Hydro-G

Stormwater Overflow & Receiving Stream Assessment

(Broadmeadow)

Assimilation Simulation Evaluation Report

Celestica Site Stormwater Storage Tank to Foul Network

Junction of Glen Ellan Rd/ Balheary Rd Lane

Swords, Co. Dublin

Consultant

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CLIENT

Gerard Gannon Properties

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NOTES:

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About the Author

PAMELA BARTLEY B.ENG., MSC., PH.D

Pamela is a water focussed civil engineer with 20 year's field-based practice in water and wastewater, surface water hydrology and groundwater hydrogeology, surface water quality and impact assessments, groundwater evaluations and water supply borehole drilling. Pamela Bartley's company is Bartley Hydrogeology ltd., registered to trade as Hydro-G. The company holds professional indemnity insurance of €2million for each and every claim in each period and the company holds both employers and public liability insurances.

Pamela is qualifiedand IOSH certified to act as PSDP (Project Supervisor Design Phase) & PSCS (Project Supervisor Construction Stage) as defined by the Construction Regulations.

The company is a registered Irish Water Supplier (no. 1855) and Pamela Bartley is HSQE approved within Irish Water and is one of their Hydrogeologist service providers.

Upon completion of a Diploma in Water and Wastewater Technology at Sligo RTC, she completed her primary degree in Civil Engineering at Queens University, Belfast and then completed a Masters in Environmental Engineering followed by a hydrogeologically focussed Ph.D. within the school of Civil Engineering at Trinity College, Dublin.

Her key work areas include hydrological impact evaluation for discharges to groundwater and surface waters, engineering abstractions for groundwater as a source of public water supply, the studies required for Section 4 wastewater Discharge Licences and the hydrology and hydrogeology of quarries.

Pamela has successfully completed post doctorate formal course training in the areas of:

- PSDP & PSCS (IOSH certified, 2016)
- Sustainable Drainage (Wallingford/CIRIA, 2005 & 2008)
- On Site Wastewater & Water Services Amendment Act 2012 (IE, Western Region 6 week programme 2012 & Dublin 2012)
- Expert Witness (IE, 2011)
- Planning & Development Act (IE, 2010)
- Surface Water Regulations 2009 (DoE, 2010 & 2011)
- Zero Discharge Willow Wastewater Systems Design Courses (Denmark 2008 & 2011 & Ireland 2012)
- Source Protection Zone Delineation (IGI/GSI, 2007)
- Groundwater & Contaminant Microbiology (IGI/GSI, 2006)
- Applied Groundwater Modelling (ESI, UK, 2000)
- Karst Hydrogeology (GSI, 2013)
- Site Suitability Assessment (FETAC, 2002)

As a result of work in evaluating planning appeals, Pamela has become specialist in planning evaluations in the context of enacted Irish Regulation and EU Directives concerning the water environment such as the Groundwater Regulations (S.I. No. 9 of 2010 as amended), Surface Water Regulations (S.I. No. 272 of 2009 as amended), Water Framework and Habitats' Directives.

Pamela is a qualified and certified 'Site Assessor' and was an interviewer of examination candidates in respect of eligibility for the Site Suitability FETAC Qualification.

In the past, she has lectured in third level institutions (WIT, CIT, 1996 – 1999), delivered practical laboratory instruction in the assessment of subsoils for the FETAC Site Assessor programme and demonstrated hydraulics laboratory modules at Trinity College Dublin (1996).

She has been an invited guest speaker at An Board Pleanála, The Irish Concrete Federation, The Health Service Executive, Environmental Health Officers National Conference, The Irish Planning Institute's National Conference, The International Association of Hydrogeologists National Conference (Irish Branch) and has delivered hydrogeological lectures to the public during Science Week.

Pamela's water supply borehole expertise has been gained in the field by personal supervision of the drilling and designing the required subsurface completions for large scale Public Water abstractions for Group Water Schemes, many Public Supply sources for Galway County Council, Clare County Council and later for Irish Water in Counties from Donegal to Galway and the Roscommon border. She is Irish Water's panel hydrogeologist for the Northwest.

Her successful assessments of regionally important quarries in proximity to SAC environments has driven her development of the adaptation of DoEHLG (2011) assimilation capacity simulations to reflect mean flow hydrometric drivers on surface water systems.

Contents

Executive Summary

- This report has been prepared by Hydro-G to enable **evaluation of a storm driven, intermittent, overflow discharge** in the context of the Objectives of the European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272 of 2009), as amended by the European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2012 (S.I. No. 327 of 2012) and the European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2015 (S.I. No. 386 of 2015) and the European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 (S.I. No. 77 of 2019): hereafter simply referred to as the Surface Water Regulations.

- The **overflow discharge, requiring environmental impact evaluation, will be from a proposed Stormwater Storage Tank** required on the Irish Water foul water network draining to the Swords Wastewater Treatment Plant and serving the Oldtown / Mooretown and Holybanks catchment in Swords, Co. Dublin. The proposed tank will alleviate constraints within the Irish Water foul system.

- Irish Water have undertaken modelling of the catchment and have concluded that a 2,250m3 off-line tank will supply the requisite storage for a 1 in 5-year storm as further discussed in the associated, accompanying, Waterman Moylan Engineering Assessment Report (August 2021).

- The objective of this evaluation is to present a reasoned and justified assimilation impact simulation for Fingal County Council in order to facilitate their consideration regarding the feasibility for compliance with the Surface Water Regulations.

- With respect to the Environmental Objectives of the Surface Water Regulations, Article (28) of the parent Statutory Instrument states as follows:

    1. A surface water body whose status is determined to be high or good (or good ecological potential and good surface water chemical status as the case may be) when classified by the Agency in accordance with these Regulations **shall not deteriorate in status**.

    (2) A surface water body whose status is determined to be less than good (or good ecological potential and good surface water chemical status as the case may be) when classified by the Agency in accordance with these Regulations **shall be restored to at least good status** (or good ecological potential and good surface water chemical status as the case may be) by not later than 22 December 2015 unless otherwise provided for by these Regulations.

- S.I. No. 327 of 2012 made provision for amending the date by which pollution reduction programmes for surface water bodies must be prepared.

- Hydro-G has been commissioned to simulate the effects of an occasional, storm driven, overflow on a surface water that is currently assigned a Poor Status classification. Given that an Objective of the Surface Water Regulation is to 'Restore to At Least Good Status', the focus of the assessment then becomes a question as to whether the effect of the proposed development will aid efforts in catchment improvements aimed at improving Status class to Good.

- The Environmental Quality Objectives of the Surface Water Regulations specify Environmental Quality Objective **concentrations**. Therefore, the assessment presented in this Hydro-G report focusses on determining potential resultant concentrations in the downstream water environment. Assimilation simulations have been completed.

- Based on assimilation capacity simulations, it can be concluded that the discharge is feasible, justifiable and defensible in the context of the objectives of EC Environmental Objectives (Surface Waters) Regulations Statutory Instrument S.I. No. 272 of 2009, as amended 2012, 2015, 2019. This conclusion is made because the simulations have been carried out to evaluate whether the proposed development would aid or hinder catchment efforts to improve the Status from the assigned Poor Status to the Regulatory requirement that is Good Status. Simulated resultant concentrations suggest potential for improvement in Status class as a result of the proposed infrastructure improvements.

1.0 Introduction

This report relates to the proposed Celestica Site Stormwater Storage Tank to Foul Network @ Junction of Glen Ellan Rd / Balheary Rd Lane, Swords, Co. Dublin. An overflow discharge mechanism from a proposed Stormwater Storage Tank requires assimilation impact assessment in the context of compliance with the Objectives of the Surface Water Regulations.

The proposed Stormwater Storage Tank is required on the Irish Water foul water network draining to the Swords Wastewater Treatment Plant and serving the Oldtown / Mooretown and Holybanks catchment in Swords, Co. Dublin. The proposed tank will alleviate constraints within the Irish Water foul system. Irish Water have modelled the situation and offer that it is important to note that the driver for this scheme is the reduction of flooding risk. The reduction of pollution risk is an added benefit. With respect to conventional network analysis, Irish Water's modelling suggests that reduction in pollution risk is not apparent from the typical year TSR analysis, instead it is apparent from the results of the previously completed 5 year return period design rainfall analysis.

Hydro-G has been commissioned to simulate the effects of an occasional, storm driven, overflow on a surface water that is currently assigned a Poor Status classification. Given that an Objective of the Surface Water Regulation is to 'Restore to At Least Good Status', the focus of the assessment then becomes a question as to whether the effect of the proposed development will aid efforts in catchment improvements aimed at improving Status class to Good. A fluvial pathway from the Broadmeadow River to the subject site will exist via this overflow outfall pipe, however this is mitigated against via a non-return valve as explained in the accompanying Waterman Moylan Reports.

This Hydro-G report presents as follows:

- Section 2.0 presents summary information regarding the site and the development proposal as extracted from Waterman Moylan Engineering ltd.'s reports listed as follows:
    - Engineering Assessment Report (August 2021).
    - Flood Risk Assessment, including Statement of Design Consistency (August 2021).
    - Preliminary Construction, Demolition and Waste Management Plan (August 2021)
- Section 3. 0 presents volumes and likely hydrochemical quality of waters arising for discharge at the site.
- Section 4.0 presents catchment hydrometrics and selected simulation flow characteristic for the receiving stream.
- Section 5.0 presents the rationale for the baseline hydrochemical quality for the receiving water.
- Section 6.0 presents assimilation capacity modelling simulations based on DoEHLG (2011) Guidance for Assimilation Capacity Resultant Concentrations.
- Section 7.0 presents a Discussion of results.
- Section 8.0 presents the work's Conclusion.

The assessment presented in this work relies upon technical information presented for the proposed development by Waterman Moylan Engineers Ltd. The assimilation simulation methodology applied by Hydro-G has evolved in field practice and experience gained in over a decade of complex assessments for stormwater driven scenarios.

2.0 The Site & Proposed Development

Details relating to the site, the proposed development and technical aspects are presented in the Waterman Moylan Engineering ltd.'s reports listed as follows:

a. Engineering Assessment Report (August 2021).
b. Flood Risk Assessment, including Statement of Design Consistency (August 2021).
c. Preliminary Construction, Demolition and Waste Management Plan (August 2021)

The proposed site for the Stormwater storage tank is located on the junction of the Glen Ellan Road and the Balheary Road, Swords, Co. Dublin, as indicated in Figure 1. The site is 1.4km north of Swords, 1.1km west of the M1 motorway and 300m south of the Broadmeadow River. The site is owned by Gannon Properties and is locally referred to as the Celestica/Motorola site.

The proposed Stormwater Storage Tank will be part of the Irish Water foul water network which drains to the Swords Wastewater Treatment Plant and will serve the Oldtown / Mooretown / Holybanks catchment in Swords, Co. Dublin. The proposed tank will alleviate constraints within the Irish Water foul system. Irish Water have undertaken modelling of the catchment and have concluded that a 2,250m3 off-line tank will supply the requisite storage for a 1 in 5-year storm.

Waterman Moylan Engineering ltd.'s Engineering Assessment Report (August 2021) presents detail as follows:

- *The Oldtown / Mooretown / Holybanks land catchment discharges eastwards via gravity sewer to the Swords Wastewater Treatment Plant (WwTP) located at Spittal Hill, east of the M1 Motorway. This treatment plant caters for 90,000 PE.*

- *Known constraints within the existing Irish Water gravity foul network, as a result of groundwater / stormwater ingress, result in the foul water system regularly surcharging, during heavy rainfall events, resulting in Stormwater overflow (SWO) at a low point in the system at the Ward River, and also at the WwTP itself. As noted, this is due to groundwater and stormwater ingress; this situation is exacerbated during times of prolonged or extreme rainfall with manhole lids known to lift as a result, and excess water (largely surface water) discharging directly to the adjacent Ward River, a tributary of the Broadmeadow River.*

- ***Irish Water (IW) have modelled the constraints in the network and have indicated that they require a storage tank of 2,250m3 volume to be located near the outfall sewer on the Balheary Road**.*

A response to a request for further information from Waterman Moylan provided an Irish Water response regarding the FREQUENCY with which the proposed tank will overflow (once the 2,250m^3 storage tank is full) and what flows/volumes will be overflowing through the outfall pipe to the Broadmeadow River.

> *"SWO run for pre and post full development scenario (sic.) worked on to compare need for the tank and showing its benefit. This will be required for planning purposes. The primary objective is to prevent flooding and balance a tank volume with a compliant overflow. It's not practical to install a tank volume over 1/20 year event if no property is at risk and a 1/30 year event if property is at risk.*
>
> *Given that the primary objective is to retain the flood volume we are providing a volume to contain the 1/5 year fully.*

Section 2.0 of Waterman Moylan Engineering ltd.'s Engineering Assessment Report (August 2021) presents detail of Irish Water's modelling results and explains the significance of model outputs for many different Return Period Scenarios. Of **PARTICULAR NOTE** is that Irish Water suggest, in clarification responses to Waterman Moylan's Engineering Assessment team, that the modelling of the proposed infrastructure improvements **"show the benefit in terms of reduction of overflow from existing SWO's downstream. Irish Water can show the number of activations for a rainfall event, we have chosen a 1/ 5 and 1/ 30-year event."**

With the proposed 2,250m³ tank in place there is no spill predicted in either model run for the SWOs at the WwTP, and there is no spill predicted at the proposed storage tank overflow. These model results are for a in a 1 in 5-year storm event.

For storm events with a greater return period (up to 1 in 30-year event), there will be a significant reduction of the outfall volume compared to a "do nothing" approach.

The provision of the proposed off-line stormwater storage tank will ensure that there will be significantly less surcharge events, or at worst significantly reduced surcharge overflow volumes occurring to the Broadmeadow River.

Waterman Moylan's DWG 19-048-P003 presents Plan Views, Headwall Detail and Cross Sections for the proposed Storage Tank.

Alternative resolutions to the problem of multiple existing Storm Water Overflows s at the Ward River and Swords WWTP were considered by Irish Water, including fixing cross connections and / or laying additional upsized drainage lines in parallel to the existing infrastructure. However, the outcome of modelling or evaluating the alternative was that the most practical solution is to install a new offline 2,250m³ surface water storage tank with an overflow to the Broadmeadow River via gravity. Gannon Homes own the Motorola / Celestica site at this junction and have agreed with Irish Water to apply for and construct the storage tank at this location.

Figure 1 Site Location and River system (https://gis.epa.ie/EPAMaps/Water)

3.0 Discharge Volumes & Hydrochemistry

3.1 Discharge Rate & Volumes

Project information supplied to Hydro-G indicates that the outfall pipe proposed is a 300mm diameter pipe laid at a gradient of 1 in 250, permitting a flow of 70l/s or 0.07m3/second.

Discharge Flow Rate = Q_{out} = 70l/s or 0.07m3/s

Information relating to modelled Discharge Rates, Volumes and the Frequency of Spillover were supplied to Waterman Moylan by Irish Water as presented in the Engineering Assessment Report (2021), which can be summarised as follows:

- Irish Water simulation result tables indicating that there will be no overflow from the rainfall events associated with the 1 in 5 year and 1 in 10 year Return Periods (M5 CC & M10 CC).
- There will be surcharge and overflow from the storage tank for the M20 CC & M30 CC events.

NOTE:

Hydro-G therefore offers that state of flow in the receiving waters at the time of discharge will be the extreme rainfall storm event flows associated with the > 1 in 10 year Return Period.

Irish Water's model results relating the Yes/No overflow scenario to storm return periods were supplied as Table 1.

Table 1 Discharge Pipe Overflow Scenarios as a function of Storm Return Periods M5 to M30

Frequency	Scenario 3: 300mm dia orifice		
	Spill from proposed new tank of volume 2,250 m³	WwTP Stormwater Tank 2 SWO	WwTP Inlet SWO
M5 CC	No	No	No
M10 CC	No	No	Yes
M20 CC	Yes	No	Yes
M30CC	Yes	Potentially	Yes

Irish Water also supplied Waterman Moylan with model outputs for the volume of overflow (in m³) for differing frequencies of flood event (5, 10, 20 & 30 years) [Engineering Assessment Report, waterman Moylan, 2021]. The tested model scenarios were provided to illustrate the differences between the modelling data with and without the construction of the proposed tank, and these are further sub-divided to show the calculation results with and without the effects of climate change accounted for.

Irish Water's Model outputs for volumetric discharge under the differing frequencies of flood event (with and without the proposed tank and with a factor for climate change), was supplied as presented in Table 2.

