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TECHNICAL NOTE: STORMWATER IMPACT ASSESSMENT; DONORE ROAD, DROGHEDA, CO. MEATH.

Technical Report Prepared For

Amazon Data Services Ireland Limited

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CONTENTS

1.0 INTRODUCTION

This report presents the assessment of the potential for water quality impacts as a result of the discharge of evaporative cooling water to stormwater sewer at the Amazon Data Services Ireland Ltd. ("ADSIL" or 'the applicant') data storage facility (the subject 'installation' under this IED licence application) located in Drogheda IDA Business and Technology Park, Donore Road, Drogheda, Co. Meath.

The Installation comprises one two-storey data storage facility building (Building A) with mezzanine floors at each level and ancillary elements. The ancillary elements of the development include loading bays, maintenance and storage spaces, associated water tanks, fire sprinkler, tanks, fire sprinkler pump house, electrical rooms, security and utility spaces, underground foul and stormwater drainage network, on site attenuation ponds, internal road network, and site landscaping. The overall site includes the Oldbridge 110kV Substation. The permitted site layout and main building is shown on Site Layout Plan Drawing Ref: 21_123G-CSE-00-XX-DR-C-0002- Overall Site Plan included with the IED application.

The Site stormwater drains outfalls at 1 no. Emission Point (SW1) via the attenuation basin which discharges at SW1 into the existing 450 mm storm sewer to the east of the site. The emissions to storm sewer consist of stormwater runoff from building roofs, yards and the road network and residual evaporative cooling water (mains water that has passed through the cooling equipment).

The surface water drainage network for the development collects runoff from roofs, roads and other hard standing areas in a sealed system of pipes and gullies. The pipe network outfalls to a surface water attenuation basin located in the east adjacent to the site entrance. The proposed attenuation system outfalls via a carrier drain which discharges attenuated flows to the existing IDA Business and Technology Park surface water network. This network runs north in the Estate Road in the IDA Drogheda Business Park as shown on Drawing 21_123G-CSE-00-XX-DR-C-1100 included with the IED application. The IDA Business and Technology Park stormwater network ultimately discharges to the River Boyne (c. 1.0 km hydrologically downgradient). Further details on the stormwater network and emissions are set out in Attachment 4-8-1 Operational Report of the IED licence application.

As described in the Operational Report submitted with the IED licence application (Attachment-4-8-1), the cooling units or Air Handling Units (AHUs) on the data storage facility roofs provide conditioned air to maintain temperature, relative humidity and pressurisation in the data halls. The cooling units operate under two modes; free cooling (normal temperatures) and evaporative cooling (when temperatures are elevated). Evaporative cooling is used when atmospheric temperatures are above a setpoint, to cool components within the facility, it has been assumed for the purpose of this assessment that the peak discharge occurs 5 days a month throughout the year. Evaporative cooling utilises mains water (at ambient temperature) from the mains supply as the cooling media. The majority of the evaporative cooling water is evaporated in this process. Prior to the cooling process, water is sanitised using ultraviolet disinfection. When water is used for cooling, it is recirculated in a closed loop system. When a conductivity of 1,500 µS/cm is reached, evaporative cooling water is automatically discharged to the onsite stormwater network at ambient temperature.

The main objective of this study is to assess the likely impact of the assumed evaporative cooling water discharge (recirculated evaporative cooling water from the AHUs) on the surface waterbody receptor (River Boyne) using a numerical analysis, based on the assimilative capacity of this surface water body.

2.0 METHODOLOGY

This assessment of the stormwater emissions assesses the potential impact on the surface water environment i.e., the River Boyne at the Environmental Protection Agency (EPA) monitoring point downgradient of the site. It includes a desktop review of the emission (flow and quality) of evaporative cooling water from the installation to the River Boyne.

A highly conservative approach is taken in assuming all of the evaporative cooling water reaches the River Boyne (undiluted by rainwater) when the river is at low and average flow and there is no tidal influence on it. In reality, evaporative cooling water will likely accumulate in the stormwater attenuation system until there is adequate rainfall for discharge to occur from the system. This will result in dilution of the evaporative cooling water in the installation attenuation system, and once discharge occurs, there will be further dilution within the stormwater network prior to reaching the River Boyne.

As described in the Operational Report (Attachment-4-8-1) submitted with the IED licence application, the attenuation system at the Installation comprises 1 no. detention basin (6,144 m^3 capacity) located to the east of the Site (see Drawing: 21_123G-CSE-00-XX-DR-C-1100). As mentioned above, all stormwater from the Site stormwater network outfalls at 1 no. emission point (SW1) that discharges attenuated flows to the existing IDA Business and Technology Park storm water network via a 300 mm connection to the east of the Site.

The exact location of the discharge point of the IDA stormwater drainage network into the River Boyne is unknown but for the calculation purposes it has been assumed to be located in a straight line to the north of the development site.

2.1.1 Sources of Information

This assessment has been prepared from a desktop review of existing information. The following is a list of sources of information consulted for use in this section:

- Environmental Protection Agency (EPA, 2023) monitoring data, *www.catchments.ie*. which includes the following information: EPA monitoring stations; historical water quality data; and Water Framework Directive (WFD) Status, surface water bodies status and risk score.
- HydroNet (https://epawebapp.epa.ie/hydronet/#Flow) developed by the EPA that includes information on river flow, and the EPA Hydrotool for estimating flow.

The EPA has a water quality monitoring station in the River Boyne (Obelisk Br) from which information has been obtained by accessing the above EPA data sources.

According to the EPA, the River Boyne is a transitional waterbody (Boyne Estuary) in the stormwater discharge point. This means that its hydrological conditions are influence by the tidal level. For the purpose of this assessment, this tidal influence has been disregarded from the calculations. This is a conservative approach, as tidal level would increase the potential dilution within the river.

The EPA does not have a water gauging station (flow monitoring) within the River Boyne. As there is no measured flow for the point of discharge, the EPA (2023)

Hydrotool[1] has been used to estimate 95%ile (low flow) and 50%ile (average) flow (EPA Hydrotool ungauged ref. point 09-1459). 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.

2.2 CALCULATION METHODOLOGY

2.2.1 Assimilative Capacity

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.

The Assimilative Capacity is estimated for any parameter of concern using the following calculation:

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

Where:

- Q_{95} = Dry Weather or 95%ile flow in river stream (m^3/s);
- C_{max} = Maximum permissible concentration (mg/l) ;
- C_{back} = Background upstream concentration (mg/l);
- 86.4 = Time conversion factor from seconds to day.

Q_{95} is the flow rate in the River Boyne associated with a dry weather condition (DWF).

C_{max} is the concentration associated with threshold values based on European regulations which are defined in Section 2.3 below for both the 95%ile hydrological conditions, and the also 50%ile flow in the river stream (Q_{50}).

C_{back} is the concentration associated with the quality data obtained by the EPA at its station located in the River Boyne (refer to Section 3.3 below) which is considered representative of the River Boyne where the IDA Business and Technology Park storm water network discharge point is located. Based on this data, the 95%ile value of these records have been considered as the C_{back} concentration.

2.2.2 Downstream Concentration

In order to assess the effect of the evaporative cooling water discharge on the River Boyne, the downstream concentration ($C_{D/S}$) has been estimated from the EPA quality data (C_{back}) and the expected ADSIL effluent water quality as follows.

