



Section D: Assessment of Impact on Receiving Waters

Attachment D.1.1: Ambient Monitoring Data

Attachment D.2.1: Impact Assessment Report

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Attachment D.2.1: Impact Assessment Report

1. Introduction

This Report provides a summary of the Impact Assessments prepared to determine the impact of the discharges from the Ramelton Milford Rathmullan (RMR) agglomerations (D0341) on the receiving waterbody of the Swilly Estuary and associated designations, and also addresses the criteria as outlined in Section D.2 of the EPA guidance document.

The following agglomerations are to be amalgamated into one, which will be served by the RMR Wastewater Treatment Plant (WwTP):

- Ramelton (D0341)
- Milford (D0342)
- Rathmullan (D0345)

The proposed RMR WwTP will have a capacity to treat 5,500p.e. with provision to increase this to a 30-year design capacity of 7,100p.e. in the future. Some elements of the WwTP such as the buildings, preliminary treatment units, pumping stations and the outfall have been designed for the 30-year design horizon of 7,100p.e. Hence, the impact on the receiving waters was assessed based on the flows and loadings associated with 7,100 p.e.

The treated effluent from the proposed RMR WwTP will be discharged to the Swilly Estuary via a new outfall pipe approximately 165m long terminating in a 3-port diffuser. The discharge point is located on southern side of the estuary approximately 4.1km northeast of Ramelton and discharges into the main channel of the estuary.

The completed RMR Sewerage Scheme will remove the current discharge into Maggy's Burn from the Milford WwTP at Milford, the untreated discharge from Ramelton into the Leannan/Swilly Estuary at Ramelton, and untreated discharge from Rathmullan into the Swilly Estuary at Rathmullan.

2. Water Environment

The primary discharge from the new RMR WwTP will be into the transitional waterbody Swilly Estuary, WFD Code IE_NW_220_0100. The results of the WFD monitoring programme indicate that there are water quality issues within the Swilly Estuary. It is currently (2013-2018) categorised as having 'Moderate' status with the objective of restoration to 'Good' status. It is "At risk" of achieving WFD objectives.

The metrics driving ecological status are dissolved oxygen, BOD and phytoplankton. The phytoplankton biomass and bloom frequency are driven by excess nutrients (both phosphorus and nitrogen) in the estuary. The significant pressure is Letterkenny town, where misconceptions in the urban waste water agglomeration and septic tank systems, which serve half the population of the town, are the primary source of nutrients.

The trophic status of the Swilly Estuary based on the Trophic Status Assessment Scheme (TSAS) is "Intermediate" trophic status. The TSAS status is based on data collected by the EPA between 2018 – 2020.

The ambient coastal water quality for the outfall area was derived from EPA monitoring data (2016-2022). The EPA sampling locations are shown in **Figure 2.1** with summary seasonal data presented in **Table 2.1**. The most

recent 5 years of EPA data was used in the assessment of background values. The ‘summer’ dataset extended from May 2016 to September 2021 with the winter dataset extending from February 2017 to January 2022.

Location LS150 is approximately 250m upstream and closest to the proposed outfall location. Location LS160 is approximately 3,740m downstream of the proposed outfall location. The results, particularly for locations LS140 and LS150 include the contributions from the existing discharges at Ramelton.

The proposed outfall will discharge into transitional waters and therefore under the Surface Water Regulations (SI 272/2009) BOD and the PO₄ concentration is the relevant controlling standard. Concentrations for other parameters such as DIN, TON and TA are not specified for transitional waters but were included for completeness.

The EQS for PO₄ is 0.06mg/l (0-17psu) median & 0.04mg/l (34psu) median. The summer and winter median PO₄ values in **Table 2.1** for all locations are both less than the EQS even for the higher 34psu limit. The BOD limit for “good status” is <4mg/l. The median values for BOD in **Table 2.1** for all location are less than 4mg/l.

EPA Site	Salinity	BOD	DO	TON	NH3	Free-NH ₃	PO ₄	DIN
	psu	mg/l	% Sat	mg/l N	mg/l N	mg/l N	mg/l P	mg/l N
LS 140 (2016-2022 -12No Winter Samples, 32No Summer Samples)								
All	27.60	0.50	98.00	0.0515	0.0300	0.001	0.0105	0.0910
Summer	29.50	0.50	98.00	0.0160	0.0275	0.001	0.0090	0.0465
Winter	17.50	0.50	98.00	0.1900	0.0355	0.001	0.0145	0.2190
LS 150 (2016-2022 -10No Winter Samples, 27No Summer Samples)								
All	30.30	0.50	98.00	0.0230	0.0290	0.001	0.0130	0.0600
Summer	31.40	0.50	99.00	0.0050	0.0240	0.001	0.0120	0.0320
Winter	27.80	0.50	97.50	0.1450	0.0385	0.000	0.0135	0.1875
LS 160 (2016-2022 -12No Winter Samples, 33No Summer Samples)								
All	32.60	0.50	98.00	0.0050	0.0250	0.001	0.0120	0.0410
Summer	32.90	0.50	98.00	0.0050	0.0240	0.001	0.0110	0.0300
Winter	31.00	0.50	97.50	0.1100	0.0260	0.000	0.0155	0.1415

Table 2.1 – EPA Median Background Water Quality Data



Figure 2.1 - EPA Sampling Locations

3. Appropriate Assessment Screening

A Stage 1 Screening for Appropriate Assessment was completed in respect of the proposed RMR Sewerage Scheme. The Screening report concluded that an Appropriate Assessment (Stage 2) of the proposed development would be required due to the likelihood of significant effects on 8 No. European (Natura 2000) Sites (Special Areas of Conservation for certain habitats and species, and Special Protection Areas for birds) in the absence of mitigation. The Screening for Appropriate Assessment is attached as Appendix 1 to the Natura Impact Assessment

4. Natura Impact Assessment

An Appropriate Assessment in the form of a Natura Impact Statement (NIS) was completed. The NIS was informed by a detailed suite of ecological surveys undertaken from 2017 to 2020 and fully assessed the potential for adverse effects upon the 8 No. European sites and their qualifying interests.

The Development directly affects at least 4 no. European Sites given that it occurs within the Lough Swilly SAC / SPA and proposed works at Milford will remove an overcapacity WwTP discharge to Lough Fern SPA / Leannan River SAC. Consequently, there is potential for the Proposed Development to result in direct impacts on these European Sites.

In addition, the Development is connected to an additional 4 no. European sites via hydrological (North Inishowen Coast SAC and Horn Head to Fanad Head SPA) or via ecological linkages through the potential for foraging QI / SCI species utilising the affected areas of Lough Swilly (Derryveagh and Glendowan Mountains SPA and Greers Isle SPA) 52.

All of these European Sites have QIs / SCI's which are also sensitive to disturbance and adverse impacts upon water quality, to varying degrees.

A detailed suite of ecological surveys has been undertaken across the Proposed Development Site from 2017 to 2020 to inform the potential for adverse impacts upon sensitive ecological features, including the potential for any impacts upon European Sites.

8 No. European Sites were considered to be at risk of potential adverse impacts. In addition, it is considered that the Lough Swilly Catchment (which includes Lough Fern and Lough Swilly) will also benefit from positive impacts as a result of the proposal progressing through planning through the upgrade of local services which will improve on an existing outdated and over-capacity local sewerage network.

Detailed mitigation has been put forward within the Natura Impact Statement to ensure that the Proposed Development does not result in adverse impacts upon the integrity of any European Sites or their listed QI / SCI habitats and species. These mitigation measures are set out in Section 9 of the Natura Impact Statement.

The Natura Impact Statement concluded as follows:-

This Natura Impact Statement has been undertaken in the light of best scientific knowledge and concludes that the incorporation of the mitigation measures specified for this specific development in full, and their subsequent implementation on site, will mean that the Proposed RMR Sewerage Scheme will not, beyond reasonable scientific doubt, adversely affect the integrity of any European Site, taking account of their ecological structure and function, either alone or in combination with any other plans or projects.

The Natura Impact Statement including the Screening for Appropriate Assessment is attached as **Attachment D.2-3**.

5. Water Quality Modelling Assessment Summary

Irish Hydrodata Ltd. constructed a hydrodynamic & water quality model to investigate water circulations and simulate the impacts of the proposed discharge from the primary discharge based on the **7,100 p.e. 30-year** design horizon loadings. The potential impacts of the proposed discharges on the receiving waters were assessed using various calculations and hydraulic modelling methods. These included:

1. Initial dilution simulations of the outfall diffuser.
2. Water circulation modelling.
3. Contaminant dispersion modelling.

A jet type model was used to simulate the effluent stream issuing from the diffuser and to estimate the near-field dilutions at the immediate discharge location. Water movements in the wider area were simulated with a 2D-hydrodynamic model driven by tidal forcing. A contaminant simulation model, driven by the aforementioned hydrodynamics was used to evaluate the location- specific impacts of discharges within the mid- and far-field areas

The proposed outfall will discharge into transitional waters and therefore under the Surface Water Regulations (SI 272/2009) the PO₄ concentration is the relevant controlling standard. **Concentrations for other parameters such as DIN and TA are not specified for transitional waters but were included for completeness.** The target water quality limits are as outlined in the **Table D.2-1** hereunder.

Parameter	Transitional Waters	Coastal Waters
	Target	Target
PO4 (mg P/l)	0.06 (0-17psu) median 0.04 (34psu) median	Not Specified
DIN (mg N/l)	Not Specified	Good Status <2.6mg/l(0psu) median <0.25mg/l(34.5psu) median High Status <0.17mg/l(34.5psu) median
TA (mg N/l)	Not Specified	Not Specified
BOD (mg/l O2)	<4.0 (Good Status, 95%ile)	Not Specified
SS mg/l	Not Specified	Not Specified

**Table D.2-1 - Target Water Quality Standards (EQS) for Surface Waters
(SI 272/2009, SI 386/2015)**

5.1 Initial Dilution Simulations of the Outfall Diffuser

Section 4.1 of the Irish Hydrodata Report presents the findings of the initial dilution simulations at the outfall discharge location. The following is a summary of some of the key findings of the initial dilution simulations.

The predicted initial dilutions were used to calculate the near- field concentration of the relevant parameters. The diffuser was based on 3 ports, each of 0.1m diameter and spaced 1m apart. These calculations were based on the future 7,100 p.e.

The target water quality limits must be achieved at the edge of the mixing zone. A regulatory method for determining the extent of the mixing zone is not defined. However, it is recommended that it be restricted to the proximity of the discharge, be proportionate and occupy less than 25% of the cross-sectional area.

The discharge standards that were used in the outfall assessment are summarised in the **Table D.2-2** hereunder.

Parameter	10-year horizon	30-year horizon
Population Equivalent PE	5,500 pe	7,100 pe
Dry Weather Flow (DWF)	14.32 l/s	18.49 l/s
Average Daily Flow (1.6 x DWF)	22.91 l/s	29.58 l/s
Discharge Standards		
BOD	25 mg/l	

Suspended Solids	35 mg/l
Ortho Phosphorous (P)	8 mg/l
Dissolved Inorganic Nitrogen (N)	60 mg/
Total Ammonia, NH3 (N)	55 mg/l
E Coli	100,000 cfu/100ml
Intestinal Enterococci (IE)	20,000 cfu/100ml

Table D.2-2 - Discharge Standards used in the Outfall Assessment

As outlined above the outfall is located in transitional waters and so the parameter of primary concern in terms of the Surface Water regulations (SI 272/2009) is the PO₄ concentration. This must meet the relevant EQS outside the mixing zone. On the basis of a median background salinity of 30.43ppt and a linear interpolation of the EQ standards in the above, the target level for PO₄ at the edge of the mixing zone is 0.044mg/l P (median).

The calculated PO₄ concentrations in the surfacing plume ranged from 0.16mg/l to 0.74mg/l depending on the stage of the tide. As the plume moved further upstream or downstream it spreads laterally and longitudinally. To provide an illustration of this additional dispersion a typical scenario was examined. The tide was assumed to be at mid-level and the ambient velocity is 0.15m/s. The model indicates that the target of 0.044mg/l P is achieved within 100m of the outfall diffuser. The plume reaches a maximum width of about 25m and occupies about 10% of the full channel cross-sectional area. Compliance with SI 272/2009 is based on median conditions. Thus, the flood and ebb tide plumes must be spatially combined in the overall assessment of the mixing zone. When this approach was followed the mixing zone is predicted to extend about 60m downstream and 50m upstream of the outfall.

The predicted BOD concentrations ranged from 0.95 to 2.95mg/l and are below the target of 4mg/l at all times.

The SS target level is a function of the background value as specified by the Quality of Shellfish Waters Regulations (SI 268/2006). The discharge must not cause an increase of more than 30% of the background level. As typical levels in shallow estuarine locations can range from 1mg/l to well over 50mg/l the target level can vary widely. If it is assumed that the background is a low value of 1.5mg/l then the resulting target would be 2mg/l. The model indicated that this will be achieved within about 50m of the outfall and thus levels will not increase beyond the target value in the shellfish waters which are 750m downstream.

The predicted DIN concentrations range from 1.14 to 6.17mg/l and will reach the coastal waters target of 0.46mg/l within 90m of the outfall.

5.2 Water Circulation Modelling

Section 4.2 of the Irish Hydrodata Report presents the findings of the water circulation modelling. The following is a summary of some of the key findings.

Tidal circulation within Lough Swilly and the Leannan estuary was investigated using a 2- dimensional, vertically-averaged, numerical model (M2D). The model simulates flow in surface water systems and is used in conjunction with a dispersion model to simulate the fate of outfall discharges. Further information on the preparation, calibration and verification of the model is included in Section 4.2 of the Irish Hydrodata report. The calibration and validation exercises demonstrated that the model was fit for purpose for the assessment of the impacts of the proposed WWTP discharges on Lough Swilly

5.3 Contaminant Dispersion Simulations

The contaminant dispersion model (LAG) was used to simulate the mid and far-field dispersion of outfall discharges. This model was driven by the flow fields generated by the M2D model.

Four scenarios were examined with this model. These were:

- a) *The existing scenario with untreated discharges at Ramelton and Rathmullan;*
- b) *The proposed outfall PE 5,500 (10-year horizon);*
- c) *The proposed outfall PE 7,100 (30-year horizon);*
- d) *The interaction of the proposed outfall with other nearby outfalls.*

The outfall contaminants of particular interest were e.coli and IE due to the proximity of the shellfish and bathing waters, and PO4 as the outfall is located in transitional waters. **Other parameters were modelled for completeness and included BOD, TA and DIN.**

Model output was generated in the form of percentile plume concentration plots. Tabular data was also generated for specified regions in the model as shown in Figure 4.9 below to facilitate before and after comparisons. These regions were chosen to coincide with relevant locations such as the shellfish waters boundary, the bathing waters and EPA sampling locations.

The percentile plots were generated by simulating a full spring-neap tidal cycle and computing percentile occurrences at each model cell. Summer and winter scenarios were simulated for shellfish waters e.coli (T90 = 12 and 48 hours) and the nutrient parameters.

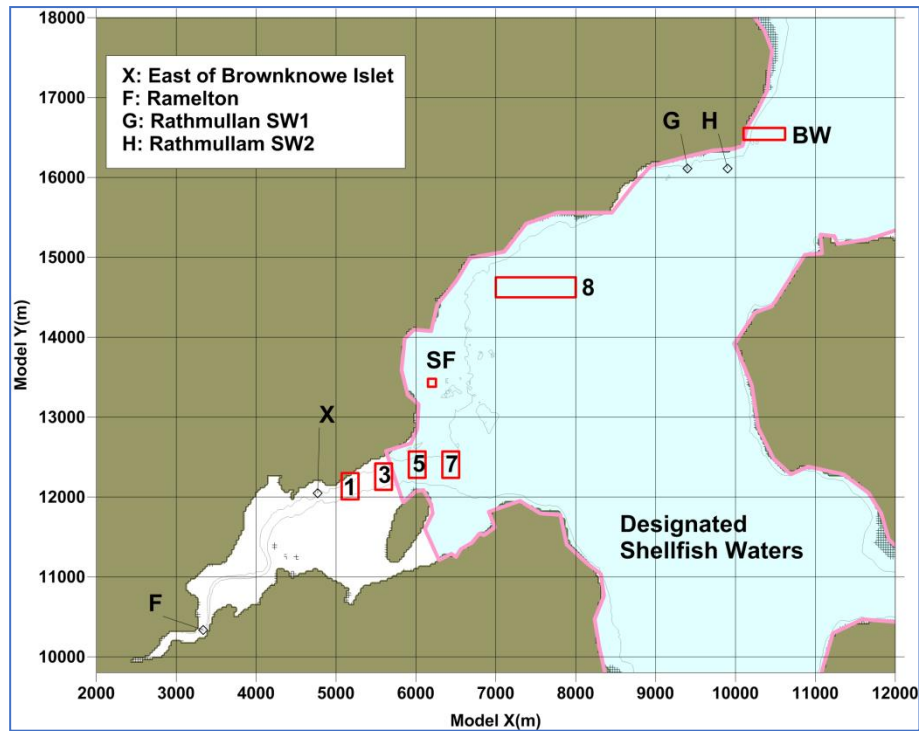


Figure 4.9 - Model output sampling regions for tabular outputs

A summary of the **7,100 PE** (30-year horizon) is presented hereunder. Full details of all the scenarios and the percentage plume concentration plots are included in Section 4.3 of the Irish Hydrodata Report.

Bacteriological Conditions

The bacterial impact of the proposed discharge on the bathing waters is assessed by means of the percentile plots. **Figure 4.22** shows the 95%ile e.coli concentration plot. A bacterial mixing plume is observable in the Leannan Estuary in the vicinity of the proposed outfall point. However, in terms of impact on Bathing Waters, the plume does not impact on the Designated Bathing Waters at Rathmullan and the proposed discharge is compatible with the achievement of Excellent Bathing Water Quality at Rathmullan. The 95%ile plot of IE concentration is shown in **Figure 4.23**. The impacted area is less than that indicated for e.coli. The impacted waters do not reach as far north as the Rathmullan designated bathing waters. The impacts are summarised numerically for the sampling regions in **Table 4.4a**.

The impact on designated shellfish waters was assessed on the basis of the geometric mean approach and relevant concentration plots are presented in **Figure 4.24a** for the summer season ($T_{90} = 12$ hours) and in **Figure 4.24b** for the winter season ($T_{90} = 48$ hours). The predicted values do not exceed the 110cfu/100ml target at any location. Values above 5cfu/100ml are predicted to extend 500m into the shellfish waters during the summer season while this increases to about 1000m during the winter season, however these values remain well below the target of 110cfu/100ml. There is a significant improvement in the E.Coli concentrations in the designated Shellfish water in the vicinity of Rathmullan compared to the existing scenario. The impacts are summarised numerically for the sampling regions in **Table 4.4b**.

	Model Sampling Region						
	1	3	5	7	8	SF	BW
	E.coli (cfu/100ml) (T90 = 12 hours)						
Calm	245	168	106	103	<5	<5	<5
	Intestinal Enterococci (cfu/100ml) 9T90 = 24 hours)						
Calm	60	37	32	32	<5	<5	<5

Table 4.4a - Predicted 95%ile bacterial concentrations at model sampling regions for discharge from the proposed outfall, (PE =7,100, 30-year horizon)

	Model Sampling Regions						
	1	3	5	7	8	SF	BW
	E.coli (cfu/100ml) – Geomean						
Summer	16	11	7	<5	<5	<5	<5
Winter	31	18	14	7	<5	<5	<5

Table 4.4b - Predicted geomean bacterial concentrations at model sampling regions for discharge from the proposed outfall (PE =7,100, 30-year horizon) for Summer (T90 = 12hrs) and Winter (T90 = 48hrs) conditions

Nutrient and Oxygenation Conditions

The 95%ile BOD concentration has been computed and is presented in **Figures 4.25a & 4.25b** for summer and winter respectively. Values are significantly lower than the target EQS of 4mg/l.

The 50%ile PO4 prediction is shown in **Figures 4.26a & 4.26b** for summer and winter respectively. The transitional waters target level of <0.044mg/l for summer and 0.048mg/l for winter is only exceeded in a very small area around the outfall (+/-20m) and is barely visible on the plot scale. It thus complies with mixing zone requirements.

As noted previously the colour banding shown on the plots differ for winter and summer season outputs. This is because the upper value is set by the EQS target for each season and the lower value by the relevant background value.

The 50%ile DIN prediction is shown in **Figures 4.28a & 4.28b** for summer and winter respectively. There is no transitional waters target for this parameter. If the coastal waters criteria are applied, then the discharge would comply with the 'Good' status limit (<0.71mg/l N based on winter salinity of 27.8psu). The local winter background DIN level is about 0.19mg/l N with slightly lower values of 0.14mg/l N further out in the lough. These background levels include the impacts of the existing Rathmullan discharges.

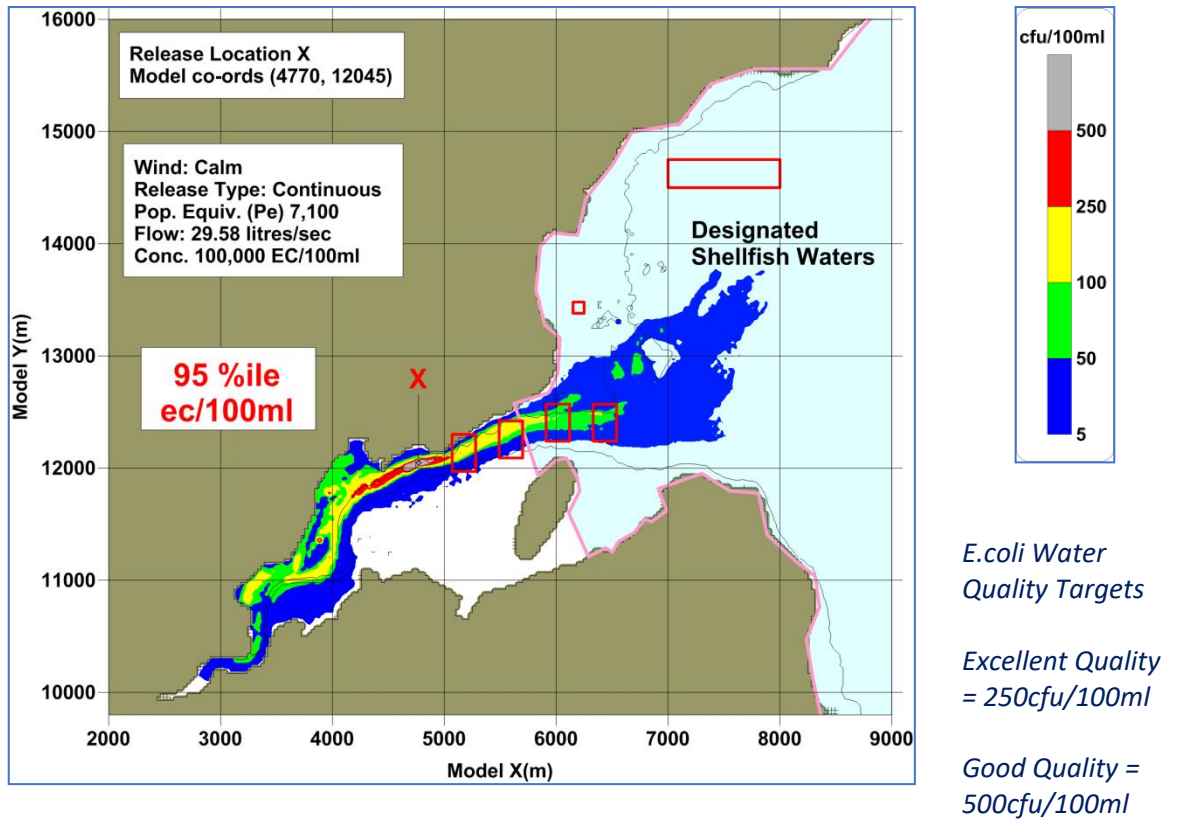


Figure 4.22 - Simulated 95%ile e.coli concentration for discharge from proposed outfall

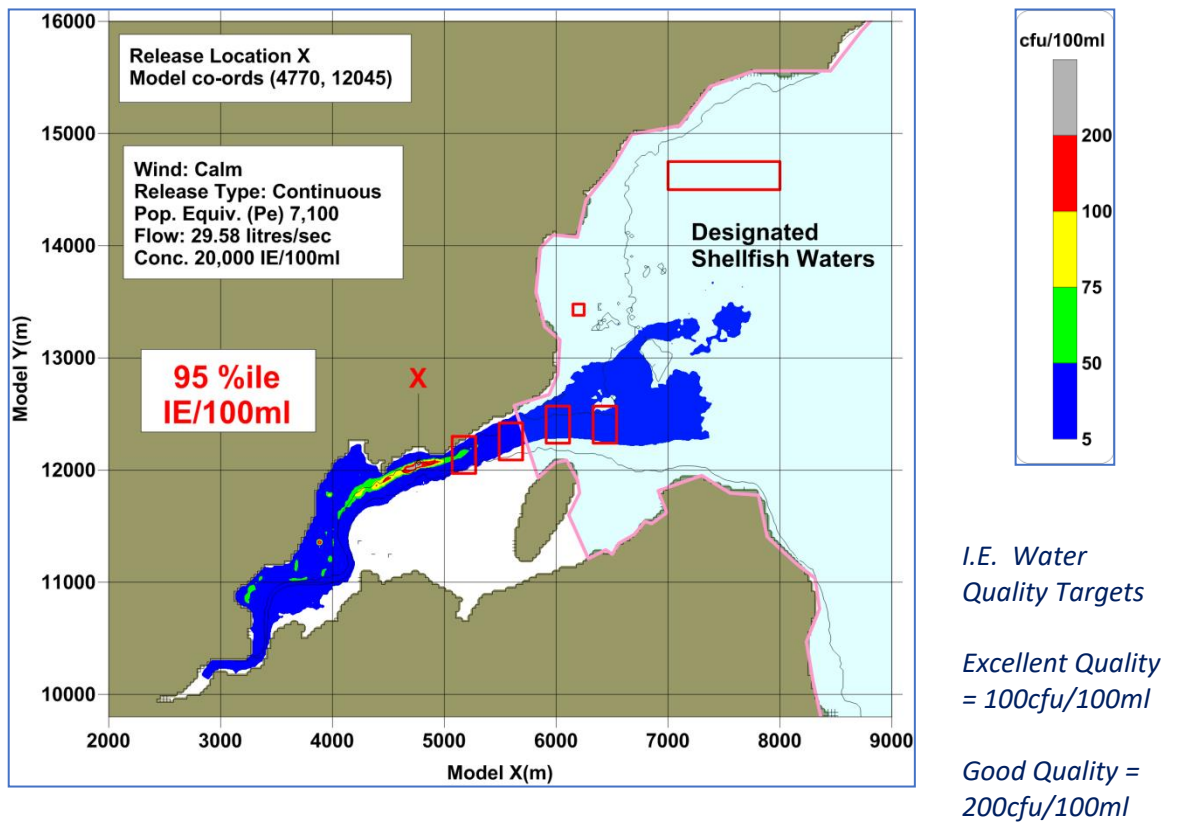
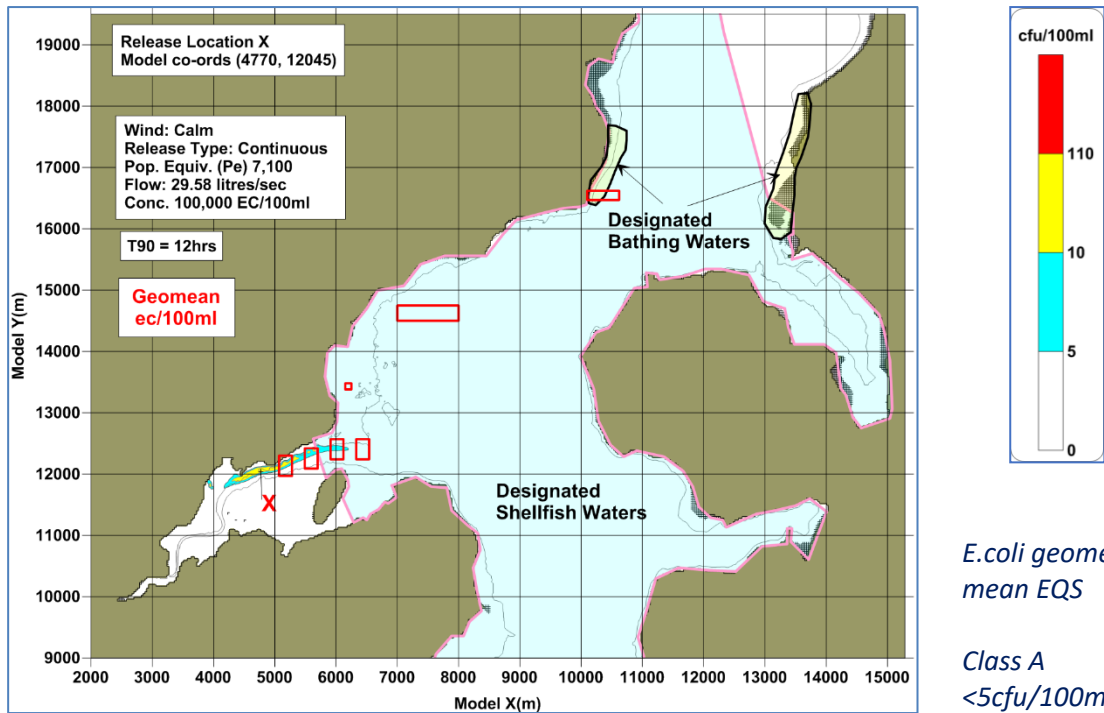


Figure 4.23 - Simulated 95%ile IE concentration for discharge from proposed outfall

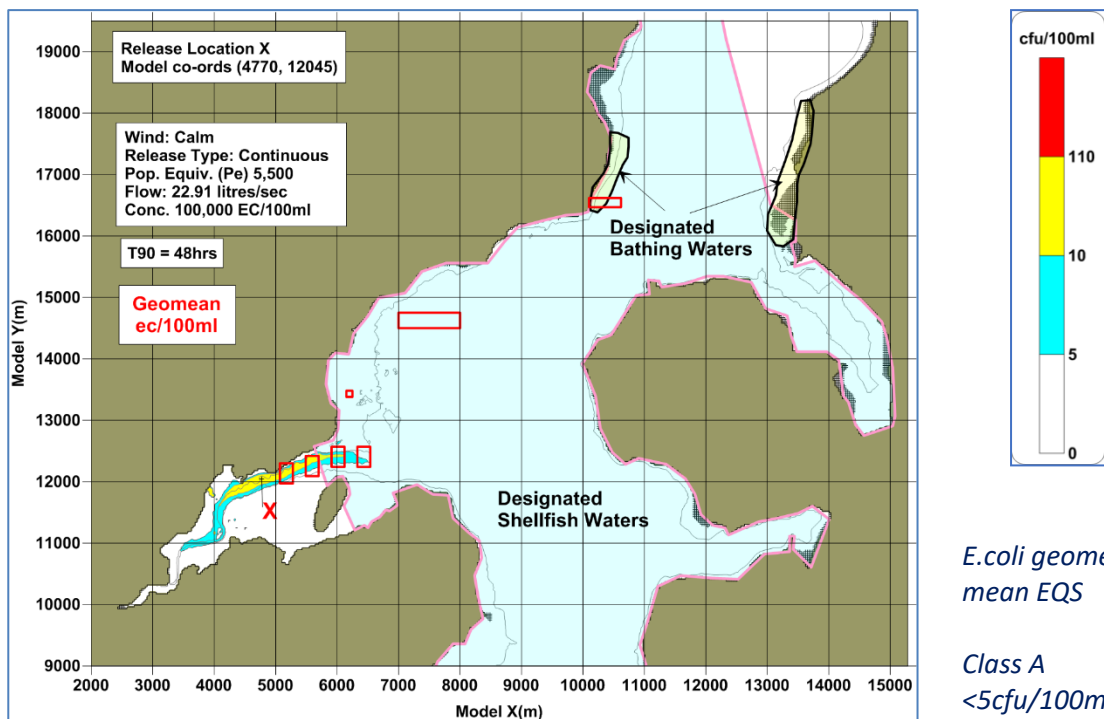


E.coli geometric mean EQS

Class A <5cfu/100ml

Class B <110fu/100ml

Figure 4.24a - Simulated Summer (T90=12hrs) geomean e.coli concentration for discharges from the proposed outfall location



E.coli geometric mean EQS

Class A <5cfu/100ml

Class B <110fu/100ml

Figure 4.24b - Simulated Winter (T90=48hrs) geomean e.coli concentration for discharges from the proposed outfall location

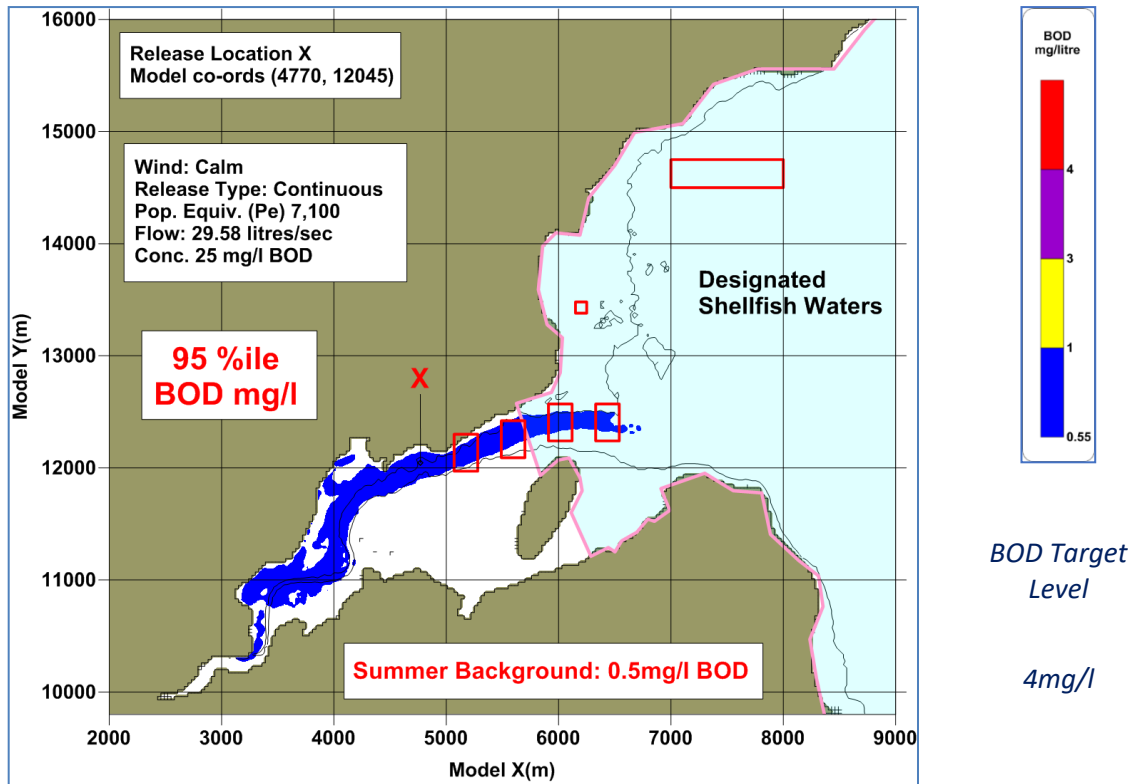


Figure 4.25a - Simulated Summer 95%ile BOD concentration for discharge from proposed outfall

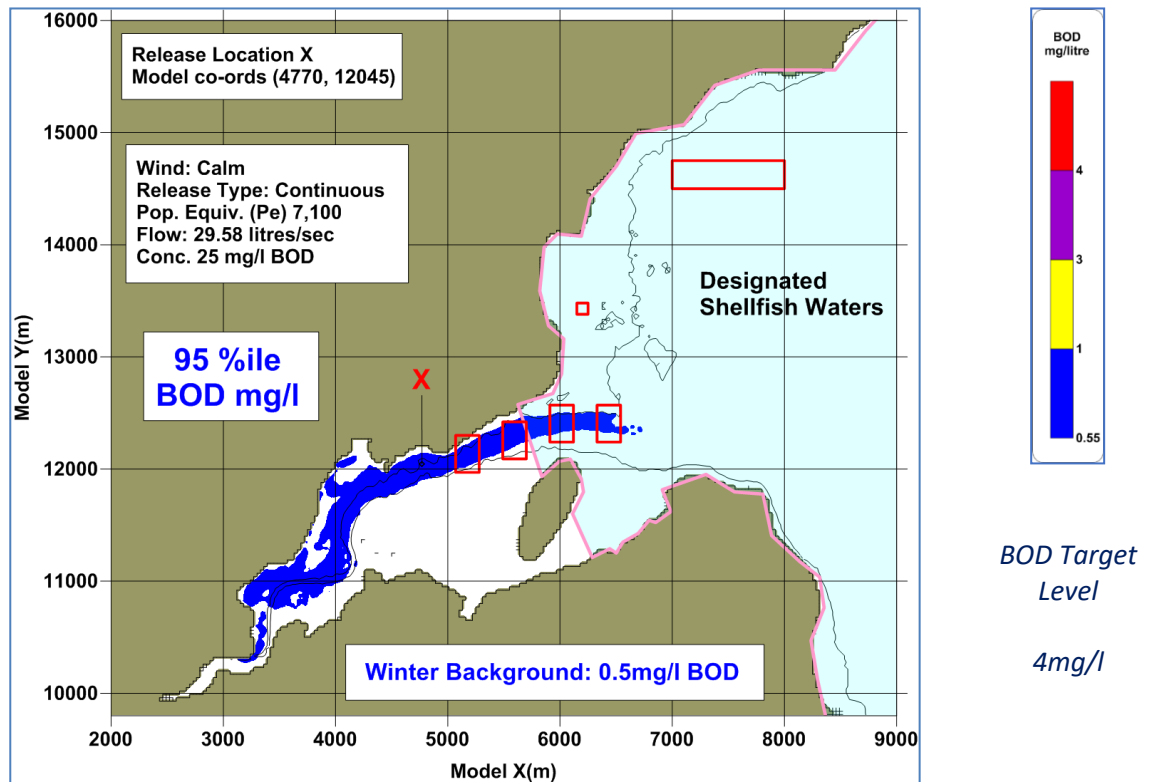


Figure 4.25b - Simulated Winter 95%ile BOD concentration for discharge from proposed outfall

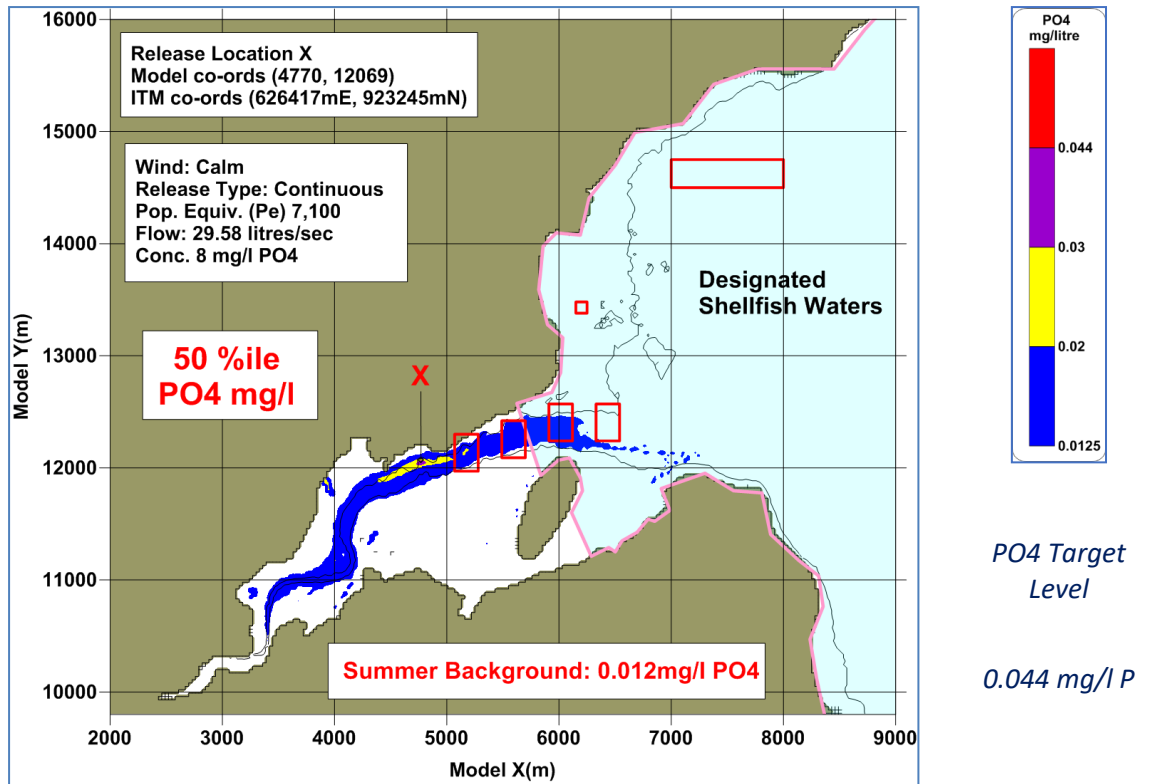


Figure 4.26a - Simulated Summer 50%ile PO4 concentration for discharge from proposed outfall

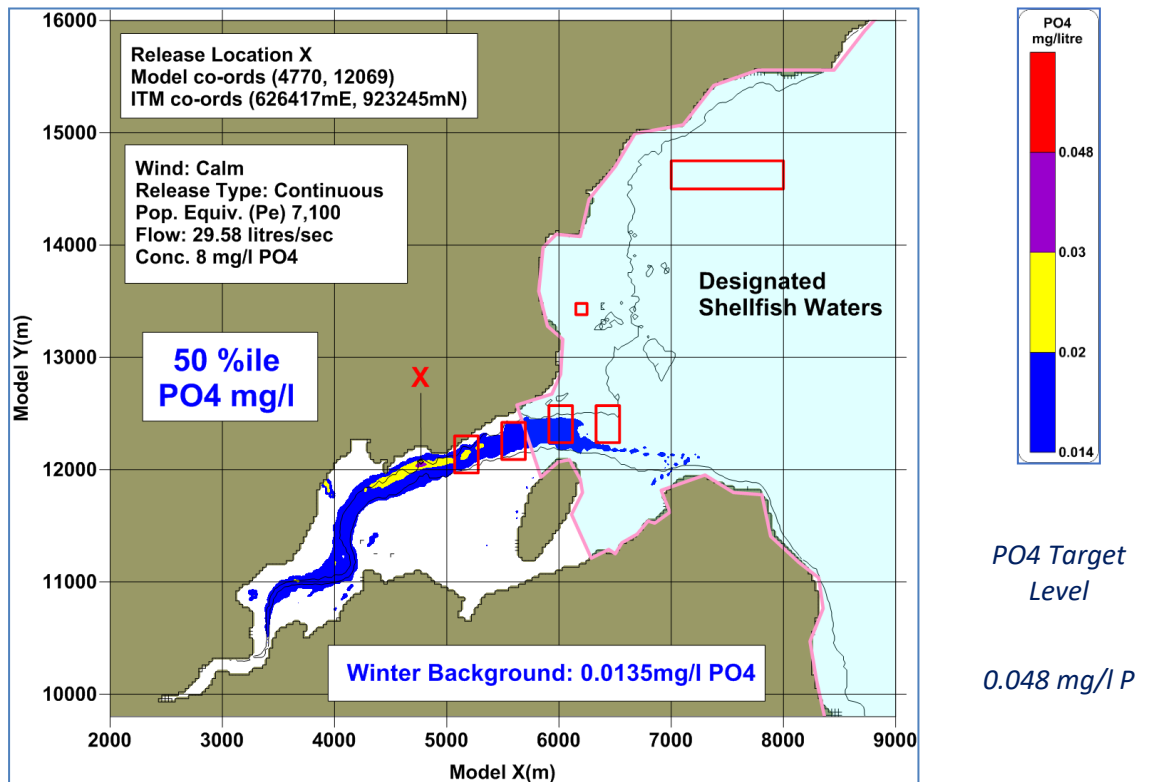


Figure 4.26b - Simulated Winter 50%ile PO4 concentration for discharge from proposed outfall

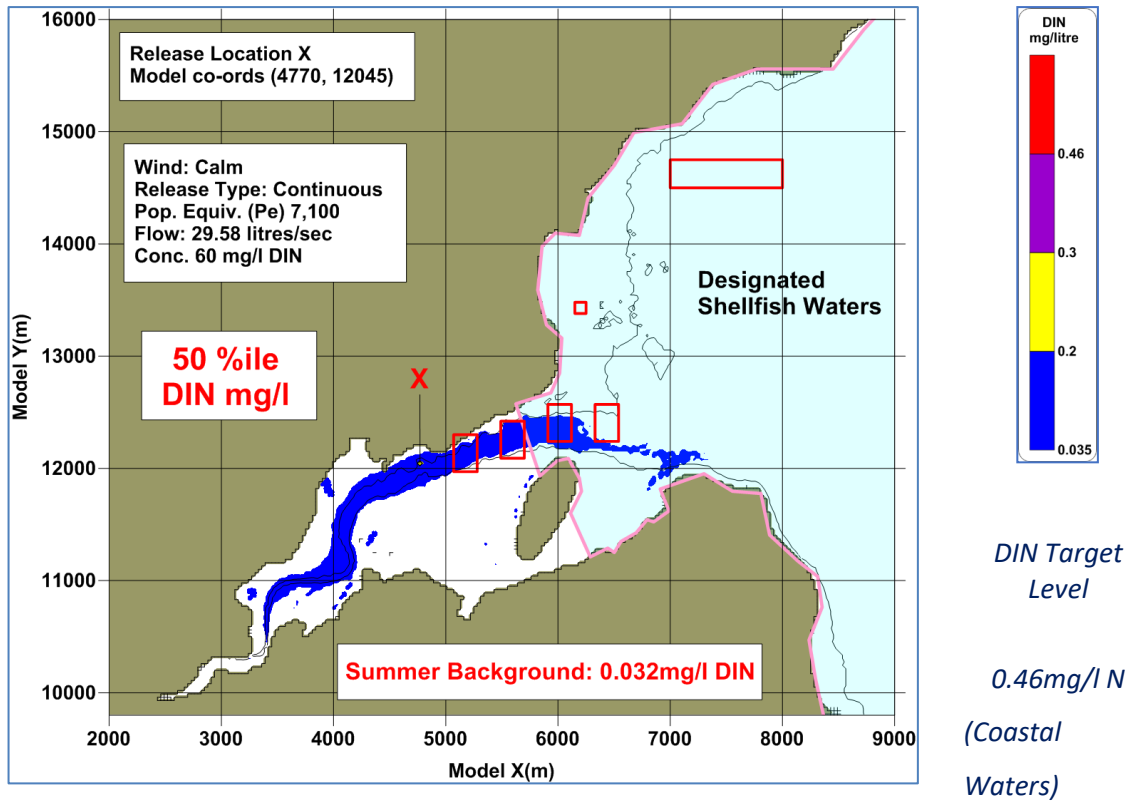


Figure 4.28a - Simulated Summer 50%ile DIN concentration for discharge from proposed outfall

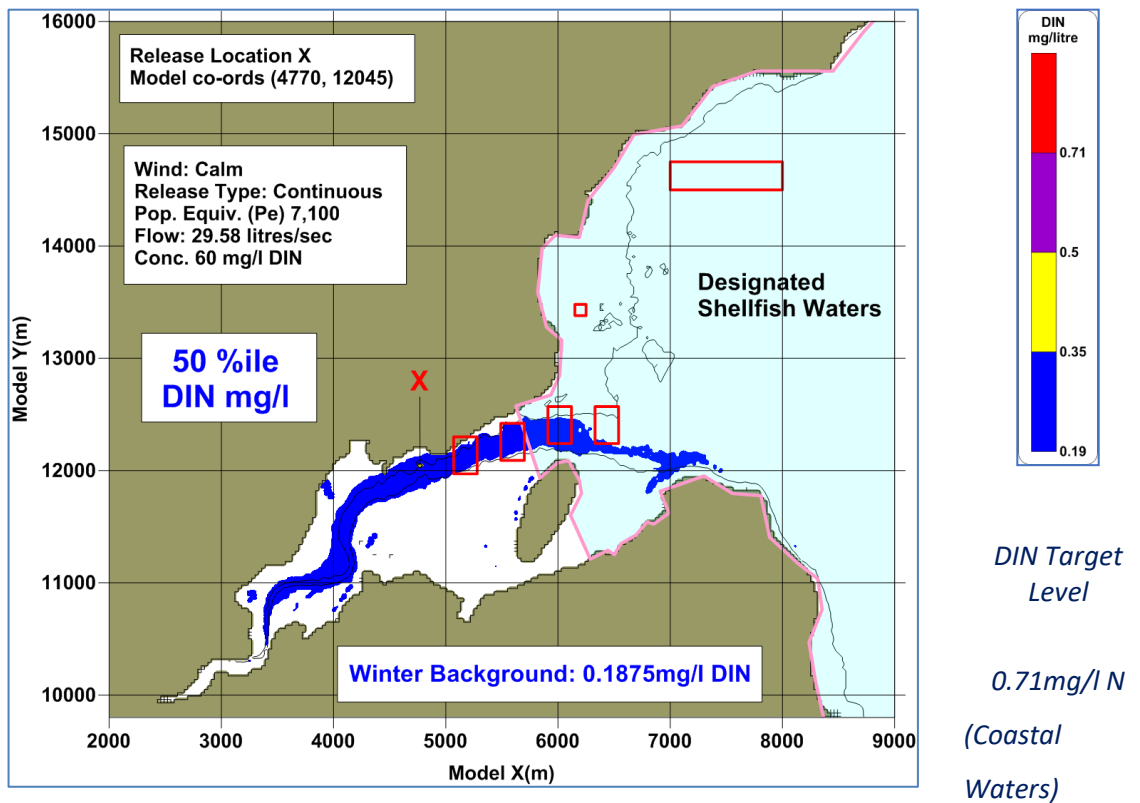


Figure 4.28b - Simulated Winter 50%ile DIN concentration for discharge from proposed outfall

Emission Limit Values (ELVs) are not proposed for TA and DIN. However, model simulations have been completed for a range of TA and DIN limits that can be typically achieved by a secondary treatment process. The proposed secondary treatment process will typically result in TA and DIN values of 55 and 60mg/l respectively. Model simulations have also been completed for DIN of 45 and 75mg/l and TA of 40 and 70mg/l. These results are included in Appendix A of the Irish Hydrodata modelling report.

