of the gauging weir at Restormel. Since the counter was installed in 1994, data has been collected each year since 1995. The counter data has displayed that the river Fowey supports a large population of both salmon and sea trout which, when assessing the 26 year timeseries, appears to be subjected to levels of interannual variability (**Error! Reference source not found.** and Figure 4-11).

Salmon and large sea trout are shown to predominantly migrate between March – July with peaks in May, and a lesser number are shown to move in the latter months between September – January which peaks in October and November.

Sea trout are shown to migrate between April – August with peak numbers being recorded in July. Much like salmon, a smaller second migration window is shown in the latter months between September – December with almost equal peaks in October and November. However, it must be noted that these numbers are significantly less than the initial main migration peak in July.

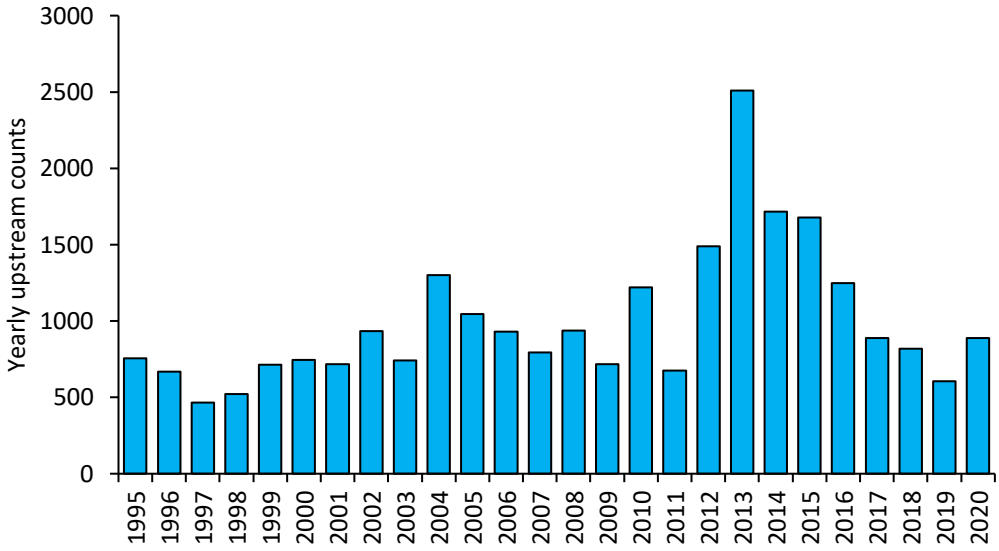


Figure 4-10: Upstream salmon and large sea trout counts at Restormel Weir, River Fowey between 1995 – 2020.

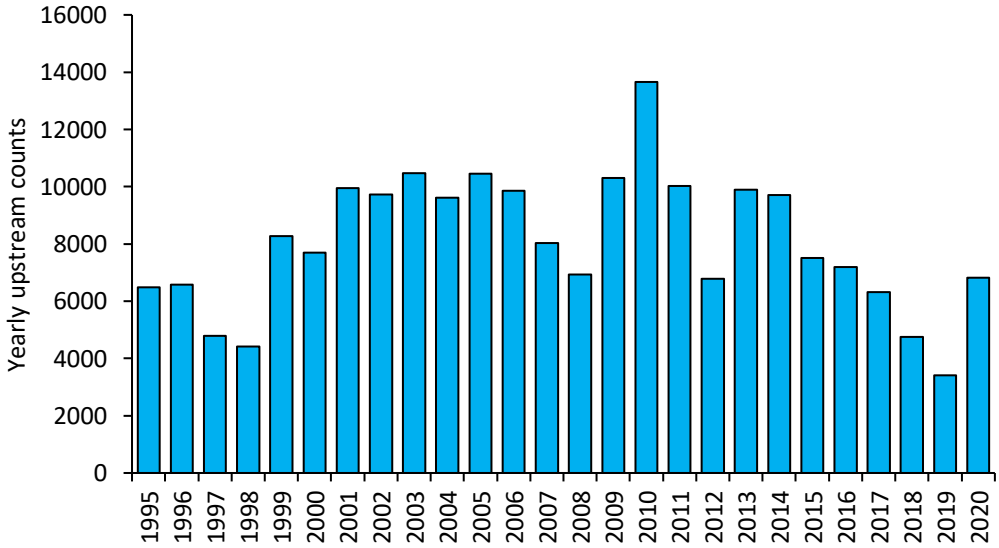


Figure 4-11: Upstream sea trout counts at Restormel Weir, River Fowey between 1995 - 2020.

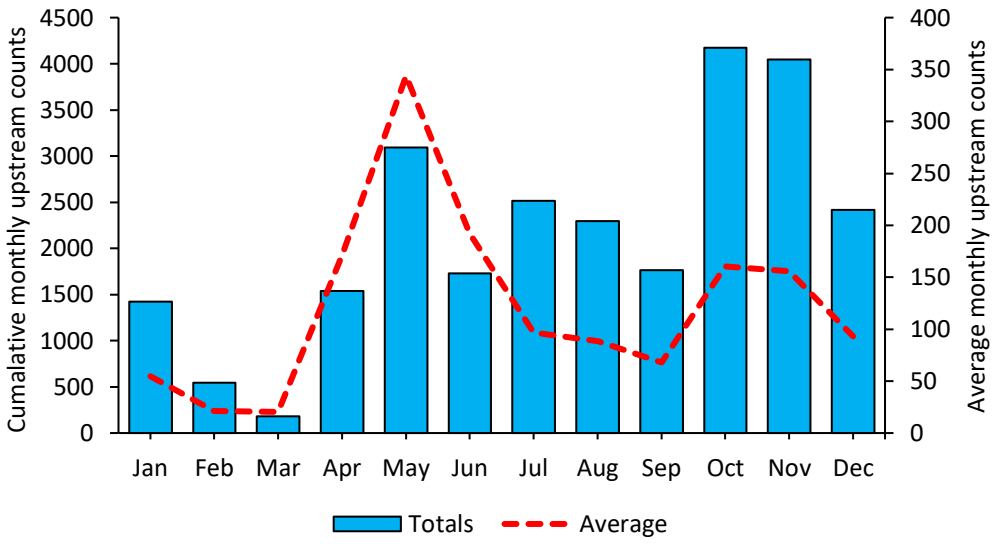


Figure 4-12: Upstream monthly salmon and large sea trout count totals and averages at Restormel Weir, River Fowey between 1995 – 2020.

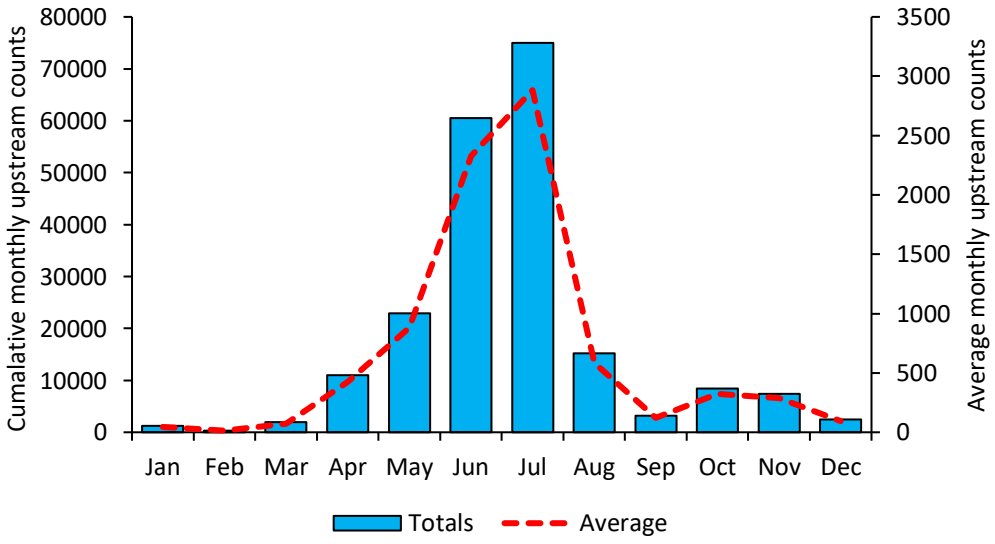


Figure 4-13: Upstream monthly sea trout count totals and averages at Restormel Weir, River Fowey between 1995 - 2020.

Flow is a known driver for triggering the upstream migration in both salmon and sea trout and it can be seen from the 11 year time series that the migration of both species in the river Fowey is intrinsically linked to flow (Figure 4-14 and Figure 4-15). For both species, the main migration occurs in spring following high winter flows (April – May) and subsequent smaller migrations are driven immediately after high flow events (albeit significantly smaller to the winter flows) during the autumnal months (September, October and November;

Figure 4-16 and Figure 4-17). It must be noted that these flows and thus migrations do vary each year depending on the timing of the high flows. However, the migration of these species in the river Fowey is as expected.

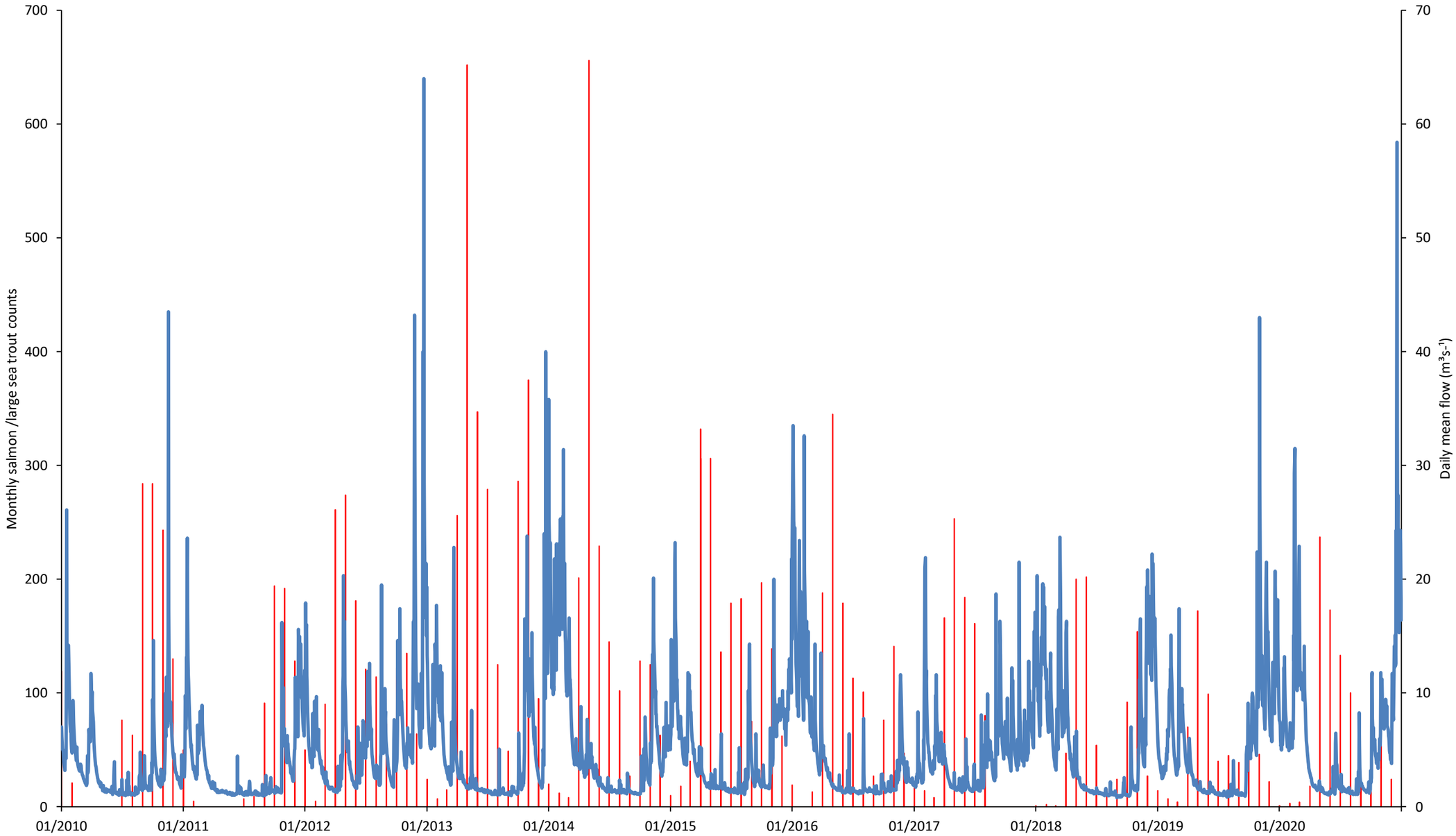


Figure 4-14: 11 year time series of salmon and large sea trout counts (red) taken from the Restormel weir fish counter and its relationship to flow (blue) taken from Restormel gauging weir.

