Technical Report

DATE: 1st December 2025

SUBJECT: Curraghinalt – Betterment Plan Calculations for Nitrogen

1 Overview

1. Transboundary consultation responses have made comment in relation to the Betterment Plan.

2. As a result, this report updates nitrogen loading calculations for the Betterment Plan for the Curraghinalt Project (TR6 App 13 of the submitted Statement of Case), based on additional calibration with site data. This additional information is then presented along with predicted nitrogen loadings from the mine site discharge to provide more clarity on how the Betterment Plan will reduce overall nitrogen loading to the Owenkillew SAC, which will address concerns raised by consultees.

3. Nitrogen in the water is predominantly sourced from nitrate (NO3) and ammonia (NH4), with minor/negligible contributions from nitrite (NO2).

4. The calculations compare the nitrogen loading from the proposed mine discharge(s) at the Project with the reduction in loading due to the removal of agricultural land as part of the Betterment Plan. In the 2023 Protected Site Conservation Management Plan, agricultural activities in the catchment have been identified as ranging between High and Very High in terms of current identified Pressures and Threats (see Appendix 1 of Annex 13 to TR6).

5. The calculations demonstrate that the Betterment Plan will result in a net reduction in nitrogen loading to the Owenkillew SAC. A net reduction in nutrient loadings in the SAC, as a result of the development, will mean the project performs better than project Nutrient Neutrality. The proposals are also compared to a scenario where the Betterment Plan is not in place, but where discharges from the mine are set to JNCC concentrations for nitrate and ammonia (adopted within the SAC Protected Site Conservation Management Plan as target values for favourable status of the SAC), which is an option proposed by regulators (i.e., compliance with target values at the discharge point. This assessment confirms that the Betterment Plan will reduce nitrogen loadings to the SAC below that which would be obtained by the mine discharging at the JNCC values.

6. The key components of the calculation are:
   - Calculation of reduction in annual nitrogen loading from removal of farming from DGL land, i.e., the total reduction in agricultural nitrogen loading within the Betterment Plan
   - Calculation of discharge from mine site, i.e., the loading from the mine site
   - Comparison of these two items and assessment of overall impact (net decrease or increase in nitrogen to SAC)

2 Calculation of Reduction in annual nitrogen loading from DGL farmland

7. The calculation of the reduction in nitrogen loading from agricultural land is based on;
   a) Calculation of current annual nitrogen loading to land in control of DGL and which will be removed from production. The annual loading will include nitrogen that would be generated from land not under active management (i.e., there will be nitrogen loading from natural soils) as well as nitrogen actively applied during farming
   b) Calculation of percentage of nitrogen loading that would report to surface water (i.e., not retained on fields and used by grass/farmland)

8. The calculation of current annual active loading to farmland has been undertaken by Burnhead Rural Services and a copy of the updated report is appended with DGLs response. This report has been recently updated based on further interviews with farmers to ensure the most accurate data is used. It also includes data for the farm which had only recently been acquired by DGL at the point of producing the Betterment Plan (and not included in previous calculations. The location of the agricultural land is shown in Figure 1 and the annual loadings per farm are summarised in Table 1, Column 1.

9. A literature review was undertaken for the project Betterment Plan to obtain values for the percentage of nitrogen applied to farmland which would be expected to enter watercourses, i.e., the residual amount not used by crops/plants and which is washed into rivers after rain. The literature review produced values of 24 to 30% from Hergoualc'h et al. (2019) and Mosier et al. (1998). Eder et al. (2015) also suggested a national value of 24% for the UK and further review of the available information suggested a range of 20-70% of nitrate/ammonia from farmland reaching watercourses. For this assessment we have undertaken a mass balance calculation (based on observed nitrogen in Owenreagh and Owenkillew Rivers and land use across the catchment) to test this range for the Owenreagh River and Owenkillew River, with the results summarised in Appendix A. The analysis produced a value of 15.6% for the Owenreagh and a value of 29.8% for the Owenkillew River. The average of the two values is 22.7% and this value is carried forward in the calculations, as representative of the wider catchment area. This is consistent with the lower end of the range of values obtained in literature.

10. Applying the average calculated percentage values of 22.7% from the nitrogen application values in Column 1 of Table 1 gives an annual discharge to surface water of 1117.1 kg N/year in Column 2 of Table 1. Once active farming stops the land will still have some nitrogen contribution, and a value of 2 kg/ha/year N reaching the watercourse is applied in Column 3 of Table 1 (as outlined for 'Natural Grasslands' in Appendix A). This gives a final nitrogen reduction for the farmland in Column 4 in Table 1 of 641.9 kg N/year.

