



UTS: INSTITUTE FOR SUSTAINABLE FUTURES

Pyrmont-Ultimo Precinct (PUP) Scale Organics Management

Scoping Study



2017

ABOUT THE AUTHORS

The Institute for Sustainable Futures (ISF) was established by the University of Technology, Sydney in 1996 to work with industry, government and the community to develop sustainable futures through research and consultancy. Our mission is to create change toward sustainable futures that protect and enhance the environment, human wellbeing and social equity. For further information visit: www.isf.uts.edu.au

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EXECUTIVE SUMMARY

This report, the “*Pymont Ultimo Precinct (PUP) Scale Organics Management Scoping Study*” has been prepared by the Institute for Sustainable Futures (ISF), University of Technology Sydney (UTS). The research, conducted by ISF and funded through a collaboration between Sydney Water Corporation (SWC) and the NSW Environment Protection Authority (EPA), has investigated at a high level, a suite of innovative organic waste management options that could potentially be piloted in Pymont-Ultimo, currently the densest urban area in Australia. The Pymont-Ultimo precinct (PUP), encompassing Pymont, Ultimo and the newly developed Central Park, has been specifically chosen due to the significant potential in the area, existing network of sustainability practitioners (i.e. Smart Locale¹) and ISF’s/UTS’s direct involvement in research in food waste management.

Australia is one of the highest municipal waste producers per capita in the world (OECD, 2015) with organic waste forming a significant fraction of the waste generated by the residential and non-residential sectors, around 25% (ABS 2013). The majority of organic waste (i.e. food waste) is sent to landfill, producing leachate and methane gas. Additional environmental as well as economic and social impacts are also caused by the dominant linear approach of collecting and transporting waste from cities out to distant landfill sites. With existing landfill becoming constrained and the population of major cities such as Sydney and Melbourne set to hit 8 million each by the middle of the century, this traditional linear model of collection and transport of organic waste to landfill will need to change and a more localised and on-site resource recovery focused approach adopted.

Both at a federal and state level governments have taken steps in recent years to reduce waste to landfill, including organic waste, with a combination of reduction targets, increased landfill levies and major funding for both behavioural and technical solutions at various scales. The NSW EPA is leading such actions through their waste levy (the highest in Australia) including a \$105.5 million Organics Infrastructure Fund specifically for organic waste management, part of the \$802 million nine year Waste Less Recycle More program².

Such investment is creating new markets and business opportunities in innovative organics management: from avoidance such as food rescue and redistribution services; to new on-site technologies that pre-treat waste through maceration, decomposing and/or dehydration; to large scale anaerobic digestion systems creating renewable energy and biosolids. This range of solutions is assisting in diverting organic waste from landfill and helping to recover resources in line with the NSW EPA waste hierarchy. It is also creating an emerging convergence with the wastewater industry. This is taking the form, for example, of SWC investigating the efficacy of a growing number of pre-processing technologies and trade waste applications, where businesses are seeking to discharge food waste to sewer instead of the more traditional disposal to landfill to avoid large waste fees. Another example is where SWC are trialling the use of food waste as an input to their existing anaerobic digesters at Cronulla wastewater treatment plant to create energy and assist in reducing wastewater treatment costs.

There is significant potential to manage organics within a dense urban setting more sustainably both now and in the future. To begin to look at such opportunities within the PUP this study has collated a suite of national and international examples of innovative organics management that span:

- sectors (residential, commercial, institutional);
- types of buildings (restaurants to universities);
- scales (single buildings and precincts to LGAs and whole cities);

¹ <https://www.smartlocale.com.au> (accessed 30/06/2017)

² <http://www.epa.nsw.gov.au/wastestrategy/waste-less-recycle-more.htm> (accessed 30/06/2017)

- technology types (decomposers and dehydrators to anaerobic digesters);
- the waste hierarchy (avoidance to reuse); and
- components of the system (collection, transport and treatment through to reuse).

These examples are provided in the form of 35 half-page vignettes with well over 50 national and international examples cited.

The study has also collated where available data and assumptions on organic flows within the PUP and subsequently mapped them geospatially to help gauge the scale of organics available. This data has included:

- residential municipal food waste – approximately 2,940 tonnes/year - based on City of Sydney (CoS) council waste audit data;
- commercial food waste – over 945 tonnes/year - based on over 550 Bin Trim audits conducted in the PUP provided by the EPA and Central Park retail management;
- grease from grease trap waste – over 200 tonnes/year – based on data from 120 grease traps in the PUP provided by SWC and Central Park; and
- volatile solids from sewage – approximately 7,830 tonnes/year - based on the water usage of over 1,000 properties in the area provided by SWC and associated SWC assumed sewage discharge factors.

Additional site data and information was collated from UTS, TAFE, Central Park and the Sydney Fish Markets.

This data set, whilst incomplete, begins to identify the potential sources of organics that could effectively be “mined” within a dense urban setting such as the PUP for productive reuse. Importantly the analysis and mapping goes beyond food waste by considering other organic waste streams, such as sewage managed by SWC, that has the potential to be combined and treated with other organics at a local scale to create energy and biosolids through anaerobic digestion. Other organic waste streams not included in the study but that could also be collated and mapped include for example, garden waste, used cooking oil and trade waste. These require further investigation.

Having gathered a suite of international examples and conducting a high level analysis of the volumes of potential streams of organics and where they are generated, a suite of “illustrative options” have been developed spanning similar criteria to those used to gather the national and international examples. A total of 16 illustrative options were developed for the PUP as summarised in Table 1. The options are a small subset of what is possible in the PUP and illustrate “one size does not fit all” and that context is highly important when deciding which option/s to adopt.

The illustrative options were designed to provide a spectrum of solutions to aid discussion at an “Organics Summit” conducted at the end of the project in June 2017. Twenty eight stakeholders from diverse organisations were involved in the Summit including: SWC; EPA; City of Sydney; Southern Sydney Region of Councils; site managers for the Sydney Fish Markets and Central Park; technology providers of food waste decomposers, anaerobic digestion and vacuum systems and those involved in the Smart Locale group. The Summit was designed to:

- inform a broad audience with interest and influence in the PUP about the findings of the study;
- discuss the potential of such options including barriers and opportunities to innovation; and
- seek comments and importantly buy-in for potential pilots/demonstration sites in the PUP.

Table 1 – Summary of illustrative options

No.	Focus	Waste	Scale	Collection>transport	Treatment
1	Low rise	Food waste	Neighbourhood	Kitchen caddies > door pick-up by bike with trolley	Localised: pre-treatment (compost, decomposer, dehydrator) or anaerobic digestion (AD) Centralised: AD
2	Low rise & commercial cafes	Food waste	Neighbourhood	Kitchen caddies & small commercial bins > door pick-up by bike with trolley	Localised: pre-treatment or AD Centralised: AD
3	Low & high rise MUDs & commercial	Food waste	Whole of precinct	One waste contractor for residential & commercial properties	Centralised: AD
4	High rise MUDs	Food waste	Building	Kitchen caddies > chutes > basement	On-site: pre-treatment or AD Centralised: AD
5	High rise MUDs	Food & pet waste	Building	Kitchen caddies & pet waste bags > chutes > basement	On-site: AD Localised: AD Centralised: AD
6	High rise MUDs (NEW)	Food waste	Precinct	Insinkerator in kitchen > pipe to basement	On-site: AD Centralised: AD
7	High rise MUDs (NEW)	Food waste & sewage	Precinct	Kitchen bench food waste vacuum + vacuum toilet > vacuum to basement	On-site: AD
8	Commercial cafes	Food waste avoidance	Neighbourhood	Café > App > collection by end user	Food waste avoidance & redistribution
9	Commercial cafes	Food waste	Neighbourhood	Small commercial bins > door pick-up by bike with trolley	Localised: pre-treatment or AD Centralised: AD
10	All commercial	Food waste	Whole of precinct	Policy: Zero food waste to landfill	Various methods
11	Commercial cafes	Food waste	Precinct	Café vacuum inlet > vacuum to basement	On-site: AD Localised: AD Centralised: AD
12	Commercial cafes/market (NEW) Fish Markets	Food waste	Precinct	Café vacuum inlet > vacuum to central location on-site	On-site: AD Localised: AD
13	Education centre	Food waste avoidance	Neighbourhood	Students with spare food/meal > App > students share meal	Food waste avoidance & redistribution/sharing
14	Education centres	Food waste	Neighbourhood	Cafes > commercial bins	On-site: decomposer/dehydrator
15	Education & large government organisations	Food waste	Neighbourhood	One waste contractor for multiple sites	Centralised: AD
16	Council Parks	Pet waste	Council parks	Owners use bags > deposit in park collection point	Localised: AD

The Summit participants expressed great interest in the project and ideas generated. During a workshop session several options stood out for participants, in particular:

- the use of Apps for local café food waste avoidance, redistribution and improved social outcomes (See: Options 8 & 13);
- involving new multi-unit dwellings (MUDs) (See: Options 6 & 7) including the use of insinkers in kitchens and vacuum systems for collection of both kitchen and sewage waste to allow local treatment and generation of energy through anaerobic digestion (AD);
- mandating zero food waste to landfill for commercial properties (See: Option 10) - this option aligns with the City of Sydney strategy of 'zero-waste' by 2030;
- installing vacuum systems and local AD in existing large commercial retail areas such as Central Park (See: Option 11);
- taking advantage of the new Sydney Fish Markets relocation by incorporating vacuum and anaerobic systems to capture organics, including the potential of nearby residential and commercial sites for local energy generation (See: Option 12); and
- collecting food and animal waste from existing MUDs for either local or off-site treatment (See: Option 5).

What is clear is that there is significant opportunity and interest to do things differently in the PUP and Sydney more broadly. What is also clear is that decision-making around which options are implemented is highly dependent on the stakeholders involved and their specific objectives. Broadening the stakeholders involved, and criteria for decision-making, has the potential to assist in a paradigm shift in organics management in our cities.

As identified through the national and international examples many innovative solutions similar to the illustrative options suggested are already being adopted internationally. To assist in facilitating a shift toward the adoption of such alternative systems of organics management in Sydney a series of recommendations and next steps have been made in this report. Key will be the development of pilots/demonstration sites in the PUP to validate feasibility in an Australian urban context. Such pilots/demonstration sites could be implemented now in existing buildings but also as important new developments come on-line in the coming years. These sites can provide a much needed hub of demonstration and learning of what works and what doesn't in the rapidly changing field of organics management and help leap-frog Australia towards its waste reduction and resource recovery goals.

LIST OF ABBREVIATIONS

ABS	Australian Bureau of Statistics
AD	Anaerobic digestion
C&D	Construction and demolition
C&I	Commercial and industrial
COAG	Council of Australian Governments
CoS	City of Sydney
FOGO	Food organics garden organics
FW	Food waste
HH	Household
ISF	Institute for Sustainable Futures
LGA	Local government area
PUCC	Pymont Ultimo Chamber of Commerce
MUDs	Multi-unit dwellings
NSW EPA	NSW Environment Protection Authority
OECD	Organisation for Economic Co-operation and Development
OIF	Organics Infrastructure Fund
PUP	Pymont-Ultimo precinct
SFM	Sydney Fish Markets
SMEs	Small and medium sized enterprises/business
SWC	Sydney Water Corporation
TAFE	Technical and Further Education
TEC	Total Environment Centre
UCO	Used Cooking Oil
UTS	University of Technology Sydney
WARR	Waste Avoidance and Resource Recovery
WLRM	Waste Less Recycle More
WWTP	Waste Water Treatment Plant

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1 INTRODUCTION

BACKGROUND

This project, the '**Pymont-Ultimo Precinct (PUP) Scale Organics Management Scoping Study**', has been developed by the Institute for Sustainable Futures (ISF), University of Technology Sydney (UTS). The research has been funded by Sydney Water Corporation (SWC) and the NSW Environment Protection Authority (EPA) with collaboration and input from organisations affiliated with the Smart Locale initiative³, a diverse group of organisations and businesses with a keen interest in sustainability in the Pymont-Ultimo precinct.

STUDY AIM

The aim of the study has been to investigate opportunities for innovative organics waste management in the Pymont-Ultimo precinct (PUP) in the heart of Sydney, currently the highest population density in Australia with over 14,000 people per sq km⁴.

The study has:

- collated national and international examples of innovative organics management;
- collated preliminary data/information on organic flows within the PUP;
- mapped available flows of organic waste streams (i.e. food waste, grease trap waste, sewage);
- investigated in more detail site-specific case studies in the PUP to gain greater insights on organics flows;
- identified barriers and opportunities for innovation through interviews with a range of expert stakeholders;
- developed a selection of illustrative options for potential pilots/demonstration sites in the PUP; and
- shared knowledge from the study with industry and government stakeholders through a half day Organics Summit and workshop.

The study does not aim to be an exhaustive, in-depth analysis of national and international literature, innovative options in this field, nor a detailed analysis and mapping of organic waste flows in the PUP. It does aim to bring together relevant literature and data on organics flows in the precinct where available and share research findings with interested industry and government stakeholders to facilitate discussion on how organic waste streams might be managed differently. That is, to reduce and divert food waste from landfill, firstly through avoidance, but also through opportunities to collect and treat organic waste streams at multiple scales: from on-site decentralised systems to large scale centralised systems. Based on this research and a final workshop with industry and government stakeholders to gain insight into future opportunities and barriers, this study makes recommendations on potential next steps for facilitating innovation in the PUP, relevant to urban areas more broadly.

³ <https://www.smartlocale.com.au> (accessed 30/06/2017)

⁴ <http://www.abs.gov.au/ausstats/abs@.nsf/Previousproducts/3218.0Main%20Features42012-13?opendocument&tabname=Summary&prodno=3218.0&issue=2012-13&num=&view=> (accessed 30/06/2017)

REPORT STRUCTURE

The report is structured as follows:

- **Introduction** – Details the funders, background, aims of the study and the report structure, study tasks and research methods adopted.
- **The PUP context** – Details the Smart Locale initiative from which the study emerged, the characteristics of the study area, projected growth and detailed sites of interest.
- **Organic waste management** – Provides a brief overview of waste management practices across Australia.
- **Innovative systems to manage organics waste** – Summarises a suite of national and international examples of innovative organics waste management, using vignettes, based on a systems perspective.
- **PUP organic flows and mapping** - Provides an overview of data, analysis and mapping of residential food waste, commercial food waste, grease trap waste and wastewater in the PUP.
- **Site-specific case studies** – Details four PUP sites with high levels of organic waste produced. Each case study provides site-specific data and management approaches including Central Park, UTS, TAFE and the Sydney Fish Markets.
- **PUP illustrative options** – Summarises a suite of illustrative options that demonstrate innovative organics management that could potentially be piloted in the PUP.
- **Institutional analysis** – Provides an overview of findings from 10 interviews with key industry and government stakeholders and their perceptions on institutional enablers and disablers to innovation in the field of organics management.
- **Organics summit** – Provides an overview of the structure and outcomes of the Organics Summit as a knowledge sharing workshop.
- **Discussion and recommendations** – Summarises discussion and recommendations from the study and potential next steps.

RESEARCH METHODS

The study has involved:

- **Desktop review** of national and international literature on innovative systems and practices on the collection, transport, treatment and reuse of organic waste in the residential, commercial and institutional sectors.
- **Literature synthesis** into vignettes of innovative approaches to organic waste management.
- **Data collection, material flows analysis and mapping** of organic waste flows within the PUP.
- **Case study analysis** of four key sites within the PUP to gather more detailed data to analyse potential opportunities for innovation.
- **Semi-structured interviews** with key industry and government stakeholders to identify enablers and disablers of innovation.
- **Options analysis** to explore a suite of potential innovative organics options relevant to the PUP context.
- **Workshop** with key stakeholders to share innovative options, seek participant feedback, validate research findings and identify next steps and potential pilots/demonstration sites in the PUP in the future.

The project tasks are highlighted in Figure 1.1.

2 THE PUP CONTEXT

SMART LOCALE

The initial concept for this study was developed through the Smart Locale initiative, which brings together agencies, organisations and businesses in the precinct with an interest in implementing sustainability initiatives in the PUP corridor. This includes for example, SWC, UTS, the Pyrmont Ultimo Chamber of Commerce (PUCC), Flow Systems at Central Park, TAFE, the Total Environment Centre (TEC), the City of Sydney (CoS), Sydney Fish Markets, the Powerhouse Museum and the Star. Members of the Smart Locale have provided access to high level data/information of case study sites including, Central Park, UTS, TAFE and the Sydney Fish Markets. In addition, participants in the Smart Locale have been engaged throughout the study with knowledge shared on the project at regular Smart Locale meetings held at ISF.

STUDY AREA

The study area is the PUP corridor (refer to Figure 2.1), which encompasses the LGAs of Pyrmont and Ultimo and part of Chippendale (the former Carlton United Brewery (CUB) site), now the transformed iconic Central Park development.

The current populations of Pyrmont and Ultimo are 12,558 and 7,681 respectively according to the 2011 census⁵. The 2016 ABS estimated populations are closer to 14,362⁶ and 8,519⁷ respectively. The \$2 billion Central Park mixed use development, which will be completed in 2018, is expected to add another 2,200 residential apartments and 869 student dwellings to the PUP corridor, an estimated 5,300 people (pers com L Chan, Frasers). This gives a combined current estimated population of over 28,000 people across Pyrmont, Ultimo and Central Park.

As noted in Section 1 the PUP corridor currently has the highest population density in Australia, with over 14,000 people per sq km⁸. This density is set to increase further over the coming years. According to available projections, the area of “Harris Street” encompassing Pyrmont and only part of Ultimo, is set to increase by another 6,500 people to over 26,274 by 2036⁹.

The current land zoning of the PUP corridor and associated heights of buildings are shown in Figures 2.2 and 2.3.

⁵ <http://profile.id.com.au/sydney/population-estimate?WebID=240> & <http://profile.id.com.au/sydney/population-estimate?WebID=310> (accessed 30/06/2017)

⁶ <http://profile.id.com.au/sydney/about?WebID=240> (accessed 30/06/2017)

⁷ <http://profile.id.com.au/sydney/about?WebID=310> (accessed 30/06/2017)

⁸ <http://www.abs.gov.au/ausstats/abs@.nsf/Previousproducts/3218.0Main%20Features42012-13?opendocument&tabname=Summary&prodno=3218.0&issue=2012-13&num=&view=> (accessed 30/06/2017)

⁹ <http://forecast.id.com.au/sydney/about-forecast-areas/?WebID=150> (accessed 30/06/2017)

Figure 2.1 – Location map

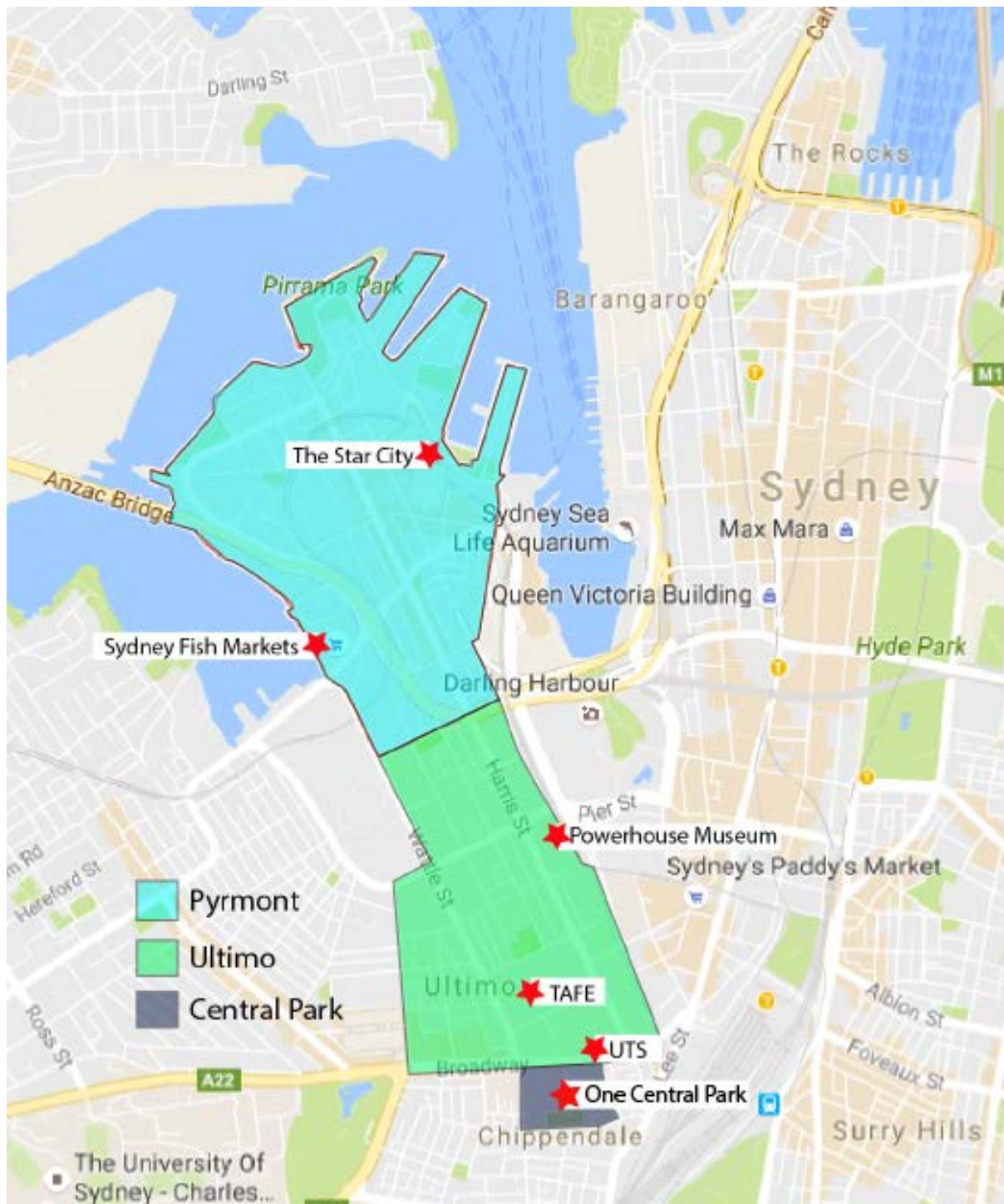
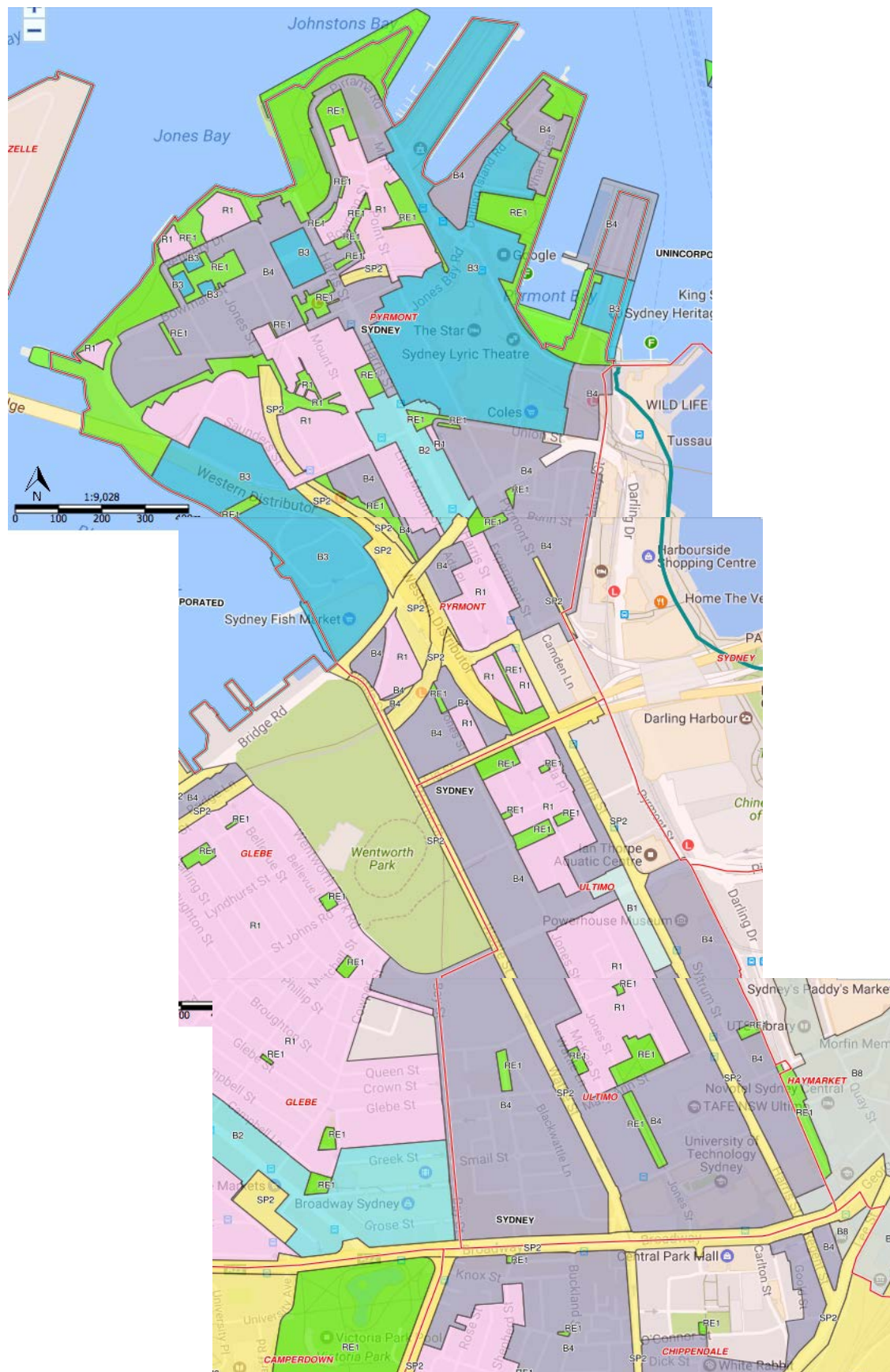


Figure 2.2 – Current land use zoning¹⁰



¹⁰ https://www.planningportal.nsw.gov.au/find-a-property/property/3731053_9-73_Broadway_2012_Ultimo_DP1183894/9-73_broadway_ultimo_2007 (accessed 30/06/2017)

With such a diverse character from low to high-density residential sites and significant daily increase in the population due to the educational, office, entertainment and commercial/retail properties, the PUP corridor is a complex study area with significant volumes of organic waste produced through multiple streams.

DETAILED SITE-SPECIFIC CASE STUDIES

There are many sites within the PUP corridor that have the opportunity to provide both significant volumes of organic waste but equally significant opportunities for innovative approaches to organics waste management. A selection of these sites have been chosen as case studies to investigate in more detail potential volumes of organics produced and potential opportunities for innovation. These sites include:

- Central Park
- UTS
- TAFE
- Sydney Fish Markets

Organisations managing these sites (and members of the Smart Locale group) were approached to collaborate in the project and assist in collating data on waste flows and how organic waste is currently being managed on-site. Details on these sites and their current waste management practices are provided in Section 6. Other sites were also approached but were unable to provide detailed data within the timing of the project.

With significant population growth expected for both Sydney and the PUP over the next decade there is a need to investigate the potential of food waste separation, collection and management in multi-unit dwellings (MUDs). In the CoS alone, 75% of the current population live in MUDs, which is expected to rise to 95% by 2030 (pers com G Dawson, CoS). Hence opportunities for MUDs at Central Park and other locations in the PUP have also been explored.

3 ORGANIC WASTE MANAGEMENT

AUSTRALIA

Australia is currently the fifth largest municipal waste producer per capita of Organisation for Economic Co-operation and Development (OECD) members, just behind Denmark, the US, Switzerland and Luxemburg (OECD, 2015). Organic waste forms a significant component of the waste generated by industry and households, currently around 25% (ABS 2013). Most organic waste (i.e. food waste) is sent to landfill, producing leachate and methane gas, a greenhouse gas (GHG) now estimated to be 25 times¹² more damaging to the atmosphere than carbon dioxide, as part of the degradation process, resulting in significant environmental impacts. In addition, the current linear system of collecting and transporting waste from cities to landfill sites, typically on the edge or outside city limits, has significant economic, environmental and social impacts.

Organic waste is typically defined as organic material such as food, garden and lawn clippings but also encompasses animal and plant based materials and degradable carbon such as paper, cardboard and timber, which take longer to breakdown. In a broader waste context it also includes other biosolids and sludges derived from wastewater treatment plants (WWTPs). In Australia these materials are typically applied to land in agricultural production or used in land remediation. Those biosolids contaminated above recommended levels (typically from heavy metals) are often stockpiled, as in the case of the major stockpile associated with Melbourne's Western (sewage) Treatment Plant (Fam et al, 2017).

With the population of Australia currently just below 25 million¹³ and projected to reach 40 million by the middle of the century (Commonwealth of Australia, 2015) there will be increasing pressure on water, wastewater, energy and waste services and the need to shift the traditional linear system of waste management to circular systems that value waste streams as resources rather than waste products.

Australian governments have a long history of collaborating on waste policy and actions with the first comprehensive agreement on domestic waste management agreed under the Council of Australian Governments (COAG) in 1992¹⁴. In 2009, a National Waste Policy was agreed to by all Australian environment ministers to facilitate resource recovery from waste streams to 2020¹⁵. Based on this policy direction most states and territories around Australia have set targets of between 60% to 90% for municipal solid waste (MSW), commercial and industrial (C&I) and construction and demolition (C&D) waste, by 2020¹⁶.

¹²http://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/Browse_by_Topic/ClimateChange/old/theBasic/greenhouse (accessed 30/06/2017)

¹³ <http://countrymeters.info/en/Australia> (accessed 30/06/2017)

¹⁴ <http://www.environment.gov.au/system/files/pages/94aa70c5-6681-44c6-8d83-77606d1d6afe/files/fs-national-waste-policy.pdf> (accessed 30/06/2017)

¹⁵ <http://www.environment.gov.au/protection/national-waste-policy> (accessed 30/06/2017)

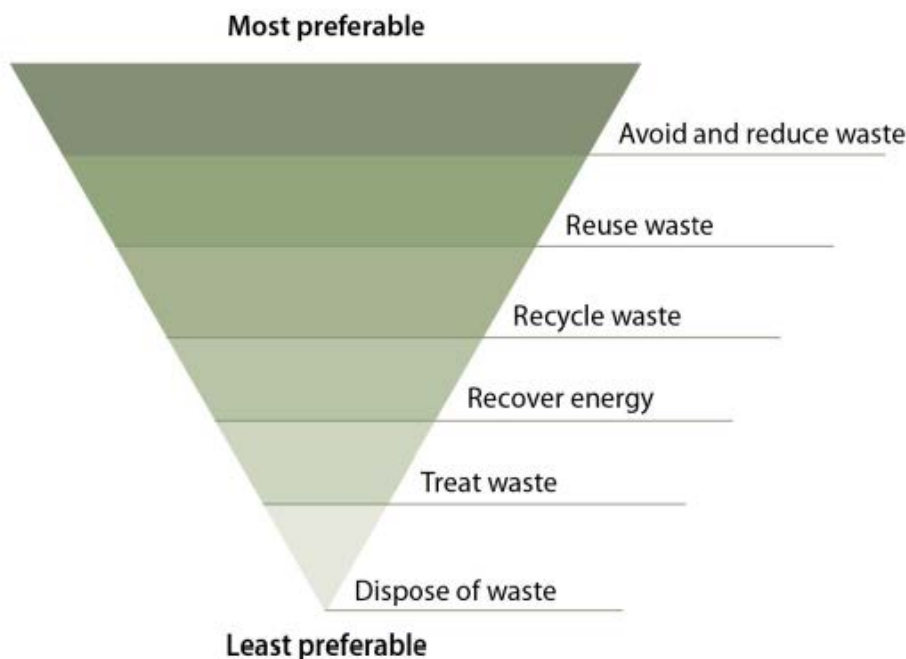
¹⁶ <https://blog.mraconsulting.com.au/2016/04/20/state-of-waste-2016-current-and-future-australian-trends/> (accessed 30/06/2017)

NSW

The current population of NSW is 7.8 million¹⁷. 5 million now live in Sydney alone¹⁸, which is set to rise to 8 million by the middle of the century (Greater Sydney Commission, 2015). With rapid population growth on the horizon there are both significant challenges but also major opportunities for waste reduction.