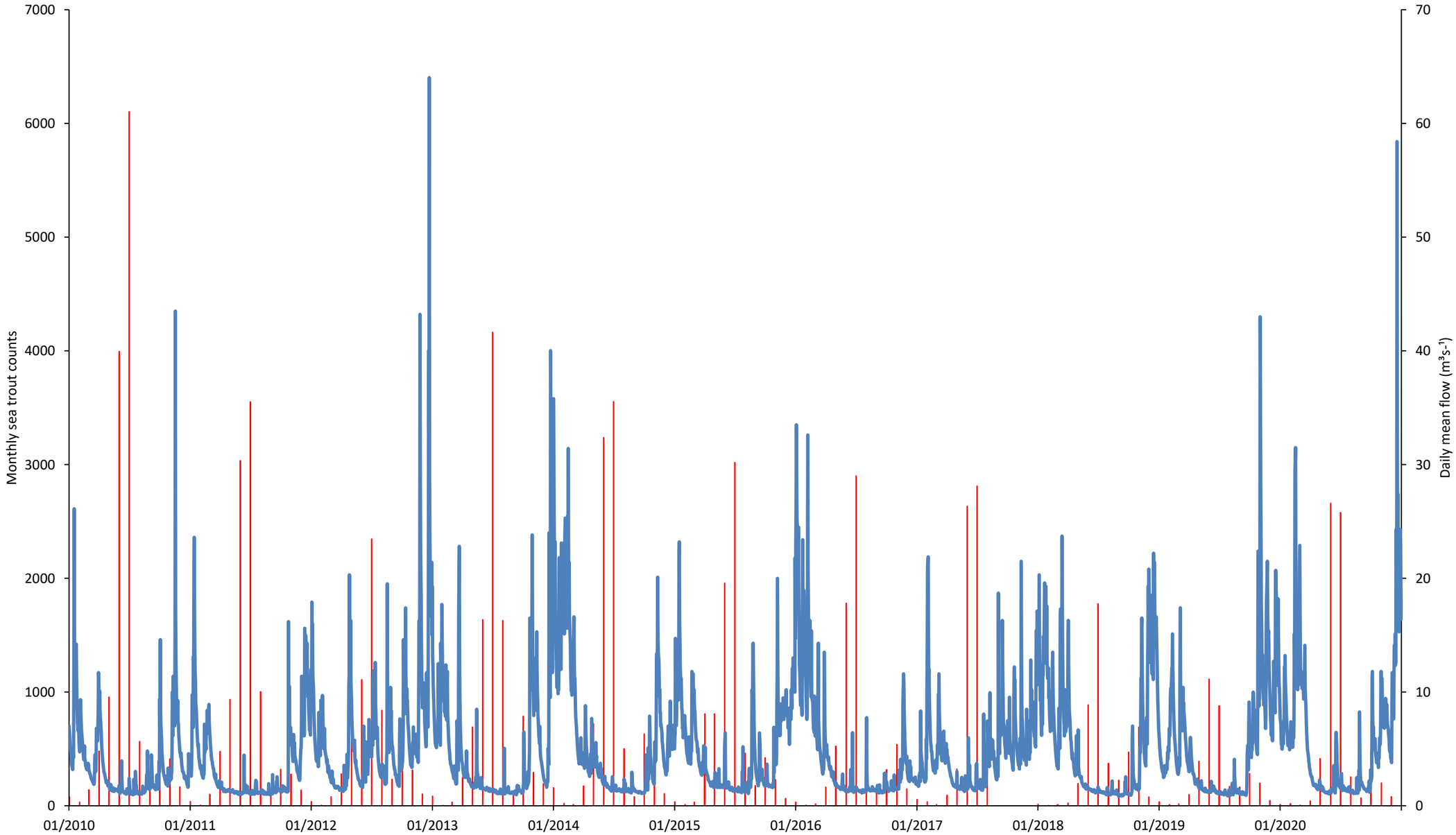


Figure 4-15: 11 year time series of sea trout counts (red) taken from the Restormel weir fish counter and its relationship to flow (blue) taken from Restormel gauging weir.

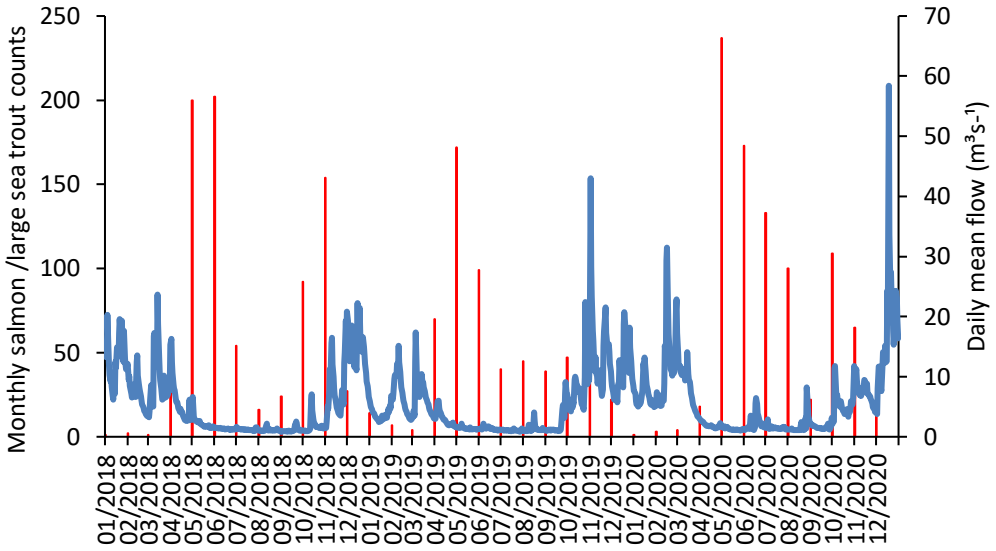


Figure 4-16: The last three years of salmon and large sea trout counts (red) taken from the Restormel weir fish counter and its relationship to flow (blue) taken from Restormel gauging weir.

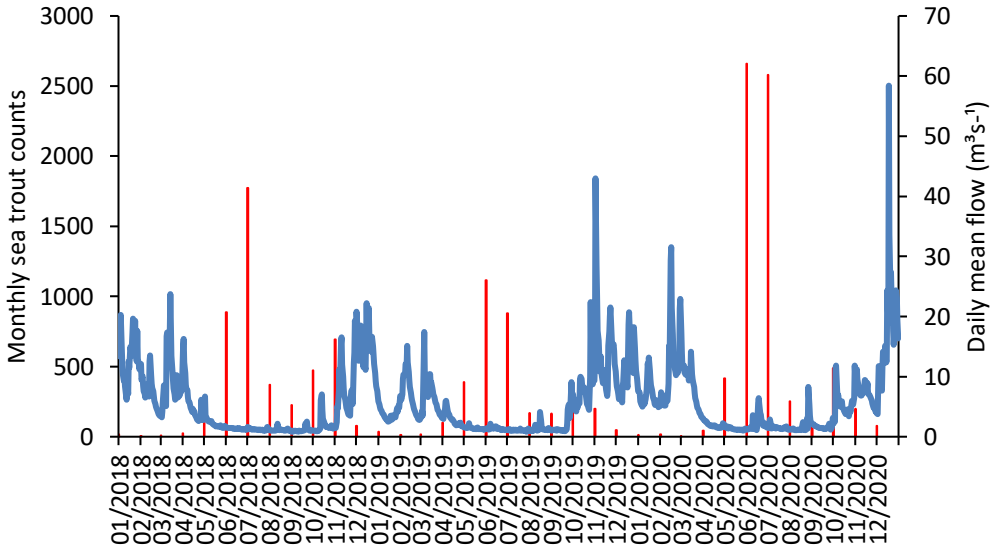


Figure 4-17: The last three years of sea trout counts (red) taken from the Restormel weir fish counter and its relationship to flow (blue) taken from Restormel gauging weir.

4.8.1 Potential pathways of impact

The main potential effects of the proposed drought permit are reduced flow in the River Fowey below Restormel WTW which may result in Restormel weir becoming a barrier to the migrations of certain fish species. At a receptor specific level the following pathways for potential impacts are as follows:

- Restormel Weir may become a barrier to migration under lower flow conditions;
- Reduction in flows may impact the migration trigger flows for migratory salmonids;
- Increase in piscivorous predation due to the reduced flows which may make spotting individuals easier and increase stranding;
- Reduction in available marginal habitats, which if suitable, could result in a loss of lamprey ammocete habitat;
- Reduction in spawning habitats, which could impact spawning and egg incubation in adult salmonids; and
- Fish could also be affected by changes in water quality, in this case reduced dilution of pollutants with reduced discharge.

4.9 Birds

4.9.1 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 58 bird species were recorded as being present in the two 1 km grid squares for Lostwithiel in the Cornwall Bird Atlas (2018) during the winter with an additional two species, of greater conservation sensitivity, being recorded within the 10 km square which covers the southern extent of Lostwithiel. These latter two species are peregrine and Cetti's warbler. Wetland bird species recorded within these grid squares were Canada goose, mute swan, shelduck, mallard, teal, water rail, golden plover, snipe, black-headed gull, lesser black-backed gull, herring gull, little grebe, little egret, cattle egret, grey heron, kingfisher and dipper.

There are no WeBS data recorded for the River Fowey at or upstream of the abstraction point, but an abutting sector, the Fowey Estuary, starts to the south of Lostwithiel and is likely to hold a similar avifauna to the area of study, albeit with an estuarine influence. During the previous five years (2015/16 to 2019/20) 22 species of waterfowl were recorded on the Fowey Estuary WeBS sector, as shown in Table 4-17**Error! Not a valid bookmark self-reference.**. The most commonly occurring species (peak counts of over 100 individuals were herring gull, black-headed gull, mallard, lapwing and lesser black-backed gull.

There are no designated sites within 2 km of the study area, although one SSSI, the Mid Cornwall Moors SSSI, located just over 2 km to the west, has willow tit, cuckoo, nightjar, tree pipit, stonechat, Dartford warbler and grasshopper warbler listed within its citation as species of interest with willow tit highlighted as particularly important. Of these species, only stonechat was recorded in the study area.

