SECTION 14: Water

14.1 Introduction

This Section of the EIAR assesses the potential impacts (and resulting effects) likely to occur as a result of the Proposed Castletroy WwTP Upgrade Project on the receiving water environment, in terms of hydrology, surface water quality and flood risk. It further outlines the measures required to minimise these potential impacts. The section should be read in conjunction with **Section 11, Biodiversity** and **Section 13, Land and Soils** due to overlapping impacts and mitigation measures.

It should also be noted, groundwater features and hydrogeology have been considered in **Section 13, Land and Soils.**

This assessment was drafted by Orla O'Brien with the support of Kieran O'Dwyer. Orla is a civil engineer with a master's degree from NUI Galway in water and wastewater engineering, and she has 3 years' work experience in the field. Her thesis was the development of a water quality dispersion model for Galway Bay to determine the effects of known discharges on Blue Flag Status of beaches in the area. Since then, she has worked on successful tenders in relation to wastewater licencing, the development of a water quality model for the Shannon Estuary and she has been heavily involved with the scoping and coordination of this EIAR.

Kieran is a Technical Director with J. B. Barry and Partners and has over 40 years' experience in the field of environmental and hydrogeological consultancy. He holds a BE from UCD and is Member of the Institution of Engineers Ireland (MIEI) and International Association of Hydrogeologists (IAH). He is the overall project manager responsible for the coordination of this EIAR. He was formerly a director with K. T. Cullen and Co. Ltd (Environmental Consultants) and a Regional Director with WYG Ireland. Kieran has been responsible for the Land Soils and Hydrogeology element of numerous Environmental Impact Assessments (including TII tranche 4 motorway service areas (3 No.), NRA Tranche 4 Motorway Service Areas (5 No. oral hearings), Ringsend Wastewater Treatment Plant Upgrade Project and Greater Dublin Drainage (GDD) project and has presented specialist evidence at numerous planning oral hearings.

14.2 Assessment Methodology

This section of the EIAR was prepared having regard to:

- Guidelines on the Information to be Contained in Environmental Impact Assessment Reports by the Environmental Protection Agency, EPA 2022;
- Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports by the Environmental Protection Agency, EPA 2017; and
- Draft- Advice Notes on Current Practice (in the preparation of Environmental Impact Statements), EPA 2015.

EPA EIAR guidance appraisal methodology considers a description of the impact i.e. the "quality" of the effects (i.e. whether it is adverse or beneficial), the "significance" of the effects (i.e. the magnitude of the effect in terms of the environment), the "probability" of the event occurring, and the "duration" of the effects (i.e. whether it is short or long term) and also considers the significance / sensitivity of the existing environment. Terminology for describing the quality, significance, extent, probability and duration of effects is set out in Section 3.7.3 of the EPA EIAR guidance. A qualitative approach was used in this evaluation and Figure 14-1 taken from the EPA EIAR guidance (2022) shows how comparison of the character of the predicted impact to the sensitivity of the receiving environment can determine the significance of the impact.

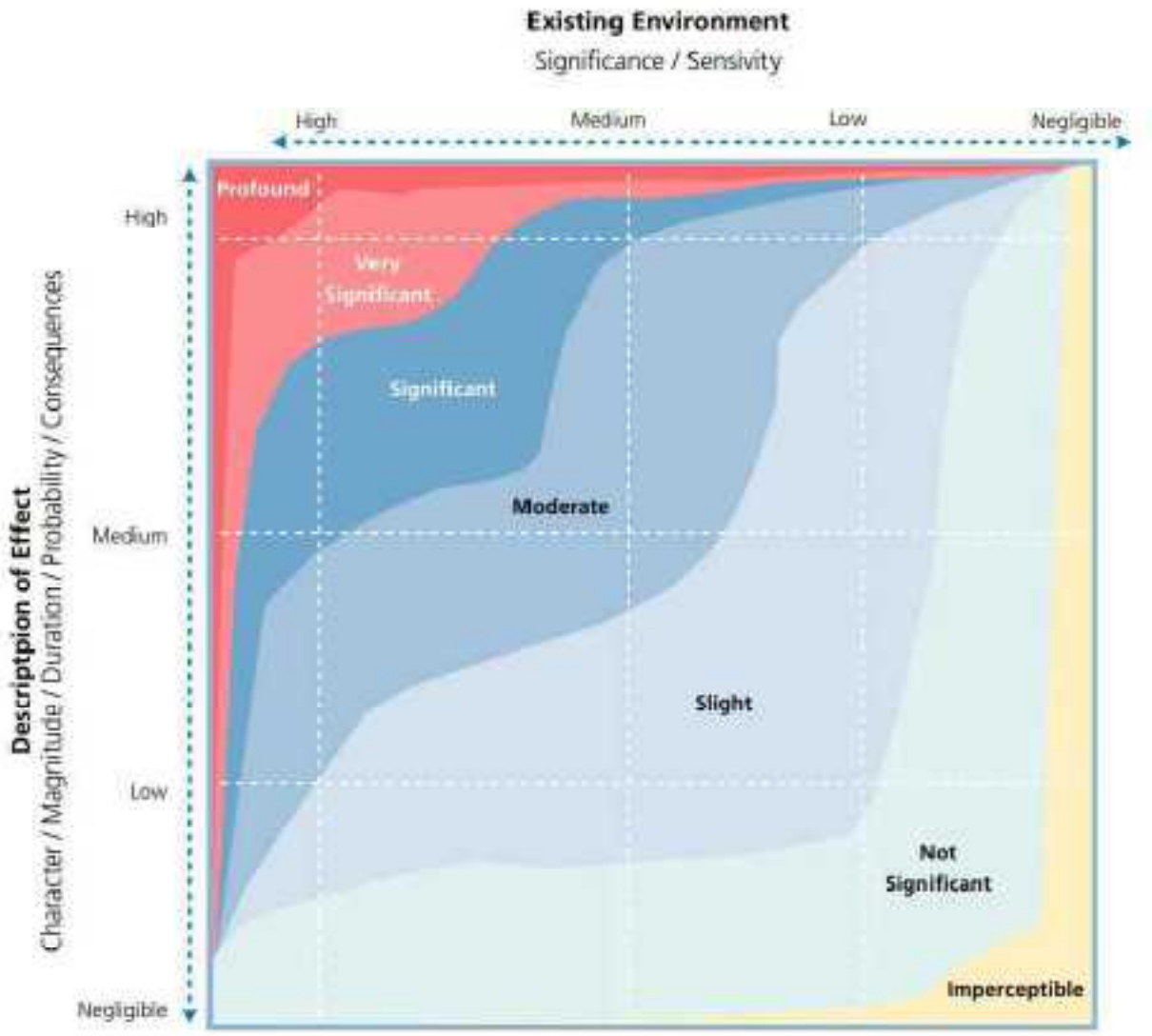

Figure 14-1: Classification of Significance of Effects, EIAR Guidelines (2022)

14.2.1 Water Quality Legislation

The Water Framework Directive (WFD)

The Water Framework Directive (WFD) establishes a framework for the protection, improvement and management of all waters. The overall aim for surface waters, which include rivers, lakes, transitional (estuaries and lagoons) and coastal waters, is to achieve at least 'good ecological status' and 'good chemical status'. A surface water body must achieve both good ecological status and good chemical status before it can be considered to be of good status. The chemical status of a water body is assessed based on the concentrations of certain chemical pollutants. The ecological status is assessed on Quality (Q) Values (Biotic Indices). The EPA scheme of Q Values and its relationship to WFD is set out in the Table 14.1.

Table 14.1: WFD Q Values

Q Value	WFD Status
Q5	High
Q4-5	High
Q4	Good
Q3-4	Moderate
Q3	Poor
Q2-3	Poor
Q2	Bad
Q1-2	Bad
Q1	Bad

Surface Water Regulations

Environmental Quality Standards (EQSs) for classifying surface water status were established in the European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (SI No. 272 of 2009). These regulations set standards for biological quality elements, physicochemical conditions supporting biological elements (including general conditions and specific pollutants), priority substances and priority hazardous substances. The water quality parameters of concern in river water bodies are primary wastewater parameters BOD, Ammonia and Orthophosphate. EQS concentration limits, as specified in Surface Waters Regulations 2019 (as amended), are listed in Table 14.2.

Whereby a Wastewater Treatment Plant releases final effluent into a river, ambient water quality monitoring must be carried out at points upstream and downstream of the discharge location. Findings are compared to relative EQS values to determine whether the plant is having a significant effect on the quality of the receiving water. If upstream samples contain significantly lower concentrations of primary wastewater parameters than downstream (annual mean results), and downstream results exceed the EQS, it is assumed the effluent discharged from the plant is having a negative impact on water quality.

Table 14.2: Environmental Quality Standards (EQS)

Parameter	High Status EQS	Good Status EQS
BOD (mg/l as 0_2)	≤ 1.3 (mean) **or** ≤ 2.2 (95%ile)	≤ 1.5 (mean) **or** ≤ 2.6 (95%ile)
Total Ammonia (mg/l as N)	≤ 0.04 (mean) **and**[10] ≤0.09 (95%ile)	≤ 0.065 (mean) **and** ≤ 0.14 (95%ile)
Molybdate Reactive Phosphorus[11] (mg/l as P)	≤ 0.025 (mean) **and** ≤0.045 (95%ile)	≤ 0.035 (mean) **and** ≤ 0.075(95%ile)

14.2.2 Desktop Study

[10]. There was an amendment to the Surface Water Regulations in 2019, whereby Ammonia and ortho-P standards were changed from OR to AND requirements for both high and good status.

[11] "Reactive phosphorus" is a method-based term that describes what is measured in the test for ortho-Phosphate. AERs and WQ monitoring results list findings as ortho-Phosphate.

The assessment has been based on a desktop study of published hydrological and water quality data for the Lower River Shannon and contributing watercourses.

The sections of the assessment took various elements in to consideration such as the available baseline information, potential impacts, consultations with other specialists, and other available relevant information gained through research and discussion. In collating this information, as well as referencing relevant legislation and policy documents, the following sources of information were consulted:

- EPA Maps (https://gis.epa.ie/EPAMaps/);
- EPA Catchment website (www.Catchment.ie);
- Office of Public Works flood mapping data (www.floodmaps.ie);
- Environmental Protection Agency; [Available on-line at: http://gis.epa.ie];
- National Parks and Wildlife Services (NPSW) www.npws.ie on-line database; Protected Register; and
- Lower Shannon & Mulkear Catchment Assessment (HA 25D).