Table 2 Irish Water's Model outputs for volumetric discharge under the differing frequencies of flood event (with and without the proposed tank and with a factor for climate change

2880 min duration with Date	Model Taken from DAP		DAP Long term model updated with the developer proposed tank, bifurcation removal and below scenarios		Model Taken from DAP		DAP Long term model updated with the developer proposed tank, bifurcation removal and below scenarios		Model Taken from DAP		DAP Long term model updated with the developer proposed tank, bifurcation removal and below scenarios		Model Taken from DAP		DAP Long term model updated with the developer proposed tank, bifurcation removal and below scenarios	
	Long Term Strategic Model		Scenario 3: 300 mm dia orifice		Long Term Strategic Model		Scenario 3: 300 mm dia orifice		Long Term Strategic Model		Scenario 3: 300 mm dia orifice		Long Term Strategic Model		Scenario 3: 300 mm dia orifice	
Location	Max in M5 event	Max in M5 event with Climate Change	Max in M5 event	Max in M5 event with Climate Change	Max in M10 event	Max in M10 event with Climate Change	Max in M10 event	Max in M10 event with Climate Change	Max in M20 event	Max in M20 event with Climate Change	Max in M20 event	Max in M20 event with Climate Change	Max in M30 event	Max in M30 event with Climate Change	Max in M30 event	Max in M30 event with Climate Change
WwTP Inlet SWO	533	897	0	11	875	1,242	27	234	1,215	1,606	220	451	1,395	1,900	332	614
WwTP Stormawater Tank 2 SWO	0	0	0	0	0	0	0	0	0	0	0	0	0	330	0	0
Spill from poroposed new tank of volume 2250 m3	0	0	0	0	0	0	0	7	0	0	0	606	0	0	260	938

In Waterman Moylan's textual explanation (Engineering Assessment Report, 2021) of the significance of the Irish Water data, presented here as Hydro-G Table 2, the following points were made:

> For the results to be compared between scenarios with and without the tank, the Model taken from DAP (the scenario with no tank constructed) will need to be compared to the DAP long-term model with the tank constructed. Care should be taken to ensure that the correct comparison of figures is being made so that both scenarios have the same storm frequency return period and are either both inclusive, or non-inclusive, of climate change.
>
> A simple example of this is the comparison of the storage tank overflow volume of 7m^3 that will occur for the M10 event inclusive of climate change. The corresponding figure for the scenario if no tank is built and for the 10-year event, inclusive of climate change, is an overflow volume from the WwTP inlet of 1,242m^3.

As a means of further simplifying the Irish Water model outputs for volume of overflow (Table 2), Hydro-G presents the information for the Stormwater Overflow (SWO) at the Swords WWTP Inlet for the two scenarios: (a) Do nothing and don't build the new stormwater tank at the Celestica site and (b) build the proposed new stormwater tank at the Celestica site and the Storm Events with Climate Change only. Refer to Table 3.

Table 3 Hydro-G's volumetric discharge (m3) data extracts for the Inlet to SWORDS WWTP from Irish Water's Model output table (Table 2, above)
WITH Hydro-G's calculation on the % Reduction in Volume spilling out at the Inlet to Swords WWTP.

	Storm Return Period			
WWTP SWO Overflow (m3) WITH CLIMATE CHANGE Factor	**M5**	**M10**	**M20**	**M30**
NO New Stormwater Tank @ Cellestica Site	897	1242	1606	1900
IF new Stormwater Tank @ Cellestica Site	11	234	451	614
% REDUCTION IN Surface Water Overflow SPILL @ Inlet to Swords WWTP	**99**	**81**	**72**	**68**

With respect to the information presented by Irish Water (Table 2) and extracted by Hydro-G as Table 3, without the proposed stormwater tank there would be 897 m3 of combined foul and stormwater overflowing at the inlet to the Swords WWTP for the 1 in 5 year Storm event, with a climate change factor incorporated. It is clear that IF the new stormwater tank is installed at the Celestica site, there could be a 99% reduction in the amount of combined sewer overspill at the inlet to the Swords WWTP for the 1 in 5 year Return period storm. Similarly, extrapolating Irish Water's model outputs suggests that there could be an 81% reduction of SWO for the 1 in 10 year return period storm and reductions of 72% and 68%, respectively, for the M20 and M30 Storms. It would seem clear that the environmental benefit is unquestionable. That information relates to the SWO at the inlet to Swords WWTP.

With respect to the data relating to the volume of discharge from the tank itself at the proposed development location on the Celestica site, Irish Water's model outputs were extracted by Hydro-G from Table 2 to present the volume and then calculate the probable duration of overflow discharge from the site, given that project information suggest a full bore flow of 0.07m3/s (above). Data are presented as Table 4.

Table 4 Irish Water's model outputs for Discharge Volumes (m3) from the proposed stormwater tank at the Celestica site per storm return periods M5 to M30 = 0, 7m3, 606m3 and 928 m3 with Hydro-G's calculated associated durations

Storm Event Return Period	M5	M10	M20	M30	
Discharge Volume Spill from Proposed Tank (m3) with CLIMATE CHANGE Factor	**0**	**7**	**606**	**938**	
Discharge Duration (time) @ Discharge Rate Q = 0.07m3/s	0	100	8657	13400	Seconds
	0	2	144	223	minutes
	0	0.03	2.40	3.72	hrs

Model Output data (Table 2 and Table 4) suggest volumetric and duration discharge volumes the proposed storm tank as follows, per model storm return period:

a) For the 1 in 5 year return period there will be ZERO overflow
b) For the 1 in 10 year return period there will be a total of 7m3 discharge and it will be over in 2 minutes
c) For the 1 in 20 year return period there will be a total of 606m3 discharge and it will be over in 2.4 hours
d) For the 1 in 30 year return period there will be a total of 938m3 discharge and it will be over in 3.7 hours

Durations have been calculated based on project information supplied to Hydro-G indicating that the outfall pipe proposed is a 300mm diameter pipe laid at a gradient of 1 in 250, permitting a flow of 70l/s or 0.07m3/second.

With respect to the proposed stormwater tank's discharge rate, frequency, volume and duration, Hydro-G concludes as follows:

1. Discharge Flow Rate = Q_{out} = 70l/s or 0.07m3/s

2. Frequency = Never for the M5 but yes at >M's, when climate change is considered

3. Total Volume & Durations =
   a. 7m3 in 2 mins for the M10,
   b. 606m3 over 2.4hrs for the M20 &
   c. 938m3 over 3.7hrs for the M30

As previously stated, the discharge will be a mix of groundwater ingress, stormwater and foul water overflow to the Broadmeadow River.

As previously stated, the state of flow in the receiving waters at the time of discharge will be the extreme rainfall storm event flows associated with the > 1 in 10-year Return Period.

Given that the discharge durations are relatively brief as well as occasional, the receiving waters are likely to still be in high flow for the duration of the discharge.

3.2 Discharge hydrochemistry

The proposed development is a new stormwater tank required on the Irish Water foul water network draining to the Swords Wastewater Treatment Plant and serving the Oldtown / Mooretown and Holybanks catchment in Swords, Co. Dublin. The proposed tank will alleviate constraints within the Irish Water foul system. The proposed occasional overflow, requiring assimilation capacity simulation, will be a discharge that represents mostly stormwater and groundwater infiltration from parts of the older network. The overflow represents ingress over and above the Irish Water design DWF foul component for the pump station and the specified 2 day retention capacity. Details were extracted for the purposes of summary in Sections 2.0 and 3.1 of this Hydro-G report but are presented in more detail in Waterman Moylan's Engineering Assessment and Flood Risk Assessment Reports (August 2021).

Given the nature of the design proposal, it is reasonable to expect that the **Discharge Hydrochemistry** will be a mixture of stormwater and groundwater interflow from the upgradient catchments, local developed areas, the road network and some residual foul element associated with the network infrastructure itself. Waterman Moylan engaged with Irish Water regarding their concept for the hydrochemical concentration data. Irish Water responded "*that It is critical to note that the driver for this scheme is the reduction of flooding risk;– the reduction of pollution risk is an added benefit. Reduction in pollution risk is not apparent from the typical year TSR analysis, instead it is apparent from the results of the previously completed 5 year return period design rainfall analysis*"

No hydrochemical data for the proposed discharge were available but it is understood that the discharge constituents are storm and catchment related and by that very nature, the sources are groundwater infiltration and road runoff. Hydro-G reverted to published Irish results for the diverse sources. With respect to any potential stormwater concentrations resulting from runoff off paved areas and local roads, TII (2014) and Higgins (2007 & 2009) present the appropriate Irish hydrochemical values for consideration.

With respect to the baseline contribution from upgradient agricultural lands, Regan et al (2010) present a quantification and ranking of the amount of Dissolved Reactive Phosphorus (DRP), particulate phosphorus (PP), total phosphorus (TP) and suspended solids (SS) released in from five tillage soils subject to a rainfall intensity of 30 mm h–1 applied in three successive events. The research presented by Bruen et al. (2006) is also relevant. Corine 2018 mapping presents the entire eastern and northern catchments as Arable land (https://gis.epa.ie/EPAMaps/default).

Given the catchment area and the magnitude of the storms that will drive the stormoverflow, Hydro-G has merged published concentration constituents to deduce reasoned hydrochemical characteristics of the discharge. Experience and review of Irish stormwater runoff literature for both roads and agricultural systems, in addition to EPA published data on wastewater composition (EPA, 1999, 2021 and I.S. EN 12566 3: 2005) suggest hydrochemical characteristics of relevance as presented by Hydro-G in Table 5. The dataset was arrived at by integration of information presented in TII (2014), Higgins (2007 & 2009), Teagasc and NUIG research presented by Regan et al., (2010), EPA (1999) and likely dilution rainfall of mixed constituents. This is a reasonable **estimate** approach. Monitoring experience of Bartley (2003) and Bruen et al. (2006) also informed the selection of parametric values for the discharge.

Table 5 Literature Discharge Constituents and Storm driven overflow selected concentrations

Parameter	**Agricultural Runoff Concentration^**	**Road Runoff Concentration***	**Raw Wastewater ** (mgl)**	**LIKELY Rainfall Concentration (mg/l)**	**WORST CASE simulation Discharge Concentration Value adopted by Hydro G**
pH	Not reported	Not reported	7.5	7.5	7.5
BOD	Not reported	Not reported	150 - 500	<1	30
COD	Not reported	Not reported	300 - 1000	<10	400
Dissolved Reactive P	0.01 mg/l	Not reported	7.1	0	1.5 mg/l
Total Suspended Solids	<100 mg/l [Fig 2, heavy soil category)	139 mg/l SS Median (43 to 437 mg/l)	200 - 700	0	150 mg/l
Ammonium N as NH4N	Not reported	Not reported	22 to 80	0.005	3
Nitrate as NO3	Not reported	Not reported	1	0.001	37.5 (*i.e.* TV for GW Regs)
Nitrite as N	Not reported	Not reported	0.04	0.00001	0.04
PAH	Not reported	3.3 ug/l	Not specified but 0 envisaged	0	1.75
Cadmium[1]	Not reported	8 ug/l		0	4

^ Regan et al., (2010) in storm event @ 24hrs after initial rainfall event (Figure 2, heavy soils). * TII 2014, Higgins, 2007, 2009

** EPA 2021 (I.S. EN 12566 3: 2005, EPA 1999 presents a larger range of typical WW constituents than EPA 2021. When referring to EPA 1999, Hydro-G has selected domestic dataset rather than hotels.

[1] Surface Water Regulations 2019 specify Cd EQS's annual average value (EQS-AA) OR a maximum allowable concentration (EQS-MAC).

4.0 Surface Water Hydrology

The subject lands are in the catchment of the Broadmeadow River which is a tributary to the Broadmeadow (Malahide) estuary. The Broadmeadow River (IE EA 08B020800) receives discharge from the Ward River approximately 700m to the east of the projected discharge point and ultimately outfalls into the Malahide Estuary c. 1.5 Km downstream of it. The development site is located with EPA Hydrometric Area No. 08 (Nanny-Delvin) and the Broadmeadow_SC_010 WFD Sub-catchment.

On a regional scale the application site is located within the site is in the Nanny-Devlin catchment (Hydrometric Area 08), which is mapped by the EPA as having a total catchment size of 711km2, approximately. https://gis.epa.ie/EPAMaps/Water. The EPA catchments report states that this catchment includes the area drained by the Rivers Nanny and Delvin and by all streams entering tidal water between Mornington Point and Sea Mount, Co. Dublin, draining a total area of 711km². The largest urban centre in the catchment is Swords. The other main urban centres in this catchment are Donabate, Lusk, Skerries, Balbriggan, Stamullin, Laytown, Bettystown, Duleek, Ashbourne, Ratoath and Dunshaughlin. The total population of the catchment is approximately 159,230 with a population density of 224 people per km². This catchment is characterised by an undulating landscape, underlain for the most part by impure limestones and shales with metamorphic bedrock underlying the northern part of the catchment.

The site lies in the Broadmeadow_SC_010 WFD River sub-basin and the catchment upgradient of the discharge point on the Broadmeadow_040 segment is reported on the EPA HydroTOOL portal (https://gis.epa.ie/EPAMaps/Water) as having a total catchment area of 108.66 km2, approximately. Statistics of relevance for the upgradient catchment are as follows:

- RAINFALL_SAAR 716.6mm
- POORLYDRAINED 57.6%

This Broadmeadow River flows in a south easterly direction towards the Irish Sea. It is joined by the Ward River prior to discharging to the Malahide Estuary. The estuary is designated a Special Protection Area (SPA Site Code 004025), a candidate Special Area of Conservation (cSAC Site Code 000205), a proposed Natural Heritage Area (pNHA Site Code 000205) and a Ramsar site.

The proposed development site is located in Swords, c. 300 m south of the Broadmeadow River, which runs in a west-east orientation towards the Irish Sea. The proposed overflow discharge location is projected directly in this river directly to the north of the site, just downstream of the Balheary Road bridge.

OPW Hydrometric Station 08008 is situated 784m, approximately, upgradient of the proposed point at which the 300mm diameter outfall pipe from the proposed storm overflow meets the Broadmeadow_040 River. Flow and level data are available for Station 08008. While there is an OPW station (08001) that is closer to the proposed discharge point, only water level, not flow, is recorded there. Flow characteristics for Stn 08008 are therefore selected as model inputs in this work.

The hydrology of the area and the Broadmeadow River has been extensively studied and reported upon for the purposes of the Fingal East Meath Flood Risk Assessment and Management Study (Halcrow Barry, 2010). Details for the hydrology of the Broadmeadow catchment were also presented by Bhattarai and Baigent (2009). Information regarding the Design Flood of various periods, with 95%tile confidence limits was presented in the Fingal East Meath FRA & Management Study (Halcrow Barry, 2010) in full in Table 5-6 of that report and the information for the Broadmeadow 08008 Station is extracted here by Hydro-G as Table 6.

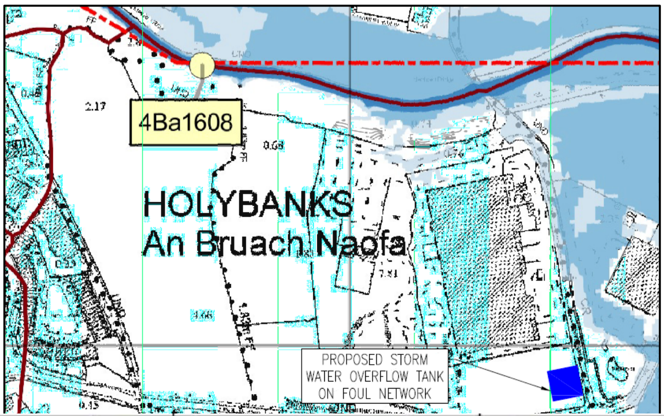
Table 6 FEMS FRAMS Design Flood of various periods, with 95%tile confidence limits for Stn 08008(Halcrow Barry, 2010)

Station	AEP	50%	20%	10%	4%	2%	1%	0.50%	0.10%
	T (years>)	2	5	10	25	50	100	200	1000
8008	QT	21.1	32.1	39.8	50.1	58.2	66.6	75.3	96.9
Lower	95%le	18.4	28.1	34.8	43.8	50.3	56.6	63.1	79.9
Upper	95%le	23.7	36.1	44.8	56.5	66.1	76.5	87.5	113.9

Note: QT = Peak flow value of T year return period (m3/s)

With reference to Table 6 and the knowledge that the discharge will commence in storm return periods of 1 in 10 year OR GREATER, the most conservative value of 34.8m3/s (i.e. QT Peak Flow Value at Lower 95%tile) is selected by Hydro-G as the value for assimilation capacity simulation for the receiving Broadmeadow_040 River.

Waterman Moylan's Flood Risk Assessment Report (August 2021) presents information on flood flows as extracted from the Fingal East Meath Flood Risk Assessment and Management Study (FEM FRAMS) maps, available on the OPW's National Flood Information Portal and the associated data. FEM FRAMS maps show that none of the subject site falls within the 0.1% AEP (1-in-1,000 year) flood plain, as shown in Figure 2.



Node Label	Water Level (mOD) 10% AEP	Flow (m3/s) 10% AEP	Water Level (mOD) 1% AEP	Flow (m3/s) 1% AEP	Water Level (mOD) 0.1% AEP	Flow (m3/s) 0.1% AEP
4Ba1608	5.02	36.09	5.55	69.46	6.32	129.69

Figure 2 Extract from the FEM FRAMS Fluvial Flood Extents Map "BRO/HPW/EXT/CURS/009" as presented by Waterman Moylan (Flood Risk Assessment, 2021).

With reference to FEM FRAMS modelling and mapping and Figure 2, the nearest node point on the receiving water Broadmeadow River, reference number: 4Ba1608, located circa 400m to the north-west, will have flood event flows of ranging from 36.09m3/s in the 1 in 10-year Return Period to 69.46m3/s in the 1 in 100 year and 129.69m3/s in the 1 in 1000 year.

The subject application tank will have a 300mm diameter outfall overflow pipe that will drain to the Broadmeadow River, as explained in the accompanying Waterman Moylan Engineering Assessment Report (2021). The overflow outfall pipe will always have the same discharge rate value of 0.07m3/s, no matter what the magnitude of storm flow in the receiving water. With reference to Tables 2, 4 and 6, above, it is possible to combine and summarise discharge overflow volumes, durations and concurrent receiving water's flow for the purposes of assimilation capacity simulation input values as presented here as Table 7.