Table 4-17 Bird Species recorded during WeBS counts in the Fowey Estuary sector (2015-16 to 2019-20)

Species	Peak Count	Average Count	Species	Peak Count	Average Count
Herring gull	810	589	**Mute swan**	16	9
Black-headed gull	390	308	**Shag**	9	9
Mallard	135	65	**Cormorant**	15	9
Lapwing	300	60	**Common gull**	30	7
Lesser black-backed gull	105	52	**Little grebe**	7	5
Curlew	59	31	**Grey heron**	6	5
Little egret	26	23	**Greenshank**	4	3
Shelduck	33	22	**Red-breasted merganser**	10	2
Redshank	28	20	**Oystercatcher**	6	2
Great black-backed gull	25	12	**Dunlin**	6	2

Species	Peak Count	Average Count	Species	Peak Count	Average Count
Canada goose	23	10	**Kingfisher**	1	0

4.9.2 Potential pathways of impact

The main potential effects of the proposed drought permit are reduced flow in the River Fowey below Restormel WTW to the tidal extent at Lostwithiel Weir. 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 waterbirds, such as dippers and grey wagtails, impacts may be concentrated to changes in the total abundance and species composition of macroinvertebrates.

4.10 Protected Species

Limited information on the presence of protected species was available for this assessment therefore this assessment is based upon records obtained from the NBN atlas[4] and Defra Magic Map[5].

Of the terrestrial species associated with the Fowey River downstream of the abstraction point to the tidal limit approximately 2km downstream, the species most likely to be impacted

[4] https://records.nbnatlas.org/ last accessed 09/09/2022

[5] https://magic.defra.gov.uk last accessed 09/09/2022

by any change in water level are common amphibians and otter (*Lutra lutra*). Historically records show that otter are active in the wider landscapes of the site and the surrounding woodland could also provide suitable holt habitat for otter. It is likely that otter will utilise the watercourse for both feeding and a commuting corridor.

There is the potential for additional protected species to be present around the site and records show that several species of bat are present in the wider landscape. The river corridor provides suitable commuting, roosting and foraging habitat for bats.

4.11 Invasive non-native species

4.11.1 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 in the River Fowey at Restormel WTW. 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 May 2022)

4.11.2 Baseline

From the River Fowey catchment, at the zone of influence at Restormel WTW, only Himalayan balsam (*Impatiens glandulifera*) and New Zealand mud snail (*Potamopyrgus antipodarum*)

were recorded. American mink (*Neovison vison*) have large home ranges and have been recorded approximately 600m upstream of the WTW. See Table 4-18.

Table 4-18: INNS recorded within the zone of influence

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

*Included as found within 600m from zone of influence

4.11.3 Potential pathways of impact

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

i) A reduction in river wetted width, 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 species;

ii) Changes in river flow rates. Reduced flows may decrease the potential for certain species (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 other species; 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.

4.12 Tourism and recreation

Several walking trails can be found on both sides of the river in the reach between Restormel and Lostwithiel particularly around Restormel castle.

The reach is also popular with anglers with fishing for Atlantic Salmon, Sea Trout and Brown Trout. There is a pool feature on the river by Mellingey House which is a known angling location but is also popular with walkers and for river swimming[6].

Several historical sites are popular with tourists. See section 4.15 of this report – all 5 locations are tourist attractions.

The proposed drought permit would take place over winter months, when tourism is at its lowest. The main pathways of impact of the drought permit on recreation would be via changes in water quality and hydrology that could affect angling practices in the zone of influence.

4.13 Other abstractors

There are 27 groundwater abstractions in the catchment and also surface abstractions upstream of Restormel on the rivers Fowey and St Neots. The principal surface water abstractions are operated by SWW and shown in Table 4-19.

However, there are no surface water abstractions from the River Fowey in the zone of influence of the drought permit, downstream of Restormel.

On this basis other abstractions are not considered further in this report.

[6] https://www.mellingey.co.uk/salmon-trout-river-fishing-fowey-lostwithiel/ last accessed 25/08/2022

Table 4-19 Other SWW surface water abstractions in the Fowey catchment

Licence No.	Abstraction name	Purpose	NGR	Quantities
15/48/018/S/034	Siblyback Reservoir	Public Water Supply	SX231703	9.092 Ml/day, 1100 Ml/year
15/48/018/S/032	River Fowey (Trekeivesteps Intake)	Public Water Supply	SX227698	15.911 Ml/day, 5807.5 Ml/year
15/48/018/S/043	Lampen Mill, St Neot	Public Water Supply	SX186673	-
15/48/018/S/035	Colliford Lake	Public Water Supply	SX179711	35 Ml/day, 5390 Ml/year

4.14 Aesthetics and landscape

The zone of influence is not associated with landscape designations such as AONBs. The visual aesthetics of the river Fowey underpin the appeal of the walking trails for tourists and local residents.

The main element of the landscape in the zone of influence are the heritage sites (see Section 4.16) rather than natural features.

The abstraction weir and WTW have been in place for several decades and are generally well hidden from view by trees.

The pathways for impact on aesthetics and landscape are centred upon visual changes in water quality such as algal blooms, and changes to the riverscape caused by changes in river flow.

4.15 Archaeology and heritage

Five listed buildings and scheduled monuments lie close to the impacted reach of the river Fowey, between Restormel and the A 390 road bridge. These are listed in Table 4-20.Only one, Lostwithiel Bridge is directly on the River Fowey.

Pathways of impact on Lostwithiel bridge centre upon drops in water level that would temporarily expose previously submerged stonework, which could be damaged by a cycle od drying and rewetting.

Table 4-20: Heritage sites in proximity of the zone of impact

Name	Reference	Type	NGR	Distance from River (m)
Restormel Castle	1017574	Scheduled monument	SX1039161415	238
Roman Fort Southwest of Restormel Farm	1004660	Scheduled monument	SX1021061056	632
Battle of Lostwithiel	14113619	Battlefield	SX1033161361	322
Restormel Manor	1137912	Grad 2 listed building	SX1072761291	35
Lostwithiel Bridge	1327324	Grade 1 listed building	SX1061559809	0

5. Impact assessment: pathways

5.1 Hydrology

5.1.1 DP scenarios

Removal of the annual cap on abstraction at Restormel can have a range of outcomes, depending on flows and the operational choices made by Southwest Water. DP and baseline scenarios may not always differ - if flows are beneath the Restormel HOF, any abstraction would have to be supported from Colliford and/ or Siblyback Reservoirs and the incentive for the DP operation might be removed. Alternatively, if flows were very high, the difference in abstraction would be (proportionately) small. In contrast, abstraction is most important as a proportion of flow when inflows to Restormel are 214 Ml/d, allowing the full take to reduce flows downstream of the abstraction to the 104 Ml/d HOF.

2022 abstraction data (which cover the period up to and including 17th July 2022) suggest that if abstraction continued at the maximum daily rate after the 17th of July, the annual cap would force a cessation of abstraction in early November. After this, provided flows were above the Restormel HOF, abstraction could continue under a DP that removed the annual cap. Without such a DP, abstraction would cease.

Such a scenario may, however, exaggerate the volume of abstraction; with abstraction increasing to assist Colliford refill, an average of c.85 Ml/d was taken in mid-July. Were that to have continued over the late summer, and continue further into the autumn, the annual cap would force a cessation of abstraction in early December.

Alternatively, without a DP, South West Water might conceivably abstract at a lower rate to allow assisted refill of Colliford throughout the remainder of 2022 whilst working to just within the annual abstraction cap. Abstraction records provided suggest that an abstraction of 64 Ml/d could be sustained to the end of 2022, compared with a maximum abstraction of 110 Ml/d should the annual cap be removed.

There are therefore many potential differences in abstraction regimes that may result from a temporary removal of the annual cap on abstracted volume at Restormel. The following scenarios are intended to illustrate potential differences that may arise:

- A 'max rate' abstraction case in which 110 Ml/d is taken under both the DP and No DP scenarios until early November 2022, at which point abstraction ceases under the No DP scenario and continues under the DP scenario. There would therefore be no difference in the scenarios until early November and a 110 Ml/d difference from then until the 31st December 2022. This scenario allows a large difference between DP and non-DP scenarios, but for a relatively short period maximises the magnitude of the difference for a relatively short period.

- A 'sustained' abstraction case in which abstraction continues at 64Ml/d for the rest of the year under the No DP scenario and at 110 Ml/d under the DP scenario. This allows a relatively small difference in the magnitude of abstraction (46 Ml/d) for a longer period.

- A 'continue at last recorded rate' case in which 85 Ml/d is taken under both the DP and No DP scenarios until early December 2022, at which point abstraction ceases under the No DP scenario and continues under the DP scenario. There would therefore be no difference in the scenarios until early December and a 110 Ml/d difference from then until the 31st December 2022. This is a hybrid case in which the difference between scenarios (85 Ml/d) is between those of the other cases, for a shorter period. Note that the annual abstraction limit at a daily rate is just below 80 Ml/d.

5.1.2 Derivation of scenarios

The naturalised flow series at Restormel was adjusted to remove the contribution from the catchments to Colliford and Siblyback Reservoirs. The compensation flows were then added to create a denaturalised series that simulates dry weather flow behaviour with no spills or regulation releases made from the two upstream reservoirs. This.

Abstraction at Restormel was then simulated by allowing maximum abstraction of 64 Ml/d 85 Ml/d or 110 Ml/d, assumed either to be supported entirely from Colliford and Siblyback Reservoirs with no residue, or capping abstraction to ensure adherence to the 104 Ml/d HOF. For the purposes of the illustrations of selected dry weather periods, abstraction was simulated regardless of the annual allowable volume.

5.1.3 Results

Simulated flows for selected dry weather periods are shown in **Error! Reference source not found.**. Key points are given below:

- The differences between DP and No DP scenarios for the various abstraction cases is small in relation to the natural range of flows. (At high flows the difference is too small to be visible on the charts.)

- Dry weather can force summer flows below the Restormel HOF. During these periods there is no difference in abstraction cases and DP/ No DP scenarios.

- Spate flows occur frequently and can occur even during summer dry weather periods. During these events, for example as occurred during the summer 2018, abstraction is simulated to occur for short periods before flows revert below the HOF.

- Abstraction effects are most evident during moderate flows above the Restormel HOF. During such periods, abstraction can be limited below the maximum rate by the available flow, but the requirement to abstract only half the available flow above the HOF ensures that flows are not maintained at the HOF for long durations.

- Whilst the difference between abstraction and no abstraction is evident during moderate flows, the differences between 64 Ml/d, 85 M/d and maximum (110 Ml/d) abstraction is inevitably smaller and tends also to be less sustained.

- Reduction in the annual cap is most likely to allow increased abstraction in late 2022. Winter baseflows can be sufficiently low that abstraction is reduced below the 64, 85 or 104 Ml/d maximum daily takes (dependent on the scenario). However, the HOF is not reached during these months in the 1995-96, 2010 – 2012 or 2018 dry periods, and periods during which abstraction is reduced below the maximum takes tend to be of short duration.

- Subject to the HOF, and to taking only 50% of unsupported flows above this, the DP application also makes provision to abstract an additional 3600 Ml/d from the 1st January 2023 to the 31st March 2023, the volume of which shall not be included for the purposes of calculating the maximum annual abstraction allowance of 28,900 Ml. Late winter baseflows and early spring can be sufficiently low that abstraction is reduced below the 64, 85 or 104 Ml/d maximum daily takes (dependent on the scenario). However, as with late autumn/ early winter flows, the HOF is not reached during these months in the 1995-96, 2010 – 2012 or 2018 dry periods, and periods during which abstraction is reduced below the maximum takes tend to be of short duration.

