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Technical Note: Stormwater Impact Assessment; Clonshaugh, Dublin 17

Technical Report Prepared For

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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 at Clonshaugh Business and Technology Park, Dublin 17.

The Installation comprises 3 no. two storey data storage installation buildings with mezzanine floors at each level (Buildings W, X and Y) and ancillary elements. Building X and Y consists of a 2-storey building connected via link corridor, and share a loading bay and offices. The ancillary elements of the development include; loading bays, maintenance and storage spaces, associated water tanks, sprinkler tanks, pump house and electrical rooms, security and utility spaces, underground foul and storm water drainage networks, attenuation storm cells, internal roading network, hardstanding areas, and site landscaping. The site includes the Newbury 110 kV Substation. The site layout and main buildings is shown on Site Layout Plan Drawing Ref: 21_123F-CSE-00-XX-DR-C-0002 - Overall Site Plan included with the IED licence application.

The Site stormwater discharges offsite at 2 no. Emission Points (SW1 and SW2). The Site drainage is shown on Drawing 21_123F-CSE-00-XX-DR-C-1100 Surface Water Layout Plan included with this IE application. The emission to storm sewer consists of stormwater runoff from building roofs, and the site hardstanding areas. The residual cooling water, associated with the evaporative cooling process, is also discharged from the cooling systems to the stormwater sewer when elevated temperatures occur.

The stormwater from the site is discharged at the 2 no emission points. SW1 discharges to a 450mm Clonshaugh Business Park storm sewer which in turn outfalls into the Santry River c. 50 m to the south of SW1; SW2 connects to a 900 mm diameter, Clonshaugh Business Park storm sewer that is located to the east of the site that flows north to south which discharges into the Santry River c. 380 m to the south of SW2. The stormwater passes through Hydrocarbon Interceptors on site to ensure that the quality of the stormwater discharge is controlled. This network is shown on Drawing 21_123F-00-XX-DR-C-1100 Surface Water Layout Plan included with the IED licence application.

The Clonshaugh Business Park storm sewers outfall into the Santry River in 2 no. adjacent locations that are located to the east and to the south of the Site (Shown on Drawing 21_123F-CSE-00-XX-DR-C-1100 Surface Water Layout Plan); the Santry River is located c. 50 m to the southern boundary of the site and flows 5.15 km east, to the North Bull Island transitional water body, and ultimately the Dublin Bay.

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 centre 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. No treatment chemicals are added to the 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 of 1,500 µS/cm is reached, 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 cooling water discharge (recirculated evaporative cooling water from the AHUs) on the surface waterbody receptor (the Santry River) using a numerical analysis, based on the existing assimilative capacity of this surface water body.

2.0 METHODOLOGY

This assessment of the stormwater emissions, arising from the discharge of evaporative cooling water to the stormwater sewer, evaluates the potential impact on the surface water environment i.e. the Santry River 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 Santry River.

A highly conservative approach is taken in assuming all of the cooling water reaches the EPA monitoring point (undiluted by rainwater) when the river is at low and average flow. In reality, 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 cooling water in the installation attenuation system, and once discharge occurs, there will be further dilution within the Clonshaugh Business Park stormwater network prior to reaching the Santry River.

As described in the Operational Report (Attachment-4-8-1) submitted with the IED licence application the attenuation system at the Installation comprises of 2 no. attenuation storm cells (See Drawing See Drawing 21_123F-CSE-00-XX-DR-C-1100). The first, Attenuation Storm cell 1 (170 m^3 capacity) is to the south of the site and discharges directly at SW1 to the existing Clonshaugh Business Park storm sewer located to the south of the Site and subsequently to the Santry River. Attenuation Storm cell 2 (1,351 m^3 capacity) is located to the south of Building Y, and discharges at SW2 directly to the existing Clonshaugh Business Park storm sewer located to the east of the Site and subsequently to the Santry River.

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 Santry River (Clonshaugh Rd Br) from which information has been obtained by accessing the above EPA data sources.

In terms of flow data, Dublin County Council has a water gauging data in the Santry River (Cadburys) from which data has also been obtained by accessing the above EPA HydroNet data.