Figure 1: Catchment map showing location of project and DGL farmland

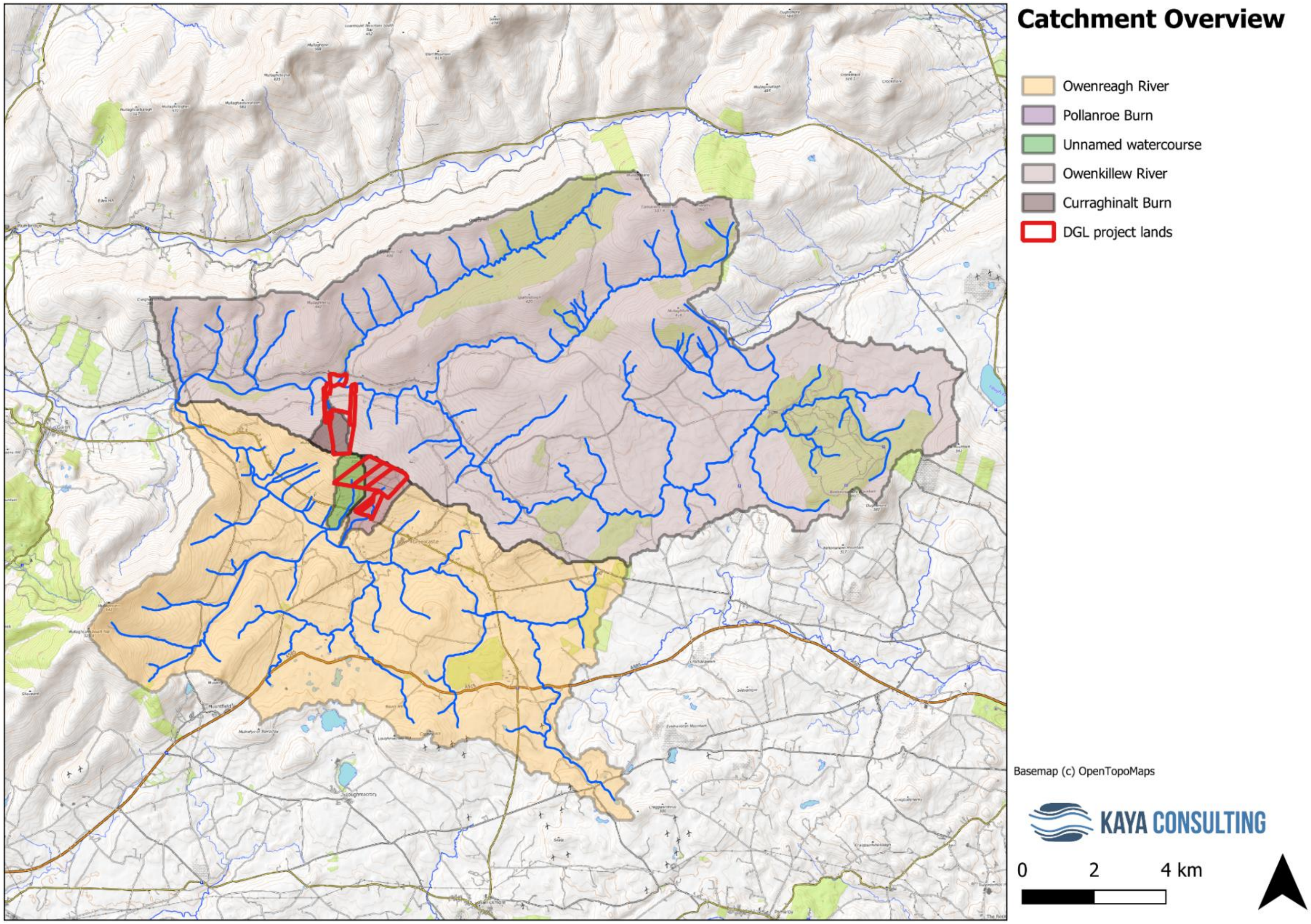


Table 1: DGL Farm Load Calculations

Farms	Column 1			Column 2	Column 3	Column 4
	Current Nitrogen Loading From Farmland			Total released to surface water (22.7%)	Total produced by grassland (2 kg N/ha/year) once removed from farming (kg N/year)	Net reduction in Nitrogen to surfaec water due to removal of farming (kg N/year)
	Manure (kg N / year)	Fertiliser (kg N / year)	Total (kg N /year)			
Farm 1	126.7	0.0	126.7	28.8	12.4	16.4
Farm 2	420.4	479.7	900.1	204.3	37.0	167.3
Farm 3	650.0	0.0	650.0	147.5	93.5	54.0
Farm 4	416.2	0.0	416.2	94.5	56.6	37.8
Farm 5	316.7	404.6	721.3	163.7	88.0	75.8
Farm 6	391.6	216.1	607.7	137.9	135.0	2.9
Farm 6A	804.2	296.4	1100.6	249.8	23.9	225.9
Farm 7	152.4	119.4	271.8	61.7	28.8	32.9
Farm 8	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	**3278.2**	**1516.1**	**4794.2**	**1088.3**	**475.2**	**613.1**

3 Calculation of Nitrogen Loading from Mine Activities

11. The mine will produce nitrogen loadings from the discharge from the project Water Treatment Plant and from fuel emissions.