5.1.4 Summary

Comparison of synthesised estimates of historic dry weather periods suggests that abstraction is a relatively modest effect relative to normal seasonal variation, and also that outside of the summer months, abstraction is unlikely to cause sustained periods at the Restormel HOF without episodic disturbance.

The magnitude of impact of the drought permit on flow downstream of Restormel Weir was determined to be Low. Confidence in this assessment is **Medium**.

Table 5-1: Summary of predicted impacts on River Fowey flow d/s of Restormel Weir

Pathway	Magnitude of impact	Confidence level
River flow	**Low**	**Medium**

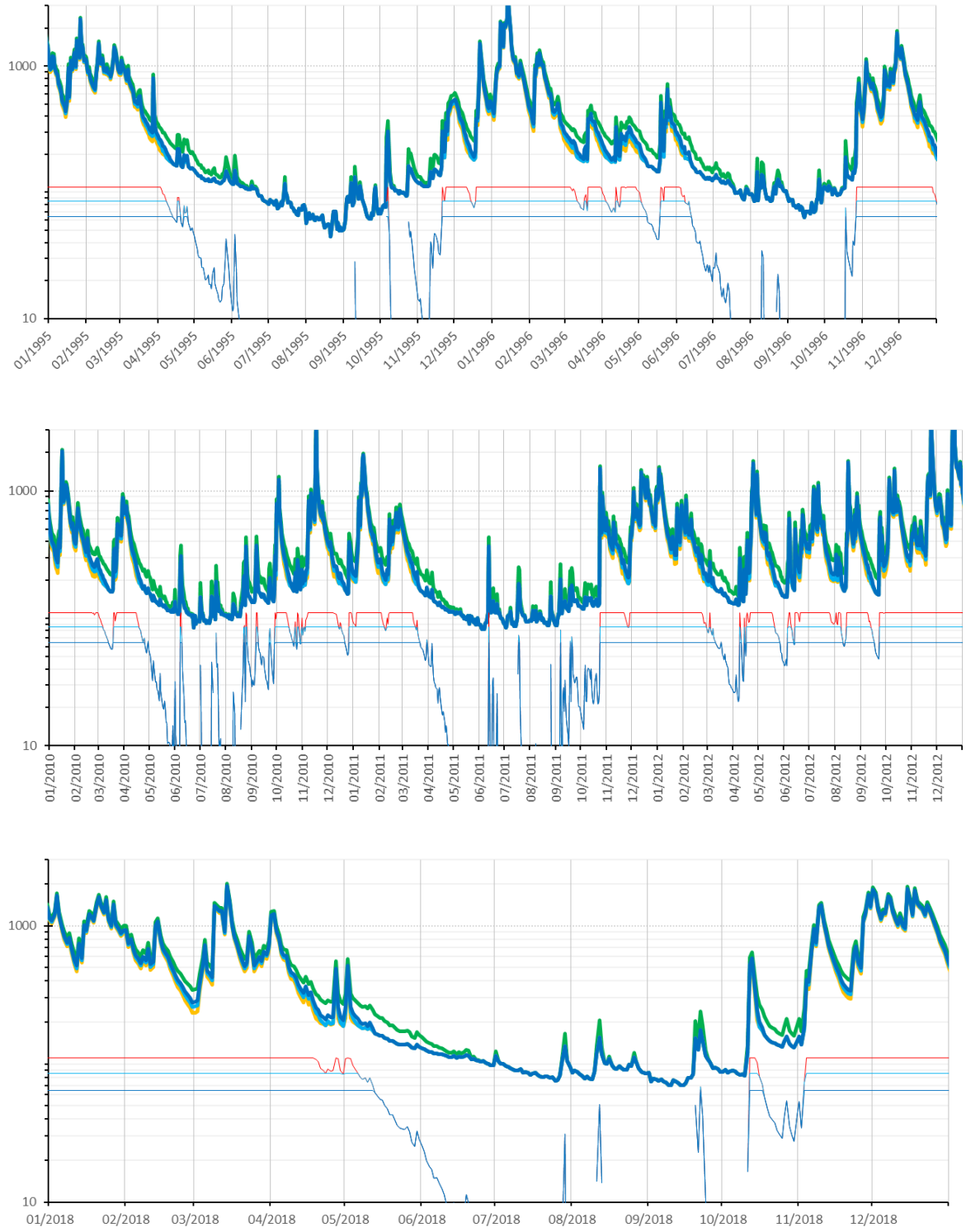


Figure 5-1 Abstraction scenarios in Ml/d, illustrating effects of DP operation - 1995/96 (top), 2010 -2012 (middle) and 2018 (bottom)

Green = Restormel residual flow with no abstraction. Dark blue = Restormel residual flow with 64 Ml/d abstraction. Light blue = Restormel residual flow with 85 Ml/d abstraction. Orange = Restormel residual flow with 110 Ml/d abstraction. Thin red line = abstraction (max. 110 Ml/d). Thin light blue line = abstraction (max. 85 Ml/d). Thin dark blue line = abstraction (max. 64 Ml/d). Lettered red ovals elate to text. Note log scales (Y axes).

5.2 Hydraulics

A summary of the hydraulic study is presented in Table 5-2.

Figure 5-2 shows bed level and estimated water depth for each flow scenario. Increase in water depth under different flow scenarios from the DP were found to follow a same trend at locations 1 to 3. However, at location 4, transect featured a mid-river island. The shallower and narrower left channel was shown to be wet (although very shallow) only during 'max rate' and 'continue at last recorded rate' cases.

Table 5-3 to Table 5-6 shows change of flow parameters for the DP and non-DP scenarios. Magnitude of change between DP and non-DP scenarios is considered to be constant over time. Key points for each case are given below:

- DP vs 'max rate' non-DP: in general, this case shows the highest change as the discharge of the non-DP scenario is two times higher than DP. This led to around 25% and 22% change in water depth and velocity respectively. On the other hand, changes in wetted perimeter are found to be small (2-5%) apart from location 4 where left channel is changing from dry in DP case to wet in non-DP case and consequently changing wetted perimeter value by around 20%.
- DP vs 'sustained' non-DP: On average, it is shown that the water depth and velocity decreased by 14% and 12% from non-DP to DP flow scenario respectively. On the other hand, change in wetted perimeter was found to be small.
- DP vs 'continue at last recorded rate' non-DP: Change of flow parameters between these two scenarios are similar to and slightly lower than the DP vs 'max rate' non-DP case.

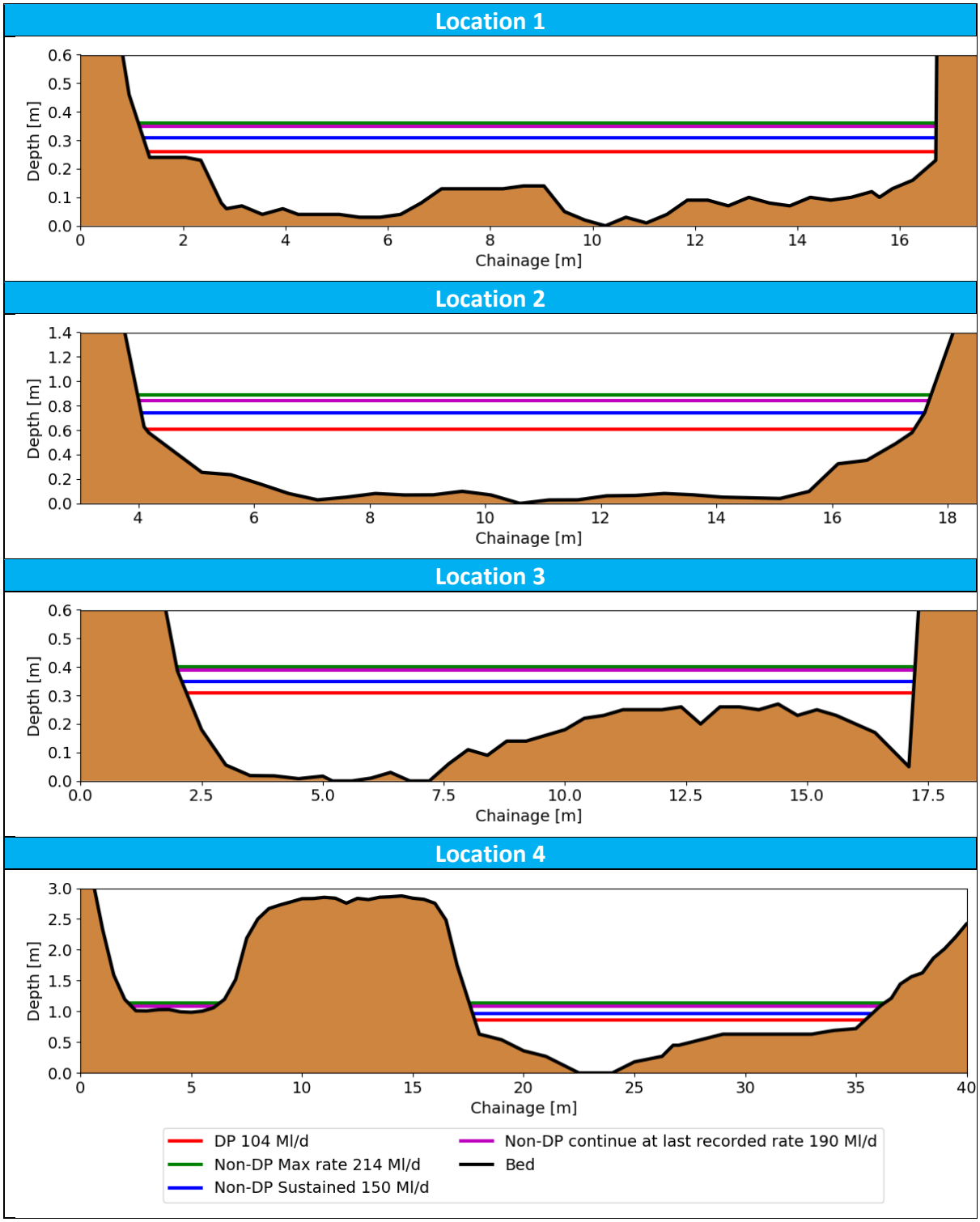


Figure 5-2 Predicted depth changes at assessment locations for the DP and Non-DP scenarios

Table 5-2 Hydraulic parameters at assessment point for the DP and Non-DP scenarios

	Scenario	Water depth [m]	Wetted perimeter [m]	Average velocity [m/s]	Bed shear stress [N/m²]	Froude Number [-]
Location 1	DP	0.26	15.50	0.45	9.17	0.35
	Non-DP Max rate	0.36	15.79	0.60	14.00	0.37
	Non-DP Sustained	0.31	15.65	0.51	10.63	0.35
	Non-DP Continue	0.35	15.75	0.56	12.22	0.36
Location 2	DP	0.61	13.50	0.19	16.18	0.09
	Non-DP Max rate	0.89	14.19	0.25	24.21	0.09
	Non-DP Sustained	0.74	13.84	0.22	19.84	0.09
	Non-DP Continue	0.84	14.07	0.24	22.70	0.09
Location 3	DP	0.31	15.28	0.47	14.23	0.37
	Non-DP Max rate	0.40	15.60	0.62	21.67	0.39
	Non-DP Sustained	0.35	15.43	0.54	17.62	0.38
	Non-DP Continue	0.39	15.56	0.60	20.26	0.39
Location 4	DP	0.86	17.85	0.16	14.52	0.08
	Non-DP Max rate	1.13	23.20	0.19	19.10	0.08
	Non-DP Sustained	0.97	18.34	0.18	17.79	0.08
	Non-DP Continue	1.09	22.69	0.19	18.06	0.08

