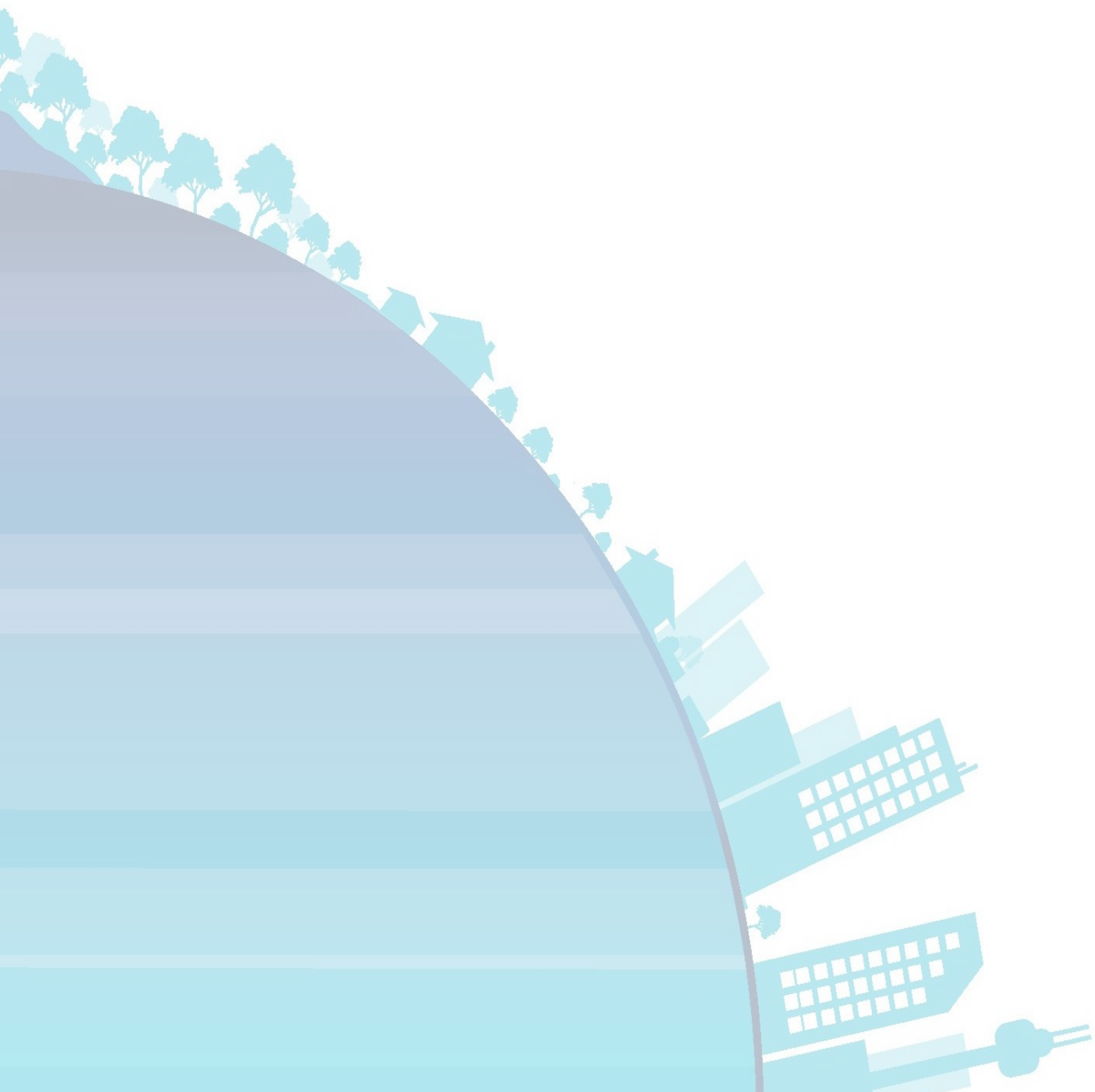
Appendix F. Updated Preliminary Waste Management Plan



Molecular and Life Sciences Building

University of Wollongong

Waste and Recycling Management Plan

Document No. 1 | 5

15 September 2017

Molecular and Life Sciences Building

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1	22/03/2017	Waste and Recycling Management Plan	TH	LC / JM	JM
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5	25/05/2017	Waste and Recycling Management Plan	TH	MS	JM
6	15/09/2017	Waste and Recycling Management Plan	TH	MS	MS

Contents

1. Purpose of this Plan

This Waste Management Plan (WMP) has been prepared by Jacobs to address waste management during the demolition, construction and operational phases of the proposed Molecular and Life Sciences (MLS) building development in accordance with the Secretary Environmental Assessment Requirements (SEARs), and to inform the preparation of the EIS for the development.

The benefits of implementing an effective WMP include:

- minimised risk of environmental pollution, occupational health and safety incident, litter, odour and pests;
- reduced costs associated with staff resource time, waste servicing and waste disposal; and
- improved amenity, environmental, and social outcomes.

Waste management provisions for the construction and demolition, and operational phases of the development have been outlined in separate sections of this Plan.

1.1 Secretary's Environmental Assessment Requirements

SEARs for the State Significant Development (SSD 8096) were issued by the NSW Department of Planning and Environment on 12 December 2016. Table 1 below identifies the section/s of the Plan addressing the SEARs as they relate to waste management.

Table 1 SEARs for the Development (SSD 8096)

SEARs (Waste Assessment)		Relevant Section/s of the Plan
Assessment requirements (of specific relevance to this Plan)		
13.	**Waste** Identify, quantify and classify the likely waste streams to be generated during construction and operation.	Sections 4.1 and 5.1, Appendix B and C
	Describe the measures to be implemented to manage, reuse, recycle and safely dispose of this waste.	Sections 4.4 and 4.5, Sections 5.4 and 5.5
	Identify appropriate servicing arrangements (including but not limited to, waste management, loading zones, mechanical plant) for the site.	Sections 4.6 and 4.7, Sections 5.6, 5.7 and 5.8
Other requirements (having elements related to waste management and servicing)		
3.	**Built Form and Urban Design** Detail how services, including but not limited to waste management, loading zones and mechanical plant are integrated into the design of the development.	Sections 5.8.
4.	**Environmental Amenity** Detail amenity impacts including solar access, acoustic impacts, visual privacy, view loss, overshadowing and wind impacts. A high level of environmental amenity must be demonstrated.	Sections 4.8 and 4.9 Notes: Amenity impacts due to inappropriate waste management can include visual, noise and nuisance odour impacts.
5.	**Transport and Accessibility** Include a transport and accessibility assessment which details, but is not limited to, the following: • the proposed access arrangements	Sections 5.9

2. Overview of the Development

2.1 Site Location

The development site is located within the Campus East Precinct of the Wollongong Campus. The precinct is bordered by the campus Ring Road to the north and east, University Square and Duck Pond Lawn to the west and Northfields Avenue to the south. The precinct comprises the faculties of Engineering and Information Sciences and Sciences, Medicine and Health. The development site is currently used as an at-grade car park in the centre of the precinct (see Figure 1 below) with the use of the surrounding buildings generally Monday to Friday.

