IRISH WATER SIGNIFICANT URBAN WASTE WATER PRESSURES ASSESSMENT

Bailieborough Agglomeration - Technical Report

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Sole significant pressures
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Abbreviations

- AA – Appropriate Assessment
- AER – Annual Environmental Report
- BOD – Biological Oxygen Demand
- CI – Compliance Investigation
- CIWEM – Chartered Institute for Water and Environmental Management
- COD – Chemical Oxygen Demand
- CSMU – Catchment Science and Management Unit
- DAP – Drainage Area Programme
- D/S - Downstream
- DWWTS – Domestic Waste Water Treatment Systems
- DWF – Dry Weather Flow
- ELV – Emissions Limit Value
- EO – Emergency Overflow
- EPA – Environmental Protection Agency
- EQS – Environmental Quality Standard
- HA – Hydrometric Area
- ICM – Integrated Catchment Management
- NCAP – National Certificate of Authorisation
- NHA – Natural Heritage Area
- NIS – Natura Impact Statement
- OEE – Office of Environmental Enforcement
- OSPAR – Oslo & Paris Convention for Protection of the Marine Environment of the North-East Atlantic
- PAL – Priority Action List
- PE – Population Equivalent
- pNHA – Proposed Natural Heritage Area
- RBMP – River Basin Management Plan
- SAC – Special Area of Conservation
- SPA – Special Protection Area
- SSRS – Small Stream Risk Score
- SWO – Stormwater Overflow
- TSS – Total Suspended Solids
- U/S - Upstream
- UWWTD – Urban Waste Water Treatment Directive
- WFD – Water Framework Directive – Directive 2000/06/EC establishing a framework for Community action in the field of water
- WWTP – Waste Water Treatment Plant

Glossary

- **Agglomeration** – An Area where the population and / or economic activities are sufficiently concentrated for urban waste water to be collected and conducted to an urban waste water treatment plant or to a final discharge point.
- **Aquifer** – Water-bearing sand, gravel or rock layer yielding usable water quantities.
- **Catchment** – A catchment area is a hydrological unit. Any precipitation that falls into a catchment area will eventually end up in the same river water body if it does not evaporate. Catchments are separated from each other by watersheds.
- **Chemical status** – Chemical status is a quality index used by the Water Framework Directive. For surface waters, the default objective is 'good' chemical status, which means no concentrations of priority substances exceed the relevant EQS established.
- **Coastal water** – Surface water on the landward side of a line, every point of which is at a distance of one nautical mile on the seaward side from the nearest point of the baseline from which the breadth of territorial waters is measured, extending where appropriate up to the outer limit of transitional waters.
- **Diffuse Pollution** – Pollution which originates from various activities, and which cannot be traced to one single source. It originates from a spatially extensive land use e.g. agriculture, industry, residential.
- **Discharge** – The release of polluting substances directly or indirectly into water bodies as defined under Article 2 (i) of Water Framework Directive 2000/06/EC.
- **Ecological status** – Ecological status is a biodiversity index developed and used by the Water Framework Directive. 'Good' ecological status is the WFD default objective in all water bodies and is defined as a slight variation form undisturbed conditions. Elements that make up ecological status included biological elements e.g. fish, macro-invertebrates, macrophytes and supporting elements e.g. physico-chemical monitoring and hydromorphology.
- **Groundwater** – All the water which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil.
- **Investigative monitoring point** – This is required where the reason for any exceedances is unknown; where surveillance monitoring indicates that the objectives set under Article 4 for a body of water are not likely to be achieved and operational monitoring has not already been established, in order to ascertain the causes of a water body or water bodies failing to achieve the environmental objectives; or to ascertain the magnitude and impacts of accidental pollution; and shall inform the establishment of a programme of measures for the achievement of the environmental objectives and specific measures necessary to remedy the effects of accidental pollution.
- **Lake** – A body of standing inland surface water.
- **Population Equivalent** – The organic biodegradable load having a five-day biochemical oxygen (BOD-5) demand of 60g of oxygen per day.
- **Ll Aquifer** - Bedrock which is Moderately Productive only in Local Zones
- **Operational monitoring point** – Monitoring that aims to establish the status of waterbodies identified at being 'at risk' of failing to meet their environmental objectives; and assess any changes in the status of such bodies resulting from the programmes of measures.
- **Parameter** – Parameters that are indicative of the quality elements listed in Annex V of the Water Framework Directive that will be used in monitoring and classification of ecological status.
- **Pl Aquifer** - Bedrock which is Generally Unproductive except for Local Zones

- **Point Source Pollution** – Pollution arising from a discrete source e.g. the discharge from a sewage treatment works.
- **Pu Aquifer** – Bedrock which is generally unproductive
- **Q values** – Irish EPA index of water quality based on aquatic conditions.
- **River** – River means a body of inland water flowing for the most part on the surface of the land but which may flow underground for part of its course.
- **Significant pressure** – In terms of WFD, a pressure that on its own or in combination with other pressures, would be liable to cause a failure to achieve the environmental objectives set out under Article 4.
- **Sole significant pressure** – In terms of WFD, a pressure that on its own would be liable to cause a failure to achieve the environmental objectives set out under Article 4.
- **Storm Water Overflow (SWO)** – In Ireland, the majority of urban areas are drained by combined sewer systems, which convey wastewater and stormwater in a single pipe. During rainfall events the capacity of the combined sewer system may be exceeded. A stormwater overflow (SWO) is a structure designed to divert excess flows from the sewer network, either directly or via a storm sewer system, to the receiving water.
- **Subcatchment** – A subcatchment area is a fundamental hydrological unit that is used to model the runoff from a given area of land.
- **Surveillance monitoring po**int – Monitoring that aims to allow assessment of long-term changes in natural conditions; the efficient and effective design of future monitoring programmes; validation of the impact assessment procedure detailed in Annex II of the Directive; and the assessment of long term changes resulting from human activity.
- **Transitional water body** – Water bodies of surface water in the vicinity of river mouths which are partly saline in character as a result of their proximity to coastal waters but which are substantially influenced by freshwater flows.
- **Water body** – The basic compliance and management unit for the Water Framework Directive into which all rivers, lakes, ground, transitional and coastal waters are divided

1 STEP 1 – INTRODUCTION & DATA COLLECTION

The Environmental Protection Agency (EPA) Catchment Science and Management Unit (CSMU) identified 'significant pressures' during initial characterisation activities undertaken as part of the development of the River Basin Management Plan (RBMP) 2018-2021.

During this initial characterisation process, significant pressures were considered to be pressures that are causing, or are likely to cause, receiving water issues. The official Water Framework Directive[1] (WFD) definition of significant pressures are '…those pressures which, either alone, or in combination with other pressures prevent or put 'at risk' the achievement of WFD Article 4(1) Environmental Objectives including the achievement of 'good' status, the non-deterioration of status, the avoidance of a significant and sustained upward trend in pollution of groundwater, and the achievement of objectives in WFD protected areas'.

The urban waste water significant pressure category encompasses both waste water treatment plants (WWTPs) and waste water networks (Storm Water Overflows (SWOs) and Emergency Overflows (EOs)). Where only one significant pressure category is affecting a water body, it is referred to as a 'sole' significant pressure.

The EPA CSMU identified 63 urban waste water agglomerations as sole significant pressures on a total of 67 river, lake, transitional and coastal water bodies. For each of the urban waste water significant pressures, the EPA CSMU identified what element has been determined to be causing issues i.e. the WWTP, Storm Water Overflows (SWOs), Emergency Overflows (EO) or a combination of these. The EPA Office of Environmental Enforcement (OEE) has raised Compliance Investigations (CIs) in relation to the urban waste water sole significant pressures. These CIs include requirements to examine the WWTPs and SWOs in terms of their potential to impact on receiving water body objectives. In addition, 57 of the sole significant urban waste water pressures have been added to the Priority Action List (PAL) by EPA OEE.

The objectives of the Significant Urban Waste Water Pressures Assessment Project are to:

- collect, collate, summarise and synthesise information in relation to the nature and magnitude of the urban waste water pressures, the pathways to receiving waters from all discharges including SWOs, and the impact on the receiving water environment;
- determine whether or not each of these pressures is significantly impacting water body status or risk, either alone or in combination with other pressure categories;
- quantify any improvements necessary to eliminate the impact of sole significant pressure agglomerations on water body status and/or risk;
- address all of the issues highlighted in the EPA's online Water Framework Directive Application (WFD App) and in Compliances Investigations (CIs) opened for these pressures.

Outputs from the Significant Urban Waste Water Pressures Assessment Project include:

- Technical reports for each agglomeration describing in detail all of the assessment work undertaken and the conclusions and determinations made;
- Summary outcome reports for each agglomeration summarising the outcome of the assessments;
- An overall summary spreadsheet.

[1] European Commission, *Common Implementation Strategy for the Water Framework Directive,* 2003

This document is the technical report in relation to the Bailieborough agglomeration (D0085-01).

1.1 Assessment Approach

Figure 1.1 outlines the steps involved in the assessment of the sole significant pressure agglomerations.

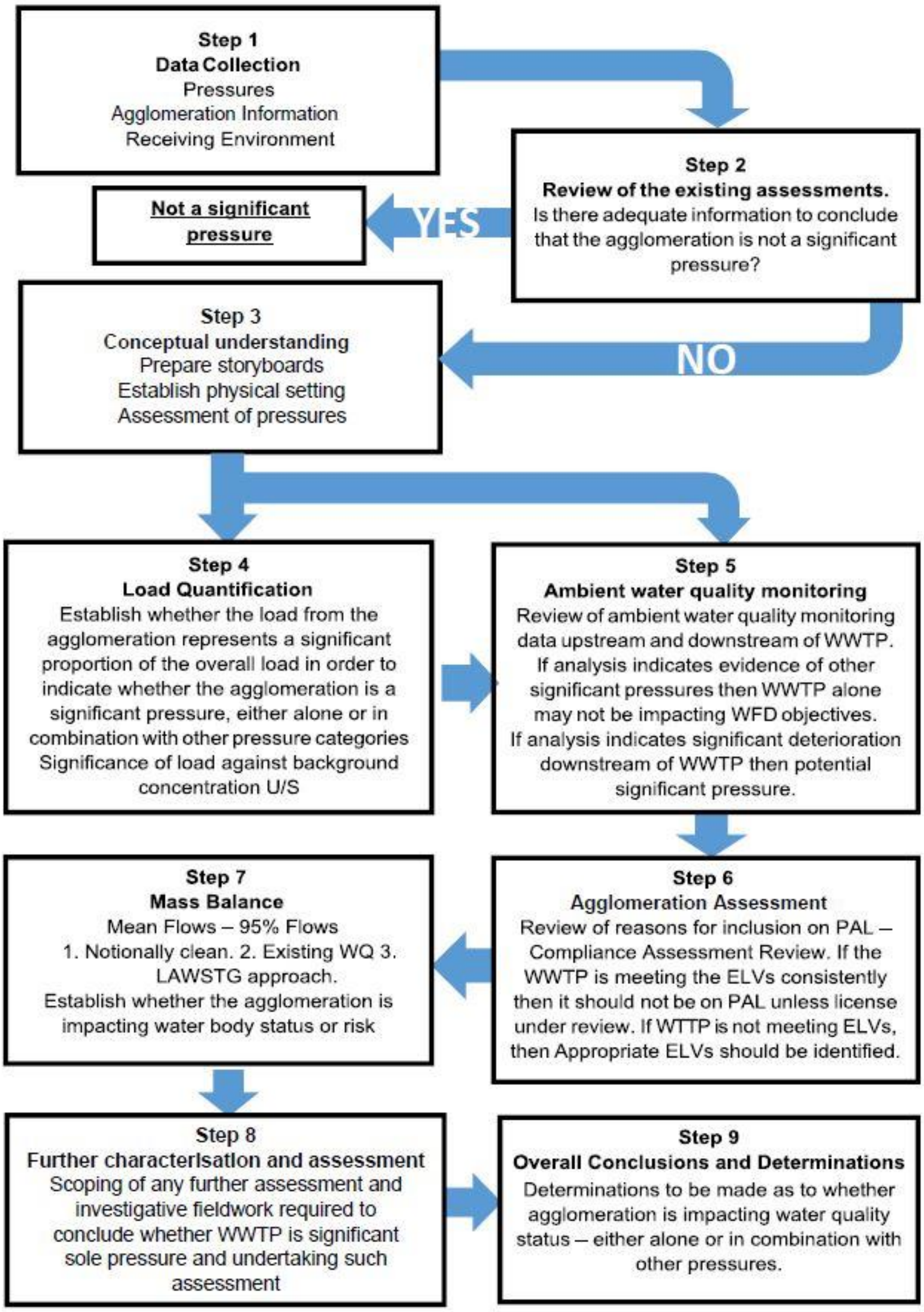

Figure 1.1: Steps included in the methodology

1.2 Bailieborough Agglomeration

Table 1.1 provides an overview of the Bailieborough agglomeration, the receiving water environment, and the reason(s) for identification as a sole significant pressure by the EPA CSMU during initial characterisation. **Figure 1.2** provides an overview map of the area surrounding the Bailieborough agglomeration.

Table 1.1: Overview of the Bailieborough agglomeration

Agglomeration name	Bailieborough	Authorisation code	D0085-01
Design PE	2,500	2019 collected PE	2,711
Treatment level	Tertiary, P removal	2018 ELV compliant	No
Discharges	Primary: 1 no. (TPEFF0200D0058SW001)) Storm Water Overflows: 4 SWO (SW002 plus 3 no. at pumping stations – Maple Court PS (to be abandoned), Lisnalee PS, Kinscourt no.2 PS)		
EPA Priority Action List (PAL)	Yes (see Section 6 for more details)	EPA Compliance Investigation (CI)	Yes (see Section 6 for more details)
WWTP upgrade project (completion date)	Yes – Upgrade WWTP (2024)	IW Programme(s)	SWO Programme
Water bodies where agglomeration is a significant pressure			
WB Name (code): **Blackwater (Kells)_020 (IE_EA_07B010170)**	2010-2015 monitoring period: 'moderate' ecological status 'at risk' 2013-2018 monitoring period: 'poor' ecoloigcal status		
WFD App pressure and impact details:			
Pressure sub-category	WWTP		
Impacts	Nutrient pollution Organic pollution		

1.3 Data Collection

There were a large number of datasets available, both internally within Irish Water and from other sources, in relation to the agglomeration and the receiving water environment.

The data collected was registered in a dedicated project register and is summarised in Appendix A of this report. An indication of the relevance of the data to the Bailieborough agglomeration assessment has been provided.

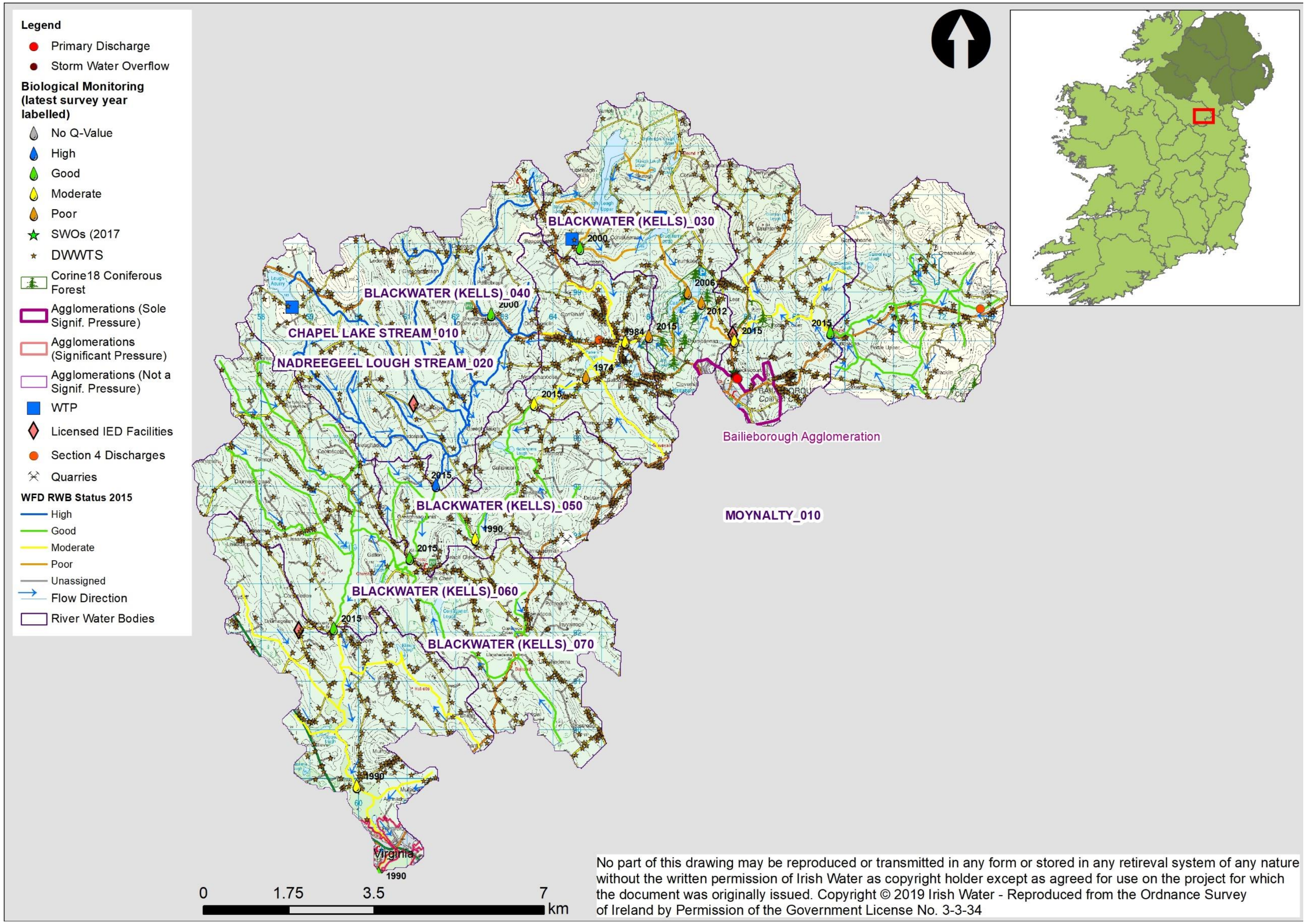

Figure 1.2: Bailieborough agglomeration overview map

1.4 Data Quality

1.4.1 Overview

As outlined in the Assessment Approach (Figure 1.1), Steps 4 to 6 involve a series of calculations which use data from numerous datasets. The data is listed in Appendix A. Data availability and quality checks have therefore been carried out to ensure that data is fit for purpose and can be used in the relevant calculations.

1.4.2 Ambient Data – General

Available monitoring data from the WFD monitoring programme, compliance assessments and investigative monitoring was obtained from EPA, Local Authorities and Irish Water including:

- Ambient biological and physico-chemical monitoring results for both upstream and downstream monitoring points for all agglomerations;
- Ambient monitoring station locations;
- WFD App information on water body status, drivers, risk status, updated ambient and effluent monitoring datasets, and pressures information.

Note ambient water quality data for water bodies receiving primary discharges was downloaded from the WFD App and has already undergone review and cleansing by the EPA. Data checks typically involved are outlined in Appendix B.

1.4.3 Suitability of ambient monitoring locations

Further characterisation of the stretch of water body between the upstream (RS07B010160) and downstream (RS07B010170) monitoring points allows for the identification of other potential pressures in the area, and determination of whether these may be significant pressures.

Based on the available pressure information, there are no known point source pressures between the Bailieborough primary discharge and the downstream ambient monitoring point (RS07B010170). Potential pressures identified include part of Bailieborough town which would be a source of diffuse urban pressure, pasture, forestry and Domestic Waste Water Treatment Systems (DWWTSs) in an area where surface pathways have moderate to high susceptibility to phosphates. A potential point source pressure identified includes an IED licensed discharge, however it appears that this discharge is downstream of the downstream monitoring location. There is the potential for unlicensed discharges to be present also. There are numerous single dwellings within the village and environs that are outside of the agglomeration boundary and not connected to the sewer network and wastewater treatment plant. It is possible that these properties are discharging directly to the Blackwater (Kells)_020 river water body via misconnections; or, given the susceptibility along the river channel, they could be a potential source of phosphates and nitrates via individual septic tanks systems. The SWO discharges to a culverted stream within the Blackwater (Kells)_020 water body. The primary discharge is to the same culverted stream a short distance upstream of the SWO discharge.

There are no inputting waterbodies or streams between the two monitoring points.

EU Member States may designate mixing zones adjacent to points of discharge where concentrations of one or more substances may exceed a relevant EQS within such mixing zones if they do not affect the compliance of the rest of the body of surface water with those standards.

The distance between the Bailieborough WWTP primary discharge point and the downstream monitoring station location was assessed to determine whether sampling may be taking place within the mixing zone which could lead to inappropriate conclusions as to the impact of the discharge.

EU Common Implementation Strategy (CIS) guidance on the identification of mixing zones (CIS-WFD, 2010[2]) states that a precautionary approximation of the extent of the mixing zone (i.e. the extent of EQS exceedance in rivers that can be considered acceptable without further assessment) should be the lesser of 10* River Width or 1km, provided this does not exceed 10% of the overall water body length. The Small Stream Risk Score (SSRS) methodology (EPA, 2015[3]) recommends that these assessments be carried out between 150m and 250m downstream of a discharge point on small streams.

The river width was determined from the original Local Authority WWDA licence and is approximately 1.5 metres wide at the location of the primary discharge. On this basis, and the EU CIS guidance, the mixing zone would be within 15 metres of the primary discharge.

The distance between the Bailieborough WWTP primary discharge point and the downstream ambient monitoring location (RS07B010170) is 739m. This is in line with recommended practise for undertaking SSRS downstream of a primary discharge and is outside of the estimated mixing zone based on EU CIS guidance. It is therefore concluded that this monitoring site is acceptable to assess impacts from Bailieborough WWTP on the Blackwater (Kells)_020 water body.

1.4.4 Effluent data check

A quality check of the available effluent data was undertaken using an adopted EPA methodology. The load from the WWTP as reported in the 2017 AER ($Load_{WWTP\ (AER)}$) was compared with estimated load based on the population equivalent ($Load_{WWTP\ (PE)}$). Where values differ considerably (i.e. by more than ten times) the possible reason for this is reviewed, i.e. it may be that the WWTP is operating at a much higher treatment efficiency rate which differs from the assumed treatment standards for the particular level of treatment when estimating the effluent load from the PE. The quality check is calculated as follows:

When;

$Load_{WWTP\ (PE)} * 0.1 < Load_{WWTP\ (AER)} < Load_{WWTP\ (PE)} * 10$

$Load_{WWTP} = Load_{WWTP\ (AER)}$

Otherwise $Load_{WWTP} = Load_{WWTP\ (PE)}$

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[2] EC (2010) Technical Guidelines for the identification of Mixing Zones pursuant to Art. 4(4) of the Directive 2008/105/EC. https://circabc.europa.eu/sd/a/78ce94bb-6f1c-4379-87ac-88a18967c4c3/Technical%20Background%20Document%20on%20the%20Identification%20of%20Mixing%20Zones.doc

[3] Guidance on Application and Use of the SSRS in Enforcement of Urban Waste Water Discharge Authorisations in Ireland. https://www.epa.ie/pubs/advice/water/wastewater/SSRS%20in%20Enforcement%20of%20UWWDAs.pdf

Where;

$Load_{WWTP\ (AER)}$ = Reported AER Effluent WWTP Load

$Load_{WWTP\ (PE)}$ = PE * production rate

Table 1.2 provides a summary of the assessment. The effluent loadings calculated from measured data, as recorded in the AER, are a reasonable representation of the loads to the plant, i.e. are within the range as specified above.

Table 1.2: Effluent loading check for measured parameters at Bailieborough agglomeration

Parameter	Loading (kg/yr)		Representative
	Load WWTP (AER)	Load WWTP(PE)	
BOD	3,401	24,359	Yes

1.4.5 Step Change Detection

Effluent data for Bailieborough WWTP is available for the period 2015-2019, and it is recognised that there may have been operational improvements, operational issues or process changes during this time. A step change analysis was therefore undertaken to identify any step changes.

The step change analysis was undertaken by calculating the rolling mean of the seven previous data points and plotting the results as illustrated in graphs in Appendix B for effluent parameters BOD, ammonia, and orthophosphate.

On review of the graphs, there are no identifiable step changes. The full period of available data (2015-2019) for all parameters should therefore be used in calculations, such as mass-balance and load quantification.