Model plots for Unionised Ammonia (UIA) are also included in Appendix A of the Irish Hydrodata modelling report.

5.5 Summary Water Quality Modelling

For the proposed 30-year design horizon, a discharge with a PO₄ concentration of **8mg/l** will meet the requirements of the Surface Water Regulations. The secondary treatment discharge limit of **25mg/l BOD** was also assessed by the model as meeting the requirements of the Surface Water Regulations.

There is no transitional waters target for TA (NH₃) and was only modelled for completeness.

There is no transitional waters target for DIN and was only modelled for completeness. However, if the coastal waters criteria are applied the discharge complies with the 'Good' status limit (<0.71mg/l N based on winter salinity of 27.8psu).

A large area of Lough Swilly is designated as Shellfish Waters. The Shellfish waters are approximately 750m north-east of the primary discharge. The model analysis shows that the geomean EQS target of 110cfu/100ml will be met in the Shellfish Waters for both the 5,500 p.e. and the 7,100 p.e designs. Overall predicted concentrations are substantially lower than the target.

The Quality of Shellfish Waters Regulations specify that a discharge affecting shellfish waters must not cause the suspended solids content to increase by more than 30% of the background level. The diffuser model shows that such increases will be limited to within 55m of the outfall and will not impact the shellfish waters.

The nearest designated bathing waters are those off Rathmullan which are approximately 7.0km north-east of the primary discharge. The modelling indicates that the plume from the proposed outfall will not reach this area even at its maximum ebb excursion. Therefore, the proposed outfall will not impact the Rathmullan bathing water status.

When the proposed RMR WwTP is completed there will be four municipal treatment plants discharging into the inner part of Lough Swilly. These will include the proposed primary discharge, Buncrana, Fahan and the Letterkenny environs. Simulation of the combined bacterial discharges does not show any plume interaction which could lead to increased bacterial contamination of the Shellfish or Bathing Waters.

Given the findings of the water quality report, Irish Water considers that the level of treatment being proposed (secondary) for this agglomeration is appropriate and the emission limit values proposed in **Table B.2-4** will be sufficient to ensure the discharge will not adversely affect the environment or sensitive receptors, and are also compatible with achieving the WFD objectives for the receiving waters:

Parameters	Proposed Emission Limit Values
Biochemical Oxygen Demand	25mg/l
Chemical Oxygen Demand	125mg/l
Suspended Solids	35 mg/l
Ortho-phosphate PO4 (as P)	8 mg/l

Table B.2-4 - Proposed Emission Limit Values

The Irish Hydrodata Water Quality Report is attached as **Attachment D.2-3**

6. Priority Substance Assessment

A desk top study Priority Assessment has been prepared to inform this WWDL review. This assessment is based only on loads to the WWTP and was carried out in line with the Guidance on the Screening for Priority Substances for Waste Water Discharge Licences, issued by the EPA.

Estimated data from the PRTR reporting tool was used to inform this desktop assessment. The assessment considered the primary discharge relevant to Environmental Quality Standards (EQS) for priority substances in surface waters, as set out in the European Communities Environmental Objectives (Surface Waters) Regulations 2009, as amended (now S.I No. 77 of 2019).

It was concluded that none of the substances listed in the Specific Pollutants, Priority and Priority Hazardous Substances as outlined in the Surface Water Regulations, are likely to be present in the WwTP discharge at concentrations above the specified standards as per European Communities Environmental Objectives (Surface Waters) Regulations 2009, as amended (now S.I No. 77 of 2019).

This Report is contained in **Attachment D.2.5: Priority Substance Assessment**.

7. Shellfish Waters

A large area of Lough Swilly is designated as Shellfish Waters (Figure D.2-1). The Shellfish waters are approximately 750m north-east of the primary discharge. At present there are several licensed shellfish production areas in the lough waters off the Ramelton channel (Figure D.2.2). Shellfish flesh monitoring indicates that there is occasional faecal contamination in the shellfish areas



Figure D.2-1: Designated Shellfish Waters

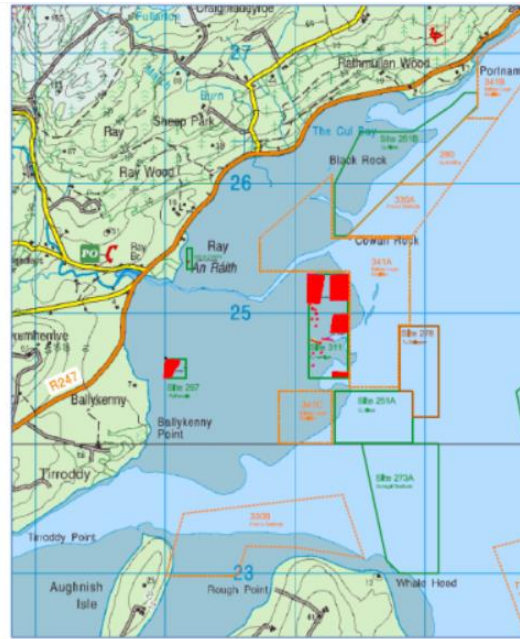


Figure D.2-2: Shellfish Licences in the Vicinity of the Outfall

Bacterial concentrations are relevant to shellfish waters though there are currently no specific regulations for such waters. In the absence of guidelines and following engagement with stakeholders including EPA and Marine Institute, Irish Water is applying the Urban Pollution Management Manual geomean EQS target of 110cfu/100ml for the protection of Shellfish Waters.

The model analysis demonstrated that this bacterial target will be met for both the 5,500 PE and 7,100 PE design scenarios. Overall predicted concentrations are substantially lower than the targets.

The Quality of Shellfish Waters Regulations specify that a discharge affecting shellfish waters must not cause the suspended solids content to increase by more than 30% of the background level. The diffuser model shows that such increases will be limited to within 55m of the outfall and will not impact the shellfish waters.

8. Bathing Waters

The nearest designated bathing waters are those off Rathmullan which are approximately 7.0km north-east of the primary discharge. In the four-year assessment period from 2012 to 2015, the current classification for this bathing water is Excellent Quality. The bacterial standards to be complied with are set out the Bathing Water Regulations (SI 79/2008) which stipulate: e.coli <250 cfu/100ml and intestinal enterococci <100 cfu/100ml for Excellent quality. The water quality modelling indicates that the plume from the proposed outfall will not reach this area even at its maximum ebb excursion. Therefore, the proposed outfall will not impact the Rathmullan bathing water status.

Plume Interactions

As outlined above the interactions of the discharges from the proposed WwTP and the existing treated wastewater discharges from Buncrana, Fahan and the Letterkenny were assessed. Simulation of the combined bacterial discharges does not show any plume interaction which could lead to increased bacterial contamination of the shellfish or bathing waters.

9. Combined Approach

The Waste Water Discharge Authorisation under the European Union (Waste Water Discharge) Regulations 2007 to 2020, specify that a 'combined approach' in relation to licensing of waste water works must be taken, whereby the emission limits for the discharge are established on the basis of the stricter of either or both, the limits and controls required under the Urban Waste Water Treatment Regulations, 2001, as amended, and the limits determined under statute or Directive for the purpose of achieving the environmental objectives established for surface waters, groundwater or protected areas for the water body into which the discharge is made.

Under the Urban Waste Water Treatment Regulations discharges to fresh waters and estuaries from agglomerations of between 2,000 and 10,000p.e. were required to provide secondary treatment by 31st December 2005.

As outlined in **Section 5** above emission limits or treated effluent standards were established and proposed which meet the limits for the purpose of achieving compliance with the environmental objectives established for surface waters. The treated effluent standards also comply with the Urban Waste Water Treatment Regulations by providing secondary treatment.

10. Compliance with Relevant National or EU Legislation

As per Attachment B.6.1, the RMR WwTW has been designed to ensure that the emissions from the agglomeration will comply with, and will not result in the contravention of, EU Legislation and National Regulations.

11. Cumulative and In Combination Effects

The Appropriate Assessment in the form of a Natura Impact Statement addresses combination effects. Refer to **Attachments D.2-3** and section 4 above.

12. Mixing Zone or Transitional Areas of Exceedance

The mixing zone is defined as the area around the primary discharge point within which the concentration is above the regulatory EQS threshold for each parameter. A regulatory method for determining the extent of the mixing zone is not defined. It is recommended that it be restricted to the proximity of the discharge, be proportionate and occupy less than 25% of the cross-sectional area.

The proposed outfall discharges into Transitional Waters and a key objective as per the Surface Waters Regulations (SI 272/2009) is to establish the extents of the mixing zone. The relevant controlling parameter is the median PO₄ nutrient concentration. For the proposed 30-year horizon discharge with a PO₄ concentration of 8mg/l the mixing zone (delineated by the median target EQS of 0.044mg/l) has been shown to be confined to the immediate outfall area (+/- 20m). It will thus meet the PO₄ requirements of SI 272/2009. The regulations also limit the BOD to 4mg/l within the mixing zone. The diffuser model indicates that this level will also be achieved in the immediate vicinity of the outfall. Predictions of the DIN concentration indicate that 'Good' status will be achieved in all but the immediate vicinity of the outfall.

The e.coli target of 500cfu/100ml for good quality is only exceeded in a localised area adjacent to the outfall as illustrated in **Figure 4.22** above.

The IE target of 200cfu/100ml is only exceeded in a localised area adjacent to the outfall as illustrated in **Figure 4.23** above.

The Quality of Shellfish Waters Regulations specify that a discharge affecting shellfish waters must not cause the suspended solids content to increase by more than 30% of the background level. The diffuser model shows that such increases will be limited to within 55m of the outfall and will not impact the shellfish waters.

13. Dilutions and retention times for lakes

Not applicable. No discharges to lakes.

14. The impact of the discharges on any environmental media other than those into which the emissions are to be made

Not applicable. No other relevant media into which the emissions are to be made.

15. Groundwater Details

Not applicable. No discharge to ground waters.

16. High Status Waterbodies

No High Status waterbodies are downstream of the operational discharges.

17. Fresh Water Pearl Mussels

Not applicable. No Fresh Water Pearl Mussels within the region of the primary discharge point

18. For waste water treatment plants with coastal discharges, provide evidence that the end of the discharge pipe is below the mean spring tide low water line

Although the proposed primary discharge is to transitional waters, refer to **Attachment D.2-4** – showing a Plan and Longitudinal section of the marine outfall pipe demonstrating that the outfall is located below the mean spring tide low water line.

Document Ref. No. 1277/22/F

Final Report

Donegal Towns & Villages

Proposed Wastewater Treatment Plant
serving
Ramelton, Milford and Rathmullan

**Investigation of the Impact of
Treated Wastewater Discharges
to Lough Swilly from a
Proposed Outfall east of Brownknowe Islet**

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04th July 2022

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References

Appendix

Project	Title
	Donegal Towns & Villages, Proposed Wastewater Treatment Plant Serving Ramelton, Milford and Rathmullan
Project Title	Investigation of the Impact of Treated Wastewater Discharges to Lough Swilly from a Proposed Outfall East of Brownknowe Islet
Client	Irish Water
Document	Report
First Issue Date	28 th November 2018
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Prepared By	J. Walshe, T. Bruton
Approved	

Glossary of Terms

ADF	Average Daily Flow
ATT	Admiralty Tide Tables
BOD	Biochemical Oxygen Demand
cfu	Bacterial Colony Forming Unit
DIN	Dissolved Inorganic Nitrogen (N)
DO	Dissolved Oxygen
DWF	Dry Weather Flow
EC	E.Coli
ELV	Emission Limit Value
EPA	Environmental Protection Agency
EQS	Environmental Quality Standards
GSI	Geological Survey of Ireland
HW	High Water (high tide)
IE	Intestinal Enterococci
IHD	Irish Hydrodata Ltd
IW	Irish Water
LW	Low Water (low tide)
MHWN	Mean High Water Neap
MHWS	Mean High Water Spring
MLWN	Mean Low Water Neap
MLWS	Mean Low Water Spring
NHA	National Heritage Area
NH ₃	Total Ammonia (as N)
NPWS	National Parks and Wildlife Service
OPW	Office of Public Works
PE	Population Equivalent
PO ₄	Molybdate reactive phosphorus (P)
PRP	Pollution Reduction Program
SAC	Special Area of Conservation
SEPA	Scottish Environment Protection Agency
SFPA	Sea Fisheries Protection Authority
SS	Suspended Solids
T ₉₀	Bacterial decay time
TA	Total Ammonia (as N)
TON	Total Oxidised Nitrogen (as N)
UWTR	Urban Wastewater Treatment Regulations
WFD	Water Framework Directive
WQ	Water Quality
WWTP	Wastewater Treatment Plant

1. Introduction

1.1 Background Information

Ramelton is a small town on the western shores of Lough Swilly. It had a population of approximately 1266 in the 2016 census and currently does not have a wastewater treatment plant. Untreated waste waters discharge to the Leannan estuary just downstream of the town. Milford is a slightly smaller town (pop: 1037) and lies 7km to the north-west of Ramelton (Figure 1.1). It is served by an old and outdated treatment plant from which waste waters discharge to a small stream which flows into Lough Fern. Waters from Lough Fern flow down the Leannan river and ultimately into Lough Swilly at Ramelton. Rathmullan is a coastal village (pop: 493) 6km to the north-east of Ramelton. It is served by a basic treatment system that discharges to the lough via two sea outfalls.

New treatment plants are required for all three locations to ensure water discharges comply with EU regulations. The possibility of treating the effluent in a centralised plant is being considered. The likely location for such a treatment plant is within the eastern environs of Ramelton with the treated waters discharging to the Ramelton channel/Leannan estuary (Figure 1.2). A suitable outfall location has been identified.

The Ramelton channel is a small inlet near the head of Lough Swilly. It covers an area of 4km² and mostly dries at low water. Lough Swilly itself is a large tidal inlet and covers an area of 34km². Several rivers discharge into the lough, including the Leannan, the Swilly and the Crana.

Inner Lough Swilly (Figure 1.3) is a designated Special Area of Conservation (SAC) (ref:1) and hosts examples of at least four habitats listed in Annex I of the EU Habitats Directive (estuaries, lagoons, Atlantic salt meadows, old oak woods). The National Parks and Wildlife Service (NPWS) has devised specific conservation objectives for the area (ref:2).

The inner lough is listed as the Swilly Estuary under the Water Framework Directive (WFD Code IE_NW_220_0100). The area to the south of Rathmullan is designated as Transitional Waters (Figure 1.4). The results of the WFD monitoring programme indicate that there are water quality issues within the lough area. It is currently (2013-2018) categorised as having 'Moderate' status with the objective of restoration to 'Good' status.

A large area of Lough Swilly is designated as Shellfish Waters (Figure 1.5). At present there are several licensed shellfish production areas in the lough waters off the Ramelton channel (Figure 1.6). Shellfish flesh monitoring indicates that there is occasional faecal contamination in the shellfish areas (ref:3). The shellfish waters monitoring station is located in Fahan Creek on the eastern shoreline of Lough Swilly (Figure 1.7).

There are two designated 'bathing beaches' in the lough, one at Rathmullan and the other on the eastern shoreline at Lisfannon (Figure 1.8).

1.2 Study Brief

A single treatment plant is being considered to serve Ramelton, Milford and Rathmullan. A potential site has been identified to the east of Ramelton town between Brownknowe Islet and Tiroddy Point. This will facilitate a short outfall to the Leannan channel. The objectives of the study were to:

- make an assessment of effects of existing untreated wastewater discharges to the locality;
- make an assessment of the potential effects of treated wastewater discharges to the Leannan Estuary/Ramelton Channel;
- establish suitable effluent discharge standards;
- ensure compliance with all European and national regulations.

The main concerns with the proposed discharge are the potential impacts on the designated shellfish and bathing waters.

A previous study carried out by Irish Hydrodata Ltd (IHD) in 2013 (ref:4) considered the option of a single treatment plant serving Milford and Ramelton. Three potential outfall locations were investigated, all in the locality of the Leannan estuary. This report contains extracts from the 2013 report.

1.3 Regulatory Framework

The main regulatory constraints that apply to the discharges are:

- Urban Wastewater Treatment Regulations, SI 254/2001, SI 440/2004, SI 48/2010;
- Water Framework Directive, SI 722/2003; SI 350/2014;
- EC Environmental Objectives (Surface Waters), SI 272/2009, SI 372/2012, SI 386/2015, SI 77/2019;
- Quality of Shellfish Waters, SI 268/2006, SI 55/2009, SI 464/2009;
- EC Food and Feed Hygiene Regulations, SI 432/2009, SI 22/2020;
- Bathing Water Regulations, SI 79/2008, SI 351/2011, SI 163/2016;
- Birds and Natural Habitats Regulations, SI 477/2011, SI 293/2021.

Section 6 of the Quality of Shellfish Waters Regulations (SI 268/2006) requires the development of Pollution Reduction Programmes (PRPs) for designated shellfish areas. The objectives of Shellfish PRPs are to:

- protect or improve water quality in designated shellfish areas;
- achieve compliance with water quality parameter values outlined in the Quality of Shellfish Waters Regulations (SI 268/2006, as amended);
- determine the factors responsible for any non-compliances with the water quality parameter values; and
- ensure that implementation of the Shellfish PRPs does not lead, directly, or indirectly, to increased pollution of coastal and brackish waters.

The Department of the Environment, Heritage and Local Government (DEHLG) was responsible for the development of Shellfish PRPs. The responsibility now resides with the Department of Housing, Planning and Local Government. The regulations place an obligation on every public authority to perform its functions in a manner that promotes compliance with the directive and the regulations and to take such actions as are necessary to secure compliance with the directive and the regulations and with the Shellfish PRPs.

1.4 Shellfish Standards in Lough Swilly

The Sea Fisheries Protection Authority (SFPA) has classified Lough Swilly as outlined in Table 1.1. The classification is updated annually based on the previous 3 years of microbiological (e.coli) data. The classification criteria are outlined in Table 1.2. The current sampling point (DL-LS-FC) is located in Fahan Creek on the eastern shoreline of Lough Swilly as shown in Figure 1.7. A sampling location on the western shoreline used in the SPRP Characterisation reports (ref:3) is no longer active.

Location	Bed Name	Species	Class
Lough Swilly	All Beds	Oysters (Native)	B
		Oysters (Pacific)	B

Table 1.1 - SFPA 2022 Classified bivalve mollusc production areas under SI 432/2009

Category	E.Coli MPN/100g (flesh)	Treatment Required
Class A	<230	May go direct for human consumption
Class B	<4600	Heat treated or re-laid to meet Class A

Table 1.2 - E.coli hygiene classification criteria for shellfish harvesting waters

Bivalves are filter feeders and can accumulate contaminants in their flesh. Hence there is no direct relationship between coliform concentrations in the flesh and those in the surrounding waters. Following engagement with stakeholders including EPA and Marine Institute Irish Water is applying the Urban Pollution Management Manual (ref: 5) geomean target of 110cfu/100ml for the protection of Shellfish Waters.

1.5 Summary of Study Works

The 2013 study included a review of available data followed by limited field measurement works. Subsequently a hydrodynamic & water quality model was constructed to investigate water circulations and simulate the impacts of the proposed discharges. For this report the model area has been expanded to include a larger part of Lough Swilly and additional field measurements were conducted in the vicinity of the proposed outfall.



Figure 1.1 - Lough Swilly, Ramelton, Milford and Rathmullan

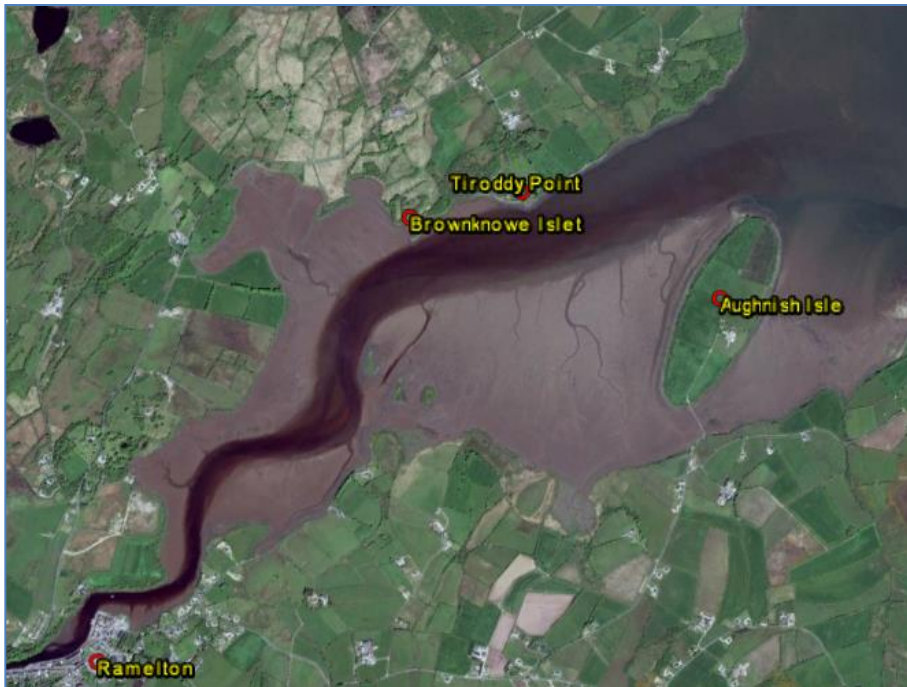


Figure 1.2 - Ramelton Channel/Leannan Estuary

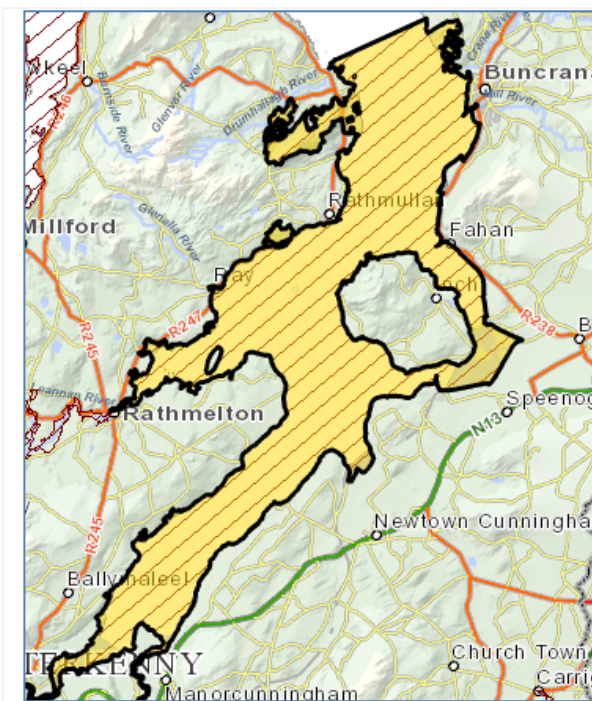


Figure 1.3 - Lough Swilly SAC 002287

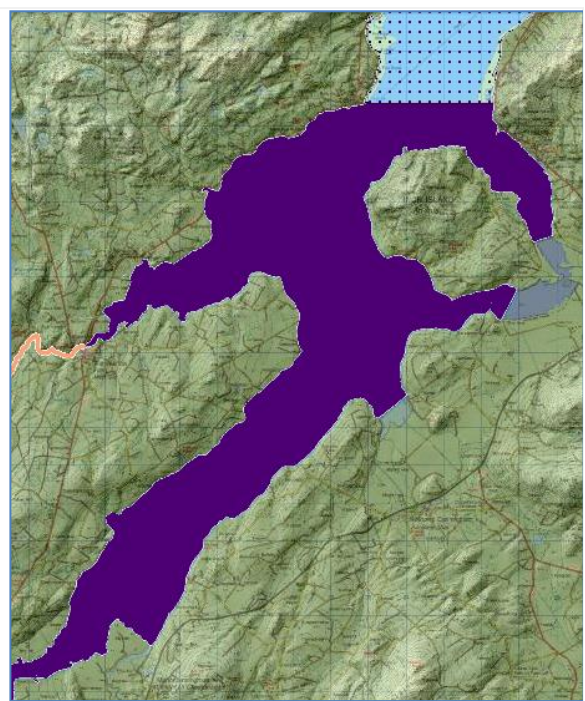


Figure 1.4 - WFD Transitional Waters



Figure 1.5 - Designated Shellfish Waters

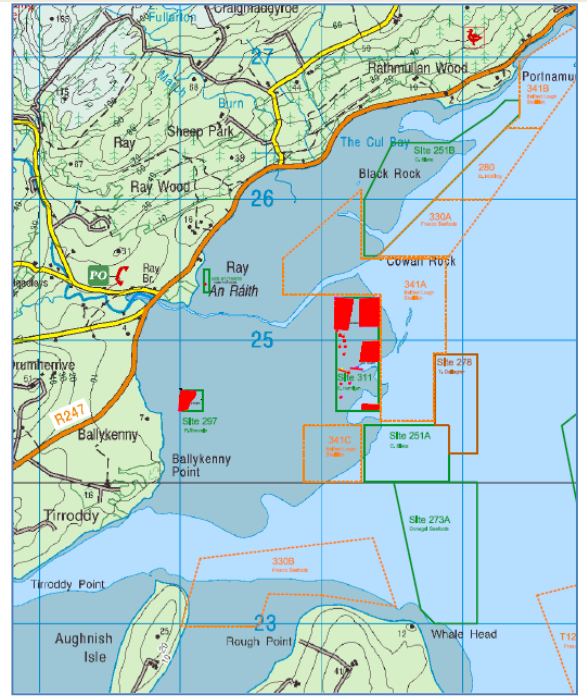


Figure 1.6 - Shellfish licenses in vicinity of Ramelton channel

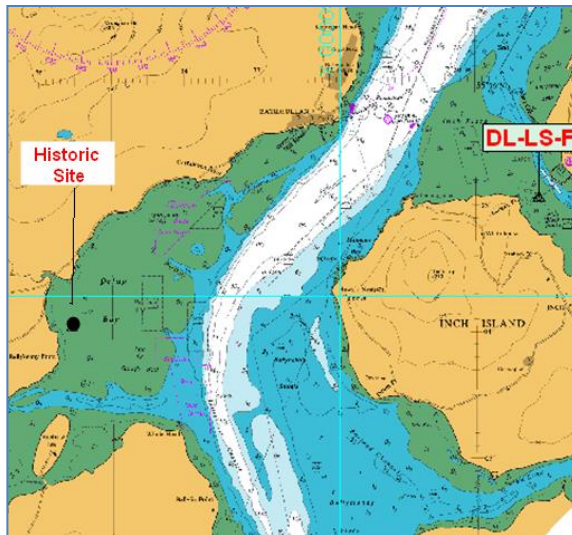


Figure 1.7 - Shellfish waters monitoring stations, the current sampling location is DL-LS-FC

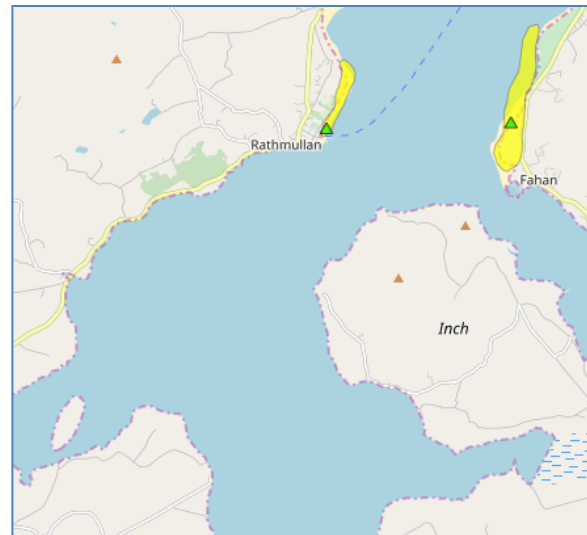


Figure 1.8 - Designated Bathing Waters at Rathmullan and Lisfannonn (sampling locations indicated by green triangle markers)

2. Bay Characteristics

2.1 Bathymetry

The inner part of Lough Swilly was surveyed by aerial LIDAR in 2010 by the Geological Survey of Ireland (GSI) under the INFOMAR program. Data was obtained on a 5m square grid for use in this study. This included the mudflats in the Leannan estuary. The channel, from the Ramelton town quays to Aughinish Isle was surveyed by echo-sounding as part of this project. The combined bathymetry is presented in Figure 2.1. The general bathymetry for Lough Swilly is available on the Admiralty chart of the area (No 2811) and is presented in Figure 2.2.

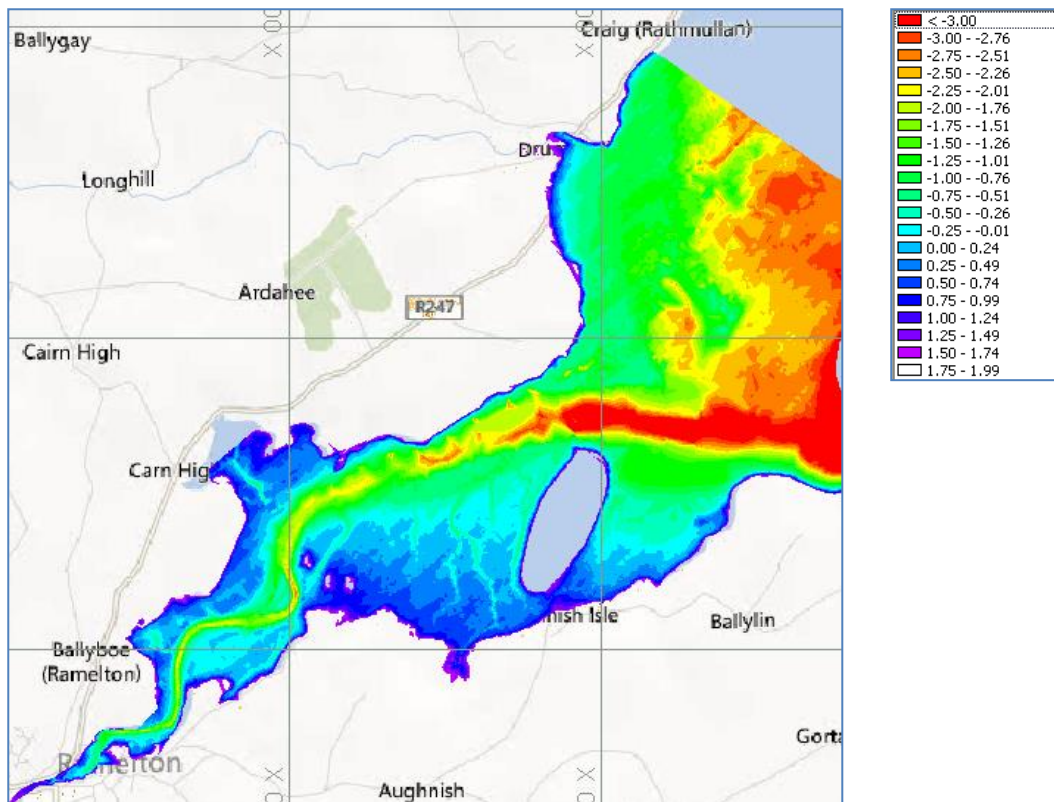


Figure 2.1 - Ramelton channel bathymetry (Malin Head datum)

2.2 Freshwater Inputs at Ramelton

A recording flow gauge is located at Claragh on the Leannan river, upstream of Ramelton. The average flow (based on digitised data 1977-2016) was $8.7\text{m}^3/\text{s}$. The 95% percentile low flow for this period was $0.83\text{m}^3/\text{s}$.

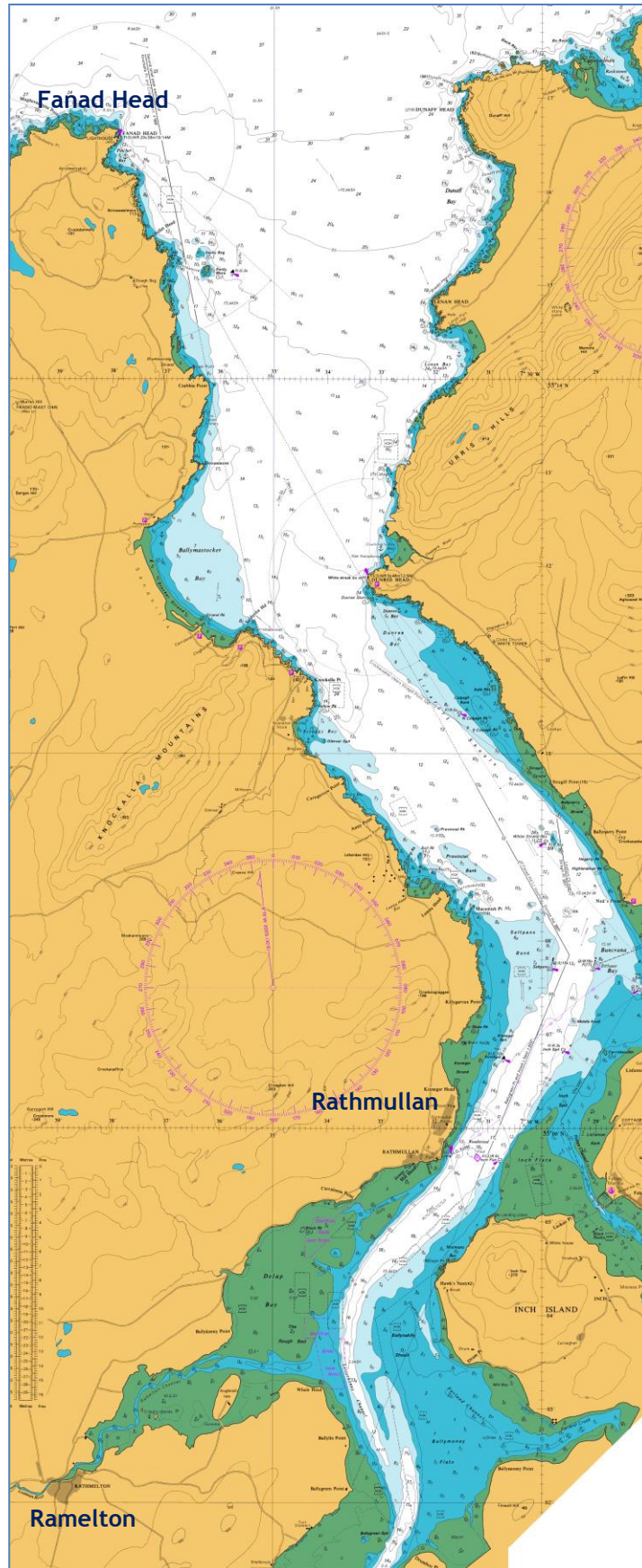


Figure 2.2 - Lough Swilly bathymetry (Chart Datum)

2.3 Tidal Levels

Tidal patterns in the lough are well documented. Admiralty publications (ref:6) provide tidal level information for Fanad Head and Rathmullan pier (Table 2.1). This shows a small increase in tidal range from the open sea towards the head of the Lough.

During a previous study of Lough Swilly (ref:7) tidal data was recorded at a number of locations including Rathmullan and Buncrana. A recording gauge was also deployed during the 2013 study for a period of 24 hours on a spring tide at the location shown in Figure 2.3 to provide additional information in the Ramelton channel. The time series of water levels is shown in Figure 2.4 with the levels related to Chart Datum.

Tidal data is usually referred to a chart datum, typically being the lowest level to which astronomical tides are likely to fall in a particular area. The difference between Malin Head datum and Chart Datum at Rathmullan is shown in Figure 2.5. The tidal statistics for Rathmullan relative to the various datums are outlined in Table 2.1. The water level exceedance based on one year of hourly prediction for Fanad Head is shown in Figure 2.6.



Figure 2.3 - Tidal information locations (Admiralty ●, IHD 2004 ●, IHD 2013 ●)

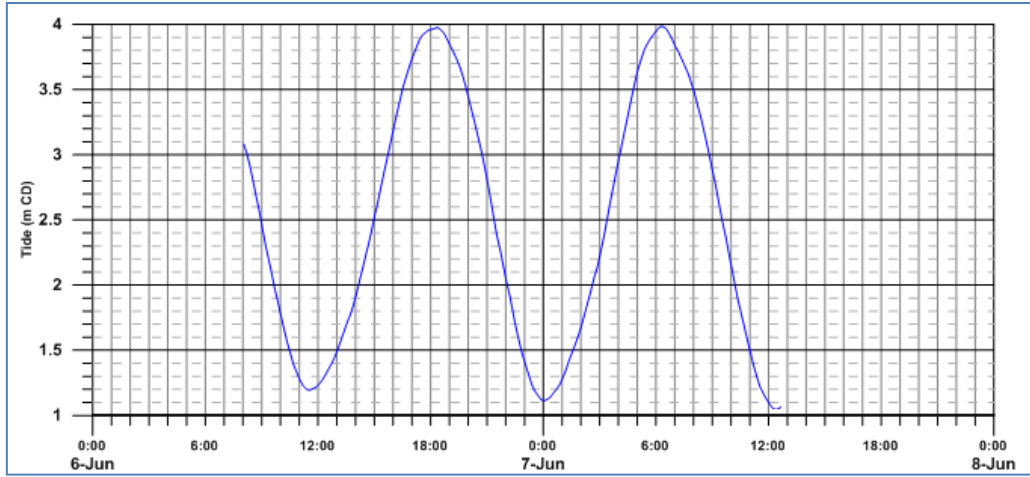


Figure 2.4 - Observed tidal elevations (Chart Datum) at Ramelton Quay (2013).

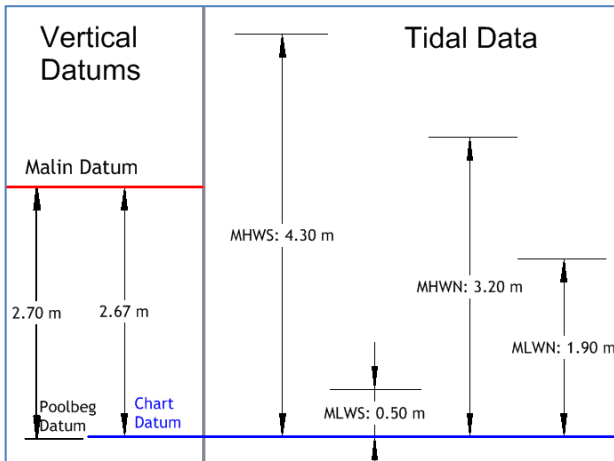


Figure 2.5 - Datum relationship and tidal data for Rathmullan

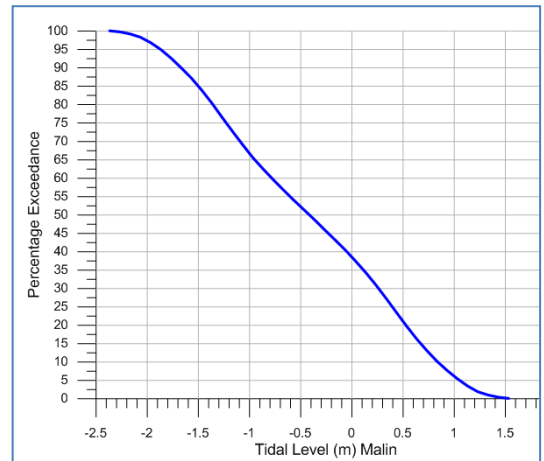


Figure 2.6 - Tidal level (ODM) exceedance at Fanad Head

Location	MHWS	MHWN	ML	MLWN	MLWS
	Chart Datum (m)				
Fanad Head	4.0	3.0	2.26	1.5	0.5
Rathmullan	4.3	3.2	-	1.9	0.5
	Malin Head Datum (m)				
Fanad Head	1.33	0.33	-0.41	-1.17	-2.17
Rathmullan	1.63	0.53	-	-0.77	-2.17
	Mean Tide Level (m)				
Fanad Head	1.74	0.74	0	-0.76	-1.76
Rathmullan	2.04	0.94	-	-0.36	-1.76

Table 2.1 - Admiralty tidal statistics referenced to different datums

MHWS: Mean high water springs; MLWS: Mean low water springs;
 MHWN: Mean high water neaps; MLWN: Mean low water neaps;
 ML: Mean tide level.

2.4 Tidal Current Patterns

There is a reasonable amount of tidal current data available for Lough Swilly. The admiralty chart shows maximum spring and neap current speeds of 1.8knots (0.93m/s) and 0.8knots (0.41m/s) respectively off Rathmullan. There is no published information on current patterns in the Leannan estuary.

Field measurements 2004

In 2004 Irish Hydrodata Ltd conducted detailed measurements at six locations within the lough (Figure 2.7) for Donegal County Council. Current meter data for the two locations nearest to Ramelton, CM05 & CM06 are presented later in Section 4 overlain on modelled data. Current patterns were found to be well defined and tidally dominated. Peak speeds reached 0.3 to 0.4m/s with directions aligned to the local NE-SW orientation of the lough.

Field measurements 2013

For the 2013 study, current metering and drogue tracking exercises were undertaken. The current meter was deployed for 12 hours at one location and drogue tracking was conducted from three locations on two dates during neap tides. The locations are shown in Figure 2.8. Currents were measured at location CM and drogue releases were from locations DR-1, DR-2 and DR-3. Currents at location CM were well defined and followed a rectilinear pattern. Peak speeds reached approximately 0.4m/s on both the flood and ebb.

Surface floats were released on June 6th and 7th 2013 from the three potential outfall locations then being considered. The floats comprised a number of cruciform drogues and oranges in net bags ballasted to float just at the sea surface. Speeds of about 0.1 to 0.2m/s were observed in the inner estuary at locations DR-1 and DR-2 while further downstream at DR-3 peak speeds of 0.4m/s were recorded. The drogues travelled easily while the waters were high but as the tide ebbed, they grounded on the channel sides and bottom. Data are presented later in Section 4 overlain on modelled data.

Field measurements 2017

In 2017 current and drogue measurements were made at a location off Tiroddy point (DR-4 in Figure 2.8). This location is about 200m east of the now proposed outfall location east of Brownknowe Islet (Figure 1.2). Current speeds reached 0.3m/s on the flood and ebb tides while drogues released soon after high water travelled eastwards into the lough. Data are presented later in Section 4 overlain on modelled data.

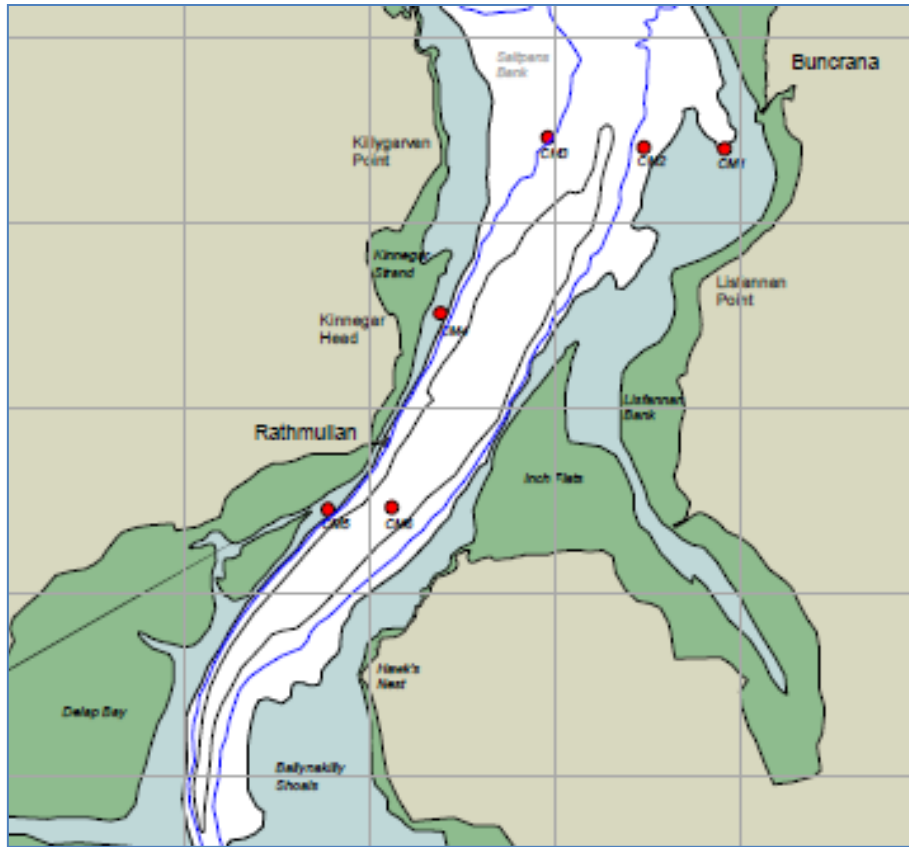


Figure 2.7 - Current measurement sites in Lough Swilly (2004)

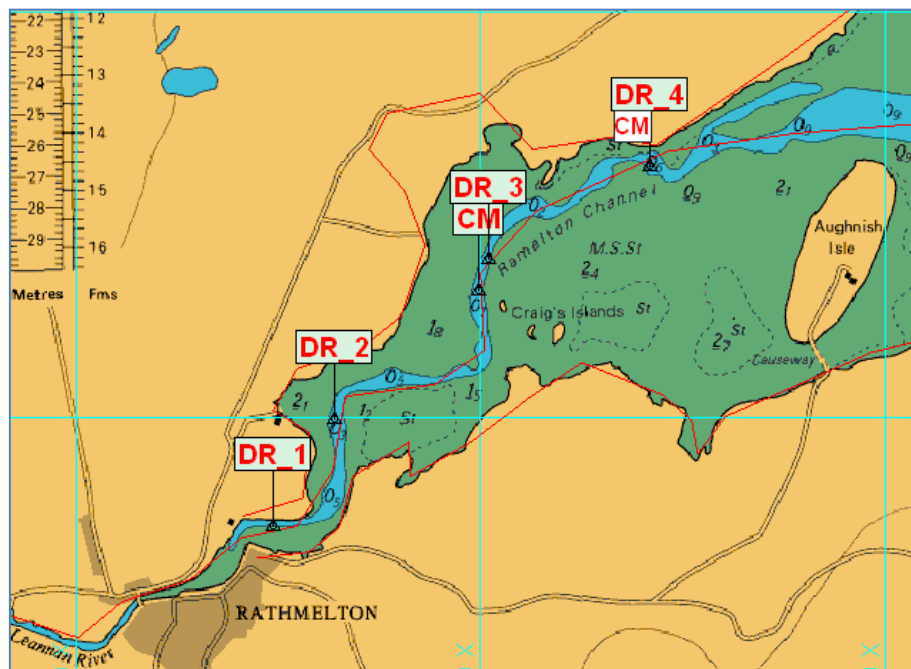


Figure 2.8 - Drogue and current measurement locations (2013, 2017)

3. Analysis Approach

3.1 Methods

The potential impacts of the proposed discharges on the marine waters were assessed using various calculations and hydraulic modelling methods. These included:

1. Initial dilution simulations of the outfall diffuser;
2. Water circulation modelling;
3. Contaminant dispersion modelling.

