Appendix 15

Ecological Risk Assessment for PCDD/F

To: Indaver Ireland Ltd.

From: Dr Fergal Callaghan

Date: 13 August 2025

RE: 257501.M03

SUBJECT: PCDD/F (Dioxin and Furan) ecological uptake Ringaskiddy Resource Recovery Centre

AWN have prepared this response to the request from An Bord Pleanála (now An Coimisiún Pleanála) to Indaver, with regard to the application for planning consent for the Ringaskiddy Resource Recovery Centre – the request requires a review of whether baseline environmental conditions of relevance to the application may have materially changed in the period since the planning application was originally submitted in 2016.

"Dioxins" is a collective term for the category of polychlorinated dibenzo-para-dioxin compounds (PCDDs) and polychlorinated dibenzofuran compounds (PCDFs) – for clarity referred to as PCDD/F. Seventeen PCDD/F compounds are considered to be of toxicological significance.

AWN had input to the planning application with regard to the modelling of PCDD/F exposure of bird and fish species.

I understand that air dispersion modelling for the proposed development has been updated to take account of updated baseline monitoring, the most recent meteorological data for the Ringaskiddy area and to use the most current version of the modelling software. I have prepared this technical note to address any variations that may have occurred in the predicted process contribution to PCDD/F exposure to birds and fish as a result of the updates.

The PCDD/F ecological uptake modelling report submitted with the 2016 application was updated in 2019, with no material changes to the report conclusions. This was included in the NIS prepared for the Industrial Emissions licence application in 2019 and is included again in Appendix 15 of the 2025 NIS. A comparison of the 2019 predicted PCDD/F deposition data with the 2025 deposition data shows the following in Table 1.1:

Year	Deposition Rate
	ng/m2/yr
2019	0.277
2025	0.326
% increase	17.7

Table 1.1   Deposition Data 2019 & 2025

As noted in Appendix 15 of the NIS, the baseline calculated PCDD/F concentration for the eggs of fish eating birds was 2.23 pg/g and the predicted change with the development in operation was an increase to 2.31 pg/g, which is 0.08 pg/g, an increase of 3.6% over the baseline value, this is summarised in Table 1.2 below.

2019	baseline	predicted	Increase	% increase over baseline
	pg/g	pg/g	pg/g	%
Eggs of fish eating birds	2.23	2.31	0.08	3.6

Table 1.2   Baseline and Predicted 2019 (Fish eating birds)

As an initial screening assessment, and allowing for the 17.7% increase in deposition rate and adopting the conservative approach of assuming that all deposited PCDD/F is available for intake, this equates to an increase from 0.08 pg/g to 0.094 pg/g.

This is summarised in Table 1.3 below:

Parameter	Value
Increase 2019	0.08
% increase in deposition rate 2025	17.70%
increase 2025	0.094

Table 1.3 Predicted uptake increase with the development in operation, 2025.

As can be seen from Table 1.4, the increase in 2025 in the predicted concentration from 2.23 to 2.324 pg/g, is an increase of 4.2% over the baseline value which when compared with the previously predicted 3.6% increase over baseline is considered to be negligible.

2025	baseline	predicted	increase	% increase over baseline
	pg/g	pg/g	pg/g	%
Eggs of fish eating birds	2.23	2.324	0.094	4.2

Table 1.4 Baseline and Predicted 2025 (Fish-eating birds)

Similarly, the calculated baseline for fish was 0.25 pg/g and the predicted increase from the development in operation (for 2019) was an increase of 0.01 pg/g to 0.26 pg/g, see Table 1.5 below.

2019	baseline	predicted	increase	% increase over baseline
	pg/g	pg/g	pg/g	%
Fish	0.25	0.26	0.01	4.0

Table 1.5 Baseline for Fish and Predicted Increase, 2019

The predicted increase allowing for a 17.7% increase in deposition rate is presented in Table 1.6.

Parameter	Value
Increase 2019	0.01
% increase in deposition rate 2025	17.70%
increase 2025	0.01177

Table 1.6 Predicted Uptake Increase for Fish, 2025

The predicted increase for 2025 is presented in Table 1.7 below.