14.3 Study Area

14.3.1 Site Description

Castletroy WwTP is surrounded by the University of Limerick campus and the Lower River Shannon spans its northern boundary. The drainage infrastructure and the WwTP were constructed in the early 1990's, and various improvement works have been carried out since then to meet the demands of an increasing population. Sources of wastewater loading to the WwTP are from the domestic population, the University of Limerick, commercial and industrial sectors, and imported sludges and leachates. The WwTP treats the wastewater with secondary biological and nutrient removal processes. Stormwater overflows (SWOs) and final treated effluent are discharged into the main flow channel of the Lower River Shannon. The WwTP redline boundary and discharge location can be seen in Figure 14-2.

Figure 14-2: Castletroy WwTP and Discharge Point Location

14.3.2 Hydrological Environment

The Lower River Shannon travels from Lough Derg to the Parteen Weir where flows in excess of 10m^3/s are diverted to the Ardnacrusha Headrace Canal for use in the ESB Ardnacrusha hydroelectric power station. Therefore, it creates the unusual situation where there is a constant 10m^3/s flow rate in the downstream section of the main river channel. This section is also sometimes referred to as the 'Old River Shannon' due to it being the original pathway of the river before construction of the canal.

A small portion of the flow exits the main river channel downstream of the weir, into the Erriva Canal. This merges with the Blackwater River (Clare) and re-joins the main river channel just upstream of the WwTP.

The Mulkear River joins with the Lower River Shannon upstream of the WwTP. It merges with the main channel flow at the rivers' confluence as seen in Figure 14-3. The combined flow passes the WwTP and re-joins the Ardnacrusha (Tailrace) Canal downstream at Limerick Dock, whereby the Lower River Shannon transitions into the Shannon Estuary which releases to the Atlantic Ocean.

Figure 14-3: Overview of the Hydrological Environment

14.3.3 Outfall Arrangement

Figure 14-4 shows the existing outfall arrangement, as included in the EPA Wastewater Discharge license application documents. Final effluent and stormwater are combined in the final effluent inspection chamber before gravitating to the main river channel via three outfall pipes, as seen in figure 14.4. The pipes extend approximately 75m into the main river channel and each is fitted with 2 no. diffuser heads. The diffuser heads have 4 no. legs to disperse discharge and enhance mixing with the river flow, Figure 14-5.

During normal weather conditions the final effluent consists of treated discharge from WwTP process (SW-1). During storm and heavy rainfall conditions it is mixed in the final effluent chamber with screened

stormwater from the inlet works (SW-4) and possibly unscreened emergency overflows (EOs). Further details are discussed in Stormwater management, **Section 14.4.6.**

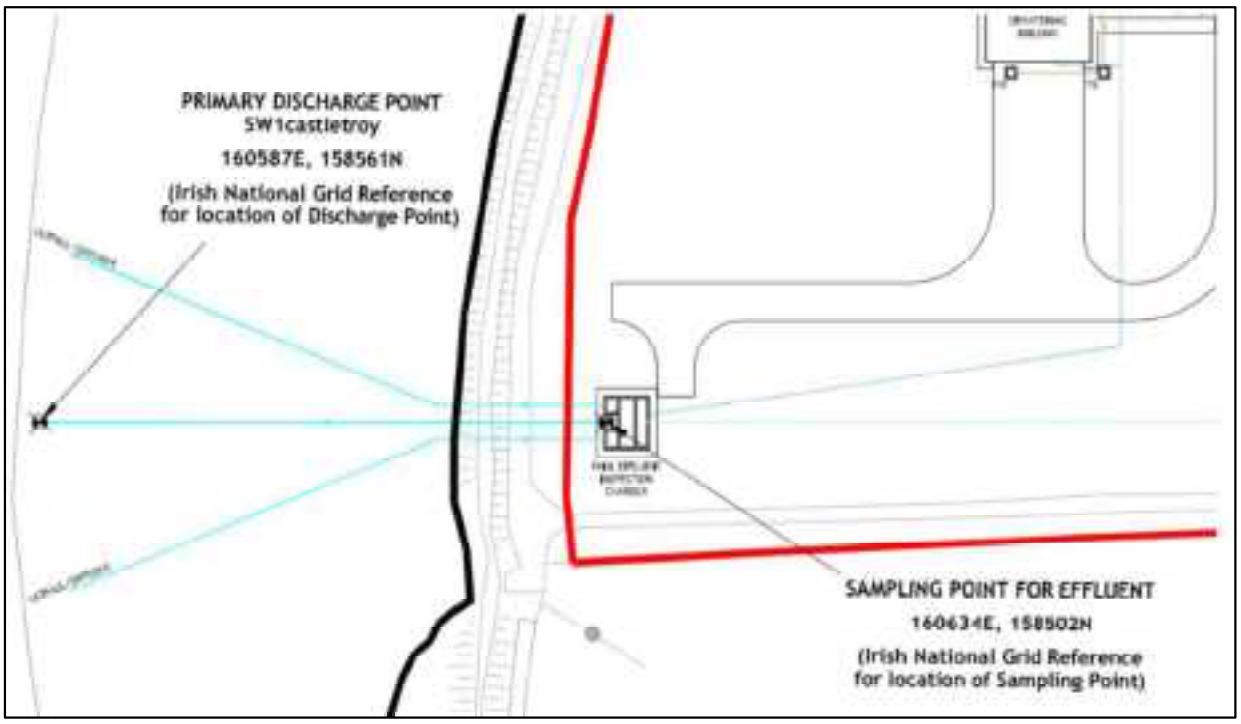

Figure 14-4: WwTP Outfall Arrangement

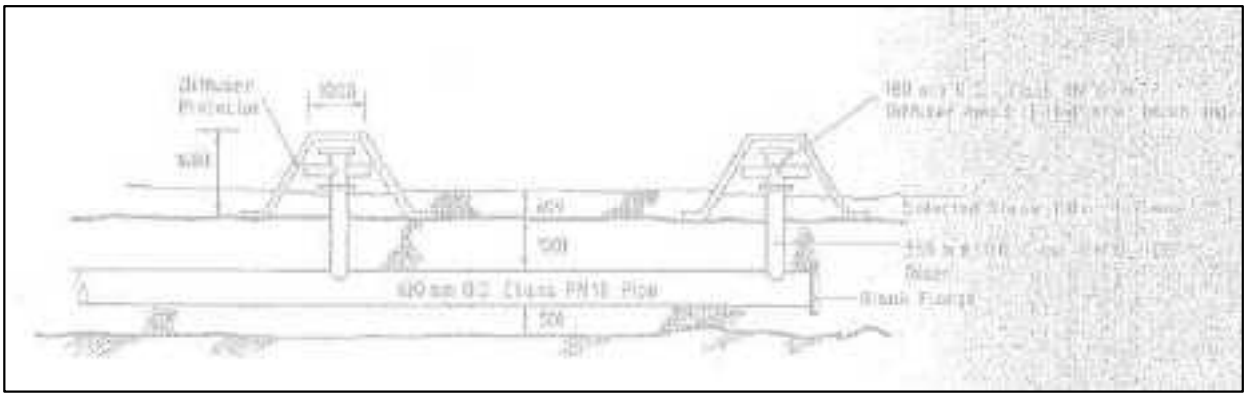

Figure 14-5 Diffuser Arrangement

14.3.4 Key Receptors

Special Areas of Conservation and Special Protected Areas (Natura 2000)

The point of discharge is designated on ecological grounds as a Special Area of Conservation (SAC); applicable SAC is titled 'Lower River Shannon' with Site Code: 002165. It is a large site that encompasses the lower reaches of the Lower River Shannon extending from just south of Lough Derg at its eastern end to a line drawn from Loop Head to Kerry Head at the west. There are reaches of six main rivers in the Lower River Shannon SAC: The Lower River Shannon (between Killaloe and Limerick), the Cloon, the Fergus, the Mulkear, the Maigue and the Feale. The site is selected for 14 habitats listed in Annex I of the Habitats Directive and seven species in Annex II.

The potential for the Proposed Development to impact on designated conservation sites is discussed in further detail in **Section 10**, Biodiversity.

Contact/ Recreational Waters

The UL Boat Club jetty is 115m downstream of the discharge point, and members regularly use the area for contact/recreational water-based activities. Figure 14-6 displays the location of the UL Boat Club Jetty with regard to the WwTP discharge point.

Recreational water is defined in Section 8.3.2 of Uisce Éireann Technical Standard IW-TEC-800-03 for Stormwater Overflows (SWOs) as *'waters where bathing and /or contact sports (immersion) is regularly practiced (e.g. wind-surfing, canoeing)'*.

