16. Health Risk Assessment

16.1 Introduction

This Section provides an assessment of the potential impacts to community health of the REA WtE proposal to be located in Laverton North in an area zoned for industry. For additional detail on the Health Impact Assessment (HIA) refer to the consultant's report in Appendix 22.

16.2 Legislation, Policy Guidelines and Other Guidance

The HIA has been undertaken in accordance with the following guidance (and associated references as relevant):

- Environment Protection Act 1970 (EP Act);
- enHealth, 2017. Health Impact Assessment Guidelines (enHealth 2017);
- enHealth, 2012. Environmental Health Risk Assessment: Guidelines for Assessing Human Health Risks from Environmental Hazards (enHealth 2012a);
- enHealth, 2012. Australian Exposure Factor Guidance – Guidelines for Assessing Human Health Risks from Environmental Hazards (enHealth 2012b); and
- Harris, P., Harris-Roxas, B., Harris, E. & Kemp, L., Health Impact Assessment: A Practical Guide, Centre for Health Equity Training, Research and Evaluation (CHETRE). Part of the UNSW Research Centre for Primary Health Care and Equity. University of New South Wales, Sydney, 2007 (Harris 2007).

While the conduct of the HIA did not involve any additional air quality modelling, the HIA does draw on the air quality modelling undertaken by others and provides an assessment of health impacts. Where the air modelling aspects are considered, the following guidance has been considered (where relevant):

- State Environment Protection Policy (Air Quality Management) No. S240, Gazette 21/12/2001 (SEPP AQM)
- EPA Victoria 2013. Publication 1551 – Guidance Notes for Using the Regulatory Air Model AERMOD in Victoria (Publication 1551)

16.3 Project Description

The WtE Project relates to the use of waste separated from the general waste stream (from Melbourne local municipal areas), converting this to electricity using a gasification technology to generate steam. Detailed information on the process and the emission control features is found in Section 6 of this Works Approval Application.

The site is located within an industrial precinct located 15 kilometres west of Melbourne at 24 Alex Fraser Drive, Laverton North. The surrounding area is predominantly industrial with the closest residential dwelling residing at a distance of 1.8 kilometres south from the site and the prison receptor approximately 1.3 kilometres west of the site. The site, and adjacent properties are zoned industrial zone 2 (IN2) within the Wyndham Planning Scheme.

A summary of the multiple discrete processes and systems management strategies that, in combination, serve to control and ensure emissions are minimised and remain below SEPP and IED emission limits is provided below:

- Maintaining gasifier temperatures above 850°C and syngas oxidation chamber temperatures between 1100°C – 1200°C to induce near complete destruction of all hydrocarbons including the char generated in gasification;
- Controlled air flow through the gasifier maintains a low oxygen environment which minimises the potential for the generation of particulates;
- Gasification in a low oxygen environment minimises the formation of NOx compounds with the syngas oxidation chamber operating temperatures above 1100°C but lower than 1200°C also ensures the production of NOx in the flue gas is minimised;
- The risk of NOx levels spikes are alleviated by installation of the SNCR nitrogen reduction system in the syngas oxidation chamber that will activate if required (SCNR is not incorporated in the reference plant designs so is an additional NOx mitigating factor in the REA design not reflected in the performance of the reference facilities);
- Installation of a primary semi dry operating acid scrubber to remove acid gases through the introduction of atomised alkali. In the REA facility design, this treatment system has been expanded over that typically used in the reference facilities;
- Installation of a powdered activated carbon injection system that dispatches activated carbon into the flue gas to capture and remove volatilised base metals and reformed hydrocarbons such as dioxins and furans;
- Installation of a baghouse flue gas filtering system designed to maximise the capture the products of acid neutralisation, the activated carbon and any particulates prior to reaching the stack;
- The refuse waste bunker area is fully enclosed and under negative pressure as air is continuously drawn from the pit into the gasifiers. This effectively eliminates odour leakage outside of the refuse pit area of the facility.
- MSW delivered in closed vehicles (primarily compactor trucks);
- Unloading of MSW in entirely enclosed in buildings;
- Automated rapid roller doors control truck access to receival area;
- Automated doors at tipping point from receival area to refuse pit which open and close with proximity switches to ensure minimum exposure to odours in refuse pit;
- During the unlikely event that no combustion lines are operating then deodorant addition to the tipping hall and refuse bunker will be installed.

16.4 Methodology

The objective of the HIA presented is to assess potential impacts to community health in relation to the operation of a proposed WtE facility in Laverton North. The focus of the HIA relates to impacts on community health. The HIA has not addressed any worker health and safety risks relevant to the operation of the facility.