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 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 Santry River (refer to Section 3.3 below) which is considered representative of the Santry River where the stormwater sewers discharge points are 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 ADSIL cooling water discharge on the Santry River, 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. For calculation purposes, it has been assumed that effluent from ADSIL are discharged in 1 no, single sewer discharge point. The distance between the 2 no. surface water drainage outfall points to the Santry River is c. 140 m. Given that there are no known abstraction or discharges between these point, no significant dilution or mixing is expected between the 2 outfalls and therefore the expression for a single discharge point is valid.

Where:

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

- $C_{D/S}$ = Estimated concentrations at Santry River 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 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 of evaporative cooling working at these peak weather conditions.
- 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 cooling water concentrations and discharge flow from the site are presented in Table 2.1 below. To note 117 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	1,050
Alkalinity	mg/l	440
Ca (as CaCO3)	mg/l	573
Chloride	mg/l	64
Silicone (as SiO2)	mg/l	11
Sulphate (SO4)	mg/l	146
Barium	mg/l	0.092
Magnesium	mg/l	95
Potassium	mg/l	5.6
Sodium	mg/l	46
Discharge Flow	m^3/d	117

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

Table 2.1 *Estimation of 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., Santry River); when compared with available drinking water quality parameters monitored by the EPA in the Santry River 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. The area is drained by the Santry River which runs approx. 50m of the southern boundary of the site and ultimately discharges into Dublin Bay c. 6 km to the east of the site. Storm water drainage from the site currently discharges to the two attenuation basins on site prior to discharge to the existing storm water systems within the Clonshaugh Business Park via Class 1 hydrocarbon interceptors and flow control devices. This eventually discharges into the Santry River at two locations (see Figure 3.1 below).

