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# ORAL HEARING INTO THE

# RINGASKIDDY WASTE MANAGEMENT FACILITY

## PROOF OF EVIDENCE

## SOIL PCDD/F CONCENTRATIONS AND PCDD/F INTAKE


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## 1.0 QUALIFICATIONS AND EXPERIENCE

Fergal J. Callaghan will say:

1.1 I hold a 2.1 honours degree of Bachelor of Science in Chemistry (1991) from the University of Limerick, where I majored in Environmental Chemistry and a Ph.D. in Chemical Engineering from the University of Birmingham (1998), where I specialised in the chemistry and degradation of waste materials. I am an associate member of the Institute of Chemical Engineers (AMIChemE), a graduate member of the Chartered Institute of Water and Environmental Management, a member of the IChemE Environmental Protection Subject Group (EPSG), a member of the IChemE Loss Prevention and Safety Group and a Member of the Institute of Environmental Management and Assessment (IEMA) and am currently on the Irish Committee of this Organisation. It is a requirement of membership of these organisations that I am active in the field of professional chemistry and environmental assessment and satisfy their requirements with regard to level of qualifications and experience.

1.2 I have been active in the field of chemistry and environmental assessment for 17 years, the last 8 as an Environmental Consultant. I have considerable experience with respect to the analysis and behaviour of chemicals in the environment, and have monitored and modelled the behaviour of many man made chemicals on green field and brown field sites. I have conducted soil PCDD/F sampling studies in both urban and rural environments, in Ireland and the UK, for private developers and Local Authorities, and have modelled PCDD/F exposure for PCDD/F uptake and movement in the environment, in the UK and Ireland. I worked for many years in the UK where I designed and implemented soil contaminant monitoring programmes for the UK (Environment Agency) EA and private companies, and constructed mathematical models of contaminated sites to determine impacts on soil, water and human beings, through multiple exposure pathways. I have represented major brown field developers and Government Agencies developing brown field sites, in the UK and put together models and contaminant assessment strategies for PCDD/F, PAH, heavy metals and other contaminants, which have been accepted by the UK EA, as part of planning and licensing submissions. I have prepared soil quality assessments and modelled contaminant behaviour on development sites in Ireland and successfully presented these assessments to An Bord Pleanala and the EPA.

1.3 I am currently Director with responsibility for Soil Quality with AWN Consulting.

## 2.0 INTRODUCTION

2.1 AWN Consulting Limited was commissioned to conduct a detailed appraisal of the soil in Cork Harbour for concentrations of Polychlorinated Di-benzo Dioxin/Furan (PCDD/F) and to model the possible impact of PCDD/F emissions from the Ringaskiddy Waste Management Facility.

2.2 The existing soil PCDD/F concentrations were quantified by means of an intensive soil sampling survey.

2.3 Consideration was given, through reference to published guidance and standards, to suitable means for assessing the potential impact associated with the proposed Ringaskiddy Waste Management Facility.

2.4 Using background (measured) soil and ambient air PCDD/F and also modelled PCDD/F ambient concentration and deposition data, the theoretical worst case impact of the Facility was modelled, in terms of PCDD/F dose to a theoretical Maximum At Risk Individual (MARI) following US EPA methodology and modelling techniques.

## 3.0 SUMMARY OF RESULTS

### Introduction

The risk assessment study comprised the following components:

- the existing soil and air PCDD/F concentrations in Ringaskiddy and the Cork Harbour area was monitored
- the air emissions from the proposed Ringaskiddy waste management facility were characterised and quantified (by Dr Edward Porter of AWN Consulting Ltd)
- the dispersion of these emissions was modelled by computer (by Dr Edward Porter of AWN Consulting Ltd)
- the resulting ground level concentrations and wet and dry deposition rates were used to model the theoretical PCDD/F exposure of the MARI

### Existing Soil PCDD/F in Ringaskiddy and Cork Harbour

Soil sampling was conducted at 7 locations in the Cork Harbour Area and at EPA Inishcarra, in July 2001, with the aim of determining background PCDD/F and PCB's. Soil samples were analysed for PCDD/F, PCBs and PAH and the results compared with current data, previous data for the Cork Harbour Area and data from other countries. The conclusions of the sampling and analysis programme were as follows:

- Background soil PCDD/F concentrations were found to be very similar to those found by the EPA (at the same or adjacent sampling locations) during a soil sampling programme carried out in December 2000, with the exception of one sample in the vicinity of the Martello Tower. The soil concentrations found and a comparison with previous studies is shown below.