A jet type model was used to simulate the effluent stream issuing from the diffuser and to estimate the near-field dilutions at the immediate discharge location. Water movements in the wider area were simulated with a 2D-hydrodynamic model driven by tidal forcing. A contaminant simulation model, driven by the hydrodynamics was used to evaluate the location-specific impacts of discharges within the mid- and far-field areas.

3.2 Applicable Water Quality Standards

The proposed outfall will discharge into transitional waters (Figure 1.4) and therefore under the Surface Water Regulations (SI 272/2009, as amended) the PO4 concentration is the relevant controlling standard. Concentrations for other parameters such as DIN and TA are not specified for transitional waters but are included here for completeness. The target water quality limits are as outlined in Table 3.1. These targets must be achieved at the edge of the mixing zone. A regulatory method for determining the extent of the mixing zone is not defined. It is recommended that it be restricted to the proximity of the discharge, be proportionate and occupy less than 25% of the cross-sectional area. Guidelines for the assessment of discharges have been developed by Irish Water (ref 8). The general approaches are followed here.

The proposed discharge location is within 0.75km of designated shellfish waters and within 7km of designated bathing waters. The relevant microbiological water quality parameters for these areas are listed in Table 3.2. As noted earlier in Section 1.4 there is no direct relationship between coliform concentrations in the shellfish flesh and those in the surrounding waters.

Parameter	River Waters	Transitional Waters	Coastal Waters
	Target	Target	Target
PO4 (mg P/l)	0.025 (High Status, mean) 0.045 (High Status, 95%)	0.06 (0-17psu) median 0.04 (34psu) median	<i>Not Specified</i>
DIN (mg N/l)	<i>Not Specified</i>	<i>Not Specified</i>	Good Status <2.6mg/l(0psu) median <0.25mg/l(34.5psu) median High Status <0.17mg/l(34.5psu) median
TA (mg N/l)	High Status 0.040mg/l (mean) or 0.090mg/l (95%ile) Good Status 0.065mg/l (mean) or 0.140mg/l (95%ile)	<i>Not Specified</i>	<i>Not Specified</i>
BOD (mg/l O ₂)	1.3 (High Status, mean) 2.2 (High Status, 95%)	<4.0 (Good Status, 95%ile)	<i>Not Specified</i>
SS mg/l	<i>Not Specified</i>	<i>Not Specified</i>	<i>Not Specified</i>

Table 3.1 - Target water environmental quality standards (EQS) for surface waters (SI 272/2009, as amended)

Parameter	Shellfish Waters Target	Regulation/Code
Faecal coliform	≤300 fc/100g in the shellfish flesh and inter-valvular liquid	SI 268/2006 as amended, based on 75% compliance
E.coli	230 ec/100g flesh 300 fc/100g flesh <110 ec/100ml geometric mean	SI 432/2009 as amended Urban Pollution Management Manual (V3)
SS mg/l	Must not cause SS to increase by more than 30% above surrounding levels	SI 268/2006 as amended
	Bathing Waters Target	
E.coli	<250 cfu/100ml (Excellent Quality) <500 cfu/100ml (Good Quality)	Bathing Waters: SI 79/2008 as amended. Based on 95%ile evaluation Bathing Season 1 June to 15 Sept
Intestinal enterococci (IE)	<100 cfu/100ml (Excellent Quality) <200 cfu/100ml (Good Quality)	

Table 3.2 - Target bacterial water quality standards for shellfish and bathing waters

3.3 Background Coastal Water Quality

The background coastal water quality for the outfall area was derived from EPA monitoring data (2016-2022). The EPA sampling locations are shown in Figure 3.1 with summary seasonal data presented in Table 3.3. The most recent 5 years of EPA data was used in the assessment of background values. The ‘summer’ dataset extended from May 2016 to September 2021 with the winter dataset extending from February 2017 to January 2022.

Location LS150 is closest to the proposed outfall location. These results, particularly for locations LS140 and LS150 include the contributions from the existing discharges at Ramelton.

The target EQS values for DIN and PO4 will change seasonally depending on the salinity. Median seasonal values for salinity, temperature and pH are presented for location LS150 (Brownknowe) in Table 3.4. The pH and temperature data are required for calculation of Unionised Ammonia (UIA) which is presented in Appendix A. The seasonal target EQS values for DIN and PO4 are presented in Table 3.5.

EPA Site	Salinity	BOD	DO	TON	NH3	Free-NH ₃	PO4	DIN
	psu	mg/l	% Sat	mg/l N	mg/l N	mg/l N	mg/l P	mg/l N
LS 140 (2016-2022 - 12No Winter Samples, 32No Summer Samples)								
All	27.60	0.50	98.00	0.0515	0.0300	0.001	0.0105	0.0910
Summer	29.50	0.50	98.00	0.0160	0.0275	0.001	0.0090	0.0465
Winter	17.50	0.50	98.00	0.1900	0.0355	0.001	0.0145	0.2190
LS 150 (2016-2022 - 10No Winter Samples, 27No Summer Samples)								
All	30.30	0.50	98.00	0.0230	0.0290	0.001	0.0130	0.0600
Summer	31.40	0.50	99.00	0.0050	0.0240	0.001	0.0120	0.0320
Winter	27.80	0.50	97.50	0.1450	0.0385	0.000	0.0135	0.1875
LS 160 (2016-2022 - 12No Winter Samples, 33No Summer Samples)								
All	32.60	0.50	98.00	0.0050	0.0250	0.001	0.0120	0.0410
Summer	32.90	0.50	98.00	0.0050	0.0240	0.001	0.0110	0.0300
Winter	31.00	0.50	97.50	0.1100	0.0260	0.000	0.0155	0.1415

Table 3.3 - Median coastal background water quality data

Season	Temperature (°C)	Salinity (PSU)	pH
All	15.0	30.3	8.0
Summer	15.4	31.4	8.1
Winter	6.5	27.8	7.9

Table 3.4 - Median values at location LS150

Season	Salinity (PSU)	DIN (mg/l)	PO4 (mg/l)
Summer	31.4	0.46	0.044
Winter	27.8	0.71	0.048

Table 3.5 - Seasonal Target EQS for DIN and PO4

Bacterial data (Table 3.6) is taken from the shellfish waters monitoring location at Fahan Creek (Figure 1.7) and the Rathmullan bathing water monitoring location (Figure 1.8).

Parameter	
	Shellfish Waters Sampling Location
E coli	95%ile = 362 cfu/100g flesh
	Rathmullan Bathing Waters Sampling Location (2016-2021)
E coli	95%ile = 258 cfu/100ml
Intestinal enterococci (IE)	95%ile = 51 cfu/100ml

Table 3.6 - Bacteriological water quality data

3.4 WWTP Discharge Characteristics

The proposed plant is to be designed so that the treatment levels can be upgraded in line with population growth. The 10-year design value is 5,500 PE (population equivalent) while the longer term 30-year projection is 7,100 PE. The flow rate and contaminant concentrations of the final effluent are shown in Table 3.7. These values are typical of the output from a modern treatment plant. The treatment will provide a 2-log reduction of e.coli from a raw sewage value of about 1×10^7 cfu/100ml to 1×10^5 cfu/100ml. The IE values are correspondingly reduced from about 2×10^6 cfu/100ml to 2×10^4 cfu/100ml. There are no standardised decay times for either e.coli or IE as they have been found to vary substantially with environmental stress factors such as ambient solar radiation, season and water clarity. An e.coli decay time of 12 hours and an IE decay time of 24 hours have been applied in the analysis of summer season bathing waters. E.coli decay times of 12 hours and 48 hours have been employed in the calculation of summer and winter geometric mean data for shellfish water assessment. An average daily flow of 1.6xDWF was used in the far-field dispersion assessments to account for fluctuations at the plant which might lead to locally elevated level.

The typical PO₄ concentration from secondary treatment is about 8 mg/l P. Further reductions in concentration can be achieved by chemical dosing if necessary.

Parameter	10 year horizon	30 year horizon
Population Equivalent PE	5,500 pe	7,100 pe
Dry Weather Flow (DWF)	14.32 l/s	18.49 l/s
Average Daily Flow (1.6 x DWF)	22.91 l/s	29.58 l/s
Discharge Standards		
BOD	25 mg/l	
Suspended Solids	35 mg/l	
Ortho Phosphorous (P)	8 mg/l	
Dissolved Inorganic Nitrogen (N)	60 mg/l	
Total Ammonia, NH ₃ (N)	55 mg/l	
E Coli	100,000 cfu/100ml	
Intestinal Enterococci (IE)	20,000 cfu/100ml	

Table 3.7 - Preliminary discharge standards used in the outfall assessment

3.5 Proposed Outfall Location

Three potential outfall locations were reviewed in the 2013 study and are shown as R-1, R-2 and R-3 in Figure 3.2. A new location off Brownknowe Islet (R-4 in Figure 3.2) was considered in 2018 and, following shoreline environmental studies, another more suitable site some 250m further to the east (R-5 in Figure 3.2) towards Tiroddy Point has been identified and is the subject of this report. The new proposed discharge point lies within the narrow river channel. Grid coordinates of this location are listed in Table 3.8 with a cross-sectional depth profile along the line (Figure 3.3) shown in Figure 3.4.

Outfall Location	ING East(m)	ING North(m)	Bed Level (m) Malin	Depth (m)at mid tide	Distance to Shellfish Waters (m)
East of Brownknowe Islet	224671	423257	-2.9m	2m	750

Table 3.8 - Proposed outfall location coordinates



Figure 3.1 - EPA Sampling Locations

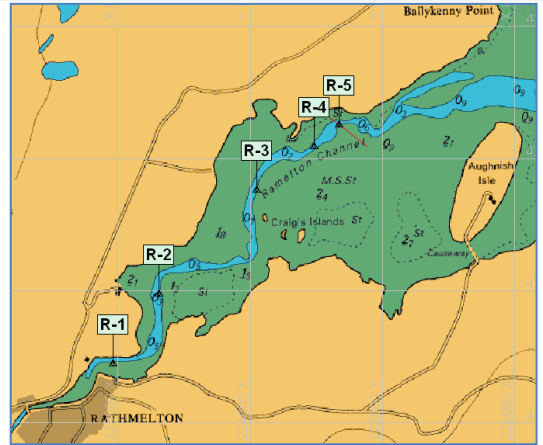


Figure 3.2 - Investigated outfall locations R1 to R5



Figure 3.3 - Seabed cross-section line plan showing proposed diffuser location

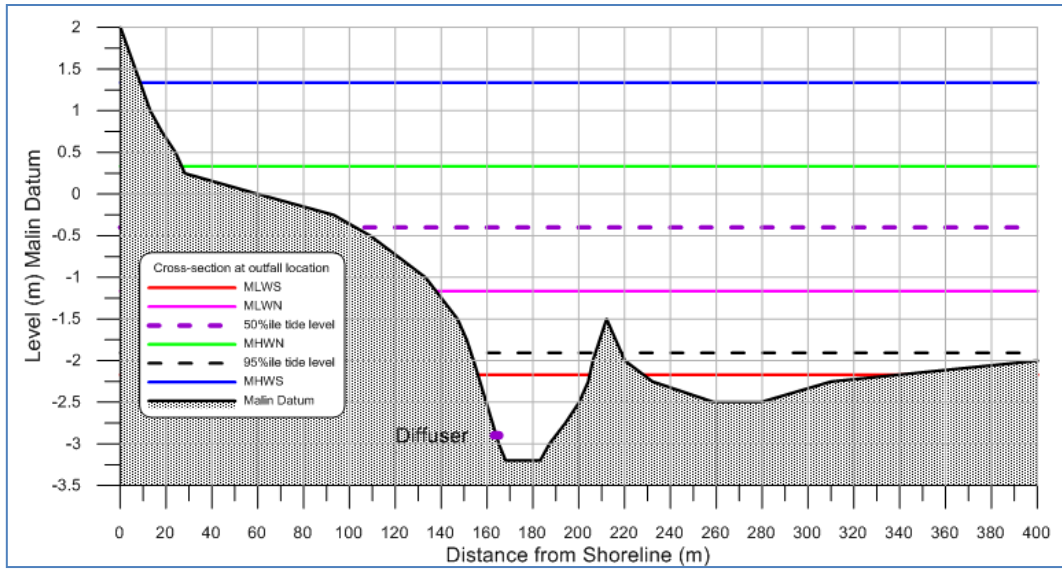


Figure 3.4 - Seabed section at outfall location (Tidal levels from Admiralty tide tables (ref:5), 95%ile and 50%ile water levels computed from one year of predicted tides at Fanad Head, Figure 2.6)

4. Calculations & Model Simulation Results

4.1 Initial Dilutions at Outfall Discharge Location

An effluent plume discharging from a pipe near the seabed rises to the surface at a rate dependent on the momentum and buoyancy forces. Subsequently it goes through various stages until spreading by advection/diffusion processes are established. In the case of multiple plumes from a diffuser the individual plumes may interact and merge depending on the diffuser port spacing. Analyses of this initial mixing process and subsequent near-field dilutions were made with the IJP model (ref:9).

The current speed data used in the model is based on the current meter data outlined in Section 2.4. The speed at low water is based on the 95%ile river flow ($0.83\text{m}^3/\text{s}$) and the associated channel cross-sectional area. The predicted initial dilutions have been used to calculate the near-field concentration of the relevant parameters. The diffuser is assumed to have 3 ports, each of 0.1m diameter and spaced 1m apart. Background concentrations where applicable have been taken from the EPA data as presented in Table 3.3. The predicted concentrations of BOD, SS, PO₄, TA, DIN, e.coli and IE in the immediate vicinity of the surfaced plume are indicated in Tables 4.1a and 4.1b for summer and winter respectively. This calculation is based on the future 7,100 PE. The distance downcurrent from the diffuser at which the plume surfaces, depends on the water depth and the current. The model predicts that this will vary from 2m at low tide to 50m at times of maximum flood or ebb current.

The outfall is in transitional waters and so the parameter of primary concern in terms of the Surface Water Regulations (SI 272/2009, as amended) is the PO₄ concentration. This must meet the relevant EQS outside the mixing zone. Based on a median background salinity of 31.4psu for summer and 27.8psu for winter (Tables 3.4 and 3.5) and a linear interpolation of the EQ standards in Table 3.1 the target levels for PO₄ at the edge of the mixing zone are 0.044mg/l P (median) for summer and 0.048mg/l P (median) for winter.

The calculated PO₄ concentrations in the surfacing plume range from 0.16mg/l to 0.82mg/l (Tables 4.1a,b) depending on the stage of the tide and the season. As the plume moves further upstream or downstream it spreads laterally and longitudinally. To provide an illustration of this additional dispersion a typical scenario is examined. The tide is assumed to be at mid-level and the ambient velocity is 0.15m/s. The predicted PO₄ concentrations across the width of the plume as a function of distance from the diffuser are as shown in Figure 4.1. The IJP model indicates that the target of 0.044mg/l P (lowest value, summer season) is just achieved within 100m of the outfall diffuser. The plume reaches a maximum width of about 25m and occupies about 10% of the full channel cross-sectional area.

Compliance with SI 272/2009 is based on median conditions. Thus, the flood and ebb tide plumes must be spatially combined in the overall assessment of the mixing zone. When this approach is followed, the mixing zone is predicted to extend about 60m downstream and 50m upstream of the outfall. There is little difference between winter and summer scenarios due to the similarity of background and EQS target values. This process is further examined with the 2D model in the next section.

The predicted BOD concentrations range from 0.95 to 2.95mg/l and are always below the target of 4mg/l. The background is the same for both winter and summer seasons and consequently there is no difference in the predicted values in Tables 4.1a and 4.1b.

The SS target level is a function of the background value as specified by the Quality of Shellfish Waters Regulations (SI 268/2006). The discharge must not cause an increase of more than 30% of the background level. As typical levels in shallow estuarine locations can range from 1mg/l to well over 50mg/l the target level can vary widely. If it is assumed that the background is a low value of 1.5mg/l then the resulting target would be 2mg/l. The model indicates that this will be achieved within about 50m of the outfall and thus levels will not increase beyond the target value in the shellfish waters which are 750m to the east.

The predicted DIN concentrations range from 1.14 to 6.17mg/l and in the summer season will reach the lower coastal waters target of 0.46mg/l within 90m of the outfall.

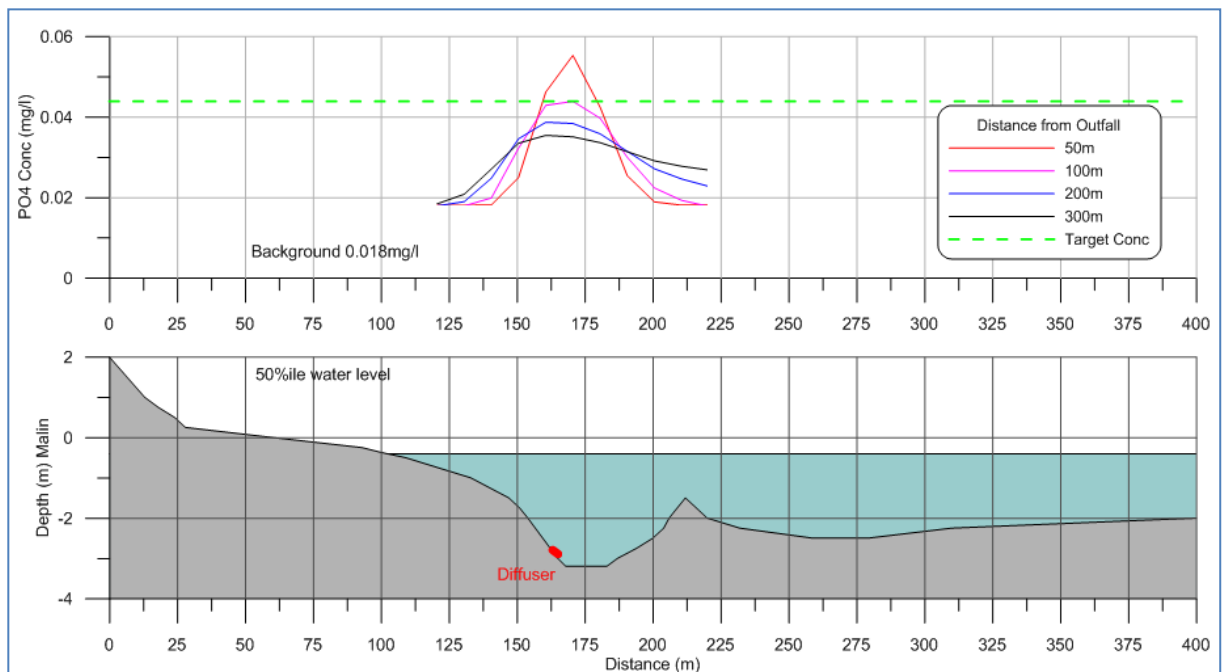


Figure 4.1 - Plot showing PO4 concentrations at channel cross-sections away from outfall for median water level condition

Parameter	Background	Treated effluent conc.	Surfaced plume conc. after initial dilution (ID)	Target EQS mg/l
At Mean Low Water Spring Tide	ID = 9, current speed = 0.03m/s, Surfacing Plume Displacement = 2m			
BOD (mg/l)	0.5	25	2.95`	4
SS (ppt)	1.5**	35	4.85	-
NH ₃ (mg/l N)	0.024	55	5.52	-
DIN (mg/l N)	0.032	60	6.03	0.46*
PO ₄ (mg/l P)	0.012	8.0	0.82	0.044*
E.coli cfu/100ml	0	100,000	9092	500
IE cfu/100ml	0	20,000	1820	200
At 95%ile Water Level	ID = 13, current speed = 0.05m/s, Surfacing Plume Displ = 5m			
BOD (mg/l)	0.5	25	2.25	4
SS (ppt)	1.5**	35	3.89	-
NH ₃ (mg/l N)	0.024	55	3.95	-
DIN (mg/l N)	0.032	60	4.32	0.46*
PO ₄ (mg/l P)	0.012	8.0	0.58	0.044*
E.coli cfu/100ml	0	100,000	7140	500
IE cfu/100ml	0	20,000	1430	200
At Low Water + 1.5hrs	ID = 30, Current Speed = 0.15m/s, Surfacing Plume Displ= 28m			
BOD (mg/l)	0.5	25	1.29	4
SS (ppt)	1.5**	35	2.58	-
TA (mg/l)	0.024	55	1.79	-
DIN	0.032	60	1.97	0.46*
PO ₄ (mg/l P)	0.012	8.0	0.27	0.044*
E.coli cfu/100ml	0	100,000	3225	500
IE cfu/100ml	0	20,000	645	200
At Low Water + 3hrs	ID = 53, current speed = 0.20m/s, Surfacing Plume Displ = 55m			
BOD (mg/l)	0.5	25	0.95	4
SS (ppt)	1.5**	35	2.12	-
TA (mg/l)	0.024	55	1.04	-
DIN	0.032	60	1.14	0.46*
PO ₄ (mg/l P)	0.012	8.0	0.16	0.044*
E.coli cfu/100ml	0	100,000	1850	500
IE cfu/100ml	0	20,000	370	200

Table 4.1a - Predicted peak SUMMER concentrations in the immediate vicinity of the surfacing plume after initial dilution [ID] (PE = 7,100, *summer salinity = 31.4psu, ** assumed-no data)

Parameter	Background	Treated effluent conc.	Surfaced plume conc. after initial dilution (ID)	Target EQS mg/l
At Mean Low Water Spring Tide	ID = 9, current speed = 0.03m/s, Surfacing Plume Displacement = 2m			
BOD (mg/l)	0.5	25	2.95	4
SS (ppt)	1.5**	35	4.85	-
NH ₃ (mg/l N)	0.0385	55	5.54	-
DIN (mg/l N)	0.1875	60	6.17	0.71*
PO ₄ (mg/l P)	0.0135	8.0	0.81	0.048*
E.coli cfu/100ml	0	100,000	9092	500
IE cfu/100ml	0	20,000	1820	200
At 95%ile Water Level	ID = 13, current speed = 0.05m/s, Surfacing Plume Displ = 5m			
BOD (mg/l)	0.5	25	2.25	4
SS (ppt)	1.5**	35	3.89	-
NH ₃ (mg/l N)	0.0385	55	3.96	-
DIN (mg/l N)	0.1875	60	4.46	0.71*
PO ₄ (mg/l P)	0.0135	8.0	0.58	0.048*
E.coli cfu/100ml	0	100,000	7140	500
IE cfu/100ml	0	20,000	1430	200
At Low Water + 1.5hrs	ID = 30, Current Speed = 0.15m/s, Surfacing Plume Displ= 28m			
BOD (mg/l)	0.5	25	1.29	4
SS (ppt)	1.5**	35	2.58	-
TA (mg/l)	0.0385	55	1.81	-
DIN	0.1875	60	2.12	0.71*
PO ₄ (mg/l P)	0.0135	8.0	0.271	0.048*
E.coli cfu/100ml	0	100,000	3225	500
IE cfu/100ml	0	20,000	645	200
At Low Water + 3hrs	ID = 53, current speed = 0.20m/s, Surfacing Plume Displ = 55m			
BOD (mg/l)	0.5	25	0.95	4
SS (ppt)	1.5**	35	2.12	-
TA (mg/l)	0.0385	55	1.06	-
DIN	0.1875	60	1.30	0.71*
PO ₄ (mg/l P)	0.0135	8.0	0.161	0.048*
E.coli cfu/100ml	0	100,000	1850	500
IE cfu/100ml	0	20,000	370	200

Table 4.1b - Predicted peak WINTER concentrations in the immediate vicinity of the surfacing plume after initial dilution [ID] (PE = 7,100, *winter salinity = 27.80psu, ** assumed-no data)

4.2 Water Circulation Modelling

Preparation

Tidal circulation within Lough Swilly and the Leannan estuary was investigated with a 2-dimensional, vertically averaged, numerical model M2D (ref:10). A conventional explicit finite-difference scheme is employed. The model simulates flow in surface water systems and is used in conjunction with a dispersion model LAG (ref:11), to simulate the fate of outfall discharges.

A model of Lough Swilly was constructed extending from Letterkenny in the south to Buncrana in the north (Figure 4.2) employing a rectangular grid with cells of size 30m x 30m. The model used channel survey data acquired for this project, GSI LIDAR data and Admiralty bathymetry all mapped onto the spatial grid as the basis for calculations. The model was driven by a tidal elevation on the northern boundary.

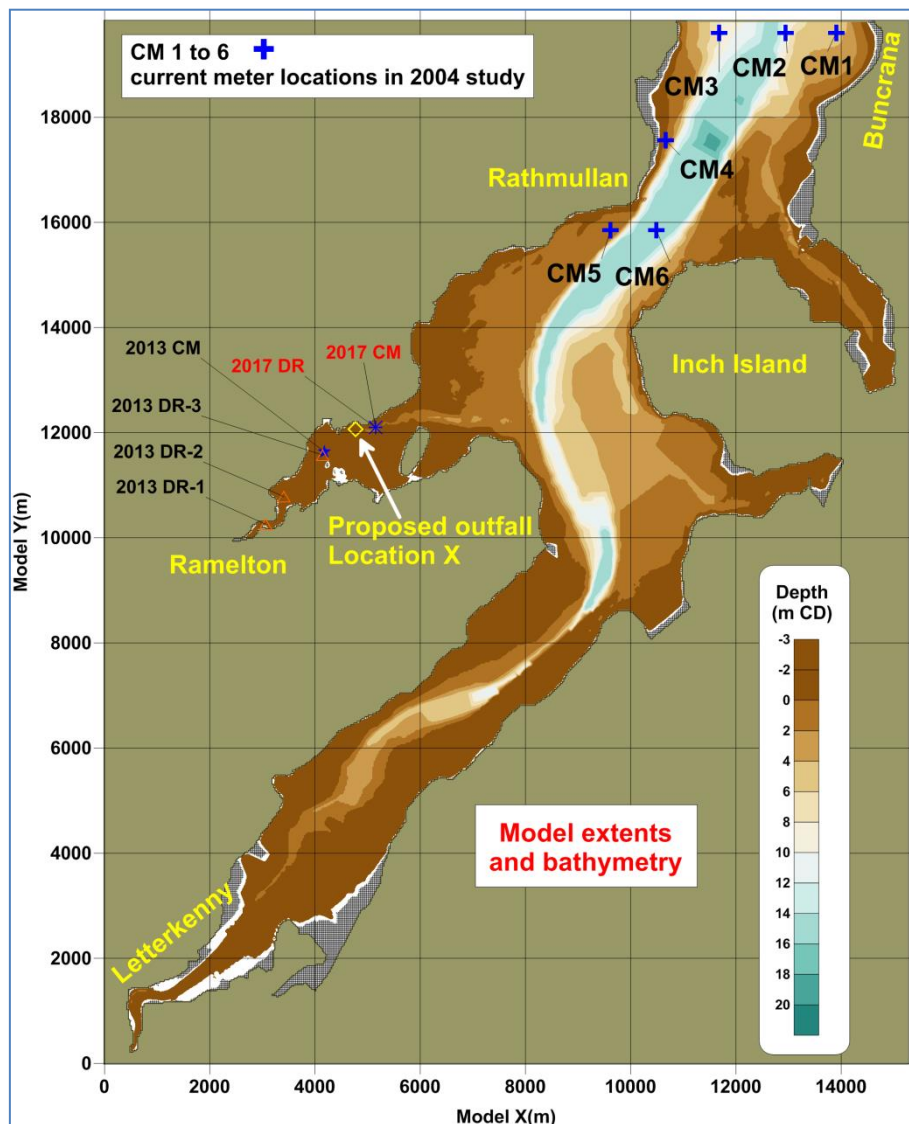


Figure 4.2 - Lough Swilly model extents and bathymetry

Calibration and Verification

The model was calibrated with observed tidal elevation, drogue track and current meter data taken from previous studies in 2004 (ref:6) and 2013 (ref:4). More recent field data from June 2017 was also used in this process. Initial model runs with typical coefficient settings were found to reproduce the observed current speeds and directions and tidal elevations to an acceptable level. Figures 4.3a & 4.3b show example spatial plots of modelled currents in the Leannan estuary/Ramelton channel at maximum ebb on a neap tide. The flow patterns are predominately driven by the bathymetry and vectors are parallel to the channel outline.

Figure 4.2 shows the locations of the outer lough current meters for the 2004 study. Data at instrument locations CM5 and CM6 was used here for calibration purposes. Time series plots showing the measured and modelled data at locations CM5 (on a mean tide range) and CM6 (on a neap tide range) are presented in Figure 4.4. The measured data was recorded with ADCP profilers and reveals local turbulence in the water column. The modelled data is smoother and both data sets compare reasonably well. Figure 4.5 shows data measured in the Ramelton channel during the 2013 survey overlain with the corresponding modelled data. Figure 4.6 compares data measured in 2017 with modelled data. The pattern is similar to that observed in 2013 with good speed comparison and slightly shortened flood times. This difference is the result of the Leannan river flow.

Drogue tracks were reproduced to a good accuracy and simulated drogue speeds were comparable with measured data (Figure 4.7a-b).

The simulated salinity profiles in the Leannan estuary are presented in Figure 4.8. These correspond to the median ($8.7\text{m}^3/\text{s}$) and 95%ile low flows ($0.83\text{m}^3/\text{s}$). The results are consistent with EPA data for location LS150 (Figure 3.1) which is near the proposed outfall location.

The calibration and validation exercises have demonstrated that the model is fit for purpose and an appropriate tool for the assessment of the impacts of the proposed WWTP discharges on Lough Swilly.

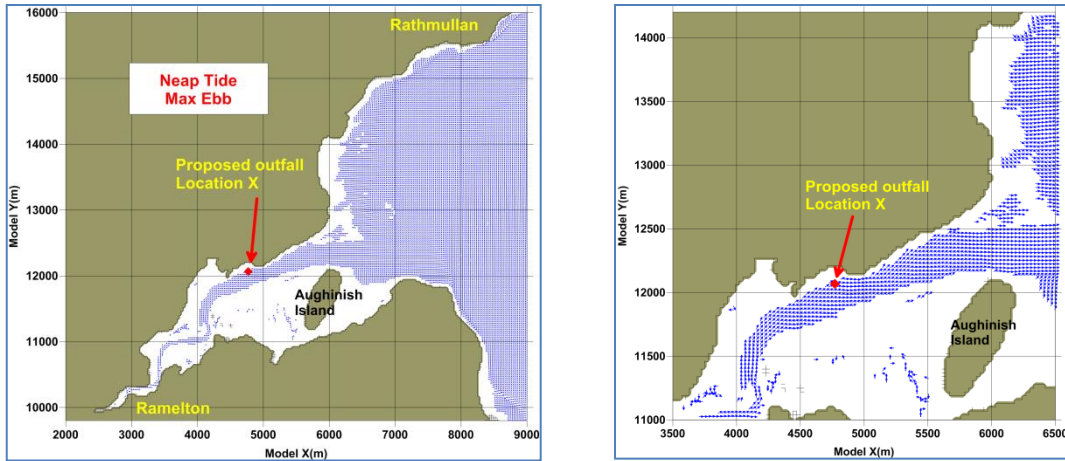


Figure 4.3a,b - Model current simulations at HW+3h

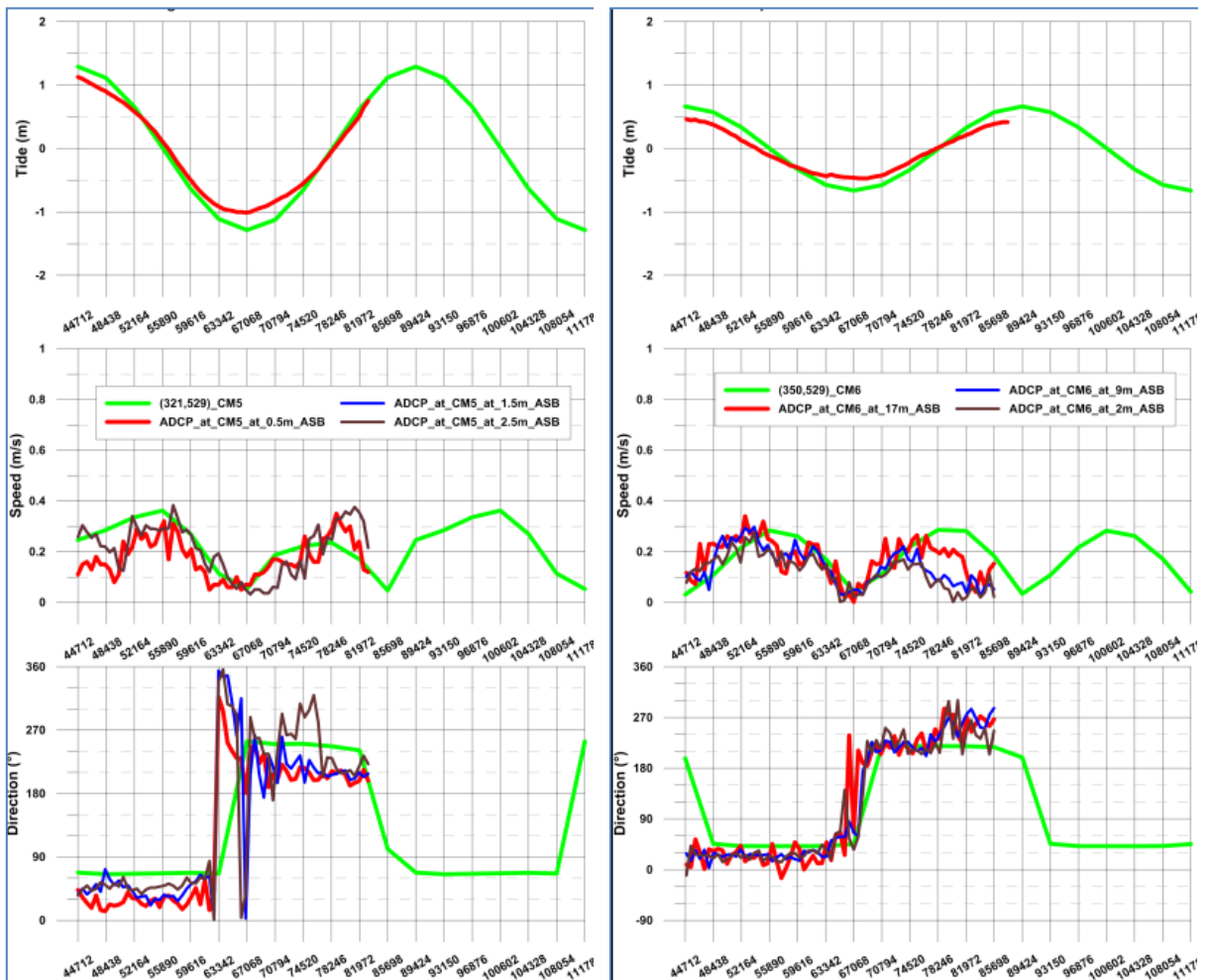


Figure 4.4a,b - Current meter data and model simulations at locations CM5 and CM6, time axis in seconds, grid intervals = 1/12 tidal period (refer to Figure 4.2 for locations)

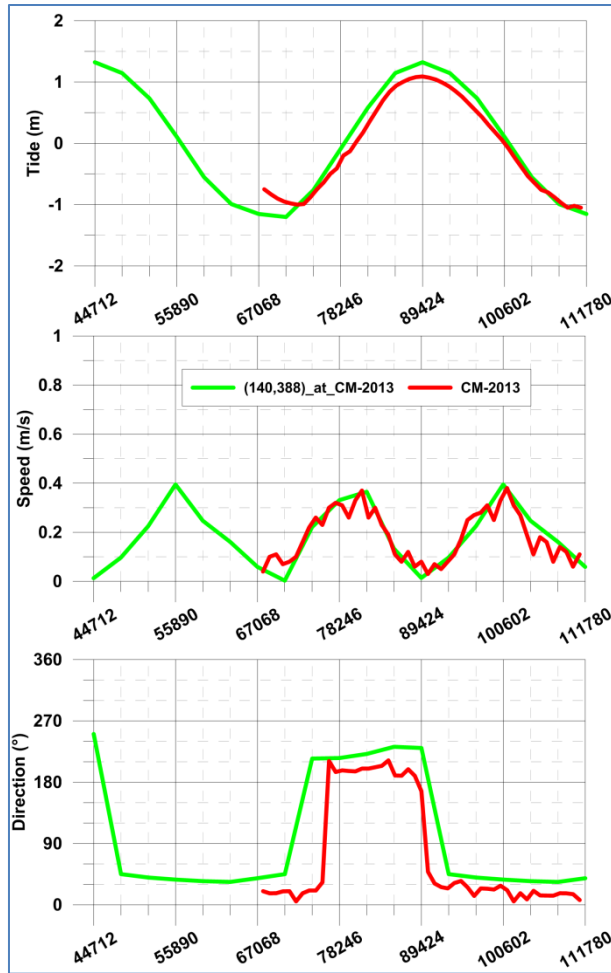


Figure 4.5 - Current meter simulation at location CM from 2013, time axis in seconds, grid intervals = 1/4 tidal period (see Figure 4.2 for locations)

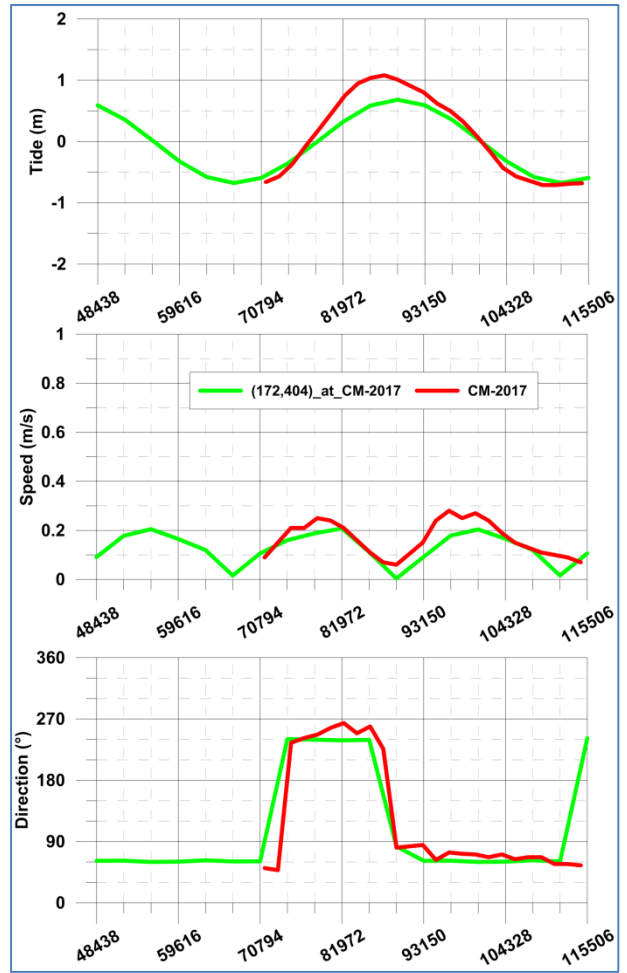


Figure 4.6 - Current meter simulation at location CM from 2017, , time axis in seconds, intervals = 1/4 tidal period (see Figure 4.2 for locations)

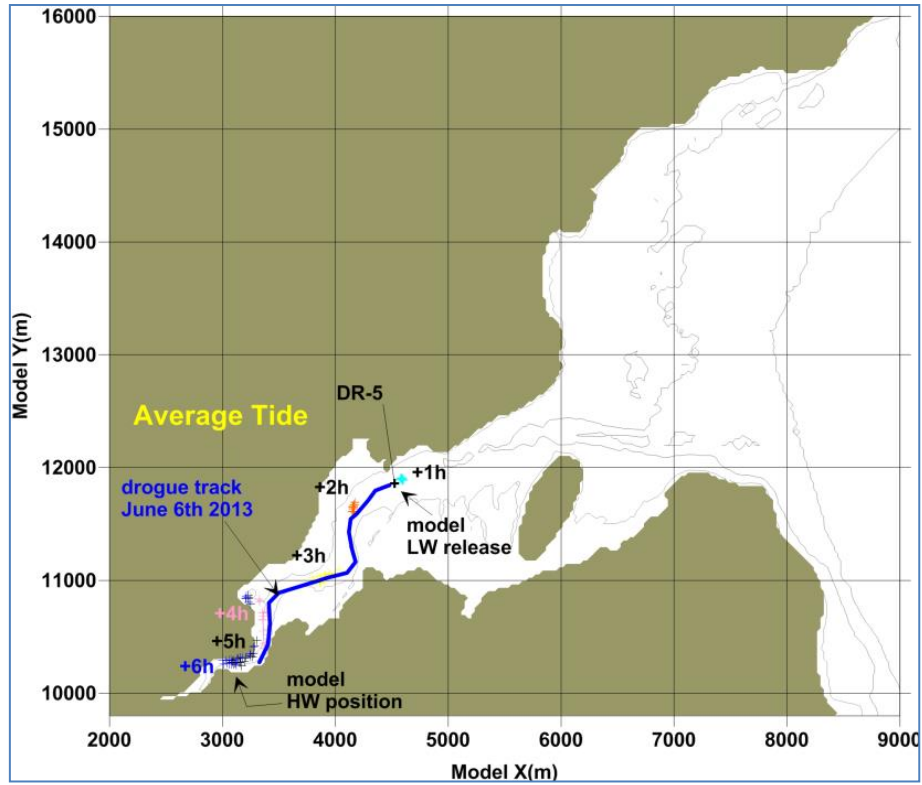


Figure 4.7a - Average Tide LW drogue release simulation from DR-5

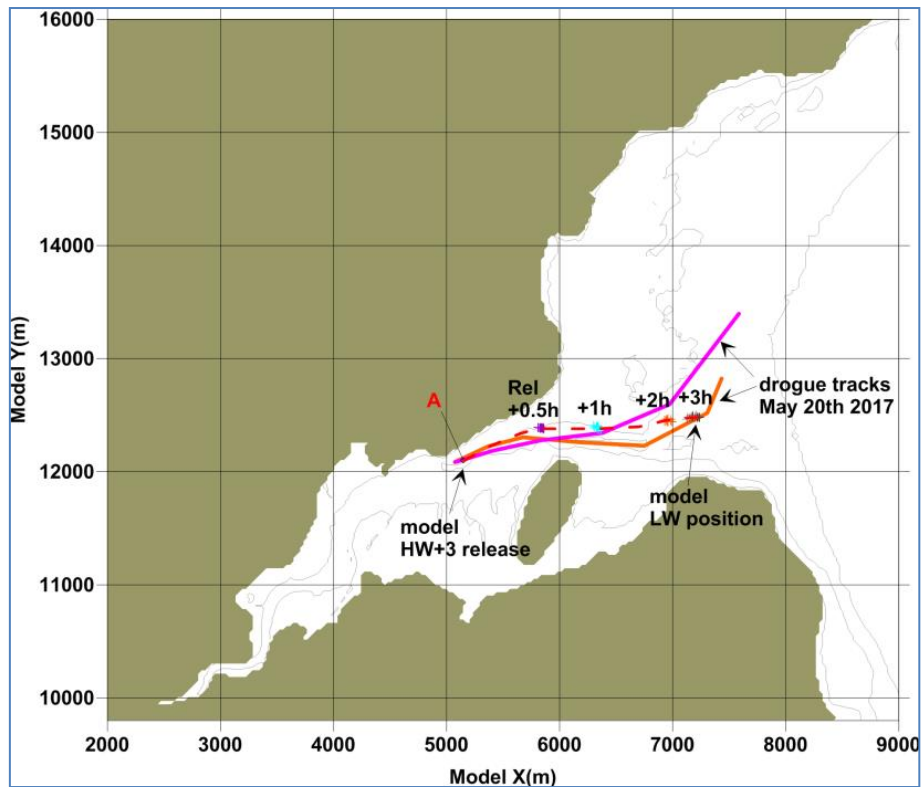


Figure 4.7b - Neap Tide HW drogue release simulation from DR-5

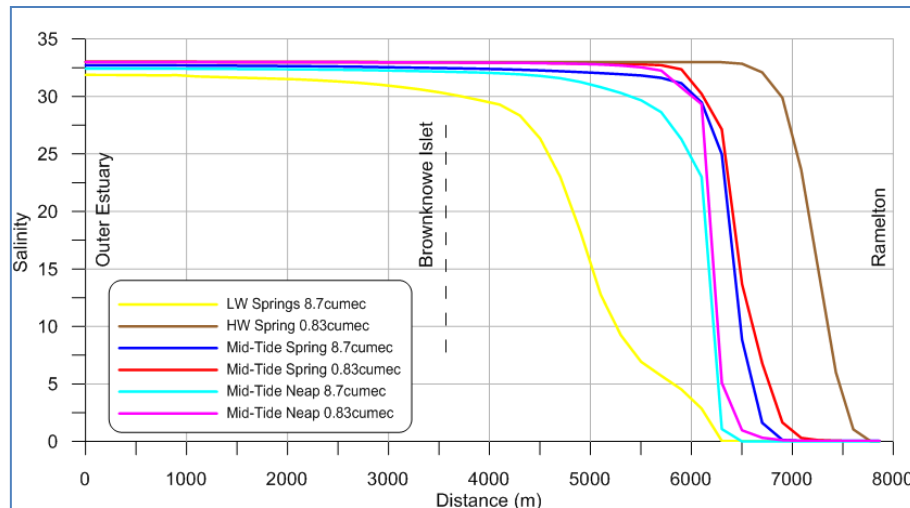


Figure 4.8 - Modelled salinity profiles

4.3 Contaminant Dispersion Simulations

The contaminant dispersion model LAG was used to simulate the mid and far-field dispersion of outfall discharges. This model is driven by the flow fields generated by M2D.

Four scenarios were examined with the model. These were:

- a. *The existing scenario with untreated discharges at Ramelton and Rathmullan;*
- b. *The proposed outfall PE 5,500 (10-year horizon);*
- c. *The proposed outfall PE 7,100 (30-year Horizon);*
- d. *The interaction of the proposed outfall with other nearby outfalls.*

The outfall bacterial contaminants of particular interest are e.coli and IE due to the proximity of the shellfish and bathing waters. As the outfall is located in transitional waters PO4 is the most relevant nutrient under the surface water regulations. Other parameters were modelled for completeness and included BOD, TA, UIA and DIN.

Model output was generated in the form of percentile plume concentration plots. Tabular data was also generated for specified regions in the model (Figure 4.9) to facilitate before and after comparisons. These regions were chosen to coincide with relevant locations such as the shellfish waters boundary, the bathing waters and EPA sampling locations.

The specific requirements of the various regulations listed in Tables 3.1 & 3.2 frame compliance in terms of occurrences at either the 95%ile, 50%ile level or geometric mean. The percentile plots were generated by simulating a full spring-neap tidal cycle and computing percentile occurrences at each model cell. Summer and winter scenarios were simulated for shellfish waters e.coli (T90 = 12 and 48 hours) and the nutrient parameters.

