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Environmental Licensing Programme Office of Environmental Sustainability
Environmental Protection Agency
PO Box 3000
Johnstown Castle Estate
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07/07/2022

IW ref: LT0594

Dear Inspector,

RE: Whitegate-Aghada Waste Water Discharge Licence (D0423-02)

In response to Regulation 18(3)(b) request for information dated 10th March 2022 please see below relevant information.

Provide an updated Marine Outfall Modelling Study which assesses winter and summer impacts from the worst case scenario of waste water discharges. In order to conclude that the Good Water Framework Directive (WFD) status of Outer Cork Harbour (WFD Code: IE_SW_050_0000) will be maintained and that the seasonal DIN EQSs will not be breached, the worst case winter and summer discharges must be assessed.

A detailed MIKE 21 hydrodynamic and water quality model of Cork Harbour has been utilised to assess the impact of the discharge from the proposed WwTP at Whitegate and Aghada on the concentrations of DIN in Cork Harbour for both Summer and Winter conditions.

The marine study concluded that the proposed WwTP for Whitegate and Aghada will have no significant impact on concentrations of DIN across Cork Harbour and that the proposed discharge is compatible with the achievement of WFD objectives for the receiving waters

A copy of the updated marine study is appended to this submission.

Yours sincerely,

Sheelagh Flanagan

Sheelagh Flanagan

Wastewater Strategy

ARUP

Irish Water

Cork UTAS

Whitegate Far Field Modelling Supplementary Report - Further DIN Modelling

Reference:

Issue 2 | 5 July 2022

Job number 257589-00

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Document Verification

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		Signature			
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		Name	Lisa Condon/ Kevin Barry	Kevin Barry	Catherine Buckley
		Signature			
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		Name	Lisa Condon/ Kevin Barry	Kevin Barry	Catherine Buckley
		Signature	Lisa Condon	Kevin Barry	Catherine Buckley

Issue Document Verification with Document ☑

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1. Introduction

1.1 Overview

Arup was commissioned by Irish Water to advance an Untreated Agglomerations (UTAS) project for Whitegate/Aghada, Co. Cork in July 2017. A detailed water quality assessment was undertaken as part of the project to determine the impact of the effluent discharges from the proposed wastewater treatment plant (WwTP) on the receiving waters. The findings of the study were submitted as part of the planning application for the project in November 2020. Planning permission for the project was granted in August 2021.

Irish Water have now commissioned Arup to undertake additional modelling of Dissolved Inorganic Nitrogen (DIN) in order to assess the impact that discharges from the proposed WwTP will have on the concentrations of DIN in the receiving waters of the plant. The findings of the study are to be used to address a Request for Information (RFI) on the application for a Wastewater Discharge Licence.

This report describes the work undertaken as part of the additional modelling. It is to be read in conjunction with the original Whitegate Aghada Far Field Modelling Report[1] that was issued as part of the planning application.

1.2 RFI – Water Quality Modelling

The RFI issued by the EPA that is relevant to the water quality modelling is RFI number 1 which states:

"Provide an updated Marine Outfall Modelling Study which assesses winter and summer impacts from the worst case scenario of waste water discharges. In order to conclude that the Good Water Framework Directive (WFD) status of Outer Cork Harbour (WFD Code: IE_SW_050_0000) will be maintained and that the seasonal DIN EQSs will not be breached, the worst case winter and summer discharges must be assessed."

This RFI has been addressed by utilising the water quality model of Cork Harbour that was developed as part of the original study to undertake additional DIN model runs that reflect Summer and Winter conditions in the harbour.

2. DIN Modelling

2.1 Overview

The Whitegate Aghada far field model developed as part of the original study has been utilised to assess the impact of the discharge from the proposed WwTP on seasonal DIN concentrations in Cork Harbour.

Section 2.2 details the DIN thresholds and the set-up of the model is presented in Section 2.4.

2.2 DIN Thresholds

The DIN EQS thresholds are outlined in the Surface Water Regulations 2009 (as amended in 2019) and are reproduced in Figure 1 of this report.

[1] Whitegate Aghada Far Field Modelling Report. Arup, October 2020.

