

APPENDIX B

Addendum to original Medical Report on the Health Effects of Landfill

The additional information presented hereunder concentrates on three aspects of landfill: the chemical characteristics of leachate, the association between landfill and cancer; the health effects of chemicals found in leachate.

Leachate Characteristics

The 2008 report by Oman and Junstedt on Swedish municipal landfills identified more than 90 organic and metal organic compounds as well as 50 inorganic elements, some of which appear not to have been detected before. Compounds isolated include halogenated aliphatic compounds, benzene and alkylated benzenes, phenol and alkylated phenols, polychlorinated biphenyls (PCBs), chlorinated dioxins (PCDDs) and chlorinated furans, bromated flame-retardants, pesticides, organic tin, methyl mercury and heavy metals. The authors commented: *“The presence of this large number of hazardous compounds in landfill leachates should have a significant effect on future landfill risk assessments”*.

Also in 2008 there was published research by Ham et al. on the leaching characteristics of PCDDs/dibenzofurans(DFs) and dioxin-like PCBs from landfills containing municipal solid waste and incineration residues. This confirmed the presence of these chemicals in leachate with the following concentrations: the concentration of PCDDs/DFs ranged from 0.65 to 5.88 pg-TEQ(dioxin-like toxic equivalents)/1 (average 2.86 pg-TEQ/1) and those of dioxin-like PCBs from 0.05 to 0.32 pg-TEQ/1 (average 0.18 pg-TEQ/1). The major congeners of leached PCDDs/DFs and dioxin-like PCBs in liquid and solid phases were OCDD (about 60%), 2,3',4,4',5-PeCBs (about 30%), and 2,3,4,4',5-PeCBs (about 54%). Any entry of leachate into ground water could have potentially catastrophic consequences.

Carcinogenesis

In 2008, Hardell comments in Acta Oncologica: *“ Unfounded criticism from industry experts may prohibit the precautionary principle, and early warnings of cancer risk may be ignored. Cancer risks by certain chlorinated phenols may serve as a model of how the precautionary principle should be used in taking early warning seriously.”*

Our original Medical Report submitted by CLAG documents the potential mechanisms whereby landfill may be associated with carcinogenesis and how this may be difficult to detect due to a time lag. The studies cited by Hardell demonstrated association between exposure to phenoxyacetic acids and chlorophenols and various malignant tumours including sarcoma and malignant lymphoma. The author further cites other studies showing an association between dioxins such as 2,3,7,8-tetrachlorodibenzo-p-dioxin, polychlorinated biphenyls and non-Hodgkins lymphoma.

Effects of dioxins and furans

In 2005 the World Health Organisation re-evaluated toxicity equivalency factors (TEFs) for dioxins and dioxin-like compounds. In November, 2007, Vrioni and Deves published a review on the known human health effects following exposure to chlorinated chemical compounds including PCDDs, PCDFs, PCBs and organochloride insecticides. The authors describe how these compounds exhibit a high level of physical and chemical stability along with low biodegradability, which explains why they accumulate, selectively, in human adipose tissue.

In summary, the authors conclude: “*Chlorinated compounds have been shown to be a risk factor for various clinical manifestations, especially cancer*”. The World Health Organisation has proposed that the average intake of dioxin and dioxin-like PCBs should be lower than the weekly statutable tolerable intake (TWI=14rgWHO-TEQ/kg bw).

Recent evidence (February, 2008) points to a relationship between dioxins and abnormal pubertal development. Schroeters et al. discuss how “*epidemiological studies have investigated the relationship between pubertal development and exposure to endocrine-disrupting chemicals (polychlorinated biphenyls, polybrominated biphenyls, 1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane, phthalate esters, furans and the pesticide endosulphan)*”: associations with both perinatal and postnatal exposure have been reported.

In January, 2007 Wigle et al. produced a major literature review published in the Journal of Toxicology and Environmental Health. The review demonstrated very clear links between landfill, landfill chemicals and adverse child health. The study summarised the knowledge of associations between child health and development outcomes and environmental exposures, including lead, methyl mercury, polychlorinated biphenyls, dioxins and related polyhalogenated aromatic hydrocarbons, certain pesticides, environmental tobacco smoke, aeroallergens, ambient air toxicants (especially particulate matter and ozone), chlorination disinfection by-products, sunlight, power frequency magnetic fields, radiofrequency radiation, residential proximity to hazardous waste disposal sites and solvents. The authors comment “*The adverse effects linked to such exposures include fetal death, birth defects, being small for gestational age, preterm birth, clinically overt cognitive, neurologic, and behavioural abnormalities, subtle neuropsychologic deficits, childhood cancer, asthma, other respiratory disease and acute poisoning*”.