Table 7 Integrated Dataset: Discharge Volumes, Frequencies & Concurrent Strom Flow Rates in the Broadmeadow

Storm Event	M5	M10	M20	M30
Discharge Volume Spill from Proposed Tank (m3) CC	**0**	**7**	**606**	**938**
Discharge Rate (m3/s)	**0.07**	**0.07**	**0.07**	**0.07**
Discharge Duration (hrs)	0	0.03	2.40	3.72
APPROXIMATE Qt 95tile Lower Confidence-Receiving Water's Strom Flow (m3/s)	28.1	34.8	~38	~40
[Qt data source = FEMS FRAMS Table 5-6 main Halcrow Barry 2010 report, Table 6, above. ~ approximate symbol used because the data in the FEM FRAMS are for M25 and M50 rather than M20 and M30 modelled by Irish Water]				

It is therefore concluded that a discharge volume of 0.07m3/s shall discharge to storm flows in the receiving water that are AT LEAST 500 times greater than the discharge. The discharge under consideration is not constant, it will be occasional and at a known storm frequency. Therefore, it is not appropriate to adopt the DOEHLG (2010) guidance to use the low flow 95%tile flow in the receiving water.

Receiving Water's 1 in 10-year Storm flow Q = 34.8 m3/s is a reasonable and justifiable assimilation capacity model input value (refer to Table 6).

5.0 Receiving Water's Quality

5.1 WFD 'Status' of the Receiving Water Environment

The Water Framework Directive (WFD) Directive 2000/60/EC was adopted in 2000 as a single piece of legislation covering rivers, lakes, groundwater and transitional (estuarine) and coastal waters. In addition to protecting said waters, its objectives include the attainment of 'Good Status' in water bodies that are of lesser status at present and retaining 'Good Status' or better where such status exists at present.

The WFD requires 'Good Water Status' for all European waters to be achieved through a system of river basin management planning and extensive monitoring. 'Good status' means both 'good ecological status' and 'good chemical status'.

The section of the Broadmeadow River related to the proposed discharge point is associated with the surface WFD waterbody Broadmeadows_040. The most recent published status (www.epa.ie - River Waterbody WFD Status 2013-2018) of this waterbody is **'Poor'** and its environmental risk is qualified by the WFD as 'At Risk of not achieving good status'.

The WFD Cycle 2 Catchment Nanny-Delvin Subcatchment Broadmeadow_SC_010 Code 08_3 report (2018) is available at https://catchments.ie suggests that "*Eight out of eleven river water bodies within this subcatchment are At Risk. The Broadmeadow has Poor 2010-2015 ecological status and elevated orthophosphate throughout in this subcatchment, as well as elevated ammonia in the Broadmeadow_010 and Broadmeadow_020. The Broadmeadow_020, Broadmeadow_030 and Broadmeadow_040 are also failing on dissolved oxygen levels." and that "The significant pressures throughout this subcatchment are agriculture (pastures, tillage, farmyards, land drainage), septic tanks, diffuse urban run-off and channelisation. Combined sewer overflows is (sic) also a pressure".* Hydro-G presents the sub catchment report as Appendix A, for ease of reference.

The catchments.ie Nanny-Devlin Catchment Assessment 2010-2015 (HA 08) cites that "*there is one designated Nutrient Sensitive Area (NSA) (Broadmeadow Estuary (Inner)) in the catchment. The NSA is associated with Swords wastewater treatment which has tertiary treatment and, therefore, is compliant with environmental objectives for NSAs."*

With respect to the EPA's labelling of watercourses (https://gis.epa.ie/EPAMaps) and WFD designations relating to 'Risk' and 'Status' for the EPA's most recent reporting period (2013 – 2018):

- The named downstream receiving water is the 'Broadmeadow_040' (IE_EA_08B020800):
  - Its **Status** is '**Poor'** & it is Risk Status in the WFD 3rd Cycle is mapped as '**At Risk'**

- The 'Broadmeadow_040' discharges to the 'Broadmeadow Water' (Malahide) Estuary (IE_EA_060_0100):
  - Mayne Estuary **Status** is **'Poor' &** it is mapped as **'At Risk'.**

- The Broadmeadow Water Estuary is connected to the 'Northwestern Irish Sea (HA 08)' (IE_EA_020_0000):
  - Irish Sea's **Status** is **'High'** & it is mapped as **'Not at Risk'**

While the EPA map the downstream 'transitional' water as the Broadmeadow Water Estuary (IE_EA_060_0100), NPWS map it as the Malahide Bay SAC (Site code 000205) and SPA (Site code 004025). Furthermore, Malahide Bay has its very own Statutory Instrument: S.I. No. 91/2019 - European Union Habitats (Malahide Estuary Special Area Of Conservation 000205) Regulations 2019.

It is worth noting that the Status and Risk classes assigned are those concurrent with a foul network that suffers from groundwater ingress, storm overflows and even lifting manholes in the storm situation (EAR, 2021). However, agriculture is also a big player in the catchment's problems. However, improvements in tandem are most likely. The purpose of the proposed works is to improve infrastructural capacity, and this should assist Status and removal of Risks from the catchment.

5.2 River Basin Management Plan Details

In 2018 the Basin Management Plan for Ireland 2018-2021 was launched, and it sets out the actions that Ireland will take to improve water quality and achieve 'good' ecological status in water bodies (rivers, lakes, estuaries and coastal waters) by 2027. The Plan provides a national framework for improving the quality of waters. The Eastern, South-eastern, South-western, Western and Shannon River Basin Districts are now merged to form one national River Basin District: The Plan refers to programmes such as catchments.ie. The document itself makes no specific reference to any points of note of relevance to this assessment.

5.3 Assimilation Simulation Upstream Water Quality

There is an EPA National Water Monitoring Station immediately downgradient of the point at which it is proposed that the stormwater tank's 300mm discharge pipe will join the Broadmeadow _040 river. The EPA monitoring station is called the 'Br nr Waterworks' (RS08B020800). Downloaded and selected monitoring results for that station are presented as Hydro-G's Appendix B as well as rainfall data for the closest Met Eireann Station.

While the Broadmeadow_040 river is currently assigned WFD 'Poor' Status, graphing and interrogation of the EPA's monitoring results clearly reveal the spikey response of BOD and Ammonia as N concentrations in the receiving water and that response is almost always observed in the high rainfall storm months of November and February. With reference to Appendix B's Data Tables and Graphs for the EPA monitoring data, Ammonia as N and BOD concentrations are generally always low in summer months and comply with the Surface Water Regulation Environmental Quality Objective concentrations specified for Good Status criteria. However, winter first flush storm events cause peak responses. The same is not true for ortho-P concentrations in the river. While baseline ortho-P concentrations are just about borderline Good Status most of the time, the peak responses for ortho-P coincide with the commencement of agricultural activity in the catchment in April. Remember, the catchment upgradient of the discharge point on the Broadmeadow_040 segment is reported on the EPA HydroTOOL portal (https://gis.epa.ie/EPAMaps) as having a total catchment area of 108.66 km2, approximately (Section 4.0), Corine 2018 mapped cover reports most of the catchment upgradient is Arable and the EPA report that 57.6% of the catchment is Poorly Drained. This creates an agricultural melting pot for P release to rivers in April and Summer, which is clear for the ortho-P response in the data. This is also why the WFD Cycle 2 report firstly mentions "significant pressures throughout this subcatchment are agriculture (pastures, tillage, farmyards, land drainage)" as well as other pressures.

Generally, actual upgradient water quality results are used in assimilation capacity simulations to simulate resultant concentrations for comparison with the Environmental Quality Objective concentrations specified in the Surface Water Regulations. However, Hydro-G deems it irrational to utilise the existing state of the environment data to justify a proposed improvement designed to aid repair in a damaged waterbody. However, given that the Broadmeadow_040 river is currently assigned WFD 'Poor' Status, if one were to apply the discharge Guidance (DoEHLG, 2010) in its generic steps, there is 'technically' no assimilative capacity for discharges to Poor Status rivers. However, one cannot apply the generic DOEHLG Guidance formulae for reasons including, but not limited to, the following:

a) Yes, the Broadmeadow_040 river is currently assigned WFD 'Poor' Status but the proposal to improve the foul network infrastructure is part of Irish Water's efforts to alleviate one of the identified and published pressures cited as 'Storm Water Overflows' in the WFD Cycle 2 Catchment Nanny-Delvin Subcatchment Broadmeadow_SC_010 Code 08_3 Dec 2018 report (Appendix A). Therefore, the proposal is essentially an 'action' identified as requiring attention during the 2nd Cycle WFD catchment assessments and the aim of the proposal is to contribute to catchment improvements.

b) The discharge under consideration is not constant, it will be occasional and at a known frequency of occurring at > than the 1 in 5-year storm event and it will be infrequently driven by the extreme storm situation. Therefore, adopting the DOEHLG (2010) guidance to use upgradient background quality and the lowest flow is not appropriate.

c) The proposed development will contain stormwaters in all situations until the 1 in 10-year storm event and even at that extreme storm event/return period the discharge will be a total of 7m3 of groundwater ingress, stormwater runoff and foul water combined. The 7m3 total volume will be discharged at a rate of 0.07m3/s for a total of 10 seconds or <2 mins. The receiving water's flow rate at that time will be 34.8m3/s. Under other storms the discharge will last 2.4 hrs at the in 20 year storm and 3.7 hrs at 1 in 30 year storm event. Refer to Section 4.0 Tables 2 and 7).

d) With respect to the information presented by Irish Water (Table 2) and extracted by Hydro-G as Table 3, without the proposed stormwater tank positioned in the network leading to the Swords WWTP, model outputs suggest that 897 m3 of combined foul and stormwater overflows at the inlet to the Swords WWTP for the 1 in 5 year Storm event, with a climate change factor incorporated. It is clear that IF the new stormwater tank is installed at the Celestica site, there could be a 99% reduction in the amount of combined sewer overspill at the inlet to the Swords WWTP for the 1 in 5 year Return period storm. Similarly, extrapolating Irish Water's model outputs suggests that there could be an 81% reduction of SWO for the 1 in 10 year return period storm and reductions of 72% and 68%, respectively, for the M20 and M30 Storms. It would seem clear that the environmental benefit is unquestionable. That information relates to the SWO at the inlet to Swords WWTP. IF one considers that the Swords WWTP is currently operational and serves 90,000 PE and we do have storms now, it is easy to understand how many factors combine to cause the Broadmeadow_040 to be assigned its Poor Status. The proposal is to remove one source of many pressures. Therefore, assimilation simulation using the EPA water quality dataset, as a baseline, that includes the hydrochemical response to that pressure is not rational.

The concept of 'notional' quality will be adopted as the baseline so as to determine if the proposed improvement in this component of the foul network in the catchment can aid the objectives of the Water Framework Directive and Surface Water Regulations (2009 as amended).

When a 'notional' background quality is adopted, one can evaluate whether the proposal has potential to cause a deterioration in Status.

The goal of national efforts is to improve to Good Status, at least. The proposed development has now been specified and designed, in 2021, to provide enhanced capacity (EAR, Waterman Moylan, 2021). The proposals for improvement are not confined to this site because multiple improvements in the catchment are under way and require panning consent. Additional and complimentary Irish Water driven works elsewhere in the foul network aim to remove/reduce storm waters so as not to continue to surge national infrastructure.

In order to simulate the effect of a discharge, once can begin simulations using a notional background water quality that is a notionally 50% of the concentrations cited under the Good Status criteria of the Surface Water Regulations. Good Status, at least, is what the nation is aiming for.

Results of the assimilation capacity can then be considered in terms of whether the discharge has the potential to cause a deterioration in status class. This is industry practice that has been adopted previously by the EPA in similar type scenarios in the licensing of agglomerations.

Environmental Quality Objectives for all Status Classes are presented in Table 8 and the 'Notional' baseline quality calculations @ 50% of the Good Status EQOs of the Surface Water Regulations are presented in Table 9.

Table 8 Environmental Quality Objectives Surface Water Regulations (2009, as amended 2012, 2015 and 2019) & Salmonid Regulations

Parameter	EQOs (mg/l) Surface Water Regulations 2009 as amended 2012, 2015, 2019				European Communities (Quality of Salmonid Waters) Regulations (SI 293/1988)
	GOOD STATUS Mean Concentration	GOOD STATUS 95%tile Concentration	HIGH STATUS Mean Concentration	HIGH STATUS 95%tile Concentration	
pH units	6 to 9 pH units				6 to 9 pH units
BOD (mg/l)	1.5	2.6	1.300	2.20	≤5
Ammonia as N (mg/l)	0.065	0.14	0.040	0.09	1mg/l as Total NH4
Ortho-P as P (mg/l)	0.035	0.075	0.025	0.05	-
Poly Aromatic Hydrocarbons (ug/l)	Not specified in Surface Water Regulations but Groundwater Regulations EQS = 0.075 ug/l PAH				should not be present
Cadmium (ug/l)	0.08 ug/l Annual Average EQS Class 1 Inland Surface Water		0.45 ug/l MAC EQS Class 1 Inland Surface Water		-
Suspended Solids (mg/l)	suspended solids not specified in SW Regulations but Salmonid Regs				25
Nitrates as NO3 (mg/l)	not specified in SW Regulations [37.5mg/l as NO3 = the TV of the GW Regulations]				-

Table 9 Surface Water Regulation GOOD Status and SIMULATION 'notional' Environmental Quality Objectives

Surface Water Regulation Parameter	EQOs (mg/l) Surface Water Regulations 2009 as amended 2012, 2015, 2019		Hydro G Assimilation Evaluation SIMULATION 'NOTIONAL' BACKGROUND CONCENTRATIONS [i.e. 50% of Good Status Mean]
	GOOD STATUS Mean Concentration	GOOD STATUS 95%tile Concentration	
pH	6 to 9 pH units		7.75
BOD	1.5	2.6	0.75
Ammonia as N	0.065	0.14	0.0325
Ortho-P as P	0.035	0.075	0.0175
Suspended Solids	Suspended Solids not specified in SW Regulations but 25mg/l SS EQO specified in the Salmonid Regs		12.50
Nitrates as NO3	not specified in SW Regulations [37.5mg/l as NO3 = the TV of the GW Regulations]		37.50
Cadmium	0.08 ug/l Annual Average EQS Class 1 Inland Surface Water	0.45 ug/l MAC EQS Class 1 Inland Surface Water	0.04
COD	not specified		20.00
PAH	Not specified in Surface Water Regulations but Groundwater Regulations EQS = 0.075 ug/l PAH		0.02

6.0 Assessment

This section presents the evaluation of the potential effect of the discharge in the context of regulatory obligations. Overall, assessment of this discharge requires consideration as to whether the discharge is feasible and defensible in the context of the European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009 as amended). The primary Objective of the Surface Water Regulations is to improve to, at least, Good Status. The improvement is the key.

The discharge is reported to be an intermittent overflow occurring only at time of storm return periods and stormwater or groundwater ingress to the foul network system. The discharge will not be continuous. Therefore, neither the assimilative mass load nor headroom concepts are applied in this case. The enacted Statutory Instrument (S.I. No. 272 of 2009 as amended) details the requirements to improve Status and provides target Environmental Quality Objective concentrations for a selection of parameters.

The purpose of this assimilation capacity simulation is to evaluate whether the intermittent discharge has the potential to cause resultant concentrations in the receiving waters to breach the Environmental Quality Objectives of the Surface Water Regulations (2009, as amended). In this regard, the Resultant Concentrations approach is applied in this assessment.

The Department of the Environment (DoEHLG, 2011) mixing equation is, as follows:

Csw = [(Cqd x Qqd) + (Cswu x Qsw)] / Qsw + Qqd)

Whereby

Csw = predicted resultant downstream concentration in the receiving waters

Cqd = concentration in discharge **[refer to Section 3.2]**

Qqd = discharge flow rate = 0.07 m3/s **[refer to Section 3.1]**

Cswu = notional background concentration in the Stream upgradient of the mixing point **[refer to Section 5.0]**

Qsw = Receiving water's storm flowrate at the simulation mixing point **[refer to Section 4.0, Tables 6 & 7]:**

- M10 Q = 34.9 m3/s
- M20 Q = 38 m3/s
- M30 Q = 40 m3/s

For the purposes of evaluation of potential for impact, assimilation capacity simulations to determine resultant concentrations were completed for a range of Surface Water and Salmonid Regulation parameters including BOD, ortho-P, Total Ammonia, Suspended Solids, Nitrates, COD and pH. While the Surface Water Regulations do not specify COD, Nitrates, Nitrites nor Suspended Solids EQOs, the parameter simulations are included here because of the nature of the discharge and downgradient SAC Conservation Objectives. Simulation resultant concentrations are presented in full in Appendix C and are summarised in Table 10. All three storm return periods for the proposed overflow discharge were simulated: M10, M20, M30 and each of these are presented in Appendix C. Irish Water's design is predicated on full retention of the M5 driven flows to the new storage tank and so there is no assimilation simulation required for the M5 storm.

Summary results for the M10 storm are presented in Table 10.

