



APPENDIX R

Sustainability Assessment Report



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Orange City Council

Orange Resource Recovery and Waste Management Project

Environmental Sustainability Assessment

September 2009



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1. Introduction

The environmental sustainability of the project has been assessed using a Life Cycle Assessment methodology. This approach has enabled the project to be assessed and benchmarked against a base case option. Environmental impact categories that are common to waste management systems analysis are reported against including:

- ▶ Global warming potential,
- ▶ Solid waste to landfill
- ▶ Resource use benefits (soil structure and water use).
- ▶ Air and water pollutant loads (considered for a limited range of transport air toxins and landfill).

The two options compared in terms of environmental sustainability include:

Option 1. The Project – Organics composting and residual waste baling

This option is based on waste separation at source to maximise the value of recycling. It includes separate food and garden waste collection for Orange City Council, and enclosed composting of this material at Euchareena Road. It also includes resource recovery of recyclables and baling of residual waste at Ophir Road, for landfill disposal at Euchareena Road.

Option 2. Base Case - Transport to remote landfill

The second option involves the transfer of residual wastes to a remote landfill such as Dubbo, an assumed 150 km away from the current Ophir Road site. This option would involve bulk haulage of waste by semi trailers, B doubles or road trains. There is no additional resource recovery or composting of food and garden organics in this option.

1.1 Scope of Assessment

The following parameters have been modelled for each of the two options:

- ▶ Global Warming Potential of landfilled wastes using the NGERs calculation procedures (tCO₂-e/yr);
- ▶ Landfill space – valued based on amenity losses (\$/yr);
- ▶ Toxicity impacts of landfilled waste (\$/yr);
- ▶ Soil Property Benefits of composting (water retention, soil structure, salinity, acidification);
- ▶ Landfill stabilisation benefits arising from toxicity reduction through organics removal;
- ▶ Benefits of compost avoided products (fertiliser, urea, KCl, pesticide);
- ▶ Greenhouse gas impacts of waste transfer (Ophir Road RRC to Euchareena Road RRC vs Ophir Road RRC to Dubbo);
- ▶ Greenhouse gas impacts of extra food and garden waste collection services (preferred option only);



- ▶ Transport air toxins impacts of waste transfer (Ophir road to Euchareena Road vs Ophir road to Dubbo; and
- ▶ Transport air toxins impacts of extra food and garden waste collection services (preferred option only).



2. Methodology

2.1 Overview

One underlying method for the environmental assessment of two waste management systems is Life Cycle Assessment (LCA). Life Cycle Assessment is internationally recognised (International Standard ISO 14040: 1997) as a technique for assessing the environmental aspects and potential impacts associated with a product or service, by:

- ▶ Compiling an inventory of relevant inputs and outputs of a product (or service) system;
- ▶ Evaluating the potential environmental impacts associated with those inputs and outputs;
- ▶ Interpreting the results of the inventory analysis and impact assessment phases in relation to the objectives of the study.

This assessment has involved the application of publicly available LCA data within the context of an LCA assessment framework to determine the benefits of the preferred project over the business as usual option. This is achieved by using published data on the value of individual inventory loads extrapolated across the data using equivalence factors.

This is conducted in much the same way as a dollar value for carbon dioxide can be applied for other greenhouse gases such as methane using an equivalence factor. The financial valuation of environmental benefits is used to simplify the results and make the assessment more meaningful. It is a relative assessment between the two options and should not be used as an absolute value.

2.2 The Assessment Steps

The steps involved in this environmental sustainability assessment are:

1. Detailed system characterisation and waste flow analysis;
2. Assessment of system components by LCA data acquisition and application to system boundary;
3. Gap analysis to define unquantified impacts and inventory data collection as appropriate; and
4. Impact assessment and financial valuation of inventory data.

Step 1. Detailed system characterisation and waste flow analysis

Data was analysed for the two options using detailed process flow charts (Appendix 1) and waste flow analysis. The environmental assessment is a comparative study and as the assessment of alternative management options involved the same treatment for kerbside recycling and C&D waste and recycling, for the purpose of the final benefit assessment, these have been removed from the system.