The HIA has addressed the following areas to evaluate the impacts of on community health:

- Identification of the community of concern – this is the location and characteristics of the population surrounding the site;
- Assessment of health impacts from air emissions – this is a quantitative assessment of potential community health impacts from changes in air quality as a result of the operation of the facility;
- Assessment of health impacts from changes in noise – this is a qualitative assessment of potential community health impacts from changes in noise as a result of the operation of the facility;
- Assessment of other health impacts relevant to the operation of the facility, including odour, waste management issues such as fire hazards, and changes in traffic. The benefits of the project will also be presented (where relevant to health);

- Uncertainty and sensitivity assessment.

16.5 Community Profile

16.5.1 Population

Based on an analysis of the population data available, the project will be implemented within a community that may have some increased susceptibility to impacts from the project (should these be of significance).

16.5.2 Population Health

In general, the key indicators of health for the population in the Wyndham and Hobsons Bay Local Government Areas (LGAs) are somewhat similar to those for Victoria, with adult rates of overweight and obesity and inadequate consumption of vegetables in the Wyndham LGA suggesting a population that is potential more vulnerable to health stressors. However the population indicators for Hobsons Bay LGA for vegetable intakes and Wyndham for long-term risk alcohol consumption suggests lower vulnerability. Higher rates of cardiovascular disease and lower rates of respiratory disease and prevalence of childhood asthma are also noted. Analysis of this data suggests the population in the areas surrounding the site may not be more sensitive (in terms of health) to impacts derived from the proposed WtE facility.

16.6 Community Engagement

This WAA provides information on the community engagement activities undertaken in relation to the project (Section 4, Appendix 3) as well details in relation to the Community Engagement Plan (CEP). The community consultation works undertaken have included consultation with a range of stakeholders including neighbours, state government, Wyndham City Council, Statutory and regulatory agencies/authorities, community groups, broader industry and environmental groups and the local media. A summary of the issues raised by stakeholders as part of the community engagement process are listed in Section 4 of the WAA. No specific health issues were raised. However issues relating more generally to aspects such as pollution, noise and odour, all of which were addressed in the HIA form a community health perspective.

16.7 Assessment of Health Impacts – Air Emissions

16.7.1 Emissions Modelling

The HIA has relied on the emissions assessment conducted by Edge Group Pty Ltd (Appendix 15). Edge predicted the concentration of emissions from the proposed WtE facility using the AEROMOD air dispersion model, which is the Victorian EPA regulatory dispersion model. This model uses air emissions estimates, plant design (for example stack location and height), local terrain and meteorological data to predict the ground level concentrations and deposition of pollutants within a defined study area, and more specifically at the residential receptor locations.

The modelling undertaken predicted concentrations and deposition rates over a grid covering an area of 4 km x 4 km, with a 50 m spacing. In addition, three sensitive receptors were included

- 2 residential receptors CDR1 and CDR2, which are the closest residential properties to the site, and;
- 1 prison receptor CDR3 located approximately 1.3 km to the west.

These three receptors have been considered to represent the closest and most sensitive residential receptors in the HIA.

Emissions from the facility were based on data provided from reference plants. Based on the available emissions data, the Air Quality Impact Assessment (AQIA) has presented the following scenarios:

- Normal operating conditions – based on average emissions concentrations, representing steady-state operating conditions for the proposed facility; and
- Upset conditions – based on the maximum emissions concentrations.

16.7.2 Conceptual Site Model

Understanding how a community member may come into contact with pollutants released in air emissions from the proposed WtE facility is a vital step in assessing potential health risk from these emissions. A conceptual site model has been developed and this provides a holistic view of these exposures, outlining the ways a community may come in contact with these pollutants.

There are three main ways a community member may be exposed to a chemical substance emitted from the WtE facility:

- Inhalation (breathing it in);
- Ingestion (eating or drinking it); or
- Dermally (absorbing it through the skin).

For some of the emissions from the proposed WtE facility, inhalation is considered the only route of exposure. This is due to the substance's chemical properties, which make the other pathways inconsequential. In this instance, gases such as NO_2, SO_2, HCl, HF and CO as well as fine particulate matter as particulates less than 10 micrometres (PM_{10}) and particulate matter less than 2.5 micrometres ($PM_{2.5}$) that are so small they remain suspended in air could be considered in this class (i.e. inhalation only exposure pathway). The composition of the fine particulates, comprising metals and organics are also important from an inhalation perspective.

Other emissions may be inhaled, but also may be deposited on the ground. These emissions can then be ingested either directly through incidental consumption of soil/dust or indirectly through food grown or raised in the soil (fruit, vegetables and eggs – which may be present in urban yards). Skin contact with the soil is also possible. Therefore, it is important with these emissions that all three exposure pathways are considered. In this instance, metals and organics that are bound to the heavier particulate matter that may fall out and deposit onto the ground could be considered in this class.