NUTRIENT CONDITIONS

Nutrient conditions	River water body	Lake	Transitional water body (winter and summer)		Coastal water body (winter and summer)	
Total Ammonia (mg N/l)	High status ≤ 0.040 (mean) and ≤ 0.090 (95%ile) Good status ≤ 0.065 (mean) and ≤ 0.140 (95%ile)					
Dissolved Inorganic Nitrogen (mg N/l)					High status (0 psu (1)) ≤ 1.0 High status (34.5 psu(1)) ≤ 0.17	Good status (0 psu (1)) ≤ 2.6 Good status (34.5 psu(1)) ≤ 0.25

(1) Linear interpolation to be used to establish the limit value for water bodies between these salinity levels based on the median salinity of the water body being assessed."

Figure 1 Surface Water Regulations 2019 (Table 9 Part A)

The thresholds are dependent on the median salinity of the waterbody, with linear interpolation to be used to establish the exact limit value. As part of this study Arup have adopted the DIN thresholds derived by the EPA for both Summer and Winter conditions. These values are presented in Table 1. It is noted that these values have been derived using monitored salinity data for Cork Harbour.

Table 1 Seasonal DIN thresholds for Outer Cork Harbour

Median salinity (PSU)	Scenario	DIN Threshold (mg/l)
34.0	Summer	0.314
33.1	Winter	0.378

It is noted that Cork Harbour has presently achieved good indicative quality for DIN.

2.3 EPA Monitoring Points

The location of the EPA monitoring points within the Outer Cork Harbour Waterbody are presented in Figure 2. The results of the model at these locations have been used to assess the indicative quality of the waterbody as regards the concentrations of DIN in Section 3 of the report.

Figure 2 Monitoring points within Outer Cork Harbour Waterbody

2.4 Whitegate/Aghada UTAS Project Water Quality Model

A high-resolution MIKE 21 hydrodynamic and dispersion model of Cork Harbour and the area outside the harbour mouth was developed by Arup as part of the original Whitegate/Aghada UTAS project. The model was used to assess the impact of discharges from the proposed WwTP at Whitegate. The model consists of two separate parts which are dynamically coupled and run together as a single model:

- **Hydrodynamic model:** calculates the time varying water level, current velocities and water fluxes on an irregular grid of points throughout the model domain in response to the oscillation of the tide, river inflow and wind;
- **Water Quality (EcoLab) model:** calculates the spatially and time varying concentrations of the relevant water quality parameters on the same irregular grid of points as per the hydrodynamic model in response to the hydrodynamics, outfall loadings and dispersion characteristics of the harbour.

The extent and configuration of the flexible mesh used in the model is presented in Figure 3. As the key area of interest for the UTAS project was Whitebay (near the mouth of the harbour) the mesh was defined to have a very fine grid cell resolution at this location.