Table 5-3 Change of hydraulic parameters at location 1 for the DP and Non-DP scenarios

Hydraulic parameters	Change DP vs Non-DP Max rate	Change DP vs Non-DP Sustained	Change DP vs Non-DP Continue	Change DP vs Non-DP Max rate [%]	Change DP vs Non-DP Sustained [%]	Change DP vs Non-DP Continue [%]
Depth [m]	0.10	0.05	0.09	27%	16%	25%
Wetted Perimeter [m]	0.29	0.15	0.25	2%	1%	2%
Velocity [m/s]	0.15	0.06	0.11	25%	12%	20%
Shear Stress [N/m2]	4.83	1.46	3.05	35%	14%	25%
Froude Number [-]	0.02	0.00	0.01	5%	1%	2%

Table 5-4 Change of hydraulic parameters at location 2 for the DP and Non-DP scenarios

Hydraulic parameters	Change DP vs Non-DP Max rate	Change DP vs Non-DP Sustained	Change DP vs Non-DP Continue	Change DP vs Non-DP Max rate [%]	Change DP vs Non-DP Sustained [%]	Change DP vs Non-DP Continue [%]
Depth [m]	0.28	0.13	0.23	31%	18%	27%
Wetted Perimeter [m]	0.69	0.34	0.57	5%	2%	4%
Velocity [m/s]	0.06	0.03	0.05	23%	12%	20%
Shear Stress [N/m2]	8.03	3.66	6.52	33%	18%	29%
Froude Number [-]	0.01	0.00	0.01	6%	3%	5%

Table 5-5 Change of hydraulic parameters at location 3 for the DP and Non-DP scenarios

Hydraulic parameters	Change DP vs Non-DP Max rate	Change DP vs Non-DP Sustained	Change DP vs Non-DP Continue	Change DP vs Non-DP Max rate [%]	Change DP vs Non-DP Sustained [%]	Change DP vs Non-DP Continue [%]
Depth [m]	0.09	0.04	0.08	23%	12%	20%
Wetted Perimeter [m]	0.32	0.15	0.28	2%	1%	2%
Velocity [m/s]	0.15	0.07	0.13	24%	13%	21%
Shear Stress [N/m2]	7.44	3.39	6.02	34%	19%	30%
Froude Number [-]	0.03	0.01	0.02	6%	3%	5%

Table 5-6 Change of hydraulic parameters at location 4 for the DP and Non-DP scenarios

Hydraulic parameters	Change DP vs Non-DP Max rate	Change DP vs Non-DP Sustained	Change DP vs Non-DP Continue	Change DP vs Non-DP Max rate [%]	Change DP vs Non-DP Sustained [%]	Change DP vs Non-DP Continue [%]
Depth [m]	0.27	0.11	0.23	24%	11%	21%
Wetted Perimeter [m]	5.35	0.49	4.84	23%	3%	21%
Velocity [m/s]	0.03	0.02	0.03	17%	13%	13%
Shear Stress [N/m2]	4.58	3.27	3.54	24%	18%	20%
Froude Number [-]	0.00	0.00	0.00	4%	4%	4%

In conclusion, it was found that the different flow scenarios have an impact of **Medium** magnitude on the water depth, velocity and bed shear stress. Meanwhile impact on wetted perimeter and Froude number[7] was found to be **Negligible**. Note that the results presented above contain some degree of uncertainty, hence confidence in this assessment is **Medium** (Table 5-7).

Table 5-7: summary of impacts on hydraulics

Pathway	Magnitude of impact	Confidence level
Depth, velocity & shear stress	**Medium**	**Medium**
Wetted perimeter & Froude number	**Negligible**	**Medium**

5.3 Water quality

No STWs discharge into the Lower River Fowey water body and owing to the lack of any notable discharge, the scope for reduced dilution of pollutants in this water body is considered to be small. The scale of effect is expected to be Negligible. Thus, the drought permit is predicted to have a **Negligible** impact on water quality in the zone of influence downstream of Restormel Weir. The overall assessment is judged to have a **Medium** confidence level. The water body has a reasonable coverage of data, which is presumed to be accurate and reliable. The monitoring results demonstrate that water quality is fairly

[7] The Froude number, Fr, is a dimensionless value that describes different flow regimes of open channel flow. The Froude number (Fr) is equal to V/√(gD) where V is water velocity, g is gravity and D is hydraulic depth. Fr>1, fast rapid flow, Fr <1 slow tranquil flow

consistent and of high quality. Impacts on the water quality pathway are summarised in Table 5-8.

Table 5-8: Summary of predicted impacts on water quality

Pathway	Magnitude of impact	Confidence level
Water Quality	**Negligible**	**Medium**

6. Impact assessment: receptors

6.1 Designated sites

There are no designated sites in the zone of influence.

Downstream of the zone of influence, the Fowey estuary is an AONB and a MCZ. The change in flow reaching the estuary due to the drought permit is expected to have a negligible impact on the estuary, in the sense that these flow variations have been experienced before without negative impacts and are short term only. The AONB and MCZ were therefore determined to be of **Low** sensitivity, with impact significance **Minor** in the absence of a Negligible category. Confidence in this assessment is **Medium**. See Table 6-1

Table 6-1 Summary of predicted impacts on designated sites

Receptor	Sensitivity	Significance of impact	Confidence level
Upper Fowey and Pont Pill MCZ	Low	Minor*	Medium
Fowey AONB	Low	Minor*	Medium

* Impact predicted to be negligible, but categorised as Minor in the absence of a negligible category.

6.2 WFD status of the waterbodies

The WFD ecological status of the Lower River Fowey is currently Good, based on 2019 data. The drought permit scenario presents flows experienced in the zone of influence in previous years, that did not affect the WFD ecological status. Impacts on flow downstream of Restormel Weir are predicted to be **Low** (Section 5.1.4). In addition, the drought permit is short term, and any effect would be in addition to those caused by natural drought conditions in 2022. Impacts on water quality are predicted to be **Negligible** (Section 5.3). On this basis the sensitivity of the WFD ecological status receptor is considered to be **Low**, with

Low magnitude impacts and a **Minor** significance of impacts. Confidence on this assessment is **Medium**.

The WFD chemical status of the waterbody is Fail (2019), due to two priority hazardous substances. The drought permit will not affect this situation as effects on dilution are predicted to be **Negligible** (Section 5.3). On this basis the sensitivity of the WFD chemical status to the drought permit is considered **Not Sensitive**, with significance of impact **Minor** in the absence of a negligible category. Confidence in this assessment is **High**. See Table 6-2.

Table 6-2 Summary of predicted impacts on WFD status

Receptor	Sensitivity	Significance of impact	Confidence level
GB108048001420 WFD ecological status	Low	Minor	Medium
GB108048001420 WFD chemical status	Not Sensitive	Minor*	High

* Impact predicted to be negligible but categorised as Minor in the absence of a negligible category.

6.3 Macrophytes & phytobenthos

The macrophyte communities in the zone of influence indicate a community adapted to higher flow environments, with no obvious indications of a community impacted by nutrients or flow conditions. Impacts on flow downstream of Restormel Weir are predicted to be **Low** (Section 5.1.4). The drought permit scenario presents flows that have been experienced in recent years without having an effect on the macrophyte community, and in addition the drought permit is short term and the recovery potential of plant communities is high. Only **Negligible** impacts on water quality are predicted (Section 5.3). On this basis the sensitivity of plants was deemed to be **Low** for submerged macrophytes and phytobenthos, and **Medium** for marginal emergent macrophytes that could become exposed in the event of a reduction in wetted river width. Potential impacts of the drought permit were determined to be of **Minor** significance. Confidence in this assessment is **Medium**. See Table 6-3.

Table 6-3 Summary of predicted impacts on macrophytes

Receptor	Sensitivity	Significance of impact	Confidence level
Submerged macrophytes	Low	Minor	Medium
Emergent macrophytes	Medium	Minor	Medium
Phytobenthos	Low	Minor	Medium

6.4 Macroinvertebrates

The macroinvertebrate community in the zone of influence is diverse and contains species normally sensitive to flow conditions. Therefore, the sensitivity of macroinvertebrates to the drought permit scenario was determined to be **Medium**. However, similar flow conditions have been experienced in previous years without impacting the macroinvertebrate community and the drought permit is short term only. In addition, impacts on flow downstream of Restormel Weir are predicted to be **Low** (Section 5.1.4). Macroinvertebrates are resilient to change and generally recover rapidly from short term changes in environmental conditions. Impacts on water quality are predicted to be **Negligible** (section 5.3), hence will not impact on macroinvertebrates. The significance of impacts was therefore determined to **Minor**. Confidence in this assessment is **Medium**.

Table 6-4 Summary of predicted impacts on macroinvertebrates

Receptor	Sensitivity	Significance of impact	Confidence level
Macroinvertebrates	Medium	Minor	Medium

6.5 Fish

The fish community in the zone of influence contains migratory species sensitive to flow conditions. Therefore, the sensitivity of fish to the drought permit scenario was determined to be **Medium**. This is due to the potential for the flow conditions over Restormel Weir decreasing, leading to it becoming a barrier to their migration.

To assess if the weir could be become a barrier, under low flow conditions, a 'WFD111 Phase 2a Course resolution rapid-assessment methodology to assess obstacles to fish migration 2010' (Sniffer, 2010) was completed under low conditions during the drought of September 2022. The sniffer methodology is a rapid assessment at a coarse level providing the likely passability of structures and is appropriate for the full range of structures and species encountered in the UK. It provides passability scores for a structure which are sub-divided into fish groups (species, family and life-stage) to provide a holistic overview on the structures impact on the fish assemblage passability. The criteria used for determining passability scores are based on published data describing the swimming and leaping abilities of different fish species. Often riverine constructions are complex in form, with a number of component parts that can each present challenges for fish passage. These components can occur either

transversally, where a single structure has different characteristics across its width, or longitudinally, where multiple obstacles are in a sequence along a section of the channel. Commonly, these result from changes in the physical structure and/or hydraulics across the structure which form distinct components for each structure. These varied structural components, termed transversal sections (TS), can provide alternative routes for fish passage and therefore must be assessed individually to provide a holistic passability score of a structure. For example, at Restormel Weir, there are three separate sections by which fish can ascend and as such each require an assessment.

For each transversal section, at the foot, mid-point and crest, hydraulic characteristics including water velocity and depth of water over the structure face are surveyed or estimated (where access to the watercourse was deemed unsafe and thus precluded direct measurement), at an evenly distributed number of locations across the width of the section. In addition, head loss, obstacle height, length of structure, presence/absence of a plunge pool and flow type (e.g., turbulent, plunging, adherent flows, and/or presence of hydraulic jump) was either directly surveyed or described. A summary of the data used in this assessment has been summarised in Table 6-5below.

Table 6-5: A summary of the data and its sources used in the WFD 111 assessment.

Data	Data source
Water depths	Expert judgement from visual analysis on site and post-photo analysis
Velocities	Restormel flow gauging station from the day of the survey and approximations whilst on site
Pool depths	Inferred from topography survey
Hydraulic head	Calculated from topography survey
Structure dimensions	Measured using aerial photography

Passability values were assigned for each hydrological aspect (e.g., depth and velocity) according to the physiology of the fish under consideration (specifically burst swimming speed, leaping capability and size range of fish present in the river).