The NSW EPA prepares a Waste Avoidance and Resource Recovery (WARR) Strategy every 5 years. The latest WARR Strategy 2014 - 2021 (2014) defines clear strategies and targets to 2021 including: avoiding and reducing the amount of waste generated per person in NSW; increasing recycling rates to 70% for both MSW and C&I waste and 80% for C&D waste; and increasing the volume of waste diverted from landfill by 75% (NSW EPA, 2014a). As with most states and territories across Australia, the NSW EPA adopts the ‘waste hierarchy’ as a guiding framework (refer to Figure 3.1) with avoidance of waste the most preferred option through to landfill of waste the least preferred.

Figure 3.1 – The NSW waste hierarchy¹⁹



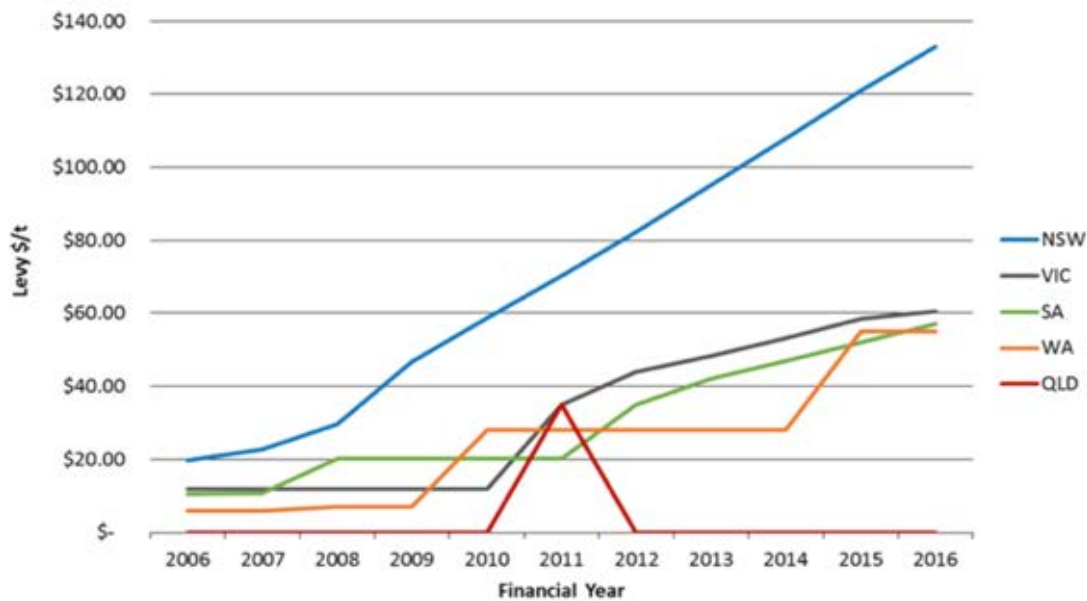
NSW has the highest landfill levy in Australia, significantly higher than any other state or territory (refer to Figure 3.2), providing funds and incentives for waste management initiatives. A suite of programs/initiatives and policies support the WARR Strategy such as Waste Less Recycle More (WLRM), originally a five year \$465 million program funded by the waste levy but which has recently been extended by an additional four years and is now a nine year \$802 million initiative²⁰.

¹⁷ <http://www.abs.gov.au/ausstats/abs@.nsf/mf/3101.0> (accessed 30/06/2017)

¹⁸ <http://www.abs.gov.au/ausstats/abs@.nsf/mf/3218.0> (accessed 30/06/2017)

¹⁹ <http://www.epa.nsw.gov.au/wastestrategy/waste-hierarchy.htm> (accessed 29/03/2017)

²⁰ <http://www.epa.nsw.gov.au/wastestrategy/waste-less-recycle-more.htm> (accessed 30/06/2017)

Figure 3.2 – Landfill levies in major states in Australia²¹


A core component of the WLRM initiative is the \$105.5 million Organics Infrastructure Fund (OIF) to boost food and garden organics recycling and reduce the amount of organic waste sent to landfill. The fund has four key components (pers com S McGhie, NSW EPA):

- Local Government Organics Collection Systems Program - \$27 million - provides funding for new or enhanced kerbside collection services for food and garden organics waste.
- Organics Infrastructure (Large and Small) Program - \$57 million - supports new and enhanced infrastructure and on-site processing for organic waste in collaboration with the Environmental Trust.
- Love Food Hate Waste Education - \$9.7 million - supports programs to raise awareness of food waste and food waste avoidance and helps NSW households and businesses reduce the amount of wasted food sent to landfill.
- Organics Market Development grants - \$7.5 million - for projects that develop new markets or expand existing markets for recycled organics.

Due to the combination of high landfill fees and funding for infrastructure grants to manage organics differently, organic waste sent to landfill is being reduced and new technologies and systems to manage organic waste are being adopted across sectors²². However, to achieve the 75% waste reduction target it is recognised that residential, commercial and institutional organics management will need to play an even greater role going forward.

²¹ Ritchie, M., 2016 State of Waste 2016 – current and future Australian trends, MRA Consulting <https://blog.mraconsulting.com.au/2016/04/20/state-of-waste-2016-current-and-future-australian-trends/> (accessed 29/03/2017)

²² <http://www.epa.nsw.gov.au/resources/wastestrategy/waste-less-recycle-more-scorecard-2016.pdf> (accessed 30/06/2017)

SYDNEY WATER CORPORATION (SWC)

SWC currently have 29 wastewater treatment plants (WWTPs) across the greater Sydney region. Many of these are reaching system limits and/or the end of their functional lives. As the population increases SWC are reviewing how they will provide services to their customers over the coming decades and will be upgrading/augmenting many of their WWTPs to optimise service delivery.

As the main water and wastewater utility for Sydney and the largest water utility in Australia, there is significant opportunity to provide additional services where it makes commercial sense. This includes organic waste streams such as food waste being treated at their WWTPs. An example of this has been the recent trial by SWC at their Cronulla WWTP²³. The three year waste-to-energy trial (see Figure 3.3) uses locally sourced food waste to power the Cronulla WWTP. *“Not only will the food waste help to generate renewable energy to power the plant, it will also save 150,000 wheelie bins of fruit and vegetables per year from landfill”*²⁴

Figure 3.3 – Cronulla Food Waste Anaerobic Digestion Trial



This trial, along with others, will assist SWC in implementing the vision of their evolving internal Food Waste to Energy 2020 Plan that aims to provide customers with an alternative sustainable food waste organics disposal service by 2020.

SWCs broader sustainability objectives involve participation in research, projects and trials to optimise the processing and recovery of solid and liquid organic waste contributing to more liveable, sustainable cities.

²³ http://alternate.sydneywater.com.au/web/groups/publicwebcontent/documents/document/zgrf/mdgw/~edisp/dd_080141.pdf (accessed 30/06/2017)

²⁴ <http://wastemanagementreview.com.au/utility-first-food-waste-to-energy-plant/> (accessed 30/06/2017)

SWC are also involved in the nexus between food waste (and food preparation derivatives) and wastewater services as they are responsible for trade waste licences from commercial and industrial sites, including grease trap waste. SWC are increasingly involved in the assessment of food waste pre-treatment processes discharging food waste to their sewers. These emerging technologies are being developed to assist food preparation businesses pre-treat food waste before being discharged to the sewer. This provides an alternative and cheaper waste management solution for businesses that traditionally send food waste to landfill. However, there may be detrimental impacts and unexpected consequences of such technologies. For example, in 'slow flow' sewer systems that take a long time for the sewage to pass to the WWTP, food waste has the potential to contribute to sewer chokes and a build up of hydrogen sulphide, causing pipe corrosion and odour. On the other hand shorter 'fast flow' sewer systems that take a vastly shorter period of time for sewage to pass to the receiving WWTP, that receive food waste into the sewer, could provide an efficient way of collecting and treating food waste and the potential for generating renewable energy at WWTPs.

As we look to the future, water, wastewater, energy and waste services will require a flexible mixture of small and large-scale solutions (i.e. one size doesn't fit all) with the appropriateness of such solutions being highly context specific and requiring detailed assessment.

4 INNOVATIVE SYSTEMS TO MANAGE ORGANIC WASTE

LITERATURE REVIEW

A national and international literature review of innovative approaches to organic waste management has been conducted. The literature review focuses on the urban context and does not aim to be an exhaustive account of innovation in this field but rather illustrate a range of collection, transport, treatment and reuse approaches being adopted in dense urban settings that could potentially be adopted in the PUP corridor.

The criteria used to select examples included consideration of approaches across:

- sectors (residential, commercial, institutional) and various sub sectors within each sector (single residential, MUDs);
- scales from individual houses/buildings, through to MUDs, precincts, LGAs and city scale;
- system components from collection, transport, treatment to reuse;
- applications from restaurants to market stalls and hospitals to universities;
- individual technologies and systems;
- social and behavioural practices;
- the waste hierarchy from avoidance to reuse; and
- national and international examples.

COLLATED EXAMPLES

Tables 4.1 to 4.4 provide a summary of the examples collated in the residential, combined mixed residential-commercial, commercial and institutional sectors. Appendix A contains around 35 vignettes of each of these examples and references for further details and information.

Table 4.1 – Summary of national and international examples of innovative organic waste management systems (residential sector)

Ref	Scale	Waste > Technology Type > Output	Novelty/Interesting Characteristic	Technology/Approach	Examples by Country
Residential sector					
R1	Household	HH FW avoidance	Multiple behavioural/technical tools	Love Food Hate Waste	UK, NZ, Canada Australia
R2	Household	HH FW > on-site decomposer/dehydrator > HH soil amendment	HH decomposer/dehydrator	Food cycler: home Clo'ey	USA Australia
R3	Household	HH FW > on-site AD > HH cooking gas & liquid fertiliser	HH AD	Homebiogas	USA and 56 countries including Australia
R4	Neighbourhood	HH FW > community fridge > HH redistributed food	Communal fridge	Fridge	Frome - UK, Spain, Germany
R5	MUD	HH FW > on-site insinkerators > city AD	Insinkerators	InSinkErator	Calgary Canada + Philadelphia, Chicago, Milwaukee USA
R6	LGA	HH FW > on-site compost/worm farms/bokashi buckets > HH compost/fertiliser	On line training incorporating food waste avoidance & how to recycle the remainder on site.	Compost revolution	Woollhara, Waverly, Randwick 40 Australian councils
R7	LGA	MUDs FW collection > city AD	MUD caddies	MUD FW collection	Leichhardt + Randwick, Australia UK
R8	LGA	HH FOGO > city compost	Combined FOGO	FOGO	Lismore, Australia + > 20 NSW Councils & Nillumbik Shire Council (Vic)
R9	LGA	HH FW avoidance > rewards/incentives > HH-city compost/fertiliser	Rewards	Greenredeem	Royal Borough of Windsor and Maidenhead (RBWM), UK Randwick "Green Money", Australia
R10	LGA/ development	HH FW > city vacuum > city AD > fertiliser	Vacuum	Envac	Hammarby Sweden & China, Doha, Spain, UK Maroochydore, Sunshine Coast, Australia
R11	City	MUDs FW collection > city AD	MUD caddies	MUDs FW collection	Milan, Italy
R12	City	HH/MUDs FW collection points > city AD	Pay as you waste/collection points	Residential FW collection points	Multiple urban centres Korea + Germany & Belgium

Acronyms

- HH (household)
- FW (food waste)
- AD (anaerobic digestion)
- MUD (multi-unit dwelling)
- LGA (local government area)
- FOGO (food organics garden organics)
- SMEs – (small and medium sized enterprises/businesses)

Table 4.2 – Summary of national & international examples of innovative organic waste management systems (mixed residential-commercial sector)

Ref	Scale	Waste > Technology Type > Output	Novelty/Interesting characteristic	Service/approach	Examples by Country
Mixed Residential and Commercial Sector					
RC1	Neighbourhood	FW avoidance > apps > re-distribution	Apps	Food for All	USA Australia
RC2	Neighbourhood	FW collection (bikes) > city compost/worms	R&C bike collection service	Healthy Soil Compost	Chicago, USA
RC3	Market/ neighbourhood	Market & HH FW > off-site compost & worm farm	Market waste collection point	Green City Market	Chicago, USA

Table 4.3 – Summary of national and international examples of innovative organic waste management systems (commercial sector)

Ref	Scale	Waste > Technology Type > Output	Novelty/Interesting characteristic	Service/approach	Examples by Country
Commercial Sector					
C1	SMEs	FW avoidance/advice	Extensive	Bin Trim	NSW, Australia
C2	Grocery store	Part on-site decomposition > sewer > city WWTP	On-site decomposition/sewer discharge	Waste to Water PowerKnot	Banana Joes (Fruit market), Marrickville, Australia USA
C3	Grocery store	On-site maceration > collection > city AD	On-site maceration	Grind2Energy Pulpmaster	Massachusetts, USA Australia
C4	Shopping centre	FW vacuum > on-site dehydrator > city composting	On-site vacuum/centrifugal dehydrator	Rendisk	Shepherds Bush, London, UK
C5	Markets	Market FW > on-site worm farm > fertiliser	On-site worm farms	Hungry Bin Worm farms	Queen Victoria, Melbourne, Australia
C6	Commercial precinct	Precinct various organic waste > varies on-site closed loop & AD processes > energy & fertiliser	On-site symbiotic treatment/AD	Various	The Plant, Chicago, USA
C7	Commercial precinct	Precinct FW > on-site dehydrator > soil conditioner	On-site FW dehydrator	Giai Recycling EcoGuardians	Degraves, Melbourne, Australia
C8	Commercial precinct	Precinct FW > on-site AD > biogas & fertiliser	On-site AD	Active Research	Federation Square, Melbourne, Australia
C9	Commercial sector	FW regulation > city compost/AD	Regulation banning commercial food waste from landfill	Regulation	California, USA + Connecticut, Massachusetts, New York City and Rhode Island
C10	City commercial	FW collection > redistribution	City partnerships	Oz Harvest Foodbank, Secondbite Fareshare	Sydney & multiple city & regional areas, Australia
C11	City commercial	Various FW sites > on-site maceration > utility city WWTP AD	City & utility partners	Pulpmaster	Cronulla, Sydney, Australia

Table 4.4 – Summary of national and international examples of innovative organic waste management systems (institutional sector)

Ref	Scale	Waste > Technology Type > Output	Novelty/Interesting characteristic	Service/approach	Examples by Country
Institutional Sector					
I1	University building	FW > on-site maceration > city AD	On-site maceration	Pulpmaster	Western Sydney University, Australia
I2	University precinct	FW > on-site rapid food decomposers > city AD (future potential reuse)	On-site decomposers/potential reuse	Closed loop	University of Technology Sydney, Australia New England, USA
I3	Public Park	Dog waste > on-site AD	Dog waste/on-site AD	Bespoke AD	Gilbert, Arizona + Cambridge, Massachusetts, USA
I4	Public Park	Dog waste > on-site compost	Dog waste/on-site compost		Montreal, Canada + NY and Alaska USA
I5	Hospital	Kitchen/FW > on-site vacuum > off-site compost	Vacuum	Vacuum	Royal Adelaide Hospital, Australia
I6	Hospital	Kitchen/FW avoidance	Avoidance management	Management	NSW Hospitals, Australia
I7	Airport	Airline FW > on-site dehydration	On-site dehydrator	Gaia	Heathrow Airport, London UK
I8	Zoo	Animal waste/FW > onsite composter	On-site composter	Hot rot	Melbourne, Australia UK

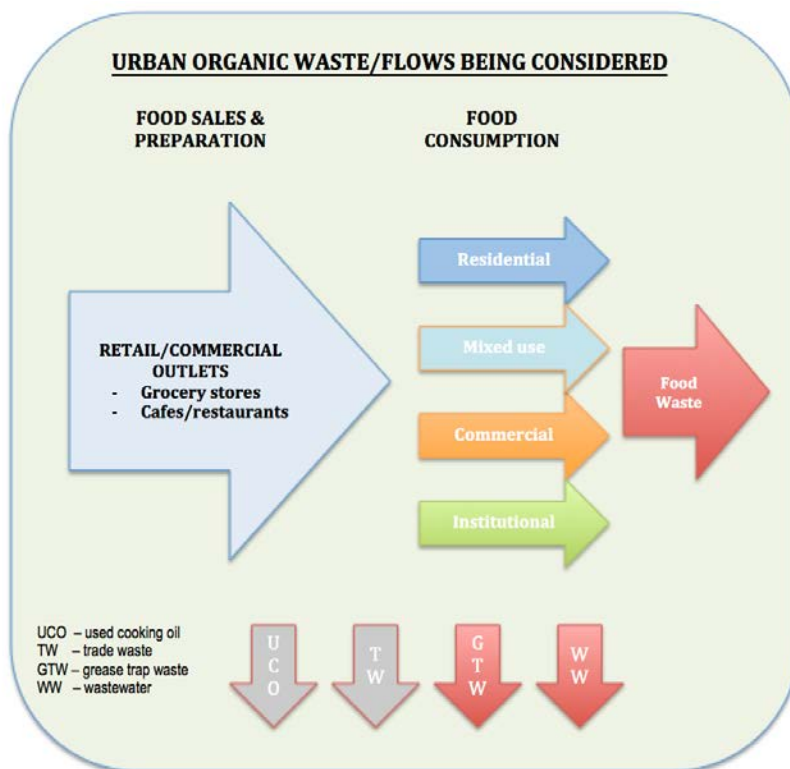
5 MAPPING ORGANIC FLOWS IN THE PUP

OVERVIEW

As previously discussed there are various types of organic flows within an urban context. The aim of this section is to quantify, at a high level, some of these organic flows in the PUP as well as the potential opportunities for utilising these flow and in the process identify knowledge gaps. The flows of organic waste streams considered in this report are shown in Figure 5.1 and include:

- municipal (residential) food waste
- commercial food waste
- grease collected from commercial grease traps; and
- wastewater (sewage)

Figure 5.1 - Organic waste streams considered



Organics waste streams not included are used cooking oils (UCO), trade waste and garden waste. They have been omitted due to limitations in data availability.

Data has been collated and mapped to the cadastral lot scale²⁵, to give an indication of organic flows within individual building footprints based on the data available.

²⁵ <https://data.nsw.gov.au/data/dataset/b8659c69-7666-4b5d-97a9-3c5036f50315> (accessed 30/06/2017)

MUNICIPAL FOOD WASTE DATA

This analysis maps the generation of food waste from municipal (residential) sources in the PUP area. As previously indicated a high proportion of food waste is generated in NSW municipalities and disposed to landfill as the majority of councils do not provide food waste separation services.

The primary data source for municipal waste volumes is provided from council waste audit data (2005 to 2015)²⁶. This data contains the total amount of waste generated, as well as waste recovered and waste disposed to landfill in each reporting year for councils in NSW. Food waste generated is not a separate component of this data. For this study 2011 waste data for the CoS council area was used as it aligns with ABS census years for population estimates.

The composition of municipal waste for the Sydney Metropolitan Area was taken from NSW EPA kerbside audit reports conducted in 2011 (NSW EPA, 2014b). This data contains the material breakdown of each waste fraction (i.e. organics (garden waste), dry recyclables, and residual waste). Food waste generated can be estimated from the residual waste fraction (i.e. the red bin), as this is the waste fraction that contains food waste as no municipal food waste collection service existed in 2011 for the CoS council area.

Population data was taken from ABS estimates for the CoS council area. Population estimates at the mesh block level (the smallest geographical division used by the ABS, equivalent to areas with approximately 30-60 dwellings) were used, as the fine scale of the mesh block allows for a much more detailed estimation of food waste generation at other spatial scales (i.e. cadastral scale).

Data collection method

To estimate food waste generated in the PUP, the quantity of food waste generated across the entire CoS council area was first estimated by applying the proportion of food waste estimates to total residual waste generation estimates from the 2011 NSW EPA waste audit report data. This is a single figure, estimating total food waste generated in 2011 across the entire LGA.

To arrive at a disaggregated figure for the study area, per capita food waste generated in 2011 was first estimated by dividing food waste generated in 2011 by the 2011 population estimate for the CoS council area. As population data does not exist for the cadastral lot boundary scale, data was first disaggregated to the mesh block level, where population estimates are available. The estimated per capita food waste generation was multiplied by mesh block population estimates for the PUP area.

To further disaggregate food waste estimates to the cadastral lot scale, each lot in the cadastral data was assigned the mesh block food waste estimate for the mesh block in which the lot falls. Lots which are described a non-residential land-use category were removed, and the estimates for the remaining lots within a mesh block scaled by a weighting factor to ensure consistency with the mesh block level estimate.

²⁶ <http://www.epa.nsw.gov.au/warrlocal/data.htm> (accessed 30/06/2017)

Assumptions

Several assumptions have been made for estimating food waste generation in the PUP area. The primary assumption is that waste generation in the PUP is not significantly different to waste generation across the CoS council area. This may not be strictly true, as socioeconomic and demographic factors can be drivers for waste generation. In addition, variation in dwelling types can have a significant impact on levels of waste generation. We justify this assumption by considering that PUP is a precinct with a varied social fabric (e.g. variation in income levels), as well as variation in residential form (e.g. mix of MUDs, small houses, etc.).

A further assumption is that as no food waste collection service was in effect in 2011, that all food waste generated in dwellings is disposed of through the residual waste fraction. This assumption can be justified based on the high proportion of kitchen waste found in the residual fraction in waste audit data for the Sydney Metropolitan Area.

Limitations of method and data collected

There are limitations with the above method and data sources. Firstly, disaggregation of population estimates to the cadastral scale introduces “noise” into the data, meaning there will be some inaccuracies with population estimates. As population is the key variable in estimating food waste generation, these inaccuracies carry over to estimates of food waste.

More fine-grained population data, in addition to fine grained waste generation and waste characteristics of the PUP will improve the accuracy of these estimates. It should also be noted that population estimates are for 2011 because the 2016 census data has not (at the time of writing this report) been released. A disaggregated population model for PUP, which could project population geospatially was beyond the scope of this study. The analysis could be updated once the 2016 ABS census data has been released. The development of a geospatial projection model could assist in determining the impact of urban densification and associated projected organic material intensity mapping in the future.

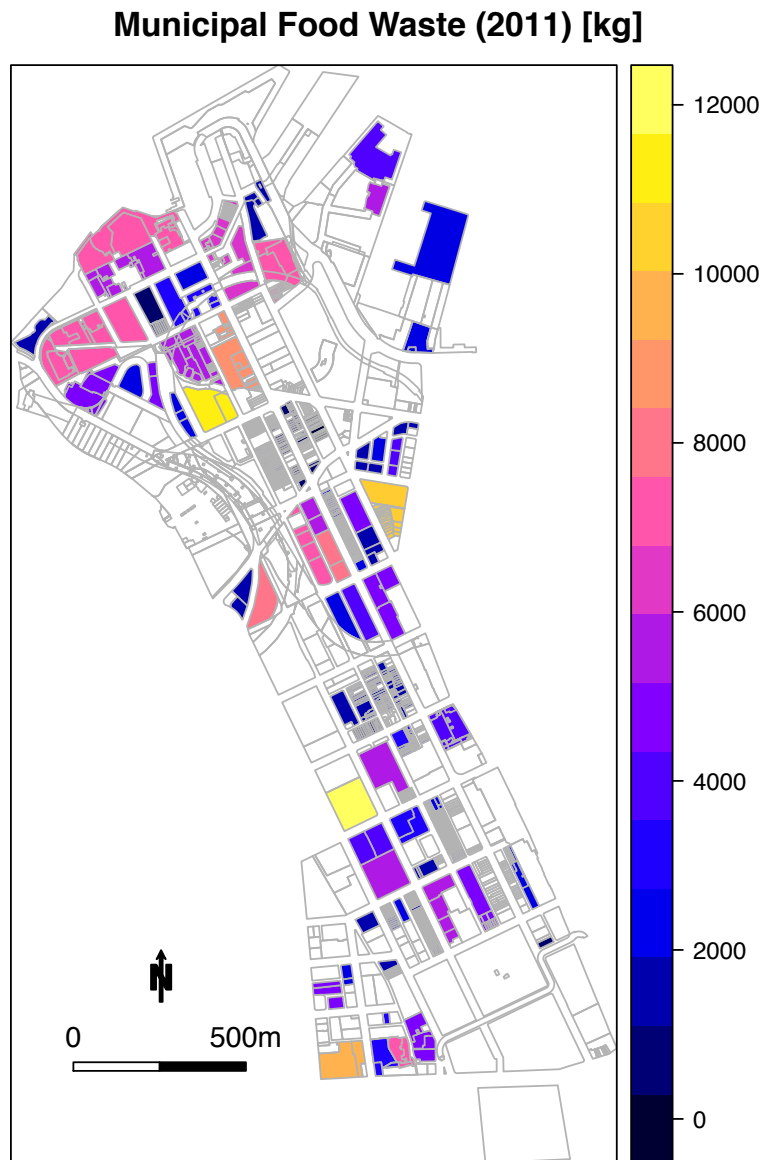
Municipal food waste estimation

Figure 5.2 provides the estimation at the cadastral level for municipal food waste generation for 2011. There are pockets of high levels of food waste generation, where high density residential buildings are located. Total municipal food waste generated in the PUP for 2011 (i.e. based on a population of 19,465 as per 2011 census mesh block data) was approximately 2,312 tonnes of waste, assuming an average per capita rate of food waste generation of 118 kg/year.

It should be noted that the map does not include details of Central Park. The reasons for this are twofold:

- Firstly Central Park opened at the end of 2014 hence the population is not included in the 2011 census data. Considering Central Park is within the PUP boundary of analysis and is so large (estimated population is 5,300 people when complete in 2018) the food waste associated with the 2017/18 Central Park population has been added to the food waste estimates even though it is from a different point in time. The total food waste estimate for this study is therefore 2,942 tonnes (i.e. 2,312 + 630 tonnes)
- Secondly Central Park is not included on the map because of its high population density. It has been excluded from the map to enable the intensity of food waste to be observed in the other buildings/mesh blocks across the PUP.

Figure 5.2 - Municipal food waste intensity in kg/year



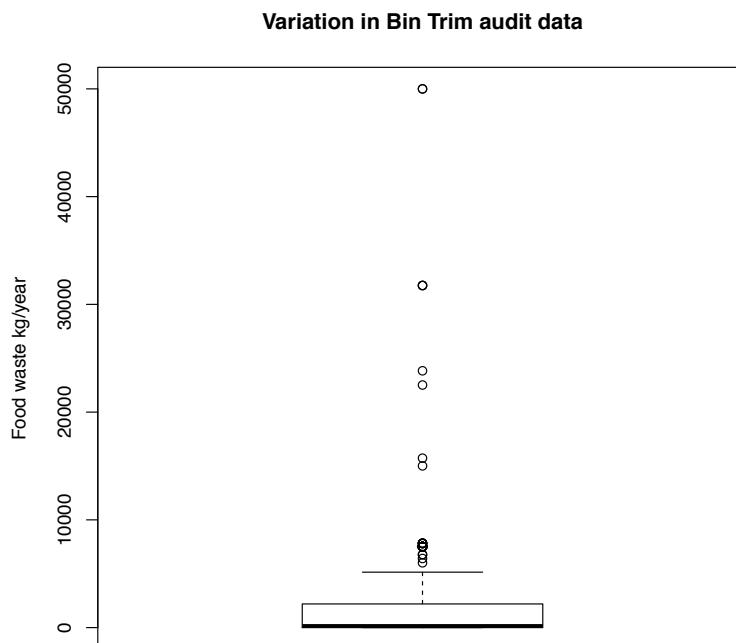
COMMERCIAL FOOD WASTE DATA

This analysis maps the generation of food waste from commercial sources in the PUP. A paucity of data exists for Australian commercial waste generation in general. The estimations in this section were conducted with the best available data sources. ‘Bin Trim’ audit data, provided by the NSW EPA, was used from small to medium sized businesses audited in the PUP area. This data included an estimated figure for food waste generated per audited property per year.

Figure 5.3 contains a boxplot describing the variation in the Bin Trim audit data. There is a wide distribution of food waste generation values across the audit data. Outliers in the boxplot represent locations with intense food waste generation, namely Broadway shopping centre, and dense food retail locations.

In total, data was provided for 527 Bin Trim audits, of which 520 were used in this analysis. Seven audit data points were removed due to insufficient address information.

Figure 5.3 - Box plot showing the distribution of Bin Trim audit volumes



Assumptions

No assumptions were made for this data, other than the data being a limited picture of commercial waste activities in the precinct. Data provided by the EPA was used in its raw form.

Limitations of method and data

The primary limitation with this data is that it is not a complete picture of commercial food waste generation in the precinct, as the audits were only conducted on a limited number of small to medium sized establishments, of which the majority were food retailers. It is also only a visual estimate of how full the bins are and the associated volume. This is then converted to a tonnage based on assumed density.

According to ABS there were approximately 3,605 businesses in the Pymont-Ultimo area in 2015²⁷. This will include a wide range of businesses with and without association with food waste. An attempt was made to map geospatial data from SWC, which has associated ANZSIC codes for different types of businesses but SWC indicated that ANZSIC codes in their databases are not kept up to date and thus are unreliable. An attempt to investigate the use of SWC ANZSIC codes and assess their reliability and potential for auditing and updating is highly recommended. Verification of ANZSIC codes may require collaboration with other government agencies and organisations (i.e. CoS, ABS).

²⁷http://stat.abs.gov.au/itt/r.jsp?RegionSummary®ion=117031334&dataset=ABS_REGIONAL_ASGS&geoconcept=REGION&datasetASGS=ABS_REGIONAL_ASGS&datasetLGA=ABS_NRP9_LGA®ionLGA=REGION®ionASGS=REGION (accessed 30/06/2017)

An attempt to data-mine other fields within the SWC databases that may assist in triangulation of data was also attempted. For example in the SWC trade waste department the grease trap data has details on seat numbers in food serving establishments. However, again these details are considered unreliable and subjective hence they were not used. Again it would be highly advantageous to audit and verify such figures in the databases as they could be used for multiple purposes including estimation of food waste levels. It is highly recommended that an assessment of the fields within the SWC databases is made to identify potentially useful fields for organic waste management and a series of actions put in place to systematically audit and update the fields plus protocols set up to maintain their integrity in collaboration with other government/non government organisations.

CoS data (Floor Space and Employment Survey data) was also considered to be used, in conjunction with Bin Trim data, to estimate food waste generated across all commercial sites in the study area. It was intended to use average waste generation figures by ANZSIC code obtained from Bin Trim data to estimate average generation by commercial segment. While this method would theoretically yield rough estimates for waste generation across all commercial floor space in the study area, it was deemed unsatisfactory for this scoping study, as robust validation of the data would be required, and is beyond the scope of this project. Future work in estimating commercial food waste for PUP could entail sampling of businesses belonging to specific ANZSIC categories to determine average waste generated, employment and patronage figures, and floor space, per ANZSIC category. This data could then be merged with other data, in particular the CoS Floor Space and Employment Survey data, to yield an efficient, and rough yet robust estimate for commercial food waste generation in the precinct.

