Central
Local Government Region of South Australia
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Municipal organics management in regional Australia

Final report April 2015

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Executive Summary

The Central Local Government Region of South Australia (CLGR) received a grant from the Local Government Research and Development Scheme (LGR&DS) to investigate approaches to organics management suitable for implementation by regional councils. The scope of the project encompassed composting trials undertaken by three Central Region councils, the development of an organics collection and processing cost model and the compilation of case studies from across Australia. Zero Waste SA (ZWSA) contributed additional funding to the composting trials.

A low-tech, low cost method of composting developed as part of the NSW City to Soil Project was trialled at three council-owned transfer stations at Clare, Mallala and Peterborough. Kerbside collected food and garden waste was processed at Mallala, whilst the other sites utilised a mix of garden and timber waste deposited at the transfer stations. The process differs from conventional open windrow composting in that it requires less frequent watering and turning and the material is covered. The aim of the local trials was to establish whether the method could be successfully replicated under South Australian conditions, at rural transfer stations utilising existing staff and equipment.

The consulting firm, Blue Environment, was commissioned to develop a model to assist councils in evaluating the cost implications of introducing a kerbside organics collection, along with various processing alternatives. Currently, only six of the fifteen Central Region Councils operate a 3-bin system and, of these, only two collect both food and garden organics in the third bin. Where kerbside organics recycling is not available, 50% of a typical household garbage bin consists of organic waste, the bulk comprised of food scraps (Hyder Consulting, 2012). By diverting this material away from landfill, councils can potentially save on disposal costs, whilst realising significant environmental benefits.

Following extensive research and interviews with municipal waste officers from across Australia, seven case studies were selected to be part of this report. These represent a broad cross-section of the many different approaches taken by regional councils in dealing with organic waste and will hopefully inspire local councils to consider how they might foster organics recycling in their own communities.

The composting trials produced a product that could not properly be classified as compost, according to the Australian composting standard (Standards Australia, 2012), but was nevertheless free from pathogens and weed seeds and suitable for use as a soil improver. The process itself was more labour intensive than anticipated and not feasible for a sole operator to undertake, with all the other demands on their time during transfer station opening hours. Nevertheless, if additional time and staffing were made available and certain procedural improvements implemented, it is probable that a high quality,

pasteurised product could be achieved. Guidelines are provided in Appendix 1 to assist with implementing the process at other sites.

Councils are encouraged to trial the Organics Management Options Model, which is an MS Excel-based tool. They can experiment with varying different parameters such as the frequency of collection or whether there is 'garden only' or 'food and garden organics' collected to gauge the impact on cost. There is also the opportunity to assess the respective cost implications of councils using regional, sub-regional or 'local' organics processing facilities. The work undertaken in the composting trials is representative of the third option; whilst transport costs were minimised through this approach, there were limitations in the volume and types of materials that could be processed and significant resource constraints. Given sufficient interest councils might explore the potential for a regional or sub-regional processing facility. Collaborative funding arrangements would allow consideration of more advanced processing technologies including several described in the case studies section.

Introduction

Organic waste management poses a significant problem to Local Government authorities, particularly in regional areas where recycling costs are inflated by the need for long-distance haulage to processing sites. A desire on the part of Central Region councils to investigate the feasibility of local solutions to this problem became the impetus for the current project. Three Councils – the District Council of Mallala, Clare and Gilbert Valleys Council and the District Council of Peterborough – agreed to conduct composting trials at their transfer stations, utilising a low-tech, minimal handling process adopted by participants in the City to Soil Project in New South Wales. The councils provided the labour and heavy machinery required to establish and manage the composting piles. Additional necessary equipment and services were purchased with funding from the LGR&DS and ZWSA.

To date, the South Australian Government has not established municipal landfill diversion targets for regional councils requiring only that they maximise diversion to the extent practically achievable (ZWSA, 2011) . Nevertheless, the CLGR is committed to implementing high-performing waste management systems that are cost-effective, responsive to resident needs and achieve high rates of waste diversion (CLGR, 2014). The majority of Central Region councils do not currently provide a kerbside food and garden organics (FOGO) collection service; however, the introduction of such a service is likely to provide the best opportunity for significantly increasing recycling rates above present levels.

There is a widespread perception that the costs associated with collecting and recycling FOGO would be prohibitive in rural areas and communities would be unwilling to pay for the service. It is further argued that the service is unnecessary, given that the majority of country residents recycle their food and garden waste at home. This last assumption is challenged by data obtained during the course of the ZWSA food waste pilot in 2009-10 (EC Sustainable Environmental Consultants, 2009(a)-(d)), and a more recent study undertaken by the Fleurieu Regional Waste Authority (One World Environmental Solutions, 2012). The results of audits carried out as part of these investigations, demonstrated that food waste accounts for a similar proportion of the total weight of domestic garbage as found in urban centres, that is, 30-40%.

In order to assist Councils in evaluating whether the introduction of a kerbside food and garden collection service could be achieved at a price acceptable to their residents, the consultancy Blue Environment was commissioned to model the costs of kerbside collection and various processing alternatives, applicable to the Central Region. The resulting cost model is an MS Excel based tool that allows the user to see how changing different variables (e.g. frequency of collection, location of the processing facility etc.) will affect system performance and costs. A user guide is provided in Section 2 of this document and the model is attached as Appendix 3.

The third and final section of the report details the results of investigations into local and interstate approaches to municipal organics management, with a regional focus. A literature review was undertaken and telephone interviews conducted with relevant personnel from regional waste associations and councils across Australia. The result is a collection of case studies that provide an overview of the diversity of solutions developed to address a shared problem: how to manage municipal organics cost-effectively, satisfying community expectations and delivering the best environmental outcomes possible.

Section 1: Central Region Compost Trials

Background

Waste management is a large expenditure item for Local Government and there are few opportunities for cost recovery, especially for waste items collected outside of regular kerbside services. Transfer station gate fees only partly cover the costs associated with transport and disposal, councils being mindful that if they charge too much it may lead to a spike in illegal dumping. This is certainly the case with organic waste, large volumes of which are deposited each year by residents. Councils themselves generate considerable quantities of green waste through tree trimming and public park maintenance.

The options for appropriately disposing of this material are limited. The *Environment Protection (Waste to Resources) Policy 2010* imposed a landfill ban on vegetative matter effective, state-wide, from September 2010. Most councils engage contractors to shred or chip the material, which they have been using to remediate their now-defunct landfill sites. Post-closure remediation works are coming to an end in many areas, and councils are faced with the dilemma of how to dispose of this burgeoning waste stream. Organics recycling by commercial, Adelaide-based facilities is not economically viable for most regional councils, because of the additional high cost of transporting the material to these sites. Selling or giving away the raw mulch to the public is not an acceptable option either, given the risk of contamination by foreign objects, pathogens and weed seeds.

Composting is the process by which organic wastes are biologically transformed by the action of various micro-organisms, in the presence of oxygen, to produce a humus-like substance that is beneficial to soil health. The rate at which decomposition occurs is directly proportional to the biological activity within the composting system, and the heat that is generated. Hot composting is generally favoured by commercial composters because of the faster processing time and also because it can guarantee the destruction of weeds and pathogens. One approach to 'hot composting', popular because of its relatively low capital and operating costs, is open windrow composting. Although a number of metropolitan and regional councils around Australia have adopted this approach (see Case Study 1), processing food and garden organics collected at the kerbside to produce a high-value end product, it is not considered feasible for implementation by CLGR councils. The degree of active management required to maintain the micro-biological conditions necessary to produce a quality product, not to mention the infrastructure requirements, are beyond the human and financial resources of small, regional councils.

A promising alternative solution has emerged in recent years with the development of a static, covered composting process, successfully implemented by a number of regional councils in New South Wales and Victoria. This method is promoted as a low-cost option suitable for remote sites that have no power, limited water and minimal machinery; it is also said to require little human intervention. Unlike open windrowing, the organic matter is piled under cover and is exposed only to apply water and a compost accelerator at the beginning and 4 to 6 weeks into the process. Coverage prevents the material drying out, eliminating the need for frequent water replenishment. The use of a biological additive that contains a variety of composting microorganisms is claimed to address the risk of oxygen depletion, reducing how often the material needs to be turned. The balance of carbon to nitrogen is also said to be less critical in this process, in comparison with alternative composting methods, because the additive contains both nitrogen and carbon fixing bacteria.

A presentation by City to Soil Project Manager, Simone Dilkara, at the 2012 Central Region Waste Forum, stimulated interest in testing the static, covered composting method under local conditions. Subsequently, three Central Region councils committed to participating in a trial: the District Council of Mallala (DCM), Clare and Gilbert Valleys Council (CGVC) and the District Council of Peterborough (DCP). With funding contributions of $25, 000 from the Local Government Association Research and Development Scheme Fund and $12,000 from

Zero Waste SA, planning for the project commenced with the intention of investigating whether the City to Soil composting process could be successfully implemented with the human and technical resources available at small, rural transfer stations.

It was proposed that the end product of the composting process would be utilised by councils in their parks and garden operations, hence, there was no requirement to demonstrate compliance with AS 4454-2012, the voluntary Australian Standard for Composts, soil conditioners and mulches (Standards Australia, 2012), for the purpose of selling the product. However, in order to minimise the risks associated with the presence of weed seeds, plant pathogens and physical contaminants, it was agreed that the product would be tested against the standard to verify that pasteurisation had occurred.

Methodology

Trial sites

Composting sites were established in council transfer stations at Clare, Mallala and Peterborough.

Composting works that produce in excess of 200 tonnes of compost per annum are classified as an activity of environmental significance under Schedule 1 of the *Environment Protection Act 1993* and, as such, require a license in accordance with Section 36 of the Act. It was agreed that each site would generate less than the prescribed amount and councils would not therefore require an amendment to their existing transfer station licenses to participate in the trial. Nevertheless, the Environmental Protection Authority (EPA) was involved in the planning phase of the project and provided guidance on establishing and managing the composting operations.

It was recommended that a hard stand, preferably formed of compacted rubble, be established with a slight gradient to assist drainage. Suitable locations were identified at each transfer station; however, no attempt was made to alter the existing substrate other than compacting the surface. Areas of approximately 20 x 30 metres were delineated at each site for the purpose of composting. There was no history of contamination in these locations.

Equipment & inputs

It was intended that the trials would replicate the methodology adopted in the City to Soil Project, a highly successful endeavour involving four regional NSW councils that ran between 2007 and 2011 (Pamphilon & Chevalier, 2011). Interestingly, the fundamental elements of the process were first described in the 1940s by Sir Albert Howard (1943) and Maye Bruce (1946).

The static, covered composting method is designed to: require minimal labour, machinery or composting expertise; operate in exposed sites with no power and minimal water; operate consistently with variable feed stocks, including putrescible organic waste; and manage odour and other nuisance concerns (Dilkara, 2010). The process utilises a biological additive that stimulates microbial activity giving rise to temperatures that are sustained at sufficiently high levels, that is, in excess of 55^0C, to achieve pasteurisation. The literature suggests that there is no need to pre-shred material and piles do not need to be turned as frequently as with conventional windrow composting (Beavis, 2010).