The final waste flow data is for an estimated 35,000 tonnes of residual waste per year including the organic waste fraction. Under the preferred project, 14,000 tonnes is diverted to composting each year including biosolids.



Step 2. LCA data acquisition and application to system boundary

LCA data has been modelled in Australia and NSW for all of the main aspects of the integrated waste solutions under consideration for options 1 and 2. As such, it has been possible to model the systems using existing data where it was applicable and current. A summary of the unit processes in the waste management system and the data referenced is provided in Table 2.

Data was considered to be fit-for-purpose if the management option and data set matched at a generic level – ie the data related to the generic treatment process (such as composting) and it was not necessary to obtain data for a technology patent; and the data was available as a factor using a relevant functional unit – per tonne (or equivalent) for waste and compost and per km (or equivalent) for transport.

Life cycle data dates as new approaches become standardised and as new data becomes available. The project team assessed the quality of LCA data and undertook analysis to update the data as required. This included modification of referenced data on compost and recycling benefits assessment as these were modified for recent updates in methodological approaches for greenhouse gas accounting according to the national greenhouse gas accounting technical guidelines, NGERs (DEC, 2008).

Step 3 and 4 - Gap analysis, inventory data collection and impact assessment

Where LCA results were not fit-for-purpose, inventory data was collected and then an appropriate valuation technique applied to the data. This approach was taken for transport impacts, sequestration of carbon from compost and avoided peat substitution from compost.

The valuation data is summarised in Table 1 below. The use of inventory data for unit processes within the waste system is summarised in Table 2.

Table 1 Inventory Valuation Data

Pollutant	Assume valuation A\$/tonne pollutant	Source
CO ₂ -e	30	Within a valid range under the CPRS (DEC, 2009)
PM ₁₀	147,400	Beer. T., 2002
Non-methane hydrocarbons	19,300	Beer. T., 2002
Nitrous oxides	870	Beer. T., 2002



2.3 Summary of System Assumptions

Final approaches to modelling results are summarised in Table 2 below.

Table 2 System assumptions and assessment approaches by unit process

Unit Process	System assumptions	Approach
Waste collection	<p>Option 1. Assume net collection for fortnightly garbage, weekly food and garden and fortnightly recycling is 500,000 km/yr.</p> <p>Option 2. Assume net collection of 375,000 km/yr for weekly garbage and fortnightly recycling.</p>	<p>Inventory data and NGA factors</p> <p>Valuation as per table 2</p>
Waste transfer to landfill	<p>Assume the assumptions are as follows:</p> <p>Option 1. Transfer distance of 40 km for a total of 93,000 km.</p> <p>Option 2. Transfer distance of 150 km for a total of 369,000 km.</p> <p>No backhaul assumed for either option – i.e. - truck returns empty.</p>	<p>Inventory data and NGA factors</p> <p>Valuation as per table 1.</p>
Kerbside recycling	Assume equivalent benefits across options	No difference assumed between systems.
C&D Recycling	Assume equivalent benefits across options	No difference assumed between systems.
Organics Recycling	<p>Assume compost benefits as per DECC, 2005 update data for more recent sequestration and avoided product values.</p> <p>For toxicity reduction from carbon reduction to landfill use 90% (Stegmann, 1999).</p>	<p>Adapt and apply final LCA data and NGA factors</p> <p>See Appendix A for compost valuation.</p>
Waste to landfill	<p>Assume landfill modelling as per NGERs 2008 with default NSW composition for MSW, C&I and C&D wastes. Assume no gas recovery with no legacy emissions.</p> <p>LCA data emissions attributable to each tonne of waste over the active life – 30 years.</p> <p>For toxicity data, assume average between available published valuation data (NPCC, 2001; PC, 2007).</p> <p>Updated amenity valuation (NSW EPA, 1996) for current property price index.</p>	<p>Adapt and apply final LCA data NGERs modelling</p> <p>Valuation as per table 1.</p>
Waste compaction and baling	<p>Assume compaction density of waste to be equivalent for bales and compacted landfill waste from 0.3 t/m³ to 1 t/m³.</p> <p>Assume plastic impact negligible and less than 5% significant to final results.</p>	No difference assumed between systems.



