Wastewater Treatment Plants Flow and Loads Summary Report

Document no: 321120AW-DOC-007
Version: 1.0

Uisce Éireann

Cork Wastewater Strategy
27 September 2024

Wastewater Treatment Plants Flow and Loads Summary Report

Client name: Uisce Éireann

Project name: Cork Wastewater Strategy

Project no: 321120AW

Document no: 321120AW-DOC-007

Project manager: Colm Noonan

Version: 1.0

Prepared by: Chris Kyne

Date: 27 September 2024

File name: 321120AW-DOC-007-WWTP Flow & Loads Summary Report-V1

Document status: DRAFT

Document history and status

Version	Date	Description	Author(s)	Checked	Reviewed	Approved
1.0	27/09/2024	Flow and Loads Summary	B. Delmond C. Walsh	C. Kyne	C. O'Keeffe	C. Noonan

Distribution of copies

Version	Issue Approved	Date Issued	Issued To	Comments
1.0	Colm Noonan	27/09/2024	Uisce Éireann	DRAFT – Issued for UÉ review

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Executive Summary

The purpose of the Cork Wastewater Strategy is to produce a report that will identify sustainable drainage strategies and projects for the growing Cork Metropolitan Area. The study area contains over 25 towns and villages in the Cork Metropolitan Area and Grenagh.

The Strategy covers 26 Uisce Éireann wastewater treatment plants (WwTPs) ranging in size from less than 100 PE treatment capacity to greater than 400,000 PE treatment capacity. A key consideration within the strategy is the existing capacity of these WwTPs, both hydraulically and organically, and the projected future flow and nutrient loading across the three strategy horizons of 2030, 2055 and 2080. As part of the Strategy, the future population and loading projections of each agglomeration has been projected. The methodology and results of this projection are outlined in the Cork Wastewater Strategy Populations Projections and Land Use Report. As part of the Strategy, it was identified that as a whole the existing Strategy study area has a total organic treatment capacity of approximately 585,000 population equivalent (PE). Whilst the 2030 horizon capacity demand was projected as 560,220 PE, indicating sufficient capacity within the study area currently and up to 2030, there are a number of WwTPs that are currently overloaded, either organically or hydraulically, or the treatment plant is not currently meeting their Wastewater Discharge Licence (WWDL) compliance requirements. The assessment projected a total loading of approximately 690,000 PE by 2055 and approximately 755,000 PE by 2080. This assessment provides context to the projected required capacity increase across the Cork Wastewater Strategy study area.

In order to ascertain capacity upgrade requirements i.e. organic, hydraulic or both, the future population and loading projections are key in determining the future flow and load that is projected to be received at each WwTP across each of the horizons. This report aims to outline the methodology for calculating current and future flow and load projections and identify any capacity shortfalls and the projected date of shortfall.

A current flow and load analysis is completed in order to understand the immediate needs of the WwTP and identify any existing capacity issues. The current flow and load analysis uses measured data where available, or data reported in the WwTPs latest Annual Environmental Report (AER). In some instances, there is insufficient flow and load data which results in a theoretical loading assessment using industry standard Per Capita Contributions (PCCs) being used. Where measured data is available, this is used in the future flow and load projections in order to account for specific loading characteristics of a catchment.

The flow and load assessment methodology considers three succinct analysis scenarios to provide a robust calculation and improve confidence in projections made over the 55-year design period. A brief description of each of the Scenarios and instances where they are applied is provided below:

- Scenario 1: Measured Data Approach – using measured flow and load data and projecting future flow and loading based on the current catchment characteristics.
- Scenario 2: Hybrid Measured Data and Theoretical Loading Approach – using current measured flow and load profiles to baseline the assessment for 2023 and applying theoretical flow loading factors for any projected growth.
- Scenario 3: Theoretical Approach – Applying Theoretical Flow PCCs to Total Future PE Projection

The three scenarios have been developed to enhance the accuracy of future flow and load projections by providing an approach that can be used where the catchment flow and loading profile/characteristics is well understood i.e. has large amounts of monitoring data, or an approach where there is insufficient/no flow and influent loading data. The hybrid approach, Scenario 2, provides a level of catchment characterisation whilst standardising the future loading profile to account for water demand reductions which is a driver for Uisce Éireann.

Once the available data has been assessed, recommendations are provided on the appropriate flow and load scenario that should be progressed per WwTP catchment within the Strategy. In summary, it is recommended to use Scenario 1 on two sites (Midleton and Dripsey), Scenario 2 on seven sites, (Carrigrennan, Shanbally,

Ballincollig, Carrigtwohill, Blarney, Watergrasshill, and Kileens) and Scenario 3 on the remaining seventeen sites.

Finally, the aim of the assessments report is to identify and outline existing capacity shortfalls and projected date of exceedance. The assessment considers both projected Average Daily Flows (ADF) and 3x Dry Weather Flows (3DWF). It should be noted, the capacity assessment for approximately one third of sites within the study area could not be completed due to the lack of existing capacity information. The hydraulic capacity assessment is summarised at the end of this report. In summary, only two sites have sufficient existing capacity to meet 2080 peak flow projections. On the other hand, fourteen assessable sites have insufficient capacity to meet 2080 peak flow projections however seven of these sites have sufficient hydraulic capacity to meet ADF projections for 2080. A full break down of the hydraulic capacity assessment is available in Table 29-1. Furthermore, Table 1-1 below provides a summary of the existing organic and hydraulic capacity, the future projected PE loading and the estimated future flow projections for the WwTPs within the study area.

Table 1-1 – Cork Wastewater Strategy WwTP Flow Projection Summary

WwTP (Selected Flow Scenario)	Horizon	Horizon PE	Organic Design Capacity (PE)	Hydraulic Design Capacity (m^3/d)	Horizon Dry Weather Flow (DWF) (m^3/d)	Horizon Average Daily Flow (ADF) (m^3/d)	Horizon Flow to Full Treatment (FtFT) (m^3/d)
Carrigrennan (Scenario 2)	2030	390,857	413,200	359,592	137,855	205,076	303,961
	2055	465,286			164,106	241,821	359,535
	2080	500,415			176,496	259,163	385,765
Shanbally (Scenario 2)	2030	66,955	65,000	43,875	19,269	21,065	57,808
	2055	81,307			22,498	25,102	67,495
	2080	92,431			25,001	28,230	75,004
Ballincollig (Scenario 2)	2030	37,755	33,000	22,275	7,984	11,343	23,953
	2055	59,486			12,874	17,455	38,622
	2080	67,214			14,613	19,628	43,838
Carrigtwohill (Scenario 2)	2030	16,017	30,000	20,250	7,735	8,962	23,205
	2055	19,047			8,417	9,815	25,250
	2080	20,840			8,820	10,319	26,460
Midleton (Scenario 1)	2030	27,441	15,000	10,368	9,072	13,221	18,876
	2055	33,969			11,230	16,365	23,366
	2080	38,867			12,849	18,725	26,735

WwTP (Selected Flow Scenario)	Horizon	Horizon PE	Organic Design Capacity (PE)	Hydraulic Design Capacity (m^3/d)	Horizon Dry Weather Flow (DWF) (m^3/d)	Horizon Average Daily Flow (ADF) (m^3/d)	Horizon Flow to Full Treatment (FtFT) (m^3/d)
Blarney (Scenario 2)	2030	13,724	13,000	2,925	2,228	5,166	6,683
	2055	23,640			3,484	7,955	10,451
	2080	26,939			4,226	8,882	12,678
North Cobh (Scenario 3)	2030	1,755	2,000	900	395	494	1,009
	2055	2,144			482	603	1,233
	2080	2,454			552	690	1,411
Watergrasshill (Scenario 2)	2030	2,892	3,000	2,025	666	1,242	2,096
	2055	3,450			795	1,481	2,501
	2080	3,871			892	1,662	2,806
Whitechurch (Scenario 3)	2030	1,091	3,000	1,800	245	307	627
	2055	1,262			284	355	726
	2080	1,418			319	399	815
Cloyne (Scenario 3)	2030	3,199	1,400	295	720	900	1,839
	2055	3,813			858	1,072	2,192
	2080	4,279			963	1,203	2,460

Ballygarvan (Scenario 3)	2030	930	634	375	209	262	535
	2055	1,079			243	303	620
	2080	1,212			273	341	697
Kileens (Scenario 2)	2030	1,550	600	270	236	325	709
	2055	2,084			356	475	1,069
	2080	2,285			402	532	1,205
Dripsey (Scenario 1)	2030	628	600	135	74	174	407
	2055	726			86	201	470
	2080	817			96	226	529
Grenagh (Scenario 3)	2030	1,042	1,200	648	234	293	599
	2055	1,250			281	352	719
	2080	1,411			317	397	811
Carrignavar (Scenario 3)	2030	907	300	68	220	276	538
	2055	1,104			268	335	655
	2080	1,248			303	379	740
Killumney (Scenario 3)	2030	3,234	700	-	728	910	1,860
	2055	3,936			886	1,107	2,263
	2080	4,417			994	1,242	2,540

Courtbrack (Scenario 3)	2030	660	250	-	149	186	380
	2055	752			169	212	432
	2080	836			188	235	481
River Valley (Minane Bridge) (Scenario 3)	2030	426	250	-	96	120	245
	2055	511			115	144	294
	2080	577			130	162	332
Inniscarra Waterworks (Scenario 3)	2030	334	100	-	75	94	192
	2055	401			90	113	231
	2080	455			102	128	262
Ballincurrig (Scenario 3)	2030	567	150	-	128	159	326
	2055	682			153	192	392
	2080	771			173	217	443
Lisgoold North (Scenario 3)	2030	266	80	-	60	75	153
	2055	324			73	91	186
	2080	366			82	103	210
Lisgoold South (Scenario 3)	2030	266	500	-	60	75	153
	2055	324			73	91	186
	2080	366			82	103	210

Knockraha (Scenario 3)	2030	737			166	207	424
	2055	841	350	-	189	237	484
	2080	935			210	263	538
Saleen (Scenario 3)	2030	891			200	251	512
	2055	1,032	40	-	232	290	593
	2080	1,158			261	326	666
Whitegate and Aghada (Scenario 3)	2030	3,361			756	945	1,933
	2055	3,959	-	-	891	1,113	2,276
	2080	4,444			1,000	1,250	2,555
Halfway (Scenario 3)	2030	363			82	102	209
	2055	417	450	270	94	117	240
	2080	470			106	132	270

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Acronyms and Abbreviations

ADF	Average Daily Flow
AER	Annual Environmental Report
BOD	Biochemical Oxygen Demand
CMA	Cork Metropolitan Area
COD	Chemical Oxygen Demand
DBO	Design Build Operate
DIN	Dissolved Inorganic Nitrogen
DWF	Dry Weather Flow
ELV	Emission Limit Values
EPA	Environmental Protection Agency
EQS	Environmental Quality Standards
FtFT	Flow to Full Treatment
N	Nitrogen
NH3	Ammonia
No	Number
Ortho-P/OP	Orthophosphate
P	Phosphorus
PCC	Per Capita Contribution
PE	Population Equivalent
SS	Suspended Solids
TN	Total Nitrogen
TP	Total Phosphorous
TSS	Total Suspended Solids
UÉ	Uisce Éireann
UWWTD	Urban Wastewater Treatment Directive
WWDA	Wastewater Discharge Authorisation
WWDL	Wastewater Discharge Licence
WwTP	Wastewater Treatment Plant

1. Introduction

The Cork Wastewater Strategy includes 26 Uisce Éireann (UÉ) wastewater treatment plants (WwTPs) ranging in size from less than 100 population equivalent (PE) treatment capacity to greater than 400,000 PE treatment capacity. These WwTPs provide varying levels of treatment such as primary, secondary, tertiary, and nutrient reduction, and discharge to a range of water bodies. In addition, there are other settlements in the study area that are not currently served by UÉ assets. The WwTP locations are shown in Figure 1-1.

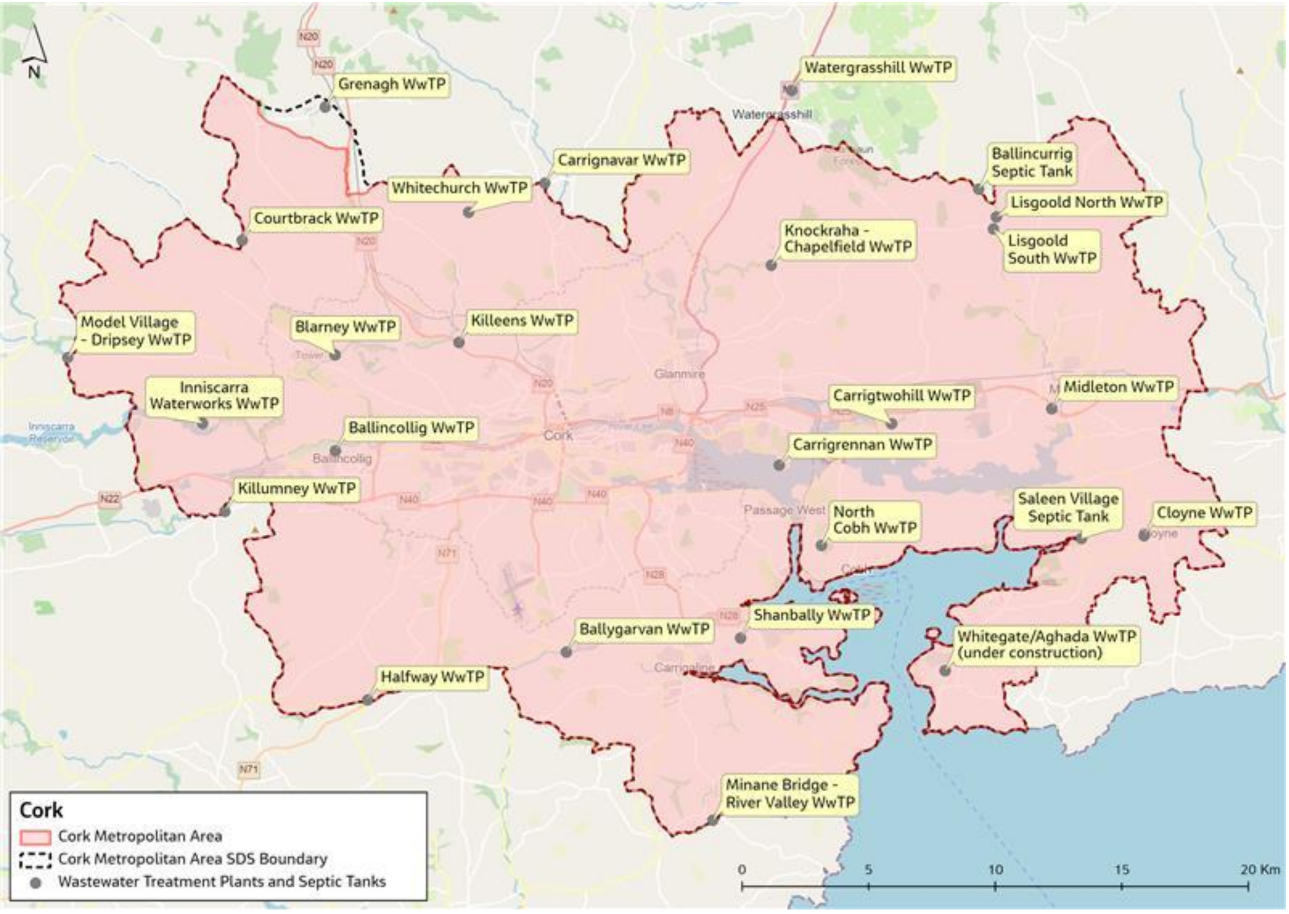


Figure 1-1 - Wastewater Treatment Plant Locations

These existing WwTPs currently experience a range of issues that include non-compliance with environmental quality standards and exert significant pressure on their receiving waters. It is recognised that the projected growth in population, commercial developments and industry in the Cork Metropolitan Area will further exasperate wastewater treatment issues and lead to a shortfall in the capacity of the existing and planned WwTPs leading to a deterioration in the quality of the receiving waters.

The capacity of a treatment works can be measured in the following ways:

- Hydraulic Capacity: The maximum or average design flow capacity of the treatment works measured in volumetric flow per day (m^3/d). There are typical industry standard wastewater flow contributions per person, known as Per Capita Contributions (PCCs), which can be applied to the design flow to determine the hydraulic capacity in terms of Population Equivalent (PE).

- Organic Load Capacity: This is the measure of organic treatment capacity i.e. the WwTPs ability to treat and reduce Biochemical Oxygen Demand. Organic capacity is measured in PE and is typically determined using a PCC of 60gBOD/PE/d. The organic capacity is dependent on the treatment standards i.e. the final effluent discharge limits prescribed to the WwTP.

Within this Strategy, both the hydraulic and organic capacities will be assessed to understand future upgrade requirements in order to deliver recommendations for upgrades that will address hydraulic loading and treatment of wastewater to the desired standard. This report aims to highlight when current capacity is likely to be exceeded by the projected population or economic growth and provide the estimated capacity increase requirements on a strategic level.

1.1 Population Projection

An objective of the Cork Wastewater Strategy is to determine the future projected demand on UE's assets at the three strategy horizons of 2030, 2055 and 2080 to understand future upgrade and investment needs. Population projections for the future strategy horizons have therefore been derived. A comprehensive assessment was completed which assessed the current agglomeration and catchment population (from the latest census 2022 data where available) and current industrial and commercial loadings. Annual population growth rates specific to each agglomeration were used to project the future domestic, residential and commercial loading for the three horizons. For full details and further information of the assessment, please refer to the Population Projections and Land Use Report (321120AW-DOC-006-Population and Land Use Report) included within Appendix B of this report.

The future growth of the Cork Metropolitan Area (CMA) was assessed and used to determine future WwTP loading projections for each agglomeration and ultimately for each WwTP catchment. This finalised population loading is based on the following allowances:

- Domestic & Residential Loadings
- Commercial Loading (16% of Domestic across all agglomerations)
- Industrial Loading (where applicable)
- Headroom Allowance (20% for Cork City agglomerations; 15% for agglomerations outside of Cork City)

The future plant population and loading projections and allowance breakdown for each WwTP have been summarised in Appendix A of this report.

Figure 1-2 represents the overall current capacity of treatment works within the Cork Wastewater Strategy study area and compares this capacity against projected future demand for the study area to demonstrate the potential capacity shortfall at each strategy horizon.

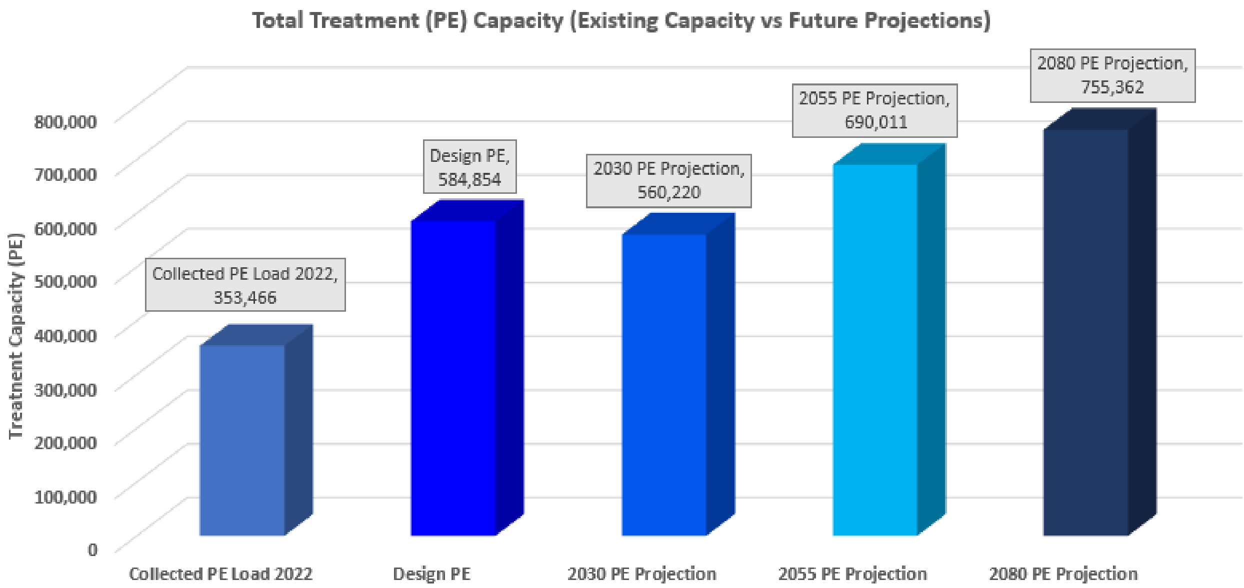


Figure 1-2 - Cork Wastewater Strategy Overall Current Organic Capacity and Future Loading Demand

The population equivalent projection assessment indicates that whilst the study area as a whole has sufficient installed capacity for the 2030 horizon, it will be overloaded by over 100,000PE by 2055 and by over 170,000PE by 2080, should no treatment capacity upgrades or expansions be completed. Whilst this graphic provides an overview of the total CMA installed capacity and future demand, it is imperative to note the study area comprises of 26 individual WwTPs, approximately half of which are currently organically overloaded and/or are not compliant with their WWDL discharge parameters. Thus, upgrades are required on the **existing** infrastructure to provide sufficient capacity and/or improve treatment processes at these plants for current loading to improve compliance with currently prescribed discharge limits. Note, the future horizon projections include a headroom of 15% for WwTPs outside of the Cork City agglomeration and 20% for the WwTP within Cork City.

Additionally, the design capacity PE reported within Figure 1-2 is based on the existing as constructed capacity which is also based on the treatment capacity requirements to meet current wastewater discharge licence (WWDL) stipulations, across the study area. It is envisaged that changes to the discharge requirements prescribed within the existing WWDLs, arising from the Water Quality Modelling completed as part of this strategy or updated drivers from the UWWT Recast Directive, may result in a modified capacity figure e.g. the tightening of ammonia discharge limits could potentially reduce the reported capacity of an existing treatment works, should no upgrade or expansion be completed.

Figure 1-3 graphically summarises the organic design capacity and future projected loading to Carrigrennan WwTP which constitutes a large proportion of the current design capacity within the study area. Note, the design capacity is based on the as constructed design which is based on treatment capacity required to achieve compliance with the discharge standards/requirements outlined within its Wastewater Discharge Licence. At the Optioneering Workshop, held 29th July 2024, it was noted that the plant is currently struggling to achieve compliance whilst the estimated current loading of 231,000PE is considerably below the design capacity of 413,200PE which would therefore indicate the works does not possess the reported organic design capacity, however, it has sufficient hydraulic capacity.

It should be noted that for the purposes of this Flow and Loads Report, the existing organic treatment capacity is reported based on the latest as constructed information available at the time of assessment. This is in order to highlight any capacity shortfall when comparing future capacity demand based on existing treatment conditions. Alterations (both upgrading or downgrading) to the reported existing as constructed capacity will be considered within the Optioneering Report of this strategy which shall consider the impact on asset capacity due to change in discharge requirements.

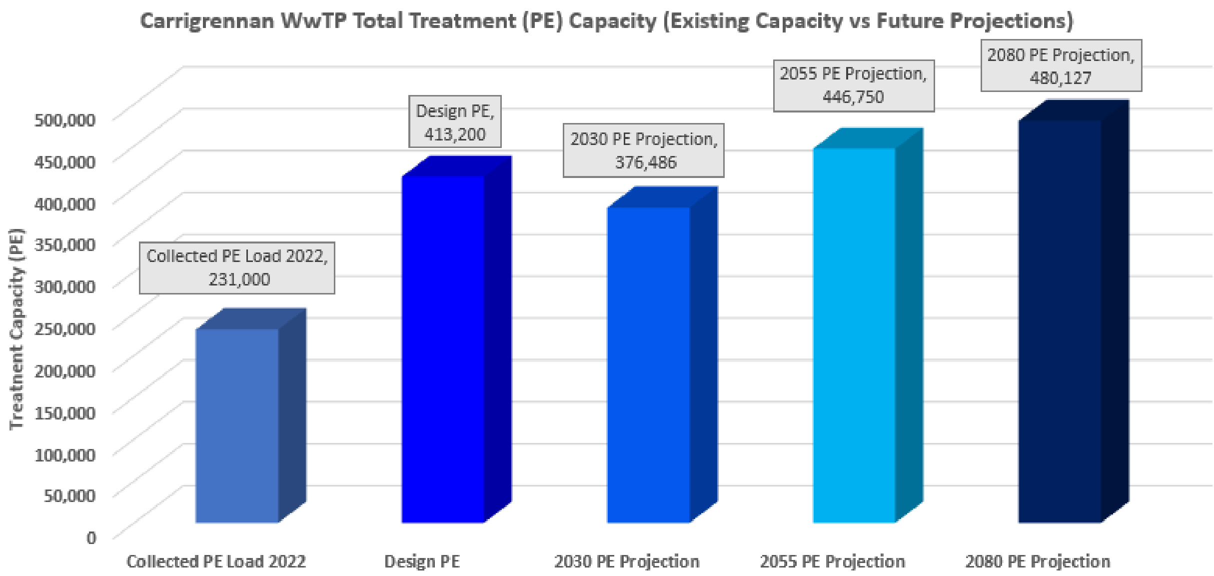
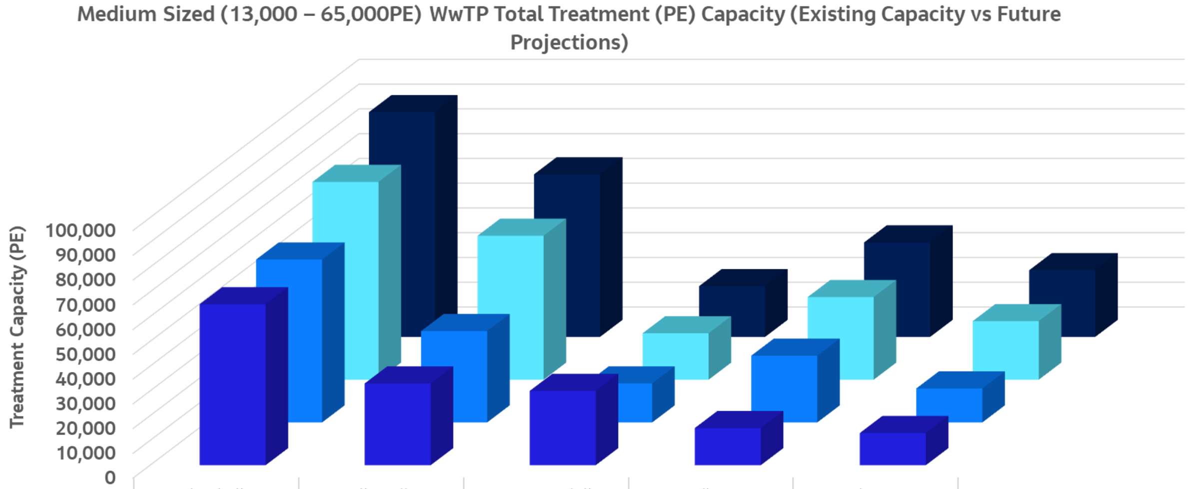


Figure 1-3 - Carrigrennan WwTP Current Capacity and Future Loading Demand

The population and loading projections indicate Carrigrennan WwTP will have sufficient treatment capacity for the 2030 horizon, however it will be overloaded by approximately 33,500 PE by 2055 and by approximately 77,000 PE by 2080, when compared to the existing treatment capacity. As stated above, the plant is currently non-compliant and upgrade projections are based on the reported design capacity only.

Figure 1-4 graphically summarises the current design capacity and future projected loading for medium sized WwTPs (13,000-65,000PE) within the study area. This includes Shanbally (65,000 PE), Ballincollig (33,000 PE), Carrigtwohill (30,000 PE), Midleton (15,000 PE) and Blarney (13,000 PE). The figure indicates the current WwTP capacity is exceeded for all treatment plants with the exception of Carrigtwohill, which has sufficient capacity across the three future strategy horizons.



	Shanbally	Ballincollig	Carrigtwohill	Midleton	Blarney
Design PE	65,000	33,000	30,000	15,000	13,000
2030 PE Projection	65,768	36,888	15,765	26,947	13,724
2055 PE Projection	79,863	58,119	18,741	33,358	23,640
2080 PE Projection	90,787	65,669	20,501	38,168	26,939

Figure 1-4 - Medium Sized WwTP (13,000 – 65,000PE) Current Capacity and Future Loading Demand

Figure 1-5 graphically summarises the current design capacity and future projected loading for small sized WwTPs (<3,000) within the study area. This includes 19 No. WwTPs which vary in treatment complexity and discharge location type i.e. surface or ground water discharge. For further information on current treatment types, identified plant issues and discharge requirements, please refer to the WwTP Assessments Report (321120AW-DOC-003-321120AW-DOC-003-Assessment of Existing WwTPs). Individual analysis and commentary on the projected capacity exceedance horizon is included within each WwTP assessment included within this report.

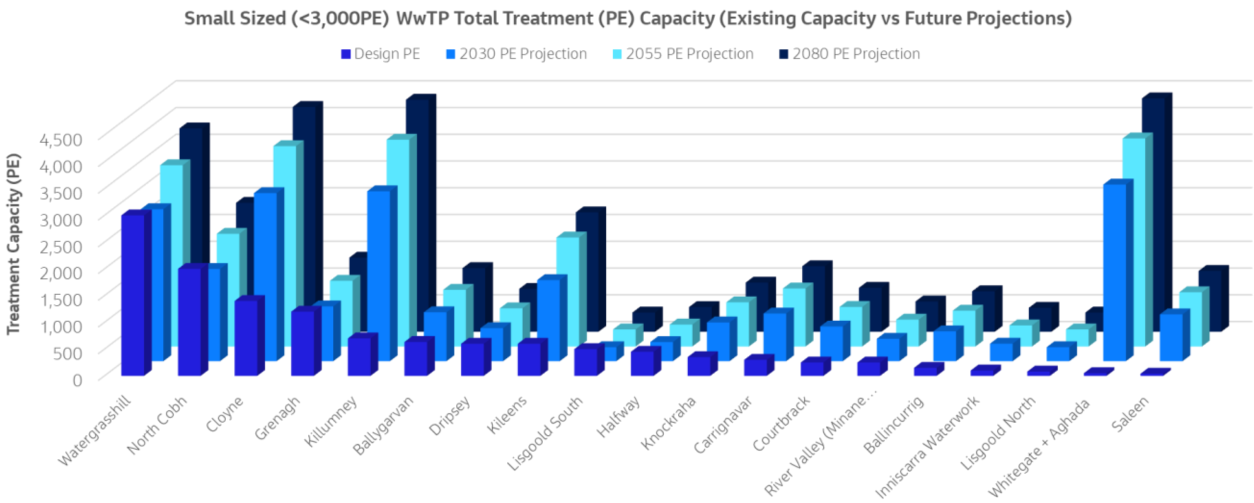


Figure 1-5 - Small Sized WwTP (<3,000) Current Capacity and Future Loading Demand

The figures presented in the above figures and summarised within Appendix A are used within the Current and Future Flow and Load Assessment for each WwTP within the study area. Further information on the Flow and Load Assessment methodology are provided in Section 2.

1.2 Report Structure

The report has been structured to provide the information highlighted below in order of WwTP capacity from largest (design) to smallest, containing the following sections;

- WwTP Introduction and Future Loading Projections
- Current WwTP Flow and Load Summary using available measured and/or AER data
- Future WwTP Flow Analysis
- Future WwTP Load Analysis

2. Methodology

This section outlines the current and future flow and load analysis and assessment methodology. The methodology was presented to Uisce Éireann at both the Future Load Assessment Workshop, held 16th April 2024, and the Optioneering Workshop, held 29th July 2024. The agreed methodology for determining future flow and loads is outlined in more detail in Section 2.2 which defines several scenarios used within the assessment, and the criteria for using each scenario.

The flow and load assessment for each WwTP follows the following steps:

1. Current Flow and Load Analysis: analysing and assessing the current measured flow and nutrient influent sample data to understand specific WwTP loading profiles;

2. Determining Flow and Load Per Capita Contributions (PCC): using agreed current WwTP PE loading and flow and nutrient influent concentration results from Step 1. In instances where measured data is unavailable, theoretical PCCs for typical wastewater flow loading and nutrient characteristics are applied to the agreed WwTP PE loading.

3. Projecting Future Horizon Flows: in this step, three scenarios are derived and assessed which use either a measured data only, hybrid measured data-theoretical loading or theoretical loading approach. Each of the three scenarios are assessed for each WwTP, with commentary provided on the suitability of the scenario to the WwTP. In this step, the PCCs derived in Step 2 are used to determine a future projected loading that is characteristic to the current catchment. Where measured flow data is unavailable or of poor quality, the measured data only scenario will be omitted from the assessment.

   Further details on the future horizon flow and load assessments are provided in Section 2.2. In summary, Scenario 1 represents a future projected load based on the current flow and load characteristics based on measured data, Scenario 2 represents a future projected load based on the current flow and load characteristics however all future growth shall be based on theoretical PCCs to standardise growth contributions for all sites across the three study horizons and Scenario 3 represents a future projected load based on theoretical loading of the projected population projection.

4. Projecting Future Horizon Nutrient Loadings: the results from the Step 3 flow analysis are used to derive future nutrient loadings based on nutrient influent concentrations assessed and derived in Step 1. Where measured influent sample data is unavailable in Step 1, theoretical PCCs are used to derive future nutrient loading based on the Scenario projected flow.

Steps 1. and 2. are outlined in Section 2.1 whilst Steps 3. and 4. are outlined in Section 2.2.

2.1 Current Flow and Load Analysis

The current flow and load analysis uses information and data from the latest Annual Environmental Report (AER) and measured flow and influent concentration data, where available. The current flow assessment methodology is outlined in Section 2.1.1 and the current load assessment methodology is outlined in Section 2.1.2.

In order to evaluate the future horizon WwTP flow and load projections, an assessment of the current WwTP loading was undertaken to understand current catchment characteristics that may influence the future horizon assessment.

The current flow and load analysis evaluates data reported in the latest AER providing information on the current DWF, ADF and FtFT to the plant as well as the raw influent make up of reported constituents. In parallel, available measured data is analysed to assess measured Per Capita Contributions (PCCs) for both hydraulic and nutrient loading. Depending on the efficacy of the data, outputs from the data analysis are used to provide future flow and nutrient loadings that will be characteristic of the current or proposed catchment.

2.1.1 Current Flow Analysis

The current flow analysis aims to assess the available measured WwTP influent flow data to determine its accuracy and reliability. Measured data that provides a higher level of accuracy shall be used in subsequent future flow projections, which is discussed in detail in Section 2.2. Where measured data is unavailable or not appropriate for use within the assessment, a theoretical approach which uses industry and Uisce Éireann standard PCCs is used. This section will outline the methodology for both measured and theoretical approaches for the current flow analysis.

As discussed above, this analysis uses measured flow data, where available, for each WwTP. Measured flow data is deemed as more accurate and reliable when there is a high volume of data points across a 3- to 4- year period or when the data points do not return erroneous and/or repeated values which are suspected error. Note, a large proportion of the study area WwTPs do not have flow monitoring data, or the data recording is deemed unreliable.

A statistical analysis is completed on the measured flow data for each WwTP to determine Dry Weather Flows (DWF), Average Daily Flows (ADF) and Flow to Full Treatment (FtFT) that is directed to the inlet of the works. DWF is taken as the 10%ile of the measured data whilst FtFT is taken as the 95%ile of the measured data.

A DWF Per Capita Contribution $(PCC)_{Current}$ is then determined using the agreed current WwTP PE loading. For WwTPs with a current organic design capacity greater than or equal to 500PE, the current PE loading is taken from the latest published AERs. For WwTPs with a current design capacity less than 500PE, the current PE loading is taken from the Population and Loading Projections derived for this Strategy. The DWF PCC allows for comparison of the actual collected daily contribution per PE against the Uisce Éireann standard theoretical loading PCC of 175 L/PE/d (for domestic loading) plus 50 L/PE/d (for infiltration).

Note, the majority of the smaller WwTPs within the study area do not possess flow monitoring data, therefore the current flow analysis is completed using theoretical PCCs which have been agreed with UÉ for use within the Cork Wastewater Strategy. The PCCs to be used and flow type calculation formula are summarised in the table below:

Table 2-1 - Cork Wastewater Strategy Flow Theoretical PCCs and Formulae

Parameter	Units	Value
Domestic Flow PCC (PC)	L/PE/d	175
Infiltration Flow PCC (I)	L/PE/d	50
Industrial Flow PCC (E)	L/PE/d	150
Dry Weather Flow (DWF)	m^3/d	PE x (PC + I)
Average Daily Flow (ADF)	m^3/d	1.25x DWF
Flow to Full Treatment (FtFT)	m^3/d	3PC + I + E

The domestic and infiltration flow PCCs are applied to projected domestic PE loading. Domestic PE loading accounts for residential, commercial and headroom allowance within the PE projections. The industrial flow PCC is applied to the industrial licence PE only.

In each analysis, measured industrial flow data is used to determine what proportion of the total flow to plant is derived from industrial contributions. At the Future Load Assessment Workshop, it was agreed to use the current industrial licence load across the three strategy horizons of 2030, 2055 and 2080. Therefore, as part of the current analysis, industrial flows are subtracted from the FtFT to determine the DWF:FtFT for domestic and residential loading. Additionally, the current DWF:ADF ratio is determined.

In parallel to the current flow analysis methodology outlined above, the DWF and ADF derived within the latest AER is recorded and compared against the measured flow data. In the absence of measured flow monitoring data or in instances where measured data is deemed inaccurate or unreliable, the AER flow data shall be used within the future flow analysis. This is specifically detailed within respective analysis summaries within this report.

2.1.2 Current Load Analysis

The current load analysis adopts a similar methodology to that presented in the previous section. Measured spot or composite nutrient sample data is assessed, where available, and used to determine average and 95%ile influent loading concentrations. The efficacy of the sample data is assessed prior to completing further analysis with any erroneous values removed.

In parallel, where daily flow data and sample results are available, the total daily mass influent loading of the selected nutrient is determined with average and 95%ile analysis completed. This latter analysis provides a more accurate mass loading analysis compared to total average concentration multiplied by total average flow. Determining daily nutrient loads provides a more representative loading pattern, accounting for days with high flow, low concentration or vice versa.

The influent nutrient concentrations and/or mass loadings derived in the Current Load Analysis are used to determine the future nutrient loading projections and this is demonstrated in Section 2.2.2.

Where sample data is not available or is deemed inaccurate/unreliable, theoretical nutrient loading PCCs, as outlined in the table below, are used to derive current loading figures.

Table 2-2 - Theoretical Nutrient Loading PCCs

Parameter	Units	Value
Biological Oxygen Demand (BOD)	gBOD/PE/d	60
Total Suspended Solids (TSS)	gSS/PE/d	75
Total Nitrogen (TN)	gTN/PE/d	12.2
Ammonia	gNH3/PE/d	2.2
Total Phosphorus (TP)	gTP/PE/d	8

2.2 Future Horizon Flow and Load Analysis

The future horizon flow and load analysis uses information and data obtained during the current flow and load assessment in combination with the projected PE plant loadings derived within the Population and Land Use Report to determine flow and loads that are characteristic to the site. In this future analysis, there are several scenarios which are examined and calculated based on the availability of data and site dependent preferred approach. The scenario outputs will be reviewed and selected to provide a robust and reasonable projection for future loading to the WwTPs within the study area. The future horizon flow analysis is outlined in Section 2.2.1 and the future load analysis is outlined in Section 2.2.2.

2.2.1 Future Horizon Flow Analysis

The future horizon flow analysis completes three individual assessments, or Scenarios, which use a measured, hybrid measured-theoretical or theoretical basis approach. A brief outline of each Scenario is provided below with further information provided within the following sections.

- Scenario 1: Measured - Applying Measured Flow PCCs to Total Future PE Projection
- Scenario 2: Hybrid - Applying Measured Flow PCCs to Current Loading and Theoretical Flow PCCs to Projected Future Growth only.
- Scenario 3: Theoretical – Applying Theoretical Flow PCCs to Total Future PE Projection

Current industrial licence flows remain constant across all three scenarios.

The three scenarios have been derived to provide a robust approach to determining future flow projections to account for instances where measured flow data is unavailable or is deemed inappropriate for use within the assessment (see Section 2.1.1).

Scenario 1 is not used for WwTPs where AERs are not completed i.e. because the capacity and WWDL permit is less than 500 PE **or** where measured flow data is unavailable or is deemed inaccurate for use in the analysis. In this instance, Scenario 3 shall be used (see Section 2.2.1.3). The following table has been included for ease of reference:

Parameter	Units	Denotation
Current DWF PCC	m^3/PE/d	$PCC_{Current}$
Future Projected Load	PE	PE_{Future}
Future DWF	m^3/d	DWF_{Future} = $PCC_{Current}$ x PE_{Future}
Future ADF	m^3/d	ADF_{Future} = DWF_{Future} x $(DWF{:}ADF)_{Current}$
Future FtFT	m^3/d	$FtFT_{Future}$ = DWF_{Future} x $(DWF{:}FfFT)_{Current}$

2.2.1.1 Scenario 1 Measured Analysis

In this Scenario 1, the measured flow Per Capita Contribution (PCC) derived in the Current Flow Analysis (see Section 2.1.1) is applied to the total Strategy horizon PE projection. The calculated DWF to ADF and FtFT ratios are also applied to the calculated future horizon DWF. In each WwTP flow assessment, the industrial flow load is applied after the FtFT is determined which ensures the future horizon design figure provides sufficient capacity allowance for peak flows.

Parameter	Units	Denotation
Current DWF PCC	m^3/PE/d	$PCC_{Current}$
Future Projected Load	PE	PE_{Future}

Future DWF	m^3/d	DWF_{Future} = $PCC_{Current}$ x PE_{Future}
Future ADF	m^3/d	ADF_{Future} = DWF_{Future} x $(DWF:ADF)_{Current}$
Future FtFT	m^3/d	$FtFT_{Future}$ = DWF_{Future} x $(DWF:FfFT)_{Current}$

2.2.1.2 Scenario 2 Hybrid Measured-Theoretical Analysis

Scenario 2 was developed following discussions at the Optioneering Workshop in order to simplify the future analysis approach and provide a level of standardisation across the study area.

In this Scenario 2, the measured flow is obtained from the latest AER and is attributed to the current PE loading figure.

The future flow projection is then determined by applying theoretical flow PCCs, as detailed in Table 2-1, to the future projected growth i.e. the future horizon projected PE minus the current PE loading. This methodology therefore brings any future loading in alignment with theoretical loading of WwTPs. The following formula has been included to clarify the approach:

$$Future\ Horizon\ Flow = Current\ Measured\ Flow + \left(PE_{Future\ Horizon,x} - PE_{Current}\right) \cdot PCC_{DWF,Theoretical}$$

$PE_{Future\ Horizon,\ x}$ = Future Projected Loading for Horizon x, x being 2030, 2055 or 2080

$PCC_{DWF,Theroetical}$ = 0.175 + 0.05 m^3/PE/d

This methodology uses the theoretical flow PCC for future growth which is thought to account for any network modifications e.g. reduction in SWOs in the future horizons which is deemed acceptable for use at this strategy level.

2.2.1.3 Scenario 3 Theoretical Analysis

In this Scenario 3, the theoretical flow PCCs and calculation formulae as outlined in Table 2-1 are applied to the total future horizon PE projection to determine DWF, ADF and 3DWF flows. This methodology is standard approach for sites where current measured data is not available.

2.2.2 Future Horizon Load Analysis

The future horizon load analysis differs to the future horizon flow analysis in that the latest AER current PE loading figure is not used to derive nutrient loading PCCs. This is believed to derive less accurate future loading figures due to the uncertainty in the AER PE figure and reduce number of data points available for the analysis (as sample results on days with available flow data is less frequent).

A brief outline of each Scenario is provided below with further information provided within the following sections.

- Scenario 1 - Applying Measured Nutrient Concentrations to Flows Determined in the Scenario 1 Flow Analysis
- Scenario 2 - Applying Measured Nutrient Concentrations to Flows Determined in the Scenario 2 Flow Analysis
- Scenario 3: Theoretical – Applying Theoretical Nutrient PCCs to Total Future PE Projection

Scenarios 1 and 2 future horizon analysis shall use nutrient concentrations derived in the Current Load Analysis (see Section 2.1.2) and average future projected flows to determine the average and 95%ile nutrient mass loading for each horizon.

Scenario 3 uses theoretical nutrient PCCs as outlined in Table 2-2 and the future total projected horizon PE load to determine average loads whilst 95%ile loads are determined using a peaking factor of 2 i.e.:

$$Future\ Horizon\ Nutrient\ Load\ (Ave) = \ Future\ Horizon\ ADF \cdot PCC_{Nutrient,Theoretical}$$

$$Future\ Horizon\ Nutrient\ Load\ (95\%ile) = \ Future\ Horizon\ Nutrient\ Load\ (Ave) \cdot Peaking\ Factor$$

3. Carrigrennan WwTP

3.1 Introduction

Carrigrennan WwTP is located at Little Island 11km east of Cork city centre, as shown in Figure 3-1. The treatment plant was commissioned in 2004 and had an M&E upgrade in 2021, which included the design and build of a phosphate removal plant and the installation of a new sludge dewatering system. Northumbrian Water Projects Limited operate and maintain the Carrigrennan WwTP on behalf of UÉ; under a DBO 20-year contract which ends in September 2024.

The WwTP has a design capacity of 413,200 PE. Treatment comprises of preliminary, primary, and secondary treatment. The treated effluent discharges to Lough Mahon. The outfall from Carrigrennan WwTP is approximately 520m downgradient from the boundary of Great Island Channel SAC. There is also sludge treatment on-site consisting of thickening, digestion, sludge dewatering and a thermal drying process.

According to the data from the 2022 census report the catchment of Carrigrennan has a domestic population of 222,526 while the UÉ Asset Capacity Register, has a current loading PE of 235,249.

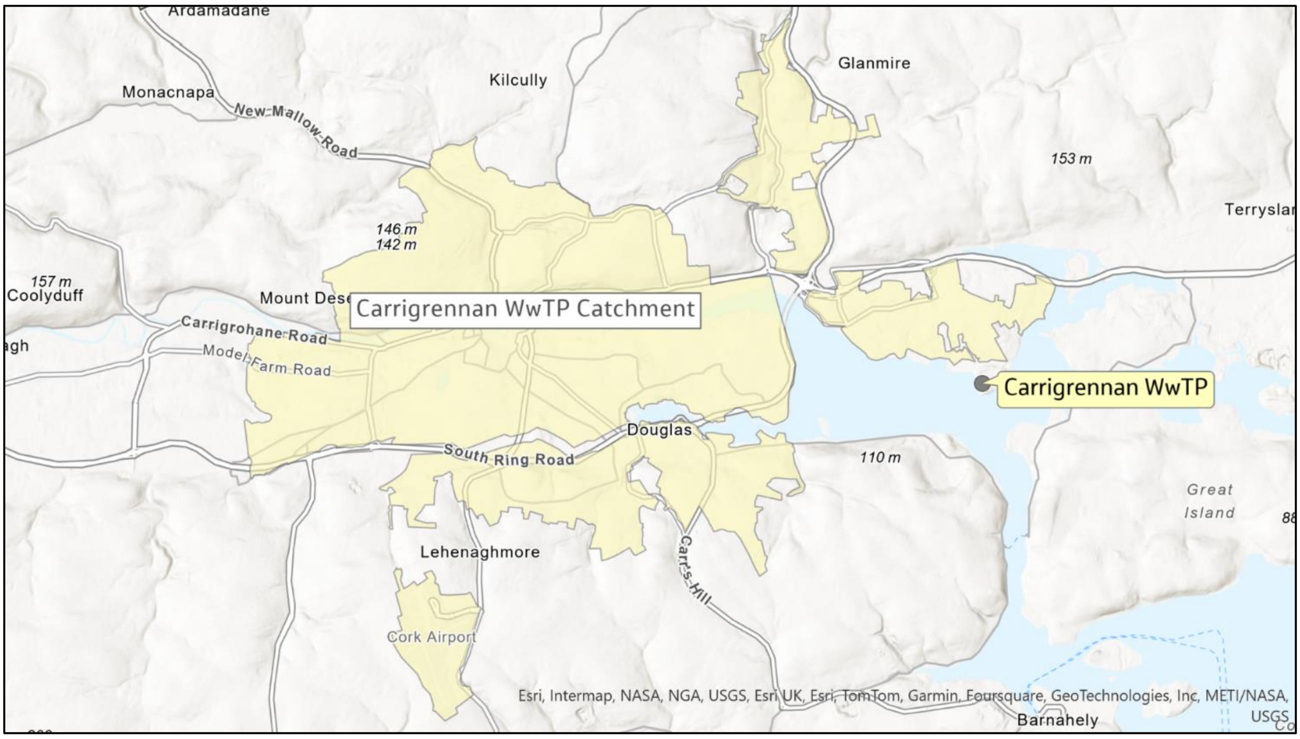


Figure 3-1 - Carrigrennan WwTP Site Location and Catchment

3.2 Current Flow and Load Summary

In order to evaluate the future horizon WwTP flow and load projections, an assessment of the current WwTP loading was undertaken to understand current catchment characteristics that may influence the future horizon assessment.

In the following sections, commentary will be provided on the interpretation of current organic capacity, the quality and reliability of raw data and recommendations on the preferred future horizon calculation methodology.

3.2.1 Current Wastewater Discharge Licence (WWDL) Summary

The Waste Water Discharge Licence (WWDL) (D0033-01) was originally granted in 2009. The licence was subsequently revised under Technical Amendment B in 2021. It is therefore assumed the reported design PE is based on the amended licence requirements, which are summarised below in Table 3-1.

Table 3-1 - Carrigrennan WwTP WWDL ELVs (D0033-01)

Parameter	Units	Value
BOD	mg/l	25
COD	mg/l	125
Suspended Solids	mg/l	35
Total Phosphorus (as P)	mg/l	2.5
Total Nitrogen (as N)	mg/l	10

3.2.2 Latest AER Data

The latest Annual Environmental Report (AER) for Carrigrennan WwTP was published in 2022. Table 3-2 summarises the WwTP flows received in 2022. The average and maximum annual concentrations for BOD, COD, Suspended Solids, Total P and Total N are also provided in the 2022 AER and have been summarised in Table 3-3 below.

Table 3-2 – Carrigrennan WwTP 2022 AER Flow Summary

Parameter	Units	Value
Peak Hydraulic Capacity (FtFT)	m^3/d	359,592
Design PE	PE	413,200
Dry Weather Flow (DWF)	m^3/d	59,359
Average Daily Flow (ADF)	m^3/d	123,959
Collected PE Load	PE	231,000

Table 3-3 – Carrigrennan WwTP 2022 AER Raw Influent Concentration Summary

Parameter	Units	No. Samples	Annual Average	Annual Maximum
BOD	mg/l	260	106	260
COD	mg/l	260	272	950
Suspended Solids	mg/l	260	123	380
Total Phosphorus (as P)	mg/l	26	2.56	7.40
Total Nitrogen	mg/l	26	20	30

3.2.3 Current Measured Flow Data

Raw influent flow and load data for period of 2020-2022 was obtained for the flow and load data analysis. There were 1,096 No. flow data points across the 3-year period, thus increasing the level of statistical confidence of the data. The following table summarises the measured flow data and the calculated DWF PCC and DWF ratios which have been determined using the 2022 AER Collected PE loading of 231,000 PE, and the methodology discussed in Section 2.1.1.

Table 3-4 – Carrigrennan WwTP Measured Flow Summary

Parameter	Units	Value
Measured Data Points	No.	1,096
Dry Weather Flow (DWF)	m^3/d	81,474
Average Daily Flow (ADF)	m^3/d	114,041
Flow to Full Treatment (FtFT)	m^3/d	172,482
Maximum	m^3/d	910,510
DWF PCC	L/PE/d	353
DWF:ADF	-	1.40
DWF:FtFT	-	2.12

Whilst the measured ADF of 114,041 m^3/d relatively aligns with the 2022 AER reported ADF of 123,959 m^3/d, there is a vast difference between the measured DWF of 81,474 m^3/d and the 2022 AER reported DWF of 59,359 m^3/d.

3.2.4 Current Measured Nutrient Loading Data

As discussed, raw influent flow and load data for period of 2020-2023 was obtained for the flow and load data analysis. There were a large number of influent spot samples for BOD, COD, Suspended Solids and Total P across the 3-year period with all samples occurring on days with flow meter readings. There were considerably less Total Nitrogen samples (75 No. in total) across the 3-year period, with all samples occurring on days with flow meter readings.

The analysis provides a summary of the average and 95%ile concentrations. A load analysis has been completed which calculates the daily load based on the daily flow reading. The following Table 3-5 summarises the results of the nutrient concentration and loads analysis.

Table 3-5 – Carrigrennan WwTP Measured Nutrient Concentration and Load Summary

Parameter	Concentrations (mg/l)		Loads (kg/d)	
	Average	95%ile	Average	95%ile
BOD	111	190	11,588	17,892
COD	291	510	30,526	48,430
Suspended Solids	132	210	13,976	21,113

Parameter	Concentrations (mg/l)		Loads (kg/d)	
	Average	95%ile	Average	95%ile
Total Phosphorus (TP)	20.2	30.0	2,107	2,643
Total Nitrogen (TN)	2.6	4.2	275	385
Measured PE (BOD Basis)	-		193,140	

As shown in the table above, the measured PE was calculated as 193,140, when using a BOD PCC of 60g/PE/d. This is significantly lower than the reported 2022 AER Collected Load of 231,000 PE. Given the difference in measured load, determined using the 3-year sample dataset, it is recommended to use measured concentration results in the future Scenario 1 and Scenario 2 horizon load assessment. Theoretical PCCs shall be used within Scenario 3 to provide comparison.

3.3 WwTP Future Flow Analysis

This section shall be used to outline the measured flow analysis and provide commentary on future flow assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.1

3.3.1 Scenario 1 Flow Analysis – Measured Data Only

The Scenario 1 flow analysis considers the current measured WwTP flow loading, deriving a DWF PCC and DWF:ADF and DWF:FFT ratios to determine the future projected flow loading based on the established projected horizon PE. Table 3-6 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.1.