Machinery for forming and turning the compost was supplied by each of the CLGR councils; this consisted of a bobcat at Mallala, a backhoe at Peterborough and a tele-handler at Clare. A fire truck was used to irrigate the piles at Peterborough. Discarded tyres were set aside to use as weights to secure the compost covers. The following additional equipment was supplied with project funding:

- heavy duty tarpaulins to cover the compost piles
- temperature probe
- water tank and spray unit (DCM and DCP supplied their own 1000L tanks)
- data-loggers
- irrigation hoses and fittings
- moisture meter (CGVC and DCP)

The following inputs were used to create the compost:

- water: sourced from the water storage pond at Clare, the bore at Peterborough and transported from the depot to the transfer station at Mallala
- shredded garden waste from council tree trimming and resident gardens (CGVC and DCP); in Clare, this was mixed with chipped timber waste, including a portion of CCA treated pine
- kerbside-collected food and garden organics (DCM)
- commercial composting agent (a.k.a. inoculant)

Technical Advice

Project support was provided by a steering committee formed with representation from the EPA (Kate Hamer), Zero Waste SA (Justin Lang) and the LGA (Simon Thompson). Guidance on procedural and quality assurance matters was offered by Jason Mitchell, Horticultural Team Manager from Coolamon Shire Council, Kellie Walters of VRM Pty Ltd, and Dr David Harrison, an Adelaide-based composting and vermiculture expert.

Process

The guidelines initially supplied to transfer station staff tasked with managing the composting process were adapted from one of the City to Soil project factsheets (Dilkara, 2010); this outlines a seven-stage process as follows:

1. Material should be deposited onto a hardstand area, spreading out as widely as possible to facilitate picking and spraying
2. The feedstock should be picked over by hand to remove all visible contaminants.
3. Inoculate the material with a commercial composting accelerant using a pressure spray.
4. Pile material into a windrow and cover with a tarp held down by tyres.
5. Uncover the pile after 4-6 weeks, spread broadly and remove any contaminants.
6. Mix well, re-spray with water and inoculant, re-pile and cover for another 4-6 weeks.
7. Screen with a trommel.

Additionally, staff were requested to record pile temperatures, where possible, on a daily basis at both ends of each pile. This was to ensure that the material had been subjected to sufficiently high temperatures over a long enough period to guarantee the elimination of pathogens and weed propagules.

The formation, management and monitoring of the compost piles was undertaken in almost all cases during transfer station opening times. At Mallala, establishment and treatment phases were implemented by two council staff members assisted by the project officer. In Clare and Peterborough this work was undertaken by the (sole) transfer station operator in conjunction with the project officer; the exception being on screening day when additional staff needed to be brought in.

Eight piles of approximately 7x2x1.5 metres were created at Mallala in February and March 2014, each comprising a truckload of food and garden organics delivered directly from the kerb. Half were treated with commercial inoculant at the recommended dilution rates (inoculated or treatment piles); the other half received water only (un-inoculated/control piles). It was intended that the results from inoculated versus un-inoculated piles would be compared to establish whether there was an advantage in using the commercial composting agent. If an acceptable product could be produced without the inoculant, this would be a significant cost-saving. A similar approach was taken at Clare, where four piles (2 inoculated, 2 un-inoculated) were established in February and March, although the feedstock there was a mix of garden and timber waste that had been shredded by a mulching contractor several months earlier.

At the first turning of piles at Mallala and Clare in April it was apparent that very little decomposition had occurred. The literature suggested that by this time the material should be dark in colour, of a uniform texture and still quite moist; by contrast, the piles at both sites were very dry and the source material was still clearly distinguishable. This result was unexpected, particularly at Mallala where temperatures exceeding 60^0C were consistently achieved.

Advice was sought from the supplier of the compost inoculant. On the basis of the establishment parameters (feedstock, water and inoculant application rates, pile dimensions and coverage details) and following inspection of site photographs, a number of issues were identified. It was suggested that insufficient water had been applied in the first instance; the piles were too small and, especially, too low and the tarpaulins needed to be more tightly secured.

Subsequently, piles were consolidated at Clare and Mallala, leaving one inoculated and one un-inoculated pile at each site. A further large inoculated pile (15x6x1.6 metres) was established under black plastic at Clare, and two piles (inoculated and water-only) were formed at Peterborough (14x4x1.6 metres) consisting of shredded garden waste. Care was taken to ensure that sufficient water was added to achieve an optimal moisture level of between 50-70%. This was tested by squeezing a handful of wet material; if water ran out, then the material was deemed wet enough. In order to ensure the even reticulation of water throughout the piles, the material was formed into an 'M-profile'.

Achieving the desired moisture level proved extremely difficult, particularly at Clare and Peterborough where the feedstock was predominantly woody waste. To put this into context, the literature reported that approximately 150-200 litres of water was applied to each 10 tonne of feedstock at Condobolin (NSW) during the City to Soil Project; by contrast, 2000 litres of water were utilised on an equivalent quantity of material at Peterborough (Dilkara, 2010). The process was time and labour intensive: the water did not easily penetrate even a shallow layer of material and it was necessary to continue hosing it whilst it was being turned and formed into a pile. The use of a fire truck at Peterborough speeded up the process of irrigation considerably.

Because of the presence of food waste, achieving the requisite moisture level was less of a problem at Mallala. Instead, it was recommended that additional garden waste be added to the piles there to improve structure. A certain amount of air space is required to ensure optimal conditions for microbial activity.

The transfer stations in all three council areas are situated out of town and only opened three days a week and so it was not convenient for staff to measure temperatures on a daily basis. Accordingly, it was suggested that electronic data-loggers be inserted into the piles to enable continuous monitoring. These were encased in water proof bags for protection. Manual measurement continued whenever possible to provide a back-up to the digital record.

Piles were turned at the three sites in July/August. High winds during winter made it difficult to secure the tarpaulins with gusts lifting up their edges and dislodging the tyres holding them down. Old carpet, railway sleepers and sandbags were somewhat effective in addressing this problem; however, they also increased the time and difficulty associated with uncovering and re-covering the compost.

Neither manual or electronic measurements provided confidence that pasteurisation had occurred during the second treatment phase in Clare and Peterborough and the material did not appear to be breaking down; hence, it was decided to proceed to a third treatment round at these sites in October. No further intervention was attempted at Mallala, where the material had already undergone multiple treatments; it was simply left under cover to mature.

The sub-optimal pile temperatures recorded at Clare and Peterborough over the winter months were again attributed to moisture-deficit; the material was too dry to support the microbial activity necessary for pasteurisation to occur. In order to address this problem extra effort was expended on saturating the material and dripper lines were set up on top of the piles, but underneath the tarpaulins, which could be turned on and off as required. Moisture meters were supplied to enable staff to gauge moisture levels within the piles.

Compost screening took place in January and early February 2015, on site, utilising a trommel with 20mm screen hired from Mini-pave Bitumen, Port Pirie. Samples were taken in accordance with the sampling protocol described in AS 4454-2012 and delivered on the same day to Veolia Environmental Services Laboratories for analysis.

Quality Assurance

AS 4454-2012 is a voluntary industry standard that establishes minimum requirements for the physical and biochemical properties of composts and related products and the labelling of these products for sale (Standards Australia, 2012). The aim of the standard is to facilitate the recycling of organic materials (such as garden waste, food scraps, animal manures and biosolids) whilst ensuring this practice has minimal adverse impact on environmental and human health. The raw materials of compost can contain a range of biological, chemical and physical contaminants, and contaminants can also be introduced in the collection process. By adhering to the requirements of AS 4454-2012, manufacturers, suppliers and consumers can have confidence that the end product of the composting process is safe to use and fit-for-purpose.

In order to demonstrate effective pasteurisation for the purpose of destroying plant and animal pathogens and weed propagules, any product supplied or described as 'pasteurised' shall have had the whole of its mass subjected to *either* a minimum of three turns with the internal temperature reaching a minimum of 55^0C for three consecutive days before each turn (S 3.2.1 [a]) *or* an alternative process that guarantees the same level of pathogen reduction as required by ARMCANZ WTC No 1/95. The latter requirement shall be confirmed by pathogen testing and the elimination of viable plant propagules (S 3.2.1 [b]). These requirements apply to ‘low risk’ feed stocks such as garden waste; the guidelines for turning and temperature maintenance are more stringent for higher risk inputs such as manures and grease trap waste (*Ibid.*).

Material that is pasteurised, but nevertheless biologically immature, may still pose a risk to plant health because it can consume or tie up resources that plants need in order to thrive. Therefore, in addition to satisfying the requirements for pasteurisation, it is also necessary to provide evidence that a product has achieved a specified level of maturity if it is to be described as ‘compost’ (S 3.2.2). Appendix N in AS 4454-2012 outlines the requirements for demonstrating that this level of maturity has been attained.

Threshold limits for a variety of chemical and physical contaminants are provided in Table 3.1 (A), 3.1 (B) and 3.1 (C) of the Standard. Table 1 below lists the key physical, chemical and biological requirements that must be met in order for a product to be deemed suitable for unrestricted use:

Table 1 Key contamination thresholds for unrestricted use of recycled organics

Physical contaminants:	Requirements:
Glass, metal, rigid plastic	≤0.5%
Plastics – light, flexible or film	≤0.05%
Stones & lumps of clay	≤5%
Chemical contaminants:	
Arsenic	≤20mg/kg
Cadmium	≤1mg/kg
Chromium	≤100mg/kg
Copper	≤150mg/kg
Lead	≤150mg/kg
Mercury	≤1 mg/kg
Nickel	≤60mg/kg
Selenium	≤5 mg/kg
Zinc	≤300mg/kg
Biological contaminants:	
Viable plant propagules	0 after 21 days
Salmonella spp.	Absent in 50g
Faecal coliforms	<1000 MPN/g

The material produced from the composting trials at Clare, Peterborough and Mallala was intended for use in council parks and gardens and not for sale or supply to the general public. Although it would not be marketed as ‘compost’ as such, it was still necessary to confirm that it would pose minimal risks in terms of public and environmental health. Consequently, pile temperatures were monitored routinely to gather evidence of pasteurisation. Testing was done manually using temperature probes and with the aid of digital data-loggers. The latter were used as a means of getting daily readings when sites were unmanned.

Additional evidence of pasteurisation was sought from laboratory tests of the presence of pathogens and plant propagules. Product samples were further tested against AS 4454-2012 requirements for physical and chemical contamination and biological maturity. Testing was undertaken by Veolia Environment Services Laboratory in Kilburn, South Australia.

Cost Analysis

Assuming 4 piles of approximately 96m^3/pile are produced annually.

Expenditure Item	Year 1	Year 2
Site preparation (labour & plant)	$ 500.00	$ -
Pump & spray system	$ 1,750.00	$ -
Irrigation	$ 100.00	$ -
Tarpaulins (2- 10x12m)	$ 1,050.00	$ -
Monitoring equipment	$ 365.00	$ -
Inoculant *	$ 2,000.00	$ 2,000.00
Labour	$ 10,120.00	$ 10,120.00
Council plant	$ 2,200.00	$ 2,200.00
Screener hire (includes crane hire)	$ 1,400.00	$ 1,400.00
Testing*	$ 700.00	$ 700.00
Total Cost	$ 20,185.00	$ 16,420.00

*Could reduce costs significantly by not using inoculant and establishing pasteurisation by process not laboratory testing.

