STRATEGIC INFRASTRUCTURE DEVELOPMENT

APPLICATION TO AN BORD PLEANÁLA

(REG NO. PL04.PA0045)

RESPONSE TO SUBMISSIONS

RINGASKIDDY RESOURCE RECOVERY CENTRE,
RINGASKIDDY, COUNTY CORK

ATTACHMENT 3

RESPONSE TO DR GORDON REID SUBMISSION OF 19th JULY 2017

RESPONSE DATED 2nd OCTOBER 2017

1. Introduction

We have set out in the following sections our response to the submission by Dr Gordon Reid dated 19th July 2017. We have also prepared a Table under Section 12 of this document which lists the matters raised in Dr Reid's submission and where we have addressed them in this report.

There were various issues raised in Dr. Reid's submission and in summary they can be listed as follows:

- MARI study underestimates the actual impact of the facility as it does not take into account the dioxin dose from a variety of different food groups (including fish, carbohydrate etc.)
- Baseline dioxin soil level was not chosen from the correct sample point
- The methodology adopted in the MARI study is not consistent with HHRAP and that certain factors such as PCB compounds, impacts on children and impacts from breastmilk are not considered
- Data consistency between assessment of Paul Johnson and final report submitted to the Board are not demonstrated (including references to specific file names)
- TEQ conversion factor is not explained or clarified.

We will address Dr Reid's submission in detail in the following sections. To provide context with regard to the submission we would like to draw An Bord Pleanala's attention to the following points:

The Resource Recovery Facility, should it be granted Planning Permission by An Bord Pleanala, will be subject to the requirements of an EPA licence under Council Directive 2010/75/EU, part of which licence will require compliance with limit values set by BAT (Best Available Technology), the relevant limit value being 0.1 ng/m^3 (TEQ) for dioxins and furans. Indaver have consistently demonstrated their ability to operate within and indeed well below this licence limit value on their site at Duleek and once the facility operates within this licence limit, which is a European-wide limit that is consistent for waste to energy facilities across the EU, the operation of a waste to energy plant is considered to be in compliance with BAT and to have no significant environmental impact. This is supported by the ongoing EPA programme of monitoring of dioxin levels in milk across Ireland which continues to show very low levels of dioxin in the Irish Environment both in the vicinity of emission sources licensed under the Directive and elsewhere.

It should also be noted that the idea behind the theoretical MARI is that someone spends their entire life living at the point of maximum deposition of PCDD/F and only obtains food from that point and is not in any way representative of actual impacts of the proposed facility which will be orders of magnitude lower. Dietary intake of food products varies substantially depending on many factors including individual preferences and external factors such as dietary and lifestyle advice, whereby people may be advised to eat more or less dairy products, meat or eggs depending on many personal and other factors. The reality of assessing the impacts of a waste to energy facility is that the population living in the general vicinity of such a facility receive their dioxin and furan exposure from the food they buy in shops and supermarkets, not from the waste to energy plant, with a very small amount of exposure from air emissions from the proposed facility.

1.1 Likely Actual Impacts when Compared with Theoretical MARI Impacts

Taking one of the main thrusts of Dr Reid's submission that the MARI underestimates the impact, the following assessment of the likely actual impacts of the proposed facility (setting aside the MARI analysis) shows that actual impact of the facility is miniscule with respect to dioxin dose.

The background dioxin concentration in air as measured in the Ringaskiddy area and the dioxin dose experienced by someone inhaling that air is presented below. A comparison with the typical dioxin dose experienced by drinking a glass of milk from the Ringaskiddy area is also shown.