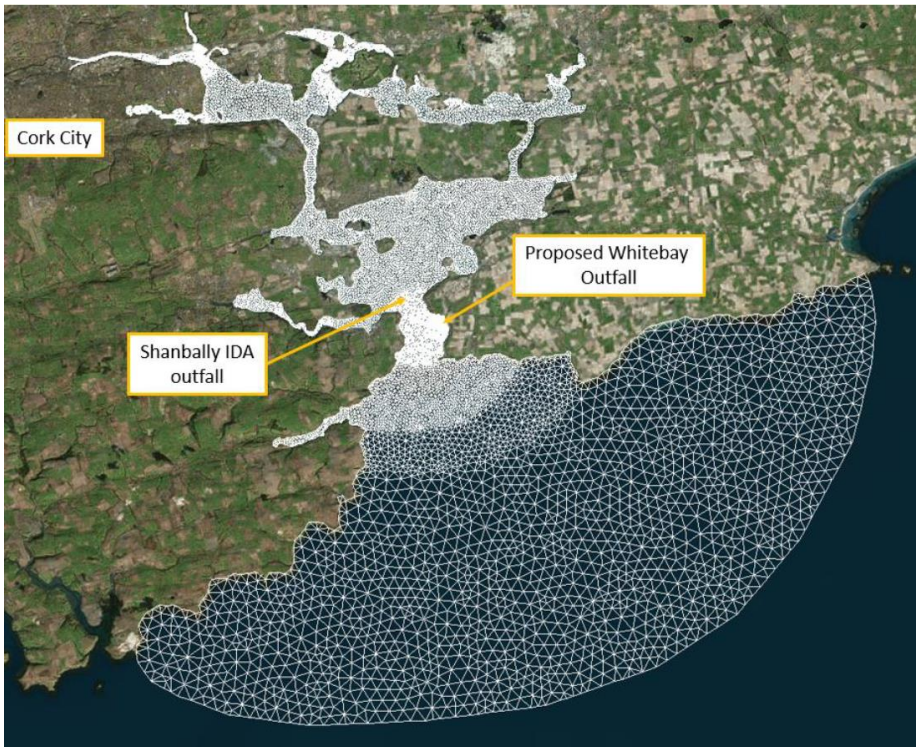


Figure 3 Flexible mesh of the Whitegate/Aghada model

The hydrodynamic component of the model was calibrated and validated against data recorded at the location of the proposed outfall in Whitebay. Overall, a very good match was achieved between the measured and modelled data which demonstrated the suitability of the model for use in the study. The reader is referred to the Whitegate Aghada Far Field Modelling Report for further information.

2.5 Reconfigured Model for Seasonal DIN Modelling

2.5.1 Hydrodynamic Model

The Whitegate/Aghada UTAS model has been used to assess the impact of the discharges from the proposed outfall on DIN concentrations. Two different outfall configurations have also considered:

- **Existing Scenario:** The model was first configured to represent the existing (baseline) scenario in the harbour i.e., with the existing discharges of untreated waste from Whitegate and Aghada.

- **Proposed Scenario:** Once the baseline scenario model was established, a separate model was developed which simulated the proposed scenario i.e., the discharge of wastewater from the proposed outfall at Whitebay.

By comparing the results of the baseline scenario model against the proposed scenario model the impact of discharges of treated effluent from the proposed WwTP in the harbour can be assessed.

2.5.2 Ecolab Model

Following discussions with Irish Water there were however a number of changes made to the configuration of the Ecolab component model in order to facilitate the DIN modelling. These are listed as:

- The outfalls which contribute to the background concentrations in the model (i.e., all the outfalls in the harbour except Whitegate/Aghada) have been configured to represent the present day. The key difference with the work undertaken as part of the original modelling study is that the discharge of raw wastewater from Cobh has been eliminated and is instead discharged as secondary treated effluent from the Shanbally Outfall.[2]
- Irish Water have provided Arup with the latest EPA monitoring data which has been used to derive winter and summer seasonal concentrations of DIN for both the riverine and open sea boundaries of the model.
- Irish Water have also provided Arup with present day outfall flow rates and concentrations for all the outfalls in the Harbour. These are the same for winter and summer.
- As agreed with IW and as per the IW Technical Standards, the 95%ile river flow rates have been used for Summer conditions and the 30%ile river flow rates have been used for Winter conditions. These values have been derived from gauged river data where available.

An overview of the Summer and Winter scenario model parameters are presented in Table 2 while all the point source discharge data is presented in Table 3.

Table 2 Summer and Winter scenario parameters

Variable	Summer	Winter
River Flows	95%ile flows	30%ile flows
River Concentrations	Summer monitored concentrations used	Winter monitored concentrations used
DIN decay rate	T90 = 552 hrs 1st order decay rate of 0.1 /day	T90 = 552 hrs 1st order decay rate of 0.1 /day

[2] Since the completion of the Cork Lower Harbour Main Drainage Project wastewater from Cobh is treated at the Shanbally WwTP. It is noted that wastewater from Ringaskiddy, Carrigaline, Crosshaven, Passage West and Monkstown is also treated at Shanbally and is discharged from the Shanbally outfall.