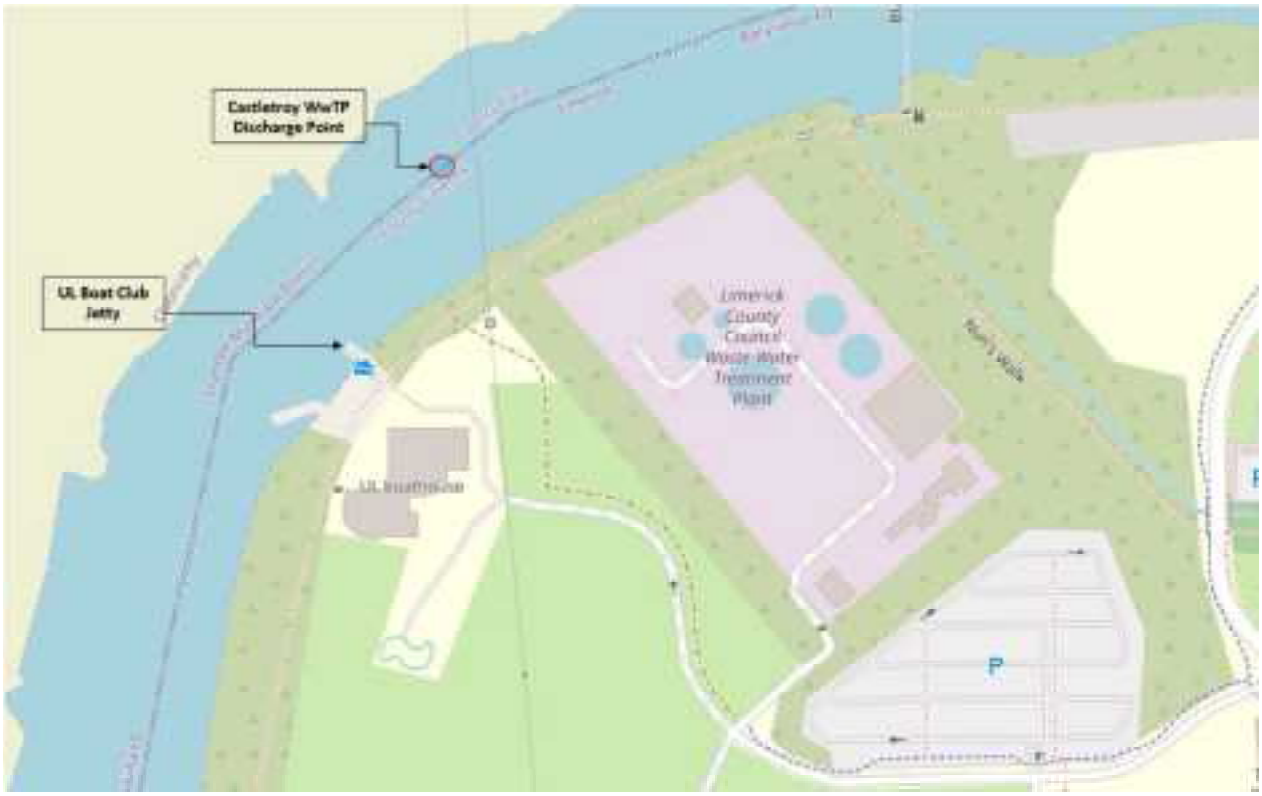

Figure 14-6 : Location of UL Boat Club relative to Castletroy WwTP

Given the proximity of the jetty and contact area to the discharge point, receiving water has been assessed under recreational water guidelines, as laid out in DoEHLG 'Procedures and Criteria in Relation to Stormwater Overflows' and Uisce Éireann Technical Standard IW-TEC-800-03 for Stormwater Overflows. See further details in **Section 14.4.6**.

Designated Bathing Waters

Areas identified as designated bathing waters are monitored by local authorities and the EPA under EU Bathing Water Directive and Irish Bathing Water Regulations. The only designated bathing water in the Shannon Estuary is at Kilrush (Cappagh Pier), which is approximately 74km west of Castletroy WwTP. This is a sufficient distance away to not be affected by the effluent discharge from the WwTP.

Designated Shellfish Waters and Classified Shellfish Production Areas

There are no designated shellfish water or classified shellfish production sites in the proximity of study area.

14.4 Baseline Conditions

14.4.1 EPA Discharge Licence

The EPA issued a wastewater discharge licence (WWDL) for the agglomeration of Castletroy and its environs on the 22nd April 2009. The WWDL was issued under Regulation 28(1) of the Wastewater Discharge (Authorisation) Regulations 2007. The licence register number is D0019-01 and the Licensee was Limerick County Council. The discharge location is the Lower River Shannon (WFD Code: IE_SH_25_3904).

Emission limit values (ELVs) are specified in the WWDL. They determine the maximum allowable concentrations of waste components/pollutants that can be discharged in the final effluent without adversely affecting the receiving aquatic environment. ELVs assigned to Castletroy WwTP are listed in Table 14.3.

Table 14.3: Castletroy WwTP Emission Limit Values (ELVs)

Parameter	ELV
BOD (mg/l)	25
COD (mg/l)	125
Suspended Solids (mg/l)	35
Ammonia (mg/l N)	5
ortho-Phosphate (mg/l P)	1
Total Phosphorus (mg/l P)	2

Annual Environmental Reports (AERs)

Water Quality Monitoring Annual Environmental Reports (AERs) are prepared in accordance with the requirements of the wastewater discharge licence (WWDL) for the agglomeration. AERs outline the environmental performance of the site over the previous year and a summary of on-going improvements measures. They also describe the measures they have taken to avoid and minimise any environmental impact outside their site and their commitments to ongoing improvements in their operations. These include reductions in emissions and waste and improved efficiency in their use of energy and water in their processes. AERs are published for public access on the following Uisce Éireann and EPA websites[12].

Reportable environmental incidences common to Castletroy WwTP include large spillages and uncontrolled releases caused mainly by adverse weather combined with absence of stormwater storage. Since 2018, the plant has had on average of 10 reportable incidences per annum.

The AERs state that the plant has been non-compliant with licence conditions in recent years due to breaches in ELVs; ortho-Phosphate in 2018 and 2021, and Ammonia in 2019. However, annual mean effluent monitoring results indicate plant is producing a final effluent considerably less concentrated than

[12] https://www.water.ie/help/wastewater/compliance/annual-environmental-repo/

and https://www.epa.ie/our-services/compliance--enforcement/whats-happening/annual-environmental-reports/

the allowable ELVs. Therefore, it can be assumed the exceedances were isolated incidences caused by WwTP deficiencies i.e., lack of stormwater storage and/or breakdown of aging plant equipment.

Mean effluent monitoring results for the period 2019 to 2021 (inclusive) are listed in Table 14.4 below.

Table 14.4: WwTP Annual Mean Effluent Monitoring Results (2019-2021)

Parameter	Effluent Monitoring Mean Results 2019-2021
BOD (mg/l)	5.65
COD (mg/l)	32.16
Suspended Solids (mg/l)	13.6
Ammonia (mg/l N)	1.26
ortho-Phosphate (mg/l P)	0.44
Total Phosphorus (mg/l P)	0.78

Specified Improvement Programme (SIP)

A wastewater discharge licence (WWDL) may require a number of reports on specific subject areas to be prepared for the agglomeration. These reports are submitted to the EPA as part of the AER. Table 14.5 provides a list of the specified improvement measures recommended for the Castletroy agglomeration under Schedule A and C of the WWDL, as per the 2021 AER.

Table 14.5: Castletroy WwTP Specified Improvement Programme (SIP)

Specified Improvement Programmes	Description	Licence Schedule	Completion Date	Status of Works	Timeframe for Completing the Work
D0019-SIP:01	Installation of Phosphate removal technology	C	31/12/2009	Complete	N/A
D0019-SIP:02	SW-4 Upgrading of Storm Water Overflows to comply with the criteria outlined in the DoEHLG 'Procedures and Criteria in relation to Storm Water Overflows, I995	C	31/12/2020	At Planning Stage	2033
D0019-SIP:03	SW-5 Upgrading of Storm Water Overflows to comply with the criteria outlined in the DoEHLG 'Procedures and Criteria in relation to Storm Water Overflows, I995	C	31/12/2020	At Planning Stage	2033
D0019-SIP:04	WWTP short term upgrade	C	31/12/2009	Compete	N/A

14.4.2 Baseline Flow Data

Calculated Hydraulic Loading to the WwTP

Theoretical hydraulic loadings to the WwTP include Census 2016 figures, which was the latest census at the time the Feasibility Study Report (FSR) was developed. Geo-directory data, Department of Education figures, EPA IPC licences and Uisce Éireann non-domestic water usage data, as well as population estimates have also been compiled to estimate the maximum discharge from all contributing sources to Castletroy WwTP. Theoretical calculations estimate hydraulic loading as being 6,043m^3/day, Table 14.6.

Table 14.6: Theoretical Hydraulic Loading to the WwTP

Loading Sources	Flow (m^3/d)
Domestic Population (Census 2016)	3,491
Commercial Loading (16% of Domestic)	558.61
Institutional Population	738
Industrial Loading	1,255.12
Total Loading	**6,043.06**

Measured Dry Weather Flow (DWF)

The DWF was calculated as per CIRIA Report 177 Section 5.1.1 as follows:

"The average daily flow to the treatment works during seven consecutive days without rain following seven days during which the rainfall did not exceed 0.25mm on any one day".

Met Eireann historical rainfall data from Castleconnell (Stn Latitude 52.707, Longitude -8.473) and historical flow data for the plant were analysed from 2016 – 2017. There was only one period in 2016 that satisfied this requirement which occurred from 21 Nov – 4 Dec 2016. Based on the data analysed the DWF was established to be 6,058m^3/day. This coincides with the theoretical hydraulic loading calculation for the same period.

Table 14.7: Measured Dry Weather Flow (DWF)

Rainfall & Flows		
Date	**Total In-Flow (m^3/day)**	**Rainfall (mm)**
26-Nov-16	6422.87	0
27-Nov-16	5740.71	0
28-Nov-16	6354.78	0
29-Nov-16	5866.37	0
30-Nov-16	6493.71	0
01-Dec-16	6173.65	0
02-Dec-16	6065.74	0
03-Dec-16	5767.05	0
04-Dec-16	5687.77	0
DWF =	**6,058**	0

Average Daily Flow (ADF)

Average daily flow (ADF) rates to the WwTP include rainfall and any other spills entering the sewer system. ADF was reported in the 2016 AER as 8043 m^3/day, which is 1.33DWF.

For the purpose of this assessment, ADF will be assumed to be 1.33DWF for full design capacity and future flows.

14.4.3 River Flow Data

There are 2 no. EPA hydrometric gauging stations upstream of Castletroy WWTP discharge locations, at the Parteen Weir (Station number 25075) and on the Mulkear River (station number 25001). As discussed previously, the Parteen Weir controls discharge at a constant 10m^3/s to the main river channel and diverts the remainder to the Ardnacrusha Headrace Channel. Mulkear River discharge data, or river Q rates, are listed in Table 14.8.

It should be noted, discharge from the Blackwater River is not required in the assessment calculations. The flow is predominantly influenced by the Errina Canal, a subsidiary of the Lower River Shannon which is already accounted for in the 10m^3/s.

Table 14.8: Mulkear River Discharge (Q) Rates

Percentage of Time	1%	5%	10%	25%	50%	75%	90%	95%	99%
Relative Flow Rate m^3/s	81.4	49.2	36.4	19.5	**10.0**	5.3	3.3	**2.53**	1.6

The combined flow rates at the WwTP discharge point location are as follows;

- Median/ Q50 = 20m3/s
- 95%ile/ Q95 = 12.53 m3/s

Dilution Rates

The combination of hydraulic loading from the WwTP and the flows in the Lower River Shannon cause the final effluent to become diluted at various rates, depending on the flow regime. Table 14.9 displays the dilution rates for DWF with Q95, and ADF with Median River Flow. At full design capacity 45,000PE, the Q95 dilution rate is 1:107 and Median is 1:179.