3. Results

3.1 Comparative Environmental Sustainability Assessment

Based on the assumptions listed, the project delivers a net environmental benefit, over the business-as-usual option, of \$56 dollars per tonne. These benefits translate to a net annual benefit of \$3.2 million per year.

As summarised in Table 3, the greatest benefits arise from the stabilisation of landfill emissions to air and water as a result of carbon removal from waste. The next most significant benefits arise from compost application and these include soil property benefits such as improved water retention in soil, reduced salinity and soil structure decline, as well as the benefits from products avoided by the use of compost including fertiliser and pesticides. Based on the valuation offered by monetisation, climate change benefits from avoided landfill amount to less than 10% of the overall benefit.

It is important to note that the financial valuation of environmental benefits is conducted only to simplify the results and make the assessment meaningful. It is a relative assessment between the two options and should not be used as an absolute valuation.

Table 3 Comparison of costs associated with each option

Net Impact (\$/yr)	The Project - Organics composting and residual waste baling	Base Case - Transport all waste to Dubbo	Benefits of Project vs Base Case
GHG Assessment Waste - LCA emissions (\$/yr). Assumes \$30/t CO ₂ e	\$1,019,591	\$1,153,830	\$134,238
Amenity loss from landfilled waste (\$/yr)	\$254,075	\$367,668	\$113,593
Toxicity impacts of landfill. Stabilisation assumed for carbon removal.	\$130,917	\$2,066,456	\$1,935,539
Soil Property Benefits (water retention, structure, salinity, acidification)	-\$458,967	-	\$458,997
Compost avoided products (fertiliser, urea, KCl, pesticide)	-\$506,409	-	\$506,409
GHG Assessment Transfer impacts	\$7,530	\$32,129	\$24,599
GHG Assessment Collection impacts	\$49,249	\$36,937	-\$12,312
Transport air toxins - Transfer	\$15,261	\$60,626	\$45,365
Transport air toxins - Collection	\$49,249	\$36,937	-\$12,312
Total (annual)	\$535,547	\$3,735,870	\$3,200,324
Total stabilisation for organics removal. LCA accounting			\$56 per tonne



3.2 Sensitivity Analysis – Stabilisation of Landfill

The dominant benefit of the system arises from the reduced pollutant load to air and water from landfill after organics removal. This stabilisation benefit of carbon removal has been highly studied and is the driving force behind the European landfill directive to stabilise waste prior to landfill.

If this benefit is ignored, the net environmental benefit of the system remains strong at \$2 M/yr or more than \$35/t. This is indicated in Table 4 below.

Table 4 Benefits assessment assuming no stabilisation

Net Impact (\$/yr)	The Project – Organics composting and residual waste baling	Base Case - Transport all waste to Dubbo	Benefits of Project vs Base Case
Toxicity impacts of landfill (\$/yr). No stabilisation assumed	\$1,309,168	\$2,066,456	\$757,288
Total no stabilisation for organics removal. LCA accounting	\$1,713,798	\$3,735,870	\$2,022,073
Total no stabilisation for organics removal. LCA accounting			\$35 per tonne



4. References

Beer. T., Valuation of pollutants emitted by road transport into Australian atmosphere, 16th clean air environment conference, New Zealand, August 2002

DECC, 2005 Assessment of Garden Organics Collection Systems, Nolan-ITU

European Commission, DG Environment, Waste Management Options and Climate Change, 2001 by AEA

International Standard ISO 14040: 1997 (E), Environmental Management – Life cycle assessment – principles and framework

New South Wales Environment Protection Agency, (1996) Regulatory Impact Statement - Proposed Waste Minimisation and Management Regulation

NPCC, Nolan-ITU and SKM Environmental, Independent Assessment of Kerbside Recycling in Australia, January, 2001

Stegmann R., (1999). Influence of mechanical-biological pretreatment of municipal solid waste on landfill behaviour. Waste Management and Research.