1.4.6 Primary Discharge Data – Outlier Detection

RPS developed a custom application to enable a consistent approach to analysis and visualisation of WFD water quality data. The application was developed in Python with a user interface in Jupyter Notebook for interactive table querying, statistical analyses including Theil-Sens Slope, outlier detection, resampling and rolling means. Additional functionalities allow the analyst to:

- Select more than one location for comparison of ambient and effluent monitoring data;
- Adjust outlier detection sensitivity;
- Remove outliers if appropriate;
- Select time period for trend analysis.

Plots are dynamic such that the axis labels, title and legends update automatically. Figure 1.3 presents the custom tool user interface.

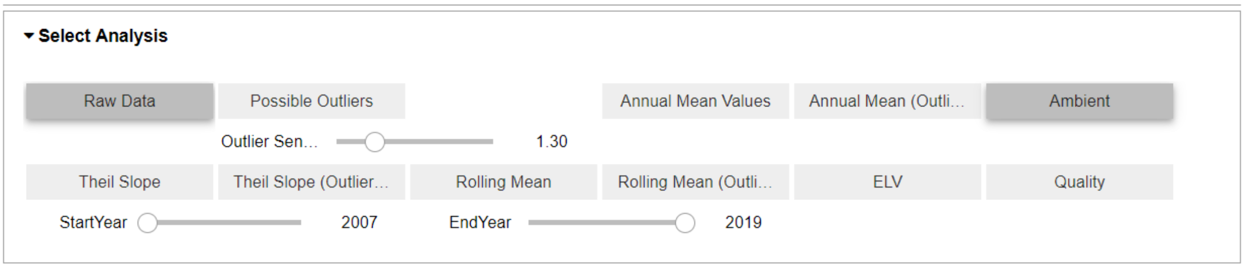

Figure 1.3: Python user interface

A sensitivity value of 1 was set for all parameters. The number of outliers detected are listed in Table 1.3 and illustrated in graphs in Appendix B.

Outliers identified for orthophosphate were high concentrations, and these correlated to elevated concentrations of other effluent parameters. This therefore suggests that whilst they are statistical outliers, they are representative of effluent quality and were not omitted from the analysis.

Ammonia outliers correlated to other effluent parameter concentrations and therefore were deemed to be representative of effluent quality, with the exception of September 2018. However, Bailieborough WWTP is noted to have had ammonia issues, and therefore to be conservative the data point has not been omitted.

For BOD, outliers were detected in July 2017 and January 2018, which did not correlate to other parameter concentrations. This therefore suggests that they are not representative of effluent quality, and therefore have been omitted from the analysis. Five other BOD outliers were retained for analysis as they correlated to elevated concentrations in other effluent parameters.

Table 1.3: Outlier Detection Summary

Sensitivity Value	Effluent Parameter	Number of Outliers Detected	Number of data points omitted
1	BOD	7	2
	Ammonia	5	0
	Orthophosphate	7	0

STEP 1 – SUMMARY

- The Bailieborough agglomeration currently provides tertiary treatment and P removal. It is currently overloaded, collecting 2,711 PE while the plant has a design capacity of 2500 PE.
- The WFD App identifies the Bailieborough WWTP as a significant pressure impacting the Blackwater (Kells)_020 water body, causing nutrient pollution and organic pollution.
- The Bailieborough WWTP has one primary discharge and four SWOs which discharge to a culverted stream within the Blackwater (Kells)_020 river water body. This water body is considered 'at risk' of not meeting its environmental objectives and was at 'moderate' ecological status (2010-2015), dropping to 'poor' ecological status (2013-2018).
- Data quality checks were undertaken on the ambient monitoring and primary discharge data, and it was determined that the effluent data available (2015-2019) would be generally appropriate for use in the calculations for Steps 4 to 7, though a small number of outliers were omitted.

2 STEP 2 - EXISTING ASSESSMENTS

The purpose of this step is to determine if adequate information is already available from existing assessments to achieve the aims of the project as set out in Section 1. Sources of existing assessments include WWDA licence documents, environmental assessments, and Irish Water's ongoing programmes as well as once-off studies.

Table 2.1 lists the key relevant existing assessments and indicates if any have been undertaken for this Agglomeration, with a complete list of data sources included in Appendix A. Relevant information or conclusions from these assessments are also summarised.

Table 2.1: Existing assessments for the Bailieborough agglomeration

Existing Information	Available for this Agglomeration	Comments/Conclusions Report Reference
Irish Water Registers, Programmes and Studies		
Waste Water Capacity Register	✓	Section 6.2
National Certificate of Authorisation Programme (NCAP)	✗	-
Disinfection Programme	✗	-
Drainage Area Programme (DAP) reports	✗	-
Modelling Studies	✗	-
SWO Assessment	✓	Section 2.1
Feasibility Study Report for upgrade works under condition 5.6 of WWDA Licence	✓	Section 6.2.3.3
Environmental Assessments		
i. Ecological Impact Assessment (including Small Streams Risk Score)	✗	-
ii. Habitats Directive Assessment	✓	Section 2.2.1
iii. Freshwater Pearl Mussel Assessment	✗	-
iv. Other environmental assessments	✗	-
Discharge authorisation-related reports		
AER Report	✓	Section 6.2.3.1
EPA OEE Inspector Reports	✓	Section 6.2.3.2
Condition 5.6 Assessment	✓	Section 6.2.3.3

2.1 SWO Assessments

The assessment of SWOs undertaken for the AERs is subjective in nature and is often not undertaken consistently across local authorities.

Irish Water's SWO Programme is a national programme for assessing the impact of SWOs based on repeated outfall site surveys and consideration of impact components and receiving water use. The methodology is robust, objective and consistent.The outputs from the SWO Assessment Programme, when available, will supersede the assessments included in the AERs.

2.1.1 AER 2018

This significance of the SWO is reported as 'low' in the 2018 AER. However, it is reported as not meeting the DoE's 'Procedures and Criteria in Relation to Storm Water Overflows' criteria. The volume discharge and number of acitivations are listed as 'unknown' in the report.

2.1.2 AER 2016

A stormwater overflow assessment was completed for Bailieborough agglomeration and reported in the 2016 AER for the agglomeration. The assessment identified one SWO:

- SW002: Located within the WWTP. The storm water discharges to a storm tank with a capacity of 80m^3, which is also treated at its inlet by a course bar screen. The storm water tank has a 300mm diameter discharge pipe to local drain and 600mm concrete pipe direct to the Blackwater River at Lear Bridge.

The SWO was found to meet the operating criteria required under the DoE's (1995) '*Procedures and Criteria in relation to Storm Water Overflows'.* The caretaker of the WWTP confirmed that the WWTP has received no complaints in relation to pollution and that the SWO does not operate in dry weather flow conditions. The significance of the spill can be concluded to be low as there is no interaction with any other discharges. However, the SWO was found to be non-compliant in terms of storm water storage within the agglomeration, with the required storage tank volume 284m^3 and the actual storage tank volume only 80m^3.

The assessment concluded that no specific works or improvement programme relating to storm water overflows was required. However a recommendation was made that should the design loading of the treatment plant not increase, the storm water storage capacity should be increased to meet the requirement for 284m^3 of storage. This provision will be included as part of the Phase 1 capital works to be completed by 2024.

2.1.3 SWO Programme

The SWOs in the Bailieborough agglomeration will be assessed under the SWO Programme. Information available to date is included in Table 2.2.

Table 2.2: Information from the SWO Programme

Overflow Type	Name	Asset	Emission Code	Assessed against DoEHLG Criteria	Monitored/Not Monitored	Significance	Included in Schedule A4 of the WWDL
SWO	TBC	WwPS	TBC	Meeting	Not Monitored	Low	No
SWO	TBC	WwPS	TBC	Meeting	Not Monitored	Not yet assessed	No
SWO	TBC	WwPS	TBC	Meeting	Not Monitored	Not yet assessed	No
SWO	SW002	WwTP	TPEFF0200D 0085SW002	Meeting	Not Monitored	Low	Yes

2.2 Environmental Assessment

2.2.1 Appropriate Assessment Screening Report

An Appropriate Assessment is required under Artcile 6 of Habitats Directive to assess, in view of best scientific knowledge and conservations objectives, if an activity (either individually or in combination with other plans or projects) is likely to have a significant effect on a European Site. The first stage of the appropriate assessment process is a screening assessment to determine if a project can be screened out of any further assessment where there is no potential for the conservation objectives of the European site to be affected. The output from the stage 1 screening is the Appropriate Assessment Screening report.

A Stage 1 Appropriate Assessment Screening was undertaken for the agglomeration by the EPA in June 2015 during the licensing process. The findings are presented in Table 2.2.

Table 2.3: Appropriate Assessment Screening Report Summary

Appropriate Assessment Screening			Author	Date
			EPA	June 2015
Protected Area/ Species	Report Findings/ Conclusion			
	Linked to Agglomeration			Further Action
River Boyne SAC and SPA and River Blackwater SAC and SPA	No	Bailieborough WWTP is not directly connected to the sites, alone or in combination with other projects, and will not have a a significant effect on any European site. This was determined based on the distance of the primary discharge to the downstream European sites of 26 km.		Further Assessment is not required.

STEP 2 SUMMARY

- The four SWOs within the agglomeration are reported in the SWO Programme as meeting the requirements of the DoE's (1995) '*Procedures and Criteria in relation to Storm Water Overflows'.* However, SWO02 was found in the 2016 AER to be non-compliant in terms of storm tank volume with a required storage tank volume of 284m^3 and an actual storage tank volume is 80m^3. This was noted as a recommended improvement and will be addressed in the phase 1 upgrade works proposed for the WWTP to be completed by 2024.

- A Stage 1 Appropriate Assessment Screening was undertaken for the agglomeration by the EPA in June 2015 during the licensing process. The report concluded that the agglomeration was not impacting, alone or in combination with other projects, on the downstream European sites of interest. This was decided due to the 26km distance between the primary discharge and the European sites.

3 STEP 3 - CONCEPTUALISATION OF THE CATCHMENT

This section details the conceptualisation of the catchment that the Bailieborough agglomeration is located within. A high level description of the catchment is provided as well as a more detailed description of the subcatchment within which the Bailieborough agglomeration is located.

3.1 Catchment Description

The Bailieborough agglomeration is situated within the Boyne Catchment (Hydrometric Area (HA) 07). This catchment includes the area drained by the River Boyne and all streams entering tidal waters between The Haven and Mornington Point, Co. Meath, draining a total area of 2,694km². The largest urban centre in the catchment is Drogheda. The other main urban centres are Navan, Trim, Kells, Virginia, Bailieborough, Athboy, Kinnegad, Edenderry and Enfield. The total population of the catchment is approximately 196,400 with a population density of 73 people per km². The catchment is characterised by an undulating landscape in the south, which changes to a more hummocky drumlin topography in the north. The catchment is underlain by metamorphic rocks in the north and limestone bedrock in the centre and south of the catchment. There are also extensive areas of sand and gravel, particularly along the upper reaches of the Boyne.

The catchment is divided into 20 subcatchments and the Bailieborough agglomeration is within subcatchment Blackwater (Kells)_SC_010 (see Figure 3.1). Catchment conceptualisation is focused at this subcatchment level.

3.2 Subcatchment Hydrology

As seen in Figure 3.1, there are 8 river water bodies and 3 lake water bodies within the subcatchment. The headwaters of the Blackwater (Kells)_010 in the north-east of the subcatchment flowing westerly into the Blackwater (Kells)_020 and onwards into the Blackwater (Kells)_030. Skeagh Lough Upper and Drumkeery Lough are in the Blackwater (Kells)_030 sub basin. These waterbodies of the Blackwater (Kells)_SC_010 are relevant to the Bailieborough agglomeration.

Further downstream of the agglomeration in the north of the subcatchment, the main channel of the Blackwater (Kells)_040 to the Blackwater (Kells)_070 flows south-west towards the subcatchment outlet. In the north-west of the subcatchment Chapel Lake Stream_010 flows into the Blackwater (Kells)_050, with Accury Lough located in the Chapel Lake Stream sub basin.

Hydrogeology and dominant pathways are included in the subcatchment conceptualisation in Section 3.5.

3.3 Subcatchment Land Use

The land use within the Blackwater (Kells)_SC_010 subcatchment is predominantly agricultural land, in the form of pastures. There are large areas in the west and east of the subcatchment where land use is agricultural, however there are also areas of natural vegetation. There is also a small area of peat bog in the east, adjacent to the subcatchment boundary. The main towns in the subcatchment are Bailieborough and Killinkere. There is also a large quarry in the east of the subcatchment, adjacent to the eastern subcatchment boundary.

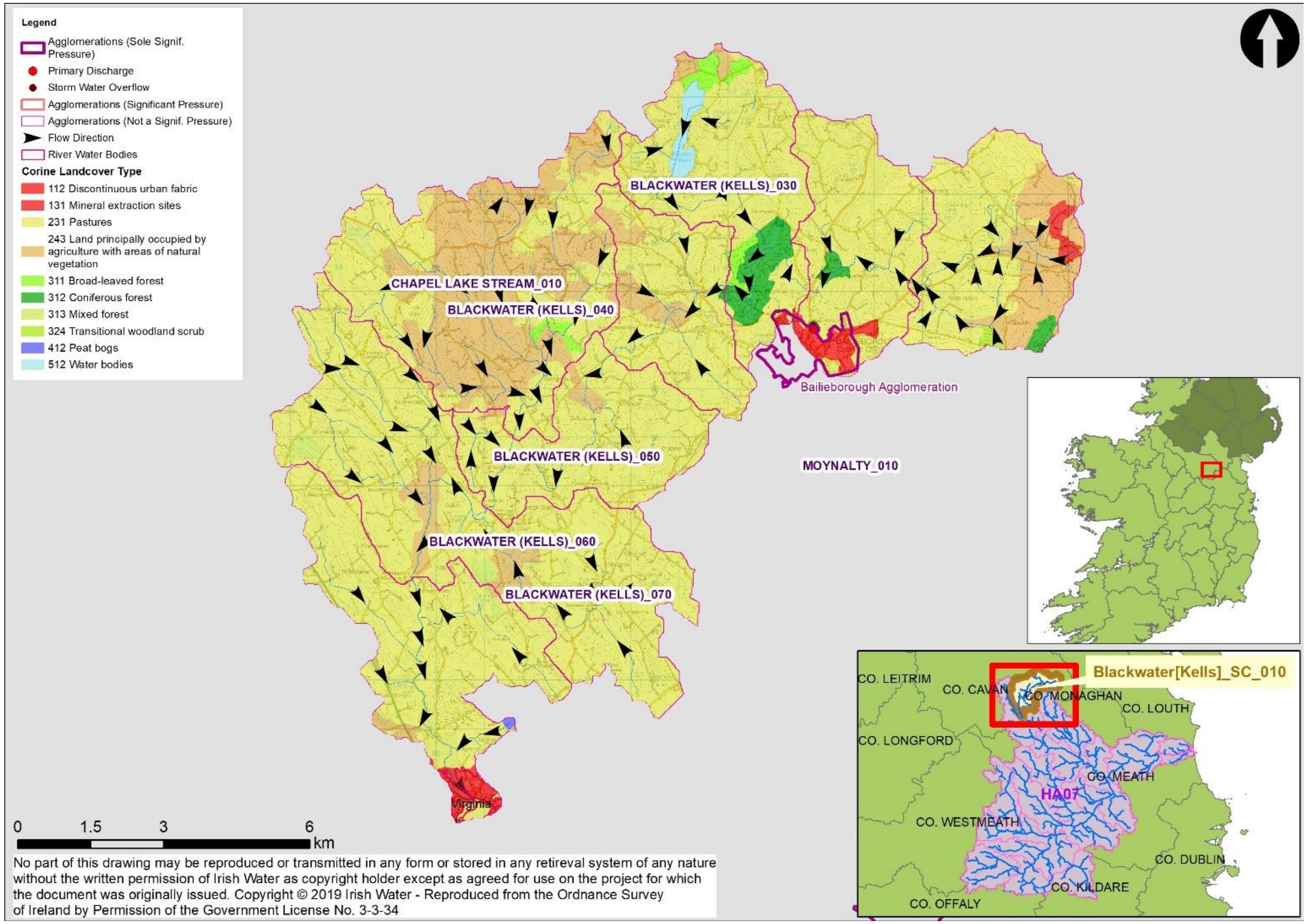

Figure 3.1: Map of subcatchments within Blackwater (Kells)_SC_010 and Bailieborough agglomeration

3.4 Subcatchment WFD Protected Areas

Protected Areas within a 15km radius of the agglomeration, which encompassed the Blackwater (Kells)_SC_010 subcatchment and beyond, were identified using the WFD App and EPA datasets, and include:

- Drinking water abstractions:
  - 2 public groundwater abstraction point (Drumkeery Lough and Acurry Lough) and 1 private water abstraction at Lough Skeagh.
  - WFD Registered Protected Area for Drinking Water: Middle reaches of the main channels of the Blackwater (Kells)_050. Also Acurry Lough and Drumkeery Lough which are designated protected surface water bodies.
- Special Areas of Conservations (SACs): There are no SACs directly connected to the water body within which the Bailieborough agglomeration is located. However there are a number of SACs located within 15km (shortest route) of the agglomeration boundary: Killyconny Bog (Cloghbally), River Boyne and River Blackwater. The hydrological connection to the River Boyne and Blackwater SAC is over 25 km away when the route of the Blackwater River is considered.

3.5 Subcatchment Conceptualisation

The topography is variable, with small areas of higher elevation and relatively steep slopes throughout the subcatchment.

The soils are predominantly poorly drained, derived from sandstone and shale till parent material, with small areas of peat throughout the subcatchment in areas at lower elevation. There are also small areas of well drained soils present in the south-west, which are derived from sandstone and shale till; and small areas of rock at surface throughout the subcatchment where elevations are higher.

The sub-soils within the subcatchment are mainly low permeability, and are predominantly sandstone and shale tills with small areas of peat throughout. There is also a small area of moderately permeable and highly permeable sub-soils in the south of the subcatchment, where sub-soils are sandstone and shale till and peat. Throughout the subcatchment, particularly in the east, there are large areas where depth to bedrock is less than 3m.

The subcatchment is underlain by a poor aquifer, which is generally unproductive except for local zones. Groundwater vulnerability ranges from low to X-Extreme throughout, with areas where overlying sub-soils have low permeability, groundwater vulnerability ranges from low to moderate. There are areas of high to X-Extreme groundwater vulnerabilities throughout the subcatchment, particularly in the east, where depth to bedrock is less than 3m and sub-soils have moderate to high permeability with well drained overlying soils or bedrock at surface.

Susceptibility and pollution impact potential mapping for both nitrates and phosphates show low susceptibility and low impact potential to groundwater by sub-surface pathways, indicating groundwater flows are an unlikely pathway of these nutrients. Nitrate susceptibility by near surface pathways are predominantly moderate with small areas of very high susceptibility where bedrock is at surface or soils are well drained with depth to bedrock less than 3m. Small areas of alluvium along the channels of the water bodies throughout the subcatchment also have high susceptibility. Pollution impact potential mapping indicates that potential pathways for nitrates to be transported will be through flows through well drained soils and higher permeability sub-soils.

Phosphate near surface pathway susceptibility is predominantly high throughout the subcatchment, where soils are poorly drained and sub-soils have low permeability and some areas where depth to bedrock is less than 3m. Pollution impact potential mapping shows high impact potential to surface waters in the same areas as high near surface susceptibility, with higher impact potential in areas where soils are peat or derived from sandstone and shale tills, with low permeability underlying sub-soils. This indicates that potential pathways for phosphates will be overland flows. The near surface phosphate susceptibility associated with Bailieborough agglomeration is shown below in Figure 3.2.

Areas of high susceptibility for near-surface pathways of phosphates in Blackwater (Kells)_010 to Blackwater (Kells)_030 are present throughout the river sub-basins, indicating the potential for diffuse pressures to impact on the waterbodies, and these coincide with areas of agricultural land use.

3.6 Catchment Storyboard

A schematic showing the relevant water bodies within the catchment is provided in Figure 3.3.

The upstream water body of the Blackwater (Kells)_010 is classified as ‘not at risk’ due to biological and ecological status remaining at ‘good’ across the 2007-2009, 2010-2015 and 2013-2018 monitoring programmes. In terms of physico-chemical monitoring, there are no issues identified with all key parameters consistent with conditions for ‘high’ biological elements and therefore ecological status. There were no pressures identified and no upstream agglomerations.

The receiving water body of the Blackwater (Kells)_020 is considered ‘at risk’ of not meeting its environmental objectives. Ecological and biological status improved from ‘poor’ status in 2007-2009 to ‘moderate’ status in 2010-2015; but deteriorated back to poor in the 2013-2018 monitoring period. In terms of physico-chemical monitoring, there are no issues identified with the key parameters, which are all at ‘high’ indicative status. Significant pressures on the water body have been noted as Bailieborough WWTP which is impacting for nutrient and organic chemistry. An industrial emissions from a food company is also identified as a pressure but not a significant pressure. The AER (2017) noted that the WWTP discharge may be having an impact on water quality; but that there may be other unknown discharges also impacting the water body, such as misconnections and industrial discharges.

The downstream water body of the Blackwater (Kells)_030 is classified as ‘at risk’ of not meeting its environmental objectives due to the ‘poor’ ecological and biological status (2010-2015 and 2013-2018), having previously been ‘unassigned’. There is no physico-chemical monitoring data for the water body. However the only significant pressure identified is from agricultural pastures impacting on nutrient and organic chemistry. It is also noted that the Drumkeery and Skeagh Lough Upper input into the water body and are currently classified at ‘bad’ status. The upstream Bailieborough agglomeration has not been identified as a pressure impacting on the water body Blackwater (Kells)_030 water body.

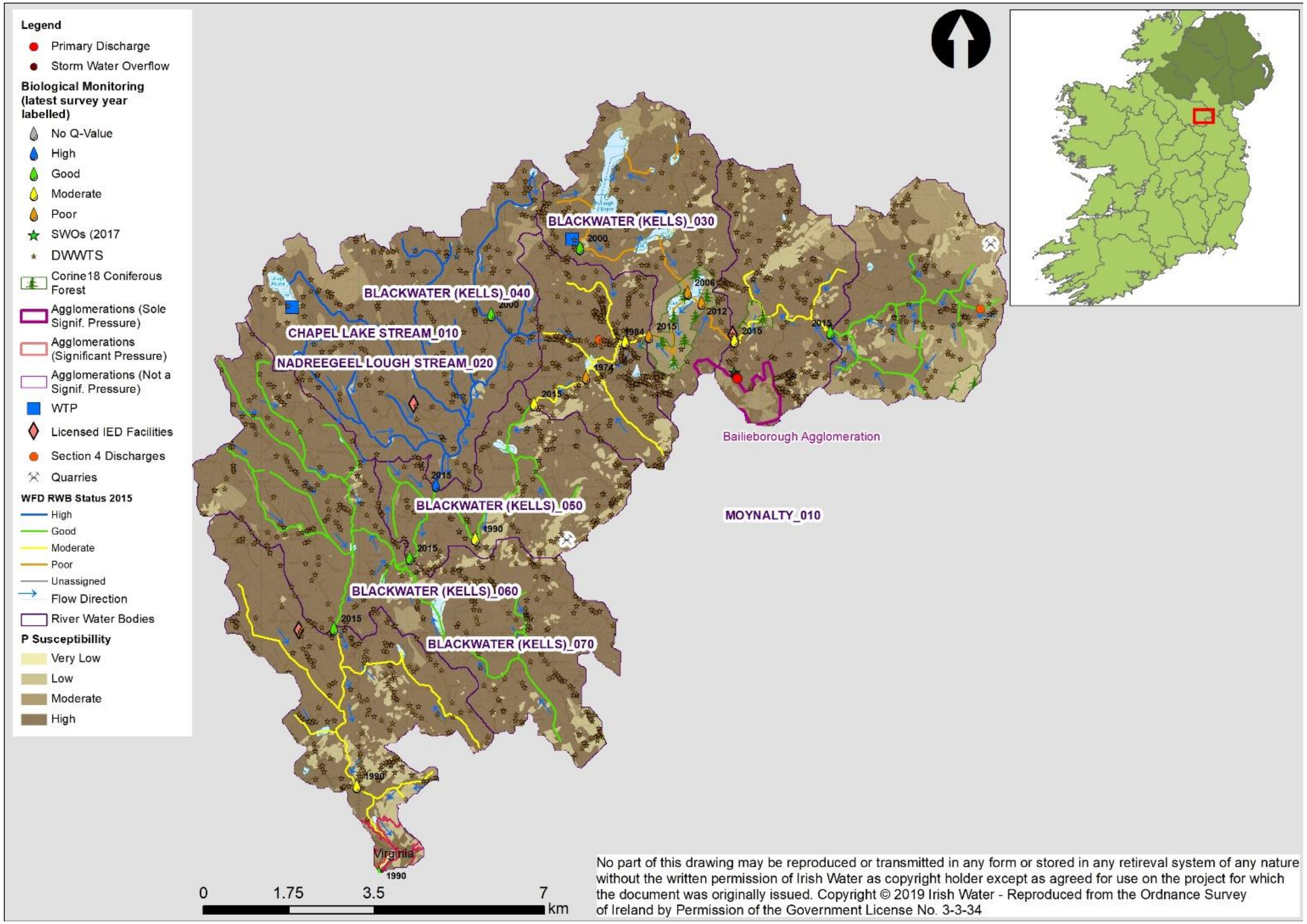

Figure 3.2: Near Surface Pathway Susceptibility (phosphates) in Blackwater (Kells) _SC_010 subcatchment

Downstream Water Body

IE_EA_07B010280 BLACKWATER (KELLS)_030	(07-09)	(10-15)	WFD Risk	Latest Q Data (Year)
Bio	Unassigned	Poor	At Risk	Poor (2018)
Eco	Unassigned	Poor		
Chem	Status	Trend	Baseline (2014) from WFD App	
Ortho-P (P)	No data	No data	No data	
TON (N)	No data	No data	No data	
Tot Am (N)	No data	No data	No data	
Comments	No comment			
Other Pressures	WFD App - Agriculture (Pasture) identified as significant pressure for nutrient pollution. Drumkeery and Skeagh Upper lake waterbodies inputting into waterbody, and are both at Bad status.			
Upstream Agglomerations	Bailieborough Agglomeration.			