Measured background PCDD/F concentration (TEQ) in Ringaskiddy currently	0.014	pg/m^3
Normal breathing rate [1]	20	m^3/day
Mass Fraction of PCDD/F absorbed in the lungs [2]	75	%
Mass of PCDD/F absorbed through inhalation over a day	0.210	pg/day
Ringaskiddy		
Mass of PCDD/F in 1 kg of full fat (3.7% fat) milk (see calculation in Table 2 below)	15.91	pg
Density of milk (3.7% fat) at 20^oC [3]	1029	kg/m^3
Volume of glass of milk	300	ml
Mass of glass (300ml) of milk	0.3087	kg
Mass of PCDD/F in 300ml glass of full fat (3.7% fat) milk	4.91142	pg
Mass Fraction of PCDD/F Absorbed in gut [4]	50	%
Mass of PCDD/F absorbed in gut from glass of milk	2.45571	pg/glass
No. of glasses of Milk Equivalent to Inhaled PCDD/F	0.08552	glasses/d
Volume of milk equivalent to inhaled PCDD/F = 5 Teaspoons of milk per day	25.66	ml/d

Table 1 Estimated PCDD/F dose expressed as milk intake

References as follows:

1. Konz, J.J, Lisi, K., Friebele, E and Nixon, D. Exposure Factors Handbook, EPA/600/8-89/043, Washington DC EPA 1989.
2. Compilation of EU Dioxin Exposure and Health Data - Task 4 Human Exposure European Commission DG Environment, October 1999
3. Goff, H.D. and A.R. Hill. 1993. Chemistry and physics. In Y.H. Hui (ed.), Dairy Science and Technology Handbook Vol.1: Principles and Properties, pp. 1-82. VCH Publishers, New York.
4. UK Department of Environment, Food and Rural Affairs Dioxin TDI Values, DEFRA, 2003

The mass of dioxin per kg milk is calculated as follows:

3.7	%	full fat milk
1	kg of milk has	
0.037	kg of fat	
37	g of fat	
0.43	WHO pg/g	milk fat (EPA Milk Report 2012)
15.91	pg WHO TEQ per kg milk	

Table 2 mass of PCDD/F per kg of milk

The process contribution from the proposed facility, as presented in the Table 8.48 of the EIS Air Chapter, is 0.9 fg/m^3. Converted to pg/m3, this is 0.0009 pg/m^3. Added to the background level, of 0.014 pg/m^3, this gives a value of 0.0149 pg/m^3.

Therefore the impact of the predicted air concentration can be assessed as follows and is calculated to be equal to an additional 0.16 glasses of milk per month as shown in Table 3 below:

Predicted PCDD/F concentration (TEQ) (Including background and Indaver contribution)	0.0149	pg/m^3
Normal breathing rate	20	m^3/day
Mass Fraction of PCDD/F absorbed in the lungs	75	%
Mass of PCDD/F absorbed through inhalation over a day	0.2235	pg/day
Ringaskiddy		
Mass of PCDD/F in 1 kg of full fat (3.7% fat) milk	15.91	pg
Density of milk (3.7% fat) at 20^{o}C	1029	kg/m^3
Volume of glass of milk	300	ml
Mass of glass (300ml) of milk	0.3087	kg
Mass of PCDD/F in 300ml glass of full fat (3.7% fat) milk	4.91142	pg
Mass Fraction of PCDD/F Absorbed in gut	50	%
Mass of PCDD/F absorbed in gut from glass of milk	2.45571	pg/glass
No. of glasses of Milk Equivalent to Inhaled PCDD/F with WTE	0.09101	glasses/day
No. of glasses of Milk Equivalent to Inhaled PCDD/F without WTE (from Table 2 above)	0.08552	glasses/day
Increase due to WTE Plant	0.00550	glasses/day
Increase due to WTE Plant	0.33	teaspoons/day
Increase due to WTE Plant	0.164769	glasses/month

Table 3 Increase in PCDD/F dose

Using published data for Irish food-stuffs we have calculated the likely dioxin dose for an Irish consumer as follows.