Appendix A

Reference Data



Appendix A - Environmental Valuation – Source Data and Process Flow Charts

Compost

Compost valuations are taken largely from the report for DECC, Assessment of Garden Organics Collection Systems, as per tables below.

Compost valuations

Compost Application Benefits	\$/tonne Compost	Source
Water Retention	-23.70	DECC, 2005
Soil Structure Improvement	-1.69	DECC, 2005
Acidification	-2.54	DECC, 2005
Salinity	-2.06	DECC, 2005
Avoided Fertiliser (P)	-22.48	DECC, 2005
Avoided Urea (N)	-6.64	DECC, 2005
Avoided KCl ((K)	-0.05	DECC, 2005
Nitrous Oxide Emissions	-1.21	DECC, 2005
Increased yield	-0.89	DECC, 2005
Avoided Pesticide	-1.82	DECC, 2005
Carbon Soil Sequestration	-2.73	Updated with AEAT, 2001
Carbon Displacement (Avoided Peat)	-2.6324	Updated with AEAT, 2001

Compost data and sources

Organics Recycling		Units	Assumptions/ Data Sources
Process emissions Scope 1 & 2	0.0008	tCO ₂ -e/t	NGERS, 2008
Sequestration (LCA derived - non NGERS)	-0.018	tCO ₂ -e/t compost	Assume 10% of DOC in compost is sequestered (AEAT, 2001). DOC of compost is 18%.
Avoided Peat (LCA derived - non NGERS)	-0.15	tCO ₂ -e/t compost	Peat substitution provides a credit of .997 t CO ₂ -e/t compost (AEAT, 2001), assume in regional NSW the peat market at 15% of compost market and use economic allocation rather than theoretical availability. European Commission, DG Environment, 2001 by AEA Technology,
Total	-0.1672	tCo ₂ -e/t compost	



Landfill Data

Landfill valuations in the Australian literature are scarce to non-existent. Internationally and in Australia, there is data available on pollutant loads to air and water from landfill, including trace contaminants but there is a need to validate data and apply research to estimate monetary values of these loads. In the absence of better data, an average of the two data sources listed below has been used.

The Independent Assessment of Kerbside Recycling in Australia (NPCC, 2001) provides an average value of landfill loads of 110 \$/t with the qualifier that this valuation applies only in the context of the goal of the study which is an assessment of the value of management options for used packaging. The study used life cycle assessment. The Productivity Commission provided an unsubstantiated estimated of landfill pollutant loads of 2 \$/t (Productivity Commission, 2006).

Landfill Valuations

Valuation	Productivity Commission (2006)	Nolan-ITU, 2001
Pollutant load valuation - air emissions from landfill (\$/t)	1	71.5
Pollutant load valuation - water emissions from landfill (\$/t)	1	38.5
Net Pollutant Load (\$/t)	2	110
Average pollutant load (\$/t)	56	

Transportation Data

Transport data assumes 40 km distance from Ophir Road RRC to Euchareena Road RRC and 150 km to Dubbo. NGA factors as presented below are used.