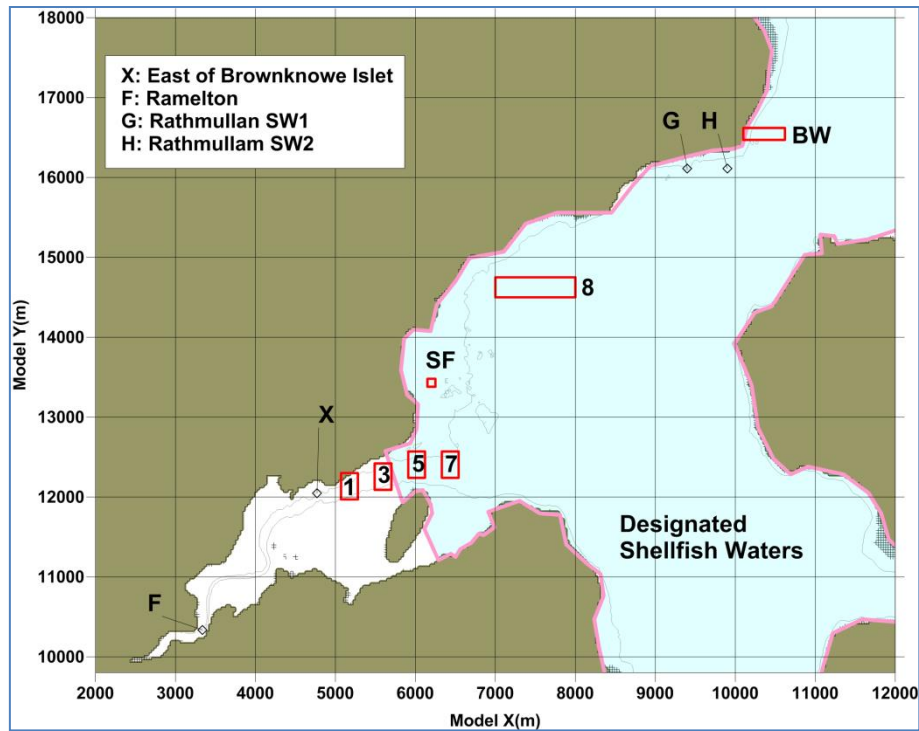


Figure 4.9 - Model output sampling regions for tabular outputs

a. Simulation of the Existing Scenario

Bacteriological Conditions

The existing Ramelton outfall (Location F in Figure 4.9) discharges untreated effluent to the Leannan estuary in the town environs. Waste waters from Rathmullan discharge directly to Lough Swilly through two sea outfalls (Locations G and H in Figure 4.9). There is limited or no treatment at these locations and the discharges can be considered raw sewage. The e.coli concentration is thus likely to be of the order of 1×10^7 cfu/100ml and the IE concentration 2×10^6 cfu/100ml.

The bacterial impact of the outfalls on the bathing waters is assessed by means of percentile plots where areas of concentration are less than the indicated value for 95% of the time. The plots are generated for calm weather conditions and are thus representative of a most concentrated plume scenario. Figure 4.10 shows the 95%ile plot for e.coli while Figure 4.11 shows the corresponding 95%ile plot for IE. The plots show the extent to which the existing discharges spatially impact the coastal waters. Adverse bathing water impacts, defined as exceeding the bathing waters 'Good' status (i.e. e.coli above 500cfu/100ml and IE above 200cfu/100ml), are confined to the Ramelton channel and the eastern extent of the bathing waters at Rathmullan. The impacts are summarised in Table 4.2a. E.coli concentrations are above 500cfu/100ml in the Ramelton channel and at the western extent of the shellfish waters indicated by regions 5 & 7 in Figure 4.9. The predicted concentrations in the designated Rathmullan bathing waters, region BW in Figure 4.9, are similar to those observed in the monitoring data (i.e. 95%ile e.coli = 208cfu/100ml, Table 3.4). Predicted e.coli concentrations at region SF which was a historic monitoring site but is now no longer used are below 5cfu/100ml. The predicted e.coli concentration at region 8, which lies in the path of the

Rathmullan plumes is predicted to be <50cfu/100ml. The corresponding IE concentration is also < 50cfu/100ml.

The Urban Pollution Management Manual (ref:5) advocates a geometric mean EQS based approach for assessment of shellfish waters. A geometric mean calculation was thus applied to the modelled e.coli concentrations in each cell over the spring-neap tide cycle. Figure 4.12a shows computed summer values (T90 = 12 hours) while winter values are shown in Figure 4.12b (T90 = 48 hours). The predicted values exceed the 110cfu/100ml target in localised areas adjacent to the individual outfalls. Values above 5cfu/100ml are predicted in the wider area extending several kilometres from the discharge points. The geomean values are also summarised in Table 4.2b.

Nutrient and Oxygenation Conditions

The model was also used to simulate the fate of both BOD and PO4 contaminant outputs from the existing outfalls. The BOD is evaluated for the 95%ile condition (Figure 4.13a,b for summer and winter respectively). However, there is no difference between the summer and winter cases for BOD since the background levels are the same for both cases, as are the EQS values. The PO4 is evaluated for the 50%ile condition (Figure 4.14a,b for summer and winter respectively). Predicted values at the EPA sampling location LS150 are at the background level. Neither of these parameters is significant in the existing situation as instanced by the water sample data in Table 3.3.

The colour banding shown on the plots differs for winter and summer season outputs. This is because the upper value is set by the EQS target for each season and the lower value by the relevant background value.

	Model Sampling Regions						
	1	3	5	7	8	SF	BW
	E.coli (cfu/100ml) (T90 = 12 hours)						
Calm	552	577	393	686	<50	<5	>250
	Intestinal Enterococci (cfu/100ml) (T90 = 24 hours)						
Calm	203	162	170	256	<50	<5	>250

Table 4.2a - Predicted 95%ile bacterial concentrations at model sampling regions for the existing scenario

	Model Sampling Regions						
	1	3	5	7	8	SF	BW
	E.coli (cfu/100ml) - Geomean						
Summer	<5	<5	<5	<5	<5	<5	50
Winter	12	8	9	6	<5	<5	260

Table 4.2b - Predicted Geomean bacterial concentrations at model sampling regions for the existing scenario (Ramelton & Rathmullan (Loc. F+G+H) for SUMMER (T90=12) and WINTER (T90 = 48hrs) conditions

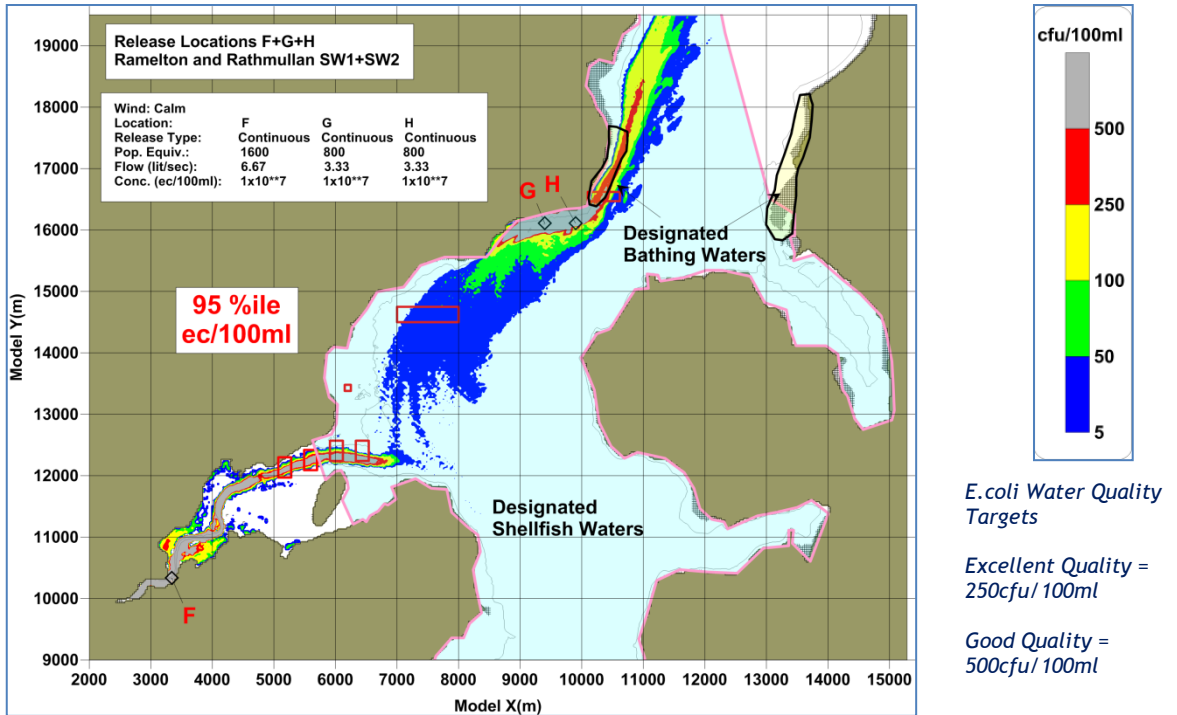


Figure 4.10 - Simulated 95%ile e.coli concentration for discharges from the existing outfall locations (T90 = 12hours)

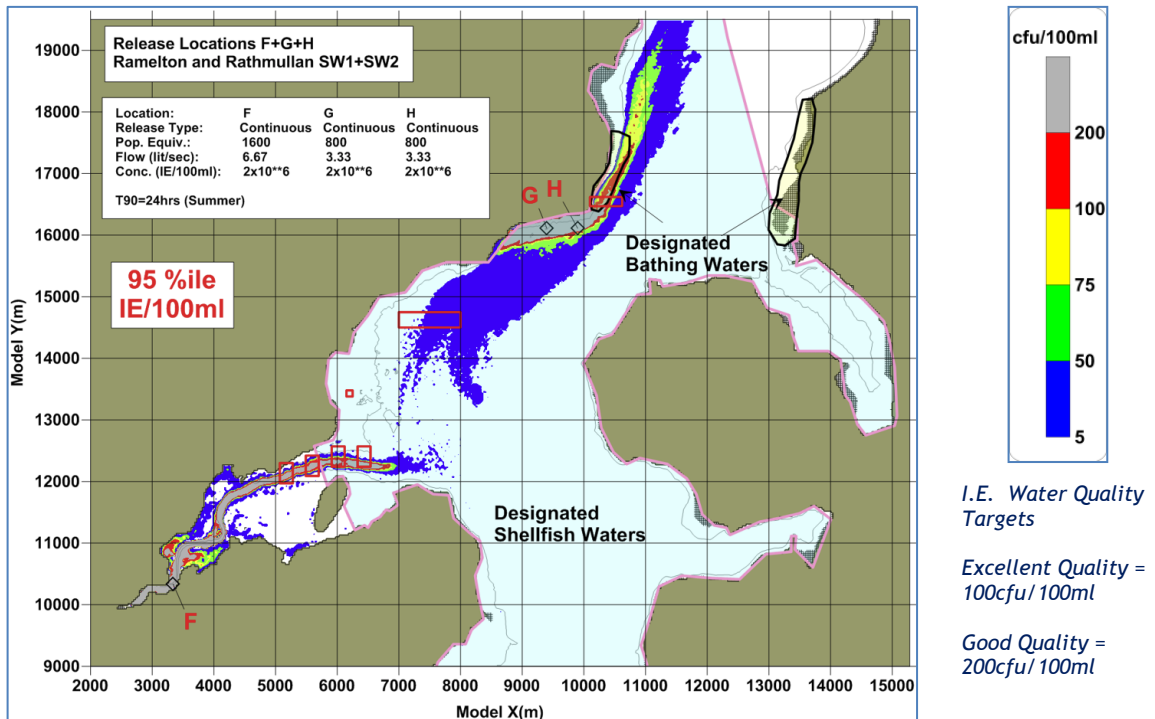


Figure 4.11 - Simulated 95%ile IE concentration for discharges from the existing outfall locations (T90 = 24hours)

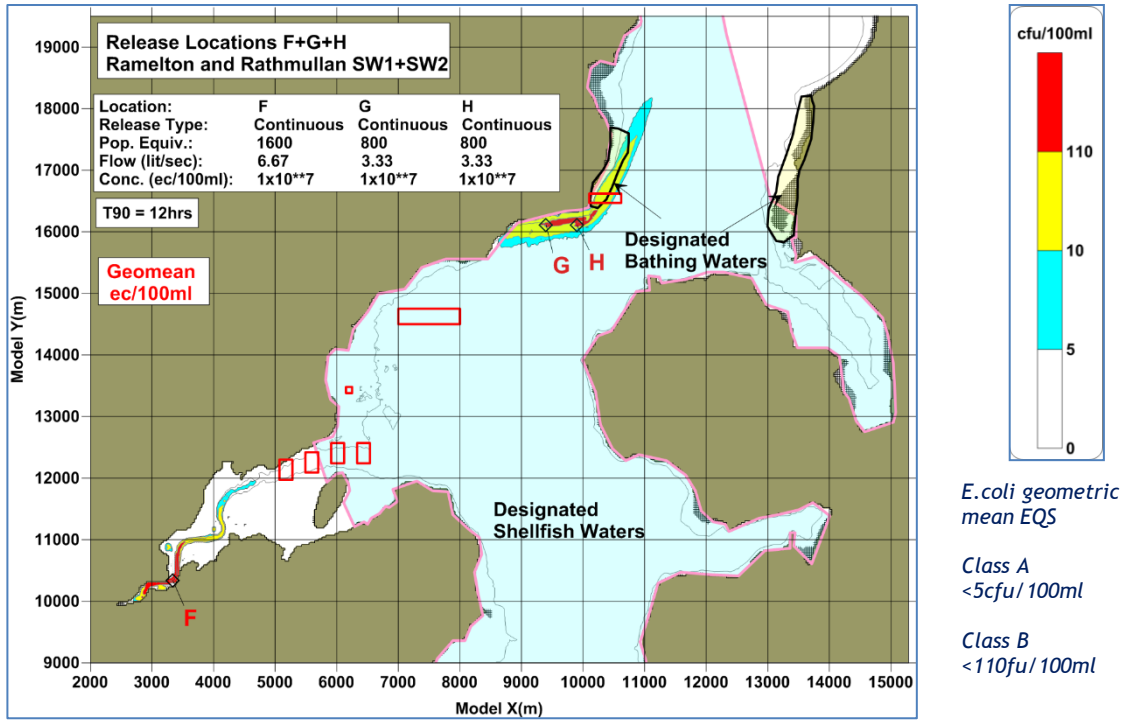


Figure 4.12a - Simulated Summer (T90=12hrs) geomean e.coli concentration for discharges from the existing outfall locations

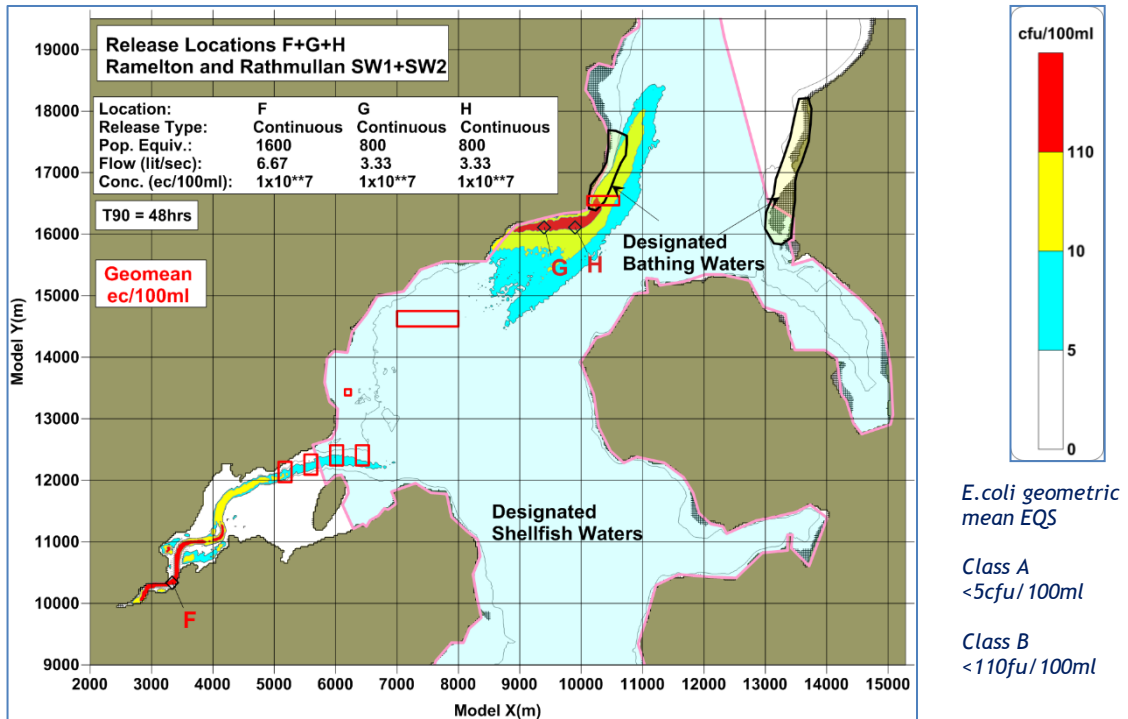


Figure 4.12b - Simulated Winter (T90=48hrs) geomean e.coli concentration for discharges from the existing outfall locations

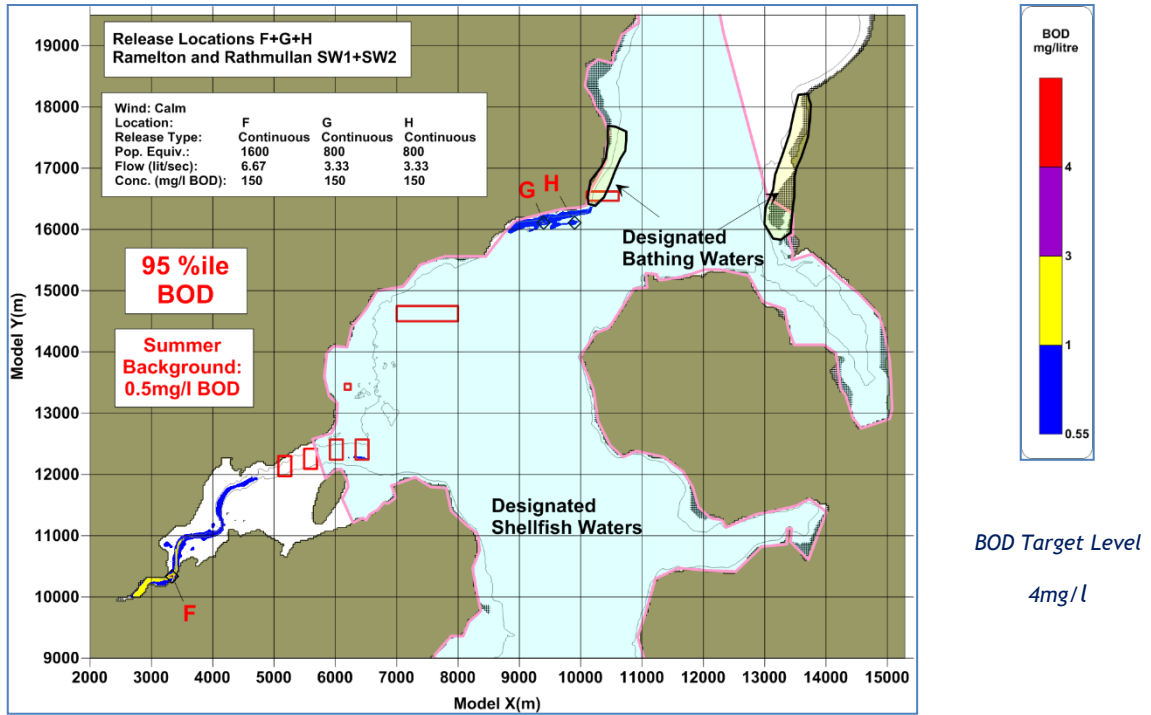


Figure 4.13a - Simulated Summer 95%ile BOD concentration for discharges from the existing outfall locations

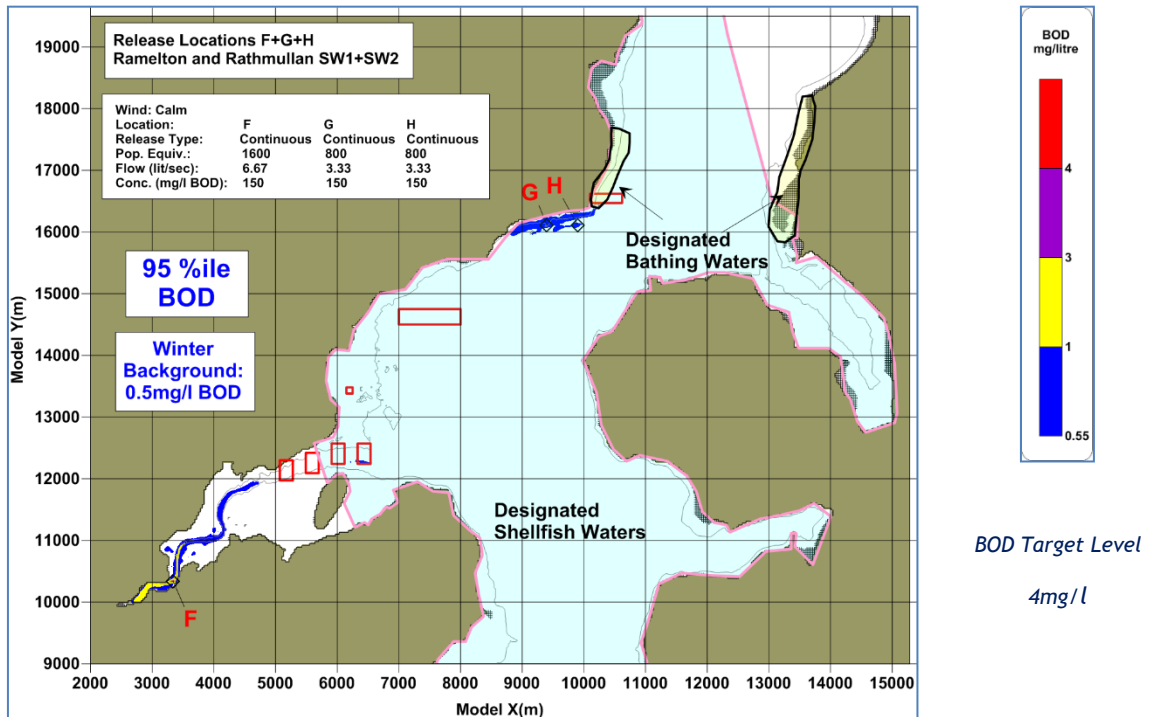


Figure 4.13b - Simulated Winter 95%ile BOD concentration for discharges from the existing outfall locations

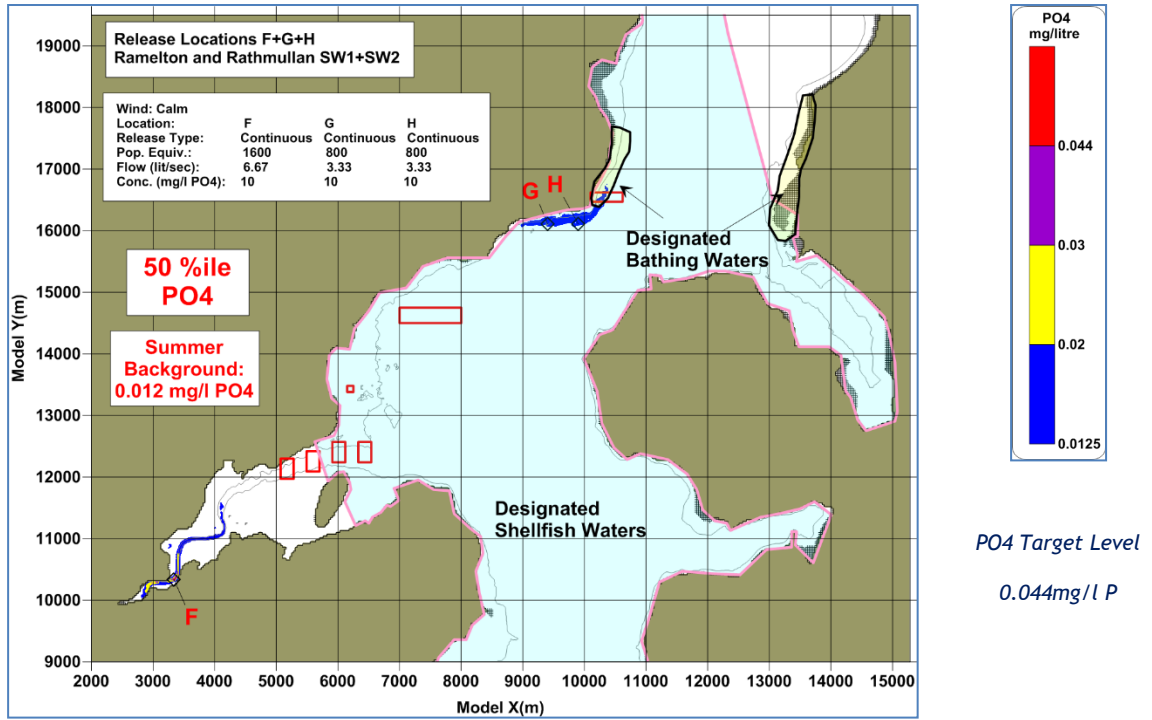


Figure 4.14a - Simulated Summer 50%ile PO4 concentration for discharges from the existing outfall locations

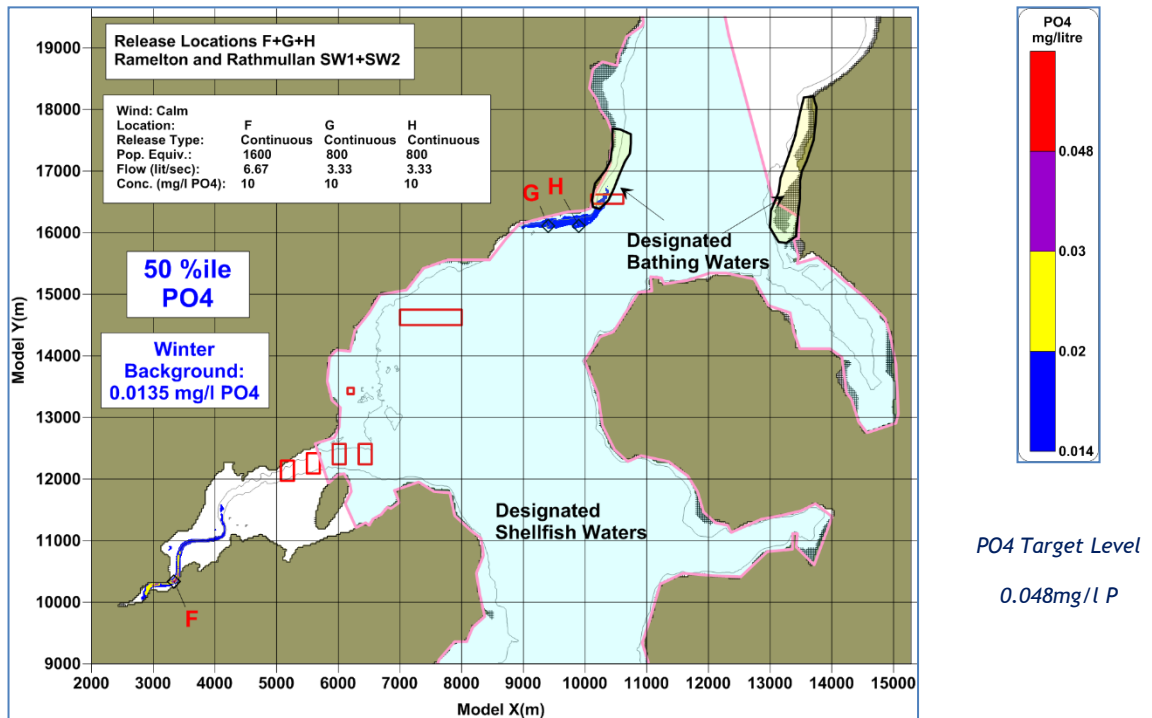


Figure 4.14b - Simulated Winter 50%ile PO4 concentration for discharges from the existing outfall locations

b. Proposed Outfall (PE 5,500 - 10year horizon)

Dispersion simulations were conducted for the proposed outfall location which is approximately 250m east of Brownknowe Islet. This location is referred to as Location X for the model runs.

Bacteriological Conditions

The bacterial impact of the proposed discharge on the bathing waters is assessed by means of the percentile plots which incorporate data for all stages of the tidal cycle. Figure 4.15 shows the 95%ile plot for e.coli. A bacterial mixing plume is observable in the Leannan Estuary in the vicinity of the proposed outfall point. However, in terms of impact on Bathing Waters, the plume does not impact on the Designated Bathing Waters at Rathmullan and the proposed discharge is compatible with the achievement of Excellent Bathing Water Quality at Rathmullan. The 95%ile plot of IE concentration is shown in Figure 4.16. The impacted area is less than that indicated for e.coli. The impacted waters do not reach as far north as the Rathmullan designated bathing waters. The impacts are summarised numerically for the sampling regions in Table 4.3a.

The impact on designated shellfish waters is assessed on the basis of the geometric mean approach and relevant concentration plots are presented in Figure 4.17a for the summer season (T90 = 12 hours) and in Figure 4.17b for the winter season (T90 = 48 hours). The predicted values do not exceed the 110cfu/100ml target at any location. Values above 5cfu/100ml are predicted to extend 400m into the shellfish waters during the summer season while this increases to about 850m during the winter season, however these values remain well below the target of 110cfu/100ml. There is a significant improvement in the e.coli concentrations in the designated shellfish water in the vicinity of Rathmullan. This is demonstrated via comparison of the existing scenario (figure 4.12b) and proposed scenario (4.17b). The impacts are summarised numerically for the sampling regions in Table 4.3b.

Both the e.coli and IE show significant reductions in all regions from those predicted for the existing situation (Table 4.2a,b).

	Model Sampling Region						
	1	3	5	7	8	SF	BW
	E.coli (cfu/100ml) (T90 = 12 hours)						
Calm	190	130	82	80	<5	<5	<5
	Intestinal Enterococci (cfu/100ml) (T90 = 24 hours)						
Calm	46	34	25	25	<5	<5	<5

Table 4.3a - Predicted 95%ile bacterial concentrations at model sampling regions for discharge from the proposed outfall (PE =5,500, 10-year horizon)

	Model Sampling Regions						
	1	3	5	7	8	SF	BW
	E.coli (cfu/100ml) - Geomean						
Summer	13	7	6	<5	<5	<5	<5
Winter	25	15	11	6	<5	<5	<5

Table 4.3b - Predicted geomean bacterial concentrations at model sampling regions for discharge from the proposed outfall (PE =5,500, 10-year horizon)- for Summer (T90=12hrs) and Winter (T90 = 48hrs) conditions

Nutrient and Oxygenation Conditions

The 95%ile BOD concentration has been computed and is presented in Figures 4.18a,b for summer and winter respectively. Values are significantly lower than the target EQS of 4mg/l.

The 50%ile PO₄ prediction is shown in Figures 4.19a,b for summer and winter respectively. The transitional waters target level of <0.044mg/l for summer and 0.048mg/l for winter is only exceeded in a very small area around the outfall (+/-20m) and is barely visible on the plot scale. It thus complies with the mixing zone requirements outlined in Section 3.2.

As noted previously the colour banding shown on the plots differ for winter and summer season outputs. This is because the upper value is set by the EQS target for each season and the lower value by the relevant background value.

The 50%ile TA (NH₃) is shown in Figures 4.20a,b for summer and winter respectively. There is no transitional waters target for this parameter.

The 50%ile DIN prediction is shown in Figures 4.21a,b for summer and winter respectively. There is no transitional waters target for this parameter. If the coastal waters criteria are applied, then the discharge would comply with the 'Good' status limit (<0.71mg/l N based on winter salinity of 27.8psu). The local winter background DIN level is about 0.19mg/l N with slightly lower values of 0.14mg/l N further out in the lough (Table 3.3). These background levels include the impacts of the existing Rathmullan discharges.

The proposed treatment process will result in TA and DIN values of 55 and 60mg/l respectively, as per Table 3.7. This may change in the final design. The model simulations have also been completed for DIN values of 45 and 75mg/l and TA of 40 and 70mg/l. These results are included in Appendix A.

Model plots for Unionised Ammonia (UIA) are also included in Appendix A.

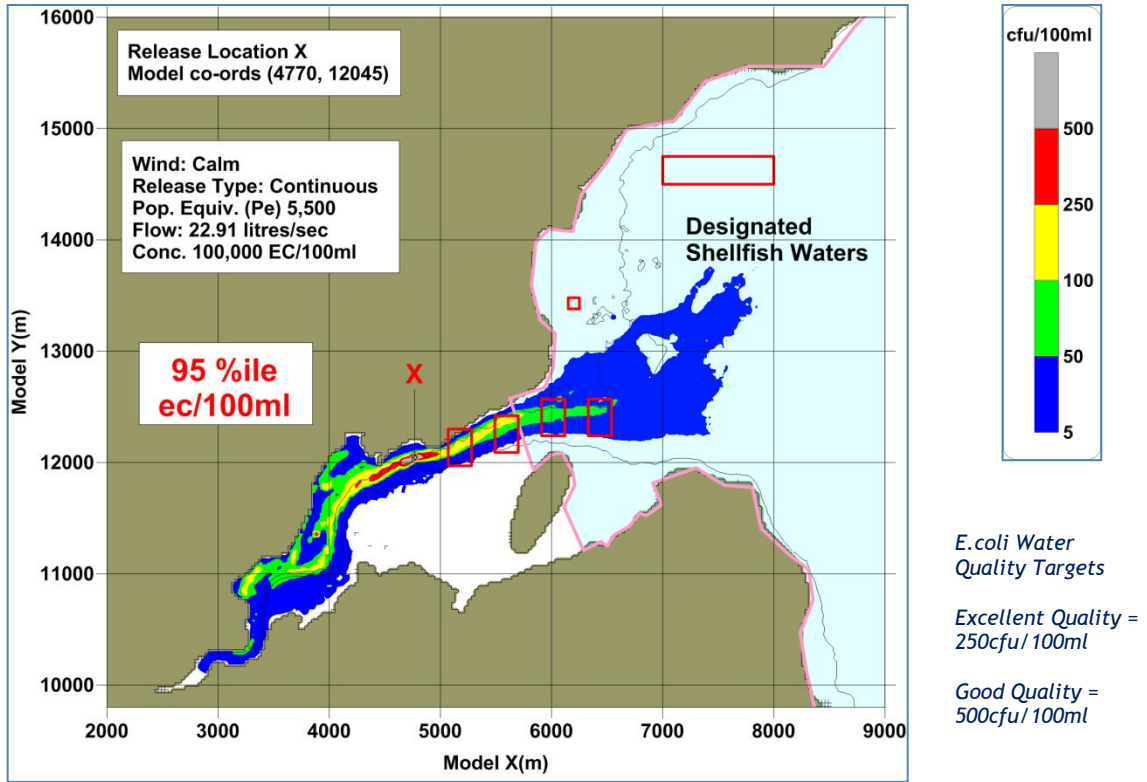


Figure 4.15 - Simulated 95%ile e.coli concentration for discharge from proposed outfall

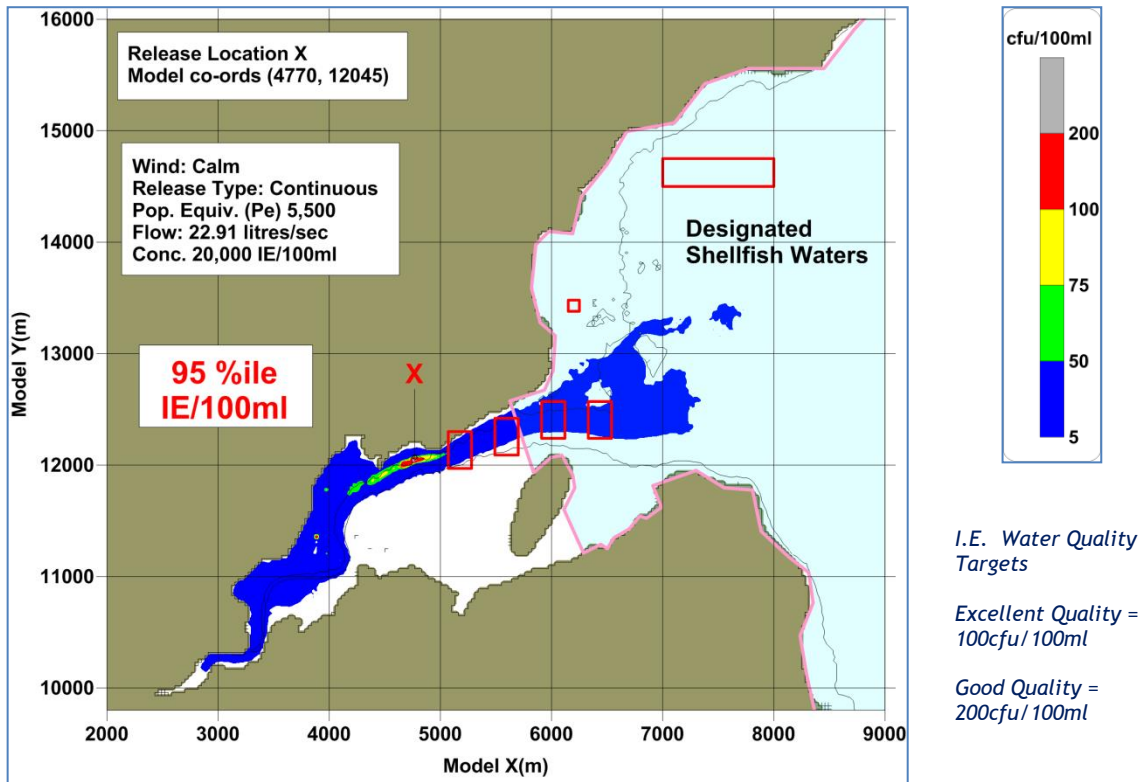


Figure 4.16 - Simulated 95%ile IE concentration for discharge from proposed outfall

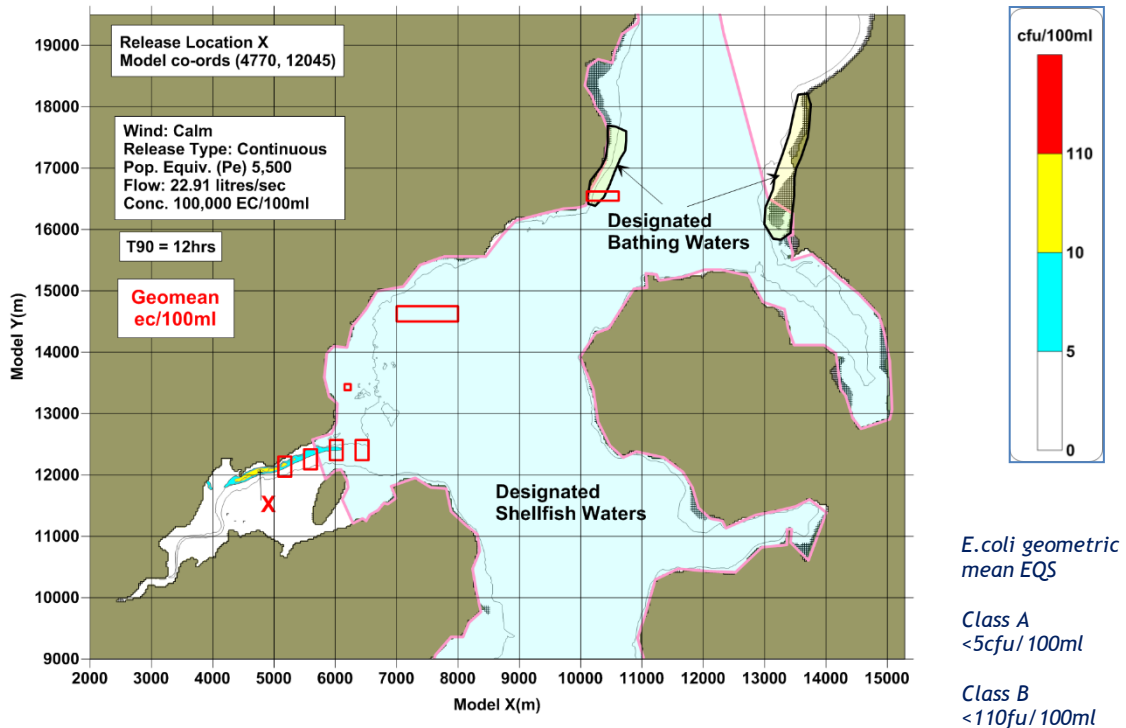


Figure 4.17a - Simulated Summer (T90=12hours) geomean e.coli concentration for discharges from the proposed outfall location

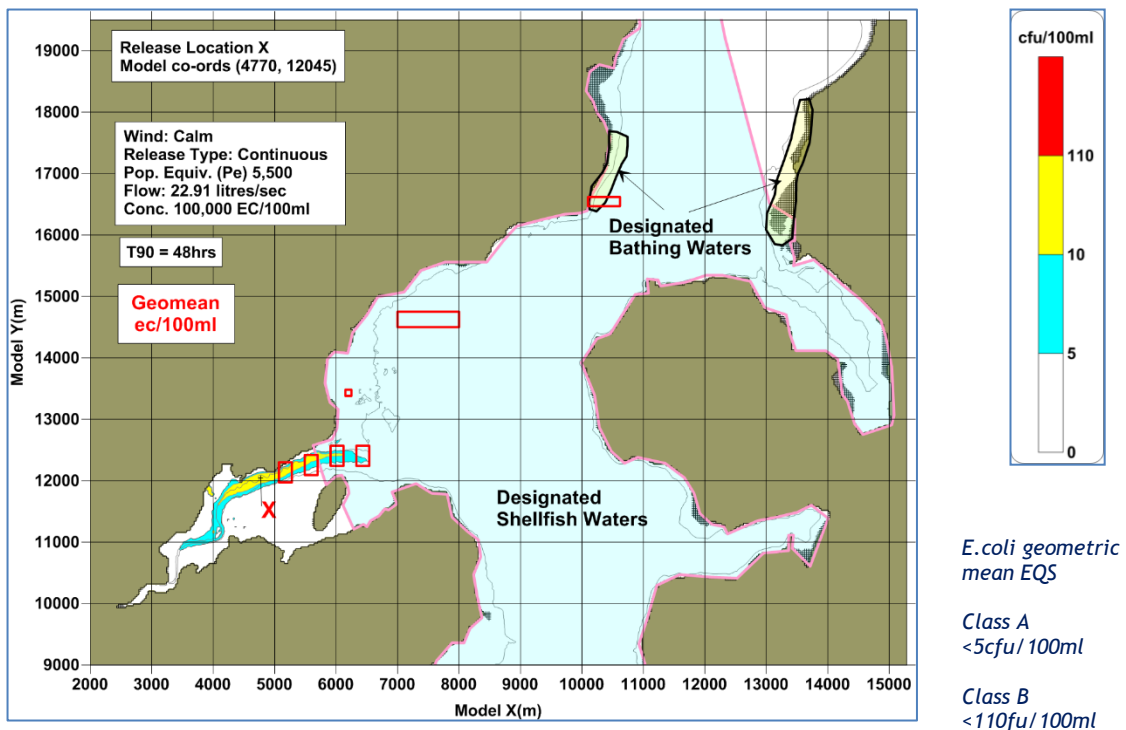


Figure 4.17b - Simulated Winter (T90=48hours) geomean e.coli concentration for discharges from the proposed outfall location

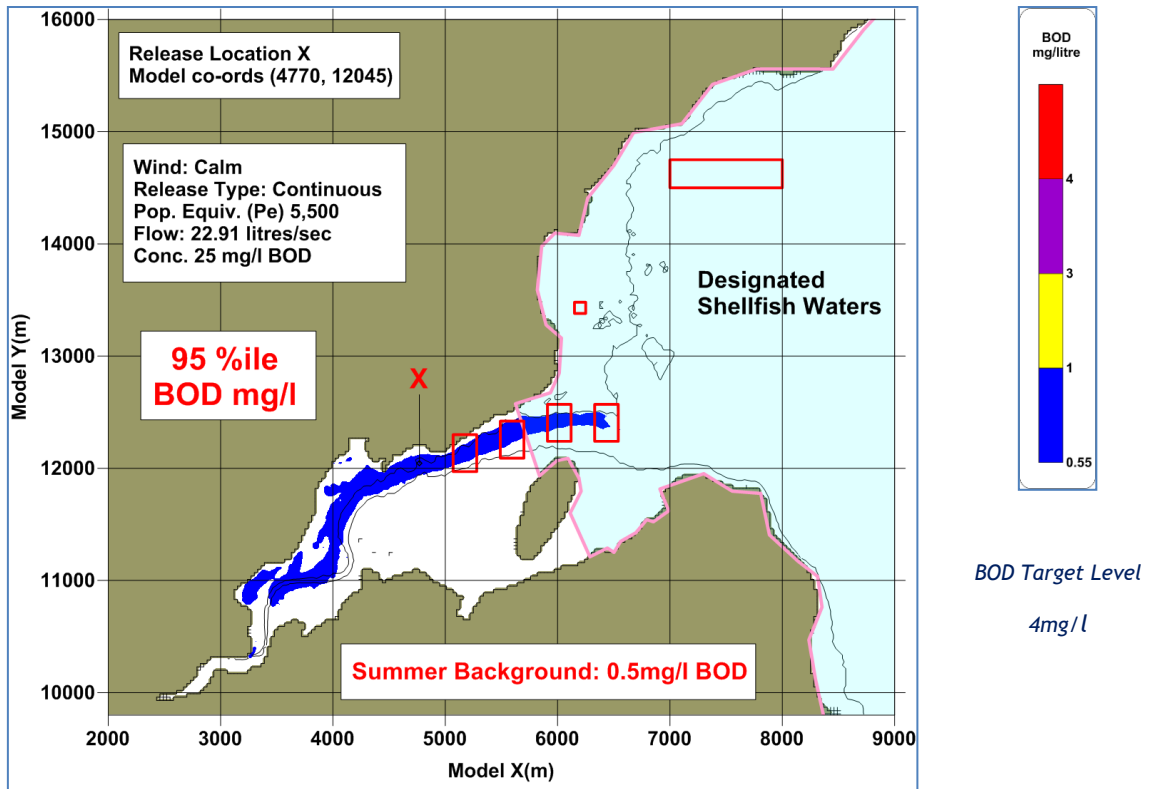


Figure 4.18a - Simulated Summer 95%ile BOD concentration for discharge from proposed outfall

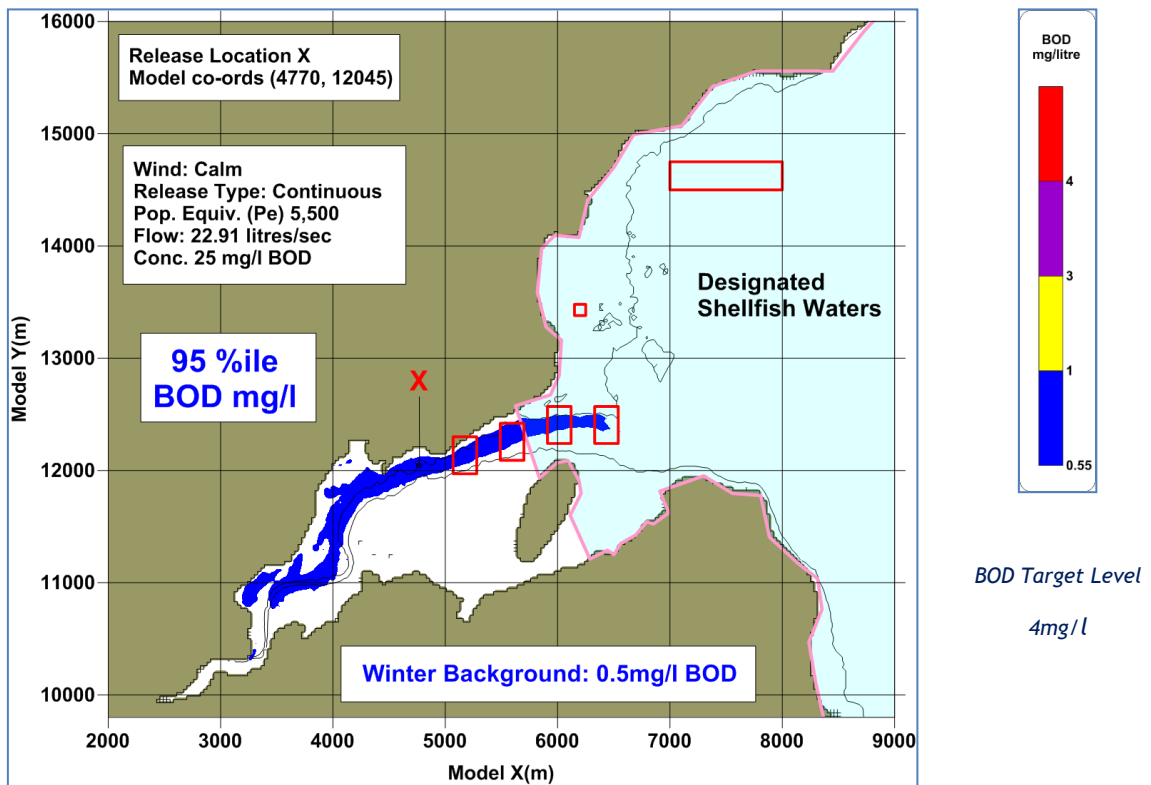


Figure 4.18b - Simulated Winter 95%ile BOD concentration for discharge from proposed outfall