2025	baseline	predicted	increase	% increase over baseline
	pg/g	pg/g	pg/g	%
Eggs of fish eating birds	0.25	0.26177	0.01177	4.7

Table 1.7 Baseline plus Predicted 2025 (Fish)

It can be seen from Table 1.7 that the predicted increase over baseline for 2025 is a 4.7% increase over background, which when compared with the previously predicted 4% increase over baseline, is considered to be negligible.

It can therefore be concluded that, based on the above data, the conclusions drawn with regard to the PCDD/F ecological intake modelling study can be considered to be unchanged since the original planning application was submitted in 2016.

Yours sincerely

Dr Fergal Callaghan

AWN Consulting Ltd

ECOLOGICAL RISK ASSESSMENT FOR PCDD/F FOR INDAVER RINGASKIDDY RESOURCE RECOVERY CENTRE

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Technical Report Prepared For

Indaver

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Technical Report Prepared By

Dr Fergal Callaghan BSc MRSC AMIChemE

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Our Reference

FC/15/8104R03

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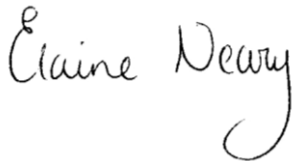
Date Of Issue

29 June 2019

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EXECUTIVE SUMMARY

Sediment sampling was conducted at 4 locations in the Cork Harbour area in 2015 with the aim of determining background PCDD/F dioxin in muddy sediment (which are the type of sediment most likely to accumulate dioxin).

Soil samples were analysed for PCDD/F, pH and TOC (Total Organic Carbon) and the results compared with current data for Ireland and data from other countries (AWN Report RH/14/8104SR01).

Increased sediment PCDD/F concentrations due to emissions from the Ringaskiddy Resource Recovery Centre and consequent increase in PCDD/F exposure for fish eating birds and otters (based on exposure from forage fish) was modelled and found to be insignificant.

Report Checked By: **Report Prepared By:**

Elaine Neary   **DR FERGAL CALLAGHAN**
Principal Environmental Consultant   Director

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1.0   INTRODUCTION

AWN Consulting was instructed by Indaver to undertake an ecological risk assessment study focussed on PCDD/F (dioxin and furan) in support of a proposed planning application for the Ringaskiddy Resource Recovery Centre.

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2.0   ECOLOGICAL RISK ASSESSMENT BASED ON SEDIMENT PCDD/F

2.1   Ecological Risk Assessment

The risk assessment approach taken is that presented by the US EPA in the documents:

- Framework for the Application of the Toxic Equivalency Methodology, Polychlorinated Dioxins, Furans and BiPhenyls in Ecological Risk Assessment, US EPA 2003 [1]

- Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities, US EPA, 1999 [2].

The approach taken was as follows:

- Model baseline impact of existing background dioxin with respect to predicted concentration in bird egg and concentration in forage fish in otter diet, bird species focused on were cormorant and common tern.

- Model worst case theoretical increase due to PCDD/F emissions from WTE plant,

- Model impact of predicted sediment concentration on selected species

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2.2   Baseline Assessment

The baseline monitoring locations used were as follows (Table 2.1):

Sample ID (2015)	Sample ID (2009)	Sample Location	OSI Grid Reference* (2105)
Beach 1A	S04	Strand at Whitegate Village	583970, 564016
Beach 2A	S01	Ringaskiddy – beach adjacent to road to Haulbowline Island	579323, 564398
Beach 3A	S03	Mud Flats at Buncoille	576396, 565400
Beach 4A	S02	Mud Flats in bay to west of Hovione facility, Loughbeg	578578, 563471

Table 2.1 Baseline Monitoring Locations

The baseline was chosen to be Sample Location S04 (strand in front of Whitegate Village), due to this location having the highest organic carbon content and therefore having the greatest potential to accumulate dioxin.

The baseline calculation for both gull eggs and otters is presented in Tables 2.2 and 2.3 and follows the relevant equations from the Framework Application Document above as follows:

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$C_{\text{(fish eating bird egg)}} = (Cs/Foc) \times BSAF_{\text{(egg)}} \times fl_{\text{(egg)}}$

Where

$C_{\text{(fish eating bird egg)}}$ is dioxin concentration (pg/g)

Cs is dioxin concentration in sediment (pg/g)

Foc is fraction of organic carbon in sediment

BSAF is the Biota-sediment accumulation factor

fl is the lipid fraction of the egg.

