RPS

Lostock Sustainable Energy Plant

Health Impact Assessment

February 2010

Brunner Mond

E.ON Energy from Waste

Brunner Mond & E.ON Energy from Waste UK Limited

Health Impact Assessment of the proposed Sustainable Energy Plant

Final

February 2010

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1 Introduction

Background

1.1 Brunner Mond in partnership with E.ON Energy from Waste UK Limited proposes to develop a Sustainable Energy Plant (hence referred to as an SEP) at the former Lostock Power Station. The proposed SEP will use pre-treated Municipal Solid Waste (MSW), Industrial and Commercial Waste (C&I) and Solid Recovered Fuel (SRF) as a fuel source to supplement the existing facilities' high annual energy consumption of approximately 2.5TWh thermal energy (heat) and 0.2 TWh of electricity. Although not a legal requirement, in keeping with best practice, a Health Impact Assessment (HIA) has been commissioned to further investigate potential health risks, to address community concerns and to develop a Health Management Plan (HMP) geared to further manage potential health risks and maximise the uptake of health benefits.

1.2 The remainder of this section presents the approach, scope and focus of the HIA.

Health Impact Assessment

1.3 HIA is a multidisciplinary process designed to identify and assess the potential health effects (both adverse and beneficial) of a proposed project, plan or programme and to deliver evidence based recommendations that maximise health gains; and reduce or remove potential negative impacts or inequalities.

1.4 Although not a statutory requirement to the planning process, HIA can be a useful mechanism by which health risks are further assessed to inform the decision making process, and has proven valuable in addressing and alleviating community health concerns.

Aim and Objectives

1.5 The core objectives of the study include:

- to provide an assessment of the potential magnitude, distribution and significance of potential health outcomes (both adverse and beneficial) directly attributed to the proposed development;
- to further investigate and address community perceived risks and providing evidence based information to help alleviate community health concerns; and

- to provide evidence based recommendations to further reduce or remove those identified negative impacts or inequalities, and to facilitate potential health gains through a Health Management Plan.

Approach

1.6 The basis of the HIA is in accordance with UK guidance (Kemm 2007) is set on a broad socio-economic model of health that encompasses conventional health impacts such as communicable disease, accidents and risk along with wider determinants of health vital to achieving good health and well-being. A key aspect of RPS's approach is to build upon the technical information provided within the Environmental Statement (ES). Such an approach ensures the accuracy of the HIA, consistency with the regulatory required ES and provides a solid basis to the assessment.

Methodology

1.7 Although guidance and a generic HIA process exists, the methods employed in HIA are often tailored to meet the particular assessment requirements of a project. As set out below, the HIA will comprise five key stages including: 1) a project profile; 2) a community profile; 3) stakeholder engagement; 4) assessment and 5) a Health Management Plan.

Project Profile

1.8 The purpose of the project profile is to identify those relevant features associated with the proposed SEP that are potential influences on key determinants of health. The profile has been compiled through a review of project specific and more generic information including:

- the construction and operational project description developed as part of the planning application;
- the Environmental Statement (ES) and associated technical appendices (air quality, noise, traffic, socio-economic etc);
- consultation with the client and EIA project team (including the community consultation team); and
- through a health and waste management literature review (available in Appendix A).

1.9 By developing the project profile it is possible to list potential causal pathways, to aid in refining the development of an appropriate evidence base, to support the development of a meaningful community profile and to focus the core issues to be assessed.

1.10 In addition to known environmental health pathways, the outputs from stakeholder engagement gathered as part of the EIA process have been applied to identify and address wider health concerns within the assessment.

Community Profile

1.11 Evidence suggests that different communities have varying susceptibilities to health impacts and benefits as a result of social and demographic structure, behaviour and relative economic circumstance. A community profile therefore not only forms the basis to exposure response modelling but also allows an insight as to how potential health pathways identified by the project profile might act disproportionately upon certain communities and sensitive receptors.

1.12 In this case, the community profile makes use of available small area demographic and socio-economic statistics taken from National Statistics supported by health and hospital admissions data available from the Public Health Observatory and the Primary Care Trust (PCT) annual public health report.

Stakeholder Engagement

1.13 An important component of gathering an appropriate evidence base and tailoring the HIA to local circumstance is seeking the views of stakeholders and key representatives of communities likely to be affected. By highlighting and responding to community concerns the HIA can be applied to address perceived as well as actual risks and develop more effective recommendations to reduce impacts and increase health improvement.

1.14 In this instance, a tiered approach has been applied to gather a range of key stakeholder and community input, including:

- EIA Scoping Exercise: This stage provides high-level input from key stakeholders responsible for protecting the health and wellbeing of local communities. By cataloguing their key health issues it has been possible to refine the focus of the assessment; and
- EIA Consultation: the HIA has utilised the outputs of the EIA consultation programme to provide a means to catalogue local community concerns and further refine the focus of the HIA to address local community concerns.

1.15 Such a tiered approach provides a means to investigate and address a range of community concerns within the HIA, to focus key issues with community and health stakeholders, and further informs the development of a bespoke Health Management Plan tailored to local requirements and circumstance.

Assessment

1.16 The assessment stage draws upon appropriate technical topic areas within the EIA to ensure the HIA is based upon realistic changes in environmental conditions directly attributable to the proposed development. The assessment stage has sought to address each of the core health pathways identified during the project profile and where possible, apply internationally recognised quantitative assessment methods to establish the distribution, significance and likelihood of worst-case potential health outcomes, including:

- quantitative exposure response modelling for changes in PM_{10}, $PM_{2.5}$ and NO_2 exposure during construction and operation (applying the UK Department of Health's Committee on the Medical Effects of Air Pollutants (COMEAP) methodology) to quantify potential changes in life expectancy and local cardiovascular and respiratory hospital admissions);
- qualitative appraisal of the potential health risk from the ingestion of trace, heavy metals and dioxin/furans (building upon the quantitative outputs of the Human Health Risk Assessment in the Air Quality Section);
- quantitative risk assessment from changes in construction and operational road traffic movements and subsequent risk of collisions directly attributed to the proposed development;
- qualitative appraisal as to community disruption from odour impacts (drawing from the technical outputs of the ES);
- qualitative appraisal as to community disruption and potential health outcome from changes in construction and operational noise (drawing from the detailed noise assessment of the ES)
- qualitative appraisal as to the socio-economical health benefits from direct, indirect and induced income and employment opportunities (drawing from the socio-economic section of the ES); and
- qualitative appraisal as to potential impact upon house value.

1.17 In so doing, the HIA has been applied to test the current UK Health Protection Position Paper on Municipal Waste Incineration (UK HPA 2009) and to establish the relative risk to local communities during the construction and operation of the proposed SEP.

Health Management Plan

1.18 A Health Management Plan (HMP) expands upon the normal recommendations section within HIA guidance, establishing recommended protocols and monitoring regimes to be implemented during construction and operation to further reduce and remove potential negative health impacts while maximising opportunities to increase health benefits.

1.19 The target audience for the HMP includes the applicants and contractors commissioned for the construction and operation of the proposed development. Additional recommendations are geared towards the PCT and Local Authority to aid in maximising health benefit uptake in local communities.

2 Project Profile

Introduction

2.1 The following section provides a brief description of the core activities associated with the construction and operation of the proposed SEP and screens potential health pathways to be investigated in greater detail within the assessment stage.

Health Pathways

2.2 A health pathway can be described as the way in which an activity influences a known determinant of health. As an example of how the health pathway concept is applied, construction activities are known to influence environmental determinants of health including air, noise and traffic. A health pathway is identified when such influences have the opportunity to impact on communities with the potential to cause a response or health effect.

2.3 Identification of potential health pathways helps to define the scope of study, from which it is possible to develop a suitable evidence base and a more informed community profile. The distribution, magnitude and significance of the health pathway are then investigated within the assessment stage.

2.4 It is important to note that the potential health pathways identified do not at this point take into account facility design features or construction, operation or traffic management plans designed to remove or reduce potential influences.

Project Overview

Brunner Mond

2.5 The original Brunner Mond & Company was formed in 1873 when John Brunner and Ludwig Mond built Winnington Works at Northwich, Cheshire and produced their first soda ash in 1874. The company grew steadily over the next 50 years and in 1924 acquired the Magadi Soda Company of Kenya. In 1926 Brunner Mond merged with three other British chemical companies to form Imperial Chemical Industries (ICI), a venture that grew to become one of the UK's largest and most successful companies. In 1991 Brunner Mond Holdings Limited was formed by the acquisition of the UK and Kenyan soda ash businesses from ICI and the heart of the original Brunner Mond was re-created as an independent company. This group was listed on the London Stock Exchange as Brunner Mond plc in 1996 and has since returned to private company status as Brunner Mond Group Limited.

2.6 Today Brunner Mond is wholly owned by Tata Chemicals Limited, and is the second largest producer of soda ash in the world supplying products essential in the manufacture of a wide range of staple and specialist goods to more than 500 customers in 60 countries. Sodium Carbonate (soda ash) is the company's primary product. 1.6m tonnes are produced by the Group each year of which approximately 1million tonnes are produced from Cheshire employing more than 500 people, and is the UK's sole manufacturer of soda ash and sodium bicarbonate.

Proposed Development

2.7 The soda ash manufacturing process is highly energy intensive, with an annual consumption of approximately 2.5 TWh thermal energy (heat) and 0.2 TWh of electricity. Steam and electricity required for the Brunner Mond process is currently generated by a purpose built gas fired combined heat and power plant (CHP) operated by E.ON. Although both Brunner Mond sites (Winnington and Lostock) are currently supplied with a local supply of steam and electricity from the most efficient gas-fired Combined Heat and Power (CHP) plant of its kind in the UK, the use of gas, a fossil fuel, is not sustainable in the long term and subject to increasing costs.

2.8 Brunner Mond has a significant, locationally specific, energy requirement as part of its role as the sole UK producer of sodium carbonate and associated products. The large heat demand of the production process operated in Winnington and Lostock means that a large scale energy recovery plant would provide a vital opportunity to sustain the business into the future.

2.9 The proposed SEP will have a total gross maximum electrical capacity of approximately 60 MWe and would be capable of producing up to 100 tonnes of steam per hour. The SEP will have a throughput of up to 600,000 tonnes of fuel feedstock per annum, comprising pre-treated Municipal Solid Waste (MSW), Industrial and Commercial Waste (C&I) and Solid Recovered Fuel (SRF).

2.10 In summary, the SEP will have the following features:

- electricity generation capacity of approximately 60MWe;
- steam generation capacity to Brunner Mond of up to 100 tonnes per hour depending on steam conditions;
- fuelled by pre-treated Municipal Solid Waste (MSW), Industrial and Commercial Waste (C&I) and Solid Recovered Fuel (SRF);
- on-site pipeline infrastructure for collection and distribution of steam;

- grid connection infrastructure for electricity export;
- an ash storage and handling facility; and
- ancillary development.

2.11 In so doing, the SEP would:

- provide approximately a third of Brunner Mond's energy needs from a sustainable fuel;
- help secure the future of the Brunner Mond business by lowering operational costs;
- reduce reliance upon gas supplies; and
- contribute to the reduction in greenhouse gases.

Site Location and Setting

2.12 The SEP will be located on land formerly occupied by Lostock Power Station, off Griffiths Road, Lostock, lying approximately 2 km to the east of the centre of Northwich. Land to the west of the former power station will be used to provide a rail connection, fuel reception and an ash treatment facility. The proposed application site occupies an area of approximately 9 hectares which includes for relocation of the coke storage area.

2.13 The site forms part of the larger industrial site occupied by a number of separate industrial operators including Solvay Ltd, Ineos Chlor, Organic Waste Management and SABIC. The site is bounded to the north by Brunner Mond's manufacturing facility and a brine purification plant owned by Ineos. Beyond this is the rail line. To the immediate west of the site is industrial land including the wider Lostock site and old waste disposal lagoons. The nearest residential receptors are located in close proximity to the southern boundary of the site. Access to the site will be via the A530, which connects to the M6.