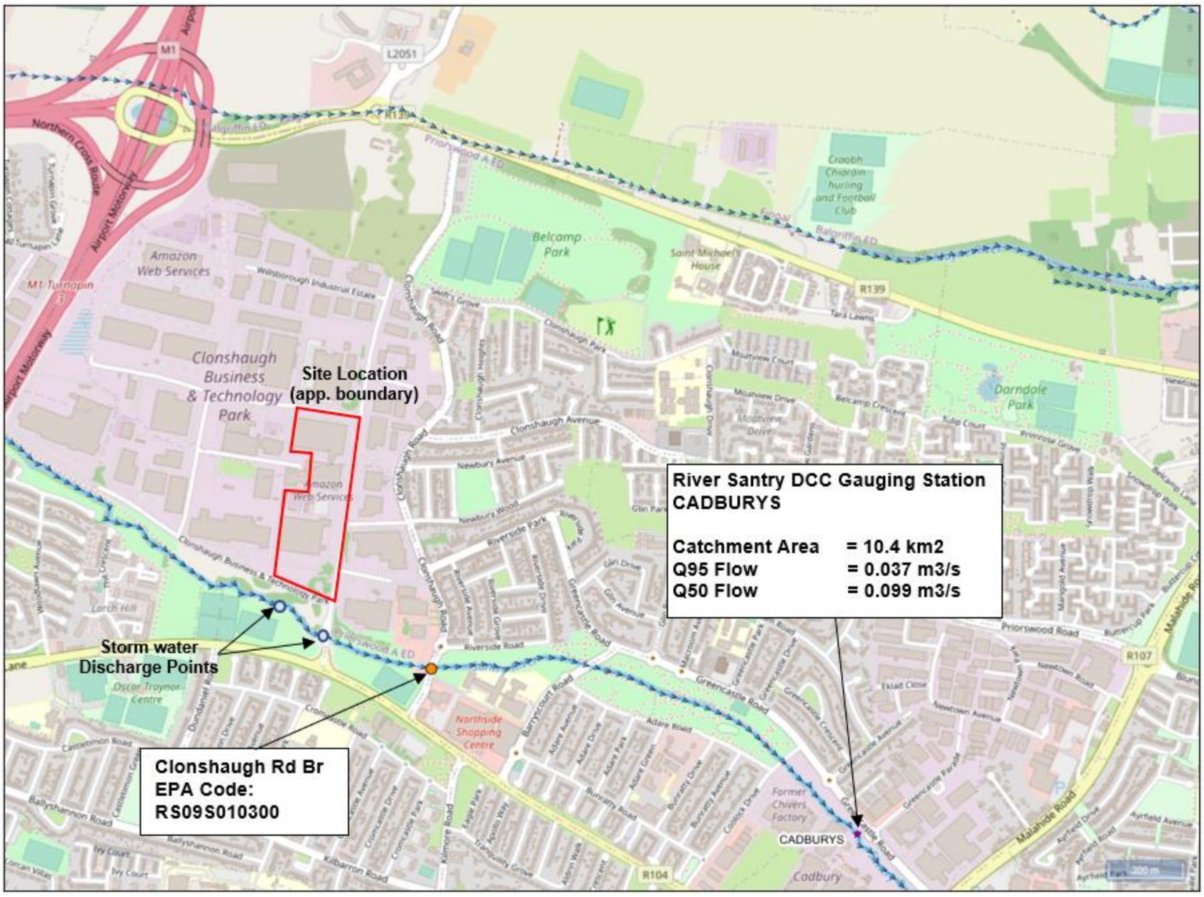

Figure 3.1 Hydrological Environment, illustrating the Santry River flowing in a south-easterly direction.

3.1 SENSITIVE AREAS OR AREAS OF SPECIAL INTEREST

The nearest European sites to the installation are North Dublin Bay SAC (Special Area of Conservation) and North Bull Island SPA (Special Protected Area), c. 6 km to the east of the site. There is an indirect hydrological link between the installation, and these European sites through the stormwater drainage from the site which discharges into the Santry River via the stormwater drainage network for Clonshaugh Business Park. There is no connectivity to any other European sites.