3.1 Nitrogen Loading from Mine Discharge

12. Based on the proposed discharge consent application for the mine site and normal mine operations treated mine water will be discharged to the Pollanroe Burn. The average discharge to the Pollanroe Burn is 24.5L/s and the proposed average Nitrate as N discharge limit concentration is 0.42 mg/L N and proposed average Ammonia as N discharge limit concentration is 0.2 mg/L N. Based on work by ASDR (Annex 17 of sHRA submitted with Bennu Environmental Transboundary Response) the Reverse Osmosis Water Treatment Plant will achieve on average nitrate concentrations of 0.24 mg/L N and ammonia concentrations of 0.072 mg/L N. Concentrations of nitrite will be negligible.

13. Discharges to Curraghinalt Burn are a contingency to allow the discharge of underground water to the Curraghinalt Burn, but under normal operation all water will go to the Pollanroe Burn.

14. Based on the proposed discharge consent values, on an annual basis the total mass of Nitrogen discharged from the site would be 24.5 L/s x 0.62 mg/L (sum of nitrate and ammonia concentrations) = 479 kg/year N.

15. Based on the RO treatment concentrations, on an annual basis the total mass of Nitrogen discharged from the site would be 24.5 L/s x 0.312 mg/L (sum of nitrate and ammonia concentrations) = 241 kg/year N.

16. If the JNCC guideline values are applied at the discharge point from the treatment plant, then Nitrate as N limit would be 0.125 mg/L and Ammonia at 0.2 mg/L N. This would mean an annual total mass of Nitrogen of 24.5 L/s x 0.325 mg/L = 251 kg/year N.

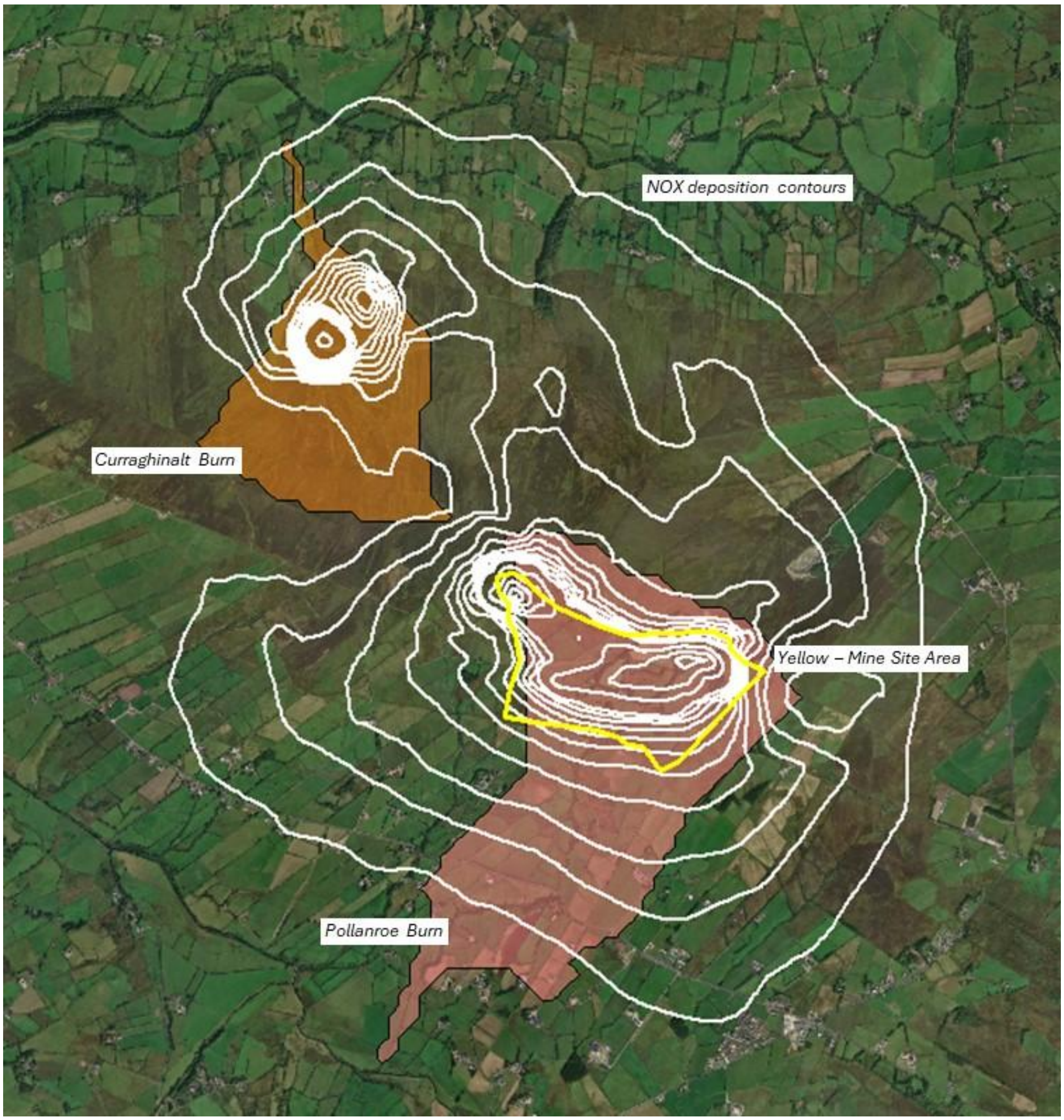
3.2 Nitrogen Loading from Fuel Emissions