Potential Offsets to Cost

- Avoided cost of processing using a commercial composter of $3,000 -$3,500 per annum
  - Assuming 384m^3 or 100 tonnes of unprocessed and compacted material and a gate fee of $30-35/tonne
- Avoided cost of contract shredding/chipping
  - Not quantified; however, if a sizeable fraction of the green waste deposited at transfer stations could be diverted into composting, it would be possible to reduce the frequency of contract chipping, a large expenditure item for councils
- Annual sales revenue of $2,880
  - Assuming 96m^3 of screened product is available for sale annually and is sold at $30/m^3

Results

Pasteurisation

Evidence of internal pile temperatures equal to or greater than 55°C for at least three consecutive days prior to turning was variable at all three trial sites. Threshold temperatures were recorded for Pile 3 in Clare at both monitoring points during the first round of treatment, but only at one end subsequently. At Mallala, satisfactory temperatures were taken from the inoculated pile at both ends during the first round, at one end in the second and not at all during the final treatment phase. The un-inoculated pile did not reach the pasteurisation threshold prior to any of the turnings. In Peterborough, satisfactory temperatures were only recorded at one end of the inoculated pile during the first and second phases, and not at all prior to the final turning. In two notable instances, Phase 1 in Peterborough and Phase 2 in Clare, manual temperature readings suggested that pasteurisation may have occurred but due to data-logger failure this could not be substantiated. The following table summarises the results from the data-logger record:

Table 1 Summary of temperature results

	Pile	Feedstock	Orig. volume	55°C for ≥3 consecutive days during Phase 1?	55°C for ≥3 consecutive days during Phase 2?	55°C for ≥3 consecutive days during Phase 3?
Clare	1 Inoc	Wood chips (incl. % CCA treated pine) with ~30% garden waste	45m^3	No	No	Abandoned
	2 Un-inoc	Ditto	45m^3	No	No	Abandoned
	3 Inoc	Ditto	144m^3	Yes	Yes, but only at one end Z	Yes, but only at one end
Mallala	1 Inoc	Kerbside garden waste + small % of food scraps	36m^3	Yes	Yes, but only at one end	No
	2 Un-inoc	Ditto	36m^3	No	No	No
Peterborough	1 Inoc	Predominantly wood chips	90m^3	Yes, but only at one end Z	Yes, but only at one end	No
	2 Un-inoc	Predominantly wood chips	90m^3	Yes, but only at one end	Material used on a council project &monitoring ceased.	Abandoned

Z Manual temperature readings suggestive of pasteurisation but unable to substantiate due to data-logger failure

Laboratory analysis of samples taken from the inoculated and un-inoculated piles at Mallala and the inoculated piles at Clare and Peterborough showed no evidence of viable weed propagules or pathogen indicators (salmonella and faecal coliforms). These findings suggest that pasteurisation had occurred, notwithstanding the inconclusive results from temperature monitoring.

Physical and chemical properties

The proportion of glass, metal and rigid and film plastics were within acceptable limits in all samples. High quantities of stones and lumps of clay were present in the material from Mallala and Peterborough. Percentage organic carbon was uniformly below the recommended limit and all samples were alkaline.

With the exception of a high arsenic reading for Clare, the range of chemical contaminants tested were all within the upper limits for unrestricted use required by AS 4454–2012.

Biological maturity and particle size grading

In order to be classified as a composted product or mature compost, material must meet pasteurisation processing requirements, laboratory test requirements for indicator pathogens and plant propagules and pass the threshold levels for three tests of biological stability and plant growth specified in AS 4454-2012. As previously discussed, none of the samples satisfied the pasteurisation-by-process requirement, all three met the second criteria, whilst only the Peterborough sample passed the biological stability and plant tests. Thus, none of the samples can be properly described as composted product as defined by AS 4454-2012.

All four samples achieved a particle size grading of ‘soil conditioner’ meaning that no more than 20% of its mass is comprised of particles greater than or equal to 16mm.

Qualitative assessment

Dr David Harrison visited the trial sites in November 2014 to assess the maturity of the product and provide procedural advice. He was impressed by the quality of the product, noting that its colour and texture were suggestive of a material rich in nutrients and with good water-holding capacity.

Volumetric reduction due to processing

On average the size of the piles reduced by approximately 50% during the composting process. A further 50-60% reduction occurred as a result of screening. For example, in Peterborough the original volume of the inoculated pile was 90m^3; this reduced to 45m^3 during processing, with 18m^3 remaining post-screening.

Discussion

The aim of the Central Region composting trials was to investigate whether the composting process adopted in the NSW City to Soil Project could be successfully implemented, using existing council resources to produce a biological soil improver that met, at a minimum, the pasteurisation requirements of AS 4454-2012. As described in the literature the approach seems straightforward, requiring minimal labour, expertise or specialised equipment. Experience on the ground would suggest that the process, in fact, requires more intensive management than current staffing at rural transfer stations allows.

Pile formation and turning required a minimum of two people to complete. The transfer stations of participating councils are currently staffed by one operator. Thus, if processing was to continue at these sites, there would need to be an extra staff member allocated to assist at these times. Furthermore, it is recommended that these activities are undertaken outside of transfer station opening times so that they can be performed without interruption.

The use of data-loggers to obtain daily temperature readings was a good idea in theory; however, despite bagging them in waterproof cases, moisture did seep in causing malfunctions. Unless a dependable alternative means of protection can be found, it is suggested that digital recording is abandoned in favour of daily manual measurements; at least until pasteurisation thresholds are achieved. This would require monitoring outside of opening hours on some days.

Pile height and moisture are critical determinants of temperature and need to be adequately addressed at the formation stage. It is recommended that piles should be at least 2 metres in height and that material must be saturated before covering. The creation of a small dip or M-profile along the length of a pile will assist with moisture reticulation. As mentioned, it was particularly difficult to wet the woody feedstock and to combat this it is suggested that small batches are watered and placed under cover until there is sufficient material to create one large pile.

The moisture meters used only provided a relative measure of moisture which was not particularly helpful. An alternative has been suggested that involves simply tapping the exterior of the tarpaulin to check for evidence of water 'beading' on the inside. Moisture should accumulate within the first week of covering, providing internal temperatures have risen as expected. This will be verified with temperature testing. Extra water can be added through a dripper system if necessary.

Water usage was substantially higher in the CLGR trials than reported in the eastern states. This is probably indicative of drier vegetation types and climatic conditions and highlights the importance of adapting procedures to suit local operating environments.

To prevent piles from drying out it is essential that they are completely covered at all times. Air pockets will develop as the material shrinks in volume which can lead to tarpaulin edges lifting and piles becoming exposed. In order to avoid this happening it is recommended that tarpaulins are periodically stretched, and tyres re-positioned, so that good contact between cover and organic material is maintained.

Stones and lumps of clay were over-represented in three of the four laboratory samples tested by Veolia, whilst the percentage of organic matter was low in all samples; this result suggests that there were excessive quantities of dirt and gravel in the compost piles. This could have been introduced in the turning process or may have been present in the original feedstock. More careful clearing and compaction of the hardstand and care in the turning process would address the first problem. Educating the public about the requirements for composting and the need to deposit only clean organic garden waste would assist in overcoming the second issue. Obviously that is easier said than done, as any transfer station attendant will confirm. Members of the public will often try to hide a miscellany of non-organic items under their garden waste in an effort to dispose of it, and a solo operator cannot possibly inspect all loads that come through. The same is true of green waste collected at the kerbside. Accordingly, it is strongly recommended that councils run a comprehensive green waste education campaign prior to commencing composting.

Due to the abandonment of un-inoculated piles at Clare and Peterborough, only one control pile from Mallala was subject to laboratory testing. Small pile sizes and lack of adequate moisture affected the outcome for both treatment and control piles at Mallala and so a clear benefit from using the inoculant could not be demonstrated. Authoritative sources have suggested that a quality pasteurised product should be possible to achieve without the use of commercial inoculant, by simply adding mature compost to new piles. This could easily be achieved by reserving the coarse fraction from the screening process and holding this under cover to add to new piles when formed. Alternatively, there are recipes available online for the in-house production of compost accelerator (e.g. Carandang, G & Gentry, P, n.d.). There would be a significant cost saving in taking either of these approaches.

The end product from the Clare composting trial should not be used for horticultural purposes due to the high level of arsenic it contains. This level is significantly higher than the upper threshold for unrestricted use stipulated in AS 4454-2012, and is in excess of sixty times greater than the level recorded for the other sites. The most likely source of this contamination is the treated pine that was present in the original feedstock. If composting is undertaken at transfer station sites in future, it is recommended that protocols are established to ensure that treated pine, painted timber and other potentially toxic materials are kept separate from the feedstock destined to undergo processing.

Whilst the remaining samples do not meet AS 4454-2012 requirements for sale as a composted product, the results of laboratory testing indicate that it is pasteurised and suitable for use as a soil improver. It is recommended that the material produced from the Mallala and Peterborough trials be used to enrich soils in council parks and gardens. Participating councils do not usually buy in products for this application so the availability of material produced 'in-house' does not represent a saving in this sense. The District Council of Mallala pays for its kerbside organic waste to be processed by a commercial composter, so by diverting approximately 44 tonnes into this project it saved approximately $1450. The majority of the feedstock used in the Clare and Peterborough trials had already been chipped by a contractor; however, if virgin garden waste had been utilised, there would have been a saving from the avoided cost of chipping.

Signs were produced early on in the project for installation at Peterborough and Clare Transfer Stations to encourage users to deposit bulky and fine green waste in separate areas. This would have allowed an estimation of the proportion of fine material suitable for composting without prior size reduction and a proximate calculation of the potential saving from material not having to be chipped. Due to operational constraints it was not possible to erect these signs during the life of the project; nevertheless, with Central Region councils spending, on average, in excess of $20,000 per annum in contracted chipping, the diversion of even a quarter of organic material into a composting program would represent a significant saving.

Fig. 1 Source separation of green waste in transfer stations

To further offset the cost of a composting program it is recommended that councils aim to produce a pasteurised product suitable for sale to the general public. Based on current prices in the Adelaide market, it would be realistic to charge $30/m^3$ for pasteurised mulch. As previously discussed, pasteurisation can be demonstrated by process providing sites maintain good records of quality control and pile temperatures and turn the material at least three times. To classify material as composted product for sale, it would be necessary to arrange laboratory testing of samples from each batch. This higher level of testing incurs a significant additional cost, which could be recouped by charging more for the end product, providing it satisfies AS 4454-2012 requirements. The production of pasteurised soil conditioner for sale is probably a good starting point for novice composting operators and provides the additional benefit of encouraging organic recycling in local communities. As the experience of the City to Soil Project demonstrated, members of the public are more likely to do the right thing if there is a tangible benefit at the end (Pamphilon & Chevalier, 2011). In this case, if they can source good quality soil improver at a reasonable price they will be motivated to ensure that the garden waste they deposit at transfer stations, or in their green organics bin, is contaminant-free.

Although the static, covered composting technique is comparatively straightforward, it does require adaptive management which, in turn, relies on a sound grasp of the conditions that need to be established and maintained for optimal results. Where it has been successfully implemented interstate, there has typically been a foreman who is knowledgeable about composting, on hand, to supervise the process (see Case Study 4). Accordingly, it is recommended that future composting programs are planned and implemented with the close involvement of senior horticultural staff.

A step-by-step guide and equipment supplier list are provided in Appendices 1 and 2, respectively, to assist other councils that may be interested in implementing the composting process trialled during this project.

Section 2: Organics Management Options Model (Author: Bill Grant)

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Disclaimer
This report has been prepared for Central Local Government Region of SA in accordance with the terms and conditions of appointment, and is based on the assumptions and exclusions set out in our scope of work. Information in this document is current as of December 2014. This report has been compiled based on secondary information and data provided by other parties; as such it relies on the accuracy of the provided material. Although the data has been reviewed, the information provided was assumed to be correct unless otherwise stated.

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CONTENTS

Introduction

This document details work undertaken by Blue Environment in developing an MS Excel based model designed to allow comparative analysis of the likely effectiveness and costs of different options for managing municipal organics within the Central Local Government Region (CLGR). The model is designed to be transparent, showing all assumptions and allowing manual data entry to 'over-ride' assumed defaults. The model allows the development of different service-type and logistics scenarios for all member councils, allowing comparison of the effects of altering:

- frequency of organics and garbage services
- whether food is or is not included in kerbside organic services
- provision of ancillary initiatives such as kitchen caddies/tidies and biobags to promote food diversion
- the location of regional or sub-regional transfer station and processing infrastructure
- the costs of different components of organics and waste management systems including collection, logistics, processing and disposal costs, as well as the value of organics product sales.