Receiving Water Body

IE_EA_07B010170 BLACKWATER (KELLS)_020	(07-09)	(10-15)	WFD Risk	Latest Q Data (Year)
Bio	Poor	Moderate	At Risk	Poor (2018)
Eco	Poor	Moderate		
Chem	Status	Trend	Baseline (2014) from WFD App	
Ortho-P (P) RS07B010160 RS07B010170	High	Downwards Downwards	0.023 0.040	
TON (N) RS07B010160 RS07B010170	High	Upwards Downwards	1.216 1.154	
Tot Am (N) RS07B010160 RS07B010170	High	Downwards Upwards	0.460 0.590	
WWTP treatment Level	Tertiary, P removal		Overloaded?	Yes
Compliant?	Non-compliant - 2017 ELV breaches for BOD, Ortho-Phosphate and Ammonia.			
Comments	2018 EPA Licensee report - receiving waters have no evidence of gross solids, however sewage fungus visible immediately downstream. 2017 AER - noted may be giving rise to breach in EQS for ammonia, may be other unknown discharges - extensive water body with misconnections, agriculture, industrial discharges. The plant as noted is overloaded with planned improvement works recommended.			
Other Pressures	WFD App - Indicates Bailieborough WWTP significant pressure, for nutrient and organic pollution. Industrial Emission for Foods company also identified as a pressure, but not significant.			
Upstream Agglomerations	None identified			

Upstream Water Body

IE_EA_07B010100 BLACKWATER (KELLS)_010	(07-09)	(10-15)	WFD Risk	Latest Q Data (Year)
Bio	Good	Good	Not at Risk	Good (2018)
Eco	Good	Good		
Chem	Status	Trend	Baseline (2014) from WFD App	
Ortho-P (P) RS07B010100	High	Downwards	0.016	
TON (N) RS07B010100	High	Downwards	0.666	
Tot Am (N) RS07B010100	High	Downwards	0.025	
Comments	No comments			
Other Pressures	WFD App - None identified.			
Upstream Agglomerations	None identified			

Key

← - Indicates direction of flow between water bodies

☐ - Receiving water body of primary discharge

Figure 3.3: Subcatchment Storyboard

STEP 3 SUMMARY

- The Bailieborough agglomeration is located within the Blackwater (Kells)_SC_010 subcatchment. Based on the available soils and subsoils information, there are areas of high susceptibility for near-surface pathways of phosphates throughout the Blackwater (Kells)_010, Blackwater (Kells)_020 and Blackwater (Kells)_030 water bodies. There is potential for diffuse pressures to impact on the water bodies, with high potential areas coinciding with areas of agricultural land use.

- A number of protected areas intersect the Blackwater (Kells)_SC_010 subcatchment within the Bailieborough agglomeration is located. There are a number of additional SACs located within a 15km radius of Bailieborough agglomeration. There are also drinking water abstractions located within the subcatchment. The River Boyne and River Blackwater SAC and SPA are located downstream of the agglomeration.

- The upstream water body (Blackwater (Kells)_010) is classified as ‘not at risk’ under WFD status, maintaining ‘good’ ecological and biological status for the 2007-2009, 2010-2015 and 2013-2018 monitoring periods. There are no pressures identified on the water body.

- The downstream water body (Blackwater (Kells)_030) is classified as ‘at risk’ of not meeting its environmental objectives, with ‘poor’ ecological and biological status in the 2010-2015 and 2013-2018 monitoring programmes. The only significant pressure identified is from agricultural pastures impacting on nutrient and organic chemistry. It is also noted that the Drumkeery Lake and Skeagh Lough Upper input into the water body and are currently classified at ‘bad’ status.

4 STEP 4 - LOAD QUANTIFICATION

Step 4 quantifies urban waste water loads and assesses their significance on the water bodies affected. This quantification of load contribution provides an effective and useful metric to establish the relative significance of pressures; and therefore provides context to other pressures within an overall integrated catchment management (ICM) approach.

4.1 Methodology

Existing up-to-date monitoring and reporting data has been analysed and, where appropriate, calculations have been carried out to generate pollutant loads from the Bailieborough WWTP, and to derive flow-weighted loads in the receiving waters upstream and downstream of the WWTP.

It should be noted that in order to undertake a direct comparison between the effluent discharge and ambient monitoring, Total P was used as ortho-P is not reported in WWTP effluent loads.

All load quantification calculations are presented in Appendix C.

4.1.1 Effluent Load Estimation

Where possible, effluent loads were based on annual averages for 2015, 2016 and 2017 presented in the AERs. Where there was no measured data available, export coefficient estimation methodologies were utilised. Loads were estimated using British Water Code of Practice[4] (BOD & ammonia) and Mockler et al. 2017[5] (Total P) production per capita figures. The effluent loadings were calculated as the product of **per capita production figures** (estimated mass of each parameter produced per person per day), **population equivalents** (from the Irish Water Waste Water Capacity Register) and **treatment reduction factors** (factor that the treatment level at the WWTP reduces concentrations of the key parameters).

4.1.1.1 Estimated Influent Loads (product of PE and production figures)

Influent loads were estimated as the product of per capita production rates and WWTP population equivalents. Population equivalents for 2017 were available from Irish Water's Waste Water Capacity Register at the time of calculation. Residential production per capita figures (production rates) were taken from the British Water Code of Practice (no. 4)[4] for BOD and ammonia, and from Mockler et al, 2017[5] were used for Total P (Table 4.2).

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[4] British Water Code of Practice (2009) *Flows and Loads - Sizing Criteria, Treatment Capacity for Sewage Treatment Systems*, London: British Water.

[5] Sources of nitrogen and phosphorus emissions to Irish rivers and coastal waters: Estimates from a nutrient load apportionment framework, Science of the Total Environment, Volumes 601-602, pp 326-339

Table 4.1: Production per capita figures for BOD, ammonia & total P

Parameter	Typical Loading (g/person/day)	Source
BOD	60	British Water
Ammonia as N	8	British Water
Total P	2	Mocker

4.1.1.2 Treatment Reduction Factors

Treatment reduction factors indicate the WWTP's efficiency in reducing the concentration of a certain parameter between influent and effluent by means of treatment processes.

Total N and Total P reduction factors are taken from OSPAR[6]. BOD reduction factors are taken from CIWEM[7].

Table 4.2 summarises the reduction factors used to compute the estimated effluent loads from WWTPs where effluent monitoring is not available.

Table 4.2: Treatment Reduction Factors

Parameter	Treatment Reduction Factor				
	No treatment/ preliminary treatment	Primary Treatment	Secondary Treatment	Nutrient Removal	Source
Total P	1	0.667	0.467	0.1	OSPAR
Total N	1	0.727	0.545	0.3	OSPAR
BOD	1	0.7	0.35	-	CIWEM

4.1.2 Ambient Load Estimation

Upstream and downstream average ambient loads were calculated from monitoring results available from the WFD monitoring programme for the period 2015 to 2018, data is taken from the nearest WFD monitoring stations which have chemistry data available. Flow estimates were taken from the EPA's Hydrotool where there is insufficient flow data in the subcatchment

The load for each parameter is derived from the product of mean flow in the river (as per EPA Hydrotool in the case of Bailieborough) at the monitoring location and the average monitored concentration for that

[6] OSPAR (2004) OSPAR Guidelines for Harmonised Quantification and Reporting Procedures for Nutrients (HARP-NUT)

[7] CIWEM Training Module - Municipal Wastewater Treatment http://training.ciwem.org/mwwt/

particular parameter. The following hierarchy of sources/methods was used in the estimation of mean flows:

1. Gauged data used where available;
2. Gauged data scaled pro-rata on areal basis where appropriate (hydrologically similar);
3. Hydrotool value (where appropriate);
4. Hydrotool values scaled pro-rate on areal basis (where appropriate).

For hydrotool flow estimates the flow that is equalled or exceeded for 30 percent of the time in the long term (30 percentile), was used in the assessment of ambient loads, as being representative of mean flows[8].

4.2 Ambient Data

Ambient data was available from the WFD App for monitoring station RS07B010160 (upstream) and RS07B010200 (downstream). A total of 36 BOD samples and 37 ortho-P samples were available from the upstream monitoring station for the 2007 to 2019 period. Downstream ambient monitoring averages were based on 15 BOD samples and 16 ortho-P samples for the 2015 to 2018 period. This data was used to calculate loads at these sites.

4.3 Results and Findings

The difference between upstream and downstream loads were calculated and compared with the effluent load for each parameter. If the difference between the upstream and downstream loads is similar to the load within the WWTP effluent, it can be considered that the WWTP is contributing the majority of the pollutant load between the monitoring stations. If the difference in loads between the stations is much larger than the load being contributed by the WWTP, it can be concluded that the WWTP is not the sole contributor along that stretch of watercourse.

Table 4.3 shows BOD, Total N and Total P loadings calculated for the upstream and downstream ambient monitoring locations, as well as for the WWTP primary discharge. The difference between upstream and downstream loads has been calculated, and the contribution of the WWTP to this load difference has been presented as a percentage for each parameter. Note, as discussed in Section 1.4.6, all available data has been used for WWTP load calculations. An assumption that all the upstream ortho-P load is Total P has been made which is conservative given that Total P is likely to be higher than ortho-P and therefore the upstream load is likely to be greater. The analysis showed that:

- There are lower levels of BOD and Total P recorded at the downstream monitoring station than the upstream station. It is expected that load concentrations would generally increase from upstream to downstream. The observed decrease could be due to sampling error, dilution or in-stream processes. The WWTP accounts for 9% of BOD loads and 24% of Total P loads at the downstream monitoring station.

[8] Environmental Protection Agency, *Hydrological Data - A list of water level recorders and summary statistics at selected gauging stations*, 1995

- There is no information available for Total N at the ambient monitoring sites so no comparison can be made.

Table 4.3: Pollutant Loads (kg/yr)

	BOD	Total N	Ortho-P	Total P
Upstream Load	80,480	-	3,178	3,178
WWTP Load	3,401	5,057*	-	232*
Downstream Load	36,178	-		949
Difference (Between Upstream and Downstream)	-44,302	-		-2,228
WWTP Load as % of Downstream Load	9%	-		24%
WWTP Load as % of Difference (Upstream and Downstream)	-8%	-		-10%

* No data available from AERs, values are estimates

STEP 4 SUMMARY

- Load quantification analysis has been carried out in relation to the Bailieborough WWTP primary discharge.
- BOD is the only parameter measured at the ambient monitoring station and in the effluent for Bailieborough.
- The load quantification analysis indicates that the Bailieborough WWTP may not be a sole significant pressure in the Blackwater (Kells)_020, due to the fact that loads are lower at the downstream site than the upstream site. However further analysis is required.

5 STEP 5 - AMBIENT MONITORING

5.1 Overview

The purpose of the ambient monitoring assessment was to analyse water quality data upstream and downstream of the agglomeration in order to determine the significance of the impact and associated response in the receiving waters; identifying patterns and trends that may suggest the presence of certain pressure categories. For example, a seasonal trend would explain elevated pollutant levels at certain times of year which may be linked to weather conditions. It involves a comparison of ambient monitoring data at selected monitoring stations to determine changes in water quality that could be attributed to specific pressures or issues identified along the waterbodies.

A map of the Blackwater (Kells)_020 water body with the monitoring stations relevant to the assessment for the Bailieborough agglomeration is shown in Figure 5.1.

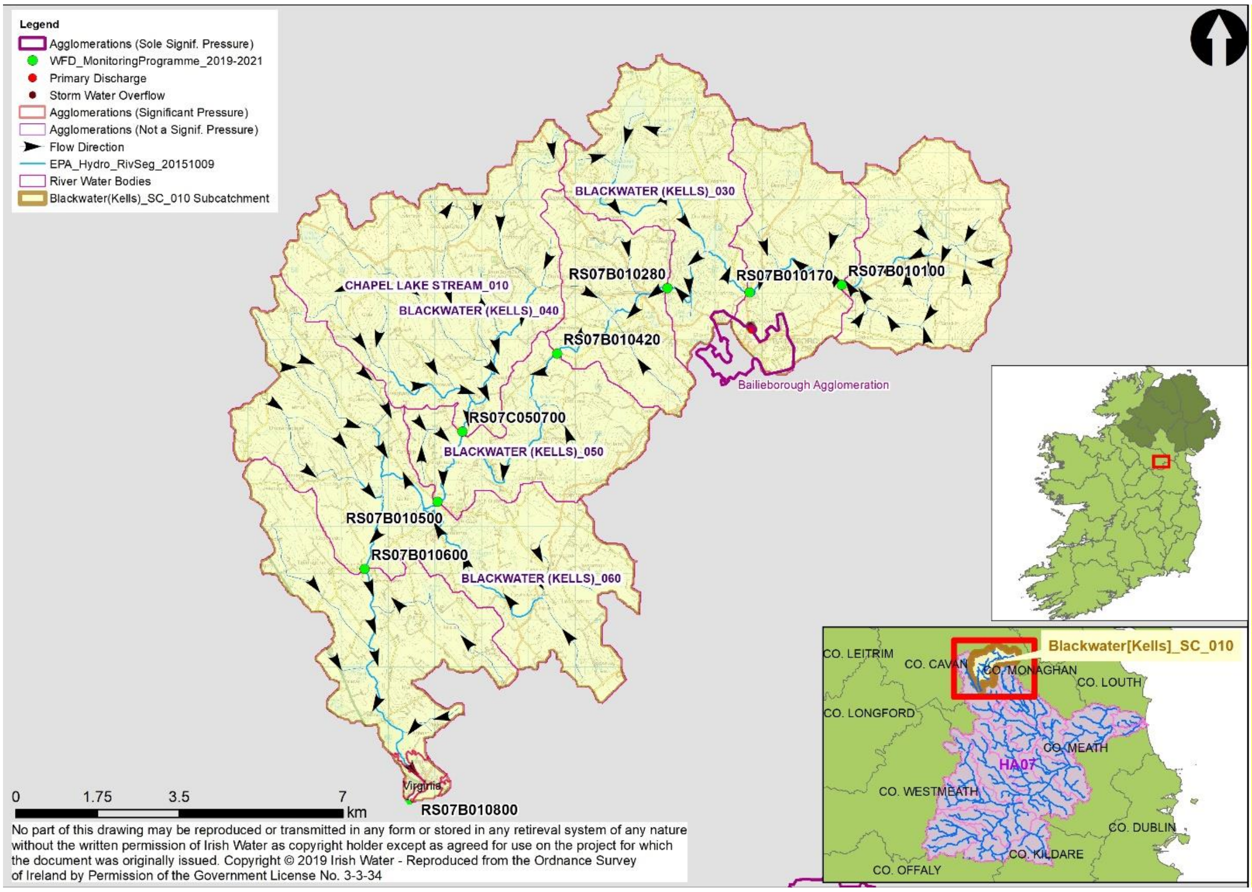

Figure 5.1: Monitoring station location map for Bailieborough agglomeration

5.2 Methodology

The ambient monitoring assessment provides an insight into the impacts and responses in the receiving water environment upstream and downstream of the Bailieborough agglomeration, informing and supporting the determination as to whether the agglomeration is a significant pressure. The assessment also aids identification of other pollution sources.

5.2.1 Data analysis

The following approach has been taken to the data analysis:

1. Summarise key ambient monitoring data (both biology and physico-chemical), including environmental objectives, status and drivers. This provides a high level overview of the water body and identifies potential issues.

   Additional factors taken into account include: comments from EPA Biologists; historic data; and any other information available in relation to the waterbodies and pressures.

2. Conduct a time-series analysis of ammonia, orthophosphate (ortho-P) and BOD. This is to further characterise the water body and understand water quality in the receiving environment. This is completed through consideration and identification of key trends upstream and downstream of the receiving water body (i.e. seasonal or cyclical trends) that may be attributable to pressures within the water body or environmental conditions. The analysis supports the determination of whether an Agglomeration is a significant pressure.

5.3 Summary of ambient and WFD monitoring data

Appendix D provides a summary of the ambient monitoring data for the Blackwater (Kells) _020 river water body which receives the discharges from the Bailieborough agglomeration. It also includes the Blackwater (Kells) _010 which is upstream of the Blackwater (Kells) _020, and the Blackwater (Kells) _030 which is the downstream water body.

5.3.1 Review of WFD App Risk Assessment information

5.3.1.1 Upstream Water Body

The Blackwater (Kells) _010 water body has remained at ‘good’ status for two consecutive monitoring periods, and the water body was therefore deemed to be ‘not at risk’ of failing to meet environmental objectives by 2021. On review of more recent data in 2018, biology remained at ‘good’ status.

5.3.1.2 Receiving Water Body

The Blackwater (Kells) _020 water body is ‘at risk’ of not meeting its environmental objectives, whilst the biology and ecology status improved from ‘poor’ to ‘moderate’ in the 2010-15 monitoring period, biology was noted to have deteriorated back to ‘poor’ status in 2018.

5.3.1.3 Downstream Water Body

The Blackwater (Kells)_030 is 'at risk' of failing to achieve its environmental objectives due to the 'poor' biological and ecological status recorded in the monitoring period 2010-15. In addition, based on recent monitoring data from 2018, biology has remained at 'poor' status.

5.4 Physico-chemical data - Time Series Analysis

The time-series analysis was completed for BOD, ammonia and ortho-P, to identify and compare trends in receiving waters to effluent data and mean EQS values for ammonia and ortho-P.

The monitoring stations and available monitoring data are listed in Table. 5.2. The locations of the monitoring stations with physico-chemical data are shown in **Figure 5.1**. The Blackwater (Kells)_030 water body did not have ambient monitoring data available.

Table 5.1: Ambient Monitoring stations and available data

Monitoring Station		Water Body	BOD Data Available	Ammonia Data Available	Ortho-P Data Available
U/S	**RS07B010160**	Blackwater (Kells)_020	2007 – 2019 (Feb)	2007 – 2019 (Feb)	2007 – 2019 (Feb)
D/S	**RS07B010170**	Blackwater (Kells)_020	2007 – 2019 (Feb)	2007 – 2019 (Feb)	2007 – 2019 (Feb)
Effluent					
Eff	**TPEFF0200D0085SW001**		2015-2019(Mar)	2015-2019(Mar)	2015-2019(Mar)

5.4.1 BOD

Figure 5.2 plots BOD concentrations at the ambient monitoring locations upstream and downstream of the Bailieborough WWTP primary discharge, with effluent BOD concentrations also included on the graph for comparison.

The upstream concentrations of BOD are slightly lower than the downstream concentrations; with similar fluctuations in water levels seen at the downstream monitoring station. As peaks correlate with each other, it is likely that these fluctuations are attributable to pressures upstream of RS07B010160, or that these are event driven. Such potential pressures include: agricultural activities in an area of high potential pollution for near surface pathways of phosphates, and DWWTS.

When comparing effluent data with ambient monitoring data downstream of Bailieborough WWTP primary discharge, there does not appear to be a correlation in peaks, suggesting that Bailieborough agglomeration is not acting as a sole significant pressure of Blackwater (Kells)_020.

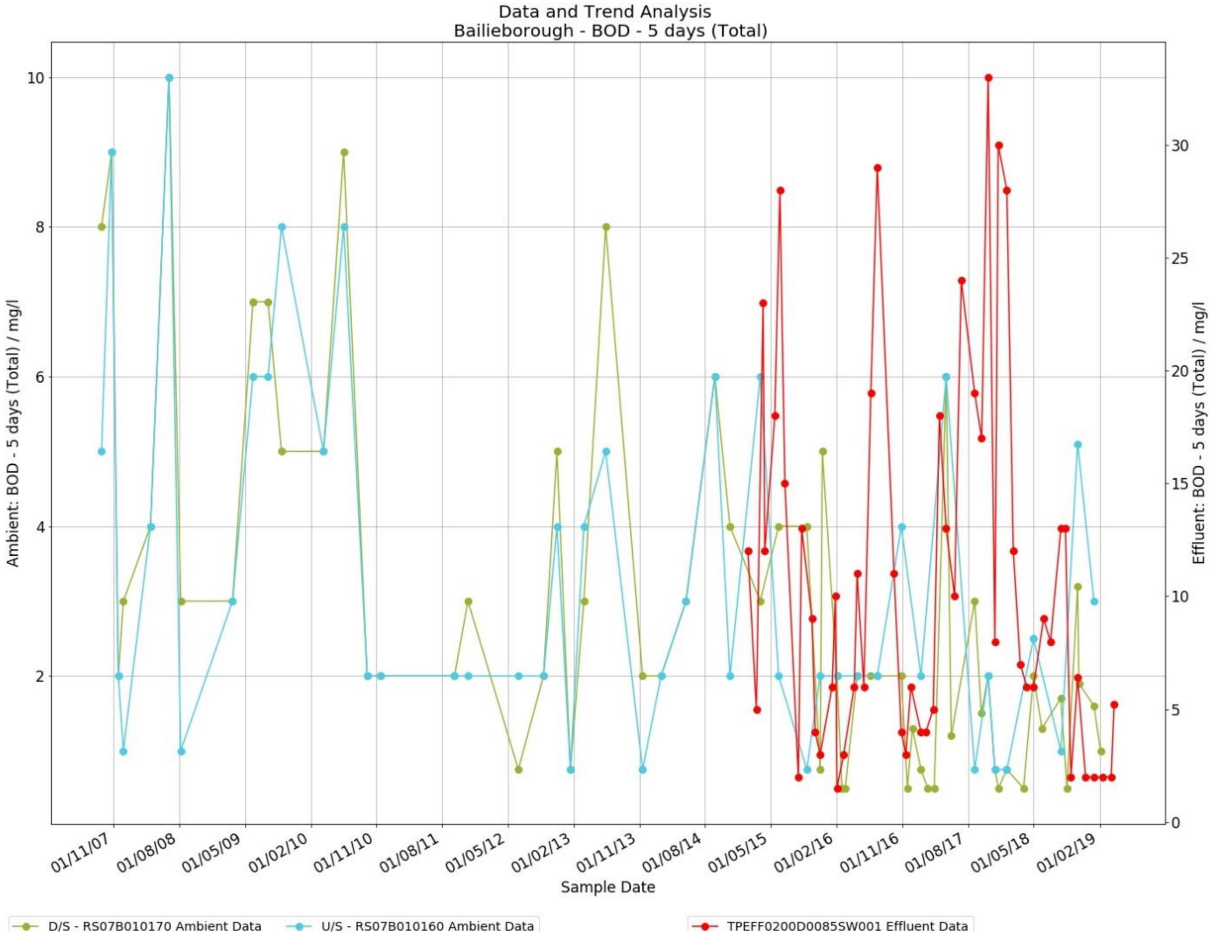

Figure 5.2: BOD Concentrations for Blackwater (Kells)_020 ambient monitoring stations and effluent data

5.4.2 Ammonia

Figure 5.3 plots ammonia concentrations at the ambient monitoring locations upstream and downstream of the Bailieborough WWTP primary discharge, with effluent ammonia concentrations also included on the graph for comparison.

Upstream ammonia concentrations are variable, with approximately 54% of samples above the mean EQS of 0.065mg/l, with the highest concentration noted in May 2014 of 4.125mg/l. These fluctuations would indicate a point pressure or event that is negatively influencing water quality at the upstream monitoring station.