Table 14.9: Dilution Rates

Description	PE	Dilution @ Median River Flow	Dilution @ Q95 River Flow
Current Loading	39,000	1:214	1:179
Design Capacity	45,000	1:128	1:107

14.4.4 Receiving Water Quality

WFD Waterbody Status

The EPA GIS Application(EPA Maps) and Catchments.ie were reviewed in order to establish a baseline on existing receiving water quality (accessed 21/10/2022). The outfall point for effluent discharge from Castletroy WwTP is located in the Shannon River (Lower), European Code IE_SH_25S012600. Table 14.10 below provides a summary of WFD Waterbody Status attributes for the Lower River Shannon (Lower) (EPA Code: 25S01) and main tributaries upstream of the Castletroy WwTP site.

Results from surveys carried out between 2013 and 2018, class the reach as ‘moderate’ WFD water quality status. It was also assigned a WFD risk score 1a in 2008, which indicates the waterbody is at risk of not achieving ‘good’ status.

Biological Q values upstream of the WwTP are also an indicator of receiving water quality. Most recent Q values were recorded 2021. Results for upstream monitoring points in the Shannon, Mulkear and Blackwater rivers range from ‘poor’ to ‘good’ ecological status.

Table 14.10: Lower River Shannon WFD Waterbody Status Attributes

WFD Waterbody Status	
River Waterbody Code	IE_SH_25S012600
Protected Area	Yes
WFD Risk 2008	1a, at risk of not achieving good status
WFD Ecological Status (2013-2018)	Moderate
Sub catchment	Shannon [Lower]_SC_090
Pressures	No Significant Pressures identified
Q-Values	
9.4km u/s, Shannon (Lower), RS25S012500	Q3, Poor (2021)
4.9km u/s, Mulkear (Limerick), RS25M040590	Q4 Good (2021)
3.6km u/s, Blackwater (Clare), RS25B060250	Q3-4, Moderate(2021)

It has also been noted the Shannon Estuary (Limerick Dock) begins approximately 3km downstream of the outfall point where the river changes into a transitional waterbody with 'good' water quality status. See extract from EPA maps in Figure 14.7 with the layout of surrounding watercourses, also available to view on https://gis.epa.ie/EPAMaps/ (accessed 10/08/2022).

Figure 14-7: Layout of Surrounding Watercourses (image courtesy of EPA Maps)

Water Quality Monitoring Data

Ambient Chemistry Monitoring data was obtained from catchments.ie (accessed 10/08/2022) for monitoring stations RS25S012561 'WDLE 21 Shannon BR in UL u/s Castletroy STP' and RS25S012570 'D/S

Castletroy UWWTP WDLE22', Figure 14.8. Sampling results for a wide range of chemical parameters was made available, but only results for primary wastewater parameters with EQS values were required for the basis of this assessment, i.e. BOD, Ammonia and ortho-Phosphate.

Figure 14-8: Water Quality Monitoring Locations (image courtesy of Google Earth)

14.4.5 Baseline Water Quality Assessment

Trends in Long Term Sampling Results

Figures 14.9,14.10 and 14.11 display the relationship between upstream and downstream concentrations of BOD, Ammonia and ortho-Phosphate, with regard to (high status) mean and 95%ile EQS values. Plots include data from almost 5 years of monthly samples, ranging from January 2016 to November 2021(inclusive).

BOD u/s and d/s results are generally consistent, at 1mg/l, with periodic spikes/outlier readings. Upstream BOD spikes are higher in concentration and slightly more frequent than the downstream. This indicates that upstream activities will have an effect BOD mean concentrations and subsequent EQS compliance. BOD spikes have also been seen to reach very high concentrations of up to 4mg/l, which is far beyond both the Mean and 95%ile EQS limits. However, it should be noted that the monitoring point is just below Shannon Bridge, so turbulence may affect the BOD samples during heavy flows after periods of prolonged rainfall.

Downstream spikes in results are taken on the same day. It can be seen that on two occasions there were spikes in the d/s results only, which may be as a result of a failure in processes in the WwTP or a stormwater spill.

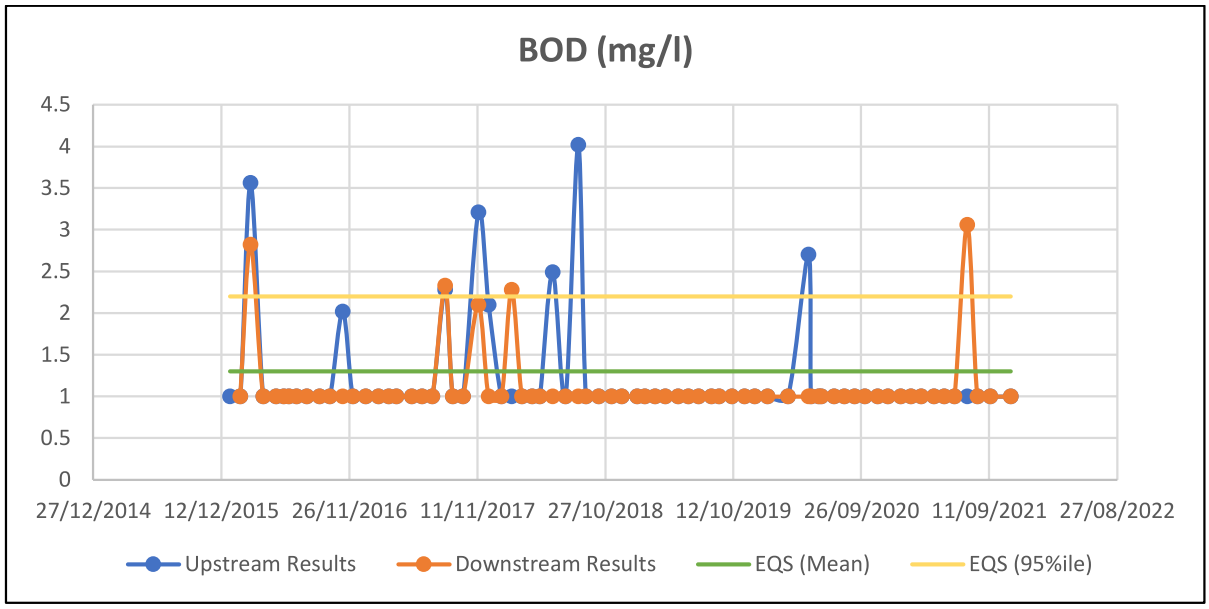

Figure 14-9: Upstream and downstream concentrations of BOD relative to EQS values

Ammonia u/s and d/s results are also generally consistent, at .02mg/l, with periodic spikes in readings. It can be seen in the diagram that u/s spikes mostly correspond with d/s on the given dates. It can also be seen that d/s concentrations are higher, unlike the consistent results where there is no change between u/s and d/s readings. This indicates that as well as upstream activities, there must also be a contribution from the WwTP during these periods, possibly the addition of stormwater to the d/s flow.

These results indicate that u/s activities effect d/s mean concentrations and subsequent EQS compliance. The spikes in concentrations typically exceed EQS mean value, but they remain below the 95%ile limit.

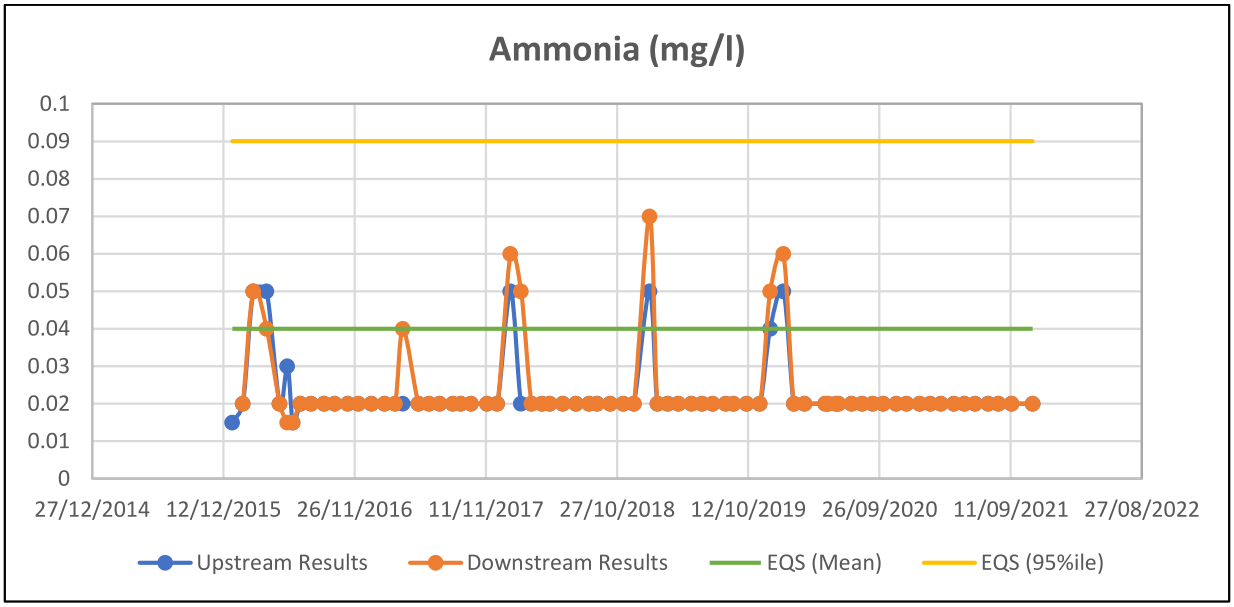

Figure 14-10: Upstream and downstream concentrations of Ammonia relative to EQS values

Ortho–Phosphate findings are erratic but there is some correlation between u/s and d/s patterns. Thus, indicating that u/s activities are having an influence on d/s monitoring results. In the preliminary analysis it can be seen that many of the data points remain below the mean EQS and the 95%ile results appear to be higher upstream.