The model also provides some 'triple bottom line' parameters and tools that allow estimation of the relative environmental and social as well as economic performance of options.

This document provides a user guide for the model and some worked examples showing the types of outputs that can be obtained using the model. The model itself contains information about how to use the model and allows self-explanatory selection of options using drop down lists and provides the option of manually entering data to override assumptions.

Using the model

The model has been designed to be transparent and largely self-explanatory, with prompts for option selection and data entry. The model has been populated with data provided by the Region as well as assumptions based on secondary data for factors such as waste composition and generation, performance of different organics collection systems, and logistics, waste disposal and processing costs. A key purpose of the model is to allow comparative analysis so that model users can see how changing different variables will affect performance and costs.

The model has the following sheets:

Introduction	This provides an overview of the model and the contents of the model.
General data and assumptions	This worksheet contains assumptions about key variables such as the number of households served, waste generation and composition, transport distances and disposal and organics processing costs. These variables can be manually over-ridden by model users, and the figures used in other model worksheets are shown.
Regional & sub-regional	This worksheet allows model users to estimate the costs to individual and collective councils to use shared regional or sub-regional organics processing facilities. This allows model users to nominate the location of the organics processing site and the member councils that might use the facility. Different organics recovery options and garbage collection services can be nominated. The model users can also manually enter information to override selected defaults. This allows sensitivity analysis of how different factors may impact on the costs/savings and cost-effectiveness of different options.
Individually "Named" worksheets	Worksheets have been provided for each council to allow model users to test different options of organics recovery on a council-by-council basis. These models allow the users to compare the likely costs/savings and cost-effectiveness of different kerbside organics recovery options. It is intended these sheets will be used by individual councils when considering whether to introduce a kerbside organics service and the type of service they might offer if they did introduce a service.

The model therefore allows users to:

- review and modify data assumptions (General data and assumptions sheet) for their municipality
- model different collection options for their council either individually or on a regional/sub-regional basis.

To avoid the need to move between worksheets, the regional & subregional and 'named' worksheets allow the user to adjust most data assumptions within the worksheet. This allows the user to more easily observe the effects of changing particular parameters – for example, the effect of increasing organics recovery rate.

Within the model, areas shaded grey are protected and should not have manual data entered into them. Unshaded cells allow entry of manual data.

Worked examples

Worked examples of model outputs are now considered.

Modifying data

The general data and assumptions sheet has been populated with data from the region and assumptions based on secondary data and the experience of other councils. It is possible to over-ride these.

Tables 1 and 2 in the model contain data provided by the region regarding numbers of households, service levels and tonnages of waste and organics recovered.

Table 3 in the model shows assumptions about the levels of: regular household participation; garden organics diversion; and food organics diversion, as well as levels of 'additional' generation that can be expected – i.e. how much additional garden and food organics that are currently not disposed to the garbage that are likely to be diverted to a kerbside garden organics service. The experience of councils is that the quantities of garden organics recovered through kerbside organics services far exceed the levels of garden organics diverted from the garbage stream. This is to be expected, the kerbside service is a convenient way to dispose of garden waste and many people will use the organics bin in preference to on-site management or taking a load of garden organics to a transfer station. The assumed figures are as follows:

Service type	% of households participating	% of garden organics diverted per participating household	% of food organics diverted per participating household	kg additional garden organics per participating household	kg additional food organics per participating household
No organics service	0%	0%	0%	0	0
Voluntary garden organics	40%	90%	0%	150	0
Voluntary garden and food organics	40%	90%	60%	150	10
Universal garden organics	80%	80%	0%	120	0
Universal garden and food organics	80%	80%	50%	120	10

These can be over-ridden with manual entry.

Table 4 in the model shows assumed composition data. The figures used – 15% garden and 40% food (by weight) are based on previous bin audits. These figures can be over-ridden. Figure 1 below shows a screen-shot showing manual entry of councils with bin audit data different from the defaults.

Figure 1: Screen-shot of Table 4 of the model showing manual over-ride of assumed levels of organics in kerbside garbage

Municipality	% garden organics			% food organics		
	Default	Manual entry	Used in modelling	Default	Manual entry	Used in modelling
Barossa Council	15%		15%	40%		40%
Barunga West	15%		15%	40%		40%
Clare & Gilbert Valley Council	15%		15%	40%		40%
Copper Coast	15%		15%	40%		40%
Flinders Ranges Council	15%		15%	40%		40%
Light Regional Council	15%	2%	2%	40%	52%	52%
Mallala	15%	14%	14%	40%	41%	41%
Mount Remarkable	15%		15%	40%		40%
Northern Areas Council	15%		15%	40%		40%
Orroroo-Carrieton	15%		15%	40%		40%
Peterborough	15%		15%	40%		40%
Port Pirie Regional Council	15%		15%	40%		40%
Regional Council of Goyder	15%		15%	40%		40%
Wakefield Regional Council	15%		15%	40%		40%
Yorke Peninsula	15%		15%	40%		40%

Table 5 in the model shows assumed transport distances between locations. Table 6 shows assumed costs. The screen-shot below shows manual entry of local data for organics processing and landfill disposal costs. This highlights the transparency and utility of the model – it is intended and anticipated that users will provide more local data and 'play with' variations to see how changes in assumptions impact outcomes.

Figure 2: Screen-shot of costing assumptions and manual over-ride

Costs	Default	Manual Entry	Used in modelling
Bin lift costs ($/bin/lift)	$1.50		$ 1.50
Small collecton vehicle costs ($/t.km)	$ 0.20	$ -	$ 0.20
Transfer costs ($/t)	$ 35.00	$ -	$ 35.00
Large bulk haul transport costs ($/t.km)	$ 0.10		$ 0.10
Cost of kichen caddies ($/year)	$1		$ 1.00
Cost of biobags ($/year)	$15		$ 15.00
Local/small scale organics processing costs - garden only ($/tonne)	$ 55.00		$ 55.00
Local/small scale organics processing costs - garden and food ($/tonne)	$ 65.00		$ 65.00
Regional/sub-regional organics processing costs - garden only ($/tonne)	$ 55.00	$ 35.00	$ 35.00
Regional/sub-regional organics processing costs - garden and food ($/tonne)	$ 65.00	35	$ 35.00
Landfill disposal costs ($/tonne)	$ 140.00	$ 77.00	$ 77.00

Individual council – Barossa

The individual 'named' worksheets are designed to allow model users to compare the relative performance of different organics management options.

The following example discussed model outputs for Barossa Council. The tables shown are from the workbook named "Barossa".

In the first instance, the sheet shows the name of the council and the number of households served. This data is linked from the general data and assumptions sheet and cells containing key information specific to a council are filled immediately when the name of the council is selected from a drop-list.

Council name	Barossa Council
Number of households with a kerbside garbage service	9740

This is followed by an Organics Services model that has default assumptions auto-filled from the selected general data and assumptions sheet. The services model allows manual entry of alternative figures allowing the user to set up the model to reflect different options. The displayed model compares the relative performance of different service options – no organics service; garden only; garden and food; voluntary and universal. It also allows selection of ancillary measures such as providing kitchen caddies/tidies and biobags.

Outputs from the model are shown in the Tables below are extracted from the model. These show the modelled performance of different kerbside recovery systems, the estimated tonnes of garbage and organics, and the total and net costs of the options. The net cost is the cost relative to the baseline scenario of no kerbside organics service being provided.

Table 1: Modelled performance of different kerbside organics service options - Barossa

Outputs	No organics service	Voluntary garden organics only service	Voluntary garden and food organics	Universal garden organics only	Universal garden and food organics only
Average landfilled garbage per participating household (kg/household/yr)	481	416	301	423	327
Garden organics diverted per participating household (kg/household/yr)	0	65	65	58	58
Food organics diverted per participating household (kg/household/yr)	0	-	115	-	96
Garden organics recovered per participating household (kg/household/yr)	0	215	215	178	178
Food organics recovered per participating household (kg/household/yr)	0	-	125	-	106
Total organics recovery per participating household (kg/household/yr)	0	215	340	178	284
Quantity of compost product per participating household (kg/household/yr)	0	129	170	107	142
Total organics to landfill (t/yr)	4,685	4,432	3,982	4,235	3,486
Total organics diverted (t/yr)	0	253	703	450	1,199
Total organics recovered (t/yr)	0	837	1,326	1,385	2,212

Table 2: Estimated costs of different kerbside organics options - Barossa

Estimated costs	No organics service	Voluntary garden organics only service	Voluntary garden and food organics	Universal garden organics only	Universal garden and food organics only
Landfill costs for MSW ($/yr)	$360,745	$341,265	$306,633	$326,113	$268,394
Reduced landfill costs for MSW ($/year)	$-	$19,480	$54,112	$34,632	$92,351
Reduced garbage collection costs ($/year)	$-	$-	$-	$-	$-
Organics collection costs $/year	$-	$151,944	$151,944	$303,888	$303,888
Organics processing costs[1] ($/yr)	$-	$29,309	$46,414	$48,468	$77,431
Value of sold products ($/yr)	$-	$6,029	$7,957	$9,971	$13,274
Net organics processing costs ($/yr)	$-	$23,279	$38,457	$38,497	$64,157
Total garbage collection and organics collection and processing costs sub-total ($/yr)	$360,745	$516,488	$497,034	$668,499	$636,440
Net costs ($/yr)	$-	$155,743	$136,289	$307,754	$275,695

Estimated costs	No organics service	Voluntary garden organics only service	Voluntary garden and food organics	Universal garden organics only	Universal garden and food organics only
Average cost per all households ($/household/yr)	$37.04	$53.03	$51.03	$68.63	$65.34
Average net costs per all households ($/household/yr)	$-	$15.99	$13.99	$31.60	$28.31
Average net costs per participating household ($/household/yr)	$0.00	$39.98	$34.98	$39.50	$35.38
Average net cost per tonne of organics diverted from landfill ($/tonne)	n/a	$616	$194	$684	$230
Net organics collection costs per participating households ($/household/year) if distance to organics processing site is:	**No organics service**	**Voluntary garden organics only service**	**Voluntary garden and food organics**	**Universal garden organics only**	**Universal garden and food organics only**
10km	n/a	$40.41	$35.41	$39.85	$35.74
20km	n/a	$40.83	$35.84	$40.21	$36.09
40km	n/a	$41.69	$36.70	$40.92	$36.80
60km	n/a	$42.55	$37.56	$41.63	$37.51

[1] *Assumes processing costs of $35/tonne of input*

This shows, that for the assumed inputs, all organics options considered will have a net cost increase, and fairly high costs per tonne of organics diverted. This is largely because of the additional garden organics that providing a regular garden organics service will attract to the kerb. In all instances, the estimated net costs of providing an organics service is less than $0.82/household/week for a fortnightly organics service. Note that the options for food and garden organics recovery are most effective in diverting material. Interestingly the voluntary food and garden organics service option reduced waste to landfill more than the universal garden only service, and has the lowest net costs per tonne of organics diverted.

The viability and cost effectiveness of organics recovery options will be affected by factors such as:

- The levels of organics diversion – the more organics diverted from garbage, the more viable the service will be.
- The levels of 'additional' organics – waste reduction messages and encouragement to manage food and garden waste on-site have a role to play.
- The relative costs of organics processing and landfilling. If processing costs are low and landfill costs are high, the viability of organics recovery will be improved.
- The value of compost sales. A low figure of $12/tonne has been used in this modelling based on 'willingness to pay' assessments in an assessment of the economics of the proposed City to Soil system with sales into agriculture. If composts are sold into urban amenity market and soil blending, they are likely to attract higher prices. If the price received increases to an achievable $30/tonne of compost (about $15/cubic m), net costs

change as shown in Table 3 below. If a higher price of $50/tonne is achieved (about $25 per cubic m, which is achievable) net costs will be as shown in Table 4. This shows that improving markets for products will reduce net costs.