Commercial food waste estimation

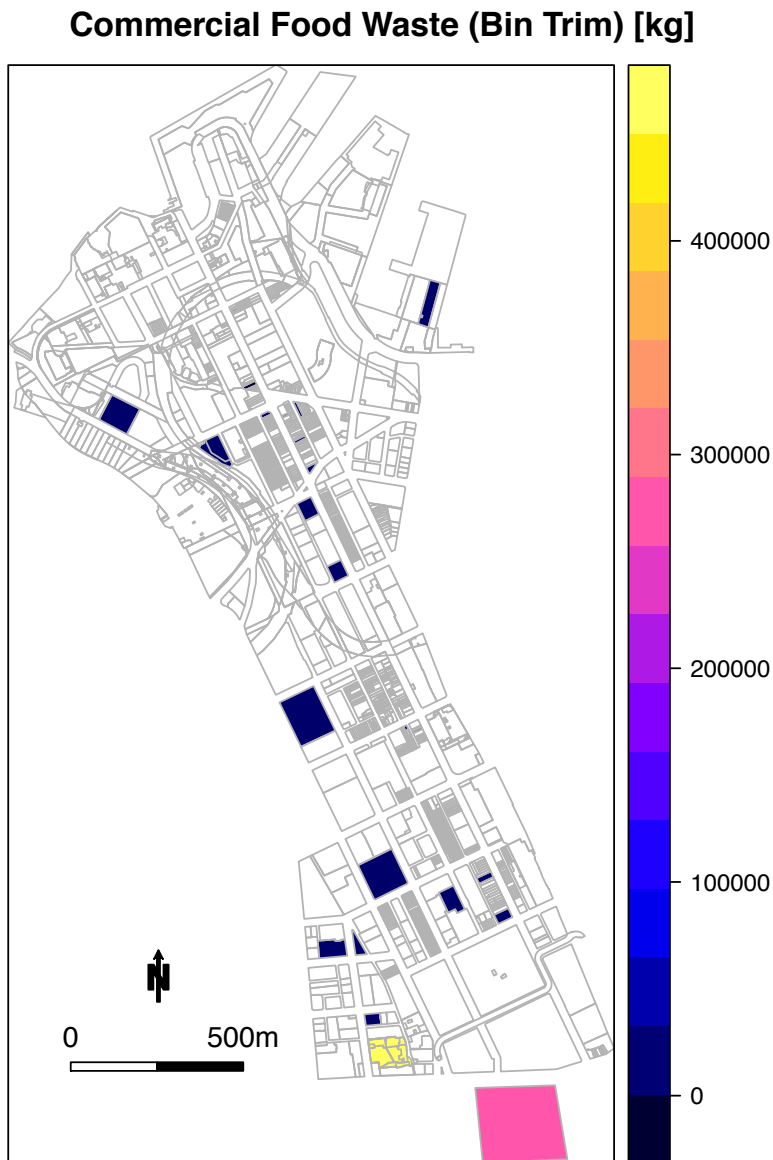
Figure 5.4 contains the estimation on the cadastral scale of commercial food waste from available Bin Trim data. The audits appear to be concentrated in a few locations. Locations with estimated food waste is sparse, indicating the paucity of available data in this sector. Locations with available data generally have low intensity food waste generation, also indicated by the boxplot in Figure 5.3. Establishments around the Broadway area in Ultimo have a much higher intensity of food waste generation owing to density of food retailers in this area.

Total commercial food waste estimated from the available 520 businesses audited by Bin Trim is approximately 664 tonnes per year, with average food waste generation per establishment estimated at approximately 1.3 tonnes per year. Although as noted in the Figure 5.3 boxplot this data is skewed by a few outliers.

An additional Bin Trim data set was obtained for Central Park (Cleanaway 2015) and has been included in the map in Figure 5.4. Over 280 tonnes/year of food waste was observed from an audit conducted in 2015 of 32 out of 45 retail outlets at One Central Park, both food and non food related. Eight of the non-participating retail outlets are food related businesses therefore the 280 tonnes/year is likely a conservative estimate.

The total food waste estimate from available Bin Trim data including data sourced directly from Central Park is 945 tonnes/year (664 + 280 tonnes/year).

Figure 5.3 - Commercial food waste intensity in kg/year



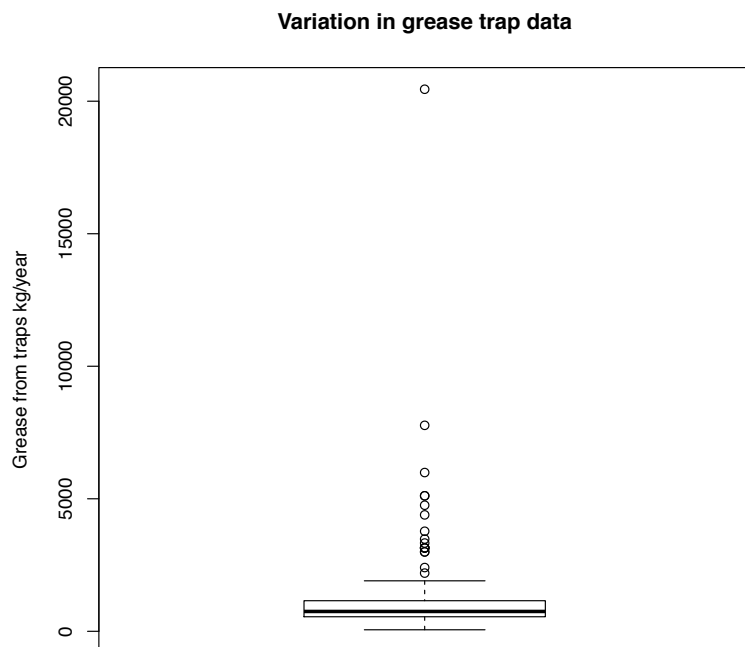
GREASE TRAP DATA

This analysis estimates the grease waste collected from commercial grease traps in the PUP. Grease collected from traps presents a potential high-value opportunity for energy recovery (e.g. through production of biofuels and feed stock to local and large scale anaerobic digestion systems) and other organic processing pathways. Existing supply chains (i.e. established grease trap collection systems) increase the potential of utilising this organic waste resource.

Data for grease collected from grease traps was sourced from SWC data, describing the capacity, frequency and volume of grease collected from registered commercial grease traps in the PUP area. This data includes only grease/oil removed from grease traps. SWC removed volumes of water and other solids in the grease traps through standard assumptions. There were 123 registered grease traps, across 94 cadastral lots within the PUP with correct address fields that could be mapped.

Figure 5.5 below shows the distribution of total grease collected from registered grease traps. The outlier is caused by one location on Broadway, Ultimo, where grease collection is estimated to be 20 tonnes per year.

Figure 5.5 - Box plot showing the distribution of grease trap volumes



Assumptions

The primary assumption was the conversion of grease trap collection volume (in litres) to mass (in kgs). For this, the density of cooking oil (0.9 kg/L) was used to derive the mass of collected grease. It was assumed that grease collected in grease traps would be primarily used cooking oil with some solid organic material.

An additional assumption is also that business activity and grease production is constant, with consideration for varying business activity and the forecasting/backcasting of grease production considered out of scope for this project.

Limitations of method and data

The data provided by SWC is for all registered grease traps within the PUP area, therefore is assumed to be a complete dataset for the purposes of this scoping study. However, from a scan of the data, some key sites appear to be missing, hence the volumes will likely be lower than in reality. Registration of grease traps in Sydney has improved significantly in recent years, however, there may be a number of unregistered grease traps in operation in the area. It is not possible to estimate this.

Grease collected from commercial grease traps estimation

Figure 5.6 provides an estimation of grease collected at the cadastral lot scale for the study area. Total grease collected from grease traps annually is estimated at approximately 144 tonnes, with an average collection rate of approximately 1.2 tonnes of grease per trap collected each year. However, as noted in Figure 5.5 the distribution of volumes can vary significantly. Within the PUP, establishments around the Broadway area including around the Broadway retail centre and UTS produce the greatest amount of grease from the data set

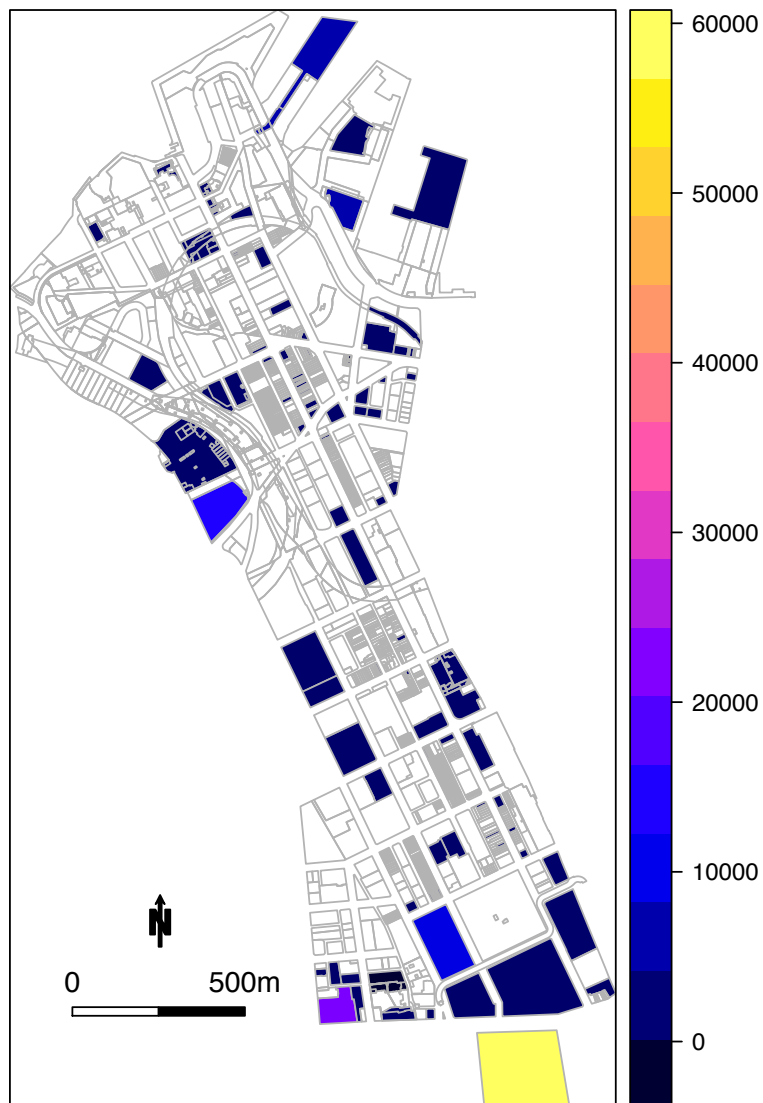
observed, consistent with the business activities in this area (e.g. a large number of food retailers). Sydney Fish Markets also produces a sizeable amount of grease owing to the business activities at that location. A potentially large site, that is not within the data set, is 'The Star'. Omission of this site and potentially others in the SWC database needs to be investigated further.

Additional data on commercial grease trap waste was sourced directly from One Central Park, which has four grease traps associated with the retail area. Approximately, 56 tonnes of grease is removed from these grease traps per year (based on assumptions outlined previously).

The total estimated grease collected from grease traps in the PUP area is therefore over 200 tonnes/year (144 + 56 tonnes/year).

Figure 5.6 - Grease trap waste intensity in kg/year

Grease collected from commercial grease traps [kg]



WASTEWATER

This analysis estimates the amount of volatile solids in sewage at the cadastral scale that could theoretically be utilised within the PUP if not passed to the current SWC WWTP system for treatment and subsequent discharge. Volatile solids are the organic portion of total solids in sewage that can be digested and turned into energy through for example an anaerobic digester. This could be at a central SWC WWTP or alternatively smaller on-site anaerobic digesters within the PUP where appropriate.

For this analysis, water consumption data and sewage discharge factors were obtained from SWC. Water consumption data and associated discharge factors were supplied for 1,065 properties with associated residential and commercial strata units. Data contained standardised monthly water consumption for each supplied property and an associated assumed sewage discharge factor, that is, the assumed portion of sewage discharged to sewer based on the amount of water consumed. Discharge factors within the data vary between 30% and 100% depending on the type of property.

Properties contained in the data set were predominately strata units, with residential strata units comprising 83% of the data, and commercial strata units comprising 8% of the data.

Assumptions

A number of assumptions were made in order to calculate the estimated mass of volatile solids in sewage that might be available for energy generation. The mass of volatile solids per litre of wastewater can vary significantly depending on dry or wet weather flow in a system, that is, during wet weather illegal stormwater and infiltration dilute the solids content. From a sampling set of Bondi WWTP inflows volatile solids in dry weather flows have been recorded as around 310 mg per 1000 litres (Pers com P Woods, SWC).

From a literature review a model²⁸ was found to estimate volatile solids from sludge treated in a WWTP. This model represents an idealised WWTP process relevant to the urban US. This model assumes that all sewage in the study area is treated. A variation of this model was used to calculate the volatile solids component available from wastewater inflows, and is described by the following equation:

$$M_T = Q \cdot TSS \cdot f$$

Where M_T is estimated volatile solids; Q is average inflow rate (i.e. sewage) in L; TSS is total suspended solids concentration in g/m^3 ; and f is the ratio of average influent volatile suspended solids to total suspended solids.

Parameters for the above were based on literature values appearing in Seiple et al. (2017) and from correspondence with SWC (pers com P Woods, SWC). Values for TSS and f_v used were $310 g/m^3$ and 0.85 respectively. Values for Q were given based on the SWC data received.

Limitations of method and data

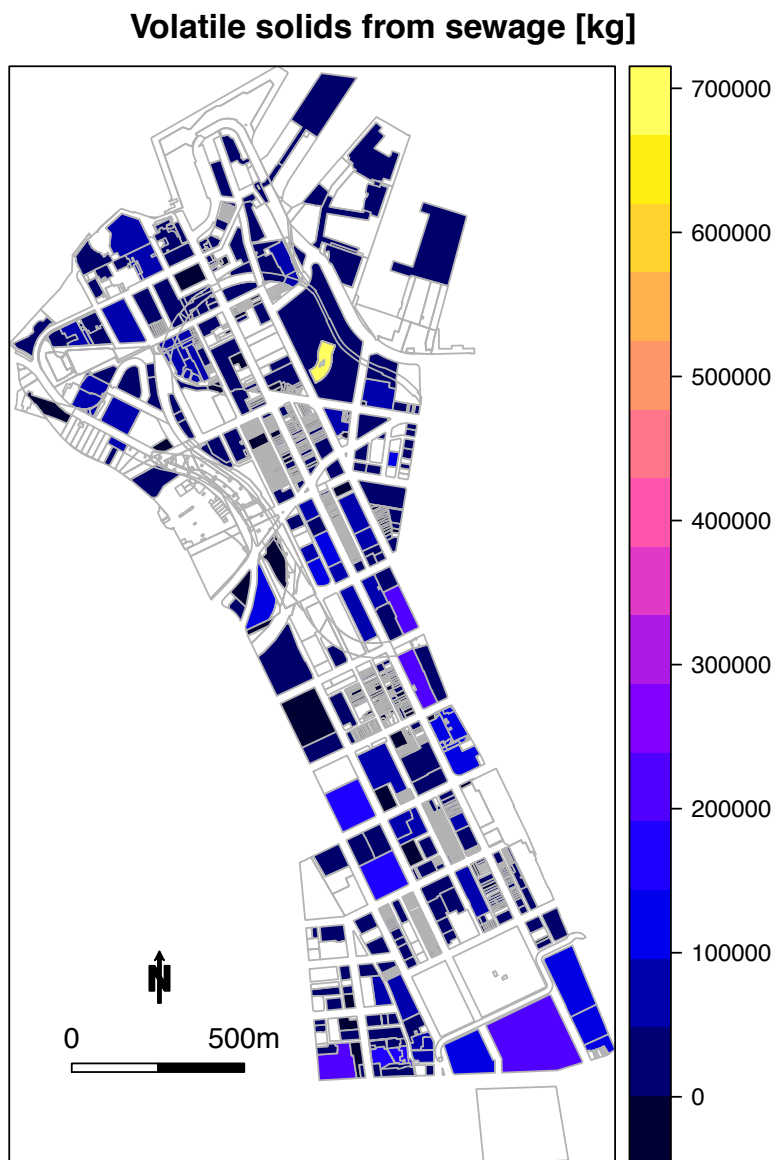
The primary limitation of this estimation is the reliance of values from the literature (i.e. for the ratio of volatile to total suspended solids), and the use of a generalised total suspended solids concentration for the entire study area. Given the paucity of data for this scoping study, the estimate was considered acceptable, and values found in the literature agreed well with estimates obtained through correspondence with SWC. Future studies should obtain better estimates of the characteristics of wastewater in the PUP.

²⁸ Seiple, T.E., Coleman, A.M., and Skaggs, R.L. (2017). Municipal wastewater sludge as a sustainable bioresource in the United States, *Journal of Environmental Management*, 197, pp. 673-680

Estimated volatile solids from sewage

Figure 5.7 shows the estimated volatile solids in sewage at the cadastral scale for the study area. Volatile solids generation is centred around multi-residential and mixed-use properties for which data was available. Large properties such as UTS and the area around the Star also stand out. From the available data, there is in the order of 7,830 tonnes of volatile solids generated in the precinct on an annual basis. This is a significant resource and shows the major potential of the organics in sewage. Such organics if captured in a more concentrated form (i.e. through vacuum toilets without large volumes of water that dilute the organics captured) this resource could potentially be treated and used for energy generation at a more local scale.

Figure 5.7 - Volatile solids intensity from sewage in kg/year



OTHER ORGANICS

Other streams of organics such as garden waste, used cooking oils (UCO) and trade waste also have the potential to be mapped and potentially utilised as an organic resource within the PUP.

Due to the high-density MUD characteristics of the PUP there is potentially less opportunity for garden waste collection in this area compared to other more “leafy” suburbs. Also the higher lignin content of more woody garden waste compared to food waste makes it less useful for energy production through processes such as anaerobic digestion. For completeness mapping of garden waste should be conducted if further stages of analysis and mapping for the PUP are conducted. This will require assistance from the CoS and access to any detailed databases on garden waste for the PUP. Some specific locations that could provide garden waste with a lower lignin content are One Central Park where green waste including clippings from the façade are removed fortnightly (pers com A Baxter, Junglify) and lawn cuttings in grassed areas in the parks at the northern end of Pymont.

UCO has a high calorific value and significant potential as a feed source for more localised treatment such as anaerobic digestion for energy generation. It is estimated that there are some 80,000 tonnes of used cooking oil produced in Australia each year (pers com UCO and grease trap contractor), which is currently collected and typically recycled into biodiesel or animal feed by a few large organisations such as Auscol, Scanline and Cookers and many smaller companies. With vulnerability in the local biodiesel market, there is the potential of using UCO at a more local scale as feedstock for anaerobic digestion. Mapping UCO within the PUP would be highly beneficial but requires assistance from existing companies providing UCO services. This should be considered for any further analysis and mapping associated with the PUP.

Finally another layer of organics currently not typically considered as a potential organic resource is trade waste. SWC have trade waste agreements with over 150 properties in the PUP area. These trade waste agreements cover licence discharge limits on for example biochemical oxygen demand, suspended solids and grease. The types of premises with trade waste agreements vary significantly from car washes to laundries and from bakeries to restaurants. The volumes permitted also vary significantly, with several outlets at the Sydney Fish Markets having very high biochemical oxygen demand licence agreements. With such variation between properties it is difficult and beyond the scope of this study to assess and map the organic opportunities of these properties across the PUP. However, there is significant opportunity to harness these organics and potentially use them as a local feedstock for energy generation through anaerobic digestion at a more local scale. The mapping of trade waste requires further discussion with SWC and more detailed analysis at a property scale. Any further analysis and mapping associated with the PUP should investigate the trade waste streams.

SUMMARY

Figure 5.8 provides a summary of the municipal food waste, commercial food waste, grease trap waste and wastewater at the mesh block scale in kg/year. As indicated in the municipal food waste section, Central Park municipal food waste has been omitted from the mapping but included in the total volumes summarised in Table 5.1.

The area in the vicinity of The Star stands out as a large generator of organics even though several streams of organics are not yet included in the mapping (i.e. the commercial food waste at the Star). The Star is a large employer in the area and has some 11 million visitors per year (refer to Section 6 for details) hence there is significant opportunity to collect organics at this site for potential local processing if not done already. Central Park is also a large generator of organics and has similarly significant opportunity.

The northern end of the precinct, including apartment dwellings around Bowman Street, the area adjacent to the Star, and extending down Harris Street, appear to generate significant volumes of organic waste. This area is densely populated, and also contains a number of commercial eateries, indicating that this zone has high potential for targeted multi-stream organic waste collection and potentially decentralised/small-scale organics processing. Other zones of high organic flows exist across the PUP, including in the vicinity of Broadway shopping centre and UTS.

Figure 5.8 - Summary of total analysed organic flows at mesh block scale in kg/year

Total surveyed organic flows at mesh block scale [kg]

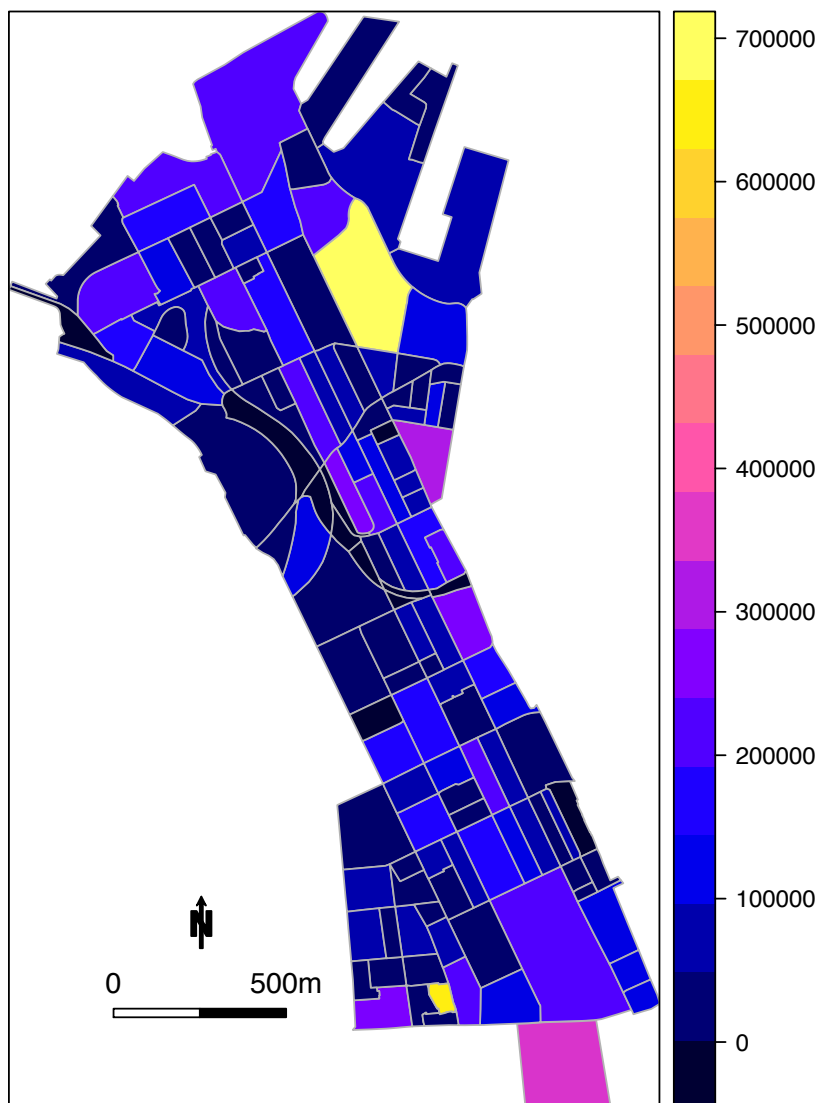


Table 5.1 summarises the total organic flows analysed across the precinct by stream. The majority of organic waste is associated with wastewater and food waste from the municipal sector. It should be acknowledged that given the limitations discussed in previous sections, that the share of commercial food waste is likely to be much higher than mapped in this study. For example the Star commercial food waste does not appear in the data set. The Star has some 20 bars and restaurants including a large staff restaurant and 500 seat buffet and is one of the highest employers in the area. Hence it is anticipated there are likely significant volumes of food waste and grease trap waste at this site that could potentially be used for beneficial purposes if not already. More detailed data on Central Park, UTS, TAFE and the Sydney Fish Markets is provided in the following section to investigate opportunities at some of these larger sites.

Table 5.1 - Summary of total analysed organic flows

Stream	Total (tonnes)	Total including additional information from Central Park
Municipal food waste	2,312	2,942
Commercial food waste (Bin Trim data) (partial data set)	664	945
Grease collected from grease traps (trade waste)	144	201
Volatile solids from sewage	7,829	7,829
Total (incomplete data set)	10,949	11,917

6 SITE-SPECIFIC CASE STUDIES

In attempting to map the organics flows across the precinct a paucity of available data was identified, particularly within commercial and institutional sites. The following section attempts to fill this gap by conducting site-specific investigations with organisations in the precinct that generate significant volumes of organic waste. The purpose of the site-specific studies is to provide more accurate data on waste streams produced not easily accessible through other means of data collection (i.e. city planning and wastewater data) and to assess the potential of more innovative management. These more in-depth site-specific case studies within the PUP include investigation of²⁹:

- Central Park
- UTS
- TAFE
- Sydney Fish Markets

Other commercial and institutional sites were approached but due to staff resourcing and other issues it was difficult to obtain detailed data. These sites have been omitted from the reporting. The details and characteristics of the four sites investigated are summarised below with data on organics flows provided where available.

ONE CENTRAL PARK

Site characteristics

Central Park, at the southern end of Ultimo, in Chippendale, is an award winning precinct development owned by Frasers Property Australia. The \$2 billion, 5.8 hectare, 5 star Green Star development is built on the former Carlton United Brewery (CUB) site. When finished in 2018, it will have 11 buildings, a 6,400 sqm public park and 1,200 sqm of green walls consisting of 35,000 plants. The 255,500 sqm gross floor area covers residential (58%), commercial (30%) and retail (12%) with approximately 5,300 residents and 1,750 workers.

“**One Central Park**”, on the western edge of the development (refer to Figure 6.1) has more than 600 apartments and currently over 50 active retail spaces with over 20 food establishments ranging in size from the large supermarket on the lower ground floor to smaller food outlets and restaurants over six floors of the retail space.



²⁹ Assistance on the details of the individual case study sites has been provided by: Cheryl Swales, Operations Manager, Central Park Mall, JLL; Andrew Eldridge and Lee Holzhauser TAFE; and Stephen Groom and Mark Luland Sydney Fish Markets.

Figure 6.1 – Site Plan of northern end of Central Park including One Central Park



Waste management at One Central Park

The 600 apartments that make up One Central Park have a combination of garbage chutes and bin rooms on each floor to manage different streams of waste (i.e. recyclables and solid waste). No residential organic food waste is currently separated or collected. The retail space houses Woolworths supermarket which manages its own waste streams in a separate waste collection area with organic/food waste streams separated, and currently transported off-site. As the Central Park Precinct heads towards completion in 2018, with increasing residential and commercial occupants, there are increasing volumes of waste generated on-site. The retail space and general food outlets are managed through the retail manager Jones Lang LaSalle (JLL) with waste collected in two waste and recycling bin rooms. JLL organised a Bin Trim audit for the retail customers in 2015 (Cleanaway 2015) identifying a significant opportunity for separation and collection of waste streams including food waste.

The basement of One Central Park houses a \$13m, 1 ML/d water recycling plant, currently the largest in the basement of a residential building in the world. Flow systems, the private utility manager of the site, provide water, wastewater and water recycling services. They also provide energy services through the on-site tri-generation Central Thermal and Electricity Plant in an adjacent building.

Organic and food waste

Organic waste streams on site include:

- General waste (residential) – Food waste currently combined within general waste and transported off site as part of Council management.
- Supermarket food waste – food waste separated and sent off-site.
- Retail food outlets – Over 280,000 kg/year of estimated food waste, with additional food waste generated from 8 retail outlets not assessed in the 2015 Bin Trim audit.
- Retail floor general waste – Food waste contained within general retail area bins. Combined general waste from all the retail sources is currently approx. 15,180 L/day. This material is collected every day and sent to landfill. This will increase to approx. 17,500 L/day once the new cinema opens.
- Grease traps – Three 15,000 L and one 5,000 L grease traps are emptied approximately every two months and treated off site at the Cleanaway treatment plant at Padstow, where the grease waste is dewatered and the concentrated grease sent to the agricultural sector for soil injection and the water component discharged to sewer.
- Used cooking oil (UCO) – UCO is collected by Scanline. On average over 1,000 kg of UCO is collected each month.
- Water recycling plant – Approx. 12,000 L/day of sewage sludge is discharged to the sewer through a tradewaste agreement with SWC.
- Animal waste – A significant number of the apartment residents have animals. The waste from domestic animals collected in bins from the onsite parks and residential bins currently goes to general waste.
- Vertical walls – Maintenance of the vertical walls at Central Park also generates organic waste. The green waste is collected fortnightly by the CoS contractor URM and transported to a designated composting facility managed by Veolia.

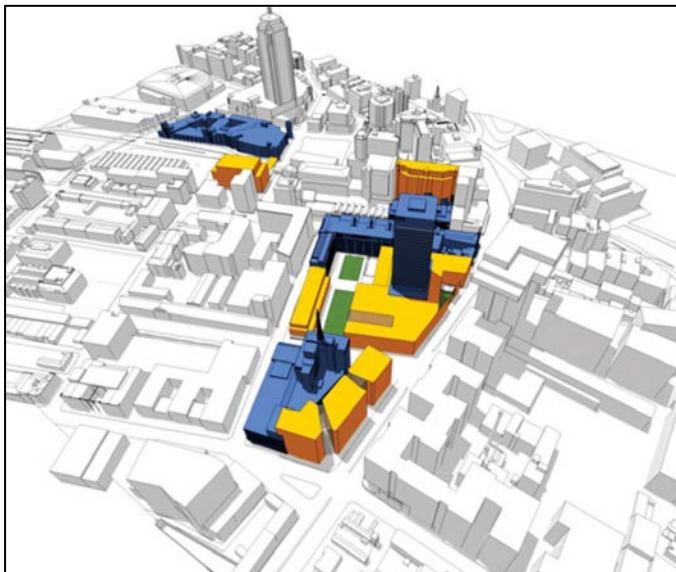
Due to the scale of One Central Park, and the larger Central Park complex developed on the former Carlton United Brewery site, which houses both private and student accommodation, there is an opportunity to divert organic waste (food waste) from landfill. A feasibility study of One Central Park is currently being lead by ISF, funded by the CoS (Innovation Grant) and Flow Systems in collaboration with JLL, Avac Australia (vacuum system specialists) and Active Research (anaerobic treatment specialists). The study will investigate the collection and treatment of organic waste from Central Park including both vacuum and anaerobic digestion opportunities “**Central Park Precinct Organics Management Feasibility Study**”³⁰. The project will be completed by the end of June 2018.

³⁰ <https://www.uts.edu.au/research-and-teaching/our-research/institute-sustainable-futures/our-research/resource-futures-43> (accessed 25/09/2017)

UNIVERSITY OF TECHNOLOGY SYDNEY (UTS)

Site characteristics

The UTS city campus is situated within the densely populated urban context at the southern end of the PUP. The university is currently undergoing significant renovation of campus buildings through the UTS Master Plan including the recent completion of the Gehry designed Dr Chau Chak Wing Building.



There are currently (as at 2016)³¹:

- 42,674 students (including 12,384 international students); and
- 3,354 staff measured as full-time equivalent

enrolled/working at the city campus, which is spread over several sites in the Pyrmont-Ultimo Precinct.

Waste management at UTS

Food waste has been separated from solid waste streams at UTS since 2014, when source separation was first introduced with the goal of diverting waste from landfill. Food waste is currently collected from 22 staff/student kitchens, 11 individual cafes from 4 separate buildings and a food concourse area servicing 5 food outlets. See Table 6.1 for volumes of food waste processed and decomposed food waste processed over the last 6 months.