Figure 1 Site Locality

Source: Jacobs 2017

2.2 Waste Collection Point

Waste from Building 32 is currently collected in a storage area between buildings 41 and 32. The waste collection occurs from the P7 car park. The loading dock and waste storage area is in the process of reconfiguration with access occurring for vehicles from the campus Ring Road with the waste storage area located on the southern side of the loading dock. The loading dock and waste area will be shared between Building 32 and MLS Building and is subject to a separate approval under the EP&A Act 1979. This WMP discusses the anticipated shared waste storage arrangements required for both buildings.

2.3 Project Description

2.3.1 Demolition and Construction Phase

The following key demolition and construction activities will be undertaken[1]:

- Initial site preparation works will involve the demolition of a brick building (Building 66), the existing car park area (about 2,500m^2) and the removal of up to 16 trees.
- About 200m^2 of concrete driveways and footpaths will be constructed. Civil works will also include the construction of a 70m long storm water diversion.
- A new Chemical Storage building will be built with a gas cylinder storage cage.
- The new MLS Building will have a Gross Floor Area of approximately 5,360m^2 (i.e. excluding plant and services areas) and will comprise of 5 storeys including a mezzanine level.

An overview of the MLS Building area schedule and activity areas are detailed below in Table 2 and Table 3.

Table 2 Building Area Schedule (Gross Floor Area, GFA)

Floor	Level No.	Total GFA (m^2)
Ground Floor	L0	707
Mezzanine	LM	62
Level 1	L1	1,215
Level 2	L2	1,144
Level 3	L3	1,111
Level 4	L4	1,106
Level 5 (Plant)	L5	11
Level 6 (Upper Plant)	L6	4
TOTAL (m^2)		**5,360**

[1] Estimates provided by Robert Bird Group (civil and construction engineering consultants) as at 3/02/17.

2.3.2 Operational Phase

The proposed new building will comprise of two wings (North and South Wing) linked at the Ground Level and at Levels 2 to 4, with a bridge link to the adjacent IHMRI building (Building 32) at Level 1.

The proposed project involves the following operational elements:

- Accommodation for 15 groups of researchers including laboratories, offices and meeting spaces.
- Cryo-TEM suite.
- Flow cytometry, fluorescence and light microscopy suites which articulate directly with cell and molecular support laboratories.
- Animal house holding space for up to 1500 rodents/aquatic cages.
- Atmospheric Chemistry rooftop platform with laboratories spaces located below.

Table 3 Breakdown by Activity Type (GFA)

Activity Type	Floor Area (m^2)
Meeting + Office (majority provided on Level 1 to 3)	1,179
Circulation + Amenity Areas	1,067
Research Laboratory Area (Level 1 to 3)	1,612
Cryo-TEM Area (Ground Floor)	495
Atmospheric Chemistry Room (Level 4)	88
Animal House (Level 4)	750
Additional Area (assumed to be Offices) (Level 4)	169
TOTAL GFA (m^2)	**5,360**

3. Legislative and Guidance

Waste legislation and guidance applicable to the development is outlined below.

Table 4 Waste Legislation and Guidance

Name of Legislation / Guidance	Authority	Notes
Waste Avoidance and Resource Recovery (WARR) Act 2001	NSW Environment Protection Authority (EPA)	The WARR Act promotes extended producer responsibility of waste and resources through minimised consumption of natural resources, efficient use of natural resources, and minimised disposal of waste through waste avoidance, reuse and recycling. It promotes industry and community participation and responsibility for reducing and managing waste.
Protection of the Environment Operations (POEO) Act 1997 & Amendment Act 2011	NSW EPA	The POEO Act enables the Government to establish legislative instruments and regulation for setting environmental standards, goals, protocols and guidelines.
POEO (Waste) Regulation 2014	NSW EPA	The Waste Regulation sets out legislation relating to the waste levy in NSW, waste tracking and management requirements for dangerous goods / hazardous wastes, resource recovery exemptions, and pollution offences.
Waste Classification Guidelines (Part 1) 2014	NSW EPA	The Guidelines provide information on how to classify, manage, treat and dispose of different classifications of waste to ensure risks to the environment and human health due to inappropriate management of waste are minimised.
Waste Avoidance and Resource Recovery (WARR) Strategy 2014-21	NSW EPA	The WARR Strategy outlines the State Government's long term targets for waste avoidance, resource recovery, and litter and illegal dumping for the domestic, construction and demolition, commercial and industrial sectors which are necessary for the environmental and economic future of the State of NSW.
Wollongong Development Control Plan (DCP) 2009	Wollongong City Council	Part E, Chapter E7 of Council's DCP requires construction and demolition projects to minimise the volume of waste generated through reuse, recycling and efficient selection and use of resources, and promoting adaptability in building design and focussing upon end of life deconstruction. The DCP requires that development provide appropriately located, sized and accessible waste storage facilities and maintain waste management systems which are compatible with collection services and maximise recovery of resources.
Better Practice Guideline for Waste Management in Commercial and Industrial (C&I) Facilities 2012, Stripout Waste Guidelines 2016	NSW EPA, Better Buildings Partnership	The Guidelines have been generated as a handy reference and resource for contractors, architects, designers, consultants, developers, building owners and managers. They contain minimum provisions for waste management in commercial and industrial facilities, and during building stripout and refurbishment activities.
Building Code of Australia (BCA)	Australian Building Codes Board	The BCA have the aim of achieving nationally consistent and minimum standards of relevant health and safety, amenity and sustainability objectives. The BCA is a set of technical provisions for the design and construction of buildings and other structures.
Relevant Australian Standards (AS)	Standards Australia	The Standards are specifications, procedures and guidelines which ensure products, services and systems are safe, reliable and consistent. Australian Standards which apply to waste management include AS 2890.2 (parking facilities for off-street commercial vehicles), AS1319 (safety signs) and AS4123.7-2006 (mobile waste containers and colour coding requirements).

Under the POEO Act pollution incidents causing or threatening harm to the environment should be reported to the Appropriate Regulatory Authority (ARA). For the purposes of this project, the ARA is expected to be Wollongong City Council. See Section 4.9 and 5.11 for additional details.

3.1 University of Wollongong: Waste Management Action Plan 2015 - 2018

The Facilities Management Division (Environment Unit) of the University of Wollongong (UOW) has developed a Waste Management Action Plan.

The waste management objectives of this Plan are to achieve the following:

- Continuous reduction in solid waste to landfill per EFTSU (equivalent full-time student unit) each year.
- Increase overall recycling rate to 66% of total waste by 2016.
- 66% of organic waste diverted from landfill by 2016.
- Work towards zero waste to landfill.

The UOW's Waste Management Action Plan 2015 – 2018 carried out an audit of the Wollongong Campus and Innovation Campus. It reports a resource recovery rate of 44% diversion from landfill for the year 2014. The Plan provides information on waste audits undertaken in 2014 which showed that a large proportion of waste generated at the university comprised of office paper, newspaper, magazines and cardboard which was recycled, and food and garden organic materials which were composted. The remainder of waste generated was sent to landfill.