17. Air dispersion modelling has been undertaken for the project by AONA Environmental and the details of the modelling are presented elsewhere. However, for the purposes of this assessment AONA provided NOX concentration isopleths (contours) which can be interrogated to calculate the annual average Nitrogen deposition over the wider catchment from air borne emissions from the mine. The contour plans are shown in Figure 2 relative to the Pollanroe and Curraghinalt catchments and the mine area. Based on these contours we calculated the total Nitrogen deposition on land from dispersion for two scenarios, (i) use of diesel fuel and (ii) use of HVO fuel. We excluded any nitrogen landing on the mine site area as this would be captured in the water management ponds and treated.

18. The calculations showed
    a. Based on Diesel fuel the total loading of Nitrogen from air emissions to land would be 23.6 kg N/year. Based on the agricultural runoff rate (see Section 2) of 22.7%, this would equate to 5.4 kg N/year entering watercourses and reaching the Owenkillew SAC.
    b. The use of HVO fuel will reduce the loading by around 30%, giving a deposition of 3.8 kg N/year entering watercourses and reaching the Owenkillew SAC.

19. Overall, this is a small fraction of the contribution of agriculture in the catchment and around 1% of the loading from the discharge into the Pollanroe Burn based on the discharge consent values. Overall, the impact of air emissions on loadings of nitrogen in the watercourses is minor.

Figure 2: Air emissions deposition contour plans relative to mine site area



4 Comparison of Betterment Plan with Discharge Options

20. The total reduction in Nitrogen from the removal of DGL owned farmland is 613.1 kg N/year, from Section 2.

21. The total nitrogen loading from the mine is calculated as;
    a. 484.4 kg/year N assuming water discharged from the mine at proposed discharge consent values (including 5.4 kg N/year from air emissions)
    b. 246.4 kg/year N assuming water discharged from the mine at RO treatment plant values (including 5.4 kg N/year from air emissions)

22. It is clear that in both cases the overall loading of nitrogen to the watercourses and eventually to the Owenkillew SAC will be lower than at present due to the Betterment Plan, by between 128.7 to 366.7 kg N/year

23. In the event that the mine was to discharge at JNCC values (as proposed by regulators) but without the Betterment Plan in place then there is a risk that the overall nitrogen loading would be increased over baseline conditions. The farmland within the proposed infrastructure area would still be removed (as they would be within the mine area) and the current nitrogen loading from those areas is 95.2 kg N/year. The input from the discharge would be 251 kg N/year, indicating an overall increase in loading and an outcome that is inferior from the proposed discharge values with the Betterment Plan in place.

24. To put the calculations of the reduction in nitrogen loading to the Owenkillew SAC in context, the total baseline loading of nitrogen in the Owenkillew River SAC just downstream of the confluence of the Owenreagh River is calculated as the combination of loadings calculated for two baseline monitoring locations; SW09 at the mouth of the Owenreagh River and SW08 on the Owenkillew River upstream of the confluence of the Owenreagh River.