Table 3 Point Discharge data used in the model

Source Type	Source Name	Easting (ING)	Northing (ING)	Treatment Type	Summer Flow Rate (m^3/s)	Winter Flow Rate (m^3/s)	DIN Summer Concentration (mg/l)	DIN Winter Concentration (mg/l)
River	Lee	168380	71950	–	6.06	53.84	1.0	1.8
River	Glashaboy	172720	72370	–	0.37	3.58	1.9	3.7
River	Douglas	172900	69720	–	0.07	0.71	1.9	3.7
River	Owenacurra	187500	71300	–	0.44	4.21	1.2	3.0
River	Aghada	186650	65840	–	0.04	0.42	1.2	3.0
River	Owenboy	179000	61500	–	0.34	3.22	1.2	3.0
River	Ardnabourkey	183600	63700	–	0.01	0.08	1.2	3.0
River	Knocknamadderee	187800	67360	–	0.02	0.16	1.2	3.0
River	Carrigtwohill	180400	72420	–	0.07	0.63	1.2	3.0
River	Glounatouig	175900	65100	–	0.02	0.23	1.2	3.0
Sea	Open Sea	Applied along downstream boundary		-	-	-	0.1	0.2
Outfall	Saleen Village	187700	67360	None	0.0003	0.0003	60.0	60.0
Outfall	Whitegate/Aghada Existing	183337	64664	None	0.00521	0.00521	60.0	60.0
Outfall	Whitegate/Aghada Proposed	182521	61580	Primary	0.00845	0.00845	54.0	54.0
Outfall	North Cobh	177535	67632	Secondary	0.00746	0.00746	12.6	12.6
Outfall	Carrigrennan	176683	69726	Secondary	1.496	1.496	20.7	20.7
Outfall	Shanbally IDA	181358	62521	Secondary	0.34	0.34	95	78.5
Outfall	Midleton ID	186177	69506	Tertiary	0.12	0.12	4.1	4.1
Outfall	Carrigtwohill 1	179911	72583	Tertiary	0.03035	0.03035	7.2	7.2

Source Type	Source Name	Easting (ING)	Northing (ING)	Treatment Type	Summer Flow Rate (m^3/s)	Winter Flow Rate (m^3/s)	DIN Summer Concentration (mg/l)	DIN Winter Concentration (mg/l)
Outfall	Carrigtwohill 2	180594	72283	Tertiary	0.03035	0.03035	7.2	7.2
Outfall	SKB	178885	62710	-	0.01505	0.01505	25.0	25.0
Outfall	ESB	183266	65316	-	0.00579	0.00579	10.0	10.0
Outfall	P66WR	182596	63221	-	0.1389	0.1389	25.0	25.0
Outfall	BGE	182410	63165	-	0.00694	0.00694	5.0	5.0
Outfall	M Chem	177310	69720	-	0.00347	0.00347	15.0	15.0

3. Model Results

3.1 Overview

The results for the Summer scenario are presented in Section 3.2 while the results for the Winter scenario are presented in Section 3.3. The format of the spatially varying plots and tables follow the same format as used in the original White/Aghada modelling report.

Mixing zone plots are presented in Section 3.4.

3.2 Summer Scenario

The spatially varying 50%ile DIN concentration plot for the Summer Scenario is presented in Figure 4. The 50%ile concentration at the individual monitoring points are presented in Table 4.

It can be seen from the results that the 50%ile concentrations of DIN in the area of the existing outfalls around Aghada are reduced with the scheme in place. There is an increase in concentration of circa 0.003 – 0.005mg/l in the immediate vicinity of the proposed outfall. This increase is deemed to be minor given that the limit of detection (LOD) for Ammonia is assumed to be 0.006mg/l.[3]

The 50%ile concentrations of DIN across most of the Harbour area remain unchanged with the proposed WwTP scheme. The concentrations of DIN are therefore not influenced by the proposed Whitegate/Aghada treatment plant due to the magnitude of the loading from the plant being small relative to the magnitude of the loading from each of the other sources in the harbour. The 50%ile concentrations across the harbour are therefore dominated by the sum of these other loadings.

In the context of the seasonal DIN thresholds (Table 1) the 50%ile concentrations of DIN in the Outer Cork Harbour Waterbody (Figure 2) are deemed to be low as they all fall below the threshold for achieving Good Indicative Quality.