Actions of the Waste Management Action Plan 2015 - 2018 as relevant to this WMP are as follows:

- Building design standard to include waste system.
- Consolidate waste collection points and have options for all streams and volumes.
- Reduce the number of waste bins serviced by cleaners from desks.
- Achieve an increase in the volume of composting units on campus.
- Collect more recyclables by stream, including plastic bags, wrap and polystyrene.
- Extend the Green Labs program to additional UOW laboratories.
- Set up and support reuse programs (e.g. for furniture, electronics and office materials).
- Ensure waste management is part of induction processes.

UOW also has an Environmental Management Plan and Laboratory Waste Disposal Procedure (as part of UOW's Policies and Guidelines) which should be referred to for further more detailed information.

4. Demolition & Construction Waste Management Plan

4.1 Waste Streams, Classifications and Quantities

Appendix A provides a template WMP. The Building Contractor will complete this table for all construction and demolition waste generated at the site. The classifications and estimated volumes of waste materials generated by construction and demolition activities have been provided for guidance and are presented in Table 5, Table 6 and Table 7. Volumes of waste materials have been calculated using waste generation rates and conservative assumptions outlined in Appendix B.

Table 5 Estimated Waste Generation – Demolition Activities

Waste Type	Waste Classification[2]	Estimated % Recovery[3]	Reuse (tonnes)	Recycling (tonnes)	Disposal (tonnes)	Potential Reuse / Recycling Method[4]
Demolition of Building 66 (Small Brick Building– Substation and Gas Bottle Store)						
Brick / Tiles	General solid (non-putrescible)	75%	11	3	5	Cleaned for reuse or crushed for reuse on-site in landscaping and driveways.
Concrete	General solid (non-putrescible)	95%	-	38	2	Reused on-site for filling, levelling or road base where possible. Or recycled offsite.
Timber / Plasterboard	General solid (non-putrescible)	50%	< 1	< 1	< 1	Untreated timber reused or mulched for reuse in landscaping on-site. Treated timber reused as formwork, bridging, blocking or propping (and then sent to landfill). Plasterboard removed for recycling off-site.
Metal	General solid (non-putrescible)	95%	< 1	2	Minimal	Steel recycled off-site by an appropriately licensed facility. Any other metals will be recycled where economically viable.
Other	Mix of general solid (non-putrescible and putrescible)	5% - 50%	<1	Minimal	2	Glass sent offsite for reuse or recycling as glazing or an aggregate for concrete production. Synthetic rubber (carpet underlay) reused on site or reprocessed offsite for use in safety devices and speed humps. Carpet sent to recyclers or reused in landscaping. Fluorescent tubes and light bulbs recycled off-site. Fire alarms disposed of as hazardous waste.
Total[1]		**87%**	**12**	**43**	**8**	
Demolition of Existing Car Park (m^3)						
Asphalt	General solid (non-putrescible)	100%	100%	-	-	Reused on or offsite for fill.
Granular base / sub base materials	General solid (non-putrescible)	100%	n/a	-	-	Reused on site as fill or in landscaping.
Top soil	General solid (non-putrescible)	100%	20	-	-	Reused on site as fill.

[2] NSW EPA's Waste Classification Guidelines (2014)
[3] Tucker, S.N. et al, *The Environmental Impact of Energy Embodied in Construction* (1993)
[4] The Hills DCP (2012) Appendix A WMP, Part E, Chapter E7 Wollongong DCP (2009)

Waste Type	Waste Classification[2]	Estimated % Recovery[3]	Reuse (tonnes)	Recycling (tonnes)	Disposal (tonnes)	Potential Reuse / Recycling Method[4]
Removal of Approximately 16 Trees (m^3)						
Wood chip	General solid (non-putrescible)	100%	~ 165	-	-	Shredded and reused at the site and/or recycled via composting at appropriately licensed facility. Significant trees will be relocated either on or offsite.

Note 1: Totals may not add up due to rounding.

It is estimated that approximately 62 tonnes of waste will be generated by the demolition of Building 66, and about 87% of this can be recovered and diverted from landfill. The demolition of the existing car park and the removal of existing trees will generate waste and resources that should be close to 100% recoverable primarily through reuse on site or recycling off site.

Table 6 Estimated Waste Generation (tonnes) – Construction Activities

Waste Type	Waste Classification[5]	Estimated % Recovery[6]	Reuse (tonnes)	Recycling (tonnes)	Disposal (tonnes)	Potential Reuse / Recycling Method[7]
Construction of MLS Building						
Brick	General solid (non-putrescible)	90%	41	12	6	Cleaned for reuse or crushed for reuse on-site in landscaping and driveways. Removed for reuse and recycling off-site.
Concrete	General solid (non-putrescible)	80%	-	105	26	Reused on-site for filling, levelling or road base where possible. Removed for reuse and recycling off-site.
Timber	General solid (non-putrescible)	50%	18	-	18	Untreated timber reused or mulched for reuse in landscaping on-site. Treated timber reused as formwork, bridging, blocking or propping.
Plasterboard	General solid (non-putrescible)	95%	-	57	3	Plasterboard with low levels of contamination (e.g. nails, screws, wall coverings) removed for recycling off-site. Contaminated plasterboard removed off-site for disposal.
Sand/Soil	General solid (non-putrescible)	100%	61	-	-	Sand/soil reused on site unless contaminated.
Metal	General solid (non-putrescible)	95%	3	15	1	Steel recycled off-site by an appropriately licensed facility. Majority of other metals will be recycled where economically viable.
Other	Mix of general solid (non-putrescible and putrescible)	50%	-	17	17	Sediment fencing, geotextile materials, paints, PVC tubing, staff compound waste.
Total[1]		**82%**	**124**	**207**	**71**	

Note 1: Totals may not add up due to rounding.

[5] NSW EPA's Waste Classification Guidelines (2014)
[6] Tucker, S.N. et al, *The Environmental Impact of Energy Embodied in Construction* (1993) with amendment by Jacobs
[7] UK BRE Smart Waste Benchmark Data for Commercial Offices (2012), The Hills DCP (2012) Appendix A WMP, Part E, Chapter E7 Wollongong DCP (2009)

It is estimated that approximately 402 tonnes of waste will be generated by the construction of the MLS Building, and about 82% of this can be recovered and diverted from landfill.

The construction of the chemical storage building and the driveways and footpaths will generate minimal waste (i.e. small amounts of waste materials noted in Table 6). This waste will be recycled or reused on site.

Additional waste streams that will be generated during construction and demolition activities are listed in Table 7 along with their proposed management method.