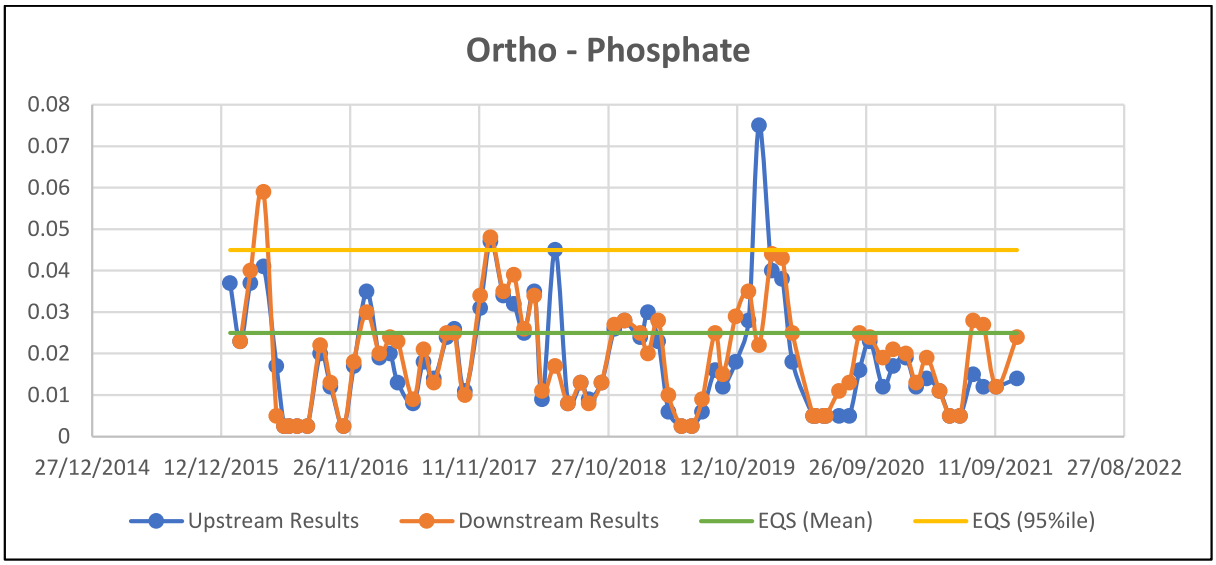

Figure 14-11: Upstream and downstream concentrations of ortho- Phosphate relative to EQS values

EQS Compliance

A preliminary assessment of sample results was carried out to establish the baseline water quality upstream (u/s), and downstream (d/s) of the WwTP. The assessment also considers the physiochemical status of the water with regard to corresponding EQS values. High status EQS values are listed for reference in 14.11.

Table 14.11: High Status EQS

Parameter	BOD (mg/l)	Ortho-P (mg/l)	Ammonia (mg/l)
EQS (High/Mean)	1.3	0.025	0.04
EQS (High/95%ile)	2.2	0.045	0.09

Both mean and 95%ile concentrations of BOD, ammonia and ortho-phosphate were calculated for a three-year period , January 2019 to November 2021. U/s and d/s results for both categories are listed in 14.12. It can be seen that changes are insignificant between u/s and d/s concentrations for all parameters. The 95%ile results for ammonia show the greatest change, at .01 mg/l or an increase of 18% in the d/s concentration, but it is still safely within the 95%ile EQS range. As expected, the 95%ile ortho-phosphate concentration is higher u/s.

Table 14.12: Baseline Water Quality Monitoring Results (2019-2022)

Baseline Upstream	BOD (mg/l)	Ortho-P (mg/l)	Ammonia (mg/l)
Mean Conc.	1.05	0.016	0.022
95%ile Conc.	1	0.039	0.043
Baseline Downstream			
Mean Conc.	1.06	0.018	0.023
95%ile Conc.	1	0.037	0.053

All sample results for measured concentrations are of WFD High Water Quality Status. Given this baseline condition, the remainder of the assessment has been based on High Status EQS parameters. It further indicates the existing WwTP is not having any significant long-term effect on the receiving water quality and confirms the WwTP is operating safely within the allowable ELVs.

Theoretical calculations of downstream concentrations were carried out as a comparative exercise to see how the WwTP (at current 39,000PE) would affect water quality if it was utilising the maximum allowable ELV on a continuous basis. Effluent concentrations were calculated with regard to ADF and median river flow, also for DWF and Q95 river flow. It can be seen from the results in Table 14.13 there would be a breach in ammonia in the ADF and median flow scenario. This indicates the current ammonia ELV is not stringent enough to maintain high water quality status if it was to be fully utilised.

Table 14.13 Theoretical Calculations of Downstream Concentrations

Calculated Downstream Concentrations @Max ELV	BOD	ortho-P	Ammonia
ADF & Median Flow	1.17	0.021	0.045
DWF & Q95 Flow	1.14	0.045	0.071

Baseline Waste Assimilative Capacity Assessment

The impact of the final effluent on the Lower River Shannon is dependent on its Waste Assimilative Capacity (WAC). WAC refers to the ability of the river to disperse wastes and pollution without exceeding EQS limits and/or causing harm to the aquatic environment. For the purpose of the baseline assessment, it has been calculated for both median and Q95 flow rates, with respective (high status) mean and 95%ile EQS limits. A full set of results is available in **Appendix 14A**.

U/s and d/s WAC figures have been calculated using measured monitoring data as listed in Table 14.4. The results are displayed as the percentage of total assimilative capacity remaining in the river after loads of the primary waste parameters (kg/day) have been deducted. U/s concentrations (converted to kg/day) reflect how much WAC is already taken up by background contributors to water pollution such as agriculture and urban run-off, and how much remains to accept WwTP effluent load. The rate of change in the d/s results indicates the impact on WAC from the WwTP.

Similar to the findings in measured concentrations, there are no significant differences between u/s and d/s values. The greatest deterioration in capacity appears in 95%ile ammonia results from 52 – 41%, but there is still sufficient remaining WAC d/s. Ortho-phosphate capacity improves downstream in the 95%ile results.

Table 14.14: Calculated WAC figures using Measured Concentrations

Baseline Upstream	BOD	ortho-P	Ammonia
Mean & Median Flow	19%	36%	45%
95%ile & Q95 Flow	55%	13%	52%
Baseline Downstream			
Mean & Median Flow	18%	28%	42%
95%ile & Q95 Flow	54%	17%	41%

Theoretical estimates were also used to assess d/s WAC. They indicate the impact the WwTP could have if it was operating at the max. ELV allowances. Effluent waste loads (kg/day) were calculated with regard to ADF and median river flow, also for DWF and Q95 river flow. It can be seen from the results in Table there would be a deficit in ammonia WAC of 13% in the ADF and median flow scenario.

Table 14.15: Calculated U/s and D/s WAC figures Using Max ELV Output

Calculated D/s WAC @ Max ELV	BOD	ortho-P	Ammonia
Mean EQS & Median Flow	10%	17%	-13%
95%ile EQS & Q95 Flow	48%	1%	21%

Summary of Baseline Water Quality Assessment

It can be seen from long term water quality monitoring results that baseline water quality is of good standard for all of parameters, with periodic spikes in concentrations at both u/s and d/s monitoring locations. This indicates that background activities such as agriculture and surface run off play a significant role in the receiving water quality.

Monitoring results from 2019-2021 indicate the WwTP is not currently having any significant impact on receiving water quality in terms of increases in d/s concentrations or deterioration in WAC in the river. However, it was observed that the WwTP is producing a final effluent with significantly lower emissions than the allowable ELVs. Further theoretical calculations indicate that if the WwTP was to utilise the ELV allowance, at the current PE, there would be a breach in the d/s ammonia mean EQS (high status) and a 13% deficit in WAC. Calculated ortho-phosphate 95%ile results are borderline with EQS compliance and WAC, however, ortho-Phosphate is generally measured using the mean (Surface Water Regs) concentration over a 12 month period due to annual variation in surface water conditions.

Given these baseline conditions, it is recommended that theoretical findings for mean concentrations and median river flows should be the focus of the assessment for all parameters going forward.

14.4.6 Stormwater Management

One of the main drivers of the project is the absence stormwater storage at Castletroy WwTP. All incoming flows from Mountshannon and Castleconnell Pumping Stations gravitate to Castletroy via the sewer network. Wastewater is received at the inlet works where it goes through preliminary treatment (screening and grit removal). A flow volume up to 3DWF can continue through the process stream as flow to full treatment (FFT). Excess flows, occurring during storm and heavy rainfall events, are diverted via a stormwater overflow channel (SW-4) and sent directly to the final effluent inspection chamber, bypassing the treatment process.

There are also 2 no. outlets upstream of the inlet pumping station that operate as emergency overflows (EOs). They activate when there is a failure of the DWF and/or Storm pumps and redirect all incoming flows directly to the final effluent inspection chamber without screening.

As discussed previously in **Section 14.3.3**, treated effluent and storm flows are combined in the final effluent chamber then discharged via gravity flow to the Lower River Shannon via 3no. outfall pipes.

It should be noted that the EPA Licence refers to a second SWO (SW-5). However, this was reclassified as an EO in the "Castletroy Agglomeration Stormwater Overflow Assessment" contained in Annual Environmental Report 2014.

Large spills and uncontrolled releases are recorded and reported in the Annual Environmental Reports (AERs) as environmental incidences. As outlined in **Section 14.4.1**, there has been a yearly average of 10 reportable environmental incidents at the WwTP between 2018.

Drainage Area Plan (DAP)

A drainage area plan (DAP) has been developed by RPS Group for the Castletroy agglomeration. A survey of the entire sewer drainage network was carried out, from which a hydraulic model was built that can assess the condition and performance of the sewers and SWOs in the catchment.

The model was used to quantify the annual frequency and volume of spills currently being discharged to the Lower River Shannon from SWO4. Flow to full treatment (FFT) for the current design capacity 45,000PE at 17,280m^3/day (or 200 l/s) was input to the model. Spill volumes equal-to or over 1m^3 in excess of FFT were recorded as spills.

Table 14.16 lists results in terms of average annual spills, average spills per bathing season and relative spill volumes from 2018 - 2028.

Table 14.16: Baseline Model Output (Spill≥1m3)

Year	Overflow ID	Avg. Annual Spills	Avg. Bathing Season Spills	Avg. Annual Spill Vol. (m^3)	Avg. Bathing Season Spill Vol. (m^3)
2028-2018	Castletroy WwTP Final Outfall	123	33	48,312	16,767

SWO WWDL Compliance

License conditions state that stormwater overflows (SWOs) are to be assessed at least every three years and reported as part of the AER. The assessment is based on SWO's compliance with DoEHLG 'Procedures and Criteria in Relation to Stormwater Overflows' and Uisce Éireann Technical Standard IW-TEC-800-03 for Stormwater Overflows. As outlined in **Section 14.3.4,** the discharge point is in close proximity to UL Boat Club and receiving water is used for recreational activities. Therefore, as set out in the standards, SWO4 should meet the following criteria;

"*Where a discharge impacts on contact/recreational waters, SWOs should be designed so that the maximum number of independent storm events discharged via the stormwater overflow must, on average, not exceed 7 per bathing season. The bathing season in Ireland runs from 1 June to 15 September.*"

Model results show that on average, there are currently 33 spills per bathing season , therefore, the assessment is not in compliance with recreational water standards which impacts conditions of the WWDL.