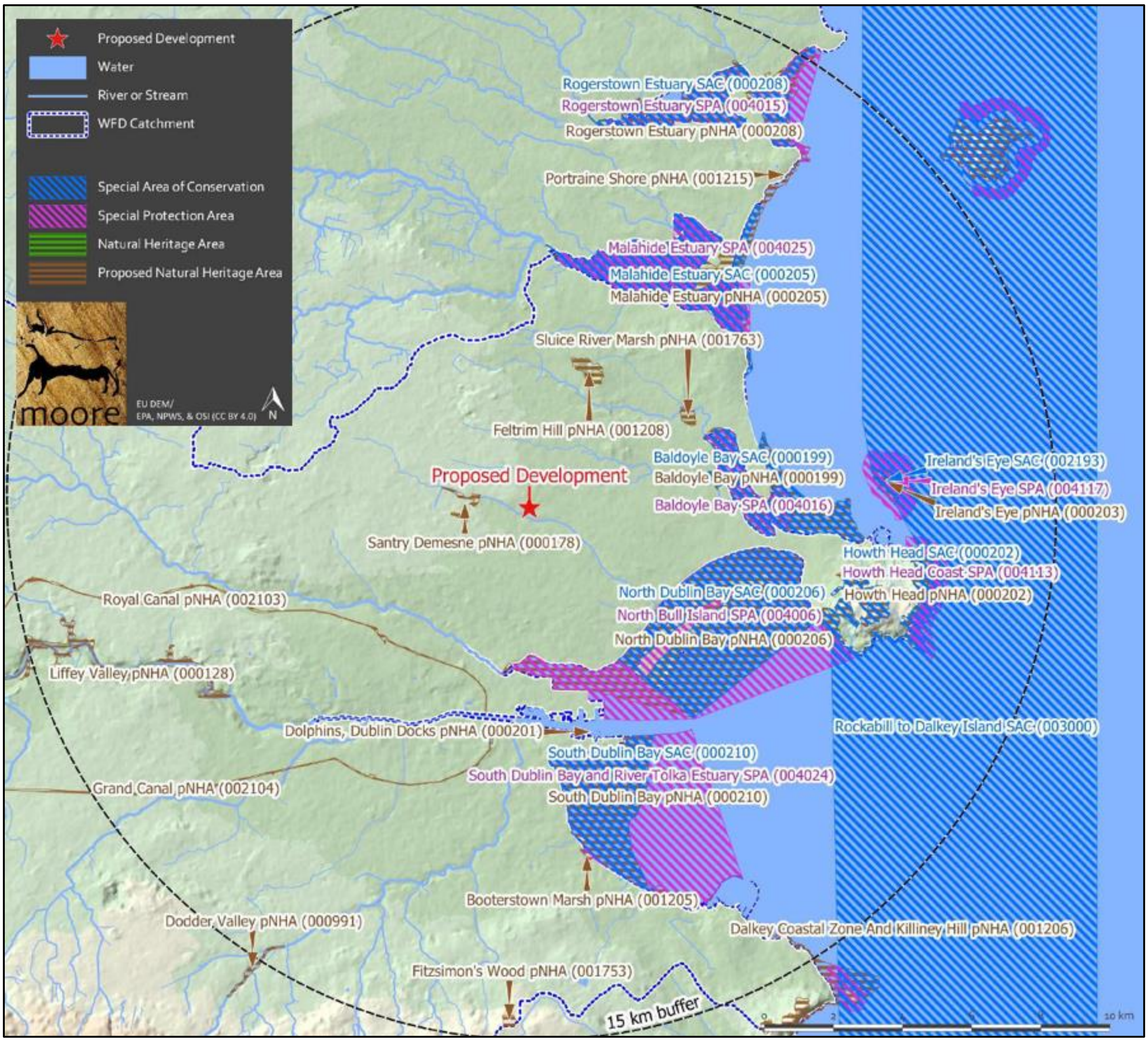

Figure 3.2 Site Location, Showing European sites and NHA's/pNHS'a in the vicinity of the Project

3.2 FLOW DATA

Based on the available information from the EPA (EPA HydroNet), the Santry River has a 95%ile flow (Q_{95}) of approx. **0.037 m^3/s** or 3,157 m^3/d at the DCC Cadburys Gauge Station, which is located c. 1.6 and 1.5 km downstream of the stormwater sewer discharge points associated to SW1 and SW2, respectively (refer to Figure 3.1 above). Additionally, at the DCC Cadburys Gauge Station, a 50%ile flow (Q_{50}) of **0.099 m^3/s** or 8,554 m^3/d has been estimated by the EPA. The data from this station is considered representative of the hydrological conditions at the stormwater sewers discharge points to the Santry River as there are no tributaries or abstractions between the gauging station and the location of the stormwater sewer discharge points (refer to Figure 3.1 above). These gauged flows have been used directly in this assessment.

3.3 WATER QUALITY DATA

A review of available EPA surface water quality data has been undertaken. There is 1 no. active downstream EPA monitoring station located in the Santry River (Clonshaugh Road Bridge, (RS09S010300)) c. 450 and 300 m downstream of the stormwater sewer discharge points to the Santry River associated to SW1 and SW2, respectively (refer to Figure 3.1 above).

The water quality data from Clonshaugh Road Bridge monitoring station is available for the period between 2007 to 2022 and was considered in this analysis. The monitoring sampled date and concentration of the parameters of interest are presented below in Table 3.1. Comparison with the Threshold Values defined above in Section 2.4 is also shown. As can be seen, the water quality for the 95%ile and mean conditions exceed all the Surface Water Regulation's threshold values, which is representative of the 'poor' water quality status of this river.

The nearest EPA monitoring station on the Santry River at the Clonshaugh Road Bridge Station (RS09S010300) obtained a Q rating of 2-3 Poor Status (EPA, 2022).

