



# Boherbue WasteWater Treatment Plant

## Waste Assimilative Capacity Report

11215-GAL-BE-XX-RP-X-003



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## **1 INTRODUCTION**

Boherbue wastewater treatment plant (WwTP) is located in County Cork and discharges into the River Brogeen, a tributary of the River Allow. The original plant was designed to treat a PE of 800. Irish Water propose to upgrade the existing WwTP at Boherbue for a design PE of 1,350 with primary discharge flow of 345m<sup>3</sup>/day.

The proposed upgrade consists of new inlet works, storm tanks, conventional activated sludge plant, clarifiers, tertiary treatment, new treated effluent pipeline to existing outfall, sludge handling including sludge drying reed beds and ancillary works including fencing, roadways and drainage.

The plant upgrade is designed to meet both the discharge quality standards set out in Urban Waste Water Treatment Regulations (UWWTR), and to a standard which will allow the Brogeen River to meet 'High' ecological status requirement associated with a Freshwater Pearl Mussel designation in this river basin catchment (Munster Blackwater).

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## **2 WWDL**

### **2.1 Wastewater Discharge Licence:**

It is noted that the Environmental Protection Agency (EPA) issued a Wastewater Discharge Authorisation (WWDA) for Boherbue WwTP in 2013 (Reg No. D0437-01). The licence was based on a daily discharge from the primary discharge point to the River Brogeen of 360m<sup>3</sup>/day for a population equivalent (PE) of 800.

As a result of the upgrade, Boherbue WwTP will exceed the 1,000PE threshold, an application for a Review of an existing licence is required. This report forms part of that application.

### **2.2 Urban Wastewater Treatment Directive:**

The upgraded plant will be designed to meet the discharge quality set out in Urban Wastewater Treatment as implemented into Irish law by the Urban Wastewater Treatment Regulations, 2001 (S.I. No. 254/2001) and subsequent amendments.

The population equivalent of the Boherbue agglomeration is below the 2,000 PE threshold. For agglomerations under this threshold, 'appropriate treatment' is required. The term appropriate treatment is defined in the Regulations in terms of the level of treatment necessary to protect water quality.

### **2.3 Water Framework Directive:**

The Water Framework Directive (WFD) has been transposed into Irish Law. In broad terms, the WFD aims to protect or enhance all waters and to achieve 'Good' status for all waters. The maximum allowable concentrations, known as EQSs (Environmental Quality Standards) are defined in the European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 (SI No.77 of 2019), known as the Surface Water Regulations.

The purpose of carrying out Emission Limit Value (ELV) calculations is to determine the effluent discharge conditions required for the receiving watercourse to meet the required EQS status as per guidelines specified by the Water Framework Directive (WFD). In this instance, it is necessary to achieve 'High' status due to the Freshwater Pearl Mussel designation associated with the River Brogeen.

The plant upgrade is designed to meet both the discharge quality standards set out in Urban Waste Water Treatment Regulations (UWWTR), and to a standard which will allow the Brogeen River to meet 'High' ecological status requirement associated with a Freshwater Pearl Mussel designation in this river basin catchment (Munster Blackwater).

## **3 WAC**

### **3.1 Waste Assimilative Capacity (WAC):**

The purpose of this assessment is to determine Emission Limit Values (ELVs) for the proposed plant that will allow the receiving watercourse to meet 'High' status. This summary includes details of the Mass Balance

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calculation procedure undertaken to determine the ELVs for discharge from the proposed plant upgrade at Boherbue.

### 3.2 Mass Balance Calculation

In order to determine the required discharge quality, the Waste Assimilative Capacity (WAC) of the receiving watercourse must be calculated. The Waste Assimilative Capacity of a watercourse is a function of its flow (dry weather flow, 95-percentile flow or median flow) and the background physicochemical quality of the watercourse. It examines the ability of a water body to absorb additional pollutants without impacting on the overall quality of the water body.

The Waste Assimilative Capacity (WAC) is calculated from the mass balance between the receiving watercourse upstream of the discharge point, the effluent from the wastewater treatment plant and the receiving watercourse downstream of the discharge point.