14.4.7 Flood Risk

A flood risk assessment (FRA) has been carried out in accordance with 'The Planning System and Flood Risk Management (FRM) Guidelines' published in November 2009 jointly by the then Department of the Environment, Heritage and Local Government, DEHLG, (now the Department of the Environment, Community and Local Government, DECLG) and the Office of Public Works (OPW). Flood risk assessment is available in **Appendix 14B**.

A desktop study of the national Catchment Flood Risk Assessment and Management (CFRAM) database indicates that site is in a high-risk category area, with portions of it lying within Flood Zones A and B. The map indicates that the 1% AEP fluvial flood level at the site is +6.37mOD and 0.1% AEP fluvial flood level is +6.93mOD.

The National Flood Hazard Mapping Website www.floodmaps.ie also shows record of historic floods occurring within the vicinity of the proposed development site and shows that the site has flooded in the past. The site was flooded severely in November 2009 due to the Lower River Shannon bursting its banks following unprecedented torrential rainfall. A report undertaken by Limerick County Council which investigates the causes and effects of this flood states *"The WwTP experienced flooding, which was very close to making the plant non-operational. A huge effort was undertaken in preventing the plant from flooding. High electricity cost for running of the pump was incurred as a result."*

From a site visit, it was noted that more recent flood events (2015) recorded levels up to the door entrance of the main control building and it was reported that flooding occurred through a channel/ditch which runs along the Western boundary of the site. Water ingress also occurred through the site entrance. Recent

flooding was not reported to have occurred in the green area which will be the primary proposed area for new infrastructure.

14.5 Characteristics of the Proposed Development

As outlined in Proposed Development **Section 4**, the upgrade works will support growth demands in the agglomeration by improving the treatment processes at Castletroy WwTP. The current planning application seeks permissions to develop the WwTP in line with requirements for 10-year growth projections of 77,500PE. There will also be provision made in the infrastructural developments, such as tank sizing and underground pipework, to allow for a future 25-year increase to 81,100PE. The future 25-year increase has been included in this assessment in terms of the potential effects on water quality with regard hydraulic loading and ELVs. However, it is noted that a planning review will be required before any further upgrade above 77,500PE can come into effect.

Improved Treatment Capacity

Treatment capacity and effluent standards will be improved with the installation of new plant processes and upgrades to existing infrastructure. Additional grit traps and new primary treatment filters will increase the removal of suspended solids and BOD. Installation of IFAS technology and additional air blowers in the existing aeration tanks will enhance secondary biological treatment, particularly with regard to ammonia removal. There will also be improvements to the chemical dosing system with the installation of a new chemical dosing tank for additional ortho-Phosphate treatment.

WWDA Licence Review

Wastewater Discharge Licence Condition 1.8 outlines the procedure for a licence review relating to infrastructural improvement works. Once the planning application for the proposed development has been submitted, Uisce Éireann proposes to submit a licence review application and supporting technical documentation. This will facilitate the mandatory consultation requirements between the planning authority and the EPA under the WWDA Regulations.

Given the scale of the development at Castletroy WwTP, is expected there will be an EPA licence requirement to reduce ELVs to account for the additional PE loading and maintain existing effluent quality. More stringent ELVs will be achievable following the proposed development due to the improved performance of the WwTP.

Stormwater Infrastructure

The Proposed Development will see the installation of new storm and flood management infrastructure that will enable the WwTP to cope with intense storm flows from the sewage network and also stay operational during flood conditions.

Stormwater Storage Tank

A new 4,500m^3 stormwater storage tank will be constructed on-site that will reduce storm spills to the Lower River Shannon. It has been designed to cater for 25-year growth projections, and in accordance with Uisce Éireann (formerly Irish Water) Document No. IW-TEC-700-99-02 “Inlet works & stormwater treatment (wastewater)” using the formula: *Required Volume = 2 hours retention at Formula A – FFT*

Allowances used for water consumption and infiltration per head per day are listed as follows:

- Water consumption (C): 175 l/head/day
- Infiltration (I): 50 l/head/day
- Population served (P): 39,492
- Trade effluent (E): 2,500 m3/day (peak is 135 m^3/hr)

Based on a 'Fully Combined System' (domestic, commercial, institutional, and industrial) FFT and Formula A and stormtank volume were calculated as below :

- DWF = (P x C) + I + E
- FFT = 3(P x C) + I + E
- Formula A = DWF + 1360P + 2E
- Stormtank Vol. = 2(Formula A – FFT)

The design Formula A flow rate and required volume for the stormwater storage tank can be seen in Table 14.17. Headroom for climate change also needed to be considered when sizing the stormtank which results in a final volume of 4,500m^3. When flows return to less than FFT, stormwater is returned to the inlet works up to a rate of 1xDWF whereby it goes through the full treatment process.

Table 14.17: Stormtank Design Calculations

DWF (m^3/hour)	Formula A (m^3/hour)	FFT (m^3/hour)	Stormwater storage tank Volume (m^3)	+20% Climate Change (m^3)
474	2,921	1,050	3,741	4,500

Flood Risk Measures

Flood Event Pumping Station

Uisce Éireann technical standard for Wastewater Gravity Sewers (IW-TEC-800-01) requires new and upgrade designs to prevent sewer flooding from an event with a 1 in 30-year return period. Results from the DAP study show the 30-year storm event flows can reach up to 1,200l/s which exceeds the 2-hour return storage capacity of the stormwater storage tank. Therefore, provisions were made in the design to account for the additional hydraulic loading during such events.

To overcome the hydraulic constraint during periods of high flood level, the new flood event pumping station will increase flow to the Final Effluent Inspection Chamber and allow gravity discharge to the outfall. The walls of the inspection chamber structure will be 8.2mOD which includes an allowance for free board to prevent overtopping during the 1% AEP event.

The pumping station will be bypassed during normal river conditions. During higher river levels, levels within the pumping station sump will trigger operation of the pumps. The pumps will lift the final effluent and excess stormwater to the inspection chamber. The mixed flows will then gravitate through the existing outfall which will prevent surcharging of the WwTP and sewer network.

Flood Risk Assessment (FRA)

CFRAM flood extent mapping was georeferenced into GIS software to assess the impact of the proposed structures on the flood area. The loss of flood plain was assessed by calculating the area occupied by proposed structures within Flood Zones A and B. A similar exercise was undertaken with regard to Flood Depth mapping, with the purpose of calculating the impact of the proposed structures on flood storage volumes. Figure 14.12 is an extract from CFRAMS flood depth mapping with proposed structures superimposed.

Figure 14-12: Flood Depth Map (1% AEP) with Proposed Infrastructure

Compensatory storage will be provided for the loss of floodplain incurred by the Proposed Development. There is no set guideline on the AEP to be used in the design of flood compensatory storage. However, Planning System and Flood Risk Management Guidelines recommend that flood protection should be designed for the 1% AEP (or 1 in 100) flood. Therefore, this approach has also been adopted in this assessment.

Given the 1% AEP flood extent and flood depths, a maximum of 28m^3 of storage volume will be removed from site due to the Proposed Development. As recommended in the FRM Guidelines, a volume of flood plain equal to that lost to the Proposed Development should be created. Compensatory storage is proposed to be provided in the north-west area of the site. Refer to EIAR **Volume 4, drawing no. 20701-JBB-00-XX-DR-Z-1207.**

Surface Water Run-off

The use of appropriate drainage measures will be incorporated to the design to reduce the impacts of any additional surface runoff from new infrastructure. Excess surface water runoff arising following the Proposed Development will be attenuated in an underground cell measuring 291m^2 and discharged at the greenfield discharge rate via a hydrocarbon interceptor. Refer to EIAR **Volume 4, drawing no. 20701-JBB-00-XX-DR-Z-1207.**

14.6 Likely Significant Effects

14.6.1 Do Nothing Scenario

The do-nothing scenario refers to what will happen if the Proposed Development is not implemented and the WwTP continues to operate at the current design PE.

The demands of population growth and industrial development will cause the WwTP to become overloaded, and it will not be able to provide appropriate wastewater treatment to the Castletroy agglomeration. Hence, the treatment process will become non- compliant with the EPA Wastewater discharge license and all relative legislation. Lack of appropriate treatment will also cause harm to the receiving waters in the Lower River Shannon, which is an area of environmental conservation under the Habitats Directive 92/43/EEC (Commission of the European Communities, 2007).

Without the provision of stormwater storage, the WwTP will remain in breach of Uisce Éireann standards and terms of the EPA WWDL, DoHELG and Uisce Éireann guidelines. Excess flows from storms and heavy rainfall will exceed 123 spills per annum as the headroom between incoming flow and the plant capacity reduces. Environmental incidents will also continue to be reported in the AERs, and there will be no potential for improvement in downstream water quality.

Notwithstanding the legislative requirements, the provision of stormwater storage and upgrade of the wastewater treatment facility in Castletroy is required to maintain water quality in the Lower River Shannon and to support development in East Limerick which is currently constrained by the WwTPs treatment capacity.

For those reasons, the 'do-nothing' scenario is not a viable option.

14.6.2 Construction Phase

The Proposed Development poses a potential negative impact on surface water quality in terms of run off associated with construction activities, particularly due to the close proximity of the works to the Lower River Shannon.

Possible impacts during the construction phase include the potential for leakage or spillage of construction related materials on the site. Runoff from the working areas during construction may contain increased sediment loads, suspended solids and contaminants typical to construction sites and working areas. Potential impacts from the Proposed Development on water quality in the construction phase may include:

- Sources of pollution from runoff and erosion during site preparation, which includes the `construction of the construction compound, temporary fencing and hoarding, and the erection of signage;
- Sources of pollution from site drainage including runoff and erosion from site excavation and associated sheet piles;
- The release of bentonite slurries, concrete washings and other grouting materials via the discharge of construction runoff and stormwater in working areas;
- Other major pollutants present include fuels, lubricants, cement, mortar, silt and soils required for plant and equipment on site;
- The washing of construction vehicles and equipment also pose a pollution risk to watercourses in the area if undertaken in inappropriate locations and in the absence of effective management and mitigation.
- Any accidental spillages of fuel and/or discharge of oil from leaks in vehicles or fuel tanks; and
- The presence of the invasive species has the potential to release legumes into the surface water or onto human clothing, thus potentially spreading this material downstream.

During construction, pollution from mobilised suspended solids would generally be the primary concern, but spillage of fuels, lubricants, hydraulic fluids and cement from construction plant may lead to incidents, especially where there are inadequate pollution mitigation measures.