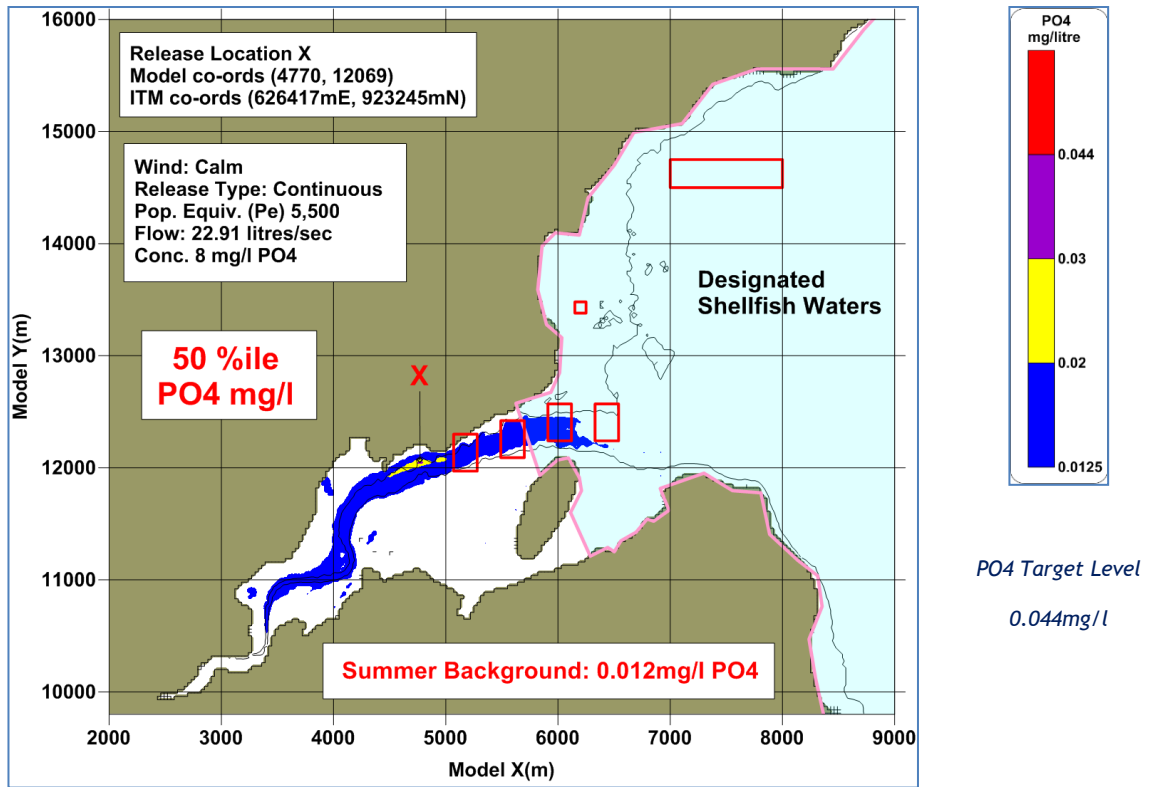


Figure 4.19a - Simulated Summer 50%ile PO4 concentration for discharge from proposed outfall

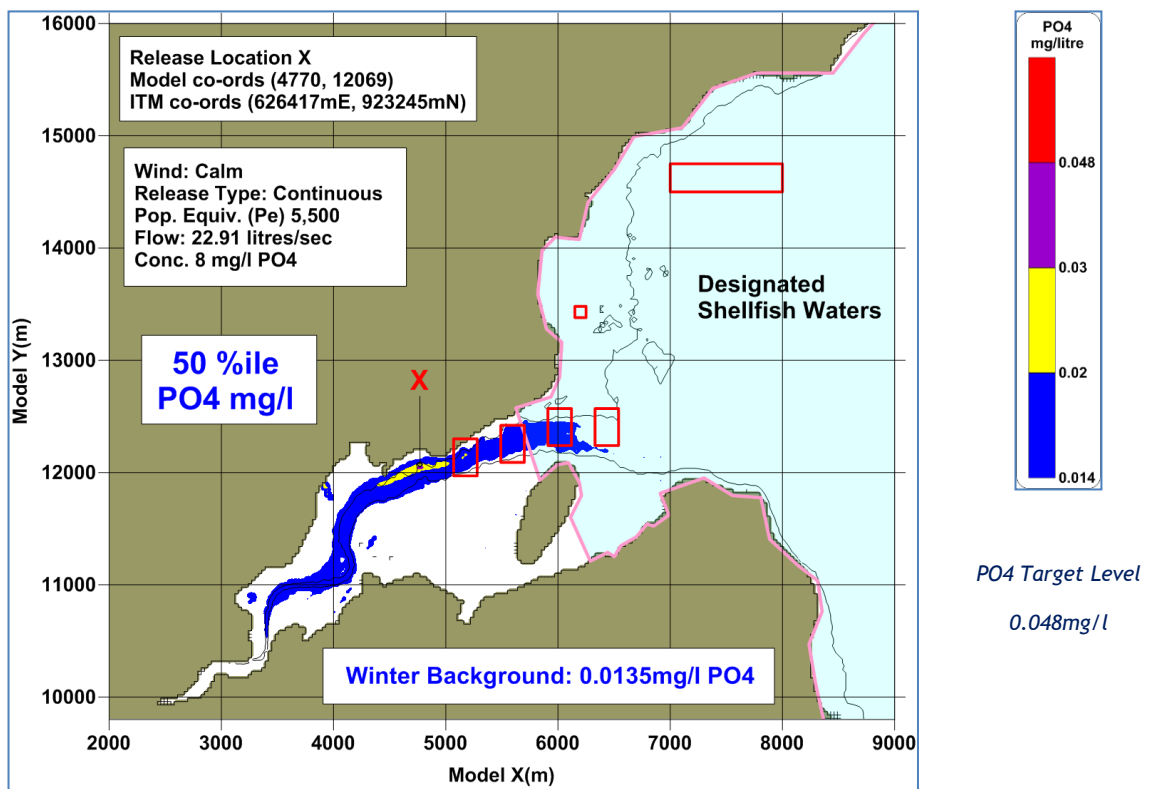


Figure 4.19b - Simulated Winter 50%ile PO4 concentration for discharge from proposed outfall

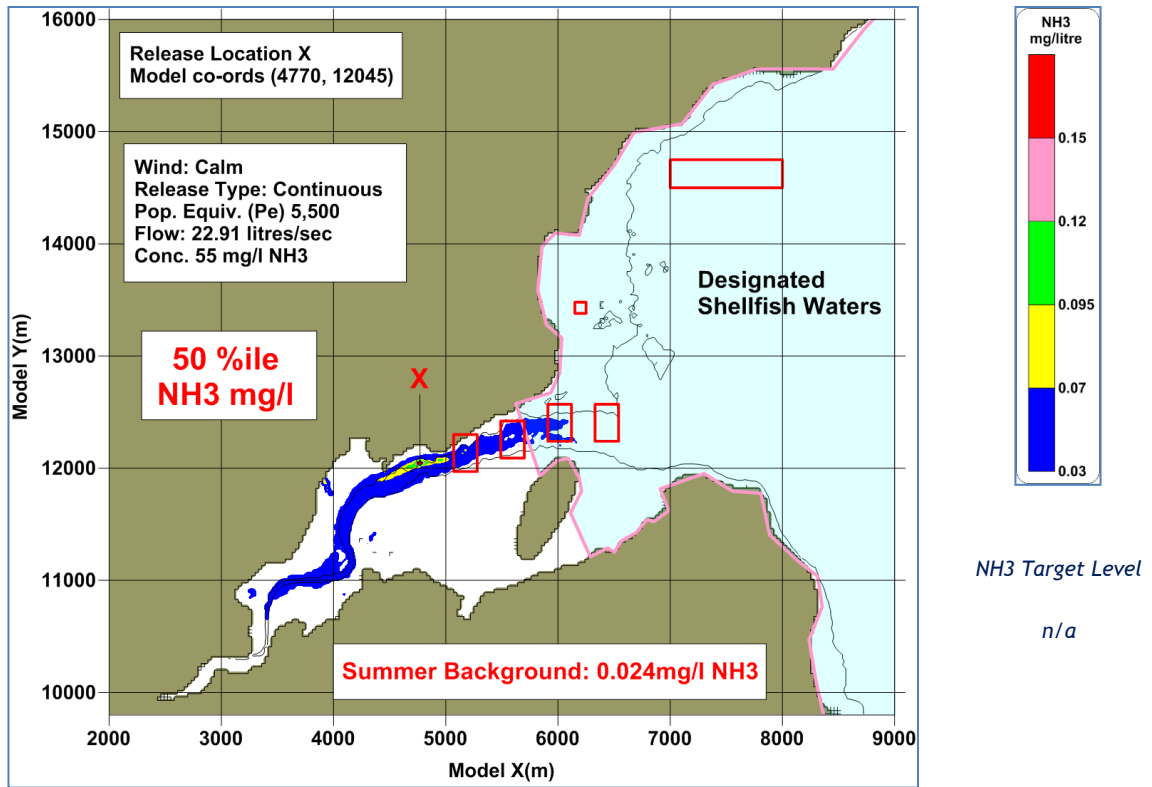


Figure 4.20a - Simulated Summer 50%ile NH3 concentration for discharge from proposed outfall

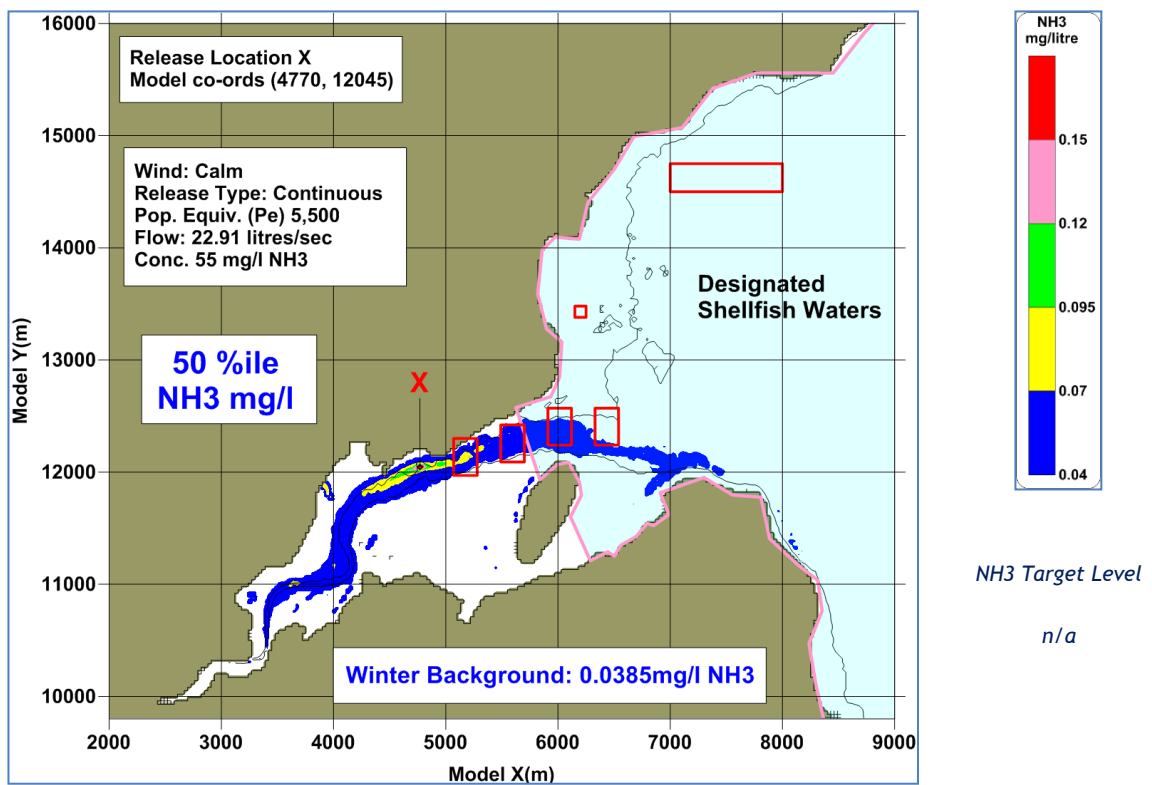


Figure 4.20b - Simulated Winter 50%ile NH3 concentration for discharge from proposed outfall

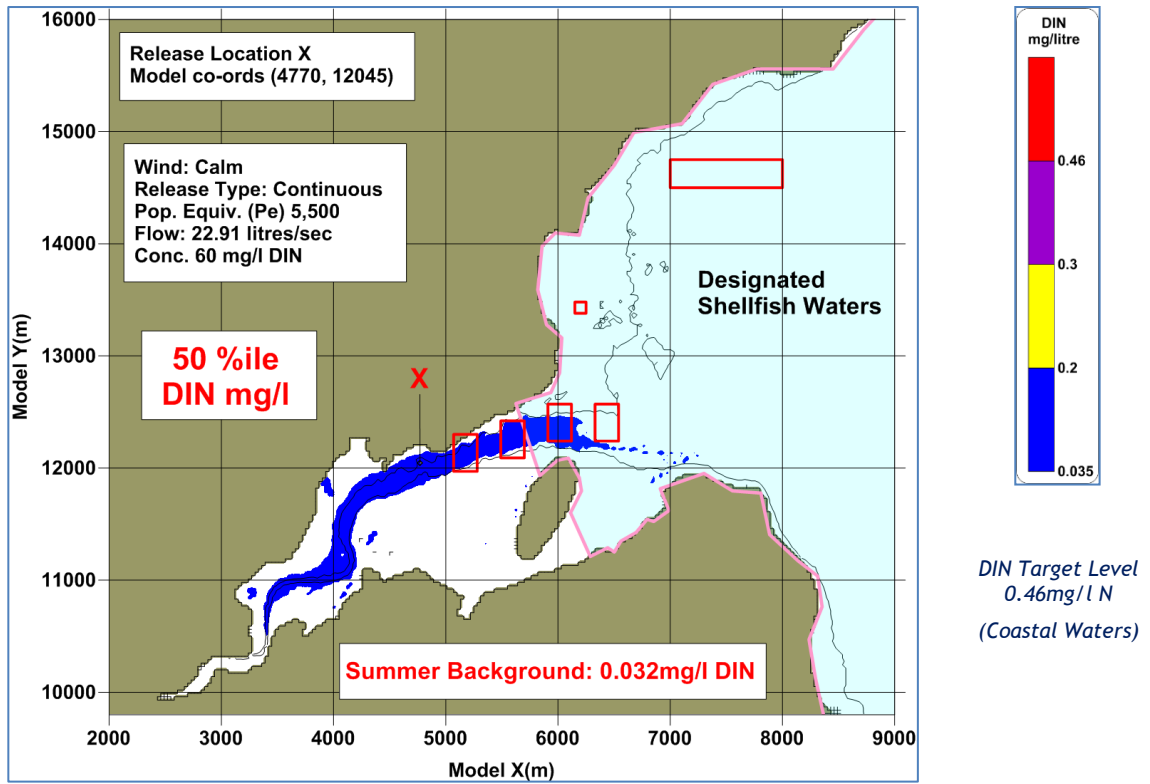


Figure 4.21a - Simulated Summer 50%ile DIN concentration for discharge from proposed outfall

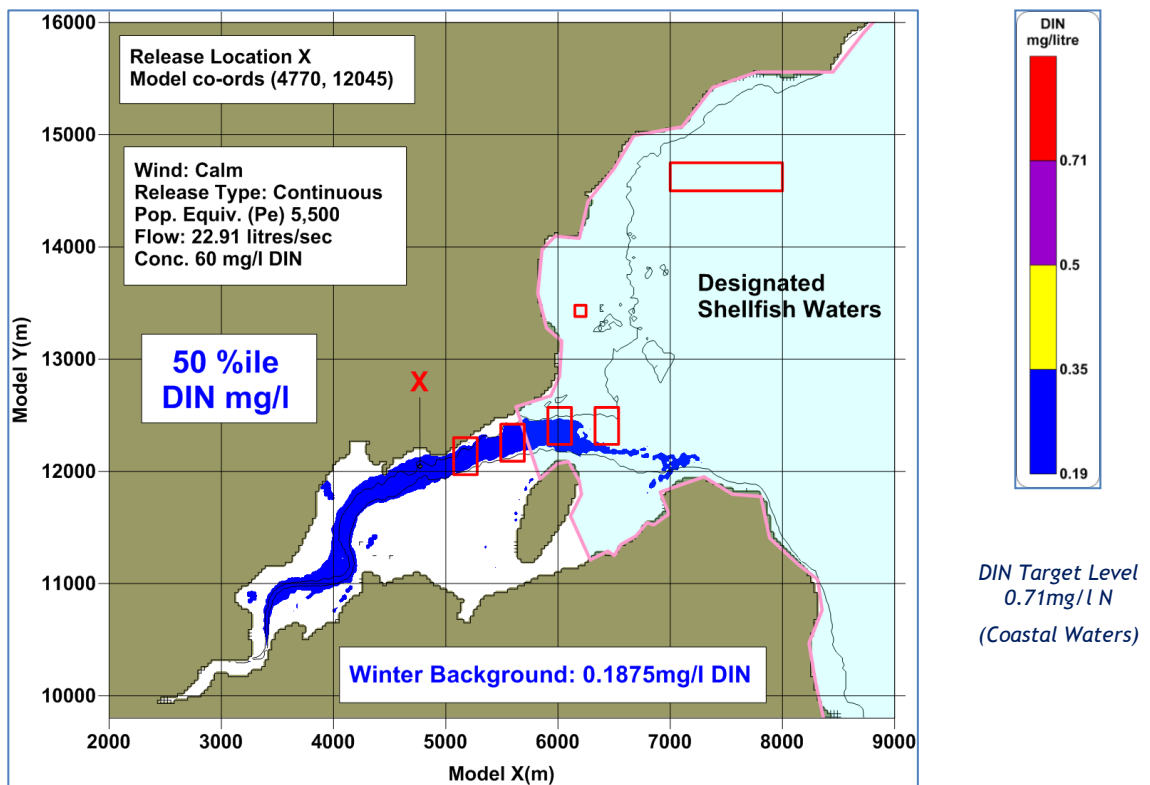


Figure 4.21b - Simulated Winter 50%ile DIN concentration for discharge from proposed outfall

c. Proposed Outfall Future Scenario (PE 7,100)

The increased outfall flow associated with the long-term PE of 7,100 has been modelled. The overall impacts of the discharges on the receiving waters are again assessed by means of the percentile and geomean plots which incorporate all data for all stages of the tide.

Bacteriological Conditions

The bacterial impact of the proposed discharge on the bathing waters is assessed by means of the percentile plots. Figure 4.22 shows the 95%ile e.coli concentration plot. The area of impact is similar to that presented previously for the 5,500 PE simulations with locally higher concentrations. A bacterial mixing plume is observable in the Leannan Estuary in the vicinity of the proposed outfall point. However, in terms of impact on Bathing Waters, the plume does not impact on the Designated Bathing Waters at Rathmullan and the proposed discharge is compatible with the achievement of Excellent Bathing Water Quality at Rathmullan. The 95%ile plot of IE concentration is shown in Figure 4.23. The impacted area is less than that indicated for e.coli. The impacted waters do not reach as far north as the Rathmullan designated bathing waters. The impacts are summarised numerically for the sampling regions in Table 4.4a.

The impact on designated shellfish waters is assessed on the basis of the geometric mean approach and relevant concentration plots are presented in Figure 4.24a for the summer season (T90 = 12 hours) and in Figure 4.24b for the winter season (T90 = 48 hours). The predicted values do not exceed the 110cfu/100ml target at any location. Values above 5cfu/100ml are predicted to extend 500m into the shellfish waters during the summer season while this increases to about 1000m during the winter season, however these values remain well below the target of 110cfu/100ml. There is a significant improvement in the E.Coli concentrations in the designated Shellfish water in the vicinity of Rathmullan. These are demonstrated via comparison of the existing scenario (figure 4.12b) and proposed scenario (4.24b). The impacts are summarised numerically for the sampling regions in Table 4.4b.

	Model Sampling Region						
	1	3	5	7	8	SF	BW
	E.coli (cfu/100ml) (T90 = 12 hours)						
Calm	245	168	106	103	<5	<5	<5
	Intestinal Enterococci (cfu/100ml) 9T90 = 24 hours)						
Calm	60	37	32	32	<5	<5	<5

Table 4.4a - Predicted 95%ile bacterial concentrations at model sampling regions for discharge from the proposed outfall, (PE =7,100, 30-year horizon)

	Model Sampling Regions						
	1	3	5	7	8	SF	BW
	E.coli (cfu/100ml) - Geomean						
Summer	16	11	7	<5	<5	<5	<5
Winter	31	18	14	7	<5	<5	<5

Table 4.4b - Predicted geomean bacterial concentrations at model sampling regions for discharge from the proposed outfall (PE =7,100, 30-year horizon) for Summer (T90 = 12hrs) and Winter (T90 = 48hrs) conditions

Nutrient and Oxygenation Conditions

The 95%ile BOD concentration has been computed and is presented in Figures 4.25a,b for summer and winter respectively. Values are significantly lower than the target EQS of 4mg/l.

The 50%ile PO4 prediction is shown in Figures 4.26a,b for summer and winter respectively. The transitional waters target level of <0.044mg/l for summer and 0.048mg/l for winter is only exceeded in a very small area around the outfall (+/-20m) and is barely visible on the plot scale. It thus complies with the mixing zone requirements outlined in Section 3.2.

As noted previously the colour banding shown on the plots differ for winter and summer season outputs. This is because the upper value is set by the EQS target for each season and the lower value by the relevant background value.

The 50%ile TA (NH3) is shown in Figures 4.27a,b for summer and winter respectively. There is no transitional waters target for this parameter.

The 50%ile DIN prediction is shown in Figures 4.28a,b for summer and winter respectively. There is no transitional waters target for this parameter. If the coastal waters criteria are applied, then the discharge would comply with the 'Good' status limit (<0.71mg/l N based on winter salinity of 27.8psu). The local winter background DIN level is about 0.19mg/l N with slightly lower values of 0.14mg/l N further out in the lough. These background levels include the impacts of the existing Rathmullan discharges.

The proposed treatment process will result in TA and DIN values of 55 and 60mg/l respectively, as per Table 3.7. This may change in the final design. The model simulations have also been completed for DIN of 45 and 75mg/l and TA of 40 and 70mg/l. These results are included in Appendix A.

Model plots for Unionised Ammonia (UIA) are also included in Appendix A.

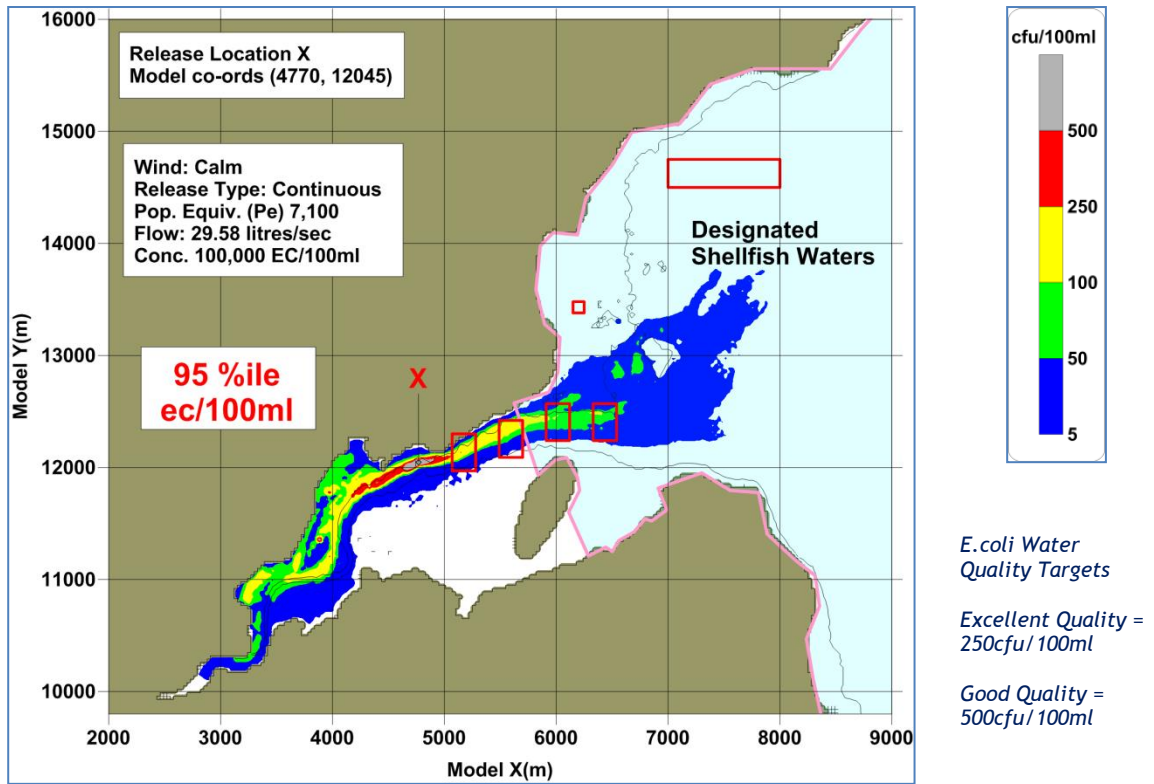


Figure 4.22 - Simulated 95%ile e.coli concentration for discharge from proposed outfall

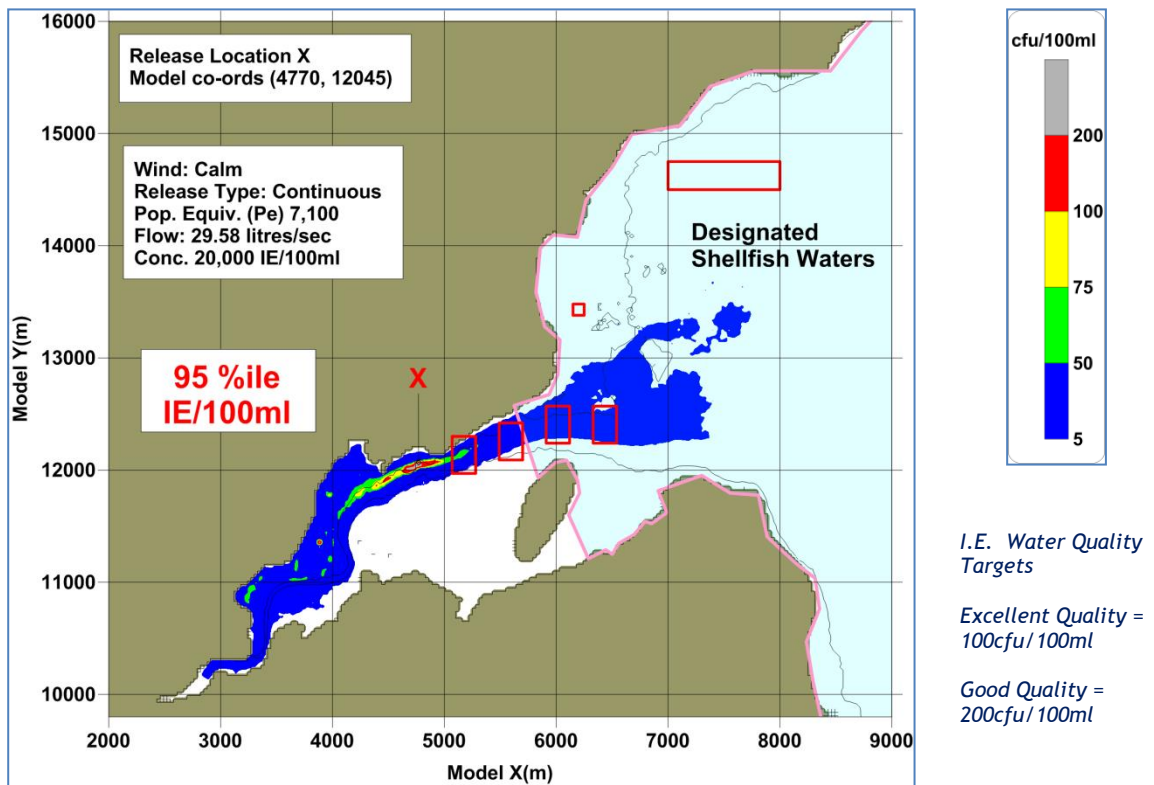


Figure 4.23 - Simulated 95%ile IE concentration for discharge from proposed outfall

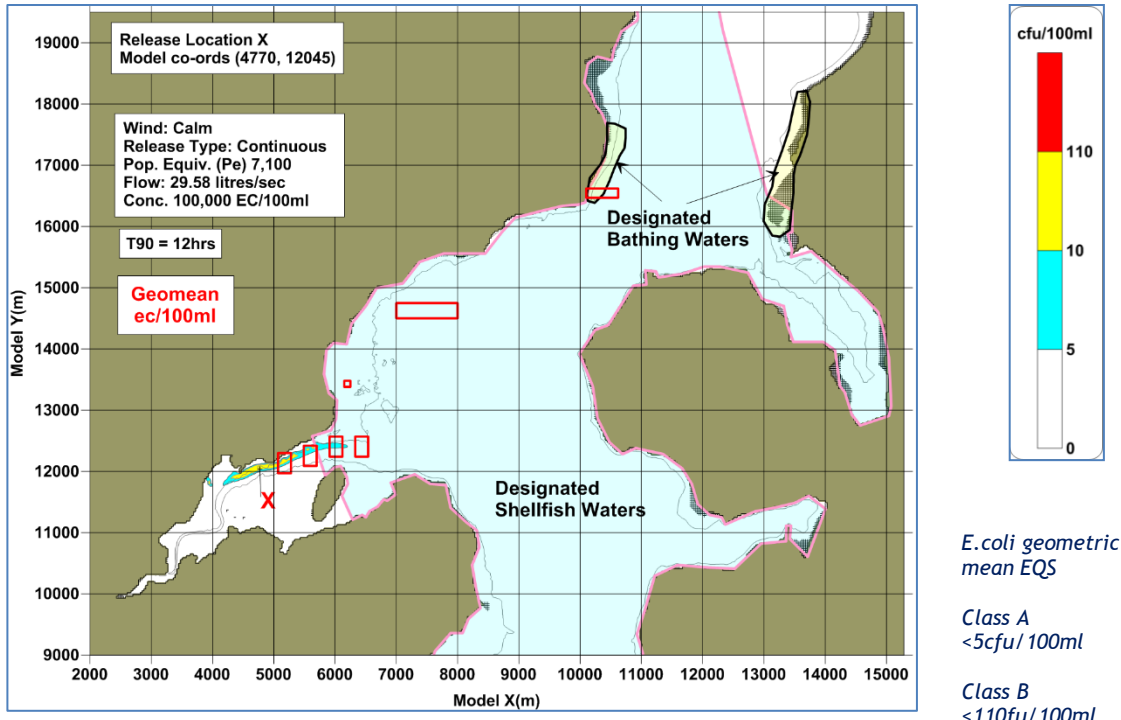


Figure 4.24a - Simulated Summer (T90=12hrs) geomean e.coli concentration for discharges from the proposed outfall location

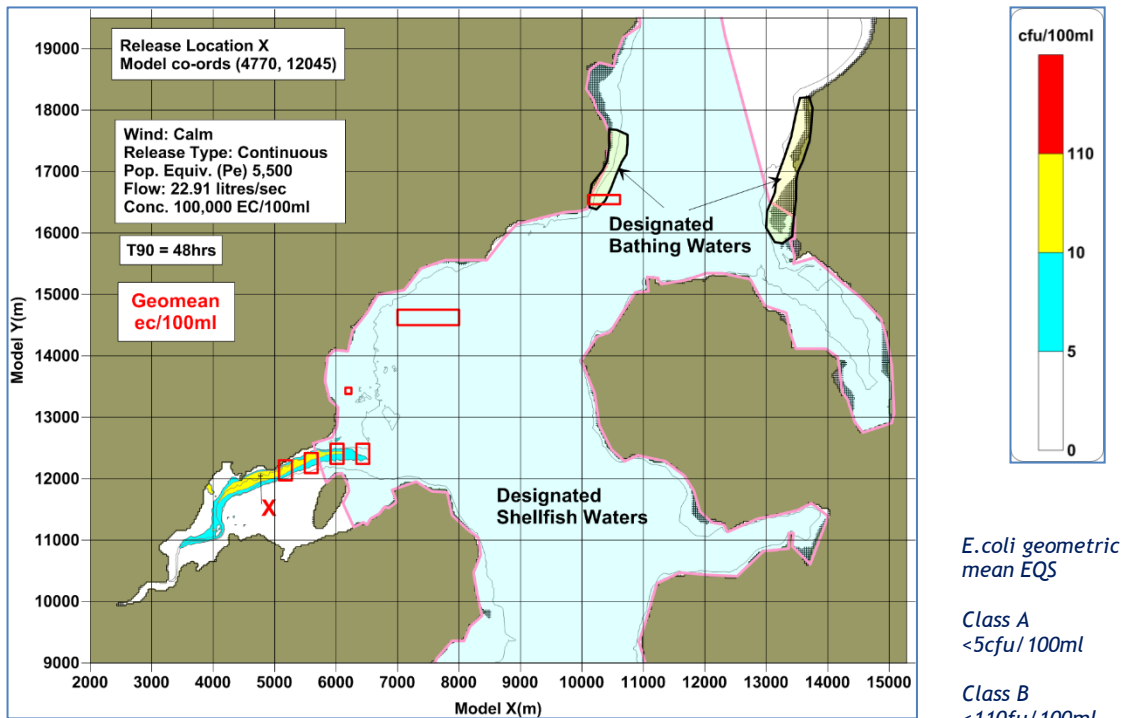


Figure 4.24b - Simulated Winter (T90=48hrs) geomean e.coli concentration for discharges from the proposed outfall location

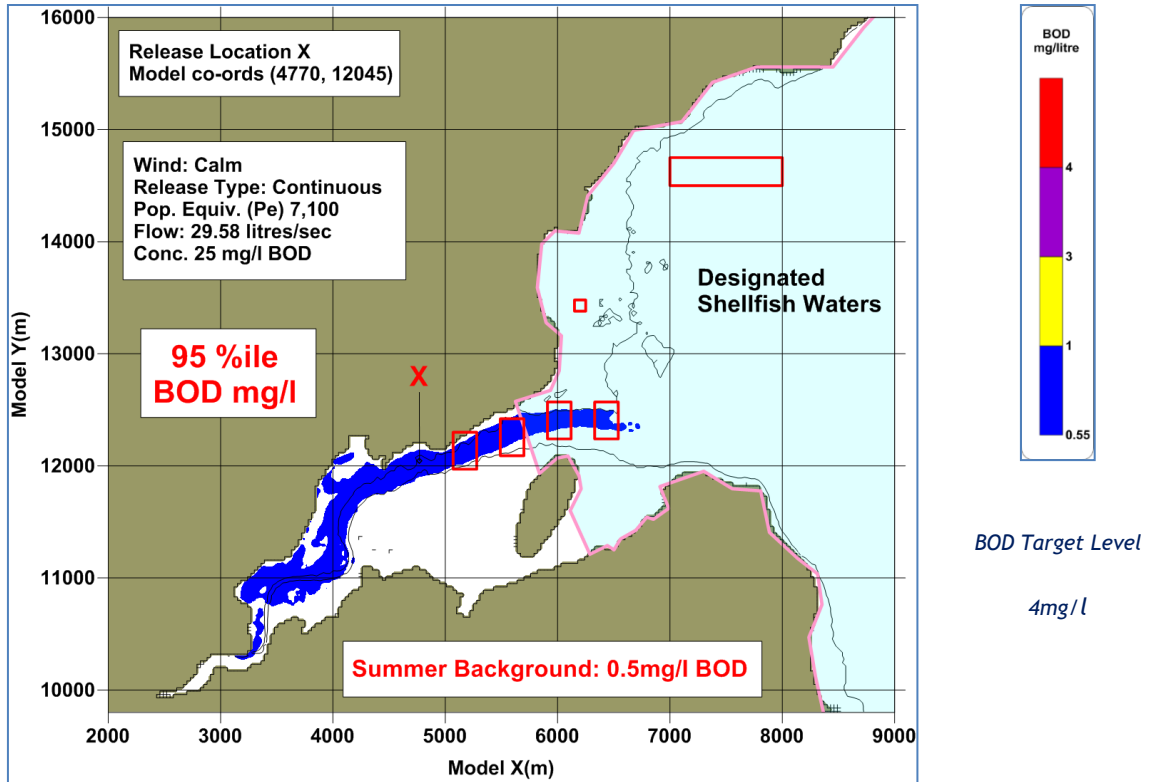


Figure 4.25a - Simulated Summer 95%ile BOD concentration for discharge from proposed outfall

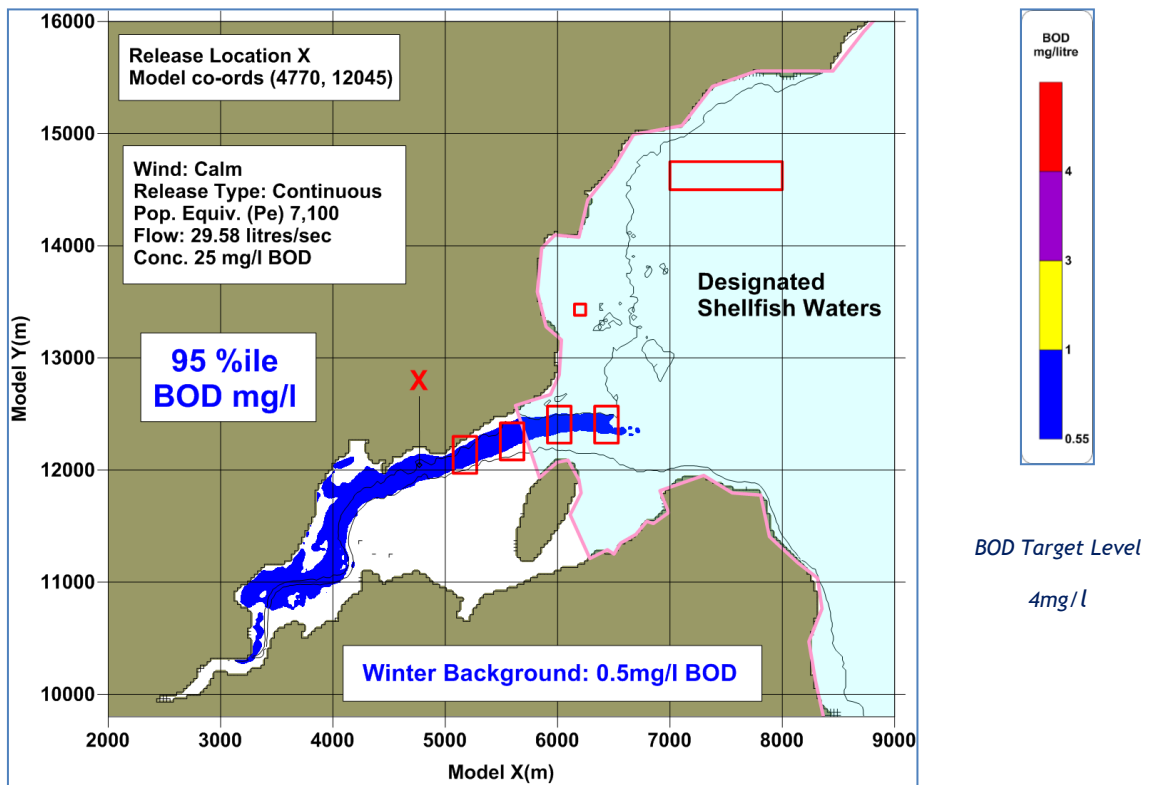


Figure 4.25b - Simulated Winter 95%ile BOD concentration for discharge from proposed outfall

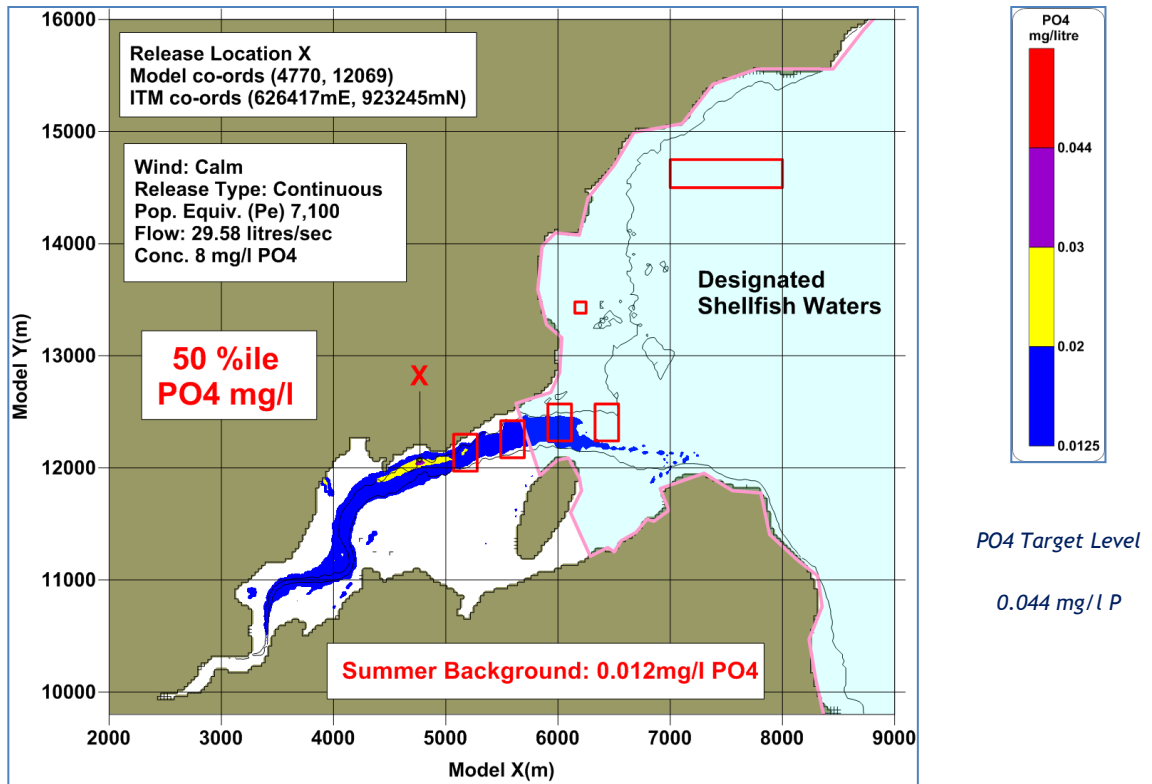


Figure 4.26a - Simulated Summer 50%ile PO4 concentration for discharge from proposed outfall

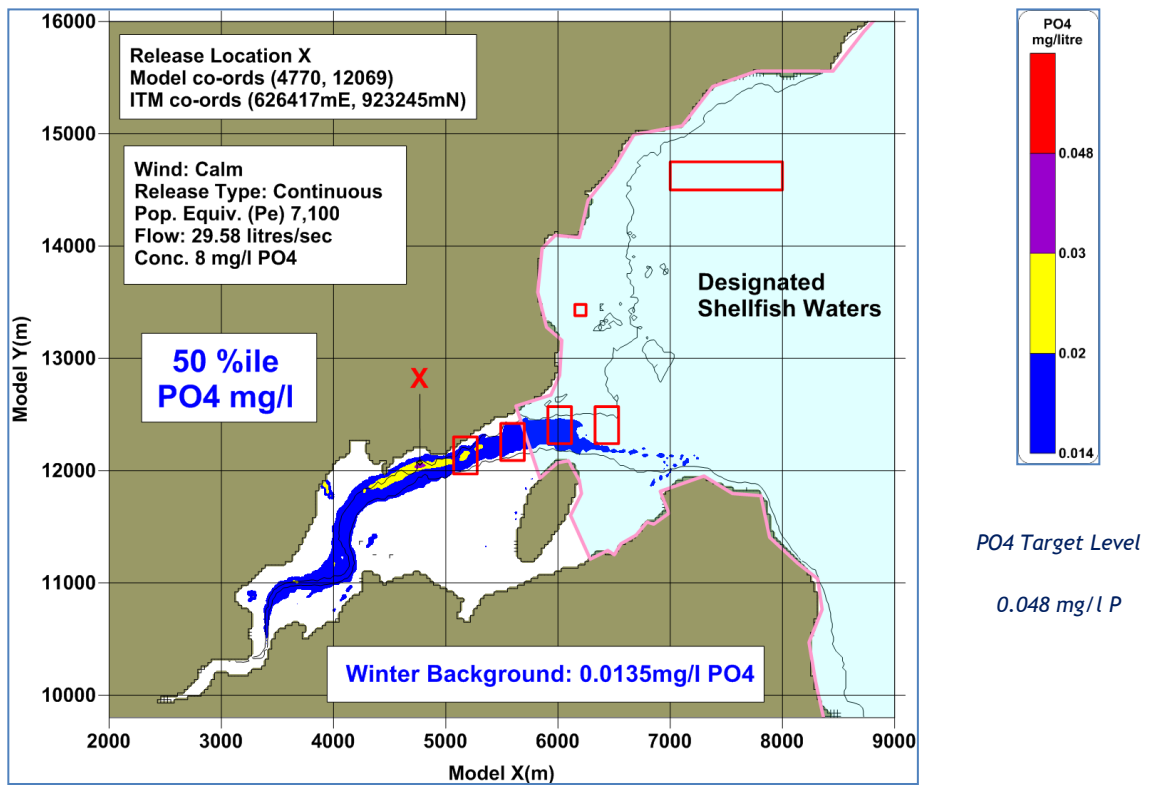


Figure 4.26b - Simulated Winter 50%ile PO4 concentration for discharge from proposed outfall

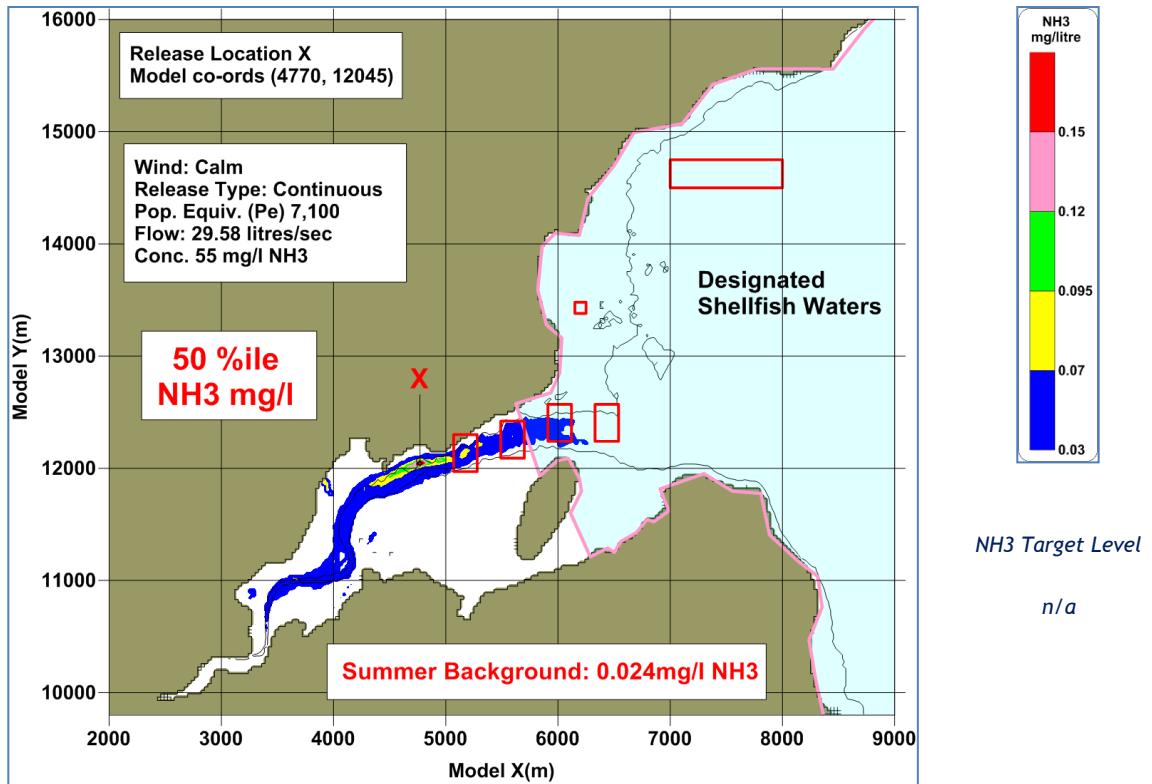


Figure 4.27a - Simulated Summer 50%ile NH3 concentration for discharge from proposed outfall