In August 2007, Turyk et al. published a detailed study of the effects of PCBs and PCDDs. The authors found inverse associations of total thyroxine with dioxin-like toxic equivalents (TEQs) in both sexes, with stronger associations in females. In women mean thyroxine was 8.2 mg/dL, and levels were 0.75 mg/dL lower (95% CI, 0.04-1.46) in women in the highest quintile of TEQ exposure compared with the lowest two quintiles. The effects were stronger in those over 60 years of age, with negative associations of thyroxine with PCBs and TEQs, and positive associations of thyroxine stimulating hormone (TSH) with PCBs and TEQs in older women and a negative association with PCBs in older men. The authors conclude that “*the results suggest that older adults, who have a high risk of thyroid disease, may be more at risk*”.

for disruption of thyroid hormone homeostasis by dioxin-like organochlorides than younger adults”.

A mechanism whereby PCBs and other dioxin-like compounds may affect pre-natal, neonatal and child development has been proposed in December, 2007 by Maervoet et al. who demonstrated a statistically significant inverse relationship between concentrations of organochlorine compounds and levels of both free tri-iodothyronine and free thyroxine. The authors conclude that *“our results suggest that environmental chemicals may affect the thyroid system of human neonates.....the observed interferences may still have detrimental effects on the neurologic development of the individual children, given the importance of thyroid hormones in brain development.”*

Further evidence has recently emerged which strongly supports the previously documented link between landfill chemicals and diabetes mellitus as documented in our previous report. This is further corroborated by Wang et al. (2008) who demonstrated that women in the Yucheng Cohort (accidental exposure to dioxins in Taiwan during late 1970's) who had endured previous exposure to PCBs and PCDFs, suffered from increased instances of diabetes, particularly those who had retained significant levels of pollutants as evident from chloracne (another marker of dioxin exposure).

In September, 2007, Lee et al. reported the follow-up study to their previous work which had demonstrated an association between persistent organic pollutants (POPs) with both prevalence of type 2 diabetes and insulin resistance in a US population with background exposure to POPs. In the 2007 study the authors investigated the relationship between POPs and the metabolic syndrome, a pre-diabetic state. A large cross-sectional population study demonstrated the association between POPs and metabolic syndrome with organochlorides being most strongly and consistently associated with metabolic syndrome: adjusted odds ratios of 1.0, 1.5, 2.3 and 5.3 across quartiles.

In May, 2008, Tsukimori et al. published the results of their study into the long-term effects of polychlorinated biphenyls and dioxins on pregnancy outcomes in women affected by the Yusho incident in which in 1968 rice oil was contaminated with PCBs and other dioxin-like compounds. The authors determined that there was a major link between exposure to PCBs and other dioxin-like compounds and induced abortion and pre-term delivery: In pregnancy years 1968-1977 (within 10 years after exposure), the proportions of induced abortion [odds ratio adjusted for age at delivery (OR(adj)) = 5.93; 95% confidence interval (CI), 2.21-15.91; two-tailed p < 0.001] and preterm delivery (OR(adj) = 5.70; 95% CI, 1.17-27.79; p = 0.03) were significantly increased compared with the proportions in previous years 1958-1967 (10 years before the incident). Spontaneous abortion (ORadj) = 2.09; 95% CI, 0.84-5.18; p=0.11), and pregnancy loss (OR(adj) = 2.11; 95% CI, 0.92-4.87; p = 0.08) were more frequent.

In 1999, in Belgium PCBs and dioxins accidentally contaminated animal feed and entered the food chain. In 2008, Covaci et al. published an overview of the incident and comment that *“neurotoxic and behavioural effects in neonates, together with an increase in the number of cancers, may be observed”.*

As Rock Common is sited on a major aquifer, there is substantial risk of leachate escape with potential for long lasting contamination of both soil and water and entry of dioxins and dioxin-like compounds into the food chain.

Conclusion

Over recent years, there has been a substantial advance in our knowledge of the health effects associated with landfill. It has been established that both leachate and gas flares at landfill sites contain toxic compounds especially dioxins and related compounds as well as heavy metals; the causative mechanism, whether through leachate escape into soil or water, whereby illness may be caused has also been established. Rock Common is sited on a major aquifer system, and in consequence, given the size of the proposed landfill site and its duration of operation, any breach in the containment system could potentially carry catastrophic consequences for the health of neighbouring communities (which, contrary to the impression given in Veolia's Regulation 19 Response, includes a primary school just 300 metres from the proposed landfill site).

With this information to hand and having been appraised of the emergence of substantial new evidence pertaining to the health hazards associated with landfill, any failure on West Sussex County Council's part to take fully into account the potential for a major public health problem as a result of permission being granted for landfill at Rock Common, could leave the Council with financial and criminal corporate liability for any foreseeable consequences in terms of ill-health of neighbouring communities.

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