BALLYNACARRICK LANDFILL SITE

ICW Discharge Mass Balance Assessment

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Contents

Tables:

1 INTRODUCTION

This water quality assessment has been prepared by RPS on behalf of Donegal County Council, in relation to the proposed construction of an Integrated Constructed Wetland (ICW) at Ballynacarrick Landfill Site, Ballintra, County Donegal. This assessment has been undertaken to support a Natural Impact Statement (NIS) that has been prepared to consider the potential for likely significant effects on European Sites, as a result of the proposed development.

The proposed project involves the development of integrated constructed wetlands (ICW) to treat leachate generated at the Ballynacarrick landfill site. The leachate will be collected within the site and pumped to the ponds for treatment. Once treated, the leachate will then be discharged to existing surface water drainage channels which flow in a westerly direction via the Ballymagrorty_Scotch_010 water body into Durnesh Lough which is designated as a Special Area of Conservation (SAC) and Special Protection Area (SPA) and eventually into Donegal Bay which is designated as an SPA.

This assessment documents the evaluation and analysis, undertaken on behalf of Donegal County Council, seeking to establish whether the proposed discharge of treated leachate from Ballynacarrick ICW into the Ballymagrorty_Scotch_010 water body is likely to have significant water quality impacts which could lead to likely significant effects on any European sites.

1.1 Hydrologically linked European sites

Following preparation of a Stage One Screening Appraisal for Appropriate Assessment, Durnesh Lough SAC and SPA has been identified as being hydrologically linked to the Ballymagroarty_Scotch_010 river water body and could not be excluded on the basis of potential for impacts to water quality. Table 1.1 outlines relevant European Sites, their features of interest and a summary of their conservation objectives.

Table 1.1: Conservation Objectives of the Durnesh Lough SAC & SPA

European site	Selection feature	Conservation Objectives
Durnesh Lough SAC [000138]	• Coastal lagoons [1150] • Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) [6410]	• To restore the favourable conservation condition of coastal lagoons in Durnesh Lough SAC, as defined by 12 attributes and targets. • To restore the favourable conservation condition of Molinia meadows in Durnesh Lough SAC, as defined by 10 attributes and targets.
Durnesh Lough SPA [004145]	• Whooper Swan (*Cygnus cygnus*) [A038] • Greenland White-fronted Goose (*Anser albifrons flavirostris*) [A395]	• To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA

1.2 Mass Balance Assessment of the Discharge

1.2.1 Existing Environment

Ballynacarrick Landfill Site is situated within the Ballymagrorty_Scotch_010 waterbody (waterbody ID: IE_NW_37B090770). The waterbody has been assigned a Moderate ecological status by EPA and forms part of the Laghy Stream-Bridgetown Priority Area for Action (PAA), as defined by the River Basin Management Plan 2018-2021. Although the waterbody has been assigned a moderate status the water quality is not monitored directly and has been assigned based on expert judgement. It is important to highlight that the proposed construction of the ICW will lead to significant improvements in water quality within this water body as the leachate will be treated prior to discharge.

1.2.2 Assessment of the Impact of the Discharge

As part of the Waste Licence Application to the Environmental Protection Agency (EPA), Leachate Emission Limit Values have been proposed as follows;

Table 1.2 Proposed Emission Limit Values and relevant Environmental Quality Standards (EQS)

Parameter	Limit	EQS-Annual Average	EQS (95%-ile)	EQS-Maximum allowable concentration (MAC)
pH	6-8	6-9	-	-
BOD	20 mg/l	1.5mg/l	2.6 mg/l	-
COD	50 mg/l	-	-	-
Suspended Solids	15 mg/l	-	-	-
Orthophosphate	0.1 mg/l	0.035 mg/l	0.075 mg/l	-
Total Ammonia (as N)	2 mg/l	0.065 mg/l	0.14 mg/l	-
Cadmium	<0.5 µg/l	0.08 µg/l*	-	0.45 µg/l *
Chromium	<1 µg/l	3.4 µg/l	-	32 µg/l
Copper	<5 µg/l	5 µg/l*	-	-
Lead	<1 µg/l	1.2 µg/l	-	14 µg/l
Mercury	<0.5 µg/l	-	-	0.07 µg/l
Nickel	<20 µg/l	4 µg/l	-	34 µg/l
Zinc	<50 µg/L	8 µg/l*	-	-