The transversal section with the maximum passability score then determines the overall passability score estimate of the structure. The estimated passability score is defined as:

"The proportion of fish that encounter an impediment and then successfully pass it (during either an upstream or downstream migration) without undue delay (i.e., the probability of reaching the final destination, e.g., spawning or feeding grounds, is not compromised due to increased energetic expense or predation risk)" (WFD111, 2010).

Table 6-6 provides a definition for each passability score. To aid in visually comparing passability scores, colour coding has also been assigned to each classification.

Table 6-6: WFD111 passability scores and classifications.

Passability score	Passability classification	Colour coding
1.0	***No barrier:*** *the obstacle does not represent a significant impediment to the target species / life-stage, or species guild, and the majority of the population will pass during the majority of the period of migration (movement). This does not mean that the obstacle poses no costs in terms of delay, e.g., increased energetics, or that all fish will be able to pass.*	
0.6	***Partial barrier low impact:*** *the obstacle represents a significant impediment to the target species / life-stage, or species guild, but most of the population (e.g., > two-thirds) will pass eventually; or the obstacle is impassable for a significant proportion of the time (e.g., < one-third).*	
0.3	***Partial barrier high impact:*** *the obstacle represents a significant impediment to the target species / life-stage, or species guild, but some of the population (e.g., < one-third) will pass eventually; or the obstacle is impassable for a significant proportion of the time (e.g., > two-thirds).*	
0.0	***Complete barrier:*** *the target species / life-stage, or species guild cannot pass the obstacle.*	

The first section of the WFD111 assessment which assesses the water velocities and depths over the weir highlighted that under low flow conditions, both the left and right hand sides of Restormel weir are complete barriers to all fish groups due to low water depths (Table 6-7). This is to be expected given that the middle channel through the weir carries the majority of water for gauging purposes. To that end, the middle of the weir was identified as not being a barrier for all fish species apart from adult salmonids and lampreys for which the section was shown to be a partial barrier due to water depths and velocity respectively (Table 6-7).

Table 6-7: Summary of the WFD11 assessment in relation to velocities and water depths.

Section 3 summary Velocities and Depths	Left	Middle	Right	Main limiting factor(s)
Adult salmon (AS)	0	0.3	0	Water depth (left, right & mid)
Adult trout (AT)	0	1	0	Water depth (left & right)
Adult Grayling (AG)	0	1	0	Water depth (left & right)
Cyprinids (C)	0	1	0	Water depth (left & right)
Adult lamprey (AL)	0	0.6	0	Water depth (left & right) & velocity (mid)
Juvenile eel (JE)*	1	1	1	Water depth (left & right)
Juvenile salmonid (JS)	0	1	0	Water depth (left & right)

The second section of the WFD111 assessment which assesses the physical attributes of the weir itself has shown that under low flow conditions, the slope of the structure is the main limiting factor which prevents all species from ascending apart from adult salmon and trout (Table 6-8). However, it must be noted that even for these two species, this still represents a partial barrier.

Table 6-8: Summary of WFD11 assessment in relation to physical attributes of the weir.

Section 4.2	Left	Middle	Right	Main limiting factor(s)
Physical attributes - barriers presenting a slope				
Adult salmon (AS)	0.3	0.3	0.3	Slope % & Pool depth / Hydraulic head
Adult trout (AT)	0.3	0.3	0.3	Slope % & Pool depth / Hydraulic head
Adult Grayling (AG)	0	0	0	Slope % & Pool depth / Hydraulic head
Cyprinids (C)	0	0	0	Slope %
Adult lamprey (AL)	0	0	0	Slope %
Juvenile eel (JE)*	1	1	1	Slope %
Juvenile salmonid (JS)	0	0	0	Slope %

The overall assessment of the passability combines both the water and physical attributes to provide a holistic overview of passability (Table 6-9). In this instance, it has shown that adult salmon and trout can ascend Restormel weir through the middle gauging section, even in drought. However, this still represents a partial barrier which will likely result in two thirds of the population not being able to ascend. For all other species, Restormel weir represents a complete barrier. However, given the species assemblage highlighted in Section 4.8, this assessment only applies to juvenile salmonids as all other species groups were not identified.

* *Please note that in both the water and physical attributes assessments (Table 6-7 and Table 6-8), European eel have been classified as having no barrier due to the presence of the pumped eel pass which circumvents the need to ascend the weir itself. It is not believed that this pass will be impacted by the drought permit.*

Table 6-9: Holistic overview of the WFD111 fish passability assessment of Restormel weir.

Species/group	Upstream passability score	Identified in baseline assessment
Adult salmon (AS)	Partial barrier high impact (0.3)	Yes
Adult trout (AT)	Partial barrier high impact (0.3)	Yes
Adult Grayling (AG)	Complete barrier (0.0)	No
Cyprinids (C)	Complete barrier (0.0)	No
Adult lamprey (AL)	Complete barrier (0.0)	No
Juvenile eel (JE)*	No barrier (1.0)	Yes
Juvenile salmonid (JS)	Complete barrier (0.0)	Yes

The assessment of Restormel weir during the current drought conditions has highlighted that it represents a partial barrier with high impact for both adult salmon and trout and a complete barrier to all other species (not including eel due to the presence of the eel pass). However, the main limiting factor preventing passability is due to the weirs physical parameters (notably its slope) which in isolation represents a barrier to all but adult salmon and trout. Conversely, the water conditions at the time of the assessment did not represent a complete barrier to any of the modelled species.

It must be noted that similar flow conditions to the DP have been experienced in previous years with migratory fish noted above Restormel weir highlighting that passability is still possible. However, it should be stressed that although this assessment and historic data highlights that flow is not a limiting factor to the passability of Restormel weir, should there be a dry autumn and/or winter without supplementary rainfall that would offset the DP, this could lead to low flow conditions over the weir. This in turn may lead to the migratory success of adult salmon and trout being hindered depending on the magnitude of the dry conditions. That said, the magnitude of the daily abstraction under the DP will not be changing from the current abstraction permit and although the DP will lead to more abstraction annually, the period of migration for adult salmon and trout migration coincides when flows are likely to be higher than they were in the period of the baseline assessment. As such, is not believed that the DP will cause an impact unless a dry autumn and/or winter is experienced.

To that end, it must be noted that as the WFD111 assessment has highlighted that the weir is a partial barrier to adult salmonids under the current drought conditions primarily due to the structures physical attributes rather than flow, should there be a dry autumn/winter, the cumulative impact of the drought permit plus prolonged dry weather may result in a **Moderate** impact on a precautionary basis.

In relation to the other impact pathways, impact on flow downstream of Restormel Weir is predicted to be **Low** (Section 5.1.4) and as such, the impact on loss of wetted width, leading to a potential increase in piscivorous predation and a reduction in migration trigger flows, are

deemed to have a **Low** impact. Further, the impact of loss of salmonid spawning habitat is deemed to have a **Low** impact due to spawning substrates being in the main channel in areas of higher velocities. However, there is a **Moderate** impact to the loss of marginal habitat in relation to lamprey ammocetes which may become stranded because of a loss in wetted width.

The impacts on water quality have been predicted as **Negligible** (Section 5.3) and as such it is unlikely that fish will be impacted by reduced dilution of pollutants with reduced discharge

On this basis the sensitivity on fish is deemed to be **Medium** with the potential impacts of the drought permit determined to be of **Moderate** significance. Confidence in this assessment is **Medium**.

Table 6-10 Summary of predicted impacts on fish

Receptor	Sensitivity	Significance of impact	Confidence level
Fish (population)	Medium	Minor	Medium
Fish (migration – weir passability)	Medium	Moderate	Medium
Fish (migration – trigger flows)	Medium	Minor	Medium
Fish (predation)	Medium	Minor	Medium
Salmonids (spawning habitat)	Medium	Minor	Medium
Lamprey ammocetes	Medium	Moderate	Medium

6.6 Birds

There is no potential pathway to impact on breeding birds due to the timing of the drought permit being outside of the breeding season for all species of relevance. Three groups of birds may be affected by the drought permit and these are considered below.

6.6.1 Wading birds

Outside of the breeding season the sensitivity of waders is **Low** from any changes in water levels and any potential impacts can also be excluded as being of **Negligible** magnitude as these birds migrate. The exceptions are lapwing, golden plover, curlew, redshank and greenshank that could winter on and around the River Fowey. However, it is more likely that slowing exposure of additional bottom sediments would offer wading birds foraging areas for additional periods, so may lead to a minor beneficial impact.

In summary, the impact significance on wading birds is **Minor** (in the absence of a negligible category) should the proposed drought permit be implemented during the non-breeding period.

Available datasets for the River Fowey at Restormel and Lostwithiel are available for all water bird species but are over 10 years old or not site specific. As such, confidence in the assessment is considered to be of a **Medium** level.

6.6.2 Wildfowl

The wintering waterfowl population includes Canada goose, mute swan, shelduck, mallard and teal, and for these species the sensitivity to changes in water levels are considered to be **Low**. Many species of wildfowl feed on aquatic plants. Lowered water levels in the River Fowey could be beneficial to feeding wildfowl as any plants can become more accessible. However, if drought conditions were 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 due to the drought permit which is not anticipated to cause any significant loss of macrophytes the magnitude of any impact is **Negligible**.

Red-breasted merganser and other piscivorous species including little grebe, kingfisher, little egret and grey heron are considered to have a **Low** sensitivity to the potential changes in water level under the drought permit. Considering the impact on fish considered to be moderate or less within the River Fowey then it is likely that there would be increased food availability for these birds. Should the water level drop significantly, then fish populations may deplete to a level where foraging becomes more difficult for piscivorous species. As such, the impact significance has been categorised as **Minor** in the absence of a negligible category.

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

6.6.3 Passerine birds

The non-breeding passerines (e.g. 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 (e.g. when a water body more or less dries up). This situation is not predicted to occur under the proposed drought permit and therefore the impact magnitude is considered to be **Negligible**. Considering the low sensitivity of all passerines during non-breeding season and a negligible impact magnitude, the resultant significance of impacts on passerine birds is considered to be **Minor** significance in the absence of a negligible category.

Available datasets for the River Fowey at Restormel and Lostwithiel are available for all passerine species but are over 10 years old. However, even if updated data was available, the outcome of the assessment would remain the same. As such, confidence in the assessment is considered of a **High** level.

Predicted impacts on birds are summarised in Table 6-11.

Table 6-11 Summary of predicted impacts on birds

Receptor	Sensitivity	Significance of impact	Confidence level
Wading birds	Low	Minor*	Medium
Wildfowl	Low	Minor*	Medium
Passerine birds	Low	Minor*	High

*Impact predicted to be negligible but categorised as Minor in the absence of a negligible category.

6.7 Protected species and habitats

Common amphibians are widespread across the region and are resilient to water level changes.

The changing water level is unlikely to have an adverse effect on otter mobility through the site and wider landscape. However, it is possible that otter could be affected by a change in fish populations within the area of interest. As fish are a staple food source to otter, any decreases on locality and population size could impact otter negatively.

It is unlikely that there will be any negative impacts on the other protected species present at site as habitat availability and quality will not be altered.

It is possible the drought permit could cause adverse effects on otter, as fish are a staple food source any changes in fish population size or changes in location availability could result in a negative impact to otter. However, otters are highly mobile species with large territories encompassing multiple prey sources and therefore are categorised as having **Low** sensitivity. Thus, the scale of the impact and impact significance for otter is predicted to be **Minor** adverse.