16.7.2.1 Inhalation Exposures

For all the pollutants released to air from the proposed facility, whether present as a gas or as particulates, there is the potential for the community to be exposed via inhalation. Assessment of potential health impacts relevant to inhalation exposures for these pollutants is discussed further below.

16.7.2.1.1 Particulates

The assessment of potential health impacts associated with exposure to particulate matter, based on the size of the particulate matter, rather than composition, has been undertaken and presented Edge (2019). The assessment has focused on fine particulates, as both PM_{10} and $PM_{2.5}$, which are small enough to reach deep into the lungs. $PM_{2.5}$ in particular, has been linked with, and shown to be causal, for a wide range of health effects. These health effects were considered in the derivation of the National Environment Protection Measure (NEPM) air guideline for PM_{10} and $PM_{2.5}$[96]. The NEPM

[96] NEPC 2016, *National Environment Protection (Ambient Air Quality) Measure*, Federal Register of Legislative Instruments F2016C00215. http://www.environment.gov.au/protection/air-quality/ambient-air-quality-nepm

criteria relate to total exposures to PM_{10} and $PM_{2.5}$; that is, background or existing levels as well as the additional impact from the proposed facility.

Table 16-1 provides a summary of the contribution of the project to the total PM_{10} and $PM_{2.5}$ concentrations, and the NEPM air criteria. This table shows that the maximum PM_{10} and $PM_{2.5}$ derived from the facility makes a negligible contribution to existing concentrations and only makes up a very small fraction of the NEPM guideline.

Parameter	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)	
	24-hour average	Annual average	24-hour average	Annual average
Guideline (NEPM 2016)	25	8	50	30
Background	NA	7	NA	21
Normal operating conditions				
Contribution from project	0.345	0.0215	0.345	0.0215
Total (background plus project)	--	7	--	21
% contribution of project to NEPM	1.4%	0.27%	0.7%	0.07%
% contribution of project to background	--	0.31%	--	0.1%
Upset operating conditions				
Contribution from project	0.86	0.054	0.86	0.054
Total (background plus project)	--	7	--	21
% contribution of project to NEPM	3.4%	0.7%	1.7%	0.2%
% contribution of project to background	--	0.8%	--	0.26%

Table 16-1: PM_{10} and $PM_{2.5}$ Impacts from the Project – Maximum Residential Receptor

In addition to the analysis presented above, it is possible to also estimate the incremental individual risk associated with the change in $PM_{2.5}$ from the facility. For the predicted maximum annual increase in $PM_{2.5}$ of 0.054 µg/m³ for upset conditions in residential areas, the resulting maximum individual risk of 2×10^{-6} has been calculated. This risk level is considered to be low and below the mortality risk criteria outlined by NEPM (NEPC 2011).

On the basis of the above, changes in $PM_{2.5}$ (and PM_{10}) derived from the project are considered to have a negligible impact on the health of the community.

16.7.2.1.2 All Other Pollutants

For all other pollutants, inhalation exposures have considered both short-term/acute exposures as well as chronic exposures.

16.7.2.1.2.1 Acute Exposures

For this assessment, the maximum predicted 1-hour average concentration from all receptors (noting that the maximum will be in the commercial/industrial area) has been considered. This has been done to address acute inhalation exposures that may occur in all areas, including industrial areas, and this will be conservative for residential areas. Table 16-2 presents a summary of the relevant health-based guideline, the predicted maximum 1-hour average concentration and the calculated Hazard Index (HI) for each pollutant.

Risks associated with acute exposures are considered to be acceptable where the individual and total HI's are less than or equal to 1. Based on the assessment presented in Table 16-2, all the individual and total HI's are less than 1. On this basis there are no acute risk issues of concern in relation to inhalation exposures.

