STORMWATER OVERFLOW & RECEIVING STREAM ASSESSMENT (BROADMEADOW) ASSIMILATION SIMULATION EVALUATION REPORT

FOR

STORMWATER STORAGE TANK ON FOUL WATER NETWORK AT BALHEARY ROAD, SWORDS, CO. DUBLIN

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Technical Report Prepared For

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1.0 INTRODUCTION

1.1 Background

AWN Consulting (AWN) was requested by Cairn Homes Properties to undertake an assimilative capacity study to determine the likely impact on receiving waters of the proposed Stormwater Storage Tank. The 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 water system, that occur during times of heavy or prolonged rainfall, resulting from surface water and foul water infiltration. The surcharging of this foul water network results in frequent overflow into the Ward River, immediately upstream of Swords Wastewater Treatment Plan (WWTP). The Ward River Connects to the Broadmeadow River c. 1km upstream of the Broadmeadow Estuary. A summary of the assessment for this tank in relation to the Irish Water requirements is provided in the Engineering Assessment Report prepared by Waterman Moylan.

Irish Water have undertaken modelling of the catchment and have concluded that a 2,250m^3 off-line tank will supply the requisite storage for over and beyond a 1 in 5-year storm event. 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.

It is proposed to also provide a new sewer outfall along the Balheary Road to the Broadmeadow River, for overflow of the excess stormwater within the foul network during the more extreme rainfall events.

1.2 Objective of Report

The main objective of this study is to assess the impact of proposed tank on the Broadmeadow River and the Malahide Estuary which hosts Natura 2000 sites (SAC/SPA/pNHA). In addition, this study intends to clarify if there would be sufficient assimilative capacity in the Broadmeadow River and the Malahide Estuary SAC/SPA/pNHA for the discharge from the proposed development. The proposed discharge point is located beside Balheary Road.

This report was prepared by Marcelo Allende (BSc, BEng), and Teri Hayes (BSc MSc PGeol EurGeol). Marcelo is a Water Resources Engineer with over 15 years of experience in environmental consultancy and water resources studies. Marcelo is an Environmental Consultant with AWN Consulting, a member of the International Association of Hydrogeologists (Irish Group) and a member of Engineers Ireland (MIEI). Teri is a hydrogeologist with over 25 years of experience in water resource management and impact assessment. She has a Masters in Hydrogeology and is a former President of the Irish Group of the Association of Hydrogeologists (IAH) and has provided advisory services on water related environmental and planning issues to both public and private sector bodies. She is qualified as a competent person as recognised by the EPA in relation to contaminated land assessment (IGI Register of competent persons www.igi.ie). Her specialist area of expertise is water resource management eco-hydrogeology, hydrological assessment and environmental impact assessment.

1.3 Sources of Information

Specific information on water quality for the Broadmeadow River was obtained through accessing EPA databases and site archives. The collection of regional data was undertaken by reviewing the following source:

- Environmental Protection Agency (EPA, 2020): EPA stations, water quality historical data, WFD map, surface water bodies status and risk score, which were obtained from the website www.catchments.ie.

Information relating to the flows modelling carried out by Irish Water and tank design was obtained from:

- Engineering Assessment Report. Stormwater Storage Tank on Foul Water Network at Balheary Road, Swords, Co. Dublin. Waterman Moylan, August 2021.

2.0 ASSESSMENT OF BASELINE WATER QUALITY, RIVER FLOW AND ASSIMILATIVE CAPACITY

2.1 Hydrological Context and Catchment Description

The proposed SHD development site is located in Swords, c. 400 m south of the Broadmeadow River, which runs in a west-east orientation towards the Irish Sea. The proposed discharge is projected directly in this river directly to the north of the site, upstream the Balheary Road bridge.

The Broadmeadow River (EPA Code: 08B02) receives discharge from the Ward River approximately 700 m 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.

Figures 2.1 and 2.2 below presents further details on the discharge point and local hydrological setting.