Construction Activities

Construction Overview

2.14 The duration of the construction stage is estimated to be three and half years, and comprise:

- site clearance and enabling works;
- civil works (including piling); and
- plant erection and commissioning.

2.15 Construction activities will typically take place between 7am and 6pm Monday to Friday and 8am and 1pm on Saturdays, although there may be a need to work extended hours, including nighttime and weekends for periods during the critical construction phases such as concrete pouring. Where possible, noisy construction activities such as piling and the erection of steelwork would be undertaken only during normal construction working hours unless agreed in advance with the Local Authority.

2.16 During the peak of construction, traffic movements are indicated to include 60 two way (i.e. to and from the site) Heavy Good Vehicles (HGV) and 240 car movements per day.

Operational Activities

Operational Overview

2.17 Once operational, the SEP will operate 24 hours a day, 7 days a week. Fuel will be fed into the SEP on a continuous basis. Deliveries of fuel will be dependant on the availability of fuel from fuel suppliers (i.e. waste processing plants). The majority of fuel feedstock will be delivered to the SEP between Monday and Saturday. The SEP will have two lines to provide operational flexibility during shutdown and maintenance periods, allowing one line to be shut down whilst the remaining line continues to operate.

<u>Fuel Delivery and Reception</u>

2.18 The fuel feedstock will consist of pre-treated Municipal Solid Waste (MSW), Industrial and Commercial Waste (C&I) and Solid Recovered Fuel (SRF). All fuel feedstock will be delivered pre-treated to the plant by bulk road or rail transport. No processing of waste fuel stock will take place on site.

2.19 As detailed in the ES, two fuel delivery scenarios have been assessed, including a likely scenario (where two thirds of waste is imported by rail and the remaining one third by road) and worst case scenario (where all waste is imported by road).

2.20 The Likely Scenario is estimated to generate between 1-2 trains per day, and approximately 120 two-way HGV movements per day. In contrast, the Worst Case Scenario, assuming that no waste is transported by rail and therefore all waste is imported by road will generate approximately 264 two-way HGV movements per day to the site.

2.21 All delivery vehicles will pass over a weighbridge prior to accessing the plant tipping hall where the storage bunker will be located. Both process lines will be served by the storage bunker. The storage bunker and tipping floor will be enclosed within the main building. Measures will be in place to minimise the escape of odour from this building.

Combustion Technology

2.22 Two grab cranes will feed fuel stock into the combustion units through a feed chute, which exits onto the combustion grate. The combustion grate is designed to ensure efficient combustion of the fuel whilst minimising the creation of air pollutants. The grate will consist of a series of stepped horizontal moving bars, which move alternately to mix and move the fuel stock across the combustion chamber. At the end of the combustion grate, only inert or incombustible material (known as bottom ash) will remain. Bottom ash is cooled in a water bath, and ferrous metals removed using electromagnetic separation.

2.23 The heat released from the combustion process is recovered in the water tube boiler to produce superheated steam, which would be passed to a condensing turbine and linked air cooled condenser. Brunner Mond intend to use steam from the turbine in its industrial process.

Power Generation

2.24 The proposed SEP is designed to store sufficient fuel to allow a continuous feed of fuel outside of peak waste acceptance hours. Energy recovery activities will be carried out entirely within the enclosed facility.

Ash Storage and Treatment

2.25 The residues from the combustion process are anticipated to comprise:

- Bottom ash: approximately 120,000 tonnes per annum;
- Fly ash and flue gas treatment residues: approximately 30,000 tonnes per annum.

2.26 Approximately 20% of fuel burnt will be converted to bottom ash. It is likely that following processing and treatment, the bottom ash will be reused as an aggregate.

2.27 The flue gas treatment process will meet the requirements of the EC Waste Incineration Directive (2000/76/EC) and will be treated using sodium bicarbonate as the air pollution control (APC) reagent (sourced from Brunner Mond at Lostock). FGT residues are classified as hazardous as they contain substances including heavy metals and dioxins. These FGT residues will be removed from site via a vacuum tanker or intermediate bulk containers for disposal at a suitably licensed landfill facility or for use by the chemical industry as a neutralising agent for the treatment of acidic wastes.

Grid Connection

2.28 The SEP will require connection to the National Grid. At the current time, the grid connection point is yet to be confirmed. Discussions with Scottish Power have confirmed that the grid connection would be via underground cables connecting to the local Scottish Power network in the vicinity of the Lostock Site. For the purposes of the HIA, an indicative grid connection route has been assessed. This would provide a connection route alongside the A350 and beneath the cycle path adjacent to the A556 to the existing Hartford substation. This represents a worst case scenario. Alternative connection points have been discussed with Scottish Power and it may be feasible to connect considerably closer to the site (and therefore with reduced environmental impact).

Relocated Coke Store

2.29 There is an existing coke store on site. This will be relocated on site to north of the SEP and the area used for an open coke store.

Operational Employment Opportunities

2.30 The SEP will employ approximately 50 full-time employees comprising operator shift staff, maintenance employees, weighbridge operators, clerical and administrative staff and plant management. The plant will have 4 shift teams. During planned shutdown periods there will be approximately 100 contractors employed.

Tailoring the HIA Scope to the Project Profile

2.31 Table 2.1 provides a summary of the potential health pathways associated with the proposed SEP and represents the scope of health topics to be addressed as part of the HIA

Table 2.1: Project Profile Summary and HIA Scope

Feature	Health Pathway	Health Determinant	Potential Implication	Distribution
Construction period	Changes to local air quality (and potential dust nuisance)	Environment	Adverse	Local
	Change in noise exposure	Environment	Adverse	Local
	Increase in construction vehicles on local roads	Environment	Adverse	Local
	Direct, indirect and	Socio-Economic	Beneficial	Local /

Feature	Health Pathway	Health Determinant	Potential Implication	Distribution
	induced employment and income opportunities			Regional
Operation	Potential changes to air quality	Environment	Adverse	Local
	Change in noise exposure	Environment	Adverse	Local
	Increase in number of vehicle movements	Environment	Adverse	Local
	Increased direct, indirect and induced employment and income opportunities	Socio-Economic	Beneficial	Local
	Reduced operational costs with direct and indirect job protection	Socio-Economic	Beneficial	Local / Regional

2.32 Based on the project profile set out below and the potential health pathways summarised in Table 2.1, the assessment will be applied to test the current UK Health Protection Position Paper on Municipal Waste Incineration (UK HPA 2009) and concentrate on investigating:

- potential exposure and health response to emissions (air and noise) from the proposed SEP;
- potential exposure and health response from changes in road traffic emissions;
- potential change in health risk from road traffic movements (i.e. road traffic collision);
- potential noise effect from changes in road and rail traffic movements; and
- socio-economic benefits from employment opportunities and retention of employment.

2.33 The net environmental and health benefits associated with the reduced volume of waste sent to landfill as a consequence of the SEP, the subsequent landfill methane emission offset (a potent green house emission) and the reduction in associated waste vehicle trips will not be assessed within the HIA.

3 Community Profile

Introduction

3.1 Evidence suggests that different communities express varying sensitivity to health effects (both adverse and beneficial) as a consequence of relative socio-economic status, deprivation and existing health burden. A community profile not only provides a means to establish changes in community exposure to certain health pathways, but also provides a means to further interpret the distribution and significance of effect.

3.2 For the purpose of this study, the community profile provides a local level profile of communities near the proposed SEP and expands to a regional overview where appropriate.

Site Location and Setting

3.3 The proposed SEP will be located on land at the former Lostock Power Station site, approximately 2 km east of the centre of Northwich within the Northwich Witton Ward and more specifically in the Vale Royal 006C Super Output Area (SOA). The proposed development comprises an area of 9 hectares and is largely surrounded by industrial land including the Brunner Mond manufacturing facility and brine purification plant owned by Ineos Chlor to the north. The nearest residential receptors are located approximately 500 metres south-west of the site, adjacent to the Rudheath area of Northwich.

3.4 The Vale Royal 006C SOA is located within the administrative boundaries of Cheshire West & Chester Unitary Authority (having previously fallen within the administrative boundaries of the Vale Royal Borough prior to local re-organisation in Spring 2009). As such, where available, more recent information for Cheshire West & Chester has been used to supplement information given for the former Vale Royal Non-Metropolitan District to interpret local population and health trends. Please note that changes in administrative boundaries have not influenced the data applied at the SOA level.

Local Demography

Population Density

3.5 In mid 2008, the Vale Royal 006C SOA had an estimated population of 1,695 residents and an average population density of 10.22 people per hectare (PPH) (ONS, 2007) which is lower than the Northwich Witton ward of 16.7 PPH.

3.6 According to mid-year estimates, between 2001 and 2008, the population of the Northwich Witton ward displayed a population increase of 4.5% that although consistent with the national trend of 4%, is higher than the Cheshire West and Chester authority and the North West region trends (a respective increase of 2% and 1.5% respectively since 2001).

Age Structure

3.7 The resident community within the Vale Royal 006C SOA comprises a relatively consistent age structure for each of the ten year age bands (0-70+). However, population forecasts available from Cheshire West and Chester Council suggest that the age structure will follow the national trend in the area comprising an increasing proportion of older people.

General Health

3.8 The health of people in Cheshire West & Chester is generally better, or similar to the England average with lower rates of all cause mortality, lower mortality from heart disease, stroke and similar trends of life expectancy (DoH, 2009).

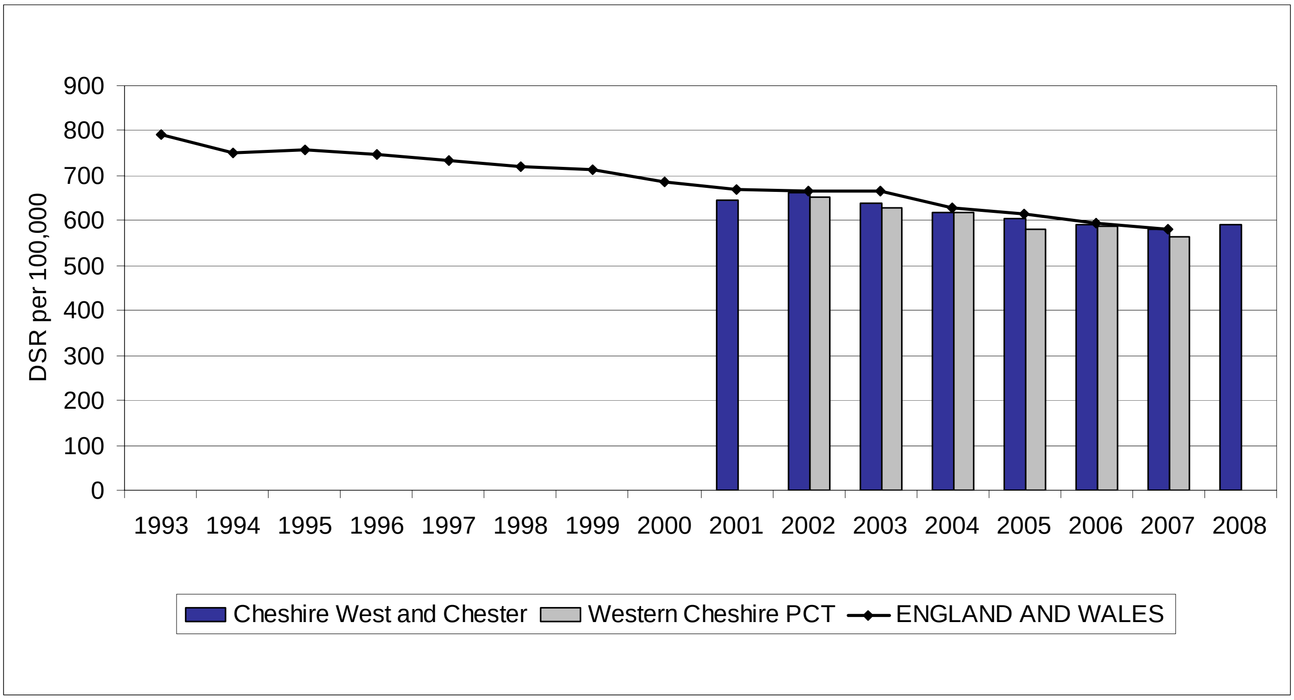
Life Expectancy

3.9 In Cheshire West & Chester, the average life expectancy for males is 77.9 years and 81.7 years for females, which are consistent with average life expectancy for England and higher than the North West average.