		TEQ (PCDDF+PCB)		TEQ (PCDDF+PCB)			
Food	**kg/annum**	**PCDD/F pg/g fat**	**% Fat**	**PCDD/F pg/kg**	**PCDD/F pg/yr**	**PCDD/F pg/d**	**PCDD/F pg/kg bw/d**
							(based on 60 kg bw)
Beef&veal	20.9	0.56	10		1170.4	3.20658	0.0534429
Pig meat	28	0.28	10		784.0	2.14795	0.0357991
Sheep meat	1.3	0.5	10		65.0	0.17808	0.0029680
Poultry meat	26	0.35	3		273.0	0.74795	0.0124658
Butter	3	0.43	80		1032.0	2.82740	0.0471233
Drinking milk	135	0.43	3.7		2147.9	5.88452	0.0980753
Cream	2	0.43	80		688.0	1.88493	0.0314155
Cheese	7	0.43	40		1204.0	3.29863	0.0549772
Eggs	6.2	0.35	11		238.7	0.65397	0.0108995
Fruit	20			10	200.0	0.54795	0.0091324
Vegetables	40.1			8	320.8	0.87890	0.0146484
Potatoes	88			5	440.0	1.20548	0.0200913
Cereals	36			7	252.0	0.69041	0.0115068
Fish	21			1240	26040.0	71.34247	1.1890411
TOTAL							**1.5915868**
without fish contribution							**0.4025457**
Assuming 50% is PCB derived, the PCDD/F dose is							**0.2012728**

Table 4 PCDD/F Dose including dioxin-like PCBS, based on CSO and other published sources

The references used are as follows:

- *CSO 2011 Food consumption data for meat and dairy product consumption*
- *Meat and Eggs PCDD/F&PCB data - Investigation into levels of chlorinated and brominated organic pollutants in carcass fat, offal, eggs and milk produced in Ireland, FSAI 2010*
- *Milk and milk products PCDD/F&dioxin-like PCB data – EPA Dioxin Levels in the Irish Environment 2012*
- *Egg, cereal, fruit and vegetable consumption from Compilation of EU Dioxin Exposure and Health Data Task 4 - Human Exposure Report produced for European Commission DG Environment United Kingdom Department of the Environment, Transport and the Regions (DETR), October 1999*
- *Potato consumption Bord Bia, 2017*

- *Potato, fruit and vegetable PCDD/F and dioxin-like PCB data from background "Contamination of Fruit and Vegetables with PCDDs, PCDFs, dioxin-like PCBs and non-dioxin-like PCBs in Germany, Organohalogens, Vol 68, 2006.*

- *Fish consumption from Bord Iascaigh Mhara "The Business of Food" Report*

- *Fish dioxin concentration from data provided for mackerel (oily fish) - Investigation into levels of dioxins, furans, polychlorinated biphenyls and brominated flame retardants in fishery produce in Ireland, FSAI, 2007.*

The data used in the assessment above incorporates dioxin-like PCB's.

Polychlorinated Bi-phenyls (PCB's)
Dioxin-like PCB's have not been modelled in the current assessment as waste to energy plants are not regulated under the IED (Industrial Emissions Directive) for PCB's. The baseline including dioxin-like PCB's is calculated to be 0.4025457 pg/kg bw/d. However if one assumes, based on milk and meat data, that approximately 50% of the total baseline may be related to dioxin-like PCB's, then the estimated baseline dioxin dose based on calculated dose from food-stuffs is 0.2012728 pg/kg bw/day, which is somewhat less than the modelled baseline of 0.29 kg/bw/day as predicted by the MARI model used in the current assessment.

It can therefore be concluded that the MARI model provides a good prediction of likely dioxin dose (excluding the fish uptake element which is not considered relevant).

Fish
The fish exposure element has been excluded from the current assessment because the current assessment looks at the point of maximum deposition on land. Any fish species will cover considerable distances in its life cycle, from the Atlantic salmon which may cover many thousands of km to the mackerel which even though it is not a migratory species, may still cover many hundreds of kilometres as it moves between deeper off-shore waters and shallower coastal waters in summer. It is therefore not relevant to the assessment of a waste to energy plant to assess impacts on marine species which migrate across many thousands of square kilometres of oceans.

It can be seen that the process contribution of PCDD/F from the proposed facility is 0.0009 pg/m3 (0.9 fg/m3) (From Table 8.48 of the EIS Air Chapter). Based on 20 m^3/day of inhaled air and 75% retention of PCDD/F, this is 0.0135 pg/day of PCDD/F dose from the proposed facility, or 0.000225 pg/kg bw/day. This is 0.1% of the calculated dioxin dose of 0.2012728 pg/kg bw/day for a consumer eating the diet described above in Table 4 (which is based on dioxin data for Irish food-stuffs a consumer would expect to buy in a supermarket), and is consistent with the known facts that the majority of dioxin dose comes from dietary sources.