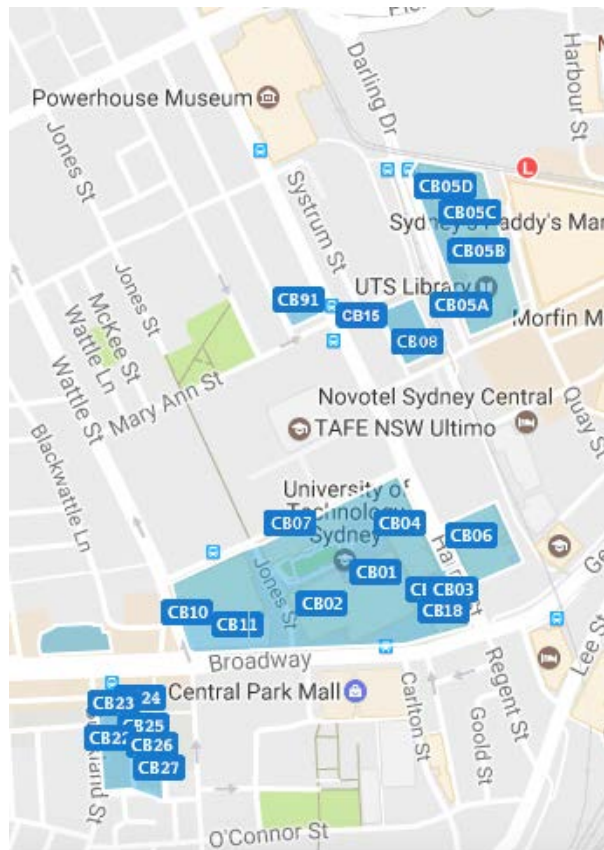
Table 6.1 - Food waste collected and processed at UTS from Dec 2016 to May 2017

Month	Food Waste input to the decomposer/ dehydrator (kg)	Food waste output from the decomposer/ dehydrator (kg)
Dec-16	3016	927
Jan-17	2628	861
Feb-17	4192	1198
Mar-17	6740	519
Apr-17	5611	1048
May-17	6091	1719
TOTAL	28,278	6,272

³¹ <https://www.uts.edu.au/about/university/facts-figures-and-rankings> (accessed 30/06/2017)

Onsite food waste management system³²

In 2016 UTS was successful in obtaining NSW EPA funding through the “*Waste Less Recycle More Organics Infrastructure (Large and Small) Grants Program*” to install two rapid food decomposers. Food waste is collected daily via dedicated 120 L bins by cleaning staff. It is transported and weighed before being loaded to two industrial scale rapid food decomposers located in the car park basements of two separate buildings at UTS (CB08 and CB10) with the aim of managing 100% of the food waste produced onsite. The Closed Loop³³ continuous batch rapid food decomposers have a capacity of 600 kgs (CL300) and 200 kgs (CL100) per day. While there is significant variability in the volumes of food waste collected over the university calendar year, on average there is approximately 4 to 5 tonnes of food waste collected per month at UTS. With the capacity of the machines more than double the current volumes processed, there is potential opportunity to import organic materials from surrounding areas but will require co-operation from the UTS facilities management team and external parties such as TAFE for this to occur in practice.



Currently food waste is being processed onsite at UTS with the volume of food waste reduced by approximately 70 to 80% through the rapid food decomposers before being transported to EarthPower (Camelia) to generate energy and soil conditioner. The ultimate goal of the UTS rapid food decomposer system is to productively use the processed food waste from UTS on local parks and gardens in strict accordance with NSW EPA waste regulation.

The project is not only currently providing sustainability benefits by diverting food waste from landfill but is also being used by students as a practice-based case study by the UTS design school.

³² <https://www.uts.edu.au/research-and-teaching/our-research/institute-sustainable-futures/our-research/food-futures/food>.
<http://www.thefifthstate.com.au/columns/spinifex/food-scraps-to-soil-conditioner-a-case-study-in-onsite-processing-at-uts/90431>
 (accessed 30/06/2017)

³³ <http://closedloop.com.au> (accessed 30/06/2017)

ULTIMO TAFE

Site characteristics

Ultimo TAFE is located in one of Sydney's strongest education, cultural and entertainment precincts in Sydney – near Central Station, UTS, the ABC, Sydney University, Chinatown and the Sydney CBD. The largest TAFE college in NSW it offers over 700 courses. There are currently:

- 30,000 student enrollments and
- 1,428 full time equivalent staff

Ultimo TAFE works closely with industry to ensure student exposure to the latest technologies, newest equipment and training in high industry-standard facilities:

- Hospitality and bakery training kitchens and
- The Apprentice training restaurant
- Fashion Design School
- Automotive repair, paint and trim workshops
- Computer labs
- Photography studios
- Science Laboratories
- Specialist technology workshops including engineering, welding, painting, printing
- Conference and exhibition rooms
- Library and technology access spaces

The site also hosts the soon to be completed Sydney School of Entrepreneurship.

The Ultimo site comprises of 19 buildings located on the main Mary Ann Street site and George Street building (refer to Figures 6.2 and 6.3). Total gross floor area is approximately 124,000 sqm. Future development of building N and building W and upgrading of existing facilities is being considered.

Figure 6.2 – Site plan of Ultimo TAFE

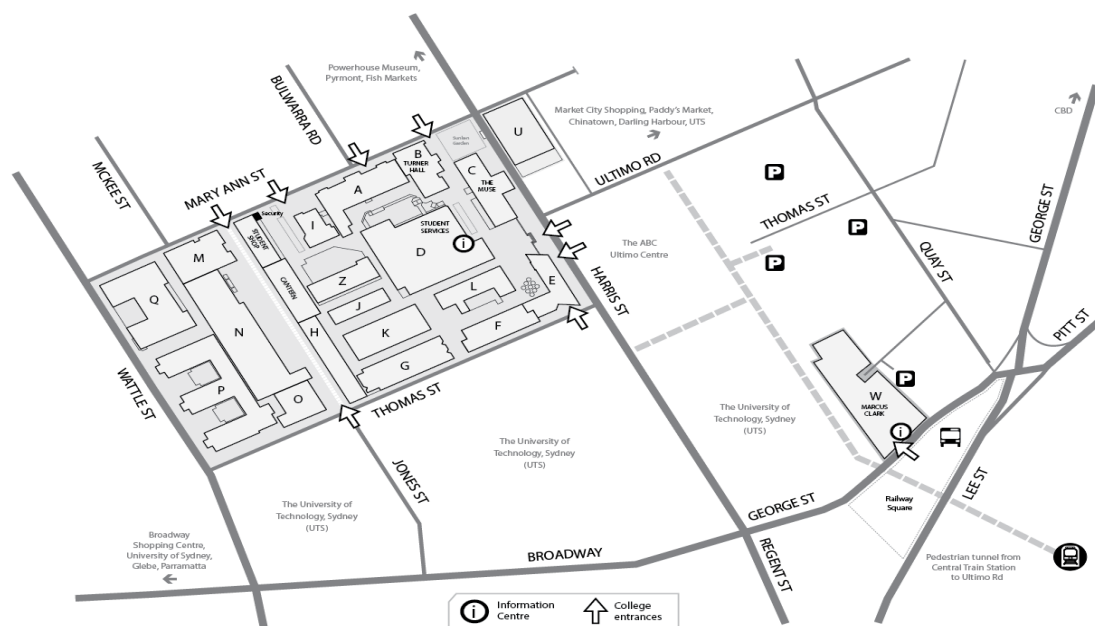


Figure 6.3 – Ultimo TAFE artists impression looking to the south



Food waste

The TAFE food outlets include the main canteen and café in Building H, a small hot food outlet in Building Q and coffee shop in Building F on the main site. In addition there are a number of drink and "food" vending machines across the campus.

The Apprentice training restaurant in Building E also produces meals to the public as part of the student learning experience. In addition, Gloria Jeans and a small independent coffee shop lease space on the ground floor (street level) of Building W on George Street and a number of food and beverage outlets lease space in the Arcade under Building W that connects the Goods Line walkway through to the Devonshire Street pedestrian tunnel.

The food outlets on the main site are operated through the canteen contract. The food and beverage outlets in Building W ground floor and in the tunnel are operated by a number of different vendors through individual contract lease arrangements.

The facilities operated by the canteen contractor are managed day to day by the Campus Manager at Ultimo TAFE. The lessees are managed through the TAFE Corporate Leasing Manager via a head lease agent.

Onsite waste management

For 2015/16 financial year the estimate of tonnage by type of waste for Ultimo TAFE was:

- Flowers (Floristry school) 2.24 tonnes
- Green waste 18.68 tonnes
- General Rubbish 46.76 tonnes
- Glass 1.4 tonnes
- Paper 50.62 tonnes
- Cardboard 50.62 tonnes
- Metals N/A

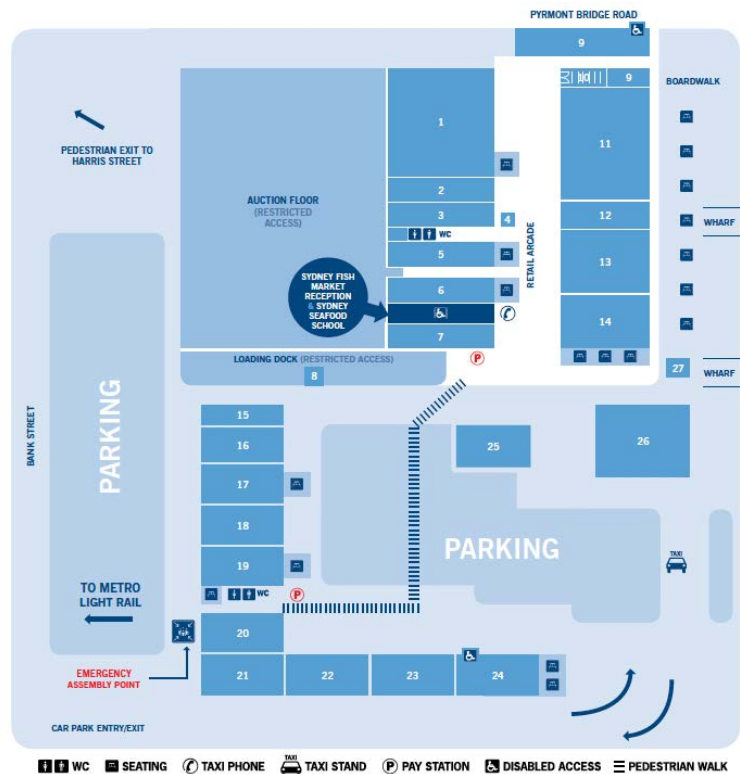
Food waste is generated from the canteen, café, training restaurants, coffee shops and fast food establishments. General waste goes to landfill. Captured food and flower waste is disposed to a facility at Camellia where it is processed into fertiliser pellets and the gasses captured converted into green electricity. Metal, cardboard, paper and secure documents are recycled.

SYDNEY FISH MARKETS

Site characteristics³⁴

The Sydney Fish Markets (SFM), located on the western side of Pyrmont in Blackwattle Bay, is the largest market of its kind in the southern hemisphere, trading over 13,500 tonnes of seafood per year. The SFM company and associated site house:

- the wholesale auction room,
- food outlet space with over 25 retail spaces featuring 6 wet fish retailers and numerous food establishments including a bakery, butcher, deli, greengrocer and restaurants; and
- the Sydney Seafood School, with over 12,000 people attending classes each year.



The SFM currently employs 50 full time staff to manage the site, which has an estimated 3 million visitors per year. Many of these staff are employed to manage the significant waste products generated on site. Waste management costs are approximately \$1 M/year, with a significant proportion associated with waste management labour costs. There are approximately 375 non-SFM staff working on site working in the retail spaces etc.

By 2021 the SFM will be transferred to the adjacent site in Blackwattle Bay, currently the location of a concrete plant, releasing the existing site for redevelopment. The plans for the redevelopment of the existing site under the “Bays Market District” are not publicly available. However, Urban Growth NSW has indicated over 2,760 apartments are likely^{35,36}. The new SFM site will expand facilities by increasing the retail establishments by approximately 50%, expanding the public seating area from the current 750 to 3,000 seats and facilitate an increase in visitors to approximately 5.5 million annually.

Waste management

Due to the age, physical constraints and volumes of waste generated on the existing site, waste management is challenging. Despite this the SFM manage significant volumes of recycling, especially with respect to materials such as cardboard and expanded polystyrene. Waste materials on-site in areas such as the auction room currently take up considerable processing room and fish waste (offal) is regularly removed to areas behind the scenes at the SFM to minimise any detrimental impact on the customers buying fresh produce.

³⁴ <http://www.sydneyfishmarket.com.au/our-company/our-company> (accessed 30/06/2017)

³⁵ <https://www.businessinsider.com.au/the-nsw-government-wants-to-move-the-sydney-fish-market-and-sell-the-old-site-off-for-apartments-2016-11> (accessed 30/06/2017)

³⁶ <http://www.smh.com.au/nsw/equivalent-of-10-highrise-towers-for-sydney-fish-markets-say-greens-20161001-grsu2x.html> (accessed 30/06/2017)

Organic and food waste

Currently organic waste streams managed on and off-site include:

- Offal – Over 750 tonnes of fish offal from filleting and oyster shucking are produced each year. The material is 60% water and 40% high protein mix. The material is currently collected, refrigerated and stored prior to being transported off-site and provided free for conversion to chicken feedstock.
- General waste – 1,750 tons of general waste is produced each year including food and protein laden general waste (i.e. cardboard) which currently goes to landfill.
- Trade waste – there are three grease traps on site which are emptied every 8 weeks. In addition SFM are charged for trade waste charges by SWC for biochemical oxygen demand, suspended solids, total dissolved solids and grease per kg, at a cost of over \$3,000 per month.
- Used cooking oil (UCO) – Cooking oil is supplied and UCO collected by a number of individual suppliers.
- Wastewater – Significant quantities of water are used on site (123 ML/year) equating to over 76 ML/year of sewage charges.

The SFM have contracted waste management specialists over recent years to assist in exploring ways in which the facilities might be upgraded to improve recycling and recovery rates and waste streams. This has included for example: polystyrene processing on-site to be used in recycled plastic products; and crate washing facilities to reduce water consumption and chemical discharge.

The new site will aim to incorporate best practice management practices including opportunities for streamlining the handling of food and organic waste through for example vacuum systems and opportunities for on-site energy generation through anaerobic digestion of organic waste streams.

MUDS AT NORTHERN END OF PYRMONT

As indicated in the analysis and mapping conducted in Section 5, there is likely a significant opportunity for food waste collection at the northern end of Pyrmont in the Jacksons Landing area. This 11 hectare area, formerly the site of the Colonial Sugar Refining Company, was completed in 2013. There are currently 1,400 apartments with a population of approximately 2,500 people in a mix of high-rise apartments (some with over 20 floors), terraces and town houses. There are also a number of large commercial properties³⁷. The site also has extensive park areas close to the water that are contiguous with the north eastern corner of Pyrmont where many residents walk their dogs. There are also groups of restaurants along Harris Street. Figure 6.4 provides a plan of the Jacksons Landing site.

³⁷ <http://jacksonslanding.net.au/stratas/> (accessed 30/06/2017)

Figure 6.4 – Multi-Unit Dwellings (MUDs) at northern end of Pyrmont



7 INSTITUTIONAL ANALYSIS

In parallel to the PUP scoping study semi-structured interviews were conducted with key actors influential in organic waste management within the PUP and more broadly within NSW. The stakeholders interviewed for this project were specialists in the collection, transport, treatment, reuse and management of organic waste.

Ten participants were recruited from regulatory, industry and government stakeholder groups. This was to ensure a range of perspectives of technical details and policy and institutional factors influencing the emergence and implementation of organic waste management systems in the PUP were identified. The number of participants was determined on the budget and timeframe available, which would only allow for approximately 10 hours of interviews to be conducted and analysed.

Recruitment and consent of participants

After potential participants were identified through the above-mentioned criteria, participants were contacted via an introductory email with an information sheet or informal introduction via the project funding partners (SWC and NSW EPA) and/or collaborators within the Smart Locale group (i.e. the Pyrmont Ultimo Chamber of Commerce) who have regular contact with many of the identified participants within the PUP corridor. In a process of 'snowballing' primary interview participants were asked if there was anyone else they thought should be contacted, and why. These secondary recommendations were then checked against the selection criteria and diversity of existing participants. The project, its purpose and how the interview data will be used was discussed with participants before asking for a verbal agreement to participate. Verbal agreement and consent was gained before each interview was conducted.

Interview questions

The interview questions were designed to inquire into the challenges and opportunities influencing the emergence of alternative organics management systems in the PUP. Three key questions were asked in each 60-minute interview. They include:

- From your perspective is there an increasing interest and uptake of organic waste management systems in NSW/Sydney? (i.e. at the household, building, precinct scale? What are they? Decentralised verses centralized? Household verses commercial scale?).
- What do you perceive as the key drivers for increasing interest of these systems in NSW/Sydney? Could you provide an example of how this has occurred in practice?
- What kinds of regulatory challenges and opportunities (i.e. policies, guidelines, norms and beliefs) do you see influencing the uptake of innovative organic waste management systems in NSW/Sydney? Could you provide an example of how this has occurred in practice?

Analysis of data

All interviews were transcribed, de-identified and using a grounded theory approach analysed for emerging themes. Eight key themes were identified as influential in both enabling and disabling innovation in organic waste management in the PUP (and more broadly in NSW). These themes included:

1. Incentives (and lack of incentives) for businesses to innovate
2. Perceived changes in the political, economic and environmental context influencing innovation
3. Socio-cultural factors: everyday habits and social practices
4. Collaboration and public-private partnership
5. Innovation at different scales of operation and management
6. Access and availability of accurate information/data for innovative options
7. Education, communication and supporting media
8. Innovative governance structures

This analysis was drawn from 15 hours of interview data and is a preliminary analysis of emerging themes. Table 7.1 provides a brief description of the overarching themes identified with illustrative quotes to support these themes.

Table 7.1 – Brief summary of emergent themes and illustrative quotes

Themes	Brief description	Illustrative quotes
Incentives (and lack of incentives) for businesses to innovate	While EPA grants were acknowledged as a driver for innovation, the majority of interviewees noted the incentives to invest in innovative systems, was also driven by the opportunity of offsetting/augmenting rising energy costs (i.e. by investing in waste-to-energy technologies) presented an opportunity to differentiate themselves from their competitors . In some circumstances even with the higher costs associated with innovation, businesses are investing in alternative approaches to managing waste driven by corporate social responsibility .	<i>...an enabler of course is that (the EPA) are providing this funding...[incentivising innovation]</i>
		<i>For the waste service providers the benefit of being innovative is that you'll have a point of difference to your competitors. The thing is you don't want to send yourself broke while you're doing it.</i>
		<i>...a lot of businesses now are much more interested from a corporate social responsibility point of view in doing something about {managing organic waste}. This is certainly what we're hearing from waste service providers is that those businesses that have a source separated organics service for their food mostly are doing it in spite of it probably costing them a bit more than throwing it all in the red garbage bin.</i>
Perceived changes in the political, economic and environmental context influencing innovation	Changing demographics such an increasing percentage of the population living in high-density multi-unit dwellings (MUDs) , provides the potential for collecting larger volumes of organics in urban settings for beneficial reuse. In addition, the perceived increase in energy costs, closing of landfill sites and planning strategies for Greater Sydney all present incentives for alternative approaches to waste management.	<i>I just see, where you've got significant high density in a new development there's real opportunities to do things differently in waste management....</i>
		<i>I think the cost of gas is really going to drive an alternative energy supply solution, energy generation solution and so waste is looking really appealing there...</i>
		<i>We've got a lot of hope with the Greater Sydney Commission, because if you look at their district plans and the aspirations there, it's pretty exciting. So to achieve those aspirations, they have to change infrastructure solutions. Even [car share has] an incredibly important role to play with your energy balance, because you can use solar spill to charge vehicles for free. So it's all about a water and energy balance. That's where waste comes into that in the model.</i>
Socio-cultural factors: everyday habits and social practices	Socio-cultural values, practices and norms emerged as an issue for consideration for the long-term success of innovative systems. Cultural values around food waste were acknowledged across residential and commercial sectors and has the potential to be leveraged when introducing innovative systems. For example, the introduction of food waste management systems was identified to boost staff morale with increased interest and support from customers .	<i>Food has cultural value and people just don't like throwing it out. That always comes up first when you're in focus groups, whether it's householders or business is that people just don't like the idea....</i>
		<i>It becomes much less about the money and much more about well this is actually building staff morale because the staff love that we're doing this. Particularly in a restaurant where everybody is there and they're all loving food. Chefs in particular, people have a different value assigned to food than they do to other areas of waste.</i>

Themes	Brief description	Illustrative quotes
	<p>Social and cultural habits in separating food waste from solid waste was overwhelming acknowledged as a significant issue to tackle for systems to be successful over the long term with behavioural change strategies and education required.</p>	<p><i>....another part is getting your staff day to day...to source separate [food waste] and to do it cleanly and to be engaged. So we need to make that become a social norm and we're not there yet. So especially if you're at a supermarket or whatever where you've got a lot of young people, constant turnover of staff, making sure that they are engaged and doing it properly, that's a big challenge...</i></p>
<p>Collaboration across sectors</p>	<p>There was a perceived need for collaboration across sectors (i.e. the water and waste sectors) to overcome regulatory barriers to local (precinct scale) collection & treatment of waste. In the private sector, collaboration in collective procurement of waste services was perceived as an innovative solution requiring consideration of timing procurement with a responsive market. (For example, in the PUP, collective procurement could mean that the ABC, UTS and TAFE collaboratively working together to procure waste services).</p>	<p><i>It's absolutely critical that...government puts its brains trust to this, because there's so many problems to solve. It can't just be the private sector. It really has to be working together, because as we've seen, there's such an imbalance in terms of regulation and legislation against local generation and local treatment.</i></p> <p><i>...the challenge has been to get our company to think beyond the silo... it was mentioned earlier today that crossing the bridge between the waste industry and the wastewater industry has been quite...separated in the past and this is about bringing them together and just working out what the best solution is for waste in the city.</i></p> <p><i>...it's more process related than actual legislative or regulatory barriers. I don't feel that those are the biggest barriers. I think the biggest barriers are actually getting people together to sign up to the same service and to procure together....and then having the market there to respond at the right time.</i></p>
<p>Innovation at scales of operation and management</p>	<p>Precinct scale innovation was one of the most highly discussed issues by interviewees. Comments spanned the need to consider, mixed-use precinct scale food waste management systems, precinct scale tenders/procurement of waste services (as mentioned above) as well as the associated challenges with implementing alternative scales of waste management. In particular, interviewees noted that existing regulatory frameworks tended to support centralised systems/infrastructure making decentralised approaches more challenging to implement in practice. In addition, there was a perception by</p>	<p><i>... our DAs specify that commercial and residential waste needs to be... collected separately. Obviously the city provides the residential collection, commercial businesses have to source their own. So is there an opportunity in the future to look at precinct [scale services]? ...that's where you may find barriers because then we're edging into providing a service for commercial businesses.</i></p> <p><i>...if you were to say, have a system that does need a centralised collection point, ...how would you go through procuring...the future capacity for that and how would you go about getting all of those separate buildings, potentially separate businesses together under one procurement contract or do they all have to then procure that capacity separately at different times.... it's less about a regulatory barrier...as a logistical/procurement innovation</i></p>

Themes	Brief description	Illustrative quotes
	<p>some interviewees that innovation is challenged by city scale centralised monopolies hindering the potential for precinct scale utilities.</p>	<p><i>...well if we can put this whole precinct under one collection banner, then that offers huge opportunities for a long-term treatment solution. Then you're only dealing with one collection company who can then negotiate with one service provider, one treatment company. So, there's lots of economies of scale I think and there'll be the other benefits like reduced traffic movements. You could probably have some co-storage, co-collection of waste streams.</i></p> <p><i>If you've got...district approaches to managing waste, it's more environmentally friendly. It's more manageable, because you've got smaller amounts...I think the point is that what you want to do is capture the resource and keep it in the community, whether it's energy, whether it's water, whether it's waste.</i></p> <p><i>....we haven't developed the market to a point where we're sophisticated. It comes back to this concept that all our governance and regulatory and legislative structures all support centralised solutions, so it's big pipe in, big pipe out.</i></p>
<p>Availability of accurate data of innovative options – Waste-to-Water</p>	<p>Key concerns of interviewees about innovative options were related to the lack of available and accurate data and/or misinformation about innovative technological systems, in particular waste-to-water systems.</p>	<p><i>...the concern I have, is that some of these organisations and the companies are going to individual businesses and providing them with free business cases [dehydration and waste-to-water systems]. They're providing them with independent - or so called independent - life-cycle assessments from consultants that are showing how wonderful these systems are and how good they are for the environment.</i></p> <p><i>I could personally pick holes in all these studies [of waste-to-water systems] because I know that they have made assumptions and they've ignored some elements. So, they're looking at the impact of landfill but they're not looking at the impact of these systems on the ocean</i></p> <p><i>I'm no scientist....but I know that 'waste to water technologies' are not good that....there is a threshold for the BOD levels. Because they have a license agreement and once they tip that then they may have to start saying, well you can't use these facilities anymore. I guess my long-term concern is that those companies who have shown a significant amount of goodwill by purchasing these systems, because they think they're doing the right thing, then they get told in 10 years' time or five years' time, you can't use these anymore because of the impact on the water system.</i></p>

Themes	Brief description	Illustrative quotes
Education, communication & supportive media	In ensuring long term viability of innovative systems there is a need to ensure education campaigns are incorporated into the introduction of innovative systems. One interviewee suggesting that all new innovative systems must have an accompanying education campaign as standard practice.	<i>.any new system...needs to have an education program that goes with it. So it would be wonderful, it would be great if we could get that because if that could be one of the new standards then that would be great.</i>
	Increasing awareness of food waste, food avoidance and minimisation in public media has a role to play in supporting innovation.	<i>I think there is an increasing awareness amongst certain members of the community around organics and organic treatment and the impact that organics has in landfill and emissions. There's a lot in the media about food waste. So, waste minimisation, using more of your food, not wasting so much. I think that is out in the media [and plays a role in facilitating innovation].</i>
Innovative governance structures	The EPA targets for resource recovery and food waste avoidance has been an identified driver for innovation.	<i>From a policy perspective...the New South Wales Plan, 2021, the waste and recycling, waste and resource recovery strategy....So these are the waste generation and resource recovery targets, those targets that are in our policies help us to achieve those outcomes and to support businesses to do them too.</i>
	A challenge for incentivising organic waste management is that there is not a system of 'weight based charges' in NSW, therefore difficulty in determining savings gained by separating and processing food waste through alternative means.	<i>A disabler for that is the fact that we don't have weight based charges, so it's very difficult for people to say, I've saved this amount on my red bin and now I can pay for the equipment this way by putting my food through this magic box thing...</i>

8 PUP ILLUSTRATIVE OPTIONS

The following section outlines a suite of illustrative options to potentially trial in the PUP corridor. The options have taken into consideration:

- the national and international examples (Section 4);
- data and mapping collated on organics flows within the PUP corridor (Section 5);
- detailed site-specific case study investigations (Section 6);
- interviews with key stakeholders (Section 7); and
- local knowledge from participating stakeholders

The options cross:

- sectors (residential, commercial and institutional);
- scales;
- existing and new properties;
- avoidance through to reuse;
- technology types; and
- technical, behavioural and regulatory solutions.

The options do not aim to replicate what is occurring in other jurisdictions observed in the literature review but build on them and specifically consider the PUP context.

Tables 8.1 provides a summary of the illustrative options and Figure 8.1 highlights particular sites where the options could be located. A total of 12 residential, 3 mixed use, 11 commercial and 8 institutional options have been developed with various associated sub options associated with treatment. The treatment column in Table 8.1 aims to be agnostic, as far as possible, as this would need to be investigated as part of a site specific feasibility study. The term pre-processing encompasses any kind of treatment from for example maceration, decomposing and/or dehydration.

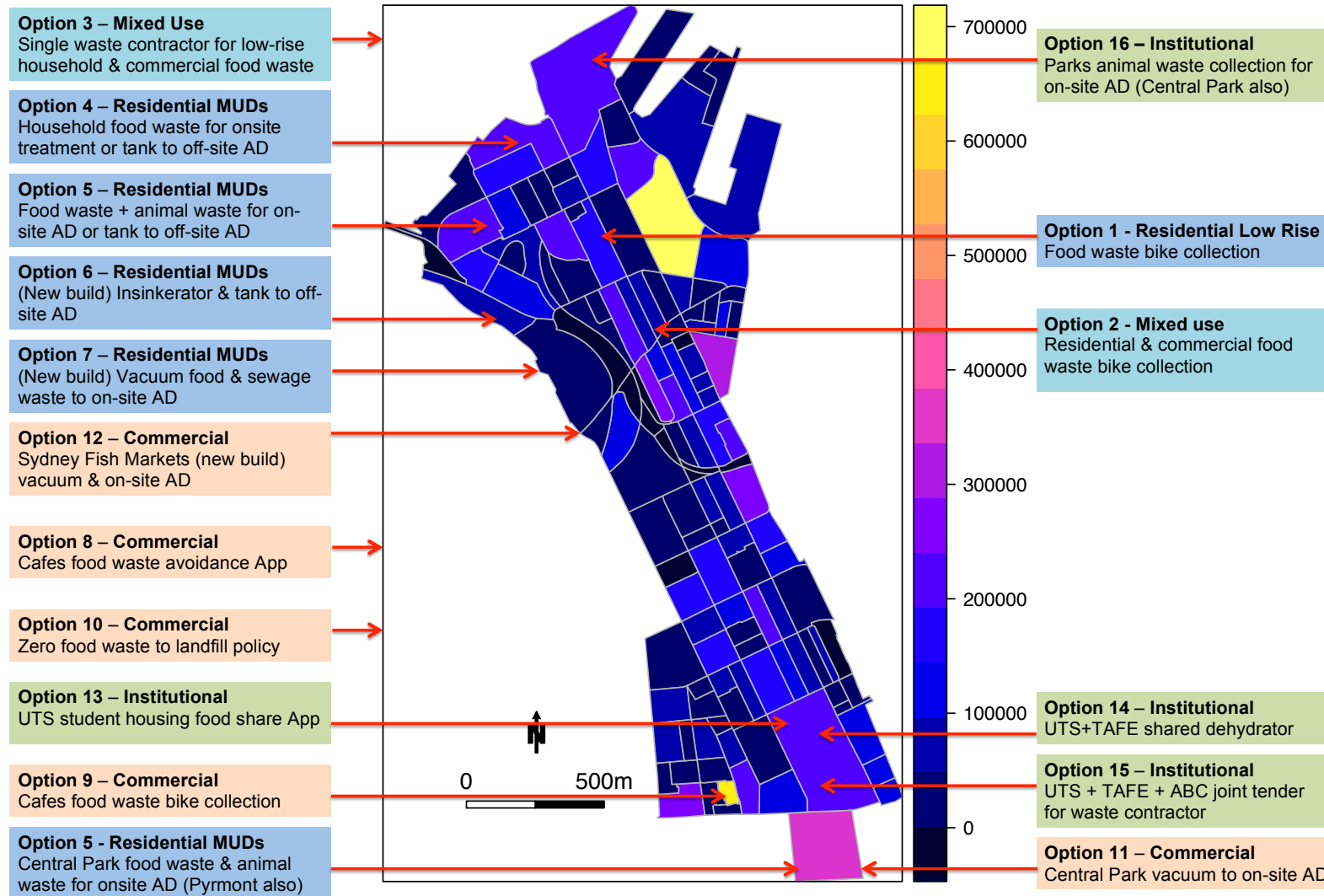
These illustrative options were designed to facilitate discussion with a diverse set of stakeholders at the Organics Summit held at the end of the project, discussed in Section 9.