Where:

$$C_{D/S} = \frac{C_{back} \cdot Q_{95} + C_{ADSIL} \cdot Q_{ADSIL}}{Q_{95} + Q_{ADSIL}}$$

[1] https://www.epa.ie/publications/monitoring--assessment/freshwater--marine/river-flow-estimates-hydrotool---read-me.php

- $C_{D/S}$ = Estimated concentrations at River Boyne immediately downstream of the stormwater sewer discharge point (mg/l);
- C_{ADSIL} = ADSIL effluent concentrations (mg/l);
- Q_{ADSIL} = ADSIL effluence discharge rate (m^3/s).

2.3 EMISSION QUALITY AND FLOW

The criteria used to estimate water use and evaporative cooling water discharge volumes and quality has been provided by the Operator's Water Team and is presented below:

- A dry-bulb temperature of 30.4 degC and wet-bulb temperature of 21.2 degC is used for modelling water use for evaporative cooling. This is a conservative design criterion, and is greater than the ASHRAE n=50 year temperature for Dublin Airport, Ireland (WMO: 039690). Water use is evaluated based on a theoretical peak day with 6 hours on evaporative cooling working at these peak weather conditions.
- Evaporative Cooling water discharge volume and quality is estimated based on the cooling systems operating at 3 cycles of concentration of the mains water supply, per mains water quality analyses carried out on-site.

Estimated evaporative cooling water concentrations and discharge flow from the site are presented in Table 2.1 below. To note 107 m^3/d is the maximum flow that could be expected within a 6-hour period at peak weather conditions, based on the conservative assumptions made. Generally, the discharge volume would be significantly less.

Parameter	Unit	Value [1]
Conductivity	µS/cm	1,500
TDS	mg/l	943
Alkalinity	mg/l	359
Ca (as CaCO3)	mg/l	550
Chloride	mg/l	42
Silicone (as SiO2)	mg/l	13.6
Sulphate (SO4)	mg/l	323
Barium	mg/l	0.150
Magnesium	mg/l	70
Potassium	mg/l	4.3
Sodium	mg/l	86
Discharge Flow	m^3/d	241

Note: 1. Data obtained from the Operator's water team

Table 2.1 *Estimation of evaporative cooling water discharge parameters*

2.4 THRESHOLD VALUES

The parameters of interest are based on the targets / thresholds for water quality established in current legislation.

The most recent Irish legislation set down as part of the Water Framework Directive 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*) (known as the 'Surface Water Regulations').

The Surface Water Regulations has established ecological, biological and chemical conditions or 'Threshold Values' 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 does not provide Threshold Values for all parameters set out in Table 2.1 above. In order to establish the basis for discussion and assessment of the impact, this assessment has considered other water regulations beyond the Surface Water Regulations. The *EU (Drinking Water) Regulations (S.I. 122/2014 and amendment S.I. 464/2017* (known as the 'Drinking Water Regulations') establishes a number of monitoring parameters in respect of every water supplies for human consumption.

This assessment uses the parametric values listed in the Drinking Water Regulations to assess if the evaporative cooling water discharge from the site would alter the water quality of the receiving waterbody (i.e., River Boyne); when compared with available drinking water quality parameters monitored by the EPA in the River Boyne downstream of the site.

The parameters considered are also related to the characteristics of the ADSIL evaporative cooling water which are also part of the EPA monitoring suite. Refer to Table 2.2 below.

Parameter	Unit	Surface Water [1]		Drinking Water [2]
		95%ile	Mean	
Ammonia as N	mg/l	0.14	0.065	*n.v.*
Biological Oxygen Demand (BOD)	mg/l	2.6	1.5	*n.v.*
Orthophosphate as P	mg/l	0.075	0.035	*n.v.*
Chloride	mg/l	250		250
Sulphate	mg/l	250		250
Alkalinity-total	mg/l	*n.v.*		*n.v.*
Conductivity	µS/cm	*n.v.*		2,500
TDS	mg/l	*n.v.*		*n.v.*
Calcium (as CaCO3)	mg/l	*n.v.*		*n.v.*
Silicone (as SiO2)	mg/l	*n.v.*		*n.v.*
Barium	mg/l	*n.v.*		*n.v.*
Magnesium	mg/l	*n.v.*		*n.v.*
Potassium	mg/l	*n.v.*		*n.v.*
Sodium	mg/l	*n.v.*		*200*

Notes: 1. EU Environmental Objectives (Surface Water) Regulations (S.I. 272/2009 and amendment S.I. 77/2019) (known as the 'Surface Water Regulations').
2. EU (Drinking Water) Regulations (S.I. 122/2014 and amendment S.I. 464/2017).
n.v.: No value

Table 2.2 Parameter and threshold values considered (mg/l)

3.0 EXISTING BASELINE CONDITIONS

The existing surface water environment in terms of water quality with reference to the Water Framework Directive environmental quality objectives and standards is described in Section 7.3 of the Baseline Report (Attachment 4-8-3) submitted with the IED licence application.

There are no streams on the site itself or along its boundaries. Stormwater run-off from the site will be collected and discharged at 1 no. emissions point (SW1) at the eastern boundary of the site which discharges into the existing IDA stormwater drainage network via a 300 mm connection. The IDA stormwater drainage network eventually discharges to the River Boyne which is c. 1 km to the north of the subject site and is a transitional body at this point (Boyne Estuary, EU Code IE_EA_010_0100). Refer to Figure 3.1 below for the Hydrological Environment.

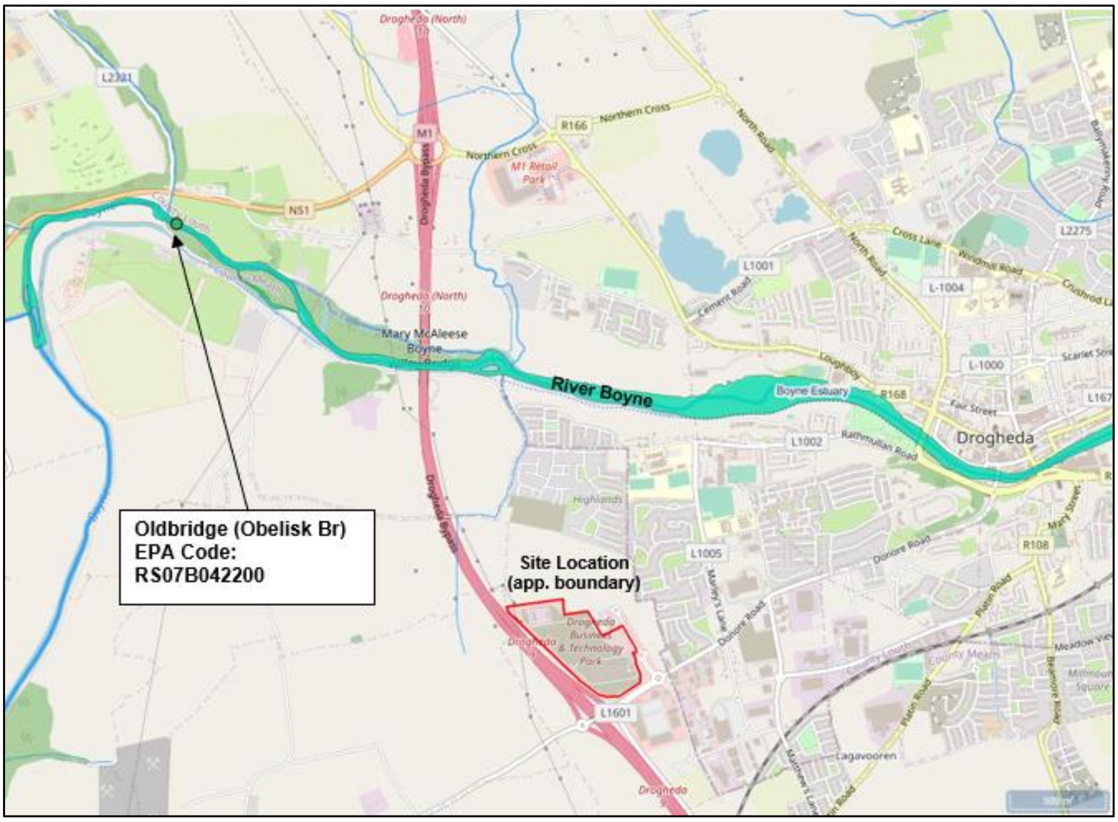

Figure 3.1 Hydrological Environment.