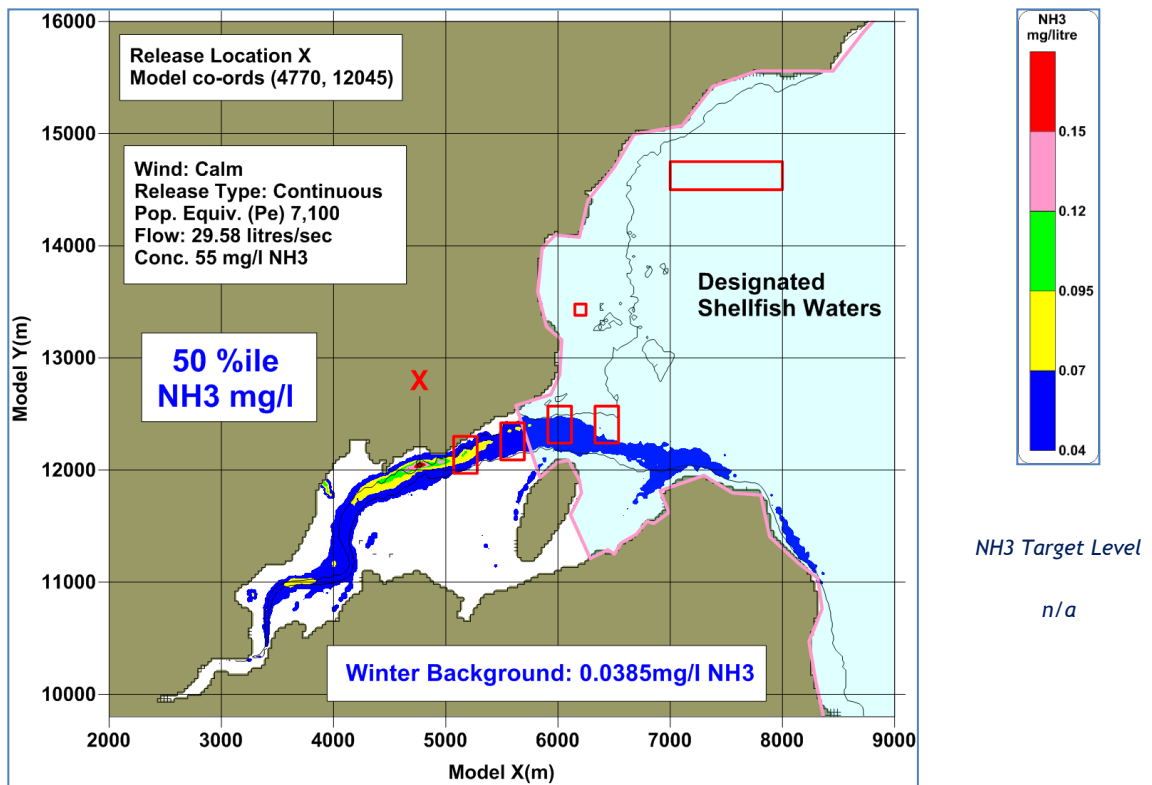


Figure 4.27b - Simulated Winter 50%ile NH3 concentration for discharge from proposed outfall

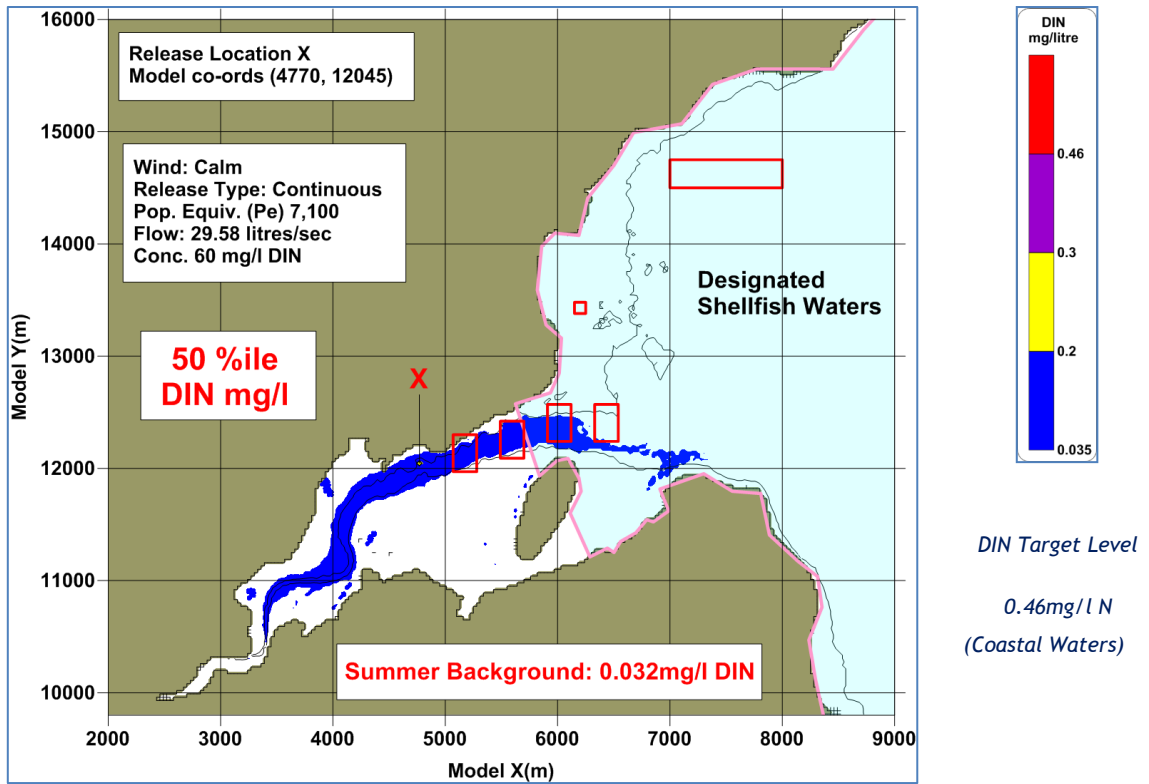


Figure 4.28a - Simulated Summer 50%ile DIN concentration for discharge from proposed outfall

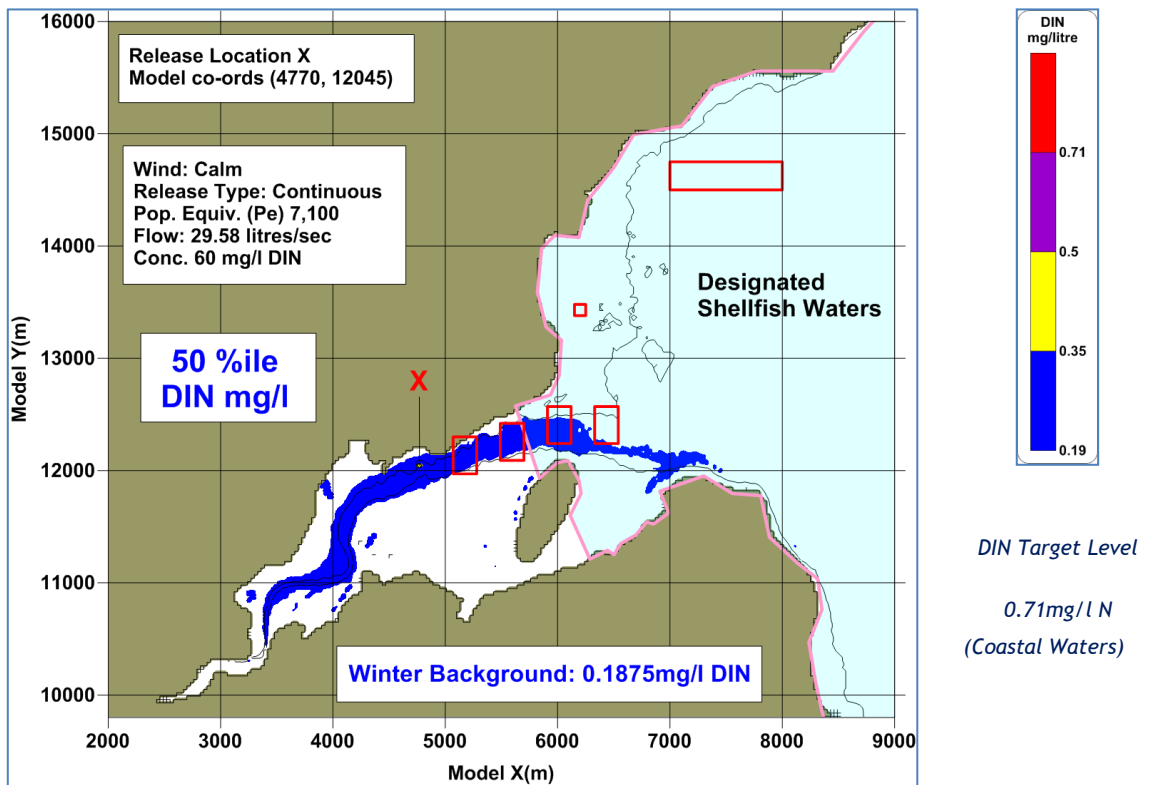


Figure 4.28b - Simulated Winter 50%ile DIN concentration for discharge from proposed outfall

d. Interactions with other Lough Swilly outfalls

There are three wastewater treatment facilities discharging to Lough Swilly. These are located at Buncrana, Fahan and Letterkenny. The currently untreated discharges at Ramelton and Rathmullan will be eliminated in the near future. A simulation of the future scenario with four treated outfalls has been conducted. The spring tide e.coli plume trajectories at LW and HW are shown in Figures 4.29 & 4.30 respectively and indicate that there will be no measurable interaction of these discharges with the proposed outfall which could lead to increased bacterial contamination of the bathing waters. Plots based on the geomean approach are presented in Figures 4.31 (Summer) and 4.32 (winter) and show that there is no measurable interaction that could adversely impact the shellfish waters.

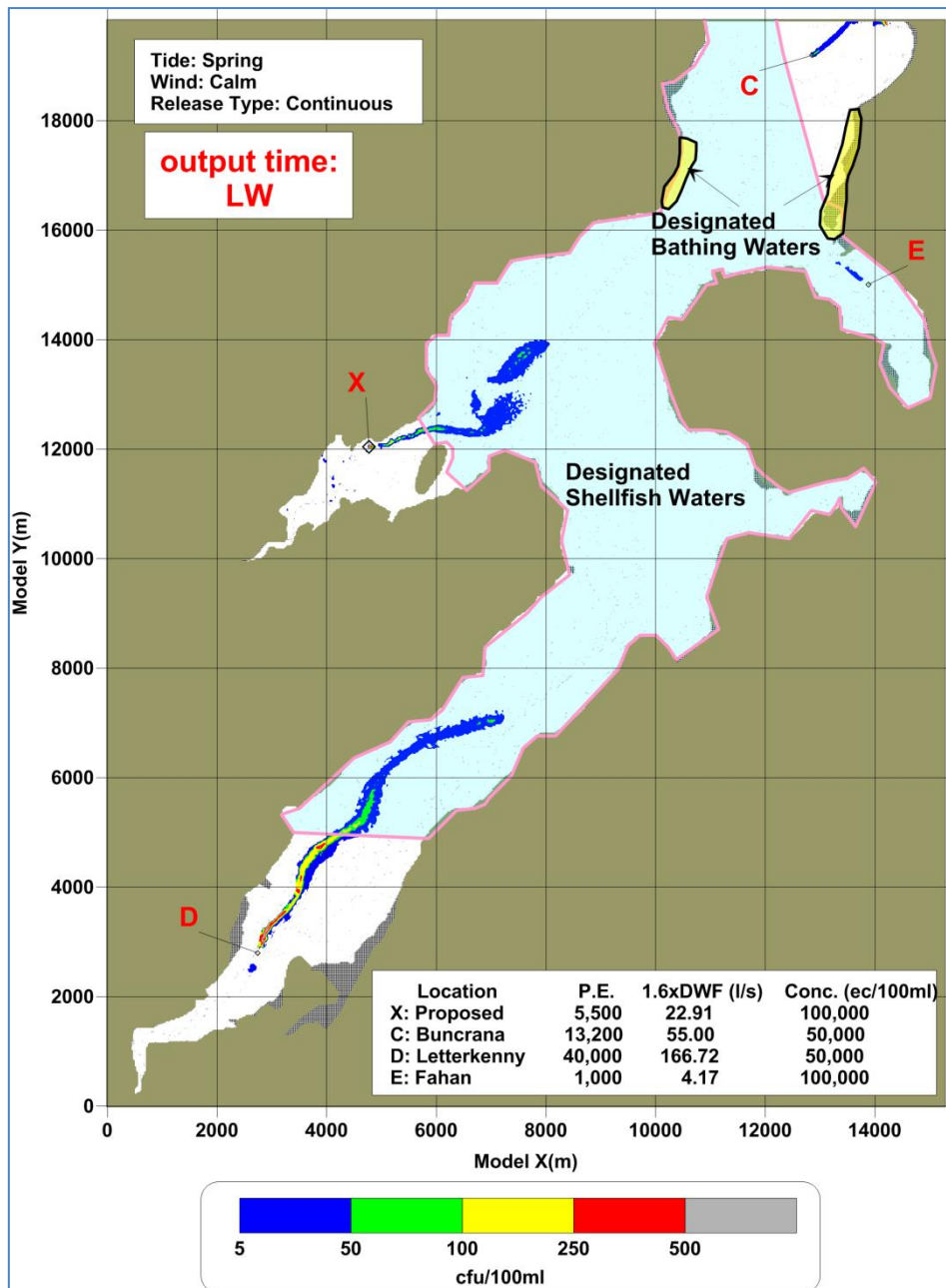


Figure 4.29 - Simulated SPRING tide Low Water e.coli plumes from nearby outfalls

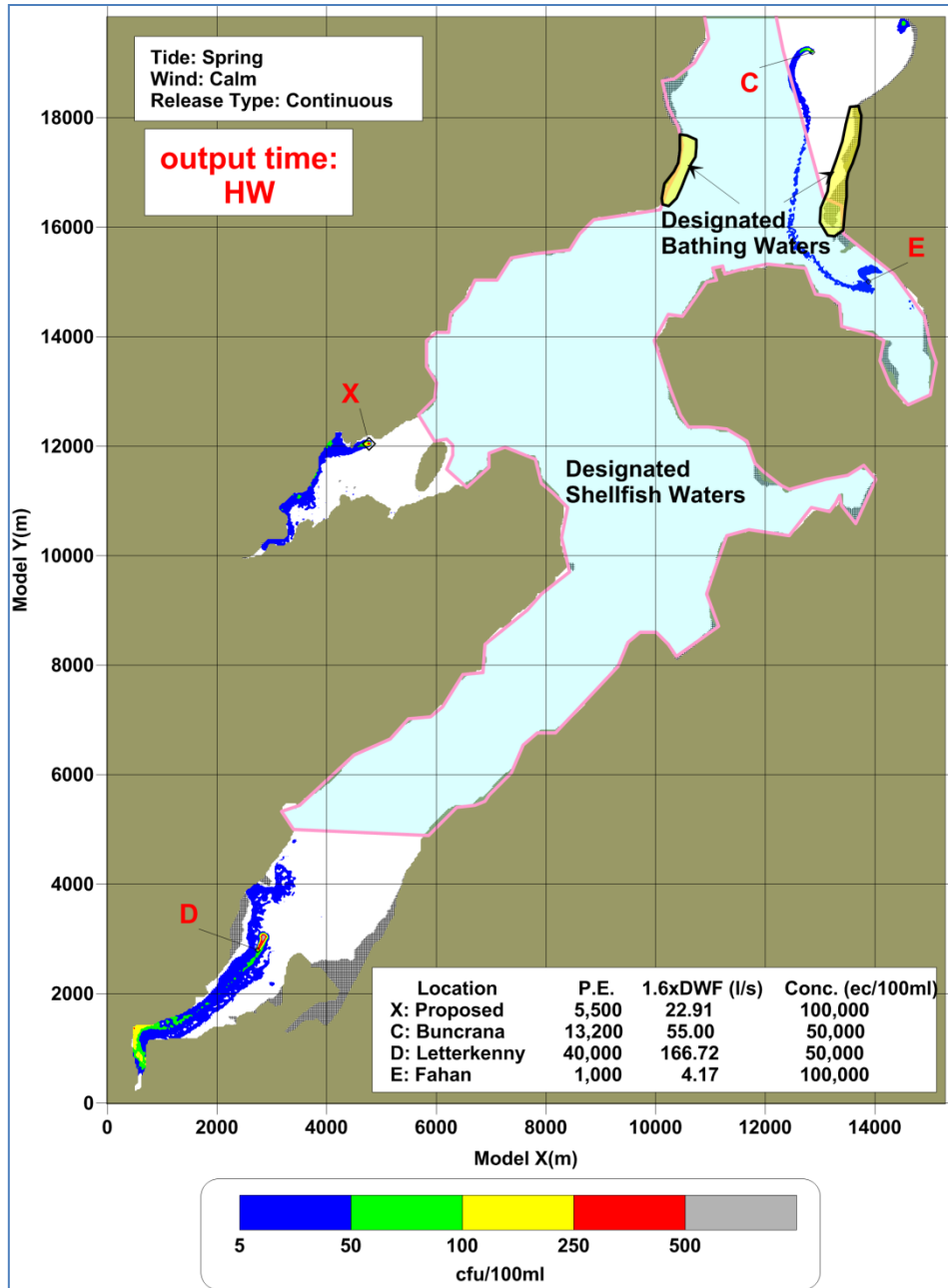


Figure 4.30 - Simulated SPRING tide High Water e.coli plumes from nearby outfalls

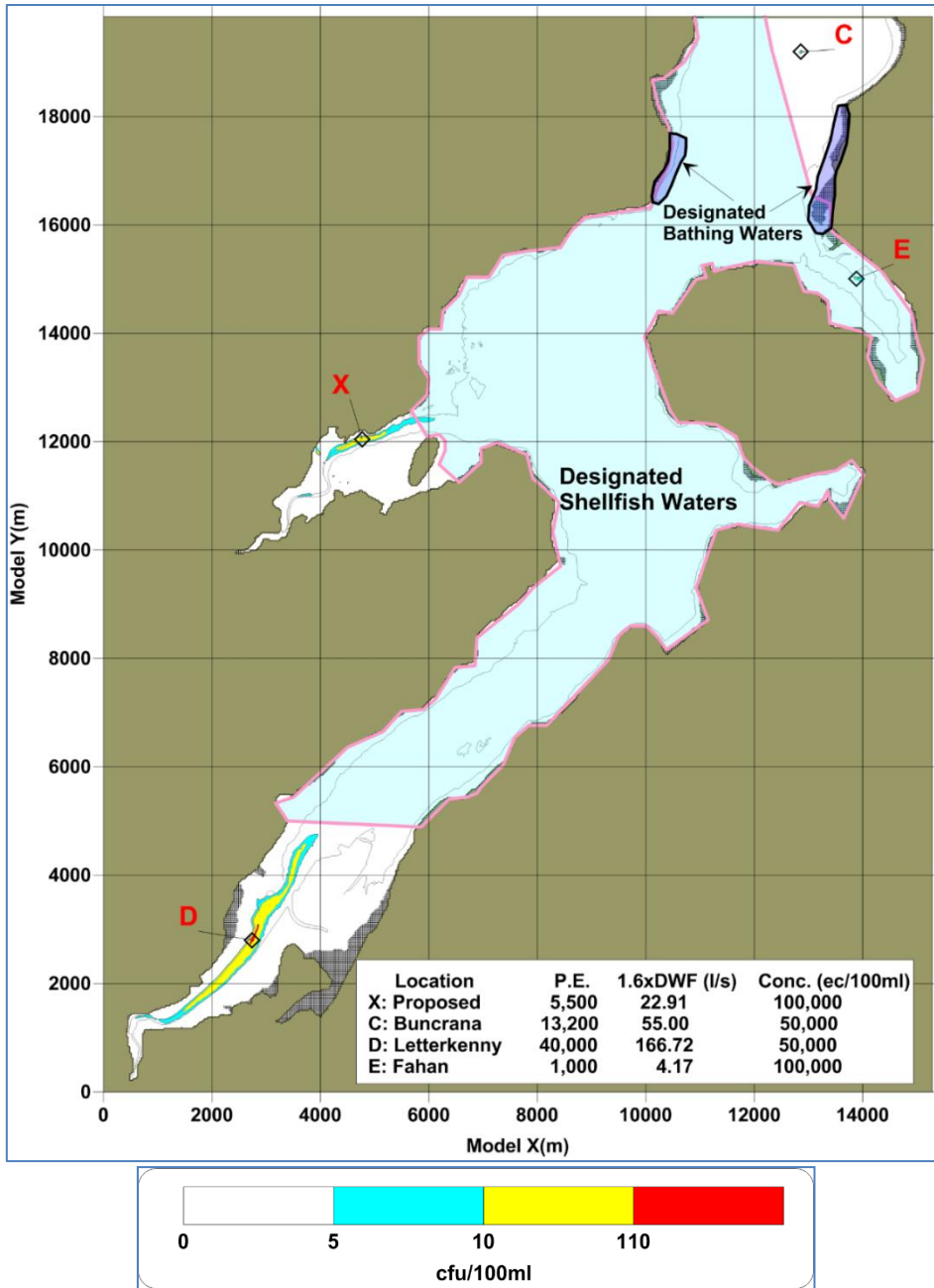


Figure 4.31 - The interaction of the proposed outfall with other nearby outfalls, Simulated Summer (T90=12hrs) geomean e.coli concentration

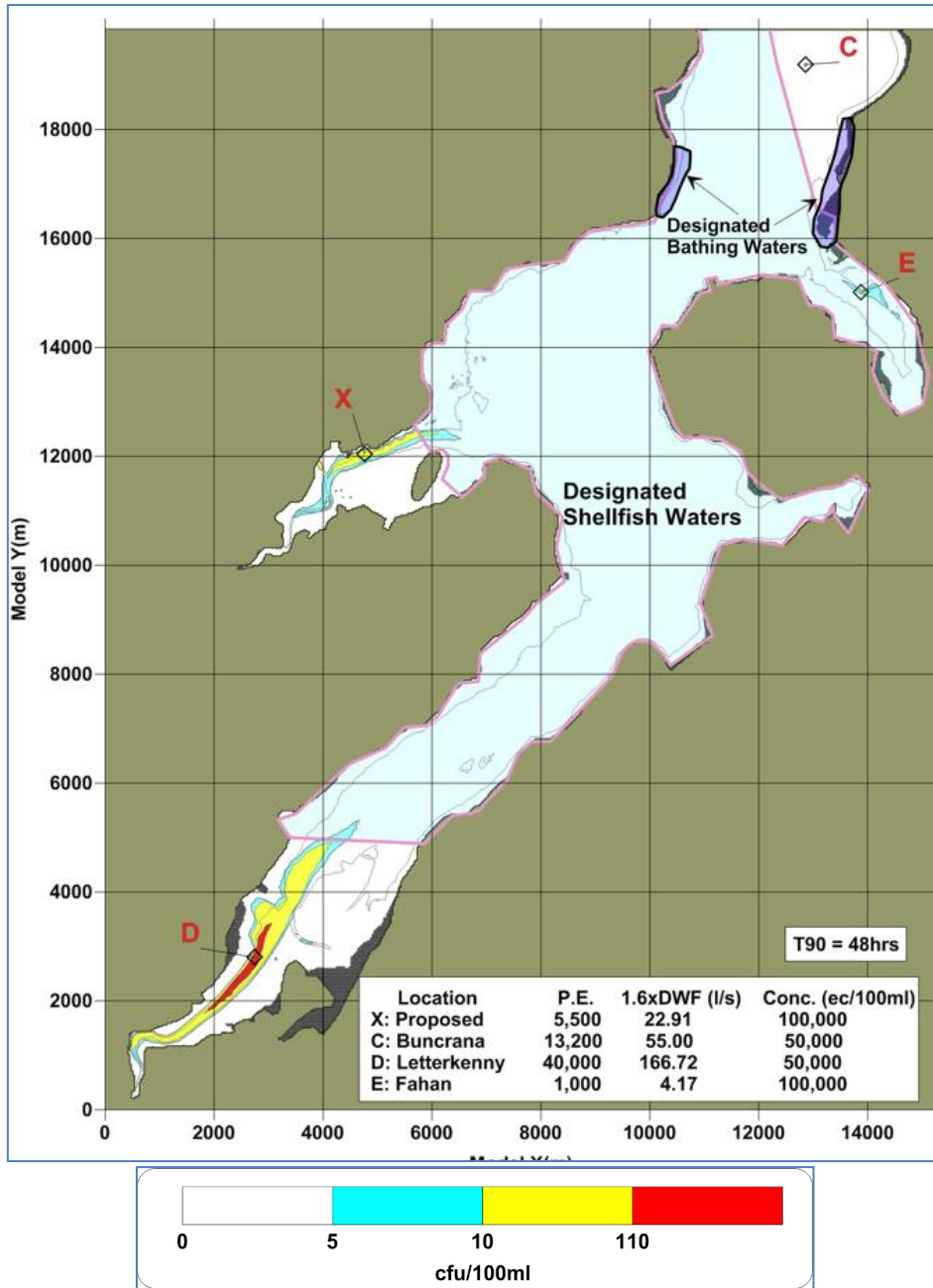


Figure 4.32 - The interaction of the proposed outfall with other nearby outfalls, Simulated Winter (T90=48hrs) geomean e.coli concentration

5. Conclusions

An assessment of the impact of wastewater discharges to the Ramelton Channel has been conducted. The study was based on numerical modelling supported by field measurements.

Outfall Location

The proposed outfall location is in the tidal channel about 250m east of Brownknowe Islet on the northern shore of the Leannan estuary. The ING coordinates of the pipe end are 224671mE, 423257mN. Varying amounts of initial dilutions are available at this location depending on the tidal level and freshwater input from the Leannan river. The WWTP capacity will be based on a 10-year design population equivalent of 5,500 with provision to increase to the 30-year PE of 7,100. The outfall is to be designed for the 30-year horizon.

The overall impact of the discharges on the receiving waters is assessed by means of contaminant concentration percentiles. The spring-neap tidal cycle is simulated, and output is generated for the various contaminants which incorporates data for all stages of the tide.

Transitional Waters

The proposed outfall discharges into Transitional Waters and therefore a key objective as per the Surface Waters Regulations (SI 272/2009 as amended) is to establish the extents of the mixing zone. The relevant controlling parameter is the median PO₄ nutrient concentration. For the proposed 30-year horizon discharge with a PO₄ concentration of 8mg/l the mixing zone (delineated by the median winter target EQS of 0.048mg/l) has been shown to be confined to the immediate outfall area (+/- 20m). It will thus meet the PO₄ requirements of SI 272/2009. The regulations also limit the BOD to 4mg/l within the mixing zone. The diffuser model indicates that this level will also be achieved in the immediate vicinity of the outfall. Predictions of the DIN concentration indicate that 'Good' status will be achieved in all but the immediate vicinity of the outfall.

Shellfish Waters

There are designated shellfish waters to the east of Auginish Island, approximately 0.75km downstream from the outfall. Bacterial concentrations are relevant here though there are currently no specific regulations for such waters. In the absence of guidelines and following engagement with stakeholders including EPA and Marine Institute, Irish Water is applying the Urban Pollution Management Manual (ref: 5) geomean EQS target of 110cfu/100ml for the protection of Shellfish Waters.

The model analysis shows that this bacterial target will be met for both the 5,500 PE and 7,100 PE design scenarios. Overall predicted concentrations are substantially lower than the targets.

The Quality of Shellfish Waters Regulations specify that a discharge affecting shellfish waters must not cause the suspended solids content to increase by more than 30% of the background level. The diffuser model shows that such increases will be limited to within 55m of the outfall and will not impact the shellfish waters.

Bathing Waters

The nearest designated bathing waters are those off Rathmullan. The bacterial standards to be met here are the Bathing Water Regulations (SI 79/2008) which stipulate: e.coli <250 cfu/100ml and intestinal enterococci <100 cfu/100ml for Excellent quality. These targets are based on a 95%ile evaluation. The modelling indicates that the plume from the proposed outfall will not reach this area even at its maximum ebb excursion. Therefore, the proposed outfall will not impact the Rathmullan bathing water status and is compatible with achievement of Excellent Bathing Water Quality.

Plume Interactions

When the WWTP is completed there will be four municipal treatment plants discharging into the inner part of Lough Swilly. These will include the proposed outfall east of Brownknowe Islet, Buncrana, Fahan and the Letterkenny environs. Simulation of the combined bacterial discharges does not show any plume interaction which could lead to increased bacterial contamination of the shellfish or bathing waters.

In conclusion, the modelling study has demonstrated that the proposed discharge under both 5,500 and 7,100PE loading, is compatible with the achievement of WFD objectives for the receiving waters.

References

1. NPWS (2003), National Parks & Wildlife Service, Lough Swilly Site Synopsis.
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4. Irish Hydrodata ltd (2013), Ramelton WWTP Investigation of the Impact of Treated Wastewater Discharges / Irish Water Jennings O' Donovan.
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8. Irish Water (2017), Technical Standards: Marine Modelling.
9. Hunter (1997), User Manual for Outfall Modelling Package. Curtin University Aus.
10. Hunter (1997), User Manual for Numerical Hydrodynamic Models of Marine Systems and Associated Plotting Package. Curtin University Aus.
11. Hunter (1997), User Manual for Two-Dimensional Lagrangian Particle Tracking Model. Curtin University Aus.
12. EPA (2011), Wastewater Discharge Licence, Ramelton, DO341-01, Donegal County Council.

Appendix A

Additional Model Outputs for DIN, TA and UIA Scenarios

DIN

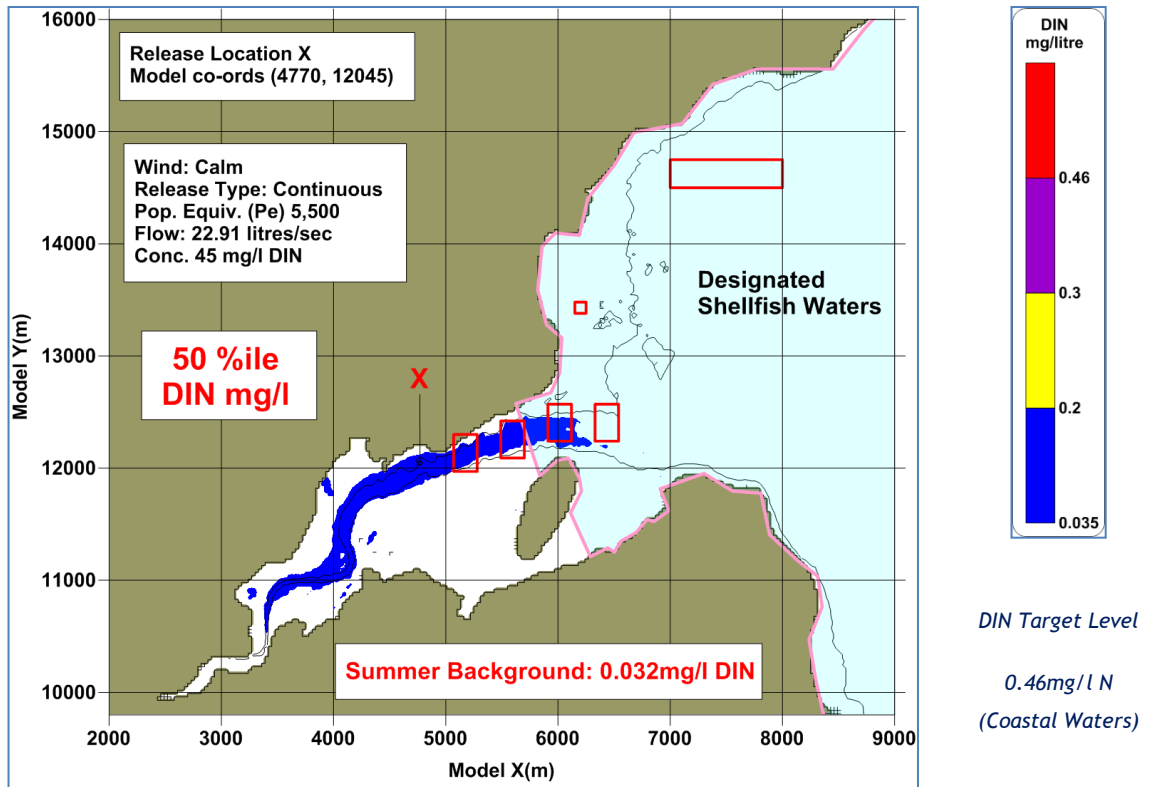


Figure A.1a - Simulated 50%ile DIN concentration for discharge from proposed outfall for 5500pe, DIN:45mg/l N - summer

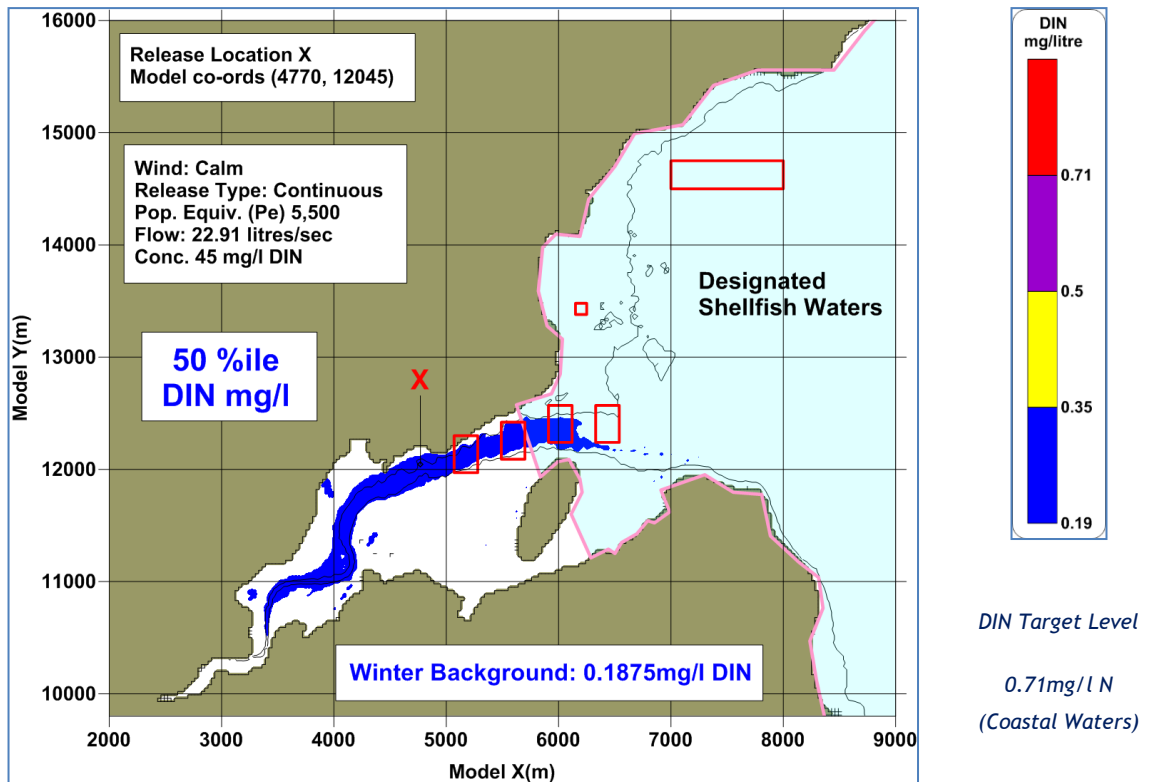


Figure A.1b - Simulated 50%ile DIN concentration for discharge from proposed outfall for 5500pe, DIN:45mg/l N - winter

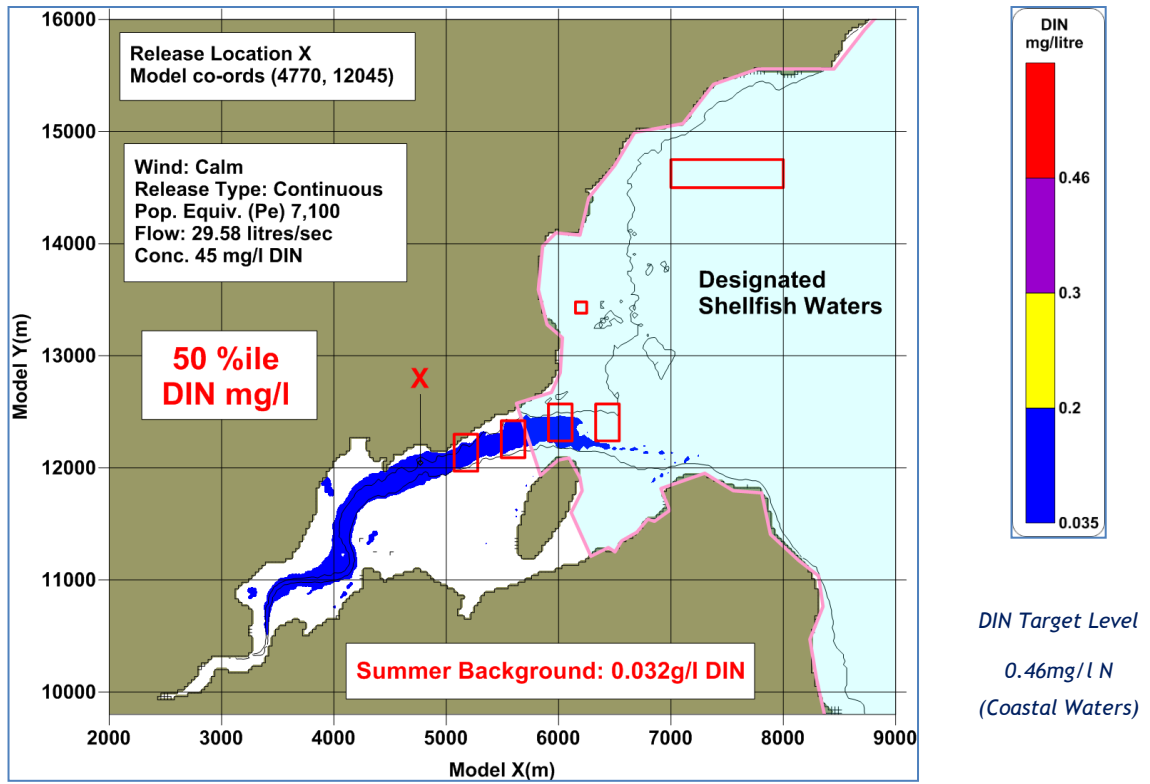


Figure A.2a - Simulated 50%ile DIN concentration for discharge from proposed outfall for 7100pe, DIN:45mg/l N - summer

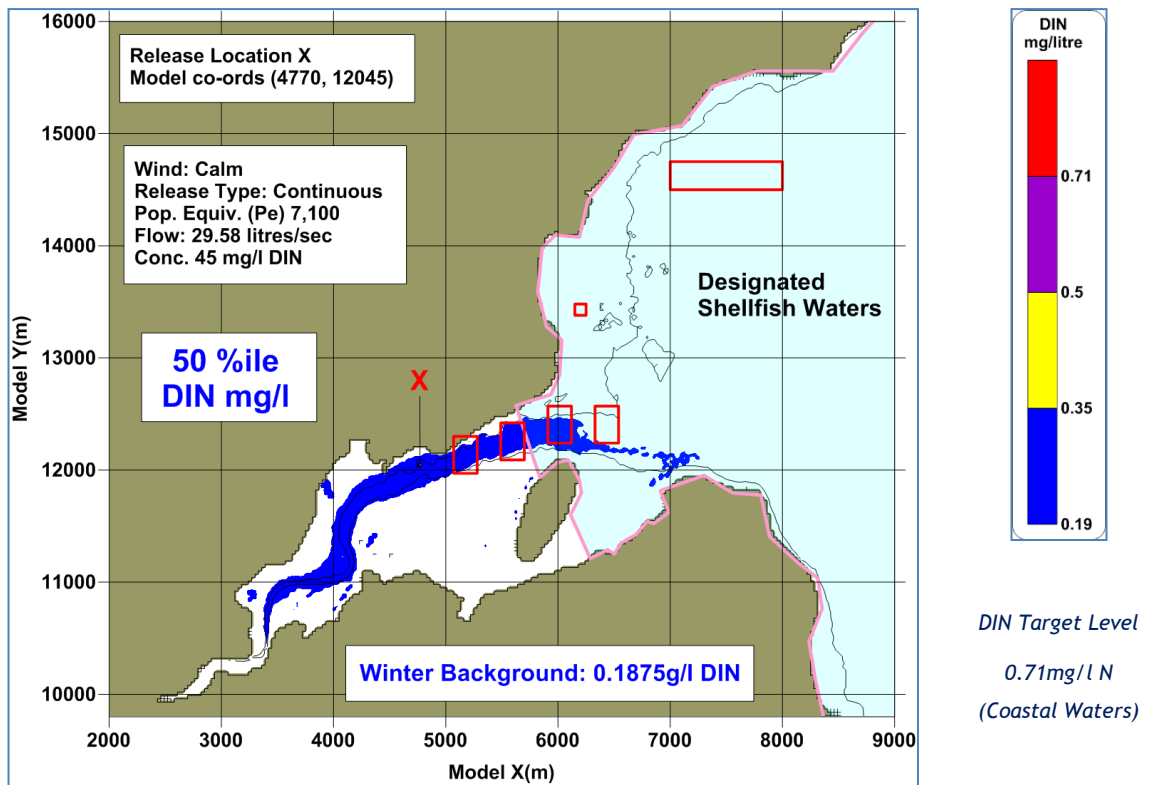


Figure A.2b - Simulated 50%ile DIN concentration for discharge from proposed outfall for 7100pe, DIN:45mg/l N - winter

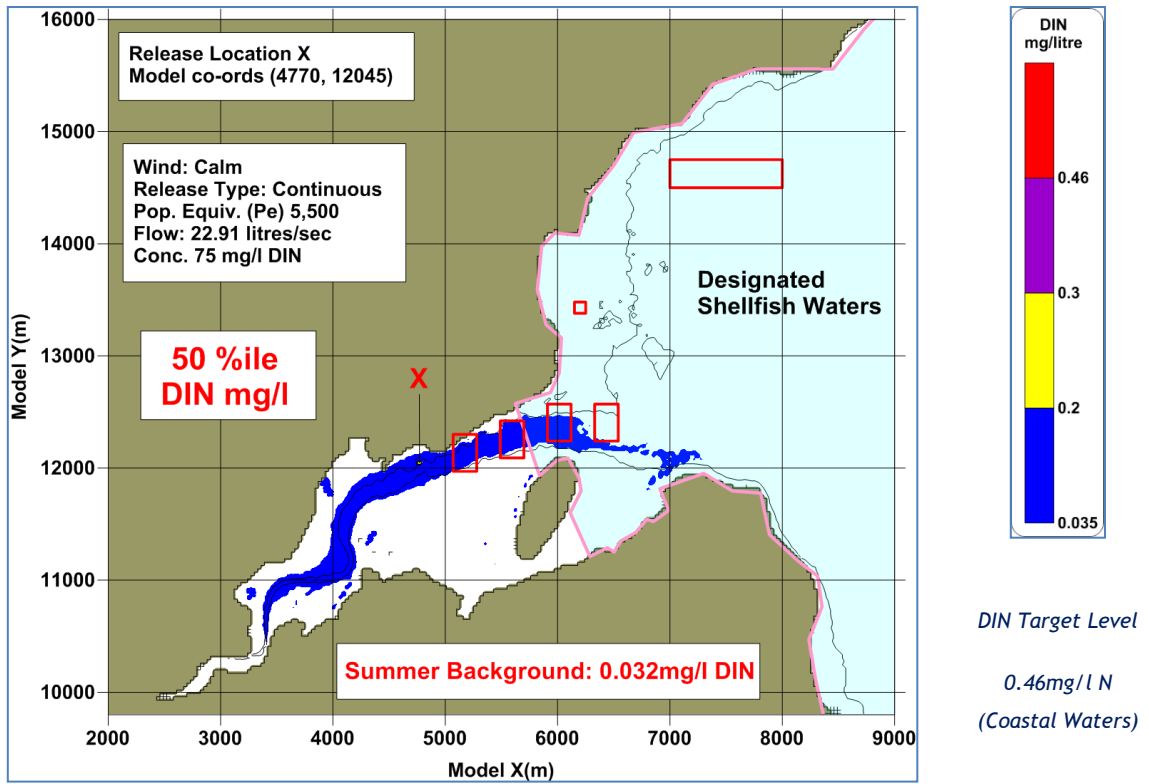


Figure A.3a - Simulated 50%ile DIN concentration for discharge from proposed outfall for 5500pe, DIN:75mg/l N - summer

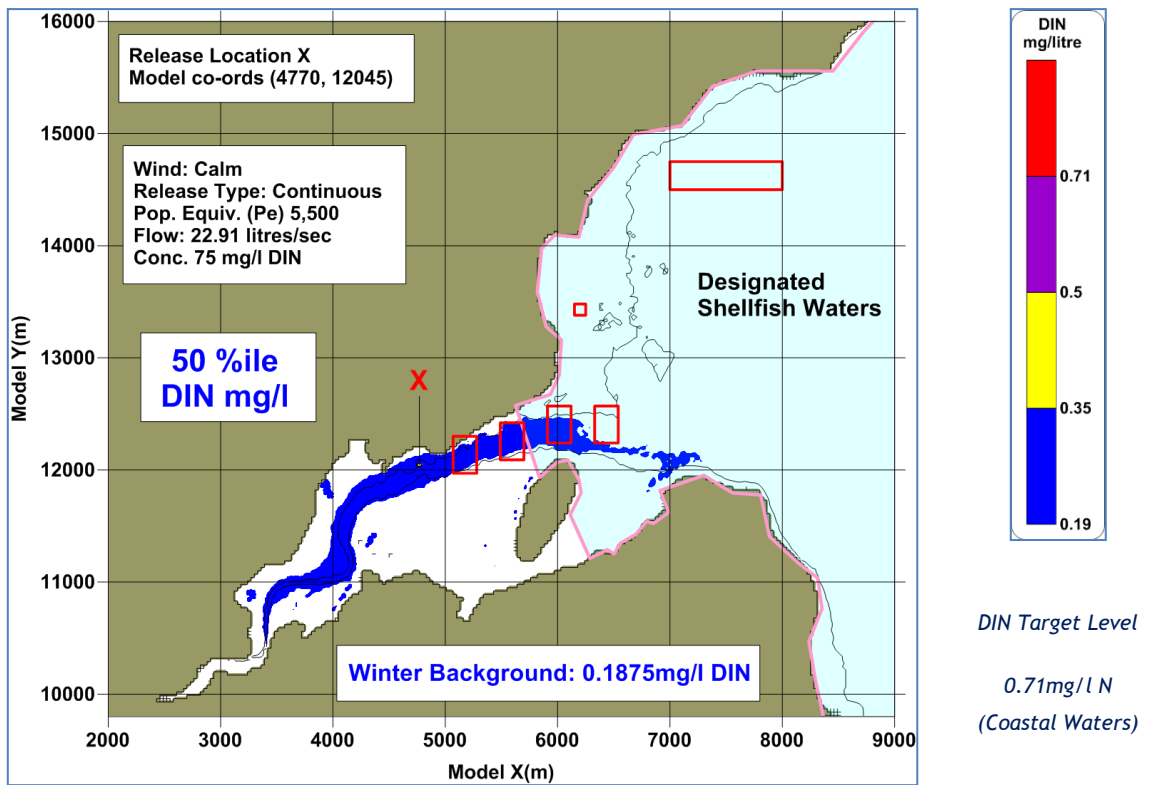


Figure A.3b - Simulated 50%ile DIN concentration for discharge from proposed outfall for 5500pe, DIN:75mg/l N - winter