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

EPA Station	Sampled Date	Ammonia	BOD	ortho-Phosphate	Alkalinity-total	Chloride	Sulphate
		mg/l as N	mg/l	mg/l as P	mg/l as CaCO3	mg/l	mg/l as N
	TV 95%ile	*0.14*	*2.6*	*0.075*	*n.v.*	*250*	*250*
	TV mean	*0.065*	*1.5*	*0.035*	*n.v.*		
Clonshaugh Rd Br (RS09S010300)	15/03/2007	0.04	1.0	0.010	272	32	
	20/06/2007	0.14	1.0	0.030	142	23	
	29/08/2007	0.07	1.0	0.070	296	33	
	04/12/2007	0.1		0.070	215	36	
	20/02/2008	0.05	1.0	0.050	262	50	86
	14/05/2008	0.11	1.0	**0.080**	214	68	75
	20/08/2008	0.08	1.0	0.050	276	30	84
	05/11/2008	0.05	1.0		272	24	64
	28/01/2009	0.13	1.0		286	55	86
	28/04/2009	0.08			209	50	95
	30/07/2009	0.06	1.0	0.040	248	21	63
	28/10/2009	0.13	1.0	**0.090**	226	35	71
	10/02/2010	0.09	**3.0**	0.030	286	66	79
	29/04/2010	**0.17**	**4.0**	0.050	234	65	68
	29/07/2010	0.11	1.0	**0.120**	199	69	81
	04/11/2010	0.015	1.0	0.015	146	36	72
	09/02/2011	0.07	**6.0**	0.030	217	73	72
	11/05/2011	0.11	1.0	0.050	190	82	66
	17/08/2011	0.08	1.0	**0.160**	155	92	70
	09/11/2011	**1.32**	2.0	**0.100**	197	55	84
	26/01/2012	0.11	1.0	0.040	170	21	20
	03/05/2012	0.07	1.0	0.040	253	44	93
	26/07/2012	0.04	1.0	0.050	187	31	59
	07/11/2012	0.08	1.0	0.060	240	60	57
	30/01/2013	0.09	**5.0**	0.015	139	60	37
	24/04/2013	0.015	2.0	0.015	240	67	79
	24/07/2013	0.09	**3.0**	**0.080**	154	66	60
	30/10/2013	0.04	0.5	0.030	186	40	109
	29/01/2014	0.06	**3.0**	0.030	139	30	41
	23/04/2014	0.06	**3.0**	0.040	205	47	61
	23/07/2014	0.06	**4.0**	0.070	179	41	52
	04/02/2015	0.06	2.0	0.050	254	64	62
	22/04/2015	0.07	2.0	0.040	233	56	67
	03/09/2015	0.05	1.0	0.060	161	46	60
	18/11/2015	**0.17**	**4.0**	**0.100**	101	17	19
	17/02/2016	0.05	**3.0**	0.040	178	93	38
	20/04/2016	0.05	1.0	**0.080**	260	11	21
	15/06/2016	0.03	**4.0**	**0.080**	196	55	58
	28/09/2016	0.07	1.0	**0.080**	155	48	60
	16/11/2016	**0.91**	**5.0**	**0.150**	160	57	54
	22/02/2017	0.08	2.0	0.070	221	74	70
	19/04/2017	0.03	2.0	0.030	221	53	69
	14/06/2017	**0.18**	1.0	**0.090**	183	45	68
	20/09/2017	0.06	2.0	0.070	173	55	61
	22/11/2017	**0.16**	**10.0**	**0.130**	103	29	39
	21/02/2018	**0.21**	**7.0**	0.060	257	116	83
	25/04/2018	0.13	2.0	0.070	224	71	72
	27/06/2018	**0.22**	2.0	**0.090**	187	61	58
	05/09/2018	0.12	**3.0**	**0.140**	158	77	49
	21/11/2018	0.13	**4.0**	0.060	118	34	69
	27/02/2019	0.07	**3.0**	**0.080**	231	66	82
	24/04/2019	0.04	**4.0**	0.040	213	68	87
	12/06/2019	0.04	2.0	**0.110**	200	234	91
	18/09/2019	**0.3**	2.0	**0.110**	146	54	63
	20/11/2019	0.1	2.0	0.050	202	60.0	63
	26/02/2020	0.1	2.0	0.039	260	75.8	
	10/06/2020	**0.56**	**3.2**	**0.160**	172	**465**	
	23/09/2020	0.051	1.2	0.046	163	68.6	
	18/11/2020	0.13	2.3	0.037	197	37.8	
	10/02/2021	0.11	2.1	0.032	264	195	
	28/04/2021	0.08	0.5	0.048	179	88.5	
	09/06/2021	0.045	1.8	0.064	188	95.2	
	29/09/2021	0.13	2.1	0.069	150	47.9	
	17/11/2021	0.084	1.4	0.061	170	68	
	27/04/2022	0.12	1.4	0.027	198	79.7	
	08/06/2022	0.074	1.3	0.059	171	62.7	
	28/09/2022	0.11	0.5	**0.078**	166	60.7	
	16/11/2022	**0.79**	1.6	0.052	189	58.3	
	Data 95%ile	**0.686**	**5.7**	**0.147**	282	159	94
	Data mean	0.139	2.2	0.064	201	65	66

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 Santry River (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 centre 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, evaporative cooling water is automatically discharged to the onsite stormwater network at ambient temperature. As there are no treatment chemicals added to the evaporative cooling water and 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 Santry River; there is however, an ***indirect*** discharge via the Clonshaugh Business Park storm sewer , which subsequently discharge to the Santry River. A flow control system at the outlet of the site stormwater attenuation system is used to achieve the controlled discharge rate to the stormwater sewers on Clonshaugh Business Park storm sewer .