Table 3: Net cost estimates at a product price of $30/tonne

	No organics service	**Voluntary garden organics only service**	**Voluntary garden and food organics**	**Universal garden organics only**	**Universal garden and food organics**
Net organics processing costs[1] ($/yr)	$-	$14,236	$26,522	$23,542	$44,246
Total garbage collection and organics collection and processing costs sub-total ($/yr)	$360,745	$507,444	$485,099	$653,543	$616,529
Net costs ($/yr)	$-	$146,699	$124,354	$292,798	$255,784
Average cost per all households ($/hh/yr)	$37.04	$52.10	$49.80	$67.10	$63.30
Average net costs per all households ($/hh/yr)	$-	$15.06	$12.77	$30.06	$26.26
Average net costs per participating household ($/hh/yr)	$0.00	$37.65	$31.92	$37.58	$32.83
Average net cost per tonne of organics diverted from landfill ($/tonne)	n/a	$580	$177	$651	$213
Net organics collection costs per participating households ($/household/year) if distance to organics processing site is:	**No organics service**	**Voluntary garden organics only service**	**Voluntary garden and food organics**	**Universal garden organics only**	**Universal garden and food organics**
10km	n/a	$38.08	$32.35	$37.93	$33.18
20km	n/a	$38.51	$32.78	$38.29	$33.54
40km	n/a	$39.37	$33.64	$39.00	$34.25

[1] *Assumes processing costs of $35/tonne of input and sales value of $30/tonne*

Table 4: Net cost estimates at a product price of $50/tonne

	No organics service	Voluntary garden organics only service	Voluntary garden and food organics	Universal garden organics only	Universal garden and food organics
Net organics processing costs[1] ($/yr)	$-	$4,187	$13,261	$6,924	$22,123
Total garbage collection and organics collection and processing costs sub-total ($/yr)	$360,745	$497,396	$471,838	$636,925	$594,405
Net costs ($/yr)	$-	$136,651	$111,093	$276,180	$233,660
Average cost per all households ($/hh/yr)	$37.04	$51.07	$48.44	$65.39	$61.03
Average net costs per all households ($/hh/yr)	$-	$14.03	$11.41	$28.36	$23.99
Average net costs per participating household ($/hh/yr)	$0.00	$35.07	$28.51	$35.44	$29.99
Average net cost per tonne of organics diverted from landfill ($/tonne)	n/a	$540	$158	$614	$195
Net organics collection costs per participating households ($/household/year) if distance to organics processing site is:	**No organics service**	**Voluntary garden organics only service**	**Voluntary garden and food organics**	**Universal garden organics only**	**Universal garden and food organics only**
10km	n/a	$35.50	$28.94	$35.80	$30.34
20km	n/a	$35.93	$29.37	$36.15	$30.70
40km	n/a	$36.79	$30.23	$36.87	$31.41

[1] *Assumes processing costs of $35/tonne of input and sales value of $50/tonne*

It is suggested council personnel familiarise themselves with use of model by changing variables to 'try' different s scenarios.

Sub-regional arrangement – Copper Coast, Yorke Peninsula, Barunga

A key component and purpose of the model is to allow users to consider the relative benefits and costs of regional and sub-regional management of organics. The 'Regional & sub-regional' worksheet has been developed to model this. This worksheet:

- Allows selection of key service options – i.e. whether the organics service is universal and or voluntary; whether the service collects garden only or food and garden organics; whether ancillary items (caddies/tidies or biobags) are provided; frequency of organics and garbage collection.
- Allows selection of processing site locations and participating councils.
- Automatically calculates the waste generation and composition, recovery rates, costs of systems.
- Allows modelling of different scenarios.

The scenario modelled for Copper Coast, Yorke Peninsula and Barunga was suggested by CLGR.

As with the individual council modelling, the first step of undertaking modelling is to review and if necessary update using the manual entry function the default assumptions in the General data & assumptions sheet. These figures are used in the Regional & sub-regional modelling sheet.

The Regional & sub-regional sheet first provides a 'control panel' that allows users to select, using drop down lists, the nature of service being modelled using a drop down sheet. This is shown below.

Figure 3: 'Control' panel allowing selection of modelled system

TYPES OF ORGANICS SYSTEM PROVIDED	
Voluntary OR Universal	Voluntary
Garden organics only OR Garden and food	Garden and food organics
Ancillary kitchen tidies, biobags	None
Frequency of organics service	Fortnightly
Frequency of garbage service	Weekly
Bin lift costs ($/bin/lift)	**$ 1.50**
Organics collections per year	**26**
Garbage collections per year	**52**

The next stage of the worksheet allows the user to select, using drop down lists, the approximate location of the organics processing facility councils to be included. 'Average' travel distances are automatically selected based on central locations within each municipality. These should be revised manually. The model also has provision to manually enter distances to transfer stations if these are used to consolidate loads before organics are sent to the processing site. Figure 4 shows the section of the worksheet for selection of councils, processing site and transport options and distances.

Figure 4: Screen-shot of model showing example of selection of organics processing site location, participating councils, and transport options and distances; the other parameters are populated automatically from selections made, but can be overridden manually by the model user

Location of organics processing site used by councils in regional/sub-regional service contract (select from drop down list)	Barunga West

Name of councils participating in service contract (select from drop down list)		Copper Coast	Yorke Peninsula	Barunga West
Distance to processing site		50	110	10
Transfer station used for green organics (select yes/no)		No	Yes	No
Distance from point of collection to transfer station	Manual entry	10	5	5
Distance from transfer station to organics processing site	Default	50	110	10
	Manual Entry			
	Used in modelling	50	110	10
Households served	Default	8074	9514	1805
	Manual Entry			
	Used in modelling	8074	9514	1805
Expected kg/yr of garbage per household	Default	843	496	212
	Manual Entry			
	Used in modelling	843	496	212
Expected % of garden organics in garbage	Default	15%	15%	15%
	Manual Entry			
	Used in modelling	15%	15%	15%
Expected % of food organics in garbage	Default	40%	40%	40%
	Manual Entry			

The model inputs and general data and assumptions generate estimates of the performance of the modelled organics systems and provide estimates of the costs of the options. In the first instance, this calculates performance and costs for each of the individual councils and then provides collated figures of the average costs to participating councils. The model can be used to include the costs of transporting and processing garden organics dropped off at council transfer stations.

Different scenarios can be modelled and variables changed to undertake sensitivity analysis. The 'split screen' function can be used to allow the user to see the effects of changing parameters on outputs. It is also recommended that screen-shots or 'copy' and 'paste values' functions are used to store results from different model runs. These can then be used to compare different options. An example of a run of the model for a garden and food organics service is shown below

Table 5: Example of outputs from the Regional & sub-regional model worksheet – individual councils

MODEL OUTPUTS	Copper Coast	Yorke Peninsula	Barunga West
Number of households regularly using the organics service	3,230	3,806	722
Diversion of garden organics (t/yr)	368	255	21
Additional garden organics collected (t/yr)	484	571	108
Total tonnes of garden organics recovered by kerbside service	852	826	129
Annual tonnage of transfer station drop off organics if it is transported to organics processing facility (t/yr) (manual entry)	-	-	-
TOTAL GARDEN ORGANICS	852	826	129
Diversion of food organics (tonnes/year)	654	453	37
Additional food organics collected (tonnes/year)	32	38	7
TOTAL RECOVERY OF FOOD ORGANICS	686	491	44
TOTAL DIVERSION OF ORGANICS AT KERB	1,022	708	57
TOTAL ALL RECOVERED ORGANICS COLLECTED AT KERB	1,538	1,317	173
Estimated annual tonnes of residual landfilled garbage if there was no kerbside organics service (t/year)	6,810	4,720	383
Estimated annual tonnes of residual landfilled garbage if there is a kerbside organics service as defined (t/year)	5,789	4,012	326
Estimated % diversion	15%	15%	15%
Estimated cost of garbage disposal if there is no organics collection service as defined ($/yr)	1,154,142	1,105,532	170,281
Estimated cost of landfill disposal of residual waste with organics service as defined ($/year)	$1,075,487	$1,051,016	$165,857
Organics bin lift costs ($/year)	$125,954	$148,418	$28,158
Ancillary costs (kitchen tidies, biobags) ($/year)	$-	$-	$-
Cost of organics transfer and transport ($/year)	$15,382	$61,894	$346
Cost of processing kerbside organics ($/year)	$53,838	$46,091	$6,054
Costs of kerbside organics collection and processing ($/year)	$195,175	$256,404	$34,558
Cost of combined residual waste disposal and organics recovery ($/year)	$1,270,662	$1,307,420	$200,415
Net costs/savings of providing organics service ($/yr) (savings as a negative in red)	$116,519.52	$201,887.87	$30,134.24
Net costs/savings of providing organics service ($/household/yr) (savings as a negative in red)	$36.08	$53.05	$41.74
Direct financial cost/savings of service per household using the service ($/hh/yr)	$60.43	$67.38	$47.86

Table 6: Example of collated results from Regional & sub-regional model worksheet

Cost of landfilled garbage collection, transport and disposal for participating councils if there is no organics service ($/year)	$2,429,955
Total financial costs for garbage collection and disposal for participating councils ($/year)	$2,292,360
Total financial costs for organics recovery collection and processing for participating councils ($/year)	$486,137
Tonnes of garden organics recovered for processing (t/year) (includes kerbside and drop off organics)	1,807
Tonnes of garden organics diverted from landfill (t/year) (includes kerbside and drop-off organics)	643
Tonnes of food organics recovered for processing (t/year)	1,221
Tonnes of food organics diverted from landfill (t/year)	1,144
Net garbage and organics services costs/savings compared with no organics service ($/year)	$348,542
Average net costs/savings per all households ($/serviced household per year)	$17.97
Average net costs/savings per households receiving/using the organics service ($/household/year)	$44.93

Greenhouse gas emissions estimates

The Region & sub-regional worksheet also allows estimation of greenhouse gas emissions outcome from different management options. This modelling uses National Greenhouse and Energy Reporting (NGER) parameters and data input from the model user to estimate gas emissions. This largely considers emissions that would occur from landfill if diverted organics were instead landfilled, as well as soil carbon benefits. This can be used to compare the greenhouse impacts of recovery options. This information can be used in promoting the benefits of organics recovery options to councils, communities and funding bodies.

Conclusions and recommendations

The organics management options model can be used by CLGR and member councils to compare the likely outcomes of different organics recovery systems, with consideration of both the nature of the kerbside systems provided as well as the location and cost of reprocessing. It is intended the modelling tool is used mainly for comparative analysis to investigate the performance and cost factors that will have greatest impact on the cost-effectiveness of options. Key factors will include:

- Whether garden only or garden and food organics services are provided. Garden only services do not have as great impact on organics diversion from landfill as garden and food services, and may encourage people to dispose of garden waste through the service that they currently manage on site. It is suggested a kerbside organics service should only be considered if food is to be recovered as well as garden organics. It is also noted that a well-used voluntary garden and food organics service is likely to be most cost-effective in reducing organics to landfill.

- The quantities of ‘additional’ organics recovered by a kerbside service. Where households use the service for materials they do not currently dispose to garbage, the provision of an organics service incurs significant cost without cost savings from diversion from landfill. It is recommended councils introducing organics services also promote waste reduction (less food waste, low-waste gardens, home composting), and charge an appropriate fee for service to discourage ‘additional’ and unbudgeted organics being disposed through the service.
- The relative costs of landfill and organics processing. If landfill costs are high and/or organics processing costs are low, then organics diversion will be more cost-effective. At current costs, the provision of an organics recovery service will almost certainly have a net cost of in the order of $1-1.50 per household per week.
- The frequency of collections services. Unless the frequency of garbage collection services can be reduced, the introduction of an organics collection service will have a net cost.
- The value of organic products. The resale value of compost products or the value of the products for council use can reduce the net costs of processing and organics recovery as a whole.