Table 8.1 – Summary of illustrative options

No.	Focus	Waste	Scale	Collection>transport	Treatment
1	Low rise	Food waste	Neighbourhood	Kitchen caddies > door pick-up by bike with trolley	Localised: pre-processing (compost, decomposer, dehydrator or AD) Centralised: AD
2	Low rise & commercial cafes	Food waste	Neighbourhood	Kitchen caddies & small commercial bins > door pick-up by bike with trolley	Localised: pre-processing or AD Centralised: AD
3	Low & high rise MUDs & commercial	Food waste	Whole of precinct	One waste contractor for residential & commercial properties	Centralised: AD
4	High rise MUDs	Food waste	Building	Kitchen caddies > chutes > basement	On-site: pre-processing or AD Centralised: AD
5	High rise MUDs	Food & pet waste	Building	Kitchen caddies & pet waste bags > chutes > basement	On-site: AD Localised: AD Centralised: AD
6	High rise MUDs (NEW)	Food waste	Precinct	Insinkerator in kitchen > pipe to basement	On-site: AD Centralised: AD
7	High rise MUDs (NEW)	Food waste & sewage	Precinct	Kitchen bench food waste vacuum + vacuum toilet > vacuum to basement	On-site: AD
8	Commercial cafes	Food waste avoidance	Neighbourhood	Café > App > collection by end user	Food waste avoidance & redistribution
9	Commercial cafes	Food waste	Neighbourhood	Small commercial bins > door pick-up by bike with trolley	Localised: pre-processing or AD Centralised: AD
10	All commercial	Food waste	Whole of precinct	Policy: Zero food waste to landfill	Various methods
11	Commercial cafes	Food waste	Precinct	Café vacuum inlet > vacuum to basement	On-site: AD Localised: AD Centralised: AD
12	Commercial cafes/market (NEW) Fish Markets	Food waste	Precinct	Café vacuum inlet > vacuum to central location on-site	On-site: AD Localised: AD
13	Education centre	Food waste avoidance	Neighbourhood	Students with spare food/meal > App > students share meal	Food waste avoidance & redistribution/sharing
14	Education centres	Food waste	Neighbourhood	Cafes > commercial bins	On-site: decomposer/dehydrator
15	Education & large government organisations	Food waste	Neighbourhood	One waste contractor for multiple sites	Centralised: AD
16	Council Parks	Pet waste	Council parks	Owners use bags > deposit in park collection point	Localised: AD

Figure 8.1 – Potential locations for illustrative options

Total surveyed organic flows at mesh block scale [kg]



9 ORGANICS SUMMIT

An “Organics Summit” was conducted at the end of the project in June, 2017. The Summit was designed to share knowledge from the project with a range of industry, government and community stakeholders and as an opportunity to discuss:

- the findings from the study;
- short- and long-term potential options to manage organic waste streams in the PUP;
- feasibility issues;
- barriers and opportunities to innovation; and
- interest and buy-in from participants for future pilots/demonstration sites.

Twenty eight participants attended the workshop including individuals from: SWC, EPA, City of Sydney; Southern Sydney Region of Councils; site managers for the Sydney Fish Markets and Central Park; technology providers of food waste decomposing systems, anaerobic digestion and vacuum systems and members of the Smart Locale Initiative.³⁸

Table 9.1 provides an agenda for the three-hour workshop conducted on Monday 19th June. Appendix B provides the slides of the day including the presentation by ISF on the *Overview of the PUP Project and Research Findings* and presentations by the EPA and SWC on *Partner Perspectives on innovation in managing organics now and into the future*.

Table 9.1 – Agenda for Organics Summit, June 19th, 2017

TIMING	TASKS
9.00-9.30	TEA & COFFEE – NETWORKING
9.30 -9.35	Acknowledgement to country
9.35-9.45	Introductions <ul style="list-style-type: none"> • Quick whip around to hear who’s in the room
9.45-9.55	Overview of the PUP project <ul style="list-style-type: none"> • Project scope and objectives • The PUP precinct & characteristics
9.55-10.35	Partner perspectives on innovation in organic waste management <ul style="list-style-type: none"> • 15min + 5 Qu: NSW EPA (Amanda Kane) • 15 + 5 Qu: SWC (Phil Woods, Farid Guirguis)
10.35-11.20	Research findings <ul style="list-style-type: none"> • Data collation & mapping (15mins) • Innovation locally/internationally (15mins) • Illustrative options (15mins)
TEA BREAK – NETWORKING SESSION	
11.30-12.20	Workshop session – the future of organic waste management in the PUP <ul style="list-style-type: none"> • Summary of the options (10 mins) • Explanation of the process (10mins) • Group work & discussion (15min) • Report back/discussion (15min)
12.20-12.30	Wrap up/next steps
LUNCH – NETWORKING SESSION	

³⁸ <https://www.smartlocale.com.au>

The half day workshop was an opportunity for participants to discuss the findings of the project with other participants at the workshop, raise any questions they had regarding the research findings and share perspectives on preferred options for managing organics in the precinct moving forward. While time was limited, the key aim of the workshop was to prompt discussion and gauge interest in participants being involved in the project in the future. Table 9.2 provides the detailed structure of the workshop session and supporting worksheets (see figures 9.1 and 9.2). Table 9.3 provides a summary of the outcomes and discussion points resulting from the workshop session.

Table 9.2 –Workshop Session – The future of organic waste management in the PUP

Timing	Details
11.50 - 12.00	<p>Explanation of the process</p> <p>The one hour workshop aimed to prompt discussion about what organic waste management might look like in the PUP precinct and the kinds of options that could/should be operating in the near future.</p> <p>Participants perspectives on selecting potential options to trial in the precinct were sought together with their insights into what would need to happen to get there.</p> <p>GROUPS</p> <p>Participants were organised into groups of 3 to 4 people who do not work in the same organisation so they might have an opportunity to gain a different perspective from the process.</p> <p>Groups were provided with:</p> <ul style="list-style-type: none"> • a printout of the map of the "Illustrative options" (Figure 9.1) ; and • a printout of the PUP map with prompting questions (Figure 9.2). <p>Four sets of questions were asked:</p> <p>Qu. 1 - CRITERIA: In selecting options there's a few things we'd like to ask of you: Be transparent and discuss the criteria you use for selecting 2-3 options to trial, why you are selecting one option over another and what criteria you are using (i.e. the waste hierarchy, triple bottom line, energy production, maximum amount of food waste diverted from landfill, multiple criteria.</p> <p>Qu. 2 - OPTIONS: Select 2-3 systems to trial in the precinct moving forward. What is the most effective option based on your criteria – if for example you most important criteria is production of energy/diverting food waste from landfill then what option would you select?</p> <p>Qu. 3 - WHAT WOULD NEED TO HAPPEN? WHO WOULD NEED TO COOPERATE? What would it take to get there? Who do we need to cooperate to get there? What would need to change? Will you need to cross organisational responsibilities (e.g. joint tender processes)? Who or what else do you need to make this work?</p> <p>Qu. 4 - ANYTHING ELSE? Are there any other options? Have we missed something? Are there any other options that should be one the table? Are there 'No Go' options for you'?</p>
12.00 - 12.15	Discussion of the workshop questions amongst groups of 3-4 participants from different organisational perspectives
12.15 - 12.30	Report back of the group on insights of the process

Several options stood out for participants throughout the workshop, in particular:

- the use of Apps for local café food waste avoidance, redistribution and improved social outcomes (See: Options 8 & 13);
- the use of insinkerators in kitchens and vacuum systems to collect both kitchen and sewage waste for local treatment and generation of energy through anaerobic digestion (AD) in MUDs (See: Option 6 & 7);
- mandating a zero food waste policy for commercial properties (See: Option 10) - this option aligns with the City of Sydney strategy of 'zero-waste' by 2030;

- installing vacuum systems and local anaerobic digestion in large commercial retail areas such as Central Park (See: Option 11);
- taking advantage of the new Sydney Fish Markets relocation by incorporating vacuum and anaerobic systems to capture organics, including the potential of nearby residential and commercial sites for local energy generation (See: Option 12); and
- collecting food and animal waste from existing MUDs for either local or off-site treatment (See: Option 5)

Some of the themes emerging throughout the facilitated discussion included consideration of:

Innovative options for the precinct in both short and long term timeframes - Selecting options to trial that provided both 'quick wins' e.g. development of apps to manage food waste avoidance and redistribution, as well as options that might require a longer timeframe for implementation i.e. anaerobic digestion and vacuum systems in new residential developments in the near future.

Mapping synergies between options - There are potential synergies that could occur between options i.e. new residential MUDs proposed (Bays Precinct and Northern Pyrmont) in close proximity to the new fish market site for example could be an opportunity to collect organic waste streams as feedstock for the proposed AD system at the fish markets (SFM). In addition, options, such as food waste avoidance apps have the potential to be used for a range of purposes i.e. in supporting co-housing for aged residents to share food and meet others.

Learning about options in practice before transference to other locations - In trialling and implementing new options it would be ideal to test and learn about how applications function onsite before transference of options elsewhere i.e. installing AD at the Sydney Fish Markets provides an opportunity to learn how the system might be transferred to other comparable sites i.e. Brisbane and Melbourne Fish Markets. Trialling and evaluating options in practice provides an opportunity to determine feasibility before releasing policies about technological systems to manage organic waste.

Economic incentives for new business models - As some of the options identified in the project present an alternative to centralised ownership, management and operation of organic waste systems, economic incentives need to be considered to drive innovation and the development of new business models e.g. onsite AD plants could be a potential business opportunity for SWC and property developers. Ensure all business, types across the waste hierarchy, are taken into consideration i.e. businesses associated with waste avoidance through to treatment of waste streams.

Accurately mapping resources against opportunities for innovation - While participants noted that combining '*Sewage & food waste is a no brainer*' there was a need to better understand the organic waste streams (resources) available in a designated area and potential sites to use these resources i.e. where is the site with the largest energy demand and in relation to significant production of organics).

Communication and education of residents and waste contractors - Education and effective communication is needed to change practices and minimize contamination rates. Both residents and commercial operators were perceived to need education in reducing and monitoring contamination rates in trialling novel systems to manage organic waste. Apps could be used as educational tools to ensure the population is well informed about collection and management of waste streams and the need for avoiding contamination.

Figure 9.1 – Potential locations for illustrative options

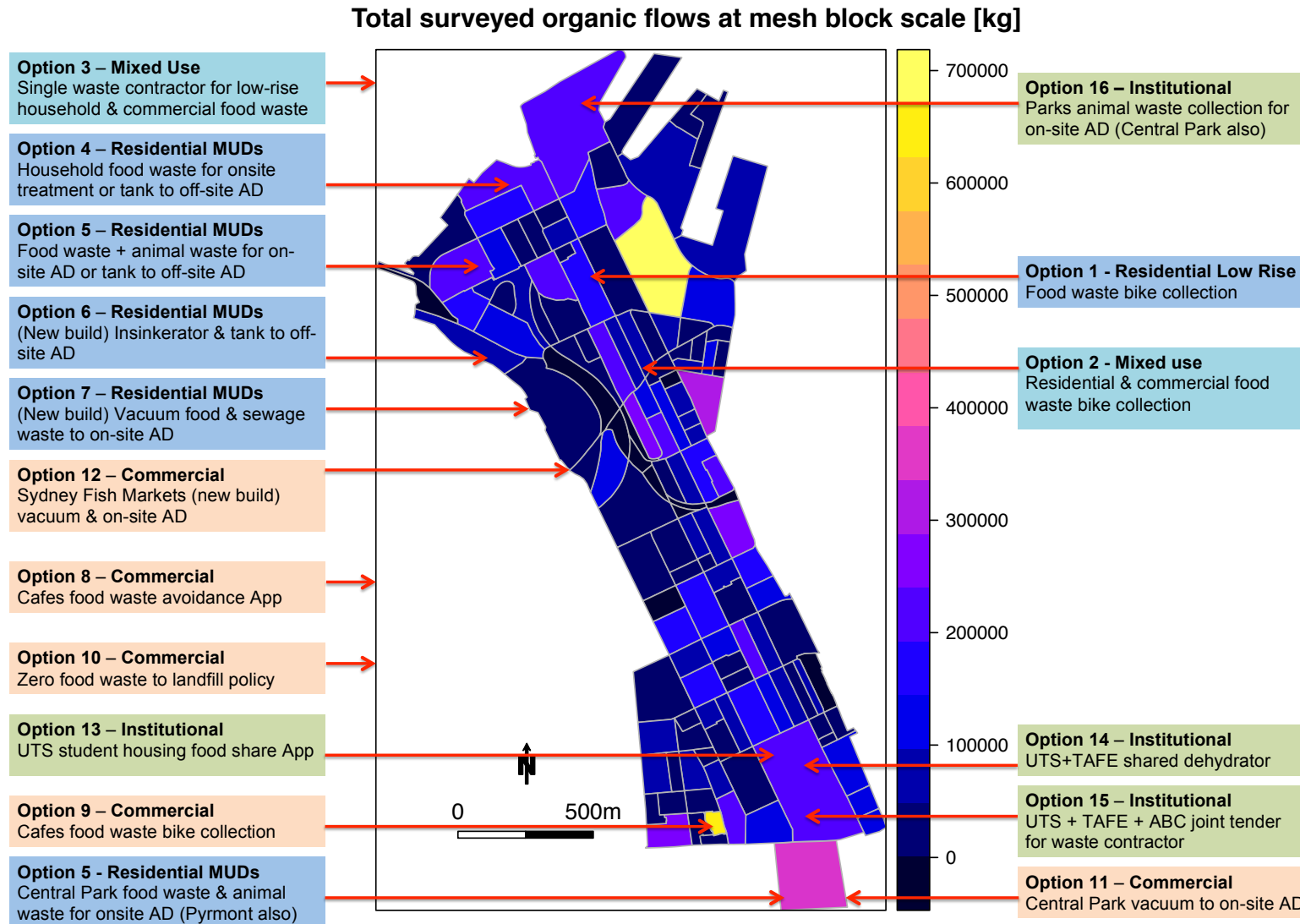
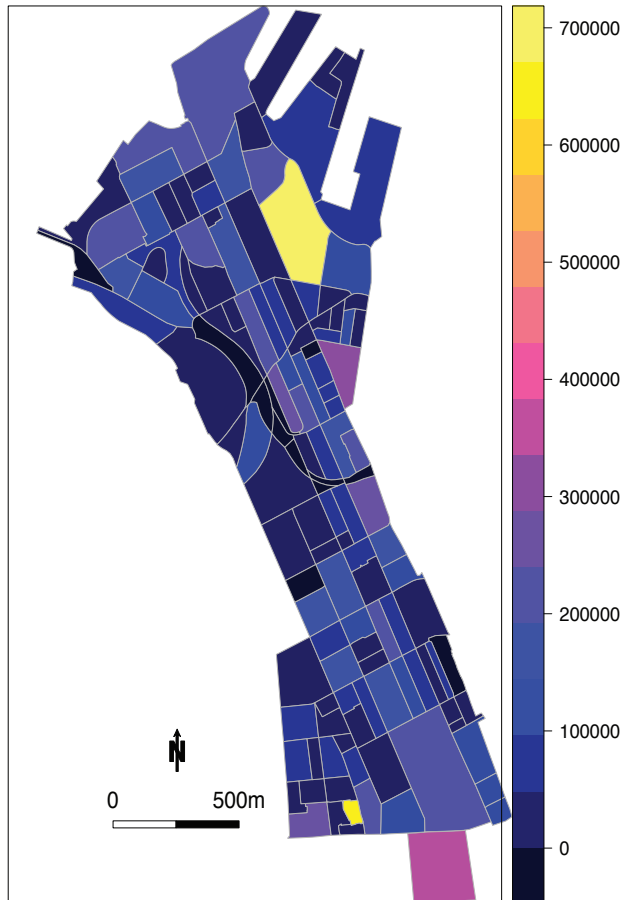


Figure 9.2 – Map of illustrative options with prompting questions

SELECTING WASTE MANAGEMENT OPTIONS FOR THE PRECINCT

Total surveyed organic flows at mesh block scale [kg]



IDENTIFY SELECTION CRITERIA: be transparent about the criteria used for selecting options why are you selecting one option over another, what criteria are you using in the selection process?

SELECT OPTIONS: Based on your selection criteria, what do you think are the most effective option(s) for the precinct?

IDENTIFY WHO WOULD NEED TO BE INVOLVED & WHAT WOULD NEED TO CHANGE?
 What would need to change for the options selected to be successful?
 What organisations would need to be involved to make this option(s) work?

ANYTHING MISSING? Are there any other options that should be on the table but haven't been mentioned? Are there 'NO GO' options?

Table 9.3 – Synthesis of discussion by teams based on response to workshop questions (see: Figure 9.2)

Teams	Selection Criteria	Comment
Team 1		
Options 8 & 13 (Apps)	<ul style="list-style-type: none"> The Triple Bottom Line model should be nuanced to include consideration of (social benefits) Other criteria should also be: <ul style="list-style-type: none"> Applicability Quick wins 	<ul style="list-style-type: none"> Need to consider the temporal dimension - short vs long term timeframes and how we might get quick wins on the board There should be a combination of apps so there is one app and one place to go rather than scattered apps. One idea could be to use this app in co-housing for aged residents to share food and meet other people. Economic incentives need some work It's easier to get an 'app' up and food waste avoidance compared to district scale AD. Use existing frameworks to develop the app and UTS events/platforms (e.g. orientation week, in different language options and e-sites - it could be communicated through UTS computer screens, wifi networks)
Options 6 & 7 (New MUDs)	<ul style="list-style-type: none"> Higher potential recovery outcome Consider the waste hierarchy and produce food for animals before generation of energy (e.g. Sydney Fish Markets) Low transport/collection costs Allows easy scalability Quality of life for users/residents, amenity issues Low costs for transport and collection Environmental benefits 	<ul style="list-style-type: none"> For new builds, innovation and data needs to be considered and documented How do we deal with funding timing issues?
Team 2		
Option 10 (zero waste) & Option 11	<ul style="list-style-type: none"> Waste Hierarchy – reducing waste to landfill Best business models – promote all business types and solutions Market driven Timeliness – will the solutions be available immediately 	<ul style="list-style-type: none"> Need systems in place + trials/demos to make sure it is achievable before releasing policy Stakeholders to consider are: residents/body corporates, facility managers, utilities, councils, solutions providers (people who have done it before) Options 6 & 7 could have synergies with Option 11 Flow is a private utility with different infrastructure which allows different thinking and tapping into opportunities rather than siloed approach Reduction > energy > residuals > means there's much lower volumes to truck away Amenities are important to consider – don't underestimate the importance of bins, space and falling over bins.

Teams	Selection Criteria	Comment
Team 3		
Options 5 (MUDs) & 12 (SFM)	<ul style="list-style-type: none"> • Triple bottom line should be updated to consider the '6 Capitals reporting/assessment model' • Need criteria for testing systems • Should we be looking at how to use existing infrastructure? 	<ul style="list-style-type: none"> • Need criteria for testing how applications function elsewhere, how big the opportunity is, for example innovation in the Sydney Fish Markets presents opportunity for a big win but can this be transferred to Brisbane and Melbourne fish markets. • Need to consider statistically valid design – so that if you get good/bad results you have certainty of its validity • It doesn't make sense to add litres of water to 300g of waste, transport it, dewater it and then send it out of the ocean outfall. • Need to try Option 5 (MUDs) in multiple locations, multiple times to learn from the applications
Team 4		
Options 7 (MUDs New) & 12 (SFM)	<ul style="list-style-type: none"> • Low contamination risk • Collection of organics suitable for mesophilic treatment • Pump out on-site, not via the sewer • Easy collection methods 	<ul style="list-style-type: none"> • New ADs on-site could be a potential new business for SWC • There is a need for source control to minimize contamination rates with education of residents and commercial operators in reducing contamination & monitoring contamination in the process
Team 5		
Option 7 & 12 (SFM) should be combined Option 10 (Zero Food Waste) is a no brainer!	<ul style="list-style-type: none"> • Economics – at what scale does the option work, this needs to be evaluated • The option should not cause added problems i.e. traffic • Avoidance of waste first 	<ul style="list-style-type: none"> • <i>'Sewage + food waste is a no brainer'</i> • There are some synergies that could occur between options (i.e. residential and AD at the SFM) • The Bays Market District will be a large development and an opportunity to truck/vacuum in waste/sewage?
Team 6		
	<ul style="list-style-type: none"> • Waste reduction • Need to think about types of organic waste in the precinct • Infrastructure • Economic viability • Impact on assets 	<ul style="list-style-type: none"> • Need to understand the resources available in the area and potential sites to use these resources (i.e. where is the site with the largest energy demand and production of organics) • Zero waste policy should guide development policy • Apps/educational tools to ensure the population understands waste • Potential to gain resources (for AD) from neighbouring MUDs • Incorporate animal waste into a solution
Team 7		
Options 12, 4, 10	<ul style="list-style-type: none"> • Eliminating food waste to landfill • Economic viability • Corporate social responsibility 	<ul style="list-style-type: none"> • There's a need to engage equipment suppliers, regulatory bodies and corporate senior management

10 DISCUSSION & RECOMMENDATIONS

DISCUSSION

Australia is one of the highest municipal waste producers per capita in the world, with organic waste representing a significant proportion of waste going to landfill. As the population of Australia and specifically Sydney grows there are increasing constraints on existing waste and wastewater infrastructure and economic, social and environmental issues implicated in continuing the current linear approach to waste management. Such growth presents both a significant issue but also an enormous opportunity to do things differently.

The NSW EPA has taken major action in recent years to reduce waste to landfill in accordance with agreed targets. Under the WLRM program, funded through the waste levy (the highest in Australia), the EPA is helping to reduce waste to landfill and create new markets and business opportunities for innovative organics waste management approaches in line with the waste hierarchy (i.e. avoidance through to recovery).

In parallel, SWC are reviewing how to provide services to its customers currently and into the future. In an attempt to optimise existing infrastructure and reduce energy costs, SWC is exploring new business opportunities in managing commercial food waste at their WWTPs driving the increasing convergence between the solid waste and wastewater sectors. This includes direct action with SWC currently conducting a three year trial of treating food waste through anaerobic digestion at the SWC Cronulla WWTP to power the plant. It also includes inadvertent actions such as SWC investigating the efficacy of a growing number of pre-processing technologies and trade waste applications, where businesses are seeking to discharge food waste to sewer instead of traditional disposal to landfill to avoid large waste fees.

This emerging convergence of the water and waste sectors provides opportunities to go beyond the management of food waste in isolation but to consider combining other waste streams such as sewage that has the potential to be treated more efficiently with other waste streams at a local scale to create energy and biosolids through anaerobic digestion.

There is a wide range of examples of innovative initiatives being implemented internationally to manage organic waste streams. Many of these, as represented by the illustrative options in this study, could be replicated in the PUP and across Australia. These solutions differ in scale and context (i.e. one size doesn't fit all). However, whilst there is significant opportunity, as highlighted through optimistic feedback from participants at the Organics Summit, interest to introduce and implement innovative options is highly dependent on a range of interrelated factors. For example, the range of stakeholders involved in managing, operating, regulating, and even producing waste streams have different drivers, objectives and decision-making frameworks for enabling and/or disabling innovation (See: Section 7). What is clear is that by broadening the stakeholders involved in, and criteria for decision-making there is the potential for a paradigm shift in organics management in our cities.

Key to this shift will be the development of pilots/demonstration sites in the PUP and Australia more broadly to validate feasibility in an Australian urban context. Such pilots/demonstration sites could be implemented now in existing buildings but also as new developments come on-line in the coming years. These sites can provide a much needed hub of demonstration and learning of what works and what doesn't in the rapidly changing field of organics management and potentially leap-frog Australia towards its waste reduction and resource recovery goals.

RECOMMENDATIONS

To be able to fully explore the opportunities of innovative organics management in a dense urban setting the following is recommended.

Piloting

- **Identify potential pilots in the PUP and surrounding areas** from the illustrative options explored as part of the Organics Summit to assist in creating a hub of innovative organics management demonstration sites and practices within the heart of Sydney.

Knowledge transfer

- **Conduct an annual Organics Summit** for the PUP to share innovative developments across sectors and support collaborative networks to support, trial and demonstrate innovative options.
- **Set-up a collaborative website to share knowledge and lessons learned** from successes and areas for improvement in innovative organics management.

Mapping, analysis and decision making

- **Conduct a more detailed phase of the PUP study through a collaborative research model with an MOU** that includes additional committed stakeholders that can both provide key data and information and have the capacity to take identified opportunities forward. The staged study should be developed with multiple stakeholders to assess the full flows of organic waste, costs, benefits and opportunities using the PUP area as a case study region, that can be expanded to the CoS and beyond. Stakeholders would include for example:
 - NSW EPA
 - SWC
 - CoS
 - Urban growth
 - SSROC
 - Pucc
 - Waste contractors
 - Large commercial properties (Sydney Fish Markets, Central Park, UTS, TAFE, ABC, The Star, Maritime Museum, Google....)
 - Large residential property managers
 - Energy suppliers
 - Private utilities
 - Residential producers of waste streams, including residents in low-rise and high-rise dwellings
- **Conduct a full assessment of data availability across the CoS and potentially Sydney more broadly**
 - Residential food waste (EPA & CoS)
 - Commercial food waste (CoS, Bin Trim, individual commercial properties, waste contractors)
 - Trade waste (SWC)
 - Grease trap waste (SWC)
 - Residential green waste (CoS)
 - Commercial green waste (Waste contractors)
 - Used Cooking Oil (Waste contractors)

- **Develop and trial an organics “hot spot” mapping** platform on PUP for broader CoS and potentially Sydney wide analysis. Existing CoS analysis and mapping platforms could potentially be adapted for this.
- **Identify knowledge gaps in data/information** and develop a research program to fill the gaps (i.e. strategic auditing of existing data sets such as SWC ANZSIC codes and strategic Bin Trim auditing across various ANZSIC coded establishments).
- **Conduct a business-as-usual analysis of volumes and flows of organic waste by sectors and subsectors** identifying economic, social and environmental costs of current management practices.
- **Identify current organic hot spots and future organics projections** across the entire PUP corridor, CoS and potentially Sydney more broadly.
- **Develop options and conduct costs and benefits analysis** across the entire PUP corridor, CoS and potentially Sydney more broadly.
- **Review the regulatory and management context** to identify enablers and disablers to innovative waste management across sectors and determine what steps are needed to improved cross cutting regulatory frameworks.
- **Assess current decision-making processes for organics management and develop a cross sectoral tool** to assist in efficient council-wide decision-making for selecting organics management options.

11 REFERENCES

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12 APPENDICES


APPENDIX A – NATIONAL & INTERNATIONAL EXAMPLES


APPENDIX A - EXAMPLES


R1 - Residential sector – household scale – waste avoidance		
Location	NSW	
Timing	Since 2009	
Waste	Household kitchen food waste	
Technology	Various behavioural	
Transport	N/A	
Treatment	N/A	
Output	Reduced waste	
<p>Details – The Love Food, Hate Waste campaign was first launched in the UK in 2007 by the Waste and Resources Action Program (WRAP) with the aim of reducing food waste in the UK. The campaign has now been successfully implemented in several countries such as Canada, New Zealand and Australia. In 2009 a food waste avoidance benchmarking study was conducted by 1,200 NSW residents responsible for purchasing/managing food within their household, the most comprehensive study of its kind at that time in NSW. The study assisted in the design of the NSW version of the Love Food Hate Waste program launched in 2009. The comprehensive and adapting program provides information on the levels of food waste in homes and economic, social and environmental impacts. The program has numerous tools and resources to help households reduce their food waste such as web and app based tools to audit your food waste, videos on meal planning, shopping lists, portion sizes, left over recipes, advice on keeping food fresh etc. and linkage to composting and worm farms for unavoidable food waste. It also links to the work place, partnership programs and grants.</p>		
Sources	http://www.wrap.org.uk/content/love-food-hate-waste http://www.lovefoodhatewaste.nsw.gov.au/Portals/0/docs/Report%20-%20Benchmark%20Survey%202009.pdf http://www.lovefoodhatewaste.nsw.gov.au/about-food-waste/research.aspx http://www.lovefoodhatewaste.nsw.gov.au http://www.lovefoodhatewaste.nsw.gov.au/at-home/Food-Waste-Tool-Kit.aspx http://www.lovefoodhatewaste.nsw.gov.au/partners/the-partnership-program.aspx	
Similar	UK http://www.wrap.org.uk/content/love-food-hate-waste Canada http://www.lovefoodhatewaste.ca	


R2 - Residential sector – household scale - dehydrator		
Location	Currently available in USA and Canada	
Timing	Residential unit released in 2014	
Waste	Household kitchen food waste	
Technology	Food Cycler: Home by Food Cycle Science (FCS) (http://nofoodwaste.com/order-now/food-cycler-cs-10)	
Transport	Householder by hand	
Treatment	Household scale dehydrator	
Output	Dehydrated food waste/soil amendment for home use	
<p>Details – After success in providing commercial dehydrators FCS released the household scale unit in 2014. The mini dehydrator has a capacity of 1kg. It grinds, sterilises and reduces waste by up to 90% converting kitchen food scraps including bones and meat into a nutrient rich soil amendment for the garden in 3 hours. The units, requiring filters to be replaced every three months require only electricity and no water, vent or drain. The units retail for \$400 plus postage.</p>		
Sources	http://nofoodwaste.com/order-now/food-cycler-cs-10	
Similar	Clo'e'y residential units (Closed Loop in Australia) dehydrate < 4kg of food waste within 24hrs - \$700 incl delivery http://www.closedloop.com.au/domestic-composter	


R3 - Residential sector - household scale - AD		
Location	Available/used in 56 countries	
Timing	Company founded in 2012	
Waste	Household food and pet waste	
Technology	Homebiogas https://homebiogas.com/	
Transport	Caddies by householder on-site	
Treatment	Backyard AD	
Output	Cooking gas and liquid fertiliser	
<p>Details – After initial investigations the company was set up in 2012. The product is now available/used in 56 countries from the USA to Kenya. Working best in day/night temperatures above 17 deg C, for every litre of food/pet waste put into the backyard AD unit about 200 litres of biogas is produced, enough for approx. one hour of cooking. The average food/pet waste produced by a family of 5 is enough to provide enough gas to cook for a family of 5. Each unit can take up to 6 litres of food or 15 litres of animal manure (or combination of the two) and produces up to 3 hours of cooking gas a day. Delivered in a box for home assembly the units currently cost approx. \$1000 plus postage.</p>		
Sources	https://homebiogas.com/	
Similar	BioBowser units for large household (5 and 10 m3 capacity) up to multiple household and commercial scale units http://biobowser.com.au/media/ Similar small scale AD units for household applications are being developed such as the 5kg/day input EcoDigest http://ecomorphosis.com.au/system-solutions/	

R4 - Residential sector – neighbourhood scale – community fridge/re-distributed food		
Location	Community fridge, Frome, Somerset, UK	
Timing	Since 2016 – ongoing	
Waste	Fresh excess food	
Technology	Fridge	
Transport	By hand	
Treatment	Sorting	
Output	Re-allocated food to anyone that can use it	
<p>Details – Edventure: Frome, a school for community enterprise, challenged a group of 9 young adults to tackle food waste in their local town. Their solution, with support from the local council, was to set up the UK's first community fridge to share unwanted food including anything except raw meat, fish or eggs or home cooked food. Anyone can add or take food from the fridge.</p>		
Sources	http://www.wehatetowaste.com/community-fridge-frome-food-waste/	
Similar	London market fridge http://www.bbc.com/news/39642662 Solidarity fridge, Galdakao, Bilbao, Spain https://www.theguardian.com/world/2015/jun/25/solidarity-fridge-spanish-town-cut-food-waste-galdakao Berlin, Germany http://www.dw.com/en/food-sharing-initiative-battles-berlin-authorities-over-closed-community-fridges/a-19042114	

R5 - Residential sector – MUDs scale - insinkerator	
Location	The conservatory, Calgary, Canada
Timing	2014-2015
Waste	Kitchen food waste
Technology	InSinkEerator (http://www.insinkerator.com.au/household-food-waste-disposers)
Transport	By hand and through municipal waste water system
Treatment	City wastewater AD plant
Output	Biogas and fertiliser through city wastewater AD plant
	