Table 10 Summary Assimilation Capacity Simulation Summary Results (refer to Appendix C for full details)

Parameter	Simulation Discharge Concentration (Cqd)	NOTIONAL Background Upstream Mean (Cswu)	Surface Water Good Status Environmental 95%tile Quality Objective (mg/l)	M10 Simulated RESULTANT CONCENTRATION (Csw)	M10 Simulated Concntration Increase	Hydro-G compliance Comment
pH units	7.5	7	6.5 to 9 pH units	7	None	Compliant
BOD mg/l	30	0.75	2.6	0.8	0.05	Compliant
COD mg/l	400	20	Not specified	31	11	Acceptable, good quality COD
Ortho-P mg/l	1.5	0.0175	0.075	0.02	0.0025	Compliant
Suspended Solids mg/l	150	12.5	Not specified but 25 mg/l SS Salmonid	13	0.5	Compliant
Ammonia as N	3	0.0325	0.14	0.04	0.0075	Compliant
Nitrate as NO3	37.5	10	Not specified	10	none	No Significant Change
Nitrite as N	0.04	0.02	Not specified	0.02		
PAH (ug/l)	1.75	0.02	Not specified	0.023	0.003	Groundwater Regulations EQS = 0.075 ug/l PAH = Compliant
Cadmium (ug/l)	4	0.04	0.45 MAC	0.05	0.01	Compliant

IMPORTANT NOTE: With reference to the Assimilation Capacity results presented in Table 5, the resultant concentrations will be TRANSITORY and OCCASIONAL in response to the predicted OCCASIONAL discharge from the storm overflow. These concentrations should return to their baseline quality values when the storm passes, and the overflow discharge stops.

Simulation results suggest that the intermittent discharge, simulated for the storm flow occasional scenario, would not result in an increase in concentration that might suggest a deterioration in status class, nor suggest potential to result in a breach in any Surface Water Regulation parameter on the basis that the catchment is improved to Good Status eventually. Simulations also suggest compliance with the requirements of the Salmonid Regulations Suspended Solids Concentration. While the Broadmeadow_040 is not a Salmonid River, the Suspended Solids concentration EQO of the Salmonid Regulations can be used as a proxy for evaluating quality upstream of features designated as SACs or SPAs for other species and habitats. Simulation results suggest no potential for impact.

With respect to the results presented in Table 10 and Appendix C, the simulated resultant concentrations present as very small increases and those increases could not cause a deterioration in Status Class. For example, for the purposes of exploration, resultant concentrations and their associated increases for the parameters of most significance in terms of Surface Water Regulation Environmental Quality Objectives are as follows:

a. Ammonia as N: when 3mg/l groundwater/foul/stormwater mix discharge concentration is simulated into the M10 flow scenario, at the known bore rate of the 300mm diameter pipe, the resultant concentration increases by 0.0075 mg/l. Given that the 95%tile EQO for Good Status is 0.14 mg/l Ammonia as N, an increase of 0.0075 mg/l can justifiably be interpreted as having no potential to cause a deterioration in Status Class.

b. Ortho-P: When a 1.5 mg/l groundwater/foul/stormwater mix discharge concentration is simulated into the M10 flow scenario, at the known bore rate of the 300mm diameter pipe, the resultant concentration increases by 0.0025 mg/l MRP-P. Given that the 95%tile EQO for Good Status is 0.075 mg/l Ortho-P, an increase of 0.0025 mg/l can justifiably be interpreted as having no potential to cause a deterioration in Status Class.

c. BOD: When a 30 mg/l groundwater/foul/stormwater mix discharge concentration is simulated into the M10 flow scenario, at the known bore rate of the 300mm diameter pipe, the resultant concentration increases by 0.05 mg/l MRP-P. Given that the 95%tile EQO for Good Status is 2.6 mg/l Ortho-P, an increase of 0.05 mg/l can justifiably be interpreted as having no potential to cause a deterioration in Status Class.

d. Suspended Solids: Even when a 150mg/l Suspended Solids (SS) concentration is simulated as input to the Broadmeandow_040 under the M10 storm flow response condition, the SS concentration in the river would increase by only 0.5 mg/l for the 'notional' baseline SS concentration that is 50% of the Salmonid Regulations Environmental Quality Objective's value of 25mg/l SS. We cannot quantify the actual baseline stormflow concentration of SS in the river upstream of the proposed discharge. It is known that there will be storms and that there will be suspended solids loads in the catchment responses prior to the proposed discharge. The point of the simulation is to evaluate the result of adding the discharge to storm flows. Simulation results suggest negligible increase in concentration. This is the take home point from the simulation is that there appears to be no potential for such a magnitude of increase in resultant concentration that could cause a deterioration in quality or Status class.

e. Nitrates as NO3: simulation results suggest that even were the discharge to have a concentration at the maximum Threshold Value for groundwater nitrate concentration i.e. that concentration that would prompt a review of activity in the agricultural catchment, even at poor status groundwater ingressing the foul network, the resultant concentration in the Broadmeadow_040 would not change. There would be no increase.

The simulation examples are for evaluation of potential for the discharge to cause a deterioration in Status. Simulation results suggest no potential for a deterioration in Status class for either the M10, M20 or M30 storms simulated (Appendix B). Indeed, comparison of model outputs for all storm events suggests that once the flow rate in the river has reached the M10 flow rate, there is no change in resultant concentrations for increased flows associated with higher flows in the river.

7.0 Discussion

Based on calculations presented, assimilation capacity simulations suggest that the proposed intermittent storm overflow can be assimilated by the Broadmeadow_040, at a mixing point upgradient of Malahide SAC and SPA and maintain Status EQO characteristics of the Surface Water Regulations.

Hydro-G offers that catchment responses and Status classifications are complex. Hydro-G acknowledges that it is not only hydrochemical concentrations that are employed in order to assign Status Class. Ecological Potential is also a measure of the health of a waterbody. The proposal to include a new stormwater holding tank in the existing foul network is not a proposal to add pressure or chemicals to a system. The stormwater/groundwater ingress mix contaminating the foul network happens now already in response to storm events. The proposal is to retain the existing stormwater in storage. While there are benefits to the watercourse, which will include ecological benefits in tandem with the chemical benefits, all benefits must be considered in combination. The most striking benefit being that with the stormwater tank in place, there will be a 99% reduction in stormwater overflow at the inlet pipe to the Swords WWTP in the 1 in 5 year storm.

Of note is that following on from a review of other Section 4 discharges in the area (https://gis.epa.ie/EPAMaps/) it is determined that there is no need to do additional assimilation capacity simulations for consideration of 'In Combination' because there is only 1 other licensed discharge upgradient (The Rolestown Inn (Kettles Hotel) WPW/F/057) but it is 5km distance upgradient and it is not mapped as a discharge adjacent to any watercourse. Mapping suggests a discharge to groundwater. However, in the event that it is a discharge to surface water, it is 5km mixing length upstream and the two discharges are unlikely to have any bearing on each other in the intermittent storm scenario that is the focus of this assessment. There is another Section 4 discharge downstream of the proposed point at which the proposed overflow pipe will join the Broadmeadow_040. That downstream discharge is WPW/F/040 Emmaus Retreat Centre, Lissenhall Swords, Co. Dublin, and it does appear to be mapped as discharging to the Broadmeadow River at a distance of 300m downstream of the proposal under consideration. Given that the simulations presented in this work result in such very small increases in concentration and no increases in some cases, Hydro-G has confidence that the discharge from the proposed discharge tank is feasible, defensible and justifiable.

8.0 Conclusions:

8.1 The Broadmeadow_040 river is currently assigned WFD 'Poor' Status but the proposal to improve the foul network infrastructure is part of Irish Water's efforts to alleviate one of the identified and published pressures cited as 'Storm Water Overflows' in the WFD Cycle 2 Catchment Nanny-Delvin Subcatchment Broadmeadow_SC_010 Code 08_3 Dec 2018 report. Therefore, the proposal is essentially an 'action' identified as requiring attention during the 2nd Cycle WFD catchment assessments and the aim of the proposal is to contribute to catchment improvements.

8.2 The overflow outfall pipe from the proposed stormwater storage tank will only come into effect during extreme rainfall events and therefore reduce the frequency and magnitude of the stormwater overflows that are currently reported in the Sub Catchment Report as being part of the problem for water quality in the Broadmeadow River.

8.3 The overflow outfall pipe from the proposed stormwater storage tank will only occur in extreme flood events greater than the 1 in 5 year event. For storms of frequencies less than 1 in 5 year, Irish Water Model data suggests as follows:

8.3.1 For the M10 storm event, a total overflow of only 7m3 will occur in a total time of 2 mins at a rate of 0.07 m3/s when the receiving water's envisaged flow rate is 34.8m3/s.

8.3.2 For the M20 storm event, a total overflow of 606m3 in a total time of 2.4 hrs at a rate of 0.07m3/s when the receiving water's envisaged flow rate is ~38m3/s.

8.3.3 For the M30 storm event, a total overflow of 938m3 in 3.7 hrs at a rate of 0.07m3/s when the receiving water's envisaged flow rate is ~40m3/s.

The dilution rate afforded is therefore >500 river water per 1 unit of tank overflow for all storm events.

8.4 The overall effect of the proposed discharge tank will be full retention of 1 in 5 year return period storms at the tank itself but, more impressively, the storm tank retention will result in a 99% reduction of overflow at the inlet to Swords WWTP for that 1 in 5 year return period storm. Similarly impressive reductions in overflow at the Swords WWTP are provided by the storm tank for other storms. Without the proposed stormwater tank there would be 897 m3 of combined foul and stormwater overflowing at the inlet to the Swords WWTP for the 1 in 5 year Storm event, with a climate change factor incorporated. It is clear that IF the new stormwater tank is installed at the Celestica site, there could be a 99% reduction in the amount of combined sewer overspill at the inlet to the Swords WWTP for the 1 in 5 year return period storm. Similarly, extrapolating Irish Water's model outputs suggests that there could be an 81% reduction of SWO for the 1 in 10 year return period storm and reductions of 72% and 68%, respectively, for the M20 and M30 Storms. It would seem clear that the environmental benefit is unquestionable. That information relates to the SWO at the inlet to Swords WWTP. The proposal will provide a significant improvement on the existing situation, where uncontrolled flooding of the foul network to the Broadmeadow occurs frequently.

8.5 Hydro-G's assimilation evaluation resultant concentration simulations suggest that the intermittent discharge, simulated for the storm flow occasional scenario, does not have potential to cause a deterioration in Status class as defined by Surface Water Regulation Environmental Quality Objective parameters, complies with the requirements of the Salmonid Regulations Suspended Solids Concentration and therefore no impacts on the downstream SAC and SPA are envisaged.

Pamela Bartley

Signed: ______________________ Date: ___ 23/8/21 _

Dr. Pamela Bartley BEng, MSc, PhD

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Appendix A

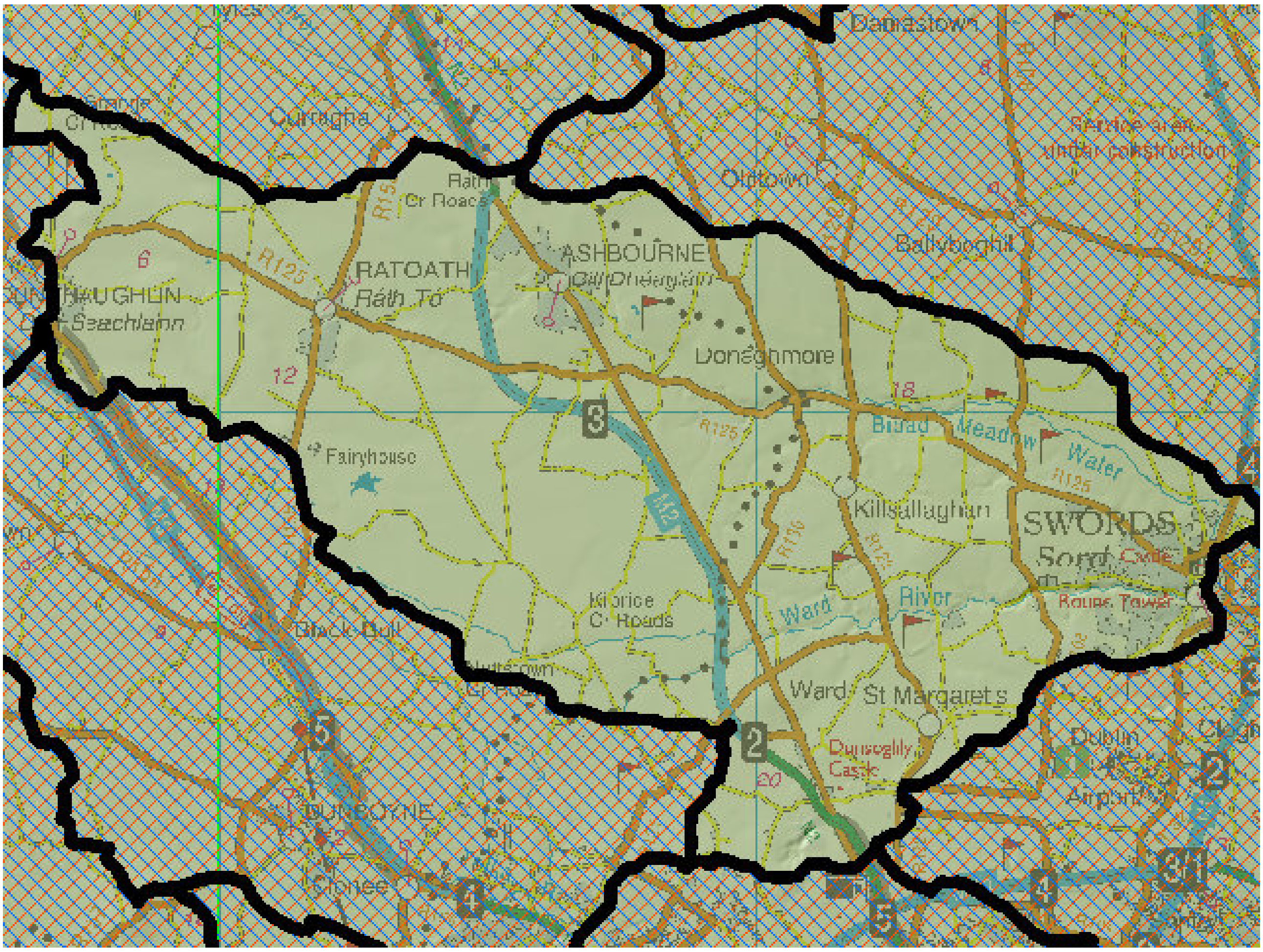
WFD Cycle 2 Subcatchment Report

WFD Cycle 2

Catchment Nanny-Delvin

Subcatchment Broadmeadow_SC_010

Code 08_3

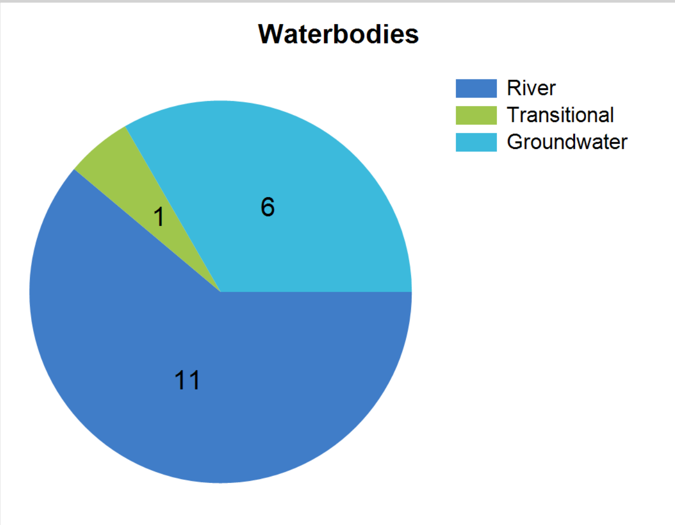


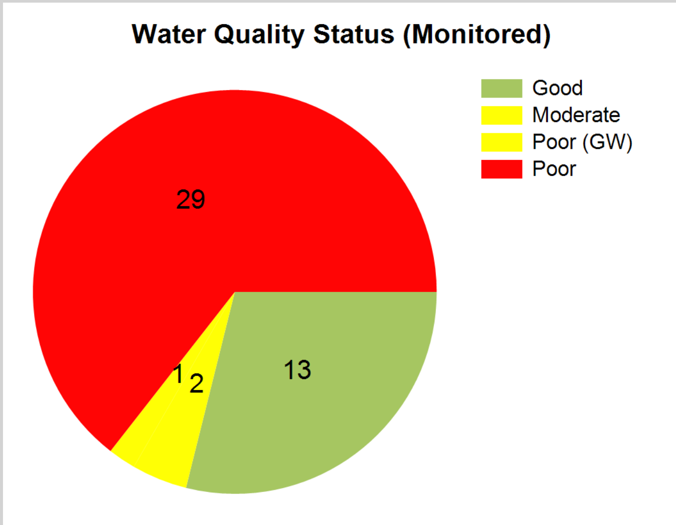
Generated on: 14 Dec 2018

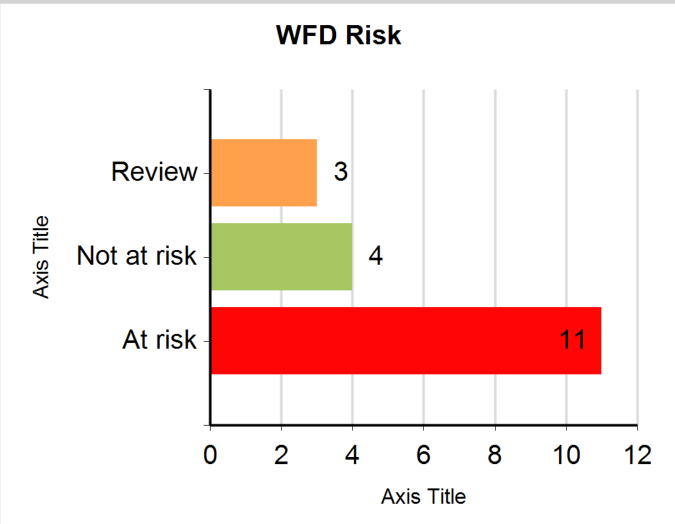
Assessment Purpose

This assessment has been produced as part of the national characterisation programme undertaken for the second cycle of Water Framework Directive river basin management planning. It has been led by the EPA, with input from Local Authorities and other public bodies, and with support from RPS consultants.