| EPA Sampling Location | EPA 2000 | AWN 2001 | Eolas 1990 | Cork 1994 |
|---|---|---|---|---|
| | I-TEQ (ng/kg) | I-TEQ (ng/kg) | I-TEQ (ng/kg) | I-TEQ (ng/kg) |
| Church Area | 28 | N/A | N/A | N/A |
| Main Square | 7.1 | N/A | N/A | N/A |
| Area beside foot.field | 11.8 | N/A | N/A | N/A |
| Cdr. Daly Area | 3.1 | N/A | N/A | N/A |
| Foot. Pitch (dockyard) | 1.6 | N/A | N/A | N/A |
| W. of Martello Tower | 0.8 | 3.4 | 21.6* | N/A |
| Pfizer/ADM (to s. of site) | 0.7 | 0.55 | 23.7** | 2.95*** |
| Ballymore (SW face field) | 1 | 1.8 | N/A | N/A |
| Carrignafoy GAA Ground | 1 | 1 | N/A | N/A |
| Iniscarra WTW | 0.6 | <0.5 | N/A | N/A |

NOTE
* At Martello Tower
** Near Ballybricken House
*** North of Barnaheely

- A comparison with limited previous data for the Cork Harbour Area indicates that soil PCDD/F concentrations have decreased significantly over the last decade, at a number of sites around Ringaskiddy.

- Background soil PCDD/F concentrations for the sites sampled in the Cork Harbour area are low when compared with data from other countries.

- PCB and PAH analysis data indicated that background soil concentrations for these analytes were also low.

**Emissions from the Ringaskiddy Waste Management Facility**

The PCDD/F emissions from the facility were characterised by Dr Edward Porter of AWN Consulting Ltd.

**Computer Modelling of the Dispersion of the Stack Emissions**

The PCDD/F emissions from the facility were characterized by Dr Edward Porter of AWN Consulting Ltd.



**Theoretical PCDD/F Exposure**

Soil sampling and ambient air monitoring data was used to establish a baseline for PCDD/F intake for a theoretical Maximum At Risk Individual (MARI) in the Ringaskiddy area. The MARI was assumed to live at the point of maximum PCDD/F deposition from the proposed development and to be a subsistence farmer, who obtained all of their food (vegetables, milk and meat) from a 100m diameter site, upon which the maximum PCDD/F deposition flux impacted.

The baseline PCDD/F intake for the MARI was modelled following US EPA Methodology (Human Health And Ecological Risk Assessment Support To The Development Of Technical Standards For Emissions From Combustion Units Burning Hazardous Waste, EPA Contract No. 68 - W6 – 0053, US EPA, Washington, July 1999.) and using the Dutch Government Approved Model RISC Human 3.1.

The baseline PCDD/F intake was predicted to be 0.284 WHO TEQ 2,3,7,8 TCDD pg /kg body wt/day, which is significantly below WHO and EU PCDD/F intake criteria. The modelled results for baseline milk and meat concentrations, when compared with measured data for the Irish and UK environments, indicated that the model was slightly over-predicting the PCDD/F concentrations in milk (15 WHO TEQ 2,3,7,8 TCDD pg whole milk compared with measured range in Ireland of (4 – 12 WHO TEQ 2,3,7,8 TCDD pg/kg) which ensures a conservative approach is being taken.

The annual average PCDD/F emissions under maximum operating conditions (worst case emissions) from the proposed WTE facility were then used to model average soil concentrations of PCDD/F over the operating life of the facility.

The modelled soil and air values were then added to the existing background values for PCDD/F and input to the RISC HUMAN Model.

The model predicted that the PCDD/F intake for the MARI, with the WTE operating at maximum emission rate to be 0.317 WHO TEQ 2,3,7,8 TCDD pg/kg body weight per day (an 11% increase in theoretical PCDD/F intake), which was still significantly less than recommended low end WHO and EU Guideline values for PCDD/F intake, of 1 WHO TEQ 2,3,7,8 TCDD pg/kg body weight per day .

It was therefore concluded that the proposed WTE facility will have no significant impact on PCDD/F intake for even the theoretical MARI.

It is important to note that the majority of dioxin intake to which the inhabitants of Cork Harbour are exposed to currently is from food, and this will still be the case when this facility is operational. The EU SCF in their report of 2000 have noted that some 90% of dioxin intake for citizens of European countries, is from food, with 80% of food related intake being from fish, meat and milk products.

The following modelling exercise puts the idea of dioxin exposure in context.

If we take a typical inhabitant of the Cork Harbour Area, the principal dioxin exposure routes for this individual will be inhalation of air and consumption of food, most if not all of which will be sourced from outside the Cork Harbour area.



The range of background concentrations of PCDD/F measured by AWN was 4 – 16 TEQ fg/ $m^3$ of air. The normal breathing rate for a health adult is on average 20 $m^3$/day of air (Kohz, J.J, Lisi, K., Friebele, E and Nixon, D. Exposure Factors Handbook, EPA/600/8-89/043, Washington DC EPA 1989). The EU DG Environment estimates that 75% of inhaled PCDD/F is absorbed (Compilation of EU Dioxin Exposure and Health Data - Task 4 Human Exposure European Commission DG Environment, October 1999). Therefore, a typical adult in the Cork harbour area will receive a PCDD/F dose from inhalation of 0.24 pg/day. Assuming a 60 kg adult, this equates to a PCDD/F dose from inhalation of 0.004 TEQ pg/kg bw/d.