The background PCDD/F concentration measured in air, as described in the air chapter of the

EIS, was 14 fg/m3 (0.014 pg/m3). Applying the same calculation, this is a PCDD/F dose of 0.21 pg/day or 0.0035 pg/kg bw/day. This is 1.7% of the annual PCDD/F dose from food of 0.2012728 pg/kg bw/day as calculated above in Table 4, meaning that 98.3% of PCDD/F dose experienced by a Ringaskiddy resident is from food available on the Irish market and purchased in shops, butchers, and other retail outlets.

This also is in line with established data and knowledge whereby 95 to 99% of dioxin dose people experience is from their diet (as referenced in Section 1.1 of Compilation of EU Dioxin Exposure and Health Data Task 4 - Human Exposure Report produced for European Commission DG Environment United Kingdom Department of the Environment, Transport and the Regions (DETR), October 1999) .

In summary therefore, it can be concluded that modelling methodology presented in the EIS predicts dioxin dose accurately when compared with dioxin data available for analysis of food in Ireland.

2.0 Comment on Air Quality Value

There is a small error in Table 5.1 where 0.00035 should be 0.0035 (this was due to 0.0014 pg being used instead of 0.014 pg).

The corrected Tables 5.1 and 7.1 from my report FC_8104R02_rev2 for the baseline and predicted dose respectively) are inserted below. The overall effect is that the predicted dose increases from 0.29 pg/kg bw/d to 0.2935 pg/kg bw/day, which is an increase of just over 1.1% and therefore is not significant as it is still well below the significance threshold established by the EU SCF in 2001 (Scientific Committee on Food) of 2 pg/kg bw/day for PCDD/F intake.

	mg/kg/d	pg/kg/d	TEF	TEF	pg/kd/d	pg/kg/d
PCDD Congeners			NATO CCMS	WHO	NATO CCMS	WHO
2,3,7,8-TCDD	1E-11	1E-02	1	1	1E-02	1E-02
1,2,3,7,8-PeCDD	8.45E-11	8.45E-02	0.5	1	4.23E-02	8.45E-02
1,2,3,4,7,8-HxCDD	32E-11	32E-02	0.1	0.1	32E-03	32E-03
1,2,3,6,7,8-HxCDD	1.56E-10	1.56E-01	0.1	0.1	1.56E-02	1.56E-02
1,2,3,7,8,9-HxCDD	1.01E-10	1.01E-01	0.1	0.1	1.01E-02	1.01E-02
1,2,3,4,6,7,8-HpCDD	1.50E-09	1.50E+00	0.01	0.01	1.50E-02	1.50E-02
OCDD	1.18E-08	1.18E+01	0.001	0.0003	1.18E-02	3.54E-03
PCDF Congeners						
2,3,7,8-TCDF	3.34E-11	3.34E-02	0.1	0.1	3.34E-03	3.34E-03
1,2,3,7,8-PeCDF	9E-11	9E-02	0.05	0.03	3.05E-03	1.83E-03
2,3,4,7,8-PeCDF	6.09E-11	6.09E-02	0.5	0.3	3.05E-02	1.83E-02
1,2,3,4,7,8-HxCDF	2.50E-10	2.50E-01	0.1	0.1	2.50E-02	2.50E-02
1,2,3,6,7,8-HxCDF	1.99E-10	1.99E-01	0.1	0.1	1.99E-02	1.99E-02
1,2,3,7,8,9-HxCDF	6.61E-11	6.61E-02	0.1	0.1	6.61E-03	6.61E-03
2,3,4,6,7,8-HxCDF	2.74E-10	2.74E-01	0.1	0.1	2.74E-02	2.74E-02
1,2,3,4,6,7,8-HpCDF	1.44E-09	1.44E+00	0.01	0.01	1.44E-02	1.44E-02
1,2,3,4,7,8,9-HpCDF	1.95E-10	1.95E-01	0.01	0.01	1.95E-03	1.95E-03
OCDF	1.41E-09	1.41E+00	0.001	0.0003	1.41E-03	4.23E-04
pg/kg bw/day					0.-268675	0.29
Base air						0.0035
Total						0.2935
pg/kg bw/wk						2.05