In comparison, downstream data shows elevated concentrations of ammonia, with approximately 79% of samples exceeding the EQS. Due to the identified significant pressures of WWTP discharge point, network overflows and the urban area of Bailieborough, it is anticipated that ammonia concentrations would be higher at this monitoring point compared to upstream.

There is a clear correlation between downstream ammonia concentrations and effluent quality. This would suggest that Bailieborough agglomeration is impacting on the quality of Blackwater (Kells) _020.

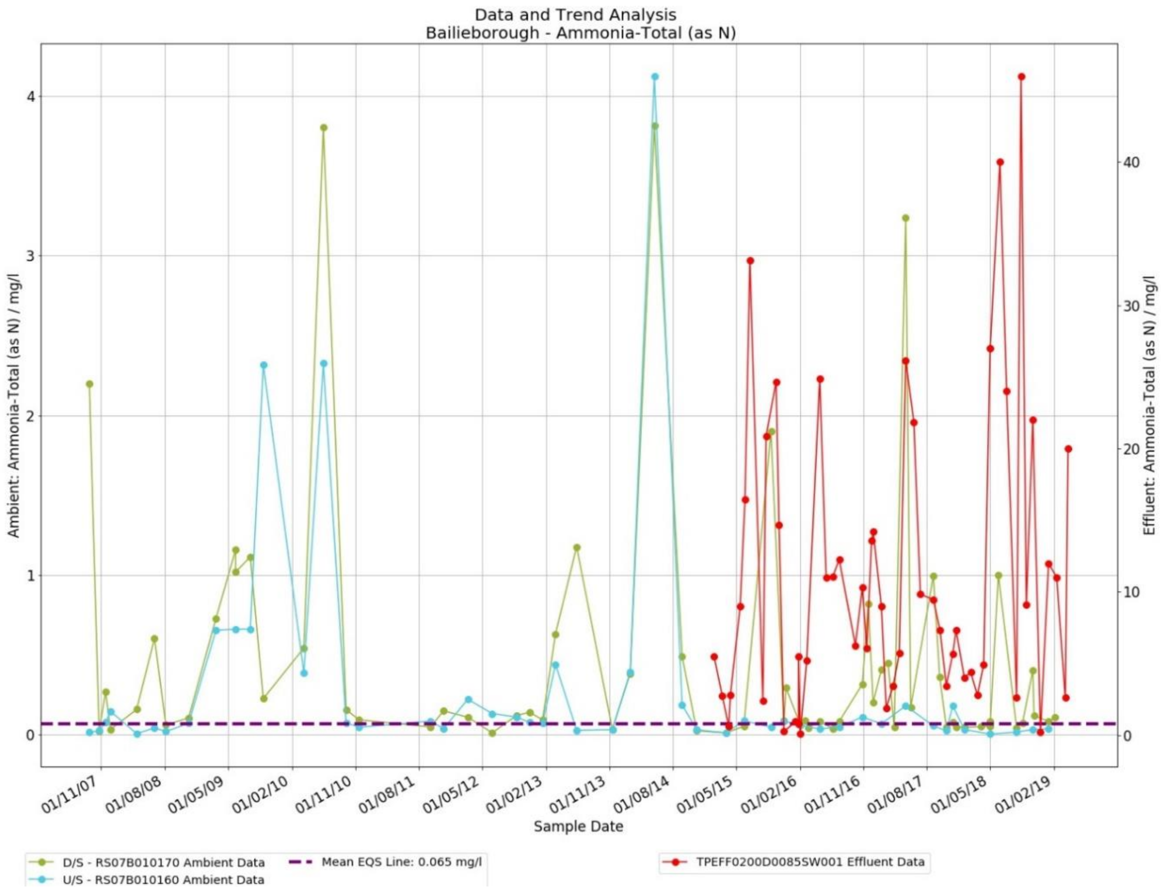

Figure 5.3: Ammonia Concentrations for Blackwater (Kells)_020 ambient monitoring stations and effluent data

5.4.3 Ortho-P

Figure 5.8 plots ortho-P concentrations at the ambient monitoring locations upstream and downstream of the Bailieborough WWTP, with effluent ortho-P concentrations also included on the graph for comparison.

Upstream data indicates an ortho-P issue in the upper reaches of Blackwater (Kells) _020 until 2011, however this appears to have improved in the period 2011-2019, where ortho-P concentrations mainly lie below the mean EQS of 0.035 mg/l. This indicates that a pressure on the upper reaches has been removed and is no longer acting on the water body. More recent data indicates infrequent fluctuations which may be attributable to point sources in the upper reaches of the water body. These fluctuations may be contributing to elevated concentrations at the downstream monitoring station.

At the downstream monitoring station, ortho-P levels are slightly elevated compared with the upstream monitoring point, with an increased number of samples exceeding the EQS.

There is a clear correlation between downstream water quality and effluent quality. This suggests that there is potential that Bailieborough agglomeration is acting as a significant pressure on Blackwater (Kells) _020, however there are additional potential pressures identified between monitoring point including network overflows from Bailieborough, urban run-off and agricultural land use.

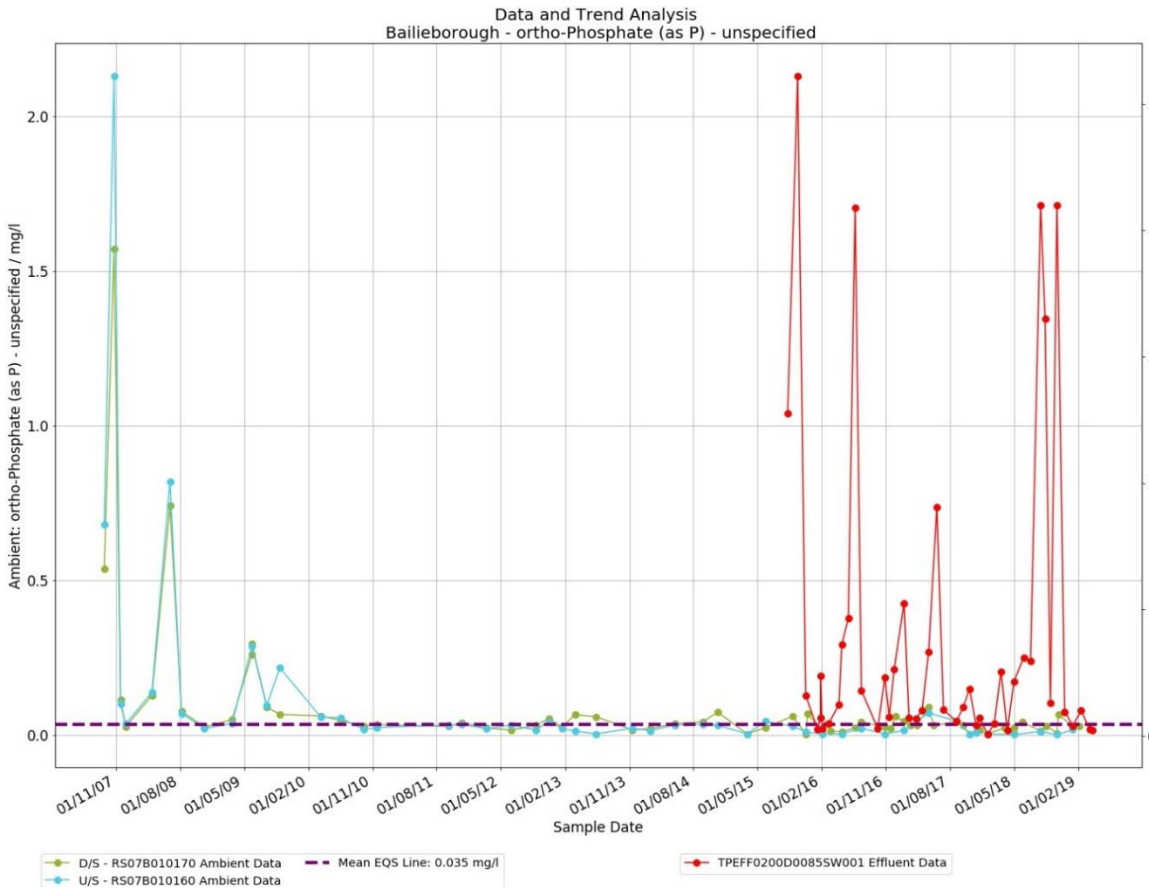

Figure 5.4: Ortho-P Concentrations for Blackwater (Kells)_020 ambient monitoring stations and effluent data

5.4.4 Comparison of BOD, ammonia and ortho-P trends

When comparing BOD, ammonia and ortho-P based on **Figure 5.5**, it is evident that there are similar trends experienced by all parameters, indicating the same source/ pressure is contributing to this. As the trends are in line with effluent data, this would suggest that Bailieborough agglomeration is impacting downstream concentrations of these parameters.

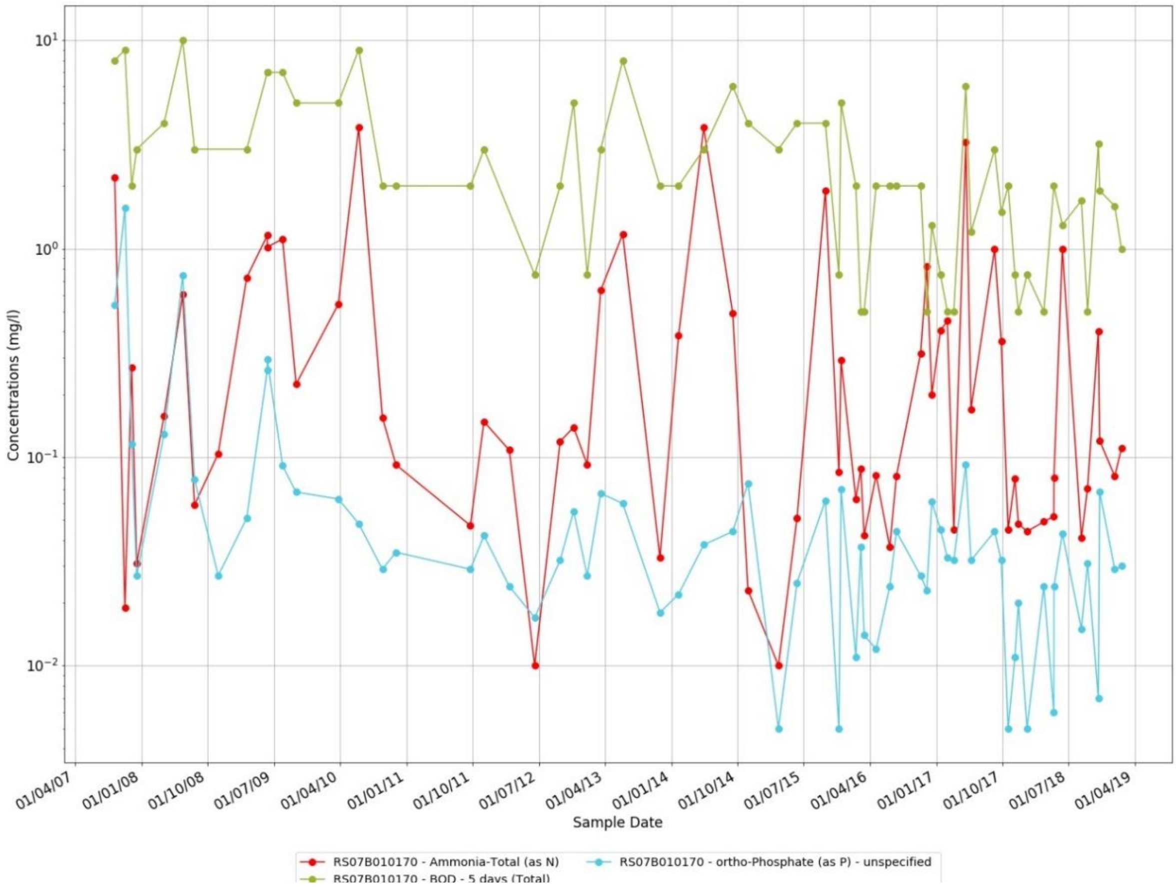

Figure 5.5: Comparison of BOD, ammonia and ortho-P at the downstream monitoring station

5.5 Biological Monitoring

Within the Blackwater (Kells) _020 river water body there are a number of monitoring stations, at some of which biological monitoring is undertaken, with the station locations are illustrated in **Figure 5.1**.

Table 5.2: Biological monitoring summary

Water body	Monitoring station	Conclusions drawn from available information
Blackwater (Kells)_010	RS07B010100	Consistently achieved 'good' biological status, with physico-chemical conditions indicating the ability to support 'good' status. Historically, biology has been at least 'good' status.
Blackwater (Kells) _020	RS07B010170	This monitoring station is downstream of WWTP discharge and industrial emission. Historically, this monitoring point was consistently at less than 'good' ecological status.
Blackwater (Kells) _030	RS07B010280	This location has consistently been at 'poor' status since 1990.

As Blackwater (Kells)_010 has consistently achieved a Q-value representative of ‘good’ status, it can be assumed that Q-values in Blackwater (Kells)_020 have not deteriorated as a result of upstream biological or ecological conditions.

STEP 5 SUMMARY

- Ambient monitoring data was available for the period 2007 to March 2019, and included biological and physico-chemical data.
- The analysis suggests that inputs from the Blackwater (Kells)_010 water body are not negatively impacting the status of the Blackwater (Kells)_020 water body in relation to nutrients.
- There is no physico-chemical information available for the Blackwater (Kells)_030 water body, and so it is not possible to assess the impact of the Bailieborough agglomeration on this water body, if any. However, the biological status would suggest that this water body is negatively impacted.
- The analysis indicates that the Bailieborough agglomeration may be impacting water quality in the Blackwater (Kells) _020 water body, based on the correlation identified between effluent quality and downstream ambient water quality.
- The analysis of key water body information indicates that the Bailieborough agglomeration may be impacting water quality due to increases in concentrations between the upstream and downstream monitoring points.
- The analysis indicates that the Bailieborough agglomeration is a significant pressure on the water body, but it may not be the sole significant pressure. Other pressures identified include: potential point source discharges from a storm water drainage network in an IED dairy facility, DWWTS and agricultural activities.

6 STEP 6 - AGGLOMERATION ASSESSMENT

This step identifies the reasons for the inclusion of agglomeration on the EPA's Priority Areas for Waste Water Improvements List (the PAL), it also details the WWTP's compliance from historic data and reporting.

6.1 Reason for Inclusion in the Priority Areas List (PAL)

A total of 57 no. of the sole significant urban waste water pressures have been added to the Priority Action List (PAL) by the EPA OEE. Table 6.1 lists the reasons for Bailieborough's inclusion on the PAL.

Table 6.1: Reasons for inclusion of Bailieborough on PAL

Reason for Inclusion on the PAL	Applicable to Bailieborough agglomeration?
Larger agglomeration which is non-compliant with the UWWTD: – An agglomeration requiring secondary treatment under Article 4 of the Directive – An agglomeration requiring more stringent treatment under Article 5 of the Directive	 ✗ ✗
Agglomeration is contributing to poor quality bathing waters	✗
Sole significant pressure on water body 'at risk' of not achieving WFD environmental objectives	✓
Agglomeration requires improvement to protect or improve habitat of the Freshwater Pearl Mussels	✗
Improvement needed to protect shellfish waters	✗
Network Improvements are needed	✗

6.2 Compliance

6.2.1 Capacity

A Waste Water Capacity Register has been developed by Irish Water to provide an indication of the available headroom (in terms of organic loads expressed as population equivalent (PE)) at WWTPs. The purpose is to support growth and development, in line with the national spatial planning policy, national housing policy and national rural development policy; without having a significant impact on the environment, specifically receiving water bodies and European sites.

The Bailieborough agglomeration is currently organically overloaded. The plant has a hydraulic design capacity of 1,900 m^3/day and a 2018 collected hydraulic loading of 956 m^3/day. Organically, the plant is overloaded by 211 PE, with a design capacity of 2,500 PE and a 2019 collected load of 2,711.

6.2.2 ELV Compliance Assessment

The purpose of the ELV compliance check is to understand the performance of the WWTP, establishing whether it is operating as designed.

The ELVs outlined in the WWDA licence are summarised in Table 6.2.

Table 6.2: ELVs for Bailieborough WWDA licence

	BOD	COD	TSS	Ortho-P	Ammonia
WWDL ELV (Schedule A)	6	125	25	0.15	0.3

The compliance of the WWTP for 2016, 2017 and 2018 is summarised in Table 6.3 based on compliance reporting provided by Irish Water. It should be noted that the plant was not designed to meet the current ELVs.ELV compliance at this plant has been costed but is not included in the 2017-2021 or 2020-2024 investment plans.

Table 6.3: Summary of compliance for Bailieborough agglomeration 2017-2018

Parameter	2017			2018		
	No. of Samples	No. ELV Breach	Compliance N (Number) Q (Quality)	No. of Samples	No. ELV Breach	Compliance N (Number) Q (Quality)
SS	12	1	PASS	12	0	PASS
COD	12	0	PASS	12	1	PASS
BOD	12	9	FAIL Q	12	8	FAIL Q
Ammonia	12	12	FAIL Q	12	11	FAIL Q
Ortho-P	12	7	FAIL Q	12	9	FAIL Q

ELV breaches can be due to changes to WWTP processes or operations, rather than to enduring issues with plant performance.

Bailieborough WWTP has been consistently non-compliant, and more frequently in breach of its ELVs set out in the WWDA licence for several parameters. From the effluent data there have been consistent breaches for BOD, ammonia and orthophosphate, with 8 out of 12 samples failing for BOD, 11 out of 12 samples failing for ammonia and 9 out of 12 samples failing for orthophosphate, respectively in 2018.

6.2.2.1 Annual Environmental Report

The latest AER (2018) notes that the WWTP is non-compliant with the ELVs set in the discharge licence. A total of 24 sample results exceeded the ELVs in relation to BOD, COD, suspended solids and ammonia. The report states that the cause of the exceedances is that the plant is not designed to achieve low levels of ammonia and that there is insufficient dosing for ferric removal and carryover from the clarifier.

The report states that the discharge from the works may be giving rise to a breach of EQS in the receiving water environment in relation to ammonia, regardless of WFD status. However, it also notes that there may be other unknown pollutant discharges to the culvert that the WWTP discharges into, given that this culvert receives other storm water drainage and a stream, prior to discharging into the Blackwater Kells River. There are also a number of issues with urban misconnections, DWWTSs, agricultural pressures and industrial discharges.

The plant was found to be organically overloaded but not hydraulically overloaded (+944 m^3/day). There is one recurring incident type, uncontrolled release, with one incident occurring in 2018This incident is closed.

6.2.2.2 EPA Inspectors Report

The latest EPA Inspector's Site Visit Report from August 2018 was undertaken to investigate a Category 2 incident (INCI014889 – uncontrolled release arising from sludge carry over from clarifier) and ongoing breaches of the specified ELVs.

The report states that there have been regular significant breaches of the ELVs for ammonia as well as BOD and orthophosphate. This has resulted in the EPA having an open Compliance Investigation (CI001181) in relation to upgrading the Bailieborough WWTP to ensure compliance with the ELVs set out in the WWDA licence.

The report notes the plant is overloaded. On the day of site visit, the discharge point of the plant into the Blackwater (Kells) appeared clear, with no evidence of any gross solids. However it appear that there was some sewage fungus immediately downstream, with the report stating the plant has been identified as the sole significant pressure on the Blackwater (Kells)_020 and is putting it 'at risk' of not achieving its WFD objectives.

The report concludes that Irish Water shall provide updates on progress on the improvement works implemented and planned in response to the actions raised under CI001181 and to update the incident notification record INCI009607 as appropriate.

6.2.2.3 Proposed Upgrade Works

In relation to condition 5.6.2 of the licence for Bailieborough agglomeration (D0085) (,Irish Water has determined based on available information and assessments carried out by, and on their behalf, that an upgrade of the treatment plant is the most appropriate measure for contributing to the achievement (or maintenance of) 'good' status in the receiving water.

The full upgrade of the treatment plant is scheduled in two Phases. Upgrade of the WWTP to achieve the ELVs set out in the WWDA constitutes Phase 2 of the proposed works in the Bailieborough agglomeration. While the Phase 2 works have been identified and costed, no funding is currently allocated to Phase 2 in the current (2017-2019) or coming (2020-2024) investment plan periods. However, this position is being kept under review by Irish Water due to the sole significant pressure status, and IW will seek to progress Phase 2 works at the appropriate interval.

In the interim, Phase 1 works are being progressed and comprise WWTP plant upgrade works to achieve a minimum discharge standard of 25 mg BOD/l, 35 mg SS/l and 125mg COD/l. Although the Phase 1 upgrade is not designed for nutrient removal, it is expected to achieve an increased level of nitrification and phosphorus removal when compared to the capabilities of the existing WWTP. Phase 1 works are currently scheduled for completion in 2024.Mass Balance Inputs

6.2.2.4 Mass Balance Inputs

The outlier detection and step change analysis showed two notable or identifiable outliers during the record period, which were omitted for the purposes of the inputs into the mass balance calculations.

STEP 6 SUMMARY

- The Bailieborough WWTP is organically overloaded, but not hydraulically overloaded.
- There have been recurring ELV breaches for ammonia, BOD and orthophosphate over the monitored period of 2017-2018.
- The EPA have an open Compliance Investigation (CI001181) for Bailieborough WWTP to ensure optimisation/improvement/upgrade works at the plant to allow the compliance with the ELVs set out in the waste water discharge. Irish Water has notified the EPA of the proposed approach to the upgrade of the WWTP on a phased basis.

7 STEP 7 - MASS BALANCE

Mixing of a discharge with a river is described by the mass balance equation. It calculates the resultant concentration in the receiving water following the addition of a discharge and is the preferred method of determining the impact on the receiving water as it accounts for the volume of flow in the discharge.

Mass balance calculations have been undertaken for the following parameters:

- Orthophosphate;
- Total ammonia; and
- Biological Oxygen Demand (BOD).

These parameters are some of the key nutrients and quality indicators in relation to WWTP discharges, and all have environmental quality standards (EQSs) or threshold values defined in the 2009 European Communities Environmental Objectives (Surface Water) Regulations[9] and/or the EPA's WFD App.

7.1 Methodology

The concentration of a contaminant downstream of a discharge is calculated by multiplying the discharge flow by the parameter concentration, adding the resulting load to the upstream background load, and dividing the result by the flow in the receiving water. These concentrations can be compared to EQSs to determine the impact of the discharge on the receiving water.

The mass balance formula is:

$$\text{Mass Balance} = T = \frac{FC + fc}{F}$$

Where:

T = resultant concentration of contaminant downstream of the discharge

F = flow in the receiving water upstream of the discharge (m^3/day) (*established from existing EPA flow records & hydrometric data presented via the EPA Hydrotool*)

C = concentration of contaminant in the receiving water upstream of the discharge (mg/l) *(calculated from existing ambient monitoring reported in water quality monitoring information available from existing EPA monitoring programmes)*

f = Effluent discharge rate (m^3/day)

c = concentration of the contaminant in the effluent discharge (mg/l) *(calculated from the effluent monitoring data for the discharge)*

[9] European Communities Environmental Objectives (Surface Waters) Regulations 2009

Mass balance calculations were undertaken for a number of scenarios to include different flows and background concentrations in assessing the impact of the discharge. This approach was taken to establish the potential impact at different flow conditions when compared against the appropriate EQS, i.e. mean flows were assessed against the mean EQS for each parameters and the 95 percentile flows were assessed against the 95 percentile EQS. When setting discharge ELVs it is best practice to base the calculation of the emission limit value on the 95%ile EQS at the 95 %ile flows in a water body[10].

Alternative background concentrations were used when the upstream concentrations were not consistent with the physico-chemical supporting conditions required for 'good' ecological status to allow the impact of the discharge to be assessed in the absence of significant pressures causing water quality issues upstream. The impact of the discharge is therefore assessed separately from impacts in the upstream catchment. This is consistent with the approach recommended in the guidance, procedures and training on the licensing of discharges to surface waters and to sewer for Local Authorities[10].

The mass balance assessment was undertaken after the data quality checks outlined in Section 1 were completed.

The scenarios include:

1. An assessment of the 95%ile flow (i.e. low flow conditions) for the receiving waters against the background concentration from the upstream monitoring point compared against the 95%ile environmental quality standards.
2. An assessment of the 95%ile flow for the receiving waters against notionally clean conditions compared against the 95%ile environmental quality standards.