		Air Concentration (mg/m^3)		Calculated HI	
Pollutants	**Acute air guideline (1-hour average) (mg/m^3)**	**Maximum - Normal**	**Maximum - Upset**	**Maximum - Normal**	**Maximum - Upset**
NEPM pollutants					
Nitrogen dioxide (NO2)	0.22[1]	1.2E-02	4.3E-02	0.056	0.2
Sulfur dioxide (SO2)	0.5[1]	6.5E-03	1.3E-02	0.013	0.026
Other pollutants					
Hydrogen chloride (HCl)	0.66[2]	2.5E-04	1.6E-03	0.00038	0.0023
Hydrogen fluoride (HF)	0.06[2]	2.3E-05	2.3E-05	0.00038	0.00038
Cadmium	0.0054[2]	7.9E-08	2.0E-07	0.000015	0.000037
Beryllium	0.0023[4]	2.3E-07	2.3E-07	0.00010	0.00010
Mercury	0.0006[3]	4.8E-07	2.0E-06	0.00080	0.0033
Antimony	1.5[4]	7.4E-07	2.2E-06	0.00000049	0.0000015
Arsenic	0.003[2]	2.4E-05	7.4E-05	0.0080	0.025
Lead	0.15[4]	1.2E-05	2.4E-05	0.000080	0.00016
Chromium (Cr VI assumed)	0.0013[2]	9.0E-07	4.8E-06	0.00069	0.0037
Copper	0.1[3]	1.3E-06	3.3E-06	0.000013	0.000033
Manganese	0.0091[2]	1.9E-06	5.5E-06	0.00021	0.00060
Nickel	0.0011[2]	4.1E-06	1.8E-05	0.0037	0.016
Dioxins and furans	0.00013[4]	1.1E-11	2.3E-11	0.000000085	0.00000018
MDI and TDI	0.012[3]	1.4E-05	1.4E-05	0.0012	0.0012
		Total HI (other pollutants)		**0.016**	**0.053**
		Target (acceptable HI)		**≤ 1**	**≤ 1**

Table 16-2: Review of Acute Exposures and Risks (maximum receptor anywhere)

References for health-based acute air guidelines (1-hour average):

1 = NEPM health based guideline (NEPC 2016)
2 = Guideline available from the Texas Commission on Environmental Quality (TCEQ), https://www.tceq.texas.gov/toxicology/dsd/final.html
3 = Guideline available from California Office of Environmental Health Hazard Assessment (OEHHA) https://oehha.ca.gov/air/general- info/oehha-acute-8-hour-and-chronic-reference-exposure-level-rel-summary
4 = Guideline available from the USEPA as Protective Action Criteria (PAC), where the most conservative value has been adopted https://www.energy.gov/ehss/protective-action-criteria-pac-aegls-erpgs-teels-rev-29-chemicals-concern-may-2016

16.7.2.1.2.2 Chronic Exposures

For the assessment of chronic exposures, all the pollutants evaluated have a threshold guideline value that enables the predicted annual average concentration to be compared with a health based or acceptable, guideline. For the assessment of chronic effects, the assessment has also considered:

- Potential intakes of these chemical substances from other sources, i.e. background intakes;
- Both the maximum concentration predicted in a commercial industrial area, and the residential receptors.

For residents, it is assumed that they are home 24 hours per day for 365 days of the year, where normal operating conditions occur for 360 days and upset conditions occur for 5 days of the year. For industrial workers, it is assumed that they are at work for 8 hours per day for 240 days of the year, where normal operating conditions occur for 235 days and upset conditions occur for 5 days of the year.

Table 16-3 presents the calculated individual Hazard Index (HI) relevant to the assessment of chronic inhalation exposures. The table presents the calculations relevant to the maximum residential receptors, where the maximum predicted annual average concentration has been utilised.

Risks associated with chronic exposures are considered to be negligible (or acceptable) where the individual and total HI's are less than or equal to 1. Table 16-3 shows that all the individual and total HI's for the maximum inhalation exposures that may occur in industrial areas and the closest residential receptors are less than 1. On this basis, there are no chronic risk issues of concern in relation to inhalation exposures. This would include exposure in future industrial premises that may be constructed close to the facility.

Pollutants	**Maximum calculated HI – Industrial areas**	**Maximum calculated HI – Residential areas**
NEPM pollutants		
Nitrogen dioxide (NO2)	0.048	0.0023
Sulfur dioxide (SO2)	0.027	0.0013
Other pollutants		
Hydrogen chloride (HCl)	0.0022	0.000099
Hydrogen fluoride (HF)	0.00016	0.0000079
Cadmium	0.0016	0.000075
Beryllium	0.0011	0.000054
Mercury	0.00022	0.000010
Antimony	0.00030	0.000014
Arsenic	0.0019	0.000093
Lead	0.0020	0.000091
Chromium (Cr VI assumed)	0.00076	0.000035
Copper	0.00000022	0.000000010
Manganese	0.0013	0.000060
Nickel	0.021	0.00098
Dioxin	0.00023	0.000011
MDI	0.00080	0.000038
Total HI (other pollutants)	**0.034**	**0.0016**
	Negligible Risk	**≤1**

Table 16-3: Calculated Chronic Risks for Inhalation Exposures

16.7.2.1.2.3 Carbon Monoxide

The assessment of carbon monoxide utilised the NEPM air guideline which relates to an 8 hour average concentration rather than an annual average.