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		Cs	Foc	Cs/Foc	BSAF	FI	Cs (egg)	C
								TEF (bird)
Congener	Avian TEF	pg/g			pg/g			pg/g egg
2,3,7,8 TCDD	1	0.053	0.01	5.3	1.2188	0.08	0.516771	0.516771
1,2,3,7,8 PeCDD	1	0.11	0.01	11	1.0313	0.08	0.907544	0.907544
1,2,3,4,7,8 HxCDD	0.05	0.17	0.01	17	0.0368	0.08	0.050048	0.002502
1,2,3,7,8,9 HxCDD	0.1	0.25	0.01	25	0.0102	0.08	0.0204	0.00204
1,2,3,6,7,8 HxCDD	0.01	0.36	0.01	36	0.2321	0.08	0.668448	0.006684
1,2,3,4,6,7,8 HpCDD	0.001	4.4	0.01	440	0.0016	0.08	0.05632	5.63E-05
OCDD	0.0001	35	0.01	3500	0.0018	0.08	0.504	5.04E-05
			0.01					
2,3,4,7,8 PeCDF	1	0.25	0.01	25	0.3068	0.08	0.6136	0.6136
1,2,3,4,7,8 HxCDF	0.1	0.32	0.01	32	0.1081	0.08	0.276736	0.027674
1,2,3,7,8,9 HxCDF	0.1	0.19	0.01	19	0.0174	0.08	0.026448	0.002645
2,3,4,6,7,8 HxCDF	0.1	0.3	0.01	30	0.12	0.08	0.288	0.0288
1,2,3,7,8 PeCDF	0.1	0.24	0.01	24	0.0221	0.08	0.042432	0.004243
2,3,7,8 TCDF	1	0.49	0.01	49	0.025	0.08	0.098	0.098
1,2,3,4,6,7,8 HpCDF	0.01	2.1	0.01	210	0.0001	0.08	0.00168	1.68E-05
1,2,3,4,7,8,9 HpCDF	0.01	0.44	0.01	44	0.0027	0.08	0.009504	9.5E-05
1,2,3,6,7,8 HxCDF	0.1	0.21	0.01	21	0.0893	0.08	0.150024	0.015002
OCDF	0.0001	2.1	0.01	210	0.0002	0.08	0.00336	3.36E-07
Sum								2.23

Table 2.2 Baseline Dioxin Concentration in Egg of Fish Eating Bird

For comparison, Ecological Risk Assessment for Dioxins in Australia, Technical Report No.11, Australian Department of Environment and Heritage, 2004, notes that the NOAEL (No Observable Adverse Effects Level) geometric mean for herring and black eyed gull eggs is 50,000 pg/g.

Congener	TEF	Cs S4 pg/g	Foc	Cs/Foc	BSAF pg/g	FI	Cs (FISH)	C TEF pg/g fish
2,3,7,8 TCDD	1	0.053	0.01	5.3	0.133	0.0311	0.021922	0.021922
1,2,3,7,8 PeCDD	1	0.11	0.01	11	0.18	0.0311	0.061578	0.061578
1,2,3,4,7,8 HxCDD	0.1	0.17	0.01	17	0.03	0.0311	0.015861	0.001586
1,2,3,7,8,9 HxCDD	0.1	0.25	0.01	25	0.02	0.0311	0.01555	0.001555
1,2,3,6,7,8 HxCDD	0.1	0.36	0.01	36	0.02	0.0311	0.022392	0.002239
1,2,3,4,6,7,8 HpCDD	0.01	4.4	0.01	440	0.008	0.0311	0.109472	0.001095
OCDD	0.0001	35	0.01	3500	0.0005	0.0311	0.054425	5.44E-06
2,3,4,7,8 PeCDF	0.5	0.25	0.01	25	0.33	0.0311	0.256575	0.128288
1,2,3,4,7,8 HxCDF	0.1	0.32	0.01	32	0.01	0.0311	0.009952	0.000995
1,2,3,7,8,9 HxCDF	0.1	0.19	0.01	19	0.04	0.0311	0.023636	0.002364
2,3,4,6,7,8 HxCDF	0.1	0.3	0.01	30	0.05	0.0311	0.04665	0.004665
1,2,3,7,8 PeCDF	0.1	0.24	0.01	24	0.01	0.0311	0.007464	0.000746
2,3,7,8 TCDF	0.1	0.49	0.01	49	0.12	0.0311	0.182868	0.018287
1,2,3,4,6,7,8 HpCDF	0.01	2.1	0.01	210	0.001	0.0311	0.006531	6.53E-05
1,2,3,4,7,8,9 HpCDF	0.01	0.44	0.01	44	0.03	0.0311	0.041052	0.000411
1,2,3,6,7,8 HxCDF	0.1	0.21	0.01	21	0.01	0.0311	0.006531	0.000653
OCDF	0.0001	2.1	0.01	210	0.001	0.0311	0.006531	6.53E-07
Sum								0.25