It is recommended CLGR and member councils trial the model, and consider different scenarios and values for variables.

Section 3: Case Studies of Municipal Organics Management

Introduction

Regional councils across Australia are faced with similar challenges with respect to organics management: large distances to processing facilities, high transport costs, low population bases and a dearth of financial and technical resources; however, they are often forced to develop solutions in isolation. Furthermore, there aren't many opportunities for councils to share experiences or details of the remedies they have found. The purpose of collecting case studies from across Australia was to document some novel and successful approaches to organics management developed in South Australia and interstate and present these to a wider audience.

South Australia

1. Open Windrow Processing by the Fleurieu Regional Waste Authority

Background:

The Fleurieu Regional Waste Authority (FRWA) was established in 2010 to manage the waste and recycling operations of four local government areas located south of Adelaide, South Australia. The City of Victor Harbor, Alexandrina Council, District Council of Yankalilla and Kangaroo Island council have a combined land area of approximately 7,300 km^2 and population of 47, 695 (ABS 2011).

In addition to kerbside waste and recycling, residents in Alexandrina Council and the City of Victor Harbor have access to a monthly green waste collection service. Household green waste is transported to the Goolwa Waste and Recycling Depot where it is processed into pasteurised mulch.

Process description:

Kerbside green waste is deposited on a hardstand area at the Goolwa Depot where contaminants are removed, by hand, soon after delivery. The green waste is then formed into windrows of up to 4 metres high and 4 metres wide. Kerbside-collected organics are mixed with 'self-hauled' green waste and mulched periodically (on average every three months) by a private contractor. After mulching, a regimen of watering and turning commences: the material is routinely watered once a week and turned with a front end loader twice a week. If the internal temperature of the windrow exceeds 75^oC, the material receives an extra turn; if the temperature drops below 55^oC, additional water is applied.

A mix of stormwater and mains water is used to irrigate the windrows via a purpose-built, overhead watering system. For efficient pasteurisation, a moisture content of 40-50% is required.

The schedule of watering and turning continues for approximately twelve weeks, at which time the material is moved to a different area where it is stored ready for sale.

To achieve effective pasteurisation so that pathogens and weeds are destroyed, state and national guidelines require that the whole mass of a windrow must be subjected to a minimum of three turns with internal temperatures reaching a minimum of 55^{o}C for three consecutive days before each turn. FRWA maintains detailed records to verify that these requirements are always met. The organisation has also developed a number of standard work procedures to regulate various aspects of the process and ensure a high degree of quality control.

After the pasteurisation process is completed, the material is screened to produce three grades of product: Premium Mulch, Budget Mulch and a very coarse material that is either re-processed or used as capping for site remediation works.

Staff allocation:
All staff members at the Goolwa Waste and Recycling Depot are trained in the processing methodology. Windrow management and monitoring requires, on average, 20 hours per week.

Equipment:
Front end loader, watering system and temperature probe, supplied by FRWA
Grinder/mulcher/screener, supplied by contractor

Outcome:
FRWA products do not undergo the biological stability and plant growth tests that are necessary to substantiate a classification of ‘compost’ or ‘mature compost’; however, the processing records that are kept do provide evidence of pasteurisation and allow categorisation of the material as ‘pasteurised mulch.”

The Premium Mulch is sold for \$30/m^3 and the Standard Mulch is \$20/m^3. Both products are popular with local residents and can be purchased at the transfer stations in Goolwa, Strathalbyn and Yankalilla.

Lessons/advice:
- Thorough picking of contaminants from the kerbside collected green waste is paramount to ensure good quality of the final product.
- Adequate space for windrowing, grinding and storing the completed product is essential, as is a reliable water supply.

- Before commencing, it is important to verify that there are markets for the end product, to ensure the financial viability of the operation and avoid being left with a surplus that is difficult to shift.
- Operating environments and other conditions vary so widely, that there is no "one size fits all" in relation to organics processing; rather, it is vital that local authorities do their homework to ensure that they have the resources (space, labour, equipment and technical expertise) needed to pursue a given approach and are fully cognisant of the likely costs and benefits before commencing.

Resources:

Standards Australia, 2012. *AS 4454-2012: Composts, soil conditioners and mulches*, Sydney: SAI Global Limited.
FRWA, 2012a. Future Management of Greenwaste by FRWA on Behalf of its Member Councils, unpublished.
FRWA, 2012b. Management of Greenwaste at Goolwa Site, unpublished.

Contact:

Fleurieu Regional Waste Authority
T: (08) 8555 7401

Interstate

2. Community partnership: Gloucester Shire Council & The Gloucester Project

Background:

Gloucester Shire Council is situated in the north-eastern reaches of the Hunter Valley, NSW, spanning an area of approximately 3000 km^2 and with a population of 5,272 (ABS 2011). The Shire operates a 3-bin waste system with residual and green waste being deposited at the Thunderbolts Way landfill for disposal and processing, respectively.

Approximately 1100 tonnes of green waste are delivered to the landfill annually. Historically, green waste would be stockpiled until there was sufficient volumes to warrant engaging a mulching contractor. Post-mulching it would be given away to residents; however, without a higher level of processing there was a risk – and actual complaints – of physical contamination and the presence of weeds. Council discontinued the practice but resolved to investigate alternative options; however, preliminary investigations indicated that the economics would not support commercial composting at the landfill site.

A more promising alternative recently emerged through a partnership with a local not-for-profit organisation, The Gloucester Project (TGP). This group is actively committed to the ideal of economic growth through local action and through its demonstration market garden, The Tucker Patch, promotes the economic, social and environmental values of community involvement in food production. TGP was convinced that with a little assistance from Council it could rescue the green waste from landfill and convert it into a valuable resource: premium-grade compost.

Project description:
The project commenced in January 2014 and ran for six months. Quantities of green waste were mulched at the landfill site with a small, council-supplied shredder. It was then transported by trailer to The Tucker Patch site for mixing with food waste sourced from Woolworths and further processing. The feedstock was contained in covered bays and turned once a week. Temperature was monitored for quality control and nothing less than $60^{o}C$ was recorded for the duration of the process, which extended over four weeks. Achieving the optimal balance of carbon and nitrogen was integral to the success of the process and quality of the end product; a 30:1 carbon to nitrogen ratio is the rule of thumb in composting and TGP used the Klickitat County Compost Calculator to ensure they got the right mix of ingredients.

Staff allocation:
Commonwealth Government funding (Local Employment Coordinator's Flexible Funding Pool) enabled two men to be employed on a casual part-time basis to undertake most of the labour required. They typically spent three mornings each week mulching at the landfill site, then transporting the material across to The Tucker Patch, carting approximately 2-3 tonnes per day.

Equipment:
A small shredder made available by Council and a trailer and tractor supplied by TGP.

Outcome:
TGP were able to produce high quality compost for use at The Tucker Patch and for sale to the general public.

Lessons/advice:

- In order to sustain the composting operation TGP will need to source funding for replacement plant. The shredder loaned by Council was prone to breaking down and was too small to process large volumes of material efficiently. Similarly, the trailer utilised to transport the mulch was inadequate for moving large volumes of mulch.

- Strategic marketing is critical to the commercial viability of a composting operation. Because there are numerous products already in the market it is important to target a range of different customer groups and highlight the specific advantages that using the compost (e.g. nutrient enrichment, water retention) will confer.

Resources:

Klickitat County, 2007. *Compost Mix Calculator.* [Online]
Available at: http://www.klickitatcounty.org/solidwaste/fileshtml/organics/compostcalc.htm
[Accessed 12 October 2014].

Contacts:

The Gloucester Project
Ph: (02) 6558 3191

Gloucester Shire Council
Ph: (02) 6538 5250

3. Benalla Compost Champions

Background:

Benalla Rural City Council (BRCC) is located in north-eastern Victoria. Almost two thirds of its population resides in the Benalla urban area; the remainder occupy the rural hinterland of approximately 2000 square kilometres. The Council delivers a kerbside waste and recycling service, but is not yet collecting organic waste. Food and garden organics account for 40-50% of the total weight of material placed in the residual waste bin, suggesting that there is plenty of scope to increase diversion.

BRCC belongs to the North East Waste and Resource Recovery Group (NEWRRG; formerly known as the North East Victorian Regional Waste Management Group or NevRwaste), one of six regional bodies in Victoria that assist Local Government in planning and delivering waste management services. In 2010 NevRwaste applied for funding from Sustainability Victoria to conduct a composting champions program with several of its member councils, including Benalla. The application was unsuccessful; however, NevRwaste decided to re-scope the program and run it on a trial basis with BRCC. Benalla council was selected due to its interest and willingness to contribute funding and also because it had previously been approached by a local community group, the Benalla Garden Club, to promote the benefits of home composting.

Project description:

The aim of the project was to test the effectiveness of home composting as a means of diverting organic matter from the municipal waste stream. BRCC residents were invited to participate in home composting workshops and people who committed to the program were supplied with educational materials and composting equipment. They also had access to personalised assistance from experienced composters at the Benalla Garden Club.

Two hundred and thirty BRCC householders took part in the project. Many of these people subsequently provided feedback about the program, what they had learned, and whether it effected lasting behavioural change. The success of the project was also measured by weighing a sample of participant bins and comparing these with results from non-participants.

Staff allocation:
Three Waste Service/Education Officers contributed approximately 400 hours to project planning, delivery and evaluation.

Equipment:
Workshop participants were supplied with composting bins (upright or tumbler variety), kitchen caddies and aerators. The total package cost approximately $70/person to which participants contributed $20.

Outcomes:
Respondents to a survey conducted three weeks after workshop attendance (36% of all participants) indicated a high level of satisfaction with all aspects of the program, including the content and delivery of the workshops, choice of composting equipment and ongoing support.

Audits conducted on the residual waste bins of participants (identified by the presence of a 'compost diet' sticker on the side of the bin) and a control group, found that on average the home composters' bins were 1.87 kg lighter (17%) than non-participants.

A further survey was administered a year after the workshops were held and found that 87% of people reported still composting and 88% felt the program provided them with sufficient information to successfully compost at home.

The overall cost of the program, excluding volunteer contributions, was just over $31,000 which included around $18,000 of infrastructure, $2,000 worth of advertising, $2000 for printing and $12, 000 of staff time, and an offset of $4000 for participant contributions to the price of the bins. The saving in avoided landfill costs attributable to the increased diversion of organics was estimated to be in the order of $3,000 per annum.

Lessons/advice:

- The program would have been more economical if a larger number of residents had participated because certain cost items (advertising, staff time) would remain constant regardless of the numbers involved.
- Informative workshops, supplemented by ongoing opportunities for guidance and support, enabled householders to compost successfully and commit to the practice over the long term.
- Subsidising the infrastructure attracted participants to the program; however, it was felt important for householders to contribute to the cost so that they would value the equipment and follow-through with composting.
- Feedback from participants suggested that the upright bin was much easier to work with and the aerator was more a hindrance than a help.

Resources:

North East Waste & Resource Recovery Group, n.d. *Compost Champions Project.* [Online] Available at: http://www.newrrg.vic.gov.au/compost-champions-project/ [Accessed 27 March 2015].

Available to download:

- Composting Champion Project – A Summary Feb 2014
- Composting Champion Project – FAQs Feb 2014
- A Guide to Home Composting

Contact:

North East Waste and Resource Recovery Group
Ph: (03) 5722 9433

4. Coolamon Shire Council & the REROC Cluster Composting Trial

Background

Coolamon Shire Council was one of four local government authorities to participate in a cluster composting trial which ran from August 2011 to January 2012. Coolamon Shire is situated in the Riverina region of south-western New South Wales and has a population of 4,200 residents (ABS 2011).