Table 7 Additional Waste Streams – Construction and Demolition Activities

Waste Type	Waste Classification	Potential Reuse / Recycling Method
Packaging materials		
Plastic wrap / stretch wrap	General solid (non-putrescible)	Off-site recycling
Cardboard	General solid (non-putrescible)	Off-site recycling
Metal ties	General solid (non-putrescible)	Off-site recycling
Plastic ties	General solid (non-putrescible)	Investigate recycling opportunities.
Wooden crates	General solid (non-putrescible)	Return to suppliers. Investigate reuse and recycling opportunities.
Plant Maintenance		
Tyres	General solid (non-putrescible)	Off-site recycling or disposal.
Empty oil drums and other drums (e.g. fuel, chemicals, paints, spill clean ups)	Hazardous if containers used to store Dangerous Goods and have not been washed or vacuumed to remove residues. Otherwise, general solid (non- putrescible).	Transport of Dangerous Goods to comply with the Dangerous Goods Code. Off-site recycling or disposal by an appropriately licensed facility.
Batteries	Hazardous	Off-site recycling.
Staff Compound		
Office paper	General solid (non-putrescible)	Off-site recycling.
Cardboard	General solid (non-putrescible)	Off-site recycling.
Recyclable drink containers	General solid (non-putrescible)	Off-site recycling.
Garbage	General solid (non-putrescible)	Investigate energy recovery opportunities.

4.1.1 Office Fit-out

Office strip-out and refurbishment projects are often smaller in scale than construction and demolition projects and as such, can result in waste being treated as mixed loads rather than stream-separate recovery.

According to audits commissioned by the NSW EPA in partnership with the Better Building Partnership, building strip-out and refurbishment projects will generate on average 63 tonnes per 1000 square metres of floor space. The composition of this waste will generally comprise (by weight) 40% furniture and fittings, (equal parts) 15% to 20% glass, plasterboard and metal, with a smaller component of carpets, ceiling tiles, concrete and garbage.

Currently, an average of 21% of strip-out waste across Sydney is diverted from landfill. BBP audit and case study information demonstrates that a significantly greater component of waste (about 60%) can be reused and recycled at significant cost savings to contractors and building managers.

UOW can contribute to waste minimisation efforts by investigating and implementing the reuse of quality furniture and other stripout materials from other buildings. Reference should be made to the BBP Stripout Waste Guidelines[8] (2016) where applicable. It provides resources (a toolkit) and range of waste avoidance, reuse and recycling measures which can be implemented to achieve improved resource recovery outcomes.

[8] Better Buildings Partnership, Stripout Waste Guidelines (June 2016) (available at www.betterbuildingspartnership.com.au and http://cdn.sydneybetterbuildings.com.au/assets/2015/12/BBP-Stripout-Waste-Guidelines.pdf)

4.2 NSW Resource Recovery Target – Construction and Demolition Projects

Each development can contribute to overall NSW State resource recovery targets. For the construction and demolition (C&D) sector, the resource recovery target is 80% by 2021 (increasing from 75%). A growing body of research has demonstrated that construction and demolition projects are achieving resource recovery rates of over 80%, including up to 25% in waste reductions, and between 20% and 66% in cost savings due to avoided disposal costs[9].

Waste avoidance measures during building fit-out activities can also be implemented to divert further waste landfill through sustainable reuse of furniture and fittings from other buildings undergoing strip-out and refurbishment.

When choosing between waste minimisation options, the following hierarchy for waste management is preferred:

- waste avoidance/reduction
- reuse
- recycling
- energy recovery
- treatment
- disposal to landfill

The objective of this hierarchy is to show a preference for waste management options in order of their environmental impacts. State targets and the landfill levy have been established to support this hierarchy and to stimulate reuse and recycling markets for the benefit of the wider community.

Further to this, landfill space in the Greater Sydney Area is rapidly approaching capacity with population growth throughout the region[10].

Construction and demolition project managers should pursue this hierarchy and seek out waste reduction opportunities to realise cost savings and improved economic, social and environmental outcomes.

[9] Fletcher Construction Australia, Building Construction case study (available at http://infohouse.p2ric.org/ref/04/03124.htm), Lendlease Barangaroo case study (Jacobs tour attended late 2015), Sustainability Victoria, *Burbank Target Zero Waste Home* Building and Construction case study (available at www.ecorecycle.vic.go.au), WRAP UK, Plasterboard case study / Demolition Recovery Rates case study / (available at www.wrap.org.uk via search case studies), Waste Management, Campus Construction case study (2012, available at www.wm.com/construction),

[10] Hyder Consulting (now Arcadis), *Australian Landfill Capacities into the Future* report (2009, Commissioned by the Department of Environment, Heritage, Water and the Arts), Wright Corporate, *Strategic Review – Putrescible landfill Demand and Capacity for the Sydney Region* (2010, Commissioned by the NSW Government).

4.3 Waste Avoidance, Reuse and Recycling Measures

The following measures will be investigated and implemented (where economically feasible) to work towards achieving the State resource recovery target of 75% waste materials reused or recycled:

- During demolition activities, materials will be carefully dismantled and sorted for reuse and recycling where applicable.
- Framing timber, windows, doors and joinery will be reused on site or recycled off site where feasible.
- Plumbing, fittings and metal elements will be recycled off site where feasible.
- Formwork (temporary or permanent moulds) will be reused where possible.
- Appropriate sorting and segregation of wastes will be undertaken to ensure efficient reuse and recycling of materials throughout construction and demolition activities.
- Site disturbance will be minimised to limit unnecessary excavation and excavated material will be reused on site where possible.
- Green waste (i.e. garden organics) will be mulched and reused in landscaping.
- Construction materials will be selected taking into consideration their long lifespan and potential for reuse at the end of their initial use.
- Pre-cut and prefabricated materials will be carefully ordered to size, and prefabricated components will be used for internal fit-outs where possible.
- Materials will be delivered on an 'as needed' basis to prevent degradation of materials through weathering and moisture damage.
- Materials, including reuse and recycling materials, will be stored and kept in good condition.
- Trade work on site will be coordinated and appropriately sequenced to increase efficiency and reduce waste materials.
- Packaging waste will be reduced by the return of packaging to suppliers where possible, use of returnable bulk packaging, through bulk purchasing and requesting cardboard or metal drums, and metal straps, in place of plastics that can't be recycled.
- Staff/subcontractors will be informed of waste and resource management procedures and resource recovery targets.
- Contractors will be made aware of the legal requirements for disposing of waste in NSW.
- Contracts will include measures which reinforce the requirement to sort wastes effectively for reuse and recycling.

4.4 Management of Wastes

4.4.1 Reuse, Recycling and Disposal

The materials and procedures for reuse and/or recycling as identified in Sections 4.1 to 4.3 will be implemented where economically feasible.

Only project waste that cannot be cost effectively reused or recycled will be taken to an appropriately licensed facility for treatment to recover further resources or for disposal to landfill in an approved manner.

4.4.2 Segregation of Waste Materials

Effective source separation is required to achieve reuse and recycling targets. The following measures will be followed for this purpose:

- A dedicated area will be nominated for the storage of materials for reuse, recycling and disposal allowing for access and handling arrangements.
- Dedicated areas for the placement of reusable or recyclable wastes will be provided and clearly signposted.
- Tarps, lids or other measures will be provided to prevent damage by the elements and to prevent windblown litter and dust.
- Separate recycling skips/bins will be utilised for bricks, concrete, plasterboard, timber and metal during the construction phase to facilitate the separation of materials that will be reused on-site or sent for recycling.
- Recycling contractors will be consulted to determine quality criteria for collections.
- Separate receptacles shall be provided for the safe disposal of hazardous waste types including batteries.
- Separate receptacles will be required for drink containers and paper/cardboard recycling at staff compound facilities and site offices during temporary installation of these facilities.