25. SW09 has average annual flow of 2,490L/s, with average nitrate concentrations of 0.31mg/L N and average ammonia concentrations of 0.051mg/L N. At SW08 the annual average flow is 5,000L/s, with average nitrate of 0.24mg/L N and average ammonia of 0.050mg/L N. Annual loadings are calculated for each site based on multiplying the annual average flow with the average concentration scaled for the whole year. Then the loads at the two sites are combined to give the total load in the Owenkillew River downstream of the Owenreagh River;
    - Total Nitrogen load: 74,100kg N/year
    - Nitrogen as nitrate: 62,200kg N/yr
    - Nitrogen as ammonia: 11,900kg N/yr

26. It is clear from this calculation that the impact of the mine and fields close to the mine are small compared to the overall catchment loadings, which are dominated by loadings from existing agricultural and other sources. In the environment on average 85% of the nitrogen in the water is associated with nitrate and 15% associated with ammonia. This contrasts with the proposed discharge values from the mine which have the nitrate discharge (at concentration of 0.42mg/L N) contributing 68% of the nitrogen and ammonia discharge (at concentration of 0.2mg/L N) contributing 32% of the nitrogen. In reality, ammonia could decay to nitrate in the environment, with the relative concentrations reverting to the more natural 85% to 15%. If the overall nitrogen reduction in loading due to the betterment plan is split 85% nitrate to 15% ammonia, then the relative reductions in each of these parameters would be;
    - Nitrate as N in the SAC would be reduced by 109.4 kg/N/year
    - Ammonia as N in the SAC would be reduced by 19.3 kg/N/year

27. This assessment has been undertaken based on a literature values, standard data sets and site-specific analyses.

28. Current farm nitrogen loadings were calculated based on interviews with individual farmers undertaken by Burnhead Rural Services, so there is a high degree of confidence in the calculations. The values are considered robust and conservative (low). The average application rate used in the calculations is 26kg N/ha/year (calculated by dividing total loading with total farm area), compared to the legally allowed application rate of 392kg N/ha/year (see Section 6.24 in Betterment Plan), which could have been considered in the calculations as the maximum allowed loading.

29. The percentage of applied nitrogen that reaches surface waters has used a site-specific calculation for the Owenreagh and Owenkillew catchments, as a calibration against literature values. The calculated value used in this report i.e., 22.7% is clearly at the lower end of the range of values in literature (20-70%) and close to typical values used for UK catchments (24%).

30. Calculations are provided assuming that the mine discharges at the maximum allowed concentrations through the proposed discharge consent, although the mine will need to operate at lower values than this to be compliant. Also provided are values based on average proposed discharges from the RO water treatment plant. These values provide further an even larger benefit of the Betterment Plan and further buffer in the event of any uncertainties in the input values to the calculation. For example, based on the RO plant discharges then the percent of applied nitrogen that reaches surface water could be halved (to 11.35%, well below any literature values) and the Betterment Plan would still provide benefit.

5 Conclusions

31. This report calculates the impact of the project Betterment Plan using catchment-specific data and methods tested and used in Northern Ireland.

32. The report shows that the combination of the Betterment Plan and discharges from the mine at proposed discharge concentrations for nitrate and ammonia, would result in a reduction in total nitrogen loadings to the Owenkillew SAC consistent with the aims of the Owenkillew SAC Conservation objectives.

33. Furthermore, the assessment shows that the combination of the Betterment Plan and proposed discharge concentrations would result in a better outcome (lower nitrogen loading to SAC) then a discharge from the mine at JNCC guideline values for nitrate and ammonia (without Betterment Plan). NIEA have indicated that they would want discharges from the mine to be limited to the JNCC concentrations, despite these being lower than background concentrations in the river. The calculations show the approach with the Betterment Plan provides outcomes more consistent with the SAC Conservation objectives.

34. The approach taken is also shown to be conservative in terms of the approach taken to calculate loadings to the farms under DGLs control, the release of nitrogen from the fields to the river and the discharge concentrations from the mine. The base values used in the calculation are at the conservative end of available values and any uncertainties in these key inputs would tend to be less conservative and would tend to show that the proposals would reduce nitrogen loadings by larger amounts.

Appendix A: Site Nitrogen Load Balance to Assess Percentage of Nitrogen Applied to Farmland enters Watercourses

Nitrogen loading calculations are undertaken for the Owenreagh River at its mouth and Owenkillew River upstream of the Owenreagh River, to calculate the percentage of applied farm nitrogen that enters river water.

Owenreagh River

Immediately upstream of the confluence with the Owenkillew River, the Owenreagh River has a catchment area of ~85km^2 (UK CEH, 2025). The total annual loading of nitrogen in the Owenreagh River is calculated based on observed average flow and average nitrogen concentrations in the river, from the Project monitoring stations at FL06 (flow monitoring) and SW09 (water quality monitoring), located close to the mouth of the river and shown in **Figure A-1**.

The average Total N in the Owenreagh River at SW09 is 0.3703 mg/L (sum of the N contributions from Nitrate + Nitrite + Ammonia). The average flow in the Owenreagh River at FL06 is 2,490 L/s. Using both values it can be assumed that there is an average of 29,078 kg/year[1] of N in the Owenreagh River prior to joining the Owenkillew River.