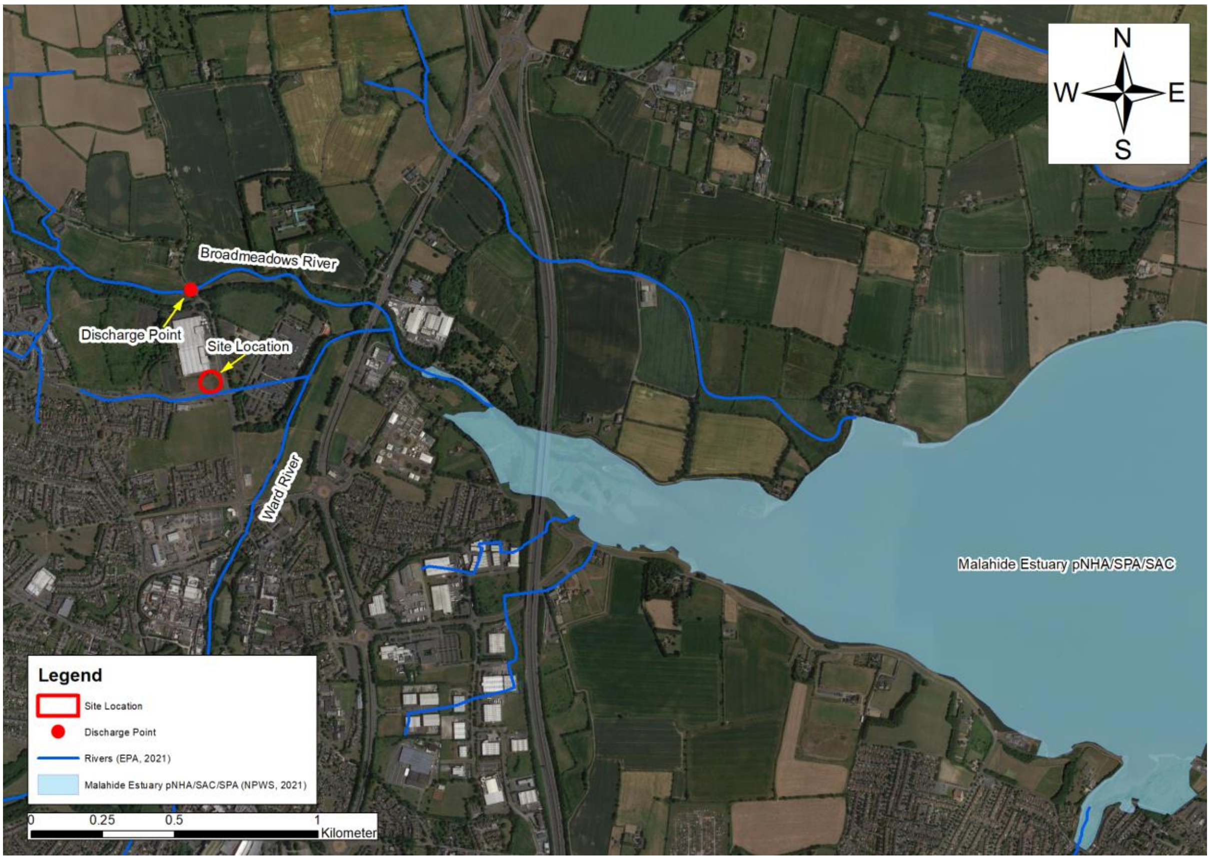


Figure 2.1 *Local hydrological setting and discharge point*

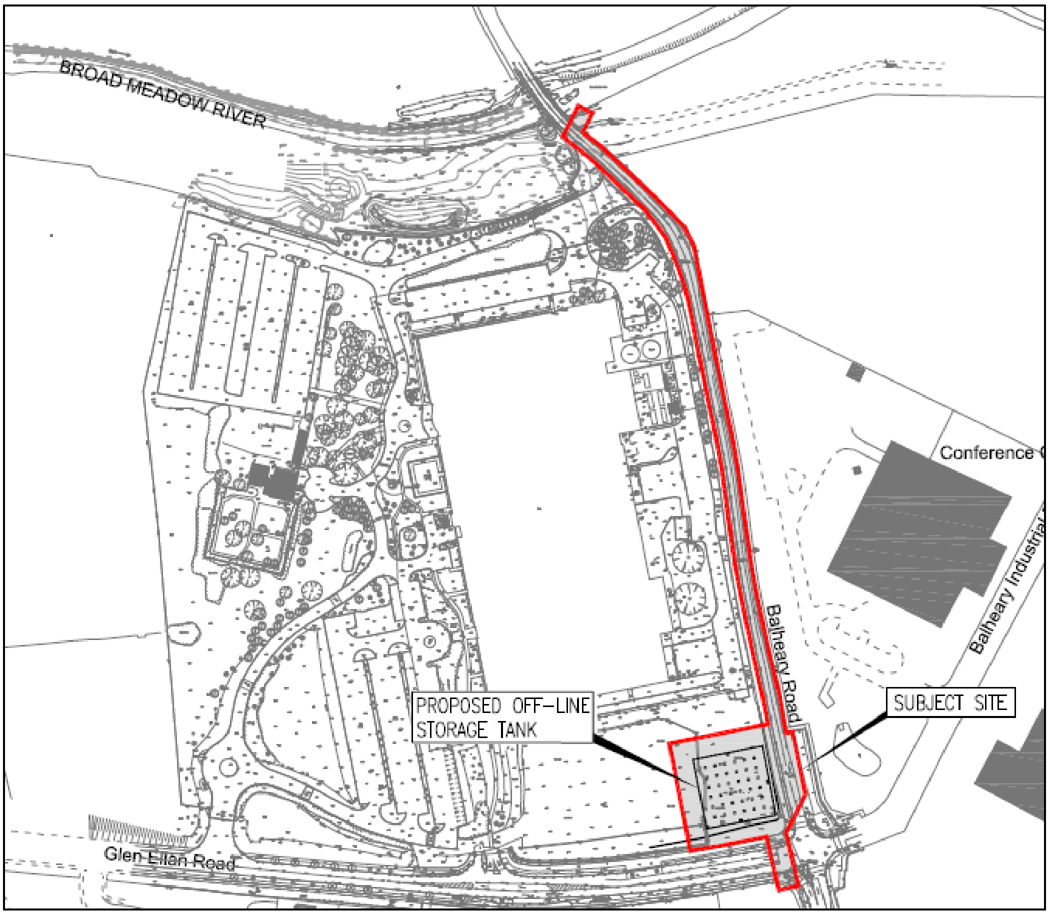


Figure 2.2 *Storage Tank location*

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 Broadmeadow_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 above status relates to data from 2 no. EPA water quality stations on the Broadmeadow River located upstream and downstream of its confluence with the Ward River ('*Br nr Waterworks*' and '*Br W of Lissen Hall'*, respectively; refer to Figure 2.3 below). Both stations are located downstream of the proposed discharge point; however, the nearest station is located under Balheary Road bridge (i.e., adjacent to the discharge location).

The '*Poor*' status of the Broadmeadow River is related to poor biological status (invertebrate status or potential), bad oxygenation conditions, and moderate phosphorous conditions.

The Ward River in its section immediately upstream of its confluence with the Broadmeadow, also has a WFD '*Poor*' Status and '*At Risk of nor achieving good status*'. This condition is due to a poor biological status (invertebrate status or potential) and moderate nitrate and orthophosphate conditions.