The drought permit is unlikely to cause any significant effects on any other protected species or habitats in the surrounding area. Thus, the scale of the impact and impact significance is **Negligible** for all species except otter.

The confidence in these assessments is considered to be of a **Medium** level.

Predicted impacts on protected species are summarised in Table 6-12.

Table 6-12 Summary of predicted impacts on protected species

Receptor	Sensitivity	Significance of impact	Confidence level
Otters	Low	Minor	Medium
Other protected species & habitats	Low	Minor*	Medium

* Impact predicted to be negligible, but categorised as Minor in the absence of a negligible category.

6.8 Invasive Non Native Species

6.8.1 A decrease in water level below baseline conditions

A reduction in wetted channel in the River Fowey because of the drought permit could increase the area available for colonisation by high-risk riparian plant INNS, one of which was identified in the baseline search (Himalayan balsam). 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 Himalayan balsam along the river, and therefore propagule loading into the system. This may result in an increase in competition with native macrophyte communities. A reduction in wetted area could also result in increases in the relative density of aquatic animal INNS, one of which were identified in the river from the baseline search (NZ mud snail). This could result in increased competition with native species. Additionally, the decrease in wetted area is likely to result in American mink adapting to more terrestrial prey which may decrease the inter-sexual prey differences of the species and prolong a behaviour naturally observed during summer. Under the drought permit scenario effects on wetted habitat space is predicted to be between **Medium** (depending on the section of river being assessed). There will therefore be a minor increase in the area of exposed inundation zone following the reduction in compensation flow which may allow minor increases distribution and spread of Himalayan balsam; relative density of NZ mud snails; and change in behaviour of American mink within zone of influence. Therefore, the overall sensitivity of INNS to water level changes has been categorised as **Low**.

6.8.2 Flow changes

Impacts on flow downstream of Restormel Weir are predicted to be **Low** (Section 5.1.4). This may cause a minor reduction to the distance that Himalayan balsam seeds can disperse along River Fowey. However, this reduction in propagule pressure may be compensated by the increased population density of the species within the zone of influence, owing to the decreased water levels. Decreased flow may also increase the potential for up-stream movement of NZ mud snails but 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**.

6.8.3 Water quality changes

Changes in water quality parameters because of the drought permit may alter the suitability of the habitat for some of the INNS detected. For instance, elevated levels of ammonia can be toxic to aquatic animals, including the mollusc species identified during the baseline search. Under the drought permit scenario, effects on water quality are predicted to be **Negligible** in the zone of influence. The risk in terms of the drought permit affecting INNS spread/impact is considered to be **Negligible** because of the **Low** sensitivity, or lack of sensitivity, of the INNS species present.

6.8.3 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 are 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.

For American Mink, the species was assessed as being **Not Sensitive** to the drought permit, and the significance of impact **Minor**, in the absence of a negligible category. Confidence in this assessment is **Medium** as there is some doubt as to their distribution along the zone of influence. For the NZ mud snail, the species was considered as **Not Sensitive**, as it is quasi-ubiquitous in UK freshwater environments and the significance of impact **Minor**, in the absence of a Negligible category. For Himalayan Balsam, sensitivity was determined as **Low** with a **Minor** significance of impact in the absence of a Negligible category. Confidence in these last two predictions is **High** although it should be noted that if any of the INNS detected are in a phase of actively expanding their ranges they may respond in unpredictable ways to environmental change. Results are summarised in Table 6-13.

Table 6-13 Summary of predicted impacts on INNS

Species	Sensitivity	Significance of impact	Confidence level
American mink (*Neovison vison*)	Not Sensitive	Minor*	Medium
New Zealand mud snail (*Potamopyrgus antipodarum*)	Not sensitive	Minor*	High
Himalayan balsam (*Impatiens glandulifera*)	Low	Minor*	High

* Impact predicted to be negligible but categorised as Minor in the absence of a negligible category.

6.9 Tourism and recreation

The drought permit, taking place over the winter, is not expected to affect tourism in the area of the zone of influence, which is very much focused on historical monuments. Activities at the golf course and the holiday cottages are not expected to be affected.

The Fowey has experienced flow variations in the range of the drought permit previously and walking along the river-side trails is not expected to be affected by the drought permit. In addition, impacts on flow downstream of Restormel Weir are predicted to be **Low** (Section 5.1.4).

Localised reductions in depth and river width may potentially enhance angling activities rather than impede them. The proposed DP is unlikely to impact rod angling *per se* because:

1) the salmon season for the River Fowey runs from 1st April to 15th December. A voluntary cessation of angling takes place in most parts of the catchment on 31st November to protect spawning fish.
2) The sea trout season runs from 1st April to 30th September. A voluntary cessation of angling takes place in most parts of the catchment on 31st August to protect spawning fish.

The sensitivity of the tourism and recreation receptor was determined to be **Low**, and the significance of impact as **Minor** in the absence of a negligible category. Confidence in this assessment is **High**.

Table 6-14 Summary of predicted impacts on tourism and recreation

Receptor	Sensitivity	Significance of impact	Confidence level
Tourism & recreation	Low	Minor*	High

* Impact predicted to be negligible but categorised as Minor in the absence of a negligible category.

6.10 Aesthetics and landscape

The drought permit is not expected to alter the visual aesthetics and landscape in the zone of influence. The abstraction infrastructure is already in place and will not require any works. Impacts on water quality are predicted to be **Negligible** (Section 5.3), hence there is no reason to expect algal blooms which can alter the aesthetics of the river.

The changes in flow in the zone of influence, which are within the range of previous flow variations, and are predicted to be of **Low** magnitude (Section 5.1.4), are not expected to

significantly change the aspect of the river and the riparian zone. Minor localised effects such as reduction in river width and depth will be short term and recover after the drought permit ceases.

The sensitivity of the aesthetics and landscape receptor was therefore assessed as **Low**. The significance of the impact was assessed as **Minor**, in the absence of a Negligible category. Confidence in this assessment is **High**.

Table 6-15 Summary of predicted impacts on aesthetics & landscape

Receptor	Sensitivity	Significance of impact	Confidence level
Aesthetics and landscape	Low	Minor*	High

* Impact predicted to be negligible but categorised as Minor in the absence of a negligible category.

6.11 Archaeology and heritage

Four of the five heritage locations are not on the River Fowey itself, hence will not be affected by the proposed drought permit. The only heritage location on the River Fowey is the Lostwithiel Bridge. This structure has been in place for centuries and experienced a range of fluctuations in river discharges from drought conditions to flood conditions. The sensitivity of this receptor was therefore considered to be **Not Sensitive**. Impacts on river flow are predicted to be of **Low** magnitude (Section 5.1.4). The significance of impact of the drought permit on the receptor was hence determined to be **Minor**, in the absence of a Negligible category. Confidence in this assessment is **High**.

Table 6-16: Predicted impacts of drought permit on archaeology & heritage

Receptor	Sensitivity	Significance of impact	Confidence level
Lostwithiel Bridge	Low	Minor*	High

* Impact predicted to be negligible but categorised as Minor in the absence of a negligible category.

6.12 Summary of impacts

The findings from the environmental sensitivity assessment are presented in Table 6-17.

A medium impact of the drought permit was predicted for the hydraulic pathway. The impacts on all other pathways were low or negligible.

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

Moderate impacts were only predicted for fish. The drought permit is predicted, due to the additional abstraction at Restormel, to have Moderate impacts on the Lower River Fowey water body (GB108048001420) in some months for upstream fish passage for Atlantic salmon, brown trout, adult eels and for habitat availability for the ammocoete life stage of lamprey in comparison with the baseline scenario.

In terms of the two periods of the drought permit these impacts can be summarised as follows:

- November – December 2022
    - Potential for a moderate impact on the migration of European eel.
    - Potential for a moderate impact on lamprey ammocoetes due to effects on habitat availability.
- January – March 2023
    - Potential for a moderate impact on the migration/movement of adult Atlantic salmon and brown/sea trout.
    - Potential for a moderate impact on migration/movement of Atlantic Salmon and brown/sea trout smolts, in March 2023 only.
    - Potential for a moderate impact on lamprey ammocoetes due to effects on habitat availability.

Table 6-17: Summary of impacts

		Sensitivity of receptor	S	O	N	D	J	F	M	A	M	J	J	A	S	Level of Confidence
Pathways	**Hydrology**															
	Flow downstream of Restormel			L	L	L	L	L	L							Medium
	Hydraulics															
	Depth, velocity & shear stress			M	M	M	M	M	M							Medium
	Wetted perimeter & Froude number			N	N	N	N	N	N							Medium
	Water quality															
				N	N	N	N	N	N							Medium
Receptors	**Designated sites**															
	Upper Fowey and Pont Pill MCZ	Low		(N)	(N)	(N)	(N)	(N)	(N)							Medium
	Fowey AONB	Low		(N)	(N)	(N)	(N)	(N)	(N)							Medium
	WFD status															
	GB108048001420 WFD ecological status	Low														Medium
	GB108048001420 WFD chemical status	Not Sensitive		(N)	(N)	(N)	(N)	(N)	(N)							High
	Macrophytes															
	Submerged macrophytes	Low														Medium
	Emergent macrophytes	Medium														Medium
	Phytobenthos	Low														Medium
	Macroinvertebrates															
		Medium														Medium
	Fish															
	Fish populations	Medium														Medium
	Fish migration/habitat loss (salmon - adults)	Medium			(N)	(N)			(N)							Medium
	Fish migration (salmon - smolt)	Medium		(N)	(N)	(N)	(N)	(N)								Medium
	Fish migration/habitat loss (brown/sea trout - adults)	Medium			(N)	(N)			(N)							Medium
	Fish migration (brown/sea trout – smolts)	Medium		(N)	(N)	(N)	(N)	(N)								Medium
	Fish migration (European eel – adults)	Medium				(N)	(N)	(N)	(N)							Medium
	Fish habitat loss (lamprey ammocoetes)	Medium														Medium
	Birds															

		Sensitivity of receptor	S	O	N	D	J	F	M	A	M	J	J	A	S	Level of Confidence
	Wading birds	Low		(N)	(N)	(N)	(N)	(N)	(N)							Medium
	Wildfowl	Low		(N)	(N)	(N)	(N)	(N)	(N)							Medium
	Passerine birds	Low		(N)	(N)	(N)	(N)	(N)	(N)							High
	Protected species															
	Otters	Low														Medium
	Other protected species & habitats	Low		(N)	(N)	(N)	(N)	(N)	(N)							Medium
	INNS															
	American mink	Not Sensitive		(N)	(N)	(N)	(N)	(N)	(N)							Medium
	New Zealand mud snail	Not Sensitive		(N)	(N)	(N)	(N)	(N)	(N)							High
	Himalayan balsam	Low		(N)	(N)	(N)	(N)	(N)	(N)							High
	Tourism & recreation															
		Low		(N)	(N)	(N)	(N)	(N)	(N)							High
	Other abstractors															
		NA		NA	NA	NA	NA	NA	NA							NA
	Archaeology and heritage															
	Lostwithiel Bridge	Not sensitive		(N)	(N)	(N)	(N)	(N)	(N)							High
	Aesthetics and landscape															
		Low		(N)	(N)	(N)	(N)	(N)	(N)							High

Key to Environmental Effects:

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

7. Environmental Monitoring Plan

7.1 Introduction

An 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 7-1, 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 fish populations and downstream movement of fish in the Lower River Fowey water body (GB108048001420), where moderate impacts are possible if flows remain at their current low levels (i.e. no winter increase in flow). 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 in order to trigger mitigation measures, if needed.