Table 5.1 Modelled baseline PCDD/F intake for MARI

Table 7.1 below is also updated with the predicted dose increasing from 0.32 pg/kg bw/day to 0.323725 pg/kg bw/day which is an increase of just over 1.1% and therefore is not significant as it is still well below the EU SCF TDI described above.

	mg/kg/d	pg/kg/d	TEF	TEF	pg/kd/d	pg/kg/d
PCDD Congeners			NATO CCMS	WHO	NATO CCMS	WHO
2,3,7,8-TCDD	3.32E-11	3.32E-02	1	1	3.32E-02	3.32E-02
1,2,3,7,8-PeCDD	8.72E-11	8.72E-02	0.5	1	4.-36E-02	8.72E-02
1,2,3,4,7,8-HxCDD	7.79E-11	7.79E-02	0.1	0.1	7.479E-03	7.79E-03
1,2,3,6,7,8-HxCDD	1.65E-10	1.65E-01	0.1	0.1	1.65E-02	1.65E-02
1,2,3,7,8,9-HxCDD	1.18E-10	1.18E-01	0.1	0.1	1.18E-02	1.18E-02
1,2,3,4,6,7,8-HpCDD	1.7E-09	1.7E+00	0.01	0.01	1.7E-02	1.57E-02
OCDD	1.23E-08	1.23E+01	0.001	0.0003	1.23E-02	3.69E-03
PCDF Congeners						
2,3,7,8-TCDF	3.36E-11	3.36E-02	0.1	0.1	3.36E-03	3.36E-03
1,2,3,7,8-PeCDF	6.44E-11	6.44E-02	0.05	0.03	3.22E-03	1.93E-03
2,3,4,7,8-PeCDF	6.88E-11	6.88E-02	0.5	0.3	3.44E-02	2.06E-02
1,2,3,4,7,8-HxCDF	2.93E-10	2.93E-01	0.1	0.1	2.93E-02	2.93E-02
1,2,3,6,7,8-HxCDF	2.18E-10	2.18E-01	0.1	0.1	2.18E-02	2.18E-02
1,2,3,7,8,9-HxCDF	7.83E-11	7.-83E-02	0.1	0.1	7.83E-03	7.83E-03
2,3,4,6,7,8-HxCDF	3.68E-10	3.68E-01	0.1	0.1	3.68E-02	3.68E-02
1,2,3,4,6,7,8-HpCDF	1.55E-09	1.55E+00	0.01	0.01	1.55E-02	1.55E-02
1,2,3,4,7,8,9-HpCDF	2.09E-10	2.09E-01	0.01	0.01	2.09E-03	2.09E-03
OCDF	1.68E-09	1.68E+00	0.001	0.0003	1.68E-03	5.04E-04
pg/kg bw/day					0.296870	0.32
Base air + Predicted						0.003725
Total						0.323725
pg/kg bw/wk						2.26

Table 7.1 Modelled predicted intake for MARI

3.0 Attachment H of Appendix 6.4 of EIS

Attachment H represents data in the raw form before it is converted to TEQ, therefore it does not represent a data set which has a TEQ conversion applied twice, as was the suggestion in the submission made. Attachment H did have a typographical error in the title block of the table. This has been corrected and is submitted as Appendix B to this document. As can be seen there is no change to the data in Attachment H, but the typographical error which had "TEQ" in the title block has been corrected.

4.0 Background Soil Dioxin Used in the Model

The sampling results for background dioxin concentrations over the period 2001 to 2015 (Table 5.3 of the Soil PCDD/F Sampling Study submitted with the EIS).