All Cause Mortality Rates

3.10 As shown in Figure 3.1, in line with national trends, between 2002-2007 the Cheshire West & Chester area has experienced a decrease in the directly age standardised rate (per 100,000 population) of all age all cause mortality.

Figure 3.1: Mortality from all causes, person all ages – Directly age standardised rate per 100,000 population



3.11 However, as shown below, such trends are not uniform throughout the area, with the most deprived areas in Cheshire exhibiting significantly higher age standardised mortality rates compared to the most affluent areas. Cardiovascular disease and cancers are the greatest causes of early death in the area and are again linked to areas experiencing socio-economic inequality.

Table 3.1: Directly Age Standardised Mortality Rates

Geographical area	Directly age standardised rates (DSR) per 100,000 people
England and Wales	597.0
Cheshire West and Chester	592.4
Index of Multiple Deprivation 2007 National Quintiles	
Most deprived in Cheshire West and Chester	831.3
Quintile 2	709.5
Quintile 3	589.1
Quintile 4	577.1
Least Deprived	470.0

Socio-Economic Status and Relative Deprivation

3.12 Employment and income influence a range of factors including access to housing, education, diet, lifestyle, services and social networks. These in turn are key determinants for a range of physical and mental health impacts and ultimately health and well-being. Unemployment, poverty and inequality are strongly associated with illness and premature death (Beland, 2002); (Stafford, 2004); (van Lenthe 2005).

Industry of Employment

3.13 The area has been an industrial area for over a century, with manufacturing still being a key industry of employment for the area. Manufacturing has undergone a continued decline in recent years both on a local scale and nationally. However, the local area still exhibits a higher proportion of its population in the manufacturing industry (18.7%) when compared to the regional and national trends (16.8% and 14.8% respectively) (ONS, 2004). In addition to manufacturing, other key industries of employment include, wholesale and retail trade, repairs; and real estate, renting and business activities.

Occupation

3.14 There have been changes in the types of occupation in the Vale Royal SOA with a significant reduction in the manual occupations between 2002 to 2009, signifying a shift from more traditional industrial employment to an increased proportion of the local population being in professional occupations (Nomis, 2009).

Unemployment

3.15 Unemployment data is not available at the SOA level. As shown in Table 3.2, between July 2008 to June 2009, Cheshire West & Chester exhibited a lower unemployment rate than the national unemployment rate of 7.1%. The unemployment rate in Cheshire West & Chester and the former Vale Royal non-metropolitan borough has consistently been lower than both the North West region and England.

Table 3.2: Employment and Unemployment (July 2008-June 2009)

	Cheshire West & Chester	North West	England
Economically active (percentage of working age population)	82.8	76.8	79.0
Percentage of population in employment	76.5	70.8	73.4

	Cheshire West & Chester	North West	England
Percentage of employees	68.9	62.4	63.7
Percentage of population self employed	7.4	8.0	9.3
Percentage of the population of working age unemployed	6.3	7.6	7.1

(Nomis, 2009)

Deprivation

3.16 The Index of Multiple Deprivation (IMD) 2007 provides an overall summary indicator of deprivation, taking into account employment, education, proximity to services, living environment, crime and disorder and the existing burden of poor health. When compared nationally, the former Vale Royal Local Authority achieved a mid-range ranking of 196 of 354 local authorities nationally (i.e. not exhibiting significant levels of deprivation or relative affluence). Please note that data from the IMD for Cheshire West and Chester Unitary Authority formed in 2009 is currently not available.

3.17 At the sub ward level, Vale Royal 006C SOA was ranked in the mid range of SOAs nationally and given an overall IMD rank of 11,727 of 32,482 SOA. Although such a score does not highlight any significant pockets of community deprivation, it does represent a slight deterioration compared to the previous ranking given for the IMD 2004.

Lifestyle

3.18 Differences in lifestyle choices made by a population are typically influenced by education, employment and socio-economic background. It is also acknowledged that these differences in lifestyle significantly influence health inequalities experienced by a community. Due to recent changes in the local authority boundaries, lifestyle indicator data is not available at the ward level, and as such, data from Central and Eastern Cheshire Primary Care Trust (CECPCT) have been applied. Communities throughout Cheshire West and Chester generally exhibit lifestyles in keeping or better than the national average, including average rates of smoking, healthy eating, drugs misuse and lower rates of teenage pregnancy (under 18) and crime (DoH, 2009). A number of these lifestyle indicators are discussed further below.

Alcohol Consumption

3.19 Levels of drinking considered harmful or hazardous to health are increasing nationally. The prevalence of binge drinking in CECPCT is higher (21.4%) than the national average (18%). This has also led to a 50% increase in the number of alcohol related hospital admissions in the CECPCT between 2002 to 2007 (CECPCT, 2009). There is no information available relating to alcohol use at the local ward level.

Smoking

3.20 Smoking is responsible for one-sixth of all deaths in the UK, and kills half of all those who smoke. Smoking remains the greatest preventable cause of morbidity and early death. Levels of smoking in Cheshire West and Chester UA as a whole are marginally lower than the England average, with 20.1% of the adult population smoking compared to 21.0% nationally.

3.21 Similar to national trends, statistics demonstrate a correlation between higher smoking rates in areas identified as deprived compared to more affluent areas in Cheshire West and Chester. There is no information available relating to smoking at the local ward level.

Crime and Anti-Social Behaviour

3.22 Statistics available indicate that violent crime rates (against a person) in 2007/08 was lower in Cheshire West & Chester (15.7 per 1,000 population) than the average for England (17.6 per 1,000 population) (DoH, 2009).

Community Profile Summary

3.23 The proposed SEP is to be located in a sparsely populated area of the Northwich Witton Ward that is largely industrial in nature. National and Northwest Public Health Observatory Statistics indicate resident communities to exhibit a relatively consistent age structure, with health, employment and levels of education generally better than, or similar to the national trend.

3.24 On the basis of the forgoing review of local population, health and socio-economic statistics, local communities are not considered to exhibit any heightened sensitivity/susceptibility to the key health pathways associated with the construction and operation of the proposed SEP.

4 Assessment

Introduction

4.1 The following assessment section separates the core health pathways to be investigated under the three categories of: 1) environment; 2) transport and 3) socio-economic. Where appropriate, each sub-section will include both construction and operational activities.

Environment

Emissions to Air

Construction

4.2 Construction of the proposed SEP is likely to give rise to local-level emissions to air including dust and exhaust fumes from construction traffic and machinery. However, dust and exhaust emissions from construction activities are typically of a low order, temporary, intermittent and are at a suitable distance from resident communities to have no measurable health outcome.

4.3 During the peak construction period, construction traffic is indicated to comprise a maximum of 60 two way (i.e. in and out of the site) HGV and 240 car movements. As detailed in the ES, construction movements and associated combustion-related emissions are not considered to be significant. The HMP will contribute towards the further refinement of site mitigation to address the key issues raised during stakeholder engagement (including dust, noise, construction traffic, mobilisation of contaminants etc).

Operation

4.4 The core health pathway and community concern associated with the operation of the proposed SEP is the generation of known emissions to air and subsequent community exposure. Research into the potential health effects of emissions is extensive and provides statistically significant associations between many classical air pollutants (e.g. Particulate Matter, Nitrogen Dioxide and Sulphur Dioxide) and effects on a wide range of cardiovascular and respiratory health outcomes.

4.5 As with any combustion process, the main products of combustion are CO_2 and H_2O owing to the nature of the fuel. However, there are a series of trace compounds that may be emitted in gaseous or solid form, including NO_x, CO and PM, SO_2, HCL and HF, NH_3, VOC's and HC and metals (many of which can be controlled by removal from the fuel).

4.6 The SEP is required to operate under the Waste Incineration Directive (WID) and its Environmental Permit using the Best Available Techniques (BAT), and a detailed description of controls is provided in the Air Quality and Project Description sections of the ES, but in summary this comprises combustion control (primary and secondary injection, grate and fuel feed), NO_x control, boiler design and heat transfer, acid gas control, injection of activated carbon and PM filtration.

4.7 In accordance with convention, the modelling of emissions carried out as part of the air quality assessment in the ES and HHRA uses conservative assumptions for assessing compliance with limit thresholds set to protect environment and health. Using this precautionary approach, the worst-case impacts of SEP emissions are all predicted to be significantly below the relevant thresholds and are not of a level to constitute any meaningful risk to health. Such a conclusion is further investigated in the following sub-sections.

Particulate Matter (PM_{10})

4.8 Using the aforementioned conservative assumptions in the ES, including a stack height of 90 m, and assuming the SEP operates at the WID emission limit (i.e. the maximum emission limit permitted) the proposed SEP is calculated to contribute a maximum of 0.2 μgm^{-3} (where μgm^{-3} = a millionth of a gram per metre cubed) of PM_{10} to the annual mean concentration (i.e. the maximum contribution to background at any modelled point).

4.9 As shown in Figure 4.1 and Table 4.1, the results of dispersion modelling from the ES have been used to quantify the relative change in population exposure at the Super Output Area (SOA). This indicates that community concentration exposure will be far lower than the aforementioned outputs of the ES, with the majority of individuals subject to a change in background concentrations typically falling within the range of 0.035 to 0.085 μgm^{-3} of PM_{10} annually

4.10 Applying the available evidence base (DoH 2007, DoH 2009, EC 2001, WHO 2000), such changes in concentration exposure are not of an order to quantify any meaningful change in health effect. This is based on the exposure response coefficients developed by the UK Department of Health's Committee on the Medical Effects of Air Pollutants (COMEAP) that established there is a 0.75% increased risk in the background rate of all cause mortality per 10 $\mu g.m^{-3}$ increase in PM_{10} per 100,000 individuals exposed (DoH 2007). As shown in Figure 4.1 and Table 4.1, in this instance, both emission concentration and community exposure are orders of magnitude lower.

Figure 4.1: Particulate Matter Dispersion Modelling (PM_{10})

Table 4.1: Population Concentration Exposure to Particulate Matter

Population Exposure at the SOA Level		PM_{10} Concentration Exposure Range (μgm^{-3})							
		0.01 - 0.035	0.035 - 0.06	0.06 - 0.085	0.085 - 0.11	0.11 - 0.135	0.135 - 0.16	0.16 - 0.185	0.185 - 0.202
E01018598	Macclesfield 007A	0	45	0	0	0	0	0	0
E01018648	Macclesfield 007C	0	17	0	0	0	0	0	0
E01018704	Vale Royal 005A	0	467	305	79	26	29	18	3
E01018705	Vale Royal 005B	0	372	0	0	0	0	0	0
E01018706	Vale Royal 005C	0	141	113	91	129	1	0	0
E01018715	Vale Royal 006C	169	0	210	38	16	7	0	0
E01018718	Vale Royal 005D	92	0	0	0	0	0	0	0
E01018721	Vale Royal 002C	0	19	0	0	0	0	0	0
E01018722	Vale Royal 005E	5	61	1	1	1	1	1	0
Total population Exposure		266	1121	1387	208	172	380	19	3
Please note that this table presents the potential change in population emission concentration exposure directly attributable to the proposed development.									