*Depending on water hardness (lowest EQS standard presented as a conservative assumption)

The assimilative capacity is the measure of receiving water's ability to absorb pollutants whilst still maintaining acceptable water quality. In order to determine the assimilative capacity, it is necessary to determine the existing water quality status and the acceptable degree to which the existing water

quality may be impacted. The assessment of the assimilative capacity provides an indication if a discharge is likely to cause an exceedance of a quality standard, however, it is only indicative and needs to be supported by a mass balance calculation.

Mixing of a discharge with a river is described by the Mass Balance Equation. The mass balance formula calculates the resultant concentration in the receiving water due to a discharge and is the preferred method of determining the impact on the receiving water as it accounts for the volume of flow in the discharge.

The Mass balance formula is shown below:

Mass Balance =T = (FC+fc)/(F+f)

where:

T = resultant concentration of the contaminant of concern downstream of the discharge

F = flow in the receiving water upstream of the discharge (established from existing flow records & hydrometric data were available, or an appropriate hydrological methodology for ungauged catchments e.g. EPA HydroNet)

C = concentration of contaminant of concern in the receiving water upstream of the discharge

f = discharge rate (m^3/s)

c = concentration of the contaminant of concern in the discharge (assumed to be the ELV proposed for the discharge as per Table 1.2 or for other parameters the worst-case concentration of the parameter from the leachate monitoring)

The impact of a continuous discharge from the leachate treatment system at Ballynacarrick Landfill, at average flows are assessed in the context of the receiving water quality and environmental quality standards for orthophosphate as detailed in Schedule 5 of the Surface Water Regulations (S.I. 272 of 2009), as amended.

The assimilative capacity was calculated to measure the receiving water body's ability to assimilate the pollutants, based on the above emission limit values, whilst still maintaining an acceptable level of water quality. This measurement is only indicative however and was supported with a Mass Balance calculation to determine the resultant concentration in the receiving water based on the above emission limit values. The results of these calculations for the receiving waters of the discharge are shown below and an assessment of the impact on the receiving water quality has been made in accordance with the European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009), as amended.

Calculations have been applied to those parameters which have been assigned an Environmental Quality Standard (EQS) in the above regulations (S.I. No. 272 of 2009), as amended. Whilst Suspended Solids does not have an EQS under the Surface Water Objectives, a limit of 35 mg/l was used, as per the Guidance, "Procedures and Training on the Licensing of Discharges to Surface Waters and to Sewer for Local Authorities (Local Authority Services National Training Group [LASNTG], 2011)".

A calculation for the 'percentage of headroom used', when determining whether or not a licence should be reviewed, is shown below in Tables 1.3. The guidance, "Procedures and Training on the Licensing of Discharges to Surface Waters and to Sewer for Local Authorities" states that if less than 25% of the headroom is used then a review of the licence is not required.

Headroom calculations are as follows:

Headroom = C_{max} – C

Where

Cmax = EQS

C= Background concentration upstream

Percentage headroom utilized (%) = $\frac{(T-C)x100}{Headroom}$

Where **T** is the resultant concentration from the mass balance

The results are summarised in Table 1.3 and the percentage of headroom utilized for all Contaminants of potential concern (COPC) is less than 25% therefore supporting the ELVs established under Table 1.1 above and their limited environmental impact.