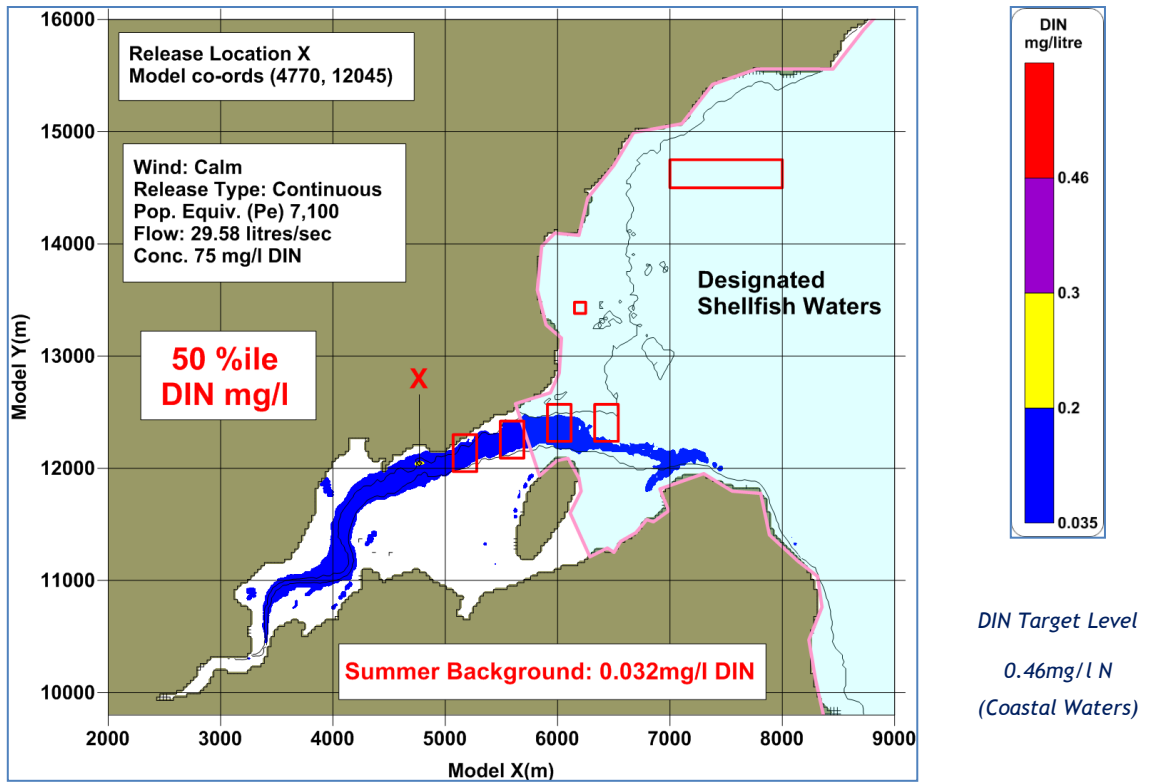


Figure A.4a - Simulated 50%ile DIN concentration for discharge from proposed outfall for 7100pe, DIN:75mg/l N - summer

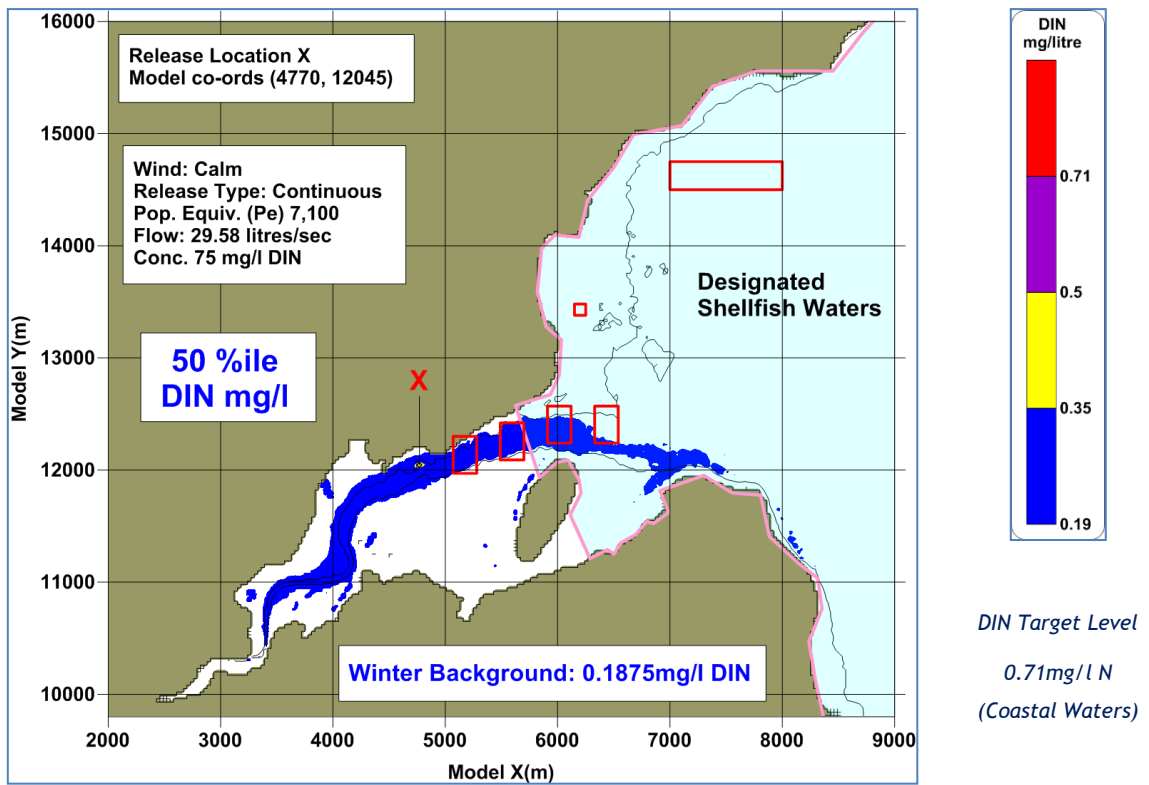


Figure A.4b - Simulated 50%ile DIN concentration for discharge from proposed outfall for 7100pe, DIN:75mg/l N - winter

TA (NH₃)

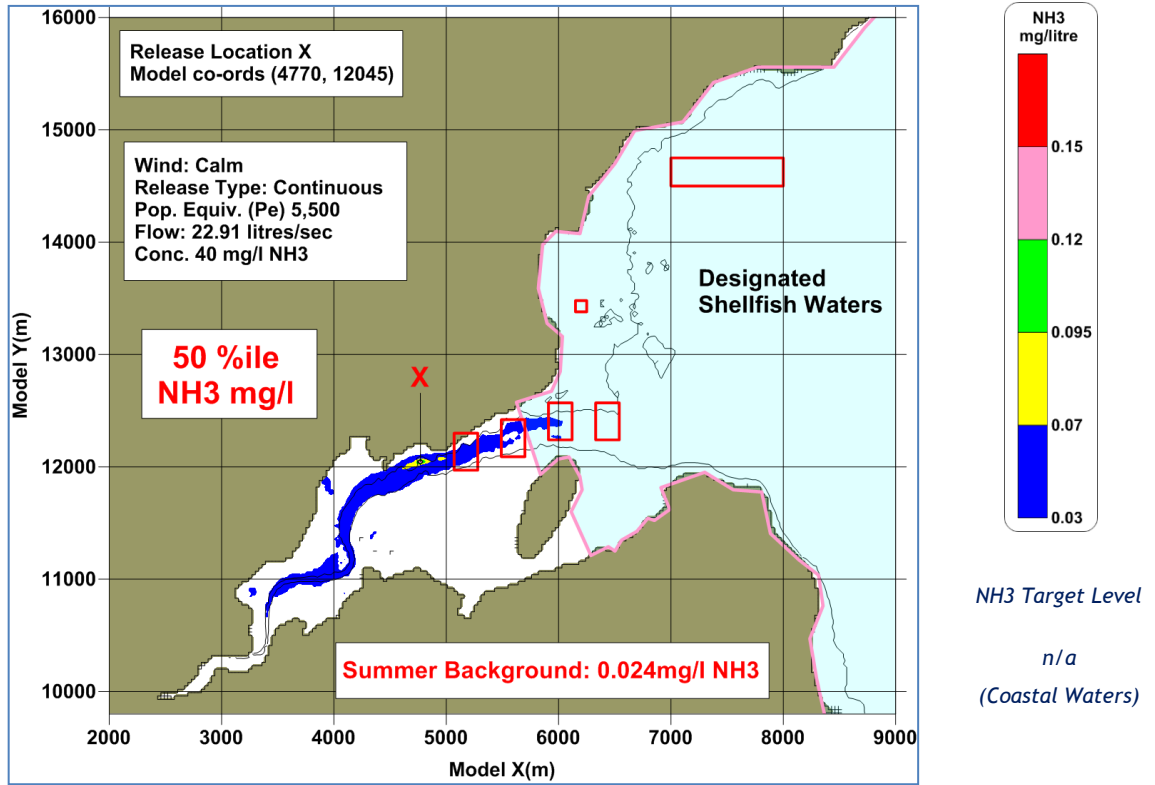


Figure A.5a - Simulated 50%ile NH3 concentration for discharge from proposed outfall for 5500pe, NH3:40mg/l N - summer

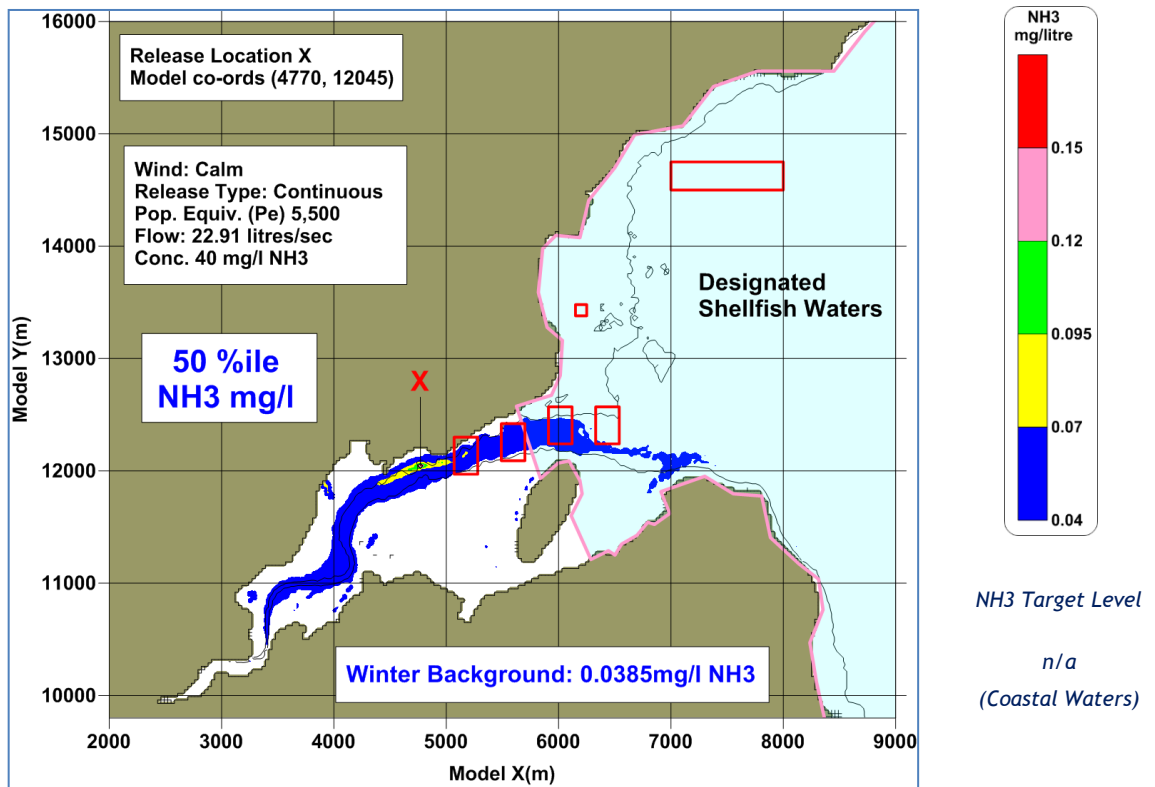


Figure A.5b - Simulated 50%ile NH3 concentration for discharge from proposed outfall for 5500pe, NH3:40mg/l N - winter

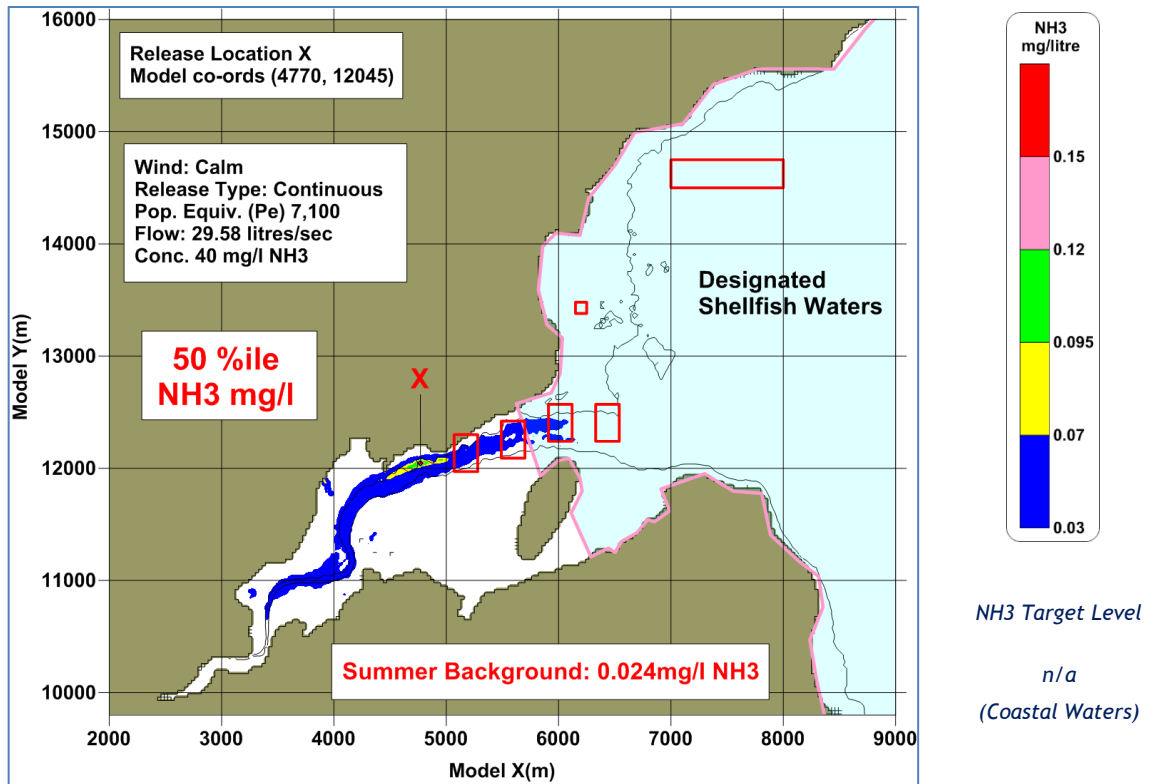


Figure A.6a - Simulated 50%ile NH3 concentration for discharge from proposed outfall for 7100pe, NH3:40mg/l N - summer

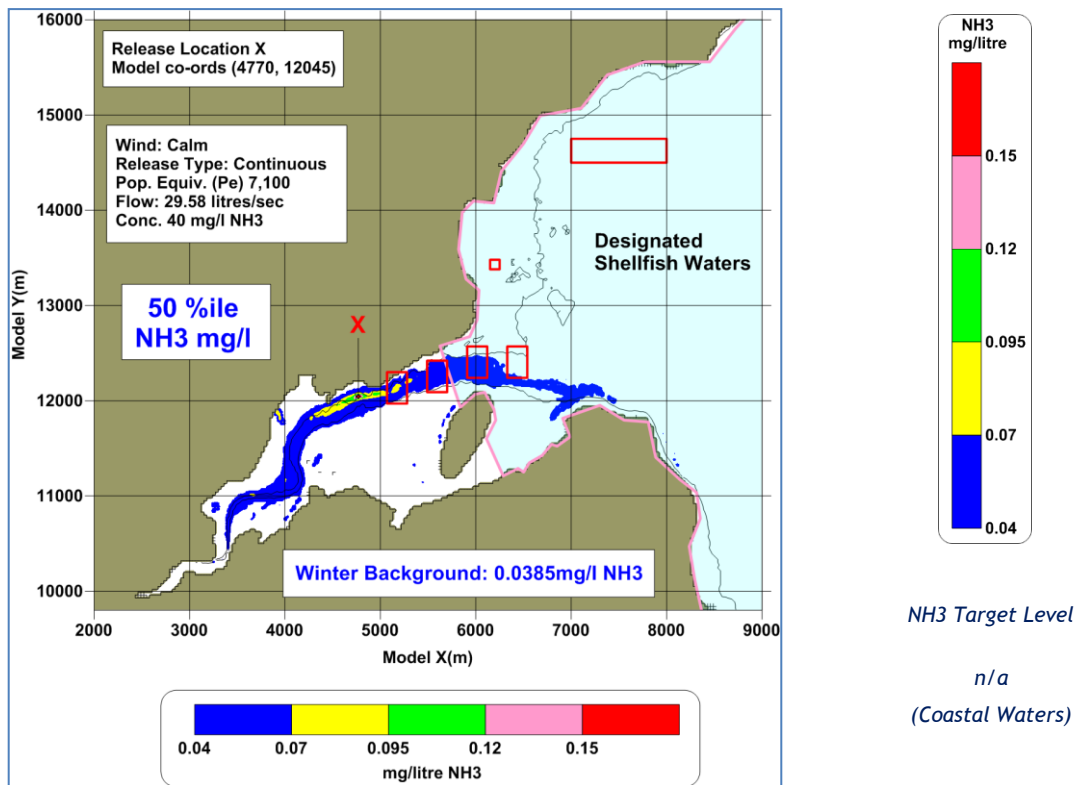


Figure A.6b - Simulated 50%ile NH3 concentration for discharge from proposed outfall for 7100pe, NH3:40mg/l N - winter

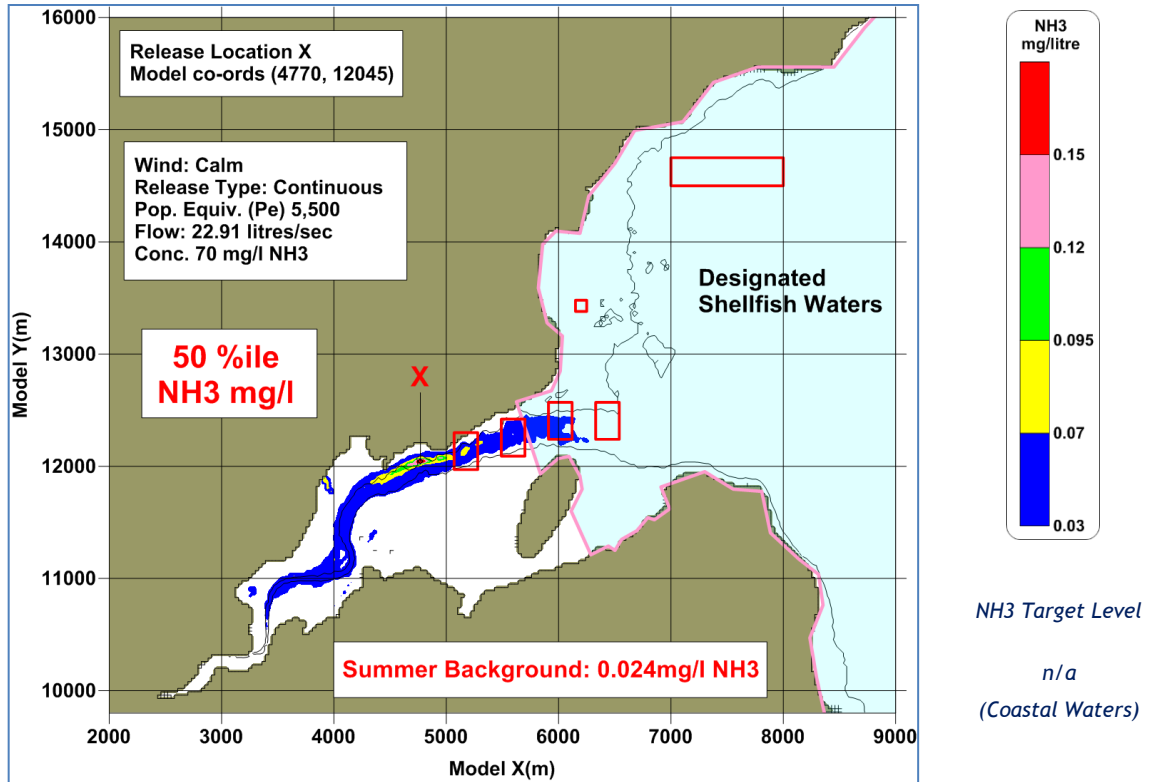


Figure A.7a - Simulated 50%ile NH3 concentration for discharge from proposed outfall for 5500pe, NH3:70mg/l N - summer

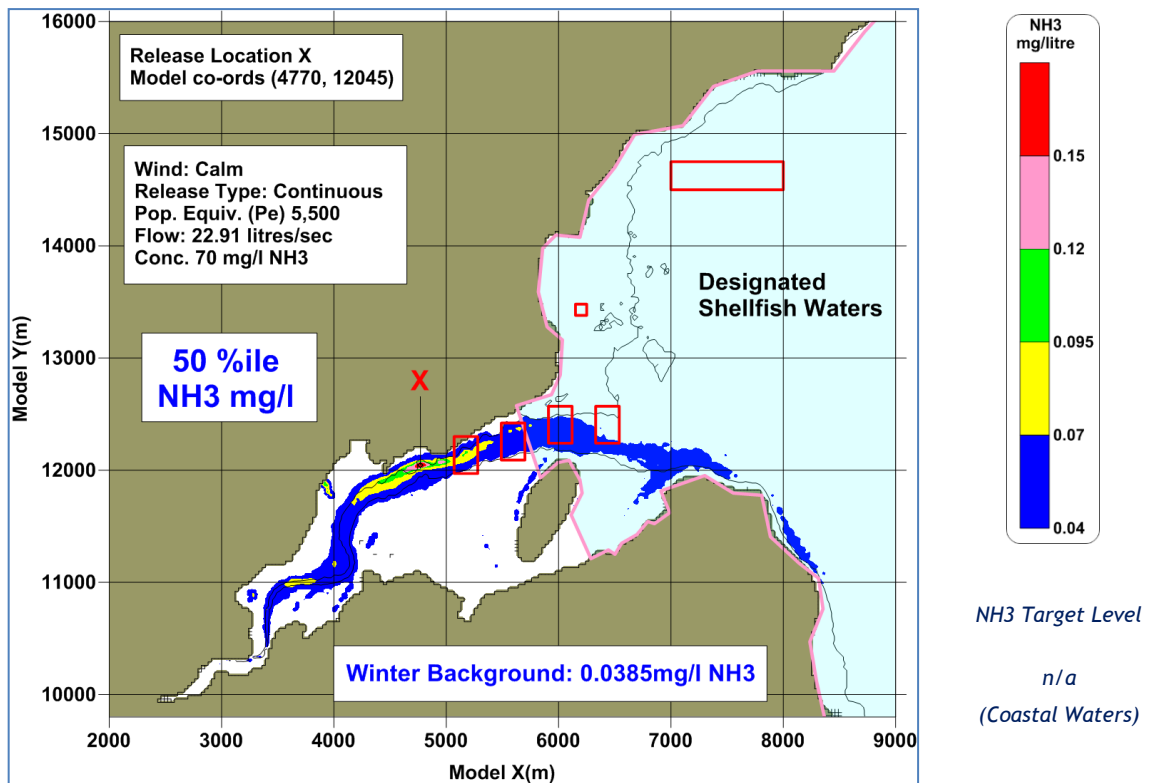


Figure A.7b - Simulated 50%ile NH3 concentration for discharge from proposed outfall for 5500pe, NH3:70mg/l N - winter

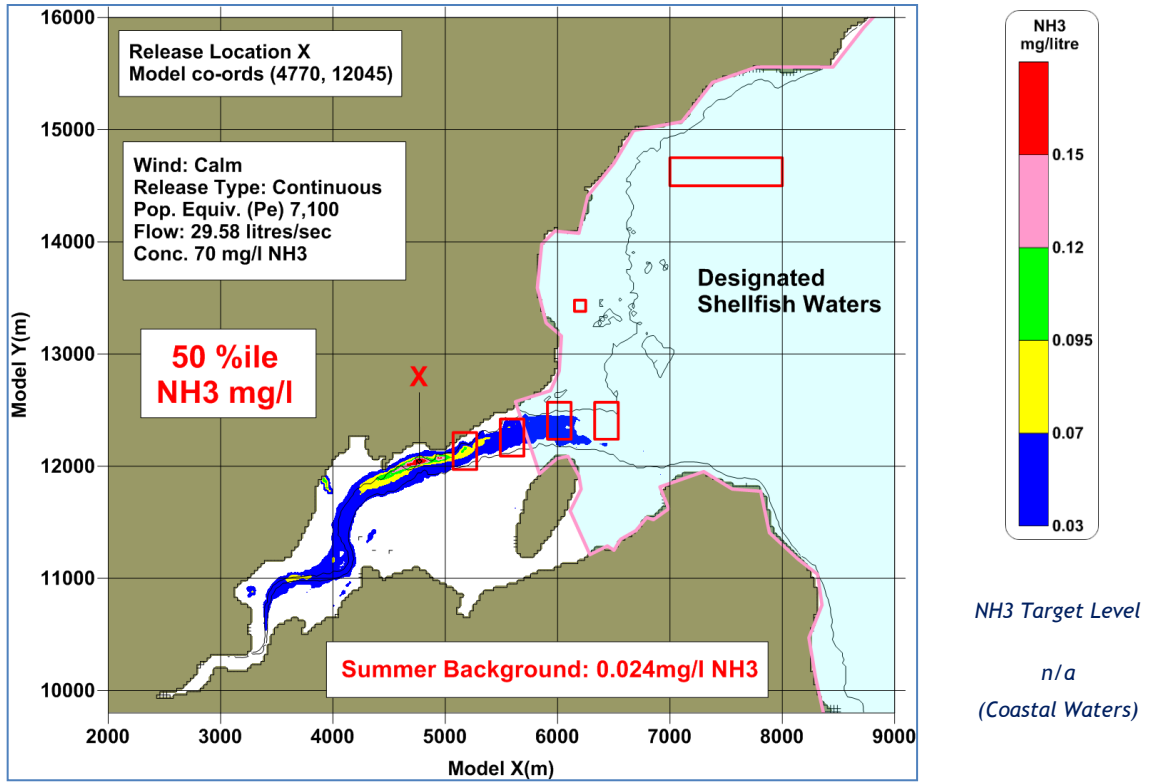


Figure A.8a - Simulated 50%ile NH3 concentration for discharge from proposed outfall for 7100pe, NH3:70mg/l N - summer

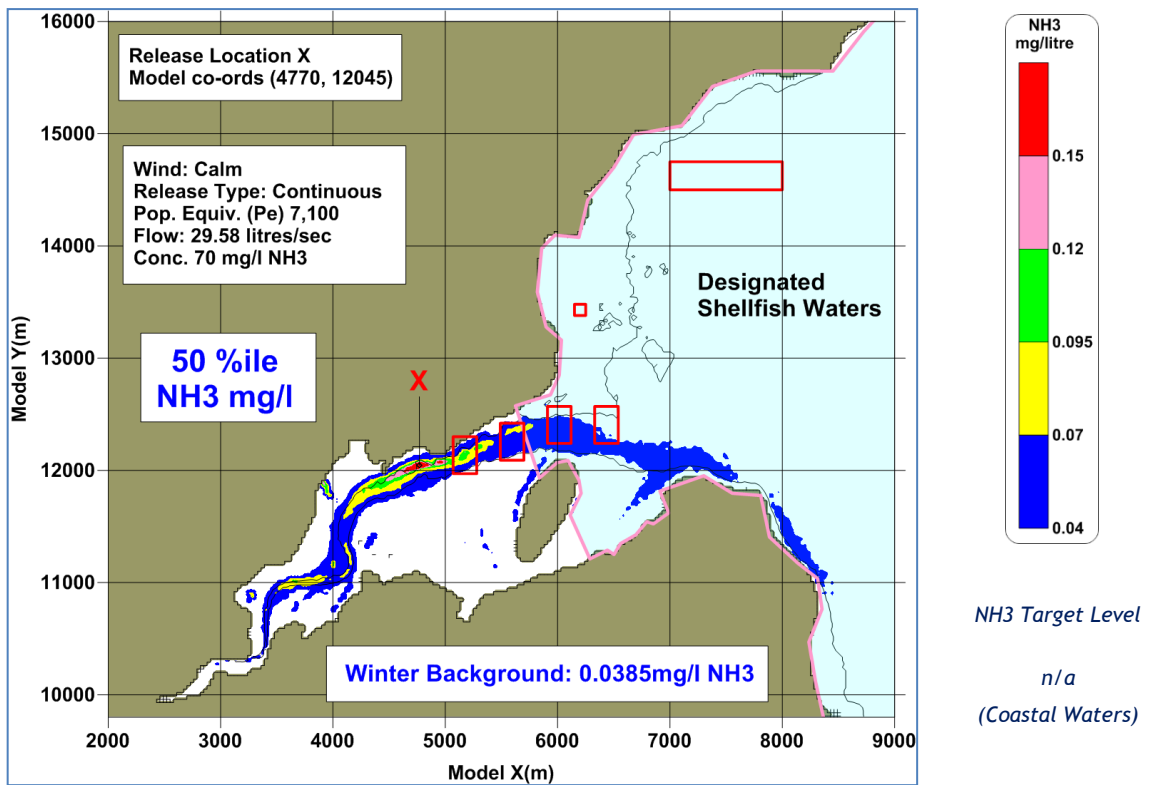


Figure A.8b - Simulated 50%ile NH3 concentration for discharge from proposed outfall for 7100pe, NH3:70mg/l N - winter

UIA

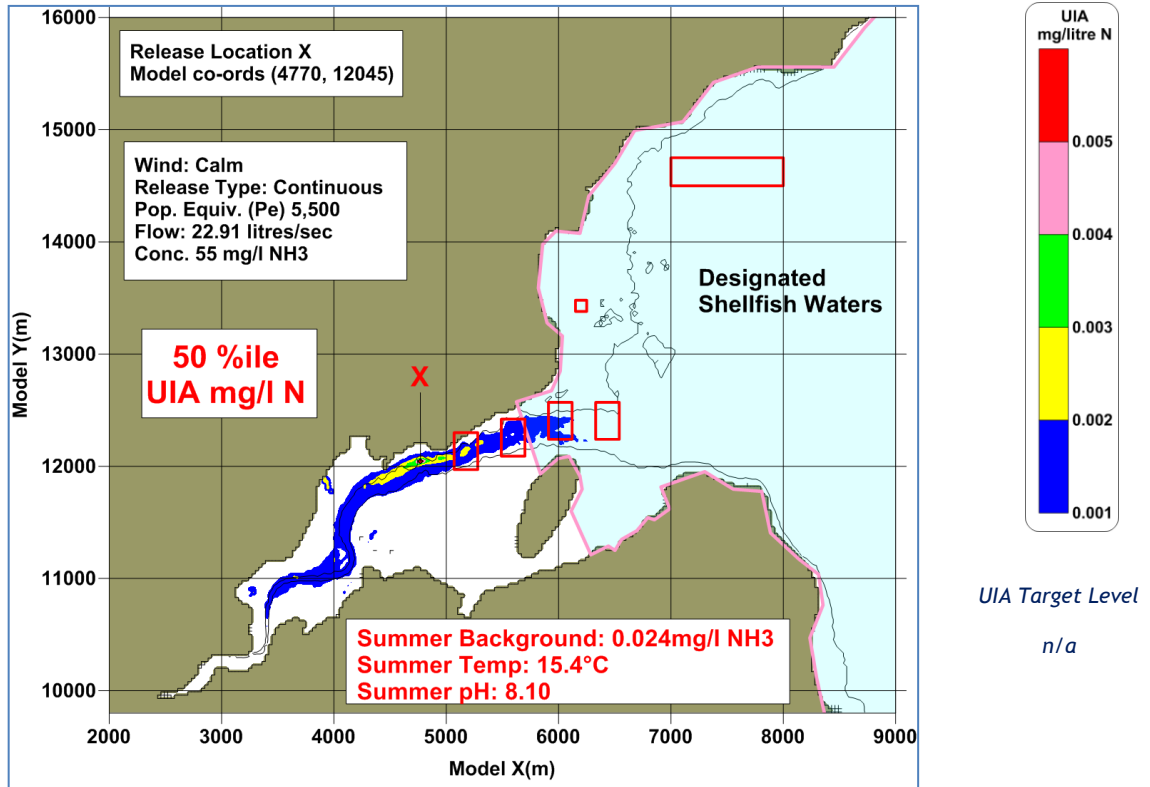


Figure A.9a - Simulated 50%ile UIA concentration for discharge from proposed outfall for 5500pe, NH3: 55mg/l N - summer

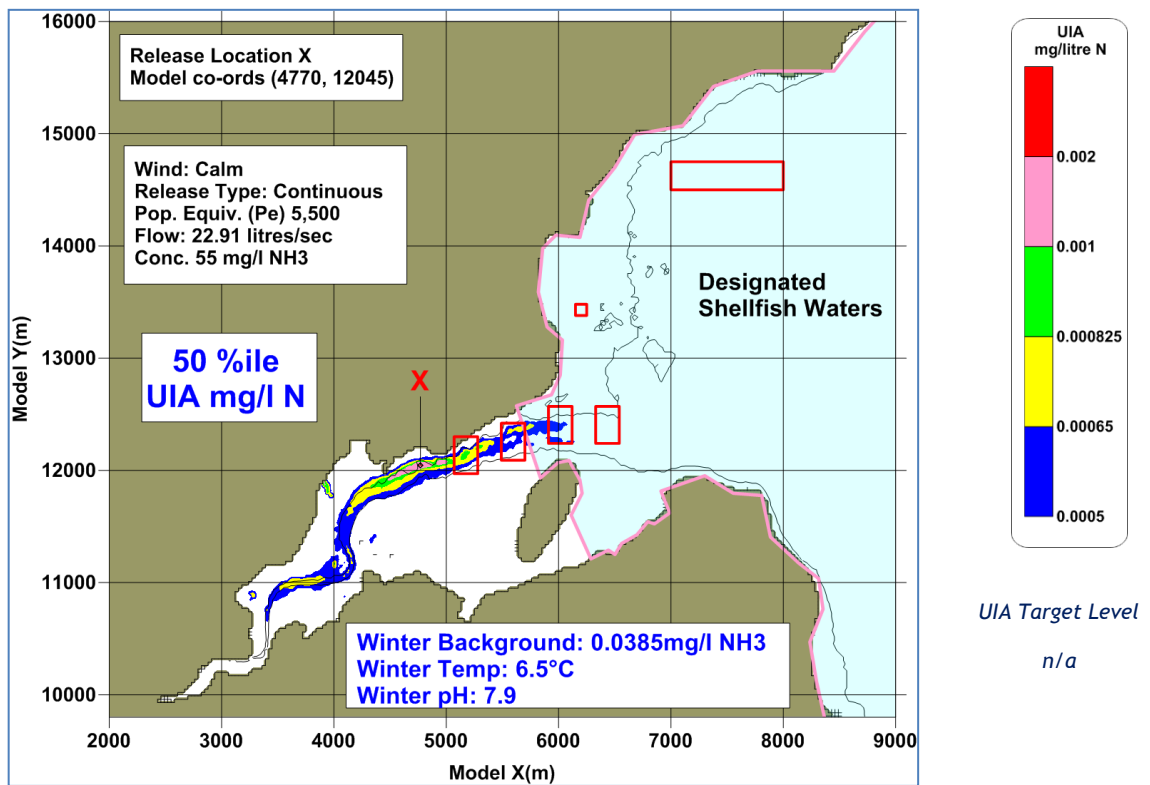


Figure A.9b - Simulated 50%ile UIA concentration for discharge from proposed outfall for 5500pe, NH3: 55mg/l N - winter

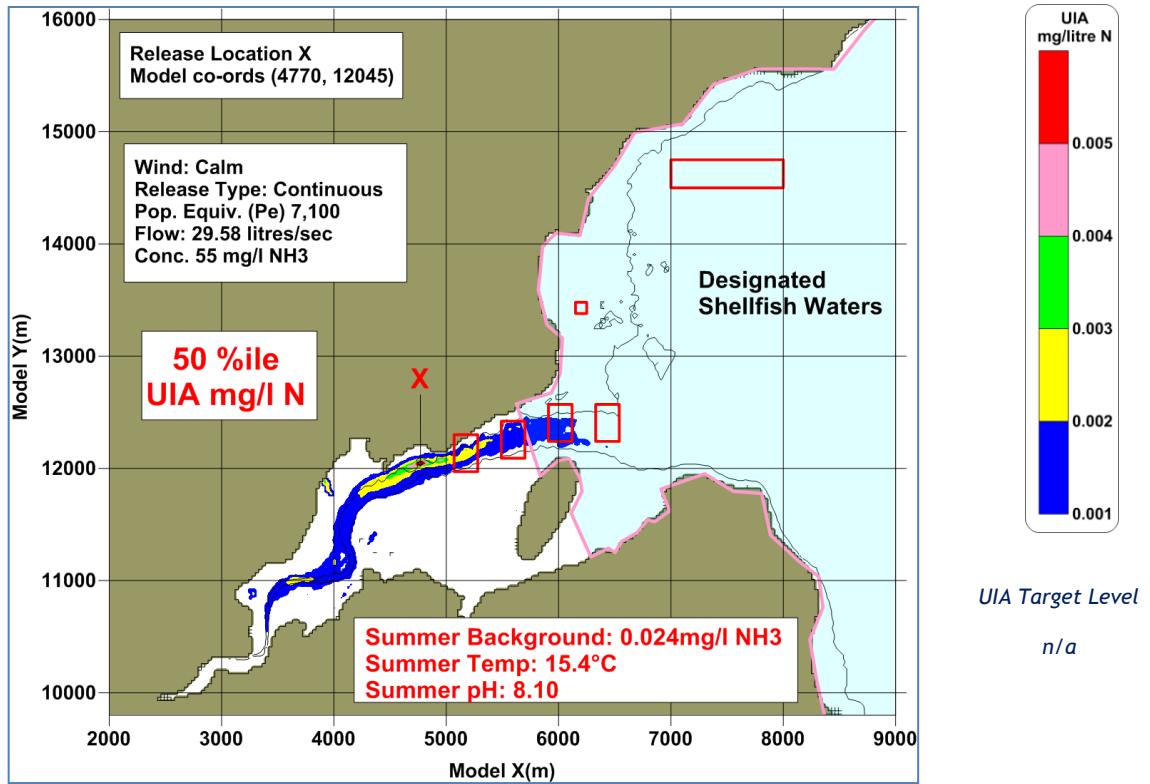


Figure A.10a - Simulated 50%ile UIA concentration for discharge from proposed outfall for 7100pe, NH3: 55mg/l N - summer

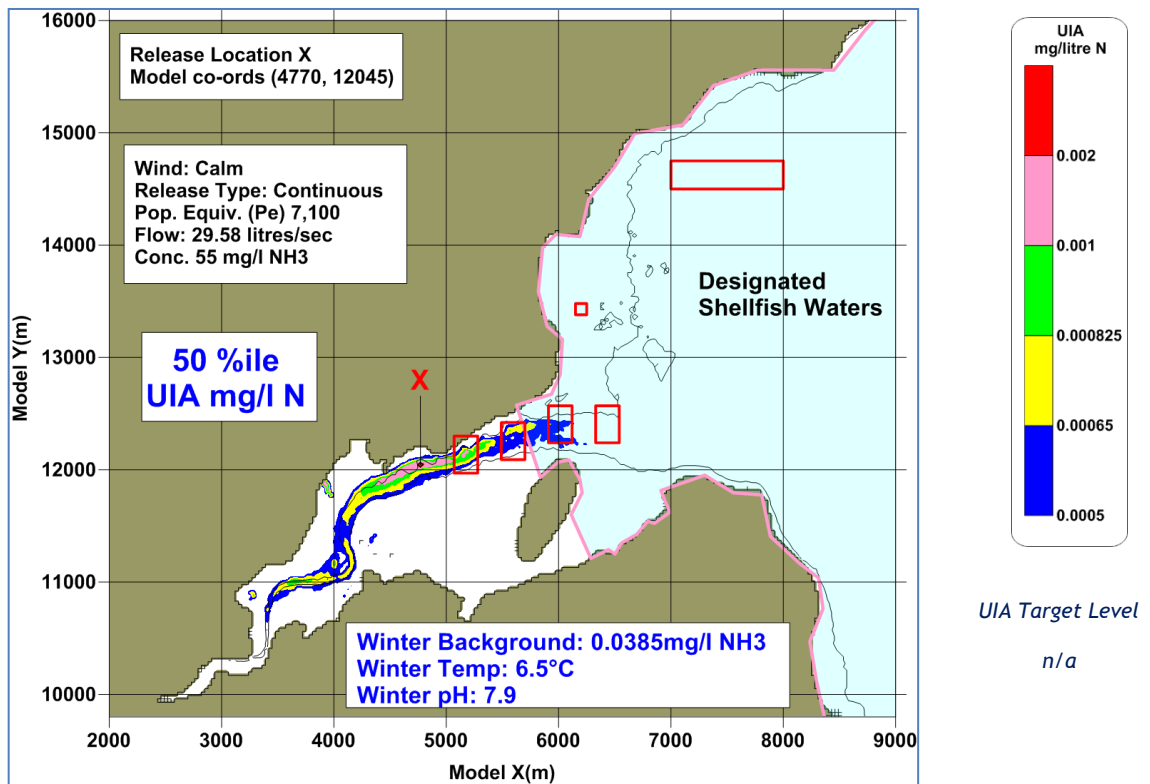


Figure A.10b - Simulated 50%ile UIA concentration for discharge from proposed outfall for 7100pe, NH3: 55mg/l N - winter

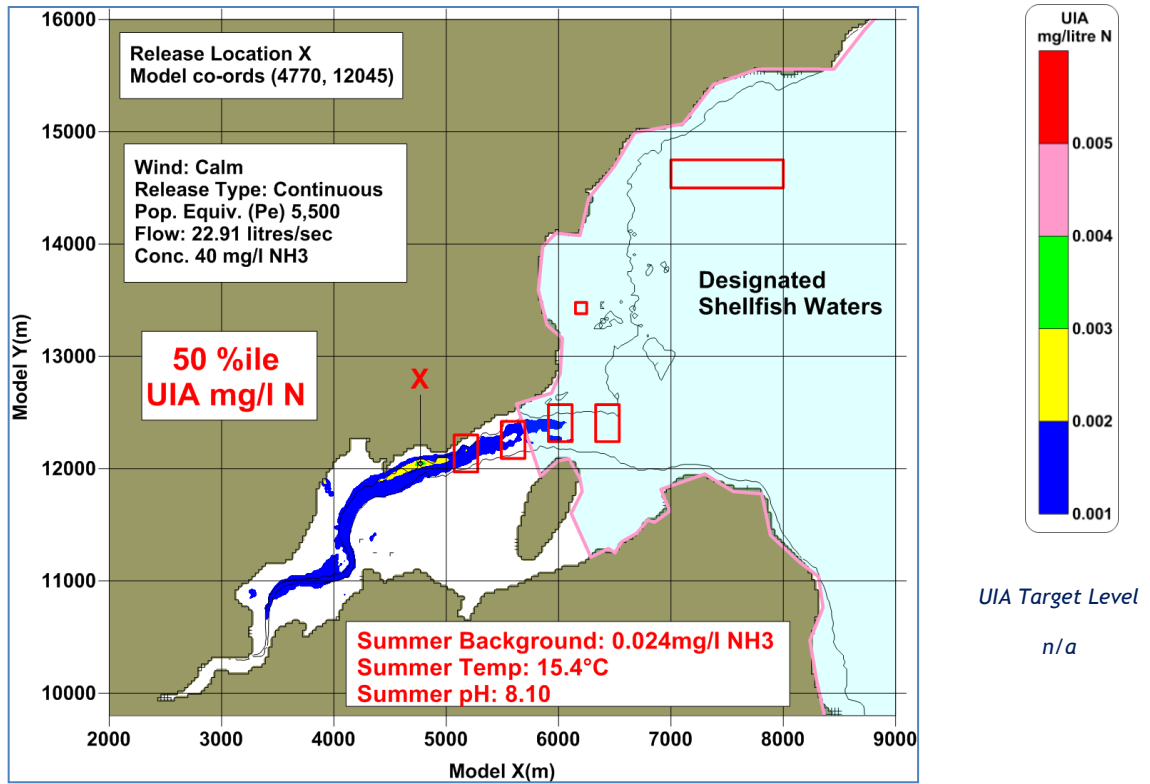


Figure A.11a - Simulated 50%ile UIA concentration for discharge from proposed outfall for 5500pe, NH3: 40mg/l N - summer

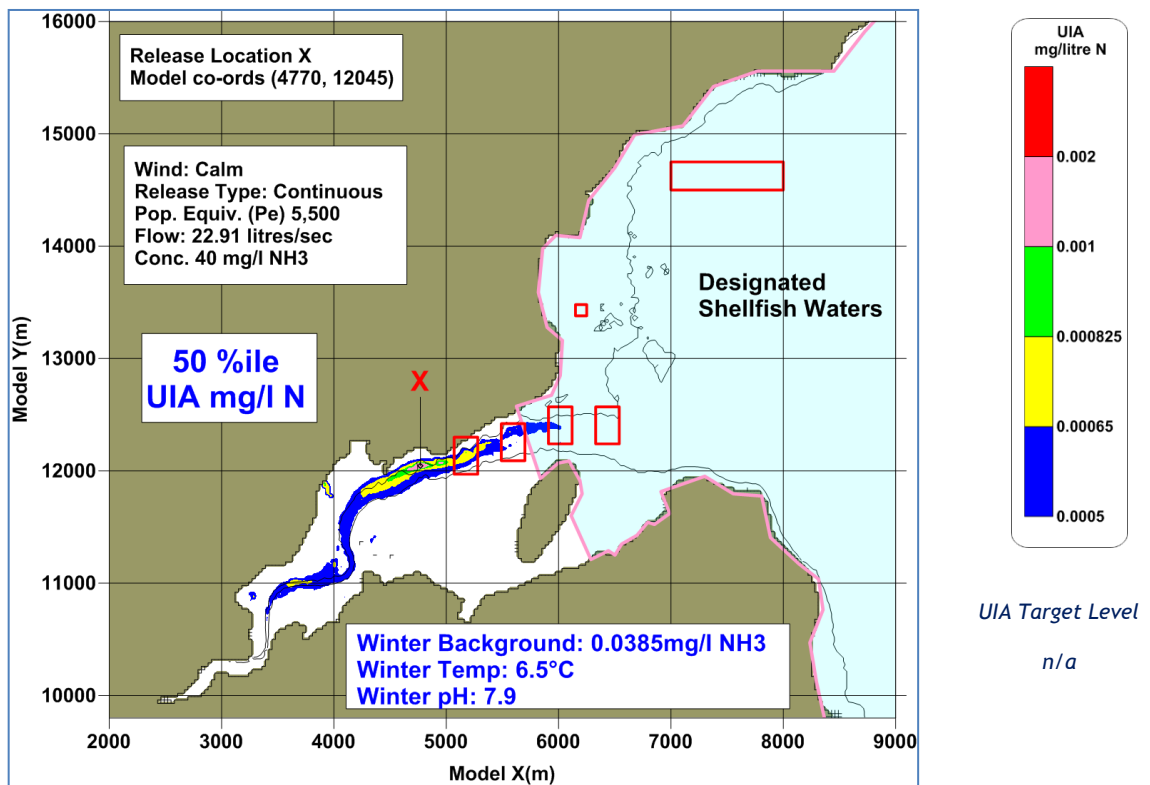


Figure A.11b - Simulated 50%ile UIA concentration for discharge from proposed outfall for 5500pe, NH3: 40mg/l N - winter