Transport

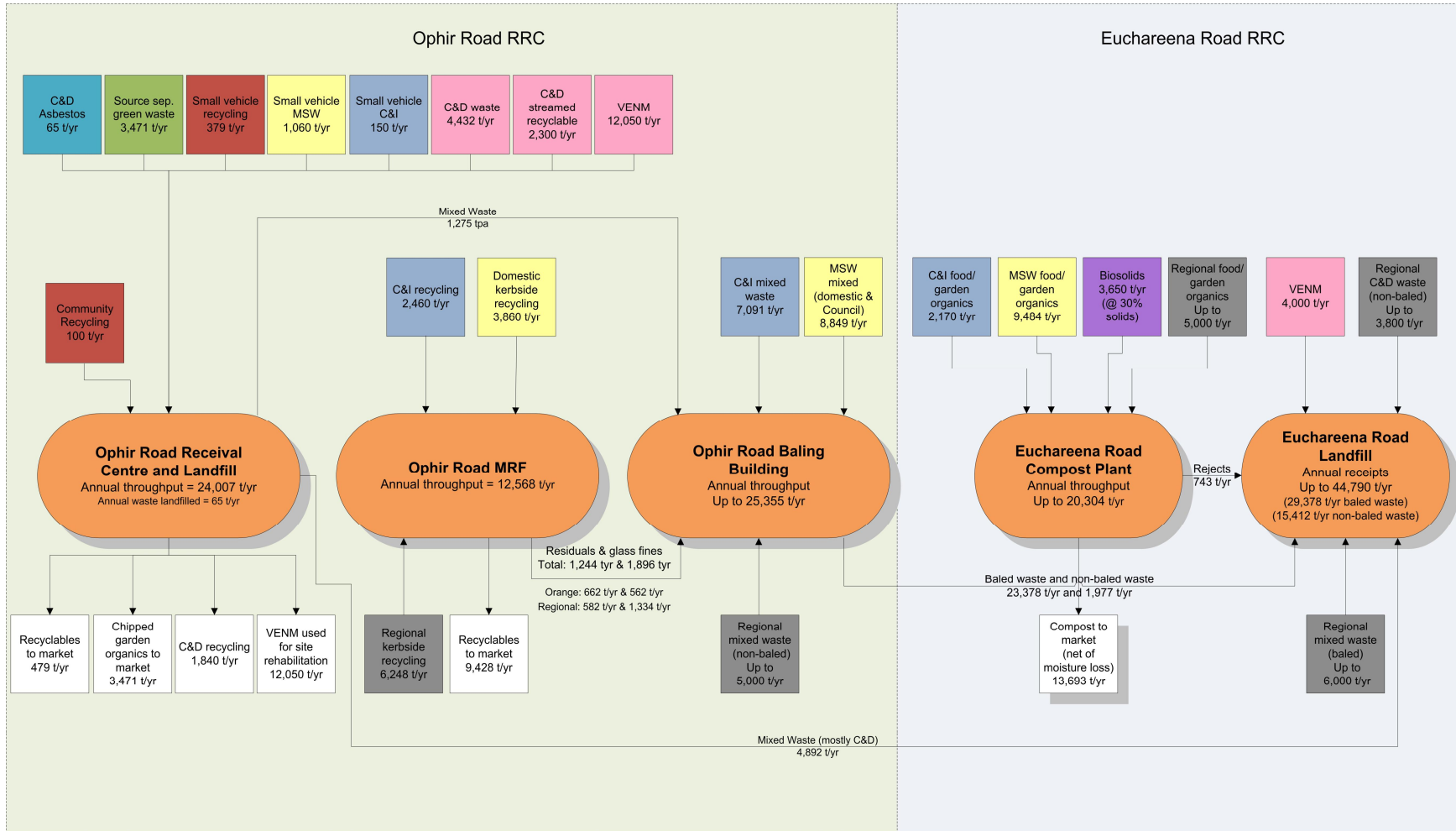
Emissions Factors and Coefficients

Emission source	Standard Used	EF for Scope 1	EF for Scope 2	EF for Scope 3
Purchased electricity	National Greenhouse Account factors, 2008 (AGO)	n/a	0.89 kg CO ₂ -e/kWh	0.17 kg CO ₂ -e/kWh
Transport (mobile fuel combustion)				
Diesel	National Greenhouse Account factors, 2008 (AGO)	2.7 t CO ₂ -e/kL	n/a	0.2 t CO ₂ -e/kL