This annual load is produced by the various current land uses in the catchment.

The landcover for the catchment was taken from the CORINE Land Cover 2018 dataset (European Environment Agency, 2020); a data source for land cover used in similar applications within Northern Ireland (i.e. Adams et al., 2022). **Figure A-1** at the end of the document shows the CORINE Land Cover 2018 across the catchment. A visual check of the CORINE data compared satellite imagery shows it provides a suitable representation of the land cover within the Owenreagh River catchment.

Table A-1 shows the area of different landcover types within the Owenreagh River catchment from the CORINE data. The dominant landcovers are *Pastures*, *Natural Grasslands* and *Moors and Heathland*.

For this study the *Pastures* and *Land principally occupied by agriculture, with significant areas of natural vegetation* landcovers are considered to be agricultural and the combined area is used when assessing loadings of N for this land type. It should be noted that there is no marked arable land in the Owenreagh River catchment and any subsequent reference to agricultural land refers solely to the landcovers above.

The remainder of the land (the landcovers in **Table A-1** shaded orange) within the catchment is referred to as non-agricultural land within this assessment.

Within the catchment there is one Northern Ireland Water sewage treatment plant discharge at Greencastle which is also considered as a point source contribution.

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[1] *29,078 N/kg/yr = ((0.3703 mg/L * 2,490 L/s) / 1,000,000) * (60s * 60s * 24hr * 365days)*

Table A-1: The landcovers within the Owenreagh River catchment from the CORINE Land Cover 2018 dataset.

CORINE ID	Landcover	Area (ha)	% of Owenreagh River catchment
121	Industrial or commercial units	11	0.1%
131	Mineral extraction sites	78	0.9%
231	Pastures	2,592	30.5%
243	Land principally occupied by agriculture, with significant areas of natural vegetation	95	1.1%
312	Coniferous forest	181	2.1%
321	Natural grasslands	1,988	23.4%
322	Moors and heathland	2,391	28.2%
324	Transitional woodland-shrub	64	0.8%
412	Peat bogs	1,085	12.8%
	TOTAL	**8,485**	**100%**

Note:

The rows shaded green are those considered in this study to be agricultural.

The rows shaded orange are those considered in this study to be non-agricultural.

A simple export coefficient approach, based on the Source Load Apportionment Model (SLAM), has been used to estimate the N loading from each landcover within the Owenreagh River catchment, excluding applied sources of N such as manure and fertiliser. Full details of the SLAM methodology are provided in *Report 3* of the EPA Pathways Project (Packham et al., 2014) and EPA Report 249 (Mockler & Bruen, 2018). Additional information is available in Deakin et al. (2016), Mockler et al. (2016), and Mockler et al. (2017).

SLAM is a flexible modelling framework designed to estimate nutrient loads from multiple sectors entering water bodies, accounting for attenuation and treatment processes. Its structure allows varying levels of detail to be incorporated for specific sources or pathways, depending on the requirements of the assessment. SLAM quantifies nutrient contributions from both point sources (e.g. municipal wastewater treatment plants, industry, and septic systems) and diffuse sources (e.g. pasture, arable land, forestry, and peatlands).

The SLAM framework estimates phosphorus (P) and nitrogen (N) emissions to water across multiple spatial scales, from sub-catchments to national level, by integrating pressure datasets with landscape characteristics to predict emissions from both point and diffuse sources. The framework has been tested under Northern Ireland conditions through the CatchmentCARE project (Adams et al., 2022) and validated across sixteen large Irish catchments, with model outputs compared against monitoring data (Mockler & Bruen, 2018).

The method used calculates the load of N by multiplying the area of a particular land use by the export coefficient. **Table A-2** shows the calculated diffuse contributions of N from each landcover in the Owenreagh River catchment, see **Figure A-1**.

For non-agricultural areas (rows shaded orange in **Table A-2**), SLAM applies a straightforward export coefficient method. In this approach, nutrient loads (N and P) are calculated by multiplying the area of specific land use types by their respective export coefficients. In Northern Ireland, the export coefficient values are based on previous studies, including work by Jordan (1997) and Jordan et al. (2000). Equivalent values applied within the Republic of Ireland are detailed in Mockler & Bruen (2018).

The approach for calculating diffuse contributions considers the agricultural land but excludes any applied N such as manure or fertiliser. For example, *Pasture*, even with no applied N from fertiliser and manure, is a key source of N in the Owenreagh River catchment and would have similar characteristics to more natural grassland. This approach helps isolate the amount of applied N on agricultural land within the catchment.

The main diffuse sources of N are *Pasture (as grassland), Natural Grasslands*, *Moor and Heathlands* and *Peat Bogs*.