Where space constraints exist at the site and can be demonstrated, the Building Contractor will consult with recycling contractors to determine which recyclable materials can be stored within the same skips/bins for sorting again off-site.

4.4.3 Contaminated / Hazardous Wastes

The Site Manager should stop work immediately if contaminated or hazardous materials are spilled or uncovered during demolition works and contact the relevant Hazardous Materials Waste Contractor prior to further works being undertaken.

Handling, transport and disposal of asbestos or other contaminated and/or hazardous material must meet the requirements of the NSW EPA's POEO (Waste) Regulation 2014 and updated provisions (as at March, July and August 2015) and Occupational Health and Safety legislation (Work Cover NSW).

4.4.4 Liquid Wastes

Liquid waste can include wash down waters, fuel, hydraulic or engine oil, paints and solvents. Liquid waste is typically generated during washing of plant or as a result of spillages. Any liquid wastes or dangerous goods wastes generated must be disposed of by a suitably qualified contractor to a licensed facility.

If a spill occurs, the contractor must immediately identify the spilled material, notify the Site Manager and contain the spill as soon as possible. Containment measures will be provided at appropriate locations and spill kits will be located in close proximity to dangerous goods storage areas and active project work areas. Material Safety Data Sheets (MSDS) will be located on the site and nearby spill kits.

4.5 Waste Storage Areas

The waste storage area will be nominated by the Building Contractor prior to commencing construction and demolition activities.

The area will be accessible by workers and waste collection vehicles, and allow sufficient space for storage of segregated waste and recycling. The waste storage area will be flexible to the changing waste volumes throughout the construction and demolition phases of the development.

The waste storage location must consider the health and safety of the workers, and the amenity impacts on the staff and students using facilities at the university. Screening will be provided to keep waste storage areas out of view from the public and to provide a barrier to capture windblown dust and litter.

Any stockpile locations must take into account slope and drainage factors to avoid contamination of storm water drains during rain events. Storm water control measures preventing sand, soil and waste from entering drains will be implemented and inspected prior to large rain events.

All bins, skips or stockpiles of waste materials will have covers available (i.e. secured lids and/or tarpaulins). Lids/covers will be secured over waste storage areas on windy or rainy days to mitigate windblown effects and potential contamination of storm water drains.

The Building Contractor will ensure waste storage areas are kept clean, and skips and/or stockpiles are inspected on a regular (daily) basis to prevent contamination and overflow of waste materials. The site will be inspected and cleaned at the end of each day for litter to prevent this from becoming a source of windblown litter.

4.6 Waste Servicing

The estimated frequency of waste removal will be specified by the Building Contractor prior to commencing construction and demolition activities.

Bins/skips nearing 80% to 85% capacity will be removed and replaced within 24 hours.

All bins/skips/waste materials leaving the site will be covered with a suitable tarpaulin or lid to ensure that the spillage of wastes during transit is eliminated.

All collection of waste and resources for construction and demolition works will be conducted during approved hours as per Council requirements.

All waste collected from the site will be deposited at an approved and appropriately licensed recycling centre, transfer station or landfill site. Refer to Section 4.9 for record-keeping requirements.

4.7 Communication

4.7.1 Inductions

All personnel employed for construction and demolition activities at the site will undergo induction training in relation to waste and resource management at the site. The following minimum requirements will be covered:

- Legal obligations (including fines for littering of waste items and cigarette butts, illegal dumping, and environmental incidents)
- Emergency response procedures
- Locations and correct use of spill kits
- Waste storage locations and sorting of waste and resources
- Responsibilities and reporting requirements

All personnel using vehicles should be made aware that any member of the public can now report 'littering from a vehicle' via the EPA's online reporting phone app.

More information is available here: www.epa.nsw.gov.au/litter/from-vehicle.htm

4.7.2 Tool Box Talk Reminders

All staff will be reminded of their legal obligations with regard to littering, waste management and daily site inspection responsibilities, and encouraged to save materials.

4.7.3 Signage

Standard signage is available and will be used to clearly signpost waste and resource bins/skips/receptacles. This signage uses images and colour coding to facilitate sorting of waste and resources on site. Examples are provided below in Figure 2.

Figure 2 Standard Signage for Construction and Demolition Sites

These are available for printing at: www.epa.nsw.gov.au/wastetools/signs-posters-symbols.htm

4.8 Monitoring and Reporting

4.8.1 Record-keeping

Records of waste volumes reused, recycled and disposed of are to be maintained. Records of waste volumes and weights removed by contractors are to be maintained.

Evidence for waste disposal and recycling services will be retained. This includes weighbridge dockets, invoices, receipts and a log book recording waste classifications and containing the site validation certificate. All entries must include:

- Time and date
- Description and weight / volume of waste
- Waste facility used
- Vehicle registration and company name

The log book and associated receipts must be made available for inspection by Council, EPA or UOW officers at any time during site works, and a final summary provided to UOW at the end of construction and refurbishment phase works.

4.8.2 Inspections

Daily inspections will be undertaken prior to leaving the site to ensure all waste items are appropriately contained and covered so as not to become a source of windblown litter and to ensure storm water controls are in place in case of rain to prevent waste contamination of storm water drains.

The contents of bins/skips will be regularly inspected by the Site Manager, or dedicated and appropriately trained personnel (i.e. training in these measures can be demonstrated), to ensure effective sorting of waste and resources is being undertaken on site. Personnel training and signage will be reviewed where procedures are not being complied with.

4.9 Incident Response

- All environmental incidents must be responded to in a prompt manner.
- An incident register must be maintained on site at all times.
- The contact details of the Appropriate Regulatory Authority (ARA) in case of pollution incidents causing or threatening environmental harm should be placed in a visible location and must be easy for personnel to read. This should include relevant contacts at Wollongong City Council (as primary ARA), SafeWork NSW and the EPA.
- The contact details of the EPA 24 hour Pollution hotline should also be placed in a visible location and must be easy for personnel to read.

Wollongong City Council: General number and after hours Council-related emergencies (02) 4227 7111

SafeWork NSW: Main number is 13 10 50

EPA 24 hour Pollution Hotline:

Environment Line: 131 555 (NSW only)
Environment Email: info@environment.nsw.gov.au

4.10 Roles and Responsibilities

All personnel have a legal responsibility for their own environmental performance and compliance with waste legislation. Roles and responsibilities are outlined below.

Table 8 Roles and Responsibilities Table

Site Manager (some responsibilities may be dedicated to an appropriately trained officer)	• Implementation of this WMP or equivalent measures to those contained within this WMP • Training of personnel • Ensuring plant and equipment are well maintained • Ordering materials on an 'as required' basis • Ensuring waste and resources are appropriately sorted to maximise resource recovery • Monitoring and tracking of performance against State resource recovery targets • Record-keeping • Daily inspections of bins/skips/stockpiles, litter and storm water controls • Investigation and establishment of local reuse opportunities where reuse of materials on-site cannot be undertaken • Approval of off-site recycling and disposal locations • Checking of off-site disposal site licensing requirements
Employees / Contractors / Subcontractors / Visitors	• Compliance with site procedures and the measures contained within this WMP (or equivalent document) • Compliance with legal requirements in relation to litter and illegal dumping, and reporting of environmental incidents • Compliance with workplace health and safety requirements

4.11 Submission Requirements Prior to Construction and Demolition Works Commencing

At the time of reporting, a Building Contractor has not been decided upon for detailed planning of construction and demolition waste and resource management. Council will be notified prior to demolition work commencing.