3.1 SENSITIVE AREAS OR AREAS OF SPECIAL INTEREST

The nearest European sites to the Proposed Development are associated with the Boyne River and include the River Boyne and River Blackwater SAC (Site Code 002299), which is located just under 1 km to the north, and the River Boyne and River Blackwater SPA (Site Code 004232), which is located approximately 1.28 km to the north. Downstream the waters of the River Boyne enter the River Boyne Estuary with its European sites, the Boyne Coast and Estuary SAC (Site Code 001957) and the Boyne Estuary SPA (Site Code 004080), which are located respectively approximately 5.15 km and 3.95 km to the north east of the Proposed Development.

There is an indirect hydrological link between the installation and the River Boyne and River Blackwater SAC (Site Code 002299), Boyne Coast and Estuary SAC(Site Code 001957), and the Boyne Estuary SPA (Site Code 004080) through the stormwater drainage from the site which discharges into the River Boyne via the IDA stormwater drainage network. There is no connectivity to the River Boyne and River Blackwater SPA (Site Code 004232) (located upstream of Mary McAleese Bridge) or any other European sites (refer to Figure 3.2 below).

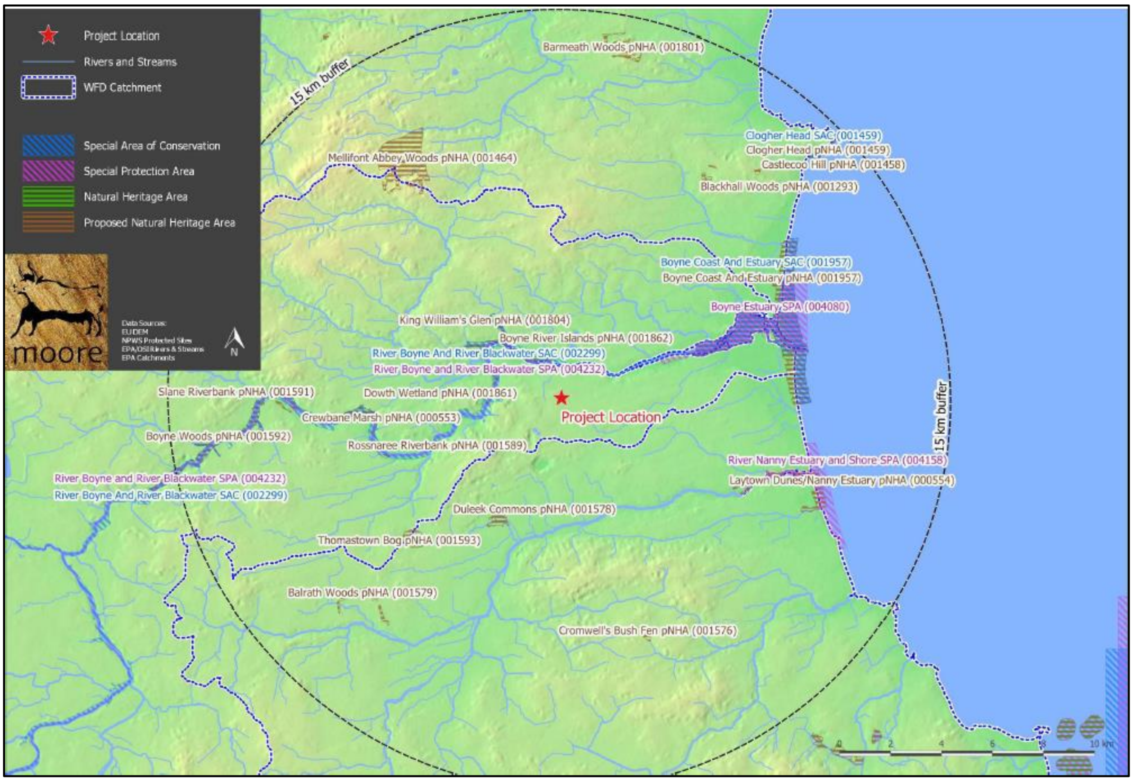

Figure 3.2 Site Location, Showing European sites and NHA's/pNHS'a in the vicinity of the Project

3.2 FLOW DATA

As noted in Section 2.1, in the absence of any available dataset at the actual stormwater discharge point and disregarding tidal influence of the River Boyne, it is assumed that the water flow at the discharge point is the same as the sum of the following EPA Hydrotool ungauged reference points:

- EPA Hydrotool ungauged ref. point 07-1716 (River Boyne upstream of confluence with Mattock River) located c. 3.3 km upstream of the stormwater network discharge point;
- EPA Hydrotool ungauged ref. point 07-1100 (Mattock River upstream of confluence with River Boyne) located c. 3.3 km upstream of the stormwater network discharge point;
- EPA Hydrotool ungauged ref. point 07-1902 (Mell River upstream of confluence with River Boyne) located c. 150 m upstream of the stormwater network discharge point.

Based on the available information from the EPA (EPA Hydrotool), the River Boyne has a 95%ile flow (Q_{95}) of approx. **5.201 m^3/s** (sum of EPA Hydrotool ungauged ref. points 07-1716 [5.11 m^3/s] + 07-1100 [0.086 m^3/s] + 07-1902 [0.005 m^3/s]). Likewise, the estimated 50%ile flow (Q_{50}) is **28.142 m^3/s** (sum of EPA Hydrotool ungauged ref. point 07-1716 [27.419 m^3/s] + 07-1100 [0.677 m^3/s] + 07-1902 [0.046 m^3/s]).