It can be seen from Figure 4 that the delta values at the EPA monitoring points all fall below the LOD (for Roches Point the delta equals the LOD). The differences are therefore deemed to be very minor and insignificant. It can also be seen from the table that the maximum 50%ile concentration at the EPA monitoring points is 0.057mg/l (Cork Estuary 2 point) for both the existing scenario and proposed scenarios. This is circa 0.26mg/l less than the DIN threshold for Summer. Good Indicative Quality is therefore maintained with the scheme in place.

[3] The IW Lab Frameworks sets a stringent minimum Limit of Detection standard of ammonia for WWDL ambient monitoring of 0.006mg/L.

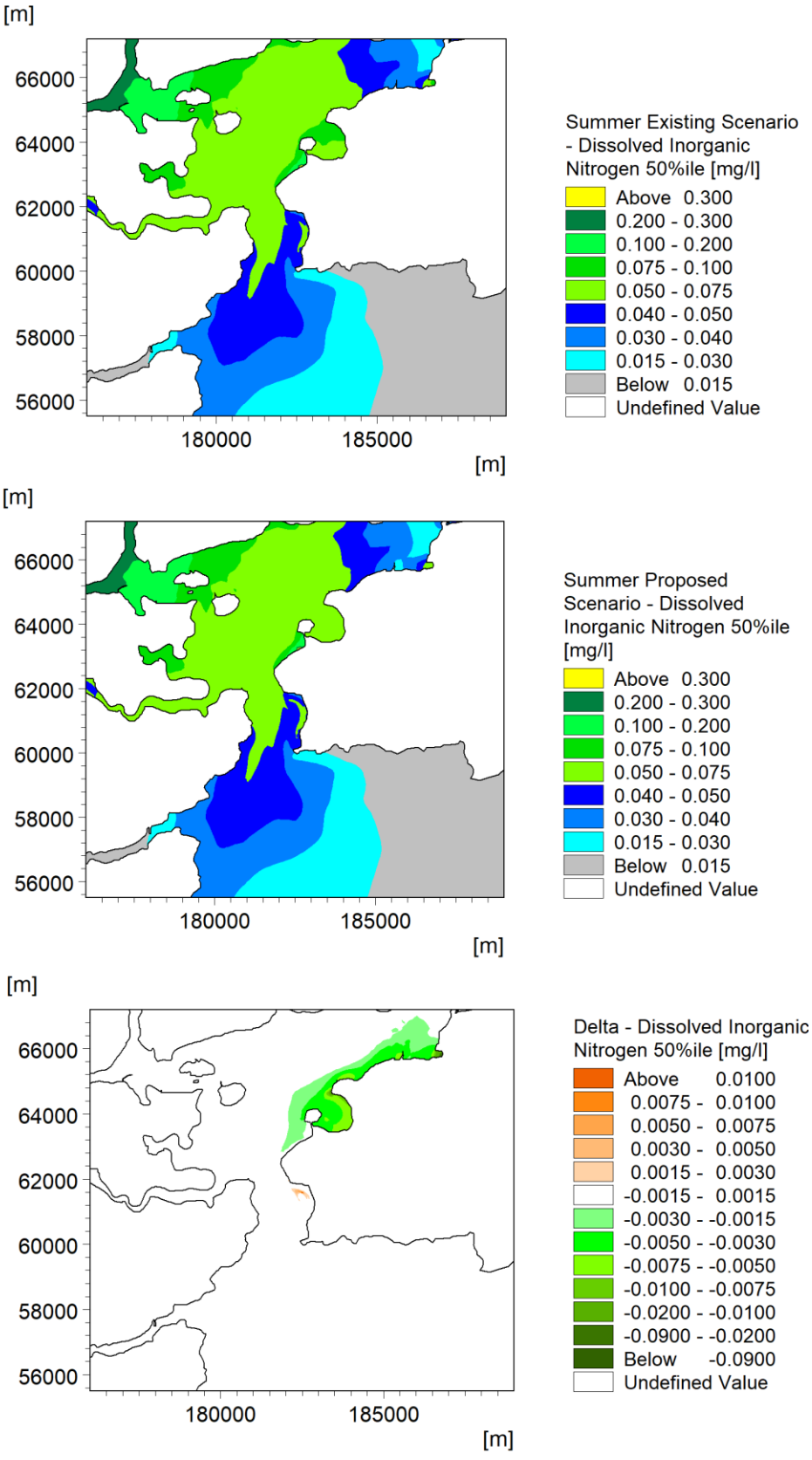


Figure 4 Existing, proposed and delta plots for the DIN Summer Scenario