   Note - the notionally clean river approach is used exclusively for municipal waste water discharges. If conditions in the river upstream of the discharge are already failing to meet the 'good' status target then, regardless of how well treated the effluent is, the target environmental quality standard cannot be met. Therefore in such instances it is necessary to separate the effect of a discharge from impacts in the upstream catchment and to assess the impact of the discharge on the assumption that upstream is meeting the 'good' quality status. Other measures are required to address other pollutant sources to ensure that the receiving water upstream of the WWTP achieves 'good' status under the Water Framework Directive.

3. An assessment the 95%ile flow for the receiving waters against an adjusted background concentration where the upstream water quality conditions are not achieving the EQS (based on the mid-point within the 'good' status band for the relevant parameter) compared against the 95%ile environmental quality standards
4. As scenario 1 but using mean flows
5. As scenario 2 but using mean flows
6. As scenario 3 but using mean flows

[10] Guidance, Procedures and Training on the Licensing of Discharges to Surface Waters and to Sewer for Local Authorities, WSNTG, 2011

Table 7.1: Data used for mass balance calculations

	Scenario 1	Scenario 2	Scenario 3
Flow of Receiving Waters (F)	95%ile	95%ile	95%ile;
Background concentration (C)	U/S background concentration	Notionally clean conditions	Adjusted U/S background concentration not achieving EQS
EQS	95%ile EQS	95%ile EQS	95%ile EQS
	Scenario 4	**Scenario 5**	**Scenario 6**
Flow of Receiving Waters (F)	Mean Flows	Mean Flows	Mean Flows
Background concentration (C)	U/S background concentration	Notionally clean conditions	Adjusted U/S background concentration not achieving EQS
EQS	Mean EQS	Mean EQS	Mean EQS

Note – effluent flow and quality remain consistent across all scenarios assessed

7.2 Results

The results of the mass balance calculations for the six scenarios outlined above are presented in **Table 7.2** and Figures 7.1 to Figure 7.3.

Table 7.2: Results of the Mass Balance Assessments

	Assessment 1		Assessment 2		Assessment 3		
Parameter	Existing B/ground (mg/l)	Resultant Conc. (mg/l)	Notionally clean (mg/l)	Resultant Conc. (mg/l)	Adjusted conc. (mg/l)	Resultant Conc (mg/l)	EQS (mg/l)
95 %ile flows							
BOD	1.363	4.337	0.260	3.609	1.400	4.362	2.200
Ortho-P	0.015	0.292	0.005	0.285	0.030	0.302	0.045
Ammonia	0.061	3.808	0.008	3.773	0.0525	3.802	0.090

	Assessment 4		Assessment 5		Assessment 6			
Parameter	Existing B/ground (mg/l)	Resultant Conc (mg/l)	Notionally clean conditions (mg/l)	Resultant Conc (mg/l)	Adjusted B/ground conc (mg/l)	Resultant Conc (mg/l)	EQS (mg/l)	Existing D/S mean conc
Mean Flows								
BOD	1.363	1.684	0.260	0.622	1.400	1.720	1.500	1.565
Orthophosphate	0.015	0.045	0.005	0.035	0.030	0.059	0.025	0.042
Ammonia	0.061	0.466	0.008	0.415	0.0525	0.458	0.040	0.345

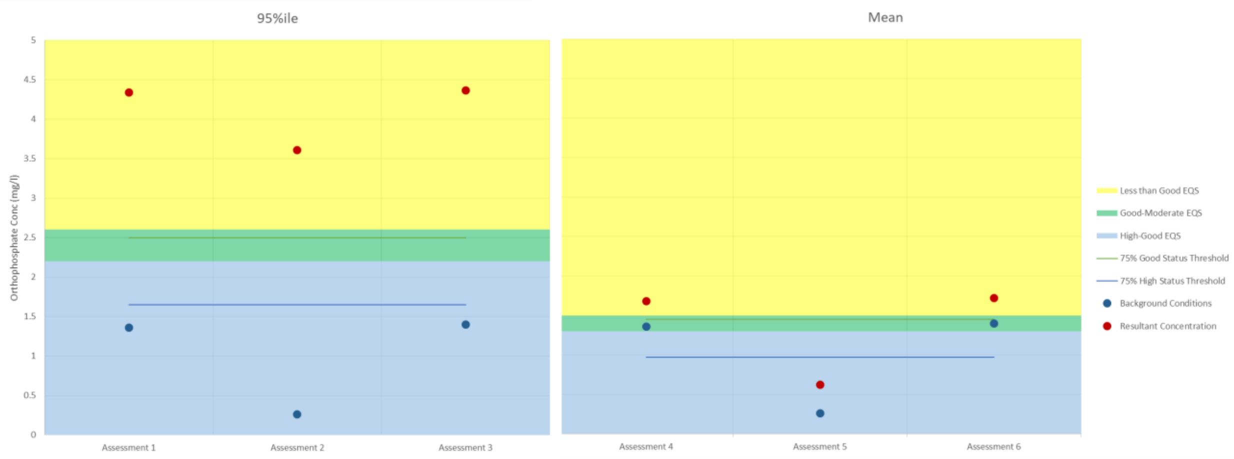

Figure 7.1 Mass balance assessments BOD (incl. background concentrations and EQS)

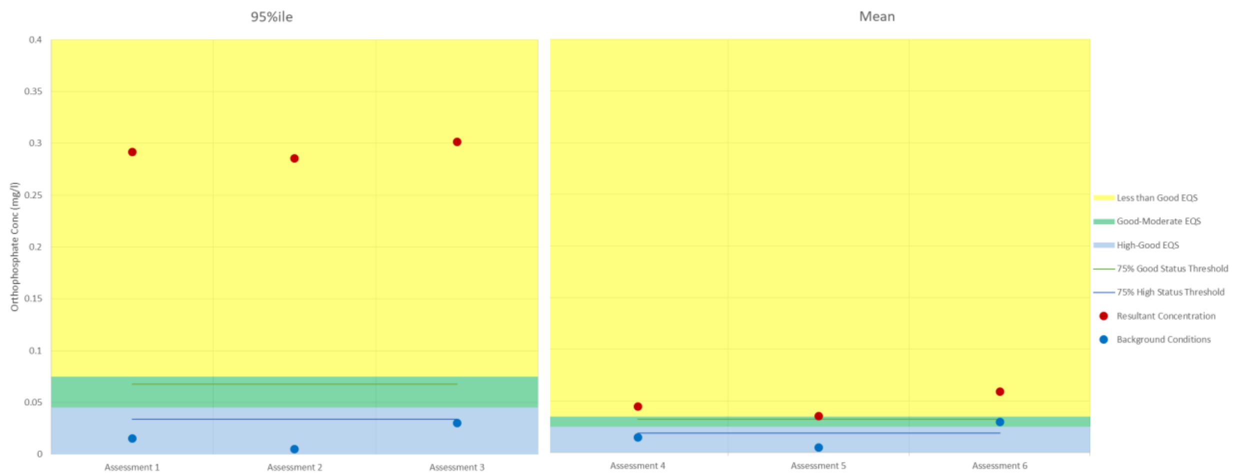

Figure 7.2 Mass balance assessments orthophosphate (incl. background concentrations and EQS)

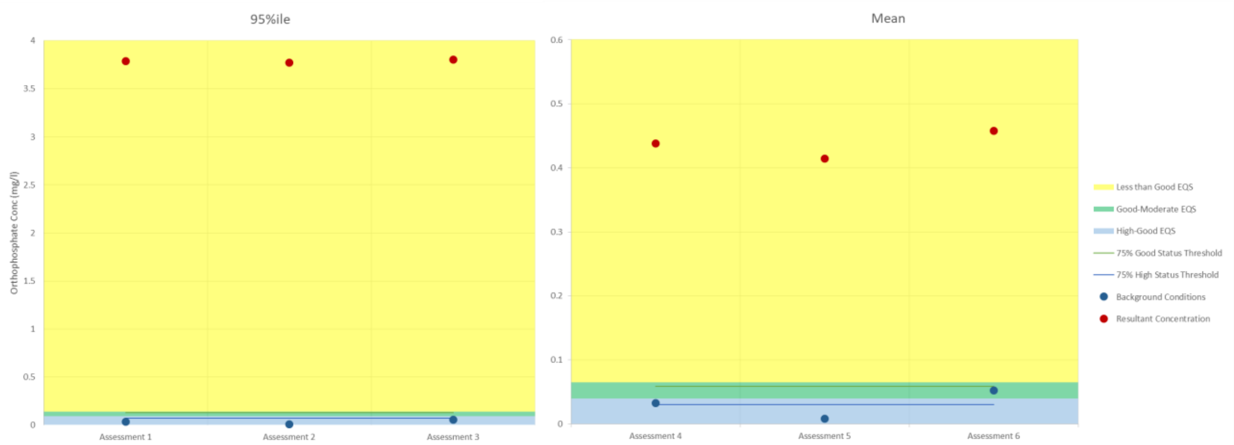

Figure 7.3 Mass balance assessments ammonia (incl. background concentrations and EQS)

The existing background concentrations are below the EQS for ‘good’ status for all parameters. This indicates that any pressures above the upstream monitoring station are not impacting the supporting physico-chemical elements of the water body.

The mass balance assessment demonstrates that receiving waters experience a deterioration in status for the key parameters in all scenarios, reducing indicative quality from ‘high’ or ‘good’ to less than good in all low flow scenarios. The discharge results in a deterioration in physico chemical supporting conditions from ‘high’ to ‘less than good’ based on existing background concentration for ortho-P and a deterioration from ‘good’ to less than good in the case of BOD and ammonia. Even in notionally clean conditions, with the exception of BOD at mean flows, the discharge is causing a deterioration in the status of physico-chemical supporting conditions, which suggests that the agglomeration is having a significant impact on the water body.

The mean concentrations for each parameter at the downstream monitoring station (which is near the downstream extent of the water body) are similar, if not lower than the concentration calculated just downstream of the discharge which suggests that there are no other pressures significantly impacting on the quality of the water body between monitoring points. Therefore it is likely that the Bailieborough agglomeration is a significant pressure impacting Blackwater (Kells)_020 water body.

The mass balance calculations demonstrate that the WWTP discharge is impacting the supporting physico-chemical conditions in the Blackwater (Kells)_020 water body, and it is likely that these impacts are contributing to this water body being ‘at risk’ of not achieving its environmental objectives.

7.3 Assessment of Emission Limit Value

If the existing discharge were compliant with its current ELVs as presented in Table 7.3, and the mass balance assessment was undertaken for the 95%ile flows at the 95%ile environmental quality standard, the impact of the discharge would still result in a failure in the 95%ile EQS for all parameters. Whilst ortho-P resultant concentrations would be consistent with the EQS for ‘good’ status downstream of the discharge the background concentration is currently at ‘high’ which means a deterioration is experienced. BOD degrades from ‘high’ 95%ile EQS to ‘less than good’ with an assumed effluent equal to the ELV limit. This is due to the very low flows and assimilative capacity in the receiving water.

A 25% reduction in the ELV for BOD (4.5 mg/l) would be required in order to ensure the 75% threshold of the ‘good’ status 95%ile EQS is not exceeded downstream of the discharge.

A 16% reduction in the ELV for ammonia (0.25mg/l) would be required in order to ensure the 75% threshold of the ‘good’ status 95%ile EQS is not exceeded downstream of the discharge.

A 53% reduction in the ELV for ortho-P (0.07mg/l) would be required in order to ensure the 75% threshold of the ‘high’ status 95%ile EQS is not exceeded downstream of the discharge.

It should be noted however that the above reductions for ammonia and ortho-P still result in more than the recommended 25% of the headroom within the water body utilised by the agglomeration. To achieve a headroom utilisation percentage of less than 25% the ELVs would need to be set at 0.11mg/l and 0.059mg/l for ammonia and ortho-P respectively.

Table 7.3: Assessment of ELV adequacy

ELV Assessment			
Parameter	**Existing B/ground (mg/l)**	**Resultant Conc. (mg/l)**	**EQS* 95%ile (mg/l)**
BOD	1.363	2.938	2.6
Ortho-P	0.015	0.061	0.045
Ammonia	0.033	0.123	0.14

**EQS for conditions consistent with 'high' status*

STEP 7 - SUMMARY

- The mass balance calculations demonstrate that the Bailieborough agglomeration is impacting water quality in the Blackwater (Kells)_020 water body, even in the notionally clean scenarios, and therefore the Bailieborough agglomeration can be considered a significant pressure.
- Measured background concentrations at the upstream ambient monitoring location indicate that the water quality in the Blackwater (Kells)_020 water body upstream of the agglomeration is not impacted. This indicates that the agglomeration is a significant pressure on this water body.
- Comparison of the calculated downstream concentrations with the measured downstream concentrations indicate that there are no pressures additional to the WWTP impacting the water body in the reach between the point of discharge and the downstream monitoring station. This indicates that the agglomeration is the sole significant pressure on this water body.
- The ELVs are not adequate even if they could be achieved. The assessment indicates that a significant reduction in all ELVs is required to result in no risk of deterioration in status and an acceptable portion of the assimilative capacity being used by the Bailieborough primary discharge.

8 STEP 8 - FURTHER DETAILED ASSESSMENT

The desktop-based assessment has been carried out (i.e. Steps 1 to 7). It has demonstrated that Bailieborough agglomeration is a significant pressure, and possibly a sole significant pressure. The data quality checks as part of Step 1 and detailed calculations produced robust determinations, with high confidence in the outputs of each step, as summarised in Table 8.2.

If Steps 1 to 7 have not provided adequate evidence that an agglomeration is a significant pressure, or a sole significant pressure, a further detailed assessment (Step 8) may be required in order to make these determinations. Further assessment categories are described in Table 8.1**Error! Reference source not ound.**.

Table 8.1: Further Detailed Assessment Categories

Further Detailed Assessment Categories	
A	Full scoping of further detailed assessment work required to achieve the aims of the overall assessment.
B	Visual assessment in relation to a discharge point in line with EPA CSMU Guidance on Further Characterisation for Local Catchment Assessments; including undertaking a stream walk, taking field notes, preparing a succinct summary and interpreting results for use in the assessments.
C	Monitoring of biological indicators upstream and downstream of a discharge point and interpreting results for use in the assessments.
D	Monitoring of physico-chemical indicators upstream and downstream of a discharge point and interpreting results for use in the assessments.
E	Taking water samples upstream and downstream of a discharge point and arranging analysis in an accredited laboratory for physicochemical parameters and interpreting results for use in the assessments.
F	Subcatchment scale modelling exercise using platforms such as SAGIS-SIMCAT or similar (to be approved by Irish Water); and interpretation of results for use in the assessments.

Table 8.2: Summary of Data Issues

Step	Data Confidence Issues	Data Gaps
1	No issues	No issues
2	No issues	No issues
3	No issues	No issues
4	No issues	No issues
5	Time series analysis of ammonia data indicates that there are some pressure upstream however background concentrations are consistent with 'good' biological conditions upstream	The overall conditions upstream of the agglomeration are consistent with good status, although there are some upstream pressures they are unlikely to be significant
6	No issues	No issues
7	No issues	No issues

STEP 8 - SUMMARY

Investigations have established that the Bailieborough agglomeration is a significant pressure in the Blackwater (Kells)_020 water body. The upstream water quality is generally good and whilst there are pressures in the upper catchment they are unlikely to impact on the water body's ability to achieve its environmental objectives. No further data collection is therefore required.

9 STEP 9 - OVERALL CONCLUSIONS AND DETERMINATIONS

The final step draws together the findings of the preceding steps to draw overall conclusions for the agglomeration based on a weight-of-evidence approach. These conclusions and determinations are presented on a water body basis for each water body where urban waste water was identified as a sole significant pressure. Table 9.1 presents the overall conclusions and determinations of the assessment.

Table 9.1: Overall conclusions and determinations

Water Body: Blackwater(Kells)_020	
Significant pressure Is the agglomeration a significant pressure i.e. is it causing water quality issues?	Yes
Sole significant pressure Is the agglomeration a sole significant pressure i.e. is urban waste water the only pressure category causing water quality issues?	Yes
Is the agglomeration causing water quality issues that, in the absence of other pressures, would result in the water body failing to achieve its environmental objectives?	Yes

- The Bailieborough agglomeration currently provides tertiary treatment and P removal. It is currently organically overloaded, collecting 2,711 PE while the plant has a design capacity of 2500 PE. Bailieborough WWTP has one primary discharge and four SWOs, which discharge to a culverted stream within the Blackwater (Kells)_020 river water body. This water body is considered 'at risk' of not meeting its environmental objectives and is at 'moderate' ecological status (2010-2015).

- The four SWOs are reported in the SWO Programme as meeting the requirements of the DoE's (1995) '*Procedures and Criteria in relation to Storm Water Overflows'.* However, SWO02 was found in the 2016 AER to be non-compliant in terms of storm tank volume with a required storage tank volume of $284m^3$ and an actual storage tank volume of $80m^3$. This was noted as a recommended improvement and will be addressed in the phase 1 upgrade works proposed for the WWTP.

- A Stage 1 Appropriate Assessment Screening was undertaken for the agglomeration by the EPA in June 2015 during the licensing process. The report concluded that the agglomeration was not impacting, alone or in combination with other projects, the downstream European sites of interest. This was concluded due to the 26km distance between the primary discharge and the European sites.

- The Bailieborough agglomeration is located within the Blackwater (Kells)_SC_010 subcatchment. Blackwater (Kells)_010 to Blackwater (Kells)_030 water bodies are noted to be adjacent to areas where near surface pathways have high susceptibility to phosphates, according to available soils and subsoils information. There is potential for diffuse pressures to impact on the water bodies, with high potential areas coinciding with areas of agricultural land use.

- The load quantification analysis indicates that the Bailieborough WWTP may be a significant pressure in the Blackwater (Kells)_020 water body.

- The correlation identified between effluent quality and downstream ambient water quality suggests that the agglomeration may be impacting water quality in the Blackwater (Kells)_020 water body.

- The analysis of key water body information indicates that the Bailieborough agglomeration may be impacting water quality in the Blackwater (Kells)_020 water body due to increases in nutrient concentrations between the upstream and downstream monitoring points.
- The analysis indicates that the Bailieborough agglomeration is a significant pressure on the water body, but other potential pressures identified in the area include: potential storm water discharges from an IED Facility, DWWTS and agricultural activities.
- The EPA have an open Compliance Investigation (CI001181) for Bailieborough WWTP to ensure optimisation/improvement/upgrade works at the plant to allow the compliance with the ELVs set out in the waste water discharge. Irish Water has notified the EPA of the proposed approach to the upgrade of the WWTP.
- The mass balance calculations demonstrate that the Bailieborough agglomeration is impacting water quality in the Blackwater (Kells)_020 water body, even in the notionally clean scenarios, and therefore the Bailieborough agglomeration can be considered a significant pressure.
- Measured background concentrations at the upstream ambient monitoring location indicate that there are no significant pressures upstream of the agglomeration affecting water quality in the Blackwater (Kells)_020 water body. This indicates that the agglomeration is potentially the sole significant pressure on this water body.
- Comparison of the calculated downstream concentrations with the measured downstream concentrations indicate that there are no pressures additional to the WWTP impacting the water body in the reach between the point of discharge and the downstream monitoring station. This indicates that the agglomeration is the sole significant pressure on this water body.

STEP 9 - SUMMARY

The Bailieborough agglomeration is a significant pressure on the Blackwater (Kells)_020 water body causing water quality issues. It is also likely to be the sole significant pressure. Other pressures upstream of the agglomeration include point source dischrges from the storm network associated with the IED licensed facility and agriculture within areas of land with high susceptibility to phosphates, however these are not significant given that upstream pressures are not impacting significantly impacting on the water body's ability to achieve its environmental objectives.

Appendix A

Data Collection Summary

Date received	Organisation Received from	Data owner	File name as received	Description	Bailieborough
24/08/2017	Irish Water	Irish Water	CoA data _22_08_2017_For Upload	Summary information for certified agglomerations	N/A
20/11/2018	Irish Water	Irish Water	IW-AM-ES-DWRA-20181116	WWDA Drinking Water Risk Assessment – methodology document and example scoresheet	N/A
20/11/2018	Irish Water	Irish Water	DWRA Official Scoresheet_20181120	WWDA Drinking Water Risk Assessment – example scoresheet	N/A
20/11/2018	Irish Water	Irish Water	IW-AM-ES-CapRegAssessment-20180831	Capacity Register assessment document – includes an assessment of impact on receiving water quality	According to the CoA (Certificate of Authorisation) (2017) No Headroom Available (2017 AER). Project underway and due completion 2024.

Date received	Organisation Received from	Data owner	File name as received	Description	Bailieborough
20/11/2018	Irish Water	EPA	National Surface Water Characterisation Spreadsheet 06122017 (full)	National Characterisation Spreadsheet	Blackwater (Kells)_020 is considered to be at risk (2010-2015) moderate ecological status.
20/11/2018	Irish Water	EPA	National WRAA 11-09-17_Regions_2018priorities_20181108	Priority Areas for Action indicating where sole pressures are located in PAAs (also includes RBMP Appendix 1 information) (National WRAA…)	Blackwater (Kells)_020 NOT identified as Area for Action.
20/11/2018	Irish Water	EPA	HES_Objectives_Feb 2018	National High Ecological Status objective	N/A
20/11/2018	Irish Water	EPA	PAs_Deter_WBs_10_11_17_EDITED 8-2-2018_queried	Priority water bodies	Blackwater (Kells)_020 identified as Area for Action. (Pressure: UWW)

Date received	Organisation Received from	Data owner	File name as received	Description	Bailieborough
20/11/2018	Irish Water	Irish Water	UWW_Final_Pressure_List_24_10_17_queried	Urban waste water significant pressures spreadsheet	Elevated total ammonia and orthophosphate concentrations noted downstream of the discharge point. Recurring total ammonia, orthophosphate and BOD ELV breaches noted at the WWTP. CIs: I refer to your licence (Reg. No. D0085-01) and Compliance Investigation CI001181 including your response of 05/01/2018 to CI Action A017546. As you are aware the Bailieborough agglomeration has been placed on the Agency's national priority action list for waste water having been identified under the Water Framework Directive characterisation process as a sole pressure on a water body at risk of not meeting environmental objectives. The onus is on Irish Water to comply with the requirements of licence Reg. No. D0085-01). Please provide an update by 30/06/2018 on progress regarding examination of options for the upgrade of the agglomeration including the report required under Condition 5.6 of your licence.

Date received	Organisation Received from	Data owner	File name as received	Description	Bailieborough
20/11/2018	Irish Water	Irish Water	Priority Area List Q2 2018_IW Update	Priority Action List (PAL) information i.e. the reason(s) why the EPA consider the agglomerations to be priority agglomerations for action	Likely cause - not determined. NOT a candidate for the next investment. Cause of pressure/solution under assessment.

Date received	Organisation Received from	Data owner	File name as received	Description	Bailieborough
	Irish Water	Irish Water	Q3 2018 Update Including EDEN responses	Compliance investigation ss	An IG was formed in 2017 for the Bailieborough plant and Process Ops recommendations as listed hereunder have all been completed. • Consideration may be required in relation to replacing the existing belt press with a double belt unit similar to Virginia WWTP to achieve dryer sludge and reduction of operation hours. • Reconfigure composite sampler location for discharge effluent, to sample prior to the Upward Flow Clarifier as part of experimental works to improve discharge effluent quality. • A DO profile of the aeration basin to be carried out • Inlet Flow meter to be calibrated immediately for accurate daily flow measurement. • Adjustment of DO probe position in the aeration tank to provide accurate and reliable measurement of DO mg/l. • The Aeration tank to be emptied and all excess sludge and solids removed to allow the full capacity of the tank to be used and promote compliance. • A DO profile of the aeration basin to be carried out. • Compliance improvements: Sampling before & after UFC to ascertain UFC performance - analysis of ammonia, SS, COD where possible. • Import Sludge monitoring using IW template for logging all sludge import details. • Review of on-site monitoring being undertaken: Daily cone test at present. Require daily cone, MLSS, SVI. • MLSS probe calibration & training for caretaker. • Calibration of Ferric Dosing pumps to achieve compliance with ELV for Ortho-P. • Review of requirement for trouble-shooting procedures on site (SSOPs). • Ensure that calibration and maintenance schedules are in place. • Compliance improvements: Re-sampling before aeration tank & after primary clarifier to ensure performance maintained - analysis of ammonia, SS, COD where possible. • Process Control Manual

Date received	Organisation Received from	Data owner	File name as received	Description	Bailieborough
20/11/2018	Irish Water	Irish Water	2016_Article_17_report_for_upload	UWWTD Article 17 report	N/A
28/11/2018	Irish Water	Irish Water	Significant Pressure Monitoring Data	Significant Pressure Monitoring Data	No Influent & Effluent Data Available
21/11/2018	Irish Water	Irish Water	Limnos Assessment Tracker	Limnos Assessment Tracker	N/A
21/11/2018	Irish Water	Irish Water	2017 AER Data Collector - cleansed MH	AER Data Collector	The WWTP was non-compliant with the ELV's set in the wastewater discharge licence.