7.1.1 Baseline monitoring

Baseline monitoring is required to formulate a description of the existing ecological conditions, from which the impacts of the drought permit 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.

7.1.2 Pre-drought permit monitoring

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

7.1.3 During-drought permit monitoring

During-drought permit monitoring is required to assess any impacts from the implementation of the drought management action and for the management of mitigation measures.

It is recommended that monitoring during drought permit period continue as per the pre-implementation period, except where, in consultation with the regulator, it is deemed that such monitoring may be environmentally damaging.

7.1.4 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 implementation and duration of post drought permit monitoring will depend upon the severity of the natural drought and of any detected impacts on the environment but will cover the period of recovery and will be carried out in consultation with the regulator.

7.2 Restormel environmental monitoring plan

A summary of the EMP for the Restormel drought permit is presented in Table 7-1.

7.2.1 Fish

Prior to implementation of the drought permit, it is recommended that a habitat walkover of the River Fowey downstream of Restormel to the A390 road bridge at Lostwithiel be carried out, in order to identify the areas of spawning habitat for species and life stages predicted to receive Moderate impacts (Table 6-17). At the same time a check of conditions at Restormel Weir and other potential barriers which may arise due to low flow conditions downstream would also be undertaken to identify any evidence of fish in distress or being unable to pass up or downstream. This is to provide a baseline to which monitoring efforts during implementation of the drought permit may be compared. These walkovers should also assess potential reductions in wetted width, to identify potential loss of habitat for (and subsequent dewatering of) lamprey ammocoetes and salmonid egg redds.

During implementation of the drought order it is recommended that weekly walkover surveys of the same reaches are carried out to identify signs of environmental stress (fish in distress, dry channel in identified spawning areas, etc.). This first survey should be timed to coincide with day one of implementation of the drought permit. These walkover surveys should be undertaken at least three times before their need is reviewed (over the first month of the drought permit implementation) if climatic conditions should change (heavy rainfall), but by default should be carried out throughout the duration of the DP. A set of triggers and a communication plan should be agreed with the EA so that results from these walkover surveys can initiate action/mitigation based on set criteria.

As impacts of the drought permit are likely to be localised and temporary in nature, it is not anticipated that any post-drought order monitoring will be necessary.

Table 7-1: Restormel EMP

Parameter	Location	By whom	Brief scope	Pre-drought permit Timing/ Frequency	During-drought permit Timing/ Frequency	Post-drought permit Timing/ Frequency
	Restormel Weir (SX 09803 62462) to tidal limit at A390 road bridge in Lostwithiel (SX 10555 60108)	SWW	Habitat walkover surveys to identify spawning habitats	One survey immediately prior to implementation covering full impacted reach.	Not required	Not required
Fish	Restormel Weir (SX 09803 62462) to the tidal limit, considered to be at the A390 road bridge in Lostwithiel	SWW	Walkover surveys to identify signs of environmental stress (fish in distress, dry channel in identified spawning areas etc.)	Not required	First survey on day one of drought permit implementation and weekly thereafter. To be undertaken at least three times before need reviewed (in case of	Not required

Parameter	Location	By whom	Brief scope	Pre-drought permit Timing/ Frequency	During-drought permit Timing/ Frequency	Post-drought permit Timing/ Frequency
	(SX 10555 60108)				sustained heavy rainfall).	
	Restormel weir (SX 09803 62462)	SWW	Visual check, photos and site notes to identify any signs of fish in distress or being able to pass upstream. Visual check of the pumped eel pass to ensure it remains operational	One survey immediately prior to implementation.	First survey on day one of drought permit implementation and weekly thereafter. To be undertaken at least three times before need reviewed (in case of sustained heavy rainfall).	Not required

8. Mitigation measures

There is a risk of Moderate impacts on the Lower River Fowey water body (GB108048001420) under the drought permit scenario for upstream fish passage and for the ammocoete life stage of lamprey through temporary habitat loss.

Given the potential for barriers to migration at Restormel and further downstream, visual assessment of identified potential barriers to migration is recommended during drought permit implementation to check for evidence of fish in distress or reduced passability during drought permit implementation.

There is the potential to make use of the fish counter installed at Restormel Weir, which is owned and operated by the EA. It is recommended that SWW agree with the EA on how to obtain daily or weekly data from the fish counter which can then be compared to previous years to give an indication of barrier effects at Restormel Weir. However, as the number of salmonids migrating up the River Fowey varies inherently from year to year, this information must be combined with on the ground visual assessments of the weir, particularly signs of fish pooling below the weir.

Monitoring of any changes in the availability of marginal lamprey ammocoete habitats downstream of Restormel during implementation of the proposed drought permit is also recommended.

A number of mitigation measures could be implemented depending on feasibility, should the proposed monitoring, during the drought permit, indicate that impacts are occurring:

- Provision to release additional flows from Colliford Reservoir (or potentially a reduction in the drought permit abstraction rate) in the event of a (unlikely) pollution incident, if there is evidence of ecological distress, and/or if reduced flows are considered to be having detrimental environmental consequences on downstream waterbodies. It should be noted that fisheries water bank is not available for SWW nor for the EA to manage a pollution incident nor for managing water quality concerns during low flow conditions.
- Provision to undertake controlled release(s) of the banked flows reserved for fish from Colliford Reservoir during the salmonid spawning season if the pre-implementation walkover survey identifies the presence of salmonid redds downstream of Restormel potentially at risk of exposure or barriers to fish passage at Restormel Weir and downstream. In discussion with local stakeholders, the releases of banked flows would be independent of the current recharging conditions (3 years and/or 100% fill at Colliford).
- Provision to mobilise a fish rescue team should significant numbers of migratory fish become trapped/stranded in between obstacles downstream of Restormel during periods of low flow. It is likely that a fish rescue would only be required should these fish be considered at high risk of mortality as a result of stranding

during periods of low flow (e.g. due to elevated risk of predation) with no rainfall or river flow increase forecast.

It may not be necessary to implement any of these mitigation measures if negative impacts are not observed to be occurring. Implementation of the mitigation measures will take place should monitoring during a drought permit indicate that impacts are being experienced. Funding of appropriate reasonable measures (e.g. habitat restoration) could be considered to remedy any impacts that are observed to have occurred.

9. Summary

The drought permit is predicted to have the following Moderate impacts on the Lower River Fowey water body (GB108048001420) in comparison with the baseline scenario:

- November – December 2022
  - Potential for a moderate impact on the migration of European eel.
  - Potential for a moderate impact on lamprey ammocoetes due to effects on habitat availability.
- January – March 2023
  - Potential for a moderate impact on the migration/movement of adult Atlantic salmon and brown/sea trout.
  - Potential for a moderate impact on migration/movement of Atlantic Salmon and brown/sea trout smolts, in March 2023 only.
  - Potential for a moderate impact on lamprey ammocoetes due to effects on habitat availability.

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

The pre-mitigation potential impacts on receptors are summarised as follows:

Drought permit	Impact Significance	Receptors
Restormel	Moderate impact	Upstream and downstream fish passage (salmonids and eels) in some months and ammocoete life stage of lamprey (all months) within Lower River Fowey water body (GB108048001420).
Restormel	Minor impacts	All other receptors.

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 in order 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 EA. Mitigation measures would be implemented to reduce the impacts of the proposed drought permit and not the impacts of the drought itself.

10.References

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Appendices

A. Macrophytes and Diatoms

Table A-1: Macrophyte monitoring scores

Location ID	NGR	Sample Date	RMHI	RMNI	RNTAXA	NRFG
10714	SX1076061320	30/08/2007	5.77	5.24	17	11
		04/09/2008	5.69	5.21	13	7
		06/09/2012	5.68	4.74	12	7
		30/07/2015	5.58	4.81	17	10

Table A-2: Trophic Diatom Index (TDI5) scores

Location ID	NGR	Sample Date	% Planktonic	% Motile	% PTV	% Salinity
10714	SX1076061320	15/08/2008	0	12.70	15.95	0.27
		05/02/2009	0	4.78	3.93	0.56
		25/11/2010	0	7.02	19.01	0
		07/01/2011	0	35.78	44.73	0
		07/11/2012	0	17.92	14.98	0
		28/12/2012	0	14.88	23.21	0
		17/06/2015	0	13.91	19.54	0.66
		11/12/2015	0	17.05	17.70	0.33
		20/04/2018 (molecular)*	0.04	6.48	8.81	0.09
		17/09/2018 (molecular)*	2.24	11.46	11.90	0.19

*Samples used molecular analysis method, all previous samples were analysed with light microscopy
PTV: pollution tolerant valves

B. Macroinvertebrates

Table B-1: Macroinvertebrate monitoring scores (last 20 years only)

Location ID	NGR	Sample Date	WHPT NTAXA	WHPT ASPT	LIFE NTAXA	LIFE FAMILY	PSI FAMILY	CCI
10714	SX1076061320	26/03/2003	28	7.49	22	8.05	82.35	15.45
		02/09/2003	34	7.19	30	7.9	77.05	24.33
		21/05/2002	30	7.31	26	8.08	81.97	15.52
		18/09/2002	29	7.16	23	8.09	76.79	13.22
		18/05/2006	28	7.31	23	8.3	74.14	16.04
		15/09/2006	29	7.28	24	7.96	80.39	15.27
		20/10/2008	20	6.92	16	7.94	80.65	-
		25/04/2008	33	7.35	29	7.9	75.81	-
		20/04/2009	29	7.13	26	7.92	78.85	12.65
		08/09/2009	33	6.7	29	7.59	70.69	14.5
		18/05/2010	33	7.35	29	7.79	77.19	21.39

Location ID	NGR	Sample Date	WHPT NTAXA	WHPT ASPT	LIFE NTAXA	LIFE FAMILY	PSI FAMILY	CCI
		14/10/2010	32	6.91	26	7.88	80.77	15.4
		07/04/2011	34	7.41	30	7.93	79.69	19.39
		27/09/2011	31	7.32	27	7.7	75.44	14.47
		20/04/2012	32	7.25	27	8	80	13.79
		20/09/2012	36	6.83	33	7.52	68.66	20
		15/03/2013	32	7.35	29	7.9	81.82	20.26
		26/09/2013	28	7.06	25	7.6	75	13.72
		04/04/2014	33	7.43	28	8	75	19.2
		03/09/2014	34	7.55	30	7.97	78.69	22.8
		10/04/2015	30	7.3	27	8	80.36	15.45
		06/10/2015	32	6.93	28	7.89	75.81	13.13
		08/04/2016	32	7.32	27	7.96	76.79	13.55
		03/11/2016	30	7.29	27	7.74	76.92	14.56
		18/04/2017	28	7.44	23	8.04	80	13.19

Location ID	NGR	Sample Date	WHPT NTAXA	WHPT ASPT	LIFE NTAXA	LIFE FAMILY	PSI FAMILY	CCI
		12/09/2017	22	6.88	20	8.1	78.57	8.33
		26/04/2018	18	7.16	15	8.2	81.25	9.12
		17/09/2018	19	7.36	17	7.88	79.41	10.29
		03/04/2019	20	7.41	17	8.35	86.11	9.25
		08/09/2020	31	7.07	26	7.81	72.73	14.84
		12/05/2021	30	7.44	24	7.83	72	16.71
		17/10/2021	31	7.26	27	7.41	62.71	15.81