The composting trial was coordinated by the Riverina East Regional Organisation of Councils (REROC) with funding contributions from participating councils, the REROC Waste Forum and the NSW Department of Environment and Heritage. Two hundred households in each council area were provided with bench top bins and liners for their food scraps and a 240 litre mobile garbage bin in which to place all food and garden waste for fortnightly collection from the kerbside. Composting was done at the landfill site owned and operated by Cootamundra Council.

The low-tech, covered composting method advanced in the City to Soil Project was implemented, which involved spreading the organics, removing contaminants, applying water and inoculant, forming material into piles and then covering it with tarpaulins. After six weeks the piles were uncovered for further decontamination, turning and respraying before being covered for a further six weeks. Piles were monitored during both phases to verify that temperatures were sufficiently high for pasteurisation to occur. Council employees were responsible for preparation, management and monitoring of the compost piles.

During the six month trial a total of 139 tonnes of organic waste was received and processed, producing approximately 83 tonnes of quality compost. Due to an effective community engagement campaign, the trial recorded high participation rates with little contamination of collected material. Participant feedback was very favourable and in Coolamon Shire the majority of respondents to a project evaluation survey wanted the service to continue and indicated that they would be prepared to pay an additional $52/year for this to occur.

In view of the level of community support and favourable cost-benefit analysis (see inset), Coolamon Shire Council resolved to continue composting. The kerbside food and garden organics service has been extended to the entire Coolamon Township of approximately 780 households, and council has established its own processing facility.

Process

Kerbside-collected organics are delivered to an area of the landfill site dedicated to composting. There is no prior shredding of the material which is spread thinly across a hardstand area to facilitate the removal of contaminants and saturation by water. It is then formed into windrows approximately 12m x 3m x 1.5m and covered by tarpaulins weighted down by tyres.

The process implemented diverges slightly from the City to Soil guidelines in that inoculant is not routinely applied, and the material is turned three times. The three-phase process typically takes 10 weeks to complete. At this point, the material is flip-screened then stockpiled ready for use.

Staff allocation

One staff member spends 1-2 hours/fortnight in managing the compost. Additionally, a contractor with a bobcat dedicates 2 hours/fortnight to working on the compost.

Equipment

- bobcat
- fire truck for watering material
- heavy duty (ex-grain bunker) tarpaulins
- flip screen with 20mm attachment (hired)

Cost of Organics Collection & Processing

EXPENDITURE
Year 1

- Bins - $40.00 x 580 houses (780 houses – 200 trial) - $23,200.00
- Pickup/delivery - $1.36 per lift = ($1,060.80 x 26) - $27,580.00
- Treatment at Tip:
  Inoculants - $2,000.00
  Labour (8hrs x $25/hr x 26) - $5,200.00
  Machinery (4hrs x $50/hr x 26) - ($5,200.00) - $12,400.00
- Education – new calendars, kits, staff time - $15,000.00
- Testing - $2,000.00
- Training of Operator (week course and time away) - $3,000.00

$83,180.00

Year 2 and Subsequent Years

- Pickup/delivery - $1.36 per lift = (1,060.80 x 26) - $27,580.00
- Treatment at Tip – as above $12,400.00
- Testing – as above $2,000.00 **$41,980.00**

INCOME

- Rates – 780 x $52.00 - $40,560.00
- Sale of organic product - 104 tonnes
- per annum (208 x 0.5) x $40.00 - $4,160.00

$44,720.00

Outcome

The kerbside collection diverts approximately 8 tonnes of waste from landfill per fortnight or 208 tonnes per annum and has been so popular with Coolamon residents that Council are now evaluating whether to extend it to other towns and villages in the Shire. Processing produces high quality compost that is used in house, replacing the need to buy in commercially-produced soil improver.

Lessons/advice:

- The composting process should be overseen by someone with an understanding of and passion for making compost; a member of the horticulture team, preferably.
- A low-tech composting method such as the modified City to Soil approach implemented by Coolamon Shire can be a feasible option where the alternative – transporting green waste to commercial composters – is costly, and there is sufficient space and time to process the material in this way.

Resources:

Donoghue, A., 2013. *The Coolamon Story: An Attempt at Waste Reduction*. [PowerPoint slides] Presented at the No Time to Waste: Rural & Regional Waste Management Conference, Wagga Wagga, NSW.

Contact:

Coolamon Shire Council
Ph: (02) 6930 1800

5. Char making in Ballarat

Background:

The City of Ballarat is a populous regional council of 97,810 residents (ABS 2011) located in western Victoria. Residents are offered several options with respect to organic waste management: they can either pay for a kerbside collection service, compost at home or deliver to the Ballarat transfer station.

Early in 2014 the council participated in a project that investigated alternative processing options for organic waste deposited at the transfer station. The established practice was to shred and compost the green waste and utilise the timber waste, once chipped, as coverage for bulk haul skips destined for landfill. The project tested the proposition that with more careful sorting, these materials could be used to make higher quality products which could then either be utilised by council or sold.

Biochar was one of four high-value products made with municipal organics in this project. Biochar is produced when organic materials, such as wood, manure or leaves, are heated with little or no available oxygen, in a process known as pyrolysis. It has a variety of beneficial applications including carbon sequestration, soil amendment and waste water filtration.

The project employed a mobile pyrolysis unit supplied by Melbourne firm, Earth Systems, to produce the biochar. This technology was developed with remote applications in mind and has been trialled at several regional waste facilities in Northern Territory. The CharMaker MPP20 is the smaller of two units Earth Systems has available; it has a maximum capacity of $15m^3$ which equates to 3-10 tonnes of material, depending on feedstock type. Processing time can range from 4-12 hours per batch depending on moisture level, but on average it is possible to complete two batches per day, producing 1 tonne of char per batch.

The other three products manufactured during the Ballarat trials were types of wood fuel that could not feasibly be produced under local (Central Region) conditions, and so will not be examined here. Interested readers are referred to the Transfer Station Waste to Energy Project Report for further details.

Process or trial description:

The green and timber waste was sourced from Ballarat Transfer Station where it was pre-screened by project staff (members of local social enterprise, Ballarat Regional Industries) to remove contaminants including chemically treated timbers (e.g. CCA treated pine), Polyvinyl Chloride (PVC) and lead-based paints. The timber was also cut to ensure that it did not exceed 1m in length and 150mm diameter.

The processing was undertaken by Earth Systems staff on a farm near Ballarat using the CharMaker MPP20 on two consecutive days in May 2014. A mix of dry and very wet green waste was processed on the first day; this batch took 4.5 hours to run and whilst some material (approximately 20% of original load) did not fully process, this was simply added to a subsequent batch to complete. Construction and demolition timber was processed on the second day; due to the dryness and uniform size of the feedstock it processed well in 4 hours and there was no un-pyrolysed material remaining.

At the completion of each batch the hot biochar was quenched with water and removed from the CharMaker for cooling and transport back to a storage compound. Because of considerable variation in particle size (<5mm to >125mm) the biochar was granulated to ensure it was fit-for-purpose as a soil additive.

Staff allocation:
Staff for screening and sizing the green and timber waste and two CharMaker operators supplied under 'wet-hire' arrangement by Earth Systems.

Resources:

- hydraulic log splitter for size reduction
- CharMaker MPP20, mobile pyrolysis machine
- excavator to load raw material into bins
- tractor for loading bins into CharMaker
- hoppers and bagging machine
- water supply (non-potable)

Outcome:
Both green waste and timber produced a high quality biochar product which met the requirements of the International Biochar Initiative Standardised Product Definition and Product Testing Guidelines for Biochar That Is Used in Soil.

The business case analysis suggested that subject to being able to negotiate favourable wet-hire arrangements with Earth Systems and providing the suggested wholesale market value of the biochar ($800/ tonne) can be achieved, a return on investment could be realised within one year.

Lessons/advice:

- ➢ The production of biochar offers several options for reducing greenhouse gas emissions which may already, or sometime in the future, qualify as carbon abatement methods under the Emissions Reduction Fund; however, as noted by the consultant to the Ballarat project, income from the sale of carbon credits is likely to be modest, at least for the foreseeable future, given trends on the international carbon market and costs of independent audit and broker fees.

- Whilst there is considerable scientific evidence for the soil-enhancing properties of biochar and its capacity to improve agricultural productivity, markets for the product are not yet well established. Identifying and securing buyers may therefore prove challenging.
- The CharMaker produces significant smoke emissions during the initial heating phase and as such could not be operated in the vicinity of sensitive land uses.

Resources:

Rossiter, I., 2014. *Transfer Station Waste to Energy Project Report,* Ballarat, Victoria: Highlands Regional Waste Management Group.

Earth Systems, n.d. *Charmaker MPP.* [Online]
Available at: www.esenergy.com.au/services/charmaker
[Accessed 2 December 2014].

Contact:

Earth Systems
Ph: (03) 9810 7500

6. Greater Taree City Council & the Mobile Aerated Floor

Background:

The Greater Taree City Council is a local government area situated on the mid-north coast of NSW with a land area of approximately 3,750 km^2 and population of 49,453 (ABS 2011). Towns and rural residential areas are provided with a 3-bin waste service with kerbside collection and recyclables processing undertaken by a single contractor, JR Richards & Sons.

Prior to 2011, kerbside-collected garden waste was composted using an open-windrow technique. Concern about the variability in quality and length of time taken to achieve a finished product led council to investigate alternative processing methods. Mobile aerated floor (MAF) technology was considered the most cost effective option for achieving the desired efficiency and quality outcomes and council resolved to purchase a three-unit system.

The MAF system is a modular system consisting of a master control unit and one or more air supply units that are connected to aeration pipes, placed directly onto the ground and over which organic material is piled. Air is injected into the material at regular intervals and in sufficient volumes to ensure that optimal aerobic conditions are maintained throughout the windrow, for the duration of the process.

 

(Source- photographs supplied courtesy of Andy Gulliver, Director, C-Wise)

Trial description:

The trial began in October 2012 and continued until December 2013. Approximately 1500 tonnes of raw organic material was processed over this period, including 600 tonnes of food waste sourced from a neighbouring council. Site preparation involved constructing a hard stand of compacted road base along with drainage lines that fed into a leachate pond.

Piles were turned twice during the active phase of composting, at two and four weeks post-formation. Since optimal levels of oxygen are much easier to achieve with forced aeration, there was no need for more frequent turning and the composting process was completed within a six week period. The pipe assembly took 20-30 minutes to dismantle when access for turning or moving the material was required. The aeration units ran off a three phase power supply and were extremely energy-efficient.

Material was saturated at pile formation with water from the leachate pond and then, subsequently with storm and mains water, to maintain an ideal moisture level of 40%. High internal temperatures of 70^{o}C and above were consistently recorded, providing assurance that conditions necessary for pasteurisation were being met. After the six weeks of active composting concluded, the material was screened and then stockpiled for several months to mature further before being used.

Staff allocation:

0.5 FTE allocated to pile formation, management, monitoring and screening

Equipment & infrastructure:

- grinder
- front end loader
- hard stand
- MAF system comprising one master and two slave units
- screener
- leachate system

Approximate costs:

- construction of hardstand and leachate system= $120,000
- MAF units= $35,000
- freight from Thailand= $10,000

Outcomes:

Independent laboratory testing confirmed that the six week MAF process was capable of producing mature compost as defined by the Australian composting standard, AS 4454-2012. NSW EPA requirements concerning the control of odour, leachate, vermin and biosecurity risks (control of weeds, pests and pathogen risks) were all met. The end product has been used on Council parks and gardens, reducing reliance on commercial soil improvers.