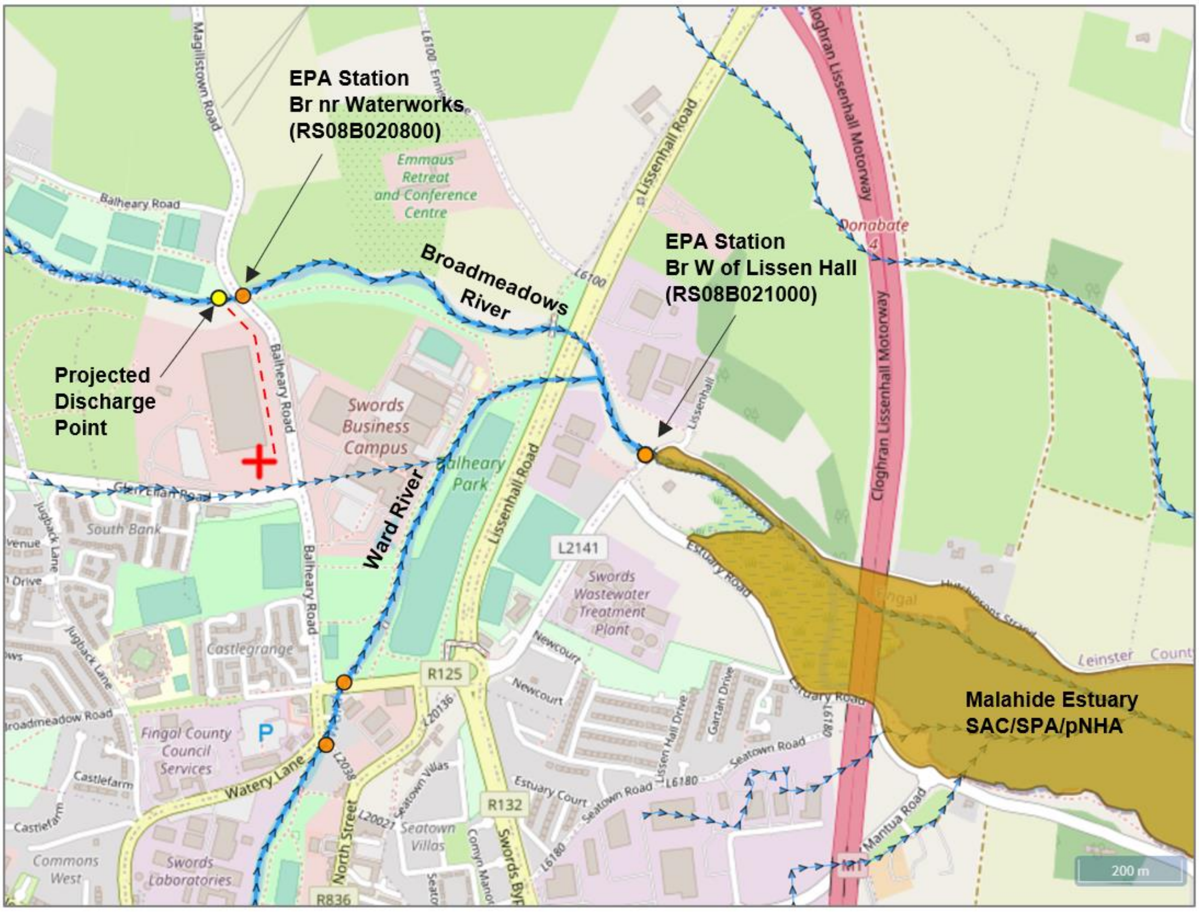


Figure 2.3 *Discharge Point and EPA Water Quality Stations in the Broadmeadow (site location marked with a red cross)*

2.2 Required Water Quality as part of European Regulations

The most recent Irish legislation set down as part of the WFD to provide guidelines for river quality in Ireland is '*EU Environmental Objectives (Surface Water) Regulations (S.I. 272/2009 and* amendment *S.I. 77/2019*).

This legislation has established ecological, biological and chemical for the protection of surface water bodies whose status is determined to be high or good and measures requiring the restoration of surface water bodies of 'less than good status' (or good potential as the case may be) to 'not less than good status'.

The surface water regulations provide targets/ thresholds for water quality in order to determine if a waterbody has good/ high or a lesser status.

Table 2.1 below presents data from Table 9 of the Surface Water Regulations 2019 which indicates threshold values required to achieve 'Good' Status for oxygenation, nutrient and acidification conditions. These values have been established for 95%ile and the mean of the measured concentration values.

Table 2.1 *Threshold Values to achieve 'Good' Status in River Waterbodies (S.I. 77/2019)*

Condition	Parameter/ Unit	Threshold value for 'Good Status' in River Waterbodies
Oxygenation	BOD (mg O_2/l)	1.5 (mean) / 2.6 (95%ile)
	Dissolved Oxygen (% saturation)	80% (lower limit, 95%ile) - 120% (upper limit, 95%ile)
Nutrient	Total Ammonia (mg N/l)	0.065 (mean) / 0.140 (95%ile)
	Molybdate Reactive Phosphorus (MRP; mg P/l)	0.035 (mean) / 0.075 (95%ile)
Acidification	pH	4.5 < pH < 9.0 for soft waters (i.e. < 100 mg/l $CaCO_3$) 6.0 < pH < 9.0 for hard waters (i.e. > 100 mg/l $CaCO_3$)

2.3 EPA Water Quality Records in the Broadmeadow River

As explained above, water quality data were obtained from the EPA website. The data from the period between 2016 to 2021 were considered. The results obtained for critical parameters (presented in Table 2.1 above) are shown below in Table 2.2 for the station adjacent to the discharge point ('*Br nr Waterworks*').

Table 2.2 *Historical Water Quality recorded by the EPA at 'Br nr Waterworks' Station (Source: EPA, 2021)*