Appendix B provides a template WMP. The Demolition and Building Contractor will complete this table for all construction and demolition waste arising at the site.

Detail and drawings will also be supplied to Council at this time identifying the nominated locations and methods for the sorting, storage and collection of waste materials on site during the construction and demolition phase for:

- Excavation materials
- Landfill waste (garbage)
- Recyclable waste
- Reusable materials

Planet Ark's 'Recycling Near You' directory will be referred to where possible to locate sites that can reuse and recycle construction and demolition materials. This organisation provides a list of local reuse and recycling options for a wide number of construction and demolition materials. The following website can be used as the resource: www.recyclingnearyou.com.au/demolition/SydneyNSW.

The measures in this WMP will be complied with and incorporated into the Building Contractors' documentation where equivalent measures are not available.

5. Operational Waste Management Plan

5.1 Waste Streams, Classifications and Quantities

5.1.1 MLS Building and Building 32

The classifications and estimated volumes of waste materials generated by the operation of the MLS Building have been based on waste audit[11] data for Building 32 (given the similar activities undertaken) and observations made by Jacobs during a site visit[12]. Waste generation rates have been scaled according to differences in GFA between the MLS Building and the GFA of Building 32. Further details of waste generation calculations and conservative assumptions are outlined in Appendix C.

The estimated waste and recycling generation rates, assumed collection frequencies and number of bins/receptacles are presented in Table 9. Calculations assume that similar types of bins/receptacles will be used due to the waste transfer requirements from each building and existing and planned storage space arrangements. In addition, it has been assumed that collections for co-mingled recycling and office paper recycling will be increased from weekly to twice weekly. Further, it has been assumed that the polystyrene bale bags and the cardboard receptacles can be shared between Building 32 and the MLS Building with increases to the collection frequencies of these waste streams as required. See Section 5.9 for estimated bin footprints.

Table 9 Estimated Waste Generation and Number of Bins – MLS Building Operational Activities

Waste Type	Waste Classification[13]	Waste Generation (L per day)	Assumed Bin Type	Assumed Collection Frequency	No. Bins (MLS)	Management Method
Garbage	General solid (putrescible)	1,742	240L Mobile Garbage Bin (MGB)	Daily (Each weekday)	9	Collected for transfer and disposal to a licensed landfill
Co-mingled Recycling	General solid (non-putrescible)	348	240L MGB	Twice weekly (Thursday and Monday)*	6	Collected for off-site recycling
Office Paper Recycling	General solid (non-putrescible)	465	240L MGB	Twice weekly (Wednesday and Monday)*	9	Collected for off-site recycling
Confidential Documents/Paper	General solid (non-putrescible)	581	240L MGB	Weekly (Tuesday)	14	Collected for off-site shredding and recycling
Clinical Waste	Special (clinical and related waste)	58	240L MGB	Fortnightly (Thursday)	3	Pre-treated via autoclaving for disposal to garbage bins
Cytotoxic Waste (where applicable)	Special (clinical and related waste)	29	240L MGB	Fortnightly (Thursday)	1	Collected by licensed contractor
Polystyrene Recycling	General solid (non-putrescible)	60	1m^3 Bale Bag (frame support)	Fortnightly (or as required)	1 (bag)	Collected for off-site recycling
Cardboard Recycling	General solid (non-putrescible)	181	1100L MGB (to replace the skip)	Weekly	1	Collected for off-site recycling
Estimated Total Waste (L per day)		**3,465**			**44**	

*Days for collection will be dependent on new arrangements with private collection contractors.

[11] Email information dated 15/12/16 provided by the Facilities Management Division at UOW and supplemented by information provided by Denton Corker Marshall architects (2017).
[12] Site visit performed by Jacobs on 26/04/17.
[13] NSW EPA's Waste Classification Guidelines (2014)

According to the estimates provided in Table 9, a total waste volume of 3,465L per day will be generated by the MLS Building. Audit results for Building 32 show that these buildings generate approximately 2,864L per day. The operation of the MLS building will therefore result in the generation of approximately 20% more waste.

A range of hazardous chemicals and liquid wastes (including Dangerous Goods) will also be generated by the MLS Building including waste solvents. Refer to the Wastes and Hazards Report 2017 (prepared as part for the UOW by Safety Engineering and Technical Services Pty Ltd) for further details. This report notes that no radioactive wastes of Class 7 Dangerous Goods or infectious wastes will be generated or kept in the building.

From time to time, bulky and electronic waste (e-waste) will also be generated by the MLS Building and Building 32. A bulky waste cage with a cover to protect the contents from rain should be provided to facilitate safe storage and collection of these wastes. Staff from both buildings should be made aware of procedures / communication protocols for the transfer of these waste types to the storage area.

5.2 NSW Resource Recovery Target – Commercial and Industrial Operations

Each development can contribute to overall NSW State resource recovery targets. For the commercial and industrial (C&I) sector, the resource recovery target is 70% by 2021 (increasing from 57%). A growing number of case studies have shown that commercial offices can achieve resource recovery rates of over 70%, while universities participating in the Green Labs program have demonstrated that significant improvements in resource recovery outcomes can be achieved through a range of initiatives (such as glove and solvent recycling programs, consolidation of hazardous waste streams, introduction of additional recycling bins) [14].

The UOW's Waste Management Action Plan 2015 – 2018 reports that in 2014 the UOW's Wollongong Campus and Innovation Campus achieved a resource recovery rate of 44% diversion from landfill through a range of recycling and food organic composting initiatives. Additional improvements will be required to improve on the university's current resource recovery performance in order to continue to meet with internal UOW targets and the State's targets for 2021.

When choosing between waste minimisation options, the following hierarchy for waste management is preferred:

- waste avoidance/reduction
- reuse
- recycling
- energy recovery
- treatment
- disposal to landfill

The objective of this hierarchy is to show a preference for waste management options in order of their environmental impacts. State targets and the landfill levy have been established to support this hierarchy and to stimulate reuse and recycling markets for the benefit of the wider community.

Further to this, landfill space in the Greater Sydney Area is rapidly approaching capacity with population growth throughout the region[15].

Facility management should continue to pursue this hierarchy and seek out further waste reduction opportunities through learnings from case studies available via the Green Labs Program to realise cost savings and improved economic, social and environmental outcomes.

[14] NSW EPA Industry Fact Sheets for Reducing Business Waste - Commercial Offices (available at www.epa.nsw.gov.au/managewaste/reduce-bus-waste.htm), MIT Green Labs (resources available at https://greenlab.mit.edu/green-programs-1), UBC Green Labs (resources available at http://greenlabs.ubc.ca/get-involved-2/toolkits/)

[15] Hyder Consulting (now Arcadis), *Australian Landfill Capacities into the Future* report (2009, Commissioned by the Department of Environment, Heritage, Water and the Arts), Wright Corporate, *Strategic Review – Putrescible landfill Demand and Capacity for the Sydney Region* (2010, Commissioned by the NSW Government).