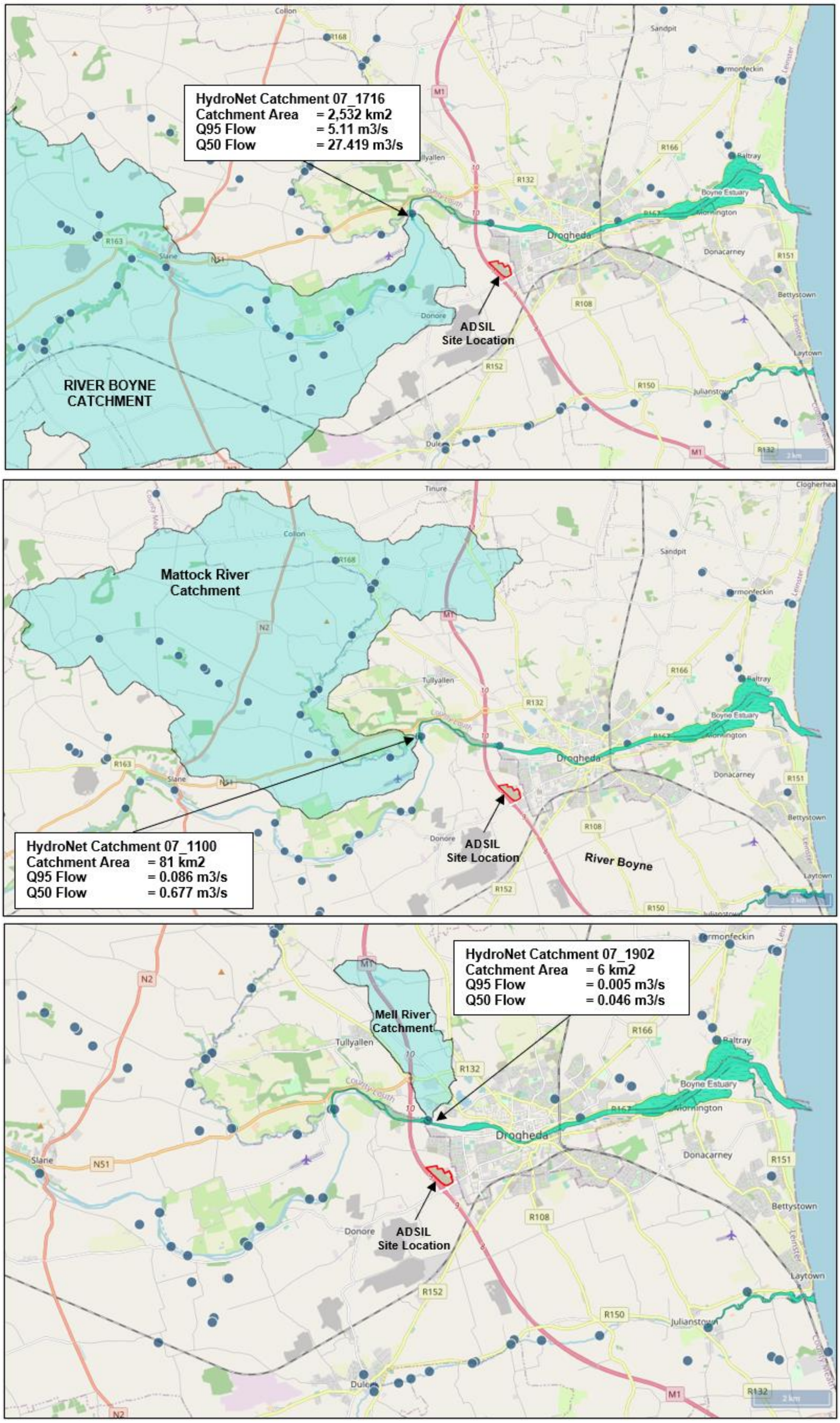

Figure 3.3 EPA Hydronet estimation points in the River Boyne

3.3 WATER QUALITY DATA

A review of available EPA surface water quality data has been undertaken. There isan active EPA monitoring station located in the River Boyne (Oldbridge (Obelisk) Bridge, (RS07B042200)) c. 2 km upstream of the stormwater network discharge point (refer to Figure 3.1 above). As noted in Section 2.1, in the absence of any available dataset at the actual stormwater discharge point, it is assumed that the water quality at the confluence is similar to that at the EPA Oldbridge (Obelisk) Bridge, (RS07B042200) station 2 km upstream.

The water quality data from Oldbridge (Obelisk) Bridge monitoring station is available for the period between 2007 to 2022 and this has been considered in this analysis. The monitoring data and concentration of the parameters of interest are presented below in Table 3.1. A comparison with the threshold values defined above in Section 2.4 is also shown. As can be seen in Table 3.1, the water quality for the 95%ile and mean conditions exceed the Surface Water Regulation's threshold values for Ammonia, and Orthophosphate as P for both the 50%ile condition and the 95%ile, BOD is exceeded for the 95%ile, however, BDO is not exceeded for the mean condition (50%ile condition). Overall, the quality data is representative of the ''Good' to 'Moderate' historical water quality status of this river.

The aforementioned EPA monitoring on the River Boyne (RS07B042200) obtained a Q rating of Q4 Good Status (EPA, 2023).

The EPA classifies the WFD Ecological Status for the Boyne Estuary water body as having '*Moderate Status'* (Cycle Status 2016-2021) with a current WFD Transitional Waterbody risk of '*At risk of not achieving good status'.*

Sampled Date	Ammonia mg/l as N	BOD mg/l	ortho-Phosphate mg/l as P	Alkalinity-total mg/l as CaCO3	Chloride mg/l
TV 95%ile	*0.14*	*2.6*	*0.075*	*n.v.*	*250*
TV mean	*0.065*	*1.5*	*0.035*	*n.v.*	
23/01/2007	0.050	1.5	0.047	256	20
22/02/2007	0.071	2.2	0.061		
21/03/2007	0.031	1.5	0.037	260	
24/04/2007	0.012	1.4	0.007		
21/05/2007	0.006	**4.0**	0.009	324	22
27/06/2007	0.014	1.9	0.062		
24/07/2007	0.018	1.3	0.062		
29/08/2007	0.009	0.9	0.051	300	17
27/09/2007	0.008	1.3	0.032		
31/10/2007	0.012	1.1	0.042		
29/11/2007	0.042	1.3	0.071	260	20
13/12/2007	0.049		0.051		
29/01/2008	0.040	1.3	0.046		
26/02/2008	0.034	0.8	0.054	292	20
19/03/2008	0.024	1.9	0.037		
27/03/2008	0.01		0.019		
23/04/2008	0.014	1.8	0.011		
15/05/2008	0.005	2.0	0.03		
27/05/2008	0.009	1.4	0.003	248	21
25/06/2008	0.012	1.4	0.005		
16/07/2008	0.014	1.2	0.041		
19/08/2008	0.047	1.7	0.069	196	14
11/09/2008	0.023	1.2	0.055		
15/10/2008	0.05	2.0	0.064		
29/10/2008	0.025	1.1	0.041		
03/11/2008	0.02	1.0	0.007		
19/11/2008	0.029	0.8	0.041	288	16
08/12/2008	0.02	**3.0**	0.017		
10/12/2008	0.046	1.1	0.033		
05/01/2009	0.03	1.0	0.01	305	20
27/01/2009	0.065	1.3	0.039		
12/02/2009	0.057	1.2	0.035	300	18
16/02/2009	0.02	1.0	0.0025	290	20
09/03/2009	0.04	2.0	0.011	298	20
24/03/2009	0.009	1.2	0.018		
14/04/2009	0.02	1.0	0.0025	256	19
23/04/2009	0.012	1.6	0.005		
11/05/2009	0.005	1.0	0.0025	241	19
27/05/2009	0.022	1.7	0.032	264	17
15/06/2009	0.005	2.0	0.0025	277	20
25/06/2009	0.016	1.0	0.034		
20/07/2009	0.01	2.0	0.014	270	19
30/07/2009	0.02	1.1	0.047		
10/08/2009	0.02	1.0	0.013		19
26/08/2009	0.045	1.9	0.059	248	16
07/09/2009	0.02	1.0	0.027	295	16
23/09/2009	0.029	1.7	0.033		
05/10/2009	0.01	1.0	0.0025	309	20
29/10/2009	0.029	1.4	0.051		
02/11/2009	0.01	**5.0**	0.052	165	13
18/11/2009	0.078	2.5	**0.091**	212	14
07/12/2009	0.04	1.0	0.019	260	16
09/12/2009	0.066	1.2	0.043		
27/01/2010	0.071	1.5	0.034		
28/01/2010	0.06	1.0	0.005	244	20
17/02/2010	0.058	1.2	0.034	306	18
18/02/2010	0.06	1.0	0.006	305	18
09/03/2010	0.005	1.0	0.031	151	24
24/03/2010	0.009	1.2	0.016		
19/04/2010	0.01	1.0	0.0025	296	18
21/04/2010	0.011	1.7	0.015		
04/05/2010	**1.16**	**3.0**	**0.181**	197	28
26/05/2010	0.007	1.4	0.003	290	25
01/06/2010	**0.27**	2.0	0.0025	277	20
30/06/2010	0.01	2.0	0.005		
19/07/2010	0.01	2.0	**0.182**	122	18
29/07/2010	0.02	1.5	0.048		
09/08/2010	0.03	2.0	0.031	262	19
31/08/2010	0.012	1.1	0.01	260	23
01/09/2010	0.005	2.0	0.0025	251	23
28/09/2010	0.018	1.4	0.041		
18/10/2010	0.1	2.0	0.007	282	18
21/10/2010	0.015	1.2	0.03		
09/11/2010	0.06	2.0	0.034	196	14
24/11/2010	0.065	1.4	0.034	284	17
13/12/2010	0.04	1.0	0.027	139	24
15/12/2010	0.094	2.2	0.035		
13/01/2011	0.08	**3.0**	0.016	79	15
27/01/2011	0.047	1.1	0.029		