4.11 On this basis, the worst-case potential change in PM_{10} concentration exposure directly attributed to the proposed SEP may result in approximately 1.2 to 3.7 seconds reduction in life expectancy per year when applying the average all cause mortality rate for Cheshire West and Chester, and 1.7 to 5.2 seconds reduction in life expectancy when assuming that the total population falls within the most socio-economic and health deprived quintile in Cheshire West and Chester.

4.12 Considering that such a calculation applied both the average and highest level of all cause mortality in Cheshire West and Chester (i.e. the most economic and health deprive quintile), and the highest concentration within each of the dispersion contours, it is concluded that the proposed SEP will not result in PM_{10} emissions of a level to result in any meaningful adverse health outcome.

4.13 The COMEAP has also established that there is a 0.8% increased risk in respiratory and cardiovascular hospital admissions per 10 $\mu g.m^{-3}$ increase in PM_{10} per 100,000 individuals exposed (DoH 2007).

4.14 However, the maximum PM_{10} process contribution of 0.2 $\mu gm^{-3}$is not of an order of magnitude to quantify any meaningful change in respiratory or cardiovascular hospital admissions. To clarify, applying the worst case maximum contribution of 0.2 μgm^{-3}, the proposed SEP might represent a potential 0.01% increase in the background respiratory and cardiovascular hospital admission rates per 100,000 people exposed. However, as shown in Table 4.1, only three people fall within this maximum process contribution contour.

4.15 On this basis, and as the proposed SEP PM_{10} contribution will remain significantly within Air Quality Standards set to protect health, it is concluded that the proposed SEP will not result in PM_{10} emissions of a level to result in any meaningful change in local cardiovascular or respiratory hospital admissions.

Particulate Matter ($PM_{2.5}$)

4.16 As detailed in Appendix A, there is typically significant community concern regarding potential exposure to $PM_{2.5}$ emissions from such facilities, where evidence suggests that increased exposure to $PM_{2.5}$ is potentially more hazardous to human health than larger particles (DoH 2009).

4.17 To aid in addressing such community concerns the following COMEAP assessment applies the following conservative assumption:

- all PM emissions are $PM_{2.5}$;

- applying the highest all cause mortality rate in Cheshire West and Chester (i.e. the most socio-economic and health deprived quintile) of 831.3 per 100,000 (approximately 40% higher than the Cheshire West and Chester trend of 592.4);
- applying the highest emission concentration within each of the dispersion contours; and
- applying the associated risk ratio recommended by the COMEAP of 6% increased mortality per 10 $\mu g.m^{-3}$ increase in exposure (DoH 2009).

4.18 On this basis, the worst-case potential change in $PM_{2.5}$ concentration exposure directly attributed to the proposed SEP may result in approximately 14 to 42 seconds reduction in life expectancy per year. Despite applying a highly conservative approach, similar to PM_{10}, such a change in emission concentration exposure is not of a level to quantify any meaningful change in life expectancy during the operational life span of the proposed SEP.

4.19 Although COMEAP recommends the application of the 6% risk ratio to quantify increased mortality per 10 $\mu g.m^{-3}$ increase in $PM_{2.5}$, there is some concern from interest groups that a higher risk ratio of 17% developed in the US should be applied. It is important to note that even when applying the higher risk ratio of the 17% and applying the previously discussed conservative approach, the proposed SEP may result in approximately 40 to 119 seconds reduction in life expectancy per year. As before, despite the highly conservative approach, this is not of a level to quantify any meaningful change in life expectancy during the life span of the proposed SEP.

Nitrogen Dioxide

4.20 As stated by COMEAP, there is currently insufficient evidence to attempt to quantify the possible but unproven effects of exposure to ambient concentrations of nitrogen dioxide on mortality (COMEAP 2009).

4.21 Although research indicates that a statistical relationship with NO_2 exists, doubt remains as to whether the associations represent a toxic effect of NO_2, per se, or whether they reflect a surrogate effect. Some epidemiological investigations have suggested that the reported associations between exposure to concentrations of NO_2 and health outcomes might be confounded by concentrations of particulate pollution. In addition, some epidemiological studies investigating the effects of particulate matter (PM) have shown that, in some geographic locations, the adverse effects of particulate pollution can be enhanced when concentrations of NO_2 are elevated, thus suggesting the possibility of effect-modification.

4.22 The inconsistencies in the evidence base on NO_2 have resulted in the tendency for many researchers and policy-makers to regard NO_2 as a surrogate of the pollution mixture emitted by combustion sources (primarily vehicular traffic). On the basis of the available evidence, COMEAP do not recommend any concentration-response function for NO_2 for use in health impact assessments. COMEAP do however provide a heavily caveated sensitivity calculation to quantify the effects of short-term exposure to NO_2 on respiratory hospital admissions, of which is performed below.

4.23 As shown in Figure 4.2 and Table 4.2, the results of dispersion modelling from the ES have been used to quantify the relative change in population exposure at the Super Output Area (SOA). This indicates that community concentration exposure to NO_2 will be far lower than the aforementioned outputs of the ES, with the majority of individuals subject to a change in background concentrations typically falling within the range of 0.31 to 1.21 μgm^{-3} of NO_2 annually.

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Figure 4.2: Nitrogen Dioxide Dispersion Modelling (μgm^{-3})

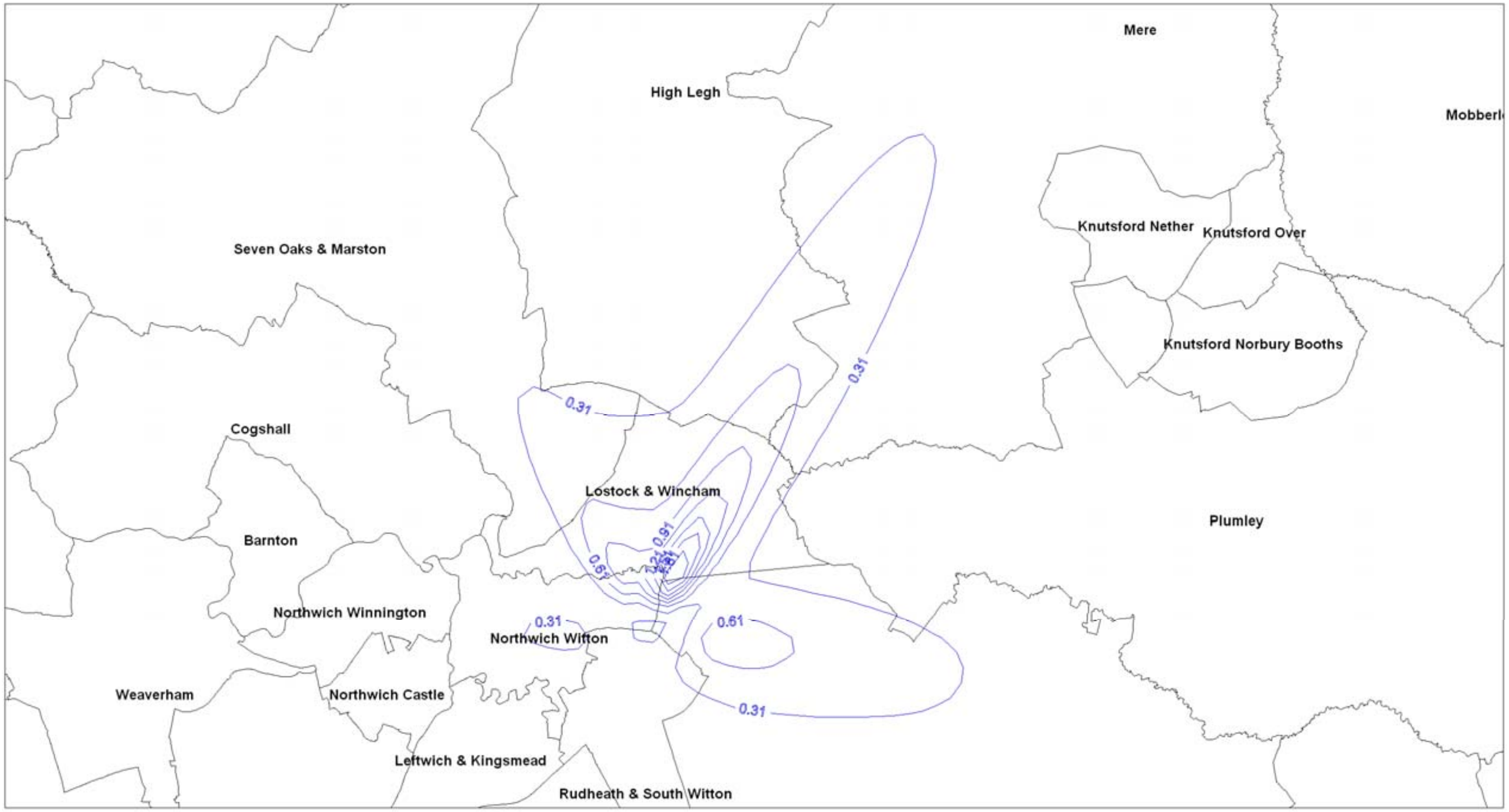


Table 4.2: Population Concentration Exposure to Nitrogen Dioxide

Population Exposure at the SOA Level		PM_{10} Concentration Exposure Range (μgm^{-3})						
		0.31 - 0.61	**0.61 - 0.91**	**0.91 – 1.21**	**1.21 – 1.51**	**1.51 – 1.81**	**1.81 – 2.11**	**2.11 – 2.79**
E01018598	Macclesfield 007A	77	18	0	0	0	0	0
E01018648	Macclesfield 007C	133	4	0	0	0	0	0
E01018654	Macclesfield 007G	6	0	0	0	0	0	0
E01018704	Vale Royal 005A	318	396	211	62	25	33	20
E01018705	Vale Royal 005B	1358	139	0	0	0	0	0
E01018706	Vale Royal 005C	254	113	101	120	95	4	0
E01018714	Vale Royal 006B	11	0	0	0	0	0	0
E01018715	Vale Royal 006C	293	97	89	37	17	5	0
E01018716	Vale Royal 009C	157	0	0	0	0	0	0
E01018717	Vale Royal 009D	238	0	0	0	0	0	0
E01018718	Vale Royal 005D	75	0	0	0	0	0	0
E01018721	Vale Royal 002C	124	0	0	0	0	0	0
E01018722	Vale Royal 005E	203	30	1	1	1	1	0
Total population Exposure		3247	796	402	221	138	43	20
Please note that this table presents the potential change in population emission concentration exposure directly attributable to the proposed development.								

4.24 Such a contribution is not of an order of magnitude to quantify any meaningful change in health outcome. To clarify, the COMEAP provides a risk coefficient of 0.5% per 10 $\mu g.m^{-3}$ increase for an effect on respiratory hospital admissions (for sensitivity analysis purposes only) (DoH 2007). Applying the maximum NO_2 process contribution at any modelled point (2.79 $\mu g.m^{-3}$) the proposed SEP represents a potential 0.13% increase in background respiratory hospital admission rates per 100,000 people exposed. However, as shown in Table 4.2, air dispersion modelling indicates that only 20 people will be exposed to this maximum annual process contribution. Annual NO_2 contributions are therefore not of a level to quantify any meaningful change in health outcome during the lifespan of the proposed SEP.

4.25 On this basis, and as the proposed SEP NO_2 contribution will remain significantly within Air Quality Standards set to protect health, it is concluded that potential changes in NO_2 community exposure will not be of a level to result in any measurable health outcome.