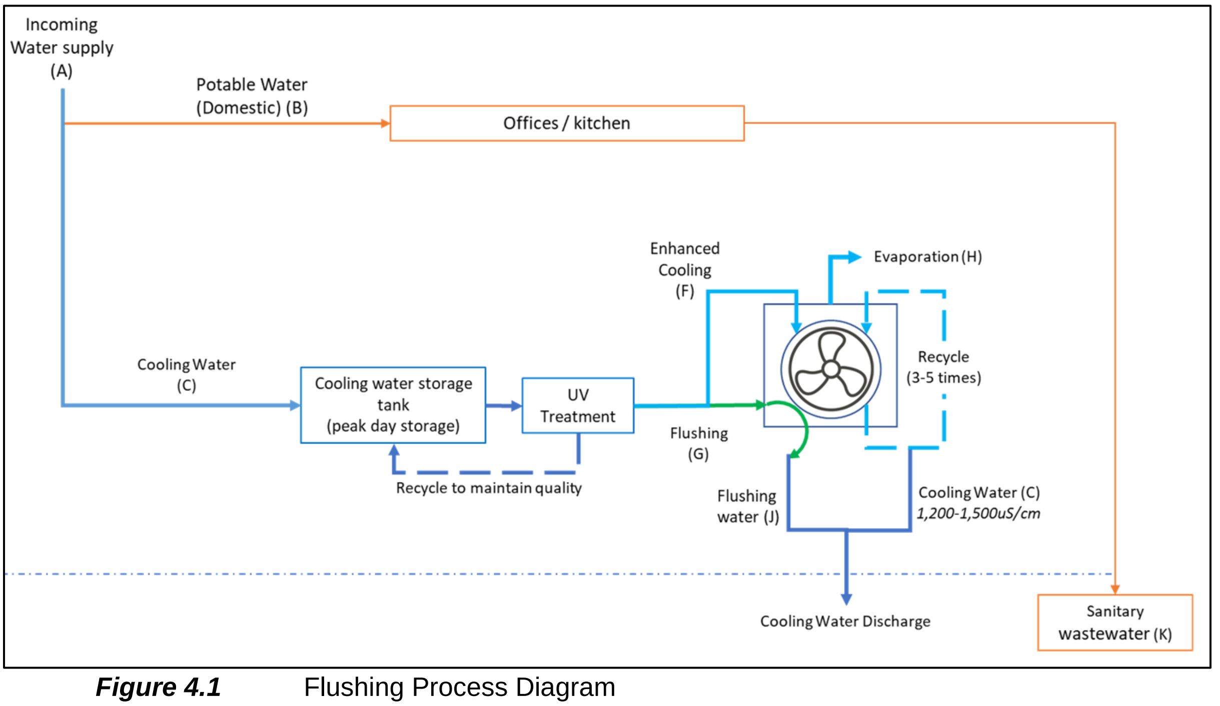

Figure 4.1 Flushing Process Diagram

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 Santry River (Clonshaugh Road Bridge (RS09S010300)) (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	64
Sulfate	mg/l	146
Alkalinity	mg/l	440
Discharge Flow (95%ile scenario)	m^3/d	117
Discharge Flow (50%ile scenario)	m^3/d	19.5

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 Santry River 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, 2 scenarios have been considered as follows:

- Dry Weather Flow or 95%ile: **117 m^3/d** evaporative cooling water discharge from the installation and Q_{95} in the Santry River.
- Mean Flow or 50%ile: This scenario estimates that 117m^3/d discharge from the installation occurs 5 days month within a 30-day month, which equates a mean installation discharge flow rate of **19.5 m^3/d** (117 m^3/d x 5 days / 30 days) and Q_{50} in the Santry River.

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 SANTRY RIVER 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	Q95 (m^3/d)	CMAX (mg/l)	CBACK (mg/l)	Assimilative Cap. (kg/d)
Ammonia	3,197	0.14	0.686	**-1.7**
BOD		2.6	5.7	**-9.8**
Orthophosphate as P		0.075	0.147	**-0.2**
Chloride		250	159	**289**
Sulphate		250	94	**499**

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

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

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

Parameter	Q50 (m^3/d)	CMAX (mg/l)	CBACK (mg/l)	Assimilative Cap. (kg/d)
Ammonia	8,554	0.065	0.139	**-0.6**
BOD		1.5	2.2	**-6.1**
Orthophosphate as P		0.035	0.064	**-0.2**
Chloride		250	65	**1,579**
Sulphate		250	66	**1,577**

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

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

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 above 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). This means that there is inadequate assimilative capacity within the Santry River for these parameters of Ammonia, BOD and Orthophosphate as P which is reflected by the negative value of the assimilative capacity.