Table 2.3 Baseline Concentration in Forage Fish

No direct measurement of the impact of forage fish intake is available, so the relative change will be assessed.

2.3 Predicted Increase

The increase in dioxin concentration in sediment resulting from airborne dioxin deposition was estimated using a very conservative approach, which was to assume the maximum dioxin deposition rate from the proposed facility fell within the SAC.

It was also assumed that the sediment in question was permanently exposed to the atmosphere, whereas in reality the sediments will be covered by the tide for much of the day.

The modelled increase was determined using deposition data modelled by AWN and the MARI model for soil dioxin.

Using this conservative approach, the predicted increase in dioxin values over the lifetime of the facility are shown in Tables 2.4 and 2.5.

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Congener	Bird TEF	Cs	Foc	Cs/Foc	BSAF	FI	Cs (egg)	C
								TEF (bird)
		pg/g			pg/g			pg/g egg
2,3,7,8 TCDD	1	0.0530	0.01	5.300282	1.2188	0.08	0.516799	0.516799
1,2,3,7,8 PeCDD	1	0.1146	0.01	11.45769	1.0313	0.08	0.945305	0.945305
1,2,3,4,7,8 HxCDD	0.05	0.1792	0.01	17.91587	0.0368	0.08	0.052744	0.002637
1,2,3,7,8,9 HxCDD	0.1	0.2682	0.01	26.81988	0.0102	0.08	0.021885	0.002189
1,2,3,6,7,8 HxCDD	0.01	0.3698	0.01	36.97569	0.2321	0.08	0.686565	0.006866
1,2,3,4,6,7,8 HpCDD	0.001	4.5010	0.01	450.0958	0.0016	0.08	0.057612	5.76E-05
OCDD	0.0001	35.172	0.01	3517.227	0.0018	0.08	0.506481	5.06E-05
2,3,4,7,8 PeCDF	1	0.2649	0.01	26.48911	0.3068	0.08	0.650149	0.650149
1,2,3,4,7,8 HxCDF	0.1	0.3729	0.01	37.28941	0.1081	0.08	0.322479	0.032248
1,2,3,7,8,9 HxCDF	0.1	0.2150	0.01	21.50024	0.0174	0.08	0.029928	0.002993
2,3,4,6,7,8 HpCDF	0.1	0.3406	0.01	34.0623	0.12	0.08	0.326998	0.0327
1,2,3,7,8 PeCDF	0.1	0.2463	0.01	24.63014	0.0221	0.08	0.043546	0.004355
2,3,7,8 TCDF	1	0.4916	0.01	49.15541	0.025	0.08	0.098311	0.098311
1,2,3,4,6,7,8 HpCDF	0.01	2.2377	0.01	223.7724	0.0001	0.08	0.00179	1.79E-05
1,2,3,4,7,8,9 HpCDF	0.01	0.4558	0.01	45.58382	0.0027	0.08	0.009846	9.85E-05
1,2,3,6,7,8 HxCDF	0.1	0.2361	0.01	23.60847	0.0893	0.08	0.168659	0.016866
OCDF	0.0001	2.2041	0.01	220.4148	0.0002	0.08	0.003527	3.53E-07
Sum								2.31