The NEPM guideline level of carbon monoxide of nine parts per million (ppm) by volume (or 10 mg/m^3) over an 8-hour period was considered to provide protection (for both acute and chronic health effects) for most members of the population. An additional 1.5-fold uncertainty factor to protect more susceptible groups in the population was included in the development of the guideline.

For this project, the maximum concentration of carbon monoxide over an 8 hour average is estimated to be 0.026 mg/m^3 (all receptors) during normal operating conditions and 0.05 mg/m^3 (all receptors) during upset conditions. These concentrations are 0.026% to 0.5% of the NEPM criteria. On this basis the operation of the facility is not expected to significantly contribute to ambient levels of CO, and there are no health risk issues of concern in relation to these emissions.

16.7.2.2 Multiple Pathway Exposures

Where pollutants may be bound to particulates, are persistent in the environment and have the potential to bioaccumulate in plants or animals, it is relevant to also assess potential exposures that may occur as a result of particulates depositing to the environment where a range of other exposures may then occur. These include:

- Incidental ingestion and dermal contact with soil (and dust indoors that is derived from outdoor soil or deposited particulates);
- Ingestion of home-grown fruit and vegetables where particulates may deposit onto the plants and is also present in the soil where the plants are grown, and where pollutants bound to these particles are taken up into these plants;
- Ingestion of eggs where particulates may deposit onto the ground and be present in soil (which the pasture/feed grows in and animals also ingest when feeding), and the pollutants bound to these particles are taken up into the eggs.

The above exposures are chronic or long-term exposures.

16.7.2.2.1 Assessment Approach

Multiple pathway exposures will only occur on urban residential properties where people live and where some home-grown produce may be present.

To evaluate these pathways a dust deposition rate was provided for normal and upset operating conditions. As the multiple pathway exposures are only relevant in the residential areas, the maximum deposition rates for the residential receptors has been utilised in the Health Impact Assessment.

16.7.2.2.2 Calculated Risks

Table 16-4 presents the calculated risks associated with these multiple pathway exposures relevant to both adults and children. These risks have been calculated on the basis of the maximum predicted deposition rate for all of the residential receptors, assuming that normal operating conditions occur for 360 days of the year and upset operating conditions occur for 5 days of the year. The table presents the total HI for each exposure pathway, calculated as the sum over all the pollutants evaluated. The table also includes the calculated HI associated with inhalation exposures, as these exposures are additive to the other exposure pathways for the residential properties.

Depending on the use of the off-site residential properties, the types of exposures that may occur are likely to vary. For this assessment, a number of scenarios have been considered where a range of

different exposures may occur. The sum of risks associated with these multiple exposures is presented in Table 16-4.

Review of Table 16-4 indicates that all calculated risks associated with each individual exposure pathway as well as a combination of multiple exposure pathways, remain below the target risk levels considered representative of negligible risks. The multiple pathway exposures do not significantly contribute to the total risk.

On the basis of the assessment undertaken there are no chronic risk issues of concern in relation to multiple pathway exposures that may be relevant to the rural residential use of the surrounding areas.

	Calculated HI	
	Adults	**Children**
Individual exposure pathways		
Inhalation (I)	0.0016	0.0016
Soil ingestion (SI)	0.0000023	0.000021
Soil dermal contact (SD)	0.00000079	0.0000016
Ingestion of home-grown fruit and vegetables (F&V)	0.0000018	0.0000043
Ingestion of home-grown eggs (E)	0.000000013	0.00000026
Multiple pathways (i.e. combined exposure pathways)		
I + SI + SD	0.0016	0.0016
I + SI + SD + F&V	0.0016	0.0016
I + SI + SD + E	0.0016	0.0016
I + SI + SD + F&V + E	0.0016	0.0016
Negligible risk	**≤1**	**≤1**

Table 16-4: Summary of Risks for Multiple Pathway Exposures

16.7.2.3 Odour

Predominant odour emissions that may occur from the WtE facility will be as a result of fugitive emissions from the receival area and refuse pit. To counter this, the receival area and refuse pit will be equipped with automatic roller doors that will open and close quickly as trucks enter and leave the refuse area to minimise fugitive odour escaping the building. Further, the receival area and refuse pit will be held under negative air pressure to minimise fugitive emissions from the doors and creating the ability to control emissions. The air from these areas will be used in the gasifier and secondary oxidation chamber.

Assessment of odorous emissions from the operation of the facility has been undertaken (Appendix 15 and Section 10.6.6.3) and this assessment determined that odours predicted at sensitive receptors are below the relevant Design Criteria for odour.

For the receptors located on the site boundary, all odours are predicted to be below the odour criteria with the exception of the southern boundary receptor (SB6) which is closest to the waste drop-off point. The odour predicted at this location is 1.2 odour units (OU) which just exceeds the criteria of 1 OU. Review of these impacts by the consultant determined that it is unlikely that odour will impact the community.