The background concentration (C_{BACK}) for the parameters of Chloride and Sulphate are below the threshold established under the Drinking Water Regulations. This means that there is assimilative capacity within the Santry River for these parameters (Chloride and Sulphate).

5.2 ASSIMILATIVE CAPACITY (WITH EVAPORATIVE COOLING WATER DISCHARGE)

This scenario assesses the assimilative capacity of the Santry River with evaporative cooling water discharge from the cooling systems with emission values as presented in Table 4.1. The downstream concentrations in the Santry River 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 stormwater water network sewer in Clonshaugh Business Park;
- 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^o 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: 117 m^3/d evaporative cooling water discharge from the Installation and Q_{95} in the Santry River.
  - Mean Flow or 50%ile: This scenario estimates that **117 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 **19.5 m^3/d** (117 m^3/d x 5 days / 30 days) and Q_{50} in the Santry River.

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

Parameter	Q95 (m^3/d)	Discharge Flow (m^3/d)	CBACK (mg/l)	CADSIL (mg/l)	CD/S (mg/l)	Assimilative Cap. (kg/d)
Ammonia	3,197	117	0.686	0.01	0.663	**-1.7**
BOD			5.7	1	5.5	**-9.2**
Orthophosphate as P			0.147	0.03	0.1	**-0.2**
Chloride			159	64	156	**300**
Sulphate			94	146	96	**493**
Alkalinity-total (*)			282	440	287	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	Q50 (m^3/d)	Discharge Flow (m^3/d)	CBACK (mg/l)	CADSIL (mg/l)	CD/S (mg/l)	Assimilative Cap. (kg/d)
Ammonia	8,554	20	0.139	0.01	0.138	**-0.6**
BOD			2.2	1	2.2	**-6.1**
Orthophosphate as P			0.064	0.03	0.064	**-0.2**
Chloride			65	64	65	**1,579**
Sulphate			66	146	66	**1,575**
Alkalinity-total (*)			201	440	201	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 decrease the chloride and increase sulphate downstream concentrations ($C_{D/S}$) marginally in terms of the assimilative capacity of the river for both hydrological conditions. The concentrations of chloride and sulphate 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 increases due to dilution from the evaporative cooling water discharge (particularly for the dry weather condition), although the resultant assimilative capacity is not 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). As such the discharge of evaporative 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 (Santry River), 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 considers that all of the evaporative cooling water discharge (at maximum discharge flow) is discharged directly to the Santry River. In reality, the installation evaporative cooling water will discharge from the site at SW1 and SW2 (discharge points) to the Clonshaugh Business Park stormwater drain network on Business Estate Road which subsequently discharges at two separate locations to the Santry River (located approx. 50 and 380m to the south of SW1 and SW2, respectively). The dilution effects from other sources of stormwater from all the other commercial/industrial developments within the Clonshaugh Business and Technology Park have not been considered in this assessment.

The parameters assessed in the assimilative capacity study were based on available EPA water quality data (for the closest monitoring stations referred to above) 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, sulphate and alkalinity) in the Santry River. The assimilative capacity of the Santry River is sufficient to ensure that exceedances of these parameters do not occur under dry weather and mean flow conditions at the EPA monitoring station on the Santry River (downstream of discharge points).

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 Santry River, although the resultant capacity is still not adequate to achieve 'Good' status. It should be noted that the Santry River currently does not have existing assimilative capacity for these parameters (i.e., Ammonia as N, BOD and Orthophosphate as P) and is already at poor 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 receiving water status in Santry River.

7.0 LIMITATIONS AND ASSUMPTIONS

There are no low flow measurements or background water quality data available for the Santry River (located approx. 100 m south of the site) at the points of discharge from the Clonshaugh Business Park stormwater network.

The exact locations of the outfall of the Clonshaugh Business Park stormwater network into the Santry estimated as approximately 300 m upstream of the EPA monitoring location Santry River (Clonshaugh Road Bridge, (RS09S010300) and approximately 1.5 km upstream of the DCC Cadburys Gauge Station. The downstream quality and flow data from the EPA database is considered representative of the outfall locations into the Santry River.

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 Santry River 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/