Table 3-6 - Carrigrennan WwTP Future Scenario 1 Flow Analysis

Parameter	Units	2030	2055	2080
Current PE	PE	8,162 (119 L/PE/d)		
Horizon PE	PE	390,857	465,286	500,415
Horizon Dry Weather Flow (DWF)	m^3/d	137,855	164,106	176,496
Horizon Average Daily Flow (ADF)	m^3/d	205,076	241,821	259,163
Horizon Flow to Full Treatment (FtFT)	m^3/d	303,961	359,535	385,765

3.3.2 Scenario 2 Flow Analysis – Hybrid Measured & Theoretical Analysis

The Scenario 2 flow analysis considers the current WwTP flow loading (as reported in the 2022 Carrigrennan WwTP AER) with all additional future flow from the projected PE growth loading determined using theoretical flow PCCs. Table 3-7 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.2.

Note, using the 2022 AER data, (PE loading of 231,000PE and DWF of 59,359 m^3/d), the equivalent DWF PCC is 257 L/PE/d which is approximately 46% greater than the theoretical PCC of 175 L/PE/d.

Table 3-7 - Carrigrennan WwTP Future Scenario 2 Flow Analysis

Parameter	Units	2030	2055	2080
Current PE	PE	231,000 (257 L/PE/d)		
Horizon PE	PE	390,857	465,286	500,415
Horizon Dry Weather Flow (DWF)	m^3/d	119,348	145,398	157,693
Horizon Average Daily Flow (ADF)	m^3/d	198,945	231,508	246,877
Horizon Flow to Full Treatment (FtFT)	m^3/d	358,044	436,194	473,079

3.3.3 Scenario 3 Flow Analysis – Theoretical Analysis

The Scenario 3 flow analysis applies the theoretical flow calculation to the total horizon PE loading projection. The table below provides the projected PE and the resulting DWF, ADF and FfFT for each Strategy horizon. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.3.

Table 3-8 - Carrigrennan WwTP Future Scenario 3 Flow Analysis

Parameter	Units	2030	2055	2080
Horizon PE	PE	390,857	465,286	500,415
Horizon Dry Weather Flow (DWF)	m^3/d	100,060	116,806	124,710
Horizon Average Daily Flow (ADF)	m^3/d	125,075	146,008	155,888
Horizon Flow to Full Treatment (FtFT)	m^3/d	236,860	279,656	299,855

3.3.4 Future Flow Design Basis

The tables provided in the previous sections can be used to compare the results of the Scenario 1, Scenario 2 and Scenario 3 flow analysis.

At this stage of the strategy, it is proposed to progress with Scenario 2 for the following reasons:

- It provides a more conservative flow estimate for the 2030, 2055 and 2080 future horizons.
- Using the Scenario 2 calculation methodology, the total flow DWF PCCs are 305, 312 and 315 L/PE/d for the 2030, 2055 and 2080 horizons, respectively. Whilst this is much greater than the theoretical DWF PCC, it represents a reduction in per capita water usage compared to the current measured data.

Figure 3-2 below represents the estimated projected flow (ADF & 3DWF) demand of the Carrigrennan WwTP across the current and future horizons.

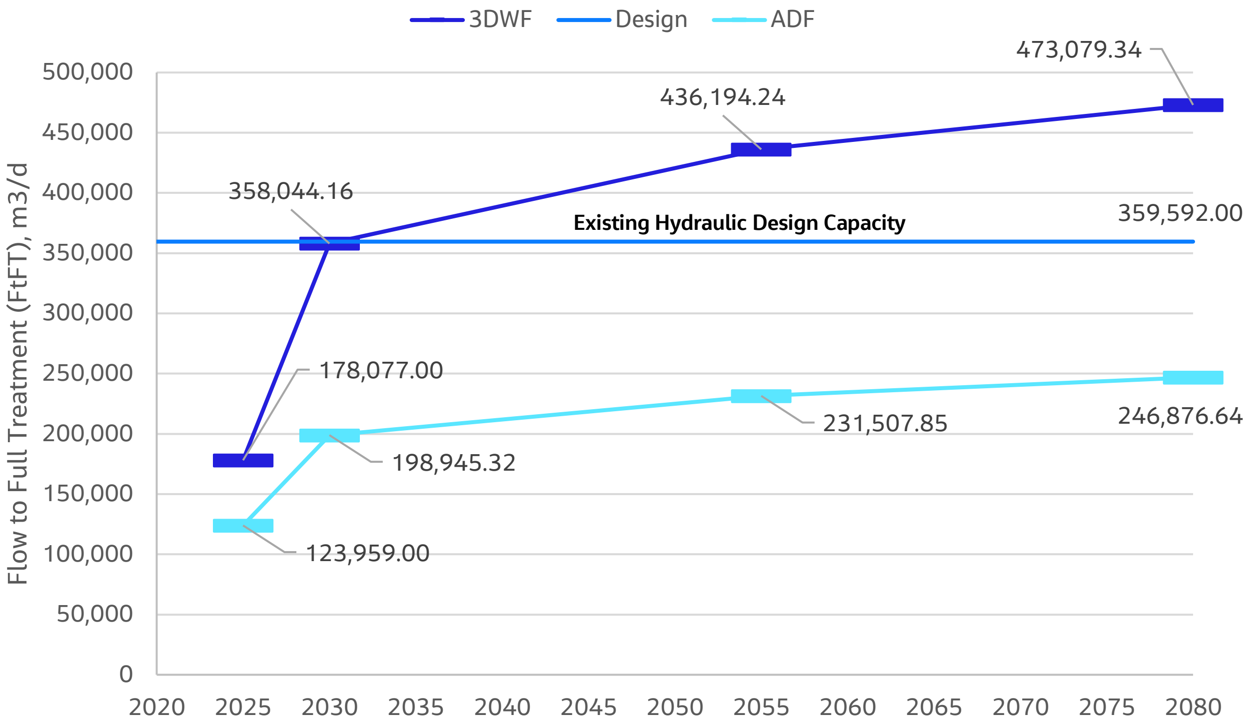


Figure 3-2 - Carrigrennan WwTP Future Flow Projection (Scenario 2)

Using flow Scenario 2, the existing hydraulic capacity is sufficient to meet the 2030 projections. However, the plant is projected to be overloaded hydraulically (3DWF) beyond this horizon. The analysis indicates there is sufficient capacity with respect to ADF for the current and future projected flow loading.

3.4 WwTP Future Nutrient Loading Analysis

This section shall be used to outline the measured load analysis and provide commentary on future load assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

3.4.1 Scenario 1 Load Analysis – Measured Data Only

In this Scenario 1 load analysis, the projected Scenario 1 future horizon flows shall be used in combination with the measured sample data concentrations (see Table 3-5) to derive the projected future nutrient loading. Table 3-9 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 3-9 - Carrigrennan WwTP Future Scenario 1 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	390,857		465,286		500,415	
Horizon ADF (m^3/d)	205,076		241,821		259,163	
BOD (kg/d)	22,701	38,965	26,768	45,946	28,688	49,241

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Suspended Solids (kg/d)	27,065	43,066	31,915	50,782	34,203	54,424
Total Nitrogen (kg/d)	4,132	6,152	4,873	7,255	5,222	7,775
Total Phosphorus (kg/d)	539	860	635	1,014	681	1,087

Note, sample data for influent ammonia concentrations was not available at the time of assessment. Therefore, for any future assessments, ammonia loading derived from the Scenario 3 analysis i.e. using a theoretical PCC of 8 gNH_3/PE/d shall be used.

3.4.2 Scenario 2 Load Analysis – Hybrid Measured & Theoretical Analysis

In this Scenario 2 load analysis, the projected future horizon flows shall be used in combination with the measured sample data concentrations (see Table 3-5) to derive the projected future nutrient loading. Table 3-10 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 3-10 - Carrigrennan WwTP Future Scenario 2 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	390,857		465,286		500,415	
Horizon ADF (m^3/d)	198,945		231,508		246,877	
BOD (kg/d)	22,022	37,800	25,626	43,986	27,328	46,907
Suspended Solids (kg/d)	26,256	41,779	30,554	48,617	32,582	51,844
Total Nitrogen (kg/d)	4,009	5,968	4,665	6,945	4,975	7,406
Total Phosphorus (kg/d)	523	835	608	971	649	1,036

Note, as above, sample data for influent ammonia concentrations was not available at the time of assessment. Therefore, for any future assessments, ammonia loading derived from the Scenario 3 analysis i.e. using a theoretical PCC of 8 gNH_3/PE/d shall be used.

3.4.3 Scenario 3 Load Analysis – Theoretical Analysis Only

In this Scenario 3 load analysis, the projected future horizon PE loading shall be used in combination with theoretical PCCs (see Table 2-2) to derive the projected future nutrient loading. Table 3-11 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 3-11 - Carrigrennan WwTP Future Scenario 3 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	390,857		465,286		500,415	
BOD (kg/d)	23,451	46,903	27,917	55,834	30,025	60,050
Suspended Solids (kg/d)	29,314	58,629	34,896	69,793	37,531	75,062
Total Nitrogen (kg/d)	4,299	8,599	5,118	10,236	5,505	11,009
Total Phosphorus (kg/d)	860	1,720	1,024	2,047	1,101	2,202
Ammonia (kg/d)	3,127	6,254	3,722	7,445	4,003	8,007

3.4.4 Future Load Design Basis

The tables presented within the previous sections can be used to compare the results of the Scenario 1, Scenario 2 and Scenario 3 flow and load analysis.

It is proposed to progress with Scenario 2 at this stage of the strategy for the reasons previously discussed in Section 3.3.4.

4. Shanbally WwTP

4.1 Introduction

Shanbally WwTP also known as Cork Lower Harbour WwTP is located approximately 12 km Southeast of Cork town centre, as shown in Figure 4-1. The wastewater treatment plant was commissioned in 2017. EPS operate and maintain Shanbally WwTP on behalf of Uisce Éireann under a DBO 20-year contract.

The WwTP has a design capacity of 65,000 PE and comprises of; preliminary and secondary treatment. There is also sludge treatment on-site consisting of thickening, digestion, and dewatering.

The Shanbally WwTP catchment comprises the Ringaskiddy, Crosshaven and Carrigaline and Environs agglomerations. The agglomerations comprise domestic wastewater, consisting of residential and commercial flows, as well as part of the non-domestic and/or industrial flow. It is noted the catchment has several major industry discharge licences, including pharmaceutical waste mostly attributed to cleaning flushes. The treated effluent discharges to Lower Cork Harbour, 2.6km from the shore near 'Dog Nose' bank.

According to the data from the 2022 census report the catchment of Shanbally has a domestic population of 29,725 while the UÉ Asset Capacity Register has a current loading PE of 46,314.

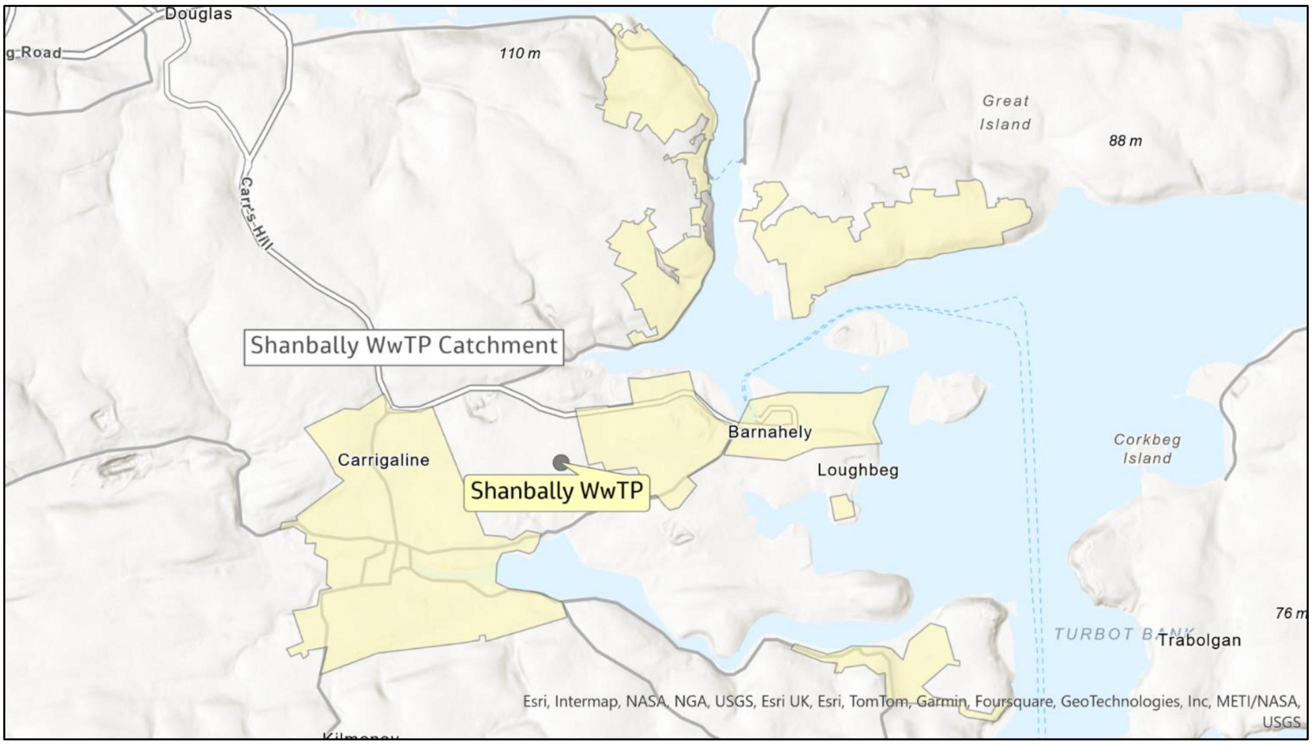


Figure 4-1 - Shanbally WwTP Site Location and Catchment

4.2 Current Flow and Load Summary

In order to evaluate the future horizon WwTP flow and load projections, an assessment of the current WwTP loading was undertaken to understand current catchment characteristics that may influence the future horizon assessment.

In the following sections, commentary will be provided on the interpretation of current organic capacity, the quality and reliability of raw data and recommendations on the preferred future horizon calculation methodology.

4.2.1 Current Wastewater Discharge Licence (WWDL) Summary

The Waste Water Discharge Licence (WWDL) (D0057-01) was originally granted in 2010. The licence was subsequently revised under Technical Amendment B in 2021. It is therefore assumed the reported design PE is based on the amended licence requirements, which are summarised below in Table 4-1.

Table 4-1 - Shanbally WwTP WWDL ELVs (D0057-01)

Parameter	Units	Value
BOD	mg/l	25
COD	mg/l	125
Suspended Solids	mg/l	35
Total Nitrogen (as N)	mg/l	28.5

4.2.2 Latest AER Data

The latest Annual Environmental Report (AER) for Shanbally WwTP was published in 2023. Table 4-2 summarises the WwTP flows received in 2023. The average and maximum annual concentrations for BOD, COD, suspended solids, total phosphorus and total nitrogen are also provided in the 2023 AER and have been summarised in Table 4-3 below.

Table 4-2 – Shanbally WwTP 2023 AER Flow Summary

Parameter	Units	Value
Peak Hydraulic Capacity (FtFT)	m^3/d	-
Design PE	PE	65,000
Dry Weather Flow (DWF)	m^3/d	-
Average Daily Flow (ADF)	m^3/d	18,891
Collected PE Load	PE	47,193

Table 4-3 – Shanbally WwTP 2023 AER Raw Influent Concentration Summary

Parameter	Units	No. Samples	Annual Average	Annual Maximum
BOD	mg/l	26	104	384
COD	mg/l	26	322	1,775
Suspended Solids	mg/l	26	175	1,004
Total Phosphorus (as P)	mg/l	26	4.4	9.1
Total Nitrogen	mg/l	26	21	52

4.2.3 Current Measured Flow Data

Raw influent flow and load data for period of 2020-2022 was obtained for the flow and load data analysis. There were 1,461 No. flow data points across the 3-year period, thus increasing the level of statistical confidence of the data. The following table summarises the measured flow data and the calculated DWF PCC and DWF ratios which have been determined using the 2023 AER Collected PE loading of 47,193 PE, and the methodology discussed in Section 2.1.1.

Table 4-4 – Shanbally WwTP Measured Flow Summary

Parameter	Units	Value
Measured Data Points	No.	1,461
Dry Weather Flow (DWF)	m^3/d	5,360
Average Daily Flow (ADF)	m^3/d	11,076
Flow to Full Treatment (FtFT)	m^3/d	23,374
Maximum	m^3/d	51,944
DWF PCC	L/PE/d	116
DWF:ADF	-	2.07
DWF:FtFT	-	4.43

The measured flow analysis indicates the reported AER values do not align with measured flow data for 2020-2022. Flow data for 2023 was not available at the time of assessment and further analysis of this data would likely align the flow values more closely.

4.2.4 Current Measured Nutrient Loading Data

As discussed, raw influent flow and load data for period of 2020-2022 was obtained for the flow and load data analysis. There were a large number of influent spot samples (~200) for BOD, COD, Suspended Solids, Total N, Total P and Ammonia across the 3-year period with all samples occurring on days with flow meter readings. There were considerably less Total Nitrogen samples (75 No. in total) across the 3-year period, with all samples occurring on days with flow meter readings.

The analysis provides a summary of the average and 95%ile concentrations. A load analysis has been completed which calculates the daily load based on the daily flow reading. The following Table 4-5 summarises the results of the nutrient concentration and loads analysis.

Table 4-5 – Shanbally WwTP Measured Nutrient Concentration and Load Summary

Parameter	Concentrations (mg/l)		Loads (kg/d)	
	Average	95%ile	Average	95%ile
BOD	193	545	1,788	4,539
COD	633	1,589	5,925	15,198
Suspended Solids	317	974	2,876	8,810

Parameter	Concentrations (mg/l)		Loads (kg/d)	
	Average	95%ile	Average	95%ile
Total Phosphorus (TP)	41	76	406	813
Total Nitrogen (TN)	9.2	18	90	170
Measured PE (BOD Basis)	-		29,792	

As shown in the table above, the measured PE was calculated as 29,792 when using a BOD PCC of 60g/PE/d. This is significantly lower than the reported 2023 AER Collected Load of 46,314 PE. Given the difference in measured load, determined using the 3-year sample dataset, it is recommended to use measured concentration results in the future Scenario 1 and Scenario 2 horizon load assessment. Theoretical PCCs shall be used within Scenario 3 to provide comparison.

4.3 WwTP Future Flow Analysis

This section shall be used to outline the measured flow analysis and provide commentary on future flow assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.1

4.3.1 Scenario 1 Flow Analysis – Measured Data Only

The Scenario 1 flow analysis considers the current measured WwTP flow loading, deriving a DWF PCC and DWF:ADF and DWF:FFT ratios to determine the future projected flow loading based on the established projected horizon PE. Table 4-6 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.1.

Table 4-6 - Shanbally WwTP Future Scenario 1 Flow Analysis

Parameter	Units	2030	2055	2080
Current PE	PE	46,314 (116 L/PE/d)		
Horizon PE	PE	66,955	81,307	92,431
Horizon Dry Weather Flow (DWF)	m^3/d	7,749	9,410	10,697
Horizon Average Daily Flow (ADF)	m^3/d	21,712	25,144	27,804
Horizon Flow to Full Treatment (FtFT)	m^3/d	39,315	46,520	52,105
Horizon Industrial Flow	m^3/d	5,700	5,700	5,700

4.3.2 Scenario 2 Flow Analysis – Hybrid Measured & Theoretical Analysis

The Scenario 2 flow analysis considers the current WwTP flow loading (as reported in the 2023 Shanbally WwTP AER) with all additional future flow from the projected PE growth loading determined using theoretical flow PCCs. Table 4-7 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.2.

Note, using the 2023 AER data, (PE loading of 46,314PE and DWF of 14,625 m³/d), the equivalent DWF PCC is 316 L/PE/d which is approximately 40% greater than the theoretical PCC of 225 L/PE/d.

Table 4-7 - Shanbally WwTP Future Scenario 2 Flow Analysis

Parameter	Units	2030	2055	2080
Current PE	PE	46,314 (316 L/PE/d)		
Horizon PE	PE	66,955	81,307	92,431
Horizon Dry Weather Flow (DWF)	m³/d	19,269	22,498	25,001
Horizon Average Daily Flow (ADF)	m³/d	21,065	25,102	28,230
Horizon Flow to Full Treatment (FtFT)	m³/d	57,808	67,495	75,004

4.3.3 Scenario 3 Flow Analysis – Theoretical Analysis

The Scenario 3 flow analysis applies the theoretical flow calculation to the total horizon PE loading projection. The table below provides the projected PE and the resulting DWF, ADF and FfFT for each Strategy horizon. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.3.

Table 4-8 - Shanbally WwTP Future Scenario 3 Flow Analysis

Parameter	Units	2030	2055	2080
Horizon PE	PE	66,955	81,307	92,431
Horizon Dry Weather Flow (DWF)	m³/d	20,765	23,994	26,497
Horizon Average Daily Flow (ADF)	m³/d	25,956	29,993	33,121
Horizon Flow to Full Treatment (FtFT)	m³/d	44,199	52,452	58,848

4.3.4 Future Flow Design Basis

The tables provided in the previous sections can be used to compare the results of the Scenario 1, Scenario 2 and Scenario 3 flow analysis.

At this stage of the strategy, it is proposed to progress with Scenario 2 for the following reasons:

- It provides a more conservative flow estimate for the 2030, 2055 and 2080 future horizons.
- Using the Scenario 2 calculation methodology, the total flow DWF PCCs are 289, 277 and 271 L/PE/d for the 2030, 2055 and 2080 horizons, respectively. Whilst this is much greater than the theoretical DWF PCC, it represents a reduction in per capita water usage compared to the current measured data.

Figure 4-2 below represents the estimated projected flow (ADF & 3DWF) demand of the Shanbally WwTP across the current and future horizons.

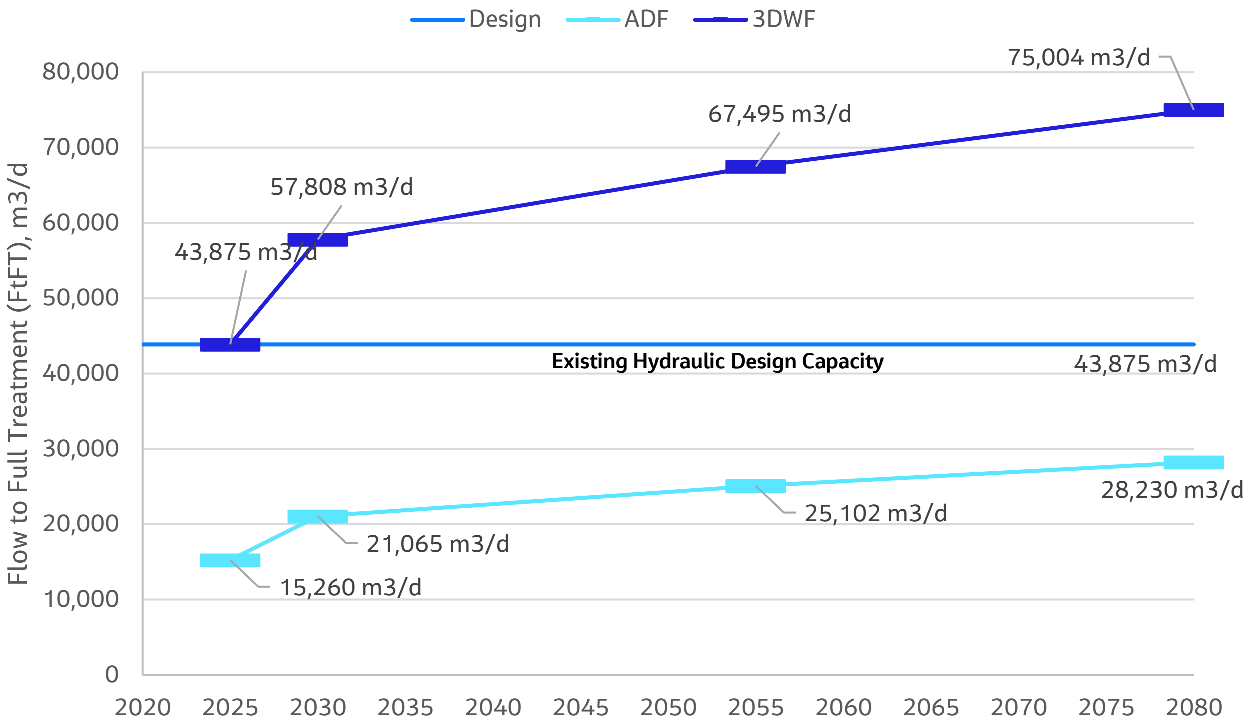


Figure 4-2 - Shanbally WwTP Future Flow Projection (Scenario 2)

4.4 WwTP Future Nutrient Loading Analysis

This section shall be used to outline the measured load analysis and provide commentary on future load assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

4.4.1 Scenario 1 Load Analysis – Measured Data Only

In this Scenario 1 load analysis, the projected Scenario 1 future horizon flows shall be used in combination with the measured sample data concentrations (see Table 4-5) to derive the projected future nutrient loading. Table 4-9 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 4-9 - Shanbally WwTP Future Scenario 1 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	66,955		81,307		92,431	
Horizon ADF (m^3/d)	21,712		25,144		27,804	
BOD (kg/d)	4,191	11,833	4,853	13,703	5,367	15,153
Suspended Solids (kg/d)	6,891	21,139	7,981	24,480	8,825	27,070
Total Nitrogen (kg/d)	897	1,652	1,039	1,913	1,149	2,116

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Total Phosphorus (kg/d)	199	383	230	444	255	490
Ammonia (kg/d)	582	943	674	1,092	746	1,208

4.4.2 Scenario 2 Load Analysis – Hybrid Measured & Theoretical Analysis

In this Scenario 2 load analysis, the projected future horizon flows shall be used in combination with the measured sample data concentrations (see Table 4-5) to derive the projected future nutrient loading. Table 4-10 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 4-10 - Shanbally WwTP Future Scenario 2 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	66,955		81,307		92,431	
Horizon ADF (m^3/d)	21,065		25,102		28,230	
BOD (kg/d)	4,066	11,481	4,845	13,680	5,449	15,386
Suspended Solids (kg/d)	6,686	20,509	7,967	24,439	8,960	27,485
Total Nitrogen (kg/d)	870	1,603	1,037	1,910	1,166	2,148
Total Phosphorus (kg/d)	193	372	230	443	259	498
Ammonia (kg/d)	565	915	673	1,090	757	1,226

4.4.3 Scenario 3 Load Analysis – Theoretical Analysis Only

In this Scenario 3 load analysis, the projected future horizon PE loading shall be used in combination with theoretical PCCs (see Table 2-2) to derive the projected future nutrient loading. Table 4-11 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 4-11 - Shanbally WwTP Future Scenario 3 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	66,955		81,307		92,431	
BOD (kg/d)	4,017	8,035	4,878	9,757	5,546	11,092

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Suspended Solids (kg/d)	5,022	10,043	6,098	12,196	6,932	13,865
Total Nitrogen (kg/d)	737	1,473	894	1,789	1,017	2,033
Total Phosphorus (kg/d)	147	295	179	358	203	407
Ammonia (kg/d)	536	1,071	650	1,301	739	1,479

4.4.4 Future Load Design Basis

The tables presented within the previous sections can be used to compare the results of the Scenario 1, Scenario 2 and Scenario 3 flow and load analysis.

It is proposed to progress with Scenario 2 at this stage of the strategy for the reasons previously discussed in Section 4.3.4

5. Ballincollig WwTP

5.1 Introduction

Ballincollig WwTP is located at Ballincollig/Cork, County Cork. The Ballincollig WwTP Sewerage Scheme caters for the wastewater from the suburb of Ballincollig and its environs in County Cork, as seen in Figure 5-1. There are four pump stations on the network namely Maglin, Leesdale, Carrigrohane and Powder Mills pump stations. Presently Wastewater drainage from the town is conveyed by the collection system to the existing WwTP to the north of the town. Ballincollig WwTP is currently operated by Cork County Council on behalf of Uisce Éireann.

The WwTP and has a design capacity of 33,000 PE. The WwTP accepts septic sludge from other Council run sites such as Ovens and Killumney which is discharged with the raw influent.

The most recent upgrade in 2013/2014 focused mainly on the Inlet Works and included: Storm Tanks, Screening & Compaction, DAF Unit for grease removal and 4 No. new Aeration Blowers. The Wastewater Treatment Plant comprises preliminary and secondary treatment. There is also sludge treatment on-site consisting of a picket fence thickener and centrifuge for sludge thickening and dewatering purposes. Treated wastewater is discharged to the River Lee.

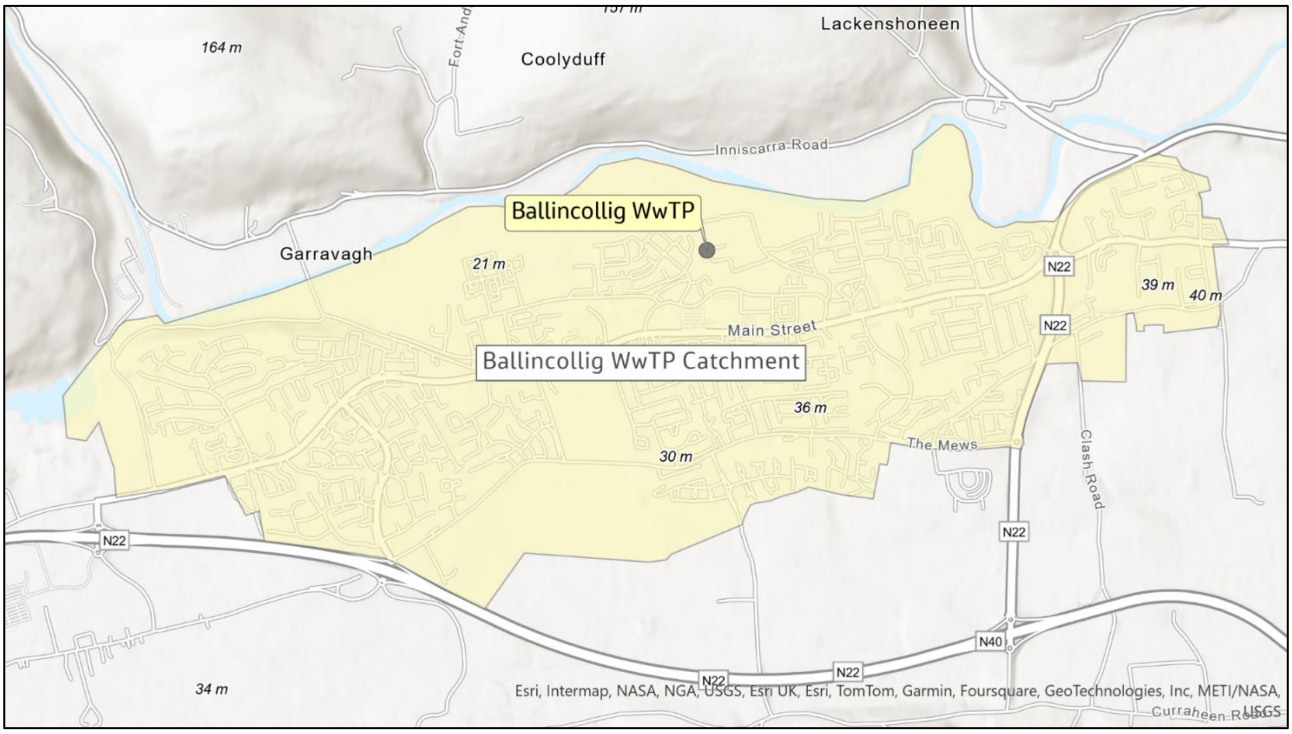


Figure 5-1 - Ballincollig WwTP Site Location and Catchment

5.2 Current Flow and Load Summary

In order to evaluate the future horizon WwTP flow and load projections, an assessment of the current WwTP loading was undertaken to understand current catchment characteristics that may influence the future horizon assessment.

In the following sections, commentary will be provided on the interpretation of current organic capacity, the quality and reliability of raw data and recommendations on the preferred future horizon calculation methodology.

5.2.1 Current Wastewater Discharge Licence (WWDL) Summary

The Waste Water Discharge Licence (WWDL) (D0049-01) was originally granted in 2008. The licence was subsequently revised under Technical Amendment C in 2021. It is therefore assumed the reported design PE is based on the amended licence requirements, which are summarised below in Table 5-1.

Table 5-1 - Ballincollig WwTP WWDL ELVs (D0049-01)

Parameter	Units	Value
PE	PE	33,000
BOD	mg/l	25
COD	mg/l	125
Suspended Solids	mg/l	34
Total Phosphorus (as P)	mg/l	2
Orthophosphate (as P)	mg/l	2
Total Nitrogen (as N)	mg/l	15
Ammonia (as N)	mg/l	5

5.2.2 Latest AER Data

The latest Annual Environmental Report (AER) for Ballincollig WwTP was published in 2022. Table 5-2 summarises the WwTP flows received in 2023. The average and maximum annual concentrations for BOD, COD, Suspended Solids, Total P, Total N and Ammonia are also provided in the 2023 AER and have been summarised in Table 5-3.

Table 5-2 – Ballincollig WwTP 2023 AER Flow Summary

Parameter	Units	Value
Peal Hydraulic Capacity (FtFT)	m^3/d	22,275
Design PE	PE	33,000
Dry Weather Flow (DWF)	m^3/d	7,425
Average Daily Flow (ADF)	m^3/d	13,755
Collected PE Load	PE	23,290

Table 5-3 – Ballincollig WwTP 2023 AER Raw Influent Concentration Summary

Parameter	Units	No. Samples	Annual Average	Annual Maximum
BOD	mg/l	16	230	641
COD	mg/l	16	510	1,282

Suspended Solids	mg/l	16	214	690
Total Phosphorus (as P)	mg/l	16	5.89	9.03
Total Nitrogen	mg/l	16	65	94
Ammonia (as N)	mg/l	4	59	74

The Ballincollig WwTP also accepts landfill leachate and septic tank discharges which are delivered via tanker. The 2023 AER reports the annual discharges quantities as 2,905 tonnes and 4,696 tonnes for leachate and septic tank sludge discharges, respectively. It should be noted that the annual discharge in 2023 constituted a negligible additional load to the WwTP load. It is assumed the future strategy flow and load projections will account for increased leachate, septic tank and sludge discharges over the strategy horizons. It should also be noted, the AER reports there is no current facility for acceptance of leachate and septic tank sludges which should be considered in any optioneering upgrade.

5.2.3 Current Measured Flow Data

Raw influent flow and load data for period of 2020-2023 was obtained for the flow and load data analysis. There were 32 No. flow data points across the 4-year period, thus reducing the level of statistical confidence of the data. It is therefore not recommended to use this data, which discounts the use of Flow Scenario 1. The following table summarises the measured flow data and the calculated DWF PCC and DWF ratios which have been determined using the 2023 AER Collected PE loading of 23,836 PE, and the methodology discussed in Section 2.1.1.

Table 5-4 – Ballincollig WwTP Measured Flow Summary

Parameter	Units	Value
Measured Data Points	No.	32
Dry Weather Flow (DWF)	m^3/d	3,033
Average Daily Flow (ADF)	m^3/d	4,436
Flow to Full Treatment (FtFT)	m^3/d	7,460
Maximum	m^3/d	9,659
DWF PCC	L/PE/d	0.127
DWF:ADF	-	1.46
DWF:FtFT	-	2.46

The measured DWF and ADF do not correlate with flows recorded in the 2023 AER as shown in Table 5-2 and Table 5-4.

5.2.4 Current Measured Nutrient Loading Data

As discussed, raw influent flow and load data for period of 2020-2023 was obtained for the flow and load data analysis. There were 46-49 influent spot samples for each of BOD, COD, Suspended Solids Total N and Total P across the 3-year period with 31 samples occurring on days with flow meter readings.

The analysis provides a summary of the average and 95%ile concentrations. A load analysis has been completed which calculates the daily load based on the daily flow reading. In this instance, there are only 23 No. datapoints where flow and sample day exist. The following Table 5-5 summarises the results of the nutrient concentration and loads analysis.

Table 5-5 – Ballincollig WwTP Measured Nutrient Concentration and Load Summary

Parameter	Concentrations (mg/l)		Loads (kg/d)	
	Average	95%ile	Average	95%ile
BOD	220	350	948	1,817
COD	495	863	2,178	4,609
Suspended Solids	207	409	953	2,089
Total Nitrogen (TN)	57.2	87.5	236	421
Total Phosphorus (TP)	6.3	11.2	27	53
Measured PE (BOD Basis)	-		15,796	

As shown in the table above, the measured PE was calculated as 15,796, when using a BOD PCC of 60g/PE/d. This is significantly lower than the reported 2023 AER Collected Load of 23,836 PE. Given the difference in measured load determined using the 3-year sample dataset, it is recommended to use measured concentration results in the future Scenario 1 and Scenario 2 horizon load assessment. Theoretical PCCs shall be used within Scenario 3 to provide comparison.

5.3 WwTP Future Flow Analysis

This section shall be used to outline the measured flow analysis and provide commentary on future flow assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.1

5.3.1 Scenario 1 Flow Analysis – Measured Data Only

As discussed in the previous section, it is not recommended to use the measured flow data for Ballincollig WwTP given the low number of data points and misalignment with the 2023 reporting. Therefore, the Scenario 1 flow analysis has not been included within this report.

5.3.2 Scenario 2 Flow Analysis – Hybrid Measured & Theoretical Analysis

The Scenario 2 flow analysis considers the current WwTP flow loading (as reported in the 2023 Ballincollig WwTP AER) with all additional future flow from the projected PE growth loading determined using theoretical flow PCCs. Table 5-6 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.2.

Note, using the 2023 AER data, (PE loading of 23,836 PE and DWF of 4,850m^3/d), the equivalent DWF PCC is 203 L/PE/d which is closely aligns with the theoretical PCC of 225 L/PE/d.

Table 5-6 - Ballincollig WwTP Future Scenario 2 Flow Analysis

Parameter	Units	2030	2055	2080
Current PE	PE	23,836 (203 L/PE/d)		
Horizon PE	PE	37,755	59,486	67,214
Horizon Dry Weather Flow (DWF)	m^3/d	7,984	12,874	14,613
Horizon Average Daily Flow (ADF)	m^3/d	11,343	17,455	19,628
Horizon Flow to Full Treatment (FtFT)	m^3/d	23,953	38,622	43,838

5.3.3 Scenario 3 Flow Analysis – Theoretical Analysis

The Scenario 3 flow analysis applies the theoretical flow calculation to the total horizon PE loading projection. The table below provides the projected PE and the resulting DWF, ADF and FfFT for each Strategy horizon. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.3.

Table 5-7 - Ballincollig WwTP Future Scenario 3 Flow Analysis

Parameter	Units	2030	2055	2080
Horizon PE	PE	37,755	59,486	67,214
Horizon Dry Weather Flow (DWF)	m^3/d	8,498	13,387	15,126
Horizon Average Daily Flow (ADF)	m^3/d	10,622	16,734	18,907
Horizon Flow to Full Treatment (FtFT)	m^3/d	21,712	34,207	38,651

5.3.4 Future Flow Design Basis

The tables provided in the previous sections can be used to compare the results of the Scenario 1, Scenario 2 and Scenario 3 flow analysis.

At this stage of the strategy, it is proposed to progress with Scenario 2 for the following reasons:

- It provides a more conservative flow estimate for the 2030, 2055 and 2080 future horizons.
- Using the Scenario 2 calculation methodology, the total flow DWF PCCs are 212, 216 and 217 L/PE/d for the 2030, 2055 and 2080 horizons, respectively. Whilst this is much greater than the theoretical DWF PCC, it represents a reduction in per capita water usage compared to the current measured data.

Figure 5-2 below represents the estimated projected flow (ADF & 3DWF) demand of the Ballincollig WwTP across the current and future horizons.

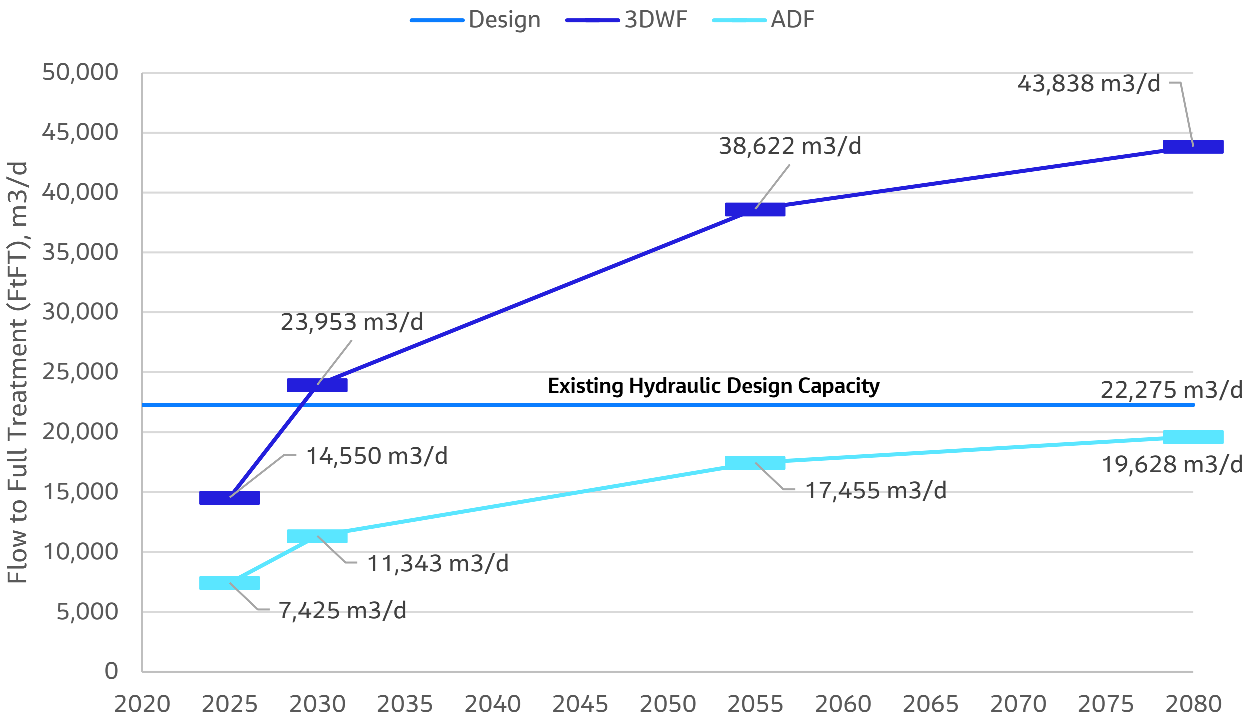


Figure 5-2 - Ballincollig WwTP Future Flow Projection (Scenario 2)

Using flow Scenario 2, the existing hydraulic capacity is insufficient to meet the future strategy horizon 3DWF projections. However, there is sufficient capacity to meet the future strategy projections for ADF.

5.4 WwTP Future Nutrient Loading Analysis

This section shall be used to outline the measured load analysis and provide commentary on future load assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

5.4.1 Scenario 1 Load Analysis – Measured Data Only

As discussed in Section 5.3.1, the measured flow data does not provide sufficient statistical analysis confidence and is therefore not recommended for use within this assessment. The Scenario 1 load analysis has therefore not been included within this report.

5.4.2 Scenario 2 Load Analysis – Hybrid Measured & Theoretical Analysis

In this Scenario 2 load analysis, the projected future horizon flows shall be used in combination with the measured sample data concentrations (see Table 5-5) to derive the projected future nutrient loading. Table 5-8 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 5-8 - Ballincollig WwTP Future Scenario 2 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	37,755		59,486		67,214	

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon ADF (m^3/d)	11,343		17,455		19,628	
BOD (kg/d)	2,495	3,970	3,840	6,109	4,318	6,870
Suspended Solids (kg/d)	2,343	4,635	3,605	7,133	4,054	8,021
Total Nitrogen (kg/d)	649	993	999	1,528	1,123	1,718
Total Phosphorus (kg/d)	72	127	110	196	124	221

Note, as above, sample data for influent ammonia concentrations was not available at the time of assessment. Therefore, for any future assessments, ammonia loading derived from the Scenario 3 analysis i.e. using a theoretical PCC of 8 gNH_3/PE/d shall be used.

5.4.3 Scenario 3 Load Analysis – Theoretical Analysis Only

In this Scenario 3 load analysis, the projected future horizon PE loading shall be used in combination with theoretical PCCs (see Table 2-2) to derive the projected future nutrient loading. Table 5-9 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 5-9 - Ballincollig WwTP Future Scenario 3 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	37,755		59,486		67,214	
BOD (kg/d)	2,265	4,531	3,569	7,138	4,033	8,066
Suspended Solids (kg/d)	2,832	5,663	4,461	8,923	5,041	10,082
Total Nitrogen (kg/d)	415	831	654	1,309	739	1,479
Total Phosphorus (kg/d)	83	166	131	262	148	296
Ammonia (kg/d)	302	604	476	952	538	1,075

5.4.4 Future Load Design Basis

The tables presented within the previous sections can be used to compare the results of the Scenario 2 and Scenario 3 flow and load analysis.

It is proposed to progress with Scenario 2 at this stage of the strategy for the reasons previously discussed in Section 5.3.4.

6. Carrigtwohill WwTP

6.1 Introduction

Carrigtwohill WwTP is located at Tullagreen to the south of Carrigtwohill, County Cork, as seen in Figure 6-1. The WwTP was commissioned in 2016 and is operated and maintained by EPS on behalf of Uisce Éireann under a 20-year DBO contract.

The WwTP has a design capacity of 30,000 PE and comprises of; preliminary and secondary treatment. There is also sludge treatment on-site consisting of sludge thickening and dewatering.

The plant treats mainly industrial loads with little domestic loads. Treated effluent is discharged via a 1.28km long outfall pipe into the Slatty Waters Estuary. This waterbody belongs to the Great Island Channel SAC and SPA.

According to the data from the 2022 census report the catchment of Carrigtwohill indicates a domestic population of 5,568 while the UÉ Asset Capacity Register, has a current loading PE of 8,654.

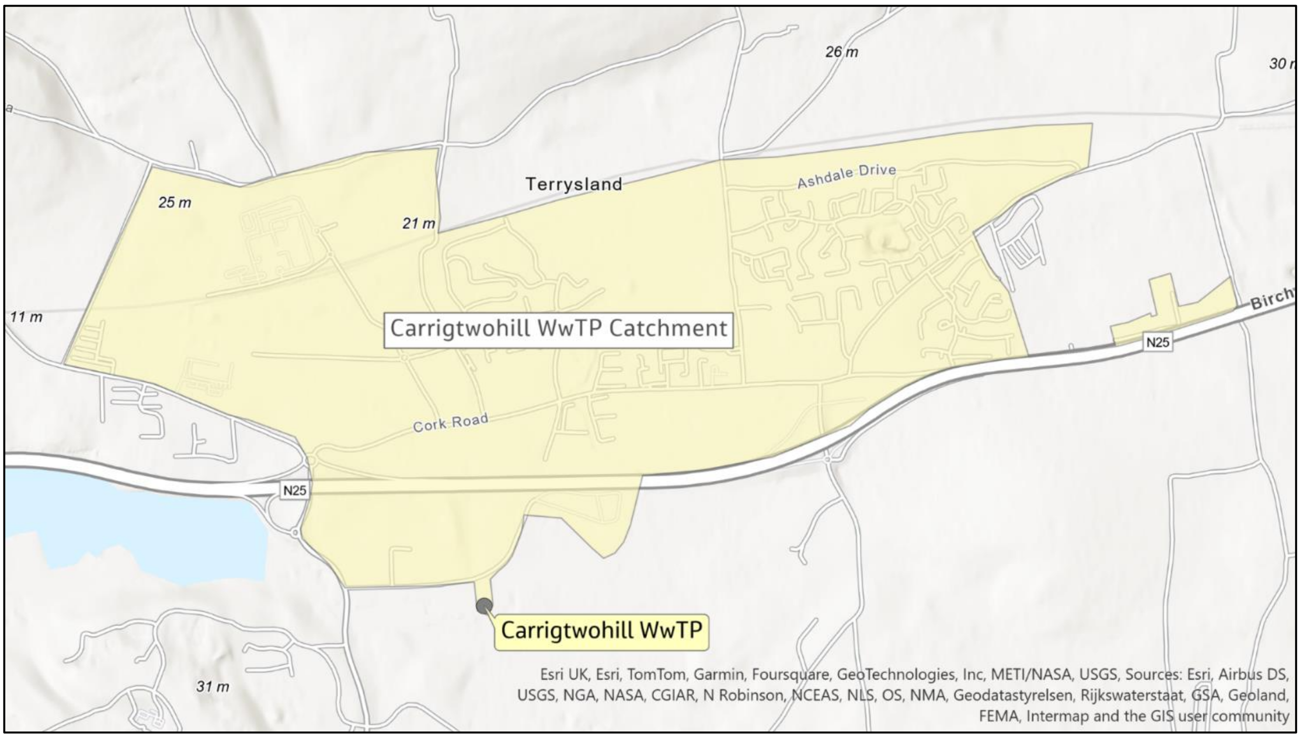


Figure 6-1 - Carrigtwohill WwTP Site Location and Catchment

6.2 Current Flow and Load Summary

In order to evaluate the future horizon WwTP flow and load projections, an assessment of the current WwTP loading was undertaken to understand current catchment characteristics that may influence the future horizon assessment.

In the following sections, commentary will be provided on the interpretation of current organic capacity, the quality and reliability of raw data and recommendations on the preferred future horizon calculation methodology.

6.2.1 Current Wastewater Discharge Licence (WWDL) Summary

The Waste Water Discharge Licence (WWDL) (D0044-01) was originally granted in 2014. The licence was subsequently revised under Technical Amendment B in 2021. It is therefore assumed the reported design PE is based on the amended licence requirements, which are summarised below Table 6-1.

Table 6-1 - Carrigtwohill WwTP WWDL ELVs (D0044-01)

Parameter	Units	Value
BOD	mg/l	25
COD	mg/l	125
Suspended Solids	mg/l	35
Total Phosphorus (as P)	mg/l	1
Orthophosphate (as P)	mg/l	0.5
Total Ammonia (as N)	mg/l	5
Total Oxidised Nitrogen (TON)	mg/l	20

6.2.2 Latest AER Data

The latest Annual Environmental Report (AER) for Carrigtwohill WwTP was published in 2022. Table 6-2 summarises the WwTP flows received in 2023. The average and maximum annual concentrations for BOD, COD, Suspended Solids, Total P and Total N are also provided in the 2023 AER and have been summarised in Table 6-3.

Table 6-2 – Carrigtwohill WwTP 2023 AER Flow Summary

Parameter	Units	Value
Peak Hydraulic Capacity (FtFT)	m^3/d	20,250
Design PE	PE	30,000
Dry Weather Flow (DWF)	m^3/d	6,750
Average Daily Flow (ADF)	m^3/d	5,965
Collected PE Load	PE	9,480

Note, the reported DWF is greater than the ADF which is assumed to be an error. Subsequent sections assume the DWF is 5,965 m^3/d and the ADF is 6,750 m^3/d.

Table 6-3 – Carrigtwohill WwTP 2023 AER Raw Influent Concentration Summary

Parameter	Units	No. Samples	Annual Average	Annual Maximum
BOD	mg/l	4	59	92

Parameter	Units	No. Samples	Annual Average	Annual Maximum
COD	mg/l	4	239	421
Suspended Solids	mg/l	4	145	170
Total Phosphorus (as P)	mg/l	4	1.97	3.85
Total Nitrogen	mg/l	4	11	18

The Carrigtwohill WwTP also accepts landfill leachate, septic tank discharges and industrial/commercial sludges which are delivered via tanker. The 2023 AER reports the annual discharges quantities as 8,571 tonnes, 8,289 tonnes and 4,864 tonnes for leachate, septic tank and sludge discharges, respectively. It should be noted that the annual discharge in 2023 only constituted less than 1% of the total WwTP load. It is assumed the future strategy flow and load projections will account for increased leachate, septic tank and sludge discharges over the strategy horizons. It should also be noted, the AER reports there is no current facility for acceptance of septic tanks and sludge which should be considered in any optioneering upgrade.

6.2.3 Current Measured Flow Data

Raw influent flow and load data for period of 2020-2022 was obtained for the flow and load data analysis. There were 1,095 No. flow data points across the 3-year period, thus increasing the level of statistical confidence of the data. The following table summarises the measured flow data and the calculated DWF PCC and DWF ratios which have been determined using the 2023 AER Collected PE loading of 9,480 PE, and the methodology discussed in Section 2.1.1.

Table 6-4 – Carrigtwohill WwTP Measured Flow Summary

Parameter	Units	Value
Measured Data Points	No.	1,095
Dry Weather Flow (DWF)	m^3/d	3,368
Average Daily Flow (ADF)	m^3/d	5,136
Flow to Full Treatment (FtFT)	m^3/d	7,482
Maximum	m^3/d	13,935
DWF PCC	L/PE/d	355
DWF:ADF	-	1.53
DWF:FtFT	-	1.95

The measured DWF and ADF do not correlate with flows recorded in the 2023 AER as shown in Table 6-2 and Table 6-4. The measured data indicates a DWF PCC of 355 L/PE/d, however the AER data indicates a DWF PCC of 629 L/PE/d. This shall be taken into consideration in the flow scenario selection to be used within the strategy.

6.2.4 Current Measured Nutrient Loading Data

As discussed, raw influent flow and load data for period of 2020-2022 was obtained for the flow and load data analysis. There were a large number of influent spot samples for BOD, COD, Suspended Solids, Total N, Total P and Ammonia across the 3-year period with most samples occurring on days with flow meter readings.

The analysis provides a summary of the average and 95%ile concentrations. A load analysis has been completed which calculates the daily load based on the daily flow reading. The following Table 6-5 summarises the results of the nutrient concentration and loads analysis.