16.7.2.4 Uncertainties

The characterisation of potential health risks related to exposures to emissions to air from the proposed WtE facility has utilised data from the air quality modelling as well as a number of assumptions. The following discussion on these data and parameters, the level of uncertainty in these values and whether changes in these values will change the outcome of the assessment is presented.

16.7.2.4.1 Air Modelling

The modelling of air emissions has been undertaken by Edge (2019) using a regulatory approved model, which utilises meteorological and terrain data for the local area. The emissions data used in the assessment were based on measured emissions from reference facilities. It is noted that the reference facilities did not include treatment specific for nitrogen emissions. The proposed facility will include additional flue gas treatment to remove NOx. Hence the estimates of NOx emissions based on data from the reference facilities are conservative and will have overestimated inhalation risks. It has also been assumed that all NOx emissions will be NO_2, which is also conservative and will overestimate actual exposures to NO_2. In addition to the assessment of NO_2, the modelling of emissions such as arsenic is also considered to be conservative.

16.7.2.4.2 Inhalation Exposures

The impacts to industrial workers were tested assuming longer working hours (12 hour shifts) and under increased lengths of time of upset conditions in the WtE facility (20 days). This assessment found that the resulting changes are very small, with risks remaining very low. Hence changing these assumptions does not change the outcomes of the assessment presented for industrial workers.

For residents it has been assumed that they are home 24 hours per day, every day of the year for as long as they live at their home. This is overly conservative as most people attend childcare, school, work or other activities and holidays away from the home. As a result, the risks calculated for inhalation exposures will be an overestimate for residents. The calculation however is relevant for exposures that may occur for residents at the prison, where they will be present 24 hours per day for 365 days of the year.

If upset conditions occur more often than 5 working days in each year, the calculated HI will increase. If it is assumed that upset conditions occur for 20 days, and normal conditions occurred for 345 days per year, the HI increases from 0.0016 to 0.0018. If upset conditions occur for 100 days of the year, then the HI increases to 0.0027.

These changes are very small, with risks remaining very low. Hence changing these assumptions does not change the outcomes of the assessment presented for residents.

16.7.2.4.3 Multi-pathway Exposures

Overall the approach taken will have overestimated actual exposures and risks and is considered conservative for the following reasons:

- For the assessment of exposures in residential areas, the maximum deposition rate for all three closest residential receptors for both normal operating conditions and upset conditions has been adopted, assuming this occurs every year;
- The quantification of potential intakes via ingestion of soil, fruit and vegetables and eggs, and dermal contact with soil, has adopted a number of assumptions relating to how the dust mixes in with soil, how much accumulates in fruit and vegetables and eggs, and how people may be exposed. These assumptions have used conservative models and uptake factors that are likely to overestimate the accumulation of pollutants in soil, fruit and vegetables and eggs. In addition, default exposure parameters have been adopted assuming exposures occur all day every day, which is conservative.

For multi-pathway exposures, intakes would need to increase by more than 30,000 fold to be considered to be of concern to health. Variation in assumptions adopted for the characterisation of these exposures will never result in changes that are this significant. On this basis there is no need to further evaluate changes in assumptions used in the multi-pathway exposure assessment.

16.7.1 Summary of HIA Outcomes Related to Air Emissions

Table 16-5 presents a summary of the outcomes of the assessment undertaken in relation to the impacts of changes in air quality, associated with the proposed project, on community health.

Impacts associated with air emissions	
Benefits	There are no benefits to the off-site community in relation to air emissions of this type
Impacts	Based on the available data and information in relation to emissions to air from the proposed facility, potential impacts on the health of the community have been assessed. The impact assessment has concluded the following: ■ There are no acute inhalation exposure risks of concern ■ There are no chronic inhalation exposure risks of concern ■ There are no chronic risks of concern from exposure to pollutants from the facility via soil or ingestion of home-grown produce The design of the facility, specifically the receival area and refuse tip, will ensure that there are no significant fugitive odour emissions from the site.
Mitigation	The proper operation and maintenance, and monitoring (including continuous monitoring), of the facility and pollution control/flue gas equipment. Management measures have been identified to minimise odours, which include ■ MSW collected in closed vehicles (compactor trucks); ■ Unloading of MSW in an entirely enclosed building; ■ Automated roller door for truck access to receival area; ■ Automated doors at tipping point from receival area to refuse pit, which open and close with proximity switches which minimise odour transmission from the refuse pit to the waste receival area; and ■ Receival area and refuse pit under negative pressure as air is drawn from these areas to supply the gasifier and the secondary oxidation chamber

Table 16-5: Summary of Health Impacts – Air Quality

16.8 Assessment of Health Impacts – Noise

A noise assessment for the proposed WtE facility has been completed (Section 11 & Appendix 15). Based on the noise modelling presented noise levels at the sensitive receivers are not impacted by noise from the facility and are in compliance with the SEPP N-1 noise limits, including under the scenario where there is a light breeze assisting in the propagation of noise.