<p>Details – From 2014 to 2015 InSinkEerator conducted a trial in a block of flats in Calgary (the Conservatory) to test reduction in food waste passing to municipal waste as well as other research. Fifty insinkerators were installed (40 new and 10 upgrades) with 15 units not participating. The insinkerators in combination with educational material were found to assist in reducing food waste to municipal waste by 60%, from >1kg to <0.5kg per household/week. Similar research was conducted by InSinkEerator in Philadelphia, Chicago, Milwaukee, Tacoma and Boston on over 500 homes resulting in various outcomes including installation of 3,000 disposal units in public housing in Boston and a building/plumbing code amendment in Philadelphia in 2016 requiring disposer installation in all new residential buildings.</p>	
Sources	https://www.aham.org/AHAMdocs/Main%20Site/InSinkEerator.pdf http://agendaminutes.calgary.ca/sirepub/cache/2/kwf1ktjdzetecvvsq4a0mlnw/51766604222017085613902.PDF http://www.cochraneagle.com/article/Industry-leader-raises-concerns-about-proposed-garburator-ban-in-Cochrane-20160324
Similar	InSinkEerator research trials in Philadelphia, Chicago, Milwaukee, Tacoma and Boston http://agendaminutes.calgary.ca/sirepub/cache/2/kwf1ktjdzetecvvsq4a0mlnw/51766604222017085613902.PDF https://www.aham.org/AHAMdocs/Main%20Site/InSinkEerator.pdf

R6 - Residential sector – LGA scale – household compost/worms	
Location	Woollhara, Waverly and Randwick councils, Sydney NSW (subsequently spread to >40 councils across Australia due to success of program)
Timing	2009 – ongoing
Waste	Household food waste
Technology	Home composting
Transport	By-hand on-site
Treatment	Composting
Output	Compost
	
<p>Details – In 2009 an intensive year long trial of home composting education was conducted across Woollhara, Waverly and Randwick councils. The trial resulted in the very successful 'Compost Revolution' that now promotes the use of home composting, worm farms and bokashi bins to help reduce food waste passing to landfill. Participating councils provide reduced rates on home composting, worm and bokashi systems and the initiative provides access to online tutorials and a website. The original program was found to have significant additional effects of increased recycling.</p>	
Sources	http://compostrevolution.com.au/about/ http://reduceyourfootprint.com.au/media/uploads/attachments/Sydneys_Compost_Revolution_Lauren_Michener_print.pdf https://www.environment.gov.au/system/files/resources/8b73aa44-aebc-4d68-b8c9-c848358958c6/files/collection-manual.pdf
Similar	40 councils across Australia 'Compost Revolution', providing face to face training opportunities, information on avoidance in tutorials and access to a trouble shooting chat room. http://compostrevolution.com.au/about/

R7 - Residential sector – LGA scale – MUDs collection	
Location	MUDs in former Leichhardt Council area (now part of Inner West Council)
Timing	2008 – ongoing
Waste	Food waste from MUDs including meat and fish but avoiding large bones
Technology	City scale AD
Transport	Collected by truck once a week
Treatment	EarthPower AD in Camellia
Output	Green energy & fertiliser
	
<p>Details – In 2008 the former Leichhardt Council, (covering Annandale, Balmain, Birchgrove, Lilyfield, Leichhardt and Rozelle), now part of Inner West Council, began providing a food waste collection service for MUDs. The initiative involves those in units with shared bin facilities to get the building corporate/strata to approach council and request participation in the program. Kitchen bench top bins are provided free along with compostable bags. Food waste is collected once a week and taken to the EarthPower AD facility in Camellia in western Sydney where it is converted to green power and fertiliser. The MUD program was reported to cover 5,200 units in 2015.</p>	
Sources	http://www.innerwest.nsw.gov.au/environment/waste-and-recycling/food-waste http://www.leichhardt.nsw.gov.au/Living-Here/Waste-and-Recycling/Minimising-Waste/Food-Waste-Recycling-Guide/Food-Waste-Recycling-Guide
Similar	<p>Randwick City Council food scraps trial running since 2013 on 90 blocks of MUDs (5,000 units) with the view to roll-out to all MUDs in future http://www.randwick.nsw.gov.au/services/rubbish-and-recycling/household-rubbish/food-scraps-bin</p> <p>Also, various UK trials undertaken by WRAP including Swansea case study (2011 – ongoing) http://www.wrap.org.uk/content/recycling-collections-flats-food-waste-collections</p>

R8 - Residential sector – LGA scale – combined food organics garden organics (FOGO) waste collection	
Location	Lismore Council, NSW, Australia
Timing	1999/2000 – ongoing
Waste	Combined food organics garden organics (FOGO) waste
Technology	Composting city scale
Transport	Trucks
Treatment	Compost
Output	BIOcycle compost
	
<p>Details – Lismore council was one of the first councils in Australia to introduce domestic collection of food organics. Rolled out in 1999/2000 it has been extremely successful. Collection of food waste is available to all properties with the kerbside garden organics service. As at 2012, 11,000 households were serviced and 4,000 caddies (with liners) provided free of charge. A three bin service commenced in 2006 to separate paper/cardboard. Food waste caddies were introduced in 2009 and acceptance of compostable nappies in 2012. A one off caddy and roll of compostable bags are provided free of charge, available for pick up at council. Bags for subsequent purchase. The waste is taken to the city waste processing facility where it is mulched and shredded, composted in rows, screened to remove plastics/inorganics and converted to rich compost for resale. 14 kg/household/week of food waste/garden organics is collected with auditing of the residual bins showing 92% capture rate of organics and very low contamination rates of 1%.</p>	
Sources	https://www.environment.gov.au/system/files/resources/8b73aa44-aebc-4d68-b8c9-c848358958c6/files/collection-manual.pdf http://www.northernriverswaste.com.au/cp_themes/default/page.asp?p=DOC-RPK-55-48-21
Similar	<p>Cooma–Monaro Shire Council award winning 3 bin systems http://www.lgnsw.org.au/files/imce-uploads/90/Organic_Kerbside_Service_Cooma.pdf</p> <p>As at 2017 there are over 23 councils in NSW operating FOGO services including: Albury, Armidale, Ballina, Bathurst, Bellingen, Broken Hill, Byron, Clarence Valley, Coffs Harbour, Coolamon, Cooma, Corowa, Forbes, Gundagai, Gwydir, Kempsey, Kiama, Lismore, Moree, Nambucca, Narrabri, Orange, Parkes, Port Macquarie, Penrith, Richmond Valley, Shellharbour, Woollahra. These are in addition to food only services for MUDs in Leichhardt and Randwick.</p> <p>Nillumbik Shire Council, Regional Vic (since 2014) http://www.nillumbik.vic.gov.au/Living-in/Waste-and-recycling/Bin-collection</p>

R9 - Residential sector – LGA scale – rewards/incentives	
Location	Royal Borough of Windsor and Maidenhead (RBWM), UK
Timing	2015 – ongoing
Waste	Residential food waste
Technology	Greenredeem (https://www.greenredeem.co.uk/search-results.php)
Transport	On-site
Treatment	Various
Output	Various

Details	In 2015 the RBWM partnered with Greenredeem, a company specialising in developing rewards schemes for everyday green actions. RBWM set up a Food Waste Recycling initiative to encourage residents to recycle food and use leftovers more effectively, 'love your leftovers'. The scheme is an extension of an existing initiative. As part of the scheme residents receive a years supply of caddy liners and free outdoor recycling bins on request. All residents can be rewarded for recycling food waste, checked through weighing of their bins upon collection, by going to the Greenredeem website and pledging to recycle their food waste. Points earned for recycling food waste can then be converted to vouchers for local businesses such as coffee and leisure outlets.
Sources	https://www.greenredeem.co.uk/press-releases-article.php?wnID=1600 https://www3.rbwm.gov.uk/info/200175/recycling_and_waste/50/greenredeem_recycling_rewards
Similar	Various UK reward schemes – evaluation summary (Lyndhurst, 2016) Randwick Green Money two year trial (2013 to 2015) on dry recyclables http://www.randwick.nsw.gov.au/about-council/news/news-items/2015/march/green-money-trial-ends-redeem-points-by-31-march-2015

R10 - Residential sector – LGA/development scale – vacuum	
Location	Hammarby, Stockholm, Sweden
Timing	Since the 1980/90s
Waste	Food waste along with other separated waste streams
Technology	Underground vacuum system with composting for organic waste
Transport	Vacuum and trucks outside the development
Treatment	Composting
Output	Fertiliser

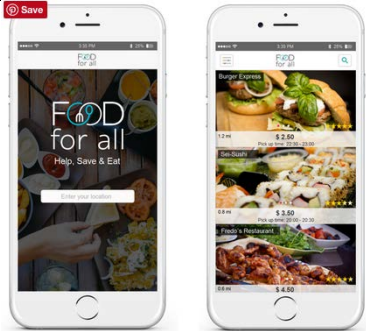
Details	Beginning in the 1980/90s and developed in several stages this development of 11,000 homes and associated facilities is now complete. It combines multiple environmental principles to represent one of the first urban green developments. A key component is the vacuum system adopted which transports multiple waste streams (general waste, food/organic waste and paper waste etc.) underground. Developed over several decades different approaches have been used, with the automated underground stationary vacuum system being a core component. The waste, from hundreds of inlets in multiple locations across the phased development is put into dedicated repositories. The waste is discharged through a single piped system at 90km/hr to areas where the waste is sorted for processing. The food/organic waste is composted into biosolids and used as fertiliser. Other areas in Sweden such as Linköping use a coloured bag system and an automated optical sorting system to sort the waste ready for processing. Australia's first large scale use of the vacuum system will be at Maroochydore in the Sunshine Coast.
Sources	http://www.solaripedia.com/files/719.pdf
Similar	Maroochydore, Sunshine Coast, Australia http://www.brisbanetimes.com.au/queensland/here-are-the-pipes-set-to-replace-maroochydores-rubbish-trucks-20170221-guhlde.html Multiple cities (i.e. Hanian China, Leon Spain, Qatar Doha, London UK) Envac n.d. Removing waste – creating value, underground vacuum systems for sustainable waste handling

R11 - Residential sector – city scale – MUDs collection	
Location	Milan, Italy
Timing	Launched Nov 2012, roll-out across city by June 2014 - ongoing
Waste	Leftover food waste
Technology	City scale AD
Transport	Small kitchen caddies lined with biodegradable bags; wheelie bins; and kerbside collection. Collection for households 2/week to AD system outside city.
Treatment	AD at Montello outside the city
Output	Energy and organic compost/fertiliser/soil amendment and wastewater Energy used to power a plastic reprocessing plant on the same site.
<p>Details – Milan is a highly urbanised city with many residents living in multi storey buildings. After two failed attempts the most recent organics program was launched in late 2012 and rolled out over 4 phases with the last in mid 2014. The roll out process involved investigating and surveying each of the four areas of the city, closing building waste chutes to force residents to deposit food waste in building bio bins provided, checking where bio bins could be located within private premises etc. and then distributing bio bins and starter kits (with leaflets on the program, a vented caddy, bio bags, access to website and call centre for advice etc.). With the program active the results have been outstanding. Nearly 300,000 tons of organic waste is collected and treated per year at the large AD site outside the city creating 9MW of energy. Most of the energy is used to power the on-site plastic reprocessing plant. Prior to the scheme food waste recycling was only 23 kg/person/year. With the scheme this has increased to 90kg/person/year with approx. 86% diversion of food waste and only 14% in residual waste.</p>	
Sources	http://www.recyclingwasteworld.co.uk/in-depth-article/the-italian-mode-how-italy-leads-the-way-in-europe-in-separate-waste-collection-systems/71126/ http://www.london.gov.uk/LLDC/documents/b10746/Minutes%20-%20Appendix%20%20-%20Food%20Waste%20in%20Milan%20Wednesday%2009-Jul-2014%2014.00%20Environment%20Committee.pdf?T=9 http://www.compost.it/attachments/article/1060/CIC_2016%20Report%20web.pdf
Similar	





R12 - Residential sector – city scale – household/MUDs collection	
Location	Multiple urban centres, Korea
Timing	2010 - 2012 pilot of 144 regions with volume based charging, now virtually every residential complex involved
Waste	Food waste
Technology	City scale AD or incineration
Transport	Trucks
Treatment	City scale AD or incineration
Output	Energy, nutrient rich fertiliser
<p>Details - Direct food waste to landfill has been banned in Korea since 2005. In 2010 to 2012 a pilot of volume based charging involving 144 local regions was rolled out. Now virtually every residential complex is involved. The 'Pay as you trash' scheme varies. 1) Dispose of food waste in plastic garbage bags with different sized coloured bags bought from grocery stores (with various \$ - a 10L bag cost <\$1), 2) Local government distributes food waste bins to customers. When disposing of food waste residents must stick a chip or sticker (bought from grocery stores) on the bin otherwise it isn't collected – a garbage truck collects the bins only if chip/sticker present, 3) Radio frequency identification (RFID) tag – RFID bin with magnetic card reader. Each household has a card that will open a bin, when use centralised bins their waste is weighed and the household charged monthly. RFID bins are approx. \$1500 each and can cater for 60 households. Due to various schemes including the pay as you trash schemes South Korea has continued to reduce food waste (from 5.1 to 4.82 million tons between 2008 and 2014 despite population rise).</p>	
Sources	http://www.legco.gov.hk/yr12-13/english/sec/library/1213inc04-e.pdf http://www.odditycentral.com/news/unique-pay-as-you-trash-system-helps-south-korea-cut-food-waste.html http://www.straitstimes.com/asia/east-asia/culture-shock-over-south-koreas-mandatory-recycling-of-food-waste
Similar	<p>Similar pay as you throw (PAYT) examples.</p> <p>County of Aschaffenburg, Germany PAYT since 1997 (Morlok et al 2017) www.mdpi.com/2079-9276/6/1/8/pdf</p> <p>Belgium PAYT, since 1995 http://www.regions4recycling.eu/upload/public/Good-Practices/GP_OVAM_PAYT.pdf</p>





RC1 – Residential/commercial sector – neighbourhood scale – food waste apps		
Location	Cambridge, Massachusetts, USA	
Timing	2016 - ongoing	
Waste	End of day food waste	
Technology	Food for All (https://foodforall.us)	
Transport	Various	
Treatment	Food waste avoidance	
Output	Food waste avoidance	
Details – In 2016 Food for All started a pilot with 30 restaurants in Cambridge Massachusetts. The app allows signed up restaurants and customers to link whereby signed up customers search for food deals (typically between 50 to 80% off retail price) close to their desired location and place an order for the registered restaurants leftovers (foods that did not/will not sell by the end of the day). The customer then goes and picks up the food at the designated time. Food for All are currently using crowd funding to advance the app and expand to other areas such as Boston and New York City.		
Sources	https://www.treehugger.com/green-food/app-reduces-food-waste-offering-restaurant-leftovers-80.html https://foodforall.us	
Similar	Yume app in Australia http://www.smh.com.au/technology/technology-news/apps-to-stop-food-waste-link-with-fellow-travellers-and-to-check-palm-oil-content-20160315-gnj6oy.html Ripenear.Me website in Adelaide http://www.ripenear.me/about-ripenearme	


RC2 – Residential/commercial sector – neighbourhood scale – food waste collection		
Location	Various suburbs, Chicago, USA	
Timing	Started in 2014 – ongoing	
Waste	Residential and commercial food waste	
Technology	Healthy Soil Compost (http://www.healthysoilcompost.com/) collected by bike	
Transport	Bikes and motor vehicles since 2016	
Treatment	Composting and worm farm through various partnerships	
Output	Compost	
Details - Healthy Soil Compost started as a hobby in 2014/15, progressed into a one man business on a bike, then to an additional 4 part time bikers and since 2016 has used a motor vehicle as well. Food waste is collected from houses and commercial restaurants in various suburbs in Chicago. A container with a lid – 5 gallons is provided on sign-up. Charges vary with frequency of pick-up – from monthly \$20 to weekly \$40. In one year the entrepreneur collected 60,000 lbs of food waste on his bike. The waste is either composted or treated by a worm farm depending on location and time of year through various partnerships. Customers also have the opportunity of buying back the compost/soil.		
Sources	http://www.healthysoilcompost.com/ http://www.chicagobusiness.com/article/20151125/ISSUE03/151129921/meet-the-guy-making-money-off-your-food-scrap	
Similar	Chicago https://www.wastenotcompost.com/	

RC3 – Residential/Commercial sector – markets - collection	
Location	Green City Market, Chicago USA
Timing	n.d.
Waste	Food/organic waste from market and recently household food scraps for a fee
Technology	Various composting and earth worm centres off-site
Transport	By hand at market, buckets from householders and then truck to composter off-site
Treatment	Composting and earth worm centres
Output	Compost
	
<p>Details – Green City Market in Chicago is a year round farmers market with 175,000 visitors a year. The markets have operated in various forms since the late 1990s. The market currently partners with WasteNote Compost and Healthy Soil Compost and the Resource Centre to treat food waste from the market. The recycling enables the market to reduce their waste from 30 bins to 6 per day. The “Compost Center” tent at the market is a centralised waste disposal / recycling area manned by staff to assist people to minimise contamination. Recently the market started a household compost drop off service. Householders can bring in their food scraps including dairy and meat in a bucket or container (tight-fitting lid advisable) at a cost of \$3/drop-off (max 5 gallons). The materials are then trucked to different locations including the Resource Centre (non-profit) composting facility on the south side of the city. Compost is used to grow food etc.</p>	
Sources	http://www.greencitymarket.org/programs/program.asp?id=12v http://www.greencitymarket.org/programs/program.asp?id=12 http://www.greencitymarket.org/cmsfiles/compost_info.pdf https://www.resourcecenterchicago.org/composting
Similar	<p>New York City Dept of Sanitation will serve 3.3 million people with a curbside organics service by the end of 2017. By the end of 2018 all New York citizens will have access to a curbside service or neighbourhood drop off service.</p> <p>http://www1.nyc.gov/assets/dsny/zerowaste/residents/sharemybin.shtml</p> <p>As the program rolls out a “share my bin” program has been implemented for adjacent areas not yet serviced</p> <p>http://www1.nyc.gov/assets/dsny/zerowaste/residents/sharemybin.shtml</p>

C1 - Commercial sector – SMEs waste avoidance/advisory services		
Location	NSW, Australia	
Timing	201? – ongoing	
Waste	Food waste and general recyclables	
Technology	Advisory services	
Transport	N/A	
Treatment	N/A	
Output	Varies	
Details – The Bin Trim program, funded by the NSW EPA Waste Less Recycle More, has already assisted more than 20,000 businesses to reduce waste. The program aims to assist small and medium sized businesses identify actions they can take to cut waste and recycle more, to assist in boosting profits. The program which focuses on all facets of potential avoidance and increased recyclables offers free or reduced cost waste and recycling assessments by a qualified assessor together with advice, a personalised action plan and access to potential rebate funding of between \$1k to \$50k to assist with the cost of recycling equipment. An online tool is also available as well as documented case studies.		
Sources	http://www.epa.nsw.gov.au/managewaste/bin-trim.htm http://www.epa.nsw.gov.au/managewaste/bin-trim-tool.htm http://www.epa.nsw.gov.au/managewaste/bin-trim-case-studies.htm	
Similar	Similar small scale advisory services are available across NSW such as recent start-up Revolve Your World and Richmond Waste and North East Waste servicing the Byron Bay area http://www.echo.net.au/2017/03/waste-not-want-not/	

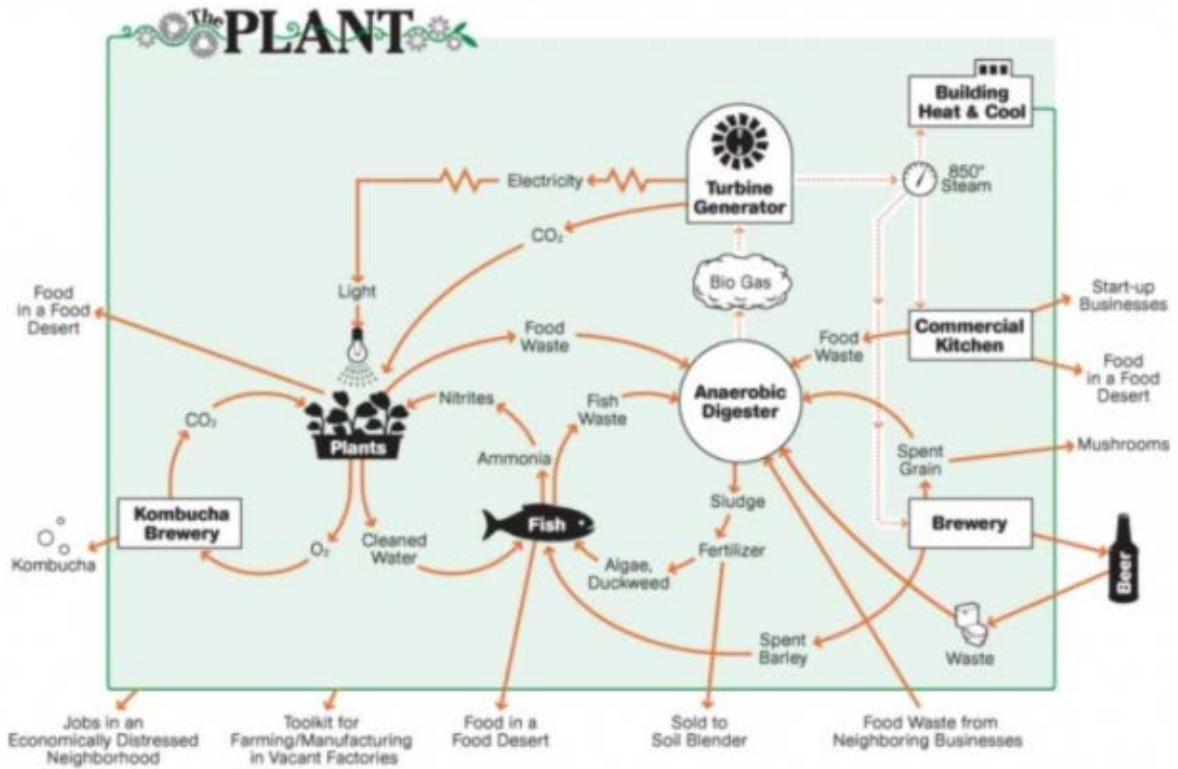
C2 - Commercial sector – grocery stores - part on-site decomposition		
Location	Banana Joes Supermarket, Marrickville, NSW, Australia	
Timing	2013 – ongoing	
Waste	Discarded fruit and vegetables from supermarket establishment	
Technology	Bio-Ez - Waste to Water (http://www.wastetowater.com.au)	
Transport	By hand, boxes and small bins by staff on-site	
Treatment	Continual feed organic food waste disposal system involving shredding and microbial decomposition (larger batch systems decompose within 24 hrs)	
Output	Liquid waste discharged to sewer	
Details – Food waste is collected by staff on-site and added to the machine. The waste is shredded within the machine and specific microbes added to rapidly decompose the material before it is discharged to sewer thereby avoiding significant waste collection, transports and landfill disposal fees.		
Sources	https://www.youtube.com/watch?v=_xyuvBOhg3E	
Similar	PowerKnot USA (e.g applications hotel, restaurant, food processor) http://www.powerknot.com/2012/11/28/big-river/	

C3 - Commercial sector – grocery stores - on-site maceration	
Location	Whole Foods Market, Andover, Massachusetts, USA
Timing	2014
Waste	Food waste including bones & paper/napkins
Technology	Grind2Energy - connected to the InSinkErator Emerson group (http://www.grind2energy.com)
Transport	Collected in wheelie bins and transferred to the grinder disposal unit under a bench connected to (monitored) storage tank then by truck (partner Casella Organics)
Treatment	Digester-ready slurry is produced on-site at the point of generation, then trucked to an AD plant
Output	Fertiliser and energy
	
<p>Details – In 2014 the Andover store in Massachusetts installed the system, the first grocery store in the USA. Food waste from the store including some paper/napkins is deposited into the grinder disposal unit via a bench which has electrical and plumbing connections. The food slurry is then pumped to a holding tank for regular collection. The food slurry is collected on a regular basis and taken to an AD plant for treatment at a local farm to produce energy and fertiliser. The system has been installed in three other Whole Food Market owned stores.</p>	
Sources	http://grind2energy.com/news/g2e-news/andover-massachusetts-whole-foods-market-diverts-to-ad-biocyte-magazine http://www.grind2energy.com/news/case-studies/whole-foods-market-evaluates-grind2energy-system https://www.youtube.com/watch?v=fb5sQZbVDw4
Similar	In Australia, similar pulping system (Pulpmaster), holding tank and subsequent transfer offsite for treatment http://pulpmaster.com.au/products

C4 - Commercial sector – shopping centre - vacuum	
	
Location	Westfield Shepherd's Bush, London, UK
Timing	2016 – ongoing
Waste	food waste
Technology	Rendisk Flex WasteDispo http://www.rendisk.com/application/files/5314/8161/9798/Brochure_Rendisk_Flex_WasteDispo_2016_DEF.pdf
Transport	Vacuum
Treatment	centrifugal dehydrator
Output	dry pulp sold for composting
<p>Details – The Westfield Shopping Centre in Shepherd's Bush at 150,000 sqm is the largest shopping mall in London. The mall with 265 high end shops, 50 restaurants, spa, cinema, library and gym has over 27 million visitors a year. The expansion of the food court meant the need to upgrade the warewashing and food waste processing system. To handle the more than 9,000 plates and bowls plus associated cups, glasses and cutlery a combination of conveyor/rack systems were installed for the plates etc. A vacuum disposal system used to eliminate all internal transport of food waste was installed together with centrifugal dehydrator system to reduce food waste by up to 80%. The dry pulp is suitable for use in biogas/composting plants</p>	
Sources	http://www.rendisk.com/news/news-2016/massive-waste-reduction-for-westfield-due-to-rendisk http://www.rendisk.com/solutions/food-waste-solutions/flex-wastedispo-dehydrated http://www.rendisk.com/application/files/5314/8161/9798/Brochure_Rendisk_Flex_WasteDispo_2016_DEF.pdf http://www.publicityworks.biz/2016/09/westfield-london-puts-sustainability-in-the-scullery/
Similar	

C5 - Commercial sector - markets		
Location	Queen Victoria Market, Melbourne, VIC, Australia	
Timing	2014 – ongoing	
Waste	Food waste (coffee grinds, chai leaves, fruit & veg scraps etc.)	
Technology	Hungry Bin Worm Farms - Wormlovers (https://www.wormlovers.com.au)	
Transport	Small bins	
Treatment	5 on-site bin worm farms	
Output	Fertiliser used on potted trees and plants around the market	
<p>Details – Part of a suite of sustainability initiatives at the market 5 worm farm bins were installed in 2014. Each can take up to 2 kg of waste each which is provided by specific vendors under lock and key feeding the worms scraps such as coffee grinds, chai leaves and fruit and veg. The fertiliser produced is taken by each vendor and reused on potted trees and plants around the market. The worm farms are strategically placed for educational purposes.</p>		
Sources	http://www.qvm.com.au/news/weve-got-worms-new-worm-farm-initiative-market/ http://www.qvm.com.au/about/sustainability/ http://prwire.com.au/pr/48363/queen-victoria-market-has-worms	
Similar		

C6 - Commercial sector – commercial precinct



Location	The Plant, Chicago, USA
Timing	2011 - ongoing
Waste	multiple
Technology	varies
Transport	varies, all on-site
Treatment	varies – symbiotic wastes are used for aquaponics, onsite AD, onsite fish food production using spent barley from onsite brewery, mushroom farming etc.
Output	multiple outputs such as fish food and biobriquettes (biomass) for fuel
Details	The Plant is a former meat packaging plant which has been repurposed with a growing list (currently 16) synergistic businesses (brewery, bakery, aquaponic farm, mushroom farm, kombucha supplier, two veg suppliers etc.) acting as a food business incubator and a vertical farm. The facility is a building, a business community, a living lab, home to farmers markets and an educational showcase for over a 1,000 tourists every month. The Plant takes the waste from one small business (i.e. the brewery in the form of spent barley and is used to feed another business (i.e. the fish farm). The waste from both of these businesses goes to the on-site AD plant along with other business wastes such as the commercial kitchen. The AD plant generates biogas for a turbine to create energy and light which then grows plants to help close the loop for other businesses. The Plant will eventually aim to treat waste on-site and import a further 10,000 tons of food waste from nearby businesses to feed the AD plant and power the Plant as well as 250 homes.
Sources	http://plantchicago.org/tour/ http://chicago.inno.streetwise.co/2016/07/04/urban-agriculture-how-plant-chicago-is-using-new-technology/ https://www.greenbiz.com/article/how-chicagos-quirkiest-companies-sprouted-circular-economy
Similar	

C7 - Commercial sector – commercial precinct	
Location	Degraves St, Melbourne, VIC, Australia
Timing	2013 – ongoing
Waste	Food waste from 32 businesses (62 involved in recycling overall by 2015)
Technology	Gaia Recycling - EcoGuardians Australia (http://www.ecoguardians.com.au/products/gaia-recycle)
Transport	Bins wheeled to on-site recycling centre in Ross House
Treatment	Shredded, heated and dehydrated with the Gaia dehydrator machine in basement of carpark
Output	Soil conditioner supplied to local community gardens and council parks and gardens

Details – Degraves is a busy café precinct in the heart of Melbourne with a high density of food businesses. Recycling of multiple waste streams was set up in 2013 by the city council due to low recycling rates, poorly managed bins and significant opportunity the site provided. Food waste (approx. 700 kg/day according to 2012 audit) is transported by a team of recyclers collecting various types of materials. The team work with the cafés and restaurants on education of kitchen separation and transfer of waste to the on-site waste recycling facility in which the dehydrator is located. The food waste is shredded, heated and dehydrated with the Gaia dehydrator machine. The soil conditioner produced is supplied to local community gardens and council parks and gardens. The aim of the project is to achieve a 70% reduction in the volume of food waste collected from participants. From an evaluation conducted in 2015 (Mitchelmore 2015) on two years of operation a reduction of 69% was achieved despite the dehydrator being out of commission for 4 months before repair.

Sources	http://www.waste2016.impactenviro.com.au/Speaker%20Presentations/Recycling_2_Rebecca%20Hughes.pdf https://www.mwrrg.vic.gov.au/assets/resource-files/Degraves-Street-Recycling-MF-R1-Final-Report-Melbourne.pdf
Similar	

C8 - Commercial sector – commercial precinct	
Location	Federation Square, Melbourne, VIC, Australia
Timing	2014 – 2017
Waste	Food waste from cafes & restaurants
Technology	Active Research (on-site AD) (http://www.activeresearch.com.au)
Transport	80 L wheelie bins
Treatment	On-site collection, maceration and AD
Output	Gas for boiler for hot water heating, digested solids for use on gardens, excess water to sewer (via trade waste agreement)

Details – Federation Square is a government building in the heart of Melbourne with multiple sustainability features and objectives. Up to 800 kg of food waste from on-site cafes and restaurants is delivered to a busy loading bay in the basement of the complex in 80 L bins where the AD plant is located. Material is macerated and pumped into the AD plant, which produces biogas (up to 14,400 L/day) used to heat water by a boiler in the building. Biosolids are collected and used by the AD manufacturer staff for garden compost. Excess water is disposed to sewer in accordance with the trade waste agreement. The plant has operated successfully for three years but due to ongoing maintenance callouts due to contaminants such as cutlery entering the system the plant will be decommissioned in 2017.