The characterisation assessments are automatically generated from the information stored in the WFD Application. They are based on information available to the end of 2015 but may be subject to change until the final 2018-21 river basin management plan is published. Users should ensure that they have the most up to date information by downloading the latest assessment before use.







Water Quality - High Ecological Status

No Data Available

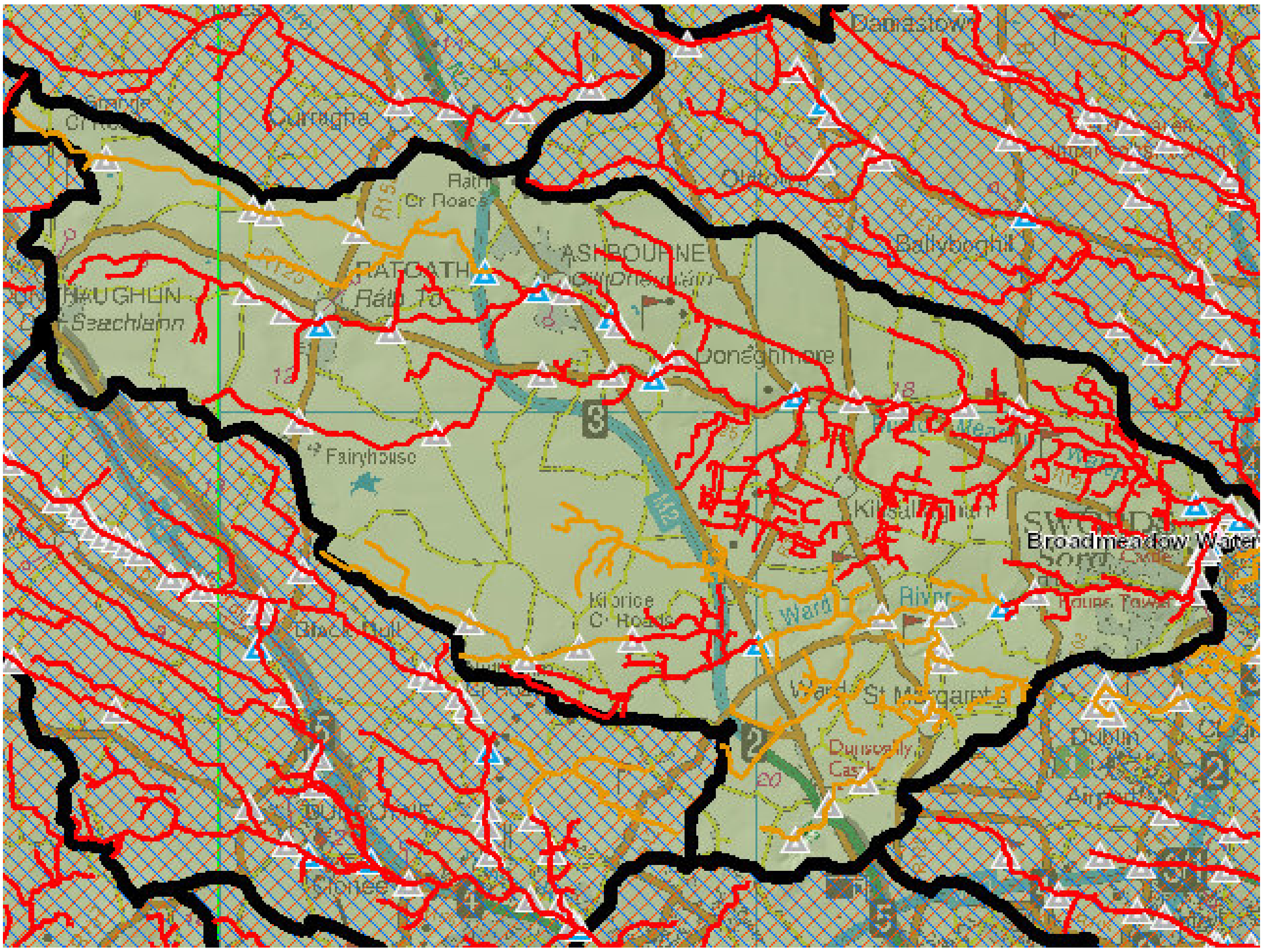
Evaluation of PrioritySubcatchment Issues

Eight out of eleven river water bodies within this subcatchment are At Risk. The Broadmeadow has Poor 2010-2015 ecological status and elevated orthophosphate throughout in this subcatchment, as well as elevated ammonia in the Broadmeadow_010 and Broadmeadow_020. The Broadmeadow_020, Broadmeadow_030 and Broadmeadow_040 are also failing on dissolved oxygen levels. In the Ward, orthophosphate is elevated throughout and at Bad indicative quality in Ward_010 and Ward_030. The Ward_010 has no biology data but historic data indicates less than Good status and is therefore under Review pending local catchment assessment. Ward_020 and Ward_040 have Poor ecological status. Ward_030 achieved Good status for 2010-2015 however orthophosphate remains highly elevated and so is under Review.

Ratoath_010 and Fairyhouse Stream_010 both have Poor ecological status and impacted supporting nutrient conditions with elevated orthophosphate. Ammonia is also elevated in Ratoath_010, and dissolved oxygen levels are failing for Fairyhouse_010. Dunshaughlin Stream_010 is under Review as while ecological status is Good, the orthophosphate concentration is highly elevated (Bad indicative quality).

The significant pressures throughout this subcatchment are agriculture (pastures, tillage, farmyards, land drainage), septic tanks, diffuse urban run-off and channelisation. Combined sewer overflows is also a pressure within Broadmeadow_010, Broadmeadow_020, Ward_020 and Ward_040. A local catchment assessment is required for Ward_010 to determine whether any pressures exist.

Map Subcatchment Risk Map

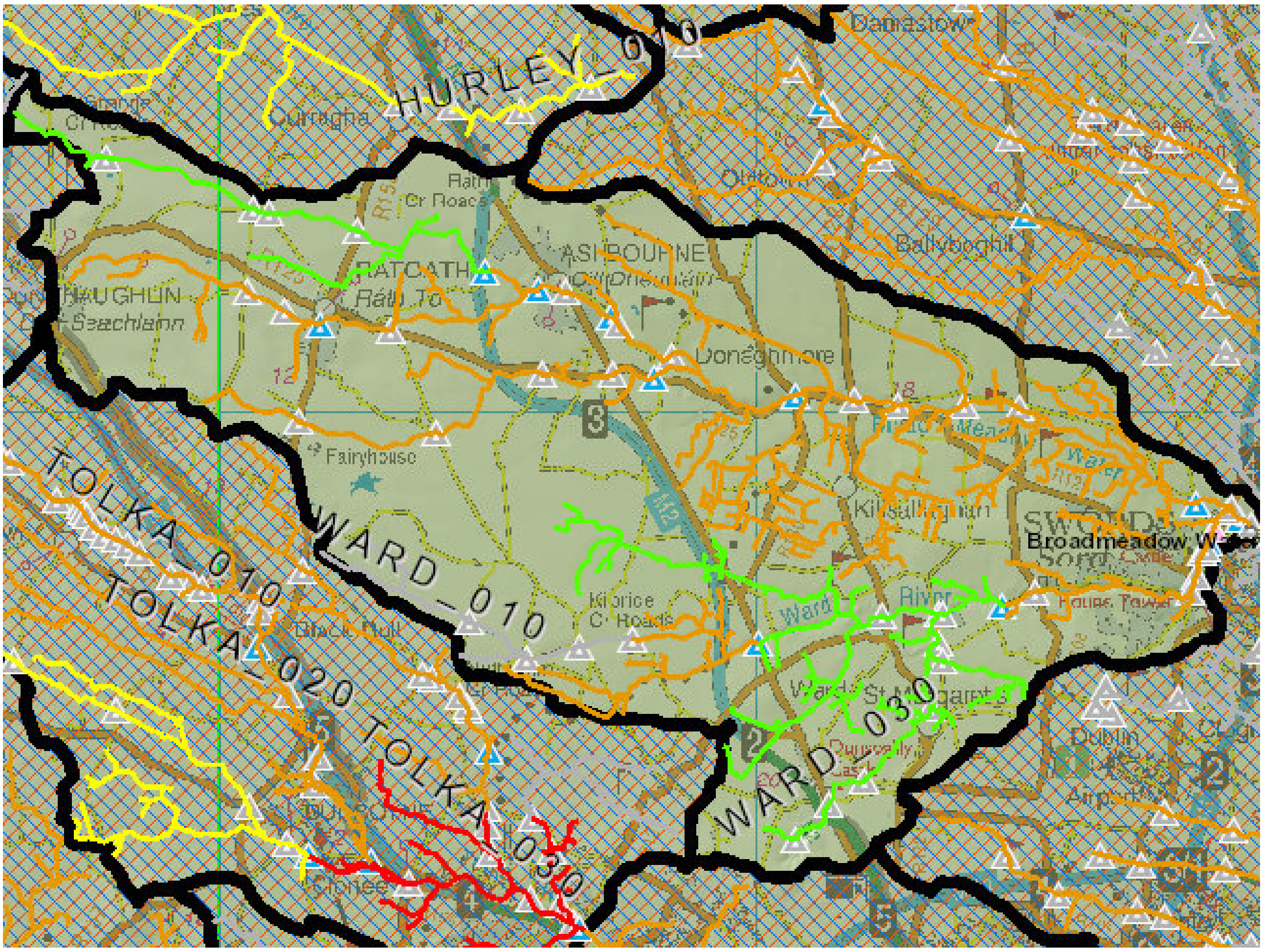


River And Lake Waterbodies: WFD Risk

The following river and lake waterbodies are in the subcatchment.

Code	Name	Type	WFD Risk	Significant Pressure
IE_EA_08B020400	BROADMEADOW_010	River	At risk	Yes
IE_EA_08B020600	BROADMEADOW_020	River	At risk	Yes
IE_EA_08B020700	BROADMEADOW_030	River	At risk	Yes
IE_EA_08B020800	BROADMEADOW_040	River	At risk	Yes
IE_EA_08F010500	FAIRYHOUSE STREAM_010	River	At risk	Yes
IE_EA_08R010150	RATOATH STREAM_010	River	At risk	Yes
IE_EA_08W010070	WARD_020	River	At risk	Yes
IE_EA_08W010610	WARD_040	River	At risk	Yes
IE_EA_08D030300	DUNSHAUGHLIN STREAM_010	River	Review	Yes
IE_EA_08W010050	WARD_010	River	Review	Yes
IE_EA_08W010300	WARD_030	River	Review	Yes

Map Subcatchment Water Quality Status Map



River And Lake Waterbodies: Water Quality Status

The water quality status of river and lake waterbodies in the subcatchment is as follows.

Code	Name	Type	2007-09	2010-12	2010-15
IE_EA_08B020400	BROADMEADOW_010	River	Poor	Poor	Poor
IE_EA_08B020600	BROADMEADOW_020	River	Poor	Poor	Poor
IE_EA_08B020700	BROADMEADOW_030	River	Unassigned	Poor	Poor
IE_EA_08B020800	BROADMEADOW_040	River	Poor	Poor	Poor
IE_EA_08D030300	DUNSHAUGHLIN STREAM_010	River	Poor	Poor	Good
IE_EA_08F010500	FAIRYHOUSE STREAM_010	River	Poor	Poor	Poor
IE_EA_08R010150	RATOATH STREAM_010	River	Poor	Poor	Poor
IE_EA_08W010050	WARD_010	River	Poor	Unassigned	Unassigned
IE_EA_08W010070	WARD_020	River	Poor	Poor	Poor
IE_EA_08W010300	WARD_030	River	Poor	Poor	Good
IE_EA_08W010610	WARD_040	River	Poor	Poor	Poor

Potentially Dependent Transitional and Coastal Waterbodies

The Transitional and Coastal waterbodies listed below intersect spatially with river and lake waterbodies in the subcatchment …

Code	Name	Type	Local Authority	WFD Risk
IE_EA_060_0100	Broadmeadow Water	Transitional	Fingal County Council	At risk

Potentially Dependent Groundwater Waterbodies

The groundwaters listed below interset spatially with river and lake waterbodies in the subcatchment …

Code	Name	Type	Local Authority	WFD Risk
IE_EA_G_002	Trim	Groundwater	Meath County Council	At risk
IE_EA_G_008	Dublin	Groundwater	South Dublin County Council	Not at risk
IE_EA_G_011	Swords	Groundwater	Fingal County Council	Not at risk
IE_EA_G_014	Lusk-Bog of the Ring	Groundwater	Fingal County Council	Not at risk
IE_EA_G_031	Dunshaughlin	Groundwater	Meath County Council	Not at risk
IE_EA_G_062	Industrial Facility (P0014-03)	Groundwater	Fingal County Council	At risk

Protected Areas intersecting River and Lake Waterbodies

The Protected Areas listed below intersect spatially with river and lake waterbodies in the subcatchment …

Code	Name	Type	Waterbody Name	Association Type
IETW_EA_2001_0026	Broadmeadow Estuary (Inner)	Nutrient Sensitive Area	BROADMEADOW_040	Overlapping / partly within Protected Area

Pressures

Below is a list of all significant pressures identified in the subcatchment.

Code	Name	WFD Risk	Pressure Category	Pressure Sub Category
IE_EA_060_0100	Broadmeadow Water	At risk	Domestic Waste Water	Waste Water discharge
IE_EA_060_0100	Broadmeadow Water	At risk	Urban Waste Water	Agglomeration PE > 10,000
IE_EA_08B020400	BROADMEADOW_010	At risk	Hydromorphology	Channelisation
IE_EA_08B020400	BROADMEADOW_010	At risk	Urban Waste Water	Combined Sewer Overflows
IE_EA_08B020400	BROADMEADOW_010	At risk	Urban Run-off	Diffuse Sources Run-Off
IE_EA_08B020400	BROADMEADOW_010	At risk	Agriculture	Agriculture
IE_EA_08B020600	BROADMEADOW_020	At risk	Urban Run-off	Diffuse Sources Run-Off
IE_EA_08B020600	BROADMEADOW_020	At risk	Hydromorphology	Channelisation
IE_EA_08B020600	BROADMEADOW_020	At risk	Urban Waste Water	Combined Sewer Overflows
IE_EA_08B020700	BROADMEADOW_030	At risk	Domestic Waste Water	Waste Water discharge
IE_EA_08B020700	BROADMEADOW_030	At risk	Agriculture	Agriculture
IE_EA_08B020700	BROADMEADOW_030	At risk	Hydromorphology	Channelisation
IE_EA_08B020800	BROADMEADOW_040	At risk	Hydromorphology	Channelisation
IE_EA_08B020800	BROADMEADOW_040	At risk	Agriculture	Farmyards
IE_EA_08B020800	BROADMEADOW_040	At risk	Agriculture	Agriculture
IE_EA_08F010500	FAIRYHOUSE STREAM_010	At risk	Agriculture	Agriculture
IE_EA_08F010500	FAIRYHOUSE STREAM_010	At risk	Domestic Waste Water	Waste Water discharge
IE_EA_08F010500	FAIRYHOUSE STREAM_010	At risk	Hydromorphology	Channelisation
IE_EA_08R010150	RATOATH STREAM_010	At risk	Urban Run-off	Diffuse Sources Run-Off
IE_EA_08R010150	RATOATH STREAM_010	At risk	Hydromorphology	Channelisation
IE_EA_08R010150	RATOATH STREAM_010	At risk	Agriculture	Agriculture
IE_EA_08R010150	RATOATH STREAM_010	At risk	Domestic Waste Water	Waste Water discharge
IE_EA_08W010070	WARD_020	At risk	Hydromorphology	Channelisation
IE_EA_08W010070	WARD_020	At risk	Agriculture	Agriculture
IE_EA_08W010070	WARD_020	At risk	Urban Waste Water	Combined Sewer Overflows

IE_EA_08W010610	WARD_040	At risk	Hydromorphology	Channelisation
IE_EA_08W010610	WARD_040	At risk	Urban Run-off	Diffuse Sources Run-Off
IE_EA_08W010610	WARD_040	At risk	Urban Waste Water	Combined Sewer Overflows
IE_EA_G_002	Trim	At risk	Agriculture	Agriculture
IE_EA_G_002	Trim	At risk	Domestic Waste Water	Waste Water discharge
IE_EA_G_062	Industrial Facility (P0014-03)	At risk	Industry	IPC
IE_EA_08D030300	DUNSHAUGHLIN STREAM_010	Review	Agriculture	Agriculture
IE_EA_08D030300	DUNSHAUGHLIN STREAM_010	Review	Domestic Waste Water	Waste Water discharge
IE_EA_08W010050	WARD_010	Review	Hydromorphology	Land Drainage
IE_EA_08W010050	WARD_010	Review	Hydromorphology	Channelisation
IE_EA_08W010050	WARD_010	Review	Domestic Waste Water	Waste Water discharge
IE_EA_08W010050	WARD_010	Review	Agriculture	Agriculture
IE_EA_08W010300	WARD_030	Review	Urban Waste Water	Combined Sewer Overflows
IE_EA_08W010300	WARD_030	Review	Other Anthropogenic Pressures	Golf Courses
IE_EA_08W010300	WARD_030	Review	Hydromorphology	Channelisation

Further Characterisation Actions

The following further characterisation actions have been identified. These are necessary to help understand more fully issues in the subcatchment and their likely cause.