EPA Station	Sampled Date	Ammonia mg/l as N	BOD mg/l	DO % Sat.	DO mg/l	ortho-Phosphate mg/l as P	pH pH
	TV 95%ile	*0.14*	*2.6*	*80-120*		*0.075*	*6.0-9.0*
	TV mean	*0.065*	*1.5*	*-*		*0.035*	*6.0-9.0*
Br nr Waterworks (RS08B020800)	17/02/2016	0.14	**4.0**	99	12.5	**0.13**	8.1
	20/04/2016	0.02	1.0	115	13.1	0.03	8.3
	15/06/2016	0.04	1.0	160	15.5	0.03	8.4
	28/09/2016	0.02	1.0	137	13.8	**0.08**	8.5
	23/11/2016	0.03	0.5	104	13.5	**0.09**	8.4
	22/02/2017	0.01	1.0	98	11.7	0.04	8.3
	19/04/2017	0.03	2.0	143	15.9	0.01	8.5
	14/06/2017	0.03	0.5	128	12.7	**0.09**	8.4
	20/09/2017	0.02	1.0	130	13.1	0.05	8.4
	06/12/2017	0.05	0.5	104	12.2	**0.12**	8.3
	21/02/2018	0.06	0.5	105	13.2	**0.1**	8.4
	25/04/2018	0.02	2.0	148	16.1	0.03	8.5
	27/06/2018	0.03	2.0	191	17.5	0.03	8.7
	05/09/2018	0.02	0.5	143	14.7	0.06	8.3
	21/11/2018	0.07	**8.0**	94	11.2	**0.12**	8
	27/02/2019	0.03	0.5	141	17	0.04	8.6
	24/04/2019	0.01	2.0	145	14.7	0.03	8.6
	12/06/2019	0.07	**3.0**	122	12.8	0.1	8.4
	18/09/2019	0.05	0.5	109	12	**0.13**	8.2
	20/11/2019	**0.16**	2.0	108	12.6	0.1	8.2
	26/02/2020	0.13	1.6	107	13.4	0.065	8.1
	10/06/2020	0.11	**2.8**	92	9.5	0.039	8
	23/09/2020	0.037	**1.2**	116	12.1	0.052	8.3
	18/11/2020	0.022	0.5	101	10.9	0.073	8.3
	10/02/2021	0.052	0.5	99	13.4	0.056	8.2
	28/04/2021	0.01	0.5	141	15.9	0.01	8.4
	09/06/2021	0.022	1.3	125	12.3	0.023	8.3
	29/09/2021	0.078	1.1	103	11.5	**0.16**	8.1
	Data 95%ile	**0.151**	**6.2**	**177**	**17.3**	**0.147**	8.7
	Data mean	0.049	1.5	-	13.4	0.067	8.3

XXX	Over 'Good Status' Threshold value (95%ile)
XXX	Over 'Good Status' Threshold value (mean)

As it can be seen in the tables and graphs above, the Broadmeadow River consistently shows exceedances of Orthophosphate (for 95%ile and mean condition) and Dissolved Oxygen threshold values. With regard to Ammonia and BOD, exceedances in the mean condition have been observed from 2019 onwards.

It also can be observed that 95%ile of the measured concentration during 2016-2019 exceeds the 95%ile threshold value for all the parameters considered, with the exception of pH. The mean of the data exceeds the mean threshold value for BOD and orthophosphate.

2.4 Flow Data in the Broadmeadow River

i. EPA Data – Dry and Mean Condition

There is no measured flow data for the Broadmeadow River in the vicinity of the projected discharge point. The EPA (2021) has estimated the naturalised river flow duration percentiles and monthly mean flows for Irish rivers. The flow estimates represent flows that could be expected in rivers under naturalised conditions and do not take account of artificial influences of any kind such as water supply abstractions or wastewater discharges and so on.

According to available information from the Agency, the Broadmeadow River has a 95%ile flow of approx. 0.117 m^3/s (EPA ref. point 08-294 ungauged) at a location c. 400 m upstream of the proposed discharge point. At this point a minimum monthly mean flow of approx. 0.568 m^3/s has been estimated by the EPA. Figure 2.4 below presents the location of this EPA estimation point.