Table 6-5 – Carrigtwohill WwTP Measured Nutrient Concentration and Load Summary

Parameter	Concentrations (mg/l)		Loads (kg/d)	
	Average	95%ile	Average	95%ile
BOD	93	210	466	1,134
COD	257	580	1,273	2,776
Suspended Solids	165	378	852	2,066
Total Phosphorus (TP)	26	52	129	251
Total Nitrogen (TN)	5.1	11.0	25	50
Ammonia	14	30	70	149
Measured PE (BOD Basis)	-		7,766	

As shown in the table above, the measured PE was calculated as 7,766 when using a BOD PCC of 60g/PE/d. This is lower than the reported 2023 AER Collected Load of 9,480 PE. Given the difference in measured load, determined using the 3-year sample dataset, it is recommended to use measured concentration results in the future Scenario 1 and Scenario 2 horizon load assessment. Theoretical PCCs shall be used within Scenario 3 to provide comparison.

6.3 WwTP Future Flow Analysis

This section shall be used to outline the measured flow analysis and provide commentary on future flow assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.1

6.3.1 Scenario 1 Flow Analysis – Measured Data Only

The Scenario 1 flow analysis considers the current measured WwTP flow loading, deriving a DWF PCC and DWF:ADF and DWF:FFT ratios to determine the future projected flow loading based on the established projected horizon PE. Table 6-6 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.1.

Table 6-6 - Carrigtwohill WwTP Future Scenario 1 Flow Analysis

Parameter	Units	2030	2055	2080
Current PE	PE	9,480 (355 L/PE/d)		

Parameter	Units	2030	2055	2080
Horizon PE	PE	16,017	19,047	20,840
Horizon Dry Weather Flow (DWF)	m^3/d	5,690	6,767	7,403
Horizon Average Daily Flow (ADF)	m^3/d	9,591	11,232	12,204
Horizon Flow to Full Treatment (FtFT)	m^3/d	12,012	14,111	15,354

6.3.2 Scenario 2 Flow Analysis – Hybrid Measured & Theoretical Analysis

The Scenario 2 flow analysis considers the current WwTP flow loading (as reported in the 2023 Carrigtwohill WwTP AER) with all additional future flow from the projected PE growth loading determined using theoretical flow PCCs. Table 6-7 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.2.

Note, using the 2023 AER data, (PE loading of 9,480PE and DWF of 5,965 m^3/d), the equivalent DWF PCC is 629 L/PE/d which is approximately 3.6 times greater than the theoretical PCC of 175 L/PE/d.

Table 6-7 - Carrigtwohill WwTP Future Scenario 2 Flow Analysis

Parameter	Units	2030	2055	2080
Current PE	PE	9,480 (629 L/PE/d)		
Horizon PE	PE	16,017	19,047	20,840
Horizon Dry Weather Flow (DWF)	m^3/d	7,735	8,417	8,820
Horizon Average Daily Flow (ADF)	m^3/d	8,962	9,815	10,319
Horizon Flow to Full Treatment (FtFT)	m^3/d	23,205	25,250	26,460

6.3.3 Scenario 3 Flow Analysis – Theoretical Analysis

The Scenario 3 flow analysis applies the theoretical flow calculation to the total horizon PE loading projection. The table below provides the projected PE and the resulting DWF, ADF and FfFT for each Strategy horizon. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.3.

Table 6-8 - Carrigtwohill WwTP Future Scenario 3 Flow Analysis

Parameter	Units	2030	2055	2080
Horizon PE	PE	16,017	19,047	20,840
Horizon Dry Weather Flow (DWF)	m^3/d	3,903	4,585	4,988
Horizon Average Daily Flow (ADF)	m^3/d	4,879	5,731	6,235
Horizon Flow to Full Treatment (FtFT)	m^3/d	9,509	11,251	12,282

6.3.4 Future Flow Design Basis

The tables provided in the previous sections can be used to compare the results of the Scenario 1, Scenario 2 and Scenario 3 flow analysis.

At this stage of the strategy, it is proposed to discuss Scenario progression further with Uisce Éireann for the following reasons:

- Whilst Scenario 2 provides a more conservative FtFT estimate however a less conservative ADF estimate for the 2030, 2055 and 2080 future horizons, it may be overestimating future flows given the disparity between Scenario 1 and Scenario 3 flow assessments.
- The Scenario 2 DWF PCCs range between 423 and 483 L/PE/d which are considerably greater than the measured and theoretical DWF PCCs.

Figure 6-2 below represents the estimated projected flow (ADF & 3DWF) demand of the Carrigtwohill WwTP across the current and future horizons, for all three Scenarios.

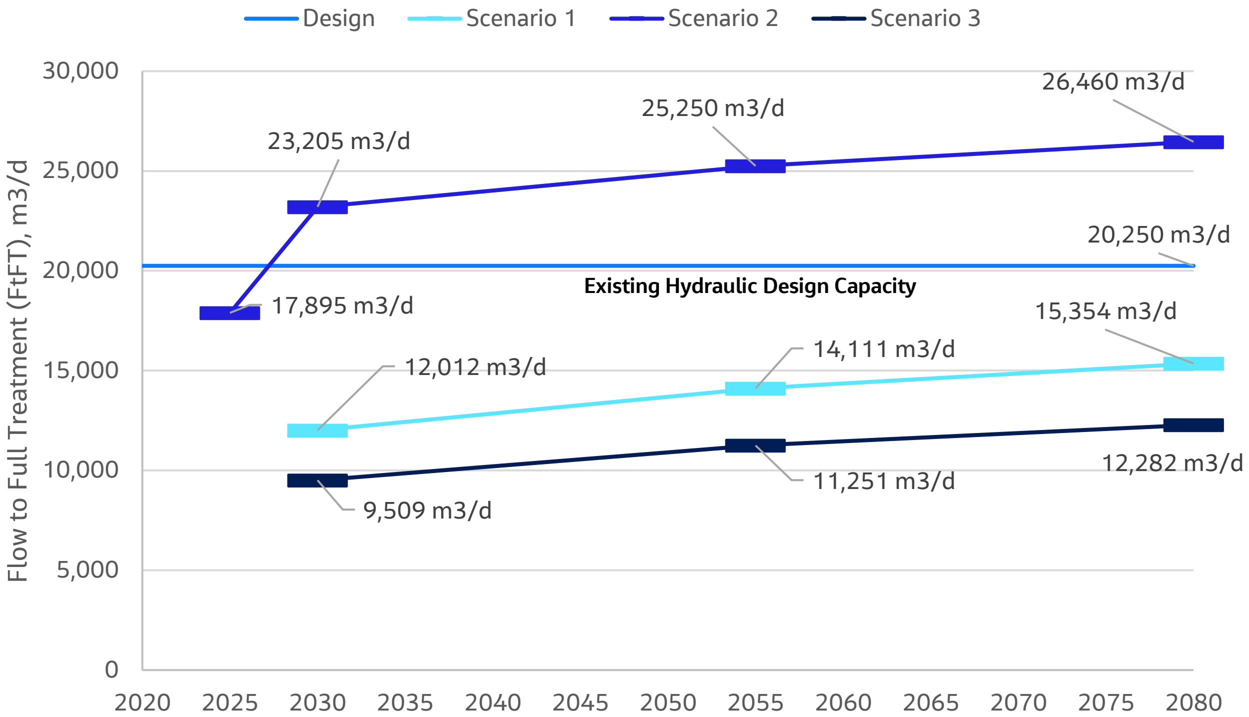


Figure 6-2 - Carrigtwohill WwTP Future Flow Projection (All Scenarios)

Using flow Scenario 2, the existing hydraulic capacity will be insufficient to meet all future strategy 3DWF projections. However, using Scenario 1 and Scenario 3, there is sufficient existing capacity to meeting all future strategy 3DWF projections.

6.4 WwTP Future Nutrient Loading Analysis

This section shall be used to outline the measured load analysis and provide commentary on future load assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

6.4.1 Scenario 1 Load Analysis – Measured Data Only

In this Scenario 1 load analysis, the projected Scenario 1 future horizon flows shall be used in combination with the measured sample data concentrations (see Table 6-5) to derive the projected future nutrient loading. Table 6-9 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 6-9 - Carrigtwohill WwTP Future Scenario 1 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	16,017		19,047		20,840	
Horizon ADF (m^3/d)	9,591		11,232		12,204	
BOD (kg/d)	894	2,011	1,047	2,355	1,137	2,559
Suspended Solids (kg/d)	1,582	3,622	1,852	4,241	2,012	4,608
Total Nitrogen (kg/d)	246	494	289	579	313	629
Total Phosphorus (kg/d)	49	106	58	124	63	134
Ammonia (kg/d)	134	286	157	335	170	364

6.4.2 Scenario 2 Load Analysis – Hybrid Measured & Theoretical Analysis

In this Scenario 2 load analysis, the projected future horizon flows shall be used in combination with the measured sample data concentrations (see Table 6-5) to derive the projected future nutrient loading. Table 6-10 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 6-10 - Carrigtwohill WwTP Future Scenario 2 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	16,017		19,047		20,840	
Horizon ADF (m^3/d)	8,962		9,815		10,319	
BOD (kg/d)	835	1,879	915	2,058	962	2,164
Suspended Solids (kg/d)	1,478	3,384	1,618	3,706	1,702	3,896
Total Nitrogen (kg/d)	230	462	252	506	265	532
Total Phosphorus (kg/d)	46	99	51	108	53	114
Ammonia (kg/d)	125	267	137	293	144	308

6.4.3 Scenario 3 Load Analysis – Theoretical Analysis Only

In this Scenario 3 load analysis, the projected future horizon PE loading shall be used in combination with theoretical PCCs (see Table 2-2) to derive the projected future nutrient loading. Table 6-11 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 6-11 - Carrigtwohill WwTP Future Scenario 3 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	16,017		19,047		20,840	
BOD (kg/d)	961	1,922	1,143	2,286	1,250	2,501
Suspended Solids (kg/d)	1,201	2,403	1,429	2,857	1,563	3,126
Total Nitrogen (kg/d)	176	352	210	419	229	458
Total Phosphorus (kg/d)	35	70	42	84	46	92
Ammonia (kg/d)	128	256	152	305	167	333

6.4.4 Future Load Design Basis

The tables presented within the previous sections can be used to compare the results of the Scenario 1, Scenario 2 and Scenario 3 flow and load analysis.

It is proposed to progress with Scenario 2 at this stage of the strategy for the reasons previously discussed in Section 6.3.4.

7. Midleton WwTP

7.1 Introduction

Midleton WwTP is located south-west of Midleton town, as seen in Figure 7-1. The plant was commissioned in 2000 and had an M&E upgrade in 2011.

The WwTP has a design capacity of 15,000 PE and comprises of; preliminary treatment (screening and grit removal), secondary treatment (extended aeration followed by clarification), final settlement and tertiary treatment (UV disinfection). There is also sludge treatment on-site consisting of thickening, and dewatering stages. There are no storm tanks at Midleton WwTP. The treated wastewater is discharged into North Channel Great Island (Owenacurra Estuary) waterbody which is a designated SAC and SPA.

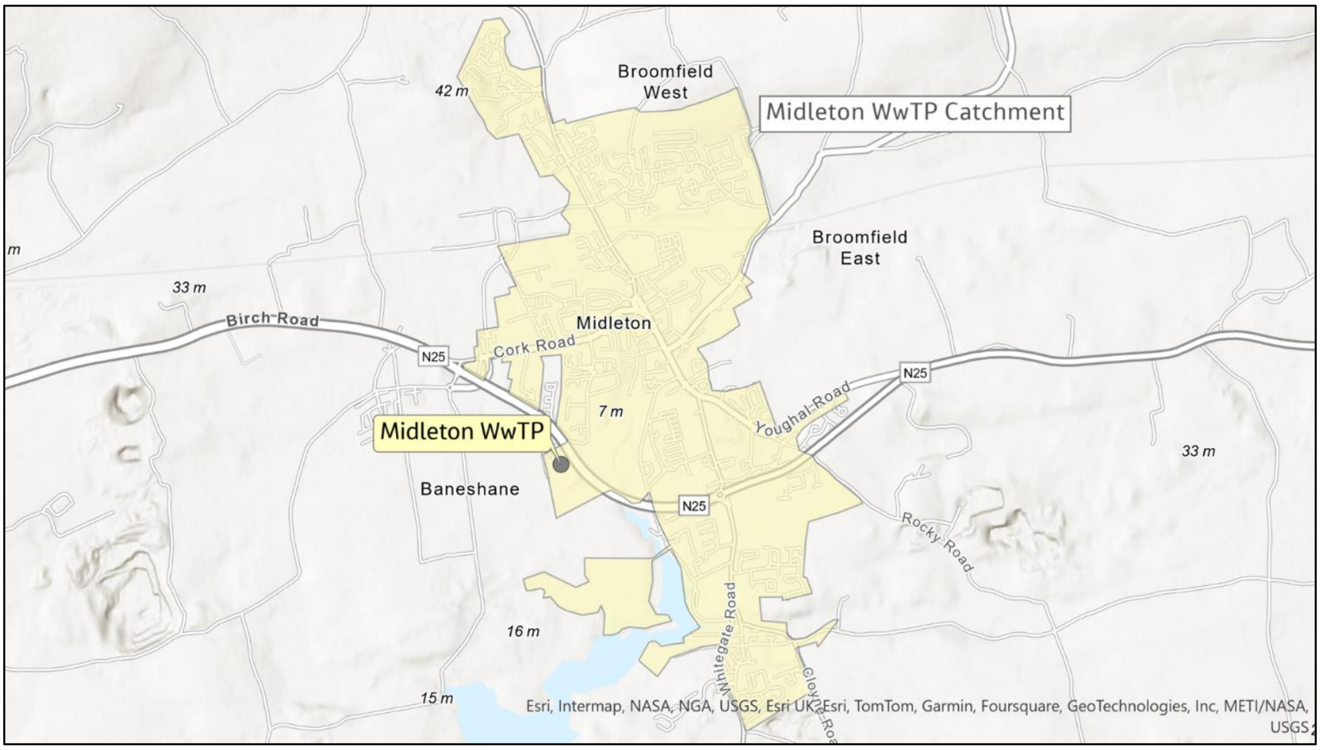


Figure 7-1 - Midleton WwTP Site Location and Catchment

7.2 Current Flow and Load Summary

In order to evaluate the future horizon WwTP flow and load projections, an assessment of the current WwTP loading was undertaken to understand current catchment characteristics that may influence the future horizon assessment.

In the following sections, commentary will be provided on the interpretation of current organic capacity, the quality and reliability of raw data and recommendations on the preferred future horizon calculation methodology.

7.2.1 Current Wastewater Discharge Licence (WWDL) Summary

The Waste Water Discharge Licence (WWDL) (D0056-01) was originally granted in 2011. The licence was subsequently revised under Technical Amendment C in 2021. It is therefore assumed the reported design PE is based on the amended licence requirements, which are summarised below in Table 7-1.

Table 7-1 - Midleton WwTP WWDL ELVs (D0056-01)

Parameter	Units	Value
BOD	mg/l	25
COD	mg/l	125
Suspended Solids	mg/l	35
Total nitrogen (as N)	mg/l	15

7.2.2 Latest AER Data

The latest Annual Environmental Report (AER) for Midleton WwTP was published in 2023. Table 7-2 summarises the WwTP flows received in 2023. The average and maximum annual concentrations for BOD, COD and Total N are also provided in the 2023 AER and have been summarised in Table 7-3 below.

Table 7-2 – Midleton WwTP 2023 AER Flow Summary

Parameter	Units	Value
Peak Hydraulic Capacity (FtFT)	m^3/d	10,368
Design PE	PE	15,000
Dry Weather Flow (DWF)	m^3/d	3,456
Average Daily Flow (ADF)	m^3/d	9,242
Collected PE Load	PE	17,042

Table 7-3 – Midleton WwTP 2023 AER Raw Influent Concentration Summary

Parameter	Units	No. Samples	Annual Average	Annual Maximum
BOD	mg/l	12	125	255
COD	mg/l	12	318	603
Total Nitrogen	mg/l	12	26	54

7.2.3 Current Measured Flow Data

Raw influent flow and load data for period of 2020-2022 was obtained for the flow and load data analysis. There were 1,096 No. flow data points across the 3-year period, thus increasing the level of statistical confidence of the data. The following table summarises the measured flow data and the calculated DWF PCC and DWF ratios which have been determined using the 2023 AER Collected PE loading of 17,042 PE, and the methodology discussed in Section 2.1.1.

Table 7-4 – Midleton WwTP Measured Flow Summary

Parameter	Units	Value
Measured Data Points	No.	1,096
Dry Weather Flow (DWF)	m^3/d	5,634
Average Daily Flow (ADF)	m^3/d	8,210
Flow to Full Treatment (FtFT)	m^3/d	11,733
Maximum	m^3/d	14,104
DWF PCC	L/PE/d	331
DWF:ADF	-	1.46
DWF:FtFT	-	2.08

Whilst the measured ADF of 8,210 m^3/d relatively aligns with the 2023 AER reported ADF of 9,242 m^3/d, there is a vast difference between the measured DWF of 5,634 m^3/d and the 2022 AER reported DWF of 3,456 m^3/d.

Note, the measured FtFT and maximum recorded flows are greater than the plants hydraulic design capacity of 10,368 m^3/d.

7.2.4 Current Measured Nutrient Loading Data

As discussed, raw influent flow and load data for period of 2020-2022 was obtained for the flow and load data analysis. There were a large number of influent spot samples for BOD, COD, Suspended Solids, Total N, Total P and Ammonia across the 3-year period with the majority samples occurring on days with flow meter readings.

The analysis provides a summary of the average and 95%ile concentrations. A load analysis has been completed which calculates the daily load based on the daily flow reading. The following Table 7-5 summarises the results of the nutrient concentration and loads analysis.

Table 7-5 – Midleton WwTP Measured Nutrient Concentration and Load Summary

Parameter	Concentrations (mg/l)		Loads (kg/d)	
	Average	95%ile	Average	95%ile
BOD	106	202	813	1,457
COD	260	562	2,024	4,253
Suspended Solids	162	343	1,248	2,649
Total Nitrogen (TN)	25.8	43.2	200	320
Total Phosphorus (TP)	3.7	6.6	29	52
Ammonia	17.0	31.3	130	218
Measured PE (BOD Basis)	-		13,550	

As shown in the table above, the measured PE was calculated as 13,550 when using a BOD PCC of 60g/PE/d. This is significantly lower than the reported 2023 AER Collected Load of 17,042 PE. Given the difference in measured load, determined using the 3-year sample dataset, it is recommended to use measured concentration results in the future Scenario 1 and Scenario 2 horizon load assessment. Theoretical PCCs shall be used within Scenario 3 to provide comparison.

7.3 WwTP Future Flow Analysis

This section shall be used to outline the measured flow analysis and provide commentary on future flow assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.1

7.3.1 Scenario 1 Flow Analysis – Measured Data Only

The Scenario 1 flow analysis considers the current measured WwTP flow loading, deriving a DWF PCC and DWF:ADF and DWF:FFT ratios to determine the future projected flow loading based on the established projected horizon PE. Table 7-6 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.1.

Table 7-6 - Midleton WwTP Future Scenario 1 Flow Analysis

Parameter	Units	2030	2055	2080
Current PE	PE	17,042 (331 L/PE/d)		
Horizon PE	PE	27,441	33,969	38,867
Horizon Dry Weather Flow (DWF)	m^3/d	9,072	11,230	12,849
Horizon Average Daily Flow (ADF)	m^3/d	13,221	16,365	18,725
Horizon Flow to Full Treatment (FtFT)	m^3/d	18,876	23,366	26,735

7.3.2 Scenario 2 Flow Analysis – Hybrid Measured & Theoretical Analysis

The Scenario 2 flow analysis considers the current WwTP flow loading (as reported in the 2023 Carrigrennan WwTP AER) with all additional future flow from the projected PE growth loading determined using theoretical flow PCCs. Table 7-7 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.2.

Note, using the 2023 AER data, (PE loading of 17,042PE and DWF of 3,456 m^3/d), the equivalent DWF PCC is 203 L/PE/d which relatively closely aligns with the theoretical PCC of 225 L/PE/d.

Table 7-7 - Midleton WwTP Future Scenario 2 Flow Analysis

Parameter	Units	2030	2055	2080
Current PE	PE	17,042 (203 L/PE/d)		
Horizon PE	PE	27,441	33,969	38,867
Horizon Dry Weather Flow (DWF)	m^3/d	5,796	7,265	8,367
Horizon Average Daily Flow (ADF)	m^3/d	12,167	14,003	15,381

Parameter	Units	2030	2055	2080
Horizon Flow to Full Treatment (FtFT)	m^3/d	17,389	21,796	25,102

7.3.3 Scenario 3 Flow Analysis – Theoretical Analysis

The Scenario 3 flow analysis applies the theoretical flow calculation to the total horizon PE loading projection. The table below provides the projected PE and the resulting DWF, ADF and FfFT for each Strategy horizon. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.3.

Table 7-8 - Midleton WwTP Future Scenario 3 Flow Analysis

Parameter	Units	2030	2055	2080
Horizon PE	PE	27,441	33,969	38,867
Horizon Dry Weather Flow (DWF)	m^3/d	6,176	7,645	8,747
Horizon Average Daily Flow (ADF)	m^3/d	7,720	9,556	10,934
Horizon Flow to Full Treatment (FtFT)	m^3/d	15,780	19,534	22,350

7.3.4 Future Flow Design Basis

The tables provided in the previous sections can be used to compare the results of the Scenario 1, Scenario 2 and Scenario 3 flow analysis.

At this stage of the strategy, it is proposed to progress with Scenario 1 for the following reasons:

- It provides a more conservative flow estimate for the 2030, 2055 and 2080 future horizons.
- It accounts for a higher DWF PCC which is believed to be more reflective of the catchment and resulting industrial loading.

Figure 7-2 below represents the estimated projected flow (ADF & 3DWF) demand of the Midleton WwTP across the current and future horizons based on Scenario 1 projections.

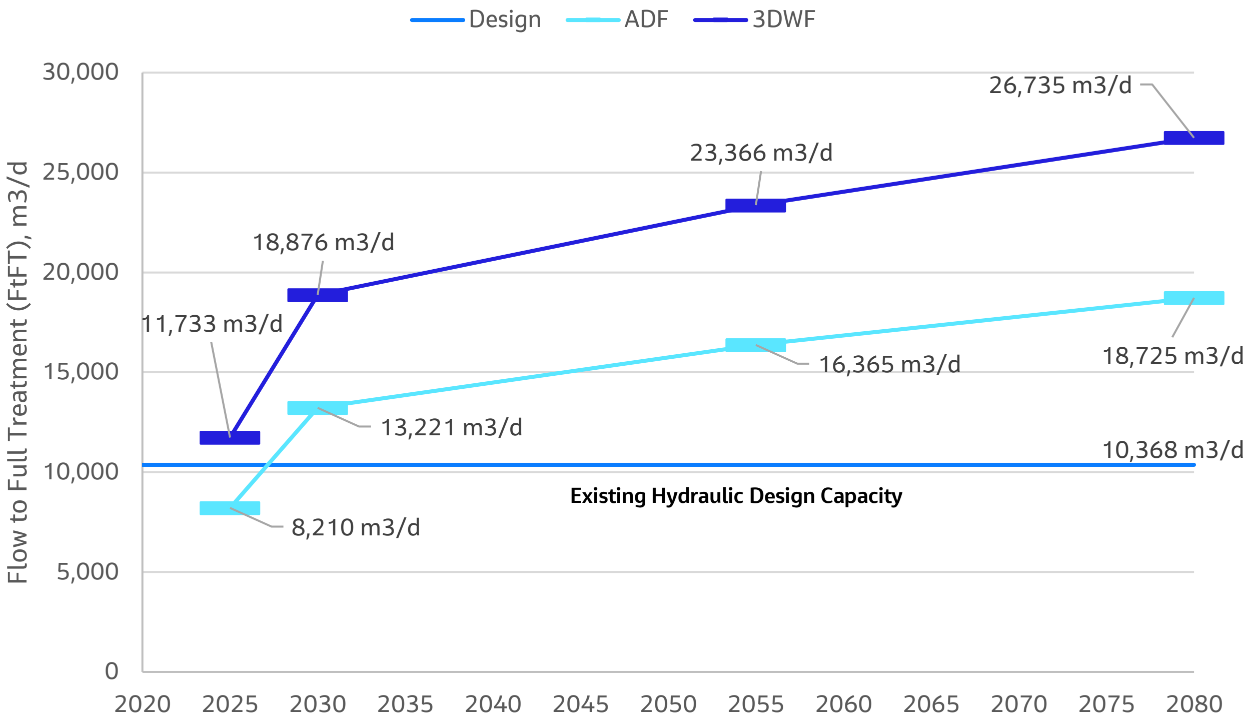


Figure 7-2 - Midleton WwTP Future Flow Projection (Scenario 1)

Using flow Scenario 1, the existing hydraulic capacity is projected to be exceeded for both 3DWF and ADF projections by 2030, with capacity needs more than doubling by 2080.

7.4 WwTP Future Nutrient Loading Analysis

This section shall be used to outline the measured load analysis and provide commentary on future load assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

7.4.1 Scenario 1 Load Analysis – Measured Data Only

In this Scenario 1 load analysis, the projected Scenario 1 future horizon flows shall be used in combination with the measured sample data concentrations (see Table 7-5) to derive the projected future nutrient loading. Table 7-9 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 7-9 - Midleton WwTP Future Scenario 1 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	27,441		33,969		38,867	
Horizon ADF (m^3/d)	13,221		16,365		18,725	
BOD (kg/d)	1,403	2,676	1,737	3,313	1,987	3,791
Suspended Solids (kg/d)	2,137	4,528	2,645	5,605	3,026	6,413

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Total Nitrogen (kg/d)	342	572	423	708	484	810
Total Phosphorus (kg/d)	49	87	60	108	69	123
Ammonia (kg/d)	225	414	279	512	319	586

7.4.2 Scenario 2 Load Analysis – Hybrid Measured & Theoretical Analysis

In this Scenario 2 load analysis, the projected future horizon flows shall be used in combination with the measured sample data concentrations (see Table 7-5) to derive the projected future nutrient loading. Table 7-10 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 7-10 - Midleton WwTP Future Scenario 2 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	27,441		33,969		38,867	
Horizon ADF (m^3/d)	12,167		14,003		15,381	
BOD (kg/d)	1,291	2,463	1,486	2,835	1,632	3,114
Suspended Solids (kg/d)	1,966	4,167	2,263	4,796	2,486	5,268
Total Nitrogen (kg/d)	314	526	362	606	397	665
Total Phosphorus (kg/d)	45	80	52	92	57	101
Ammonia (kg/d)	207	381	239	438	262	481

7.4.3 Scenario 3 Load Analysis – Theoretical Analysis Only

In this Scenario 3 load analysis, the projected future horizon PE loading shall be used in combination with theoretical PCCs (see Table 2-2) to derive the projected future nutrient loading. Table 7-11 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 7-11 - Midleton WwTP Future Scenario 3 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	27,441		33,969		38,867	
BOD (kg/d)	1,646	3,293	2,038	4,076	2,332	4,664

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Suspended Solids (kg/d)	2,058	4,116	2,548	5,095	2,915	5,830
Total Nitrogen (kg/d)	302	604	374	747	428	855
Total Phosphorus (kg/d)	60	121	75	149	86	171
Ammonia (kg/d)	220	439	272	544	311	622

7.4.4 Future Load Design Basis

The tables presented within the previous sections can be used to compare the results of the Scenario 1, Scenario 2 and Scenario 3 flow and load analysis.

It is proposed to progress with Scenario 1 at this stage of the strategy for the reasons previously discussed in Section 7.3.4.

8. Blarney WwTP

8.1 Introduction

Blarney WwTP is located approximately 9.5 km northwest of Cork City and provides wastewater services to the town of Blarney, as seen in Figure 8-1. An upgrade of the works was commissioned in 2013 and Cork County Council operate and maintain the Blarney WwTP on behalf of Uisce Éireann.

The WwTP has a design capacity of 13,000 PE and comprises of; preliminary, primary, and secondary treatment and had an M&E upgrade in 2022. This upgrade included new inlet pumps, an FBDA aeration system and blowers. The wastewater treatment process is a conventional activated sludge aeration and anaerobic processes with 2 separate streams. There is also sludge treatment on-site consisting of thickening, digestion and sludge dewatering. The treated wastewater is discharged into the Shournagh river.

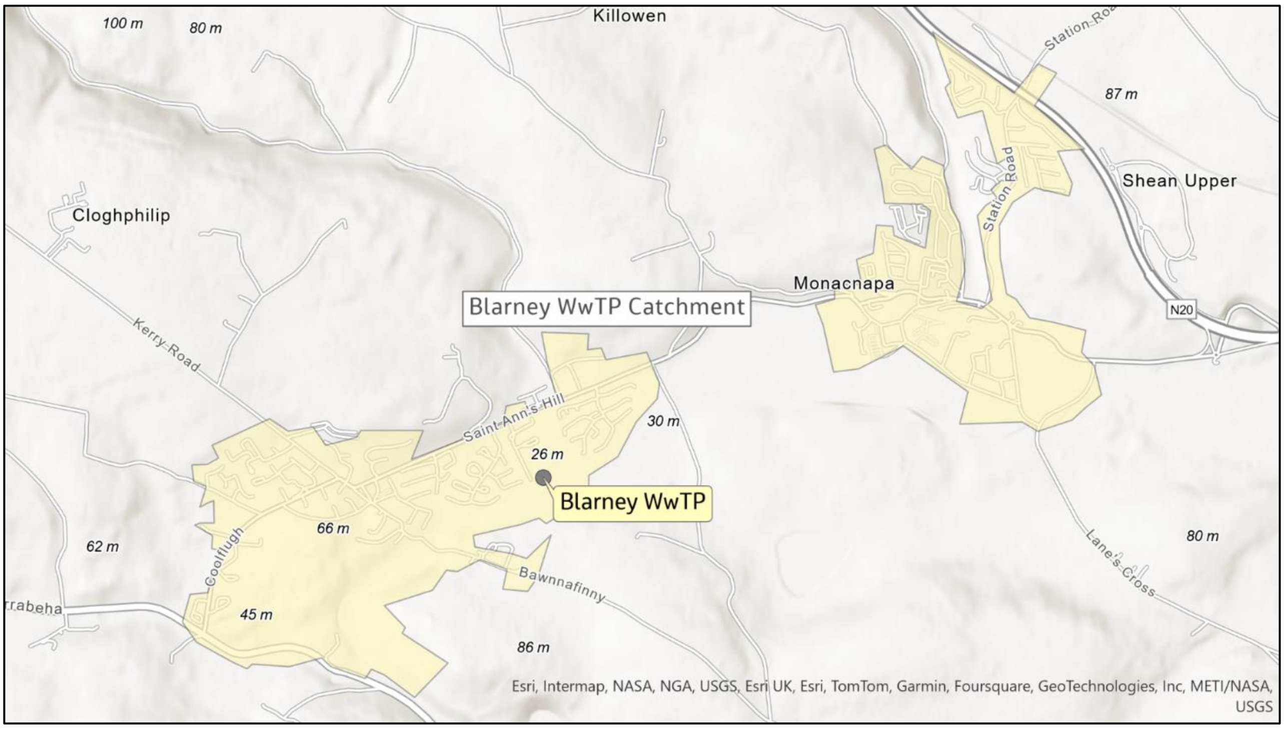


Figure 8-1 - Blarney WwTP Site Location and Catchment

8.2 Current Flow and Load Summary

In order to evaluate the future horizon WwTP flow and load projections, an assessment of the current WwTP loading was undertaken to understand current catchment characteristics that may influence the future horizon assessment.

In the following sections, commentary will be provided on the interpretation of current organic capacity, the quality and reliability of raw data and recommendations on the preferred future horizon calculation methodology.

8.2.1 Current Wastewater Discharge Licence (WWDL) Summary

The Waste Water Discharge Licence (WWDL) (D0043-01) was originally granted in 2008. The licence was subsequently revised under Technical Amendment A in 2014. It is therefore assumed the reported design PE is based on the amended licence requirements, which are summarised below in Table 8-1.

Table 8-1 - Blarney WWDL ELVs (D0043-01)

Parameter	Units	Value
BOD	mg/l	20
COD	mg/l	125
Suspended Solids	mg/l	30
Total Phosphorus (as P)	mg/l	1.5
Orthophosphate (as P)	mg/l	0.8
Total Ammonia (as N)	mg/l	1.5

8.2.2 Latest AER Data

The latest Annual Environmental Report (AER) for Blarney WwTP was published in 2023. Table 8-2 summarises the WwTP flows received in 2023. The average and maximum annual concentrations for BOD, COD, Suspended Solids, Total Phosphorus and Total Nitrogen are also provided in the 2023 AER and have been summarised in Table 8-3 below.

Table 8-2 – Blarney WwTP 2023 AER Flow Summary

Parameter	Units	Value
Peal Hydraulic Capacity (FtFT)	m^3/d	2,925
Design PE	PE	13,000
Dry Weather Flow (DWF)	m^3/d	975
Average Daily Flow (ADF)	m^3/d	3,600
Collected PE Load	PE	8,162

Table 8-3 – Blarney WwTP 2023 AER Raw Influent Concentration Summary

Parameter	Units	Annual Average	Annual Maximum
BOD	mg/l	107	245
COD	mg/l	271	567
Suspended Solids	mg/l	103	238
Total Phosphorus (as P)	mg/l	3.35	6.87
Total Nitrogen	mg/l	32	68

The Blarney WwTP also accepts septic tank discharges which are delivered via tanker. The 2023 AER reports the annual discharges as 540 m^3.

8.2.3 Current Measured Flow Data

Raw influent flow and load data for period of 2020-2023 was obtained for the flow and load data analysis. There were only 26 No. flow data points across the 4-year period, thus reducing the level of statistical confidence of the data. The following table summarises the measured flow data and the calculated DWF PCC and DWF ratios which have been determined using the 2023 AER Collected PE loading of 8,162 PE, and the methodology discussed in Section 2.1.1. Note, there is no industrial flow data available for Blarney WwTP.

Table 8-4 – Blarney WwTP Measured Flow Summary

Parameter	Units	Value
Measured Data Points	No.	26
Dry Weather Flow (DWF)	m^3/d	2,014
Average Daily Flow (ADF)	m^3/d	3,729
Flow to Full Treatment (FtFT)	m^3/d	7,344
Maximum	m^3/d	7,529
DWF PCC	L/PE/d	247
DWF:ADF	-	1.85
DWF:FtFT	-	3.65

Whilst the measured ADF of 3,729 m^3/d aligns with the 2023 AER reported ADF of 3,600 m^3/d, there is a vast difference between the measured DWF of 2,014 m^3/d and the 2023 AER reported DWF of 975 m^3/d. Given the low number of data points across the 4-year period, it is **not recommended** to use Blarney WwTP measured flow data in the future horizon flow analysis.

8.2.4 Current Measured Nutrient Loading Data

As discussed, raw influent flow and load data for period of 2020-2023 was obtained for the flow and load data analysis. There were 41 No. influent spot samples across the 4-year period with 23 No. of the results occurring on days with flow meter readings.

The analysis provides a summary of the average and 95%ile concentrations. A load analysis has been completed which calculates the daily load based on the daily flow reading. In this instance, there are only 23 No. datapoints where flow and sample day exist. The following Table 8-5 summarises the results of the nutrient concentration and loads analysis.

Table 8-5 – Blarney WwTP Measured Nutrient Concentration and Load Summary

Parameter	Concentrations (mg/l)		Loads (kg/d)	
	Average	95%ile	Average	95%ile
Measured Data Points	41		23	
BOD	117	245	324	609
COD	292	545	770	1,197

Parameter	Concentrations (mg/l)		Loads (kg/d)	
	Average	95%ile	Average	95%ile
Suspended Solids	122	261	342	801
Total Phosphorus (TP)	3.5	6.1	10	16
Total Nitrogen (TN)	34	56	98	161
Measured PE (BOD Basis)	-		5,402	

As shown in the table above, the measured PE was calculated as 5,402, when using a BOD PCC of 60g/PE/d. This is significantly lower than the reported 2023 AER Collected Load of 8,162 PE. Given the low number of sample data points, it is recommended to use theoretical nutrient loading PCCs in the future horizon load assessment.

8.3 WwTP Future Flow Analysis

This section shall be used to outline the measured flow analysis and provide commentary on future flow assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.1

8.3.1 Scenario 1 Flow Analysis – Measured Data Only

As discussed in the previous section, it is not recommended to use the measured flow data for Blarney WwTP given the low number of data points and misalignment with the 2023 reporting. Therefore, the Scenario 1 flow analysis has not been included within this report.

8.3.2 Scenario 2 Flow Analysis – Hybrid Measured & Theoretical Analysis

The Scenario 2 flow analysis considers the current WwTP flow loading (as reported in the 2023 Blarney WwTP AER) with all additional future flow from the projected PE growth loading determined using theoretical flow PCCs. Table 8-6 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.2.

Note, using the 2023 AER data, (PE loading of 8,162PE and DWF of 975 m^3/d), the equivalent DWF PCC is 119 L/PE/d which is just over half of the theoretical PCC of 225 L/PE/d.

Table 8-6 - Blarney WwTP Future Scenario 2 Flow Analysis

Parameter	Units	2030	2055	2080
Current PE	PE		8,162 (119 L/PE/d)	
Horizon PE	PE	13,724	23,640	26,939
Horizon Dry Weather Flow (DWF)	m^3/d	2,228	3,484	4,226
Horizon Average Daily Flow (ADF)	m^3/d	5,166	7,955	8,882
Horizon Flow to Full Treatment (FtFT)	m^3/d	6,683	10,451	12,678

8.3.3 Scenario 3 Flow Analysis – Theoretical Analysis

The Scenario 3 flow analysis applies the theoretical flow calculation to the total horizon PE loading projection. The table below provides the projected PE and the resulting DWF, ADF and FfFT for each Strategy horizon. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.3.

Table 8-7 - Blarney WwTP Future Scenario 3 Flow Analysis

Parameter	Units	2030	2055	2080
Horizon PE	PE	13,724	23,640	26,939
Horizon Dry Weather Flow (DWF)	m^3/d	3,087	5,318	6,061
Horizon Average Daily Flow (ADF)	m^3/d	3,859	6,648	7,576
Horizon Flow to Full Treatment (FtFT)	m^3/d	7,888	13,590	15,487

8.3.4 Future Flow Design Basis

The following tables provided in the previous sections can be used to compare the results of the Scenario 2 and Scenario 3 flow analysis.

At this stage of the strategy, it is proposed to progress with Scenario 2 for the following reasons:

- It provides greater consideration for current WwTP loading compared to Scenario 3.
- It provides a more conservative flow estimate for the 2030 and 2080 future horizons.
- Using the Scenario 2 calculation methodology, the total flow DWF PCCs are 162, 147 and 157 L/PE/d for the 2030, 2055 and 2080 horizons, respectively. This more closely aligns with the current measured PCC of 119 L/PE/d.

Figure 8-2 below represents the estimated projected flow (ADF & 3DWF) demand of the Blarney WwTP across the current and future horizons.

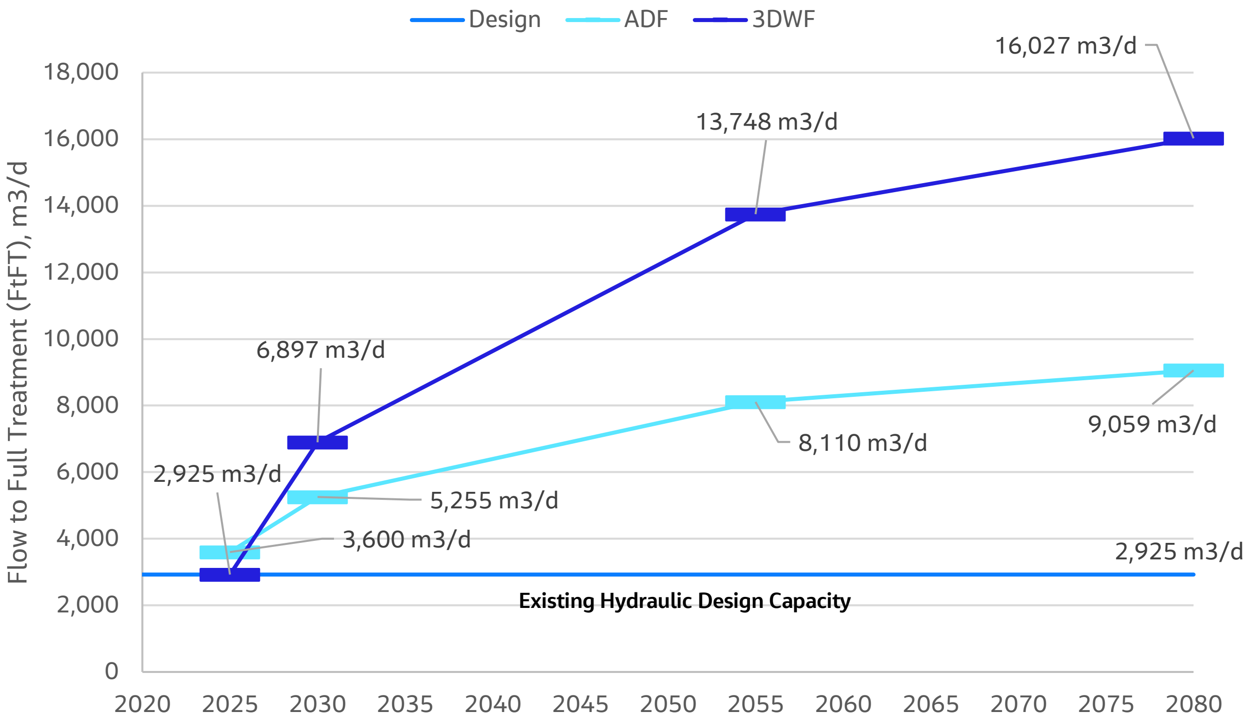


Figure 8-2 - Blarney WwTP Future Flow Projection (Scenario 2)

Using flow Scenario 2, existing hydraulic capacity is projected to be exceeded for both 3DWF and ADF projections by 2030, with capacity needs more than quadrupling by 2080.

8.4 WwTP Future Nutrient Loading Analysis

This section shall be used to outline the measured load analysis and provide commentary on future load assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

8.4.1 Scenario 1 Load Analysis – Measured Data Only

As discussed in Section 8.3.1, the measured flow data does not provide sufficient statistical analysis confidence and is therefore not recommended for use within this assessment. The Scenario 1 load analysis has therefore not been included within this report.

8.4.2 Scenario 2 Load Analysis – Hybrid Measured & Theoretical Analysis

In this Scenario 2 load analysis, the projected future horizon flows shall be used in combination with the measured sample data concentrations (see Table 8-5) to derive the projected future nutrient loading. Table 8-8 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 8-8 - Blarney WwTP Future Scenario 2 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	14,047		24,196		27,573	

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon ADF (m^3/d)	5,255		8,110		9,059	
BOD (kg/d)	616	1,288	950	1,987	1,061	2,220
Suspended Solids (kg/d)	642	1,372	991	2,117	1,107	2,364
Total Phosphorus (kg/d)	177	295	274	456	306	509
Total Nitrogen (kg/d)	18	32	28	49	32	55

Note, sample data for influent ammonia concentrations was not available at the time of assessment. Therefore, for any future assessments, ammonia loading derived from the Scenario 3 analysis i.e. using a theoretical PCC of 8 gNH_3/PE/d shall be used.

8.4.3 Scenario 3 Load Analysis – Theoretical Analysis Only

In this Scenario 3 load analysis, the projected future horizon PE loading shall be used in combination with theoretical PCCs (see Table 2-2) to derive the projected future nutrient loading. Table 8-9 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 8-9 - Blarney WwTP Future Scenario 3 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	14,047		24,196		27,573	
BOD (kg/d)	843	1,686	1,452	2,904	1,654	3,309
Suspended Solids (kg/d)	1,054	2,107	1,815	3,629	2,068	4,136
Total Phosphorus (kg/d)	155	309	266	532	303	607
Total Nitrogen (kg/d)	31	62	53	106	61	121
Ammonia (kg/d)	112	225	194	387	221	441

8.4.4 Future Load Design Basis

The tables presented within the previous sections can be used to compare the results of the Scenario 1, Scenario 2 and Scenario 3 flow and load analysis.

It is proposed to progress with Scenario 2 at this stage of the strategy for the reasons previously discussed in Section 8.3.4.

9. North Cobh WwTP

9.1 Introduction

North Cobh WwTP is located at Ballynoe in Cork Harbour on the Great Island, as seen in Figure 9-1. The plant received its first flows in May 2008 and successfully completed its commissioning phase in September 2010. EPS operate and maintain the North Cobh WwTP on behalf of UÉ under a 20-year DBO contract.

The WwTP has a design capacity of 4,000 PE with only one module of 2,000 PE used. North Cobh was built as an interim measure until the Cork Lower Harbour Main Drainage Scheme WwTP at Shanbally near Ringaskiddy was constructed. The load from this catchment will be connected into the Shanbally catchment network in the future, at which point the North Cobh WwTP will be decommissioned.

North Cobh comprises of; secondary treatment with sludge treatment on-site, consisting of a picket fence thickener. Treated wastewater from the plant is discharged to Cork Harbour.

According to the 2022 Census Small Area Population data, the North Cobh catchment Area has a population of 602 while the UÉ Asset Capacity Register has a current loading for North Cobh PE of 1,155.

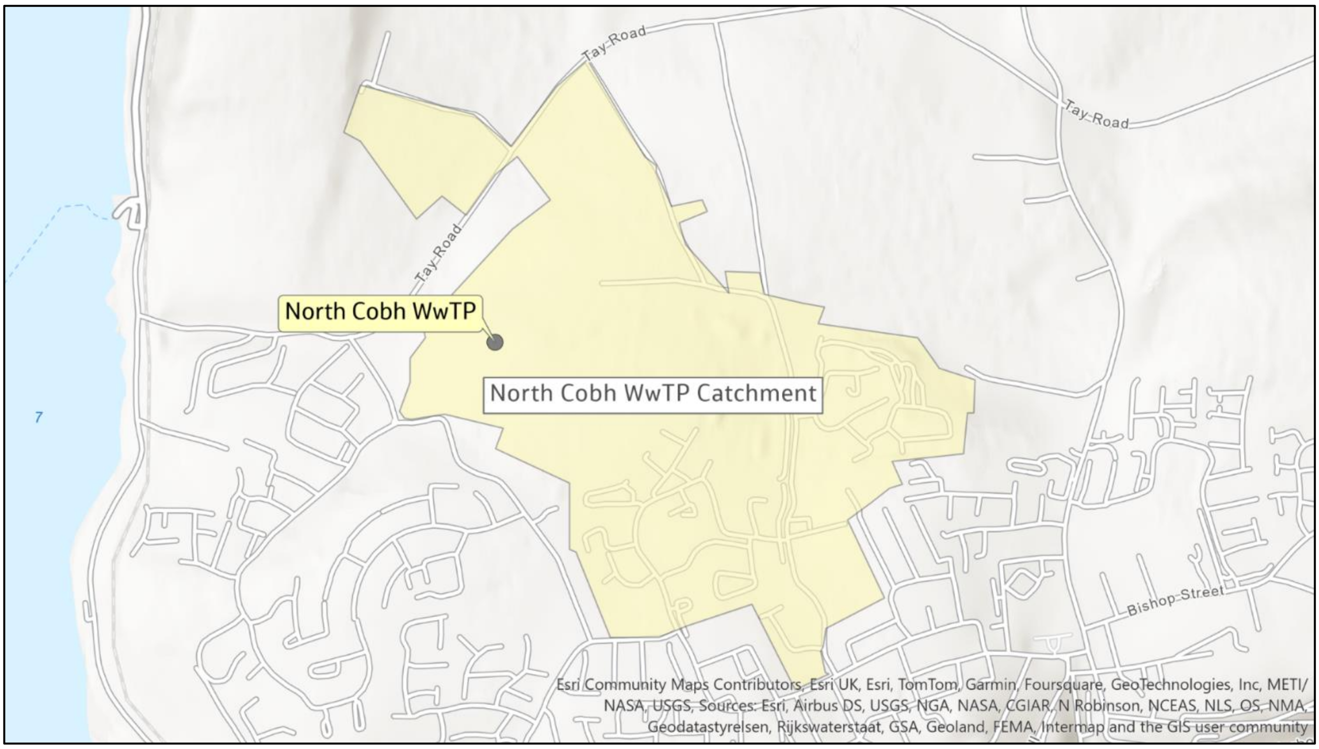


Figure 9-1 - North Cobh Site Location and Catchment

9.2 Current Flow and Load Summary

In order to evaluate the future horizon WwTP flow and load projections, an assessment of the current WwTP loading was undertaken to understand current catchment characteristics that may influence the future horizon assessment.

In the following sections, commentary will be provided on the interpretation of current organic capacity, the quality and reliability of raw data and recommendations on the preferred future horizon calculation methodology.

9.2.1 Current Wastewater Discharge Licence (WWDL) Summary

The Waste Water Discharge Licence (WWDL) (D0140-01) was originally granted in 2009. The licence was subsequently revised under Technical Amendment B in 2021. It is therefore assumed the reported design PE is based on the amended licence requirements, which are summarised below in Table 9-1.

Table 9-1 – North Cobh WwTP WWDL ELVs (D0140-01)

Parameter	Units	Value
BOD	mg/l	25
COD	mg/l	125
Suspended Solids	mg/l	35

9.2.2 Latest AER Data

The latest Annual Environmental Report (AER) for North Cobh WwTP was published in 2023. Table 9-2 summarises the WwTP flows received in 2022. The average and maximum annual concentrations for BOD, COD, Suspended Solids, Total P and Total N are also provided in the 2023 AER and have been summarised in Table 9-3.

Table 9-2 – North Cobh WwTP 2023 AER Flow Summary

Parameter	Units	Value
Peak Hydraulic Capacity (FtFT)	m^3/d	900
Design PE	PE	2,000
Dry Weather Flow (DWF)	m^3/d	300
Average Daily Flow (ADF)	m^3/d	662
Collected PE Load	PE	1,182

Table 9-3 – North Cobh WwTP 2023 AER Raw Influent Concentration Summary

Parameter	Units	No. Samples	Annual Average	Annual Maximum
BOD	mg/l	12	90	636
COD	mg/l	12	221	1,175
Suspended Solids	mg/l	12	67	400
Total Nitrogen	mg/l	12	29	62
Total Phosphorus	mg/l	12	3.3	14

9.2.3 Current Measured Flow Data

Raw influent flow and load data for period of 2021-2022 was obtained for the flow and load data analysis. There were 1,095 No. flow data points across the 3-year period, which ordinarily would increasing the level of statistical confidence of the data. However, further analysis and review of the data indicates a large quantity of repeated values which has deemed the flow data as unreliable. It is therefore not recommended to use this data, which discounts the use of Flow Scenario 1. The following table has been provided to summarise results of the measured flow data analysis. the calculated DWF PCC and DWF ratios which have been determined using the 2023 AER Collected PE loading of 1,182 PE, and the methodology discussed in Section 2.1.1.

Table 9-4 – North Cobh WwTP Measured Flow Summary

Parameter	Units	Value
Measured Data Points	No.	North Cobh
Dry Weather Flow (DWF)	m^3/d	420
Average Daily Flow (ADF)	m^3/d	670
Flow to Full Treatment (FtFT)	m^3/d	1,062
Maximum	m^3/d	1,186
DWF PCC	L/PE/d	355
DWF:ADF	-	1.60
DWF:FtFT	-	2.53

Whilst the measured flow data results relatively align with the 2023 AER reported flow, as stated above, the data returns a number of same and repeated values indicating a data logging issue. Therefore, no direct comparison can be made.

9.2.4 Current Measured Nutrient Loading Data

As discussed, raw influent flow and load data for period of 2021-2022 was obtained for the flow and load data analysis. There were over 150 influent spot samples for BOD, COD, Suspended Solids, Total N and Total P, with 42 ammonia samples across the 3-year period with all samples occurring on days with flow meter readings.

The analysis provides a summary of the average and 95%ile concentrations. A load analysis has been completed which calculates the daily load based on the daily flow reading, however, given the flow data measurements have been deemed as unreliable, this analysis may return unrealistic load values. The following Table 9-5 summarises the results of the nutrient concentration and loads analysis.

Table 9-5 – North Cobh WwTP Measured Nutrient Concentration and Load Summary

Parameter	Concentrations (mg/l)		Loads (kg/d)	
	Average	95%ile	Average	95%ile
BOD	102	316	68	190
COD	283	706	193	568

Parameter	Concentrations (mg/l)		Loads (kg/d)	
	Average	95%ile	Average	95%ile
Suspended Solids	136	453	94	318
Total Nitrogen (TN)	29.5	46.0	18.8	30.7
Total Phosphorus (TP)	4.2	8.1	2.7	5.0
Ammonia	24.1	32.6	14.1	20.9
Measured PE (BOD Basis)	-		1,135	

As shown in the table above, the measured PE was calculated as 1,135, when using a BOD PCC of 60g/PE/d. This very closely aligns with the reported 2023 AER Collected Load of 1,182 PE. However, given the difference in measured flow data points and the potential impact on the load analysis, it is recommended to use measured concentration results in the future Scenario 1 and Scenario 2 horizon load assessment. Theoretical PCCs shall be used within Scenario 3 to provide comparison.

9.3 WwTP Future Flow Analysis

This section shall be used to outline the measured flow analysis and provide commentary on future flow assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.1

9.3.1 Scenario 1 Flow Analysis – Measured Data Only

As discussed in the previous section, it is not recommended to use the measured flow data for North Cobh WwTP given the level of data uncertainty. Therefore, the Scenario 1 flow analysis has not been included within this report.

9.3.2 Scenario 2 Flow Analysis – Hybrid Measured & Theoretical Analysis

The Scenario 2 flow analysis considers the current WwTP flow loading (as reported in the 2023 North Cobh WwTP AER) with all additional future flow from the projected PE growth loading determined using theoretical flow PCCs. Table 9-6 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.2.

Note, using the 2023 AER data, (PE loading of 1,182PE and DWF of 300 m^3/d), the equivalent DWF PCC is 254 L/PE/d which is approximately 13% greater than the theoretical PCC of 225 L/PE/d.