Sampled Date	Ammonia mg/l as N	BOD mg/l	ortho-Phosphate mg/l as P	Alkalinity-total mg/l as CaCO3	Chloride mg/l
17/02/2011	0.05	1.0	0.032	221	17
24/02/2011	0.048	1.1	0.032	260	17
29/03/2011	0.009	1.3	0.013		
30/03/2011	0.01	1.0	0.017	285	19
13/04/2011	0.005	1.0	0.0025	288	19
19/04/2011	0.009	1.6	0.01		
23/05/2011	0.02	1.0	0.0025	250	22
26/05/2011	0.009	1.3	0.003	262	22
02/06/2011	0.005	2.0	0.0025	231	22
23/06/2011	0.014	1.9	0.004		
13/07/2011	0.005	1.0	0.008	229	23
27/07/2011	0.008	2.3	0.005		
17/08/2011	0.01	**2.7**	0.005	242	22
31/08/2011	0.01	1.0	0.0025	216	37
12/09/2011	0.005	2.0	0.012	201	21
20/09/2011	0.021	2.1	0.04		
25/10/2011	0.09	**5.0**	**0.098**	149	14
02/11/2011	0.037	1.9	0.041		
07/11/2011	0.005	1.0	0.04	186	22
01/12/2011	0.04	1.0	0.027	226	15
06/12/2011	0.025	1.7	0.039	266	16
18/01/2012	0.029	0.8	0.032		
24/01/2012	0.02	1.0	0.02	278	18
15/02/2012	0.023	1.2	0.029		
21/02/2012	0.01	1.0	0.038	139	22
07/03/2012	0.024	1.3	0.025	296	18
27/03/2012	0.005	**4.0**	0.0025	291	19
12/04/2012	0.02		0.0025	275	20
09/05/2012	0.02	2.0	0.0025	279	18
23/05/2012	0.011	1.1	0.003	304	20
05/06/2012	0.005	1.0	0.0025	266	20
05/07/2012	0.029	1.3	0.048		
17/07/2012	0.01	2.0	0.01	304	11
21/08/2012	0.031	1.8	0.048	300	16
29/08/2012	0.02	**4.0**	0.012	280	15
17/09/2012	0.01	2.0	0.008	296	18
25/10/2012	0.01	1.0	0.013	304	16
31/10/2012	0.01	1.4			
28/11/2012	0.05	1.0	0.008	282	15
06/12/2012	0.05	1.0	0.01	307	18
06/12/2012		2.0	0.0125		17
23/01/2013	0.05	2.0	0.012	254	16
27/02/2013	0.04	1.0	0.012	311	17
21/03/2013	0.041	2.0	0.023	320	24
27/03/2013	0.03	2.0	0.013	256	19
18/04/2013		1.9			
30/04/2013	0.01	1.0	0.0025	284	18
07/05/2013	0.01	1.0	0.0025	288	18
29/05/2013	0.027	1.6	0.009		
05/06/2013	0.01	2.0	0.0025	276	18
27/06/2013	0.015	1.4	0.003		
08/07/2013	0.01	2.0	0.0025	251	23
25/07/2013	0.014	1.3			
06/08/2013	0.01	2.0	0.005	190	19
13/08/2013	0.013	**3.0**	0.011	232	20
12/09/2013	0.014	1.2	0.005		
23/09/2013	0.01	0.5	0.0025	243	28
07/10/2013	0.04		0.043	177	21
31/10/2013	0.037	2.0	0.043		
04/11/2013	0.03	0.5	0.031	245	17
20/11/2013	0.031	2.3	0.039	268	19
12/12/2013	0.021	1.0	0.031	302	20
06/01/2014	0.046	1.5	0.032	222	21
30/01/2014	0.055	0.5	0.029		
12/02/2014	0.042	0.5	0.025	247	22
18/02/2014	0.01	0.5	0.013	223	19
10/03/2014	0.023	1.2	0.005	269	19
13/03/2014	**0.333**	0.5	0.023		
14/04/2014	0.01	1.1	0.017	269	19
29/04/2014	0.011	0.5	0.009		
06/05/2014	0.01	0.5	0.005	282	21
28/05/2014	0.018	0.5	0.033	236	18
03/06/2014	0.01	2.0	0.024	261	19
19/06/2014	0.067	0.5	0.011		
15/07/2014	0.01	1.6	0.01	257	22
17/07/2014	0.027	1.0	0.003		
05/08/2014	0.091	2.5		179	16
08/09/2014	0.01	0.5	0.005	266	22
29/09/2014	0.031	0.5	0.0045	232	21
21/10/2014	0.03	0.5	0.012	263	19
28/10/2014	0.088	**7.1**	**0.081**	199	21