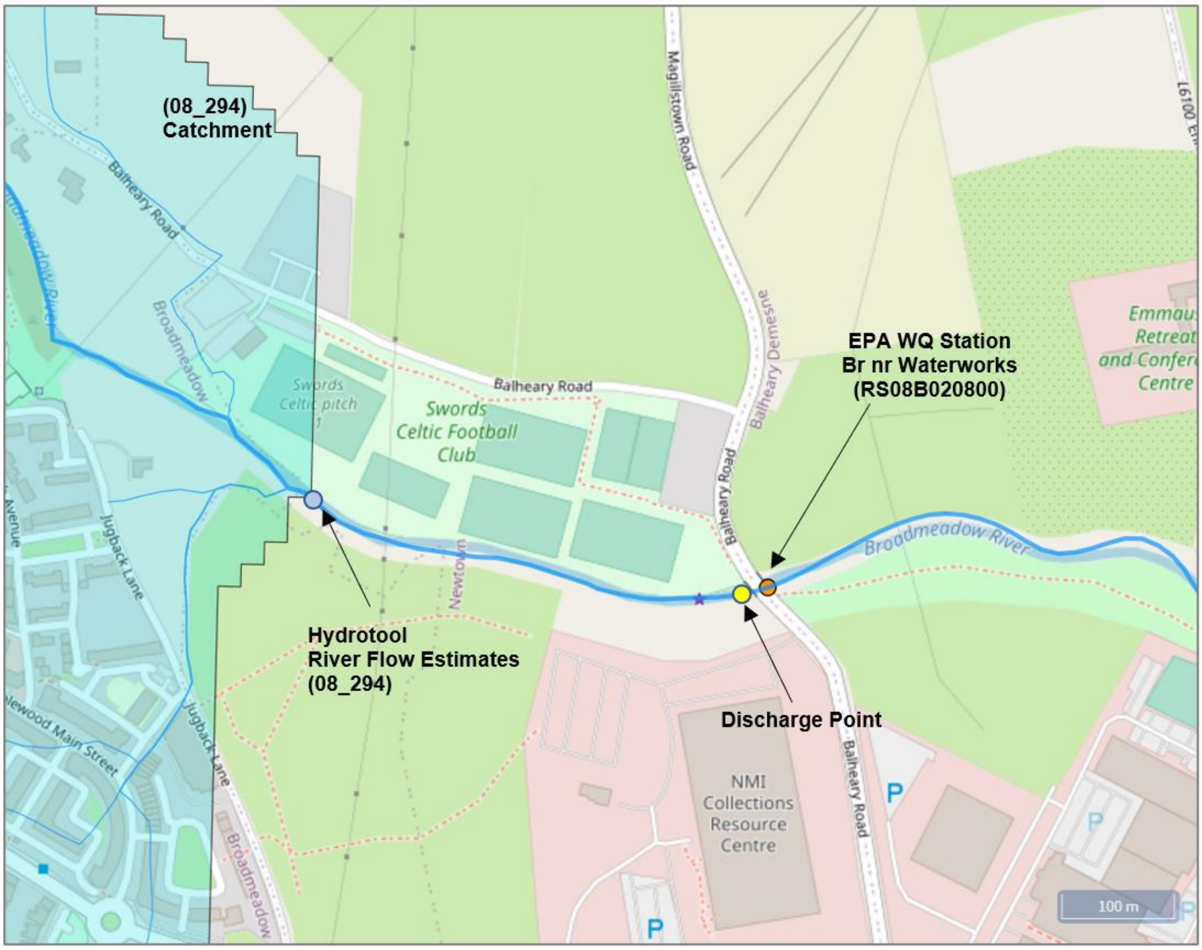
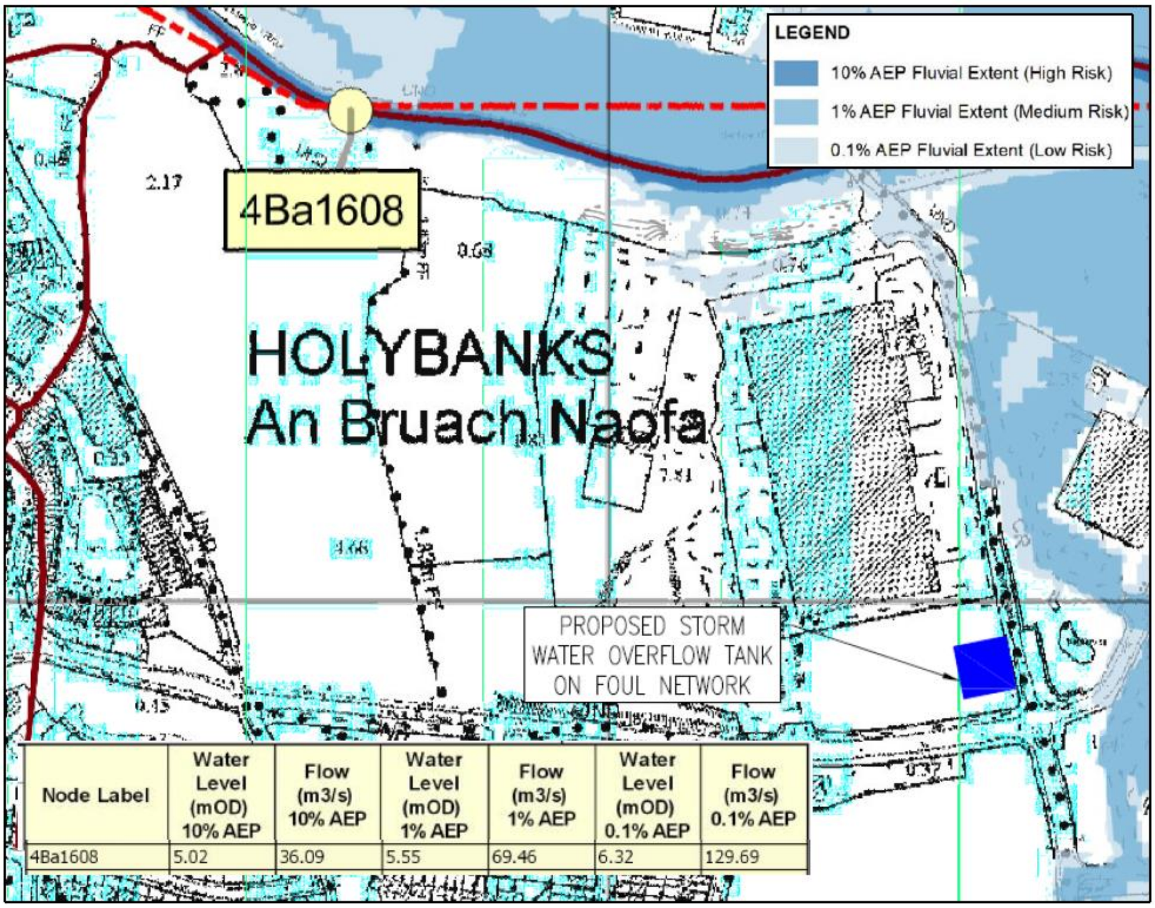


Figure 2.4 *EPA Ungauged Point considered (Source: EPA, 2021).*

ii. OPW Data – Extreme Event Flows

The Fingal East Meath Flood Risk Assessment and Management Study (FEM FRAMS) maps, available on the OPW's National Flood Information Portal shows that the nearest node point, reference number: 4Ba1608, located c. 400m to the north-west of the subject site (refer to Figure 2.5 below), will have the following extreme flows:

- 10% AEP (1-10 year return period): 36 m3/s;
- 1% AEP (1-100 year return period): 69 m3/s;
- 0.1% AEP (1-1,000 year return period): 130 m^3/s;



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

Insert 2.5 *Extract from FEM FRAMS Fluvial Flood Extent Map (Source: Waterman Moylan and OPW, 2021).*

2.5 Assimilative Capacity Estimation

The definition of assimilative capacity, as used by the EPA, is '*the ability of a body of water to cleanse itself; its capacity to receive waste waters or toxic materials without deleterious effects and without damage to aquatic life or humans who consume the water*'.

Guidance carried out by the EPA and Water Services Training Group on the assessment of assimilative capacity details the following methodology:

Assess the Assimilative Capacity with respect to the parameters considered in accordance with S.I. No. 77/2019 (refer to Table 1 above) using the following calculation:

$$Assimilative\ Capacity = (C_{max} - C_{back}) \cdot F_{95} \cdot 86.4\ [kg/day]$$

Where:

- C_{max} = Maximum permissible concentration (mg/l)
- C_{back} = Background upstream concentration (mg/l)
- Q_{95} = 95%ile flow in river stream (m^3/s)

The C_{max} is associated with threshold values for '*Good*' Status in River Waterbodies defined in SI 77/2019 (refer to Table 2.1 above) for both 95%ile and mean condition.