Sources	https://www2.health.vic.gov.au/Api/downloadmedia/%7B64FEFC4E-D275-4387-B0D7-7F17E979E904%7D https://home.kpmg.com/au/en/home/about/clients/active-research.html
Similar	

C9 - Commercial sector – regulation	
Location	California, US
Timing	2014 - ongoing
Waste	Commercial organic waste (food waste, landscape/green waste, food-spoiled paper and non-hazardous wood waste)
Technology	Regulation
Transport	Varies
Treatment	Compost or AD
Output	Varies
Details – In 2014 the Governor signed a Bill, commonly known as the Mandatory Commercial Organics Recycling (MORe) program, requiring all commercial generators of organic waste to have their food waste, landscape/green waste, food-spoiled paper and non-hazardous wood waste either composted or anaerobically digested to assist in increasing diversion and preserving landfill capacity. The program allows for staggered commencement dates.	
Sources	https://ilsr.org/rule/food-scrap-ban/california-organics-recycling/
Similar	Similar programs have been implemented in Connecticut, Massachusetts, New York City and Rhode Island to varying degrees https://ilsr.org/rule/food-scrap-ban/



C10 - Commercial sector – city scale food rescue	
Location	food recovery program active in Sydney, Adelaide, Brisbane, Canberra, Gold Coast, Melbourne, Newcastle and Perth as well as regional areas via REAP
Timing	Founded in 2004 - ongoing
Waste	Quality surplus fresh fruit and veg, fresh meat, pre-prepared sandwiches and meals, cupcakes/muffins (not sold that day) plus dry goods.
Technology	Oz Harvest food rescue and sorting
Transport	Vans
Treatment	Focuses on avoidance and food rescue from >2,000 commercial outlets and associated sorting
Output	Recovered and redistributed food to > 900 charities in multiple cities for people in need via charity organisations
Details – Oz Harvest was established in 2004 and was the first perishable food rescue organisation in Australia. It collects quality excess food from > 2,000 registered commercial businesses and delivers it, direct and free of charge, to > 900 charities in Sydney, Adelaide, Brisbane, Canberra, Gold Coast, Melbourne, Newcastle and Perth as well as regional areas via REAP to people in need. In 2017 Oz Harvest opened Australia's first rescued food supermarket. A pop up market in Kensington available for as long as the temporary site is available.	
Sources	http://www.ozharvest.org/ http://www.ozharvest.org/market/
Similar	FoodBank (https://www.foodbank.org.au/) Second Bite (http://secondbite.org/) Fareshare (http://www.fareshare.net.au/)




C11 - Commercial sector – city scale AD	
Location	Sydney Water Corporation (SWC) WWTP, Cronulla, Sydney, NSW, Australia
Timing	2016
Waste	Food waste (fruit and veg) currently from a couple of large food producers and local fruit fair
Technology	Pulpmaster (http://pulpmaster.com.au)
Transport	Liquefied food waste collected through Pulpmaster holding tank systems and transported to Cronulla WWTP
Treatment	Discharge from Pulpmaster tank into new extra tank for liquefied organic waste which is added to AD plant
Output	Biogas used to help power the AD plant and sludge
	
<p>Details – In early 2016 SWC commenced a 3 year project co-funded with the NSW Government aiming to lower energy costs and customers' bills. By building another tank to take liquefied food waste SWC is able to augment its existing AD plant processing sewage sludge and a co-generator engine generating power at the Cronulla WWTP. The food waste helps to boost the microbes creating methane and generate additional power required for operations at the Cronulla plant. SWC has partnered with Pulpmaster to bring the liquefied food waste from its clients to the Cronulla WWTP. Pulpmaster supplies equipment to commercial kitchens and markets to turn the food waste produced into a slurry, and then collects it for use at the Cronulla WWTP. The project not only diverts food waste from landfill (estimated at 150,000 wheelie bins) but has the potential to generate more than 60% of the energy the plant needs to operate, which is equivalent to powering a third of homes in the Cronulla area per year.</p>	
Sources	http://wastemanagementreview.com.au/utility-first-food-waste-to-energy-plant/ http://www.abc.net.au/news/2016-05-30/food-waste-powering-sydney-water-sewage-plant/7460182
Similar	<p>Purpose built waste to energy plant located adjacent to the Aurora wastewater treatment plant is expected to divert 33,000 tons of commercial food waste per year from 2017. The biogas produced will power both the existing wastewater treatment plant and AD food waste processing plant. Surplus energy generated will be exported to the electricity grid.</p> <p>https://www.yvw.com.au/about-us/major-projects/waste-energy-facility</p>


I1 - Institutional – university building	
Location	Western Sydney University (WSU), Hawkesbury Campus, Food Science Labs, NSW, Australia
Timing	2011 – ongoing
Waste	Food waste and paper from class kitchens
Technology	Pulpmaster (http://pulpmaster.com.au)
Transport	Collected by bucket in school kitchen and put into Pulpmaster machine
Treatment	Pulpmaster pulping machine, then holding tank before trucked by Pulpmaster to EarthPower (Camelia)
Output	Green energy and soil conditioning material
Details –WSU was the first university in Australia to trial Pulpmaster. Food waste from the university cooking classes is taken in small labelled bins from each cooking station after the classes to the Pulpmaster unit adjacent to the kitchens by technical staff. The Pulpmaster unit macerates the food waste into a slurry before it is pumped to a holding tank outside the building. This is then taken by a Pulpmaster tanker on a regular basis to EarthPower at Camelia in Western Sydney where it is processed into green energy and soil conditioning material. From 2011 to 2014 52 tonnes of food waste was recycled.	
Sources	https://www.youtube.com/watch?v=M9nDOZQcsSA http://www.thefifthstate.com.au/education/university-sustainability-research-the-latest-update/60491
Similar	



I2 - Institutional – university precinct	
Location	University of Technology Sydney (UTS), Sydney, Australia
Timing	2016 - ongoing
Waste	Food waste from UTS cafes and staff kitchens
Technology	Closed loop (http://closedloop.com.au)
Transport	Bins (+ individual green desk top bins for personal food waste)
Treatment	Rapid food decomposers in UTS buildings 8 & 10 car park basements then currently transported to EarthPower (Camelia)
Output	Green energy and soil conditioning material
Details – Since 2015 food waste has been separated at UTS in preparation for dehydrators installed in 2016/17 to assist in reducing waste to landfill across the campus. Food waste is now collected from 22 staff/student kitchens, public waste bins servicing 34,500 students and staff, 11 individual cafes and a food concourse area servicing 5 food outlets. The food waste is collected daily via dedicated 120 L bins by cleaning staff, transported and weighed before being loaded to two industrial scale rapid food decomposer systems in the car park basements of two separate buildings at UTS. The decomposed/dehydrated material is currently transported to EarthPower to generate green energy and soil conditioning material. The units have the capacity to convert 50 to 60 tonnes of organics per annum (producing 5 – 6 tonnes of soil conditioner). Although currently sent to EarthPower UTS aims to work with stakeholders such as the local council to use the material for application to land in accordance with NSW EPA waste regulation. The project is not only providing sustainability benefits but is being used by students as a case study in a UTS design course.	
Sources	https://www.uts.edu.au/research-and-teaching/our-research/institute-sustainable-futures/our-research/food-futures/food
Similar	New England universities in the US have been driving a range of food waste initiatives since around 2013 ranging from food avoidance and food donation to composting. http://www.tomarketmagazine.com/stories/2017/1/27/food-waste-on-campus



I3 - Institutional - park		
Location	Cosmo off-leash park, Gilbert, Arizona, USA	
Timing	2012 – 2013 (?)	
Waste	Dog waste	
Technology	E-TURD (energy transformation using reactive digestion) – student project	
Transport	Individual dog owners by hand	
Treatment	AD	
Output	Methane powered lamp post	
Details - In 2012 a group of university students and a local council partnered to install a student designed methane digester for dog waste at a local award winning park with 600,000 visitors/annum and approx. 200 dogs/day. Visitors were encouraged to deposit dog waste into the digester, turn a handle to mix the waste and produce methane powering a lamp post. The aim of the project was to encourage dog owners to clean up dog waste, keep the park clean, provide education (community and students), reduce costs for the local council (collecting and transporting dog waste to landfill) and provide environmental benefits (reduced landfill GHG emissions).		
Sources	http://www.pacshell.org/pdf/PSI_TCCD_FeasibilityStudy.pdf	
Similar	Park Spark Project, Cambridge, Massachusetts, USA http://parksarkproject.com/artwork/1687212.html	

I4 - Institutional - park		
Location	Notre-Dame-de-Grace Park, Montreal, Canada (NDG)	
Timing	2005 – 2010	
Waste	Dog waste	
Technology	Compost (student project & volunteers of NDG Dog Run Association)	
Transport	Individual dog owners by hand	
Treatment	Passively aerated composting system	
Output	Compost	
Details – After several years of considering composting a trial was instigated by a local student and volunteers of the NDG Dog Run Association in 2004. An ongoing system was subsequently set up to compost dog waste at the park with approx. 50 to 75 dogs/day visiting. Plastic bins were installed in strategic locations in the park and dog owners encouraged to deposit dog waste directly into the active bins using tongs/implements supplied. NDG volunteers would cover the waste with sawdust and turn the compost as needed when visiting the park with their pets. Once a year NDG volunteers harvested and bagged the compost for visitors to take away for flowerbeds. The system ran for 5 years with an estimated ton of dog waste and 7,000 bags a year from landfill avoided. The original NDG volunteers eventually dwindled without replacement and the local city council who took over maintenance discontinued the composting.		
Sources	http://recmanagement.com/feature_print.php?fid=201505GC01 http://www.alternativesjournal.ca/beyond-poop-n-scoop http://www.tandfonline.com/doi/abs/10.1080/1065657X.2007.10702339	
Similar	East River State Park, NY, USA (dog run composting system opened mid 2016) http://www.humanimpactsinstitute.org/single-post/2016/07/19/Dog-Waste-Only Denali National Park, Fairbanks, Alaska, USA (composted huskie waste since the early 1980s) http://recmanagement.com/feature_print.php?fid=201505GC01	

I5 - Institutional – hospital	
Location	Royal Adelaide Hospital, Adelaide, Australia
Timing	2009 – ongoing
Waste	Kitchen food waste
Technology	Vacuum
Transport	Vacuum in building then truck
Treatment	Composting
Output	Compost
	
<p>Details – As South Australia’s largest teaching hospital the hospital has 650 patient beds, employs 4,100 full-time and casual staff and has over 300 residential students. Each year the hospital caters for 50,000 emergencies and 400,000 outpatients. The main kitchen provides 2,000 meals a day plus another 820 for associated facilities. In 2009 the hospital invested in a vacuum system for the main kitchen as part of the new integrated environmental management plan and aim to reduce waste across the hospital. Three collection stations in the food preparation and dishwashing areas receive the food waste which is then transferred to a grinding machine. A small amount of water is added and the liquefied food waste transferred to a 7,000 L tank for collection 1 to 2 times a week. A garden supply company turns the material into compost for resale. Currently 218 tonnes of kitchen food waste is recycled annually.</p>	
Sources	http://www.zerowaste.sa.gov.au/upload/REAP/91392%20WSA%20UpClose%20RAH%20WEB.pdf http://jeffries.com.au/what-happens-to-your-green-organics/
Similar	

I6 - Institutional – hospital	
Location	Various hospital, NSW, Australia
Timing	2016 – ongoing
Waste	Kitchen food waste
Technology	Avoidance
Transport	N/A
Treatment	Various
Output	Various
	
<p>Details – Healthcare NSW Food and Patient Support Services provides around 24 million patient meals each year from snacks to hot meals. With assistance from OEH and a \$0.5 million grant a new meal delivery system, My Food Choice, is being rolled out that will provide a better food choice service to patients and a dramatic reduction in organic waste. As at 2017 the system is being used at Blacktown, Mt Druitt and Mona Vale hospitals. The service replaces the food plating lines used since the 1970s with a more agile service involving patients ordering meals from a tablet and food service staff preparing and delivering meals to small patient groups based on orders made. The staff assist in recording patient consumption which assists clinicians. Various treatment systems are being considered/used for the reduced food waste generated including waste to water, dehydrators and organics collection services for delivery to Earthpower.</p>	
Sources	http://www.healthshare.nsw.gov.au/features/my_food_choice_wins_environmental_grants http://www.healthshare.nsw.gov.au/services/food-patient http://www.healthshare.nsw.gov.au/features/meal_time_a_highlight_at_blacktown_hospital
Similar	


I7 - Institutional – airport	
Location	Heathrow airport, DHL food waste management and recycling centre, UK
Timing	2009 – ongoing
Waste	Food waste from British Airways (BA) international flights including non putrescibles
Technology	Gaia Recycling- EcoGuardians Australia (http://www.ecoguardians.com.au/products/gaia-recycle)
Transport	Truck to DHL sorting facility at Heathrow
Treatment	Dehydrator in DHL facility, screened to remove non organic contamination
Output	Non organic material recycled as dry mixed recyclate. Clean dry organic food waste residue pelletised for use as renewable biomass fuel
<p>Details – The installation of the dehydrator at the DHL facility at Heathrow Airport in 2009 was the first application of a dehydrator within the UK and global airline industry with BA’s aim to achieve zero BA food waste to landfill by mid 2011. Once removed from planes and transported to the DHL waste sorting facility food waste is separated. 600 kg of food waste is loaded into each of two food dryers running 24 hours a day with two batches a day. The material is screened and non organic material recycled as dry mixed recyclate. The clean dry organic food waste residue is pelletised for use as a renewable biomass fuel.</p>	
Sources	https://www.youtube.com/watch?v=WD30YX0rwUU https://www.environmental-expert.com/videos/british-airways-food-waste-solution-by-dhl-video-690445
Similar	After detailed auditing of international flights Qantas caterers, have installed a “Closed Loop” rapid food decomposer system at Mascot, part of a suite of organics waste collection and management practices http://wastemanagementreview.com.au/qantas-sky-high-ambitions-for-airline-recycling/





I8 - Institutional - zoo	
Location	Royal Melbourne Zoo, Melbourne, Australia
Timing	2012 – ongoing
Waste	animal manures, bedding, food & garden organic wastes & onsite food outlets compostable food packaging
Technology	Hot Rot (composter) (http://www.hotrotsolutions.com)
Transport	Collected on site & truck used to transport manure/bedding etc. to the composting facility & to load it
Treatment	Shredder, passed to an aerobic in-vessel composting facility, stored in a bay & then sent off for packaging.
Output	Zoo gro' branded compost for sale at selected nurseries, bulk supplier or used in zoo gardens
<p>Details – Prior to installing the Hot Rot system Melbourne Zoo’s combined organic waste stream was 800 tonnes/annum. Garden waste, animal bedding, food and compostable food packaging from onsite food outlets are composted on site using an in-vessel (Hot Rot). The composted material is commercially blended to create Zoo Gro for use as soil conditioner and organic fertiliser. The system enables Melbourne Zoo to avoid sending one tonne/day of organic material to landfill, helping Zoos Victoria to achieve its goal of zero waste to landfill by 2019 and to be the world’s first carbon neutral zoological organisation.</p>	
Sources	http://www.zoo.org.au/sustainability/zoo-gro http://www.zoo.org.au/about-us/vision-and-mission/environmental-sustainability/waste-management http://www.hotrotsolutions.com/images/Testimonials/Melbourne-Zoo-Testimonial.pdf
Similar	Twycross Zoo, UK http://www.hotrotsolutions.com/images/Testimonials/Installation-of-HotRot-1811-Twycross-Zoo.pdf



APPENDIX B – PRESENTATIONS FROM THE ORGANICS SUMMIT




 Institute for Sustainable Futures


Pyrmont Ultimo Precinct (PUP) Scale Organics Management Scoping Study

Institute for Sustainable Futures,
University of Technology Sydney, Australia

Organics Summit - 19th June 2017

Andrea Turner & Dena Fam
[contact: andrea.turner@uts.edu.au]

UTS - INSTITUTE FOR SUSTAINABLE FUTURES

AGENDA

- | | |
|----------------------|---|
| 9.30 - 9.45 | Introductions |
| 9.45 - 9.55 | Overview of the PUP project <ul style="list-style-type: none"> - Project scope & objectives - The PUP & characteristics |
| 9.55 - 10.35 | Partner perspectives on organics waste management <ul style="list-style-type: none"> - NSW EPA - Sydney Water Corporation |
| 10.35 - 11.20 | Research findings <ul style="list-style-type: none"> - Data collation & mapping - Innovation locally/internationally - Illustrative options |
| 11.20 - 11.35 | Coffee |
| 11.35 - 12.20 | Workshop session |
| 12.20 - 12.30 | Wrap up |
| 12.30 - 13.00 | Lunch |



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INTRODUCTIONS

Around the room.....

- Sydney Water Corporation
- NSW EPA
- Smart Locale members
 - Flow Systems, JLL, Sydney Fish Markets, TAFE, UTS, ISF
- NSW Office of Environment & Heritage
- City of Sydney
- Southern Sydney Regional Organisation of Councils (SSROC)
- Technology providers
 - Avac, Flovac, Active Research, Closed Loop

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OVERVIEW OF THE PUP PROJECT

Aim

To investigate opportunities for innovative organics waste management in the Pyrmont-Ultimo precinct (PUP) relevant to both the PUP and Sydney more broadly now and in the future.

Funded by

- Sydney Water Corporation
- NSW EPA

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OVERVIEW OF THE PUP PROJECT

- Collate examples of innovative organics management (local & international)
- Collate data & information on flows & volumes of organics in the PUP
- Map organics flows & volumes
- Investigate detailed sites (UTS, TAFE, Central Park, Sydney Fish Markets...)
- *Conduct stakeholder interviews*
- Develop a selection of illustrative options
- Share knowledge including an 'Organics Summit'
- Produce summary report with body of knowledge and suggested next steps (e.g. pilot/s)

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OVERVIEW

The PUP & characteristics

- The PUP (Pyrmont, Ultimo & Central Park)
- Densest area in Australia
- over 14,000 people per km²
- Current population
 - Pyrmont - 14,362
 - Ultimo - 8,519
 - Central Park - 5,300
- 28,000 people now
- Population set to rise by
 - over 6,500 by 2036



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OVERVIEW

The PUP & characteristics

Mix of:

- High density dwellings (i.e. Central Park, Jacksons Landing)
- Low density housing
- Museum (Power House)
- Casino (The Star)
- Hotels
- Office blocks
- Educational facilities (UTS, TAFE)
- Restaurants, entertainment
-

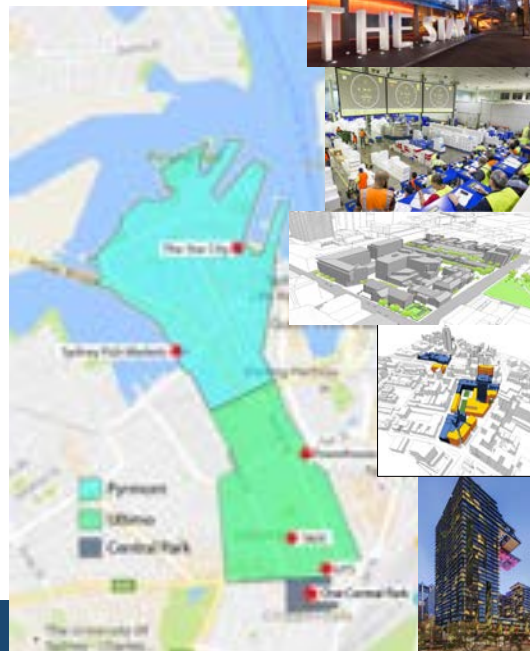


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OVERVIEW

The PUP & characteristics

- Central Park
2,200 appt, 870 student units, 5,300 people, 1,750 workers
- UTS
43,000 students & 3,354 FTE staff
- TAFE
30,000 students
1,428 FTE students



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OVERVIEW

The PUP & characteristics

- Powerhouse Museum

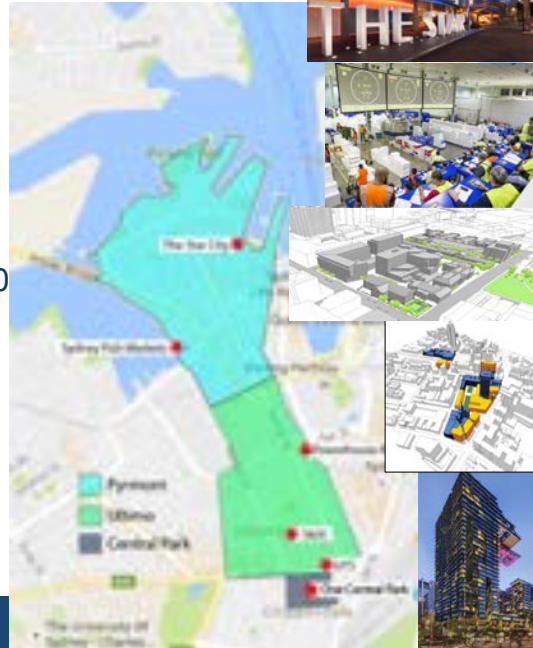
Over 0.5 million visitors per year

- Sydney Fish Markets

3 million visitors & 13,500 tonnes of fish traded per year, 25 retail outlets

- The Star City

11 million visitors per year, 20 bars & restaurants, hotel, apartments



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PARTNER PERSPECTIVES

- NSW EPA
- Sydney Water Corporation

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**Food and Garden Waste
Organics Infrastructure Fund
\$100.5 million over nine years**

Scale and scope

- 45.3% of the average household red bin was food and garden organics
- 800,000 tonnes of food waste going to landfill a year
- 470,000 tonnes a year of food waste from business
- Almost \$4,000 a year for homes
- 23% of food business waste



Waste Less Recycle More organics

- \$100.5 million program
 - Avoidance
 - Kerbside collections
 - Food donation
 - Infrastructure to process more
 - Improve quality
 - Secure markets



Broader agenda

- National food waste strategy
- Inter-jurisdictional collaboration
- The environment
- Maximising a resource
- Community mood
- The opportunities



Prevention

- \$5 million Love Food Hate Waste
- Education programs for households and business
- Tracking survey undertaken every three years
- The Great NSW Food Waste Study
- BehaviourWorks



5

LFHW - Your business is food

- Sept 16 – March 2017
- 40 Cafes/Restaurants where
 - 30% of their general waste is food
 - 50% of their food consumed on site
 - Had the right attitude and opportunity
- Result 476 tonnes food waste avoided



6

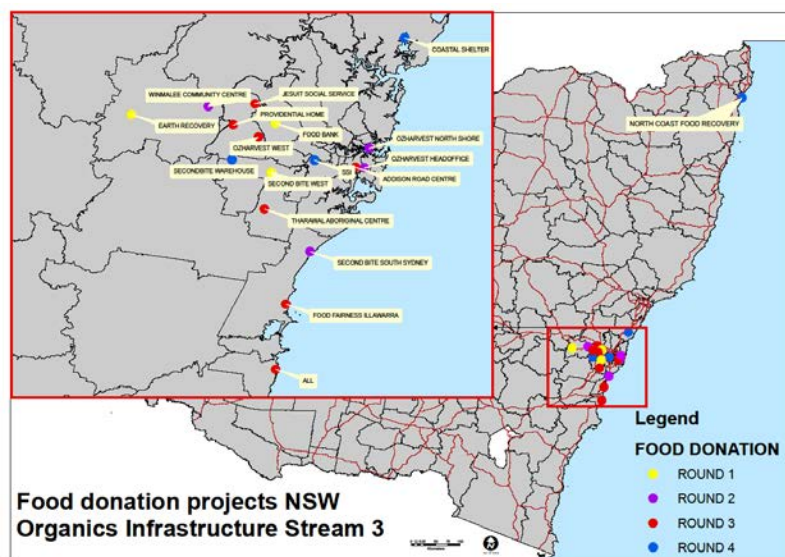
Grant funding - Food Donation

- \$2 million to June 2021 for food donation 'education'
- New \$1.6 million grants program opening October 2017
- Three Pilots testing food hubs for better coordination, education of supermarket staff, & local awareness raising
- So far \$2.9 million to 18 projects to rescue additional 6,000 tonnes of food in NSW each year.



7

Increased food rescue



8

Grant funding - Collections

- Additional \$10 million 2017-2021
- Provides up to \$1.3 million for councils for organics collections
- Stage 1 - \$17.4 million to 40 councils, introducing new or improved services to 500,000 more households
- Going well – low contamination, additional 100,000 tonnes pa supply



Households with kerbside organics bins

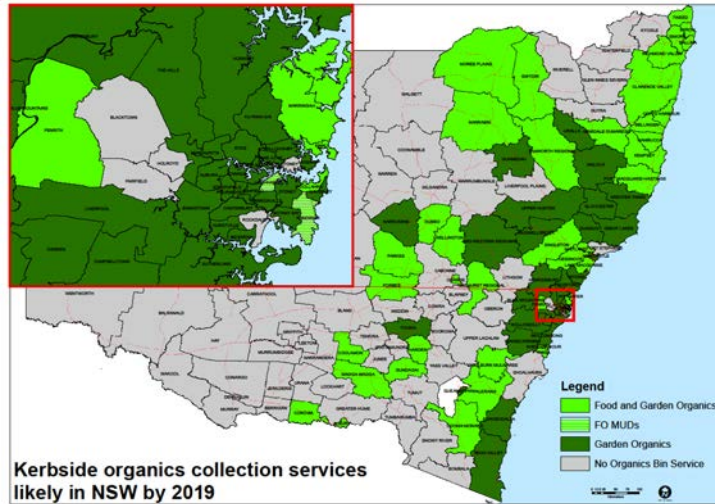


56% in 2010-11



70% in 2017-18

Collections service by 2019



11

Organics collection increasing overseas

- Milan, Italy
 - whole city service, 1.3M people, 81% live in MUDs
- San Francisco, USA
 - in 2009 introduced 1st American mandatory recycling and composting ordinance – ie must have 3 bins and use them properly



2

Organics collection increasing overseas

- New York, USA
 - Pilots and voluntary services SUDs, MUDs, schools since 2013. Compulsory services for larger businesses since 2015.
 - Aiming to serve all households by end of 2018
 - On going development of regional processing capacity and local composting capacity for fruit, vegetables, bread and pasta



Grant funding - Infrastructure

- Additional \$14 million to 2021
- Opening tomorrow
- Funding for organics processing equipment
- Food donation infrastructure, like fridges and vans
- So far, \$40 million to 71 projects, increasing processing capacity by 400,000 tonnes a year



Increased processing equipment

- Large scale infrastructure for new facilities
- Equipment upgrades for increased processing
- Equipment to improve product quality
- Small on site machines – ie UTS



15

Organics Market Development

- \$4.5 million over four years to June 2021
- Funding to support new markets for the recycled product
- We're driving increased supply, want to support the industry to build markets for it
- So far \$2.55 million on 13 projects, ag and hort markets, sports fields, roadside rehabilitation





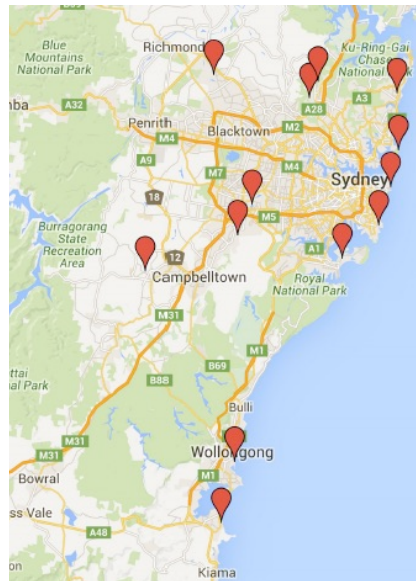
Sydney
WATER

Sydney Water and food waste

Phil Woods, Service Planning Lead
Organics Summit, June 2017

Why Sydney Water & food waste?

- There is a waste problem, and.....
- We have the capability and assets to turn organic (food) waste into a resource
- We are already in the waste business
- Anaerobic digestion of food waste is the best environmental outcome
- Part of our mission to help create a more liveable city
- Generate more renewable energy



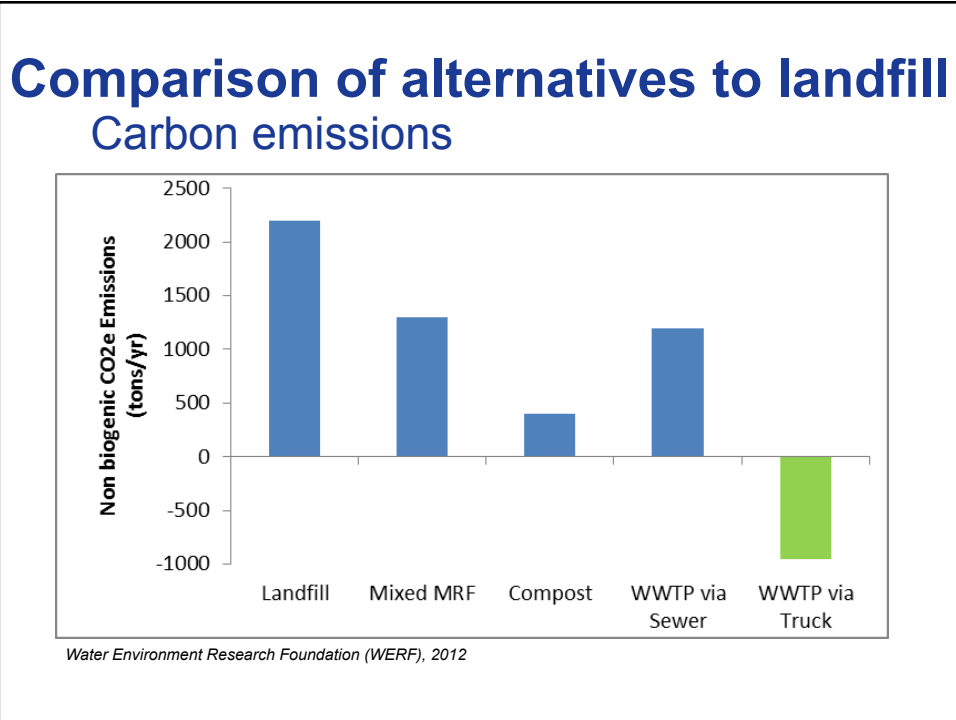


HOW ANAEROBIC DIGESTION WORKS

The diagram illustrates the anaerobic digestion process. On the left, three input categories are shown: 'WASTEWATER SOLIDS' (represented by a person icon), 'OTHER (POTENTIAL) ORGANICS (grass, cheese whey, brewery waste)' (represented by a food waste icon), and 'BIOMASS INPUTS (GOOD FOR MICROBES)'. These inputs feed into a central 'DIGESTER' tank. Inside the tank, a circular arrow indicates 'MIXING OF SOLIDS' and text states 'MICROBES DIGEST ORGANIC SLURRY, PRODUCING GAS'. From the top of the tank, 'DIGESTER GAS (40% METHANE / 40% CO2 + OTHER)' is produced, which is then used as 'BIOGAS APPLICATION' for 'ELECTRICITY', 'HEAT', and 'GAS UTILITY'. From the bottom of the tank, 'BIOSOLIDS APPLICATION' is produced, which can be used for 'FOREST', 'AGRICULTURE', and 'COMPOST'. A summary line at the bottom reads 'BIOMASS INPUTS → ANAEROBIC DIGESTION → RESOURCE PRODUCTS'. To the right of the diagram is a photograph of a large, cylindrical stainless steel industrial tank at a facility.