Sampled Date	Ammonia mg/l as N	BOD mg/l	ortho-Phosphate mg/l as P	Alkalinity-total mg/l as CaCO3	Chloride mg/l
10/11/2014	0.04	1.4	0.043	214	18
25/11/2014	0.068	0.5	0.022	237	17
01/12/2014	0.028	0.5	0.029	282	18
14/01/2015	0.028	0.5	0.026	257	19
21/01/2015	0.032	2.2	0.029		
18/02/2015	0.027	0.5	0.013	253	22
26/02/2015	0.06		0.025	225	19
18/03/2015	0.01	0.5	0.011	280	20
01/04/2015	0.073	**3.5**	0.03	224	15
16/04/2015	0.033	2.1	0.023	226	15
21/04/2015	0.01	0.5	0.013	277	21
06/05/2015	0.039	2.2	0.02	210	17
20/05/2015	0.041	1.8	0.014	261	17
17/06/2015	0.01	0.5	0.005	249	21
29/06/2015	0.058	1.4	0.0045	207	22
14/07/2015	0.1	0.5	0.0045	256	20
23/07/2015	0.021	1.0	0.005	266	24
05/08/2015	0.01	1.3	0.005	213	23
25/08/2015	0.1	**2.8**	0.049	168	19
09/09/2015	0.11	2.0	0.023	226	20
14/09/2015	0.024	1.0	0.005	242	23
05/10/2015	0.01	1.2	0.012	256	24
08/10/2015	0.038	2.4	0.021	265	22
25/11/2015	0.035	1.2	0.032	248	19
27/11/2015	0.071	2.0	0.03	294	16
08/12/2015	0.037	0.5	0.046	211	17
20/01/2016	0.046	0.5	0.035	282	18
15/02/2016	0.037	1.1	0.035	271	18
21/03/2016	0.01	0.5	0.027	300	19
18/04/2016	0.01	0.5	0.02	257	18
09/05/2016	0.01	0.5	0.005	283	20
08/06/2016	0.029	1.0	0.005	281	21
20/07/2016	0.033	0.5	0.021	269	20
17/08/2016	0.024	0.5	0.011	169	66
29/09/2016	0.01	0.5	0.047	273	19
25/10/2016	0.01	0.5	0.031	286	19
14/11/2016	0.025	0.5	0.039	273	20
07/12/2016	0.032	0.5	0.033	312	20
26/01/2017	0.021	0.5	0.036	334	20
16/02/2017	0.01	0.5	0.031	305	21
23/03/2017	0.14	**2.8**	**0.08**	222	20
06/04/2017	0.01	0.5	0.021	290	19
26/05/2017	0.01	1.1	0.005	234	22
08/06/2017	0.01	1.2	0.005	296	23
31/07/2017	0.01		0.013	278	23
10/08/2017	0.01	0.5	0.014	244	22
28/09/2017	0.028	1.1	0.02	270	20
25/10/2017	0.01	0.5	0.026	287	18
23/11/2017	0.084	**4.3**	**0.12**	179	17
14/12/2017	0.049	0.5	0.039	291	24
18/01/2018	0.14	1.7	0.028	250	24
08/03/2018	0.066	1.1	0.021	248	30
13/03/2018	0.034	0.5	0.015	264	25
12/04/2018	0.027	0.5	0.005	282	22
01/05/2018	0.01	0.5	0.005	313	22
15/06/2018	0.01	0.5	0.005	262	24
11/07/2018	0.01	1.4	0.005	237	28
14/08/2018	0.01	0.5	0.005	232	44
27/09/2018	0.01	0.5	0.005	244	31
24/10/2018	0.01	0.5	0.005	211	32
20/11/2018	0.028	0.5	0.018	189	27
05/12/2018	0.061	1.2	0.034	185	26
21/01/2019	0.025	0.5	0.017	294	26
21/02/2019	0.01	1.0	0.01	259	25
13/03/2019	0.025	1.0	0.025	216	24
09/04/2019	0.027	0.5	0.005	282	23
08/05/2019	0.01	0.5	0.005	261	24
20/06/2019	0.01	1.6	0.028	240	23
16/07/2019	0.01	1.1	0.005	254	26
07/08/2019	0.056	1.1	0.021	233	26
12/09/2019	0.01	0.5	0.018	261	23
15/10/2019	0.031	1.0	0.023	257	19
14/11/2019	0.039	1.2	0.045	245	19
04/12/2019	0.028	0.5	0.038	285	21
27/01/2020	0.028	0.5	0.033	304	21
13/02/2020	0.05	1.5	0.038	245	22
24/03/2020	0.02	0.5	0.011	196	19
21/04/2020	0.01	1.2	0.005	196	22
06/05/2020	0.01	1.3	0.005	209	23
10/06/2020	0.01	0.5	0.005	253	27
14/07/2020	0.027	0.5	0.025	191	23

Sampled Date	Ammonia mg/l as N	BOD mg/l	ortho-Phosphate mg/l as P	Alkalinity-total mg/l as CaCO3	Chloride mg/l
05/08/2020	0.023	0.5	0.038	207	22
17/09/2020	0.01	0.5	0.033	274	21
12/10/2020	0.025	0.5	0.03	275	20
10/11/2020	0.024	0.5	0.035	265	19
07/12/2020	0.023	0.5	0.028	288	20
13/01/2021	0.082	2.0	0.027	179	22
04/02/2021	0.062	1.1	0.045	213	18
23/03/2021	0.01	0.5	0.025	275	20
20/04/2021	0.01	1.2	0.005	290	23
04/05/2021	0.01	1.2	0.005	273	25
10/06/2021	0.01	1.3	0.005	282	22
27/07/2021	0.01	**4.1**	0.005	228	28
11/08/2021	0.034	1.2	0.03	187	21
23/09/2021	0.023	0.5	0.015	253	29
12/10/2021	0.025	0.5	0.017	175	23
09/11/2021	0.01	0.5	0.037	243	22
06/12/2021	0.023	0.5	0.021	244	22.5
19/01/2022	0.028	0.5	0.034	299	21.6
03/02/2022	0.021	0.5	0.05	310	23
22/03/2022	0.01	0.5	0.021	297	21.8
19/04/2022	0.01	1.1	0.012	280	23.5
03/05/2022	0.01	1.0	0.005	289	24
09/06/2022	0.01	2.3	0.005	236	24.2
12/07/2022	0.01	0.5	0.011	223	25.2
02/08/2022	0.02	0.5	0.005	226	29.0
22/09/2022	0.021	1.2	0.02	143	24
10/10/2022	0.022	0.5	0.049	187	22.6
08/11/2022	0.025	0.5	0.04	231	20.1
05/12/2022	0.053	1.4	0.054	242	20.3
Data 95%ile	**0.09**	**2.9**	**0.060**	306	28
Data mean	**0.03**	1.3	**0.024**	252	21

XXX	*Over 95%ile threshold value (95%ile)*
XXX	*Over mean threshold value (95%ile)*
n.v.	*No value*

Table 3.1 *EPA Water Quality Data in the River Boyne (Data Source: https://catchments.ie/)*

4.0 ANTICIPATED EMISSION LOADING

4.1 PROCESS GENERAL BACKGROUND

As described in the Operational Report (Attachment-4-8-1) submitted with the IED application, the cooling units or Air Handling Units (AHUs) on the data storage facility roofs provide conditioned air to maintain temperature, relative humidity and pressurisation in the data halls. The cooling units operate under two modes; free cooling (normal temperatures) and evaporative cooling (when temperatures are elevated). Evaporative cooling is used when atmospheric temperatures are above a setpoint, to cool components within the facility it has been assumed for the purpose of this assessment that the discharge occurs 5 days a month. Evaporative cooling utilises mains water (at ambient temperature) from the mains supply as the cooling media. The majority of the evaporative cooling water is evaporated in this process.

No treatment chemicals are added to the evaporative cooling water. Prior to the cooling process, water is sanitised using ultraviolet disinfection. When water is used for cooling it is recirculated in a closed loop system. When a conductivity setpoint of 1,500 µS/cm is reached, the evaporative cooling water is automatically discharged to the onsite stormwater network at ambient temperature. As the water is supplied from the Irish Water mains, there is no risk of Principle Pollution Substances, Priority Substances or Priority Hazardous Substances (main polluting substances as defined in the Schedule of EPA (Licensing)(Amendment) Regulations 2004, S.I. No. 394 of 2004 being discharged from the installation above the limits outlined in the Surface Waters Regulations (S.I. No. 272 of 2009).

See Figure 4.1 below which details the water flow and evaporative cooling water discharge process. It should be noted that there is no ***direct*** discharge from the site to the River Boyne; there is however, an ***indirect*** discharge via the IDA stormwater network to the east of the site, which subsequently discharges to the River Boyne. A flow control system at the outlet of the site stormwater attenuation is used to achieve the controlled discharge rate to this IDA stormwater network.