The purpose of the mass balance calculations is to show the impact of the discharge with respect to water quality standards. In this instance, the mass balance calculations are based on the 95%ile flow in the receiving water, notional clean river background concentrations, the effluent discharge rate proposed with the upgraded WwTP and the maximum concentration of the respective parameter in the treated effluent from the proposed upgraded WwTP.

The Blackwater River (Cork/Waterford) catchment is designated a freshwater pearl mussel water catchment, which requires 'High' ecological status. However, as 'High' status is not currently being achieved upstream of the Boherbue WwTP discharge, a 'High' status cannot be achieved downstream of the discharge point. This suggests there is insufficient capacity to accept additional ammonia and Orthophosphate from the treated effluent discharge and meet the ecological status requirements.

In this scenario, where background river concentrations exceed requirements, and in line with IW WWDA ELV Assessment Technical Guidance Note, mass balance calculations for assimilative capacity were carried out using the 'Notional Clean River Approach' for a hypothetical clean stretch of river. The notional clean background concentrations are 0.26 mg/l BOD, 0.005 mg/l Orthophosphate (as P) and 0.008 mg/l Ammonia (as N).

Therefore

$$Q_E C_E + Q_R C_R = Q_T C_T$$

Where:

QE = characteristic flow of wastewater treatment plant m<sup>3</sup>/day

CE = allowable concentration of parameter in effluent from wastewater treatment plant mg/L

QR = relevant flow of receiving watercourse upstream of discharge m<sup>3</sup>/day

CR = concentration of parameter in watercourse upstream of discharge mg/L

QT = combined flow of receiving watercourse upstream of discharge and effluent from wastewater treatment plant m<sup>3</sup>/day.

CT = concentration of parameter in watercourse downstream of discharge mg/L. See below for a discussion of the limits set on the downstream concentration of each parameter.

QE, QR, CR are known. QT is the sum of QE and QR. The units here are m<sup>3</sup>/day and mg/L.

Waste Assimilative Capacity (WAC) calculations have been carried out for the proposed upgraded WwTP. Upstream water quality data from EPA ambient monitoring results, along with data for the river flows, were used in the calculations.

### 3.3 Ambient Monitoring:

There is a monitoring station approximately 1.3km upstream of Boherbue WwTP known as Br Islandav RS 18B060100. There is a second monitoring station approximately 2.2km downstream of the plant at Brogeen Br RS 18B060200. The data collected from the monitoring stations is presented in the Annual Environmental Reports (AER) which are available on the EPA website and are submitted by Irish Water each year.

In this assessment, the mean of the data for BOD, Orthophosphate and Ammonia as reference parameters, collected between years 2018 to 2020 and reflected in the respective AERs was used. This ambient data is also referred to as the background concentration in the river or C<sub>back</sub>. These values were used in the Mass Balance calculations.

Parameter	BOD (mg/L)	Ortho-P (mg/L)	Ammonia (mg/L)
Mean	1.92	0.036	0.045

Table 3.3 Summary of ambient monitoring results for River Brogeen

The ambient monitoring results indicate that the receiving water is not achieving 'High' status as specified in European Communities Environmental Objectives (Surface Water) Regulations 2009, (as amended). In this instance, the 'Notional Clean River' approach was used as part of the WAC assessment.

### 3.4 Stream Flow:

The Irish Water ELV Assessment Technical Guidance indicates that assimilative capacity is calculated on the basis of the 95-percentile (95%ile) flow rate of the watercourse, that being the flow rate which is exceeded for 95% of the time.

The EPA's hydrotool estimated the Q<sub>95</sub> flow at 0.028m<sup>3</sup>/s, approximately 1.4km downstream of the discharge point, which is the value used in the Mass Balance calculations for this project. In addition, Glan Agua Ltd, appointed as ECI Contractor by Irish Water, conducted site-specific flow gauging of the River Brogeen, upstream and downstream of the existing Boherbue WwTP. A temporary hydrometric station was installed and water level data was collected between the 29th of July 2021 and the 1st of November 2021.

The flow rate to be used in calculating loadings discharged to the watercourse is the average daily flow to the wastewater treatment plant during a period without rain, known as dry weather flow (DWF). The DWF used for the proposed upgrade at Boherbue WWTP is 345m<sup>3</sup>/day.