There is one point source, the Greencastle and Rouskey Wastewater Treatment Works (WTW), accounted for the N loading calculations for the Owenreagh River. Data provided by ASDR (2024) on the WTW indicates a maximum allowed flow of 400 m^3/day and a sampled average Ammonia as N concentration of 1.51 mg/L. Whilst the flow leaving the WTW is likely to be significantly less than the maximum, the calculation for the N loading from the WTW has been based on the 400 m^3/day value. As shown in **Table A-2,** the contribution of N from the WTW in the Owenreagh River catchment appears to be less than 1%.

Collectively, the diffuse sources of N and the point sources of N account for 62.5% of the 29,078 kg of N in the Owenreagh River. The remaining 37.5% (10,892 kg) of the N in the river can be assumed to come N applied to agricultural land as either fertiliser or manure.

Table A-2: The contribution of N in the Owenreagh River from diffuse sources and point sources.

CORINE ID	Landcover	Area (ha)	Diffuse Source Export Coefficient of N (kg/ha/yr)	Source N Contribution to Owenreagh River (kg/yr)	% Contribution of N to Owenreagh River
121	Industrial or commercial units	11	5	55	0.2%
131	Mineral extraction sites	78	5	390	1.3%
231	Pastures	2,592	2	5,184	17.8%
243	Land principally occupied by agriculture, with significant areas of natural vegetation	95	2	190	0.7%
312	Coniferous forest	181	5.42	981	3.4%
321	Natural grasslands	1,988	2	3,976	13.7%
322	Moors and heathland	2,391	2	4,782	16.4%
324	Transitional woodland-shrub	64	3.71	237	0.8%
412	Peat bogs	1,085	2	2,170	7.5%

n/a	Greencastle and Rouskey Wastewater Treatment Works	Point Source	n/a	220	0.8%
TOTAL (excluding N applied to agricultural land)				**18,186**	**62.5%** (of the 29,078 kg/year)

Note:
The agricultural diffuse sources are assumed to have no N applied as fertiliser or manure with the N contribution from the landcover only.
The rows shaded green are those considered in this study to be agricultural.
The rows shaded orange are those considered in this study to be non-agricultural.
The rows shaded blue are point-sources.

Data collected by Burnhead Rural Services on the applied N rates (fertiliser and manure) for a range of landowners within the Owenreagh River and Owenkillew River catchments provides an average N application rate of 26.0 kg/ha/yr onto agricultural land. This application rate is well below the combined livestock manure N limit (170 kg/ha/yr or 250 kg/ha/yr with derogation) and the N chemical fertiliser limit (222 kg/ha/yr or 272 kg/ha/yr for dairy farms) (Northern Ireland Environment Agency, 2019).

If the N application rate of 26.0 kg/ha/yr is assumed for be representative for all the agricultural land in the Owenreagh River catchment (2,687 ha) then there would be a total applied N of 69,862 kg/yr. From Table 3 the agricultural load in the river is 37.5% of the total N in the river (29,078 kg/yr) = 10,892 kg/yr. Therefore, dividing the calculated agricultural contribution to the river (10,892 kg/yr) by the applied agricultural load (69,862 kg/yr) gives an export rate of 15.6% of the applied N entering the river from agricultural land.

Owenkillew River

Nitrogen loading calculations are undertaken for the Owenkillew River at its mouth, using the same method as for the Owenreagh River above.

Immediately upstream of the confluence with the Owenreagh River, the Owenkillew River has a catchment area of ~137km^2 (UK CEH, 2025). The total annual loading of nitrogen in the Owenkillew River is calculated based on observed average flow and average nitrogen concentrations in the river, from the Project monitoring stations at FL05 (flow monitoring) and SW08 (water quality monitoring, located close to the mouth of the river.

The average Total N in the Owenkillew River at SW08 is 0.3732 mg/L (sum of the N contributions from Nitrate + Nitrite + Ammonia). The average flow in the Owenkillew River at FL0 is 5,000 L/s. Using both values it can be assumed that there is an average of 58,846 kg/year[2] of N in the Owenkillew River prior to joining the Owenreagh River.

This annual load is produced by the various land uses in the catchment.

[2] *58,846 N/kg/yr = ((0.3732 mg/L * 5,000 L/s) / 1,000,000) * (60 * 60 * 24 * 365)*

The landcover for the catchment was taken from the CORINE Land Cover 2018 dataset (European Environment Agency, 2020); a data source for land cover used in similar applications within Northern Ireland (i.e. Adams et al., 2022). **Figure A-1** at the end of the document shows the CORINE Land Cover 2018 across the catchment. A visual check of the CORINE data compared satellite imagery shows it provides a suitable representation of the land cover within the Owenkillew River catchment.