To put this in context, milk samples from rural Cork showed PCDD/F concentrations of 5.8 pg/kg I-TEQ. A glass of milk from rural Cork therefore provides a PCDD/F dose of 1.79 pg of PCDD/F, so 1/7$^{th}$ of a glass of milk from rural Cork provides the same daily PCDD/F dose as one days inhalation of PCDD/F in the Ringaskiddy area.

The annual average predicted ground level concentration of PCDD/F, from the proposed WTE facility is 11.44 fg/m$^3$. The additional PCDD/F dose from inhalation is therefore predicted to be 0.172 pg TEQ or 0.00286 TEQ pg/kg bw/d or the equivalent of drinking an additional 1/10$^{th}$ of a glass of milk from rural Cork each day.

This PCDD/F dose should also be put in the context of the PCDD/F dose experienced by the population from other food stuffs. Taking meat and milk related PCDD/F dose, which is derived as follows, using Irish Department of Agriculture data for food consumption, PCDD/F data from the Teagasc Food Research Centre and the EPA PCDD/F Milk Studies.

| ADULT | | PCDD/F | PCDD/F | PCDD/F | Adult | PCDD/F |
|---|---|---|---|---|---|---|
| | kg/day | ng/kg | ng/day | pg/day | Body Wt | pg/kg/day |
| Meat | 0.258 | 0.062 | 0.015996 | 15.996 | 60 | 0.2666 |
| Milk | 0.425 | 0.0058 | 0.002465 | 2.465 | 60 | 0.041083 |
| | | | | | | |
| Sum | | | | | | **0.308** |

The predicted dose is 0.308 pg/kg bw/day. This is over 100 times the PCDD/F dose through inhalation predicted for the WTE facility. This puts in context the insignificant PCDD/F exposure from the WTE facility.

**Summary of Assessment**

The background soil PCDD/F in Ringaskiddy and Cork Harbour was found to be low when compared with data from other countries. The predicted impact of the of the facility was found to be insignificant for even the theoretical MARI.



The EPA National Dioxin Inventory 2002 noted that, even assuming incinerator projects currently in planning are in operation, the projected contribution of incinerators to airborne PCDD/F emissions is at most 0.75 TEQ/annum or 1.8% of airborne PCDD/F emissions in 2010. The bulk of PCDD/F emissions (84%) will continue to come from accidental fires at buildings and uncontrolled burning of wastes.

The following Figures from the Inventory are particularly relevant in this regard, for both the situation in Year 2000 and in 2010.

Figure I: Best Estimate Emissions to air – 2000 (range also shown)

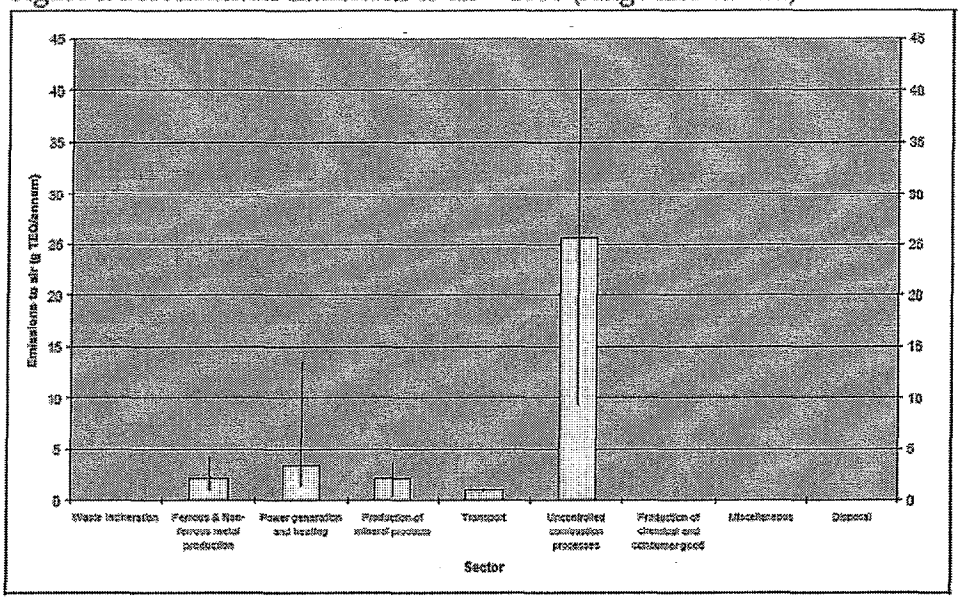


Figure III: Best estimate emissions to air – 2010 (range also shown)