Environmental noise has been identified as a growing concern in urban areas because it has negative effects on quality of life and well-being and it has the potential for causing harmful physiological health effects. With increasingly urbanised societies impacts of noise on communities have the potential to increase over time. The HIA has considered a wide range of potential health effects which include:

- Sleep disturbance (sleep fragmentation that can affect psychomotor performance, memory consolidation, creativity, risk-taking behaviour and risk of accidents);
- Annoyance;
- Hearing Impairment;
- Interference with speech and other daily activities;

- Impacts on children's school performance (through effects on memory and concentration);
- Impacts on cardiovascular health;
- Effects on mental health (usually in the form of exacerbation of existing issues for vulnerable populations rather than direct effects);
- Tinnitus (which can also result in sleep disturbance, anxiety, depression, communication and listening problems, frustration, irritability, inability to work, reduced efficiency and a restricted participation in social life);
- Cognitive impairment in children (including deficits in long term memory and reading comprehension);
- Possible indirect effects such as impacts on the immune system.

The potential noise impacts on community health have been assessed against criteria developed by the World Health Organization[97] [98] that have been established on the basis of the relationship between noise and health impacts, where annoyance and sleep disturbance are of most significance. The predicted noise impacts are those that would be outside of a dwelling. These predicted impacts are all below the World Health Organization guideline values that are protective of adverse health effects. Consequently, the potential for noise impacts to result in adverse health impacts at the closest noise sensitive receptors is considered to be negligible.

16.9 Health impact assessment: Water, Economics, Transport, Hazardous Waste, Community and Social Aspects

The potential health impacts associated with other aspects of the proposed project, including wastewater, economics, transport, pestilence, community and social aspects are addressed in this section.

16.9.1 Waste Water

The proposed WtE process generates various water losses; steam via the stack, residues from the treatment of mains water and the generation of leachate in the waste receival pit. Water resulting from the leachate in the waste pit, all water resulting from mains water treatment and all spillage and washdown water is collected within the facility and reused within the process. No wastewater treatment is required and no wastewater is expected to be discharged. In addition, no trade waste is expected. As no wastewater is to be discharged from the facility, there is no potential for the community to be exposed to this water at any point.

16.9.2 Economics

The benefits of the proposed WtE project are outlined in Section 1.6.3 of this WAA. These benefits include:

- Providing an additional 40 full time equivalent jobs during operation and approximately 400 jobs during construction;
- Localised electricity generation (which can support local industry and community) and increased energy security;
- Improved environmental waste management outcomes;

[97] WHO (1999b) *Guidelines for Community Noise*, World Health Organisation, Geneva https://www.who.int/docstore/peh/noise/guidelines2.html
[98] WHO (2009) *Night Noise Guidelines for Europe* World Health Organisation Regional Office for Europe. http://www.euro.who.int/__data/assets/pdf_file/0017/43316/E92845.pdf

- A localised operation that will reduce waste haulage distances and is expected to be cost comparable with landfill gate fees;
- Delivering a significant reduction in net greenhouse gas (GHG) emissions;

In relation to the benefits indicated above, the most significant health outcomes in the community are expected to be benefits associated with job creation. Improvements in health and wellbeing in the local community can be enhanced by encouraging local employment at the facility.

16.9.3 Transport

An assessment of the proposed traffic generation and traffic impacts of the proposed WtE facility has been undertaken (Appendix 12).

The assessment identified that the traffic volumes generated by the proposed project are relatively low and expected to be easily accommodated by the existing road network. In addition, the proposed project includes car parking onsite as well as bicycle parking which will encourage active commuting. Based on current information, the health impacts from increased traffic are considered to be negligible.

16.9.4 Discovery and Disposal of Hazardous Waste

It is inevitable that during operations processing household residual waste, the discovery of hazardous waste will occur. Hazardous waste in this context includes for example, smoke alarms, batteries (household, car, phone, laptop and rechargeable) and light bulbs. These wastes contribute a very minor proportion of the residual household waste directed to the WtE facility and the facility design ensures that these wastes do not result in emissions above the legislated criteria. As outlined in Section 6.2.5 of this WAA, the facility will accept only non-hazardous MSW from contracted Councils and MRFs. These contracts will include clauses which define the types of waste that will be accepted, and waste that will not be accepted at the facility. Random compliance audits will be conducted on waste supplied from transfer stations of MRF's.