Sulphur Dioxide

4.26 Similar to NO_2, COMEAP concluded in their 2009 report that although some research indicates a positive and statistically significant association for sulphur dioxide and all-cause mortality, it is not possible to distinguish between a direct effect of sulphur dioxide and an apparent effect due to sulphur dioxide acting as a marker for broader combustion sources. For this reason, although COMEAP provided a risk coefficient in their 1998 report of 0.6% of a death brought forward per 10 $\mu g.m^{-3}$ increase in SO_2 (COMEAP 1998), they do not recommend quantifying the possible effects of sulphur dioxide directly (COMEAP 2009).

4.27 Instead, COMEAP recommends that the $PM_{2.5}$ coefficient should be applied irrespective of the relative contributions of sulphate, nitrate or any other component to the total. This is not to say that all components of $PM_{2.5}$ have the same toxicity – but that there is not, at present, evidence to quantify the effects of different components separately.

4.28 As previously shown in Section 4.16, applying the recommended COMEAP $PM_{2.5}$ risk coefficients and a highly conservative approach, maximum $PM_{2.5}$ process contributions are not of a level to quantify any meaningful change in life expectancy during the operational life span of the proposed SEP.

4.29 Furthermore, although COMEAP recommends the application of the 6% risk ratio to quantify increased mortality per 10 $\mu g.m^{-3}$ increase in $PM_{2.5}$, the HIA also applied the higher risk ratio developed in the US of 17% to quantify a worst case scenario (which includes risk from SO_2).

4.30 Even when applying the higher risk ratio, maximum $PM_{2.5}$ process contributions (including SO_2) are not of a level to quantify any meaningful change in life expectancy during the life span of the proposed SEP.

4.31 Although COMEAP do not recommend the direct quantification of health risk from changes in exposure to SO_2, it is understood that local communities require additional information to a address and alleviate their health concerns. On this basis, please see below for a high level calculation to ascertain the potential risk from changes in SO_2 exposure.

4.32 As shown in Figure 4.3 and Table 4.3, the results of dispersion modelling from the ES have been used to quantify the relative change in population exposure at the Super Output Area (SOA). This indicates that community concentration exposure to SO_2 will be far lower than the maximum process contribution of 1.01 $\mu g.m^{-3}$ reported in the ES, with the majority of individuals subject to a change in background concentrations typically falling within the range of 0.1 to 0.35 μgm^{-3} of SO_2 annually.

Figure 4.3: Sulphur Dioxide Dispersion Modelling (µgm^{-3})

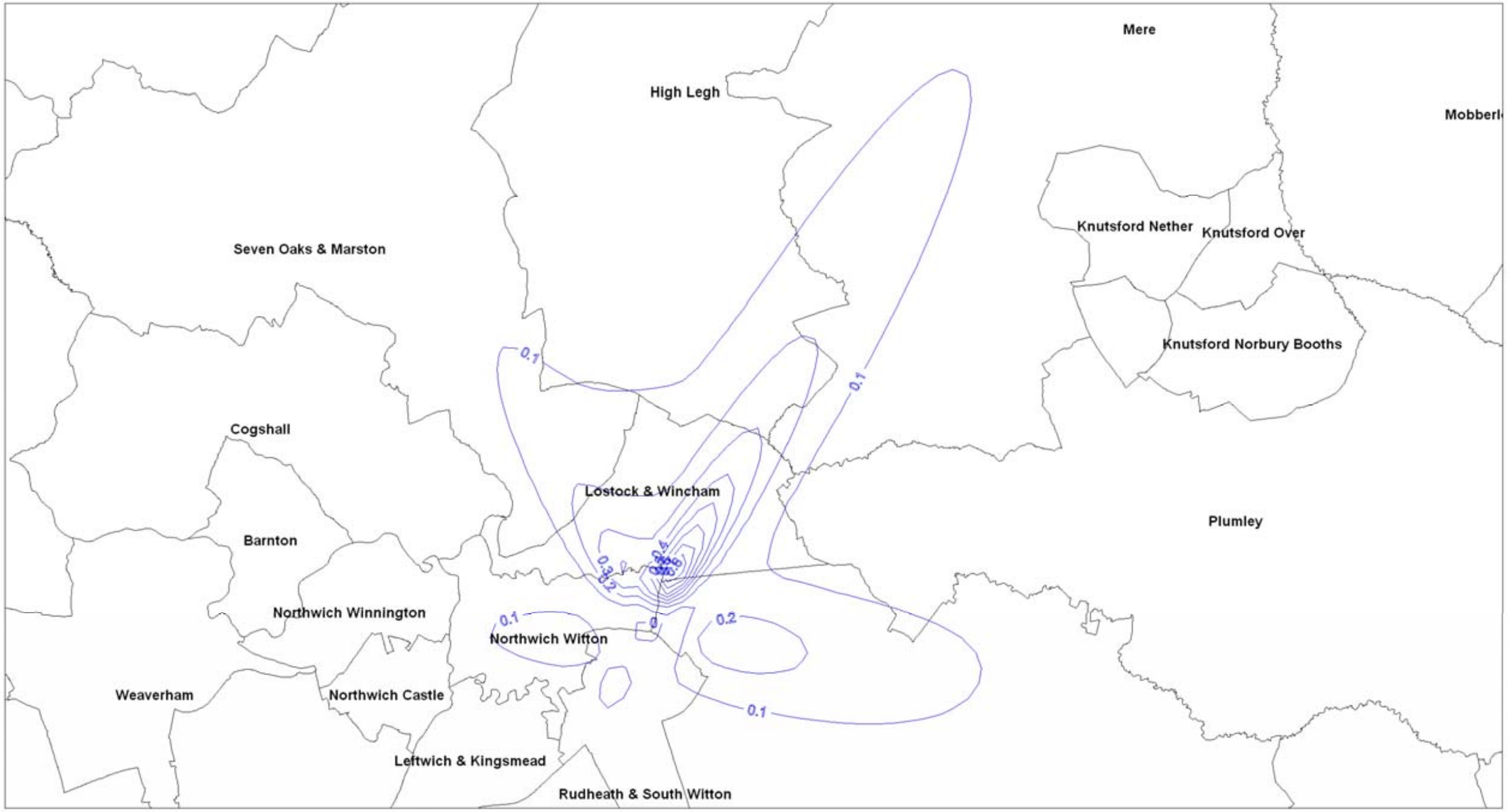


Table 4.3: Population Concentration Exposure to Sulphur Dioxide

Population Exposure at the SOA Level		PM_{10} Concentration Exposure Range (μgm^{-3})								
		0.1 - 0.2	0.2 - 0.3	0.3 – 0.35	0.35 – 0.4	0.4 – 0.5	0.5 – 0.6	0.6 – 0.7	0.7 – 0.8	0.8 -1.0
E01018598	Macclesfield 007A	85	31	0	0	0	0	0	0	0
E01018648	Macclesfield 007C	197	6	0	0	0	0	0	0	0
E01018654	Macclesfield 007G	11	0	0	0	0	0	0	0	0
E01018704	Vale Royal 005A	238	375	280	2	89	33	31	25	13
E01018705	Vale Royal 005B	1388	207	0	0	0	0	0	0	0
E01018706	Vale Royal 005C	427	105	102	0	69	146	32	0	0
E01018714	Vale Royal 006B	169	0	0	0	0	0	0	0	0
E01018715	Vale Royal 006C	413	102	81	0	51	23	11	2	0
E01018716	Vale Royal 009C	463	0	0	0	0	0	0	0	0
E01018717	Vale Royal 009D	661	0	0	0	0	0	0	0	0
E01018718	Vale Royal 005D	83	0	0	0	0	0	0	0	0
E01018721	Vale Royal 002C	188	0	0	0	0	0	0	0	0
E01018722	Vale Royal 005E	258	2	1	0	1	1	1	1	0
Total population Exposure		4582	827	466	2	209	202	75	27	13
Please note that this table presents the potential change in population emission concentration exposure directly attributable to the proposed development.										

4.33 This is not of an order of magnitude to quantify any meaningful change in health outcome. To clarify, the COMEAP provides a risk coefficient of 0.6% per 10 $\mu g.m^{-3}$ increase in all cause mortality (COMEAP 1998) per 100,000 people. The worst case maximum process contribution of 1.01 $\mu g.m^{-3}$ therefore represents a potential 0.06% increase in background mortality rates for those communities exposed.

4.34 However, as shown in Table 4.2, air dispersion modelling indicates that only 13 people will be exposed to this maximum annual process contribution. Annual SO_2 contributions are therefore not of a level to quantify any meaningful change in health outcome

4.35 On this basis, it is concluded that potential changes in SO_2 will remain significantly within Air Quality Standards set to protect health, and community exposure will not be of a level to result in any measurable health outcome during the lifespan of the proposed SEP. Please note that as both NO_2 and SO_2 are already addressed through the application of the $PM_{2.5}$ COMEAP risk coefficient, it is therefore not appropriate to combine the risk values calculated.

Dioxin and Furans

4.36 As detailed in Appendix A, there is typically significant community health concern regarding potential changes in exposure to specific emissions including dioxins and furans. It is important to note that the Human Health Risk Assessment models the cumulative risk of contaminants of concern (including dioxin, furans and metals) to the most sensitive receptors via multiple health pathways (inhalation and ingestion of locally produced food and soil) over an average lifetime of exposure.

4.37 The ‘most sensitive receptors’ are not selected from the local community but reflect a worst-case hypothetical receptor. As such, the model is highly conservative assuming that the most sensitive receptors live in and consume food items grown or reared in an area of maximum impact from the facility operating continuously at the maximum allowable emission limit.

4.38 The results of the health risk assessment (presented in the HHRA) indicates that the uptake of emissions from the proposed SEP operating at a maximum hypothetical scenario are significantly below the European Community Tolerable Weekly Intake (EC TWI) threshold for Dioxins and Furans. It is also important to note that the EC TWI is a conservative measure of the level that contaminants can be ingested or absorbed without appreciable health risk over an average life time).

4.39 Despite applying a conservative approach, the assessment concludes that worst case emission and exposure scenarios of the proposed SEP fall significantly below World Health Organisation guidance levels and do not pose a significant risk to health of local communities.

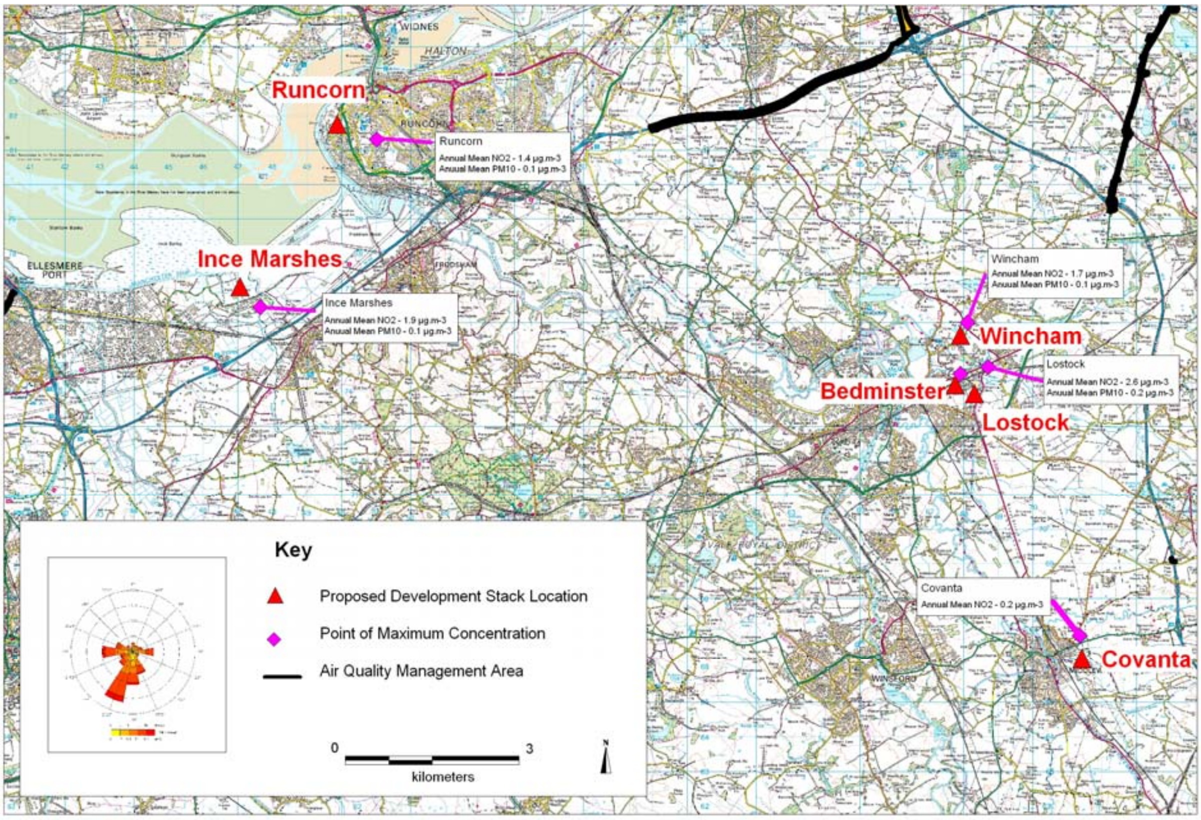
4.40 On this basis, it is concluded that the proposed SEP does not constitute a significant risk to health from emissions to atmosphere during construction or operation. This conclusion is in keeping with the current evidence base on the potential health effects from modern Energy from Waste facilities (Appendix A) and as shown below, is supported by the UK Health Protection Agency in their position statement on Municipal Waste Incineration (HPA 2009), and the Department for Environment Food and Rural Affairs (DEFRA 2004).