The C_{back} has been associated with the quality data obtained by the EPA at the 'Br nr Waterworks' station (adjacent to the discharge point). Based on this data, the 95%ile and the mean values of these records have been considered as the C_{back} concentration. As such, an Assimilative Capacity was estimated for a 95%ile and mean condition.

The 95%ile flow considered is 0.117 m^3/s (refer to previous section above).

It is also suggested to estimate the assimilative capacity for the Dry Weather Flow (DWF) condition. The DWF is defined by the EPA as the annual minimum daily mean flow rate with a return period of 1 in 50 year. However, since there are no statistical measures on the Broadmeadow River, this estimation could not be estimated.

The pH results were not considered in these analysis, as all measured values are within the defined threshold range (i.e., between 6.0-9.0).

The results obtained are presented in Table 2.3 below.

Table 2.3 *Assimilative Capacity Results in the Broadmeadow River*

Parameter	Q95 (m^3/s)	Cmax (mg/l)		Cback (mg/l)		Assim. Cap. (kg/d) [2]	
		95%ile	*Mean*	*95%ile*	*Mean*	*95%ile*	*Mean*
Ammonia	0.117	0.14	0.065	0.151	0.049	-0.1	0.16
BOD		2.6	1.5	6.2	1.5	-36.3	-0.36
Dissolved Oxygen [1]		13.37	-	17.3	-	-39.4	-
Orthophosphate as P		0.075	0.035	0.147	0.1	-0.7	-0.33

Note: 1. For dissolved oxygen, a concentration associated with 120% saturation has been estimated to define the Cmax, based on observed historical data and a linear regression between saturation and concentration. Cback concentration was also estimated with same linear regression.
Note 2. A negative assimilative capacity (highlighted in red) means that there is not sufficient capacity in the river to assimilate the excess of concentration over the maximum permissible concentration.

As it can be seen in table above, there is not sufficient assimilative capacity for the 95%ile recorded data considering current oxygenation and nutrient condition (i.e., baseline condition). With regard to the mean values recorded, there would be capacity for oxygenation condition but possibly not sufficient for nutrient condition based on the estimates obtained for orthophosphate.

These results are consistent with the classification for this surface waterbody defined by the EPA, whose '*Poor*' status is related to poor biological status, bad oxygenation conditions, and moderate phosphorous conditions.

3.0 ASSESSMENT OF THE OPERATION OF THE SURFACE WATER OVERFLOW (SWO) FROM THE TANK

Irish Water have estimated a volume of 2,250m^3 for the projected tank in order to contain the 1 in 5-year event fully and thus alleviate constraints within the Irish Water foul system. The tank will provide full retention of mixed foul/storm water overflow for up to a 1 in 5 year storm event. It is proposed to also provide a new outfall sewer along the Balheary Road to the Broadmeadow River, for overflow of the excess stormwater (SWO) within the foul network during more extreme rainfall events (i.e. greater than 1 in 5 year event).

3.1 Discharge rate from the tank

According to project information provided to AWN, the outfall sewer from the tank is a 300 mm diameter pipe at a gradient of 1/250, permitting a flow of c. **70 l/s or 0.07 m^3/s**. This flow has been determined using the Hazen-Williams equations.

3.2 Foul water flow inlet (FW)

According to the Engineering Assessment Report (Waterman Moylan, 2021), the tank is required for the delivery of critical wastewater infrastructure within the northwest catchment in Swords including on-going housing developments in the Oldtown / Mooretown LAP lands and Strategic Housing Development in Holybanks LAP lands, and specifically, to cater the following number of housing units:

- Circa 400 units within Oldtown / Mooretown and Holybanks lands with planning permission awaiting connection agreements with Irish Water;
- Circa 1,500 units through the SHD planning process and awaiting final submission to An Bord Pleanála.
- Another c. 3,300 already under construction from Oldtown / Mooretown lands and Holybanks lands
- Total: c. **5,200 units**.
- Population: 2.7 PE/ unit = 14,040 PE ("Code of Practice for Wastewater Infrastructure. Irish Water, 2020")

The 2020 AER Swords WWTP indicates that during a peak week an organic capacity of 59,109 PE has been collected and the WWTP has also received an average hydraulic loading of 14,148 m^3/d (see Table 3.1 below).

Table 3.1 *Treatment Capacity Summary Swords WWTP (Source: 2020 AER D0024-01)*

SWORDS WWTP	
Peak Hydraulic Capacity (m^3/day) - As Constructed	60,750
DWF to the Treatment Plant (m^3/day)	20,250
Current Hydraulic Loading - annual max (m^3/day)	39,869
Average Hydraulic loading to the Treatment Plant (m^3/day)	14,148
Organic Capacity (PE) - As Constructed	70,500
Organic Capacity (PE) - Collected Load (peak week)[Note1]	59,109
Organic Capacity (PE) - Remaining	11,391
Will the capacity be exceeded in the next three years? (Yes/No)	No

Combining these figures with the population to be served by the proposed tank (14,040 PE), results in a foul water inflow to the tank (FW) of **39 l/s**.

3.3 Estimated inflows to the tank in combined sewer

The following information/data has been supplied by Irish Water during and following their modelling exercise, to facilitate a planning submission package to be made to Fingal County Council:

- Determined Existing Flows in the gravity foul sewer
  - DWF in sewer is 80 l/s.
  - 5-year rainfall event increases flow in sewer to 330 l/s.
  - 30-year rainfall event increases flow in sewer to 460 l/s.

According to these figures and a FW value of 39 l/s estimated above, the following ratios FW/SW (where SW = surface water from rainfall) have been calculated:

- FW/SW 5-year flow: 12%;
- FW/SW 30-year flow: 8% .

The chemical composition of the flow is not available as a dataset, therefore estimates are made below.