Table 9-6 - North Cobh WwTP Future Scenario 2 Flow Analysis

Parameter	Units	2030	2055	2080
Current PE	PE	1,182 (254 L/PE/d)		
Horizon PE	PE	1,755	2,144	2,454
Horizon Dry Weather Flow (DWF)	m^3/d	400	468	523
Horizon Average Daily Flow (ADF)	m^3/d	787	872	940

Parameter	Units	2030	2055	2080
Horizon Flow to Full Treatment (FtFT)	m^3/d	1,201	1,405	1,568

9.3.3 Scenario 3 Flow Analysis – Theoretical Analysis

The Scenario 3 flow analysis applies the theoretical flow calculation to the total horizon PE loading projection. The table below provides the projected PE and the resulting DWF, ADF and FfFT for each Strategy horizon. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.3.

Table 9-7 - North Cobh WwTP Future Scenario 3 Flow Analysis

Parameter	Units	2030	2055	2080
Horizon PE	PE	1,755	2,144	2,454
Horizon Dry Weather Flow (DWF)	m^3/d	395	482	552
Horizon Average Daily Flow (ADF)	m^3/d	494	603	690
Horizon Flow to Full Treatment (FtFT)	m^3/d	1,009	1,233	1,411

9.3.4 Future Flow Design Basis

The tables provided in the previous sections can be used to compare the results of the Scenario 2 and Scenario 3 flow analysis.

At this stage of the strategy, it is proposed to progress with Scenario 2 for the following reasons:

- It provides a more conservative flow estimate for the 2030, 2055 and 2080 future horizons.
- Using the Scenario 2 calculation methodology, the total flow DWF PCCs are 228, 218 and 213 L/PE/d for the 2030, 2055 and 2080 horizons, respectively which align with the theoretical DWF PCC.

Figure 9-2 below represents the estimated projected flow (ADF & 3DWF) demand of the North Cobh WwTP across the current and future horizons.

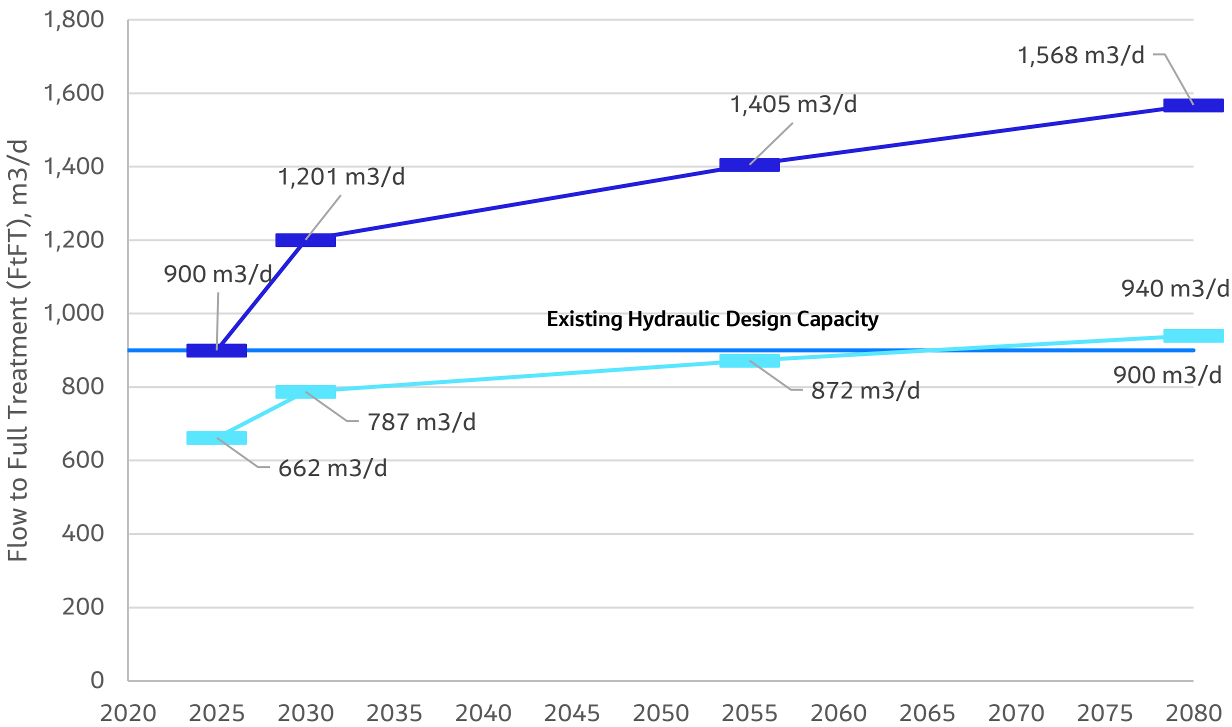


Figure 9-2 - North Cobh WwTP Future Flow Projection (Scenario 2)

Using flow Scenario 3, the existing hydraulic capacity is projected to be exceeded for 3DWF projections by 2030, with hydraulic capacity needs increasing by approximately 74% by 2080. The analysis indicates there is sufficient capacity to meet the ADF projections until 2080 where it is projected to be exceed by approximately 5%.

9.4 WwTP Future Nutrient Loading Analysis

This section shall be used to outline the measured load analysis and provide commentary on future load assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

9.4.1 Scenario 1 Load Analysis – Measured Data Only

As discussed in Section 9.3.1, the measured flow data does not provide sufficient statistical analysis confidence and is therefore not recommended for use within this assessment. The Scenario 1 load analysis has therefore not been included within this report.

9.4.2 Scenario 2 Load Analysis – Hybrid Measured & Theoretical Analysis

In this Scenario 2 load analysis, the projected future horizon flows shall be used in combination with the measured sample data concentrations (see Table 9-5) to derive the projected future nutrient loading. Table 9-8 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 9-8 - North Cobh WwTP Future Scenario 2 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	1,755		2,144		2,454	
Horizon ADF (m^3/d)	787		872		940	
BOD (kg/d)	81	249	89	276	96	297
Suspended Solids (kg/d)	107	356	118	395	128	425
Total Nitrogen (kg/d)	23	36	26	40	28	43
Total Phosphorus (kg/d)	3.3	6.4	3.6	7.1	3.9	7.6
Ammonia (kg/d)	19	26	21	28	23	31

9.4.3 Scenario 3 Load Analysis – Theoretical Analysis Only

In this Scenario 3 load analysis, the projected future horizon PE loading shall be used in combination with theoretical PCCs (see Table 2-2) to derive the projected future nutrient loading. Table 9-9 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 9-9 - North Cobh WwTP Future Scenario 3 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	1,755		2,144		2,454	
BOD (kg/d)	105	211	129	257	147	294
Suspended Solids (kg/d)	132	263	161	322	184	368
Total Nitrogen (kg/d)	19	39	24	47	27	54
Total Phosphorus (kg/d)	3.9	7.7	4.7	9.4	5.4	10.8
Ammonia (kg/d)	14	28	17	34	20	39

9.4.4 Future Load Design Basis

The tables presented within the previous sections can be used to compare the results of the Scenario 1, Scenario 2 and Scenario 3 flow and load analysis.

It is proposed to progress with Scenario 3 at this stage of the strategy for the reasons previously discussed in Section 9.3.4.

10. Watergrasshill WwTP

10.1 Introduction

Watergrasshill WwTP lies approximately 22km north of Cork city and serves the Watergrasshill catchment, as seen in Figure 10-1. It was commissioned in 2002 on a 0.2-hectare site and issued with its EPA licence (D201-01) in November 2009. It is currently operated and maintained by Cork County Council on behalf of UÉ.

The WwTP has a design capacity of 3,000 PE and the existing treatment process comprises of; preliminary and secondary treatment. The tertiary sand filters at the site have been decommissioned. Treated wastewater is discharged to a small stream Flesk (Bride).

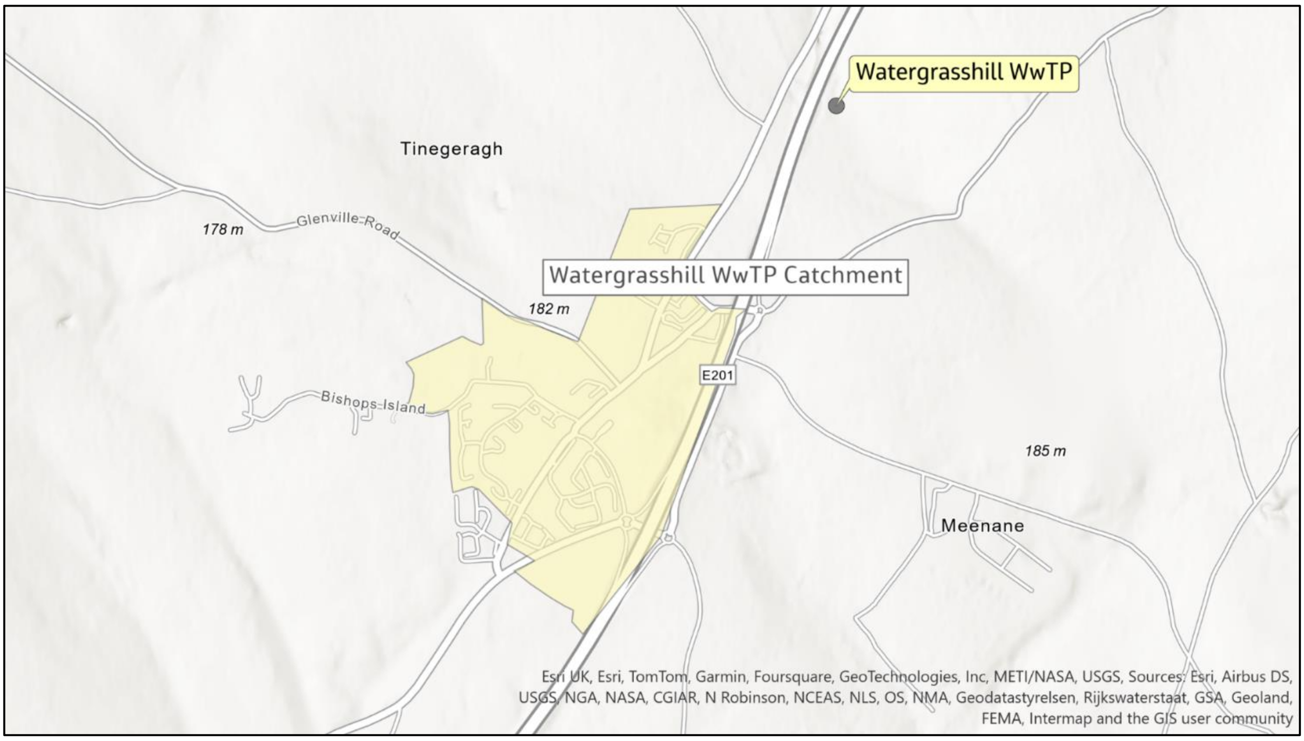


Figure 10-1 - Watergrasshill WwTP Site Location and Catchment

10.2 Current Flow and Load Summary

In order to evaluate the future horizon WwTP flow and load projections, an assessment of the current WwTP loading was undertaken to understand current catchment characteristics that may influence the future horizon assessment.

In the following sections, commentary will be provided on the interpretation of current organic capacity, the quality and reliability of raw data and recommendations on the preferred future horizon calculation methodology.

10.2.1 Current Wastewater Discharge Licence (WWDL) Summary

The Waste Water Discharge Licence (WWDL) (D0201-01) was originally granted in 2009. The licence was subsequently revised under Technical Amendment B in 2021. It is therefore assumed the reported design PE is based on the amended licence requirements, which are summarised below in Table 10-1.

Table 10-1 – Watergrasshill WwTP WWDL ELVs (D0201-01)

Parameter	Units	Value
BOD	mg/l	10
COD	mg/l	125
Suspended Solids	mg/l	35
Total Phosphorus (as P)	mg/l	2
Orthophosphate (as P)	mg/l	1
Total Ammonia (as N)	mg/l	1

10.2.2 Latest AER Data

The latest Annual Environmental Report (AER) for Watergrasshill WwTP was published in 2023. Table 10-2 summarises the WwTP flows received in 2023. The average and maximum annual concentrations for BOD, COD, Suspended Solids, Total P and Total N are also provided in the 2023 AER and have been summarised in Table 10-3.

Table 10-2 – Watergrasshill WwTP 2023 AER Flow Summary

Parameter	Units	Value
Peak Hydraulic Capacity (FtFT)	m^3/d	2,025
Design PE	PE	3,000
Dry Weather Flow (DWF)	m^3/d	675
Average Daily Flow (ADF)	m^3/d	1,139
Collected PE Load	PE	1,659

Table 10-3 – Watergrasshill WwTP 2023 AER Raw Influent Concentration Summary

Parameter	Units	No. Samples	Annual Average	Annual Maximum
BOD	mg/l	12	86	199
COD	mg/l	12	212	445
Suspended Solids	mg/l	12	52	138
Total Nitrogen	mg/l	12	30	63
Total Phosphorus	mg/l	12	2.88	5.66

10.2.3 Current Measured Flow Data

Raw influent flow and load data for 2021 was obtained for the flow and load data analysis. There were 364 No. flow data points across the 1-year period, thus increasing the level of statistical confidence of the data for that year only. The flow data did not extend closer to the assessment period i.e. 2024 and insufficient data was available to perform a year-on-year and seasonal loading assessment. The following table summarises the measured flow data and the calculated DWF PCC and DWF ratios which have been determined using the 2023 AER Collected PE loading of 1,659 PE, and the methodology discussed in Section 2.1.1.

Table 10-4 – Watergrasshill WwTP Measured Flow Summary

Parameter	Units	Value
Measured Data Points	No.	364
Dry Weather Flow (DWF)	m^3/d	382
Average Daily Flow (ADF)	m^3/d	712
Flow to Full Treatment (FtFT)	m^3/d	1,203
Maximum	m^3/d	1,678
DWF PCC	L/PE/d	230
DWF:ADF	-	1.86
DWF:FtFT	-	3.15

The measured flow data does not align with the 2023 AER reported flow data; however, this can be expected as the measured data only covers a 1-year period from 2021.

10.2.4 Current Measured Nutrient Loading Data

The raw influent flow spot sample data extends from 2020 to 2023 however there were a small number of samples for BOD, COD, Suspended Solids, Total N and Total P across the 4-year period with few samples occurring on days with flow meter readings.

The analysis provides a summary of the average and 95%ile concentrations. The load analysis could not be completed due to the lack of sample results on same data flow metering. The following Table 10-5 summarises the results of the nutrient concentration and loads analysis.

Table 10-5 – Watergrasshill WwTP Measured Nutrient Concentration and Load Summary

Parameter	Concentrations (mg/l)		Loads (kg/d)	
	Average	95%ile	Average	95%ile
BOD	140	309	-	-
COD	351	776	-	-
Suspended Solids	113	266	-	-
Total Nitrogen (TN)	40	83	-	-

Parameter	Concentrations (mg/l)		Loads (kg/d)	
	Average	95%ile	Average	95%ile
Total Phosphorus (TP)	4.0	8.6	-	-
Measured PE (BOD Basis)	-		-	

Given the measured load analysis could not be completed, it is recommended to use measured concentration results in the future Scenario 1 and Scenario 2 horizon load assessment. Theoretical PCCs shall be used within Scenario 3 to provide comparison.

10.3 WwTP Future Flow Analysis

This section shall be used to outline the measured flow analysis and provide commentary on future flow assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.1

10.3.1 Scenario 1 Flow Analysis – Measured Data Only

As discussed in the previous section, it is not recommended to use the measured flow data for Watergrasshill WwTP given the level of data uncertainty. Therefore, the Scenario 1 flow analysis has not been included within this report.

10.3.2 Scenario 2 Flow Analysis – Hybrid Measured & Theoretical Analysis

The Scenario 2 flow analysis considers the current WwTP flow loading (as reported in the 2023 Watergrasshill WwTP AER) with all additional future flow from the projected PE growth loading determined using theoretical flow PCCs. Table 10-6 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.2.

Note, using the 2023 AER data, (PE loading of 1,659PE and DWF of 675 m^3/d), the equivalent DWF PCC is 230 L/PE/d which closely aligns with the theoretical PCC of 225 L/PE/d.

Table 10-6 - Watergrasshill WwTP Future Scenario 2 Flow Analysis

Parameter	Units	2030	2055	2080
Current PE	PE	1,659 (230 L/PE/d)		
Horizon PE	PE	2,892	3,450	3,871
Horizon Dry Weather Flow (DWF)	m^3/d	891	988	1,062
Horizon Average Daily Flow (ADF)	m^3/d	1,409	1,531	1,623
Horizon Flow to Full Treatment (FtFT)	m^3/d	2,672	2,965	3,186

10.3.3 Scenario 3 Flow Analysis – Theoretical Analysis

The Scenario 3 flow analysis applies the theoretical flow calculation to the total horizon PE loading projection. The table below provides the projected PE and the resulting DWF, ADF and FfFT for each Strategy horizon. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.3.

Table 10-7 - Watergrasshill WwTP Future Scenario 3 Flow Analysis

Parameter	Units	2030	2055	2080
Horizon PE	PE	2,892	3,450	3,871
Horizon Dry Weather Flow (DWF)	m^3/d	651	776	871
Horizon Average Daily Flow (ADF)	m^3/d	813	970	1,089
Horizon Flow to Full Treatment (FtFT)	m^3/d	1,663	1,984	2,226

10.3.4 Future Flow Design Basis

The tables provided in the previous sections can be used to compare the results of the Scenario 1, Scenario 2 and Scenario 3 flow analysis.

At this stage of the strategy, it is proposed to progress with Scenario 2 for the following reasons:

- It provides a more conservative flow estimate for the 2030, 2055 and 2080 future horizons.
- Using the Scenario 2 calculation methodology, the total flow DWF PCCs are 308, 287 and 274 L/PE/d for the 2030, 2055 and 2080 horizons, respectively. Whilst this is much greater than the theoretical DWF PCC, it represents a reduction in per capita water usage.

Figure 10-2 below represents the estimated projected flow (ADF & 3DWF) demand of the Watergrasshill WwTP across the current and future horizons.

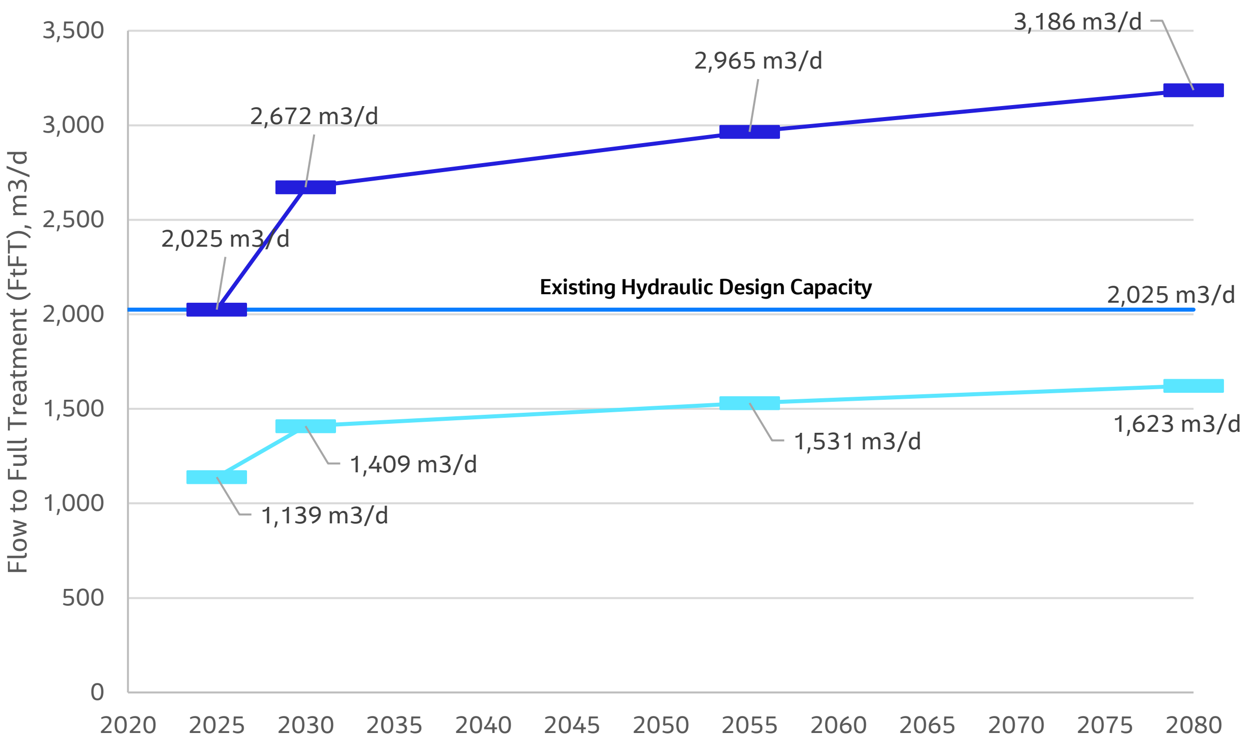


Figure 10-2 - Watergrasshill WwTP Future Flow Projection (Scenario 2)

Using flow Scenario 2, the existing hydraulic capacity is projected to be exceeded for 3DWF projections by 2030, with capacity needs increasing by over 57% by 2080. The analysis indicates there is sufficient hydraulic capacity to meet the projected ADF for the future strategy horizons.

10.4 WwTP Future Nutrient Loading Analysis

This section shall be used to outline the measured load analysis and provide commentary on future load assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

10.4.1 Scenario 1 Load Analysis – Measured Data Only

As discussed in Section 10.3.1, the measured flow data does not provide sufficient statistical analysis confidence and is therefore not recommended for use within this assessment. The Scenario 1 load analysis has therefore not been included within this report.

10.4.2 Scenario 2 Load Analysis – Hybrid Measured & Theoretical Analysis

In this Scenario 2 load analysis, the projected future horizon flows shall be used in combination with the measured sample data concentrations (see Table 10-5) to derive the projected future nutrient loading. Table 10-8 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 10-8 - Watergrasshill WwTP Future Scenario 2 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	2,892		3,450		3,871	
Horizon ADF (m^3/d)	1,409		1,531		1,623	
BOD (kg/d)	197	435	214	473	227	501
Suspended Solids (kg/d)	159	375	173	407	183	432
Total Nitrogen (kg/d)	57	117	62	127	65	134
Total Phosphorus (kg/d)	5.7	12.2	6.1	13.2	6.5	14.0

Note, as above, sample data for influent ammonia concentrations was not available at the time of assessment. Therefore, for any future assessments, ammonia loading derived from the Scenario 3 analysis i.e. using a theoretical PCC of 8 $gNH_3/PE/d$ shall be used.

10.4.3 Scenario 3 Load Analysis – Theoretical Analysis Only

In this Scenario 3 load analysis, the projected future horizon PE loading shall be used in combination with theoretical PCCs (see Table 2-2) to derive the projected future nutrient loading. Table 10-9 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 10-9 - Watergrasshill WwTP Future Scenario 3 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	2,892		3,450		3,871	
BOD (kg/d)	174	347	207	414	232	465
Suspended Solids (kg/d)	217	434	259	518	290	581
Total Nitrogen (kg/d)	32	64	38	76	43	85
Total Phosphorus (kg/d)	6.4	12.7	7.6	15.2	8.5	17.0
Ammonia (kg/d)	23	46	28	55	31	62

10.4.4 Future Load Design Basis

The tables presented within the previous sections can be used to compare the results of the Scenario 1, Scenario 2 and Scenario 3 flow and load analysis.

It is proposed to progress with Scenario 2 at this stage of the strategy for the reasons previously discussed in Section 10.3.4.

11. Whitechurch WwTP

11.1 Introduction

Whitechurch WwTP is located at Farranstig, Whitechurch, County Cork, approximately 11km north of Cork city, as seen in Figure 11-1. EPS operate and maintain the Whitechurch WwTP on behalf of UÉ under a 20-year DBO contract.

The WwTP comprises preliminary and secondary treatment. Whitechurch WwTP was constructed for Whitechurch Village in 2008 and has a design capacity of 3,000 PE. The WwTP and Water supply was co-financed by Cork County Council, Castlelands Construction and BDW Construction and provided Whitechurch Village with sufficient water supply and wastewater treatment for the next twenty years.

The effluent is dosed with Septiox before being discharged to the county sewer network. Sludge is thickened by a picket fence thickener on site. According to the data from the 2022 census report the catchment of Whitechurch has a domestic population of 719 while the UÉ Asset Capacity Register, has a current loading PE of 236.

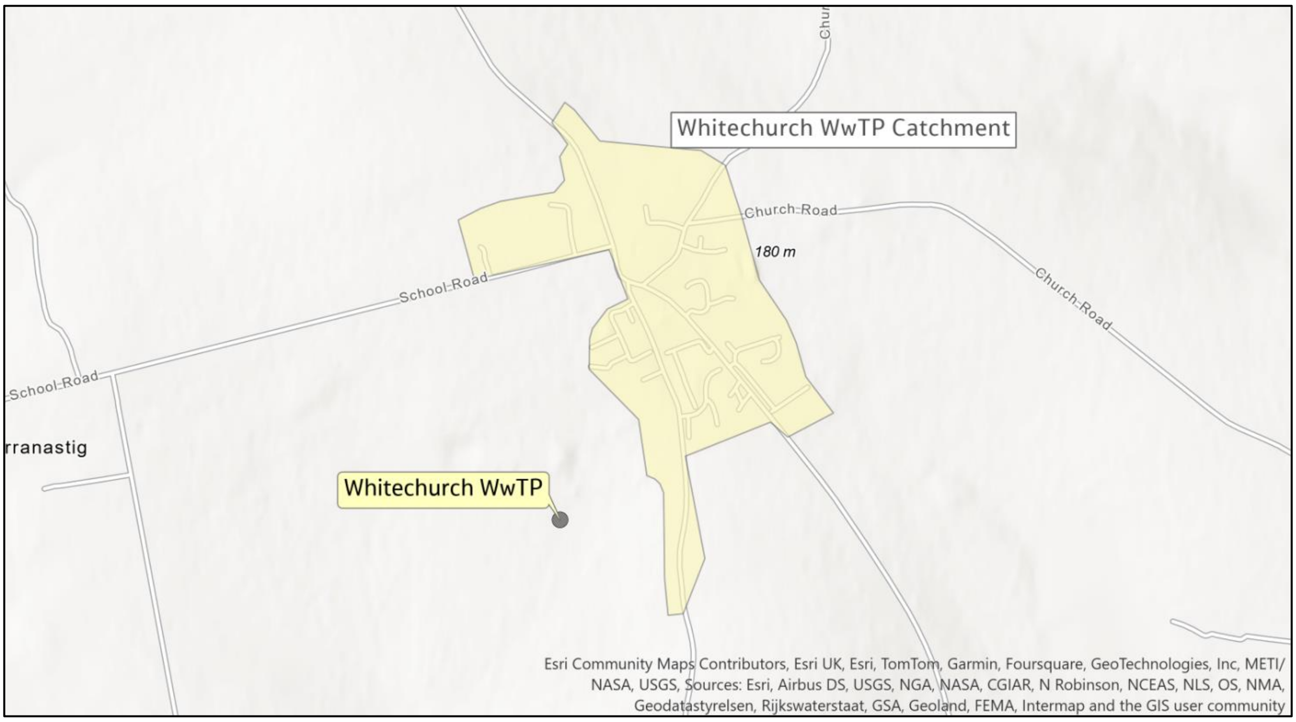


Figure 11-1 - Whitechurch Site Location and Catchment

11.2 Current Flow and Load Summary

In order to evaluate the future horizon WwTP flow and load projections, an assessment of the current WwTP loading was undertaken to understand current catchment characteristics that may influence the future horizon assessment.

In the following sections, commentary will be provided on the interpretation of current organic capacity, the quality and reliability of raw data and recommendations on the preferred future horizon calculation methodology.

11.2.1 Current Wastewater Discharge Licence (WWDL) Summary

There is no discharge license for Whitechurch WwTP as it discharges to the County Cork network, therefore there is no document stating the ELV's for this site. However, the current DBO contractor, EPS, have the contract discharge limits as summarised in Table 11-1.

Table 11-1 – Whitechurch WwTP Contract DBO ELVs

Parameter	Units	Value
BOD	mg/l	25
COD	mg/l	125
Suspended Solids	mg/l	35

11.2.2 Latest AER Data

As stated above, there is no discharge licence for Whitechurch WwTP and therefore the latest Annual Environmental Report (AER) for Whitechurch WwTP is not recorded and published.

11.2.3 Current Measured Flow Data

Raw influent flow and load data for period of 2019-2022 was obtained for the flow and load data analysis. There were 1,430 No. flow data points across the 4-year period, which ordinarily would increasing the level of statistical confidence of the data. However, further analysis and review of the data indicates a large quantity of repeated values which has deemed the flow data as unreliable. It is therefore not recommended to use this data, which discounts the use of Flow Scenario 1. The following table summarises the measured flow data and the calculated DWF PCC and DWF ratios which have been determined using the projected current PE loading in the absence of a published AER.

Table 11-2 – Whitechurch WwTP Measured Flow Summary

Parameter	Units	Value
Measured Data Points	No.	1,430
Dry Weather Flow (DWF)	m^3/d	215
Average Daily Flow (ADF)	m^3/d	398
Flow to Full Treatment (FtFT)	m^3/d	897
Maximum	m^3/d	1,397
DWF PCC	L/PE/d	258
DWF:ADF	-	1.85
DWF:FtFT	-	4.17

11.2.4 Current Measured Nutrient Loading Data

As discussed, raw influent flow and load data for period of 2019-2022 was obtained for the flow and load data analysis. There were a large number of influent spot samples (~200) for BOD, COD, Suspended Solids, Total N, Total P and Ammonia across the 4-year period with the majority of samples occurring on days with flow meter readings.

The analysis provides a summary of the average and 95%ile concentrations. A load analysis has been completed which calculates the daily load based on the daily flow reading. The following Table 11-3 summarises the results of the nutrient concentration and loads analysis.

Table 11-3 – Whitechurch WwTP Measured Nutrient Concentration and Load Summary

Parameter	Concentrations (mg/l)		Loads (kg/d)	
	Average	95%ile	Average	95%ile
BOD	130	313	42.9	99.2
COD	314	670	110.0	256.6
Suspended Solids	176	434	61.4	189.9
Total Nitrogen (TN)	40	80	14.1	30.5
Total Phosphorus (TP)	5.8	13.5	2.0	5.4
Ammonia	30	59	10.3	24.7
Measured PE (BOD Basis)	-		715	

As shown in the table above, the measured PE was calculated as 715, when using a BOD PCC of 60g/PE/d however there is no available AER to compare and contrast this calculated PE against. Given the repetition of measured flow data results, it is recommended to use measured concentration results in the future Scenario 1 and Scenario 2 horizon load assessment. Theoretical PCCs shall be used within Scenario 3 to provide comparison.

11.3 WwTP Future Flow Analysis

This section shall be used to outline the measured flow analysis and provide commentary on future flow assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.1

11.3.1 Scenario 1 Flow Analysis – Measured Data Only

As discussed in the previous section, it is not recommended to use the measured flow data for Whitechurch WwTP given the level of data uncertainty. Therefore, the Scenario 1 flow analysis has not been included within this report.

11.3.2 Scenario 2 Flow Analysis – Hybrid Measured & Theoretical Analysis

The Scenario 2 flow analysis considers the current WwTP flow loading with all additional future flow from the projected PE growth loading determined using theoretical flow PCCs.

In this instance, there is no available current loading information from the latest AER. Therefore, the Scenario 2 flow analysis has not been completed or included within this report.

11.3.3 Scenario 3 Flow Analysis – Theoretical Analysis

The Scenario 3 flow analysis applies the theoretical flow calculation to the total horizon PE loading projection. The table below provides the projected PE and the resulting DWF, ADF and FfFT for each Strategy horizon. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.3.

Table 11-4 - Whitechurch WwTP Future Scenario 3 Flow Analysis

Parameter	Units	2030	2055	2080
Horizon PE	PE	1,091	1,262	1,418
Horizon Dry Weather Flow (DWF)	m^3/d	245	284	319
Horizon Average Daily Flow (ADF)	m^3/d	307	355	399
Horizon Flow to Full Treatment (FtFT)	m^3/d	627	726	815

11.3.4 Future Flow Design Basis

The tables provided in the previous sections can be used to compare the results of the Scenario 1, Scenario 2 and Scenario 3 flow analysis.

At this stage of the strategy, it is proposed to progress with Scenario 3 for the following reasons:

- The Scenario 1 analysis has insufficient reliable data available.
- The Scenario 2 analysis requires flow data from the latest AER, which is not available.

Figure 11-2 below represents the estimated projected flow (ADF & 3DWF) demand of the Whitechurch WwTP across the current and future horizons.

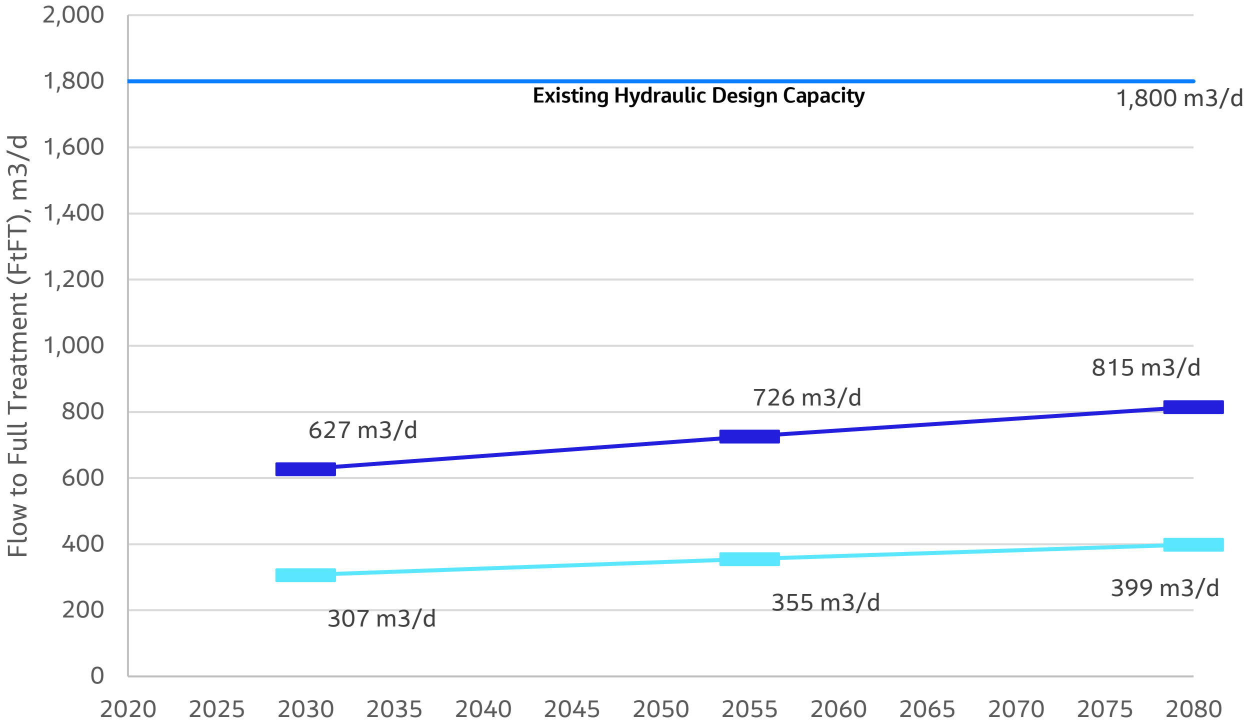


Figure 11-2 - Whitechurch WwTP Future Flow Projection (Scenario 3)

Using flow Scenario 3, there is sufficient hydraulic capacity for the three future strategy horizon projections.

11.4 WwTP Future Nutrient Loading Analysis

This section shall be used to outline the measured load analysis and provide commentary on future load assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

11.4.1 Scenario 1 Load Analysis – Measured Data Only

As discussed in Section 11.3.1, the measured flow data does not provide sufficient statistical analysis confidence and is therefore not recommended for use within this assessment. The Scenario 1 load analysis has therefore not been included within this report.

11.4.2 Scenario 2 Load Analysis – Hybrid Measured & Theoretical Analysis

As discussed in Section 11.3.2, the Scenario 2 flow analysis could not be completed due to the lack of AER data. Therefore, the Scenario 2 load analysis has not been completed.

11.4.3 Scenario 3 Load Analysis – Theoretical Analysis Only

In this Scenario 3 load analysis, the projected future horizon PE loading shall be used in combination with theoretical PCCs (see Table 2-2) to derive the projected future nutrient loading. Table 11-5 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 11-5 - Whitechurch WwTP Future Scenario 3 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	1,091		1,262		1,418	
BOD (kg/d)	65	131	76	151	85	170
Suspended Solids (kg/d)	82	164	95	189	106	213
Total Nitrogen (kg/d)	12	24	14	28	16	31
Total Phosphorus (kg/d)	2.4	4.8	2.8	5.6	3.1	6.2
Ammonia (kg/d)	8.7	17	10	20	11	23

11.4.4 Future Load Design Basis

The tables presented within the previous sections can be used to compare the results of the Scenario 3 flow and load analysis.

It is proposed to progress with Scenario 3 at this stage of the strategy for the reasons previously discussed in Section 11.3.4.

12. Cloyne WwTP

12.1 Introduction

Cloyne WwTP is located East of Cork Harbour and serves the village which is approximately 7 km south of Midleton and 4 km east of Cork Harbour, as seen in Figure 12-1. Cloyne WwTP was constructed in 1995 and EPS operate and maintain Cloyne WwTP on behalf of UÉ under a 20-year DBO contract.

The WwTP has a design capacity of 1,400 PE and comprises of; preliminary, secondary, and tertiary treatment. The WwTP treats the incoming influent to a tertiary treatment standard by conventional aeration methods and polishing the effluent by passing it through a reed bed system. There is also sludge thickening on-site. Untreated wastewater and stormwater overflow from the plant is discharged to the adjacent Spital Stream and final effluent is discharged to Cork Harbour.

According to the data from the 2022 census report the catchment of Cloyne indicates a domestic population of 1,967 while the UÉ Asset Capacity Register, has a current loading PE of 2,076.

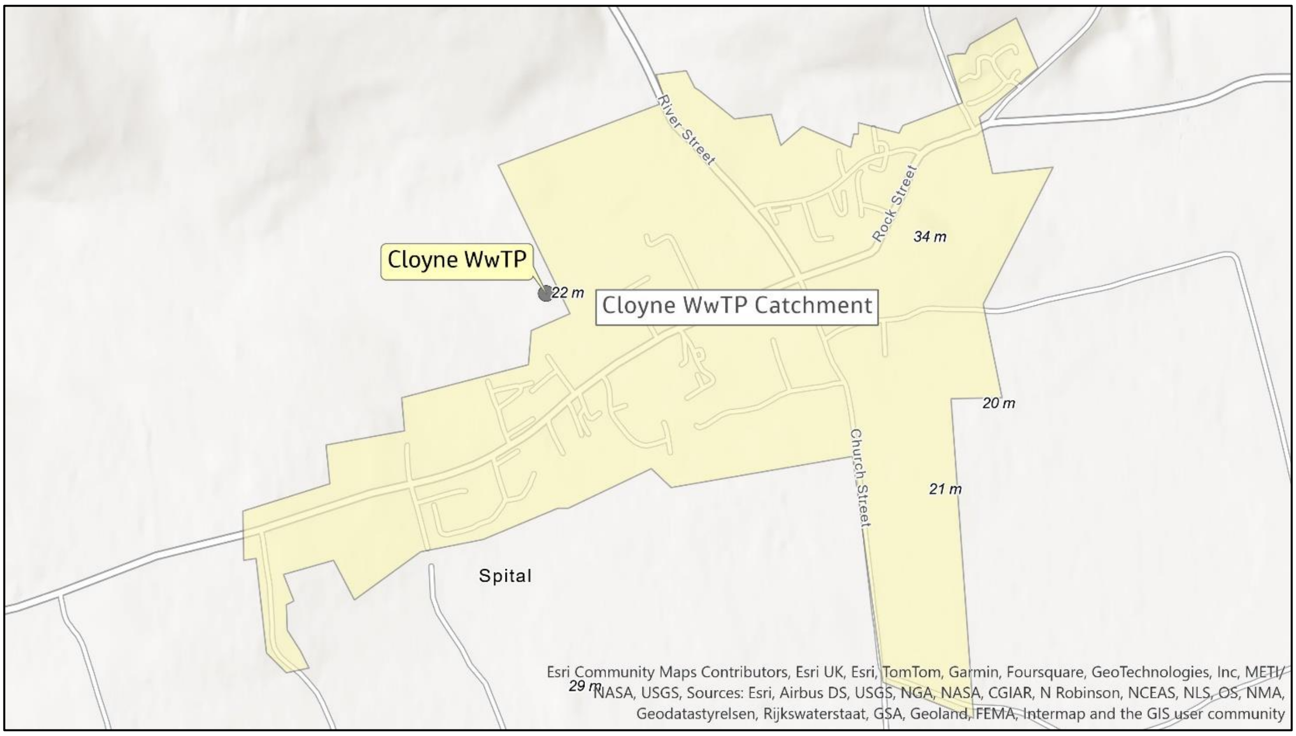


Figure 12-1 - Cloyne WwTP Site Location and Catchment

12.2 Current Flow and Load Summary

In order to evaluate the future horizon WwTP flow and load projections, an assessment of the current WwTP loading was undertaken to understand current catchment characteristics that may influence the future horizon assessment.

In the following sections, commentary will be provided on the interpretation of current organic capacity, the quality and reliability of raw data and recommendations on the preferred future horizon calculation methodology.

12.2.1 Current Wastewater Discharge Licence (WWDL) Summary

The Waste Water Discharge Licence (WWDL) (D0298-01) was originally granted in 2010. The licence was subsequently revised under Technical Amendment B in 2021. It is therefore assumed the reported design PE is based on the amended licence requirements, which are summarised below in Table 12-1.

Table 12-1 – Cloyne WwTP WWDL ELVs (D0298-01)

Parameter	Units	Value
BOD	mg/l	10
COD	mg/l	50
Suspended Solids	mg/l	10
Total Nitrogen (as N)	mg/l	15

12.2.2 Latest AER Data

The latest Annual Environmental Report (AER) for Cloyne WwTP was published in 2023. Table 12-2 summarises the WwTP flows received in 2023. The average and maximum annual concentrations for BOD, COD, Suspended Solids and Total N are also provided in the 2023 AER and have been summarised in Table 12-3 below.

Table 12-2 – Cloyne WwTP 2023 AER Flow Summary

Parameter	Units	Value
Peak Hydraulic Capacity (FtFT)	m^3/d	315
Design PE	PE	1,400
Dry Weather Flow (DWF)	m^3/d	105
Average Daily Flow (ADF)	m^3/d	767
Collected PE Load	PE	2,125

Table 12-3 – Cloyne WwTP 2023 AER Raw Influent Concentration Summary

Parameter	Units	No. Samples	Annual Average	Annual Maximum
BOD	mg/l	12	199	401
COD	mg/l	12	524	1,286
Suspended Solids	mg/l	12	283	1,336
Total Nitrogen	mg/l	12	64	116

The Cloyne WwTP also accepts landfill leachate which are delivered via tanker. The 2023 AER reports the annual discharges quantities as 90 m^3. It should be noted that the annual discharge in 2023 only constituted less than 0.07% of the total WwTP load. It is assumed the future strategy flow and load projections will account for increased leachate, septic tank and sludge discharges over the strategy horizons. It should also be noted, the AER reports there is no current facility for acceptance of landfill leachate which should be considered in any optioneering upgrade.

12.2.3 Current Measured Flow Data

Raw influent flow and load data for period of 2020-2022 was obtained for the flow and load data analysis. There were 1,096 No. flow data points across the 3-year period, which ordinarily would increasing the level of statistical confidence of the data. However, further analysis and review of the data indicates a large quantity of repeated values which has deemed the flow data as unreliable. It is therefore not recommended to use this data, which discounts the use of Flow Scenario 1. The following table summarises the measured flow data and the calculated DWF PCC and DWF ratios which have been determined using the 2023 AER Collected PE loading of 2,125 PE, and the methodology discussed in Section 2.1.1.

Table 12-4 – Cloyne WwTP Measured Flow Summary

Parameter	Units	Value
Measured Data Points	No.	1,096
Dry Weather Flow (DWF)	m^3/d	221
Average Daily Flow (ADF)	m^3/d	351
Flow to Full Treatment (FtFT)	m^3/d	590
Maximum	m^3/d	918
DWF PCC	L/PE/d	104
DWF:ADF	-	1.59
DWF:FtFT	-	2.67

Whilst the measured ADF of 351m^3/d closely aligns with the 2023 AER reported ADF of 105 m^3/d, there is a vast difference between the measured DWF of 221 m^3/d and the 2023 AER reported DWF of 357 m^3/d. The measured data analysis also indicates the DWF PCC is low at 104 L/PE/d.

12.2.4 Current Measured Nutrient Loading Data

As discussed, raw influent flow and load data for period of 2020-2022 was obtained for the flow and load data analysis. There were a relatively large number influent spot samples (~150-170) for BOD, COD, Suspended Solids, Total N, Total P and Ammonia across the 3-year period with the majority of samples occurring on days with flow meter readings.

The analysis provides a summary of the average and 95%ile concentrations. A load analysis has been completed which calculates the daily load based on the daily flow reading. The following Table 12-5summarises the results of the nutrient concentration and loads analysis.

Table 12-5 – Cloyne WwTP Measured Nutrient Concentration and Load Summary

Parameter	Concentrations (mg/l)		Loads (kg/d)	
	Average	95%ile	Average	95%ile
BOD	216	435	69	138
COD	498	1,026	160	344
Suspended Solids	265	654	85	185
Total Nitrogen (TN)	67	128	22	44
Total Phosphorus (TP)	7.1	13.4	2.3	4.5
Total Nitrogen (TN)	42	76	12	23
Measured PE (BOD Basis)	-		1,153	

As shown in the table above, the measured PE was calculated as 1,153 when using a BOD PCC of 60g/PE/d. This is significantly lower than the reported 2023 AER Collected Load of 2,125 PE. Given the difference in measured load, determined using the 3-year sample dataset, it is recommended to use measured concentration results in the future Scenario 1 and Scenario 2 horizon load assessment. Theoretical PCCs shall be used within Scenario 3 to provide comparison.

12.3 WwTP Future Flow Analysis

This section shall be used to outline the measured flow analysis and provide commentary on future flow assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.1

12.3.1 Scenario 1 Flow Analysis – Measured Data Only

As discussed in the previous section, it is not recommended to use the measured flow data for Cloyne WwTP given the level of data uncertainty. Therefore, the Scenario 1 flow analysis has not been included within this report.

12.3.2 Scenario 2 Flow Analysis – Hybrid Measured & Theoretical Analysis

The Scenario 2 flow analysis considers the current WwTP flow loading (as reported in the 2023 Cloyne WwTP AER) with all additional future flow from the projected PE growth loading determined using theoretical flow PCCs. Table 12-6 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.2.

Note, using the 2023 AER data, (PE loading of 2,125PE and DWF of 105 m^3/d), the equivalent DWF PCC is 49 L/PE/d which is considerably lower than the theoretical PCC of 225 L/PE/d.

Table 12-6 - Cloyne WwTP Future Scenario 2 Flow Analysis

Parameter	Units	2030	2055	2080
Current PE	PE	2,125 (49 L/PE/d)		

Parameter	Units	2030	2055	2080
Horizon PE	PE	3,199	3,813	4,279
Horizon Dry Weather Flow (DWF)	m^3/d	347	485	590
Horizon Average Daily Flow (ADF)	m^3/d	659	832	963
Horizon Flow to Full Treatment (FtFT)	m^3/d	1,040	1,454	1,769

12.3.3 Scenario 3 Flow Analysis – Theoretical Analysis

The Scenario 3 flow analysis applies the theoretical flow calculation to the total horizon PE loading projection. The table below provides the projected PE and the resulting DWF, ADF and FfFT for each Strategy horizon. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.3.

Table 12-7 - Cloyne WwTP Future Scenario 3 Flow Analysis

Parameter	Units	2030	2055	2080
Horizon PE	PE	3,199	3,813	4,279
Horizon Dry Weather Flow (DWF)	m^3/d	720	858	963
Horizon Average Daily Flow (ADF)	m^3/d	900	1,072	1,203
Horizon Flow to Full Treatment (FtFT)	m^3/d	1,839	2,192	2,460

12.3.4 Future Flow Design Basis

The tables provided in the previous sections can be used to compare the results of the Scenario 2 and Scenario 3 flow analysis.

At this stage of the strategy, it is proposed to discuss Scenario progression further with Uisce Éireann for the following reasons:

- Whilst Scenario 2 provides a less conservative FtFT estimate compared to Scenario 3, it is more reflective of the current catchment characteristics which indicate a considerably lower DWF PCC than the theoretical.
- However, Scenario 2 reflects an increasing DWF PCC over the 2030-2080 horizon, which conflicts the reduce usage targets.
- Scenarios 1 and 2 have very low DWF PCCs which should be discussed in greater detail to understand any potential planned or ongoing changes which may increase this allowance.

Figure 12-2 below represents the estimated projected flow (ADF & 3DWF) demand of the Cloyne WwTP across the current and future horizons.

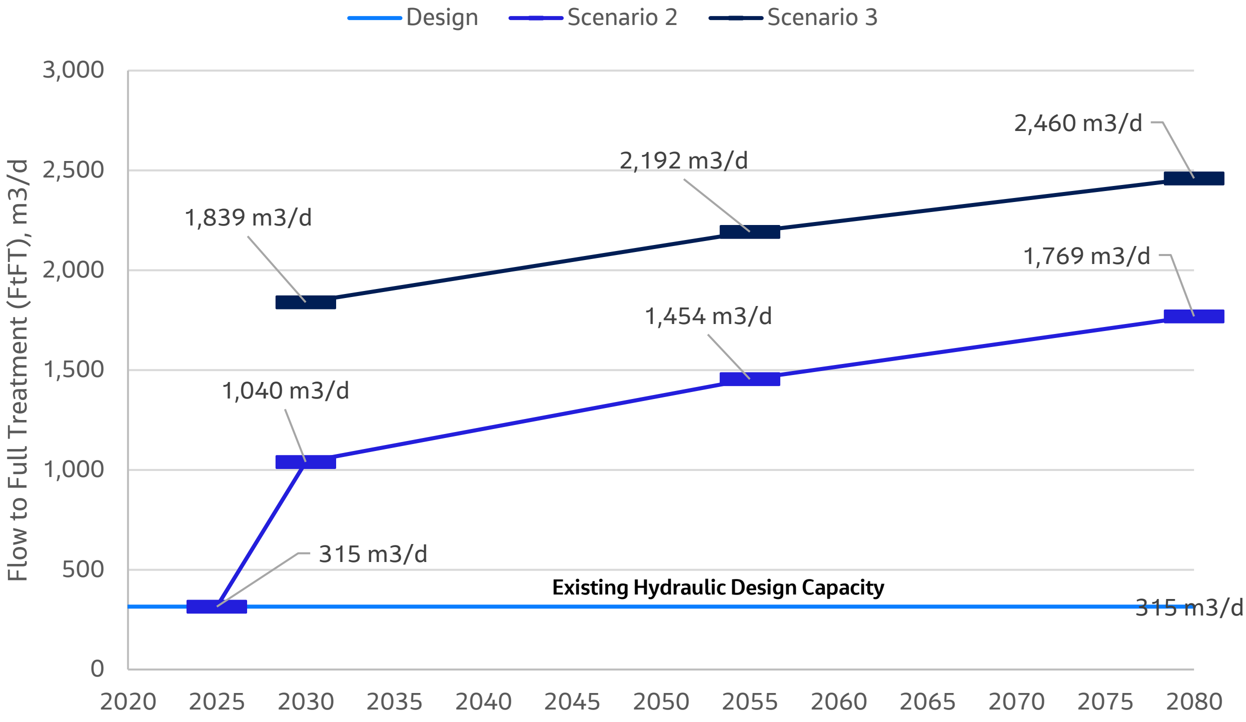


Figure 12-2 - Cloyne WwTP Future Flow Projection (Scenario 2 and 3)

Using flow Scenario 2 and Scenario 3, the existing hydraulic capacity is projected to be exceeded by 2030, with capacity needs increasing by over 560% for flow Scenario 2 and by over 780% for flow Scenario 3 for the 2080 horizon.

12.4 WwTP Future Nutrient Loading Analysis

This section shall be used to outline the measured load analysis and provide commentary on future load assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

12.4.1 Scenario 1 Load Analysis – Measured Data Only

As discussed in Section 12.3.1, the measured flow data does not provide sufficient statistical analysis confidence and is therefore not recommended for use within this assessment. The Scenario 1 load analysis has therefore not been included within this report.

12.4.2 Scenario 2 Load Analysis – Hybrid Measured & Theoretical Analysis

In this Scenario 2 load analysis, the projected future horizon flows shall be used in combination with the measured sample data concentrations (see Table 12-5) to derive the projected future nutrient loading. Table 12-8 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 12-8 - Cloyne WwTP Future Scenario 2 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	3,199		3,813		4,279	
Horizon ADF (m^3/d)	659		832		963	
BOD (kg/d)	143	286	180	361	208	418
Suspended Solids (kg/d)	175	431	221	544	255	629
Total Nitrogen (kg/d)	44	84	56	106	64	123
Total Phosphorus (kg/d)	4.7	8.8	5.9	11.1	6.8	12.9
Ammonia (kg/d)	28	50	35	64	40	74

12.4.3 Scenario 3 Load Analysis – Theoretical Analysis Only

In this Scenario 3 load analysis, the projected future horizon PE loading shall be used in combination with theoretical PCCs (see Table 2-2) to derive the projected future nutrient loading. Table 12-9 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 12-9 - Cloyne WwTP Future Scenario 3 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	3,199		3,813		4,279	
BOD (kg/d)	192	384	229	458	257	513
Suspended Solids (kg/d)	240	480	286	572	321	642
Total Nitrogen (kg/d)	35	70	42	84	47	94
Total Phosphorus (kg/d)	7	14	8	17	9	19
Ammonia (kg/d)	26	51	31	61	34	68

12.4.4 Future Load Design Basis

The tables presented within the previous sections can be used to compare the results of the Scenario 2 and Scenario 3 flow and load analysis.