Sample ID	Location	I-TEQ 2015 (ng/kg)	I-TEQ 2008 (ng/kg)	I-TEQ 2001 (ng/kg)
Location 1A	EPA Offices Iniscarra	0.033	0.230	<0.500
Location 2A	Low Ground at Indaver Site	0.052	2.100	3.400
Location 3A	Martello Tower, Ringaskiddy	0.749	1.900	3.000
Location 4A	High Ground at Indaver Site	0.373	0.460	0.650
Location 5A	Cobh Water Tower	0.413	1.200	1.000
Location 6A	Cushkinny Nature Reserve	0.219	0.580	1.800
Location 7A	Lighthouse, Roche's Point	0.802	0.130	1.400
Location 8A	Land overlooking Pfizer (OSP4) Plant and N28 Road	0.344	0.086	0.550

It can be seen that from a comparison of Sample location 4A and 3A that the background at 3A was elevated when compared with 4A and that this pattern is consistent over time. When originally sampled, it was noted that there was evidence of bonfires in the vicinity of 3A and certainly it is apparent that some localised source is contributing to elevated concentrations when compared with 4A. If one examines the other results it can be seen that 6 of the 8 samples have PCDD/F concentrations less than or between 0.219 and 0.413 ng/kg, with only two samples being greater than that range. Of these one is at Roche's point and not in the vicinity of the proposed facility and the other is the sample at Location 3A. It was decided to use Location 4A because it was felt to be more representative of likely background concentrations, rather than using one sample which had some localised influence from an activity such as a bonfire. It will be noted that the predicted PCDD/F dose using this baseline is very similar to the likely dose when calculated using PCDD/F in foodstuffs, as presented in Section 1.0 of this submission to An Bord Pleanala, and also accurately predicts the milk PCDD/F dose for Ringaskiddy. Therefore it is considered that location 4A was appropriate for use as the baseline, as it is a representative baseline value.

5.0 Lifetime exposure 70 year

The important point to note is that for PCDD/F the TDI (Tolerable Daily Intake) value is defined over a long period, not a short term period. This is accepted by WHO and EU and is central to the HHRAP approach and hence we can stand over the robustness of the approach and methodology used in the assessment. The UK COT stated in 2001:

"We note that the body burden is the most appropriate dose metric for establishment of a tolerable intake and, because of its long half-life, the body burden of TCDD at steady state is about 2000 fold higher the average daily intake. For example, an intake of 10 times the TDI on a single day would result in a 0.5% increase in the body burden. Therefore short term variation in intake does not significantly alter the body burden, and occasional exceedance of the TDI would not be expected to result in harmful effects, provided that intake averaged over a prolonged period is within the TDI."

AND

Using a bioavailability of 0.5 and a half-life of 2740 days (7.5 years), the tolerable human equivalent steady-state body burden from the study of Faqi et al would be produced in humans by a daily intake of 1.7pg/kg bw/day. Given the imprecision and assumptions inherent in these calculations we concluded that the tolerable daily intake for dioxins and dioxin-like PCBs should be based on this value rounded to a single figure, i.e. 2pg WHO TEQ/kg bw per day. We note that SCF and JECFA have used longer averaging periods, but because intakes are usually expressed on a daily basis, we considered that establishment of a tolerable daily intake was more appropriate and transparent. This value is consistent with tolerable intakes derived recently using similar data (WHO: 1-4pg WHO TEQ /kg bw/day; SCF: 14pg WHO TEQ /kg bw/week; JECFA: 70pg WHO TEQ /kg bw/month.

AND

"*We recommend that a tolerable daily intake of 2 pg WHO-TEQ/kg bw per day is established based upon effects on the developing male reproductive system mediated via the maternal body burden*".

Reference: *STATEMENT ON THE TOLERABLE DAILY INTAKE FOR DIOXINS AND DIOXINLIKE POLYCHLORINATED BIPHENYLS – October 2001.*

The UK COT in July 2004 stated:

The TDI is set to protect against the most sensitive effects of dioxins and dioxin-like PCBs, which occur in the male foetus as a result of the mother's accumulated body burden. There is uncertainty with respect to whether similar effects would arise from post-natal exposure, but there is currently no basis for assuming that the young infant is at increased risk.