Table 2.4 Predicted Increase in Dioxin Concentration in Egg of Fish Eating Bird

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Congener	TEF	Cs	Foc	Cs/Foc	BSAF	FI	Cs (FISH)	C
		pg/g			pg/g			TEF pg/g fish
2,3,7,8 TCDD	1	0.0530	0.01	5.300282	0.133	0.0311	0.021924	0.021924
1,2,3,7,8 PeCDD	1	0.1146	0.01	11.45769	0.18	0.0311	0.06414	0.06414
1,2,3,4,7,8 HxCDD	0.1	0.1792	0.01	17.91587	0.03	0.0311	0.016716	0.001672
1,2,3,7,8,9 HxCDD	0.1	0.2682	0.01	26.81988	0.02	0.0311	0.016682	0.001668
1,2,3,6,7,8 HxCDD	0.1	0.3698	0.01	36.97569	0.02	0.0311	0.022999	0.0023
1,2,3,4,6,7,8 HpCDD	0.01	4.5010	0.01	450.0958	0.008	0.0311	0.111984	0.00112
OCDD	0.0001	35.1723	0.01	3517.227	0.0005	0.0311	0.054693	5.47E-06
2,3,4,7,8 PeCDF	0.5	0.2649	0.01	26.48911	0.33	0.0311	0.271858	0.135929
1,2,3,4,7,8 HxCDF	0.1	0.3729	0.01	37.28941	0.01	0.0311	0.011597	0.00116
1,2,3,7,8,9 HxCDF	0.1	0.2150	0.01	21.50024	0.04	0.0311	0.026746	0.002675
2,3,4,6,7,8 HpCDF	0.1	0.3406	0.01	34.0623	0.05	0.0311	0.052967	0.005297
1,2,3,7,8 PeCDF	0.1	0.2463	0.01	24.63014	0.01	0.0311	0.00766	0.000766
2,3,7,8 TCDF	0.1	0.4916	0.01	49.15541	0.12	0.0311	0.183448	0.018345
1,2,3,4,6,7,8 HpCDF	0.01	2.2377	0.01	223.7724	0.001	0.0311	0.006959	6.96E-05
1,2,3,4,7,8,9 HpCDF	0.01	0.4558	0.01	45.58382	0.03	0.0311	0.04253	0.000425
1,2,3,6,7,8 HxCDF	0.1	0.2361	0.01	23.60847	0.01	0.0311	0.007342	0.000734
OCDF	0.0001	2.2041	0.01	220.4148	0.001	0.0311	0.006855	6.85E-07
Sum								0.26

Table 2.5 Predicted Increase in otter exposure based on forage fish dioxin concentration

The predicted increase for a fish eating bird is a 4% increase in egg dioxin concentration, still well below the 50,000 pg/g value described above.

As previously discussed, no direct limit exists for an otter exposed to forage fish, however the predicted increase is from 0.25 to 0.26 pg/g (a 5% increase) of fish with regard to exposure from forage fish dioxin over the lifetime of the facility, and given that this is for an unrealistically conservative assumption, with respect to deposition, it can be assumed that the increase is not significant.

3.0   CONCLUSIONS

- Baseline dioxin concentrations in the eggs of fish eating birds and in otters considered to be low and well within limit values for the eggs of fish eating birds.

- The predicted change in dioxin concentrations is considered to be insignificant for both fish eating birds eggs and otters, based on exposure to forage fish.

REFERENCES

1.   Framework for the Application of the Toxic Equivalency Methodology, Polychlorinated Dioxins, Furans and BiPhenyls in Ecological Risk Assessment, US EPA 2003

2   Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities, US EPA, 1999.

3.   AWN Consulting Ltd Air Dispersion Modelling Report for Ringaskiddy Resource Recovery Centre EIS, 2019

4.   AWN Consulting Ltd PCDD/F Sampling and Analysis in Soil and Sediment Report for RIngaskiddy Resource Recovery Centre EIS, 2015

END OF REPORT