Date received	Organisation Received from	Data owner	File name as received	Description	Bailieborough
22/11/2018	Irish Water	Irish Water	211118 Surface Water Yield Assessment	Surface Water Yield Assessment	0200PUB0102 included in Assessment
21/11/2018	Irish Water	Irish Water	IW_EPA_SW Methodology 091216 for IW presentation	Irish Water National Water Resources Plan	
22/11/2018	Irish Water	Irish Water	FPM ES Report Tracker 2018	FPM Ecological Statement Report	Bailieborough not located in FPM catchment -N/A
28/11/2018	Irish Water	Irish Water	Ambient Mon Locations 63	Monitoring locations	Bailieborough data from monitoring stations available.
07/12/2018	RPS Galway	RPS	NCAP Reports Priority 1.zip	Site Assessment report for 7 agglomerations (CoA) on NCAP Programme	NCAP Report NOT Completed for Bailieborough
07/12/2018	RPS Galway	RPS	Small Stream Risk Score for 7 WWTP and their associated discharges	Small Stream Risk Score for 7 WWTP and their associated discharges	N/A
18/12/2018	Irish Water	Irish Water	IW_Agglomerations_141218	Shapefile with boundaries of agglomerations	boundary included
17/12/2018	Irish Water	Irish Water	WFD_Chemistry_Monitoring_17122018_Donegal	WFD Monitoring Data	Bailieborough monitoring stations included.

Date received	Organisation Received from	Data owner	File name as received	Description	Bailieborough
14/12/2018	Irish Water	Irish Water	CSO Outfall Field Inspection - Entries (Rev 6) - to SFPA.xlsx	· A spreadsheet outlining the information that will be collected in the field using the SWO Visual Assessment App (this is still draft but is unlikely to change much). I have copied some text below to put some context to this.	Information that will be collected but has not yet been captured
14/12/2018	Irish Water	Irish Water	Annex 1 - EPA correspondence of 8 November 2016.pdf	· A PDF document of an EPA report on a review of nutrient sensitive areas as required by the UWWTD. As mention in the workshop on Tuesday, Irish Water do not agree with all aspects of this report.	N/A

Date received	Organisation Received from	Data owner	File name as received	Description	Bailieborough
14/12/2018	Irish Water	Irish Water	Loads Template v11 20170405	Information on loads (existing and projected) issues to the EPA CSMU to assist them in their initial characterisation work.	N/A
17/12/2018	Irish Water	Irish Water	20181126-DAP Progress	List of agglomerations in our DAP programme. DAP outputs are on the SPA Alfresco Cloud site.	N/A - Bailieborough not included in the assessment
17/12/2018	Irish Water	Irish Water	IW-AM-ES-SPAAggloms	63 aggloms in the SPA project with extra columns of info attached for: whether the agglomeration is included in the telemetry programme; whether the aggloms has (or will get) event duration monitors (EDMs).	Bailieborough not scheduled for inclusion in either monitoring programme

Date received	Organisation Received from	Data owner	File name as received	Description	Bailieborough
18/12/2018	Irish Water	Irish Water	IW-AM-ES-SPAAggloms	63 agglomerations with a new column indicating which agglomerations are contained with existing/planned model domains	As Above
18/12/2018	EPA	EPA	http://www.epa.ie/QValue/webusers/	Hyperlink to Q values	Bailieborough included
18/12/2018	Irish Water	Irish Water	Q4 2018 PAL IW Update_SPs	Q4 2018 PAL update attached for sole pressure agglomerations (only 57 of the 63 sole pressure agglomerations are included on the PAL).	Bailieborough still classified as Sole Pressure in this dataset
20/12/2018	Irish Water	Irish Water	Shellfish Tracker for 2018 AERs_SPA aggloms	Info in relation to the disinfection programme attached	N/A

Date received	Organisation Received from	Data owner	File name as received	Description	Bailieborough
20/12/2018	Irish Water	Irish Water	Shellfish_LSR_SourceMapper_SPA aggloms	Info in relation to the disinfection programme attached	N/A

Date received	Organisation Received from	Data owner	File name as received	Description	Bailieborough
20/12/2018	Irish Water	Irish Water	IW-AM-ES-SPAAggloms_20181220v2	Update of overall list on Project status	Planning and assessment stage.
21/12/2018	Irish Water	Irish Water	Sole Pressure Sites - BOD Data	BOD data for the sole pressure aggloms	BOD data available for Bailieborough
21/12/2018	Irish Water	Irish Water	Ww Disinfection Shellfish Tracker_SP	information on the disinfection programme	N/A
21/12/2018	Irish Water	Irish Water	20745 - Prioritisation Matrix_SP	information on the disinfection programme	N/A
21/12/2018	Irish Water	Irish Water	20745 SAR - Conclusions	information on the disinfection programme	N/A
24/12/2018	Irish Water	Irish Water	Proposed Interim Generated Load Methodology IW 20161128 v5.2	Interim load methodology document. The methodology is currently under revision, due to be complete by end Jan 2019	Bailieborough NOT included in the Pilot Study
24/01/2019	Irish Water	Irish Water	NCAP Report_H2_2018.xlsx	BOD data for the sole pressure cert sites (CoA) aggloms (<500 PE)	N/A
30/01/2019	Irish Water	Irish Water	Regulatory_Influent_Effluent2018	2018 influent and effluent regulatory data	Data available for Bailieborough

Date received	Organisation Received from	Data owner	File name as received	Description	Bailieborough
04/02/2019	Irish Water	Irish Water	Cert Sites 2016-2018	Available effluent monitoring for CoA sites for 2016 - 2018	N/A
05/02/2019	Irish Water	Irish Water	IW-AM-ES-DraftReviewList-20180720_record of decisions	List of licences that we are considering for review	N/A
05/02/2019	Irish Water	Irish Water	Phosphate Susceptibility	Phosphate Susceptibility map from EPA CCT	Susceptibility mapping for Bailieborough Available
13/02/2019	Irish Water	Irish Water	Cert Sites 2014-2018	Available effluent monitoring for CoA sites for 2014 - 2018	N/A

Appendix B

Data Quality Checks

Monitoring Data General Quality Check

Numerous datasets have fed into the calculations required to assess the effluent loads, the data is listed in Appendix A.

Data availability and quality checks have been carried out to ensure that data is fit for purpose. Note that ambient data downloaded from the WFD App has already undergone review and cleansing by the EPA. Data checks typically ensured:

- that the data is within the expected range for each parameter;
- that the data has valid entries for missing data (zeros have been removed to aid statistical analysis);
- that the data has valid entries for samples below ELVs of detection or quantification;
- that the data has valid sample date and time information;
- that the measurement units are correctly recorded;
- whether flow data is available concurrently with concentrations (data taken from Hydrotool mean flow estimates at the ambient monitoring locations, if available, to calculate existing upstream and downstream loads);
- whether flows correlate with any physical constraints on the discharge arrangements (e.g. consistent pipe capacity exceedances could indicate that a sample is in a receiving watercourse rather than the actual discharge);
- that the analysis quality assurance metadata is also available (samples would have been taken and analysed in line with EPA methodologies);
- that sampling point locations are known, ideally are georeferenced, and correctly identified (analysed in ArcGIS to avoid any inter-mixing of discharge/upstream or downstream concentration datasets);
- that there is no seasonal bias within the sampling regime which might extrapolate to inaccurate annual loadings given population loading variation and other seasonal factors (the WFD monitoring programme collects samples quarterly, effluent samples are generally sampled monthly thereby ensuring averages are not heavily swayed by seasonal bias).

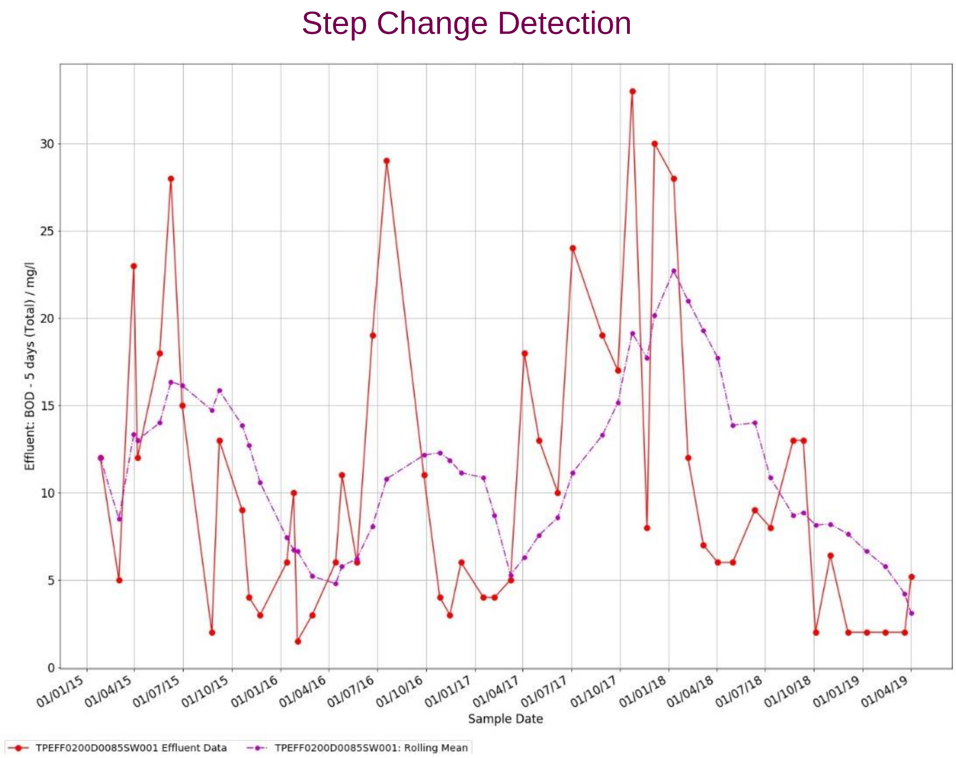

Figure 9.1: Bailieborough effluent BOD concentrations step change detection

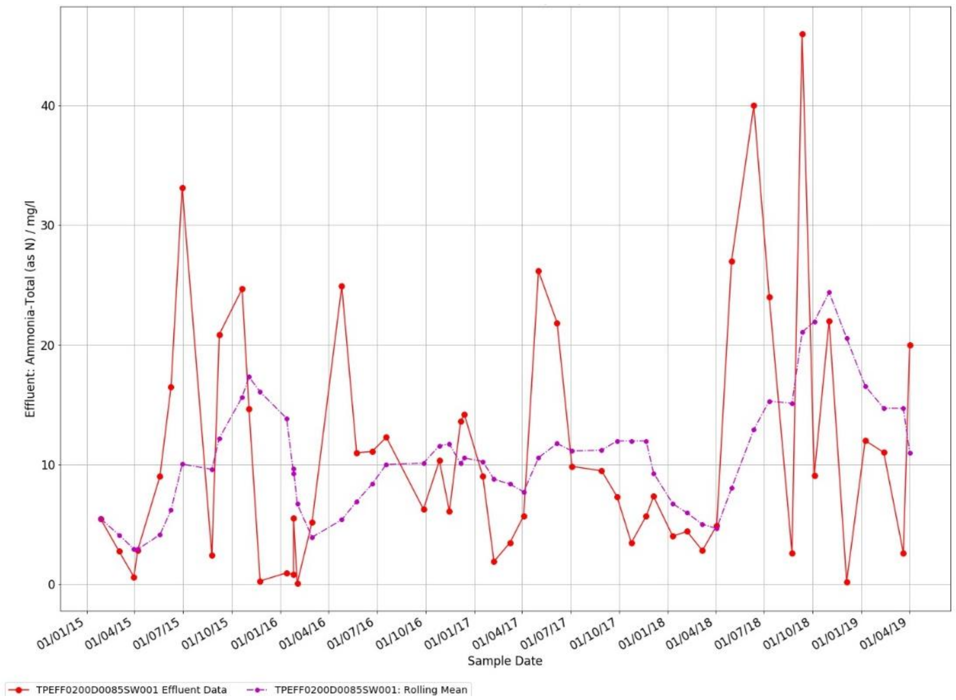

Figure 9.2: Bailieborough effluent ammonia concentrations step change detection

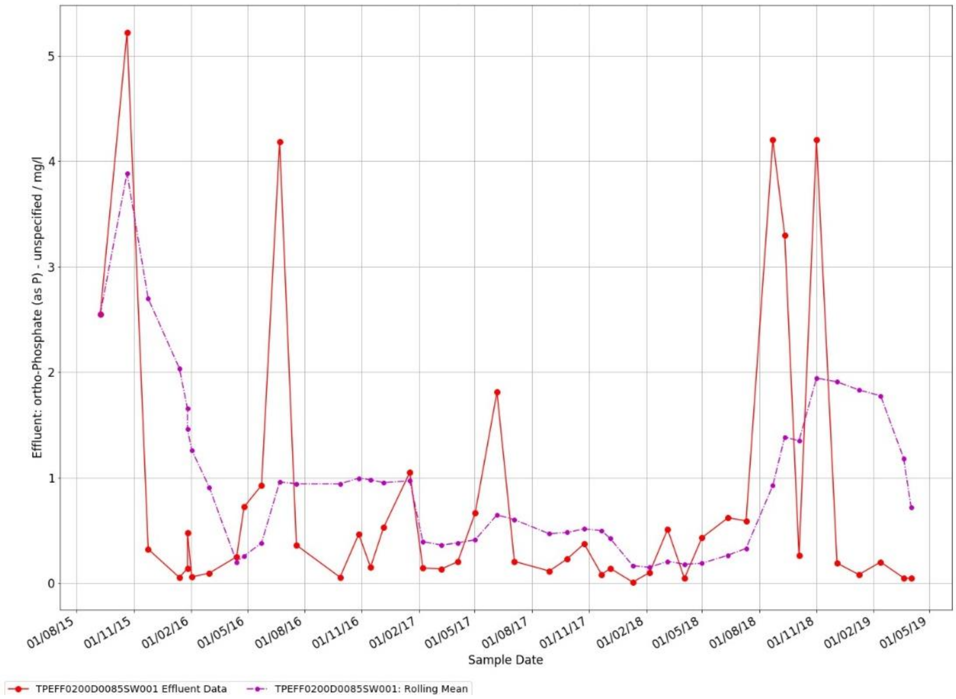

Figure 9.3: Bailieborough effluent orthophosphate concentrations step change detection

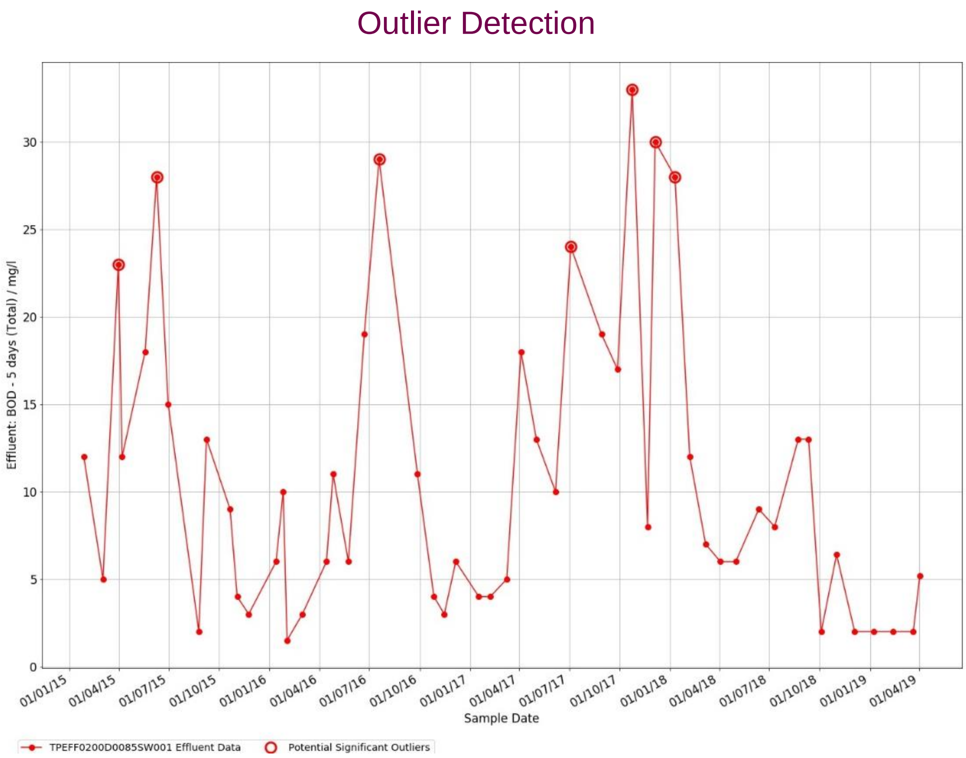

Figure 9.4: Bailieborough Effluent Outlier Detection for BOD concentrations

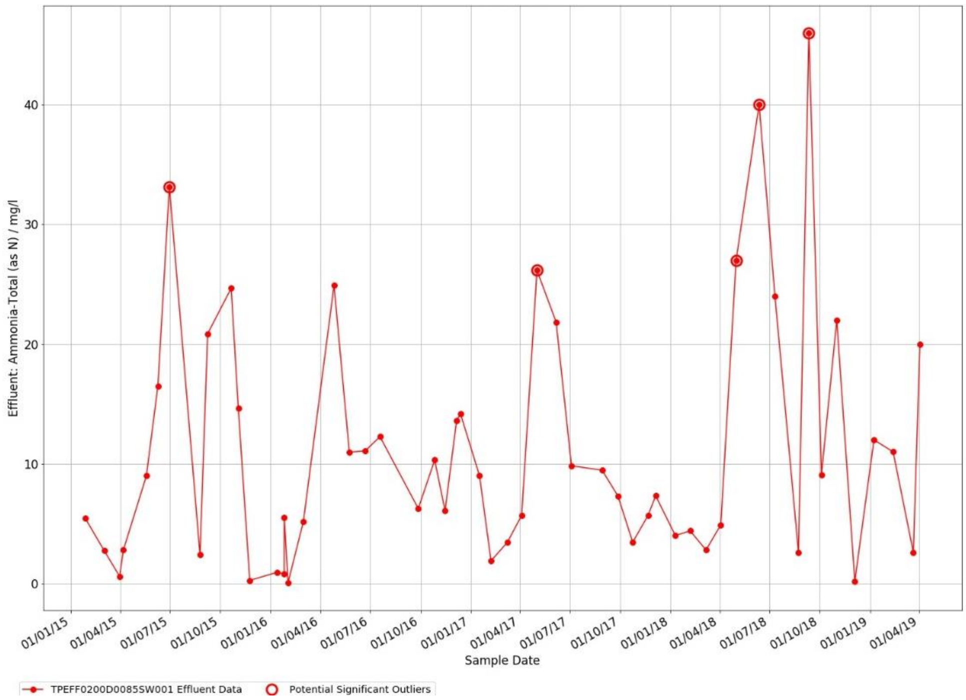

Figure 9.5: Bailieborough Effluent Outlier Detection for ammonia concentrations

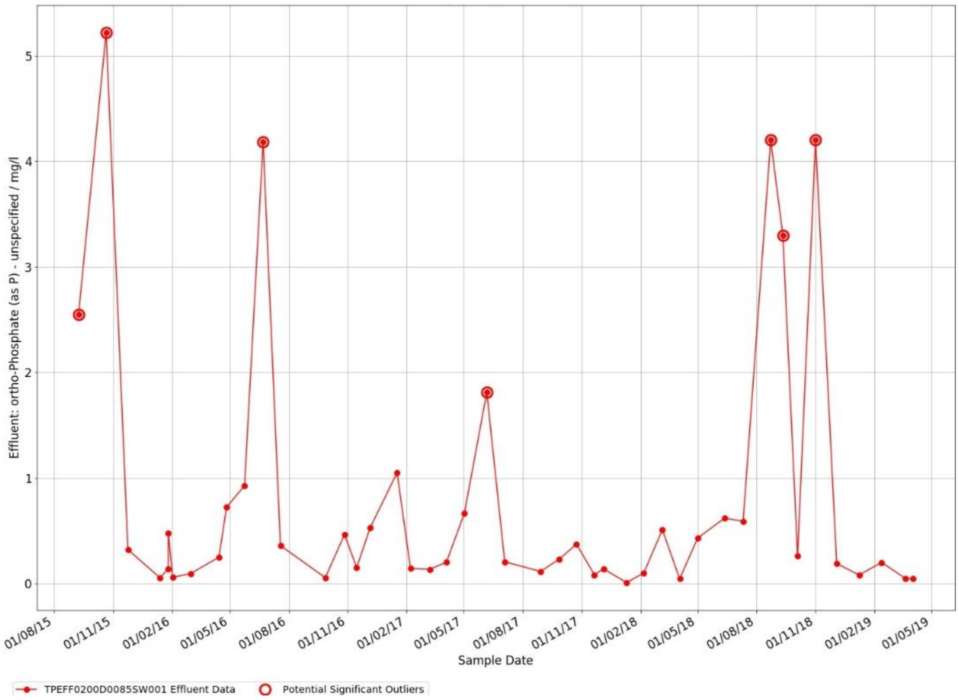

Figure 9.6: Bailieborough Effluent Outlier Detection for orthophosphate concentrations

Appendix C

Load Quantification Calculations

LOAD QUANTIFICATION METHODOLOGY

In order to quantify the annual load (kg/year) of a particular substance at any given location within a water body it is necessary to establish the concentration of the particular substance at that location (mg/l) and the flow at that particular location in (m^3/s).

Annual Load (kg/year) = Conc. (mg/l) * (Flow (m^3/s) * 3600 * 24 * 365) / 1000000

Where * 3600 * 24 * 365 converts m^3/s into m^3/year

And / 1000000 converts mg/l in kg/l

BOD, ammonia and ortho-P loads discharged from the WWTPs, as well as loads upstream and downstream of the point of discharge in the channel were calculated in attempt to quantify the load from other sources entering the water body between the two monitoring points.

1. WWTP Loads Calculation

For licenced WWTPs, i.e. WWTPs >500 PE, the loads were extracted from the AERs for BOD, ammonia and ortho-P, where available. For WWTP with <500 PE or where loads for these specific parameters were not reported the loads were calculated / estimated based on PEs and export coefficients. Estimated loads were also used to sense-check the load data reported in the AER.

AER Effluent Loads

For each specific parameter AER loads were calculated using an average of the Effluent mass emission values reported in table 3.1 of the 2015, 2016 and 2017 AERs. Where values were not reported for a specific year the average was based on the years where data was available.

AER data for 2015, 2016 & 2017, respectively, were obtained from the following sources provided by Irish Water included in the incoming data register;

- 2017 AER Data Collector
- 2016 AER Data Collector rev 4a
- 2015 AER Data Collector

For Bailieborough only BOD effluent mass emissions were reported in the AER. The table below illustrates how the AER loads were derived initially.

2015 BOD Effluent Mass Emission (kg/year)	2016 BOD Effluent Mass Emission (kg/year)	2017 BOD Effluent Mass Emission (kg/year)	WWTP AER Load (average of 3 annual means)
1,490	2,870	5,843	3,401

The step change analysis, undertaken as part of the data quality checks (see Section 1 of the main document) highlighted no identifiable change in trend between 2015 and 2017 data. Therefore an average of 2015-2017 effluent mass figures were used.

Estimated Effluent Loads

An estimate of loads generated by the WWTP where AER data is not available can be calculated by applying a treatment reduction factor (see 0) available at the plant to the estimated influent load (see 0).

Treatment Reduction Factor

For the purpose of estimating effluent pollutant loadings, treatment reduction factors are based on pre-determined values for each level of treatment (i.e., no-treatment, primary treatment, secondary treatment and nutrient removal) as opposed to influent mass loading values reported in the AERs, where available. For agglomerations with no treatment of wastewater a reduction factor of "0" is applied. Tables 2-4 below breakdown the reduction factors applied the levels of treatment for Total N, Total P and BOD respectively.

Total Nitrogen

Typical Total N reduction factors as reported by OSPAR (2004) were used for the purpose of load estimation in this assessment.

Treatment Reduction Factor (Total N)			
Primary Treatment	Secondary Treatment	Tertiary Treatment	Source
0.727	0.545	0.3	OSPAR

Total Phosphorous

Typical Total P reduction factors as reported by OSPAR (2004) were used for the purpose of load estimation in this assessment.