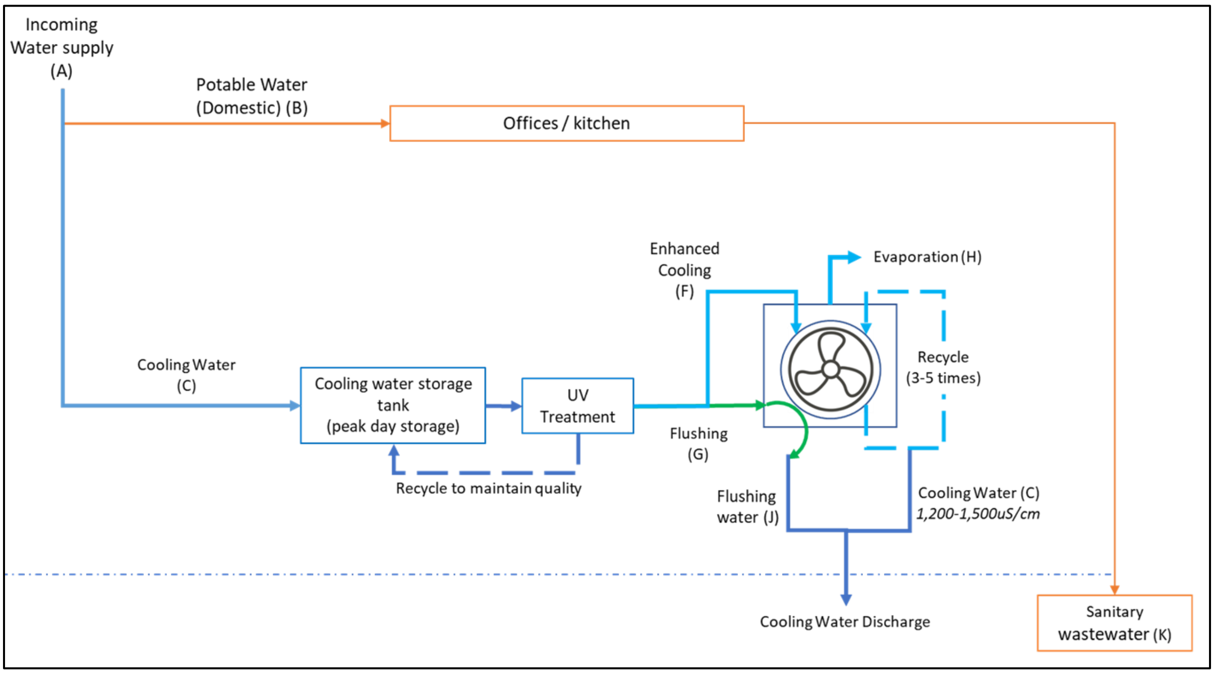

Figure 4.1 Flushing Process Diagram

4.2 EMISSION QUALITY AND FLOW

The expected concentrations for the parameters of interest and discharge flow from their flushing process are presented in Table 4.1 below. The parameters considered in the assessment are based on: (1) the data available from the Operator's Water Team (Table 2.1), and (2) the available data monitored by the EPA within the River Boyne (Oldbridge (Obelisk) Bridge, (RS07B042200)) (Table 3.1). However, where specific parameters of the Operator's data and the EPA data do not correspond, the impact assessment has not been undertaken. Ammonia as N, BOD and Orthophosphate as P have been included in the assessment as they are used by the EPA to assess the water quality status of a river under the WFD.

Parameter	Unit	Value
Ammonia as N	mg/l	0.01
BOD	mg/l	1
Orthophosphate as P	mg/l	0.03
Chloride	mg/l	42
Alkalinity	mg/l	359
Discharge Flow (95%ile scenario)	m^3/d	241
Discharge Flow (50%ile scenario)	m^3/d	40

Table 4.1 Emission Values (Source: Operator's Waters Team)

It should be noted that the parameters Ammonia as N, BOD and Orthophosphate as P have been assumed to be at the limit of detection in order to estimate the potential increase in assimilative capacity in the River Boyne due to possible dilution, given that the water quality in the river currently exceeds the established threshold values as set out in Table 2.2. For calculation purposes, it has been assumed that the discharge concentrations of these parameters are at the laboratory limit of detection reported in the EPA water quality data (refer to Section 3.3).

With regard to the discharge flow, two scenarios have been considered as follows:

- Dry Weather Flow or 95%ile: **241 m^3/d** evaporative cooling water discharge from the installation and Q_{95} in the River Boyne.
- Mean Flow or 50%ile: This scenario estimates that 241m^3/d discharge from the installation occurs 5 days month within a 30-day month, which equates a mean installation discharge flow rate of **40 m^3/d** (241 m^3/d x 5 days / 30 days) and Q_{50} in the River Boyne.

5.0 ASSESSMENT RESULTS

The assessment considers the assimilative capacity without the evaporative cooling water discharge (Section 5.1) and with the evaporative cooling water discharge (Section 5.2)

5.1 RIVER BOYNE ASSIMILATIVE CAPACITY (NO EVAPORATIVE COOLING WATER DISCHARGE)

Based on the Q_{95} and the EPA water quality data presented above, the Assimilative Capacity was calculated using the formula in Section 2.2.1 above, for the Dry Weather Flow ('DWF') (or 95%ile condition). The results obtained are presented in Table 5.1 below.

Parameter	Q_{95} (m^3/s)	C_{MAX} (mg/l)	C_{BACK} (mg/l)	Assimilative Cap. (kg/d)
Ammonia	5.2	0.14	0.09	**24**
BOD		2.6	2.9	**-151**
Orthophosphate as P		0.075	0.060	**7**
Chloride		250	28	**99,699**

XXX	*Concentration over threshold value*
XXX	*Negative Assimilative capacity*

Table 5.1 Assimilative Capacity for 95%ile hydrological condition in the River Boyne

In addition, the assimilative capacity in the River Boyne was also estimated for a mean (or 50%ile) condition. The results obtained are presented in Table 5.2 below.

Parameter	Q_{50} (m^3/s)	C_{MAX} (mg/l)	C_{BACK} (mg/l)	Assimilative Cap. (kg/d)
Ammonia	28.1	0.065	0.034	**74**
BOD		1.5	1.3	**432**
Orthophosphate as P		0.035	0.024	**26**
Chloride		250	21	**557,243**

XXX	*Concentration over threshold value*
XXX	*Negative Assimilative capacity*

Table 5.2 Assimilative Capacity for 50%ile hydrological condition in the River Boyne

Table 5.1 and Table 5.2 shows that for the parameters of Ammonia, BOD and Orthophosphate as P in the background concentration (C_{BACK}) is below the threshold established under the Surface Water Regulations for this waterbody (C_{MAX}) during both the dry weather (95%ile condition) and the mean condition (50%ile condition), with the exception of the BOD for the 95%ile condition. This means that there is assimilative capacity within the River Boyne for these parameters of Ammonia, BOD and Orthophosphate as P which is reflected by the negative value of the assimilative capacity.

Likewise, the background concentration (C_{BACK}) for Chloride is below the threshold established under the Drinking Water Regulations. This means that there is assimilative capacity within the River Boyne for this parameter (Chloride).

5.2 RIVER BOYNE ASSIMILATIVE CAPACITY (WITH EVAPORATIVE COOLING WATER DISCHARGE)

This scenario assesses the assimilative capacity of the River Boyne with evaporative cooling water discharge from the cooling systems with emission values as presented in Table 4.1. The downstream concentrations in the River Boyne of the assessed parameters have been estimated (Refer to Table 5.3 below). It should be noted that:

- This scenario is conservative as it has assumed no dilution of evaporative cooling water discharge through the public stormwater water sewer;
- This assessment represents a maximum flow and maximum concentrations, which are only likely to occur under very high temperatures generally seen less than 5 days a year (> 30° C) as set out in Section 4.1.
- As explained in Section 4.2 above, 2 no. hydrological scenarios have been considered:

- Dry Weather Flow or 95%ile: 241 m^3/d evaporative cooling water discharge from the Installation and Q_{95} in the River Boyne.
- Mean Flow or 50%ile: This scenario estimates that **241 m^3/d** discharge from the installation occurs 5 days per month within a 30-day month, which equates a mean installation discharge flow rate of **40 m^3/d** (241 m^3/d x 5 days / 30 days) and Q_{50} in the River Boyne.