It should be noted that the mass balance has been undertaken under the assumption of discharge at mean flows. During low flow conditions no discharge would occur from the ICW due to the significant evapotranspiration that would occur and low rainfall inputs. During these times there will be adequate capacity within the ICW to attenuate any leachate within the ICW and ensure no discharge occurs under these conditions.

The results of these calculations are collated below in **Table 1.3**.

1.2.3 Mass Balance assessment at Mean flow (Q30) calculations

The flow estimates in the receiving water for the purposes of the mass balance assessment were derived from the EPA Hydronet tool. The Ballymagrorty_Scotch_010 waterbody disappears underground downstream of the proposed point of discharge resurfacing at the downstream end of the Ballymagrorty_Scotch_010 water body prior to discharge into Durnesh Lough. On this basis and for the purposes of assessing the impact on the water body's supporting physico-chemical and water chemistry conditions and the potential impact on the conservation objectives of the downstream European Sites, this was established as the appropriate location for the point of assessment.

As mentioned above, the assessment when taking the 95 percentile low flow statistics into consideration is not applicable to the discharge from the ICW given that during low flow conditions there will be no discharge. Therefore, the mass balance assessment has also been undertaken using an estimated maximum discharge flow of 120m^3/day and an estimate of the mean flows (Q30) based on the EPA Hydronet tool as a more appropriate flow statistic. This suggests that the flow rate is likely to be 0.302 m^3/s.

Given the location of the landfill at the top of the catchment, upstream background concentrations were not available, therefore, an adjusted background concentration was used as per the LASNTG guidance. This provides an indication of the likely impact of the discharge based on the assumption that the waterbody is already achieving Good status.

In the case of metals, an adjusted background concentration is derived by halving the Annual Average EQS value. The proposed ELVs as listed above were used as the maximum allowable discharge concentration in order to provide a conservative assessment, as it is anticipated that treatment standards will always result in a quality of effluent that will be less than the ELVs.

Where there is assimilative capacity at the point of discharge in a watercourse, this does not infer that it is acceptable to allow a discharge to utilise the full amount of this capacity. Other downstream discharges may be relying on the dilution effects of the upstream flows to comply with the water quality standards.

In order to assess this increase in concentration, the headroom (difference in concentration between the background concentration and the EQS Standard) should be calculated and the percentage of this headroom utilized by the increase in concentration is derived. The Guidance states that if the discharge alone will not use >25% of the headroom then the discharge may be permitted.

The calculations assume that:

- *Upstream concentrations are indicative of good status;*
- *Discharge concentrations are equal to the proposed ELVs; and,*
- *Discharge does not occur during periods of low flow.*
- *Furthermore, the assessment considers the assimilative capacity of the Ballymagrorty_Scotch_010 rather than Durnesh Lough itself. Given the dilution that would occur to any discharge from the watercourse into Durnesh Lough, the assessment undertaken is considered extremely conservative.*

Based on these assumptions the mass balance assessment indicates that the headroom utilised will remain below 11% for all parameters considered as presented in Table 1.3.

As such, the discharge will not impact on the environmental quality standards for the various parameters assessed and therefore conditions are considered to be consistent with the achievement of at least 'good' status for the biological elements in the Ballymagrorty_Scotch_010, based on the EQS values in the Surface Water Regulations 2009 (as amended). The discharge will therefore not result in a deterioration or prevent the attainment of the required WFD environmental objectives of 'good' ecological status for this water body.