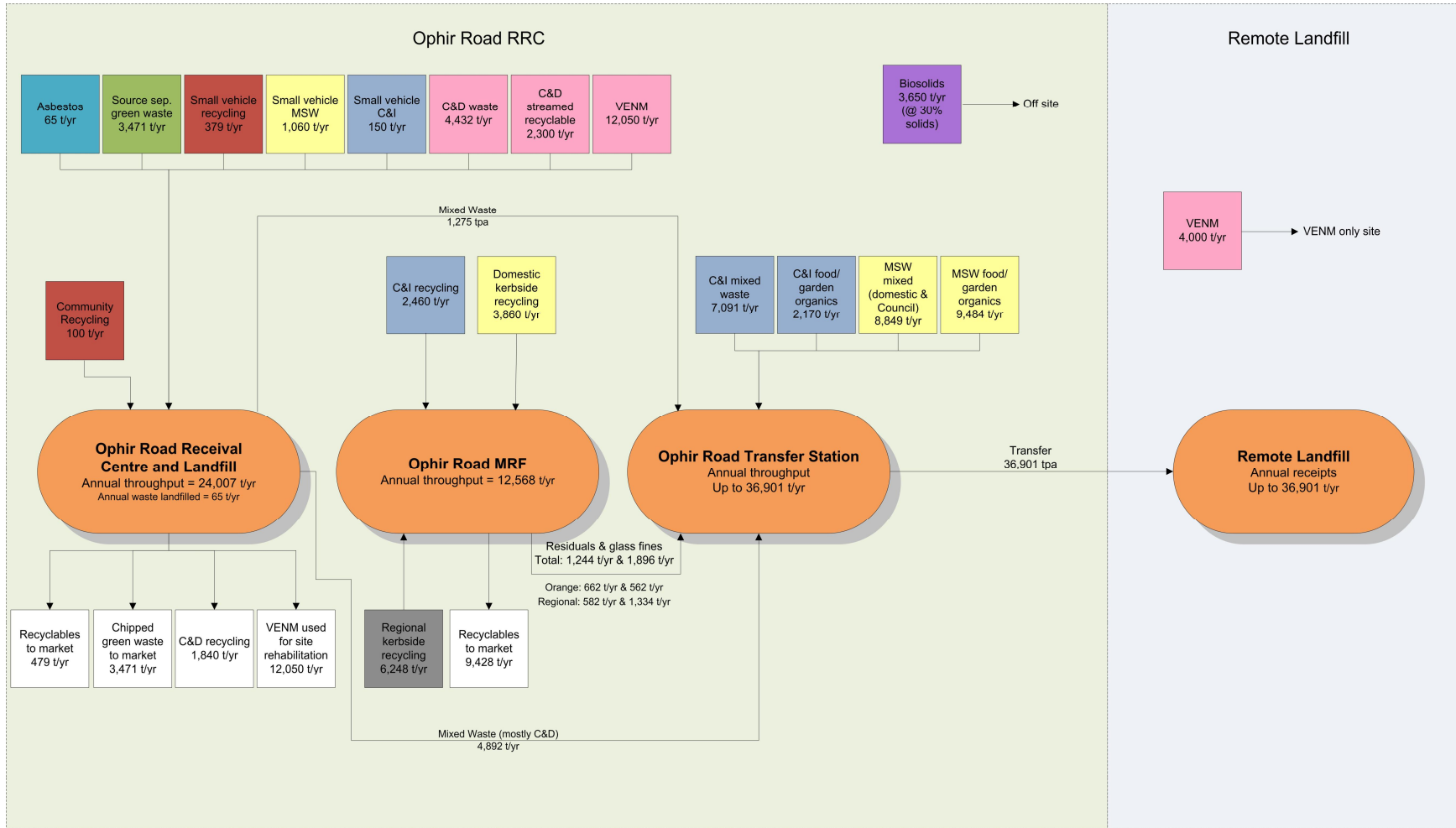
Landfill

Landfill pollutant load valuation has been controversial in Australia.

Recognised pollutant load data are less disputed than valuations and there is a need to subject the inventory data to contingent or other valuation in order to provide the Australian community with a landfill pollutant load valuation.



Waste flows for Option 1 – the Project



Waste flows for Option 2 – Base Case (Remote Landfill)



GHD

10 Bond Street Sydney NSW 2000

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T: 2 9239 7100 F: 2 9239 7199 E: syndmail@ghd.com.au

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
01	L Philpott	D Gamble	<i>David Gambles</i>	D Gamble	<i>David Gambles</i>	17/6/09
02	A Montgomery	D Gamble	<i>David Gambles</i>	D Gamble	<i>David Gambles</i>	1/9/09