> *The findings of the assessment concurs with the previous and latest Health Protection Agencies position paper, which indicates that modern, well managed energy from waste facilities present a negligible contribution to ambient air quality and no measurable impact upon health.*
>
> *Any potential damage to the health of those living close-by is likely to be very small, if detectable. This view is based on detailed assessments of the effects of air pollutants on health and on the fact that modern and well managed municipal waste incinerators make only a very small contribution to local concentrations of air pollutants. The Committee on Carcinogenicity of Chemicals in Food, Consumer Products and the environment has reviewed recent data and has concluded that there is no need to change its previous advice, namely that any potential risk of cancer due to residency near to municipal waste incinerators is exceedingly low and probably not measurable by the most modern techniques. Since any possible health effects are likely to be very small, if detectable, studies of public health around modern, well managed municipal waste incinerators are not recommended. (UK HPA 2009).*
>
> *We found no consistent evidence for significantly elevated levels of ill-health in populations potentially affected by emissions from Municipal Solid Waste incineration'. (DEFRA 2004).*

Cumulative Air Quality Impacts

4.41 It is understood that local communities have expressed concern regarding the cumulative impact on air quality from the proposed SEP, the Runcorn, Ince Marsh and Covanta energy from waste facilities and the Bedminster precious metals plant. As shown in Figure 4.4, the zones of maximum particulate matter and nitrogen dioxide deposition from these facilities do not present a cumulative risk, nor will they cumulatively impact upon any Air Quality Management Area.

Figure 4.4: Cumulative Air Quality Impact: Zones of Maximum Deposition



4.42 On this basis, it is concluded that there is no risk of a cumulative air quality impact from these facilities that would modify the previous exposure response assessments or the previous conclusion drawn that the proposed SEP does not constitute a significant risk to health from emissions to atmosphere during construction or operation.

Odour

4.43 The potential impact of odours on health is largely psychological, where the perception of odour may result in increased annoyance, anxiety and changes in social behaviour. Aside from possible health impacts from these psychological effects, odour is not normally associated with physical health effects.

4.44 Due to the nature of the fuel (pre-treated), delivered in enclosed vehicle there are no areas on site that have the potential to emit significant odours. Furthermore, the proposed SEP will operate in a slight negative air pressure, where combustion air for the boilers will be drawn from within the building. As such, odour emissions are unlikely to present a significant risk of community annoyance and no measurable health outcome.

Noise

4.45 Consensus on the level and duration of noise required to instigate potential health impacts is not clearly defined. The main emphasis of noise standards and regulations is therefore placed on annoyance and sleep deprivation, as these are the most immediate consequences of noise impacts, and applicable to everyone.

Construction

4.46 Construction activities associated with developments of this type can have the potential to result in noise impacts, depending on the construction techniques applied and the type of plant used. As demonstrated in the ES, the construction stages with the greatest potential for noise disturbance include the following:

- site preparation and ground excavations;
- pre-cast concrete driven piling;
- night-time concrete pour of foundations; and
- general building construction.

4.47 The results of the noise assessment indicate that the noise emission levels from the daytime construction activities are not expected to exceed 65dB LAeq, 12h at any Noise Sensitive Receptors (NSR) during the construction of the project. The results of the assessment further indicate that the noise from night-time concrete pouring activities are not expected to exceed 45dB LAeq, 8h at any NSR. On this basis, prior to mitigation, daytime and night-time noise is considered to be neutral and not of a level to cause significant community annoyance, disrupt sleep or result in any measurable health outcome.

Operation

4.48 Once operational, the proposed SEP will be designed to suppress and avoid noise, including the following specific measures:

- the chimney flues are supplied with silencers to reduce noise and tones from the fans;
- noisy equipment with a potential for tones such as turbine, scrubbers, fans, etc. are placed inside the building;
- ventilation and openings to the building are damped; and
- fuel is unloaded in an enclosed reception hall.

4.49 As stated in the Noise Assessment of the ES, neither of the two waste delivery options assessed for the proposed SEP (i.e. Option 1:- 2/3rd waste delivered by rail and 1/3rd waste delivered by road, Option 2:- all waste delivered by road) will result in a significant change in ambient day or night-time noise at any of the residential NSR or recreational areas assuming that suitable measures are adopted.

4.50 On this basis, following the additional mitigation suggested in the Noise Assessment of the ES, and subject to good site management, the proposed SEP will not pose a significant risk of community annoyance or sleep disturbance and is likely to present a neutral impact on environment and health with respect to noise emissions.

Road Traffic

4.51 Potential health pathways associated with changes in road traffic movements include increased exposure to vehicle exhaust emissions, noise and risk of road traffic accident and injury. Each is discussed in more detail below.

Risk of Road Accident and Injury

4.52 The major and most obvious hazard of road transport is human injury as a result of collision. The calculation of injuries as a result of new journeys and increased traffic flows is not an exact science. One approach is to calculate an accident rate per journey, based on the gross national statistics.

4.53 The advantage of this method is that the number of accidents can be calculated without a detailed knowledge of road traffic movements on particular road types or the number of kilometres travelled. This method is considered conservative in that it takes into account the additional risk associated with the whole trip and not just the additional vehicle kilometres in the area around the development. The disadvantages are that it applies a standard rate to the population and does not consider any of the more sophisticated data that is available about particular road types or the effect of the number of kilometres. Notwithstanding this, it is consistent with the approach adopted on a national basis.

4.54 According to UK Department for Transport statistics (DfT 2005), there were 32,155 people killed or seriously injured on all Great Britain roads for all forms of transport in 2005. The annual number of vehicle journeys or ‘trips’ per person per annum can be estimated by the following method; there are currently 60 million people in the UK and an average of 488 trips per person per year (DfT 2005b). Taken together, the result is 29.3 billion trips per year in road vehicles. There are also approximately 306 million trips made in the UK per annum by goods vehicles. This gives a total of 29.6 billion trips per annum by cars, buses and vans/goods vehicles.

4.55 Therefore, the incidence of a road user (including pedestrians) involved in road accidents per trip can be calculated by dividing the number of accidents by the number of trips. The extra number of accidents can then be calculated by multiplying the number of new trips by the risk of an accident in a single trip. It is important in this context to define the meaning of a new trip and to consider the effect of traffic redistribution.

4.56 As detailed in the traffic modelling provided within the ES, during the peak construction period, construction staff vehicle movements and HGV's will generate an additional 300 vehicle two-way road trips per day (comprising 240 staff vehicle trips and 60 HGV trips in and out). Once operational, assuming the worst case scenario where all fuel is transported by road, the proposed SEP would generate 132 HGV and 40 staff vehicle trips per day.

4.57 Applying the worst case construction traffic scenario, where maximum construction traffic rates remain constant throughout the year and prior to mitigation, the increase in road vehicle movements attributable to the construction of the proposed SEP may contribute to 1.4 accidents per year, 0.1 of which may be serious and 0.01 fatal.

4.58 Once operational, applying the worst case scenario where all RDF would be delivered by road, the proposed SEP increase in road vehicle movements may contribute to 0.8 accidents per year, 0.08 of which may be serious and 0.009 fatal. It is important to note that such an assessment is highly conservative; applying all road traffic accidents throughout the UK to a local level; maximum peak road traffic movements as an average rate and assuming that all RDF will be delivered by road in order to establish the worst case potential risk.

4.59 Following mitigation, potential road traffic collisions attributable to the proposed SEP are not anticipated to present any meaningful increase in local risk during construction or operation.

Socio-economic

Employment, Income & Education

4.60 Employment and income are potentially the most significant determinants of long-term health, influencing a range of factors including the quality of housing, education, diet, lifestyle, coping skills, access to services and social networks.

4.61 As a consequence, poor economic circumstances can influence health throughout life, where communities subject to socio-economic deprivation are more likely to suffer from morbidity, injury, suffer from mental anxiety, depression and tend to suffer from higher rates of premature death than those less deprived. (Beland 2002) (Stafford 2004) (Van Lenthe 2005).

4.62 Although quantitative methods have been established to demonstrate the health benefit of employment and income, where a 10% rise in income can reduce the relative risk of mortality by 0.0035 in men and 0.03 in women, the intensive data requirements (i.e. the need for information on the relative change of an individual's pay range) limits this assessment to a qualitative appraisal.

4.63 Projects with the potential for long-term, stable employment with opportunities for promotion and advancement through training and experience will contribute in improving health and wellbeing of socio-economically deprived communities. It is important to note however that increasing employment and income opportunities alone will not maximise health benefits. Increased support, training and community involvement is required in order to link and develop skills to employment and reduce the risk of inequality.

Construction

4.64 Construction of the key facilities on the main site is anticipated to take approximately 3.5 years, generating a peak of 500 construction jobs with a significant capital expenditure. The distribution of such employment opportunities will vary during the construction phase and are anticipated to be typically diffuse, distributed at a regional level.

4.65 In contrast, indirect and induced employment and income opportunities are likely to be experienced on a more local level (i.e. services and amenities to serve and accommodate the construction activities and staff) with increased local spending. As such, the construction stage presents a significant socio-economic opportunity with associated health benefits at the individual level.

Operation

4.66 Once fully operational, the proposed SEP will aid in reducing reliance upon fossil fuel energy generation, reducing significant operational costs associated with increasing fuel rates, and increasing commercial viability and job protection. The workforce required to operate the proposed SEP will comprise approximately 50 people. Although small in number, such employment opportunities are more likely to be taken up by local communities.

4.67 Considering the local skills base and key industries of employment, it is concluded that the direct employment impact of the proposed development presents a relatively small yet important contribution to local sustainable employment opportunities with subsequent beneficial health outcomes for those individuals. However, the proposed development will also improve the overall viability of the Brunner Mond site, and associated industries with significant scope for job protection at the local and regional level.

Housing

4.68 Housing is an often-underrated determinant of health. It not only provides shelter from the elements, but also acts as a socio-economic buffer that supports good physical, mental and social health. As such, a project that impacts upon the quality, availability and value of housing can have a subsequent impact on an individual's health and wellbeing.