It is proposed to progress with Scenario 3 at this stage of the strategy for the reasons previously discussed in Section 12.3.4.

13. Ballygarvan WwTP

13.1 Introduction

Ballygarvan WwTP is located in Ballygarvan village in County Cork. It lies 9 km south of Cork City, as seen in Figure 13-1. The WwTP was commissioned in 2010 and subsequently had an M&E upgrade in 2013. EPS operate and maintain Ballygarvan WwTP on behalf of UÉ under a 20 DBO year contract.

The WwTP has a design capacity of 634 PE and comprises of; preliminary, secondary treatment and a tertiary sand filter. There is no sludge treatment on-site. Treated wastewater from the plant is discharged to the Owenboy River.

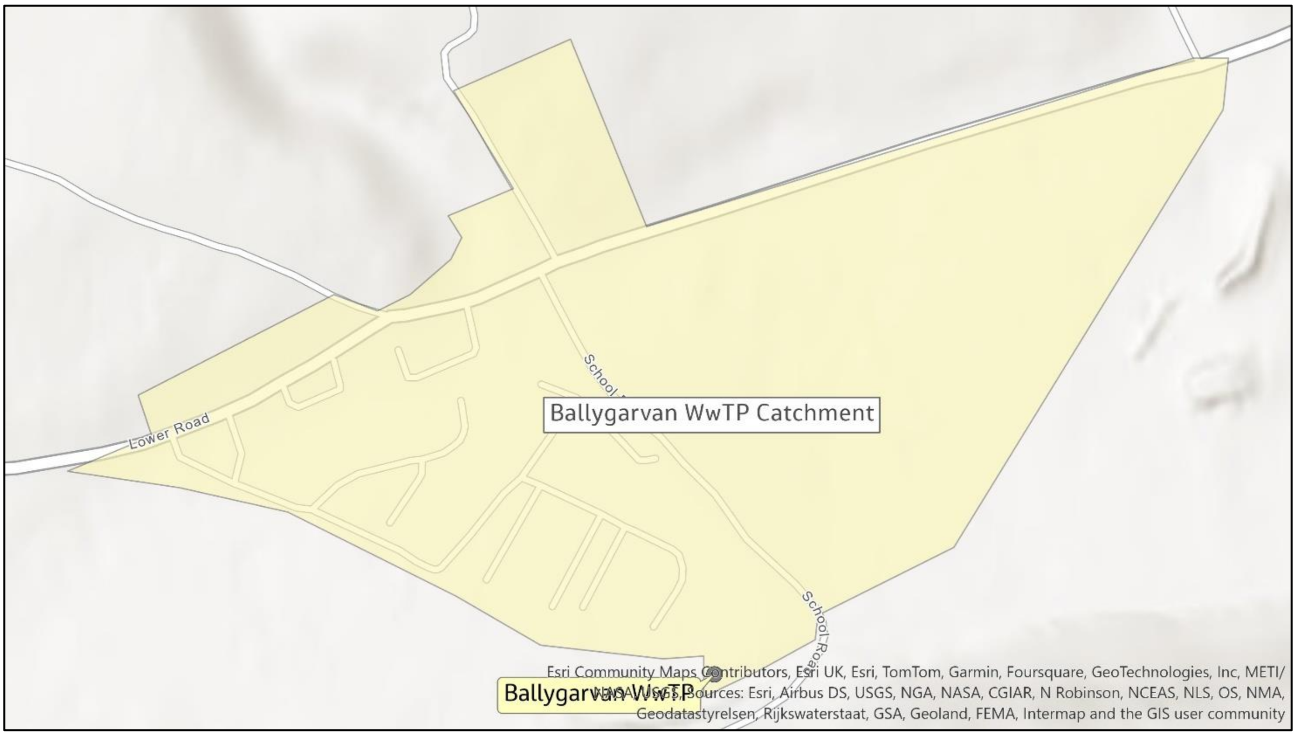


Figure 13-1 - Ballygarvan WwTP Site Location and Catchment

13.2 Current Flow and Load Summary

In order to evaluate the future horizon WwTP flow and load projections, an assessment of the current WwTP loading was undertaken to understand current catchment characteristics that may influence the future horizon assessment.

In the following sections, commentary will be provided on the interpretation of current organic capacity, the quality and reliability of raw data and recommendations on the preferred future horizon calculation methodology.

13.2.1 Current Wastewater Discharge Licence (WWDL) Summary

The Waste Water Discharge Licence (WWDL) (D0540-01) was originally granted in 2013. The licence was subsequently revised under Technical Amendment A in 2021. It is therefore assumed the reported design PE is based on the amended licence requirements, which are summarised below in Table 13-1.

Table 13-1 – Ballygarvan WwTP WWDL ELVs (D0298-01)

Parameter	Units	Value
BOD	mg/l	25
COD	mg/l	125
Suspended Solids	mg/l	35
Ammonia	mg/l	5
Ortho-P	mg/l	3

13.2.2 Latest AER Data

The latest Annual Environmental Report (AER) for Cloyne WwTP was published in 2023. Table 13-2 summarises the WwTP flows received in 2023. The average and maximum annual concentrations for BOD and COD are also provided in the 2023 AER and have been summarised in Note, the reported DWF is larger than the ADF which is assumed to be an error. However, the DWF is a third of the peak hydraulic capacity and it is suspected DWF are inputted correctly. An ADF of 125 m3/d has been assumed for assessments completed for the purposes of this report.

Table 13-3 below.

Table 13-2 – Ballygarvan WwTP 2023 AER Flow Summary

Parameter	Units	Value
Peak Hydraulic Capacity (FtFT)	m^3/d	375
Design PE	PE	634
Dry Weather Flow (DWF)	m^3/d	125
Average Daily Flow (ADF)	m^3/d	110
Collected PE Load	PE	663

Note, the reported DWF is larger than the ADF which is assumed to be an error. However, the DWF is a third of the peak hydraulic capacity and it is suspected DWF are inputted correctly. An ADF of 125 m3/d has been assumed for assessments completed for the purposes of this report.

Table 13-3 – Ballygarvan WwTP 2023 AER Raw Influent Concentration Summary

Parameter	Units	No. Samples	Annual Average	Annual Maximum
BOD	mg/l	6	619	1,740
COD	mg/l	6	252	678

13.2.3 Current Measured Flow Data

Raw influent flow and load data for period of 2020-2022 was obtained for the flow and load data analysis. There were 1,096 No. flow data points across the 3-year period, which increases the level of statistical confidence in the data. The following table summarises the measured flow data and the calculated DWF PCC and DWF ratios which have been determined using the 2023 AER Collected PE loading of 2,125 PE, and the methodology discussed in Section 2.1.1.

Table 13-4 – Ballygarvan WwTP Measured Flow Summary

Parameter	Units	Value
Measured Data Points	No.	1,096
Dry Weather Flow (DWF)	m^3/d	64
Average Daily Flow (ADF)	m^3/d	124
Flow to Full Treatment (FtFT)	m^3/d	217
Maximum	m^3/d	490
DWF PCC	L/PE/d	97
DWF:ADF	-	1.93
DWF:FtFT	-	3.39

Whilst the measured ADF of 124 m^3/d closely aligns with the 2023 AER reported ADF of 110 m^3/d, there is a vast difference between the measured DWF of 64 m^3/d and the 2023 AER reported DWF of 125 m^3/d. The measured data analysis also indicates the DWF PCC is low at 97 L/PE/d.

13.2.4 Current Measured Nutrient Loading Data

As discussed, raw influent flow and load data for period of 2020-2022 was obtained for the flow and load data analysis. There were a relatively large number influent spot samples (~150) for BOD, COD and Suspended Solids across the 3-year period with all samples occurring on days with flow meter readings. However, there are less than 19 samples for Total N, Total P and Ammonia over the period, providing less statistical confidence in the measured data results.

The analysis provides a summary of the average and 95%ile concentrations. A load analysis has been completed which calculates the daily load based on the daily flow reading. The following Table 13-5 summarises the results of the nutrient concentration and loads analysis.

Table 13-5 – Ballygarvan WwTP Measured Nutrient Concentration and Load Summary

Parameter	Concentrations (mg/l)		Loads (kg/d)	
	Average	95%ile	Average	95%ile
BOD	212	490	25	63
COD	567	1,367	65	190
Suspended Solids	280	1,053	34	131

Parameter	Concentrations (mg/l)		Loads (kg/d)	
	Average	95%ile	Average	95%ile
Total Nitrogen (TN)	55	93	6.7	10.8
Total Phosphorus (TP)	6.1	10.1	0.7	1.1
Measured PE (BOD Basis)	-		409	

As shown in the table above, the measured PE was calculated as 409 when using a BOD PCC of 60g/PE/d. This is lower than the reported 2023 AER Collected Load of 663 PE. Given the difference in measured load, determined using the 3-year sample dataset, it is recommended to use measured concentration results in the future Scenario 1 and Scenario 2 horizon load assessment. Theoretical PCCs shall be used within Scenario 3 to provide comparison.

13.3 WwTP Future Flow Analysis

This section shall be used to outline the measured flow analysis and provide commentary on future flow assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.1

13.3.1 Scenario 1 Flow Analysis – Measured Data Only

The Scenario 1 flow analysis considers the current measured WwTP flow loading, deriving a DWF PCC and DWF:ADF and DWF:FFT ratios to determine the future projected flow loading based on the established projected horizon PE. Table 13-6 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.1.

Table 13-6 - Ballygarvan WwTP Future Scenario 1 Flow Analysis

Parameter	Units	2030	2055	2080
Current PE	PE		663 (97 L/PE/d)	
Horizon PE	PE	930	1,079	1,212
Horizon Dry Weather Flow (DWF)	m^3/d	90	104	117
Horizon Average Daily Flow (ADF)	m^3/d	174	201	226
Horizon Flow to Full Treatment (FtFT)	m^3/d	305	354	397

13.3.2 Scenario 2 Flow Analysis – Hybrid Measured & Theoretical Analysis

The Scenario 2 flow analysis considers the current WwTP flow loading (as reported in the 2023 Cloyne WwTP AER) with all additional future flow from the projected PE growth loading determined using theoretical flow PCCs. Table 13-7 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.2.

Note, using the 2023 AER data, (PE loading of 663PE and DWF of 125 m^3/d), the equivalent DWF PCC is 189 L/PE/d which is aligns with the theoretical domestic allowance PCC of 225 L/PE/d.

Table 13-7 - Ballygarvan WwTP Future Scenario 2 Flow Analysis

Parameter	Units	2030	2055	2080
Current PE	PE	663 (189 L/PE/d)		
Horizon PE	PE	930	1,079	1,212
Horizon Dry Weather Flow (DWF)	m^3/d	185	219	249
Horizon Average Daily Flow (ADF)	m^3/d	185	227	264
Horizon Flow to Full Treatment (FtFT)	m^3/d	555	656	746

13.3.3 Scenario 3 Flow Analysis – Theoretical Analysis

The Scenario 3 flow analysis applies the theoretical flow calculation to the total horizon PE loading projection. The table below provides the projected PE and the resulting DWF, ADF and FfFT for each Strategy horizon. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.3.

Table 13-8 - Ballygarvan WwTP Future Scenario 3 Flow Analysis

Parameter	Units	2030	2055	2080
Horizon PE	PE	930	1,079	1,212
Horizon Dry Weather Flow (DWF)	m^3/d	209	243	273
Horizon Average Daily Flow (ADF)	m^3/d	262	303	341
Horizon Flow to Full Treatment (FtFT)	m^3/d	535	620	697

13.3.4 Future Flow Design Basis

The tables provided in the previous sections can be used to compare the results of the Scenario 1, Scenario 2 and Scenario 3 flow analysis.

At this stage of the strategy, it is proposed to progress with Scenario 2 for the following reasons:

- It provides greater consideration for current WwTP loading compared to Scenario 3.
- It provides a more conservative flow estimate for the 2030, 2055 and 2080 future horizons.
- Using the Scenario 2 calculation methodology, the total flow DWF PCCs are 199, 203 and 205 L/PE/d for the 2030, 2055 and 2080 horizons, respectively, which aligns more closely with UÉ's future loading projections.

Figure 13-2 below represents the estimated projected flow (ADF & 3DWF) demand of the Ballygarvan WwTP across the current and future horizons.

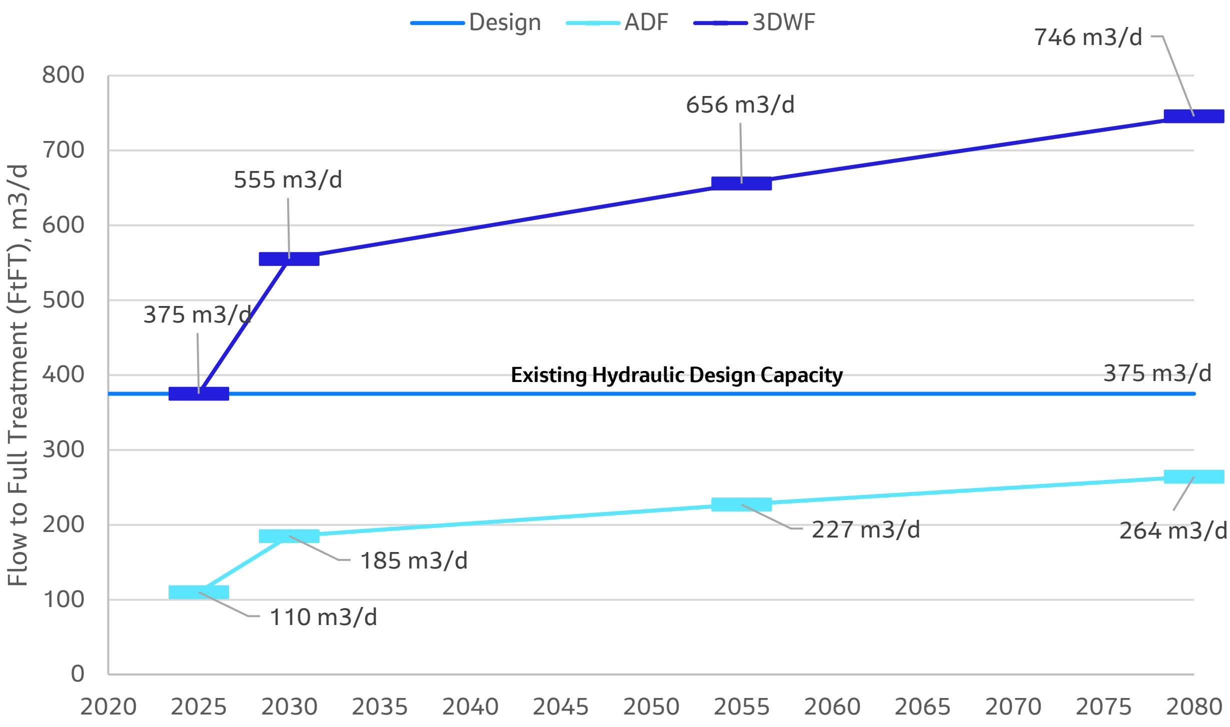


Figure 13-2 - Ballygarvan WwTP Future Flow Projection (Scenario 2)

Using flow Scenario 2, the existing hydraulic capacity is projected to be exceeded by 2030, with capacity needs more than doubling by 2080. The analysis indicates there is sufficient hydraulic capacity to meet the future ADF projections.

13.4 WwTP Future Nutrient Loading Analysis

This section shall be used to outline the measured load analysis and provide commentary on future load assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

13.4.1 Scenario 1 Load Analysis – Measured Data Only

In this Scenario 1 load analysis, the projected Scenario 1 future horizon flows shall be used in combination with the measured sample data concentrations (see Table 13-5) to derive the projected future nutrient loading. Table 13-9 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 13-9 - Ballygarvan WwTP Future Scenario 1 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	930		1,079		1,212	
Horizon ADF (m^3/d)	174		201		226	
BOD (kg/d)	37	85	43	99	48	111

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Suspended Solids (kg/d)	49	183	56	212	63	238
Total Nitrogen (kg/d)	10	16	11	19	13	21
Total Phosphorus (kg/d)	1.1	1.8	1.2	2.0	1.4	2.3
Ammonia (kg/d)	6.3	10.6	7.3	12.3	8.2	13.8

13.4.2 Scenario 2 Load Analysis – Hybrid Measured & Theoretical Analysis

In this Scenario 2 load analysis, the projected future horizon flows shall be used in combination with the measured sample data concentrations (see Table 13-5) to derive the projected future nutrient loading. Table 13-10 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 13-10 - Ballygarvan WwTP Future Scenario 2 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	930		1,079		1,212	
Horizon ADF (m^3/d)	185		227		264	
BOD (kg/d)	39	91	48	111	56	129
Suspended Solids (kg/d)	52	195	64	239	74	278
Total Nitrogen (kg/d)	10	17	13	21	15	25
Total Phosphorus (kg/d)	1.1	1.9	1.4	2.3	1.6	2.7
Ammonia (kg/d)	6.7	11.3	8.3	13.8	9.6	16.1

13.4.3 Scenario 3 Load Analysis – Theoretical Analysis Only

In this Scenario 3 load analysis, the projected future horizon PE loading shall be used in combination with theoretical PCCs (see Table 2-2) to derive the projected future nutrient loading. Table 13-11 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 13-11 - Ballygarvan WwTP Future Scenario 3 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	930		1,079		1,212	

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
BOD (kg/d)	56	112	65	129	73	145
Suspended Solids (kg/d)	70	140	81	162	91	182
Total Nitrogen (kg/d)	10	20	12	24	13	27
Total Phosphorus (kg/d)	2.0	4.1	2.4	4.7	2.7	5.3
Ammonia (kg/d)	7.4	14.9	8.6	17.3	9.7	19.4

13.4.4 Future Load Design Basis

The tables presented within the previous sections can be used to compare the results of the Scenario 1, Scenario 2 and Scenario 3 flow and load analysis.

It is proposed to progress with Scenario 2 at this stage of the strategy for the reasons previously discussed in Section 13.3.4.

14. Kileens WwTP

14.1 Introduction

Kileens WwTP is located approximately 1.5km to the west of Cork City, as seen in Figure 14-1. The plant was commissioned in 2009 and it is currently operated and maintained by Cork County Council on behalf of UÉ. Kileens is currently progressing through UÉ's Stage 3 – Final Business Case; WS6 is due to progress in June 2024.

The WwTP has a design capacity of 1,200 PE and the existing treatment comprises of; preliminary, primary, secondary, and tertiary treatment. There is no sludge treatment on-site, a sludge tank is used to collect and dewater the sludge before it is tankered offsite. Treated wastewater from the plant is discharged to the river Blarney.

The domestic population of Kileens according to the 2022 Census Small Area Population data is 588, while the UÉ Asset Capacity Register has a current loading PE of 605.

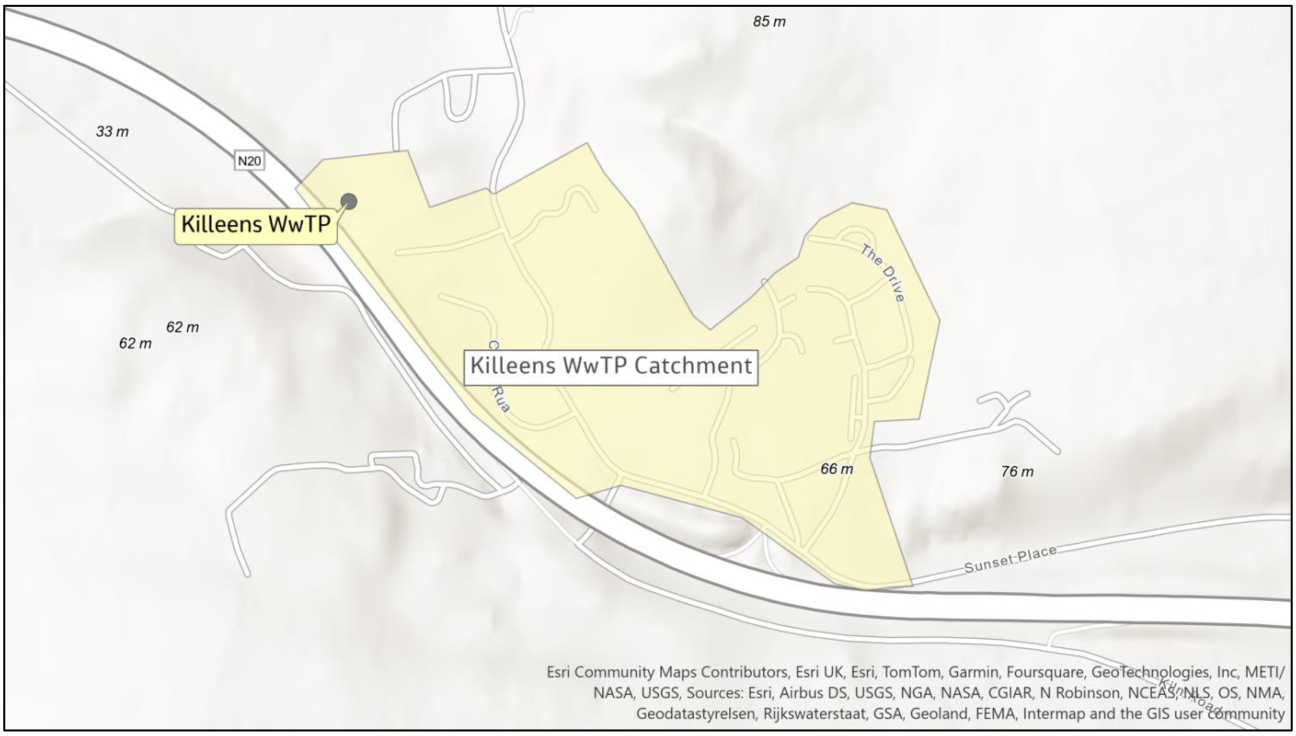


Figure 14-1 - Kileens WwTP Site Location and Catchment

14.2 Current Flow and Load Summary

In order to evaluate the future horizon WwTP flow and load projections, an assessment of the current WwTP loading was undertaken to understand current catchment characteristics that may influence the future horizon assessment.

In the following sections, commentary will be provided on the interpretation of current organic capacity, the quality and reliability of raw data and recommendations on the preferred future horizon calculation methodology.

14.2.1 Current Wastewater Discharge Licence (WWDL) Summary

The Waste Water Discharge Licence (WWDA) (D0329-01) was originally granted in 2011. The licence was subsequently revised under Technical Amendment A in 2021. It is therefore assumed the reported design PE is based on the amended licence requirements, which are summarised below in Table 14-1.

Table 14-1 – Kileens WwTP WWDL ELVs (D0329-01)

Parameter	Units	Value
BOD	mg/l	25
COD	mg/l	125
Suspended Solids	mg/l	35
Ammonia	mg/l	5
Ortho-P	mg/l	3

14.2.2 Latest AER Data

The latest Annual Environmental Report (AER) for Kileens WwTP was published in 2023. Table 14-2 summarises the WwTP flows received in 2023. The average and maximum annual concentrations for BOD, COD, Suspended Solids, Total P, Total N and Ammonia are also provided in the 2023 AER and have been summarised in Table 14-3 below.

Table 14-2 – Kileens WwTP 2023 AER Flow Summary

Parameter	Units	Value
Peak Hydraulic Capacity (FtFT)	m^3/d	270
Design PE	PE	600
Dry Weather Flow (DWF)	m^3/d	90
Average Daily Flow (ADF)	m^3/d	142
Collected PE Load	PE	900

Table 14-3 – Kileens WwTP 2023 AER Raw Influent Concentration Summary

Parameter	Units	No. Samples	Annual Average	Annual Maximum
BOD	mg/l	12	201	291
COD	mg/l	12	453	978
Suspended Solids	mg/l	12	133	576
Total Nitrogen	mg/l	12	49	71
Total Phosphorus	mg/l	12	5.05	7.46

Parameter	Units	No. Samples	Annual Average	Annual Maximum
Ammonia	mg/l	1	49	49

14.2.3 Current Measured Flow Data

Raw influent flow data was not available for the flow and load data analysis and therefore no assessment has been completed. The Scenario 1 flow and load assessment will therefore not be included within this report.

14.2.4 Current Measured Nutrient Loading Data

As discussed, raw influent flow and load data for period of 2020-2022 was obtained for the flow and load data analysis. There were a relatively small number influent spot samples (~40) for BOD, COD and Suspended Solids, Total N, Total P and Ammonia across the 4-year period.

The analysis provides a summary of the average and 95%ile concentrations. A load analysis could not be completed to calculate the daily load as there were no daily flow readings available at the time of assessment. The following Table 14-4 summarises the results of the nutrient concentration and loads analysis.

Table 14-4 – Kileens WwTP Measured Nutrient Concentration and Load Summary

Parameter	Concentrations (mg/l)		Loads (kg/d)	
	Average	95%ile	Average	95%ile
BOD	21	35	-	
COD	78	144	-	--
Suspended Solids	25	59	-	-
Total Nitrogen (TN)	42	64	-	-
Total Phosphorus (TP)	0.8	1.5	-	-
Ammonia	38	61	-	-
Measured PE (BOD Basis)	-		-	

As shown in the table above, the measured PE was calculated as 214 when using a BOD PCC of 60g/PE/d. This is lower than the reported 2023 AER Collected Load of 441 PE. Given this difference in measured load, determined using the 2-year sample dataset, it is recommended to use measured concentration results in the future Scenario 1 and Scenario 2 horizon load assessment. Theoretical PCCs shall be used within Scenario 3 to provide comparison.

14.3 WwTP Future Flow Analysis

This section shall be used to outline the measured flow analysis and provide commentary on future flow assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.1

14.3.1 Scenario 1 Flow Analysis – Measured Data Only

As discussed in the previous section, there is no measured flow data for Kileens WwTP give and therefore, the Scenario 1 flow analysis has not been included within this report.

14.3.2 Scenario 2 Flow Analysis – Hybrid Measured & Theoretical Analysis

The Scenario 2 flow analysis considers the current WwTP flow loading (as reported in the 2023 Kileens WwTP AER) with all additional future flow from the projected PE growth loading determined using theoretical flow PCCs. Table 14-5 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.2.

Note, using the 2023 AER data, (PE loading of 900E and DWF of 90 m^3/d), the equivalent DWF PCC is 100 L/PE/d which is less than half the theoretical domestic allowance PCC of 225 L/PE/d.

Table 14-5 - Kileens WwTP Future Scenario 2 Flow Analysis

Parameter	Units	2030	2055	2080
Current PE	PE	900 (100 L/PE/d)		
Horizon PE	PE	1,550	2,084	2,285
Horizon Dry Weather Flow (DWF)	m^3/d	236	356	402
Horizon Average Daily Flow (ADF)	m^3/d	325	475	532
Horizon Flow to Full Treatment (FtFT)	m^3/d	709	1,069	1,205

14.3.3 Scenario 3 Flow Analysis – Theoretical Analysis

The Scenario 3 flow analysis applies the theoretical flow calculation to the total horizon PE loading projection. The table below provides the projected PE and the resulting DWF, ADF and FfFT for each Strategy horizon. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.3.

Table 14-6 - Kileens WwTP Future Scenario 3 Flow Analysis

Parameter	Units	2030	2055	2080
Horizon PE	PE	1,550	2,084	2,285
Horizon Dry Weather Flow (DWF)	m^3/d	375	505	554
Horizon Average Daily Flow (ADF)	m^3/d	469	631	692
Horizon Flow to Full Treatment (FtFT)	m^3/d	918	1,234	1,353

14.3.4 Future Flow Design Basis

The tables provided in the previous sections can be used to compare the results of the Scenario 2 and Scenario 3 flow analysis.

At this stage of the strategy, it is proposed to progress with Scenario 2 for the following reasons:

- It provides greater consideration for current WwTP loading compared to Scenario 3.

- Using the Scenario 2 calculation methodology, the total flow DWF PCCs are 152, 171 and 176 L/PE/d for the 2030, 2055 and 2080 horizons, respectively, which aligns more closely with UÉ's future loading projections.

Figure 14-2 below represents the estimated projected flow (ADF & 3DWF) demand of the Kileens WwTP across the current and future horizons.

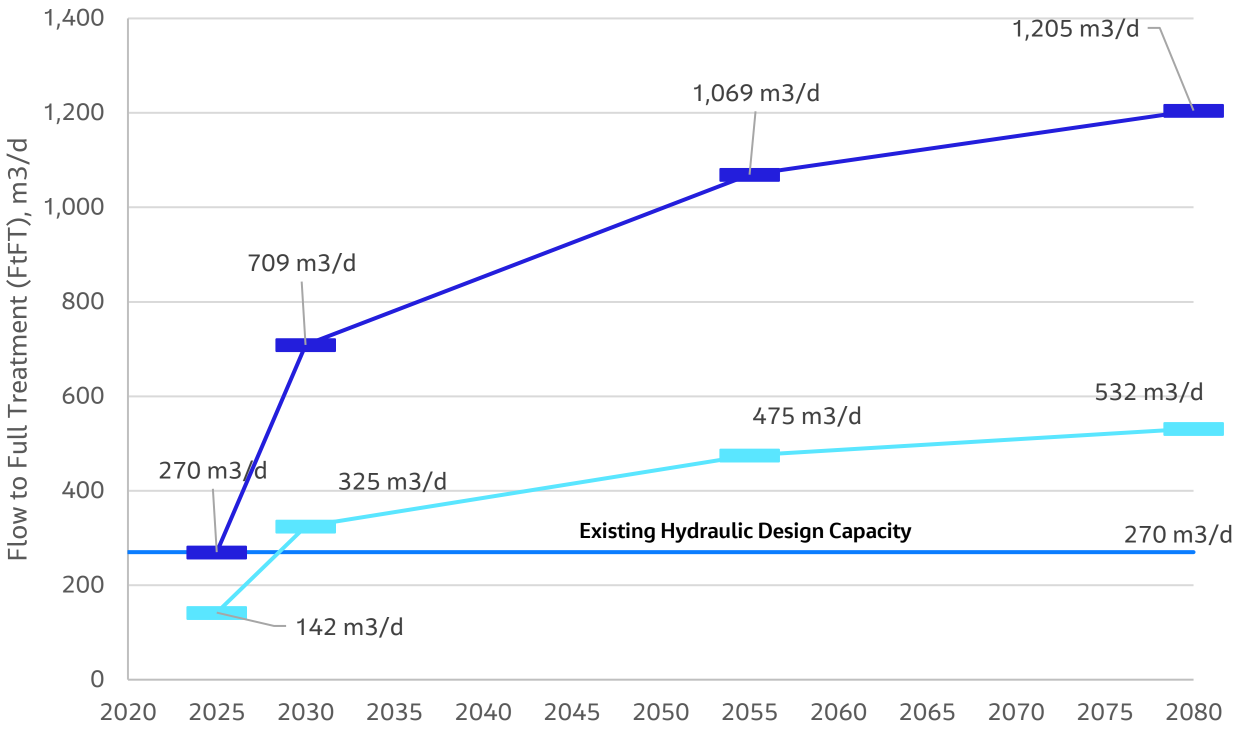


Figure 14-2 - Kileens WwTP Future Flow Projection (Scenario 2)

Using flow Scenario 2, the existing hydraulic capacity is projected to be exceeded for 3DWF and ADF projections by 2030, with capacity needs increasing fivefold by 2080.

14.4 WwTP Future Nutrient Loading Analysis

This section shall be used to outline the measured load analysis and provide commentary on future load assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

14.4.1 Scenario 1 Load Analysis – Measured Data Only

As discussed in Section 14.3.1, the measured flow data does not provide sufficient statistical analysis confidence and is therefore not recommended for use within this assessment. The Scenario 1 load analysis has therefore not been included within this report.

14.4.2 Scenario 2 Load Analysis – Hybrid Measured & Theoretical Analysis

In this Scenario 2 load analysis, the projected future horizon flows shall be used in combination with the measured sample data concentrations (see Table 14-4) to derive the projected future nutrient loading. Table 14-7 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 14-7 - Kileens WwTP Future Scenario 2 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	1,550		2,084		2,285	
Horizon ADF (m^3/d)	325		475		432	
BOD (kg/d)	7	11	10	17	11	19
Suspended Solids (kg/d)	8	19	12	28	14	31
Total Nitrogen (kg/d)	14	21	20	30	22	34
Total Phosphorus (kg/d)	0.2	0.5	0.4	0.7	0.4	0.8
Ammonia (kg/d)	12	20	18	29	20	32

14.4.3 Scenario 3 Load Analysis – Theoretical Analysis Only

In this Scenario 3 load analysis, the projected future horizon PE loading shall be used in combination with theoretical PCCs (see Table 2-2) to derive the projected future nutrient loading. Table 14-8 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 14-8 - Kileens WwTP Future Scenario 3 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	1,550		2,084		2,285	
BOD (kg/d)	93	186	125	250	137	274
Suspended Solids (kg/d)	116	233	156	313	171	343
Total Nitrogen (kg/d)	17	34	23	46	25	50
Total Phosphorus (kg/d)	3.4	6.8	4.6	9.2	5.0	10.1
Ammonia (kg/d)	12	25	17	33	18	37

14.4.4 Future Load Design Basis

The tables presented within the previous sections can be used to compare the results of the Scenario 1, Scenario 2 and Scenario 3 flow and load analysis.

It is proposed to progress with Scenario 2 at this stage of the strategy for the reasons previously discussed in Section 14.3.4.

15. Dripsey (Model Village) WwTP

15.1 Introduction

Dripsey is a settlement located approximately 19 km west of Cork City and 1 km north of the River Lee at the Inniscarra Lake Reservoir. The settlement consists of three nodes of development namely, Model Village, Upper Dripsey and Lower Dripsey but only the Model Village is serviced by a public sewer.

Dripsey WwTP is a new plant and was commissioned in 2022 and it is currently operated and maintained by Cork County Council on behalf of UÉ. The wastewater treatment process involves preliminary, primary and secondary treatment, before discharging at the outfall to Dripsey River.

There are conflicting reports regarding the WwTPs design capacity and FtFT as it has been reported that the new WwTP and upgrades to the sewer networks which serve Dripsey and the surrounding local area, has a PE of approximately 1,200. However, the UÉ Asset Capacity Register and relevant commissioning reports has a design capacity of 600PE. According to the data from the 2022 census report the catchment of Model Village (Dripsey) has a domestic population of 323 while the UÉ Asset Capacity Register, has a current loading PE of 431.

The operator has flagged that there is considerable capacity and urgency for the plant to take more foul water flows.

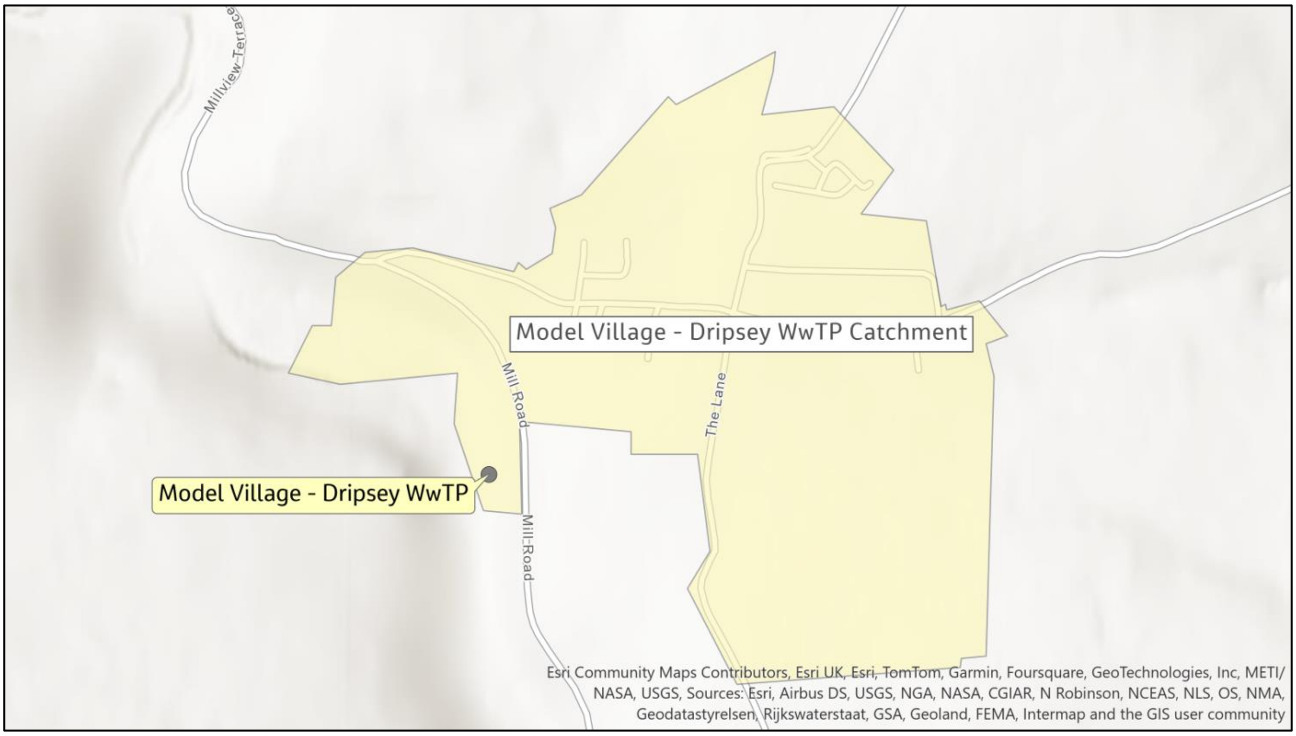


Figure 15-1 - Dripsey WwTP Site Location and Catchment

15.2 Current Flow and Load Summary

In order to evaluate the future horizon WwTP flow and load projections, an assessment of the current WwTP loading was undertaken to understand current catchment characteristics that may influence the future horizon assessment.

In the following sections, commentary will be provided on the interpretation of current organic capacity, the quality and reliability of raw data and recommendations on the preferred future horizon calculation methodology.

15.2.1 Current Wastewater Discharge Licence (WWDL) Summary

The Waste Water Discharge Licence (WWDL) (D0426-01) was originally granted in 2011. The licence was subsequently revised under Technical Amendment A in 2021 and further updated in 2024 (D0426-02). It is therefore assumed the reported design PE is based on the amended licence requirements, which are summarised below in Table 15-1.

Table 15-1 – Dripsey WwTP WWDL ELVs (D0426-02)

Parameter	Units	Value
BOD	mg/l	25
COD	mg/l	125
Suspended Solids	mg/l	35
Ammonia	mg/l	5
Ortho-P	mg/l	3

15.2.2 Latest AER Data

The latest Annual Environmental Report (AER) for Dripsey WwTP was published in 2023. Table 15-2 summarises the WwTP flows received in 2023. The average and maximum annual concentrations for BOD, COD, Suspended Solids, Total P and Total N are also provided in the 2023 AER and have been summarised in Table 15-3 below.

Table 15-2 – Dripsey WwTP 2023 AER Flow Summary

Parameter	Units	Value
Peak Hydraulic Capacity (FtFT)	m^3/d	135
Design PE	PE	600
Dry Weather Flow (DWF)	m^3/d	45
Average Daily Flow (ADF)	m^3/d	115
Collected PE Load	PE	663

Table 15-3 – Dripsey WwTP 2023 AER Raw Influent Concentration Summary

Parameter	Units	No. Samples	Annual Average	Annual Maximum
BOD	mg/l	5	115	258
COD	mg/l	5	275	564
Suspended Solids	mg/l	5	83	151
Total Nitrogen	mg/l	5	29	67

Parameter	Units	No. Samples	Annual Average	Annual Maximum
Total Phosphorus	mg/l	5	2.9	7.83

15.2.3 Current Measured Flow Data

Raw influent flow and load data for period of 2021-2022 was obtained for the flow and load data analysis. There were 730 No. flow data points across the 2-year period, which increases the level of statistical confidence in the data, however, does not reflect the hydraulic loading in 2023. The following table summarises the measured flow data and the calculated DWF PCC and DWF ratios which have been determined using the 2023 AER Collected PE loading of 441 PE, and the methodology discussed in Section 2.1.1.

Table 15-4 – Dripsey WwTP Measured Flow Summary

Parameter	Units	Value
Measured Data Points	No.	730
Dry Weather Flow (DWF)	m^3/d	52
Average Daily Flow (ADF)	m^3/d	122
Flow to Full Treatment (FtFT)	m^3/d	286
Maximum	m^3/d	614
DWF PCC	L/PE/d	118
DWF:ADF	-	2.35
DWF:FtFT	-	5.49

Both the measured DWF and ADF closely align with the 2023 AER reported DWF and ADF of 45 and 110 m^3/d, respectively.

15.2.4 Current Measured Nutrient Loading Data

As discussed, raw influent flow and load data for period of 2021-2022 was obtained for the flow and load data analysis. There were a relatively small number influent spot samples (~25) for BOD, COD and Suspended Solids, Total N, Total P and Ammonia across the 2-year period.

The analysis provides a summary of the average and 95%ile concentrations. A load analysis could not be completed to calculate the daily load as there were no daily flow readings available at the time of assessment. The following Table 15-5 summarises the results of the nutrient concentration and loads analysis.

Table 15-5 – Dripsey WwTP Measured Nutrient Concentration and Load Summary

Parameter	Concentrations (mg/l)		Loads (kg/d)	
	Average	95%ile	Average	95%ile
BOD	121	279	13	37

Parameter	Concentrations (mg/l)		Loads (kg/d)	
	Average	95%ile	Average	95%ile
COD	376	660	40	108
Suspended Solids	185	835	21	73
Total Nitrogen (TN)	36	69	4.1	10.1
Total Phosphorus (TP)	4.3	7.6	0.4	1.1
Ammonia	28	53	3.7	11.7
Measured PE (BOD Basis)	-		214	

The measured PE could not be calculated due to the lack of measured flow data. Although there are only ~40 data points across the 4-year period, it is recommended to use measured concentration results in the future Scenario 1 and Scenario 2 horizon load assessment. Theoretical PCCs shall be used within Scenario 3 to provide comparison.

15.3 WwTP Future Flow Analysis

This section shall be used to outline the measured flow analysis and provide commentary on future flow assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.1

15.3.1 Scenario 1 Flow Analysis – Measured Data Only

The Scenario 1 flow analysis considers the current measured WwTP flow loading, deriving a DWF PCC and DWF:ADF and DWF:FFT ratios to determine the future projected flow loading based on the established projected horizon PE. Table 15-6 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.1.

Table 15-6 - Dripsey WwTP Future Scenario 1 Flow Analysis

Parameter	Units	2030	2055	2080
Current PE	PE	441 (118 L/PE/d)		
Horizon PE	PE	628	726	817
Horizon Dry Weather Flow (DWF)	m^3/d	74	86	96
Horizon Average Daily Flow (ADF)	m^3/d	174	201	226
Horizon Flow to Full Treatment (FtFT)	m^3/d	407	470	529

15.3.2 Scenario 2 Flow Analysis – Hybrid Measured & Theoretical Analysis

The Scenario 2 flow analysis considers the current WwTP flow loading (as reported in the 2023 Dripsey WwTP AER) with all additional future flow from the projected PE growth loading determined using theoretical flow

PCCs. Table 15-7 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.2.

Note, using the 2023 AER data, (PE loading of 441 PE and DWF of 45 m^3/d), the equivalent DWF PCC is 102 L/PE/d which is less than half the theoretical domestic allowance PCC of 225 L/PE/d.

Table 15-7 - Dripsey WwTP Future Scenario 2 Flow Analysis

Parameter	Units	2030	2055	2080
Current PE	PE	441 (102 L/PE/d)		
Horizon PE	PE	628	726	817
Horizon Dry Weather Flow (DWF)	m^3/d	87	109	130
Horizon Average Daily Flow (ADF)	m^3/d	168	195	221
Horizon Flow to Full Treatment (FtFT)	m^3/d	261	327	389

15.3.3 Scenario 3 Flow Analysis – Theoretical Analysis

The Scenario 3 flow analysis applies the theoretical flow calculation to the total horizon PE loading projection. The table below provides the projected PE and the resulting DWF, ADF and FfFT for each Strategy horizon. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.3.

Table 15-8 - Dripsey WwTP Future Scenario 3 Flow Analysis

Parameter	Units	2030	2055	2080
Horizon PE	PE	628	726	817
Horizon Dry Weather Flow (DWF)	m^3/d	141	163	184
Horizon Average Daily Flow (ADF)	m^3/d	177	204	230
Horizon Flow to Full Treatment (FtFT)	m^3/d	361	417	470

15.3.4 Future Flow Design Basis

The tables provided in the previous sections can be used to compare the results of the Scenario 1, Scenario 2 and Scenario 3 flow analysis.

At this stage of the strategy, it is proposed to progress with Scenario 1 for the following reasons:

- It provides greater consideration for current WwTP loading compared to Scenario 2 and Scenario 3.
- It provides a more conservative future loading estimation, which is beneficial for the purposes of this strategy.

Figure 15-2 below represents the estimated projected flow (ADF & 3DWF) demand of the Kileens WwTP across the current and future horizons.

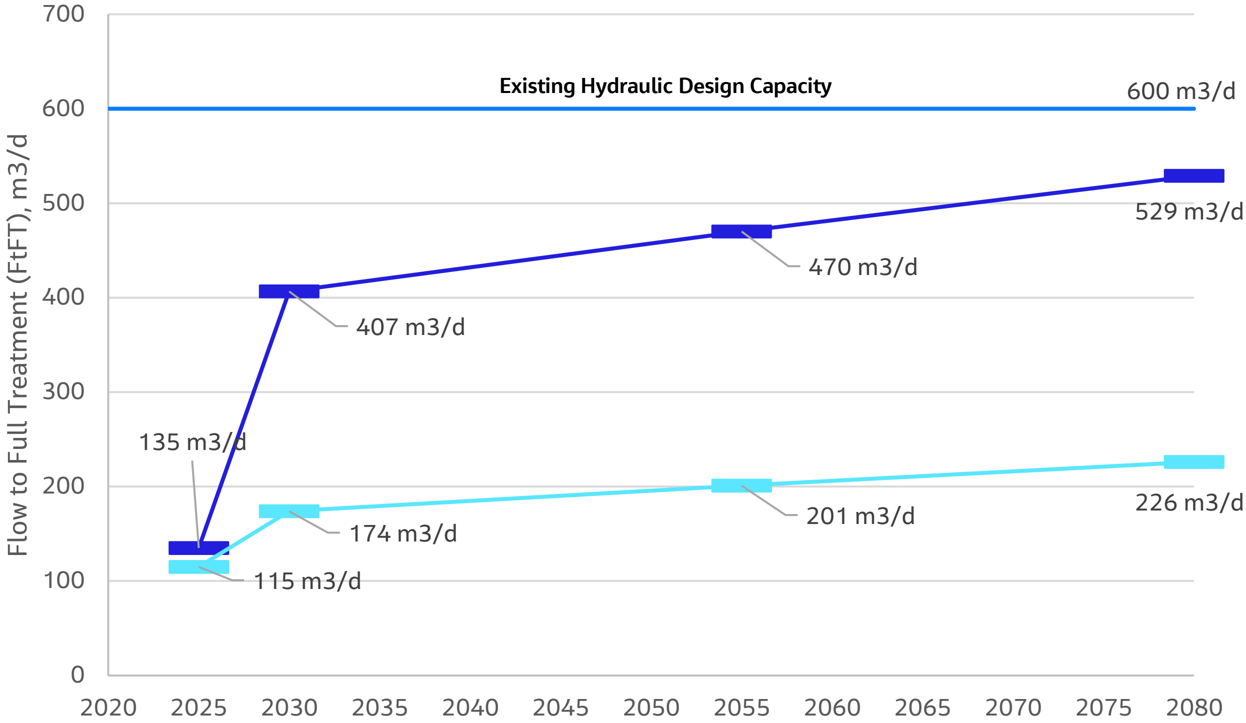


Figure 15-2 - Dripsey WwTP Future Flow Projection (Scenario 1)

Using flow Scenario 1, there is sufficient hydraulic capacity for the three future strategy horizon projections.

15.4 WwTP Future Nutrient Loading Analysis

This section shall be used to outline the measured load analysis and provide commentary on future load assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

15.4.1 Scenario 1 Load Analysis – Measured Data Only

In this Scenario 1 load analysis, the projected Scenario 1 future horizon flows shall be used in combination with the measured sample data concentrations (see Table 15-5) to derive the projected future nutrient loading. Table 15-9 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 15-9 - Dripsey WwTP Future Scenario 1 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	628		726		817	
Horizon ADF (m^3/d)	174		201		226	
BOD (kg/d)	21	48	24	56	27	63
Suspended Solids (kg/d)	32	145	37	168	42	189

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Total Nitrogen (kg/d)	6.3	11.9	7.3	13.8	8.2	15.5
Total Phosphorus (kg/d)	0.8	1.3	0.9	1.5	1.0	1.7
Ammonia (kg/d)	4.9	9.2	5.7	10.6	6.4	12.0

15.4.2 Scenario 2 Load Analysis – Hybrid Measured & Theoretical Analysis

In this Scenario 2 load analysis, the projected future horizon flows shall be used in combination with the measured sample data concentrations (see Table 15-5) to derive the projected future nutrient loading. Table 15-10 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 15-10 - Dripsey WwTP Future Scenario 2 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	628		726		817	
Horizon ADF (m^3/d)	168		195		221	
BOD (kg/d)	20	47	24	54	27	62
Suspended Solids (kg/d)	31	140	36	163	41	184
Total Nitrogen (kg/d)	6.1	11.5	7.1	13.4	8.0	15.1
Total Phosphorus (kg/d)	0.7	1.3	0.8	1.5	1.0	1.7
Ammonia (kg/d)	4.8	8.9	5.6	10.3	6.3	11.7

15.4.3 Scenario 3 Load Analysis – Theoretical Analysis Only

In this Scenario 3 load analysis, the projected future horizon PE loading shall be used in combination with theoretical PCCs (see Table 2-2) to derive the projected future nutrient loading. Table 15-11 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 15-11 - Dripsey WwTP Future Scenario 3 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	628		726		817	
BOD (kg/d)	38	75	44	87	49	98

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Suspended Solids (kg/d)	47	94	54	109	61	123
Total Nitrogen (kg/d)	6.9	13.8	8.0	16.0	9.0	18.0
Total Phosphorus (kg/d)	1.4	2.8	1.6	3.2	1.8	3.6
Ammonia (kg/d)	5.0	10.0	5.8	11.6	6.5	13.1

15.4.4 Future Load Design Basis

The tables presented within the previous sections can be used to compare the results of the Scenario 1, Scenario 2 and Scenario 3 flow and load analysis.

It is proposed to progress with Scenario 1 at this stage of the strategy for the reasons previously discussed in Section 15.3.4.

16. Grenagh WwTP

16.1 Introduction

Grenagh WwTP is located at Grenagh, County Cork, as seen in Figure 16-1. The Grenagh agglomeration consists largely of a village with a substantial residential element. The agglomeration is located approximately 16 km north of Cork City and west of the N20 Cork-Mallow Road and railway line. A certificate of Authorisation was issued to UÉ for the Grenagh agglomeration in 2015 and EPS operate and maintain Grenagh WwTP on behalf of UÉ under a DBO 20-year contract.

The WwTP has a design capacity of 1,200 PE and comprises of; preliminary and secondary treatment, the plant was upgraded in 2004 with a new aeration tank, FST and storm tank were installed. Treated wastewater from the plant is discharged to the River Martin, a tributary of the River Blarney.

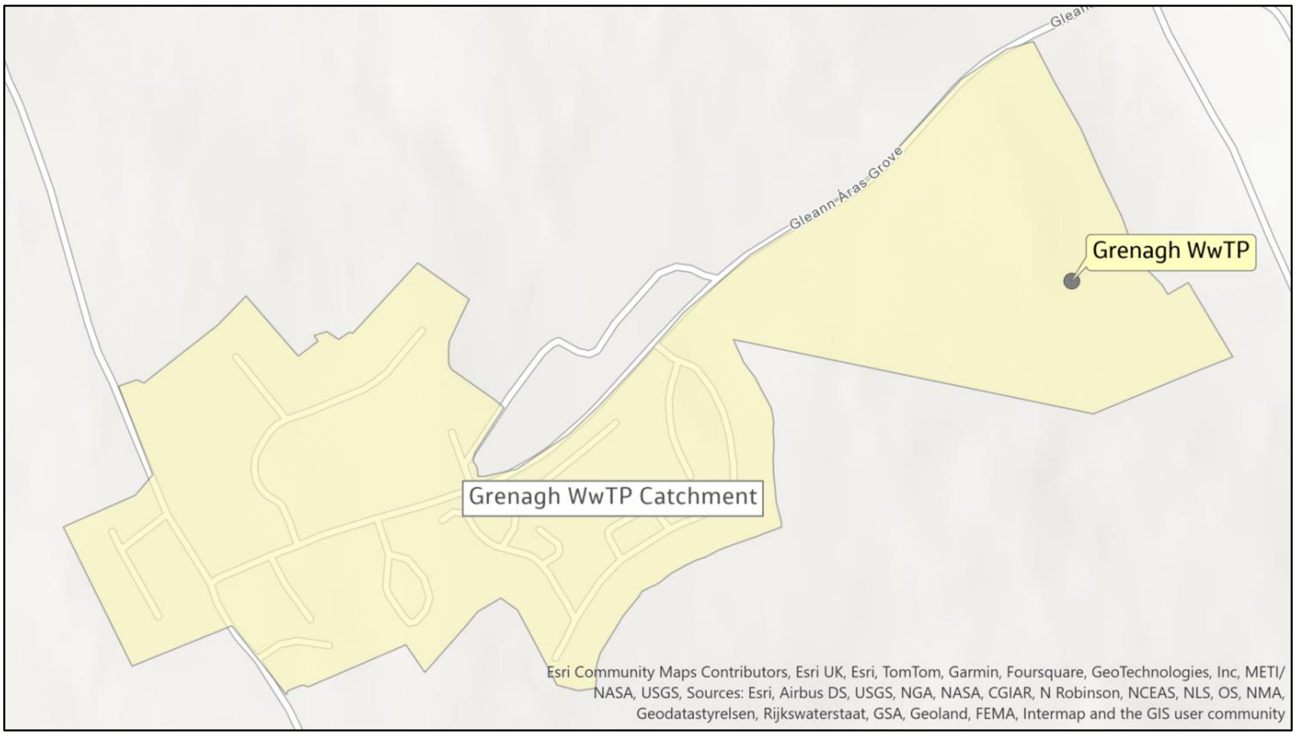


Figure 16-1 - Grenagh WwTP Site Location and Catchment

16.2 Current Flow and Load Summary

In order to evaluate the future horizon WwTP flow and load projections, an assessment of the current WwTP loading was undertaken to understand current catchment characteristics that may influence the future horizon assessment.