### 3.5 Notional Clean Flow:

This method has been applied to situations where the upstream background concentrations of pollutants exceed, or are very close to, ecological quality standards.

The approach assumes a theoretically clean river upstream of the discharge point. Values are adopted for key parameters of BOD, Orthophosphate and Ammonia, which are equivalent to one fifth of the mean values for 'High' status rivers in the Surface Waters Regulations for upstream concentrations. In summary the upstream conditions for a 'Notionally Clean' river are set out below:

Parameter	BOD (mg/L)	Ammonia (mg/L)	Ortho-P (mg/L)
Mean	0.26	0.008	0.005

Table 3.5.1 Summary of parameters for Notional Clean River assessment

Mass Balance using Notional Clean River parameters				
	BOD	Ortho	Ammonia	
C <sub>max</sub> (mg/l)	2.2	0.045	0.09	
C <sub>clean</sub> (mg/l)	0.26	0.005	0.008	Notional Clean River parameters
ELV	15	0.3	0.5	
Predicted River Concentration (mg/l)	1.89	0.038	0.062	
Less than C <sub>max</sub> - High Status	Yes	Yes	Yes	

Table 3.5.2 Summary of WAC outputs using Notional Clean River parameters

### 3.6 Sensitivity Analysis:

In addition to the Mass Balance calculations, a basic sensitivity analysis was carried out to determine ELVs where the relevant downstream allowable concentrations of the river were lowered further to consider future potential loadings from other sources. In this instance, the sensitivity analysis compared the ELVs calculated to maintain concentrations below 75% of the EQS, to ELVs for 80%, 90% and 100% of the EQS. The sensitivity analysis was carried out for parameters BOD, Orthophosphate and Ammonia.



<b>Mass Balance using Notional Clean River parameters and Sensitivity Analysis at 75%</b>				
	BOD	Ortho	Ammonia	
Cmax (mg/l) using 75% of Cmax-Cclean	1.72	0.035	0.070	
Cclean (mg/l)	0.26	0.005	0.008	Notional Clean River parameters
ELV	12.5	0.25	0.5	Proposed adjustment to ELVs to meet Cmax 75%
Predicted River Concentration (mg/l)	1.61	0.032	0.062	
Less than Cmax - High Status	Yes	Yes	Yes	

Table 3.6 Summary of WAC outputs Sensitivity Analysis at 75% and proposed adjustments to ELVs

### 3.7 Proposed ELVs:

In this instance, the analysis found that the ELV for BOD needed to be adjusted lower (from 15mg/L to 12.5mg/L) in order for the predicted river concentrations to be within the maximum concentrations for that parameter as set out in the Surface Water Regulations. Similarly, the ELV for Orthophosphate was reduced (from 0.3mg/L to 0.25mg/L) while the ELV for Ammonia was maintained at 0.5mg/L using the Sensitivity Analysis method.

## 4 CONCLUSION

The purpose of carrying out the WAC analysis and ELV calculations is to determine the effluent discharge conditions required for the receiving watercourse to meet 'High' status as per guidelines specified by the Water Framework Directive (WFD). By adhering to the ELVs calculated, it can be ensured that the quality of the receiving river water body downstream of the discharge point will meet the necessary standard for the Brogeen River.

The Boherbue WwTP upgrade will produce a discharge standard complying with 12.5mg/L BOD, 0.25mg/L Orthophosphate and 0.5mg/L Ammonia. This will ensure that the water quality of the river continues to comply with maximum allowable concentrations as defined in the European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 (SI No.77 of 2019).

An assessment of the potential for impacts on receiving waters from priority substances in the primary discharge has been carried out. Based on the estimated data, no parameters were identified as potentially being higher than the required EQS. Based on the assessment carried out it is not considered that any further sampling or analysis is required.

In conclusion, the proposal upgrade to Boherbue WwTP will provide secondary and tertiary treatment that will produce a final effluent whose loadings will not cause the receiving watercourse to exceed WFD chemical quality concentrations. The proposed upgrade to Boherbue WwTP is designed to also meet the 'High' standards for Fresh Water Pearl Mussel. Therefore, the proposal complies with the requirements of the WFD.

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