3.4 SWO Flow Scenarios

Irish Water has calculated volumes of overflow (in m³) from the proposed storage tank for different frequency of flood events (5, 10, 20 & 30 year) with climate change incorporated. The results obtained are presented in Table 3.2 below. The overflow at the Swords WWTP is also presented for the same events without tank operation (i.e., do-nothing-scenario) in order to illustrate the benefit of the operation of the tank in the Swords WWTP.

Table 3.2 *Irish Water Model's output for volumetric discharge and overflow at Swords WWTP*

Event	Tank SWO (m^3)	WWTP Inlet SWO (m^3)		
		With tank	No tank	Reduction
5-year	0	11	897	99%
10-year	7	234	1,242	81%
20-year	606	451	1,606	72%
30-year	938	614	1,900	68%

A simple example of this is the comparison of the storage tank overflow volume of 7m³ that will occur for the 10-year 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 1,242m³. **In this case, the reduction of the overflow volume at the WWTP is 81% which means a significant improvement over the existing situation**.

With regard to the volume of discharge from the tank, considering a discharge rate of 0.07 m^3/d (see above) and the aforementioned discharge volume, a probable duration of the discharge from the tank has been determined for each scenario as follows.

Table 3.3 *Estimated tank overflow durations for each scenario*

Event	SWO (m^3)	Duration SWO		
		(sec)	(min)	(h)
5-year	0	-	-	-
10-year	7	100	2	0.03
20-year	606	8,657	144	2.4
30-year	938	13,400	223	3.7

From the durations and volumes estimated above, it can be concluded the following operation conditions for each scenario:

- For the 5-year event there will be **zero** overflow from the tank;
- For the 10-year event there will be a total of 7 m3 overflow and it will be over 2 minutes;
- For the 20-year event there will be a total of 606 m3 overflow and it will be over 2.4 hours;
- For the 30-year event there will be a total of 938 m3 overflow and it will be over 3.7 hours.

From these figures and the ratios FW/SWO calculated above, the following flows have been estimated. The 5-year event has not been considered, as there will be no overflow from the tank in this hydrological condition.

Table 3.4 *Overflow from Tank and estimated ratio Foul Water / Storm Water*

Event	SWO (l/s)	FW / SWO ratio	FW Flow (l/s)	SW Flow (l/s)
10-year	70	0.11	8	62
20-year	70	0.10	7	63
30-year	70	0.08	6	64

Notes: - SWO: Storm Water Overflow from Tank
- FW/SWO: Ratio Foul Water / SWO. It has been considered that the ratio estimated in the sewer can be applied to the tank overflow
- SWO = FW + SW.

3.5 SWO Quality Calculations

In this analysis the following water quality parameters have been considered: Ammonia as N, BOD, and Orthophosphate as P.

The flows above (FW – foul water & SW – surface water from rainfall) have been associated to the following quality conditions:

Foul Water:
Representative values of domestic foul water (FW) for the above parameters have been obtained from the 2020 AER Swords WWTP, which indicates the following annual mean conditions for its inflow as presented below.

Table 3.5 *Influent Monitoring Summary – Swords WWTP (Source: 2020 AER D0024-01)*

Parameters	Number of Samples	Annual Max	Annual Mean
Total Nitrogen mg/l	25	65	50.92
Suspended Solids mg/l	25	705	357.12
COD-Cr mg/l	25	1,233	675.58
Total Phosphorus (as P) mg/l	25	10.4	7.16
BOD, 5 days with Inhibition (Carbonaceous BOD) mg/l	24	561	300.43
Hydraulic Capacity	N/A	39,869	14,148

Stormwater:
Given the expected dilution in the surfaces waters associated with the hydrological events analysed, it has been considered that all parameters would be below their laboratory limit of detection (LoD) as follows:

- Ammonia as N: 0.01 mg/l;
- BOD: 1 mg/l
- Phosphorus: 0.03 mg/l

With these concentrations and the flows (FW & SW) estimated above, by applying a simple mass balance, the following representative overflow SWO concentrations are obtained.

Table 3.6 *Representative SWO Concentrations Obtained*

Ammonia

Event	FW Flow (l/s)	SW Flow (l/s)	FW Conc (mg/l)	SW Conc (mg/l)	SWO Conc (mg/l)
10-year	8	62	51	0.01	5.7
20-year	7	63			5.0
30-year	6	64			4.3

BOD

Event	FW Flow (l/s)	SW Flow (l/s)	FW Conc (mg/l)	SW Conc (mg/l)	SWO Conc (mg/l)
10-year	8	62	300	1	34
20-year	7	63			30
30-year	6	64			26

Phosphorus (as P)

Event	FW Flow (l/s)	SW Flow (l/s)	FW Conc (mg/l)	SW Conc (mg/l)	SWO Conc (mg/l)
10-year	8	62	7.2	0.03	0.8
20-year	7	63			0.7
30-year	6	64			0.6

3.6 Broadmeadow River Flow

Based on the OPW flow for the Broadmeadow River presented above, the following flow rates associated with each of the hydrological scenarios considered have been obtained.

Table 3.7 *Representative Broadmeadow River Flows*

Event	Flow (m^3/s)	Ratio Flow/SWO
10-year	36.1	516
20-year	39.8	569
30-year	43.5	622

As can be seen above, the flows obtained in the Broadmeadow river are immensely higher (500-600 times greater) than the discharge flow (SWO).

3.7 Receiving Water Quality Calculations

With regard to the water quality conditions in the Broadmeadow upgradient, 2 no. conditions have been considered as follows:

- Condition A: Mean concentrations measured at EPA Station ‘*Br nr Waterworks*’;
- Condition B: A ‘notional’ quality associated with national efforts to improve the Broadmeadow river status.

Details and results of these conditions are presented below.

Condition A – Current Status

With the above estimated concentrations and flows for the tank overflow (SWO), the concentrations in the Broadmeadow given by the mean measured at EPA Station '*Br nr Waterworks*' (refer to Table 2.2 above) and above river flows, applying a mass balance equation gives the following representative downstream concentrations in the river. These results are representative of current 'Poor' status of the Broadmeadow river.