5.3 Waste Avoidance, Reuse and Recycling Measures

5.3.1 Current Measures

As outlined in Section 2.1, the Facilities Management Department (Environment Unit) of the UOW has developed a Waste Management Action Plan.

The operation of the MLS Building will need to contribute to the objectives of the UOW Waste Management Action Plan, which are:

- To continue to reduce in solid waste to landfill per EFTSU (equivalent full-time student unit) each year
- To continue to achieve university's overall recycling rate of 66% of total waste (by 2016)
- To achieve 66% of organic waste diverted from landfill by 2016
- To work towards zero waste to landfill

Actions of the Waste Management Action Plan 2015 - 2018 as relevant to this WMP are as follows:

- Building design standard to include waste system
- Consolidate waste collection points and have options for all streams and volumes
- Reduce the number of waste bins serviced by cleaners from desks
- Achieve an increase in the volume of composting units on campus
- Collect more recyclables by stream, including plastic bags, plastic wrap and polystyrene
- Extend the Green Labs program to additional UOW laboratories
- Set up and support reuse programs (e.g. for furniture, electronics and office materials)
- Ensure waste management is part of induction processes

Recycling measures currently implemented for Building 32 will be carried across to the MLS Building as appropriate. These measures include:

- Recycling of bulk cardboard and polystyrene, office paper, confidential (secure) documents, drink containers and other containers via the co-mingled / office paper / secure documents recycling services.
- Sorting of special, clinical and related waste into appropriate receptacles to reduce contamination of other materials which would otherwise need to be classified and managed as clinical waste.

5.3.2 Proposed Additional Measures

The following additional measures should also be investigated and implemented where appropriate and not currently in place:

- Fit-out of the new MLS Building to utilise unwanted but otherwise high quality office furniture from other buildings as appropriate[16]. A range of contractors offering this service are available and studies have shown that up to 60% or more of waste can be reused and recycled during office strip out and refurbishment activities – a large proportion of this could be minimised through reuse of unwanted materials during fit-out activities.
- Implementation of double-sided, black and white printing defaults and other office paper use minimisation measures should be investigated to reduce paper and confidential paper recycling generation rates.
- Food organics composting to be implemented in staff eating areas and kitchens as per the Waste Management Action Plan 2015 – 2018. Composting of other materials such as paper towels from bathrooms to be investigated.
- Recycling of electronic waste (or e-waste) through return to suppliers or collection by an appropriately licensed contractor.
- Recycling of hazardous wastes such as batteries, printer toners and ink cartridges (free recycling options available via planet ark) and fluorescent tubes / light bulbs through available schemes.
- Recycling of gloves and solvents to be investigated.
- Recycling of coffee pods where applicable in kitchen areas (free return to supplier arrangements available).
- Reductions in the amount of compressed gas consumed through modification of low tank alarms.
- Implementation of a sustainable purchasing policy and guideline for staff morning teas / other events, and also for the laboratories and offices to reduce packaging / food waste.
- Use of compostable packaging and promotion the use of reusable kitchenware, reusable water bottles, reusable coffee cups and reusable or compostable takeaway containers.
- Compositional waste audits undertaken annually for MLS Building to track progress against resource recovery targets, and determine further areas for improvement.
- Visual audits of bin use / bin capacities utilised prior to collections should also be undertaken, particularly once MLS becomes operational, to determine potential cost savings and cleaning contractor / staff education requirements.
- Review signage, audit data and surveys of staff and students to determine awareness of reuse and recycling measures, and to pin point any confusing messaging around recyclable items.
- Implementing a policy or ban on the provision of single use plastic cups, plates and cutlery for university seminars / events (incorporating Waste Wise principles) and within staff common areas and water dispensers.

[16] Audits commissioned by the the NSW EPA in partnership with the Better Building Partnership have shown that a circular approach to stewardship can save significant resources during the fitout design phase (e.g. carpet, plasterboard and furniture reuse). Refer to BBPs' Stripout Waste Guidelines for further information (available at http://cdn.sydneybetterbuildings.com.au/assets/2015/12/BBP-Stripout-Waste-Guidelines.pdf)

Takeaway Coffee Cups

According to the 2014 audit results for the Wollongong Campus, takeaway coffee cups make up approximately 2% of the university's waste stream.

At the time of reporting, takeaway coffee cups (including those which claim to be made of recyclable or biodegradable materials) are not currently recyclable. All coffee cups currently incorporate an amount of plastic that is too difficult to separate from paper fibres and as such these are treated as contamination within the recycling stream and are disposed of to landfill.

The packaging of these coffee cups often provides confusing and conflicting information. Some coffee cups are compostable however the rate at which coffee cups are generated may lead to a poorer quality of composting mixtures.

Reference can be made to Australian Packaging Covenant (www.packagingcovenant.org.au) for additional details and work on takeaway coffee cups[17].

5.4 Management of Wastes

5.4.1 Reuse, Recycling and Disposal

The control measures and initiatives for reuse and/or recycling as identified in Sections 5.1 to 5.3 will be implemented where economically feasible.

Only wastes that cannot legally or cost effectively reused or recycled will be removed for treatment (and potential resource recovery) at appropriately licensed facilities or disposal to landfill in an approved manner.

Reference shall be made to UOW's Laboratory Waste Disposal procedure for further, more detailed information.

5.4.2 Segregation of Waste Materials

Effective source separation is required to achieve reuse and recycling targets. The following measures will be followed for this purpose:

- Where source segregation of different waste types is required, a dedicated area will be nominated for the location of different waste receptacles to provide options at waste disposal points. The waste disposal points will allow for appropriate access and waste handling arrangements.
- Teaching and research laboratory waste segregated into solid waste (garbage), liquid wastes and sharps, as well as clinical and biological waste as appropriate.
- Dedicated bins/receptacles for the placement of reusable or recyclable wastes will be provided and clearly colour-coded and signposted.
- Recycling contractors will be consulted to determine quality criteria for collections.
- Lids or bin/receptacle security measures will be provided as appropriate to prevent workplace health and safety incidents and reduce the potential of spills.
- Methods for cleaning, treatment, sorting and disposal of different laboratory waste types will be included in all relevant laboratory protocols and procedures.

Reference shall be made to UOW's Laboratory Waste Disposal procedure and the UOW's Environmental Management Plan (UOW's Policies and Guidelines) for further, more detailed information.

[17] Australian Packaging Covenant case study (available at www.packagingcovenant.org.au/news.php/57/coffee-cup-recycling-project). At the time of reporting, a working group has been established to determine a way forward on this issue.

5.5 Other Wastes

5.5.1 Clinical and Related Wastes (primarily biological and sharps wastes)

Clinical and related waste, as described by the NSW EPA's Waste Classification Guidelines (Part 1), includes animal tissue, carcasses or other waste from animals used for medical research and sharps waste.