Table 4 Summer monitoring point concentrations

Monitoring Point	50%ile		
	Dissolved Inorganic Nitrogen (mg/l)		
	Existing	Proposed	Delta
Roches Point	0.039	0.045	0.006
Cork Estuary 1	0.048	0.048	0.000
Cork Estuary 2	0.057	0.057	0.000
Poulnacallee Bay	0.045	0.045	0.000
Fountainstown Beach	0.028	0.028	0.000
Myrtleville Bay	0.040	0.040	0.000
Ringaskiddy Downstream Monitoring Point #2	0.047	0.048	0.000
Myrtleville	0.044	0.044	0.000
Outer Cork Harbour WFD Station	0.041	0.041	0.000
Gyleen	0.006	0.007	0.000

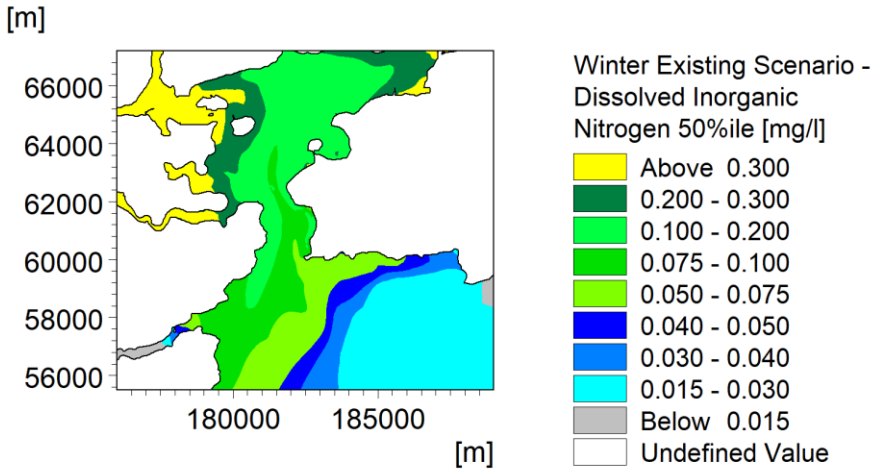
3.3 Winter Scenario

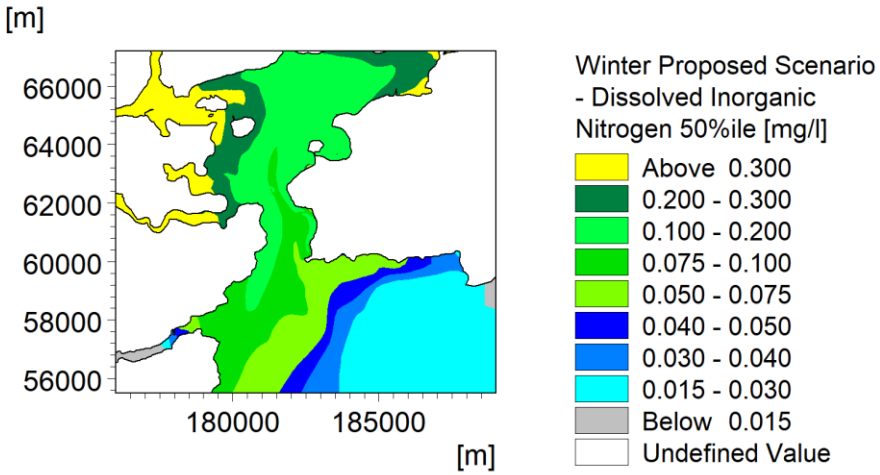
The spatially varying plots of the 50%ile DIN concentration for the Winter Scenario is presented in Figure 5. The 50%ile concentration at the individual monitoring points are presented in Table 5.