Treatment Reduction Factor (Total P)			
Primary Treatment	Secondary Treatment	Tertiary Treatment	Source
0.667	0.467	0.1	OSPAR

BOD

BOD reduction factors are based on typical (conservative) values for each level of treatment as reported in the CIWEM (2015) Municipal Wastewater Treatment training manuals.

CIWEM have assumed that anywhere between a 30-50% reduction of BOD can be achieved through Primary treatment. As a conservative approach, for the purpose of this assessment 30% reduction of BOD is assumed after primary treatment (reduction factor of 0.7).

CIWEM have assumed that anywhere between a 65-85% reductions of BOD can be achieved through Secondary treatment. As a conservative approach, for the purpose of this assessment 65% reduction is assumed after secondary treatment (reduction factor of 0.35).

None of the agglomerations within this assessment receive tertiary treatment for BOD. Primary and secondary treatment reduction factors for BOD illustrated in the table below:

Primary	Secondary	Source

Treatment	Treatment	
0.7	0.35	CIWEM (2015)

Wastewater at Bailieborough (D0085) receives nutrient (phosphorous) removal treatment and therefore the following reduction factors were applied to the estimation of effluent load calculations:

Parameter	Reduction Factor
Total N	0.545
Total P	0.1
BOD	0.35

Estimated Influent Load

The influent load is the product of the population equivalent (obtained from The Irish Water Waste Water Capacity Register) and production rates.

The typical values for standard residential production per capita figures (production rates) obtained from British Water code of Practice (no. 4) were used as an estimate of the BOD and ammonia mass produced (grams) per person per day.

OSPAR (2004) Guidelines were used as an estimate of the Total P mass produced per person per day. The table below summarises the typical Loadings by parameter:

Parameter	Typical Loading (g/person/day)	Source
Ammonia as N	8	British Water
Total P	2	Mockler et al, 2017
BOD	60	British Water

The collected load PE figures from the 2017 Irish Water Waste Water Capacity Register were used to calculate influent loads as follows::

Parameter	Typical Loading (g/person/day)		Population Equivalent		Influent Load (g/day)
Ammonia as N	8	×	3,178	=	25,424
Total P	2	×	3,178	=	6,356
BOD	60	×	3,178	=	190,680

*Estimated Influent load = PE * Production per capita*

Estimated Effluent Load Results

Applying the recommended treatment reduction factor, based on the level of treatment at the WWTP, to the estimated influent load calculated above provided an estimate of the effluent pollutant loads as demonstrated in the table below. In the absence of a typical reduction factor for ammonia the Total N reduction factor was assumed and applied to the estimate effluent load calculations.

Parameter	Influent Load (g/day)		Reduction Factor		Effluent Load Estimate (g/day)
Ammonia as N	25,424	×	0.545	=	13,856
Total P	6,356	×	0.1	=	636
BOD	190,680	×	0.35	=	66,738

*Estimated Effluent load = Influent Load * Reduction Factor*

Effluent loads generated above indicate the loads generated in grams per day which were subsequently converted to annual loads in kilograms (kg/yr).

Parameter	Effluent Load Estimate (g/day)		Converts Grams to kilograms		Converts Days to year		Effluent Load Estimate (kg/yr)
Ammonia as N	13,856	÷	1000	×	365	=	5,057
Total P	636	÷	1000	×	365	=	232
BOD	66,738	÷	1000	×	365	=	24,359

2. Upstream and Downstream Loads

Loads upstream and downstream of the point of discharge from the agglomeration to the main channel were estimated based on monitoring data from the nearest WFD monitoring stations. The estimated upstream and downstream loads for each parameter were derived from the product of mean flow in the river at the respective monitoring points and the average monitored concentration for that particular parameter.

*Annual Load (kg/year) = Conc. (mg/l) * (Flow (m³/s) * 3600 * 24 * 365) / 1000000*

This provides an average load for the monitoring locations to allow a determination of the potential additional sources of load between the two monitoring locations.

Quality data

To establish concentrations for each parameter, firstly, all EPA Chemistry monitoring was downloaded from the MDS module on the EDEN system for monitoring Stations upstream and downstream of each Agglomeration's Primary Discharge point and compiled in a single excel worksheet (*'Compiled*

Chem_Monitoring'). Monitoring stations were chosen based on proximity to the discharge point and sufficient chemistry data.

Data was checked to ensure the column illustrating the reported concentrations (column Q) contained only numeric values. Where a value was not included in the column but a limit of detection was stated, the limit of detection was halved to derive an absolute value. Where non-numeric and zero values were identified the rows were removed.

Flow data

Mean flow data was required at the same point on the river as the selected EPA monitoring locations to calculate the loads at that location. Mean flows were obtained using a hierarchical approach as summarised in the different methods below.

Gauged flow data is preferred to the EPA's hydrotool data as it provides a measured record of the flows at that point rather than an estimation and therefore where gauged data was available an average of the daily means were used. Where gauged data is available on the same river the gauged flows are factored on drainage area on a pro rata basis. If gauged data is not available at the point of interest or on the same river where typology is similar, then the 30 percentile flow from the EPA hydrotool, was used. If flows are needed at a location beyond the extent of hydrotool outputs, the most upstream hydrotool value is calculated and factored up based on additional drainage area.

Method 1: Gauged data

If the WFD monitoring location coincides with a hydrometric station with sufficient flow data available, all available data from that station is downloaded and an average of the daily mean flow data is used as the mean flow at that location.

Method 2: Gauged data scaled pro-rata on an areal basis where appropriate (hydrologically similar)

If the WFD monitoring location does not coincide with a hydrometric station but there is a reliable station within the same river (as long as typology is similar) with sufficient flow data available, all available data from that station is downloaded. An average of the daily mean flow data is used to derive a long term mean flow at that location, then factored up or down on a pro rata basis, based on catchment area of the hydrometric station when compared to the catchment area of the WFD monitoring station. Flood Studies Update (FSU) nodes are used to determine drainage area of the WFD monitoring station location.

Method 3: Hydrotool value (where appropriate)

Where it is deemed there is no suitable recorded flow data available a shapefile containing river segments illustrating the outputs of EPA Hydrotool flow estimates is used to estimate the mean (30%ile) flows at the location of the WFD monitoring points upstream and downstream.

30%ile flows (the flow that is equalled or exceeded for 30 per cent of the time in the long term) has been used for flow calculations, as this flow statistic is considered a reasonable representation of mean flows (EPA, 1995).

Method 4: Hydrotool values scaled pro-rate on areal basis (where appropriate)

In the event where there is no suitable recorded flow data available and beyond the extent of the EPA's hydrotool, a similar approach to step 2, using the most upstream flows available from the EPA's hydrotool is employed. Whereby, the most upstream hydrotool 30%ile flows are factored on a pro rata basis, based on catchment area at the downstream extent of the EPA hydrotool river segment in relation to the catchment area of the WFD monitoring station. Flood Studies Update Nodes are used to determine drainage area at specific locations

Calculation of loads

For Bailieborough the following information was used to calculate **upstream** pollutant concentrations:

Parameter	Upstream Monitoring Station (station code)	No. of samples used to calculate average conc.	Sample Date Range	Upstream Conc. mg/l
Ammonia as N	Up Stream pipe discharge at Drumbannon (RS07B010160)	37	2007 - 2019	0.30
Total P	Up Stream pipe discharge at Drumbannon (RS07B010160)	37	2007 - 2019	0.14
BOD	Up Stream pipe discharge at Drumbannon (RS07B010160)	36	2007 - 2019	3.54

For Bailieborough the following information was used to calculate **downstream** pollutant concentrations:

Parameter	Downstream Monitoring Station (station code)	No. of samples used to calculate average conc.	Sample Date Range	Downstream Conc. mg/l
Ammonia as N	Br at XRds SW (u/s) Castle L (RS07B010200)	16	2015 - 2018	0.34
Total P	Br at XRds SW (u/s) Castle L (RS07B010200)	16	2015 - 2018	0.04
BOD	Br at XRds SW (u/s) Castle L (RS07B010200)	15	2015 - 2018	1.59

For Bailieborough the following mean flows were recorded and used for upstream and downstream loading calculations:

Position in relation to primary discharge to main channel	Mean Flow (l/s)	Step Used to obtain flow information	Comment
Upstream	720	Step 3	Both upstream and downstream monitoring locations used for this assessment exist on the same Hydrotool river segment (hence why the flows values are the same upstream and downstream.
Downstream	720	Step 3	

The product of the pollutant concentration and flows above generated the following pollutant loadings in mg/s.

Parameter	Position	Flow (l/s)		Conc. mg/l		Load mg/s
Ammonia as N	Upstream	720	×	0.30	=	6,788
	Downstream	720	×	0.34	=	7,703
Total P	Upstream	720	×	0.14	=	3,178
	Downstream	720	×	0.04	=	949
BOD	Upstream	720	×	3.54	=	80,479
	Downstream	720	×	1.59	=	36,178

The above load figures in mg/s were subsequently converted to kg/year using the conversion factor of 31.536.

Parameter	Position	Load mg/s	Converts mg/s to kg/year			Load mg/s
Ammonia as N	Upstream	215	×	31.536	=	6,788
	Downstream	244	×	31.536	=	7,703
Total P	Upstream	101	×	31.536	=	3,178
	Downstream	30	×	31.536	=	949
BOD	Upstream	2,552	×	31.536	=	80,479
	Downstream	1,147	×	31.536	=	36,178

The difference between upstream and downstream loads were then calculated, and the contribution of the WWTP to this load difference has been presented as a percentage for each parameter.

	BOD kg/yr	Ammonia kg/yr	Total P kg/yr
Upstream Load	80,479	6,788	3,178
WWTP Load	3,401	5,057*	232*
Downstream Load	36,178	7,703	949
Difference (Between Upstream and Downstream)	-44,302	915	-2,228
WWTP Load as % of Downstream Load	9%	66%	24%
WWTP Load as % of Difference (Upstream and Downstream)	-8%	553%	-10%

* No data available from AERs, values are estimates

Appendix D

Ambient Monitoring Summary

Ambient and WFD monitoring data for the Blackwater (Kells)_020, Blackwater (Kells)_010 and Blackwater (Kells)_030 river water bodies

	Primary Discharge Waterbody				Upstream Waterbody		Downstream Waterbody	
Factor	IE_EA_07B010170 BLACKWATER (KELLS)_020				IE_EA_07B010100 BLACKWATER (KELLS)_010		IE_EA_07B010280 BLACKWATER (KELLS)_030	
Risk Category	At Risk				NAR		At Risk	
Biological Status Variations/trends in Q values. 2016-2018 Q value data were available	Latest	Poor (2018)- Br at Drumbannon			Latest	Good (2018)Br 2km NE of Bailieborough	Latest	Poor (2018) 3rd Br d/s Castle L
	1997	2-3			2000	4-5	1997	3
	2003	2-3			2003	4-5	2003	3*
	2006	2-3			2006	4	2006	3
	2009	3			2009	4	2009	3
	2012	3-4			2012	4*	2012	3
	2015	3-4			2015	4*	2015	3
	2018	2-3			2018	4	2018	3
						-		
	Latest	-			Latest	-	Latest	-
	1999	-			1999	-	1999	-
	2002	-			2003	-	2003	-
	2005	-			2006	-	2006	-
	2008	-			2008	-	2008	-
	2011	-			2012	-	2012	-
	2015	-			2014	-	2014	-
	2018	-			2017	-	2017	-
Chemistry								
Ammonia-Total (as N)	WFD App annual Averages		Ambient Monitoring U/S	Ambient Monitoring D/S	WFD App annual Averages		WFD App annual Averages	
	Br at Drumbannon				Br 2km NE of Bailieborough			
	2007	0.629	0.064	-	2007	0.024	2007	-
	2008	0.231	0.035	-	2008	0.032	2008	-
	2009	0.848	1.073	-	2009	0.015	2009	-
	2010	1.149	-	-	2010	0.107	2010	-
	2011	0.098	-	-	2011	0.053	2011	-
	2012	0.097	-	-	2012	0.04	2012	-
	2013	0.483	0.141	-	2013	0.029	2013	-
	2014	1.177	1.183	-	2014	0.027	2014	-
	2015	0.109	0.059	0.255	2015	0.02	2015	-
	2016	-	0.062	0.151	2016	-	2016	-
	2017	-	0.120	0.552	2017	-	2017	-
	2018	-	0.021	0.332	2018	-	2018	-
	Up Stream pipe discharge at Drumbannon		-	-				
	2007	0.064	-	-	2007	-	2007	-
	2008	0.035	-	-	2008	-	2008	-
	2009	1.073	-	-	2009	-	2009	-
	2010	0.707	-	-	2010	-	2010	-
	2011	0.061	-	-	2011	-	2011	-
	2012	0.134	-	-	2012	-	2012	-
	2013	0.141	-	-	2013	-	2013	-
	2014	1.183	-	-	2014	-	2014	-
	2015	0.056	-	-	2015	-	2015	-
	2016	-	-	-	2016	-	2016	-
	2017	-	-	-	2017	-	2017	-
	2018	-	-	-	2018	-	2018	-
ortho-Phosphate (as P) - unspecified	WFD App annual Averages		Ambient Monitoring U/S	Ambient Monitoring D/S	WFD App annual Averages		WFD App annual Averages	
	Br at Drumbannon				Br 2km NE of Bailieborough			
	2007	0.563	0.738	-	2007	0.026	2007	-
	2008	0.244	0.263	-	2008	0.022	2008	-
	2009	0.153	0.161	-	2009	0.015	2009	-
	2010	0.044	-	-	2010	0.015	2010	-
	2011	0.036	-	-	2011	0.025	2011	-
	2012	0.032	-	-	2012	0.02	2012	-
	2013	0.043	0.018	-	2013	0.13	2013	-
	2014	0.045	0.030	-	2014	0.02	2014	-
	2015	0.033	0.024	0.037	2015	0.014	2015	-
	2016	-	0.013	0.031	2016	-	2016	-
	2017	-	0.036	0.056	2017	-	2017	-

	2018	-	0.008	0.040	2018	-	2018	-
	Up Stream pipe discharge at Drumbannon		-	-				
	2007	0.273	-	-	2007	-	2007	-
	2008	0.263	-	-	2008	-	2008	-
	2009	0.161	-	-	2009	-	2009	-
	2010	0.04	-	-	2010	-	2010	-
	2011	0.034	-	-	2011	-	2011	-
	2012	0.029	-	-	2012	-	2012	-
	2013	0.018	-	-	2013	-	2013	-
	2014	0.03	-	-	2014	-	2014	-
	2015	0.023	-	-	2015	-	2015	-
	2016	-	-	-	2016	-	2016	-
	2017	-	-	-	2017	-	2017	-
	2018	-	-	-	2018	-	2018	-
BOD - 5 days (Total)	WFD App annual Averages		Ambient Monitoring U/S	Ambient Monitoring D/S	WFD App annual Averages		WFD App annual Averages	
	2007	-	4.500	-	2007	-	2007	-
	2008	-	5.333	-	2008	-	2008	-
	2009	-	5.750	-	2009	-	2009	-
	2010	-	-	-	2010	-	2010	-
	2011	-	-	-	2011	-	2011	-
	2012	-	-	-	2012	-	2012	-
	2013	-	3.000	-	2013	-	2013	-
	2014	-	3.250	-	2014	-	2014	-
	2015	-	2.875	2.000	2015	-	2015	-
	2016		2.500	1.580	2016	-	2016	-
	2017		2.750	1.540	2017	-	2017	-
	2018		2.525	1.575	2018	-	2018	-
Total Oxidised Nitrogen (as N)	WFD App annual Averages		Ambient Monitoring U/S	Ambient Monitoring D/S	WFD App annual Averages		WFD App annual Averages	
	Br at Drumbannon				Br 2km NE of Bailieborough			
	2007	1.503	1.483	-	2007	1.495	2007	-
	2008	0.868	0.778	-	2008	0.855	2008	-
	2009	1.092	1.073	-	2009	0.94	2009	-
	2010	1.053	-	-	2010	1.113	2010	-
	2011	0.955	-	-	2011	0.795	2011	-
	2012	0.915	-	-	2012	0.89	2012	-
	2013	1.07	0.898	-	2013	0.625	2013	-
	2014	1.62	1.750	-	2014	0.645	2014	-
	2015	0.773	1.000	0.990	2015	0.728	2015	-
	2016	-	-	1.016	2016	-	2016	-
	2017	-	-	1.020	2017	-	2017	-
	2018	-	-	1.072	2018	-	2018	-
	Up Stream pipe discharge at Drumbannon							
	2007	1.483	-	-	2007	-	2007	-
	2008	0.778	-	-	2008	-	2008	-
	2009	1.073	-	-	2009	-	2009	-
	2010	1.075	-	-	2010	-	2010	-
	2011	0.88	-	-	2011	-	2011	-
	2012	0.84	-	-	2012	-	2012	-
	2013	0.898	-	-	2013	-	2013	-
	2014	1.75	-	-	2014	-	2014	-
	2015	1	-	-	2015	-	2015	-
	2016	-	-	-	2016	-	2016	-
	2017	-	-	-	2017	-	2017	-
	2018	-	-	-	2018	-	2018	-
Additional Information								
Ecological status	Moderate				Good		Poor	
WFD objective	Moderate				Good		Poor	
Protected areas	No				No		Blackwater (Kells) Drinking Water	
Relevant info. from notes of EPA biologist	The Blackwater (Kells) River was in unsatisfactory ecological condition at nine of the twelve stations surveyed in 2018. Station 0170 (at Drumbannon) downstream of Baileborough deteriorated to poor ecological condition after improving slightly in 2012.							
Significant issue/impact for receptor (e.g. PO4)	WFD App - Indicates Bailieborough WWTP significant pressure, for nutrient and organic pollution. Industrial Emission for Foods				-		-	

(from Initial Characterisation in WFD App)	company also identified as a pressure, but not significant.		
NOTES	2018 EPA Licensee report - receiving waters have no evidence of gross solids, however sewage fungus visible immediately downstream. 2017 AER - noted may be giving rise to breach in EQS for ammonia, may be other unknown discharges - extensive water body with misconnections, agriculture, industrial discharges, etc. Overloaded with planned improvement works.		

Appendix E

Mass Balance Calculations

MAKING COMPLEX EASY

REPORT

Scenario 1 - 95%ile Flows, Existing Upstream Background Concentration

AGGLOMERATION	Bailieborough		
	PO4-P = 50% TP		
INPUT DATA			
	P production (g/person/day)	2	
	Treatment reduction fator based on *OPSPAR Guideline No. 4* for treatment types	0.1	P Removal
	Treatment reduction factor based on AER Data where available	-	
	TP to PO4-P ratio	0.5	
	Agglomeration PE	3178	
	Average Annual Hydraulic Load (Q) from AER where available	324,485	
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	144,996	
	Existing annual TP load from AER where available (Kg/yr)	-	
	Existing annual TP load from PE (Kg/yr)	2,320	
RECEIVING WATERS	BLACKWATER (KELLS)_020 (IE_EA_07B010170)		
	95%ile Flow (l/s)	20	flow taken from EPA hydrotool on Blackwater (Kells) main channel between ambient monitoring locations (mean flow 720l/s)
	Background concentration (C) (mg/L)	0.015083333	2016-2018 average of annual means at RS07B010160
	Agglomeration PE	3178	
INFLUENT LOADS	Existing annual TP load from PE (Kg/yr)	2320	
EFFLUENT LOADS	Existing Effluent TP Loads based on Treatment Reduction Factor (Kg/yr)	232	
	Existing Effluent orthophoshate Loads based on Treatment Reduction Factor @ half TP (mg/l)	116	
EFFLUENT CONCENTRATIONS	Existing effluent TP Concentration mg/l (= g/m3)	0.7	
	Existing effluent Orthophosphate Concentration @ half TP (mg/l)	0.36	
	Measured Effluent Concetration (mg/l)	0.8295	Compiled_Effluent_Monitoring_Data_MDS_2015-2019 average of all data
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	10.3	
	Existing effluent Orthophosphate Concentration @ half TP (mg/l)	0.36	
	Measured Orthophosphate Concentration @ half TP (mg/l)	0.83	
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l Ortho-P)	0.1314	
	Mass Balance Calculation Resultant Concentration (T) for Measured Discharge (mg/l PO4-P)	0.2917	

AGGLOMERATION	Bailieborough		
	BOD		
INPUT DATA			
	P production (g/person/day)	60	
	Treatment reduction fator based on *CIWMEN Training manual for Municalp WasteWater Treatment* for treatment types	0.35	
	Treatment reduction factor based on AER Data where available	-	
	Agglomeration PE	3178	
	Average Annual Hydraulic Load (Q) from AER where available	324,485	
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	144,996	
	Existing anual BOD load from AER where available (Kg/yr)	-	
	Existing anual BOD load from PE (Kg/yr)	69,598	
RECEIVING WATERS	BLACKWATER (KELLS)_020 (IE_EA_07B010170)		
	95%ile Flow (l/s)	20	
	Backgroud concentration (C) (mg/L)	1.3625	2016-2018 average of annual means at RS07B010160
	Agglomeration PE	3178	
INFLUENT LOADS	Existing Influent BOD load from AER (kg/yr)	69598	
EFFLUENT LOADS	Existing Effluent BOD Loads based on Treatment Reduction Factor (Kg/yr)	24359	
EFFLUENT CONCENTRATIONS	Estimated Existing effluent BOD Concentration mg/l (= g/m3)	75.1	
	Measured Effluent Concetration (mg/l)	10.11960784	Compiled_Effluent_Monitoring_Data_MDS_2015-2019 average of all data with 2 outliers removed
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	10.3	
	Existing effluent BOD Concentration (mg/l)	75.07	
	Existing measured effluent BOD Concentration (mg/l)	10.12	
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l BOD)	26.401	
	Mass Balance Calculation Resultant Concentration (T) for Measured Discharge Discharge (mg/l BOD)	4.337	

AGGLOMERATION	Bailieborough		
	Ammonia		
INPUT DATA			
	P production (g/person/day)	8	
	Treatment reduction fator based on *OPSPAR Guideline No. 4* for treatment types	0.545	
	Treatment reduction factor based on AER Data where available	-	
	Agglomeration PE	3178	
	Average Annual Hydraulic Load (Q) from AER where available	324,485	
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	144,996	
	Existing anual Ammonia load from AER where available (Kg/yr)	-	
	Existing anual TP load from PE (Kg/yr)	9,280	
RECEIVING WATERS	BLACKWATER (KELLS)_020 (IE_EA_07B010170)		
	95%ile Flow (l/s)	20	
	Backgroud concentration (C) (mg/L)	0.0325	2016-2018 average of annual means at RS07B010160
	Agglomeration PE	3178	
INFLUENT LOADS	Existing Influent Ammonia load from AER (kg/yr)	9280	
EFFLUENT LOADS	Existing Effluent Ammonia Loads based on Treatment Reduction Factor (Kg/yr)	5057	
EFFLUENT CONCENTRATIONS	Existing effluent TP Concentration mg/l (= g/m3)	15.6	
	Measured Effluent Concetration (mg/l)	11.0907037	Compiled_Effluent_Monitoring_Data_MDS_2015-2019 average of all data
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	10.3	
	Existing effluent Ammonia Concentration (mg/l)	15.59	
	Existing measured effluent Ammonia Concentration (mg/l)	11.09	
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l Ammonia)	5.316	
	Mass Balance Calculation Resultant Concentration (T) for measured Discharge (mg/l Ammonia)	3.789	

Scenario 2 - 95%ile Flows, Notionally Clean Background Concentration

AGGLOMERATION	Bailieborough		
	PO4-P = 50% TP		
INPUT DATA			
	P production (g/person/day)	2	
	Treatment reduction fator based on *OPSPAR Guideline No. 4* for treatment types	0.1	P Removal
	Treatment reduction factor based on AER Data where available	-	
	TP to PO4-P ratio	0.5	
	Agglomeration PE	3178	
	Average Annual Hydraulic Load (Q) from AER where available	324,485	
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	144,996	
	Existing annual TP load from AER where available (Kg/yr)	-	
	Existing annual TP load from PE (Kg/yr)	2,320	
RECEIVING WATERS	BLACKWATER (KELLS)_020 (IE_EA_07B010170)		
	95%ile Flow (l/s)	20	
	Background concentration (C) (mg/L)	0.005	
	Agglomeration PE	3178	
INFLUENT LOADS	Existing annual TP load from PE (Kg/yr)	2320	
EFFLUENT LOADS	Existing Effluent TP Loads based on Treatment Reduction Factor (Kg/yr)	232	
	Existing Effluent orthophosphate Loads based on Treatment Reduction Factor @ half TP (mg/l)	116	
EFFLUENT CONCENTRATIONS	Existing effluent TP Concentration mg/l (= g/m3)	0.7	
	Existing effluent Orthophosphate Concentration @ half TP (mg/l)	0.36	
	Measured Effluent Concetration (mg/l)	0.8295	Compiled_Effluent_Monitoring_Data_MDS_2015-2019 average of all data
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	10.3	
	Existing effluent Orthophosphate Concentration @ half TP (mg/l)	0.36	
	Measured Orthophosphate Concentration @ half TP (mg/l)	0.83	
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l Ortho-P)	**0.1247**	
	Mass Balance Calculation Resultant Concentration (T) for Measured Discharge (mg/l PO4-P)	**0.2851**	