Table A-3 shows the area of different landcover types within the Owenkillew River catchment from the CORINE data, see Figure 2. The dominant landcovers are *Pastures* and *Natural Grasslands*.

For this study the *Pastures* and *Land principally occupied by agriculture, with significant areas of natural vegetation* landcovers are considered to be agricultural and the combined area is used when assessing loadings of N for this land type. It should be noted that there is no marked arable land in the Owenkillew River catchment and any subsequent reference to agricultural land refers solely to the landcovers above.

The remainder of the land (the landcovers in **Table A-3** shaded orange) within the catchment is referred to as non-agricultural land within this assessment.

Table A-3: The landcovers within the Owenkillew River catchment from the CORINE Land Cover 2018 dataset.

CORINE ID	Landcover	Area (ha)	% of Owenreagh River catchment
121	Industrial or commercial units	26	0.2%
231	Pastures	2,806	20.5%
243	Land principally occupied by agriculture, with significant areas of natural vegetation	219	1.6%
311	Broad-leaved forest	41	0.3%
312	Coniferous forest	1,920	14.0%
321	Natural grasslands	6,414	46.9%
322	Moors and heathland	1,523	11.1%
324	Transitional woodland-shrub	726	5.3%
412	Peat bogs	14	0.1%
	TOTAL	**13,689**	**100%**

Note:
The rows shaded green are those considered in this study to be agricultural.
The rows shaded orange are those considered in this study to be non-agricultural.

A simple export coefficient method is used to calculate the N loading for non-agricultural land and agricultural land with the added applied N (fertiliser and manure) removed in the Owenkillew River catchment; the approach and export coefficient values for each landcover are taken from Adams et al. (2022). The method calculates the load of N by multiplying the area of a particular land use by the export coefficient.

Table A-4 shows the calculated diffuse contributions of N from each landcover in the Owenkillew River catchment (excluding applied N to agricultural land). *Pasture*, even with no applied N from fertiliser and manure, is a key source of N in the Owenkillew River catchment and would have similar characteristics to more natural grassland. The main diffuse sources of N are *Natural Grasslands, Pasture (as grassland)* and *Coniferous Forest*.

Collectively, the diffuse sources of N and the point sources of N account for 60.2% of the 58,846 kg of N in the Owenkillew River. The remaining 39.8% (23,442 kg) of the N in the river can be assumed to come N applied to agricultural land as either fertiliser or manure.

Table A-4: The contribution of N in the Owenkillew River from non-agricultural landcover diffuse sources.

CORINE ID	Landcover	Area (ha)	Diffuse Source Export Coefficient of N (kg/ha/yr)	Source N Contribution to Owenreagh River (kg/yr)	% Contribution of N to Owenreagh River
121	Industrial or commercial units	26	5	130	0.2%
231	Pastures	2,806	2	5,612	9.5%
243	Land principally occupied by agriculture, with significant areas of natural vegetation	219	2	438	0.7%
311	Broad-leaved forest	41	5.42	222	0.4%
312	Coniferous forest	1,920	5.42	10,406	17.7%
321	Natural grasslands	6,414	2	12,828	21.8%
322	Moors and heathland	1,523	2	3,046	5.2%
324	Transitional woodland-shrub	726	3.71	2,693	4.6%
412	Peat bogs	14	2	28	0.05%
			TOTAL (excluding Agriculture)	**35,404**	**60.2%** (of the 58,846 kg/year)

Note:
The agricultural diffuse sources are assumed to have no N applied as fertiliser or manure with the N contribution from the landcover only.
The rows shaded green are those considered in this study to be agricultural.
The rows shaded orange are those considered in this study to be non-agricultural.

Data collected by Burnhead Rural Services on the applied N rates (fertiliser and manure) for a range of landowners within the Owenreagh River and Owenkillew River catchments provides an average N application rate of 26.0 kg/ha/yr onto agricultural land. This application rate is well below the combined livestock manure N limit (170 kg/ha/yr) and N fertiliser limit (222 kg/ha/yr) which has total N application limit of 392 kg/ha/yr.

If the N application rate of 26.0 kg/ha/yr (calculated in the Burnhead Rural Services report) is assumed for be representative for all the agricultural land in the Owenkillew River catchment (3,025 ha) then there would be a total applied N of 78,650 kg/yr. From Table 5 the agricultural load in the river is 39.8% of the total load in the river of

58,846kg/yr = 23,442 kg/yr. Therefore, dividing the calculated agricultural contribution to the river (23,442 kg/yr) by the applied agriculture load (78,650 kg/yr) gives an export rate of 29.8% of applied N entering the river from agricultural land.

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Figure A-1: Land Cover map of Owenreagh and Owenkillew Rivers used in analysis