The 50%ile concentrations of DIN in the area of the existing outfalls around Aghada are reduced with the scheme in place but there is an increase in concentration in the vicinity of the proposed outfall of circa 0.003 – 0.005mg/l. As this increase is less than the LOD it is however deemed to be very minor and not significant.

As with the Summer scenario the 50%ile concentrations of DIN are unchanged across most of the Lower Harbour area with the proposed WwTP scheme in place. This can be attributed to the magnitude of the loading from the plant being small when compared to the magnitude of the loading from the other sources in the harbour. The 50%ile concentrations across the harbour are therefore dominated by these other loadings.

The maximum 50%ile concentration at the EPA monitoring points is 0.122mg/l (Poulnacallee Bay point) for both the existing scenario and proposed scenarios. This is circa 0.25mg/l less than the DIN threshold for Winter. Good Indicative Quality is therefore maintained at each of the EPA monitoring points across the area with the proposed scheme in place.





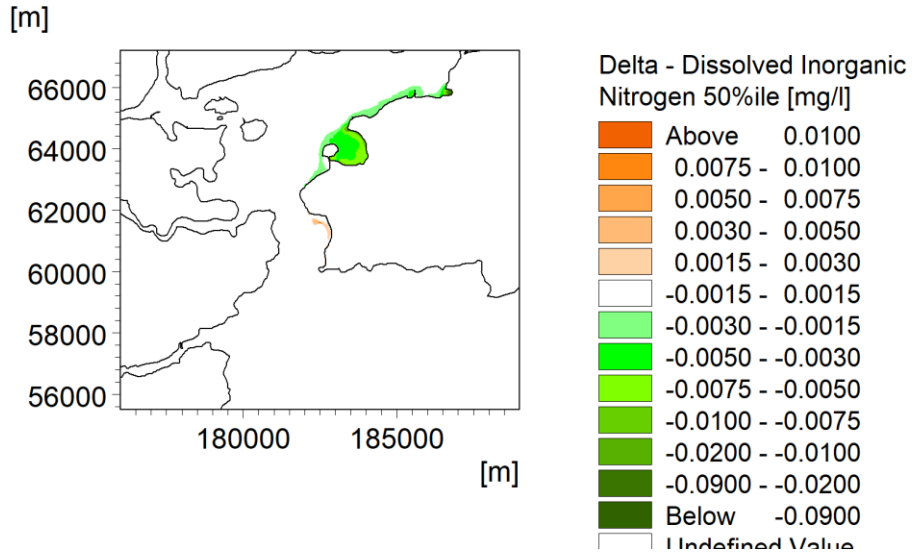


Figure 5 Existing, proposed and delta plots for the DIN Winter Scenario

Table 5 Winter monitoring point concentrations

Monitoring point	50%ile		
	Dissolved Inorganic Nitrogen (mg/l)		
	Existing	Proposed	Delta
Roches Point	0.084	0.087	0.003
Cork Estuary 1	0.086	0.087	0.001
Cork Estuary 2	0.103	0.103	0.000
Poulnacallee Bay	0.122	0.122	0.000
Fountainstown Beach	0.066	0.066	0.000
Myrtleville Bay	0.096	0.096	0.000
Ringaskiddy Downstream Monitoring Point #2	0.086	0.087	0.001
Myrtleville	0.088	0.088	0.000
Outer Cork Harbour WFD Station	0.076	0.076	0.000
Gyleen	0.032	0.032	0.000

3.4 Mixing Zone Plots

The mixing zone for DIN for the proposed outfall has been estimated as part of the study by undertaking the following steps:

- Run the proposed scenario model with all background concentrations included;
- Calculate the 50%ile spatially varying plot;
- Present the results with the colour palette set to threshold values as specified in Table 1.

The results for the Winter DIN scenario are presented in Figure 6. It can be seen that no mixing zone envelope is shown which indicates that the threshold of 0.378mg/l is not exceeded at the outfall location. It can therefore be concluded that Good Indicative Quality is achieved at the location of the proposed outfall for this scenario.