In the following sections, commentary will be provided on the interpretation of current organic capacity, the quality and reliability of raw data and recommendations on the preferred future horizon calculation methodology.

16.2.1 Current Wastewater Discharge Licence (WWDL) Summary

The Grenagh WwTP currently has a Waste Water Discharge Certificate of Authorisation (WWDA) (A0524) which was originally granted in 2015. There is a current application for a Waste Water Discharge Licence (WWDL) (D0544-02) which is still under review by the EPA. The EVLs as outlined in the Certificate are summarised below in Table 16-1.

Table 16-1 - Grenagh WwTP WWDA ELVs (A0524-01)

Parameter	Units	Value
BOD	mg/l	25
COD	mg/l	125
Suspended Solids	mg/l	35
Ammonia	mg/l	3
Ortho-P	mg/l	1.65

16.2.2 Latest AER Data

As stated above, there is no discharge licence for Grenagh WwTP and therefore the latest Annual Environmental Report (AER) is not recorded and published.

16.2.3 Current Measured Flow Data

Raw influent flow and load data for period of 2020-2022 was obtained for the flow and load data analysis. There were 1,096 No. flow data points across the 3-year period, which ordinarily would increasing the level of statistical confidence of the data. However, further analysis and review of the data indicates a large quantity of repeated values which has deemed the flow data as unreliable. It is therefore not recommended to use this data, which discounts the use of Flow Scenario 1. The following table summarises the measured flow data and the calculated DWF PCC and DWF ratios which have been determined using the agreed estimated current collected PE loading of 840 PE, and the methodology discussed in Section 2.1.1.

Table 16-2 – Grenagh WwTP Measured Flow Summary

Parameter	Units	Value
Measured Data Points	No.	1,065
Dry Weather Flow (DWF)	m^3/d	24
Average Daily Flow (ADF)	m^3/d	35
Flow to Full Treatment (FtFT)	m^3/d	44
Maximum	m^3/d	148
DWF PCC	L/PE/d	29
DWF:ADF	-	1.45
DWF:FtFT	-	1.83

The measured data analysis yields a DWF PCC of 29 L/PE/d, which particularly low further justifying the recommendation not to use this flow data in further analysis within the strategy.

16.2.4 Current Measured Nutrient Loading Data

As discussed, raw influent flow and load data for period of 2020-2022 was obtained for the flow and load data analysis. There were a relatively large number influent spot samples (~145) for BOD, COD, Suspended Solids, Total N, Total P and Ammonia across the 3-year period with the majority of samples occurring on days with flow meter readings.

The analysis provides a summary of the average and 95%ile concentrations. A load analysis has been completed which calculates the daily load based on the daily flow reading. The following Table 16-3 summarises the results of the nutrient concentration and loads analysis.

Table 16-3 – Grenagh WwTP Measured Nutrient Concentration and Load Summary

Parameter	Concentrations (mg/l)		Loads (kg/d)	
	Average	95%ile	Average	95%ile
BOD	334	661	12	23
COD	768	1,394	26	53
Suspended Solids	0	909	12	30
Total Nitrogen (TN)	102	184	3.6	7.7
Total Phosphorus (TP)	11	23	0.4	0.9
Ammonia	67	134	2.4	5.1
Measured PE (BOD Basis)	-		192	

As shown in the table above, the measured PE was calculated as 192, when using a BOD PCC of 60g/PE/d. This is significantly lower than the estimated current load of 840 PE. Given this difference in measured load, determined using the 3-year sample dataset, it is recommended to use measured concentration results in the future Scenario 1 and Scenario 2 horizon load assessment. Theoretical PCCs shall be used within Scenario 3 to provide comparison.

16.3 WwTP Future Flow Analysis

This section shall be used to outline the measured flow analysis and provide commentary on future flow assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.1

16.3.1 Scenario 1 Flow Analysis – Measured Data Only

As discussed in the previous section, it is not recommended to use the measured flow data for Grenagh WwTP given the level of data uncertainty. Therefore, the Scenario 1 flow analysis has not been included within this report.

16.3.2 Scenario 2 Flow Analysis – Hybrid Measured & Theoretical Analysis

The Scenario 2 flow analysis considers the current WwTP flow loading with all additional future flow from the projected PE growth loading determined using theoretical flow PCCs. In this instance, there is no available current loading information from the latest AER. Therefore, the Scenario 2 flow analysis has not been completed or included within this report.

16.3.3 Scenario 3 Flow Analysis – Theoretical Analysis

The Scenario 3 flow analysis applies the theoretical flow calculation to the total horizon PE loading projection. The table below provides the projected PE and the resulting DWF, ADF and FfFT for each Strategy horizon. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.3.

Table 16-4 - Grenagh WwTP Future Scenario 3 Flow Analysis

Parameter	Units	2030	2055	2080
Horizon PE	PE	1,042	1,250	1,411
Horizon Dry Weather Flow (DWF)	m^3/d	234	281	317
Horizon Average Daily Flow (ADF)	m^3/d	293	352	397
Horizon Flow to Full Treatment (FtFT)	m^3/d	599	719	811

16.3.4 Future Flow Design Basis

The tables provided in the previous sections can be used to compare the results of the Scenario 3 flow analysis.

At this stage of the strategy, it is proposed to progress with Scenario 3 for the following reasons:

- There is insufficient reliable data available to complete the Scenario 1 analysis. The Scenario 3 analysis uses theoretical PCCs which shall improve alignment with assessments for other sites within the study area.
- The Scenario 2 analysis could not be completed as there is no published AERs available.

Figure 16-2 below represents the estimated projected flow (ADF & 3DWF) demand of the Grenagh WwTP across the current and future horizons.

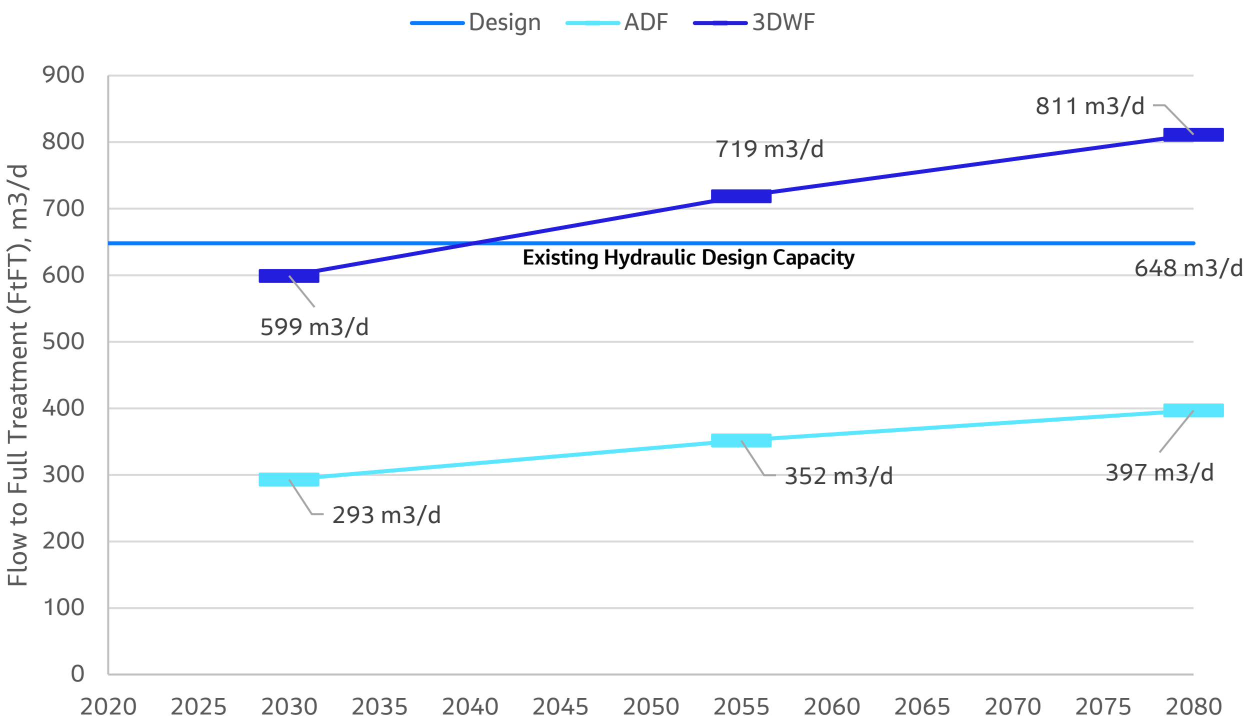


Figure 16-2 - Grenagh WwTP Future Flow Projection (Scenario 3)

Using flow Scenario 3, there is sufficient existing hydraulic flow capacity for the 3DWF projections for the 2030 horizon. However, the projections indicate the existing capacity will be exceeded for the 3DWF projections by the 2050 horizon with capacity needs increasing by 25% by 2080. However, the analysis indicates there is sufficient hydraulic capacity to meet the future ADF projections.

16.4 WwTP Future Nutrient Loading Analysis

This section shall be used to outline the measured load analysis and provide commentary on future load assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

16.4.1 Scenario 1 Load Analysis – Measured Data Only

As discussed in Section 16.3.1, the measured flow data does not provide sufficient statistical analysis confidence and is therefore not recommended for use within this assessment. The Scenario 1 load analysis has therefore not been included within this report.

16.4.2 Scenario 2 Load Analysis – Hybrid Measured & Theoretical Analysis

As discussed in Section 16.3.2, the Scenario 2 flow analysis could not be completed due to the lack of AER data. Therefore, the Scenario 2 load analysis has not been completed.

16.4.3 Scenario 3 Load Analysis – Theoretical Analysis Only

In this Scenario 3 load analysis, the projected future horizon PE loading shall be used in combination with theoretical PCCs (see Table 2-2) to derive the projected future nutrient loading. Table 16-5 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 16-5 - Grenagh WwTP Future Scenario 3 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	1,042		1,250		1,411	
BOD (kg/d)	63	125	75	150	85	169
Suspended Solids (kg/d)	78	156	94	188	106	212
Total Nitrogen (kg/d)	11	23	14	28	16	31
Total Phosphorus (kg/d)	2.3	4.6	2.8	5.5	3.1	6.2
Ammonia (kg/d)	8.3	16.7	10.0	20.0	11.3	22.6

16.4.4 Future Load Design Basis

The tables presented within the previous sections can be used to compare the results of the Scenario 1, Scenario 2 and Scenario 3 flow and load analysis.

It is proposed to progress with Scenario 3 at this stage of the strategy for the reasons previously discussed in Section 16.3.4.

17. Carrignavar WwTP

17.1 Introduction

Carrignavar WwTP is located approximately 8km north of Cork City and 2km east of Whitechurch in the Cloghnagashee River Valley, as seen in Figure 17-1. A certificate of Authorisation was issued to UÉ for the Grenagh agglomeration in 2015 and Cork County Council operate and maintain Carrignavar WwTP on behalf of UÉ.

The WTP has a design capacity of 300PE and comprises of; primary settlement stage and extended aeration stage followed by clarification and tertiary UV treatment. Currently there is sludge storage with no sludge treatment on-site. The treated effluent discharges to the Ballycaskin River adjacent to the WwTP.

According to the data from the 2022 census report the catchment of Carrignavar has a domestic population of 563 while the UÉ Asset Capacity Register, has a current loading PE of 634.

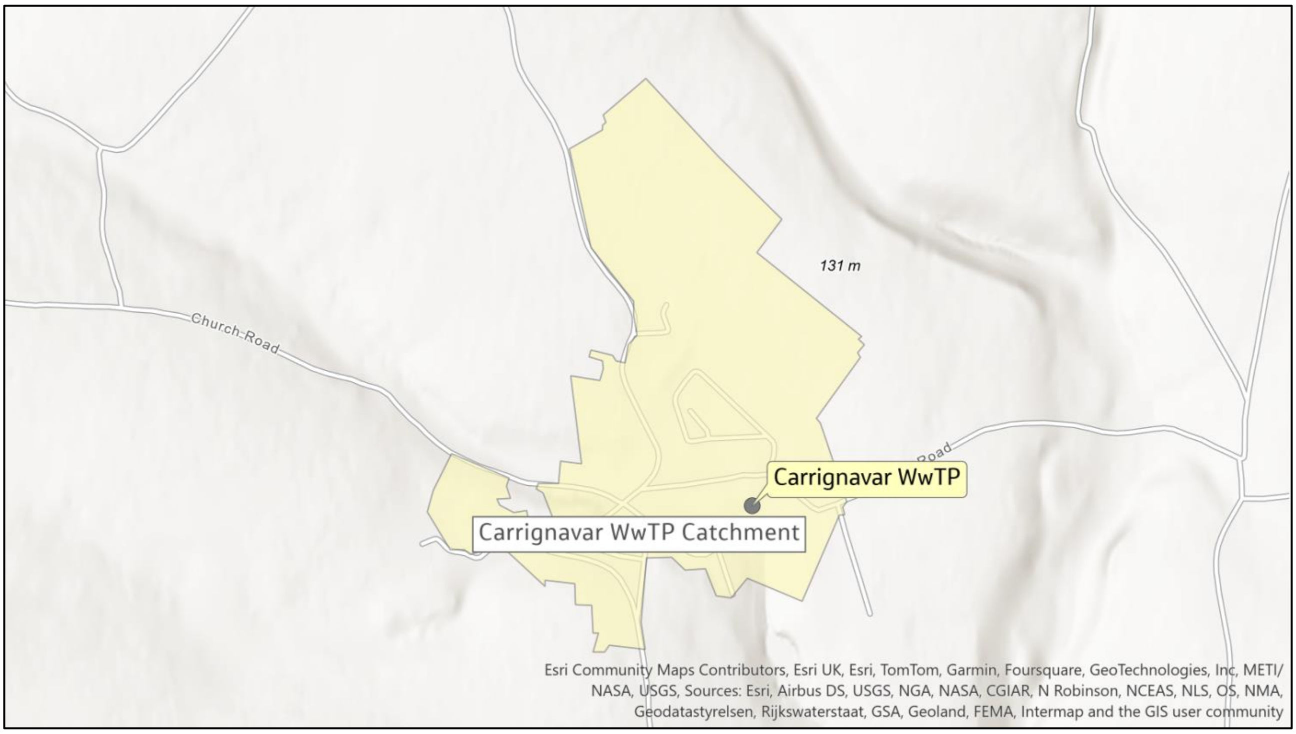


Figure 17-1 - Carrignavar WwTP Site Location and Catchment

17.2 Current Flow and Load Summary

In order to evaluate the future horizon WwTP flow and load projections, an assessment of the current WwTP loading was undertaken to understand current catchment characteristics that may influence the future horizon assessment.

In the following sections, commentary will be provided on the interpretation of current organic capacity, the quality and reliability of raw data and recommendations on the preferred future horizon calculation methodology.

17.2.1 Current Wastewater Discharge Licence (WWDL) Summary

The Waste Water Discharge Licence (WWDL) (D0517-01) was originally granted in 2013. The licence was subsequently revised under Technical Amendment A in 2021. It is therefore assumed the reported design PE is based on the amended licence requirements, which are summarised below in Table 17-1.

Table 17-1 - Carrignavar WwTP WWDL ELVs (D0517-01)

Parameter	Units	Value
CBOD	mg/l	25
COD	mg/l	125
Suspended Solids	mg/l	35
Ammonia as N	mg/l	2
Ortho-P	mg/l	1.5
pH	-	6-9

17.2.2 Latest AER Data

The latest Annual Environmental Report (AER) for Carrignavar WwTP was published in 2023. Table 17-2 summarises the WwTP flows received in 2023. The average and maximum annual concentrations for BOD, COD, Ammonia an Ortho-P are also provided in the 2023 AER and have been summarised in Table 17-3.

Table 17-2 – Carrignavar WwTP 2023 AER Flow Summary

Parameter	Units	Value
Peak Hydraulic Capacity (FtFT)	m^3/d	68
Design PE	PE	300
Dry Weather Flow (DWF)	m^3/d	23
Average Daily Flow (ADF)	m^3/d	225
Collected PE Load	PE	649

Note, the reported DWF is considerably lower than the reported ADF which is an assumed error. DWF calculations appear to be based on a third of the peak hydraulic capacity. The reported DWF is typically used within the Scenario 2 flow analysis and in this instance, it should be omitted with the ADF used for the analysis.

Table 17-3 – Carrignavar WwTP 2023 AER Raw Influent Concentration Summary

Parameter	Units	No. Samples	Annual Average	Annual Maximum
BOD	mg/l	6	205	406
COD	mg/l	6	511	682
Ammonia (as N)	mg/l	6	41	75
Ortho-Phosphate (as P)	mg/l	6	3.13	6.80

17.2.3 Current Measured Flow Data

Raw influent flow and load data for period of 2020-2022 was obtained for the flow and load data analysis. There were 16 No. flow data points across the 3-year period, thus reducing the level of statistical confidence of the data. It is therefore not recommended to use this data, which discounts the use of Flow Scenario 1. The following table summarises the measured flow data and the calculated DWF PCC and DWF ratios which have been determined using the 2023 AER Collected PE loading of 649 PE, and the methodology discussed in Section 2.1.1.

Table 17-4 – Carrignavar WwTP Measured Flow Summary

Parameter	Units	Value
Measured Data Points	No.	16
Dry Weather Flow (DWF)	m^3/d	54.7
Average Daily Flow (ADF)	m^3/d	234.9
Flow to Full Treatment (FtFT)	m^3/d	540.2
Maximum	m^3/d	625.2
DWF PCC	L/PE/d	84.3
DWF:ADF	-	0.23
DWF:FtFT	-	0.10

Whilst the measured ADF of 234.9 m^3/d relatively aligns with the 2023 AER reported ADF of 225 m^3/d, there is a vast difference between the measured DWF of 54.7 m^3/d and the 2023 AER reported DWF of 23 m^3/d.

17.2.4 Current Measured Nutrient Loading Data

As discussed, raw influent flow and load data for period of 2020-2022 was obtained for the flow and load data analysis. Overall, there were only 18 sample results for BOD and COD over the 3-year period, 14 of which occur on days with daily flow readings.

The analysis provides a summary of the average and 95%ile concentrations. A load analysis has been completed which calculates the daily load based on the daily flow reading. The following Table 17-5 summarises the results of the nutrient concentration and loads analysis.

Table 17-5 – Carrignavar WwTP Measured Nutrient Concentration and Load Summary

Parameter	Concentrations (mg/l)		Loads (kg/d)	
	Average	95%ile	Average	95%ile
BOD	252	630	31	56
COD	584	1,773	76	153
Suspended Solids	-	-	-	-
Total Phosphorus (TP)	-	-	-	-

Parameter	Concentrations (mg/l)		Loads (kg/d)	
	Average	95%ile	Average	95%ile
Total Nitrogen (TN)	-	-	-	-
Measured PE (BOD Basis)	-		512	

As shown in the table above, the measured PE was calculated as 512, when using a BOD PCC of 60g/PE/d. This is lower than the reported 2023 AER Collected Load of 649 PE. Given lack of flow and influent concentration data over the 3-year sample dataset, it is not recommended to use measured concentration results in the future Scenario 1 and Scenario 2 horizon load assessment. Theoretical PCCs shall be used within Scenario 3 to provide comparison.

17.3 WwTP Future Flow Analysis

This section shall be used to outline the measured flow analysis and provide commentary on future flow assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.1

17.3.1 Scenario 1 Flow Analysis – Measured Data Only

As discussed in the previous section, it is not recommended to use the measured flow data for Carrignavar WwTP given the low number of data points and misalignment with the 2023 reporting. Therefore, the Scenario 1 flow analysis has not been included within this report.

17.3.2 Scenario 2 Flow Analysis – Hybrid Measured & Theoretical Analysis

The Scenario 2 flow analysis considers the current WwTP flow loading (as reported in the 2023 Carrignavar WwTP AER) with all additional future flow from the projected PE growth loading determined using theoretical flow PCCs. Table 17-6 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.2.

Note, using the 2023 AER data, (PE loading of 649 PE and DWF of 23 m^3/d), the equivalent DWF PCC is 35 L/PE/d which is approximately 133% smaller than the theoretical PCC of 175 L/PE/d.

Table 17-6 - Carrignavar WwTP Future Scenario 2 Flow Analysis

Parameter	Units	2030	2055	2080
Current PE	PE		649 (35 L/PE/d)	
Horizon PE	PE	907	1,104	1,248
Horizon Dry Weather Flow (DWF)	m^3/d	68	103	128
Horizon Average Daily Flow (ADF)	m^3/d	281	325	356
Horizon Flow to Full Treatment (FtFT)	m^3/d	204	308	383

17.3.3 Scenario 3 Flow Analysis – Theoretical Analysis

The Scenario 3 flow analysis applies the theoretical flow calculation to the total horizon PE loading projection. The table below provides the projected PE and the resulting DWF, ADF and FfFT for each Strategy horizon. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.3.

Table 17-7 - Carrignavar WwTP Future Scenario 3 Flow Analysis

Parameter	Units	2030	2055	2080
Horizon PE	PE	907	1,104	1,248
Horizon Dry Weather Flow (DWF)	m^3/d	220	268	303
Horizon Average Daily Flow (ADF)	m^3/d	276	335	379
Horizon Flow to Full Treatment (FtFT)	m^3/d	538	655	740

17.3.4 Future Flow Design Basis

The tables provided in the previous sections can be used to compare the results of the Scenario 1, Scenario 2 and Scenario 3 flow analysis.

At this stage of the strategy, it is proposed to progress with Scenario 3 for the following reasons:

- Scenario 1 does not have sufficient data to be statistically representative.
- Scenario 3 provides a more conservative flow estimate for the 2030, 2055 and 2080 future horizons than scenarios 2.

Figure 17-2 below represents the estimated projected flow (ADF & 3DWF) demand of the Carrignavar WwTP across the current and future horizons.

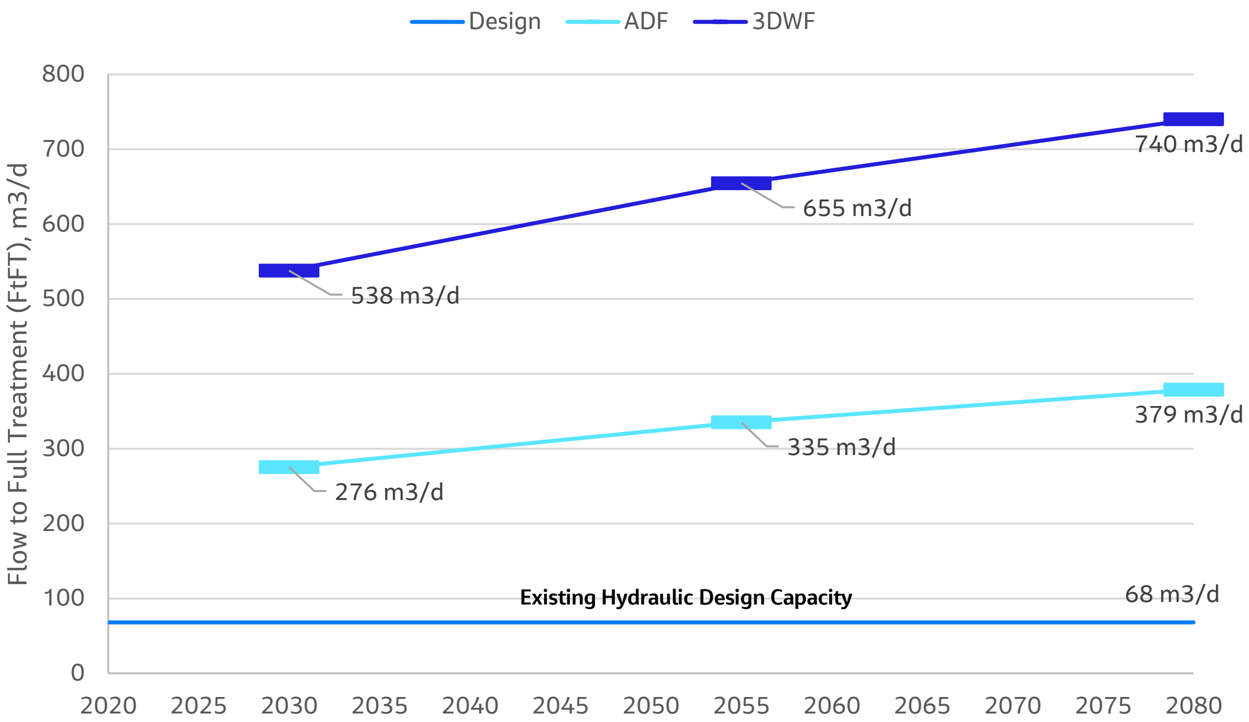


Figure 17-2 - Carrignavar WwTP Future Flow Projection (Scenario 3)

The assessment indicates the existing hydraulic capacity is currently overloaded for both 3DWF and ADF with future capacity needs increased by more than tenfold by 2080.

17.4 WwTP Future Nutrient Loading Analysis

This section shall be used to outline the measured load analysis and provide commentary on future load assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

17.4.1 Scenario 1 Load Analysis – Measured Data Only

As discussed in Section 17.3.1, the measured flow data does not provide sufficient statistical analysis confidence and is therefore not recommended for use within this assessment. The Scenario 1 load analysis has therefore not been included within this report.

17.4.2 Scenario 2 Load Analysis – Hybrid Measured & Theoretical Analysis

In this Scenario 2 load analysis, the projected future horizon flows shall be used in combination with the measured sample data concentrations (see Table 17-5) to derive the projected future nutrient loading. Table 17-8 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 17-8 - Carrignavar WwTP Future Scenario 2 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	907		1,104		1,248	
Horizon ADF (m^3/d)	281		325		356	
BOD (kg/d)	71	177	82	205	90	224
COD (kg/d)	164	499	490	575	208	631

Note, sample data for influent suspended solids, total nitrogen, total phosphorus and ammonia concentrations were not available at the time of assessment. Therefore, for any future assessments, parameter loading derived from the Scenario 3 analysis i.e. using a theoretical PCC shall be used.

17.4.3 Scenario 3 Load Analysis – Theoretical Analysis Only

In this Scenario 3 load analysis, the projected future horizon PE loading shall be used in combination with theoretical PCCs (see Table 2-2) to derive the projected future nutrient loading. Table 17-9 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 17-9 - Carrignavar WwTP Future Scenario 3 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	907		1,104		1,248	

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
BOD (kg/d)	54	109	66	132	75	150
Suspended Solids (kg/d)	68	136	83	166	94	187
Total Nitrogen (kg/d)	10.0	20.0	12.1	24.3	13.7	27.5
Total Phosphorus (kg/d)	2.0	4.0	2.4	4.9	2.7	5.5
Ammonia (kg/d)	7.3	14.5	8.8	17.7	10.0	20.0

17.4.4 Future Load Design Basis

The tables presented within the previous sections can be used to compare the results of the Scenario 1, Scenario 2 and Scenario 3 flow and load analysis.

It is proposed to progress with Scenario 3 at this stage of the strategy for the reasons previously discussed in Section 17.3.4.

18. Killumney WwTP

18.1 Introduction

Killumney WwTP is located at in the centre of the Killumney village as seen in Figure 18-1. The plant is situated adjacent to the river Bride and approximately 5.8 km Southwest of Ballincollig. The plant was commissioned in 1999 and Cork County Council operate and maintain Killumney WwTP on behalf of UÉ.

The treatment processes currently in operation in Killumney WwTP are aeration and settlement. The treated effluent is discharged to the River Bride (South) via a Ø225mm gravity pipe, at a location approximately 400m downstream of the works. There is a large difference in the treatment capacities of the aeration tank and the clarifier. The plant has an aeration treatment capacity of 700 PE, and the clarifier treatment capacity is 150 PE.

It is understood that Killumney WwTP is being decommissioned and the preferred upgrade option involves connecting the flows from Killumney WwTP and Grange Manor WwTP, where combined flows will be transferred via a rising main to Cork City Network and discharged to Ballincollig WwTP.

According to the data from the 2022 census report the catchment of Killumney has a domestic population of 1,466 while the UÉ Asset Capacity Register, has a current loading PE of 102.

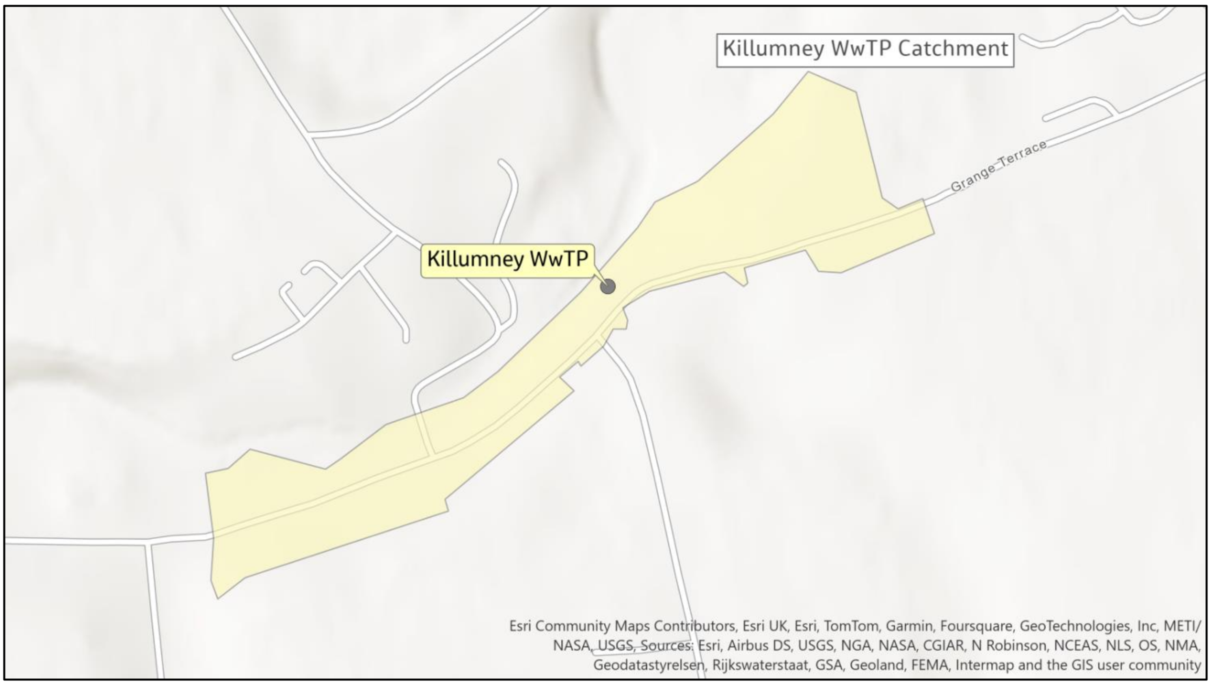


Figure 18-1 - Killumney WwTP Site Location and Catchment

18.2 Current Flow and Load Summary

In order to evaluate the future horizon WwTP flow and load projections, an assessment of the current WwTP loading was undertaken to understand current catchment characteristics that may influence the future horizon assessment.

In the following sections, commentary will be provided on the interpretation of current organic capacity, the quality and reliability of raw data and recommendations on the preferred future horizon calculation methodology.

18.2.1 Current Wastewater Discharge Licence (WWDL) Summary

The Killumney WwTP currently has a Waste Water Discharge Certificate of Authorisation (WWDA) (A0435) which was originally granted in 2011. The plant must comply with the Urban Wastewater Treatment Directive (91/271/EEC) ELVs of BOD 25mg/l, COD 125mgl and of suspended solids 35mg/l apply as summarised below in Table 18-1.

Table 18-1 - Killumney WwTP WWDL ELVs (A0435-01)

Parameter	Units	Value
BOD	mg/l	25
COD	mg/l	125
Suspended Solids	mg/l	35

18.2.2 Latest AER Data

As stated above, there is no discharge licence for Killumney WwTP and therefore the latest Annual Environmental Report (AER) is not recorded and published. The Scenario 2 flow and load assessment will therefore not be included within this report.

18.2.3 Current Measured Flow Data

Raw influent flow data was not available for the flow and load data analysis and therefore no assessment has been completed. The Scenario 1 flow and load assessment will therefore not be included within this report.

18.2.4 Current Measured Nutrient Loading Data

Raw influent flow sample data was not available for the flow and load data analysis and therefore no assessment has been completed. The Scenario 1 and Scenario 2 flow and load assessment will therefore not be included within this report.

18.3 WwTP Future Flow Analysis

This section shall be used to outline the measured flow analysis and provide commentary on future flow assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.1

18.3.1 Scenario 1 Flow Analysis – Measured Data Only

As discussed in the previous section, there is no measured flow data available for Killumney WwTP and therefore the Scenario 1 flow analysis has not been included within this report.

18.3.2 Scenario 2 Flow Analysis – Hybrid Measured & Theoretical Analysis

The Scenario 2 flow analysis considers the current WwTP flow loading with all additional future flow from the projected PE growth loading determined using theoretical flow PCCs.

In this instance, there is no available current loading information from the latest AER. Therefore, the Scenario 2 flow analysis has not been completed or included within this report.

18.3.3 Scenario 3 Flow Analysis – Theoretical Analysis

The Scenario 3 flow analysis applies the theoretical flow calculation to the total horizon PE loading projection. The table below provides the projected PE and the resulting DWF, ADF and FfFT for each Strategy horizon. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.3.

Table 18-2 - Killumney WwTP Future Scenario 3 Flow Analysis

Parameter	Units	2030	2055	2080
Horizon PE	PE	3,234	3,936	4,417
Horizon Dry Weather Flow (DWF)	m^3/d	728	886	994
Horizon Average Daily Flow (ADF)	m^3/d	910	1,107	1,242
Horizon Flow to Full Treatment (FtFT)	m^3/d	1,860	2,263	2,540

18.3.4 Future Flow Design Basis

The tables provided in the previous sections can be used to compare the results of the Scenario 3 flow analysis.

At this stage of the strategy, it is proposed to progress with Scenario 3 for the following reasons:

- There is insufficient reliable data available to complete the Scenario 1 analysis. The Scenario 3 analysis uses theoretical PCCs which shall improve alignment with assessments for other sites within the study area.
- The Scenario 2 analysis could not be completed as there is no published AERs available.

Figure 16-2 below represents the estimated projected flow (ADF & 3DWF) demand of the Killumney WwTP across the current and future horizons. At the time of assessment, the design hydraulic capacity could not be determined.

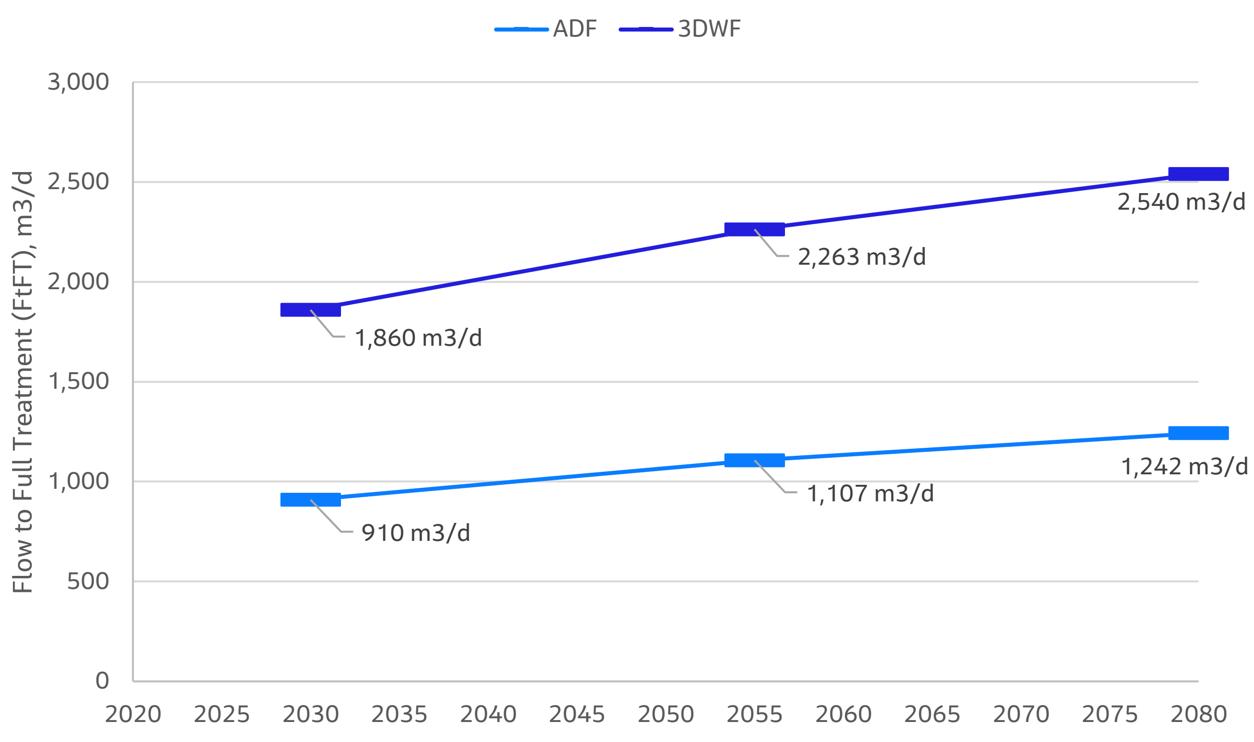


Figure 18-2 – Killumney WwTP Future Flow Projection (Scenario 3)

18.4 WwTP Future Nutrient Loading Analysis

This section shall be used to outline the measured load analysis and provide commentary on future load assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

18.4.1 Scenario 1 Load Analysis – Measured Data Only

As discussed in Section 18.3.1, there is no measured flow data for Killumney WwTP, therefore the Scenario 1 load analysis could not be completed.

18.4.2 Scenario 2 Load Analysis – Hybrid Measured & Theoretical Analysis

As discussed in Section 18.3.2, the Scenario 2 flow analysis could not be completed due to the lack of AER data. Therefore, the Scenario 2 load analysis has not been completed.

18.4.3 Scenario 3 Load Analysis – Theoretical Analysis Only

In this Scenario 3 load analysis, the projected future horizon PE loading shall be used in combination with theoretical PCCs (see Table 2-2) to derive the projected future nutrient loading. Table 18-3 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 18-3 - Killumney WwTP Future Scenario 3 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	3,234		3,936		4,417	
BOD (kg/d)	194	388	236	472	265	530
Suspended Solids (kg/d)	243	485	295	590	331	663
Total Nitrogen (kg/d)	36	71	43	87	49	97
Total Phosphorus (kg/d)	7.1	14.2	8.7	17.3	9.7	19.4
Ammonia (kg/d)	26	52	31	63	35	71

18.4.4 Future Load Design Basis

The tables presented within the previous sections can be used to compare the results of the Scenario 3 flow and load analysis.

It is proposed to progress with Scenario 3 at this stage of the strategy for the reasons previously discussed in Section 18.3.4.

19. Courtbrack WwTP

19.1 Introduction

Courtbrack WwTP is located approximately 16.5km northwest of Cork City, opposite the Drom Slí housing estate in Courtbrack village, as seen in Figure 19-1. It is a small sewage works commissioned in 2011 with a design capacity of 250 PE. Ward and Burke operate and maintain Courtbrack WwTP on behalf of UÉ under a 20-year DBO contract.

The WwTP comprises of; preliminary mechanical screening and secondary treatment that consists of an SBR with diffused aeration. There is a sludge holding tank on site but no treatment and there is a storm balancing tank with no overflow from it. Treated wastewater from the plant is discharged to the river Shournagh.

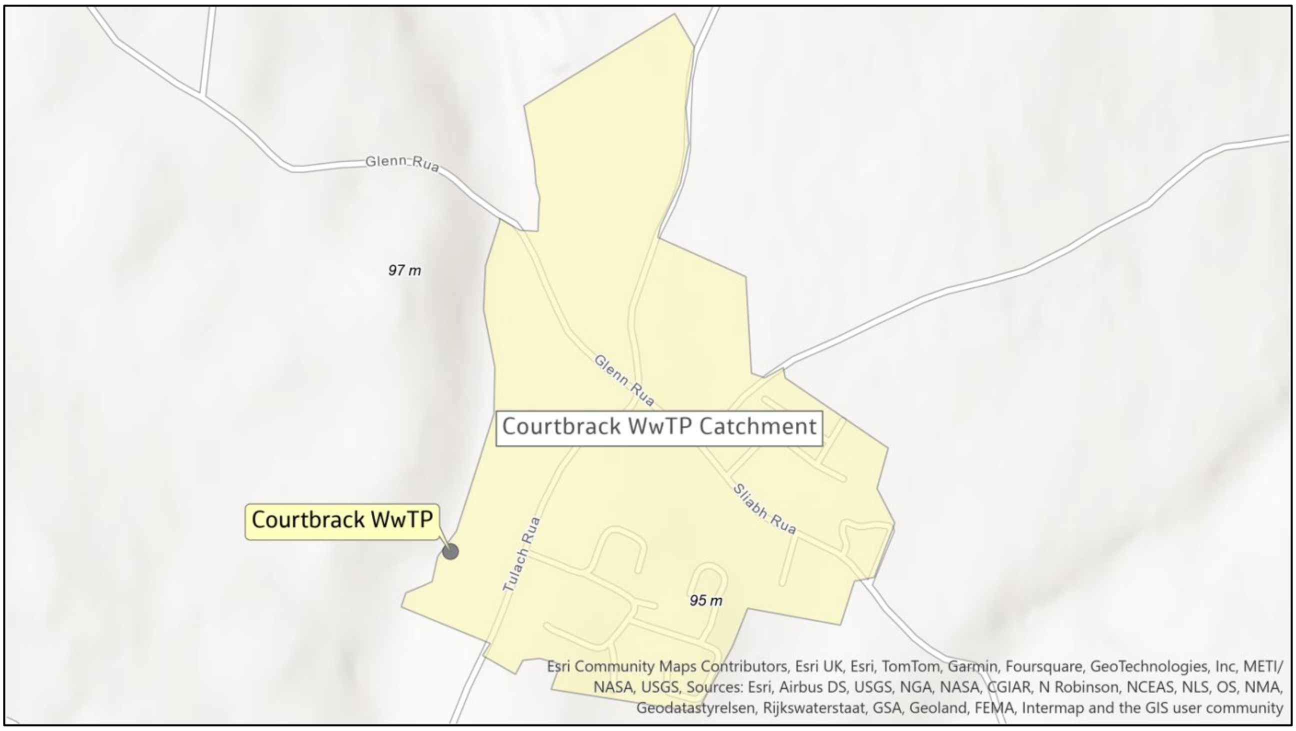


Figure 19-1 - Courtbrack WwTP Site Location and Catchment

19.2 Current Flow and Load Summary

In order to evaluate the future horizon WwTP flow and load projections, an assessment of the current WwTP loading was undertaken to understand current catchment characteristics that may influence the future horizon assessment.

In the following sections, commentary will be provided on the interpretation of current organic capacity, the quality and reliability of raw data and recommendations on the preferred future horizon calculation methodology.

19.2.1 Current Wastewater Discharge Licence (WWDL) Summary

The Courtbrack WwTP currently has a Waste Water Discharge Certificate of Authorisation (WWDA) (A0437-01) was originally granted in 2011. The EVLs as outlined in the Certificate are summarised below in Table 19-1.

Table 19-1 - Courtbrack WwTP WWDL ELVs (A0437-01)

Parameter	Units	Value
BOD	mg/l	25
COD	mg/l	125
Suspended Solids	mg/l	35
Ortho P	mg/l	2

19.2.2 Latest AER Data

As stated above, there is no discharge licence for Courtbrack WwTP and therefore the latest Annual Environmental Report (AER) is not recorded and published.

19.2.3 Current Measured Flow Data

Raw influent flow data was not available for the flow and load data analysis and therefore no assessment has been completed. The Scenario 1 flow and load assessment will therefore not be included within this report.

19.2.4 Current Measured Nutrient Loading Data

Raw influent flow data was not available for the flow and load data analysis and therefore no assessment has been completed. The Scenario 1 and Scenario 2 flow and load assessment will therefore not be included within this report.

19.3 WwTP Future Flow Analysis

This section shall be used to outline the measured flow analysis and provide commentary on future flow assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.1

19.3.1 Scenario 1 Flow Analysis – Measured Data Only

As discussed in the previous section, there is no measured flow data available for Courtbrack WwTP and therefore the Scenario 1 flow analysis has not been included within this report.

19.3.2 Scenario 2 Flow Analysis – Hybrid Measured & Theoretical Analysis

The Scenario 2 flow analysis considers the current WwTP flow loading with all additional future flow from the projected PE growth loading determined using theoretical flow PCCs.

In this instance, there is no available current loading information from the latest AER. Therefore, the Scenario 2 flow analysis has not been completed or included within this report.

19.3.3 Scenario 3 Flow Analysis – Theoretical Analysis

The Scenario 3 flow analysis applies the theoretical flow calculation to the total horizon PE loading projection. The table below provides the projected PE and the resulting DWF, ADF and FfFT for each Strategy horizon. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.3.

Table 19-2 - Courtbrack WwTP Future Scenario 3 Flow Analysis

Parameter	Units	2030	2055	2080
Horizon PE	PE	660	752	836
Horizon Dry Weather Flow (DWF)	m^3/d	149	169	188
Horizon Average Daily Flow (ADF)	m^3/d	186	212	235
Horizon Flow to Full Treatment (FtFT)	m^3/d	380	432	481

19.3.4 Future Flow Design Basis

The tables provided in the previous sections can be used to compare the results of the Scenario 3 flow analysis.

At this stage of the strategy, it is proposed to progress with Scenario 3 for the following reasons:

- There is insufficient data available to complete the Scenario 1 analysis. The Scenario 3 analysis uses theoretical PCCs which shall improve alignment with assessments for other sites within the study area.
- The Scenario 2 analysis could not be completed as there is no published AERs available.

Figure 19-2 below represents the estimated projected flow (ADF & 3DWF) demand of the Courtbrack WwTP across the current and future horizons.

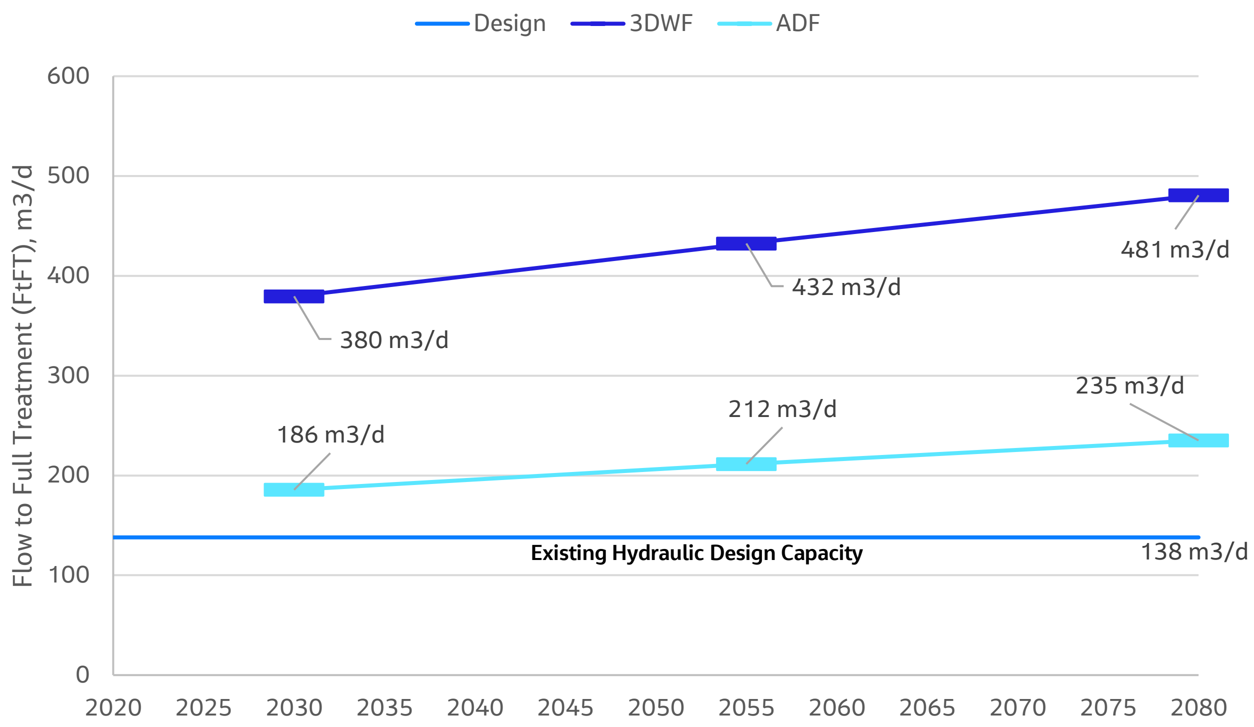


Figure 19-2 - Courtbrack WwTP Future Flow Projection (Scenario 3)

Using flow Scenario 3, the existing hydraulic capacity is projected to be exceeded for 3DWF and ADF projections by 2030, with capacity needs nearly tripling by 2080.

19.4 WwTP Future Nutrient Loading Analysis

This section shall be used to outline the measured load analysis and provide commentary on future load assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

19.4.1 Scenario 1 Load Analysis – Measured Data Only

As discussed in Section 19.3.1, the measured flow data does not provide sufficient statistical analysis confidence and is therefore not recommended for use within this assessment. The Scenario 1 load analysis has therefore not been included within this report.

19.4.2 Scenario 2 Load Analysis – Hybrid Measured & Theoretical Analysis

As discussed in Section 19.3.2, the Scenario 2 flow analysis could not be completed due to the lack of AER data. Therefore, the Scenario 2 load analysis has therefore not been completed.

19.4.3 Scenario 3 Load Analysis – Theoretical Analysis Only

In this Scenario 3 load analysis, the projected future horizon PE loading shall be used in combination with theoretical PCCs (see Table 2-2) to derive the projected future nutrient loading. Table 19-3 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 19-3 - Courtbrack WwTP Future Scenario 3 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	660		752		836	
BOD (kg/d)	40	79	45	90	50	100
Suspended Solids (kg/d)	50	99	56	113	63	125
Total Nitrogen (kg/d)	7.3	14.5	8.3	16.5	9.2	18.4
Total Phosphorus (kg/d)	1.5	2.9	1.7	3.3	1.8	3.7
Ammonia (kg/d)	5.3	10.6	6.0	12.0	6.7	13.4

19.4.4 Future Load Design Basis

The tables presented within the previous sections can be used to compare the results of the Scenario 3 flow and load analysis.

It is proposed to progress with Scenario 3 at this stage of the strategy for the reasons previously discussed in Section 19.3.4.

20. River Valley (Minane Bridge) WwTP

20.1 Introduction

The River Valley WwTP catchment is shown in Figure 20-1. The WwTP is located adjacent to the River Valley housing estate, which it was designed to serve. The plant was commissioned in 2008 and WwTP Cork County Council operate and maintain the River Valley WwTP on behalf of Uisce Éireann.

The WwTP has a design capacity of 250 PE but is currently only treating a 150 PE, according to the operator. Treatment comprises of; Inlet Pumping Station with an overflow, a storm tank with an overflow, a Klargester Package Plant with Primary and Secondary Settlement and a reed bed. Treated effluent discharges to the Minane River.

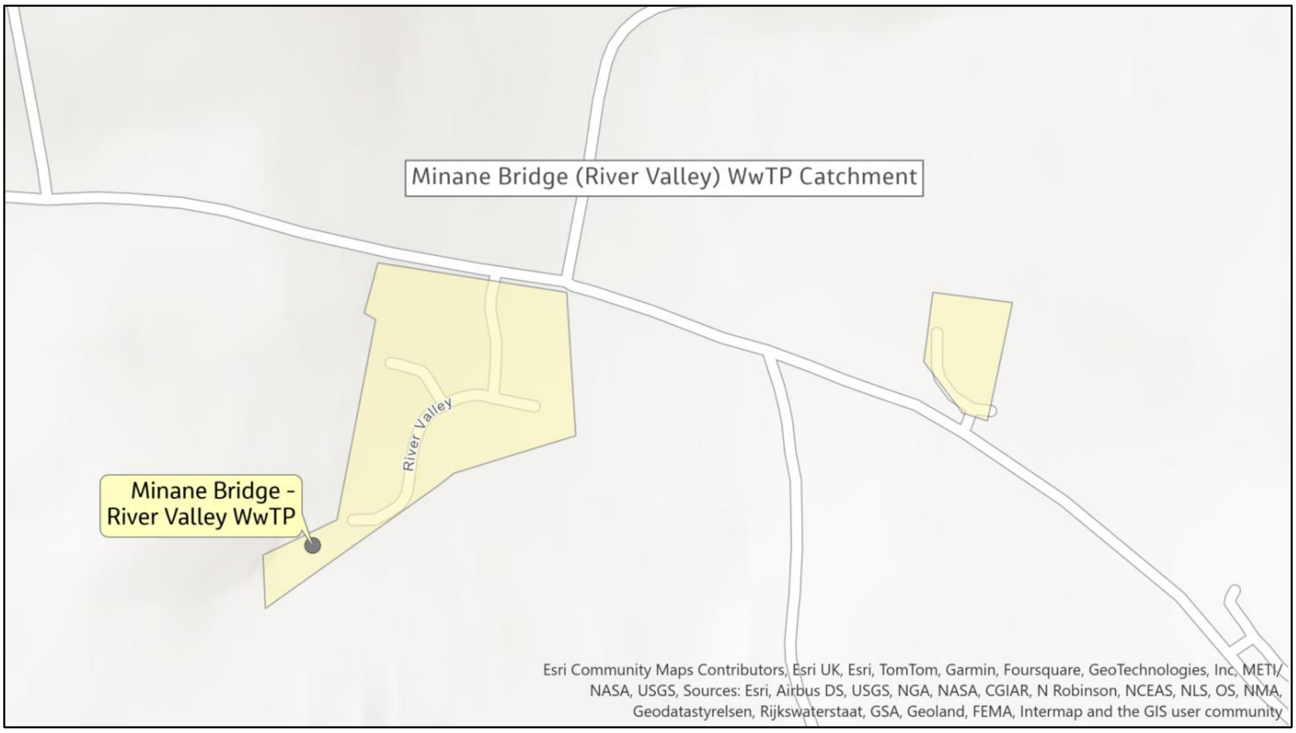


Figure 20-1 - River Valley WwTP Site Location and Catchment

20.2 Current Flow and Load Summary

In order to evaluate the future horizon WwTP flow and load projections, an assessment of the current WwTP loading was undertaken to understand current catchment characteristics that may influence the future horizon assessment.