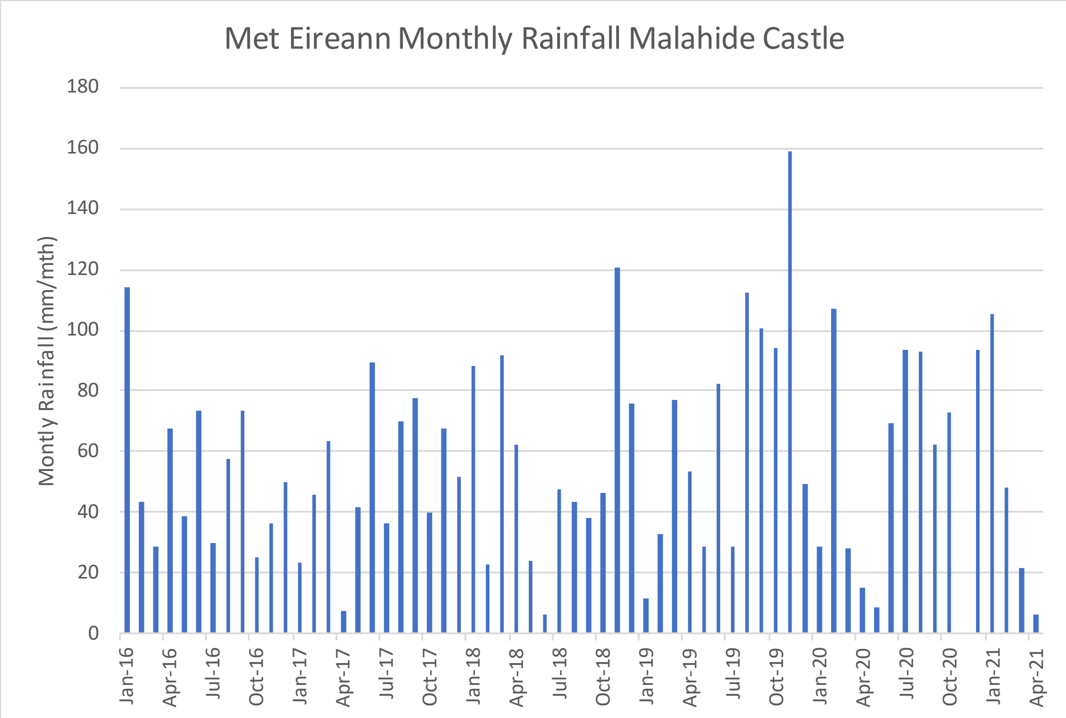
Code	Name	Action	Responsible Organisation
IE_EA_08B020600	BROADMEADOW_020	IA6 Multiple Sources in Large Urban Area	Meath County Council
IE_EA_08W010610	WARD_040	IA6 Multiple Sources in Large Urban Area	Meath County Council
IE_EA_08B020400	BROADMEADOW_010	IA1 Provision of Information	Irish Water
IE_EA_08F010500	FAIRYHOUSE STREAM_010	IA7 Multiple Sources in Multiple Areas	Meath County Council
IE_EA_08B020700	BROADMEADOW_030	IA5 Multiple Sources in defined rural area (1km) or waterbody or rural town	Fingal County Council
IE_EA_08B020400	BROADMEADOW_010	IA5 Multiple Sources in defined rural area (1km) or waterbody or rural town	Meath County Council
IE_EA_08W010050	WARD_010	IA1 Provision of Information	Environmental Protection Agency
IE_EA_08W010610	WARD_040	IA1 Provision of Information	Environmental Protection Agency
IE_EA_08B020400	BROADMEADOW_010	IA1 Provision of Information	Environmental Protection Agency
IE_EA_08W010300	WARD_030	IA1 Provision of Information	Fingal County Council
IE_EA_08F010500	FAIRYHOUSE STREAM_010	IA1 Provision of Information	Environmental Protection Agency
IE_EA_08B020800	BROADMEADOW_040	IA2 Point Source Desk Based Assessment	Fingal County Council
IE_EA_08D030300	DUNSHAUGHLIN STREAM_010	IA1 Provision of Information	Environmental Protection Agency
IE_EA_08B020400	BROADMEADOW_010	IA6 Multiple Sources in Large Urban Area	Meath County Council
IE_EA_08W010070	WARD_020	IA1 Provision of Information	Meath County Council
IE_EA_08B020800	BROADMEADOW_040	IA1 Provision of Information	Environmental Protection Agency
IE_EA_08W010610	WARD_040	IA2 Point Source Desk Based Assessment	Fingal County Council
IE_EA_08W010050	WARD_010	IA1 Provision of Information	Meath County Council
IE_EA_08W010070	WARD_020	IA1 Provision of Information	Environmental Protection Agency
IE_EA_08R010150	RATOATH STREAM_010	IA6 Multiple Sources in Large Urban Area	Meath County Council
IE_EA_08R010150	RATOATH STREAM_010	IA1 Provision of Information	Environmental Protection Agency
IE_EA_08B020600	BROADMEADOW_020	IA5 Multiple Sources in defined rural area (1km) or waterbody or rural town	Meath County Council
IE_EA_08D030300	DUNSHAUGHLIN STREAM_010	IA3 Determination of Water Quality (unassigned waterbody)	Meath County Council
IE_EA_08W010050	WARD_010	IA1 Provision of Information	Environmental Protection Agency

Appendix B

Met Eireann Rainfall

&

EPA WQ



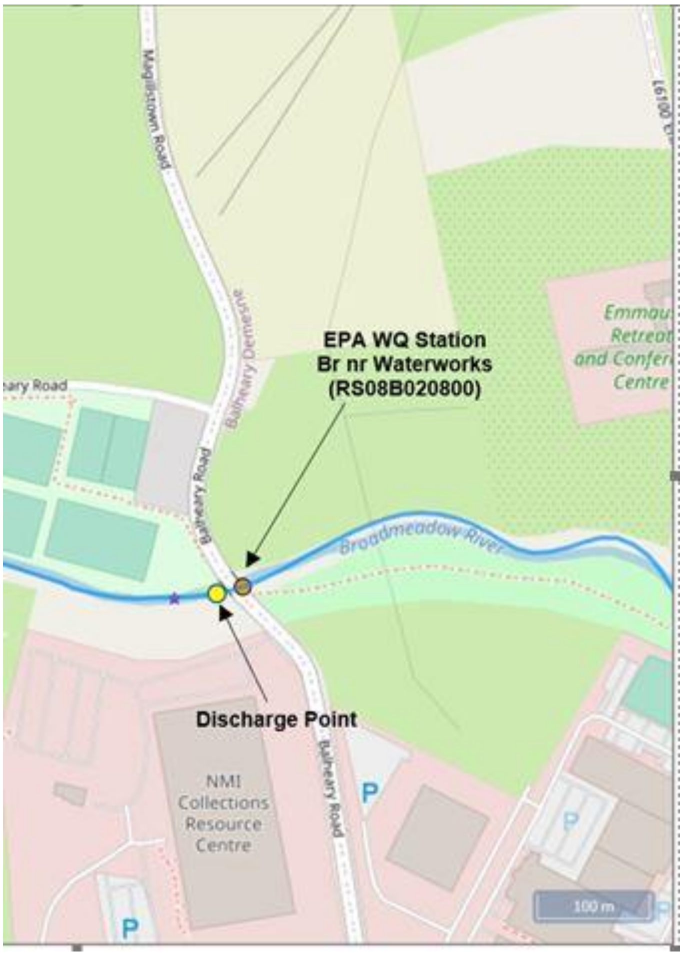
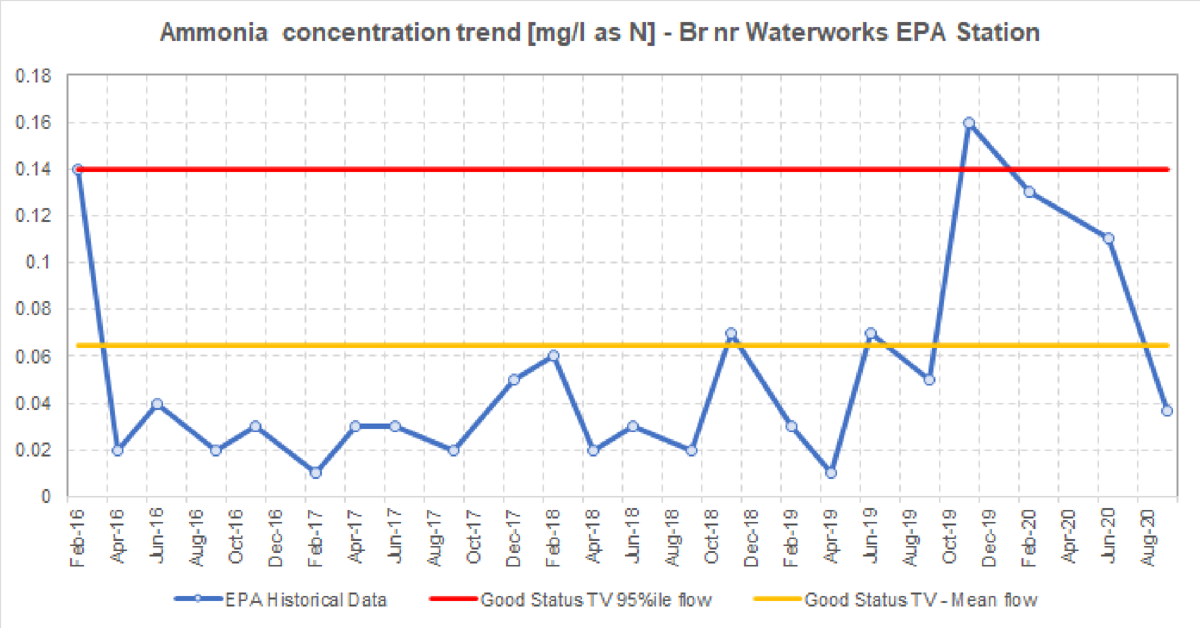


Figure C.1 EPA WQ Monitoring Stn

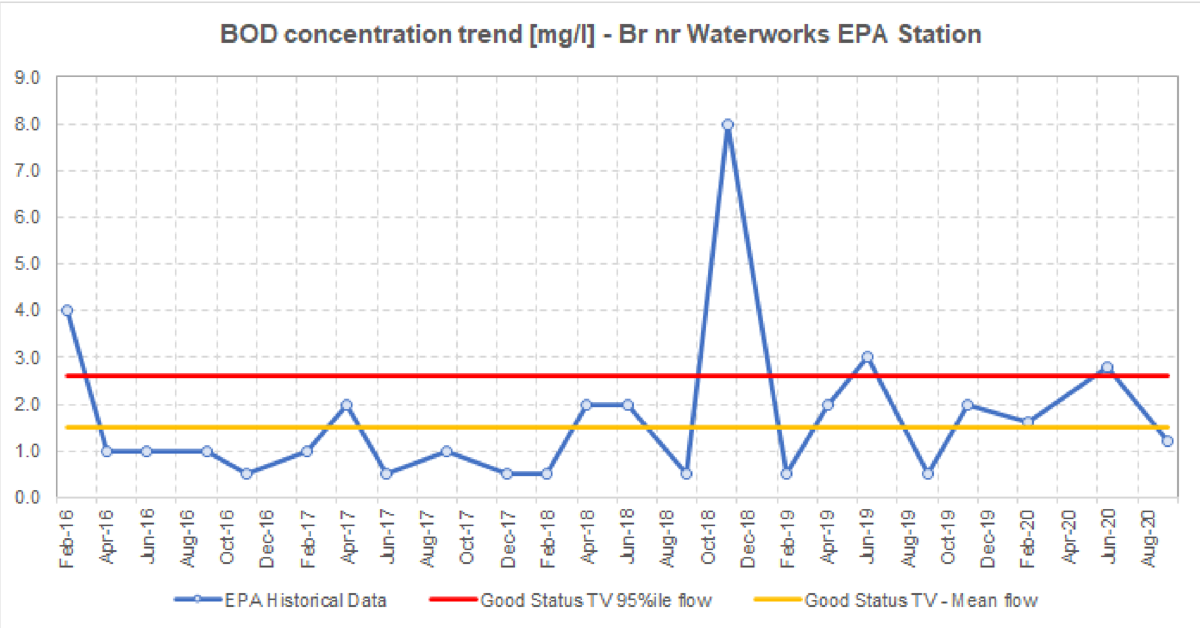
Table C.1 Hydro-G's EPA's WQ Data download merge with Met Eireann Monthly Rainfall data

Met Eireann Month & Year	Met Eireann Malahide Rainfall (mm/Month)	Br nr Waterworks: Stn RS08B020800 (mg/l) EPA Results	Ammonia-Total (as N)	BOD	MRP as P	pH	DO % Saturation
Jan-16	114.4						
Feb-16	43.6	17/02/2016	0.14	4	0.13	8.1	99
Mar-16	28.5						
Apr-16	67.8	20/04/2016	0.02	1	0.03	8.3	115
May-16	38.9						
Jun-16	73.2	15/06/2016	0.04	1	0.03	8.4	160
Jul-16	30						
Aug-16	57.5						
Sep-16	73.3	28/09/2016	0.02	1	0.08	8.5	137
Oct-16	25						
Nov-16	36.4	23/11/2016	0.03	0.5	0.09	8.4	104
Dec-16	49.7						
Jan-17	23.1						
Feb-17	45.9	22/02/2017	0.01	1	0.04	8.3	98
Mar-17	63.5						
Apr-17	7.6	19/04/2017	0.03	2	0.01	8.5	143
May-17	41.8						
Jun-17	89.1	14/06/2017	0.03	0.5	0.09	8.4	128
Jul-17	36.3						
Aug-17	70						
Sep-17	77.5	20/09/2017	0.02	1	0.05	8.4	130
Oct-17	39.9						
Nov-17	67.7						
Dec-17	51.5	06/12/2017	0.05	0.5	0.12	8.3	104
Jan-18	88.3						
Feb-18	22.6	21/02/2018	0.06	0.5	0.1	8.4	105
Mar-18	91.9						
Apr-18	62.5	25/04/2018	0.02	2	0.03	8.5	148
May-18	23.8						
Jun-18	5.9	27/06/2018	0.03	2	0.03	8.7	191
Jul-18	47.3						
Aug-18	43.4						
Sep-18	37.8	05/09/2018	0.02	0.5	0.06	8.3	143
Oct-18	46.4						
Nov-18	120.6	21/11/2018	0.07	8	0.12	8	94
Dec-18	76						
Jan-19	11.5						
Feb-19	32.6	27/02/2019	0.03	0.5	0.04	8.6	141
Mar-19	76.7						
Apr-19	53.2	24/04/2019	0.01	2	0.03	8.6	145
May-19	28.3						
Jun-19	82.1	12/06/2019	0.07	3	0.1	8.4	122
Jul-19	28.3						
Aug-19	112.6						
Sep-19	100.4	18/09/2019	0.05	0.5	0.13	8.2	109
Oct-19	94.3						
Nov-19	159.1	20/11/2019	0.16	2	0.1	8.2	108
Dec-19	49						
Jan-20	28.4						
Feb-20	107.1	26/02/2020	0.13	1.6	0.065	8.1	107
Mar-20	27.9						
Apr-20	15.1						
May-20	8.6						
Jun-20	69.5	10/06/2020	0.11	2.8	0.039	8	92
Jul-20	93.4						
Aug-20	92.7						
Sep-20	62.1	23/09/2020	0.037	1.2	0.052	8.3	116
Oct-20	73						
Nov-20		18/11/2020	0.022	0.5	0.073	8.3	101
Dec-20	93.3						
Jan-21	105.3						
Feb-21	48.2	10/02/2021	0.052	0.5	0.056	8.2	99
Mar-21	21.7						
Apr-21	6.4	28/04/2021	0.01	0.5	0.01	8.4	141
May-21							
Jun-21		09/06/2021	0.022	1.3	0.023	8.3	125

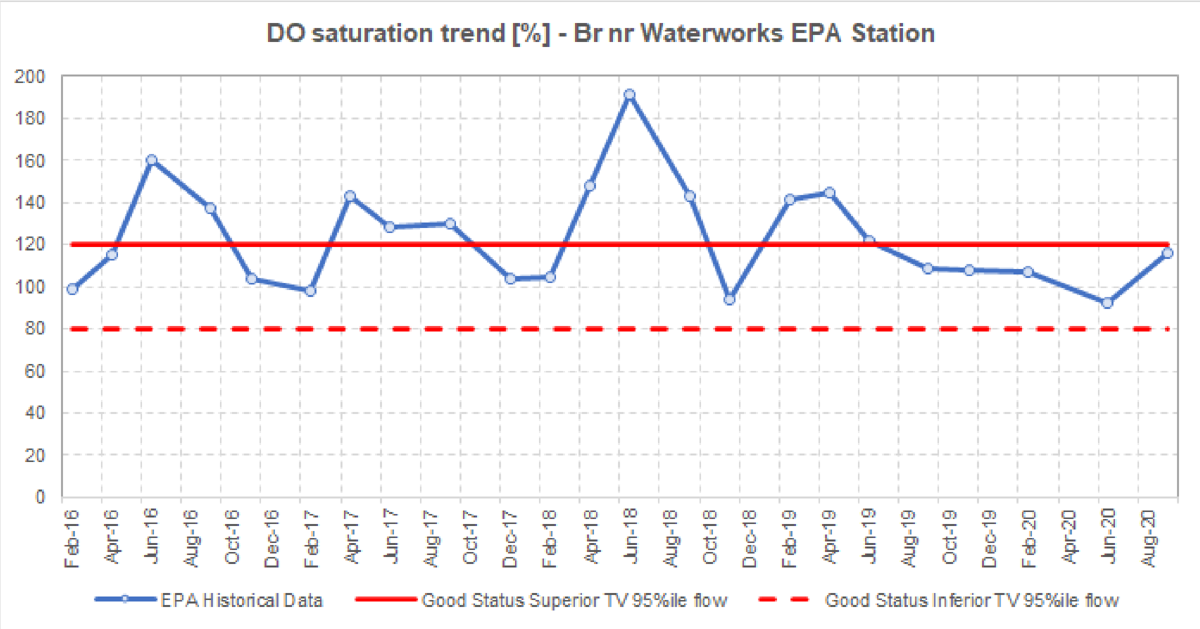
Note: Highlighted cells are Hydro-G annotations to the data to highlight extreme rainfall months and consequent elevated ammonia and BOD. Hydro-G draws attention to the fact that ortho-P is persistently elevated and this suggests upgradient agricultural pressure.