Lessons/advice:

- A finer-textured end product is achieved by grinding the larger woody material prior to composting.
- The process generates considerable run-off and it is important to make adequate provision for this when designing and constructing the leachate pond. It would be advisable to run the MAF under cover to prevent excess stormwater causing additional leachate generation
- The MAF Composting System requires less than half the space needed by conventional windrow composting, representing a significant saving in hardstand investment.
- Final screening of the product will improve the overall quality and make it a more viable and saleable product.

Resources:

C-Wise, n.d. MAF. [Online]
Available at: http://www.cwise.com.au/wastesolutions/maf.html
[Accessed 5 November 2014].

Gulliver, A. & Mitchell, S., 2012. *Affordable Waste Technology for Regional Areas- Councils, Contractors and Communities Committing to Change*. [PowerPoint slides]. Presented at the Waste And Recycle Conference, Fremantle, WA.

MAF Composting Systems, n.d. MAF (Mobile Aerated Floor). [Online]
Available at: maf-compostingsystems.de
[Accessed 6 November 2014].

Contacts:

Greater Taree City Council
Ph: (02) 6592 5399

C-Wise (Australian supplier of MAF systems)
Ph: (08) 9581 9582

7. In-vessel composting by the Central Goldfields Shire Council

Background:

Central Goldfields Shire Council (CGSC) is a local government area situated in central Victoria. In 2013-14 it conducted a project which aimed to demonstrate that smaller regional communities could successfully divert garden and food organics from landfill. The project was jointly funded by CGSC, the Highlands Regional Waste Management Group (HRWMG) and Sustainability Victoria (SV).

Since 2008 residents in the major towns of the Shire had been able to 'opt in' to a monthly garden organics collection for an additional fee. The project increased the frequency of collection in one town, Maryborough, to fortnightly and extended the service to incorporate food waste. Experience elsewhere suggested that that these changes would have a significant impact on waste diversion rates, reducing the weight of material going to landfill by as much as 35%. If realised, this decrease would deliver large savings to Council through the avoided cost of $150/tonne in waste transport and disposal. Equally important would be the associated environmental benefits including a diminished risk of land and ground water pollution and a reduction in methane emissions.

A request for tender process resulted in the selection of the Spartel FABCOM® composting unit, as the processing technology of choice.

Project description:

For logistical reasons it was decided to restrict roll-out of the fortnightly food and garden organics service to Maryborough where 760 households voluntarily committed to participating in the trial. Participants were already paying $60/year for their monthly organics collection and paid no extra for the fortnightly food and green waste trial.

A comprehensive community engagement program was conducted which promoted food diversion and the opportunity to access a fortnightly kerbside organics service. Promotional activities included:

- letters to residents
- local radio and print media
- information sessions about food organics recovery (which >200 residents attended)
- the provision of kitchen caddies to information session participants
- production and distribution of a 'How to' brochure
- installation of a large sign at the Compost Facility (see below)

Figure 1: Signage installed at the composting facility (Reproduced with permission of HRWMG).

Figure 2: The Spartel FABCOM composting unit at Carisbrook (photo courtesy of HRWMG).

The Spartel FABCOM® composting system was installed at the Shire's Carisbrook Resource Recovery Facility and site contractors were trained in its operation. It comprises two hot composting bays and a bio-filter storage unit and has the capacity to process 1000 tonnes of organic material per year. Kerbside-collected food and garden waste is deposited in the bays and then subjected to forced aeration through a slotted floor; emergent gases are captured and treated by the bio-filter. The system is fully automated and can be managed remotely via internet connection to heat probes and other monitoring equipment. Processing is completed within 4-6 weeks.

The FABCOM® composting method was selected from a field of contenders including static pile fermentation, vertical composting stacks, aerated covered piles, modular aerated composting containers and heated bio-desiccator containers. It was chosen because it was considered to offer superior process and environmental controls and would allow for future expansion of organics recovery programs. Importantly it provided a high degree of surety concerning odour management which was a key consideration given community concerns about this issue.

Organics were screened of contaminants and shredded prior to composting.

Staff allocation:

The planning and delivery of various elements of the community engagement campaign was very time consuming. By contrast, the actual composting process required minimal labour: on average 5 operator-hours were spent on the initial inspection, cleaning, shredding and bay loading operations every 2-4 weeks.

Equipment:

- Front end loader, used to load material onto deck for inspection and contaminant removal prior to shredding
- Shredder
- Spartel FABCOM® system

Outcome:

A participant survey was conducted in April 2014 and had a 30% return rate. Over half of respondents reported that they did not compost and placed all food waste in the garbage bin before the project commenced whilst only 2% of respondents claimed they continued to do so afterwards. On average respondents claimed to be diverting 5.6L of food scraps per week which equates to 130-175 kg/household/year. The information sessions and mail outs were deemed very successful as avenues for promoting organics diversion.

Garbage bins from random samples of project participants were audited prior to and at the end of the trial, in June 2013 and March 2014. The quantity of garbage attributable to garden waste did not change significantly from one audit to the next, which would be expected if residents were already effectively using the monthly garden organics collection prior to project commencement. More surprising was the finding that the percentage weight of food waste in garbage bins was actually greater following implementation of the food recovery program. A review of historical data suggests that this is an anomalous result that reflects abnormally low quantities of food being discarded by the sample population at the time of the first audit. It is unclear why this occurred but it is recommended that larger numbers of households are audited in future so that the impact of spurious events is minimised.

An examination of garbage and organics collection data showed a significant increase in the quantity of recovered organics, following commencement of the trial, yet no evidence of a corresponding reduction in the garbage stream. This would suggest that contrary to survey responses, users are not diverting large quantities of food away from landfill but are instead filling their organics bins with garden waste previously managed at home.

Once processing was completed the compost was screened and laboratory tested against the Australian Standard for Composts, Soil Conditioners and Mulches (AS 4454-2012). Whilst it was free of physical and chemical contaminants, the material failed 'toxicity' seedling emergence testing which is suggestive of an immature product. *E. coli* readings were also above threshold;

however, this was believed to be an anomalous result because the compost had achieved pasteurisation temperatures and the original feedstock was deemed unlikely to have high levels of *E. coli*. Overall the compost was judged to be a good quality product and it was made available at no charge to households that had participated in the trial. A consumer advice label was issued along with the product which contained the standard health warning along with suggestions for appropriate use.

Detailed cost modelling was undertaken for the CGSC organics recovery operation and several hypothetical scenarios reflecting different levels of participation and various sized communities. With the current levels of voluntary participation in the CGSC organics recovery scheme (~13% of households), net costs (the costs of recovery and processing minus avoided landfill costs) are estimated to be in the order of $70.70 per participating household per year. A voluntary participation rate of 40% would reduce this figure to $44.54, with universal service being even more cost effective at $27.81. In a smaller community of 5000 population it was estimated that a well-subscribed, voluntary scheme would engender net costs per participating household of $67.59, whilst a universal service would cost $39.34.

Lessons/advice:

- In selecting a composting methodology, it is critical to know upfront what minimum throughput is needed to keep processing costs at an affordable level. The FABCOM® unit purchased by CGSC was designed to process 1000 t.p.a. of food and garden organics. Under the current voluntary scheme, the system is operating at 1/3 its capacity. This has inflated the cost of recovery; however, having demonstrated that both the expanded collection program and FABCOM® technology are successful, the Shire can now work on increasing the volumes of organic waste collected, from households and food outlets.
- A well-constructed communication strategy is essential to achieving and maintaining desired changes in recycling behaviour.
- The introduction of a kerbside organics service typically leads to an increase in the amount of organic material being put out for collection. The extra capacity afforded by the third bin enables householders to dispose of materials that they once would have managed on-site. Consequently, even though organics processing is cheaper than landfilling in some locations, it may work out more costly over the long term because of the increased volumes of material involved.
- A corollary to the previous point is that the introduction of an organics service is rarely a cost-saving or even a cost-neutral exercise. Council is providing an additional service for the convenience of its rate-payers and so it is justified in imposing an extra charge on the beneficiaries.

__Resources__

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Conclusion and Recommendations

The impetus for this project was the desire to gather information about and practical knowledge of organics management that could be utilised by regional councils in the Central Local Government Region, and beyond.

Three Central Region Councils participated in composting trials, using a method developed as part of the NSW City to Soil Project. This is a comparatively low-cost alternative to conventional composting methods that has been successfully implemented by regional councils, interstate, utilising existing staff and equipment. The experience during the local trials suggested that the process requires more intensive management than is possible within the constraints of current transfer station opening times and staff availability.

Laboratory testing confirmed the reduction of pathogens and weed propagules to within acceptable limits but the AS 4454-2012 requirements for establishing biological maturity were not met; as a consequence, the material can be described as a pasteurised product but not as compost. Considered in isolation, the on-site temperature measurements do not provide proof of pasteurisation. With the exception of the Clare material that recorded a high level of arsenic, the end product is suitable for use as a soil improver on council parks and gardens.

It is highly probable that with greater experience, expert guidance, and the procedural improvements suggested above, the process described could consistently deliver a high quality, pasteurised product, suitable for sale. A favourable cost-benefit is only likely to be realised if, in addition to selling the product, further investigation confirms that there are significant cost savings to be achieved by composting, rather than having garden waste chipped by a contractor.

The results of the trials, along with the case studies presented, highlight the fact that contaminant-free feedstock is essential for the production of a quality soil improver. Members of the public need to be educated about the types of inputs that are suitable for processing, whether they dispose of their organic waste through kerbside collections or at transfer stations. For this reason, it is strongly recommended that a public green waste education campaign form an integral part of planning and implementing any council-supported organics program.

On the basis of the cost analysis and results obtained, rural councils may decide that the static, covered composting process is beyond their resource capabilities. The case studies section provides several options that may better suit their circumstances. The community partnership model, detailed in The Gloucester Project overview, is one example that could be successfully replicated by a small council. This would involve supplying equipment and green waste to a local community gardening group; in return the group would undertake to manage the composting process and utilise the end product.

The Compost Champions program trialled by Benalla Council could also be adapted for implementation by a rural council or Local Government region. The costs of the program, which was designed to promote home composting, were considerable; however, there may be opportunities to reduce expenses by bulk procurement of composting bins, in-house production of written materials and scheduling workshops so that they coincide with similar events hosted by other agencies, for example, Natural Resource Management Groups, so that the fees of expert speakers can be shared.

The capital investment required for high-tech organics management solutions, such as the Spartel FABCOM® composting unit trialled by Central Goldfields Shire Council, is almost certainly beyond the capacity of rural councils in South Australia; however, it may be achievable with joint funding arrangements established through a regional or sub-regional alliance. The Organics Management Options Model, developed by Blue Environment for the CLGR, provides a means of estimating the cost of processing at a regional or sub-regional facility. This could be a site with permanent infrastructure such as a MAF system or the FABCOM in-vessel composter or a suitable location for periodic visits by a mobile processing plant, such as the CharMaker MPP20.

There is considerable evidence that the introduction of a kerbside food and garden organics service will provide the best opportunity for significantly increasing recycling rates above existing levels, in council areas that do not currently operate a three-bin system. Whilst there is no policy or legislative imperative, as yet, to introduce kerbside food and garden organics recycling in regional areas, councils may encounter pressure from their residents to do so. There are also significant environmental benefits associated with expanding organics recycling, such as the opportunity to produce compost and other soil enhancing products, and the reduced risk of soil, air and water pollution that follows from diverting organic material from landfill. The Organics Management Options Model developed by Blue Environment was commissioned to assist councils in evaluating the costs of introducing a kerbside organics collection and of processing this material, under various scenarios. It provides councils with a sound basis on which to undertake consultation with their communities about the costs and benefits of kerbside organics recycling; it also allows them to estimate the greenhouse gas emissions outcome and soil carbon benefits of different management options.

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