Reference: Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment COT Statement on a toxicological evaluation of chemical analyses carried out as part of a pilot study for a breast milk archive

The UK COT also noted in December 2006:

The health implications of exceeding the TDI at an early age are not clear. Previously, the Committee considered that, in view of the fact that the TDI was set based on effects on the developing male reproductive system mediated by maternal body burden, there was uncertainty with respect to whether similar effects would arise from post-natal exposure. However, the Committee concluded that there was no basis for assuming that the young infant is at increased risk. Furthermore, recent publications suggest that the half lives of dioxin and certain other furan congeners in young children are considerably shorter than in adults.

Reference : UK COT 2005 WHO TOXIC EQUIVALENCY FACTORS FOR DIOXINS AND DIOXINLIKE COMPOUNDS

The important points to note from the above are that the TDI is set to protect the most sensitive receptor, the developing male reproductive system, and that it is set for the long term, and that there is no basis for assuming the infant is at increased risk.

6.0 PCB's

The important point to note is that PCB's are not regulated under the IED (Industrial Emissions Directive) for waste to energy facilities and therefore have not been considered in the modelling study.

The baseline dioxin-like PCB concentration in soil could have been used it is acknowledged, but the assessment was focused on the impact of dioxin emissions, not on the emission of PCBs which are not required to be regulated and the use of PCBs in the model would only have served to "dilute" the effects of any emissions.

The HHRAP uses phrases such as "PCBs may be emitted" and the key point of note is that in Europe, for licensing waste to energy emissions, the EU Commission legislation (IED) does not list PCBs as being part of licence limit values considered. The IED, Directive 2010/75/EU of the European Parliament and the Council on industrial emissions (the Industrial Emissions Directive or IED) is the main EU instrument regulating pollutant emissions from industrial installations. The IED was adopted on 24 November 2010. It is based on a Commission proposal recasting 7 previously existing directives (including in particular the IPPC Directive) following an extensive review of the policy. The IED entered into force on 6 January 2011 and had to be transposed by Member States by 7 January 2013.

7.0 Food Intake Values for MARI

The food intake values in the RISC HUMAN model are based on Irish Department of Agriculture figures from 2002/2003 and default model data for RISC HUMAN. We have also undertaken an alternative calculation, listed in Section 1 of this submission to An Bord Pleanala, using 2011 Central Statistics Office data for food intake and Food Safety Authority of Ireland 2012 (and other sources) data for PCDD/F intake. It should be noted that this is statistical data provided by the CSO, not theoretical calculations on calorie intakes. Theoretical calorie intakes are subject to any number of possible combinations of food intake, so it is more appropriate to rely on CSO published data.

It can be seen from Section 1 that the estimated PCDD/F intake based on the modelling methodology used in this assessment and the calculated intake values are very similar, indicating the food dioxin dose calculated by the model matches closely the likely dioxin dose experienced by someone eating those food groups and quantities.

8.0 Fish

It is noted that HHRAP "does not usually recommend the ingestion of fish exposure pathway …however we do recommend that you consider evaluating the fish exposure pathway…if regional or site-specific exposure characteristics (e.g. presence of ponds on farms or ranches that support fish for human consumption" are identified that warrant consideration.

The fish in Cork Harbour are sea fish and as noted in Section 1.0, sea fish species will cover considerable distances in their life cycle, from the Atlantic salmon which may cover many thousands of km to the mackerel which even though it is not a migratory species, may still cover many hundreds of kilometres as it moves between deeper off-shore waters and shallower coastal waters in summer. It is therefore not relevant to an assessment of a waste to energy plant to assess impacts on marine species which migrate across many thousands of square kilometres of oceans. It may be of relevance to consider a scenario if a fish-pond scenario was relevant, but this is not relevant to the current assessment.

9.0 Carbohydrate

PCDD/F compounds are lipophilic (they accumulate in fat), so the PCDD/F dose from carbohydrate is very low. Table 4 shows the PCDD/F intake from diet based on Irish data (as presented in Section 1 of this submission) shows that carbohydrates are a much smaller proportion of PCDD/F intake when compared with meat and milk. It is also important to note that this table reflects exposure from actual human food consumption data rather than theoretical estimates of a possible calorie mixture in a theoretical subsistence farmer's diet.