4.69 There are a number of case studies in dense urban areas that do not provide substantive evidence that well managed Energy from Waste facilities have had a measurable impact on property values, the volume of transactions or the ability of an area to attract inward investment (Onyx 2005, Hunt 2007).

4.70 The Hunt study (prepared on behalf of Dublin City Council) in particular reviewed similar projects throughout Europe and monitored housing transactions in Dublin prior to and during the planning process for the first EfW in Ireland. The study concluded that despite negative community perceptions and concerns, the actual impact upon property value and saleability is not significant.

' there appears to have been no negative impact on either residential property values or on the volume of transactions in the neighbourhoods that are in closest proximity to the proposed thermal treatment plant at Poolbeg. Similar fears would have been expressed when the Synergen plant went into operation in the area and when the sewage treatment plant was opened. However, these fears have not been realised'.

'We visited this facility and also a number of other similar facilities throughout Europe to investigate property impacts and have found no evidence that well-managed thermal treatment facilities treating non-hazardous waste have had any measurable impact on property values, the volume of transactions or the desirability of property in neighbouring locations in any of the similar plants we have visited around Europe'.

(Source: Hunt 2007)

4.71 When further considering the location of the proposed SEP, it is not anticipated there will be any discernible long-term influence upon property value or health.

5 Conclusions

Introduction

5.1 This HIA has investigated a wide range of health pathways in a manner that considers local circumstance and the best-available scientific evidence. In particular, this HIA has been applied to test the current UK Health Protection Position Papers on Municipal Waste Incineration (UK HPA 2009) and to establish the relative risk to local communities from the construction and operation of the proposed SEP.

5.2 The following section provides a summary as to the significance and potential distribution of health effects during construction and operation of the proposed SEP.

Assessment Conclusion

Relative Community Sensitivity

5.3 The proposed SEP is to be located in a sparsely populated area of the Northwich Witton Ward that is largely industrial in nature. National and Northwest Public Health Observatory Statistics indicate resident communities to exhibit a relatively consistent age structure, with health, employment and levels of education generally better than, or similar to the national trend. Applying local demographic, health and socio-economic statistics, local communities are not considered to exhibit any heightened sensitivity/susceptibility to the key health pathways associated with the construction and operation of the proposed SEP.

Construction

5.4 Construction of the proposed development presents a number of potential health pathways. However, taking into account the level of emissions (air and noise) generated on site, their intermittent nature/duration and minimal opportunity for community exposure, the risk to community health is not significant and will be further managed and mitigated through the recommendations of the Health Management Plan (HMP).

5.5 Prior to mitigation, although of a low likelihood, the most significant risk associated with the construction stage is from increased traffic movements and associated risk of collision. Although such risks are largely addressed through transport legislation, and a construction environmental management plan, additional recommendations to further reduce community disruption during the construction stage are outlined in the Health Management Plan.

5.6 The construction stage will generate a maximum of 500 direct jobs over the scheduled 3.5-year construction period, with additional indirect and induced income and employment opportunities at the local and regional level. Applying the available evidence base, such income and employment opportunities represent significant socio-economic health opportunities for those individuals.

Operation

5.7 Once operational, the key community health concern is the potential risk from a number of compounds emitted to air. Defining the potential risk to health is ultimately dependent upon the release rate of these compounds emitted from the proposed SEP and the level, mode and extent of community exposure to them.

5.8 Applying the ES air dispersion modelling and the HHRA, together with the application of exposure response mechanisms developed by the Department of Health's Committee on the Medical Effects of Air Pollutants (COMEAP), it is concluded that the proposed SEP does not constitute a significant risk to health from emissions to atmosphere during construction or operation.

5.9 Such a conclusion is in keeping with the current evidence base on the potential health effects from modern Energy from Waste facilities (summarised in Appendix A), and is consistent with the Position Statements issued by the Environment Agency (2008), the UK Health Protection Agency (2008 and 2009), the Committee on the Carcinogenicity of Chemicals (COC 2000 & 2009), the Chartered Institute of Water & Environmental Management (2006) and the Department for Environment Food & Rural Affairs (2004).

5.10 It is also relevant to state that the Environment Agency has a duty to ensure a high degree of protection for the environment and health of people taken as a whole, through the Environmental Permitting regime, which is enforced via the regulation of operators.

5.11 Furthermore, modelling indicates that prior to mitigation, the potential change in operational noise (day and night-time) at any of the modelled community receptors will not be significant, with no significant risk of annoyance or sleep interference. Equally, the proposed facility is not estimated to present any meaningful increase in local risk from road traffic incidents or cause community severance.

5.12 Once operational, socio-economic benefits provide a relatively small but important increase in permanent employment opportunities for those individuals, while the proposed visitor centre will aid in raising awareness as to more environmentally conscious waste management behaviour, and in demonstrating the design features in place to protect the environment and health. The following section presents the Health Management Plan.

6 Health Management Plan

Introduction

6.1 The following section presents a series of recommendations geared to address local circumstances, concerns and needs; to further reduce community disruption; and to enhance opportunities to improve health through more informed and effective community support initiatives.

6.2 The target audience is not solely directed at Brunner Mond and E.ON, but includes the Council and the PCT in order to coordinate complementary community support initiatives. The following section is separated into construction and operational stages.

Construction

Raised awareness

6.3 Prior to construction, appointed contractors will be required to demonstrate how they would comply with all the requirements set out in the Construction Environmental Management Plan (CEMP). To this end, they would be asked to produce an overall Environmental Action Plan (EAP) and Method Statement for each construction activity.

6.4 It is recommended that practical items of this HIA supplement the CEMP to ensure contractors are aware as to local circumstance and why such measures are required. In this instance it is important to establish the measures in place to minimise disruption and risk to both residential areas and individuals employed within the area.

6.5 It is anticipated that a public relations strategy will be required with the aim of keeping residents, businesses and other local communities informed about the effects of the works. It is advised that the communications officer be cognisant of the HIA and potentially have a summarised version for distribution if requested.

Site Management

6.6 Good site management of noise and dust will prevent and further reduce potential annoyance to communities during construction, this is anticipated to include:

- storage sites, fixed plant, machinery, equipment and temporary buildings etc, would be located to further limit nuisance and excessive noise affecting the closets residential receptors approximately 500 metres south-west of the site on edge of the Rudheath area of Northwich;

- construction staff parking is to prevent disruption to both residential areas and the business park and where possible avoid any reduction in access and accessibility;
- an appropriate speed limit is to be implemented along the access road;
- where appropriate, suitable pedestrian crossing will be provided;
- where appropriate, site plant will be turned off when not in use to prevent unnecessary noise and emission generation;
- advanced notification will be provided to sensitive receptors for major construction activities. These groups will be provided with a specific point of contact and given regular updates on progress and issues as the work progresses;
- particularly noise impulsive construction activities will only take place during day time working hours preventing sleep interference and associated health effects;
- dust suppression will be implemented where appropriate and measures will be established to prevent the transfer of dust, mud and spoil during transportation;
- where appropriate, street cleaning will be implemented to prevent transfer of dust on local road networks;
- hoardings and security fences would be designed to avoid, where possible, blind corners, recesses or 'dead' zones and inspected frequently to prevent unauthorised access and subsequent risk to the health and safety of all parties; and
- where appropriate, CCTV will be provided to further discourage unauthorised access and unlawful activities (vandalism, illegal dumping etc).

6.7 It is further recommended that the outputs of the public relations strategy and any recorded complaints are monitored and where appropriate acted upon to reduce community annoyance. Where such action is deemed necessary, it is important to feed back to the parties involved.

Construction Employment Strategy

6.8 As previously discussed, construction and operation of the proposed SEP will present direct, indirect and induced employment and income opportunities. Recommendations to facilitate the uptake of such benefits locally are generally outside of the developers influence, as employment will be dependent upon a range of factors including appropriate skills base, proven ability and cost. However, the proposed SEP is likely to require a range of skilled and semi-skilled labour and where possible it is recommended to draw from local communities. Such an approach will not only aid in improving the uptake of socio-economic health benefits locally, but will also aid in reducing construction staff traffic movements and associated health pathways.

Construction Traffic

6.9 Construction traffic movements, including HGV and staff movements constitute a minor risk of road traffic accidents and annoyance. It is understood that potential disruption during this stage will be managed by a construction transport strategy, including, but not limited to:

- where appropriate, staff will be encouraged to make use of public transport systems or alternatives, including car sharing and cycling, to reduce the level of associated vehicles;
- construction staff parking provision will be made available to prevent disruption to the nearest residential receptors (located approximately 500 metres south-west of the site on edge of the Rudheath area of Northwich);
- construction vehicles will be properly and regularly maintained to ensure vehicle safety, and emissions / noise are within operational norms;
- complaint data will be logged, as will the actions implemented to manage and prevent future annoyance, and applied to inform the operational stage of the SEP; and
- all construction staff will be made aware of the transport strategy and its purpose to further reduce risk and disruption to residential areas.

Operation

Monitoring and Raised Awareness

6.10 Once operational, the proposed facility is not estimated to present a significant risk to health. Key recommendations include the provision of publicly available air quality monitoring results to reassure communities as to the accuracy of the Environmental Statement (ES), HHRA and subsequent findings of the HIA.

Operational Traffic

6.11 Operational traffic movements present a minor risk of road traffic accidents and annoyance, recommendations to further reduce such risk and annoyance include:

- where appropriate, staff should be encouraged to make use of public transport systems or alternatives, including car sharing and cycling, to reduce the level of associated vehicles; and

- waste transfer vehicles should be properly and regularly maintained to ensure vehicle safety, and emissions / noise are within operational norms.

Employment Opportunities

6.12 Operational employment opportunities present moderate and sustainable long term economic benefits. To aid local benefit uptake it is recommended that the operator works with the Council to identify what jobs will be available and the associated skills base required. Such information will aid the Council in aiding local employment agencies to better equip applicants where appropriate. By supporting employment from local communities the operator will support the uptake of local socio-economic health benefits and further reduce the requirement for staff road traffic movements.

Community Support Initiatives

6.13 Once operational, it is recommended that Brunner Mond and E.ON continue to engage with the Council and PCT to discuss environmental and health-monitoring data, and to also discuss any opportunities for Brunner Mond and E.ON to support Council and PCT community support programmes and initiatives geared to improving local circumstance and health.

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Appendices

Appendix A

RPS Health and Thermal Waste Management Evidence Base

RPS Health and Thermal Waste Management Evidence Base

Thermal Waste Treatment Processes

The following section presents a detailed review of the available scientific health and waste management evidence base on Thermal Waste Treatment Processes (including incineration, gasification and pyrolysis). The review was coordinated by RPS' Health Impact Assessment and Human Health Risk Assessment Teams, draws from the Groups multidisciplinary expertise (air quality, noise, transport, waste management etc) and networks with leading academic experts and advisors to the World Health Organisation.

Incineration

Waste incineration usually involves the combustion of MSW with varying degrees of pre-treatment to the incoming feedstock. To allow the combustion to take place a sufficient quantity of air is required to fully oxidise the fuel, a proportion of which is generally drawn from fuel storage areas to reduce odour emissions beyond the facility.

During incineration, flue-gases are created that contain the majority of the available fuel energy as heat. All today's municipal waste incinerators recover energy, either in the form of steam for local industrial use or district heating or for conversion into electricity via a steam turbine. Some recover both heat and power. It should be noted that district heating scheme, carry a premium in terms of cost, depending on the site specific demand characteristics, and requires careful planning.

There are a number of different types of incinerators depending on the furnace technology used:

- Grate incinerators: widely applied for the incineration of mixed municipal wastes (at large scale). In addition grate incinerators can also treat commercial and industrial non hazardous wastes, sewage sludges and certain clinical wastes.
- Rotary kilns: widely applied for the incineration of hazardous wastes and also commonly used for clinical waste, although only used at the small scale (oscillating kiln) in the UK. They are very robust and almost any waste, regardless of type and composition, can be incinerated.
- Fluidised bed: applied to the incineration of finely separated wastes like RDF and sewage sludge. It has been used for decades, mainly for the combustion of

homogeneous fuels like coal, although there are currently only two examples operating on MSW in the UK. Fluidised bed requires an additional process to prepare the fuel for combustion and is not considered to be as robust as the moving grate technology on waste derived fuels.