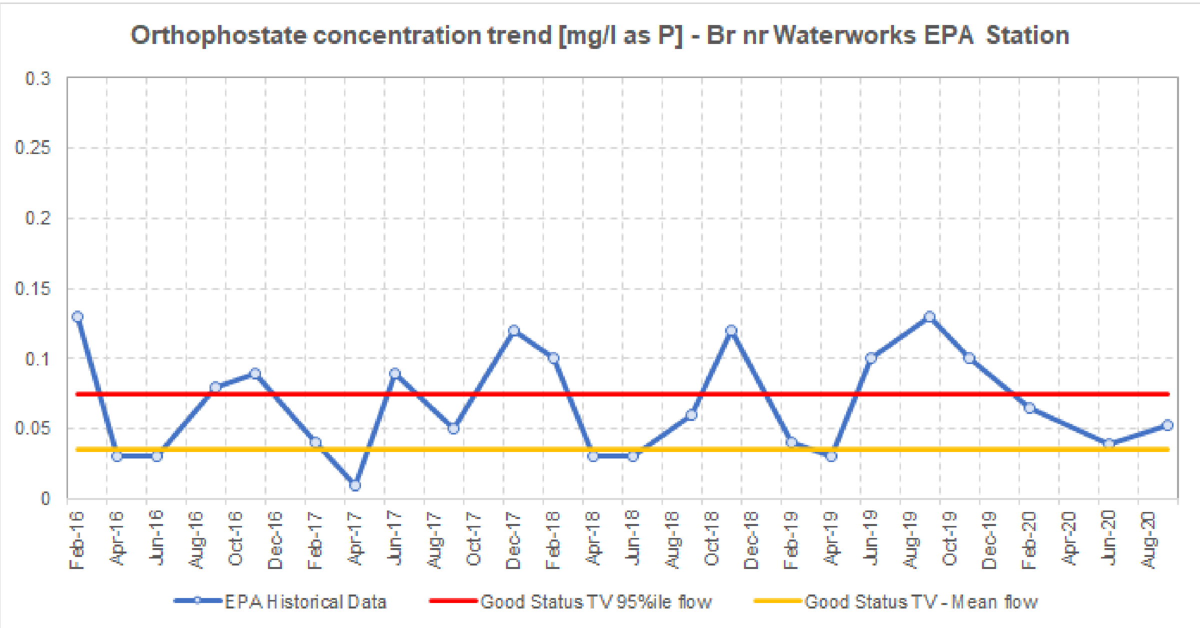
Graph 1 *Ammonia concentration trend at 'Br nr Waterworks' Station*



Graph 2 *BOD concentration trend at 'Br nr Waterworks' Station*



Graph 3 *Dissolved Oxygen trend at 'Br nr Waterworks' Station*



Graph 4 *Orthophosphate concentration trend at 'Br nr Waterworks' Station*

Note: Graph Sources = AWN (2021) Technical Note Broadmeadows River

Appendix C

Assimilation Evaluation Simulation Model Outputs

M10 Storm

OCCASIONAL Storm overflow 300mm Diameter pipe to the Broadmeadow_040 @ 0.07 m3/s discharge rate and M10 STORM 34.9 m3/s

T = (FC+fc)/(F+f)		MRP-P		Surface Water Regulations 2009 as ammended Surface WATER EQS's (mg/l)			
T = RESULTANT concentration in the receiving water (mg/l)	T	0.020	mg/l	0.035	0.075	0.025	0.045
F = RECEIVING river flow, (m3/s)	F	34.80	m3/s	Good Status Mean	GOOD STATUS 95%tile	High Status Mean	High Status 95%tile
C = Baseline concentration in receiving water (mg/l)	C	0.0175	mg/l				
f = Flow discharging to receiving waters (m3/s)	f	0.07	m3/s	Resultant MRP-P concentration in the receiving water remains Good Status Compliant for the 95%tile			
c = concentration in discharge (mg/l)	c	1.50	mg/l				

T = (FC+fc)/(F+f)		BOD		Surface Water Regulations 2009 as ammended Surface WATER EQS's (mg/l)			
				1.5	2.6	1.3	2.2
T = RESULTANT concentration in the receiving water (mg/l)	T	0.8	mg/l				
F = RECEIVING river flow, (m3/s)	F	34.80	m3/s	Good Status Mean	GOOD STATUS 95%tile	High Status Mean	High Status 95%tile
C = Baseline concentration in receiving water (mg/l)	C	0.75	mg/l				
f = Effluent flow discharging to receiving waters (m3/s)	f	0.07	m3/s	Resultant BOD concentration in the receiving remains Good Status Compliant for the 95%tile			
c = Effluent concentration in discharge (mg/l)	c	30.00	mg/l				

T = (FC+fc)/(F+f)		Ammonia-N		Surface Water Regulations 2009 as ammended Surface WATER EQS's (mg/l)			
T = RESULTANT concentration in the receiving water (mg/l)	T	0.04	mg/l	0.065	0.14	0.04	0.09
F = RECEIVING river flow, (m3/s)	F	34.80	m3/s				
C = Baseline concentration in receiving water (mg/l)	C	0.0325	mg/l	Good Status Mean	GOOD STATUS 95%tile	High Status Mean	High Status 95%tile
f = Effluent flow discharging to receiving waters (m3/s)	f	0.07	m3/s	Resultant Ammonia N concentration in the receiving water remains Good Status Compliant for the 95%tile			
c = Effluent concentration in discharge (mg/l)	c	3.00	mg/l				

T = (FC+fc)/(F+f)		Suspended Solids		Suspended Solids
T = RESULTANT concentration in the receiving water (mg/l)	T	13	mg/l	European Communities (Quality of Salmonid Waters) Regulations (SI 293/1988) (mg/l)
F = RECEIVING river flow, (m3/s)	F	34.8000	m3/s	
C = Baseline concentration in receiving water (mg/l)	C	12.5	mg/l	**25 mg/l SS Limit complied with in resultant the simulated resultant 17mg/l SS in downstream Surface Water**
f = Effluent flow discharging to receiving waters (m3/s)	f	0.07	m3/s	
c = Effluent concentration in discharge (mg/l)	c	150.00	mg/l	

T = (FC+fc)/(F+f)		COD		COD
T = RESULTANT concentration in the receiving water (mg/l)	T	21	mg/l	not specified in Regulations: COD resultant concentration oinccreasses by only 1 mg/l and this is a 'no problem' result
F = RECEIVING river flow, (m3/s)	F	34.80	m3/s	
C = Baseline concentration in receiving water (mg/l)	C	20	mg/l	
f = Effluent flow discharging to receiving waters (m3/s)	f	0.07	m3/s	
c = Effluent concentration in discharge (mg/l)	c	400.00	mg/l	

T = (FC+fc)/(F+f)		pH		pH
T = RESULTANT concentration in the receiving water (mg/l)	T	7.7	mg/l	pH Result is complaint with the 6.5 to 9 pH range specified Surface Water Regulation EQO
F = RECEIVING river flow, (m3/s)	F	34.80	m3/s	
C = Baseline concentration in receiving water (mg/l)	C	7.75	mg/l	
f = Effluent flow discharging to receiving waters (m3/s)	f	0.07	m3/s	
c = Effluent concentration in discharge (mg/l)	c	7.50	mg/l	

T = (FC+fc)/(F+f)		NO3		NO3
T = RESULTANT concentration in the receiving water (mg/l)	T	10	mg/l	not specified in Surface Water Regulations: Good Quality resultant concentration. 37.5mg/l as NO3 is the GW Regulation Threshold Vlaue for Action. Therefore, when the worst case 37.5 mg/l NO3 is the simualted input then the resultant is 1/3rd of that = reduction = great.
F = RECEIVING river flow, (m3/s)	F	34.80	m3/s	
C = Baseline concentration in receiving water (mg/l)	C	10	mg/l	
f = Effluent flow discharging to receiving waters (m3/s)	f	0.07	m3/s	
c = Effluent concentration in discharge (mg/l)	c	37.5	mg/l	

T = (FC+fc)/(F+f)		CADMIUM		CADMIUM	
T = RESULTANT concentration in the receiving water (mg/l)	T	0.05	ug/l	**0.08 ug/l**	**0.45 ug/l**
F = RECEIVING river flow, (m3/s)	F	34.80	m3/s	AA EQS Class 1 Inland Surface Water	MAC EQS Class 1 Inland Surface Waters
C = Baseline concentration in receiving water (mg/l)	C	0.04	ug/l		
f = Effluent flow discharging to receiving waters (m3/s)	f	0.07	m3/s	Resultant Cadmium concentration in the receiving water complies with the requirements of the Surface Water Regulations (2019)	
c = Effluent concentration in discharge (mg/l)	c	4	ug/l		

Note: TII (2014) Report that the influent to road side wetland systems max observed value = 0.008 ug/l and the max Cd in road runoff = 8 ug/l

T = (FC+fc)/(F+f)		PAH		PAH
T = RESULTANT concentration in the receiving water (mg/l)	T	0.023	ug/l	Not specified in Surface Water Regulations but Groundwater Regulations EQS = 0.075 ug/l PAH Compliant
F = RECEIVING river flow, (m3/s)	F	34.80	m3/s	
C = Baseline concentration in receiving water (mg/l)	C	0.02	ug/l	
f = Effluent flow discharging to receiving waters (m3/s)	f	0.07	m3/s	
c = Effluent concentration in discharge (mg/l)	c	1.75	ug/l	

Note: TII (2014) Reports median PAH concentration in road runoff is 3.3 ug/l PAH but dilution by agricultural component for this assessment rationalise as 1.75 ug/l

T = (FC+fc)/(F+f)		Nitrite		Nitrite
T = RESULTANT concentration in the receiving water (mg/l)	T	0.02	mg/l	not specified in Surface Regulations: Simualtion resultant concentration is the same as notional baseline. No change = Good
F = RECEIVING river flow, (m3/s)	F	34.80	m3/s	
C = Baseline concentration in receiving water (mg/l)	C	0.02	mg/l	
f = Effluent flow discharging to receiving waters (m3/s)	f	0.07	m3/s	
c = Effluent concentration in discharge (mg/l)	c	0.04	mg/l	

M20 Storm

OCCASIONAL Storm overflow 300mm Diameter pipe to the Broadmeadow_040 @ 0.07 m3/s discharge rate and M20 STORM ~38m3/s

T = (FC+fc)/(F+f)		MRP-P		Surface Water Regulations 2009 as ammended Surface WATER EQS's (mg/l)			
T = RESULTANT concentration in the receiving water (mg/l)	T	0.020	mg/l	0.035	0.075	0.025	0.045
F = RECEIVING river flow, (m3/s)	F	38.00	m3/s	Good Status Mean	GOOD STATUS 95%tile	High Status Mean	High Status 95%tile
C = Baseline concentration in receiving water (mg/l)	C	0.0175	mg/l				
f = Flow discharging to receiving waters (m3/s)	f	0.07	m3/s	Resultant MRP-P concentration in the receiving water remains Good Status Compliant for the 95%tile			
c = concentration in discharge (mg/l)	c	1.50	mg/l				

T = (FC+fc)/(F+f)		BOD		Surface Water Regulations 2009 as ammended Surface WATER EQS's (mg/l)			
T = RESULTANT concentration in the receiving water (mg/l)	T	0.8	mg/l	1.5	2.6	1.3	2.2
F = RECEIVING river flow, (m3/s)	F	38.00	m3/s	Good Status Mean	GOOD STATUS 95%tile	High Status Mean	High Status 95%tile
C = Baseline concentration in receiving water (mg/l)	C	0.75	mg/l				
f = Effluent flow discharging to receiving waters (m3/s)	f	0.07	m3/s	Resultant BOD concentration in the receiving remains Good Status Compliant for the 95%tile			
c = Effluent concentration in discharge (mg/l)	c	30.00	mg/l				

T = (FC+fc)/(F+f)		Ammonia-N		Surface Water Regulations 2009 as ammended Surface WATER EQS's (mg/l)			
T = RESULTANT concentration in the receiving water (mg/l)	T	0.04	mg/l	0.065	0.14	0.04	0.09
F = RECEIVING river flow, (m3/s)	F	38	m3/s	Good Status Mean	GOOD STATUS 95%tile	High Status Mean	High Status 95%tile
C = Baseline concentration in receiving water (mg/l)	C	0.0325	mg/l				
f = Effluent flow discharging to receiving waters (m3/s)	f	0.07	m3/s	Resultant Ammonia N concentration in the receiving water remains Good Status Compliant for the 95%tile			
c = Effluent concentration in discharge (mg/l)	c	3.00	mg/l				

T = (FC+fc)/(F+f)		Suspended Solids		Suspended Solids
T = RESULTANT concentration in the receiving water (mg/l)	T	13	mg/l	European Communities (Quality of Salmonid Waters) Regulations (SI 293/1988) (mg/l)
F = RECEIVING river flow, (m3/s)	F	38	m3/s	
C = Baseline concentration in receiving water (mg/l)	C	12.5	mg/l	25 mg/l SS Limit complied with in resultant the simulated resultant 13mg/l SS in downstream Surface Water
f = Effluent flow discharging to receiving waters (m3/s)	f	0.07	m3/s	
c = Effluent concentration in discharge (mg/l)	c	150.00	mg/l	

T = (FC+fc)/(F+f)		COD		COD
T = RESULTANT concentration in the receiving water (mg/l)	T	21	mg/l	not specified in Regulations: COD resultant concentration oinccreasses by only 1 mg/l and this is a 'no problem' result
F = RECEIVING river flow, (m3/s)	F	38	m3/s	
C = Baseline concentration in receiving water (mg/l)	C	20	mg/l	
f = Effluent flow discharging to receiving waters (m3/s)	f	0.07	m3/s	
c = Effluent concentration in discharge (mg/l)	c	400.00	mg/l	

T = (FC+fc)/(F+f)		pH		pH
T = RESULTANT concentration in the receiving water (mg/l)	T	7.7	mg/l	pH Result is complaint with the 6.5 to 9 pH range specified Surface Water Regulation EQO
F = RECEIVING river flow, (m3/s)	F	38	m3/s	
C = Baseline concentration in receiving water (mg/l)	C	7.75	mg/l	
f = Effluent flow discharging to receiving waters (m3/s)	f	0.07	m3/s	
c = Effluent concentration in discharge (mg/l)	c	7.50	mg/l	

T = (FC+fc)/(F+f)		NO3		NO3
T = RESULTANT concentration in the receiving water (mg/l)	T	10	mg/l	not specified in Surface Water Regulations: Good Quality resultant concentration. 37.5mg/l as NO3 is the GW Regulation Threshold Vlaue for Action. Therefore, when the worst case 37.5 mg/l NO3 is the simualted input then the resultant is 1/3r of that = reduction = great.
F = RECEIVING river flow, (m3/s)	F	38	m3/s	
C = Baseline concentration in receiving water (mg/l)	C	10	mg/l	
f = Effluent flow discharging to receiving waters (m3/s)	f	0.07	m3/s	
c = Effluent concentration in discharge (mg/l)	c	37.5	mg/l	

T = (FC+fc)/(F+f)		CADMIUM		CADMIUM	
T = RESULTANT concentration in the receiving water (mg/l)	T	0.05	ug/l	0.08 ug/l	0.45 ug/l
F = RECEIVING river flow, (m3/s)	F	38	m3/s	AA EQS Class 1 Inland Surface Water	MAC EQS Class 1 Inland Surface Waters
C = Baseline concentration in receiving water (mg/l)	C	0.04	ug/l		
f = Effluent flow discharging to receiving waters (m3/s)	f	0.07	m3/s	Resultant Cadmium concentration in the receiving water complies with the requirements of the Surface Water Regulations (2019)	
c = Effluent concentration in discharge (mg/l)	c	4	ug/l		

Note: TII (2014) Report that the influent to road side wetland systems max observed value = 0.008 ug/l and the max Cd in road runoff = 8 ug/l