Table 1.3: Assimilative Capacity and Mass Balance calculations for the Ballymagrorty_Scotch_010 receiving waterbody based on mean flows and max. discharge

Contaminant of Potential Concern											
	BOD	Susp. Sols	Ortho-P	Nitrogen (ammoniacal)	Cadmium	Chromium VI	Copper	Lead	Mercury	Nickel	Zinc
Discharge vol (m^3/day)	120	120	120	120	120	120	120	120	120	120	120
Discharge vol. (m^3/sec)	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014
Q30 flow (m^3/sec)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
U/S Background Conc. (mg/l)	1.400	25.000	0.030	0.053	0.00002	0.00170	0.00250	0.00060	0.00004	0.00200	0.00040
Dilution Factor	218	218	218	218	218	218	218	218	218	218	218
EQS – 95%ile (mg/l)	2.6	35	0.075	0.14	0.00008	0.0032	0.005	0.0012	0.00007	0.004	0.008
ELVs (mg/l)	20.000	15	0.100	2.000							
Leachate (worst case)					0.00050	0.0010	0.005	0.0010	0.00050	0.0200	0.050
Assim Capacity	31.311	260.93	1.174	2.283	0.0015	0.039	0.065	0.016	0.0009	0.052	0.198
Mass Balance assessment											
Resultant Concentration	1.4851	24.9542	0.0303	0.0614	0.0000	0.0017	0.0025	0.0006	0.00004	0.0021	0.0006
% increase	6.08%	-0.18%	1.07%	16.98%	9.72%	-0.19%	0.46%	0.31%	6.08%	4.12%	56.77%
Headroom calculations											
Headroom available	1.20000	10.00000	0.04500	0.08750	0.00006	0.00150	0.00250	0.00060	0.00004	0.00200	0.00760
% headroom utilised	7.10%	-0.46%	0.71%	10.19%	3.80%	-0.21%	0.46%	0.31%	6.08%	4.12%	2.99%

**Denotes adjusted background concentration*

1.3 Conclusions

The proposed discharge from the ICW has the potential to impact on the conservation objectives of Durnesh Lough SAC. The discharge will include treated leachate and rainfall run-off falling on the site only and will be subject to monitoring to ensure compliance with ELVs as set out in the licence.

The site is bunded to ensure that all surface water generated within the ICW will be contained, all discharges will be directed to the designated discharge points and runoff from the ICW will be prevented from directly entering any watercourse without passing through the ICW.

This assessment relates to the discharge from the landfill site and its potential impact on water quality and the surrounding European sites. As shown by the mass balance assessment, no impact is predicted since there is adequate headroom within the Ballymagrorty_Scotch_010 river waterbody to ensure that good status can be achieved within this water body. This conservative assessment did not consider the additional dilution that would occur as the watercourse discharges into Durnesh Lough, providing significant additional dilution capacity.

Although the discharge will be directed towards Durnesh Lough SAC, the mass balance assessment shows that no impact will be experienced provided ELVs are met. During low flow conditions when there is potential for impacts to utilise >25% of the headroom available for a number of parameters (BOD, ammoniacal-nitrogen, Cadmium, Mercury, Nickel and Zinc), no discharge from the ICW will occur and there will be significant capacity to attenuate leachate until normal flow levels return in the watercourse. Therefore, a more appropriate flow statistic to use in the receiving waters during discharge periods is the mean flows. When this flow is considered the mass balance assessment indicates that the headroom utilised will remain below 11% for all parameters, with an imperceptible increase in some of the parameters.

The assessment indicates that there is limited potential for an impact on the integrity of Durnesh Lough SAC and therefore as a result of the treated discharge from the Ballynacarrick Landfill site, based on the proposed ELVs. The works have reduced the risk to the SAC from the existing site due to the controlled treatment and discharge of leachate. Furthermore given the extensive additional dilution available within Durnesh Lough there will be no impact on the downstream European sites.

It is essential that the mitigation in the form of the leachate management system operation and maintenance and the monitoring of the effluent quality and receiving environment are continued to ensure that the system continues to achieve the necessary ELVs.

Therefore, the proposed discharge front he ICW represents no risk to the achievement of the conservation objectives of the Durnesh Lough SAC. The proposed construction of the ICW will significantly improve water quality within the Ballymagrorty_Scotch_010 river waterbody and ultimately within Durnesh Lough given the improvements that will occur due to the treatment through the ICW.