The Summer scenario mixing zone plot is not presented as it is evident from the results that there is also no mixing zone present as the threshold for Summer (0.314mg/l) is also not exceeded at the outfall location.

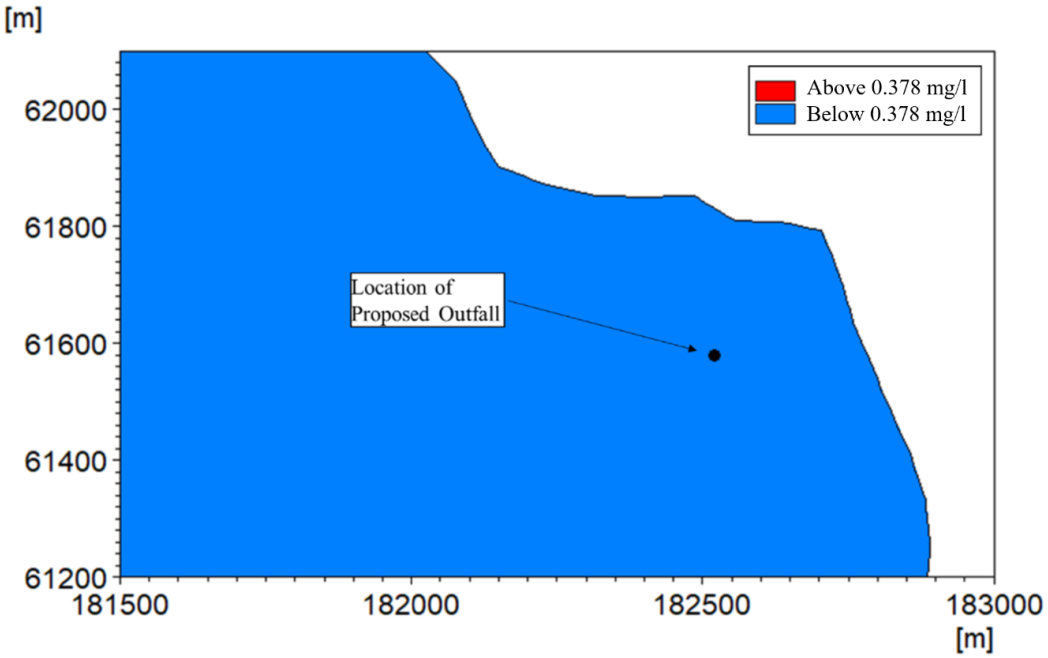


Figure 6 DIN mixing zone for proposed outfall (Winter scenario)

4. Conclusion

A detailed MIKE 21 hydrodynamic and water quality model of Cork Harbour has been utilised to assess the impact of the discharge from the proposed WwTP at Whitegate and Aghada on the concentrations of DIN in Cork Harbour for both Summer and Winter conditions.

It was seen from the results that the 50%ile concentrations of DIN are largely unchanged across the harbour with the proposed WwTP scheme in both summer and winter. The concentrations are reduced in the vicinity of the existing outfalls around Aghada but are increased in the vicinity of the proposed outfall in Whitebay. As this increase is generally less than the LOD for Ammonia (0.006mg/l) it is deemed to be very minor.

The 50%ile concentration at each of the EPA monitoring points all fall below the DIN threshold for both Summer and Winter. Good Indicative Quality is therefore maintained at these locations with the scheme in place.

No mixing zone envelopes for DIN are present for the proposed outfall in both Summer and Winter as the respective thresholds of 0.314mg/l and 0.378md/l are not exceeded at the outfall location.

When the seasonal DIN thresholds are considered, it can be concluded that the 50%ile concentrations of DIN in the Outer Cork Harbour Waterbody are low for both Summer and Winter conditions. Good Indicative Quality is therefore maintained with the proposed WwTP in place. It can therefore be concluded that the proposed WwTP for Whitegate and Aghada will have no significant impact on concentrations of DIN across Cork Harbour and that the proposed discharge is compatible with the achievement of WFD objectives for the receiving waters.