Suspended Solids (SS)

Pollution of surface waters by mobilised suspended solids (SS) can have significant adverse impacts on receiving waters. Various construction activities have the potential to release sediment and increase SS levels in the Lower River Shannon. Site stripping and excavation works during construction would leave the ground exposed to erosion by wind or rain and this could potentially lead to increases in sediment loading of the combined sewer network or Lower River Shannon.

Runoff containing high concentrations of suspended solids could potentially adversely impact on surface water. This would be considered a significant short term negative effect, given it only poses a risk during the construction stage.

Accidental Spillage and Leaks

Any construction activities carried out close to surface waters involve a risk of pollution due to accidental spillage and leaks. While liquids such as oils, lubricants, paints, bituminous coatings, preservatives and weed killers present the greatest risk, fuel spillages from machinery operating close to watercourses also present a risk. The refuelling of general construction plant also poses a significant risk of pollution, depending on how and where this activity is carried out. Pollution as a result of accidental spillage could potentially affect fish, aquatic flora and invertebrate communities, therefore, stringent mitigation measures will be in place on-site. Discussed further in **Section 10, Biodiversity**.

Accidental spillage may potentially result in the indirect impact should contaminants migrate thorough the subsoils and underlying groundwater to surface waters. The impact is considered a temporary indirect negative effect as it is only associated with the construction stage. Groundwater contamination is discussed in more detail in **Section 13, Land and Soils**. Accidental spillages and leaks are considered unlikely to occur and are should they occur are likely to be rare. Any accidental spillage would have a negative short-medium term impact on water quality in the Lower River Shannon.

Flood Risk

There are no activities during the construction phase that will affect the risk of flooding. In the event of a flood occurring the CEMP and site management procedures will be in place. Construction flood mitigation measures are discussed further in **Section 14.7.1.**

Summary of Construction Impacts

With adequate mitigation measures as, described further in **Section 14.7.1**, the rating significance of the impacts during construction are of negative quality, significant but unlikely, reversible and of temporary duration (EPA, 2022).

14.6.3 Operational Phase

The main characteristics of the Proposed Development are as follows:

- The volume of treated discharge will increase;
- Quality of the final treated effluent will remain compliant with environmental standards;
- The new storm event pump station will regulate flow rates during heavy rainfall events and greatly reduce the likelihood of surcharging in the network;
- There will be less untreated stormwater pumped into the river as the stormwater storage tank will retain stormwater until such a time it can be returned to full treatment; and
- There will be less than 7 spills per bathing season which meets recreational water regulations.

Water Quality Impact Assessment

The water quality assessment considers the future discharge from the WwTP and the changes arising from the increase in the final effluent flow, together with changes in the quality of the final effluent.

As development intensifies within the catchment area, there will be an increase in wastewater volumes received at the Castletroy WwTP and the loading rate of wastewater quality parameters will intensify. This assessment measures the potential effects of future effluent flows on water quality in the Lower River Shannon, with a focus on the wastewater parameters that hold EQS values i.e., BOD, ortho-Phosphate and Ammonia.

In the impact assessment, calculations were carried out to predict effluent concentration levels should the WwTP operate continuously at the existing allowable ELVs, and also, using the scenario of proposed ELVs subject to WWDL review. This section assesses the effect the discharges will have on d/s EQS compliance and also the impacts on d/s WAC in the Lower River Shannon. Impacts were considered for the following

loading scenarios; at full design capacity 45,000PE, the 10-year design capacity 77,500PE and the long term 25-year outlook 81,100PE.

It should be noted, calculations for the long-term 25-year outlook were included in this assessment for comparative purposes only. This application is for the 75,000PE design and a planning review will be required for any further uplift in PE at the WwTP.

Impacts have been assessed in this report according to mean concentrations and median river flow. In the baseline water quality assessment, calculated d/s ammonia concentrations and WAC were more critical than the 95%ile results. It has also been noted that water quality standards for ortho-phosphate are typically reported with regard to mean concentrations. Therefore, future impacts have been assessed accordingly.

Future WwTP Hydraulic Loading Rates

The ADF flows listed in Table 14.18 were used for the purpose of future calculations. Domestic, commercial, and institutional flows have been calculated according to the Uisce Éireann Document No. IW-TEC-700-99-02 "Inlet works & stormwater treatment (wastewater)", using the formula; PE *(.175 m^3/head/day + .05m^3 infiltration/day).

Laboratory testing provided information on the industrial contribution to WwTP hydraulic loading. Industrial flows are lower but have higher concentrations of wastewater parameters. The average daily industrial flow to Castletroy WwTP is calculated using the formula DWF (industrial)*1.33, which approximates as 2460m^3/day at current design capacity and 3352 m^3/day for both the 10- and 25-year WwTP loading scenarios.

Table 14.18: Future Average Daily Flow (ADF) Calculations

Loading Scenario	WwTP ADF (m^3/day)
45,000PE, Design PE	9,942
77500 PE, +10 year	14,081
81,100PE, +25 year	15,143

EQS Compliance

The assessment of the changes in the final effluent discharge focuses on the environmental impact of the discharge on the local receiving waters with reference to the relevant European and Irish legislation. Calculated predictions were carried out to assess (worst case) future impacts of the final effluent on water quality in the Lower River Shannon according to high status mean EQS concentration limits.

Table 14.19: High Status EQS Concentration Limits

Parameter	BOD (mg/l)	Ortho-P (mg/l)	Ammonia (mg/l)
EQS (High/Mean)	1.3	0.025	0.04

Table 14.20 displays projected downstream concentrations calculated for each loading scenario, and on the basis of median river flow, future hydraulic loading rates (ADF) at the WwTP and relative effluent concentrations when max. ELVs are utilised. It can be seen that d/s ammonia will exceed the EQS under all cases and ortho-phosphorus is on the borderline for both the 10- and 25-year scenarios. BOD comes close to the limit in long range 25-year scenario, but still remains within the allowable EQS.

Table 14.20: Predicted D/s Concentrations using Existing ELVs

Parameter	BOD (25mg/l)	Orth-P (1mg/l)	Ammonia (5mg/l)
EQS (High/Mean)	**1.3**	**0.025**	**0.04**
45,000PE (Design PE)	1.19	0.022	0.051
77,500PE (+10 year)	1.25	0.024	0.062
81,100PE (+25 year)	1.27	0.025	0.065

Following the initial assessment, calculations for the future scenario were altered to consider the d/s effects if the ELVs were reduced, subject to a WWDL review. It has been considered that demands on the WwTP will increase, but improvements in treatment capacity have been designed to meet future requirements. There should be no reduction in WwTP performance compared to the current situation with regard to quality of the final effluent. And therefore, meeting more stringent ELVs will be achievable. Again, future ELVs will be subject to licence review, but for the purposed of this assessment the following limits have been applied; BOD 20mg/l, Orth-P .75mg/l and Ammonia 2mg/l. Results in Table 14.21 indicate that by reducing the ELVs d/s water quality will remain within high status mean EQS values.

Table 14.21: Predicted D/s Concentrations using Proposed ELVs

Parameter	BOD (20 mg/l)	Orth-P (.75mg/l)	Ammonia (2mg/l)
EQS (High/Mean)	**1.3**	**0.025**	**0.04**
45,000PE (Design PE)	1.16	0.020	0.033
77,500PE (+10 year)	1.21	0.022	0.038
81,100PE (+25 year)	1.22	0.023	0.039

WAC Assessment

A similar assessment was carried out for future effects on d/s WAC in the Lower River Shannon. Projections listed in Table 14.22 were calculated using high quality EQS standards, maximum emissions from the WwTP at ADF and median river flow in the river. In line with the concentration results in the previous section, ammonia WAC is exceeded in at current full design capacity becomes increasingly deficient in the future loading scenarios.

Table 14.22: Predicted WAC using Existing ELVs

Loading Scenario	BOD	Ortho-P	Ammonia
45,000PE (Design PE)	8%	13%	-27%
77,500PE (+10 year)	4%	3%	-57%
81,100PE (+25 year)	2%	1%	-65%

Again, calculations for the future scenario were altered to consider the d/s effects if the ELVs were reduced, subject to a WWDL review. Using the same method of calculation as above with the reduced emission limits, it can be seen that there will be sufficient WAC in the Lower River Shannon for all parameters and future loading scenarios, Table 14.23.

Table 14.23: Predicted WAC using Revised ELVs

Loading Scenario	BOD	Ortho-P	Ammonia
45,000PE (Design PE)	10%	19%	16%
77,500PE (+10 year)	7%	20%	14%
81,100PE (+25 year)	6%	18%	12%

Stormwater Management

Following the Proposed Development, flows in excess of 3DWF and emergency overflows will be redirected to the new stormwater storage tank. The wastewater will be screened and held until such a time that incoming flows to the WwTP subside, then it will be returned to the main process stream for full treatment.

In the event that the storm intensity causes the tank to reach capacity, the (screened) spills will be directed to the final effluent chamber, as per the current situation.

The DAP model was ran using the same flow survey data, but with stormwater storage introduced. Model outputs for the current baseline versus future spill frequency, following the Proposed Development works, can be seen in Table 14.24. It is predicted that there will be an average less than 7 spills per bathing season, which ensures recreational water quality standards will be met. Therefore, the installation of the stormwater storage tank will result in a long term, significant, positive impact on receiving water quality.

Table 14.24: Model Outputs - Current V's Future Scenario (Spill≥1m^3)

Year	Model Output	Avg. Annual Spills	Avg. Bathing Season Spills	Avg. Annual Spill Vol. (total m^3)	Avg. Bathing Season Spill Vol. (total m^3)
2018 - 2028	Current Baseline	123	33	48,312	16,767
	Future Scenario	7	3	4,839	290

Surface Water Run-off

Increased hardstanding areas and infrastructure will increase surface water run-off from the site during operation. Excess surface water runoff arising from the Proposed Development will be minimal when compared to the existing situation. Furthermore, it will be attenuated using appropriate drainage measures and discharged at the greenfield discharge rate. Therefore, there will be no effect on flooding or receiving water quality due to surface water run-off during the operational phase.

Flood Risk

There are no other activities during the operational phase that will affect the risk of flooding. In the event of a flood occurring mitigation will be in place. Operational flood mitigation measures are discussed further in **Section 14.7.2**

Summary of Operational Impacts

Based on the water quality operational impacts assessment, there will be a slight reduction in WAC as the WwTP discharge rate increases, but it is not expected to breach high status environmental constraints if more stringent ELVs are put in place (subject to an WWDL review) i.e., creating a long term, slight negative impact on receiving water in the Lower River Shannon.