Table 3.8 *Broadmeadow Concentrations Obtained Downstream of Discharge (Condition A)*

Ammonia

Event	River Flow (m^3/s)	SWO (m^3/s)	River Conc u/s (mg/l)	SWO Conc (mg/l)	River Conc d/s (mg/l)	'Good Status' TV (mean) (mg/l)
10-year	36.1	0.07	0.049	5.7	0.060	0.065
20-year	39.8	0.07		5.0	0.058	
30-year	43.5	0.07		4.3	0.056	

BOD

Event	River Flow (m^3/s)	SWO (m^3/s)	River Conc u/s (mg/l)	SWO Conc (mg/l)	River Conc d/s (mg/l)	'Good Status' TV (mean) (mg/l)
10-year	36.1	0.07	1.54	34	1.60	1.5
20-year	39.8	0.07		30	1.59	
30-year	43.5	0.07		26	1.58	

Phosphorus (as P)

Event	River Flow (m^3/s)	SWO (m^3/s)	River Conc u/s (mg/l)	SWO Conc (mg/l)	River Conc d/s (mg/l)	'Good Status' TV (mean) (mg/l)
10-year	36.1	0.07	0.067	0.8	0.069	0.035
20-year	39.8	0.07		0.7	0.069	
30-year	43.5	0.07		0.6	0.068	

Notes: - River Concentration u/s (upstream): Mean value measured during 2016-2021 at EPA Station 'Br nr Waterworks'.
- 'Good Status' Threshold Values (TV) taken from S.I. 77/2019. Refer Table 1 above.

Condition B – Improved Status (notional condition)

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 by 2015 or, at the least, by 2027. 'Good status' means both 'Good Ecological Status' and 'Good Chemical Status'.

The proposed development has been designed to provide enhanced capacity in the foul water network. The proposals for improvement are not confined to this site as multiple improvements in the catchment are under way and require planning approval. In addition, Irish Water is driving works elsewhere in the catchment foul network to improve stormwater management.

Considering the above, in order to simulate the effect of the discharge on a notional background water quality, 50% of concentrations threshold values established for a '*Good*' status is assumed for these conditions (i.e., assuming that the river has achieved a '*Good*' status condition without the tank operation).

Results can then be considered in terms of whether the discharge has the potential to cause a deterioration in the status classification, given a condition where the river would have already achieved a ‘Good’ status condition.

Table 3.9 *Broadmeadow Concentrations Obtained Downstream of Discharge (Condition B)*

Ammonia

Event	River Flow (m^3/s)	SWO (m^3/s)	River Conc u/s (mg/l)	SWO Conc (mg/l)	River Conc d/s (mg/l)	'Good Status' TV (mean) (mg/l)
10-year	36.1	0.07	0.033	5.7	0.043	0.065
20-year	39.8	0.07		5.0	0.041	
30-year	43.5	0.07		4.3	0.039	

BOD

Event	River Flow (m^3/s)	SWO (m^3/s)	River Conc u/s (mg/l)	SWO Conc (mg/l)	River Conc d/s (mg/l)	'Good Status' TV (mean) (mg/l)
10-year	36.1	0.07	0.75	34	0.82	1.5
20-year	39.8	0.07		30	0.80	
30-year	43.5	0.07		26	0.79	

Phosphorus (as P)

Event	River Flow (m^3/s)	SWO (m^3/s)	River Conc u/s (mg/l)	SWO Conc (mg/l)	River Conc d/s (mg/l)	'Good Status' TV (mean) (mg/l)
10-year	36.1	0.07	0.110	0.8	0.111	0.035
20-year	39.8	0.07		0.7	0.111	
30-year	43.5	0.07		0.6	0.111	

Notes: - *River Concentration u/s (upstream): 50% on ‘Good Status’ Threshold Values (TV)*
- *‘Good Status’ Threshold Values (TV) taken from S.I. 77/2019. Refer Table 1 above.*

4.0 CONCLUSIONS

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 projected tank will provide full retention of mixed foul/storm water overflow for up to a 1 in 5 year storm event. This equates to a 99% reduction of overflow at the inlet to Swords WWTP for this storm event. Significant reductions over the existing situation can be seen for a greater storm events, which involve the discharge of a stormwater overflow, as indicated below:

- For the 1 in 5-year event there will be **zero** overflow from the tank;
- For the 1 in 10-year event there will be a total of 7 m3 overflow and it will be over 2 minutes;
- For the 1 in 20-year event there will be a total of 606 m3 overflow and it will be over 2.4 hours;
- For the 1 in 30-year event there will be a total of 938 m3 overflow and it will be over 3.7 hours.

These scenarios would result in the following reductions in the Swords WWTP inflow:

- **81%** for the 1 in 10-year event;
- **72%** for the 1 in 20-year event; and
- **68%** for the 1 in 30-year event.

Therefore, the proposal will provide a significant improvement on the existing situation, where uncontrolled flooding of the foul network occurs frequently.

It should be noted that the discharge of the intermittent overflow from the tank is not significant in providing dilution improvement within the Broadmeadow based on volume. The flow in the Broadmeadow is c. 500-600 times greater than the outfall flow. The overflow is not expected to bring dilution to the river due to this disproportion and the duration of the discharge.

Considering background concentrations associated to the current 'Poor' status of the Broadmeadow river (the river has not sufficient assimilative capacity considering current oxygenation and nutrient conditions), the discharge would not bring sufficient dilution to improve this condition. For a notional condition that assumes an improvement in the status of the river based on the operation of the projected development as well as the projected Irish Water works in the catchment, the project does not have the potential to cause a deterioration in the Water Framework Status.

It also should be noted that given the minimal dilution in the river mentioned above and the expected duration of the discharge for the storm events analysed (2 minutes for the 10-year event, 2.4 hours for the 20-year event and 3.7 hours for the 30-year event), the expected influence of the discharge on the river would be minimal and punctual. In addition, the Broadmeadow River receives the contribution of the Ward River, which would significantly increase dilution along the course. Therefore, the Malahide Estuary SAC/SPA/pNHA is also not expected to be affected by the operation of the tank.

5.0 REFERENCES

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