AGGLOMERATION	Bailieborough		
	BOD		
INPUT DATA			
	P production (g/person/day)	60	
	Treatment reduction fator based on *CIWMEN Training manual for Municalp WasteWater Treatment* for treatment types	0.35	
	Treatment reduction factor based on AER Data where available	-	
	Agglomeration PE	3178	
	Average Annual Hydraulic Load (Q) from AER where available	324,485	
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	144,996	
	Existing anual BOD load from AER where available (Kg/yr)	-	
	Existing anual BOD load from PE (Kg/yr)	69,598	
RECEIVING WATERS	BLACKWATER (KELLS)_020 (IE_EA_07B010170)		
	95%ile Flow (l/s)	20	
	Background concentration (C) (mg/L)	0.26	
	Agglomeration PE	3178	
INFLUENT LOADS	Existing Influent BOD load from AER (kg/yr)	69598	
EFFLUENT LOADS	Existing Effluent BOD Loads based on Treatment Reduction Factor (Kg/yr)	24359	
EFFLUENT CONCENTRATIONS	Estimated Existing effluent BOD Concentration mg/l (= g/m3)	75.1	
	Measured Effluent Concetration (mg/l)	10.11960784	Compiled_Effluent_Monitoring_Data_MDS_2015-2019 average of all data with 2 outliers removed
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	10.3	
	Existing effluent BOD Concentration (mg/l)	75.07	
	Existing measured effluent BOD Concentration (mg/l)	10.12	
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l BOD)	**25.673**	
	Mass Balance Calculation Resultant Concentration (T) for Measured Discharge Discharge (mg/l BOD)	**3.609**	

AGGLOMERATION	Bailieborough		
	Ammonia		
INPUT DATA			
	P production (g/person/day)	8	
	Treatment reduction fator based on *OPSPAR Guideline No. 4* for treatment types	0.545	
	Treatment reduction factor based on AER Data where available	-	
	Agglomeration PE	3178	
	Average Annual Hydraulic Load (Q) from AER where available	324,485	
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	144,996	
	Existing anual Ammonia load from AER where available (Kg/yr)	-	
	Existing anual TP load from PE (Kg/yr)	9,280	
RECEIVING WATERS	BLACKWATER (KELLS)_020 (IE_EA_07B010170)		
	95%ile Flow (l/s)	20	
	Background concentration (C) (mg/L)	0.008	
	Agglomeration PE	3178	
INFLUENT LOADS	Existing Influent Ammonia load from AER (kg/yr)	9280	
EFFLUENT LOADS	Existing Effluent Ammonia Loads based on Treatment Reduction Factor (Kg/yr)	5057	
EFFLUENT CONCENTRATIONS	Existing effluent TP Concentration mg/l (= g/m3)	15.6	
	Measured Effluent Concetration (mg/l)	11.0907037	Compiled_Effluent_Monitoring_Data_MDS_2015-2019 average of all data
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	10.3	
	Existing effluent Ammonia Concentration (mg/l)	15.59	
	Existing measured effluent Ammonia Concentration (mg/l)	11.09	
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l Ammonia)	**5.300**	
	Mass Balance Calculation Resultant Concentration (T) for measured Discharge (mg/l Ammonia)	**3.773**	

Scenario 3 - 95%ile Flows, Adjusted Background Concentration

AGGLOMERATION	Bailieborough		
	PO4-P = 50% TP		
INPUT DATA			
	P production (g/person/day)	2	
	Treatment reduction fator based on *OPSPAR Guideline No. 4* for treatment types	0.1	P Removal
	Treatment reduction factor based on AER Data where available	-	
	TP to PO4-P ratio	0.5	
	Agglomeration PE	3178	
	Average Annual Hydraulic Load (Q) from AER where available	324,485	
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	144,996	
	Existing annual TP load from AER where available (Kg/yr)	-	
	Existing annual TP load from PE (Kg/yr)	2,320	
RECEIVING WATERS	BLACKWATER (KELLS)_020 (IE_EA_07B010170)		
	95%ile Flow (l/s)	20	
	Background concentration (C) (mg/L)	0.03	
	Agglomeration PE	3178	
INFLUENT LOADS	Existing annual TP load from PE (Kg/yr)	2320	
EFFLUENT LOADS	Existing Effluent TP Loads based on Treatment Reduction Factor (Kg/yr)	232	
	Existing Effluent orthophoshate Loads based on Treatment Reduction Factor @ half TP (mg/l)	116	
EFFLUENT CONCENTRATIONS	Existing effluent TP Concentration mg/l (= g/m3)	0.7	
	Existing effluent Orthophosphate Concentration @ half TP (mg/l)	0.36	
	Measured Effluent Concetration (mg/l)	0.8295	Compiled_Effluent_Monitoring_Data_MDS_2015-2019 average of all data
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	10.3	
	Existing effluent Orthophosphate Concentration @ half TP (mg/l)	0.36	
	Measured Orthophosphate Concentration @ half TP (mg/l)	0.83	
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l Ortho-P)	**0.1412**	
	Mass Balance Calculation Resultant Concentration (T) for Measured Discharge (mg/l PO4-P)	**0.3016**	

AGGLOMERATION	Bailieborough		
	BOD		
INPUT DATA			
	P production (g/person/day)	60	
	Treatment reduction fator based on *CIWMEN Training manual for Municalp WasteWater Treatment* for treatment types	0.35	
	Treatment reduction factor based on AER Data where available	-	
	Agglomeration PE	3178	
	Average Annual Hydraulic Load (Q) from AER where available	324,485	
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	144,996	
	Existing anual BOD load from AER where available (Kg/yr)	-	
	Existing anual BOD load from PE (Kg/yr)	69,598	
RECEIVING WATERS	BLACKWATER (KELLS)_020 (IE_EA_07B010170)		
	95%ile Flow (l/s)	20	
	Background concentration (C) (mg/L)	1.4	
	Agglomeration PE	3178	
INFLUENT LOADS	Existing Influent BOD load from AER (kg/yr)	69598	
EFFLUENT LOADS	Existing Effluent BOD Loads based on Treatment Reduction Factor (Kg/yr)	24359	
EFFLUENT CONCENTRATIONS	Estimated Existing effluent BOD Concentration mg/l (= g/m3)	75.1	
	Measured Effluent Concetration (mg/l)	10.11960784	Compiled_Effluent_Monitoring_Data_MDS_2015-2019 average of all data with 2 outliers removed
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	10.3	
	Existing effluent BOD Concentration (mg/l)	75.07	
	Existing measured effluent BOD Concentration (mg/l)	10.12	
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l BOD)	**26.426**	
	Mass Balance Calculation Resultant Concentration (T) for Measured Discharge (mg/l BOD)	**4.362**	

AGGLOMERATION	Bailieborough		
	Ammonia		
INPUT DATA			
	P production (g/person/day)	8	
	Treatment reduction fator based on *OPSPAR Guideline No. 4* for treatment types	0.545	
	Treatment reduction factor based on AER Data where available	-	
	Agglomeration PE	3178	
	Average Annual Hydraulic Load (Q) from AER where available	324,485	
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	144,996	
	Existing anual Ammonia load from AER where available (Kg/yr)	-	
	Existing anual TP load from PE (Kg/yr)	9,280	
RECEIVING WATERS	BLACKWATER (KELLS)_020 (IE_EA_07B010170)		
	95%ile Flow (l/s)	20	
	Background concentration (C) (mg/L)	0.0525	2016-2018 average of annual means at RS07B010160
	Agglomeration PE	3178	
INFLUENT LOADS	Existing Influent Ammonia load from AER (kg/yr)	9280	
EFFLUENT LOADS	Existing Effluent Ammonia Loads based on Treatment Reduction Factor (Kg/yr)	5057	
EFFLUENT CONCENTRATIONS	Existing effluent TP Concentration mg/l (= g/m3)	15.6	
	Measured Effluent Concetration (mg/l)	11.0907037	Compiled_Effluent_Monitoring_Data_MDS_2015-2019 average of all data
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	10.3	
	Existing effluent Ammonia Concentration (mg/l)	15.59	
	Existing measured effluent Ammonia Concentration (mg/l)	11.09	
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l Ammonia)	**5.329**	
	Mass Balance Calculation Resultant Concentration (T) for measured Discharge (mg/l Ammonia)	**3.802**	

Scenario 4 – Mean Flows, Existing Upstream Background Concentration

AGGLOMERATION	**Bailieborough**		
	PO4-P = 50% TP		
INPUT DATA			
	P production (g/person/day)	2	
	Treatment reduction fator based on *OPSPAR Guideline No. 4* for treatment types	0.1	P Removal
	Treatment reduction factor based on AER Data where available	-	
	TP to PO4-P ratio	0.5	
	Agglomeration PE	3178	
	Average Annual Hydraulic Load (Q) from AER where available	324,485	
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	144,996	
	Existing annual TP load from AER where available (Kg/yr)	-	
	Existing annual TP load from PE (Kg/yr)	2,320	
RECEIVING WATERS	**BLACKWATER (KELLS)_020 (IE_EA_07B010170)**		
	Mean Flow (l/s)	270	
	Background concentration (C) (mg/L)	0.015083333	2016-2018 average of annual means at RS07B010160
	Agglomeration PE	**3178**	
INFLUENT LOADS	Existing annual TP load from PE (Kg/yr)	**2320**	
EFFLUENT LOADS	Existing Effluent TP Loads based on Treatment Reduction Factor (Kg/yr)	**232**	
	Existing Effluent orthophoshate Loads based on Treatment Reduction Factor @ half TP (mg/l)	**116**	
EFFLUENT CONCENTRATIONS	Existing effluent TP Concentration mg/l (= g/m3)	**0.7**	
	Existing effluent Orthophosphate Concentration @ half TP (mg/l)	**0.36**	
	Measured Effluent Concetration (mg/l)	0.8295	Compiled_Effluent_Monitoring_Data_MDS_2015-2019 average of all data
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	**10.3**	
	Existing effluent Orthophosphate Concentration @ half TP (mg/l)	**0.36**	
	Measured Orthophosphate Concentration @ half TP (mg/l)	**0.83**	
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l Ortho-P)	**0.0277**	
	Mass Balance Calculation Resultant Concentration (T) for Measured Discharge (mg/l PO4-P)	**0.0450**	

AGGLOMERATION	**Bailieborough**		
	BOD		
INPUT DATA			
	P production (g/person/day)	60	
	Treatment reduction fator based on *CIWMEN Training manual for Municalp WasteWater Treatment* for treatment types	0.35	
	Treatment reduction factor based on AER Data where available	-	
	Agglomeration PE	3178	
	Average Annual Hydraulic Load (Q) from AER where available	324,485	
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	144,996	
	Existing anual BOD load from AER where available (Kg/yr)	-	
	Existing anual BOD load from PE (Kg/yr)	69,598	
RECEIVING WATERS	BLACKWATER (KELLS)_020 (IE_EA_07B010170)		
	Mean Flow (l/s)	270	
	Backgroud concentration (C) (mg/L)	1.3625	2016-2018 average of annual means at RS07B010160
	Agglomeration PE	**3178**	
INFLUENT LOADS	Existing Influent BOD load from AER (kg/yr)	**69598**	
EFFLUENT LOADS	Existing Effluent BOD Loads based on Treatment Reduction Factor (Kg/yr)	**24359**	
EFFLUENT CONCENTRATIONS	Estimated Existing effluent BOD Concentration mg/l (= g/m3)	**75.1**	
	Measured Effluent Concetration (mg/l)	10.11960784	Compiled_Effluent_Monitoring_Data_MDS_2015-2019 average of all data with 2 outliers removed
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	**10.3**	
	Existing effluent BOD Concentration (mg/l)	**75.07**	
	Existing measured effluent BOD Concentration (mg/l)	**10.12**	
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l BOD)	**4.068**	
	Mass Balance Calculation Resultant Concentration (T) for Measured Discharge Discharge (mg/l BOD)	**1.684**	

AGGLOMERATION	**Bailieborough**		
	Ammonia		
INPUT DATA			
	P production (g/person/day)	8	
	Treatment reduction fator based on *OPSPAR Guideline No. 4* for treatment types	0.545	
	Treatment reduction factor based on AER Data where available	-	
	Agglomeration PE	3178	
	Average Annual Hydraulic Load (Q) from AER where available	324,485	
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	144,996	
	Existing anual Ammonia load from AER where available (Kg/yr)	-	
	Existing anual TP load from PE (Kg/yr)	9,280	
RECEIVING WATERS	BLACKWATER (KELLS)_020 (IE_EA_07B010170)		
	Mean Flow (l/s)	270	
	Backgroud concentration (C) (mg/L)	0.0325	2016-2018 average of annual means at RS07B010160
	Agglomeration PE	**3178**	
INFLUENT LOADS	Existing Influent Ammonia load from AER (kg/yr)	**9280**	
EFFLUENT LOADS	Existing Effluent Ammonia Loads based on Treatment Reduction Factor (Kg/yr)	**5057**	
EFFLUENT CONCENTRATIONS	Existing effluent TP Concentration mg/l (= g/m3)	**15.6**	
	Measured Effluent Concetration (mg/l)	11.0907037	Compiled_Effluent_Monitoring_Data_MDS_2015-2019 average of all data
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	**10.3**	
	Existing effluent Ammonia Concentration (mg/l)	**15.59**	
	Existing measured effluent Ammonia Concentration (mg/l)	**11.09**	
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l Ammonia)	**0.603**	
	Mass Balance Calculation Resultant Concentration (T) for measured Discharge (mg/l Ammonia)	**0.438**	

Scenario 5 – Mean Flows, Notionally Clean Background Concentration

AGGLOMERATION	**Bailieborough**		
	PO4-P = 50% TP		
INPUT DATA			
	P production (g/person/day)	2	
	Treatment reduction fator based on *OPSPAR Guideline No. 4* for treatment types	0.1	P Removal
	Treatment reduction factor based on AER Data where available	-	
	TP to PO4-P ratio	0.5	
	Agglomeration PE	3178	
	Average Annual Hydraulic Load (Q) from AER where available	324,485	
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	144,996	
	Existing annual TP load from AER where available (Kg/yr)	-	
	Existing annual TP load from PE (Kg/yr)	2,320	
RECEIVING WATERS	**BLACKWATER (KELLS)_020 (IE_EA_07B010170)**		
	Mean Flow (l/s)	270	
	Background concentration (C) (mg/L)	0.005	
	Agglomeration PE	**3178**	
INFLUENT LOADS	Existing annual TP load from PE (Kg/yr)	**2320**	
EFFLUENT LOADS	Existing Effluent TP Loads based on Treatment Reduction Factor (Kg/yr)	**232**	
	Existing Effluent orthophoshate Loads based on Treatment Reduction Factor @ half TP (mg/l)	**116**	
EFFLUENT CONCENTRATIONS	Existing effluent TP Concentration mg/l (= g/m3)	**0.7**	
	Existing effluent Orthophosphate Concentration @ half TP (mg/l)	**0.36**	
	Measured Effluent Concetration (mg/l)	0.8295	Compiled_Effluent_Monitoring_Data_MDS_2015-2019 average of all data
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	**10.3**	
	Existing effluent Orthophosphate Concentration @ half TP (mg/l)	**0.36**	
	Measured Orthophosphate Concentration @ half TP (mg/l)	**0.83**	
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l Ortho-P)	**0.0179**	
	Mass Balance Calculation Resultant Concentration (T) for Measured Discharge (mg/l PO4-P)	**0.0353**	

AGGLOMERATION	**Bailieborough**		
	BOD		
INPUT DATA			
	P production (g/person/day)	60	
	Treatment reduction fator based on *CIWMEN Training manual for Municalp WasteWater Treatment* for treatment types	0.35	
	Treatment reduction factor based on AER Data where available	-	
	Agglomeration PE	3178	
	Average Annual Hydraulic Load (Q) from AER where available	324,485	
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	144,996	
	Existing anual BOD load from AER where available (Kg/yr)	-	
	Existing anual BOD load from PE (Kg/yr)	69,598	
RECEIVING WATERS	BLACKWATER (KELLS)_020 (IE_EA_07B010170)		
	Mean Flow (l/s)	270	
	Background concentration (C) (mg/L)	0.26	
	Agglomeration PE	**3178**	
INFLUENT LOADS	Existing Influent BOD load from AER (kg/yr)	**69598**	
EFFLUENT LOADS	Existing Effluent BOD Loads based on Treatment Reduction Factor (Kg/yr)	**24359**	
EFFLUENT CONCENTRATIONS	Estimated Existing effluent BOD Concentration mg/l (= g/m3)	**75.1**	
	Measured Effluent Concetration (mg/l)	10.11960784	Compiled_Effluent_Monitoring_Data_MDS_2015-2019 average of all data with 2 outliers removed
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	**10.3**	
	Existing effluent BOD Concentration (mg/l)	**75.07**	
	Existing measured effluent BOD Concentration (mg/l)	**10.12**	
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l BOD)	**3.006**	
	Mass Balance Calculation Resultant Concentration (T) for Measured Discharge Discharge (mg/l BOD)	**0.622**	

AGGLOMERATION	**Bailieborough**		
	Ammonia		
INPUT DATA			
	P production (g/person/day)	8	
	Treatment reduction fator based on *OPSPAR Guideline No. 4* for treatment types	0.545	
	Treatment reduction factor based on AER Data where available	-	
	Agglomeration PE	3178	
	Average Annual Hydraulic Load (Q) from AER where available	324,485	
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	144,996	
	Existing anual Ammonia load from AER where available (Kg/yr)	-	
	Existing anual TP load from PE (Kg/yr)	9,280	
RECEIVING WATERS	BLACKWATER (KELLS)_020 (IE_EA_07B010170)		
	Mean Flow (l/s)	270	
	Background concentration (C) (mg/L)	0.008	
	Agglomeration PE	**3178**	
INFLUENT LOADS	Existing Influent Ammonia load from AER (kg/yr)	**9280**	
EFFLUENT LOADS	Existing Effluent Ammonia Loads based on Treatment Reduction Factor (Kg/yr)	**5057**	
EFFLUENT CONCENTRATIONS	Existing effluent TP Concentration mg/l (= g/m3)	**15.6**	
	Measured Effluent Concetration (mg/l)	11.0907037	Compiled_Effluent_Monitoring_Data_MDS_2015-2019 average of all data
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	**10.3**	
	Existing effluent Ammonia Concentration (mg/l)	**15.59**	
	Existing measured effluent Ammonia Concentration (mg/l)	**11.09**	
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l Ammonia)	**0.580**	
	Mass Balance Calculation Resultant Concentration (T) for measured Discharge (mg/l Ammonia)	**0.415**	

Scenario 6 – Mean Flows, Adjusted Background Concentration

AGGLOMERATION	**Bailieborough**		
	PO4-P = 50% TP		
INPUT DATA			
	P production (g/person/day)	2	
	Treatment reduction fator based on *OPSPAR Guideline No. 4* for treatment types	0.1	P Removal
	Treatment reduction factor based on AER Data where available	-	
	TP to PO4-P ratio	0.5	
	Agglomeration PE	3178	
	Average Annual Hydraulic Load (Q) from AER where available	324,485	
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	144,996	
	Existing annual TP load from AER where available (Kg/yr)	-	
	Existing annual TP load from PE (Kg/yr)	2,320	
RECEIVING WATERS	**BLACKWATER (KELLS)_020 (IE_EA_07B010170)**		
	Mean Flow (l/s)	270	
	Background concentration (C) (mg/L)	0.03	
	Agglomeration PE	**3178**	
INFLUENT LOADS	Existing annual TP load from PE (Kg/yr)	**2320**	
EFFLUENT LOADS	Existing Effluent TP Loads based on Treatment Reduction Factor (Kg/yr)	**232**	
	Existing Effluent orthophoshate Loads based on Treatment Reduction Factor @ half TP (mg/l)	**116**	
EFFLUENT CONCENTRATIONS	Existing effluent TP Concentration mg/l (= g/m3)	**0.7**	
	Existing effluent Orthophosphate Concentration @ half TP (mg/l)	**0.36**	
	Measured Effluent Concetration (mg/l)	0.8295	Compiled_Effluent_Monitoring_Data_MDS_2015-2019 average of all data
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	**10.3**	
	Existing effluent Orthophosphate Concentration @ half TP (mg/l)	**0.36**	
	Measured Orthophosphate Concentration @ half TP (mg/l)	**0.83**	
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l Ortho-P)	**0.0420**	
	Mass Balance Calculation Resultant Concentration (T) for Measured Discharge (mg/l PO4-P)	**0.0593**	

AGGLOMERATION	**Bailieborough**		
	BOD		
INPUT DATA			
	P production (g/person/day)	60	
	Treatment reduction fator based on *CIWMEN Training manual for Municalp WasteWater Treatment* for treatment types	0.35	
	Treatment reduction factor based on AER Data where available	-	
	Agglomeration PE	3178	
	Average Annual Hydraulic Load (Q) from AER where available	324,485	
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	144,996	
	Existing anual BOD load from AER where available (Kg/yr)	-	
	Existing anual BOD load from PE (Kg/yr)	69,598	
RECEIVING WATERS	BLACKWATER (KELLS)_020 (IE_EA_07B010170)		
	Mean Flow (l/s)	270	
	Background concentration (C) (mg/L)	1.4	
	Agglomeration PE	**3178**	
INFLUENT LOADS	Existing Influent BOD load from AER (kg/yr)	**69598**	
EFFLUENT LOADS	Existing Effluent BOD Loads based on Treatment Reduction Factor (Kg/yr)	**24359**	
EFFLUENT CONCENTRATIONS	Estimated Existing effluent BOD Concentration mg/l (= g/m3)	**75.1**	
	Measured Effluent Concetration (mg/l)	10.11960784	Compiled_Effluent_Monitoring_Data_MDS_2015-2019 average of all data with 2 outliers removed
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	**10.3**	
	Existing effluent BOD Concentration (mg/l)	**75.07**	
	Existing measured effluent BOD Concentration (mg/l)	**10.12**	
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l BOD)	**4.104**	
	Mass Balance Calculation Resultant Concentration (T) for Measured Discharge Discharge (mg/l BOD)	**1.720**	

AGGLOMERATION	**Bailieborough**		
	Ammonia		
INPUT DATA			
	P production (g/person/day)	8	
	Treatment reduction fator based on *OPSPAR Guideline No. 4* for treatment types	0.545	
	Treatment reduction factor based on AER Data where available	-	
	Agglomeration PE	3178	
	Average Annual Hydraulic Load (Q) from AER where available	324,485	
	Average Annual Hydraulic Load (Q) from PE (m3/yr)	144,996	
	Existing anual Ammonia load from AER where available (Kg/yr)	-	
	Existing anual TP load from PE (Kg/yr)	9,280	
RECEIVING WATERS	BLACKWATER (KELLS)_020 (IE_EA_07B010170)		
	Mean Flow (l/s)	270	
	Background concentration (C) (mg/L)	0.0525	2016-2018 average of annual means at RS07B010160
	Agglomeration PE	**3178**	
INFLUENT LOADS	Existing Influent Ammonia load from AER (kg/yr)	**9280**	
EFFLUENT LOADS	Existing Effluent Ammonia Loads based on Treatment Reduction Factor (Kg/yr)	**5057**	
EFFLUENT CONCENTRATIONS	Existing effluent TP Concentration mg/l (= g/m3)	**15.6**	
	Measured Effluent Concetration (mg/l)	11.0907037	Compiled_Effluent_Monitoring_Data_MDS_2015-2019 average of all data
MASS BALANCE CALCS	Effluent flow BASED ON HYDRAULIC LOAD Q (l/s)	**10.3**	
	Existing effluent Ammonia Concentration (mg/l)	**15.59**	
	Existing measured effluent Ammonia Concentration (mg/l)	**11.09**	
	Mass Balance Calculation Resultant Concentration (T) for Existing Discharge (mg/l Ammonia)	**0.623**	
	Mass Balance Calculation Resultant Concentration (T) for measured Discharge (mg/l Ammonia)	**0.458**	