Conversely, there will be significant improvements in the rate of stormwater overflows due to the addition of stormwater storage, which will have a long term, significant positive impact on receiving water quality.

Therefore, a conservative conclusion has been reached as follows; (as per EPA Guidelines, 2002) the proposed development is considered to have a long term, imperceptible/neutral impact on water quality, i.e. an effect which alters the character of the environment without affecting its sensitivities.

14.7 Mitigation Measures and Monitoring

14.7.1 Construction Phase

The standard best practice measures in the outline Construction and Environmental Management Plan CEMP (Refer to **Appendix 4A**) for the proposed development will mitigate significant negative effects on surface water quality and hydrology during construction.

The Project Manager will take full ownership of the CEMP and will be responsible for storing all site records, including but not limited to, training records, incidents and emergencies, environmental quality monitoring records and updates to Method Statements. Subcontractors will be made aware of the site-specific Construction and Environmental Management Plan for the work.

Surface Water Run-Off

Temporary works will be designed to minimise effects on water quality and hydrology in the study area during construction. The Outline CEMP includes a range of site-specific measures with regards to surface water run-off during construction activities including:

- Prior to the outset of works, a double silt fence will be erected along the drains present to the west and north of the WwTP boundary. This will comprise wooden posts and geotextile membrane buried in an 'L' shape to a minimum depth of 250mm. The silt fence will filter any potential surface water run-off from the site generated during the proposed works. All surface water will thus be intercepted in this way before potentially entering any of the perimeter drainage ditches. Indicative water pollution mitigation measures are detailed further in **Section 11.5.4**.
- During construction, surface water runoff will be collected by the temporary drainage system installed by the contractor and then treated or desilted on-site before discharge into the Lower River Shannon;
- Best practice measures will be implemented during excavation works to avoid the release of bentonite and prevent sediment running into the drainage network and/or to surface waters during construction;
- Earthworks operations shall be carried out such that the surfaces are designed with adequate slope to promote safe runoff.
- Any excavated vegetation, soil and subsoil will be temporarily stockpiled away at least 20 m from surface water or drainage features;
- Earthworks will aim to be carried out in periods of dry weather (from April to September inclusive) to avoid potential for suspended sediment runoff;
- All concrete works will be carried out in dry conditions;
- Good housekeeping such as site clean ups, use of disposal bins, etc will be adopted in construction areas;
- Working areas will be dewatered at the end of each working day and vehicle washdown will be carried out in an appropriate area where wash water can be captured and treated accordingly.

Accidental Spills and Leaks

With regards to accidental spills and leaks, the Main Contractor and sub-contractors shall be responsible for ensuring the following measures are implemented:

- An Emergency Plan for accidental spills will be established by the Main Contractor prior to work commencing at the site. As a minimum the Emergency Plan should contain contact details for statutory bodies such as the NPWS and IFI. All site workers should be made aware of the plan and its location in the site offices;
- There will be no refuelling of machinery within or near the river channel. Refuelling will take place at designated locations at distances of greater than 30 metres from any surface water or drainage features;
- No vehicles will be left unattended when refuelling and a spill kit including an oil containment boom and absorbent pads will be on site at all times;
- Any fuel that is stored on the site will stored appropriately and at a location that is set back from the river. All other construction materials will be stored in this compound. The compound will

also house the site offices and portable toilets. This compound will either be located on ground that is not prone to flooding or will be surrounded by a protective earth bund to prevent inundation;
- All vehicles will be regularly maintained and checked for fuel and oil leaks;
- If a spillage does occur, it will be contained with adsorbent pig bags. These will be placed in a hazardous waste bin for ultimate disposal;
- All oils and fuels will be stored in bunded tanks with the provision of a storage/retention capacity of 110% of tank storage. Care and attention will be taken during refuelling and maintenance operations. Particular attention shall be paid to gradient and ground conditions which could increase the risk of discharge to waters; and
- No fuel storage will be allowed in areas prone to temporary flooding.

Flood Risk

- Long-range and short-range weather forecasting will be used for works which carry a pollution risk such as excavations;
- Works will be postponed if heavy rain is forecast;
- The contractor will devise an appropriate construction-phase flood defence around works areas, such as a defined area bunded with sandbags. Indicative water pollution mitigation measures are detailed further in **Section 11.5.4**.
- If a flood is forecast, potentially pollutant materials will be removed from the site and will not be stored within the floodable areas around the peripheries of the site.
- A raised (above flood levels) and bunded site compound is recommended for use during construction.

14.7.2 Operational Phase

Water Quality

Given the scale of the development at Castletroy WwTP, is expected there will be an EPA licence requirement to reduce ELVs to account for the additional PE loading and maintain existing effluent quality. More stringent ELVs will be achievable following the proposed development due to the improved performance of the WwTP, therefore, quality of receiving water will also be maintained.

Stormwater Management

The proposed development will improve water quality in the Lower River Shannon by eliminating, in as far as reasonably possible, the discharge of untreated stormwater into the river channel. Excess storm flows will continue to be discharged as emergency overflows in the event of WwTP pumping station failure, however this is likely to occur significantly less than the permitted 7 spills per bathing season. Following the upgrade works, all stormwater overflows to the Lower River Shannon will be screened via mechanical screens in the stormwater storage tank to ensure the maximum particle size in the water column does not exceed 6mm in diameter to ensure compliance with Uisce Éireann standards.

Flood Risk

Where feasible, new development will be constructed within Flood Zone C of the current site, and all highly essential infrastructure be constructed at an elevation higher than the 1% AEP flood level with a suitable freeboard and an allowance for the effects of climate change. This will protect the proposed development against flooding and to preserve the existing flood plain as to avoid flooding elsewhere.

Where it is not possible to locate new infrastructure in Flood Zone C due to physical or hydraulic constraints, compensatory storage will be provided so as not to increase flood risk elsewhere. As per the FRM Guidelines, the volume of compensatory storage will equal the volume of flood plain lost to the proposed development, 28m^3. It will also be situated in an area where flood flow routes are protected.

14.8 Monitoring

14.8.1 Monitoring During Construction

The site-specific CEMP will set out the monitoring requirements for the scheme during the construction stages. Visual inspections will be undertaken as part of the regular site audits during construction to ensure surface water drainage discharge is not impacting the Lower River Shannon. The contractor will also be required to monitor weather conditions and have formal flood warning and evacuation procedures in place.

14.8.2 Monitoring During Operation

The final effluent will continue to be monitored in accordance with the terms of the Wastewater Discharge Authorisation Licence. No additional monitoring in terms of water quality and hydrology is proposed at this time.

14.9 Residual Impacts

14.9.1 Construction Phase

Residual impacts will be non-significant following implementation of mitigation measures.

14.9.2 Operational Phase

The residual impact of the Proposed Development is the maintenance of, and potential to improve, water quality in the Lower River Shannon, whilst supporting domestic and industrial growth of the agglomeration.

14.10 Cumulative Impacts

The following projects were considered with regard to the potential effects on receiving water in cumulation with the proposed development:

Construction of a water retention pond at Johnson & Johnson Vision Care, National Technology Park;

- Kings Flood Relief Scheme;
- Castleconnell Flood Relief Scheme;
- Corbally Baths Project; and
- Limerick (Bunlicky) WwTP upgrade.

14.10.1 Construction impacts

At present, there are no plans for other projects to coincide with the construction phase of the Proposed Development. Nor will the Proposed Development interact any of the projects listed above. Therefore, the possibility of cumulative impacts occurring during the construction phase of the Proposed Development is considered to be imperceptible.

14.10.2 Operational Impacts

The proposed water retention pond at Johnson & Johnson Vision Care will have no long-term cumulative impacts with the Proposed Development due to its distance from the site.

The proposed attenuation system will capture any additional surface runoff from the Proposed Development and flood compensatory storage will be provided on site, therefore there will be no cumulative impacts with Kings Island or Castleconnell Flood Relief Schemes.

Corbally Baths is a historic swimming area approximately 8km downstream from Castletroy WwTP. A project to reinstate the baths has been ongoing in recent years. The Baths draw water directly from the Lower River

Shannon, and therefore depend on its water quality which at present is not of appropriate standard. WQ monitoring in the area, carried out by a local interest group, showed a significant deterioration after the first flush of rainfall events, indicating that storm water overflows in the area are having an effect. The proposed development will see the installation of stormwater storage that will greatly reduce, and almost eliminate spills during the bathing season which will have a positive effect on cumulative downstream water quality.

Limerick (Bunlicky) WwTP is located to the west of Limerick City, approximately 13km downstream from Castletroy WwTP. It currently serves a population equivalent of 186,233PE (2020 AER) and is due to undergo a similar development project which will upgrade the treatment capacity of wastewater and sludge processes on the site. Due to the distance downstream and mixing of flow with other tributaries, there will be no cumulative effects from the combination of Castletroy effluent with current or future discharges from the Bunlicky WwTP.

14.11 References

EU Water Framework Directive (WFD) (2000/60/EC)

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

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

European Communities (Natural Habitats) Regulations, 1997 (S.I. No. 94 of 1997) and European Communities (Birds and Natural Habitats) Regulations, 2011 (S.I. No. 477 of 2011) (as amended)

Urban Wastewater Treatment Directive (UWWTD), 'Procedures and Criteria in relation to Stormwater Overflows '(91/270/EEC) also referred to as DoEHLG 'Procedures and Criteria in Relation to Stormwater Overflows', 1995

River Basin Management Plan for the Shannon River Basin 2018-2021

European Communities (Water Policy) Regulations (S.I. No. 722 of 2003)

EU Floods Directive 2007/60 EC

European Communities (Assessment and Management of Flood Risks) Regulations, 2010 (S.I. No. 122 of 2010) (as amended)

The Planning System and Flood Risk Management Guidelines for Planning Authorities, OPW 2009

Limerick Development Plan 2022-2028

Strategic Environmental Impact Assessment for the Limerick Regeneration Framework Implementation Plan prepared by HRA Planning and Limerick City & County Council, October 2013

Uisce Éireann Technical Standard, Stormwater Overflows, IW-TEC-800-03

Uisce Éireann Technical Standard, Inlet works & stormwater treatment (wastewater), IW-TEC-700-99-02

Directive 2014/52/EU of The European Parliament and of the Council amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment

CIRIA (2011). Environmental good practice on site: Construction Industry Research Industry and Information Association publication C692 (3rd edition- an update of C650 (2005). (I. Audus, P. Charles and S. Evans), 2011

Control of Water Pollution from Construction Sites - Guide to Good Practice (C532) (CIRIA, 2001).