The results obtained for the Dry Weather Flow (DWF or 95%ile) condition are presented in Table 5.3 below.

Parameter	Q_{95} (m^3/s)	Discharge Flow (m^3/d)	C_{BACK} (mg/l)	C_{ADSIL} (mg/l)	$C_{D/S}$ (mg/l)	Assimilative Cap. (kg/d)
Ammonia	5.2	241	0.09	0.01	0.09	**24**
BOD			2.9	1	2.93	**-150**
Orthophosphate as P			0.06	0.03	0.060	**7**
Chloride			28	42	28	**99,695**
Alkalinity-total (*)			306	359	306	n/a

Notes:
(*): Assimilative Capacity was not estimated for Alkalinity due to the absence of threshold value for this parameter (refer to Table 2.2 above).
n/a: Not applicable as per note above.
Concentration over threshold value: XXX
Negative Assimilative capacity: **XXX**

Table 5.3 Downstream Concentrations during the discharge scenario (DWF condition)

The results obtained for the mean (50%ile) condition are presented in Table 5.4 below.

Parameter	Q_{50} (m^3/s)	Discharge Flow (m^3/d)	C_{BACK} (mg/l)	C_{ADSIL} (mg/l)	$C_{D/S}$ (mg/l)	Assimilative Cap. (kg/d)
Ammonia	28.1	41	0.034	0.01	0.034	**74**
BOD			1.3	1	1.3	**432**
Orthophosphate as P			0.024	0.03	0.024	**26**
Chloride			21	42	21	**557,242**
Alkalinity-total (*)			252	359	252	n/a

Notes:
(*): Assimilative Capacity was not estimated for Alkalinity due to the absence of threshold value for this parameter (refer to Table 2.2 above).
n/a: Not applicable as per note above.
Concentration over threshold value: XXX
Negative Assimilative capacity: **XXX**

Table 5.4 Downstream Concentrations during the discharge scenario (mean condition)

Table 5.3 and Table 5.4 show that the evaporative cooling water discharge (C_{ADSIL}) will increase the chloride downstream concentrations ($C_{D/S}$) very marginally in terms of the assimilative capacity of the river for both hydrological conditions. The concentrations of chloride do not exceed any statutory water limits.

For the water quality parameters of interest, based on the objectives for achieving good status under the WFD in the river (i.e., Ammonia as N, BOD and Orthophosphate as P), it can be seen in Table 5.3 and Table 5.4 that the assimilative capacity in the river also increases slightly due to dilution from the evaporative cooling water discharge (particularly for the dry weather condition). As can be seen in Tables 5.3 and 5.4 above, the resultant assimilative capacity is adequate to achieve a 'Good' status as defined and established by the WFD (refer to S.I. 272/2009 and amendment S.I. 77/2019), with the only exception of BOD for the 95%ile hydrological condition. As such, the evaporative discharge of cooling water improves the water quality within the river.

6.0 CONCLUSION

In order to assess the impact of the evaporative cooling water discharge from the Installation on the receiving water course (River Boyne), a conservative numerical analysis has been undertaken, based on the existing assimilative capacity of the surface water body. This has been assessed for two hydrological conditions: dry weather (95%ile) and mean condition (50%ile).

The assessment is conservative as it considers that all of the evaporative cooling water discharge (at maximum discharge flow) is discharged directly to the River Boyne. In reality, the installation evaporative cooling water will discharge from the site at SW1 (discharge point) to the existing IDA stormwater network to the east of the Site. The IDA network(s) eventually discharge to the River Boyne (c. 1.0 km hydrologically downgradient).

The parameters assessed in the assimilative capacity study were based on available EPA water quality data (for the closest monitoring stations which was located approx. 2 km upgradient of the stormwater discharge point) which is used to determine the water body status as well as the characteristics of the evaporative cooling water discharge.

The effect of the evaporative cooling water discharge is considered to be temporary and not significant (i.e., an effect which causes noticeable changes in the character of the environment but without noticeable consequences) in terms of assimilative capacity of the river. The evaporative cooling water discharge will not result in exceedances in the statutory threshold values (as set out in Table 2.2) for the parameters (chloride, alkalinity) in the River Boyne. The assimilative capacity of the River Boyne is sufficient to ensure that exceedances of these parameters do not occur under dry weather and mean flow conditions.

For the water quality parameters of interest, based on the objectives for achieving good status in the river (Ammonia, Orthophosphate as P and BOD), the evaporative cooling water discharge will provide dilution and as a result slightly increases the assimilative capacity in the River Boyne; the resultant capacity is adequate to achieve/ maintain the current ‘Good’ status of the river. It should be noted that the River Boyne currently does have existing assimilative capacity for these parameters (i.e., Ammonia as N, BOD and Orthophosphate as P) and is already at good status.

In conclusion, based on the above assessment, the discharge of evaporative cooling water from the Installation is not anticipated to have a noticeable impact on the River Boyne.

7.0 LIMITATIONS AND ASSUMPTIONS

The exact location of the outfall of the IDA stormwater network into the River Boyne is not known is has been assumed that the outfall is located approximately 1 km north of the site (i.e., direct line from the known IDA stormwater network).

There are no low flow measurements or background water quality data available for the River Boyne (located approx. 1 km north of the site) at the point of discharge from the IDA stormwater network.

In the absence of an available dataset for flow and water quality, the water quality and flow data from the EPA database and EPA Hydrotool is considered representative for the purposed of estimating the effect of the discharge on the receiving watercourse (River Boyne). The assessment has relied upon the estimated flows from the EPA Hydrotool in River Boyne and its tributaries. The Hydrotool 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.

The evaporative cooling water discharge volumes and quality are an estimate made by the Operator's Water Team. The criteria used to estimate the water use and evaporative cooling water discharge volumes and quality has been provided by the Operator's Water Team and is presented below:

- A dry-bulb temperature of 30.4 degC and wet-bulb temperature of 21.2 degC is used for modelling water use for evaporative cooling. This is a conservative design criterion and is greater than the ASHRAE n=50 year temperature for Dublin Airport, Ireland (WMO: 039690). Water use is evaluated based on a theoretical peak day with 6 hours on evaporative cooling working at these peak weather conditions.
- Evaporative cooling water discharge volume and quality is estimated based on the cooling systems operating at 3 cycles of concentration of the mains water supply, per mains water quality analyses carried out on-site.

In order to establish the average monthly flow for the calculation of the assimilative capacity in the River Boyne during the mean flow (or 50%ile) condition it has been assumed that the peak discharge occurs 5 days a month throughout the year. This is a highly conservative estimate as the discharge only occurs from the cooling systems to the stormwater sewer when elevated temperatures occur.

8.0 REFERENCES

EPA (2023). Environmental Protection Agency. Available on-line at: https://gis.epa.ie/EPAMaps/.

EPA Catchments (2023). Water Quality Data available on-line at: https://catchments.ie/.

EPA (2023). Hydronet Monitoring Data. Available on-line at: https://epawebapp.epa.ie/hydronet/