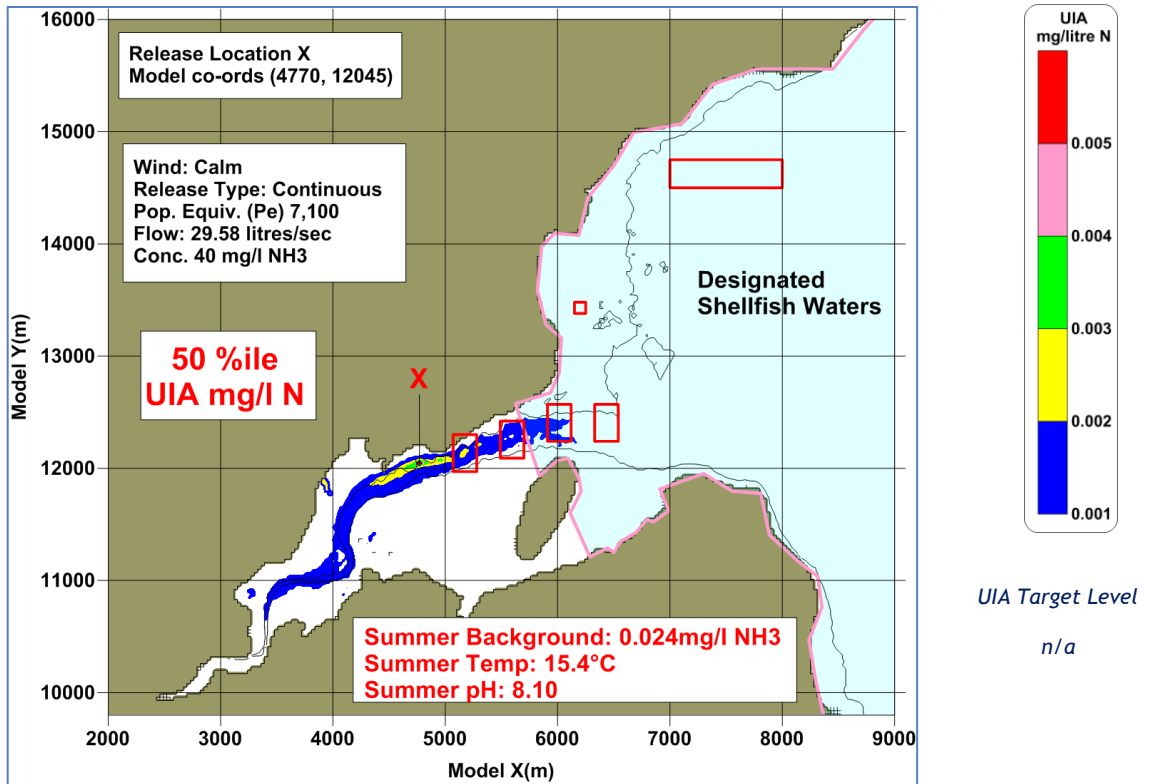


Figure A.12a - Simulated 50%ile UIA concentration for discharge from proposed outfall for 7100pe, NH3: 40mg/l N - summer

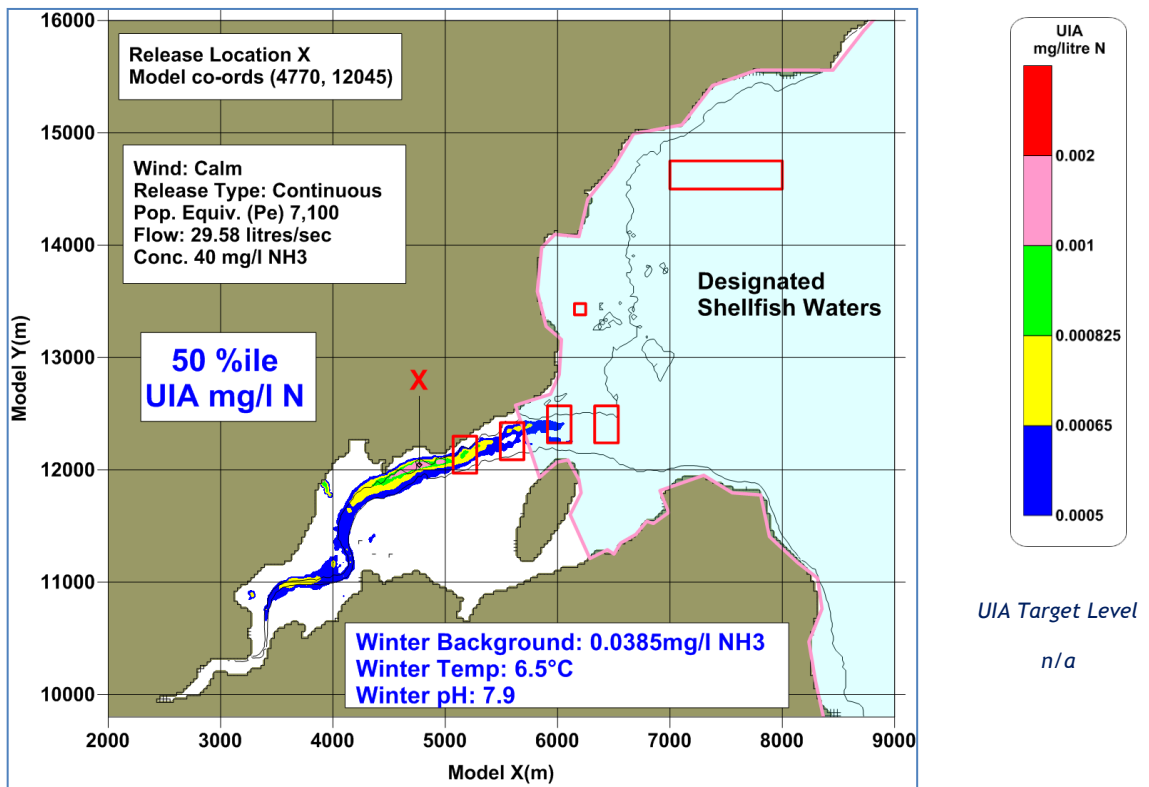


Figure A.12b - Simulated 50%ile UIA concentration for discharge from proposed outfall for 7100pe, NH3: 40mg/l N - winter

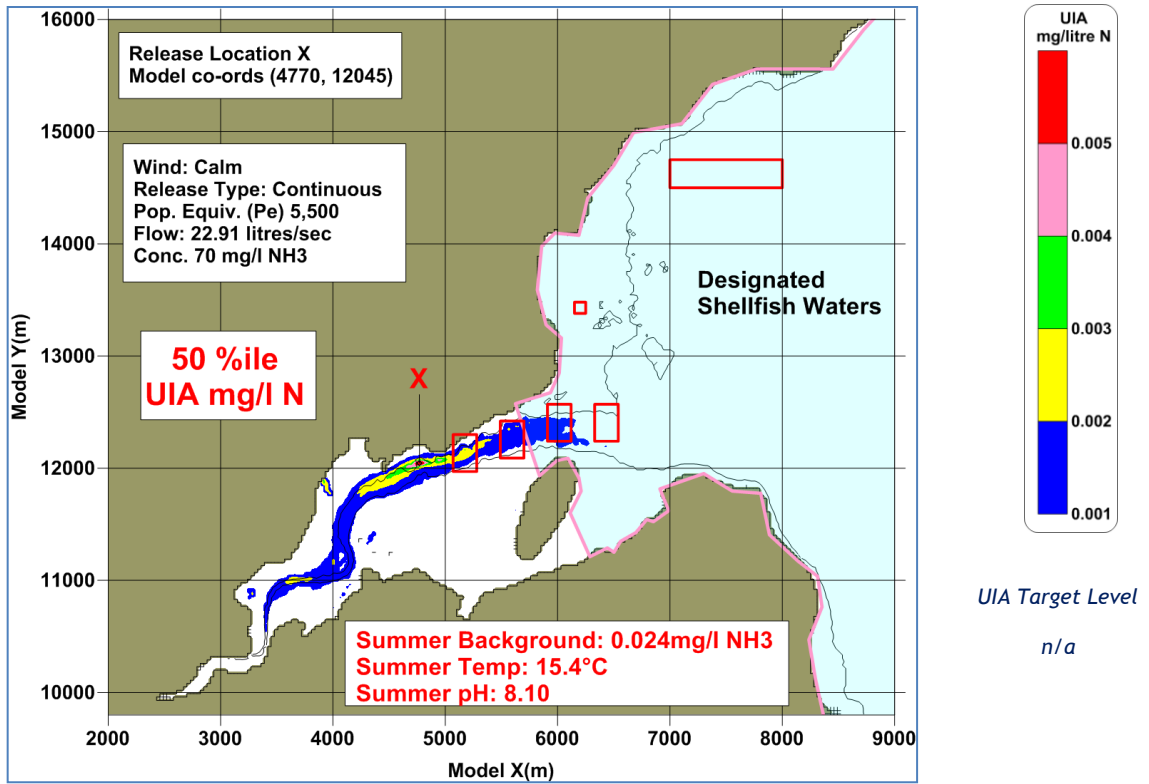


Figure A.13a - Simulated 50%ile UIA concentration for discharge from proposed outfall for 5500pe, NH3: 70mg/l N - summer

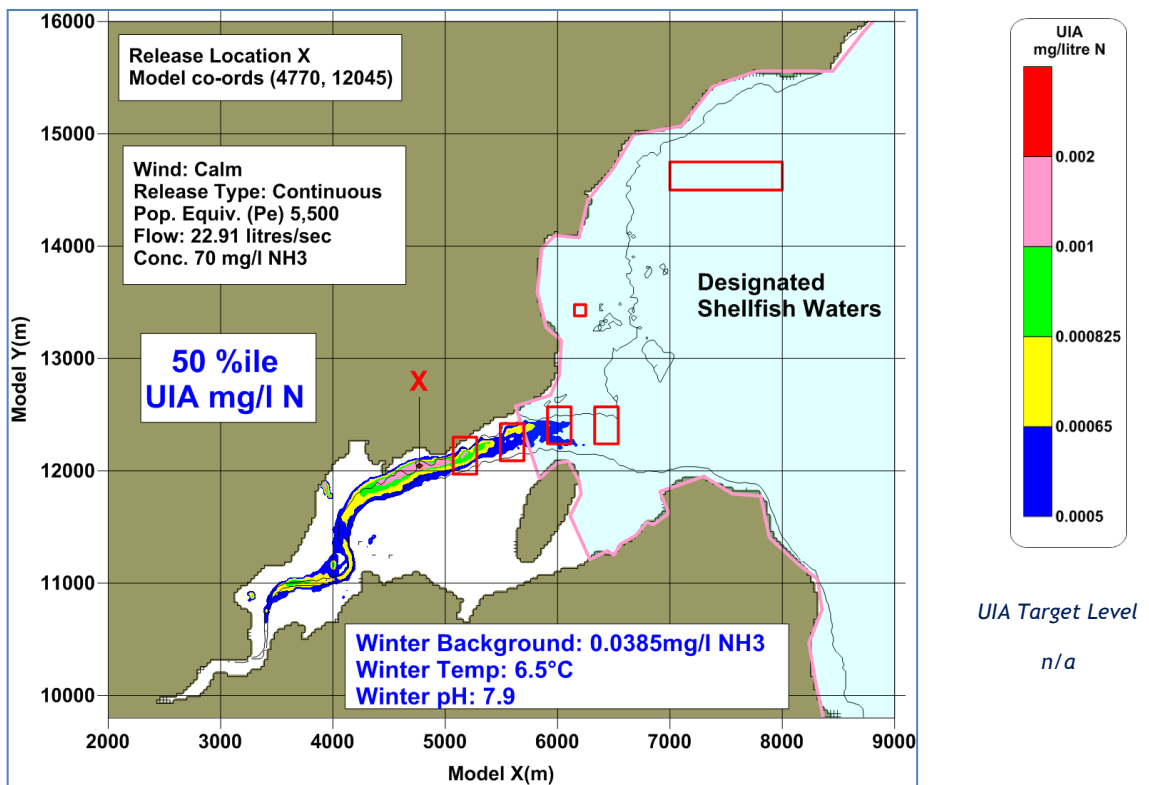


Figure A.13b - Simulated 50%ile UIA concentration for discharge from proposed outfall for 5500pe, NH3: 70mg/l N - winter

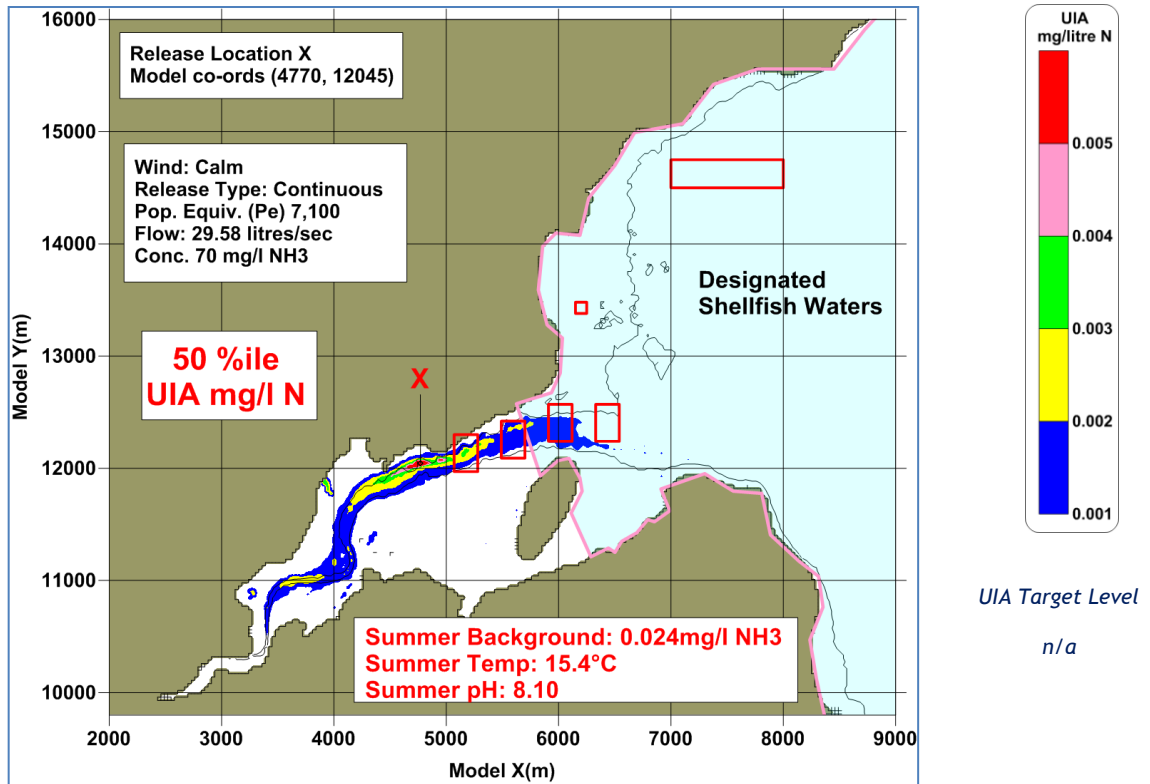


Figure A.14a - Simulated 50%ile UIA concentration for discharge from proposed outfall for 7100pe, NH3: 70mg/l N - summer

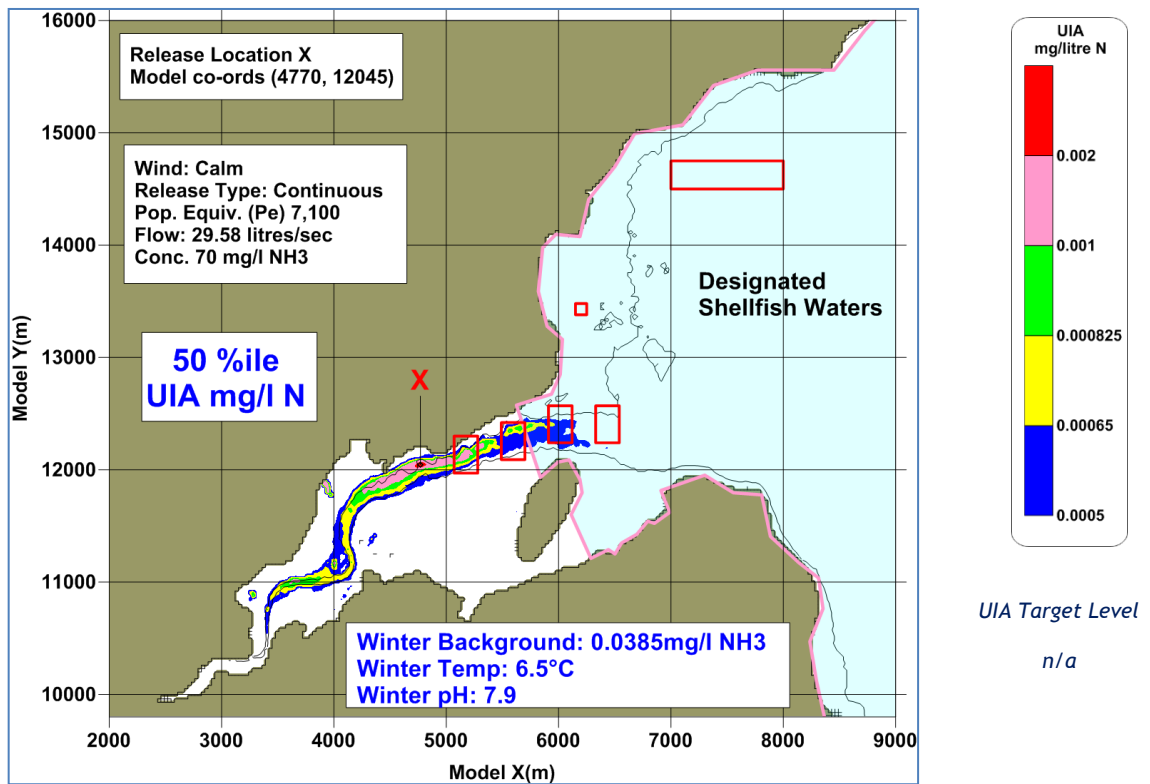
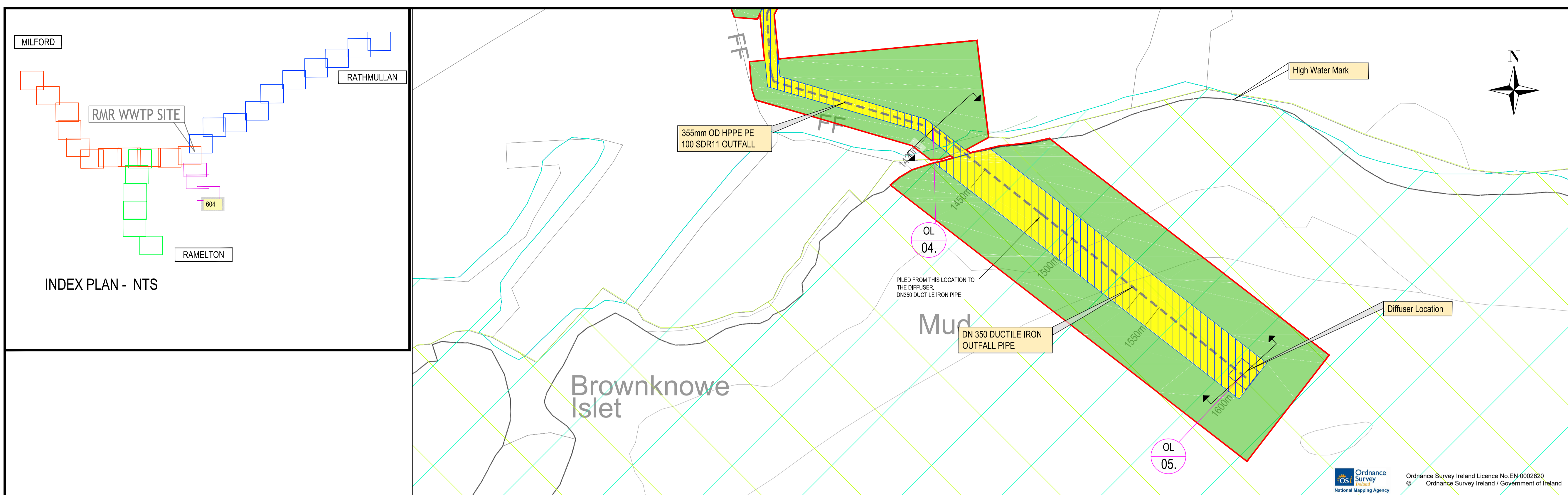
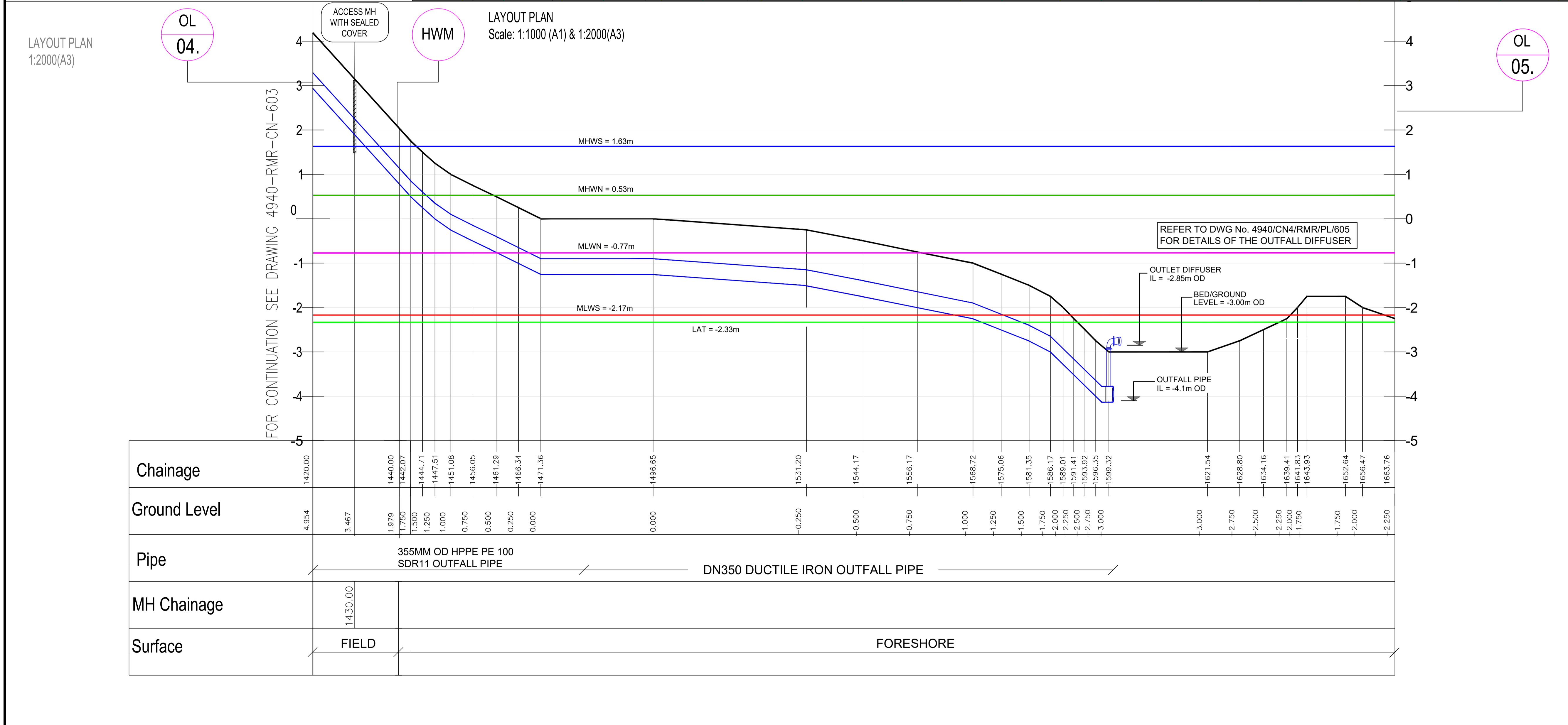


Figure A.14b - Simulated 50%ile UIA concentration for discharge from proposed outfall for 7100pe, NH3: 70mg/l N - winter



- NOTES**
- Levels are in meters O.D. and refer to Mean High Datum.
 - This Drawing is to be read in conjunction with all other relevant documentation.
 - Do not scale from this drawing, use only printed dimensions.
 - All dimensions, chainages, levels and coordinates are in metres unless defined otherwise.
 - Contractor to identify and verify the position of all services on site. Prior to works commencing.
 - All Pipework to be laid at minimum gradient 1:500
 - Rising Man
Cover shall be maintained between 0.9m and 1.2m above the crown unless deeper cover is required to avoid the need for an air valve.
 - Sewers
Cover to top of pipe shall be a minimum of 0.9m in agricultural lands and 1.2m in the road.
- LEGEND:**
- SITE BOUNDARY
 - LAND OWNERSHIP BOUNDARY
 - LOUGH SWILLY SAC
 - LOUGH SWILLY SPA
 - WAYLEAVES
 - PERMANENT RIGHT OF WAY
 - TEMPORARY WORKING AREAS
 - DESIGN CORRIDOR - PROPOSED PIPELINES WILL BE CONSTRUCTED WITHIN THE DESIGN CORRIDOR SHOWN THUS ON THE LAYOUT PLAN. INDICATIVE ROUTE OF PIPELINE SHOWN ON DRAWINGS
 - PROPOSED RISING MAIN
 - PROPOSED GRAVITY SEWER
 - PROPOSED OUTFALL PIPELINE
 - PROPOSED AIR VALVE shown thus
 - VS PROPOSED VENT STACK
 - Mean High Water Neaps (MHWN)
 - Mean High Water Springs (MHS)
 - Mean Low Water Neaps (MLWN)
 - Mean Low Water Springs (MLS)
 - Lowest Astronomical Tide (LAT)



rev.	modifications	by	date
A	LAT and the level of discharge pipe and diffuser relative to existing ground level added to the longitudinal section	LB	Jan. 21

Client
IRISH WATER

Project
RAMELTON, MILFORD AND RATHMULLAN SEWERAGE SCHEME: CONTRACT NO.4

Stage
PLANNING

Title
WwTP OUTFALL MARINE SECTION AND DIFFUSER LAYOUT PLAN AND LONGITUDINAL SECTION. Section D; Attachment D.2.4

Scales
1:1000 (A3)

Surveyed	Prepared By	Checked	Date
	LB	AG	April 2020

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Drawing No.	Revision
4940/CN4/RMR/PL/604	A

CUMULATIVE CHAINAGE 1420m **MARINE SECTION OF OUTFALL PIPELINE FROM RMR WWTP**
Scale: Horizontal 1:1000 (A3)
Scale: Vertical 1:100 (A3)

CUMULATIVE CHAINAGE 1644m

Attachment D.2.5: Priority Substances Assessment

Agglomeration Name:	Ramelton Milford Rathmullan Sewerage Scheme
Licence Register No.	D0341



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2.1	Assessment of Analysis Required	1
2.2	Review outcome of Desktop study	3
3	Assessment of Significance and Recommendations	3

Appendix 1 - Screening of Parameters for Priority Substances

Appendix 2 – Priority Substance Screening Flowchart

Appendix 3 – Receiving Waters Priority Substance Data

1 Introduction

The Ramelton, Milford & Rathmullan (RMR) Sewerage Scheme is a proposed Project that will provide wastewater treatment in a new Wastewater Treatment Plant (WwTP) serving all three agglomerations. New main pumping stations incorporating emergency/stormwater storage tanks will be constructed at all three agglomerations and the wastewater will be pumped to the proposed RMR WwTP via rising mains. The treated effluent will be discharged into the Swilly Estuary.

A review of Ramelton Wastewater Discharge Licence (**D0341**) is required to amalgamate the above-named agglomerations into one agglomeration that will be served by the proposed RMR WwTP.

This report has been prepared for **D0341**, Ramelton, Milford & Rathmullan Sewerage Scheme to inform the review application of the wastewater discharge licence for the revised agglomeration.

This desk top study has been undertaken to determine the necessity, if any, for further analysis of the discharge based on the Guidance on the Screening for Priority Substances for Waste Water Discharge Licences, issued by the EPA. Relevant inputs to the RMR WwTP and estimates of emissions from the discharge point have been taken into account in the preparation of this report.

Details of the emissions concentration for the primary discharge and impact on the receiving water are included in **Appendix 1**.

2 Desktop Study

2.1 Assessment of Analysis Required

A. Review of all industrial inputs into WWTP

A list of all licensed and unlicensed industrial or trade effluent discharges, leachate discharges and other imports is included in **Table 2.1** below. There are no known unlicensed/unauthorised discharges that Irish Water are aware of.

The main component of the influent to this wastewater treatment plant is domestic wastewater. The remainder is commercial influent, typically from schools and other institutions, domestic type waste from commercial properties and S16 licenced premises as per **Table 2.1**. There will be no industrial licensed (IPPC) sector influents discharging to the RMR WwTP.

Table 2.1 – List of Licensed Non-Domestic Discharges to WWTP

Licensee Name, Landfill Name, or Other Imports	Type of Industry	Type of Licence (IED / IPPC / Section 16 / Unlicensed)	Potential Source of Dangerous/ Priority Substances	Dangerous / Priority Substances Monitoring Undertaken (Yes/ No)
McGettigan Butchers Ltd.	Butchers	Section 16 – Lsew21	Yes	Unknown
The Milford Inn Ltd	Hotel – Food processing	Section 16 – Lsew60; Trade Effluent FOG licence	Yes	Unknown

Where the answer to “**Potential Source of Dangerous Substances (Yes / No)**” is Yes, **Table 2.2** below has been completed for each industry/landfill/other import source.

Table 2.2 – List of Potential Dangerous or Priority Substances in Non-Domestic Discharges to WWTP

Type of Activity	List Anticipated Dangerous Substances or state if unknown	Monitoring Undertaken (Yes / No)
Butchers	Naphthalene Trichloroethylene Cadmium and its compounds Hexachlorocyclohexane (Lindane) Chromium (VI) Cypermethrin Toluene Xylenes (Total)	Unknown
Schools	Dichloromethene Lead and its compounds Nickel and its compounds Trichloromethane	Unknown
Launderettes and Dry Cleaners	Di (2-ethylhexyl) phthalate (DEHP)	Unknown

Hairdressers	Nickel and its compounds Cadmium and its compounds	Unknown
Garages and filling stations	Benzene Di (2-ethylhexyl) phthalate (DEHP) Lead and its compounds Naphthalene Nickel and its compounds Cadmium and its compounds Mercury and its compounds Chromium (III) Copper	Unknown
Manufacture of food products and beverages	Lead and its compounds Nickel and its compounds Cadmium and its compounds Mercury and its compounds Chromium (III) Copper Zinc	Unknown

B. Discharge monitoring

The primary discharge is a proposed discharge; therefore, it has not been analysed for priority substances.

There is no analysis data available for the priority substances listed in the EPA's *Guidance on the Screening for Priority Substances for Waste Water Discharge Licences*.

C. Downstream monitoring location's participation in relevant monitoring programme

There are no recent priority substances monitoring data for the downstream ambient monitoring location.

D. Participation in PRTR reporting

The emissions of specific organic compounds and metals (priority substances) have been estimated for the discharge utilising the EPA's urban WWTP calculation tool for PRTR reporting. It is noted from the EPA's report, *An Inventory of Emissions to Waters in Ireland*, that extensive assessment of emission factors was undertaken during 2011 / 2012 that focused on the evaluation of inputs / output concentrations and removal efficiency using a variety of different sized plants and wastewater treatment options. This has led to the significant refinement of the electronic template toolkit used for WWTP assessment using the PRTR tool. The estimated emission data used pertains to a WWTP with a baseline concentration most relevant to the RMR WwTP. These parameters are required to generate estimated PRTR mass emission values. The relevant permutations used in the PRTR tool are as follows:

- <10,000 PE
- No saline intrusion
- Secondary Treatment – Activated Sludge
- Phosphorous Removal Only - Biological

All parameters listed in **Appendix 1** have emissions data available for the discharge from the PRTR tool. The Total Halogenated Organic Compound Value from the PRTR reporting has been used to give a conservative estimate for Trichloromethane.

2.2 Review outcome of Desktop study

Following the desktop study, all parameters in Appendix 1 have been assessed to establish any potential impact on the receiving waters. Priority substance measured concentrations in the primary discharge were not available for any parameters, as such estimated concentrations were assessed. This desktop study is considered to provide partial characterisation of the wastewater.

3 Assessment of Significance and Recommendations

An assessment of the potential for impacts on receiving waters from priority substances in the primary discharge has been carried out. The assessment considers the primary discharge relevant to Environmental Quality Standards (EQS) for priority substances in surface waters, as set out in the European Communities Environmental Objectives (Surface Waters) Regulations 2009, as amended.

Based on the estimated data, no parameters were identified as potentially being higher than the required EQS.

Based on the assessment carried out it is not considered that any further sampling or analysis is required.

Does the assessment use the Desk Top Study Method or Screening Analysis to determine if the discharge contains the parameters in Appendix 1 of the EPA guidance	Desk Top Study
Does the assessment include a review of licensed / authorised inputs to the works?	Yes
Does the assessment include a review of other (unauthorised) inputs to the works?	Not Applicable
Does the report include an assessment of the significance of the results where a listed material is present in the discharge? (e.g. impact on the relevant EQS standard for the receiving water)	Yes
Does the assessment identify that priority substances may be impacting the receiving water?	No
Does the Improvement Programme for the agglomeration include the elimination / reduction of all priority substances identified as having an impact on receiving water quality?	n/a

Appendix 1 – Screening of Parameters for Priority Substances

AA: Annual Average

MAC: Maximum Allowable Concentration

EQS: Environmental Quality Standards

Dilution factor in receiving water: A simplified approach has been adopted using the mass balance approach on the basis that the only ‘new’ water available for dilution is that entering the estuary is from the Leannan River. Mass balance is based on 95% flow of 0.83m³/s (low flow) entering the estuary from the River Leannan and calculated future effluent flow (DWF) of 0.02958m³/s based on 30yr load of 7,100p.e.

No.	Compound	Group of compounds	AA-EQS Inland SW (µg/l)	AA-EQS Other SW (µg/l)	Measured /Estimated Conc. (µg/l) ¹	Data Source	Sample Date (if applicable)	Effluent Concentration above AA concentration (Yes/No)	Effluent Concentration above AA concentration after dilution (Yes/No)
1	Benzene	VOCs	10	8	0.0168	PRTR Estimation Toolset	n/a	No	No
2	Carbon tetrachloride	VOCs	12	12	0	PRTR Estimation Toolset	n/a	No	No
3	1,2-Dichloroethane	VOCs	10	10	0	PRTR Estimation Toolset	n/a	No	No
4	Dichloromethane	VOCs	20	20	0.0455	PRTR Estimation Toolset	n/a	No	No
5	Tetrachloroethylene	VOCs	10	10	0.0591	PRTR Estimation Toolset	n/a	No	No
6	Trichloroethylene	VOCs	10	10	0	PRTR Estimation Toolset	n/a	No	No

No.	Compound	Group of compounds	AA-EQS Inland SW (µg/l)	AA-EQS Other SW (µg/l)	Measured /Estimated Conc. (µg/l) ¹	Data Source	Sample Date (if applicable)	Effluent Concentration above AA concentration (Yes/No)	Effluent Concentration above AA concentration after dilution (Yes/No)
7	Trichlorobenzenes	VOCs	0.4	0.4	0	PRTR Estimation Toolset	n/a	No	No
8	Trichloromethane	VOCs	2.5	2.5	0.0591	PRTR Estimation Toolset	n/a	No	No
9	Xylenes (all isomers)	VOCs	10	10	0.1159	PRTR Estimation Toolset	n/a	No	No
10	Ethyl Benzene	VOCs	n/a	n/a	0.0166	PRTR Estimation Toolset	n/a	No	No
11	Toluene	VOCs	10	10	0.4933	PRTR Estimation Toolset	n/a	No	No
12	Naphthlene ¹	PAHs	2	2	0.0040	PRTR Estimation Toolset	n/a	No	No
13	Fluoranthene ¹	PAHs	0.0063	0.0063	0.0023	PRTR Estimation Toolset	n/a	No	No
14	Benzo[k]fluoranthene ²	PAHs	MAC of 0.017	MAC of 0.017	0.0020	PRTR Estimation Toolset	n/a	No	No

¹ The EQS for these substances shall take effect from 22 December 2015

² No indicative parameter is provided for this group of substances

No.	Compound	Group of compounds	AA-EQS Inland SW (µg/l)	AA-EQS Other SW (µg/l)	Measured /Estimated Conc. (µg/l) ¹	Data Source	Sample Date (if applicable)	Effluent Concentration above AA concentration (Yes/No)	Effluent Concentration above AA concentration after dilution (Yes/No)
15	Benzo[ghi]perylene ²	PAHs	MAC of 8.2 x 10 ⁻³	MAC of 8.2 x 10 ⁻⁴	0.0020	PRTR Estimation Toolset	n/a	No	No
16	Indeno[1,2,3-c,d]pyrene ²	PAHs			0.0022	PRTR Estimation Toolset	n/a	No	No
17	Benzo[b]fluoranthene ²	PAHs	MAC of 0.017	MAC of 0.017	0.0020	PRTR Estimation Toolset	n/a	No	No
18	Benzo[a]pyrene	PAHs	1.7 x 10 ⁻⁴	1.7 x 10 ⁻⁴	0.0020	PRTR Estimation Toolset	n/a	No	No
19	Di(2-ethylhexyl)phthalate (DEHP)	Plasticiser	1.3	1.3	0.9173	PRTR Estimation Toolset	n/a	No	No
20	Isodrin ³	Pesticides	Σ=0.01	Σ=0.005	0	PRTR Estimation Toolset	n/a	No	No
21	Dieldrin ³	Pesticides			0	PRTR Estimation Toolset	n/a	No	No
22	Diuron	Pesticides	0.2	0.2	0.0264	PRTR Estimation Toolset	n/a	No	No

³ Σ of Aldrin, Dieldrin, Endrin and Isodrin.

No.	Compound	Group of compounds	AA-EQS Inland SW (µg/l)	AA-EQS Other SW (µg/l)	Measured /Estimated Conc. (µg/l) ¹	Data Source	Sample Date (if applicable)	Effluent Concentration above AA concentration (Yes/No)	Effluent Concentration above AA concentration after dilution (Yes/No)
23	Isoproturon	Pesticides	0.3	0.3	0.0075	PRTR Estimation Toolset	n/a	No	No
24	Atrazine	Pesticides	0.6	0.6	0.0105	PRTR Estimation Toolset	n/a	No	No
25	Simazine	Pesticides	1	1	0.0141	PRTR Estimation Toolset	n/a	No	No
26	Glyphosate	Pesticides	60	-	1.5327	PRTR Estimation Toolset	n/a	No	No
27	Mecoprop	Pesticides	n/a	n/a	0.1070	PRTR Estimation Toolset	n/a	n/a	n/a
28	2,4-D	Pesticides	n/a	n/a	0.0510	PRTR Estimation Toolset	n/a	n/a	n/a
29	MCPA	Pesticides	n/a	n/a	0.0886	PRTR Estimation Toolset	n/a	n/a	n/a
30	Linuron	Pesticides	0.7	0.7	0	PRTR Estimation Toolset	n/a	No	No
31	Dichlobenil	Pesticides	/a	n/a	0.0043	PRTR Estimation Toolset	n/a	n/a	n/a

No.	Compound	Group of compounds	AA-EQS Inland SW (µg/l)	AA-EQS Other SW (µg/l)	Measured /Estimated Conc. (µg/l) ¹	Data Source	Sample Date (if applicable)	Effluent Concentration above AA concentration (Yes/No)	Effluent Concentration above AA concentration after dilution (Yes/No)
32	2,6-Dichlorobenzamide	Pesticides	n/a	n/a	0.0805	PRTR Estimation Toolset	n/a	n/a	n/a
33	PCBs	PCBs	n/a	n/a	0	PRTR Estimation Toolset	n/a	n/a	n/a
34	Phenols (as Total C)	Phenols	8	8	0.9098	PRTR Estimation Toolset	n/a	No	No
35	Lead	Metals	1.2	1.3	3.0394	PRTR Estimation Toolset	n/a	Yes	No
36	Arsenic	Metals	25	20	0.5667	PRTR Estimation Toolset	n/a	No	No
37	Copper	Metals	5 or 30 ²	5	3.0000	PRTR Estimation Toolset	n/a	No	No
38	Zinc	Metals	8 or 50 or 100 ³	40	49.3636	PRTR Estimation Toolset	n/a	Yes	No
39	Cadmium	Metals	1.8 or 1.9 or 0.15 or 0.25 ⁴	0.2	0.2667	PRTR Estimation Toolset	n/a	Yes	No
40	Mercury	Metals	MAC of 0.07	MAC of 0.07	0	PRTR Estimation Toolset	n/a	No	No

No.	Compound	Group of compounds	AA-EQS Inland SW (µg/l)	AA-EQS Other SW (µg/l)	Measured /Estimated Conc. (µg/l) ¹	Data Source	Sample Date (if applicable)	Effluent Concentration above AA concentration (Yes/No)	Effluent Concentration above AA concentration after dilution (Yes/No)
41	Chromium VI	Metals	3.4	0.6	0.8000	PRTR Estimation Toolset	n/a	Yes	No
42	Selenium	Metals	n/a	n/a	0	PRTR Estimation Toolset	n/a	n/a	n/a
43	Antimony	Metals	n/a	n/a	0.1545	PRTR Estimation Toolset	n/a	n/a	n/a
44	Molybdenum	Metals	n/a	n/a	0	PRTR Estimation Toolset	n/a	n/a	n/a
45	Tin	Metals	n/a	n/a	0.1444	PRTR Estimation Toolset	n/a	n/a	n/a
46	Barium	Metals	n/a	n/a	13.2444	PRTR Estimation Toolset	n/a	n/a	n/a
47	Boron	Metals	n/a	n/a	61.1111	PRTR Estimation Toolset	n/a	n/a	n/a
48	Cobalt	Metals	n/a	n/a	0.1758	PRTR Estimation Toolset	n/a	n/a	n/a
49	Vanadium	Metals	n/a	n/a	2.7273	PRTR Estimation Toolset	n/a	n/a	n/a

No.	Compound	Group of compounds	AA-EQS Inland SW (µg/l)	AA-EQS Other SW (µg/l)	Measured /Estimated Conc. (µg/l) ¹	Data Source	Sample Date (if applicable)	Effluent Concentration above AA concentration (Yes/No)	Effluent Concentration above AA concentration after dilution (Yes/No)
50	Nickel	Metals	4	8.6	4.2576	PRTR Estimation Toolset	n/a	No	No
51	Fluoride	General	500	1,500	235	PRTR Estimation Toolset	n/a	No	No
52	Chloride	General	n/a	n/a	54120.	PRTR Estimation Toolset	n/a	n/a	n/a
53	TOC	General	n/a	n/a	9220	PRTR Estimation Toolset	n/a	n/a	n/a
54	Cyanide	General	10	10	2.9318	PRTR Estimation Toolset	n/a	No	No
	Conductivity	General	n/a	n/a		PRTR Estimation Toolset	n/a	n/a	n/a
	Hardness (mg/l CaCO ₃)	General	n/a	n/a		PRTR Estimation Toolset	n/a	n/a	n/a
	pH	General	n/a	n/a			n/a	n/a	n/a

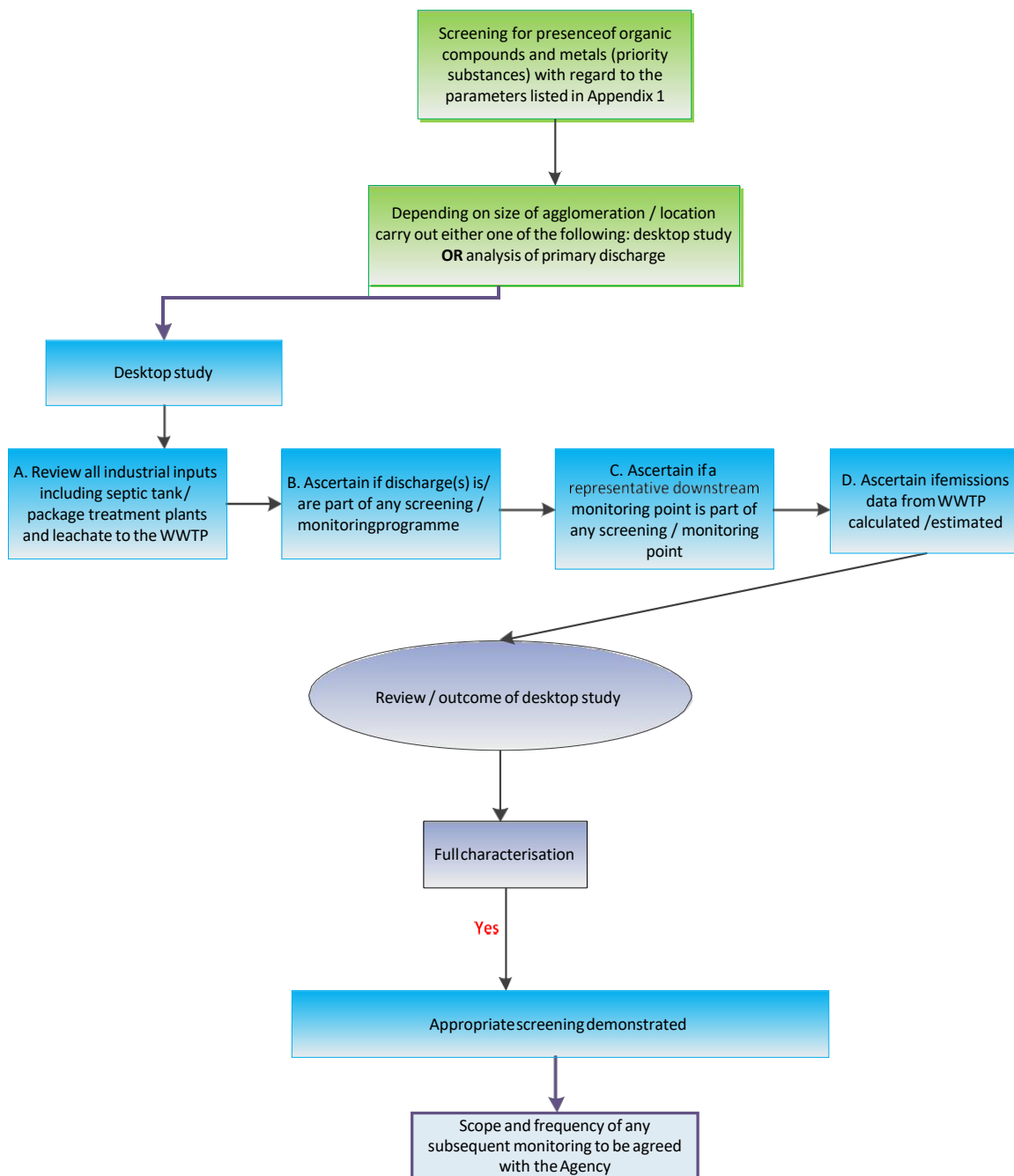
Notes:

1. Where measured values are available these should be used instead of estimated values from PRTR tool.
2. In the case of Copper the value 5 applies where the water hardness measured in mg/l CaCO₃ is less than or equal to 100; the value 30 applies where the water hardness exceeds 100 mg/l CaCO₃. Estimated CaCO₃ value > 100 where no sampling data available (based on PRTR tool)
3. In the case of Zinc, the standard shall be 8 µg/l for water hardness with annual average values less than or equal to 10 mg/l CaCO₃, 50 µg/l for water hardness greater than 10 mg/l CaCO₃ and less than or equal to 100 mg/l CaCO₃ and 100 µg/l elsewhere. Estimated CaCO₃ value > 100 where no sampling data available
4. For Cadmium and its compounds the EQS values vary dependent upon the hardness of the water as specified in five class categories (Class 1: <40 mg CaCO₃/l, Class 2: 40 to <50 mg CaCO₃/l, Class 3: 50 to <100 mg CaCO₃/l, Class 4: 100 to <200 mg CaCO₃/l and Class 5: ≥200 mg CaCO₃/l)

Appendix 2 – Priority Substance Screening Flowchart

A flow chart for the screening of the presence of organic compounds and metals (Priority Substances) from WWTP is included below. This flowchart shows that appropriate screening has been demonstrated in line with the assessment undertaken in this report.

Full Characterisation



Appendix 3 – Receiving Waters Priority Substance Data

No current data is available