All waste incinerators are subject to specific emission limits set by the EC Waste Incineration Directive (WID). Key pollutants regulated under the Waste Incineration Directive include:

- Nitrogen Dioxide (NO_x);
- Sulphur Dioxide (SO_2);
- Total Dust (including PM_{10} that constitutes the $PM_{2.5}$ fraction);
- Carbon Monoxide (CO);
- Total Organic Carbon (TOC);
- Hydrogen Fluoride (HF) and Hydrogen Chloride (HCl);
- Cadmium (Cd) & Thallium (Tl);
- Mercury (Hg);
- the sum of Antimony (Sb), Arsenic (As), Lead (Pb), Chromium (Cr), Cobalt (Co), Copper (Cu), Manganese (Mn), Nickel (Ni) and Vanadium (V); and
- Dioxins / Furans (PCDD / PCDFs).

For any waste management facility to operate it is necessary to demonstrate that such facilities do not constitute a risk to the environment and health to gain planning permission, and then again to gain an Environmental Permit from the Environment Agency (subject to the requirement of Integrated Pollution Prevention and Control). The Environmental Permit will require that each facility is compliant with all other applicable environmental and health regulations.

Potential Health Pathways

Exposure in relation to gaseous emissions and residual waste are generally the main areas of community concern, and often engender concerns relating to cancer, respiratory disease, congenital abnormalities and infant mortality. The potential health risk from gaseous emissions is discussed in more detail below.

Potential health risk from noise, odour, vermin and bio-aerosols generally present less significant health pathways, and are typically addressed through the site selection and design stages.

Potential changes in road transport movements to deliver SDF and transport residual waste presents a more diffuse health pathway, including a potential change in noise, air quality and more importantly risk of road traffic accidents in collection areas and between waste transfer facilities. Such risks are largely managed through the planning process by the appropriate choice of location and provision of good access. Residual effects can be managed through the development of a Traffic Management Plan. It is important to note that such facilities do not typically create any net overall increase in road transport movements within a region, but redistribute and contribute in reducing the number of road transport movements by managing waste closer to source and reducing the volume of waste sent to landfill.

Gaseous Emissions

Air pollution (from all sources) can have an adverse effect on health, and most notably on susceptible people (including the young, the elderly and infirm). The Committee on the Medical Effects of Air Pollutants (COMEAP) has reported that evidence regarding the effect of long-term exposure to air pollution points to an association between long-term exposure to particulate air pollution and effects on mortality. Studies on health effects from other combustion gases such as nitrogen dioxide and sulphur dioxide were found to be less consistent.

However, extrapolating health effects associated with exposure to these pollutants in general to the relatively small additional exposure from thermal waste treatment facilities is often the cause of significant but unnecessary community concern.

The Defra review of environmental and health effects of waste management (2004) concluded that whilst thermal waste treatment facilities generate a considerable amount of public concern it was not possible to identify any peer-reviewed study showing that modern thermal waste treatment facilities release hazardous substances at a level causing harm to the people in the vicinity.

Cancer

Several epidemiological studies have suggested a possible association between thermal waste treatment facilities emissions and a variety of cancers including stomach, colorectal and liver cancers; larynx and lung cancers; childhood cancers and soft tissue sarcomas and non-Hodgkin's lymphomas. However, the review carried out by Defra 2004 concluded that there is no consistent or convincing evidence of a link between cancer and thermal waste treatment facilities. In the UK, the large epidemiological studies from the Small Area Health Statistics Unit (SAHSU) examined an aggregate population of 14 million people living within 7.5 km of 72 municipal solid waste incinerators. This included all incineration plants irrespective of age up to 1987. Despite the inclusion of incinerators with emissions much higher than would occur from modern thermal waste treatment facilities, both the Defra and SAHSU studies were unable to convincingly demonstrate an excess of cancers.

Following these studies, the Department of Health's Committee on Carcinogenicity published a statement in March 2000 evaluating the evidence linking cancer with proximity to municipal solid waste incinerators in the UK. The committee specifically examined the results of these studies and concluded that:

> *'any potential risk of cancer due to residency (for periods in excess of ten year) near to municipal solid waste incinerators was exceedingly low and probably not measurable by the most modern techniques'.*

In March 2009, The Department of Health's Committee on Carcinogenicity updated their 2000 position paper on cancer incidence in proximity to municipal solid waste incinerators in the UK. The update undertook a further review of recent epidemiological studies on cancer incidence near municipal solid waste incinerators. They concluded that there is insufficient evidence to suggest that well managed and regulated thermal waste treatment facilities present a significant risk to health.

Noting that emissions from modern thermal waste treatment facilities are orders of magnitude lower than from older incinerators, it may be concluded with some confidence that any impact on cancer rates in local people are small or non-existent and unlikely to be quantified through epidemiology (Defra 2004).

Respiratory Function and Disease

Available studies have typically examined respiratory health around the older generation of incinerators, which were subject to less stringent levels of control than the modern plant regulated under the WID (2000). Overall, there is little evidence to suggest that thermal waste treatment facilities are associated with increased prevalence of respiratory symptoms in the surrounding population.

This is consistent with emissions and ambient air quality monitoring in the vicinity of thermal waste treatment facilities, which indicate that modern, well managed facilities make a very small contribution to background levels of air pollutants and are not a significant contributor to local air pollution.

The Defra Study concluded that modern thermal waste treatment facilities simply do not generate sufficient concentrations of emissions to quantify any meaningful change in health effect (Defra 2004). In the absence of any exposure response coefficient specific to thermal waste treatment facilities, the current approach is to use known exposure response coefficients derived from more significant emission sources (e.g. road emissions) to quantify the magnitude and distribution of health outcome. Here, the UK Department of Health's Committee on the Medical Effects of Air Pollutants (COMEAP) has established that:

- there is a 0.75% increased risk in the background rate of all cause mortality per 10 $\mu g.m^{-3}$ increase in PM_{10} per 100,000 individuals exposed;
- there is a 6% increased risk in the background rate of all cause mortality per 10 $\mu g.m^{-3}$ increase in $PM_{2.5}$ per 100,000 individuals exposed; and
- there is a 0.8% increased risk in respiratory and cardiovascular hospital admissions per 10 $\mu g.m^{-3}$ increase in PM_{10} per 100,000 individuals exposed.

Such potential health outcomes are primarily dependant upon the level of community exposure and their existing burden of poor health. However:

- modern thermal waste treatment facility emissions are not of a level to result in a significant impact upon ambient air quality;
- changes in ambient concentrations of particulate matter emissions are typically orders of magnitude lower than the 10 $\mu g.m^{-3}$ increase required to quantify any meaningful change in health outcome; and
- community exposure is typically far lower than the 100,000 population exposure used as the basis to quantify any meaningful health outcome.

Congenital Abnormalities

High exposure to environmental pollutants is known to adversely affect the reproductive system of animal test subjects. However, epidemiological studies fail to establish any convincing links between thermal waste treatment facility emissions and congenital abnormality (Defra 2004).

Infant Mortality

Risk of increased infant mortality as a consequence of emissions from thermal waste treatment facilities is a frequently raised issue by concerned communities. However, there is no evidence publicised in the scientific literature to suggest that modern thermal waste treatment facilities increase the risk of infant mortality.

There are a number of web sites that publish material relating to excess infant mortality near incinerators. This material does not however appear in peer reviewed scientific literature and cannot therefore be accepted as credible without further clarification of the evidence applied.

Based upon the available evidence base, it is concluded that well managed and regulated thermal waste treatment facilities contribute little to the concentrations of monitored pollutants in ambient air and that the emissions from such plants have little effect on health. This conclusion is consistent with the Position Statements issued by the Environment Agency (2008), UK Health Protection Agency (updated 2008) and the Chartered Institute of Water and Environmental Management (2006).

Pyrolysis and Gasification

Pyrolysis is the thermal degradation of a substance in the absence of oxygen to produce a carbonaceous char, oil and combustible gases. How much of each product is produced is dependant on the process conditions, particularly temperature and heating rate. Waste materials are heated at temperatures of between 300-850^{o}C.

The synthetic gas (syngas) is a mixture of combustible gases such as carbon monoxide, hydrogen, methane and a range of VOCs. Energy can then be generated from either combusting the gas and feeding the hot gases into a heat exchanger where steam is produced and used to generate energy in a steam turbine or the gas is refined to a quality suitable for use in a gas engine. The solid fraction may be used as the feed material for a gasification process.

Gasification is a partial oxidation of organic substances to produce gases than can be used as a feedstock or as a fuel. There are several different gasification processes available, which are in principle suited for the treatment of municipal waste, certain hazardous waste and dried sewage sludge (EC, 2006). Gasification involves a large number of reactions, from initial devolatilisation and char formation through heterogeneous reactions involving the formed species and the oxidising media (which is most commonly air, pure oxygen or steam).

For utilisation in entrained flow, fluidised bed or cyclone gasifiers, the feeding material must be finely granulated. Therefore pre-treatment is necessary, especially for municipal wastes. However, due to the homogeneous characteristics of some hazardous wastes, they may be gasified directly if they are liquid or finely granulated (EC, 2006).

This process generally requires a consistent waste stream such as tyres or plastics to produce a usable fuel product, and is therefore better suited to commercial and industrial waste streams. However, it is proposed as a viable alternative for dealing with residual fractions of municipal waste. These systems are reported to be less robust for dealing with raw municipal waste than conventional incinerators and require further front-end treatment and/or segregation prior to processing in pyrolysis and gasification plants (Defra 2004). These systems have also been promoted for use in processing RDF and residues from MBTs which are more homogeneous than raw MSW. Under current UK conditions these types of technology are appropriate for consideration for specific fractions of segregated residual MSW streams as a component of an integrated solution.

Some modern developments in thermo-chemical processing of waste have utilised both pyrolysis and gasification in combined technologies, which may then involve a further combustion step to combust the gases produced in the first two stages. Such pyrolysis/gasification/combustion technologies are in effect equivalent to the incineration process, where each step of the process is separated into a separate temperature and pressure-controlled reactor rather than in an incinerator where the thermal degradation steps are combined in a one-step grate combustion system. The decoupling of the thermal degradation steps has the advantage of flexibility in determining which targeted end product is best suited to each application, and can result in slightly improved efficiency of energy recovery in the form of electricity per tonne of waste produced.

Similar to incinerators, pyrolysis and gasification plants must comply with the Waste Incineration Directive emission limits.

Potential Health Pathways Associated with Pyrolysis and Gasification

Potential health pathways are the same as conventional incinerators.

Health Impacts Associated with Pyrolysis and Gasification

There is a dearth of specific evidence on the potential health impacts of pyrolysis and gasification facilities. Research that does exists suggests that emissions are comparable with other forms of thermal treatment, although this will depend on the management or disposal of the char and oil streams. The Waste Incineration Directive emission limits from the stack are applicable to emissions from these types of facilities and as such health impacts are considered to be similar to those associated with traditional thermal treatment of waste.

Literature Review Conclusion

The evidence base indicates that there is limited evidence to suggest that well managed and regulated MRF and thermal waste treatment facilities present a significant risk to community health.

This conclusion is consistent with the Position Statements issued by the Environment Agency, UK Health Protection Agency and the Chartered Institute of Water and Environmental Management.

However, it is also recognised that variation at the project level (including the size and location of the facility and type of potential exposure) coupled with local community circumstance can influence relative sensitivity to particular health pathways, hence the requirement and benefit for Health Impact Assessment.

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