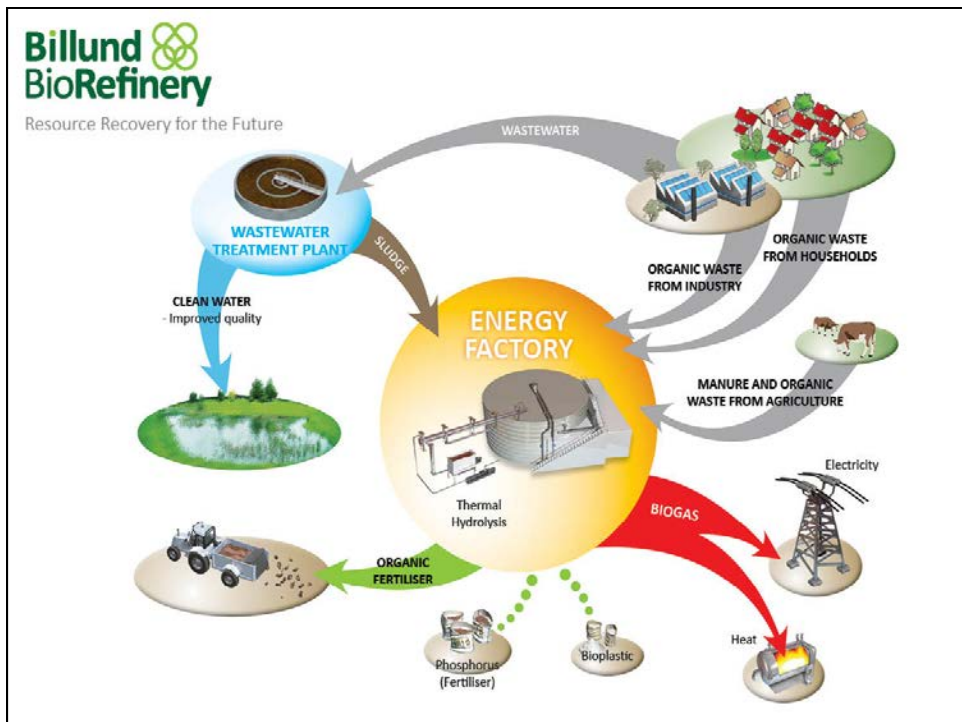
Co-digestion

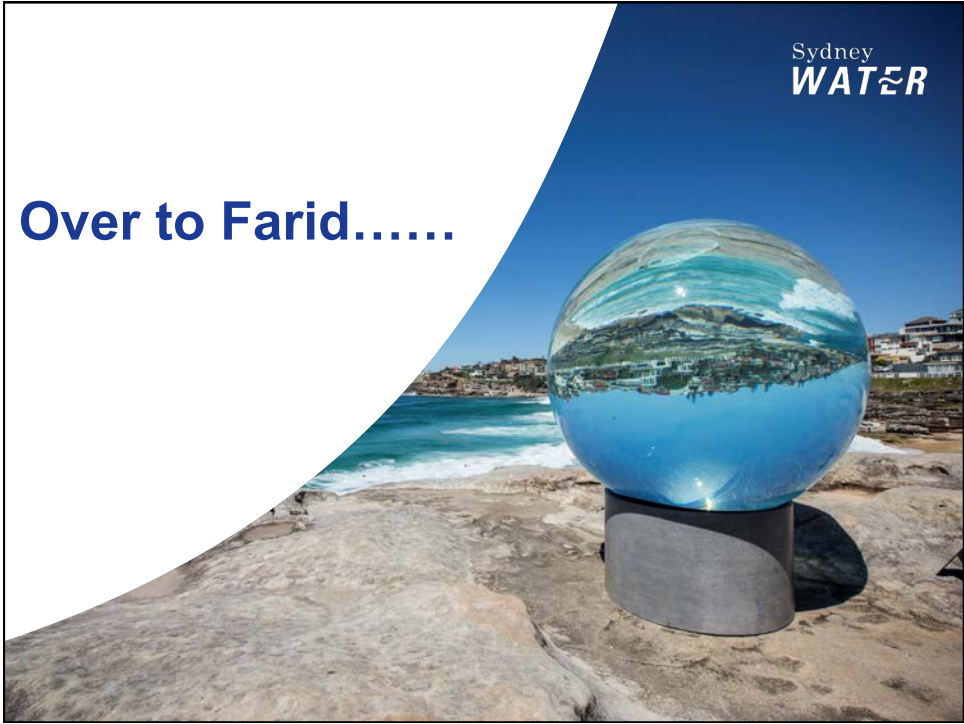
Converting organic (food) waste to energy and fertiliser



Challenges & opportunities

- ◆ Centralised or decentralised?
- ◆ Solutions may vary across the city
- ◆ Changing city – the chance to do things differently
- ◆ Behaviour change vs technology based solutions
- ◆ Waste = Resource





Sydney
WATER

Over to Farid.....



Sydney
WATER

Food Waste/Organic Waste Treatment Equipment

June 210

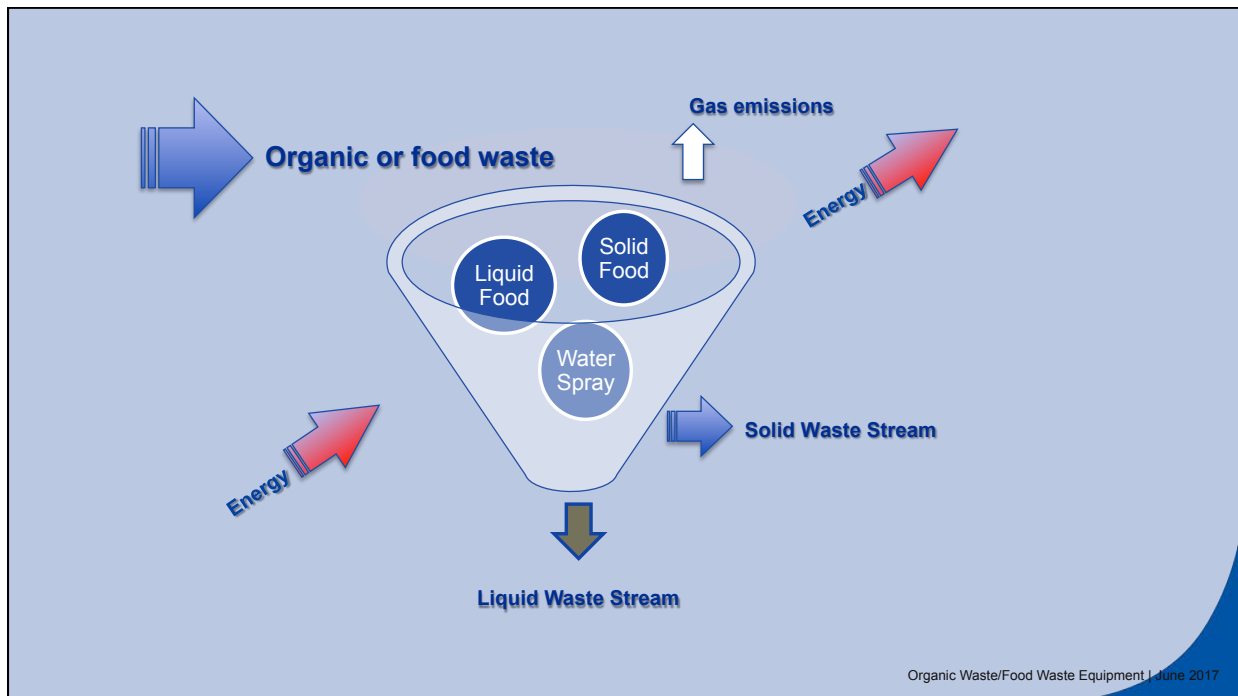
Process Description

- ❖ Food/organic liquid waste streams are typically liquid waste streams associated with processing SOLID waste streams.


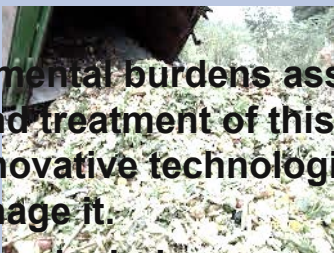


- ❖ They are very different (in origin) from typical trade wastewater streams from kitchen sinks, floor waste and dishwashers in commercial kitchens.

Organic Waste/Food Waste Equipment | June 2017



Process Description (continue)

- ❖ Food/organic waste streams stem from many commercial and industrial facilities. (Restaurants, fruit and vegetable outlets, food manufacturers, hospitals, hotels, clubs, food retailers etc...).
 
- ❖ Financial and environmental burdens associated with extensive transport and treatment of this solid waste necessitated many innovative technologies and methodologies to manage it.
 
- ❖ Management techniques include one or combination of **on-site recycling**, **reduction**, processing (**macerating**, **dewatering**, **composting** etc...)

Current and Emerging Issues

- ❖ Extensive management approaches. (as outlined in PUP study)
- ❖ Extensive list of processing equipment and suppliers. (see Business Recycling listing on Planet Ark website <http://equipment.businessrecycling.com.au>)
- ❖ Utilities Issues. (Characterising, Approval process, etc...)
- ❖ Regulators' Issues (EPA grants, Councils' initiatives and grants, etc...)

Organic/Food onsite treatment Processes

- ❖ Many organic/food onsite processing devices are currently available and being marketed for installation in commercial premises.
- ❖ They process a solid waste stream (e.g. cooked foods, fresh fruits, vegetables, poultry, meats, etc..) by macerating, thermal decomposition, composting or biological digestion.
- ❖ They typically produce solid waste and liquid waste stream of varying strengths (nutrient load).



Organic/Food onsite treatment Processes

- ❖ Commercial premises using these devices would seek discharging of liquid waste stream into sewer either directly or through their onsite pre-treatment (grease trap).
- ❖ Suitability of liquid waste stream discharge to sewer or onsite pre-treatment will depend on the treatment process and the nature/strength of liquid waste stream.
- ❖ High nutrient waste streams are typically high BOD waste streams which grease traps cannot treat. Concrete grease traps and concrete sewers would be rapidly corroded by waste of this nature.

Organic Waste/Food Waste Equipment | June 2017

Organic/Food onsite treatment Processes

- ❖ Manufacturers and distributors of these devices should provide the facility and authorising agents details of the device's water consumption and wastewater characteristics.



Organic Waste/Food Waste Equipment | June 2017

Managing liquid waste streams from Organic/Food onsite treatment Processes:

- 💧 **We have reviewed some of these equipment/processes in a variety of applications (Banana Joe Supermarket, Burwood fruit and vegetable shop, Bondi Junction fruits and vegetable, Marco Paolo nursing home Unanderra and Paddy's Markets).**
- 💧 **The outcome of these trials conclude that the quality of liquid waste stream greatly varies with the process applied and also with the treated organic/food waste stream.**

Organic Waste/Food Waste Equipment | June 2017

Managing liquid waste streams from Organic/Food onsite treatment Processes:

- 💧 **In some occasions the effluent characteristics of liquid waste stream presented pollutant loads similar or less than domestic wastewater.**
- 💧 **Other processes yielded liquid waste stream similar to those of Low-strength BOD food commercial processes.**
- 💧 **In other occasions the liquid waste stream was characterised by high BOD and low pH.**
- 💧 **Therefore we will not be able to apply one management approach that would fit all scenarios. We need to consider the equipment used, existing processes and mode of discharge before deciding how we manage the application (Industrial, Commercial).**

Organic Waste/Food Waste Equipment | June 2017

Examples of Organic/Food waste equipment and applications

System	Waste stream	Trial Location	Trial status/Date	Remarks
Hungry Giant	Fruits and Veg outlets	Burwood Plaza	OK Oct 2011	Suitable to discharge directly to sewer via trade waste connection under a commercial consent process code BD14.
Bio Ez	Fruits and Veg outlets	Banana Joe Marrickville	OK June 2015	Suitable to discharge directly to sewer using via trade waste connection under a commercial consent process code BD14.
Bio Ez	Hotels and Restaurants	Radisson Blu Hotel, Sydney	OK April 2016	Suitable to discharge upstream of grease trap. Vary commercial consent to include process code BD14.
Powerknot LFC	Aged Care facility	Marco Paolo Unanderra	Non-compliant	High BOD, SS
Powerknot LFC + Suitably sized grease trap with surge control device	Aged Care facility	Casino NSW	OK Nov. 2016	System was assessed as a whole at Casino NSW and trial concluded favourable.
ORCA	Restaurants/Cafeteria	News LTD	Ongoing	
ORCA	Supermarkets	Costco/Auburn	pending	
ORCA	Supermarkets	Coles Shell Harbour	pending	

Organic Waste/Food Waste Equipment | June 2017

RESEARCH FINDINGS

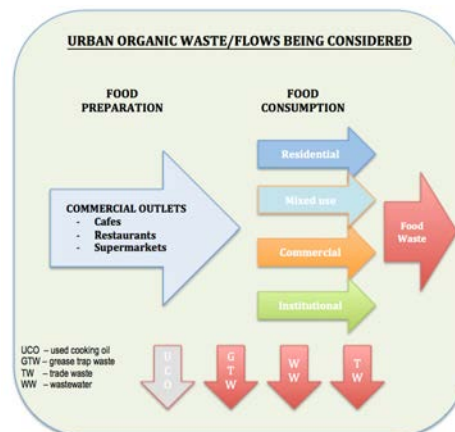
- Data collation & mapping
- Literature review – innovation locally/internationally
- Illustrative options

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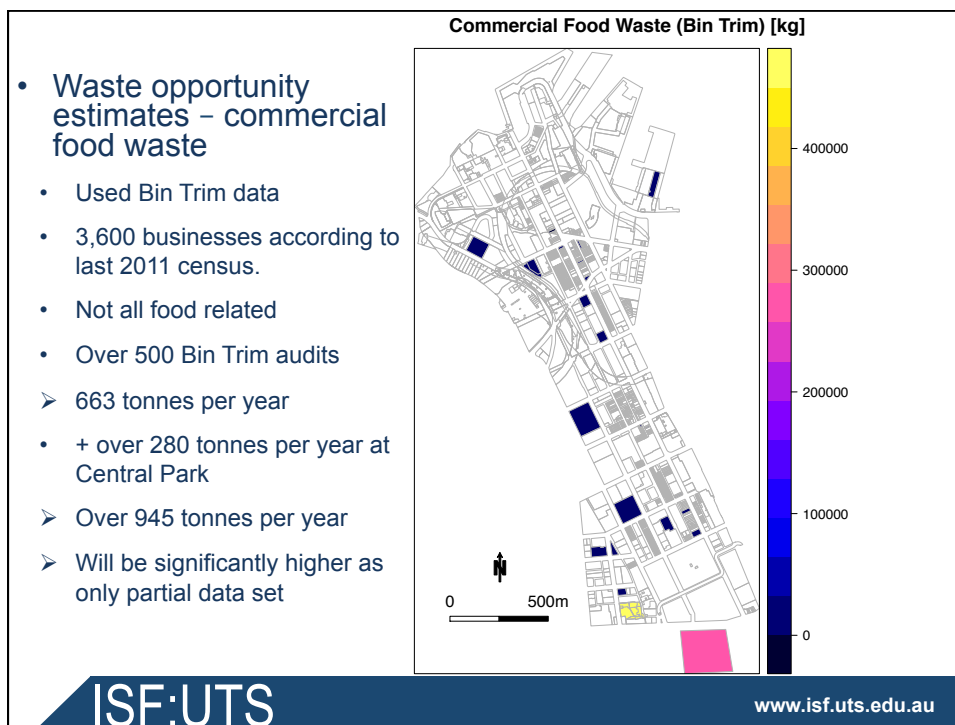
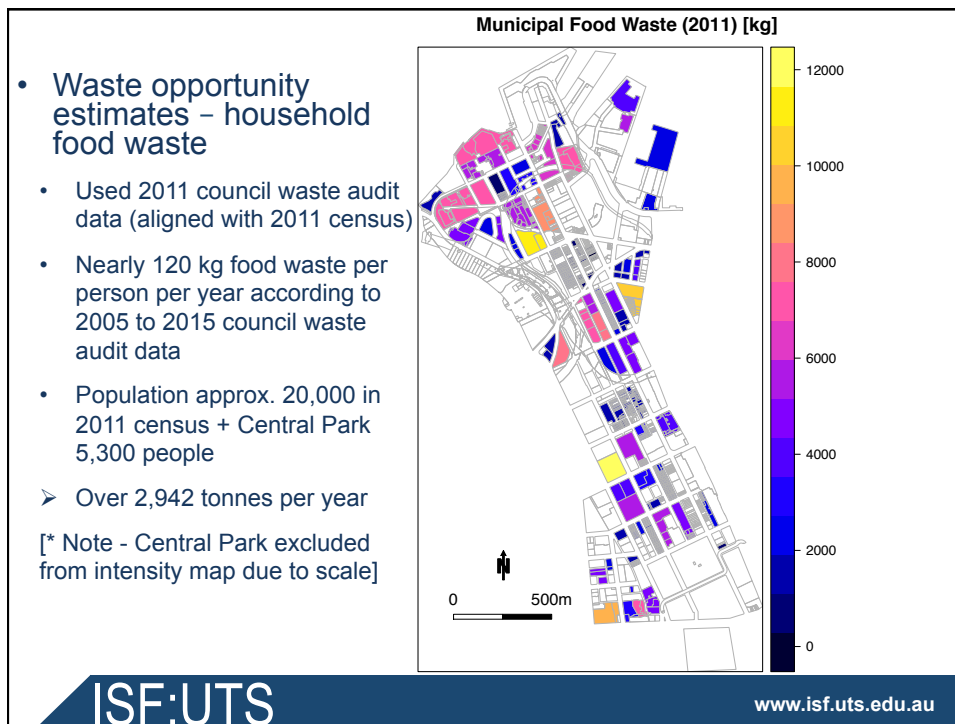
DATA COLLATION & MAPPING

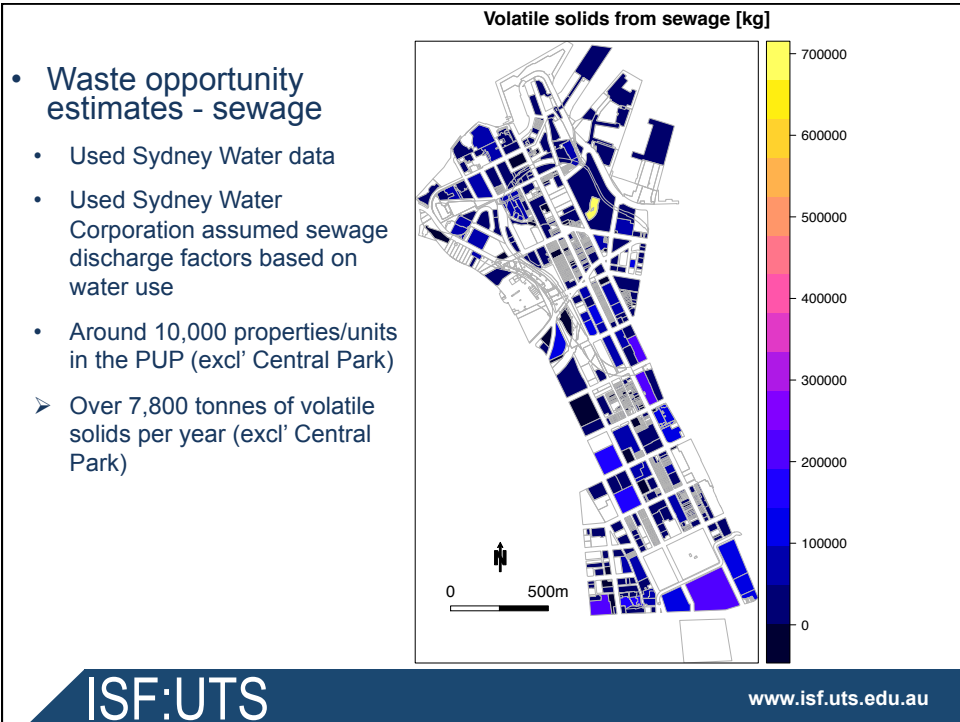
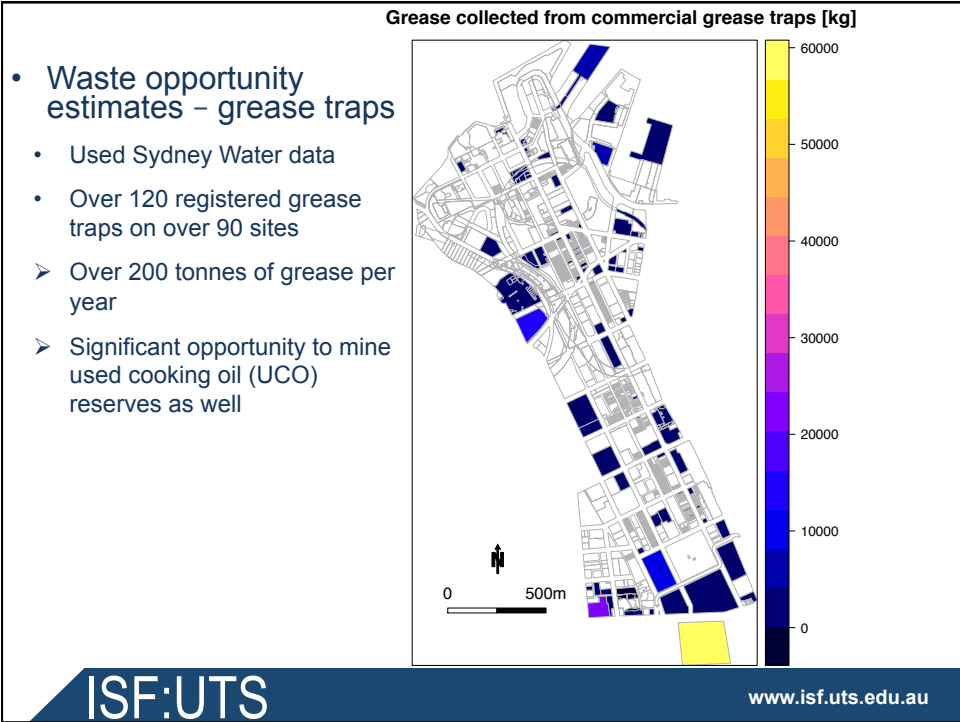
- Broad scale data collection
 - Household food waste
 - Commercial food waste
 - Grease
 - Sewage
 - Trade waste
 - Used cooking oil (UCO)
- Site specific data collection
 - Central Park, UTS, TAFE, Sydney Fish Markets
- Data assumptions & limitations in report

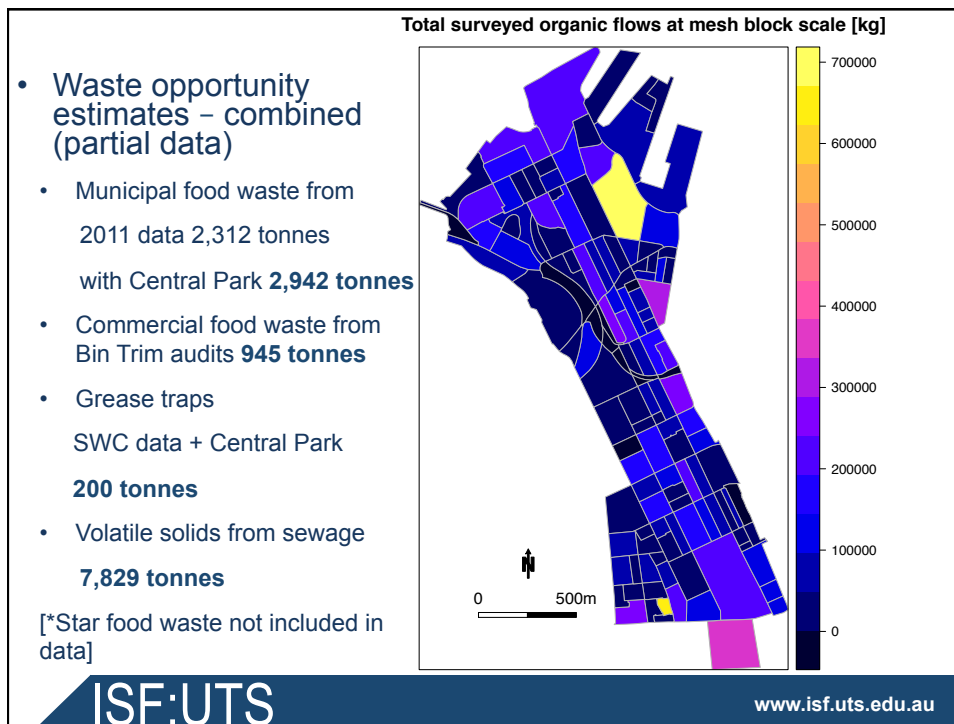


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LITERATURE REVIEW

Innovative examples investigated:

- **Across sectors**

Residential (Single house > MUDs) > Commercial > Institutional

- **Across scales of application**

Single building > Multi building > Precinct > LGA > City

- **Across system components & technology types**

Collection > Transport > Treatment (composting, dehydrators, AD) > Reuse

- **Across types of sites**

Restaurants > Markets > Mixed precincts > Hospitals > Higher education

- **Across the waste hierarchy**

Avoidance > reuse > recycling > recovery > treatment > disposal

- **Local & international**

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LITERATURE REVIEW

Innovative example vignettes developed
Available in the final study report

Sector	No. of examples
Residential	12
Mixed use	3
Commercial	11
Institutional	8
	34

I3 - Institutional - park	
Location	Cosmo off-leash park, Gilbert, Arizona, USA
Timing	2012 – 2013 (?)
Waste	Dog waste
Technology	E-TURD (energy transformation using reactive digestion) – student project
Transport	Individual dog owners by hand
Treatment	AD
Output	Methane powered lamp post
	
<p>Details - In 2012 a group of university students and a local council partnered to install a student designed methane digester for dog waste at a local award winning park with 600,000 visitors/annum and approx. 200 dogs/day. Visitors were encouraged to deposit dog waste into the digester, turn a handle to mix the waste and produce methane powering a lamp post. The aim of the project was to encourage dog owners to clean up dog waste, keep the park clean, provide education (community and students), reduce costs for the local council (collecting and transporting dog waste to landfill) and provide environmental benefits (reduced landfill GHG emissions).</p>	
Sources	http://www.pacshell.org/pdf/PSI_TCCD_FeasibilityStudy.pdf
Similar	Park Spark Project, Cambridge, Massachusetts, USA http://parksproject.com/artwork/1687212.html

ILLUSTRATIVE OPTIONS

Using a combination of

- The local & international examples
- Mapping
- PUP characteristics

established a suite of potential illustrative options for the PUP

Total of 16 options developed

- 5 - residential
- 2 - mixed use
- 5 - commercial
- 4 - institutional

ILLUSTRATIVE OPTIONS

Residential

No.	Focus	Waste	Scale	Collection>transport	Treatment
1	Low rise	Food waste	Neighbourhood	Kitchen caddies > door pick-up by bike with trolley	Localised: compost, dehydrator or AD Centralised: AD
4	High rise MUDs	Food waste	Building	Kitchen caddies > chutes > basement	On-site: dehydrator or AD Centralised: AD
5	High rise MUDs	Food waste & pet waste	Building	Kitchen caddies & pet waste bags > chutes > basement	On-site: AD Centralised: AD
6	High rise MUDs (NEW)	Food waste	Precinct	Insinkerator in kitchen > pipe to basement	On-site: AD Centralised: AD
7	High rise MUDs (NEW)	Food waste & sewage	Precinct	Kitchen bench food waste vacuum + vacuum toilet > vacuum to basement	On-site: AD



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ILLUSTRATIVE OPTIONS

Mixed use

No.	Focus	Waste	Scale	Collection>transport	Treatment
2	Low rise & commercial cafes	Food waste	Neighbourhood	Kitchen caddies & small commercial bins > door pick-up by bike with trolley	Localised: compost, dehydrator or AD Centralised: AD
3	Low rise & high rise MUDs & commercial	Food waste	Whole of precinct	One waste contractor for residential & commercial properties	Centralised: AD






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ILLUSTRATIVE OPTIONS

Commercial

No.	Focus	Waste	Scale	Collection>transport	Treatment
8	Commercial cafes	Food waste avoidance	Neighbourhood	Café > App > collection by end user	Food waste avoidance & redistribution
9	Commercial cafes	Food waste	Neighbourhood	Small commercial bins > door pick-up by bike with trolley	Localised: compost, dehydrator or AD Centralised: AD
10	All commercial	Food waste	Whole of precinct	Policy: Zero food waste to landfill	Various methods
11	Commercial cafes	Food waste	Precinct	Café vacuum inlet > vacuum to basement	On-site: AD Centralised: AD
12	Commercial cafes/market (NEW) Fish Markets	Food waste	Precinct	Café vacuum inlet > vacuum to central location on-site	On-site: AD








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ILLUSTRATIVE OPTIONS

Institutional

No.	Focus	Waste	Scale	Collection>transport	Treatment
13	Education centre	Food waste avoidance	Neighbourhood	Students with spare food/meal > App > students share meal	Food waste avoidance & redistribution/sharing
14	Education centres	Food waste	Neighbourhood	Cafes > commercial bins	On-site: decomposer/dehydrator
15	Education centres & large government organisations	Food waste	Neighbourhood	One waste contractor for multiple sites	Centralised: AD
16	Council Parks	Pet waste	Council parks	Owners use bags > deposit in park collection point	Localised: AD

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COFFEE BREAK



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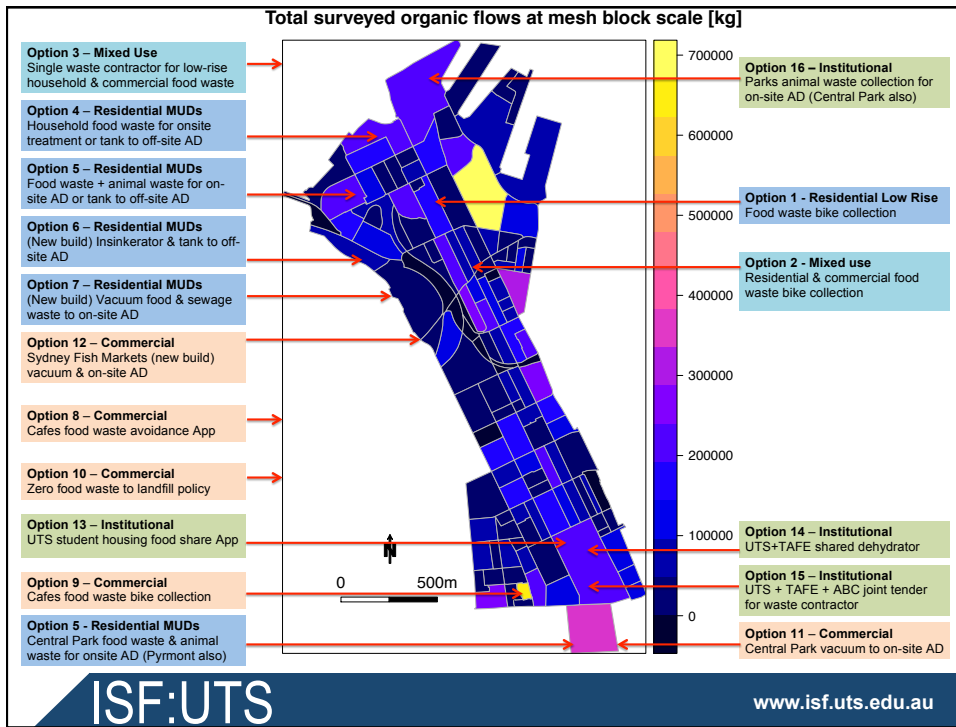
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WORKSHOP SESSION

THE FUTURE OF ORGANIC WASTE MANAGEMENT IN THE PUP?

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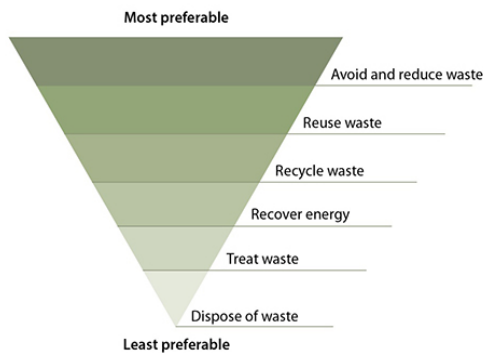
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GROUP WORK: Selecting options for the PUP in the near future

In groups of 3-4 people take 15 minutes to reflect on:

1. **CRITERIA** for selecting 2-3 options to be trialled in the PUP
2. **SELECT 2-3 OPTIONS** – the most effective options based on your criteria
3. **WHAT WOULD NEED TO CHANGE? WHO WOULD NEED TO COOPERATE?**



Source: NSW EPA (Waste Hierarchy)



Source: CSR Ambassadors (Triple bottom line)

WRAP UP....NEXT STEPS!

- **FINAL REPORT WILL BE AVAILABLE**
- **ORGANICS SUMMIT 2018!**

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LUNCH



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