In the following sections, commentary will be provided on the interpretation of current organic capacity, the quality and reliability of raw data and recommendations on the preferred future horizon calculation methodology.

20.2.1 Current Wastewater Discharge License (WWDL) Summary

There is no discharge license for River Valley (Minane Bridge) WwTP as it discharges to the County Cork network, therefore there is no document stating the ELV's for this site.

20.2.2 Latest AER Data

As stated above, there is no discharge licence for River Valley (Minane Bridge) WwTP and therefore the latest Annual Environmental Report (AER) is not recorded and published.

20.2.3 Current Measured Flow Data

Raw influent flow data was not available for the flow and load data analysis and therefore no assessment has been completed. The Scenario 1 flow and load assessment will therefore not be included within this report.

20.2.4 Current Measured Nutrient Loading Data

Raw influent flow data was not available for the flow and load data analysis and therefore no assessment has been completed. The Scenario 1 and Scenario 2 flow and load assessment will therefore not be included within this report.

20.3 WwTP Future Flow Analysis

This section shall be used to outline the measured flow analysis and provide commentary on future flow assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.1

20.3.1 Scenario 1 Flow Analysis – Measured Data Only

As discussed in the previous section, there was no measured flow data available at the time of assessment for River Valley (Minane Bridge) WwTP. Therefore, the Scenario 1 flow analysis has not been included within this report.

20.3.2 Scenario 2 Flow Analysis – Hybrid Measured & Theoretical Analysis

The Scenario 2 flow analysis considers the current WwTP flow loading with all additional future flow from the projected PE growth loading determined using theoretical flow PCCs.

In this instance, there is no available current loading information from the latest AER. Therefore, the Scenario 2 flow analysis has not been completed or included within this report.

20.3.3 Scenario 3 Flow Analysis – Theoretical Analysis

The Scenario 3 flow analysis applies the theoretical flow calculation to the total horizon PE loading projection. The table below provides the projected PE and the resulting DWF, ADF and FfFT for each Strategy horizon. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.3.

Table 20-1 - River Valley (Minane Bridge) WwTP Future Scenario 3 Flow Analysis

Parameter	Units	2030	2055	2080
Horizon PE	PE	426	511	577
Horizon Dry Weather Flow (DWF)	m^3/d	96	115	130
Horizon Average Daily Flow (ADF)	m^3/d	120	144	162
Horizon Flow to Full Treatment (FtFT)	m^3/d	245	294	332

20.3.4 Future Flow Design Basis

The tables provided in the previous sections can be used to compare the results of the Scenario 3 flow analysis.

At this stage of the strategy, it is proposed to progress with Scenario 3 for the following reasons:

- There is insufficient data available to complete the Scenario 1 analysis. The Scenario 3 analysis uses theoretical PCCs which shall improve alignment with assessments for other sites within the study area.
- The Scenario 2 analysis could not be completed as there is no published AERs available.

Figure 20-2 below represents the estimated projected flow (ADF & 3DWF) demand of the River Valley (Minane Bridge) WwTP across the current and future horizons. At the time of assessment, the design hydraulic capacity could not be determined.

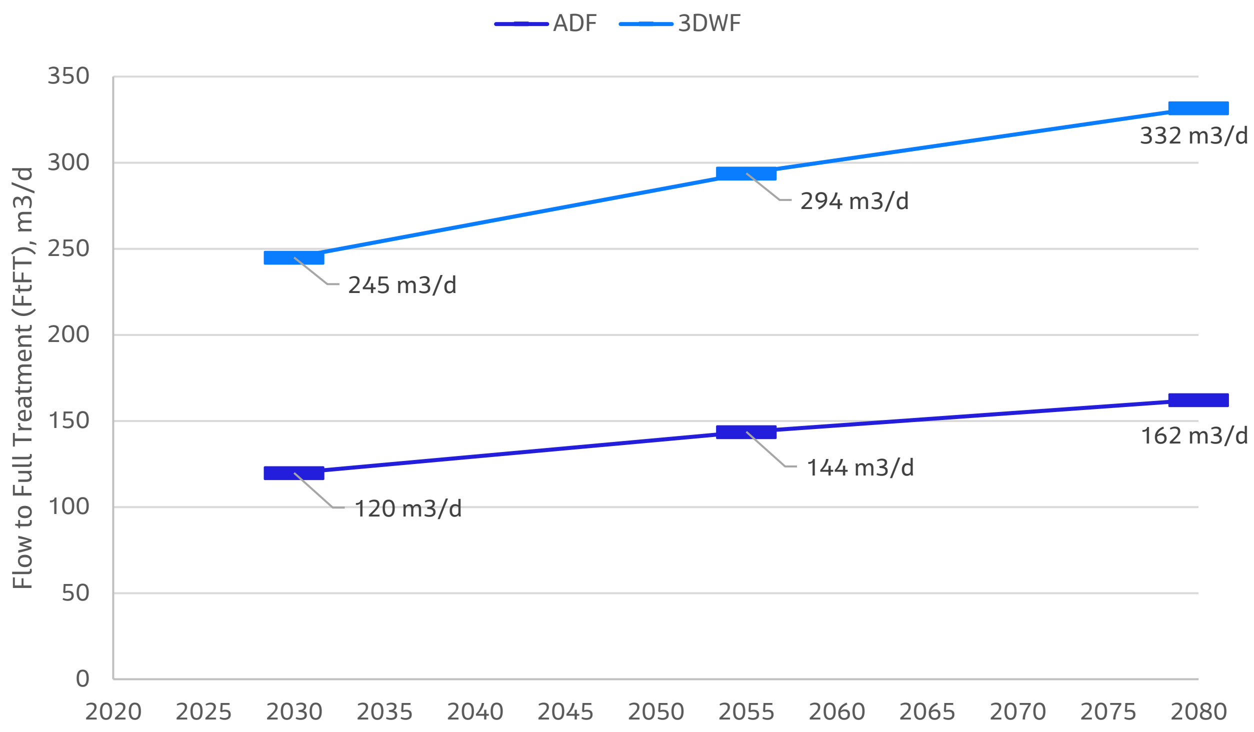


Figure 20-2 – River Valley (Minane Bridge) WwTP Future Flow Projection (Scenario 3)

20.4 WwTP Future Nutrient Loading Analysis

This section shall be used to outline the measured load analysis and provide commentary on future load assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

20.4.1 Scenario 1 Load Analysis – Measured Data Only

As discussed in Section 20.3.1, there is no measured flow data and therefore the Scenario 1 flow assessment could not be completed.

20.4.2 Scenario 2 Load Analysis – Hybrid Measured & Theoretical Analysis

As discussed in Section 20.3.2, the Scenario 2 flow analysis could not be completed due to the lack of AER data. Therefore, the Scenario 2 load analysis has not been completed.

20.4.3 Scenario 3 Load Analysis – Theoretical Analysis

In this Scenario 3 load analysis, the projected future horizon PE loading shall be used in combination with theoretical PCCs (see Table 2-2) to derive the projected future nutrient loading. Table 20-2 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 20-2 - River Valley (Minane Bridge) WwTP Future Scenario 3 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	426		511		577	
BOD (kg/d)	26	51	31	61	35	69
Suspended Solids (kg/d)	32	64	38	77	43	87
Total Nitrogen (kg/d)	4.7	9.4	5.6	11.2	6.3	12.7
Total Phosphorus (kg/d)	0.9	1.9	1.1	2.2	1.3	2.5
Ammonia (kg/d)	3.4	6.8	4.1	8.2	4.6	9.2

20.4.4 Future Load Design Basis

The tables presented within the previous sections can be used to compare the results of the Scenario 3 flow and load analysis.

It is proposed to progress with Scenario 3 at this stage of the strategy for the reasons previously discussed in Section 20.3.4.

21. Inniscarra Waterwork WwTP

21.1 Introduction

Inniscarra WwTP serves the Inniscarra waterworks and 3 domestic bungalows adjacent to the WwTP, as seen in Figure 21-1. The Inniscarra agglomeration is located within the Inniscarra Water Treatment Plant. The waterworks is located approximately 5 km west of the town of Ballincollig. It is situated on the R618 regional road on the northern shore of the Inniscarra Lake on the River Lee, upstream of the ESB Hydro-Electric Station. It was commissioned in 1993 and it is currently operated and maintained by Cork County Council on behalf of UÉ.

The original certificate estimated the PE to be 63 based on the average hydraulic flows to the WwTP. It was noted up to 125 people could be on-site during working hours Monday – Friday.

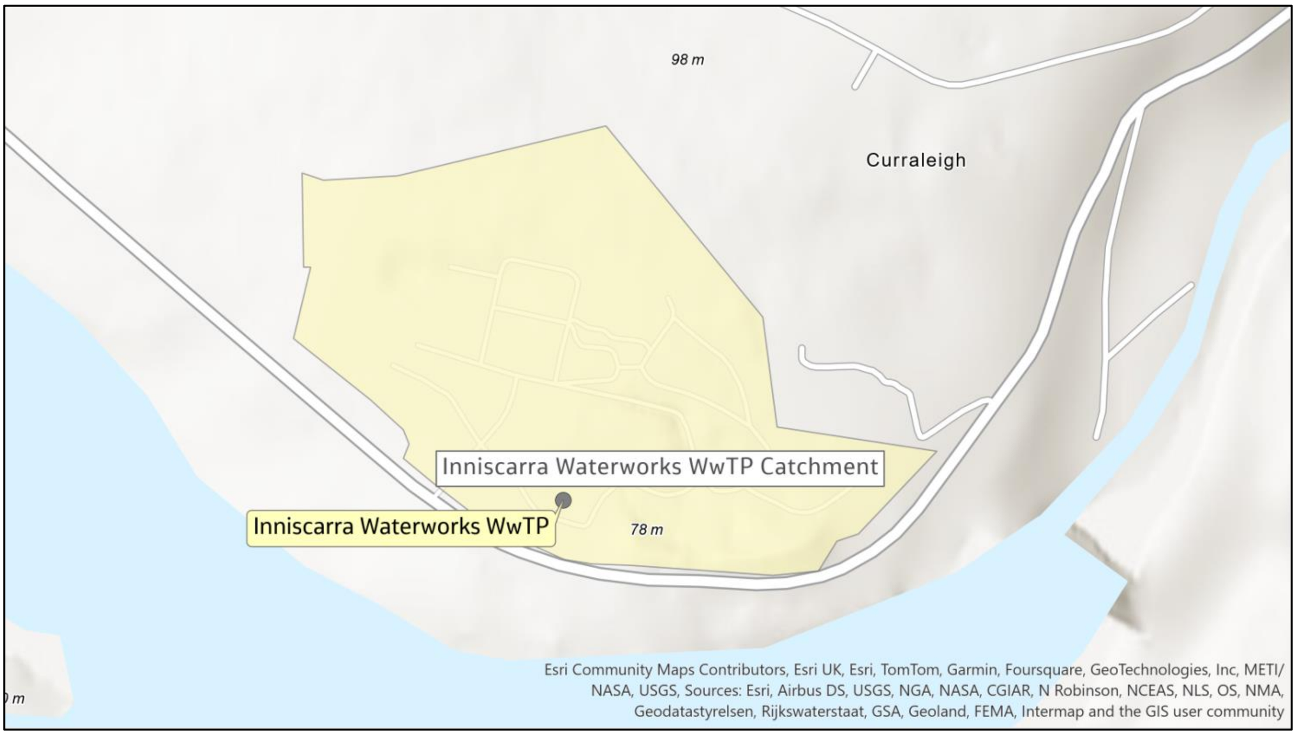


Figure 21-1 - Inniscarra WwTP Site Location and Catchment

21.2 Current Flow and Load Summary

In order to evaluate the future horizon WwTP flow and load projections, an assessment of the current WwTP loading was undertaken to understand current catchment characteristics that may influence the future horizon assessment.

In the following sections, commentary will be provided on the interpretation of current organic capacity, the quality and reliability of raw data and recommendations on the preferred future horizon calculation methodology.

21.2.1 Current Wastewater Discharge License (WWDL) Summary

The Inniscarra WwTP currently has a Waste Water Discharge Certificate of Authorisation (WWDA) (A0441) which was originally granted in 2011. The plant must comply with the Urban Wastewater Treatment Directive (91/271/EEC) ELVs as summarised below in Table 21-1.

Table 21-1 – Inniscarra Waterworks WwTP WWDL ELVs (A0435-01)

Parameter	Units	Value
BOD	mg/l	25
COD	mg/l	125
Suspended Solids	mg/l	35

21.2.2 Latest AER Data

As stated above, there is no discharge licence for Inniscarra Waterworks WwTP and therefore the latest Annual Environmental Report (AER) is not recorded and published.

21.2.3 Current Measured Flow Data

Raw influent flow data was not available for the flow and load data analysis and therefore no assessment has been completed. The Scenario 1 flow and load assessment will therefore not be included within this report.

21.2.4 Current Measured Nutrient Loading Data

Raw influent flow data was not available for the flow and load data analysis and therefore no assessment has been completed. The Scenario 1 and Scenario 2 flow and load assessment will therefore not be included within this report.

21.3 WwTP Future Flow Analysis

This section shall be used to outline the measured flow analysis and provide commentary on future flow assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.1

21.3.1 Scenario 1 Flow Analysis – Measured Data Only

As discussed in the previous section, there was no measured flow data available at the time of assessment for Inniscarra Waterworks WwTP. Therefore, the Scenario 1 flow analysis has not been included within this report.

21.3.2 Scenario 2 Flow Analysis – Hybrid Measured & Theoretical Analysis

The Scenario 2 flow analysis considers the current WwTP flow loading with all additional future flow from the projected PE growth loading determined using theoretical flow PCCs.

In this instance, there is no available current loading information from the latest AER. Therefore, the Scenario 2 flow analysis has not been completed or included within this report.

21.3.3 Scenario 3 Flow Analysis – Theoretical Analysis

The Scenario 3 flow analysis applies the theoretical flow calculation to the total horizon PE loading projection. The table below provides the projected PE and the resulting DWF, ADF and FfFT for each Strategy horizon. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.3.

Table 21-2 - Inniscarra WwTP Future Scenario 3 Flow Analysis

Parameter	Units	2030	2055	2080
Horizon PE	PE	334	401	455
Horizon Dry Weather Flow (DWF)	m^3/d	75	90	102
Horizon Average Daily Flow (ADF)	m^3/d	94	113	128
Horizon Flow to Full Treatment (FtFT)	m^3/d	192	231	262

21.3.4 Future Flow Design Basis

The tables provided in the previous sections can be used to compare the results of the Scenario 3 flow analysis.

At this stage of the strategy, it is proposed to progress with Scenario 3 for the following reasons:

- There is insufficient data available to complete the Scenario 1 analysis. The Scenario 3 analysis uses theoretical PCCs which shall improve alignment with assessments for other sites within the study area.
- The Scenario 2 analysis could not be completed as there is no published AERs available.

Figure 21-2 below represents the estimated projected flow (ADF & 3DWF) demand of the Inniscarra Waterworks WwTP across the current and future horizons. At the time of assessment, the design hydraulic capacity could not be determined.

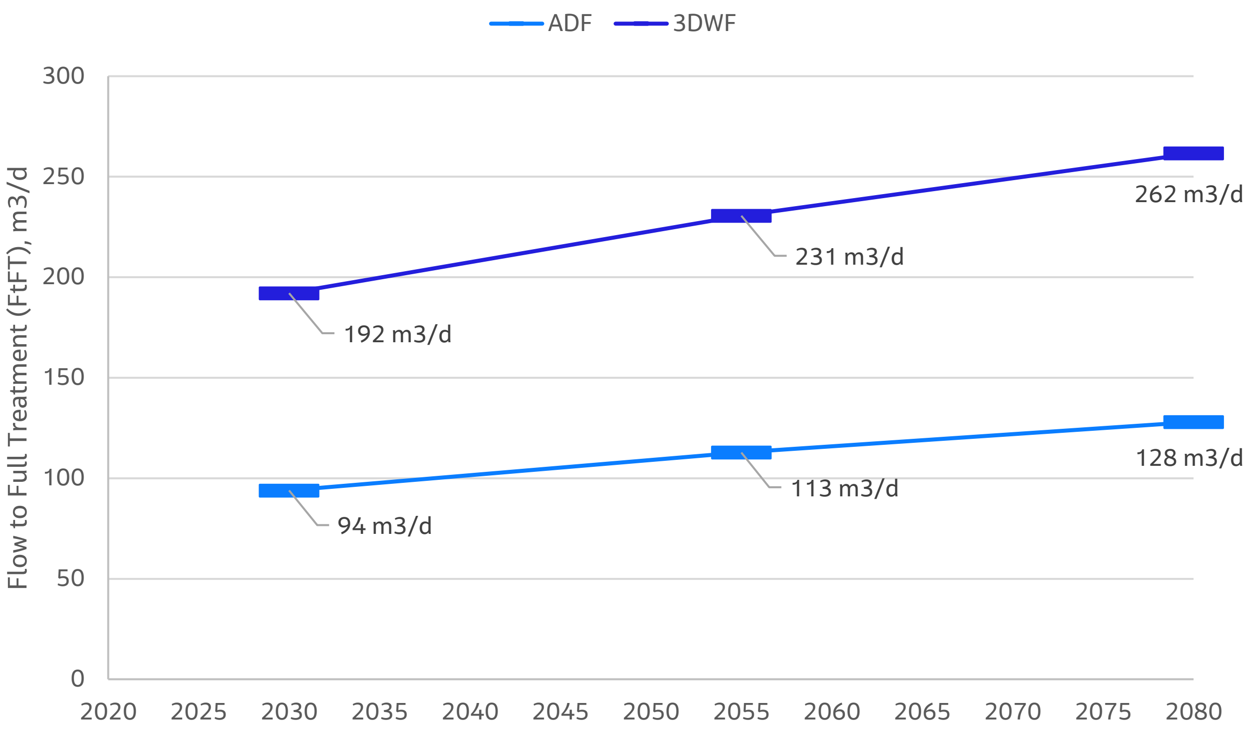


Figure 21-2 – Inniscarra WwTP Future Flow Projection (Scenario 3)

21.4 WwTP Future Nutrient Loading Analysis

This section shall be used to outline the measured load analysis and provide commentary on future load assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

21.4.1 Scenario 1 Load Analysis – Measured Data Only

As discussed in Section 21.3.1, there is no measured flow data for Inniscarra WwTP and therefore, the Scenario 1 flow assessment could not be completed.

21.4.2 Scenario 2 Load Analysis – Hybrid Measured & Theoretical Analysis

As discussed in Section 21.3.2, the Scenario 2 flow analysis could not be completed due to the lack of AER data. Therefore, the Scenario 2 load analysis has not been completed.

21.4.3 Scenario 3 Load Analysis – Theoretical Analysis

In this Scenario 3 load analysis, the projected future horizon PE loading shall be used in combination with theoretical PCCs (see Table 2-2) to derive the projected future nutrient loading. Table 21-3 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 21-3 - Inniscarra WwTP Future Scenario 3 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	334		401		455	
BOD (kg/d)	20	40	24	48	27	55
Suspended Solids (kg/d)	20	50	30	60	34	68
Total Nitrogen (kg/d)	3.7	7.3	4.4	8.8	5.0	10.0
Total Phosphorus (kg/d)	0.7	1.5	0.9	1.8	1.0	2.0
Ammonia (kg/d)	2.7	5.3	3.2	6.4	3.6	7.3

21.4.4 Future Load Design Basis

The tables presented within the previous sections can be used to compare the results of the Scenario 3 flow and load analysis.

It is proposed to progress with Scenario 3 at this stage of the strategy for the reasons previously discussed in Section 21.3.4.

22. Ballincurrig WwTP

22.1 Introduction

Ballincurrig WwTP is located approximately 1.5 km northwest of Lisgoold North WwTP, as seen in Figure 22-1. It was built in the 1950s and is currently operated and maintained by Cork County Council on behalf of Uisce Éireann. There is a school and a nursing home northwest of the site, which contribute a large portion of non-domestic PE.

The Ballincurrig and Lisgoold agglomeration is in the Owenacurra River Valley. Ballincurrig WwTP is a septic tank, with a design PE of 150, that discharges to groundwater (Ballinhassig East Ground Waterbody) via a percolation area which is currently overloaded. Ballincurrig WwTP is to be decommissioned and the flows are to be diverted and pumped to Lisgoold South WwTP for treatment.

According to the data from the 2022 census report the catchment of Ballincurrig has a domestic population of 389 while the UÉ Asset Capacity Register, has a current loading PE of 197.

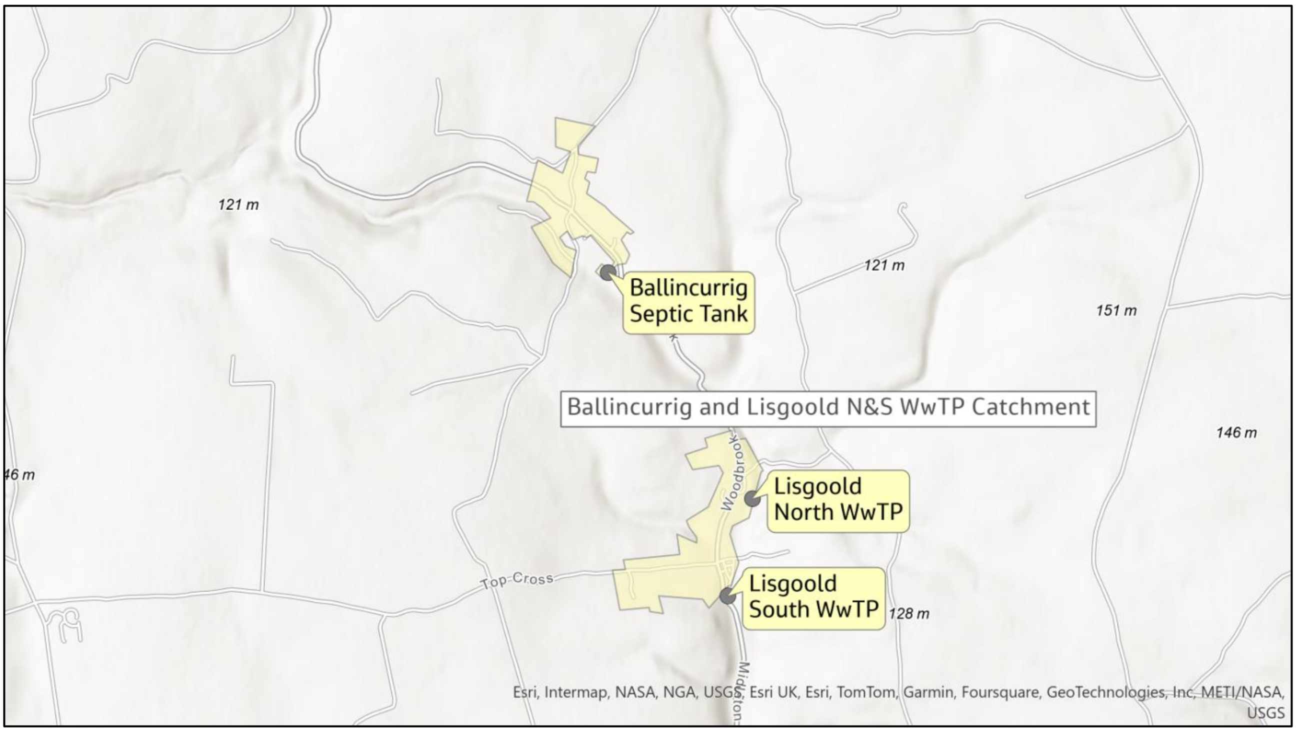


Figure 22-1 - Ballincurrig WwTP Site Location and Catchment

22.2 Current Flow and Load Summary

In order to evaluate the future horizon WwTP flow and load projections, an assessment of the current WwTP loading was undertaken to understand current catchment characteristics that may influence the future horizon assessment.

In the following sections, commentary will be provided on the interpretation of current organic capacity, the quality and reliability of raw data and recommendations on the preferred future horizon calculation methodology.

22.2.1 Current Wastewater Discharge Licence (WWDL) Summary

The Ballincurrig WwTP currently has a Waste Water Discharge Certificate of Authorisation (WWDA) (A0361-01) was originally granted in 2011. The plant must comply with the Urban Wastewater Treatment Directive (91/271/EEC) ELVs as summarised below in Table 22-1.

Table 22-1 – Ballincurrig WwTP WWDL ELVs (A0361-01)

Parameter	Units	Value
BOD	mg/l	25
COD	mg/l	125
Suspended Solids	mg/l	35

22.2.2 Latest AER Data

As stated above, there is no discharge licence for Ballincurrig WwTP and therefore the latest Annual Environmental Report (AER) is not recorded and published.

22.2.3 Current Measured Flow Data

Raw influent flow data was not available for the flow and load data analysis and therefore no assessment has been completed. The Scenario 1 flow and load assessment will therefore not be included within this report.

22.2.4 Current Measured Nutrient Loading Data

Raw influent flow data was not available for the flow and load data analysis and therefore no assessment has been completed. The Scenario 1 and Scenario 2 flow and load assessment will therefore not be included within this report.

22.3 WwTP Future Flow Analysis

This section shall be used to outline the measured flow analysis and provide commentary on future flow assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.1

22.3.1 Scenario 1 Flow Analysis – Measured Data Only

As discussed in the previous section, there was no measured flow data available at the time of assessment for Ballincurrig WwTP. Therefore, the Scenario 1 flow analysis has not been included within this report.

22.3.2 Scenario 2 Flow Analysis – Hybrid Measured & Theoretical Analysis

The Scenario 2 flow analysis considers the current WwTP flow loading with all additional future flow from the projected PE growth loading determined using theoretical flow PCCs.

In this instance, there is no available current loading information from the latest AER. Therefore, the Scenario 2 flow analysis has not been completed or included within this report.

22.3.3 Scenario 3 Flow Analysis – Theoretical Analysis

The Scenario 3 flow analysis applies the theoretical flow calculation to the total horizon PE loading projection. The table below provides the projected PE and the resulting DWF, ADF and FfFT for each Strategy horizon. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.3.

Table 22-2 - Ballincurrig WwTP Future Scenario 3 Flow Analysis

Parameter	Units	2030	2055	2080
Horizon PE	PE	567	682	771
Horizon Dry Weather Flow (DWF)	m^3/d	128	153	173
Horizon Average Daily Flow (ADF)	m^3/d	159	192	217
Horizon Flow to Full Treatment (FtFT)	m^3/d	326	392	443

22.3.4 Future Flow Design Basis

The tables provided in the previous sections can be used to compare the results of the Scenario 3 flow analysis.

At this stage of the strategy, it is proposed to progress with Scenario 3 as no flow data is available for Ballincurrig.

Figure 22-2 below represents the estimated projected flow (ADF & 3DWF) demand of the Ballincurrig WwTP across the current and future horizons. At the time of assessment, the design hydraulic capacity could not be determined.

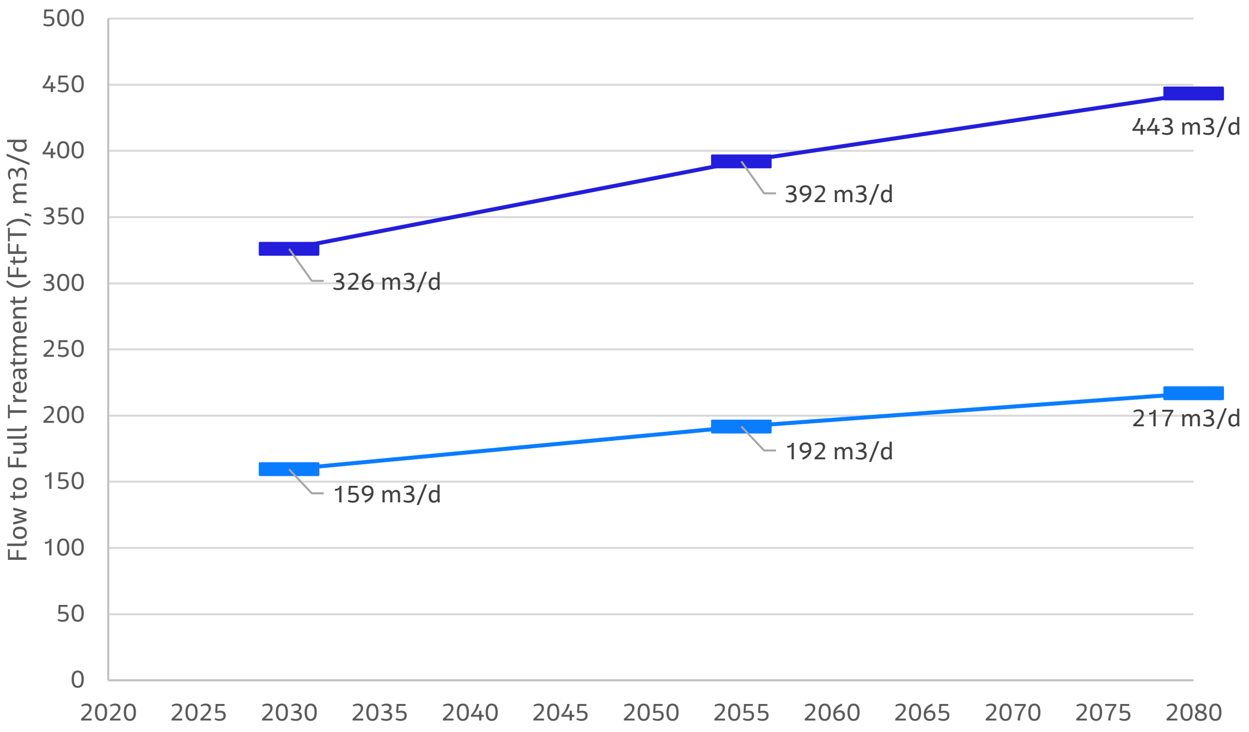


Figure 22-2 - Ballincurrig WwTP Future Flow Projection (Scenario 3)

22.4 WwTP Future Nutrient Loading Analysis

This section shall be used to outline the measured load analysis and provide commentary on future load assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

22.4.1 Scenario 1 Load Analysis – Measured Data Only

As discussed in Section 22.3.1, there is no measured flow data and therefore the Scenario 1 flow assessment could not be completed.

22.4.2 Scenario 2 Load Analysis – Hybrid Measured & Theoretical Analysis

As discussed in Section 22.3.2, the Scenario 2 flow analysis could not be completed due to the lack of AER data. Therefore, the Scenario 2 load analysis has not been completed.

22.4.3 Scenario 3 Load Analysis – Theoretical Analysis Only

In this Scenario 3 load analysis, the projected future horizon PE loading shall be used in combination with theoretical PCCs (see Table 2-2) to derive the projected future nutrient loading. Table 22-3 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 22-3 - Ballincurrig WwTP Future Scenario 3 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	567		682		771	
BOD (kg/d)	34	68	41	82	46	93
Suspended Solids (kg/d)	43	85	51	102	58	116
Total Nitrogen (kg/d)	6.2	12.5	7.5	15.0	8.5	17.0
Total Phosphorus (kg/d)	1.2	2.5	1.5	3.0	1.7	3.4
Ammonia (kg/d)	4.5	9.1	5.5	10.9	6.2	12.3

22.4.4 Future Load Design Basis

The tables presented within the previous sections can be used to compare the results of the Scenario 3 flow and load analysis.

It is proposed to progress with Scenario 3 at this stage of the strategy for the reasons previously discussed in Section 22.3.4.

23. Lisgoold North WwTP

23.1 Introduction

Lisgoold North WwTP is located in the northern half of the village of Lisgoold and is approximately 550m north of Lisgoold South WwTP, as seen in Figure 23-1. Lisgoold North WwTP is currently operated and maintained by Cork County Council on behalf of Uisce Éireann. The Lisgoold North WwTP is located at the edge of an embankment, behind a housing estate in the Owenacurra River valley area. Lisgoold is designated as a Village Nucleus within East Cork.

This 80 PE secondary treatment plant comprises of; an inlet works, aeration tank, with duty/standby blowers, clarifier section and percolation area discharging to ground. The WwTP site is fenced off, but the location and extent of the percolation area is unknown. North Lisgoold WwTP is due to be decommissioned and flow diverted to South Lisgoold WwTP for treatment.

Lisgoold is not defined as a town/settlement in the CSO small area statistics, and a direct population is not provided however, the UÉ Asset Capacity Register, has a current loading PE of 62.

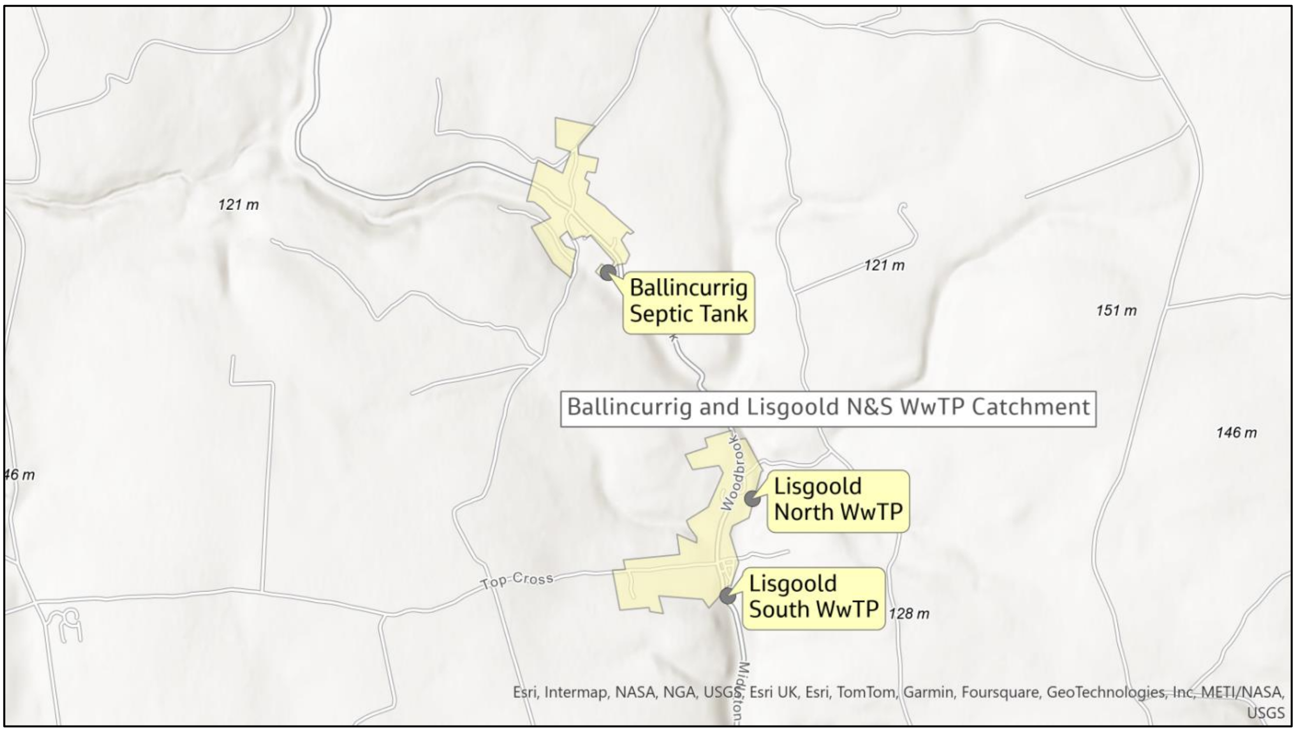


Figure 23-1 - Lisgoold North WwTP Site Location and Catchment

23.2 Current Flow and Load Summary

In order to evaluate the future horizon WwTP flow and load projections, an assessment of the current WwTP loading was undertaken to understand current catchment characteristics that may influence the future horizon assessment.

In the following sections, commentary will be provided on the interpretation of current organic capacity, the quality and reliability of raw data and recommendations on the preferred future horizon calculation methodology.

23.2.1 Current Wastewater Discharge License (WWDL) Summary

The North Lisgoold WwTP currently has a Waste Water Discharge Certificate of Authorisation (WWDA) (A0441-01) which was originally granted in 2011. The plant must comply with the Urban Wastewater Treatment Directive (91/271/EEC) ELVs as summarised below in Table 23-1.

Table 23-1 - Lisgoold North WwTP WWDA ELVs (A0441-01)

Parameter	Units	Value
BOD	mg/l	25
COD	mg/l	125
Suspended Solids	mg/l	35

23.2.2 Latest AER Data

As stated above, there is no discharge licence for North Lisgoold WwTP and therefore the latest Annual Environmental Report (AER) is not recorded and published.

23.2.3 Current Measured Flow Data

Raw influent flow data was not available for the flow and load data analysis and therefore no assessment has been completed. The Scenario 1 flow and load assessment will therefore not be included within this report.

23.2.4 Current Measured Nutrient Loading Data

Raw influent flow data was not available for the flow and load data analysis and therefore no assessment has been completed. The Scenario 1 and Scenario 2 flow and load assessment will therefore not be included within this report.

23.3 WwTP Future Flow Analysis

This section shall be used to outline the measured flow analysis and provide commentary on future flow assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.1

23.3.1 Scenario 1 Flow Analysis – Measured Data Only

As discussed in the previous section, there was no measured flow data available at the time of assessment for North Lisgoold WwTP. Therefore, the Scenario 1 flow analysis has not been included within this report.

23.3.2 Scenario 2 Flow Analysis – Hybrid Measured & Theoretical Analysis

The Scenario 2 flow analysis considers the current WwTP flow loading with all additional future flow from the projected PE growth loading determined using theoretical flow PCCs.

In this instance, there is no available current loading information from the latest AER. Therefore, the Scenario 2 flow analysis has not been completed or included within this report.

23.3.3 Scenario 3 Flow Analysis – Theoretical Analysis

The Scenario 3 flow analysis applies the theoretical flow calculation to the total horizon PE loading projection. The table below provides the projected PE and the resulting DWF, ADF and FfFT for each Strategy horizon. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.3.

Table 23-2 - North Lisgoold WwTP Future Scenario 3 Flow Analysis

Parameter	Units	2030	2055	2080
Horizon PE	PE	266	324	366
Horizon Dry Weather Flow (DWF)	m^3/d	60	73	82
Horizon Average Daily Flow (ADF)	m^3/d	75	91	103
Horizon Flow to Full Treatment (FtFT)	m^3/d	153	186	210

23.3.4 Future Flow Design Basis

The tables provided in the previous sections can be used to compare the results of the Scenario 3 flow analysis.

At this stage of the strategy, it is proposed to progress with Scenario 3 for the following reasons:

- There is insufficient data available to complete the Scenario 1 analysis. The Scenario 3 analysis uses theoretical PCCs which shall improve alignment with assessments for other sites within the study area.
- The Scenario 2 analysis could not be completed as there is no published AERs available.

Figure 23-2 below represents the estimated projected flow (ADF & 3DWF) demand of the North Lisgoold WwTP across the current and future horizons. At the time of assessment, the design hydraulic capacity could not be determined.

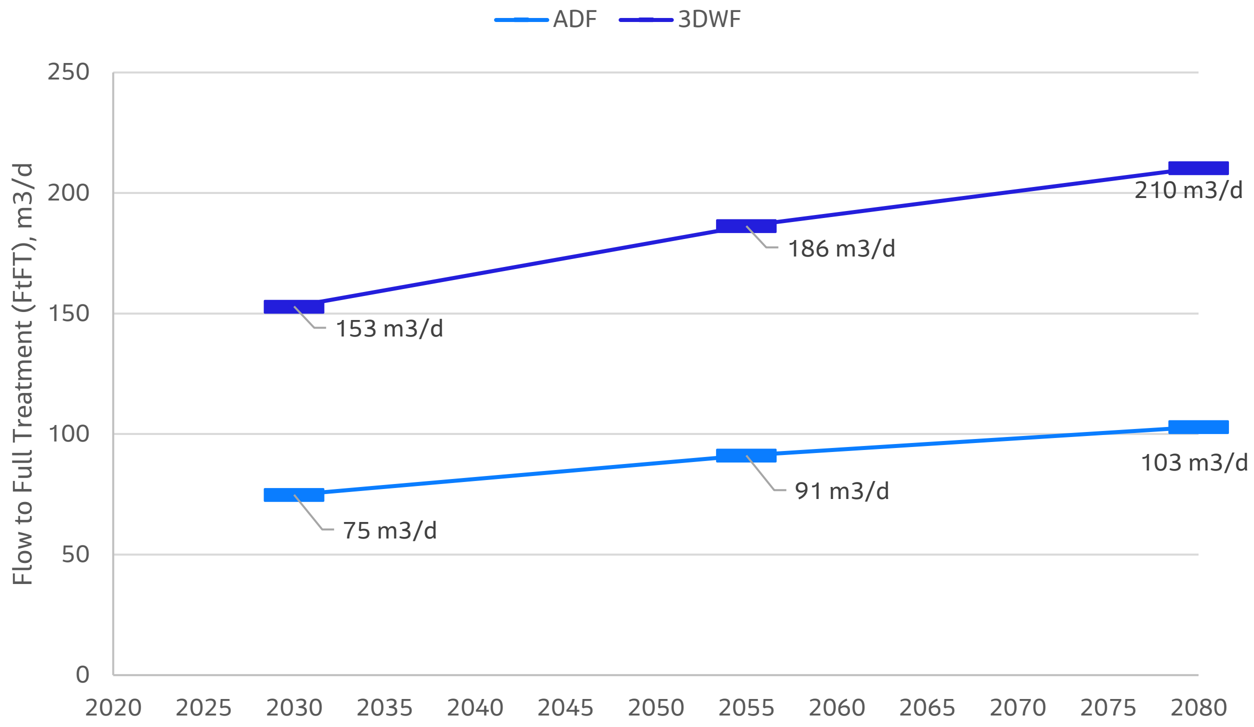


Figure 23-2 – North Lisgoold WwTP Future Flow Projection (Scenario 3)

23.4 WwTP Future Nutrient Loading Analysis

This section shall be used to outline the measured load analysis and provide commentary on future load assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

23.4.1 Scenario 1 Load Analysis – Measured Data Only

As discussed in Section 23.3.1, there is no measured flow data and therefore the Scenario 1 flow assessment could not be completed.

23.4.2 Scenario 2 Load Analysis – Hybrid Measured & Theoretical Analysis

As discussed in Section 23.3.2, the Scenario 2 flow analysis could not be completed due to the lack of AER data. Therefore, the Scenario 2 load analysis has not been completed.

23.4.3 Scenario 3 Load Analysis – Theoretical Analysis

In this Scenario 3 load analysis, the projected future horizon PE loading shall be used in combination with theoretical PCCs (see Table 2-2) to derive the projected future nutrient loading. Table 23-3 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 23-3 - North Lisgoold WwTP Future Scenario 3 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	266		324		366	
BOD (kg/d)	16	32	19	39	22	44
Suspended Solids (kg/d)	20	40	24	49	27	55
Total Nitrogen (kg/d)	2.9	5.9	3.6	7.1	4.0	8.1
Total Phosphorus (kg/d)	0.6	1.2	0.7	1.4	0.8	1.6
Ammonia (kg/d)	2.1	4.3	2.6	5.2	2.9	5.9

23.4.4 Future Load Design Basis

The tables presented within the previous sections can be used to compare the results of the Scenario 3 flow and load analysis.

It is proposed to progress with Scenario 3 at this stage of the strategy for the reasons previously discussed in Section 23.3.4.

24. Lisgoold South WwTP

24.1 Introduction

Lisgoold South WwTP is located approximately 10m from the bank of the Owenacurra River Valley, it serves the southern half of the village of Lisgoold and is located approximately 550m south of Lisgoold North WwTP, as seen in Figure 24-1. Lisgoold South WwTP is currently operated and maintained by Cork County Council on behalf of Uisce Éireann.

The WwTP was commissioned in 2008 and has a design capacity of 500PE however it is believed the design capacity is potentially considerably lower. Treatment comprises of, combined primary and secondary treatment in an aeration package plant, ferric dosing and tertiary sand filters. Sludge is stored in the primary settlement zone. Treated wastewater is discharged to the Owenacurra river. The site has never been operational as the connected load was insufficient to sustain the WwTP. Lisgoold South WwTP is currently undergoing upgrades by Glen Agua and Lisgoold North WwTP will be diverted here.

According to the data from the 2022 census report the catchment of Lisgoold has a domestic population of 325. Lisgoold has 2 No. WwTPs – Lisgoold North and Lisgoold South. There is no separate census 2022 population for the catchment of Lisgoold South WwTP and the UÉ Asset Capacity Register is showing Lisgoold South WwTP as not in service.

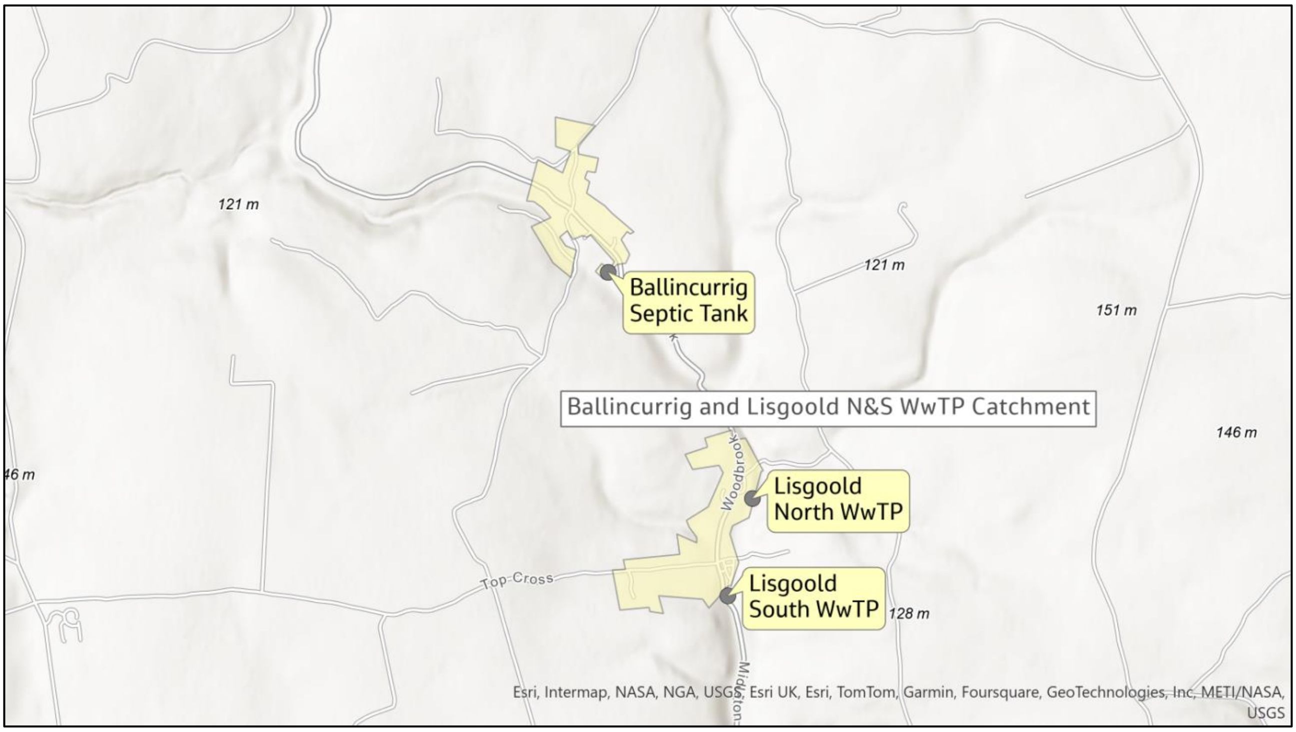


Figure 24-1 - Lisgoold South WwTP Site Location and Catchment

24.2 Current Flow and Load Summary

In order to evaluate the future horizon WwTP flow and load projections, an assessment of the current WwTP loading was undertaken to understand current catchment characteristics that may influence the future horizon assessment.

In the following sections, commentary will be provided on the interpretation of current organic capacity, the quality and reliability of raw data and recommendations on the preferred future horizon calculation methodology.

24.2.1 Current Wastewater Discharge License

The South Lisgoold WwTP is not currently operational and thus the Certificate of Authorisation or WWDL ELVs have not be established. The plant currently has a PE less than 500 PE and there must comply with the Urban Wastewater Treatment Directive (91/271/EEC) ELVs as summarised below in Table 24-1.

Table 24-1 - Lisgoold South WwTP UWWTD ELVs

Parameter	Units	Value
BOD	mg/l	25
COD	mg/l	125
Suspended Solids	mg/l	35

24.2.2 Latest AER Data

As stated above, there is no discharge licence for South Lisgoold WwTP and therefore the latest Annual Environmental Report (AER) is not recorded and published.

24.2.3 Current Measured Flow Data

Raw influent flow data was not available for the flow and load data analysis and therefore no assessment has been completed. The Scenario 1 flow and load assessment will therefore not be included within this report.

24.2.4 Current Measured Nutrient Loading Data

Raw influent flow data was not available for the flow and load data analysis and therefore no assessment has been completed. The Scenario 1 and Scenario 2 flow and load assessment will therefore not be included within this report.

24.3 WWTP Future Flow analysis

This section shall be used to outline the measured flow analysis and provide commentary on future flow assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.1

24.3.1 Scenario 1 Flow Analysis – Measured Data Only

As discussed in the previous section, there was no measured flow data available at the time of assessment for South Lisgoold WwTP. Therefore, the Scenario 1 flow analysis has not been included within this report.

24.3.2 Scenario 2 Flow Analysis – Hybrid Measured & Theoretical Analysis

The Scenario 2 flow analysis considers the current WwTP flow loading with all additional future flow from the projected PE growth loading determined using theoretical flow PCCs.

In this instance, there is no available current loading information from the latest AER. Therefore, the Scenario 2 flow analysis has not been completed or included within this report.

24.3.3 Scenario 3 Flow Analysis – Theoretical Analysis

The Scenario 3 flow analysis applies the theoretical flow calculation to the total horizon PE loading projection. The table below provides the projected PE and the resulting DWF, ADF and FfFT for each Strategy horizon. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.3.

Table 24-2 - Lisgoold South WwTP Future Scenario 3 Flow Analysis

Parameter	Units	2030	2055	2080
Horizon PE	PE	266	324	366
Horizon Dry Weather Flow (DWF)	m^3/d	60	73	82
Horizon Average Daily Flow (ADF)	m^3/d	75	91	103
Horizon Flow to Full Treatment (FtFT)	m^3/d	153	186	210

24.3.4 Future Flow Design Basis

The tables provided in the previous sections can be used to compare the results of the Scenario 3 flow analysis.

At this stage of the strategy, it is proposed to progress with Scenario 3 for the following reasons:

- There is insufficient data available to complete the Scenario 1 analysis. The Scenario 3 analysis uses theoretical PCCs which shall improve alignment with assessments for other sites within the study area.
- The Scenario 2 analysis could not be completed as there is no published AERs available.

Note, the future flow scenarios presented above account for the estimated projected flow (ADF & 3DWF) demand of the South Lisgoold **catchment** only across the current and future horizons. It is imperative to note, by 2030 the projected flows for both Ballincurrig WwTP and Lisgoold North WwTP will be diverted to the Lisgoold South WwTP as part of a planned/ongoing sewer diversion project. The total projected diverted flows to the Lisgoold South WwTP have been provided in Table 24-4 below. This accounts for the Scenario 3 flow assessment for both Ballincurrig WwTP and Lisgoold North WwTP. Figure 24-2 below represents the estimated projected flow (ADF & 3DWF) demand of the Lisgoold South WwTP across the current and future horizons.