16.9.5 Other Hazards

A Preliminary Hazard Analysis (PHA) has been undertaken, and is summarised in Section 15.4.1 of this WAA and available in Appendix 19. In addition an Environmental Risk Assessment is presented in Appendix 4 and Section 5 of the WAA. In relation to safety risk issues that are relevant to the off-site community the PHA has considered and addressed the following:

- Generation and leakage of hazardous gases from the MSW feed pit leachate collection tank (methane). The facility will include a number of management measures to mitigate risks of explosion from these areas, including the use of negative pressures and forced ventilation;
- Release of syngas from the gasifier and other faults that may result in gases, dust, fires and explosions – these hazards are principally restricted to employees within the facility and a number of mitigation measures have been identified to minimise these risks.

No risks for the off-site community have been identified.

16.9.6 Community and Social Aspects

There are a range of benefits the overall project offers to the community (Section 16.9.2). This includes feelings of wellbeing in relation to sustainability and the reuse of waste for the local generation of electricity.

Given the location of the facility within an existing industrial area, situated at least 1.8 km from the nearest residential receptor, the facility is not expected to change the existing visual landscape, or change any existing uses of residential areas.

As outlined previously, there are no impacts on the off-site community in relation to changes in air quality, odour or noise that would adversely affect the health of the off-site community, provided appropriate migration measures are undertaken. Hence there are no equity issues that require further consideration in relation to the distribution of health-related impacts in the off-site residential areas.

16.1 Summary of the Health Impact Assessment Outcomes

Based on the evaluations presented above, a range of outcomes (both positive and negative) have been assessed in relation to health impacts relevant to the off-site community. Where negative impacts have been identified, these are considered to be negligible in terms of community health.

These outcomes, along with measures that could be implemented to enhance or mitigate the identified health impacts, are summarised in Table 16-6.

Health Aspect/Issue	Reference in HIA (Appendix 22)	Potential Health Impacts Considered	Impact Identified (positive or negative and significance)	Types of measures that could be implemented to enhance positive impacts or mitigate negative impacts
Air quality – Inhalation exposures	Section 5.4	Range of health effects associated with exposure to pollutants released to air from the proposed facility	**All exposures: Negative but negligible** More specifically: ■ No acute risk issues of concern ■ No chronic risk issues of concern ■ Particulate exposures are negligible	The proper operation and maintenance, and monitoring, of the pollution control/flue gas equipment.
Air quality – Multiple pathway exposures	Section 5.5	Range of health effects associated with exposure to pollutants released to air from the proposed facility, that may then deposit and accumulate in soil, homegrown fruit and vegetables and other homegrown produce (eggs)	**All exposures: Negative but negligible** More specifically: ■ No chronic risk issues of concern for multiple pathway exposures	The proper operation and maintenance, and monitoring, of the pollution control/flue gas equipment.
Odour	Section 5.6	Annoyance, stress, anxiety	**Not significant and negligible**	The proper operation of the refuse receival area as proposed to ensure fugitive odour emissions are effectively managed.
Noise	Section 6	Sleep disturbance, annoyance, children's school performance and cardiovascular health	**Modelled noise impacts: negligible noise impacts at residential receivers and hence negligible potential for health impacts**	Mitigation measures as proposed to be implemented. Monitoring of noise at commissioning to be undertaken, with review against the noise modelling,
Economic Environment	Section 7	Reduction in anxiety, stress and feelings of insecurity	**Positive improvements in health and wellbeing**	The identified positive outcomes in the local community can be enhanced by encouraging employment of people who live within the local community
Traffic and transport	Section 7	Injury or death, stress and anxiety.	**Negligible**	NA
Discovery and disposal of hazardous waste	Section 7	Possible injury if incorrectly disposed of	**Negative but minimal**	Appropriate management of contractors delivering waste through the use of contracts (with Waste Acceptance Criteria) and auditing of waste materials
Hazardous events	Section 7	Injury	**Negative but minimal. Negligible for the off-site residential areas**	Management and monitoring of all processes in the facility as proposed.

Health Aspect/Issue	Reference in HIA (Appendix 22)	Potential Health Impacts Considered	Impact Identified (positive or negative and significance)	Types of measures that could be implemented to enhance positive impacts or mitigate negative impacts
Community and social	Section 7	Wellbeing, changes in levels of stress and anxiety	**Positive outcomes** enhancing feelings of wellbeing for aspects such as sustainability	These health impacts relate to community perceptions and trust. It is therefore important that the positive impacts associated with the project are enhanced within the local community and community consultation is continued. It is important that an effective communication/ community consultation program is maintained throughout the construction, commissioning and operational phases of the project.

Table 16-6: Summary of HIA Outcomes and Enhancement/Mitigation Measures