10.0 Breast Milk

This point does highlight the fact that the likely background dioxin exposure already for breastfed children is well above tolerable limit values, simply because breastfeeding involves the conversion of maternal body fat to breast milk and because dioxins are hydrophobic they are found in body fat rather than tissue – so breastfeeding causes the mobilisation of quantities of dioxin that are stored in the mothers fat to be mobilised in a very short period of time. For example, the UK COT study on breast milk referenced above found that the dioxin intake from breast milk in the UK was over 300 times higher than dioxin intake from infant formula milk. However the study concluded that benefits of breastmilk outweighed any negative aspects associated with the dioxin dose. The study also noted that "A TDI of 2 pg WHO-TEQ/kg bw/day was established, based upon effects on the developing male reproductive system mediated via maternal body burden. The body burden of TCDD at steady state is about 2000-fold higher than the average daily intake, and therefore occasional exceedance of the TDI would not be expected to result in harmful effects, provided that intake averaged over a prolonged period is within the TDI" - the modelling software looks at childhood exposure through dioxin deposition and diet over that prolonged period. If you were to follow the logic that exceedance of the TDI for infants or small children for short periods (short when compared with a whole life), then breastfeeding would be banned immediately. As can be seen, the COT takes the approach that although the dioxin dose during breastfeed may be high it's the long-term exposure that counts.

11.0 Filenames of Attachments D & J

In my submission as response to the RFI, the data from attachments D and J were amended to reflect the correction of the transcription errors. For clarity, the original attachments D & J that Professor Johnston reviewed and the associated filenames of these (including the filenames of the revised Attachments D & J) are outlined below. The excel file of soil PCDD/F data which Professor Johnston referred to in his report is attached in Appendix A to this report. All of the data in this table had been extracted from the relevant parts of the EIS.

	EIS 2015 (as submitted)	EIS 2015 (actual intended)	May 2017 (corrected)
Filename	RINBSL4.loc	BASE2015.loc	FBAS2015.loc
Attachment Ref	D	D	D
Filename	RINBSL5.loc	INT2015.loc	FINT2015.loc
Attachment Ref	J	J	J

12.0 Reference Table for matters raised by Dr Reid

Table 5 below lists the various matters raised by Dr Reid and where these are answered in this report.

Dr Reid Submission Section	Item	Comment
2.1 & 2.4, 2.5	Attachments D and J of Appendix 6.4 of EIS	As per our submission of May 2017, the review by Dr Johnston found minor errors in the model which were corrected
2.1	Concentration of dioxins/furans of 0.014pg/m3 vs 0.0014pg/m3	See section 2.0 of this submission
2.2, 2.3 & 3	Attachments D and J not matching what Dr Johnson Reviewed and what is in front of the Board. Filenames not matching Excel Appendix referred to Dr Johnsons report not present	See Section 11 and Appendix A of this submission
2.6	Filenames, versions etc of Attachments D & J	See Section 11 of this submission
2.7	Attachment H of Appendix 6.4 of EIS	See Section 3.0 and Appendix B of this submission
2.7	Underestimation of impact by MARI	See Section 1.1 of this document
4a	Choice of soil sample location	See Section 4.0 of this submission
4b	Ignoring child	See Section 5.0 of this submission
4c	Breastfed baby	See Section 10.0 of this submission
4d	Dioxin-like PCBs	See Section 6.0 of this submission
4e	Diet of MARI	See Section 7.0 of this submission
4f	Omission of food groups	See Section 7.0, 8.0 and 9.0 of this submission
4g	Body burden of young mother	See Section 5.0 of this submission

13.0 Conclusion

It is concluded that the determination arrived at in the EIS, that the proposed Resource Recovery Facility will have no significant impact with regard to PCDD/F impact on human receptors, remains valid. The theoretical MARI (an individual who does not in fact exist) may experience a slight increase in PCDD/F intake but this is still below the relevant EU intake guidance. For actual people living in the area, the PCDD/F exposure which may occur is insignificant when compared with the PCDD/F exposure of the general population from food-stuffs available on the Irish market.

APPENDIX A

EXCEL SPREADSHEET REFERRED TO BY PROFESSOR JOHNSTON

APPENDIX B

REVISED ATTACHMENT H