Table 24-3 - Lisgoold South WwTP Future Scenario Flow Analysis

Parameter	Units	2030	2055	2080
Horizon PE	PE	1,099	1,330	1,503
Horizon Dry Weather Flow (DWF)	m^3/d	248	299	337
Horizon Average Daily Flow (ADF)	m^3/d	309	374	423
Horizon Flow to Full Treatment (FtFT)	m^3/d	632	764	863

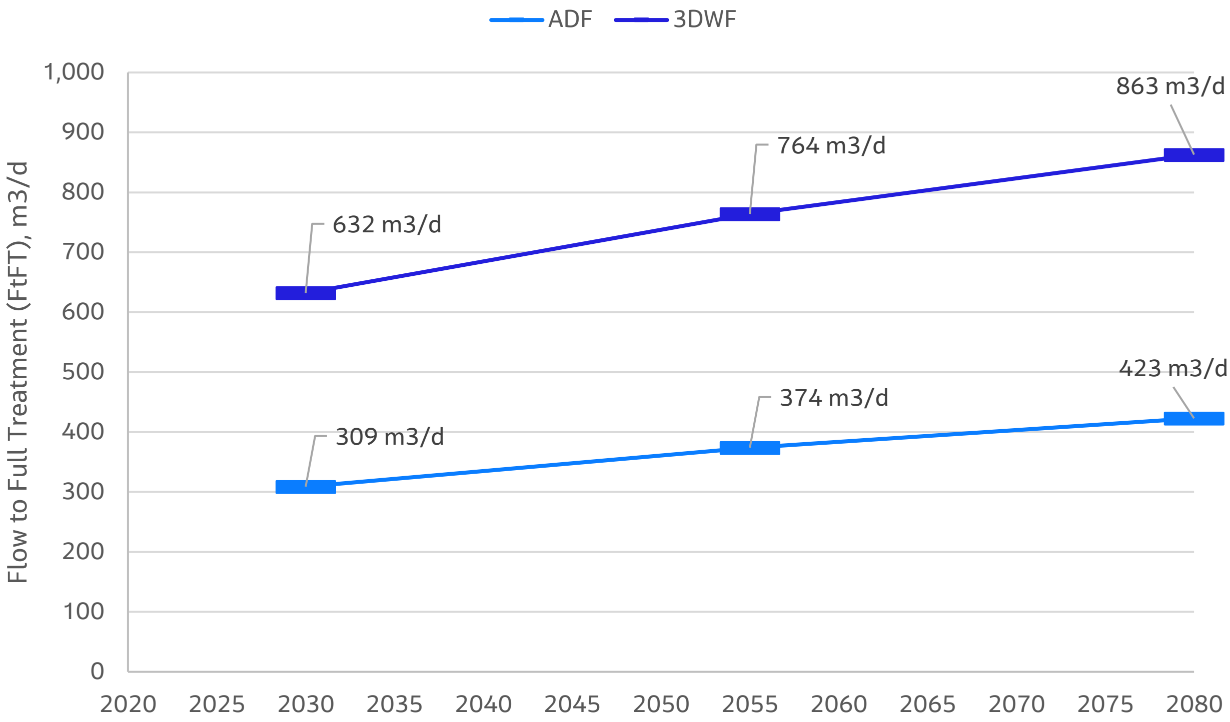


Figure 24-2 –Lisgoold South WwTP Future Flow Projection

24.4 WWTP Future Nutrient Loading Analysis

This section shall be used to outline the measured load analysis and provide commentary on future load assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

24.4.1 Scenario 1 Flow Analysis – Measured Data Only

As discussed in Section 24.3.1, there is no measured flow data and therefore the Scenario 1 flow assessment could not be completed.

24.4.2 Scenario 2 Flow Analysis – Hybrid Measured & Theoretical Analysis

As discussed in Section 24.3.2, the Scenario 2 flow analysis could not be completed due to the lack of AER data. Therefore, the Scenario 2 load analysis has not been completed.

24.4.3 Scenario 3 Flow Analysis – Theoretical Analysis

In this Scenario 3 load analysis, the projected future horizon PE loading shall be used in combination with theoretical PCCs (see Table 2-2) to derive the projected future nutrient loading. Table 24-4 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 24-4 - Lisgoold South WwTP Future Scenario 3 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	266		324		366	
BOD (kg/d)	16	32	19	39	22	44
Suspended Solids (kg/d)	20	40	24	49	27	55
Total Nitrogen (kg/d)	2.9	5.9	3.6	7.1	4.0	8.1
Total Phosphorus (kg/d)	0.6	1.2	0.7	1.4	0.8	1.6
Ammonia (kg/d)	2.1	4.3	2.6	5.2	2.9	5.9

24.4.4 Future Load Design Basis

The tables presented within the previous sections can be used to compare the results of the Scenario 3 flow and load analysis.

It is proposed to progress with Scenario 3 at this stage of the strategy for the reasons previously discussed in Section 24.3.4.

As discussed in Section 24.3.4, the planned/ongoing diversion of flow from Ballincullig WwTP and Lisgoold North WwTP to Lisgoold South WwTP will result in greater loads by 2030 than that presented in the preceding tables which have been used to determine the projected catchment loading. Table 24-5 below summarises the total projected loads following the completion of the sewer diversion to Lisgoold South WwTP.

Table 24-5 – Lisgoold South WwTP Future Scenario 3 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	1,099		1,330		1,503	
BOD (kg/d)	66	132	79	160	90	181
Suspended Solids (kg/d)	83	165	99	200	112	226
Total Nitrogen (kg/d)	12	24.3	14.7	29.2	16.5	33.2
Total Phosphorus (kg/d)	2.4	4.9	2.9	5.8	3.3	6.6
Ammonia (kg/d)	8.7	17.7	10.7	21.3	12	24.1

25. Knockraha WwTP

25.1 Introduction

Knockraha WwTP is located at Gogganstown, Knockraha, Northeast of Cork city. Knockraha WwTP was built in 2021 and is currently operated and maintained by O'Leary and O'Sullivan on behalf of UÉ under a DBO contract.

The WwTP was constructed to provide treatment of wastewater from the housing estates of Glenmore Heights and Ard Abhainn in Knockraha, Co. Cork due to the lack of treatment capacity in the existing public treatment plant (Chapel Hill). It was developed in two phases: phase 1 catering for 175 PE and phase 2 adding a further 175 PE capacity. It has an overall design capacity of 350PE.

According to the data from the 2022 census report the catchment of Knockraha has a domestic population of 517 while the UÉ Asset Capacity Register, has a current loading combined PE of 244.

25.2 Current Flow and Load Summary

In order to evaluate the future horizon WwTP flow and load projections, an assessment of the current WwTP loading was undertaken to understand current catchment characteristics that may influence the future horizon assessment.

In the following sections, commentary will be provided on the interpretation of current organic capacity, the quality and reliability of raw data and recommendations on the preferred future horizon calculation methodology.

25.2.1 Current Wastewater Discharge Licence (WWDL) Summary

The Knockraha WwTP currently has a Waste Water Discharge Certificate of Authorisation (WWDA) (A0352-01) was originally granted in 2011. The EVLs as outlined in the Certificate are summarised below in Table 25-1.

Table 25-1 - Knockraha WwTP WWDA ELVs (A0352-01)

Parameter	Units	Value
BOD	mg/l	20
COD	mg/l	125
Suspended Solids	mg/l	30
Ammonia as N	mg/l	20
Ortho as P	mg/l	1

25.2.2 Latest AER Data

As stated above, there is no discharge licence for Knockraha WwTP and therefore the latest Annual Environmental Report (AER) is not recorded and published.

25.2.3 Current Measured Flow Data

Raw influent flow data was not available for the flow and load data analysis and therefore no assessment has been completed. The Scenario 1 flow and load assessment will therefore not be included within this report.

25.2.4 Current Measured Nutrient Loading Data

Raw influent flow data was not available for the flow and load data analysis and therefore no assessment has been completed. The Scenario 1 and Scenario 2 flow and load assessment will therefore not be included within this report.

25.3 WwTP Future Flow Analysis

This section shall be used to outline the measured flow analysis and provide commentary on future flow assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.1

25.3.1 Scenario 1 Flow Analysis – Measured Data Only

As discussed in the previous section, there was no measured flow data available at the time of assessment for Knockraha WwTP. Therefore, the Scenario 1 flow analysis has not been included within this report.

25.3.2 Scenario 2 Flow Analysis – Hybrid Measured & Theoretical Analysis

As discussed in the previous section, there was no measured flow data available at the time of assessment for Knockraha WwTP. Therefore, the Scenario 1 flow analysis has not been included within this report.

25.3.3 Scenario 3 Flow Analysis – Theoretical Analysis

The Scenario 3 flow analysis applies the theoretical flow calculation to the total horizon PE loading projection. The table below provides the projected PE and the resulting DWF, ADF and FfFT for each Strategy horizon. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.3.

Table 25-2 - Knockraha WwTP Future Scenario 3 Flow Analysis

Parameter	Units	2030	2055	2080
Horizon PE	PE	737	841	935
Horizon Dry Weather Flow (DWF)	m^3/d	166	189	210
Horizon Average Daily Flow (ADF)	m^3/d	207	237	263
Horizon Flow to Full Treatment (FtFT)	m^3/d	424	484	538

25.3.4 Future Flow Design Basis

The tables provided in the previous sections can be used to compare the results of the Scenario 3 flow analysis.

At this stage of the strategy, it is proposed to progress with Scenario 3 for the following reasons:

- There is insufficient data available to complete the Scenario 1 analysis. The Scenario 3 analysis uses theoretical PCCs which shall improve alignment with assessments for other sites within the study area.
- The Scenario 2 analysis could not be completed as there is no published AERs available.

Figure 25-1 below represents the estimated projected flow (ADF & 3DWF) demand of the Knockraha WwTP across the current and future horizons. At the time of assessment, the design hydraulic capacity could not be determined.

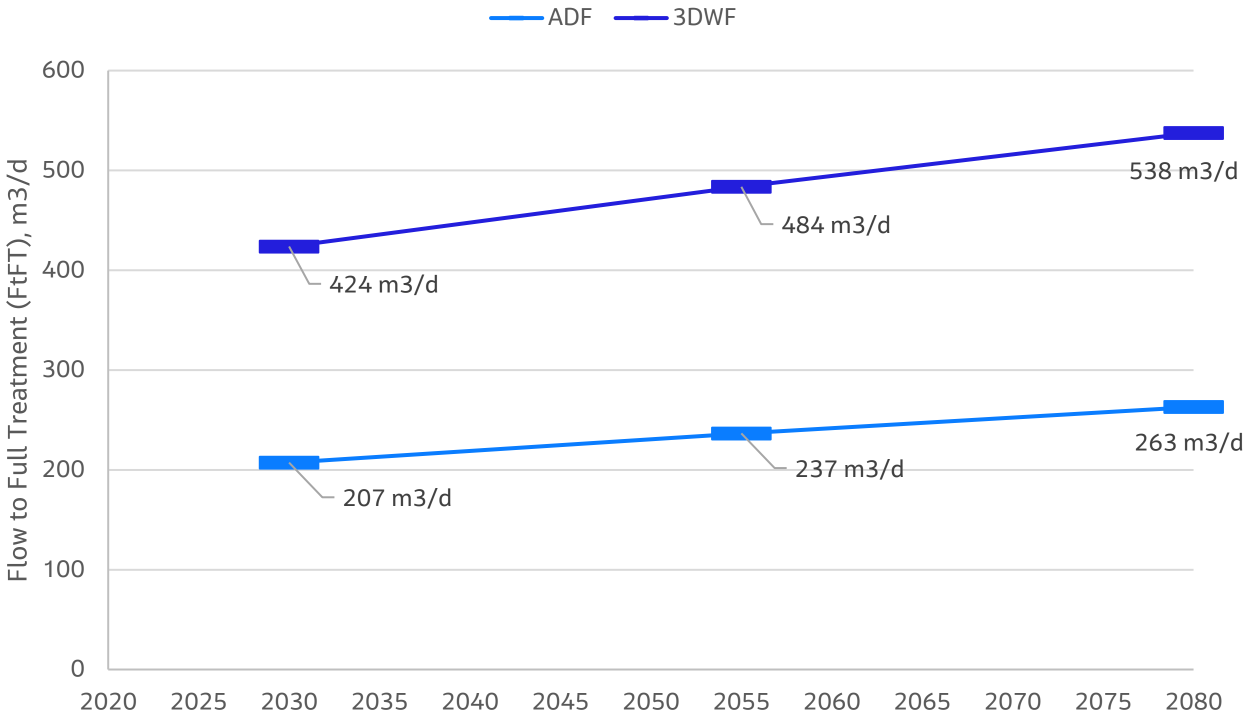


Figure 25-1 - Knockraha WwTP Future Flow Projection (Scenario 3)

25.4 WwTP Future Nutrient Loading Analysis

This section shall be used to outline the measured load analysis and provide commentary on future load assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

25.4.1 Scenario 1 Load Analysis – Measured Data Only

As discussed in Section 25.3.1, there is no measured flow data and therefore the Scenario 1 flow assessment could not be completed.

25.4.2 Scenario 2 Load Analysis – Hybrid Measured & Theoretical Analysis

As discussed in Section 0, the Scenario 2 flow analysis could not be completed due to the lack of AER data. Therefore, the Scenario 2 load analysis has therefore not been completed.

25.4.3 Scenario 3 Load Analysis – Theoretical Analysis Only

In this Scenario 3 load analysis, the projected future horizon PE loading shall be used in combination with theoretical PCCs (see Table 2-2) to derive the projected future nutrient loading. Table 25-3 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 25-3 - Knockraha WwTP Future Scenario 3 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	737		841		935	
BOD (kg/d)	44	88	50	101	56	112
Suspended Solids (kg/d)	55	111	63	126	70	140
Total Nitrogen (kg/d)	9.3	18.5	10.3	20.6	9.3	18.5
Total Phosphorus (kg/d)	1.9	3.7	2.1	4.1	1.9	3.7
Ammonia (kg/d)	6.7	13.5	7.5	15.0	6.7	13.5

25.4.4 Future Load Design Basis

The tables presented within the previous sections can be used to compare the results of the Scenario 3 flow and load analysis.

It is proposed to progress with Scenario 3 at this stage of the strategy for the reasons previously discussed in Section 25.3.4.

26. Saleen WwTP

26.1 Introduction

Saleen WwTP is located within Saleen Village and is currently served by a small septic tank which has become overloaded as the population of Saleen has increased. Saleen WwTP was built in the 1950s and is currently operated and maintained by Cork County Council on behalf of Uisce Éireann and has a design capacity PE of 40. The discharge is currently licenced by a Certificate of Authorisation (A0432-01) from the Environmental Protection Agency, issued on 18/04/2011.

UÉ plan to upgrade the existing Saleen wastewater treatment system to an Integrated Constructed Wetland (ICW) system, designed by VESI Environmental Ltd., which will provide complete treatment for combined wastewaters from the village of Saleen. This project is currently paused due to a dispute between Coillte and UÉ. Treated effluent is currently discharged to Cork Harbour.

According to the data from the 2022 census report the catchment of Saleen has a domestic population of 601 while the UÉ Asset Capacity Register, has a current loading PE of 613.

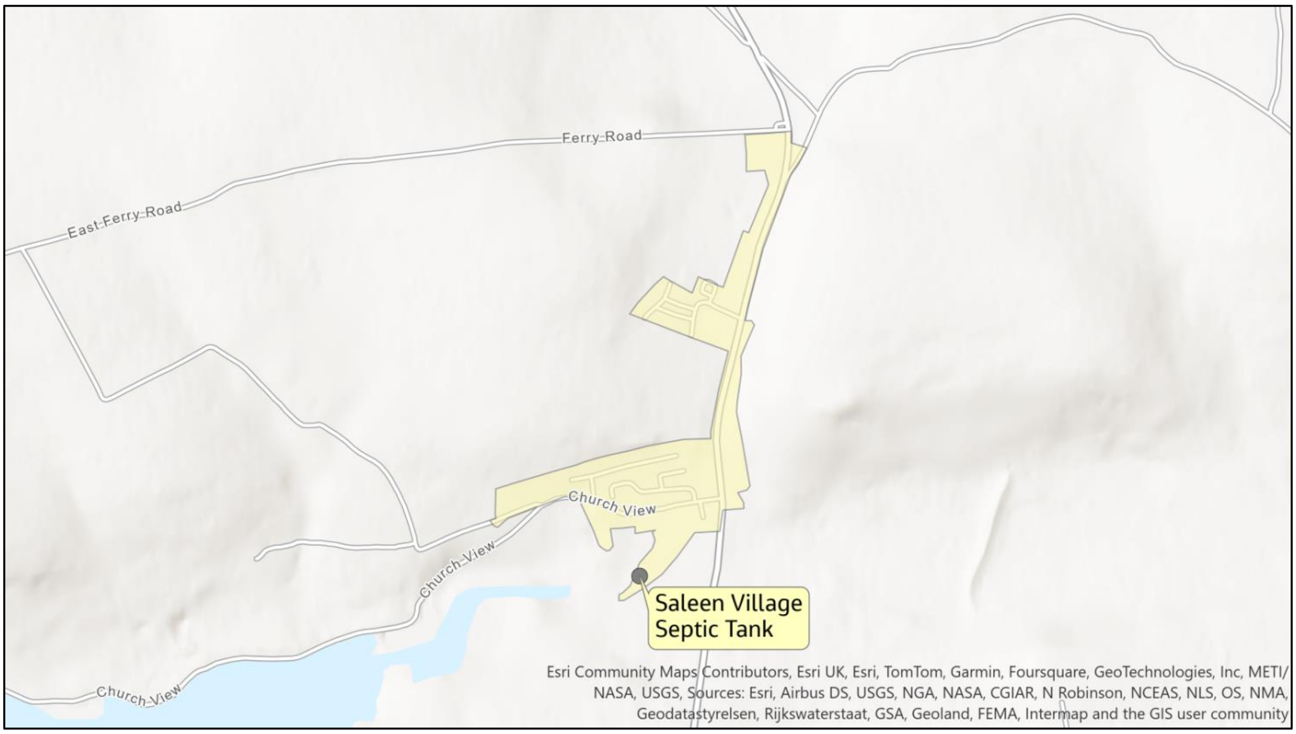


Figure 26-1 - Saleen WwTP Site Location and Catchment

26.2 Current Flow and Load Summary

In order to evaluate the future horizon WwTP flow and load projections, an assessment of the current WwTP loading was undertaken to understand current catchment characteristics that may influence the future horizon assessment.

In the following sections, commentary will be provided on the interpretation of current organic capacity, the quality and reliability of raw data and recommendations on the preferred future horizon calculation methodology.

26.2.1 Current Wastewater Discharge Licence (WWDL) Summary

The Saleen WwTP currently has a Waste Water Discharge Certificate of Authorisation (WWDA) (A0352-01) was originally granted in 2011. The EVLs as outlined in the Certificate are summarised below in Table 26-1.

Table 26-1 – Saleen WwTP WWDL WWDA ELVs (A0352-01)

Parameter	Units	Value
BOD	mg/l	20
COD	mg/l	125
Suspended Solids	mg/l	30
Total Nitrogen (as N)	mg/l	20
Ammonia	mg/l	3

26.2.2 Latest AER Data

As stated above, there is no discharge licence for Saleen WwTP and therefore the latest Annual Environmental Report (AER) is not recorded and published.

26.2.3 Current Measured Flow Data

Raw influent flow data was not available for the flow and load data analysis and therefore no assessment has been completed. The Scenario 1 flow and load assessment will therefore not be included within this report.

26.2.4 Current Measured Nutrient Loading Data

Raw influent flow data was not available for the flow and load data analysis and therefore no assessment has been completed. The Scenario 1 and Scenario 2 flow and load assessment will therefore not be included within this report.

26.3 WwTP Future Flow Analysis

This section shall be used to outline the measured flow analysis and provide commentary on future flow assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.1

26.3.1 Scenario 1 Flow Analysis – Measured Data Only

As discussed in the previous section, there was no measured flow data available at the time of assessment for Saleen WwTP. Therefore, the Scenario 1 flow analysis has not been included within this report.

26.3.2 Scenario 2 Flow Analysis – Hybrid Measured & Theoretical Analysis

As discussed in the previous section, there was no measured flow data available at the time of assessment for Saleen WwTP. Therefore, the Scenario 1 flow analysis has not been included within this report.

26.3.3 Scenario 3 Flow Analysis – Theoretical Analysis

The Scenario 3 flow analysis applies the theoretical flow calculation to the total horizon PE loading projection. The table below provides the projected PE and the resulting DWF, ADF and FfFT for each Strategy horizon. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.3.

Table 26-2 - Saleen WwTP Future Scenario 3 Flow Analysis

Parameter	Units	2030	2055	2080
Horizon PE	PE	891	1,032	1,158
Horizon Dry Weather Flow (DWF)	m^3/d	200	232	261
Horizon Average Daily Flow (ADF)	m^3/d	251	290	326
Horizon Flow to Full Treatment (FtFT)	m^3/d	512	593	666

26.3.4 Future Flow Design Basis

The tables provided in the previous sections can be used to compare the results of the Scenario 3 flow analysis.

At this stage of the strategy, it is proposed to progress with Scenario 3 for the following reasons:

- There is insufficient data available to complete the Scenario 1 analysis. The Scenario 3 analysis uses theoretical PCCs which shall improve alignment with assessments for other sites within the study area.
- The Scenario 2 analysis could not be completed as there is no published AERs available.

Figure 26-2 below represents the estimated projected flow (ADF & 3DWF) demand of the Saleen WwTP across the current and future horizons. At the time of assessment, the design hydraulic capacity could not be determined.

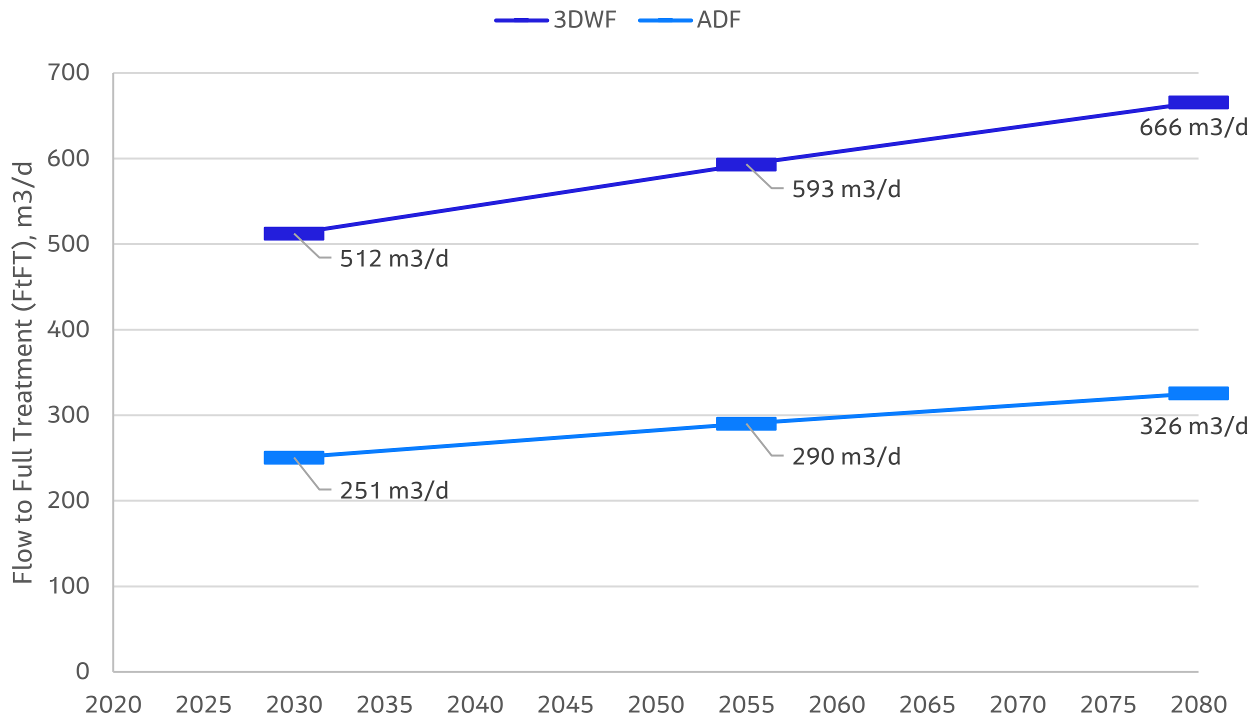


Figure 26-2 - Saleen WwTP Future Flow Projection (Scenario 3)

26.4 WwTP Future Nutrient Loading Analysis

This section shall be used to outline the measured load analysis and provide commentary on future load assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

26.4.1 Scenario 1 Load Analysis – Measured Data Only

As discussed in Section 26.3.1, there is no measured flow data and therefore the Scenario 1 flow assessment could not be completed.

26.4.2 Scenario 2 Load Analysis – Hybrid Measured & Theoretical Analysis

As discussed in Section 26.3.2, the Scenario 2 flow analysis could not be completed due to the lack of AER data. Therefore, the Scenario 2 load analysis has therefore not been completed.

26.4.3 Scenario 3 Load Analysis – Theoretical Analysis Only

In this Scenario 3 load analysis, the projected future horizon PE loading shall be used in combination with theoretical PCCs (see Table 2-2) to derive the projected future nutrient loading. Table 26-3 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 26-3 - Saleen WwTP Future Scenario 3 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	891		1,032		1,158	
BOD (kg/d)	53	107	62	124	69	139
Suspended Solids (kg/d)	67	134	77	155	87	174
Total Nitrogen (kg/d)	9.8	19.6	11.4	22.7	12.7	25.5
Total Phosphorus (kg/d)	2.0	3.9	2.3	4.5	2.5	5.1
Ammonia (kg/d)	7.1	14.3	8.3	16.5	9.3	18.5

26.4.4 Future Load Design Basis

The tables presented within the previous sections can be used to compare the results of the Scenario 1, Scenario 2 and Scenario 3 flow and load analysis.

It is proposed to progress with Scenario 3 at this stage of the strategy for the reasons previously discussed in Section 26.3.4.

27. Whitegate and Aghada WwTP

27.1 Introduction

The town of Whitegate & Aghada is located in East County Cork, as seen in Figure 27-1. The agglomeration is currently sub-divided into four drainage areas and does not have a sewage treatment works in place. The area consists of four settlements: Whitegate, Upper Aghada, Lower Aghada and Rostellan, which are located along the east coast of Cork Harbour. The nearest town is Midleton, approximately 14 km northeast from the village of Whitegate. The Whitegate-Aghada wastewater collection network is a partially combined system, handling domestic foul sewage, commercial effluent, and road surface water drainage.

According to the data from the 2022 census report the catchment of Whitegate & Aghada has a combined domestic population of 2,407 (Whitegate-1,248 & Aghada-1,159).

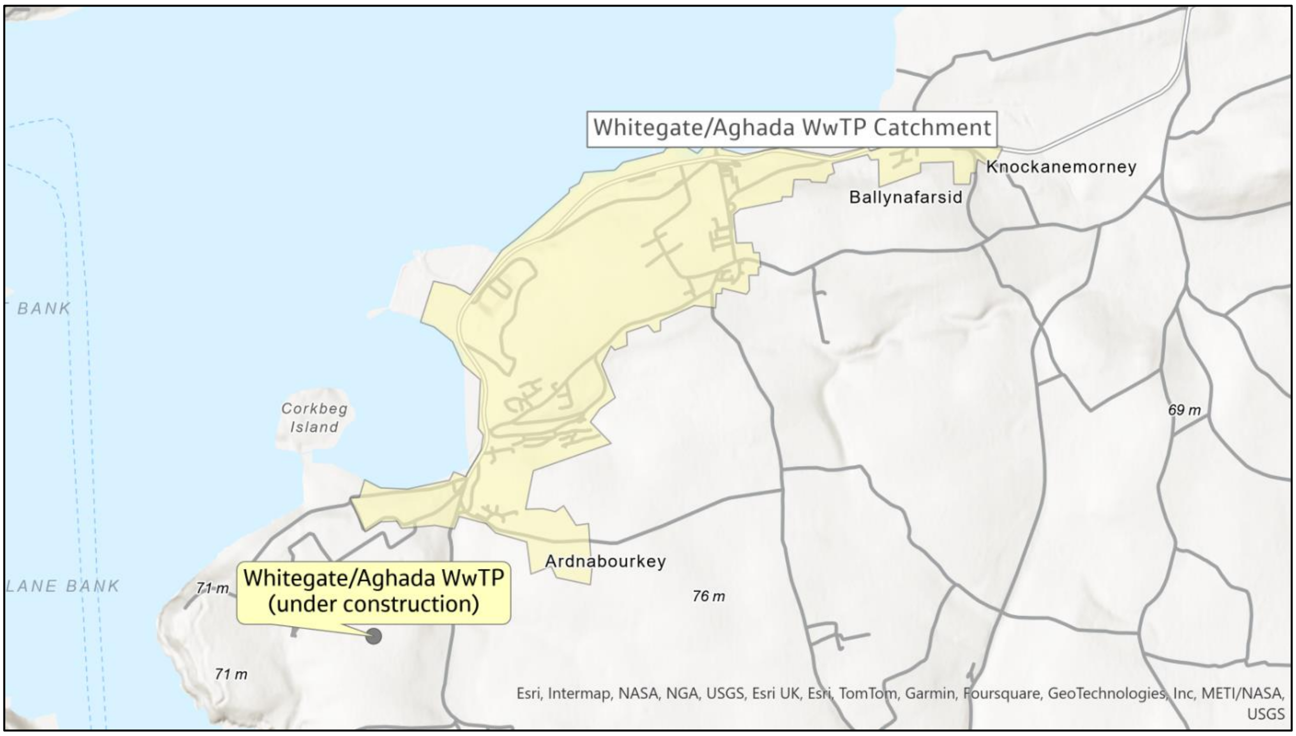


Figure 27-1 - Whitegate & Aghada WwTP Site Location and Catchment

27.2 Current Flow and Load Summary

In order to evaluate the future horizon WwTP flow and load projections, an assessment of the current WwTP loading was undertaken to understand current catchment characteristics that may influence the future horizon assessment.

In the following sections, commentary will be provided on the interpretation of current organic capacity, the quality and reliability of raw data and recommendations on the preferred future horizon calculation methodology.

27.2.1 Current Wastewater Discharge Licence (WWDL) Summary

The Waste Water Discharge Licence (WWDL) (D0423-01) was originally granted in 2015. The licence was subsequently revised in 2024 to D0423-02. It is therefore assumed the reported design PE is based on the amended licence requirements, which are summarised below.

Table 27-1 – Whitegate WWDL ELVs (D0423-01)

Parameter	Units	Value
BOD	mg/l	20% Reduction
Suspended Solids	mg/l	50% Reduction
Dissolved Inorganic Nitrogen	mg/l	54

27.2.2 Latest AER Data

The latest Annual Environmental Report (AER) for Whitegate WwTP was published in 2023. As a new treatment plant is being constructed, an influent monitoring summary was not reported within the report.

27.2.3 Current Measured Flow Data

Raw influent flow data was not available for the flow and load data analysis and therefore no assessment has been completed. The Scenario 1 flow and load assessment will therefore not be included within this report.

27.2.4 Current Measured Nutrient Loading Data

Raw influent flow sample data was not available for the flow and load data analysis and therefore no assessment has been completed. The Scenario 1 and Scenario 2 flow and load assessment will therefore not be included within this report.

27.3 WWTP Future Flow analysis

This section shall be used to outline the measured flow analysis and provide commentary on future flow assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.1

27.3.1 Scenario 1 Flow Analysis – Measured Data Only

As discussed in the previous section, there is no measured flow data available for Whitegate & Aghada WwTP and therefore the Scenario 1 flow analysis has not been included within this report.

27.3.2 Scenario 2 Flow Analysis – Hybrid Measured & Theoretical Analysis

The Scenario 2 flow analysis considers the current WwTP flow loading with all additional future flow from the projected PE growth loading determined using theoretical flow PCCs.

In this instance, there is no available current loading information from the latest AER. Therefore, the Scenario 2 flow analysis has not been completed or included within this report.

27.3.3 Scenario 3 Flow Analysis – Theoretical Analysis

The Scenario 3 flow analysis applies the theoretical flow calculation to the total horizon PE loading projection. The table below provides the projected PE and the resulting DWF, ADF and FfFT for each Strategy horizon. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.3.

Table 27-2 - Whitegate WwTP Future Scenario 3 Flow Analysis

Parameter	Units	2030	2055	2080
Horizon PE	PE	3,361	3,959	4,444
Horizon Dry Weather Flow (DWF)	m^3/d	756	891	1,000
Horizon Average Daily Flow (ADF)	m^3/d	945	1,113	1,250
Horizon Flow to Full Treatment (FtFT)	m^3/d	1,933	2,276	2,555

27.3.4 Future Flow Design Basis

The tables provided in the previous sections can be used to compare the results of the Scenario 3 flow analysis.

At this stage of the strategy, it is proposed to progress with Scenario 3 for the following reasons:

- The Scenario 1 analysis has insufficient reliable data available.
- The Scenario 2 analysis requires flow data from the latest AER, which is not available.

Figure 27-2 below represents the estimated projected flow (ADF & 3DWF) demand of the Whitegate WwTP across the current and future horizons. At the time of assessment, the design hydraulic capacity could not be determined.

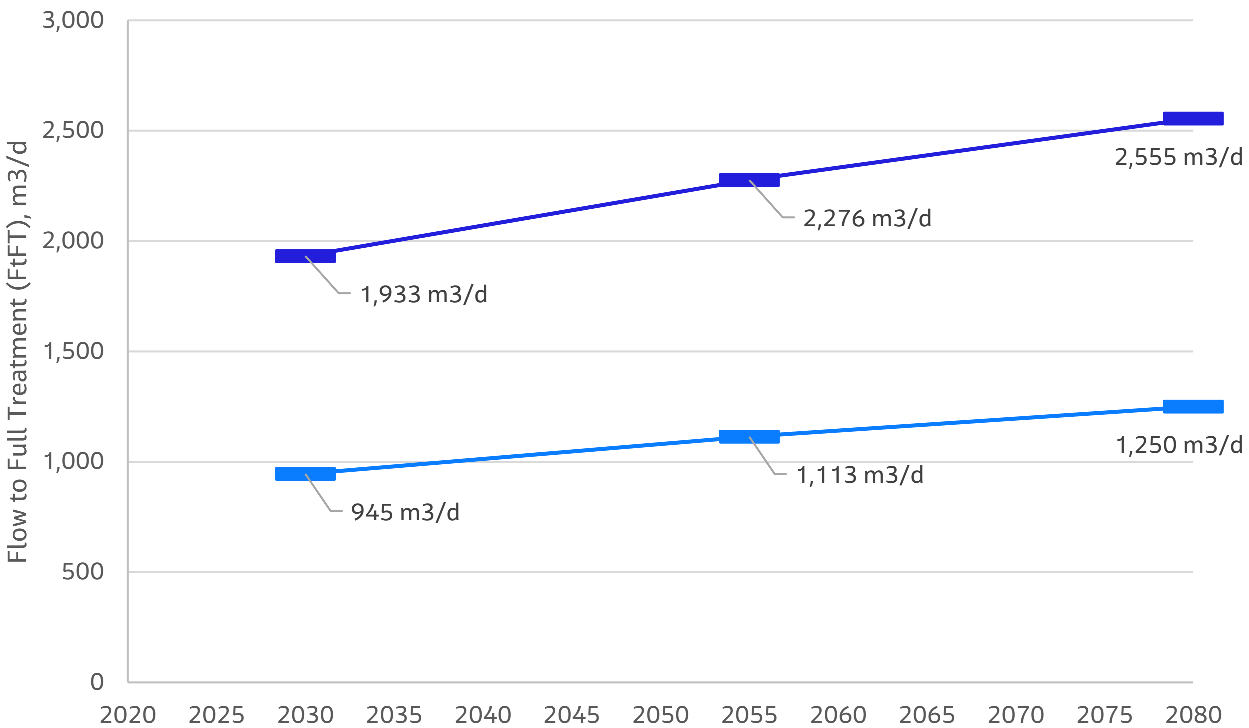


Figure 27-2 – Whitegate WwTP Future Flow Projection (Scenario 3)

27.4 WWTP Future Nutrient Loading Analysis

This section shall be used to outline the measured load analysis and provide commentary on future load assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

27.4.1 Scenario 1 Load Analysis – Measured Data Only

As discussed in Section 27.3.1, there is no measured flow data for Whitegate & Aghada WwTP, therefore the Scenario 1 load analysis could not be completed.

27.4.2 Scenario 2 Load Analysis – Hybrid Measured & Theoretical Analysis

As discussed in Section 27.3.2, the Scenario 2 flow analysis could not be completed due to the lack of AER data. Therefore, the Scenario 2 load analysis has not been completed.

27.4.3 Scenario 3 Load Analysis – Theoretical Analysis

In this Scenario 3 load analysis, the projected future horizon PE loading shall be used in combination with theoretical PCCs (see Table 2-2) to derive the projected future nutrient loading. Table 27-3 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 27-3 - Whitegate WwTP Future Scenario 3 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	3,361		3,959		4,444	
BOD (kg/d)	202	403	238	475	267	533
Suspended Solids (kg/d)	252	504	297	594	333	667
Total Nitrogen (kg/d)	37	74	44	87	49	98
Total Phosphorus (kg/d)	7	15	9	17	10	20
Ammonia (kg/d)	27	54	32	63	36	71

27.4.4 Future Load Design Basis

The tables presented within the previous sections can be used to compare the results of the Scenario 3 flow and load analysis.

It is proposed to progress with Scenario 3 at this stage of the strategy for the reasons previously discussed in Section 27.3.4.

28. Halfway WwTP

28.1 Introduction

The Halfway Wastewater Treatment Plant (WwTP) is located in Halfway, 12km southwest of Cork City and 13km to the northeast of Bandon. The treatment plant, constructed in 2005, serves the nearby residential and commercial areas, with a design PE of 450 but currently handling wastewater for a PE of 226.

The plant operates efficiently within its capacity and adheres to environmental standards, as shown by the 'Green' status for indication of available capacity by Uisce Éireann. The discharge is currently licenced by a Certificate of Authorisation (A0443-01) from the Environmental Protection Agency.

The Wastewater Treatment Plant, located in the 'An Bruach' development, is a Membrane Bio-Reactor Treatment Plant which combines biological treatment and membrane infiltration.

28.2 Current Flow and Load Summary

In order to evaluate the future horizon WwTP flow and load projections, an assessment of the current WwTP loading was undertaken to understand current catchment characteristics that may influence the future horizon assessment.

In the following sections, commentary will be provided on the interpretation of current organic capacity, the quality and reliability of raw data and recommendations on the preferred future horizon calculation methodology.

28.2.1 Current Wastewater Discharge License (WWDL) Summary

The Halfway WwTP currently has a PE less than 500 PE and there must comply with the Urban Wastewater Treatment Directive (91/271/EEC) ELVs as summarised below in Table 28-1.

Table 28-1 - Halfway WwTP UWWTD ELVs

Parameter	Units	Value
BOD	mg/l	25
COD	mg/l	125
Suspended Solids	mg/l	35

28.2.2 Latest AER Data

As stated above, there is no discharge licence for Halfway WwTP and therefore the latest Annual Environmental Report (AER) is not recorded and published.

28.2.3 Current Measured Flow Data

Raw influent flow data was not available for the flow and load data analysis and therefore no assessment has been completed. The Scenario 1 flow and load assessment will therefore not be included within this report.

28.2.4 Current Measured Nutrient Loading Data

Raw influent flow data was not available for the flow and load data analysis and therefore no assessment has been completed. The Scenario 1 and Scenario 2 flow and load assessment will therefore not be included within this report.

28.3 WWTP Future Flow Analysis

This section shall be used to outline the measured flow analysis and provide commentary on future flow assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.1

28.3.1 Scenario 1 Flow Analysis – Measured Data Only

As discussed in the previous section, there was no measured flow data available at the time of assessment for Halfway WwTP. Therefore, the Scenario 1 flow analysis has not been included within this report.

28.3.2 Scenario 2 Flow Analysis – Hybrid Measured & Theoretical Analysis

The Scenario 2 flow analysis considers the current WwTP flow loading with all additional future flow from the projected PE growth loading determined using theoretical flow PCCs.

In this instance, there is no available current loading information from the latest AER. Therefore, the Scenario 2 flow analysis has not been completed or included within this report.

28.3.3 Scenario 3 Flow Analysis – Theoretical Analysis

The Scenario 3 flow analysis applies the theoretical flow calculation to the total horizon PE loading projection. The table below provides the projected PE and the resulting DWF, ADF and FfFT for each Strategy horizon. For further details on the Scenario assessment methodology, please refer to Section 2.2.1.3.

Table 28-2 - Halfway WwTP Future Scenario 3 Flow Analysis

Parameter	Units	2030	2055	2080
Horizon PE	PE	363	417	470
Horizon Dry Weather Flow (DWF)	m^3/d	82	94	106
Horizon Average Daily Flow (ADF)	m^3/d	102	117	132
Horizon Flow to Full Treatment (FtFT)	m^3/d	209	240	270

28.3.4 Future Flow Design Basis

The tables provided in the previous sections can be used to compare the results of the Scenario 3 flow analysis.

At this stage of the strategy, it is proposed to progress with Scenario 3 for the following reasons:

- There is insufficient data available to complete the Scenario 1 analysis. The Scenario 3 analysis uses theoretical PCCs which shall improve alignment with assessments for other sites within the study area.
- The Scenario 2 analysis could not be completed as there is no published AERs available.

Figure 28-1 below represents the estimated projected flow (ADF & 3DWF) demand of the Knockraha WwTP across the current and future horizons. At the time of assessment, the design hydraulic capacity could not be determined.

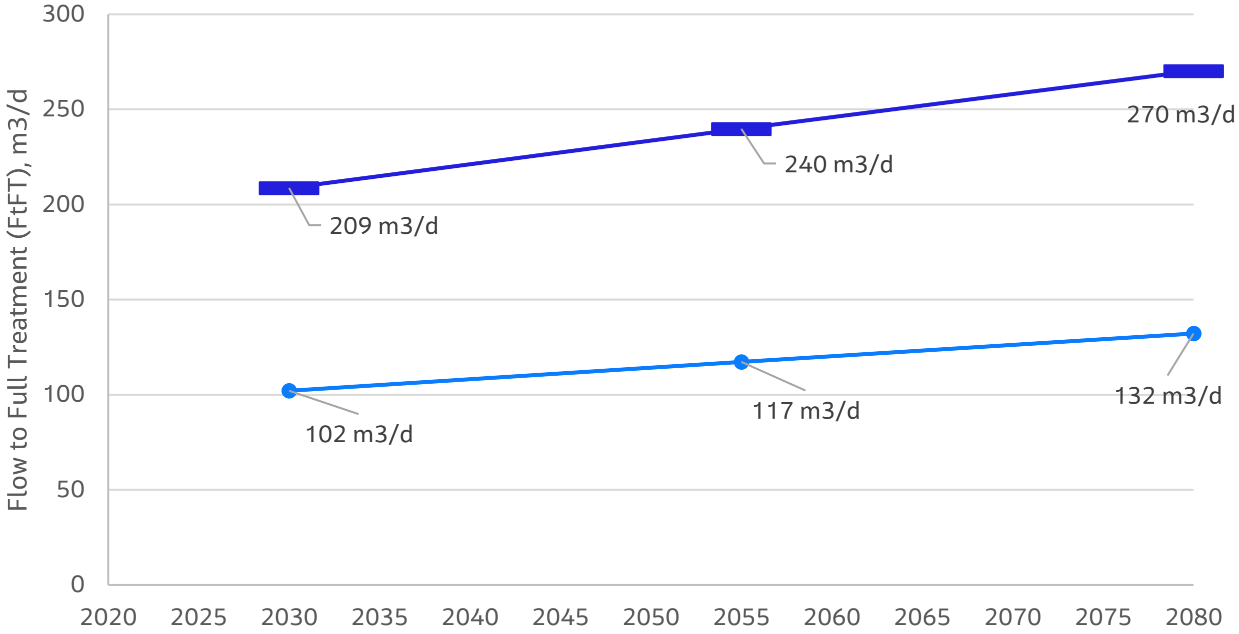


Figure 28-1 - Halfway WwTP Future Flow Projection (Scenario 3)

28.4 WWTP Future Nutrient Loading Analysis

This section shall be used to outline the measured load analysis and provide commentary on future load assessment basis for each Scenario. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

28.4.1 Scenario 1 Load Analysis – Measured Data Only

As discussed in Section 27.3.1, there is no measured flow data for Halfway WwTP, therefore the Scenario 1 load analysis could not be completed.

28.4.2 Scenario 2 Load Analysis – Hybrid Measured & Theoretical Analysis

As discussed in Section 27.3.2, the Scenario 2 flow analysis could not be completed due to the lack of AER data. Therefore, the Scenario 2 load analysis has not been completed.

28.4.3 Scenario 3 Load Analysis – Theoretical Analysis

In this Scenario 3 load analysis, the projected future horizon PE loading shall be used in combination with theoretical PCCs (see Table 2-2) to derive the projected future nutrient loading. Table 27-3 below summarises the outputs of the analysis. For further details on the Scenario assessment methodology, please refer to Section 2.2.2.

Table 28-3 - Halfway WwTP Future Scenario 3 Load Analysis

Parameter	2030		2055		2080	
	Average	95%ile	Average	95%ile	Average	95%ile
Horizon PE	363		417		470	
BOD (kg/d)	22	44	25	50	28	56
Suspended Solids (kg/d)	27	54	31	63	35	71
Total Nitrogen (kg/d)	4	8	5	9	5	10
Total Phosphorus (kg/d)	1	2	1	2	1	2
Ammonia (kg/d)	3	6	3	7	4	8

28.4.4 Future Load Design Basis

The tables presented within the previous sections can be used to compare the results of the Scenario 3 flow and load analysis.

It is proposed to progress with Scenario 3 at this stage of the strategy for the reasons previously discussed in Section 28.3.4.

29. Outline Summary

In total, the flow and load analysis and assessment were completed on 26 No. sites providing recommended flow and load scenarios for future strategy loading projections. The assessment methodology completes an analysis of the measured flow and load data, where available, which consists of daily flow monitoring readings and influent concentration grab or composite sample data.

The measured data analysis has indicated there are a total of 8 sites with reliable flow data for use within the Flow and Loads Assessment. The remaining sites have either no data available, or the data was deemed inaccurate or unreliable for the purposes of the assessment. Where measured flow data was available and recommended for use, the Scenario 1 flow analysis was completed and presented within this report. The Scenario 1 load analysis was also completed for these sites, where sufficient reliable influent concentration data was available.

The assessment also completed a Scenario 2 flow and load analysis which uses the latest recorded AER data to determine the current plant loading, with future projected strategy growth loading calculated using the theoretical standard DWF PCC. There were 13 sites with reliable AER data that was used within the Scenario 2 flow analysis. For these sites, the Scenario 2 load analysis was also completed and summarised within the report.

For all sites, the Scenario 3 theoretical analysis was completed to compare and contrast the measured data against theoretical loadings. The Scenario 3 flow and load analysis were completed and summarised within each site-specific section of this report.

In total, it is recommended to use the Scenario 2 flow and load analysis for 8 sites. This includes, Carrigrennan, Shanbally, Ballincollig, Carrigtwohill, Blarney, Watergrasshill, and Kileens. Scenario 2 has been recommended as it provides a conservative future loading projections and uses existing flow data, obtained from the latest published AER, which aligns the projection with the current loading profile whilst standardising future growth across the strategy. It is recommended to use the Scenario 1 flow and load analysis for 2 sites which includes Midleton and Dripsey. Scenario 1 has been recommended in these instances to provide a more conservative projection and to account for catchment specific flow loading profiles. It is recommended to use the Scenario 3 flow and load analysis for the remaining 17 sites. Scenario 3 is primarily recommended due to the lack of measured flow and/or influent sample data or where current loading profiles could not be obtained.

An assessment of existing hydraulic capacity against the future 3DWF/FfFT and ADF projections has also been completed. The outputs of the assessment have been summarised in Table 29-1 below which outlines the scenario used for the comparison and the projected date of hydraulic capacity exceedance. For further details on the projected flow loading, please refer to Table 29-1.

Table 29-1 – Summary of Flow Analysis Existing Capacity Exceedance

WwTP	Scenario	2030		2055		2080	
		ADF	3DWF	ADF	3DWF	ADF	3DWF
Carrigrennan	2	C	C	C	E	C	E
Shanbally	2	C	E	C	E	C	E
Ballincollig	2	C	E	C	E	C	E
Carrigtwohill	2	C	E	C	E	C	E
Midleton	1	E	E	E	E	E	E
Blarney	2	E	E	E	E	E	E

WwTP	Scenario	2030		2055		2080	
		ADF	3DWF	ADF	3DWF	ADF	3DWF
North Cobh	3	C	E	C	E	E	E
Watergrasshill	2	C	E	C	E	C	E
Whitechurch	3	C	C	C	C	C	C
Cloyne	2	E	E	E	E	E	E
Ballygarvan	3	C	E	C	E	C	E
Kileens	2	E	E	E	E	E	E
Dripsey	1	C	C	C	C	C	C
Grenagh	3	C	C	C	E	C	E
Carrignavar	3	E	E	E	E	E	E
Killumney	3	N/A	N/A	N/A	N/A	N/A	N/A
Courtbrack	3	E	E	E	E	E	E
River Valley (Minane Bridge)	3	N/A	N/A	N/A	N/A	N/A	N/A
Inniscarra Waterworks	3	N/A	N/A	N/A	N/A	N/A	N/A
Ballincurrig	3	N/A	N/A	N/A	N/A	N/A	N/A
Lisgoold North	3	N/A	N/A	N/A	N/A	N/A	N/A
Lisgoold South	3	N/A	N/A	N/A	N/A	N/A	N/A
Knockraha	3	N/A	N/A	N/A	N/A	N/A	N/A
Saleen	3	N/A	N/A	N/A	N/A	N/A	N/A
Whitegate and Aghada	3	N/A	N/A	N/A	N/A	N/A	N/A
Halfway	3	N/A	N/A	N/A	N/A	N/A	N/A

Key: C = Sufficient Capacity; E = Capacity Exceeded; N/A = Not Applicable

Appendix A. WwTP Population and Loading Projections

Table 29-2. WwTP Population and Loading Projections

WwTP	Component	2030 Population	2055 Population	2080 Population
Ballincollig	Residential	27,110	42,721	48,273
	Commercial (16%)	4,338	6,835	7,724
	Industrial	18	18	18
	Headroom	6,290	9,911	11,199
	TOTAL	**37,755**	**59,486**	**67,214**
Ballincurrig	Residential	425	511	578
	Commercial (16%)	68	82	92
	Industrial	0	0	0
	Headroom	74	89	101
	TOTAL	**567**	**682**	**771**
Ballygarvan	Residential	697	809	909
	Commercial (16%)	112	129	145
	Industrial	0	0	0
	Headroom	121	141	158
	TOTAL	**930**	**1,079**	**1,212**
Blarney	Residential	10,086	17,377	19,803
	Commercial (16%)	1,614	2,780	3,168
	Industrial	7	7	7
	Headroom	2,340	4,031	4,594
	TOTAL	**14,047**	**24,196**	**27,573**
Carrignavar	Residential	680	828	935
	Commercial (16%)	109	132	150
	Industrial	0	0	0
	Headroom	118	144	163
	TOTAL	**907**	**1,104**	**1,248**
Carrigrennan	Residential	223,022	276,576	301,847
	Commercial (16%)	35,684	44,251	48,295
	Industrial	80,780	80,780	80,780
	Headroom	51,371	63,679	69,493
	TOTAL	**390,857**	**465,286**	**500,415**
Carrigtwohill	Residential	10,512	12,784	14,128
	Commercial (16%)	1,682	2,045	2,260
	Industrial	1,994	1,994	1,994
	Headroom	1,829	2,224	2,458
	TOTAL	**16,017**	**19,047**	**20,840**

WwTP	Component	2030 Population	2055 Population	2080 Population
Cloyne	Residential	2,398	2,859	3,208
	Commercial (16%)	384	457	513
	Industrial	0	0	0
	Headroom	417	497	558
	TOTAL	**3,199**	**3,813**	**4,279**
Coole East (Septic Tank)	Residential	406	487	550
	Commercial (16%)	65	78	88
	Industrial	0	0	0
	Headroom	71	85	96
	TOTAL	**542**	**650**	**734**
Courtbrack	Residential	495	564	627
	Commercial (16%)	79	90	100
	Industrial	0	0	0
	Headroom	86	98	109
	TOTAL	**660**	**752**	**836**
Dripsey	Residential	471	544	612
	Commercial (16%)	75	87	98
	Industrial	0	0	0
	Headroom	82	95	107
	TOTAL	**628**	**726**	**817**
Grenagh	Residential	781	937	1,058
	Commercial (16%)	125	150	169
	Industrial	0	0	0
	Headroom	136	163	184
	TOTAL	**1,042**	**1,250**	**1,411**
Halfway	Residential	272	313	353
	Commercial (16%)	44	50	56
	Industrial	0	0	0
	Headroom	47	54	61
	TOTAL	**363**	**417**	**470**
Inniscarra	Residential	250	301	341
	Commercial (16%)	40	48	55
	Industrial	0	0	0
	Headroom	44	52	59
	TOTAL	**334**	**401**	**455**

WwTP	Component	2030 Population	2055 Population	2080 Population
Killeens	Residential	1114	1497	1641
	Commercial (16%)	178	240	263
	Industrial	0	0	0
	Headroom	258	347	381
	TOTAL	**1550**	**2084**	**2285**
Killumney	Residential	2,424	2,951	3,311
	Commercial (16%)	388	472	530
	Industrial	0	0	0
	Headroom	422	513	576
	TOTAL	**3,234**	**3,936**	**4,417**
Knockraha	Residential	553	630	701
	Commercial (16%)	88	101	112
	Industrial	0	0	0
	Headroom	96	110	122
	TOTAL	**737**	**841**	**935**
Lisgoold North & Lisgoold South	Residential	399	486	549
	Commercial (16%)	64	78	88
	Industrial	0	0	0
	Headroom	69	85	96
	TOTAL	**532**	**649**	**733**
Midleton	Residential	20,561	25,455	29,127
	Commercial (16%)	3,290	4,073	4,660
	Industrial	12	12	12
	Headroom	3,578	4,429	5,068
	TOTAL	**27,441**	**33,969**	**38,867**
Minane Bridge (River Valley)	Residential	319	383	433
	Commercial (16%)	51	61	69
	Industrial	0	0	0
	Headroom	56	67	75
	TOTAL	**426**	**511**	**577**
Saleen	Residential	668	773	868
	Commercial (16%)	107	124	139
	Industrial	0	0	0
	Headroom	116	135	151
	TOTAL	**891**	**1,032**	**1,158**

WwTP	Component	2030 Population	2055 Population	2080 Population
Shanbally	Residential	49,424	60,183	68,522
	Commercial (16%)	7,908	9,629	10,964
	Industrial	1,023	1,023	1,023
	Headroom	8,600	10,472	11,923
	TOTAL	**66,955**	**81,307**	**92,431**
Watergrasshill	Residential	2,168	2,586	2,902
	Commercial (16%)	347	414	464
	Industrial	0	0	0
	Headroom	377	450	505
	TOTAL	**2,892**	**3,450**	**3,871**
Whitegate-Aghada	Residential	2,520	2,968	3,331
	Commercial (16%)	403	475	533
	Industrial	0	0	0
	Headroom	438	516	580
	TOTAL	**3361**	**3,959**	**4,444**

Appendix B. Cork Wastewater Strategy Populations Projections and Land Use Report