T = (FC+fc)/(F+f)		PAH		PAH
T = RESULTANT concentration in the receiving water (mg/l)	T	0.023	ug/l	Not specified in Surface Water Regulations but Groundwater Regulations EQS = 0.075 ug/l PAH Compliant
F = RECEIVING river flow, (m3/s)	F	38	m3/s	
C = Baseline concentration in receiving water (mg/l)	C	0.02	ug/l	
f = Effluent flow discharging to receiving waters (m3/s)	f	0.07	m3/s	
c = Effluent concentration in discharge (mg/l)	c	1.75	ug/l	

Note: TII (2014) Reports median PAH concentration in road runoff is 3.3 ug/l PAH but dilution by agricultural component for this assessment rationalise as 1.75 ug/l

T = (FC+fc)/(F+f)		Nitrite		Nitrite
T = RESULTANT concentration in the receiving water (mg/l)	T	0.02	mg/l	not specified in Surface Regulations: Simualtion resultant concentration is the same as notional baseline. No change = Good
F = RECEIVING river flow, (m3/s)	F	38	m3/s	
C = Baseline concentration in receiving water (mg/l)	C	0.02	mg/l	
f = Effluent flow discharging to receiving waters (m3/s)	f	0.07	m3/s	
c = Effluent concentration in discharge (mg/l)	c	0.04	mg/l	

M30 Storm

OCCASIONAL Storm overflow 300mm Diameter pipe to the Broadmeadow_040 @ 0.07 m3/s discharge rate and M30 STORM ~40m3/s

T = (FC+fc)/(F+f)		MRP-P	
T = RESULTANT concentration in the receiving water (mg/l)	T	0.020	mg/l
F = RECEIVING river flow, (m3/s)	F	40.00	m3/s
C = Baseline concentration in receiving water (mg/l)	C	0.0175	mg/l
f = Flow discharging to receiving waters (m3/s)	f	0.07	m3/s
c = concentration in discharge (mg/l)	c	1.50	mg/l

Surface Water Regulations 2009 as ammended
Surface WATER EQS's (mg/l)

0.035	0.075	0.025	0.045
Good Status Mean	GOOD STATUS 95%tile	High Status Mean	High Status 95%tile

Resultant MRP-P concentration in the receiving water remains Good Status Compliant for the 95%tile

T = (FC+fc)/(F+f)		BOD	
T = RESULTANT concentration in the receiving water (mg/l)	T	0.8	mg/l
F = RECEIVING river flow, (m3/s)	F	40.00	m3/s
C = Baseline concentration in receiving water (mg/l)	C	0.75	mg/l
f = Effluent flow discharging to receiving waters (m3/s)	f	0.07	m3/s
c = Effluent concentration in discharge (mg/l)	c	30.00	mg/l

Surface Water Regulations 2009 as ammended
Surface WATER EQS's (mg/l)

1.5	2.6	1.3	2.2
Good Status Mean	GOOD STATUS 95%tile	High Status Mean	High Status 95%tile

Resultant BOD concentration in the receiving remains Good Status Compliant for the 95%tile

T = (FC+fc)/(F+f)		Ammonia-N	
T = RESULTANT concentration in the receiving water (mg/l)	T	0.04	mg/l
F = RECEIVING river flow, (m3/s)	F	40	m3/s
C = Baseline concentration in receiving water (mg/l)	C	0.0325	mg/l
f = Effluent flow discharging to receiving waters (m3/s)	f	0.07	m3/s
c = Effluent concentration in discharge (mg/l)	c	3.00	mg/l

Surface Water Regulations 2009 as ammended
Surface WATER EQS's (mg/l)

0.065	0.14	0.04	0.09
Good Status Mean	GOOD STATUS 95%tile	High Status Mean	High Status 95%tile

Resultant Ammonia N concentration in the receiving water remains Good Status Compliant for the 95%tile

T = (FC+fc)/(F+f)		Suspended Solids	
T = RESULTANT concentration in the receiving water (mg/l)	T	13	mg/l
F = RECEIVING river flow, (m3/s)	F	40	m3/s
C = Baseline concentration in receiving water (mg/l)	C	12.5	mg/l
f = Effluent flow discharging to receiving waters (m3/s)	f	0.07	m3/s
c = Effluent concentration in discharge (mg/l)	c	150.00	mg/l

Suspended Solids

European Communities (Quality of Salmonid Waters) Regulations (SI 293/1988) (mg/l)

25 mg/l SS Limit complied with in resultant the simulated resultant 13mg/l SS in downstream Surface Water

T = (FC+fc)/(F+f)		COD	
T = RESULTANT concentration in the receiving water (mg/l)	T	21	mg/l
F = RECEIVING river flow, (m3/s)	F	40	m3/s
C = Baseline concentration in receiving water (mg/l)	C	20	mg/l
f = Effluent flow discharging to receiving waters (m3/s)	f	0.07	m3/s
c = Effluent concentration in discharge (mg/l)	c	400.00	mg/l

COD

not specified in Regulations: COD resultant concentration oinccreasses by only 1 mg/l and this is a 'no problem' result

T = (FC+fc)/(F+f)		pH	
T = RESULTANT concentration in the receiving water (mg/l)	T	7.7	mg/l
F = RECEIVING river flow, (m3/s)	F	40	m3/s
C = Baseline concentration in receiving water (mg/l)	C	7.75	mg/l
f = Effluent flow discharging to receiving waters (m3/s)	f	0.07	m3/s
c = Effluent concentration in discharge (mg/l)	c	7.50	mg/l

pH

pH Result is complaint with the 6.5 to 9 pH range specified Surface Water Regulation EQO

T = (FC+fc)/(F+f)		NO3	
T = RESULTANT concentration in the receiving water (mg/l)	T	10	mg/l
F = RECEIVING river flow, (m3/s)	F	40	m3/s
C = Baseline concentration in receiving water (mg/l)	C	10	mg/l
f = Effluent flow discharging to receiving waters (m3/s)	f	0.07	m3/s
c = Effluent concentration in discharge (mg/l)	c	37.5	mg/l

NO3

not specified in Surface Water Regulations: Good Quality resultant concentration. 37.5mg/l as NO3 is the GW Regulation Threshold Vlaue for Action. Therefore, when the worst case 37.5 mg/l NO3 is the simualted input then the resultant is 1/3r of that = reduction = great.

T = (FC+fc)/(F+f)		CADMIUM	
T = RESULTANT concentration in the receiving water (mg/l)	T	0.05	ug/l
F = RECEIVING river flow, (m3/s)	F	40	m3/s
C = Baseline concentration in receiving water (mg/l)	C	0.04	ug/l
f = Effluent flow discharging to receiving waters (m3/s)	f	0.07	m3/s
c = Effluent concentration in discharge (mg/l)	c	4	ug/l

CADMIUM

0.08 ug/l	0.45 ug/l
AA EQS Class 1 Inland Surface Water	MAC EQS Class 1 Inland Surface Waters

Resultant Cadmium concentration in the receiving water complies with the requirements of the Surface Water Regulations (2019)

Note: TII (2014) Report that the influent to road side wetland systems max observed value = 0.008 ug/l and the max Cd in road runoff = 8 ug/l

T = (FC+fc)/(F+f)		PAH	
T = RESULTANT concentration in the receiving water (mg/l)	T	0.023	ug/l
F = RECEIVING river flow, (m3/s)	F	40	m3/s
C = Baseline concentration in receiving water (mg/l)	C	0.02	ug/l
f = Effluent flow discharging to receiving waters (m3/s)	f	0.07	m3/s
c = Effluent concentration in discharge (mg/l)	c	1.75	ug/l

PAH

Not specified in Surface Water Regulations but Groundwater Regulations EQS = 0.075 ug/l PAH Compliant

Note: TII (2014) Reports median PAH concentration in road runoff is 3.3 ug/l PAH but dilution by agricultural component for this assessment rationalise as 1.75 ug/l

T = (FC+fc)/(F+f)		Nitrite	
T = RESULTANT concentration in the receiving water (mg/l)	T	0.02	mg/l
F = RECEIVING river flow, (m3/s)	F	40	m3/s
C = Baseline concentration in receiving water (mg/l)	C	0.02	mg/l
f = Effluent flow discharging to receiving waters (m3/s)	f	0.07	m3/s
c = Effluent concentration in discharge (mg/l)	c	0.04	mg/l

Nitrite

not specified in Surface Regulations: Simualtion resultant concentration is the same as notional baseline. No change = Good

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19/1/22

Re: Technical Advice Note

Planning Reference F21A/0476

Hydro 's Response to Fingal's Additional Information Request

&

Hydro 's Response to Item 3 of Observation on the Planning File

(Broadmeadow)

Celestica Site Stormwater Storage Tank to Foul Network
Junction of Glen Ellan Rd/ Balheary Rd Lane
Swords, Co. Dublin

To Whom it may concern

In this Technical Advice Note Hydro-G provides responses additional to Waterman Moylan's overarching report, Irish Water's contributions supplied to the team to assist the provision of Additional Information, Openfield's Ecological clarifications and additional reporting on assessments, revised EIA Screening Report submission package prepared by Downey Planning, updates on the Construction Management Plan and additional landscape architect's contributions by Doyle OTroithigh.

In addition to considering the information presented here by Hydro-G, readers are referred to the Waterman Moylan's overview Response to Request for Further Information (Reg. Ref F21A/0476). The purpose of this Hydro-G note is to focus on water related impact items of the Request for Further Information.

RFI Item 2

"In relation to operational impacts the information in the submitted Screening Report for AA and in the NIS should be reconsidered in light of the fact that the proposed development will have the effect of introducing a new point source of potentially polluted / contaminated water into the Broadmeadow catchment and beyond. If it is concluded that there is in fact a risk of operational impacts on the European sites, then detailed mitigation measures should be presented and the NIS should be updated as appropriate."

Hydro-G Response: The August 2021 Hydro-G report submitted with the application for planning consent evaluated the effect of the point source of potentially polluted / contaminated water at the site. The assessment concluded that the occasional and infrequent discharge of potentially polluted / contaminated water from the upgradient catchment under extreme flow conditions did not present a risk of operational impacts on the European Sites.

RFI Item 15

The applicant/developer is invited to address the third-party concerns raised including……..

> *"3.) Experts for the applicant have rightly pointed out that the status of the Broad meadow river is poor. However, they have incorrectly applied illogical reasons that by improving the catchment the development can go ahead without breaching the Water Framework Directive. There is no evidence to support this nor is there any evidence to show thatthis development will help the Broad meadow river to reach Good Status."*

With Respect to Item3 of the third-party Observation on Planning Reference F21A/0476, Hydro-G's Response:

1. The Surface Water Regulations (2009, as amended) are the Statutory Instrument enacting the Water Framework Directive in Irish Law.

2. On behalf of the applicant, Hydro-G assessed the proposed addition of this stormwater tank in the context of the Surface Water Regulations. Hydro-G's assessment report accompanies the application (Hydro G report dated 26th August 2021).

3. Dr. Pamela Bartley, Hydro-G, is considered an expert in wastewater and hydrological impact assessment and assimilation capacity simulations. She has been both a consultant to and an invited guest speaker to staff at An Bord Pleanála on the issue of compliance with the requirements of the Surface Water Regulations.

4. As stated in the Executive Summary of Hydro-G's assessment report:

   "With respect to the Environmental Objectives of the Surface Water Regulations, Article (28) of the parent Statutory Instrument states as follows:

   > *A surface water body whose status is determined to be high or good (or good ecological potential and good surface water chemical status as the case may be) when classified by the Agency in accordance with these Regulations **shall not deteriorate in status**."*
   >
   > *A surface water body whose status is determined to be less than good (or good ecological potential and good surface water chemical status as the case may be) when classified by the Agency in accordance with these Regulations shall be restored to at least good status (or good ecological potential and good surface water chemical status as the case may be) by not later than 22 December 2015 unless otherwise provided for by these Regulations.*
   >
   > *S.I. No. 327 of 2012 made provision for amending the date by which pollution reduction programmes for surface water bodies must be prepared."*

5. The provision of this stormwater overflow tank on the network is one measure proposed to aid improvements in catchment water status. The provision of the tank on its own will not result in an improvement in status, as implied as a requirement in the Observation Item no.3. The legal obligation is to do no harm, i.e. cause no deterioration and assist in the efforts towards improvement of status. In every single catchment, efforts towards improvement in Status will comprise many individual tasks. The provision of a stormwater tank is considered a measure to assist efforts to improve the situation. The Waterman Moylan Engineering Report (2021) and Irish Water's modelling demonstrate that in most situations the stormwater tank will not overflow. That will be an improvement in itself. For very short time periods, when the receiving waters are experiencing massive flow rates there will be some overflow. Without the proposed measure the existing surface water network would present pathways for contaminants on more occasions and therefore to leave things as they are at present cannot aid catchment and WFD efforts to improve the infrastructure in catchments.

6. Hydro-G (August, 2021) assessed the model information returned by Irish Water and Waterman Moylan, reported in full and concluded as follows

   "Based on assimilation capacity simulations, it can be concluded that the discharge is feasible, justifiable and defensible in the context of the objectives of EC Environmental Objectives (Surface Waters) Regulations Statutory Instrument S.I. No. 272 of 2009, as amended 2012, 2015, 2019. This conclusion is made because the simulations have been carried out to evaluate whether the proposed development would aid or hinder catchment efforts to improve the Status from the assigned Poor Status to the Regulatory requirement that is Good Status. Simulated resultant concentrations suggest potential for improvement in Status class as a result of the proposed infrastructure improvements."

7. Hydro-G stands over the expert opinion and conclusion that the development will assist efforts in the catchment and downstream receptors. The assimilation calculations presented by Hydro-G, which are supported by overflow modelling by Irish Water, support the provision of the network improvements upgradient of the WWTP.

8. In the matter of the observation stating that *"they have incorrectly applied illogical reasons",* Hydro-G completed their assessment in August 2021. Independently, and with no consultation with Hydro-G, expert consultants AWN completed a similar assessment for another proposed storm tank improvement on the foul network elsewhere in the catchment and they reported their work in November 2021. AWN (November 2021) approached the assessment in a different mathematical fashion and yet they concluded the same, reproduced here, with permission as follows:

   - *"As a stormwater storage tank, the projected tank will store stormwater that would otherwise be discharged unimpeded to the Ward River. The function of the storage tank activates when the current Irish Water foul water system overflows during heavy rainfall events and surface/storm water and foul water infiltration occurs. The tank therefore will capture the surface/storm water and foul waters that are generated during heavy rainfall events, stopping these mixed, deleterious waters from discharging directly to the river, and thereby reducing the potential for contaminants present in the mixed storm/foul water to enter the stream. In this way, the tank will improve the capacity of the network to prevent the discharge of pollutant material to the Broadmeadow river, and by extension, the Malahide Estuary SAC/SPA/pNHA.*

   - *….. the Malahide Estuary SAC/SPA/pNHA is also not expected to be affected by the operation of the tank."*

9. In an indirect and unintentional way, AWN (November 2021), essentially peer reviewed Hydro-G's August 2021 assessment methodology and report. AWN presented their own analysis from a slightly different perspective and concluded the very same: That infrastructural improvements, such as the storm retention tanks proposed, can do no harm and can assist in catchment improvements required by the European Water Framework Directive. AWN referenced Hydro-G's report and this would mean that they do not agree with the observation that Hydro-G "*incorrectly applied illogical reasons".*

10. In overall conclusion, Hydro-G asserts that all technical and proficient experts will conclude that network improvements, such as the stormwater tanks proposed in this catchment, are necessary, defensible and legislatively justified.

Yours Sincerely

Pamela Bartley

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References

AWN (2021) STORMWATER OVERFLOW & RECEIVING STREAM ASSESSMENT (BROADMEADOW) ASSIMILATION SIMULATION EVALUATION REPORT FOR STORMWATER STORAGE TANK ON FOUL WATER NETWORK AT BALHEARY ROAD, SWORDS, CO. DUBLIN. Technical Report Prepared For KMPG Future Analytics. AWN Reference MA/217501.0122/SR01. Report authors Marcelo Allende BSc, BEng, Environmental Consultant & Teri Hayes Director, BSc MSc PGeo, Director AWN.

European Communities Environmental Objectives (Surface Water) Regulations, 2009. S.I. No. 272 of 2009.

European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations, 2012. S.I. No. 327 of 2012.

European Union Environmental Objectives (Surface Waters) (Amendment) Regulations, 2015. S.I. No. 386 of 2015.

European Union Environmental Objectives (Surface Waters) (Amendment) Regulations, 2019. S.I. No. 77 of 2019.

NOTE:

Pamela Bartley's company is Bartley Hydrogeology ltd., registered to trade as Hydro-G.

The company is a registered Irish Water Supplier (no. 1855) and Pamela Bartley is HSQE approved within Irish Water and is one of their Hydrogeologist service providers.

The company holds professional indemnity insurance of €2million for each and every claim in each period and the company holds both employers and public liability insurances.

Pamela is qualified and IOSH certified to act as PSDP (Project Supervisor Design Phase) & PSCS (Project Supervisor Construction Stage) as defined by the Construction Regulations.

As a result of work in evaluating planning appeals, Pamela has become specialist in planning evaluations in the context of enacted Irish Regulation and EU Directives concerning the water environment such as the Groundwater Regulations (S.I. No. 9 of 2010 as amended), Surface Water Regulations (S.I. No. 272 of 2009 as amended), Water Framework and Habitats' Directives.