Appropriate containment of waste must comply with the provisions of the POEO Act and associated POEO (Waste) Regulation, and WorkCover requirements as relevant. Careful segregation of clinical and all related waste will help to protect laboratory users from injury.

Clinical waste contractors will supply colour coded waste receptacles especially designed for the purposes of clinical and related waste disposal. These will be provided at all required locations for disposal of sharps and biological waste. Where wheeled bins are not available, receptacles will be transferred using trolleys to reduce the risk of spills and manual handling requirements. All bins and trolleys must be made of a rigid material and be lidded, lockable, leak proof and washable.

Bins/receptacles must be appropriately signposted with damaged receptacles and signage promptly repaired or replaced.

Full bins will be stored in a secured refrigerated store room for collection under controlled arrangements. Only empty bins will be stored in the waste enclosure area.

Reference shall be made to UOW's Laboratory Waste Disposal procedure and relevant Australian Standards for further information on decontamination and disposal.

5.5.2 Hazardous and Liquid Wastes

By law, all containers must be appropriately labelled to identify the contents contained within. Personnel must ensure containers are not leaking and there is no spillage on the exterior of the container.

No liquid wastes will be disposed of via the drain. Liquid wastes will need to be segregated and stored according to UOW's Laboratory Waste Disposal procedure and mixing avoided where possible, as unexpected reactions may occur.

5.6 Waste Storage Areas

5.6.1 Internal (MLS Building)

Each level of the MLS Building will have separate waste storage areas provided.

- On the west side of Levels 1 and 3 laboratory block, there will be a waste handling room where the laboratory personnel will take and process their wastes including:
  - Autoclaves
  - Biological red bags
  - Chemical waste
  - Garbage
- Level 2 comprises of a smaller laboratory. Users of this floor will need to transport their waste to either Level 1 or Level 3 for processing (if needed).
- Level 4 contains the animal house. It has been informed that a large proportion of waste generated in this area can be disposed of as garbage, with the remaining waste being classified as biological (i.e. special clinical or related waste, and cytotoxic waste (where applicable)). The Level 4 holding area will be used to process and bag wastes, and for temporary storage / bin staging prior to transfer to waste handling and storage rooms on the other levels.
- A small amount of waste (garbage and packaging recycling) may be generated at the loading dock and suitable receptacles will be provided at this location for this purpose.

The storage areas for each waste handling room are 27.5m^2 and 51.5m^2 for Level 1 and 3 respectively. Internal waste handling and holding rooms are identified on MLS floor plans.

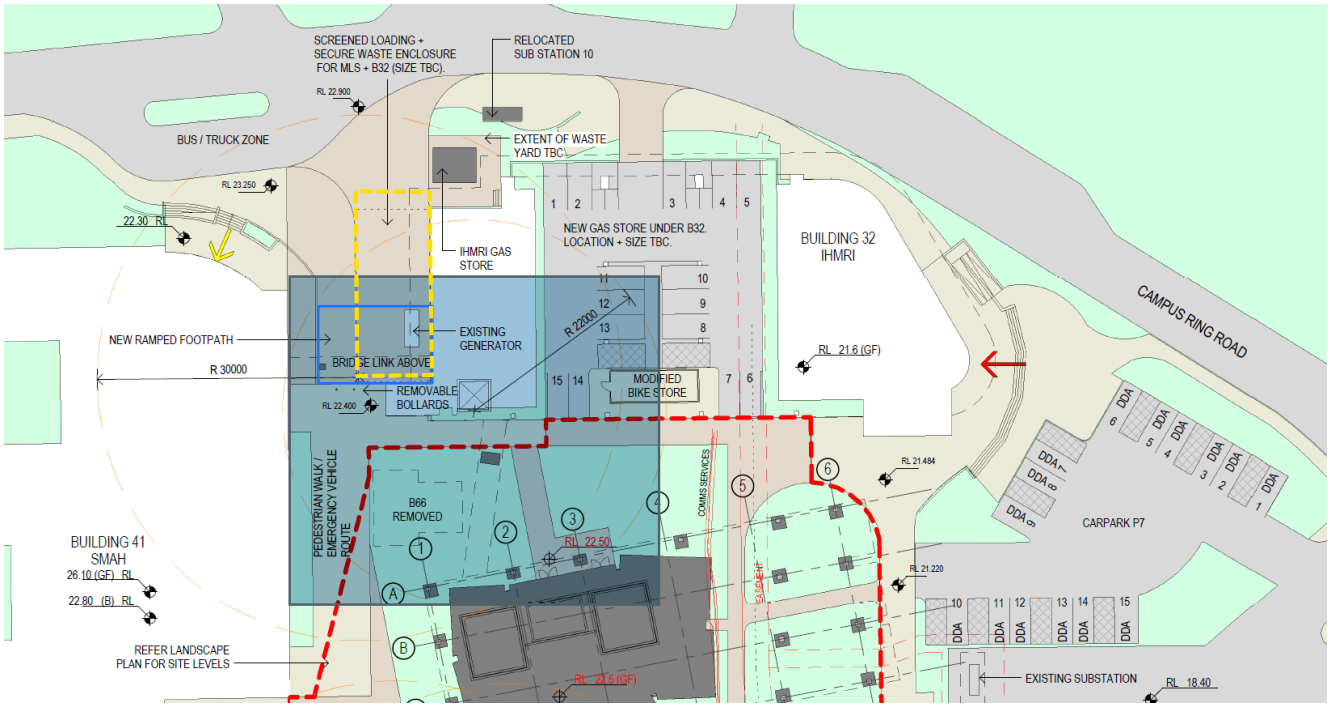
5.6.2 Internal (Building 32)

All bins containing controlled wastes (i.e. clinical, cytotoxic bins) will be stored within a designated freezer room within Building 32 prior to contractor removal.

5.6.3 External Internal (MLS Building)

It is understood that storage of all other wastes prior to contractor collection will be provided in the screened and secured waste enclosure located adjacent to Building 32 loading dock area as indicated below in Figure 3, and as such, the storage space will need to be shared with these buildings. A mixture of empty (backup) bins and full bins will be stored at this location.

Figure 3 Building 32 Loading Area with Screened and Secure Waste Enclosure



Source: Jacobs (architectural drawing DRG-0101)

Note: The blue hashed square denotes the existing secured waste enclosure area. The yellow dotted line approximately denotes the indicative area of the planned waste enclosure area.

5.6.4 Location of Waste Bins/Receptacles within the MLS Building

The type of bins/receptacles and their location are identified below:

- Smaller waste bins (for the collection of garbage and co-mingled recycling) – kitchen, office, conference and common areas
- Garbage 240L MGBs – Level 1 and 3 waste handling rooms, and other activity areas as required
- Co-mingled recycling 240L MGBs – activity areas as required
- Paper and confidential paper recycling 240L MGBs – nearby printers in all office areas
- Clinical waste / laboratory waste bins (including 240L MGBs for garbage, clinical waste and biological red bag waste) – within Level 1 and 3 waste handling rooms, and holding rooms on other floors
- 1m^3 bale bags – Building 32 waste enclosure
- 1100L MGBs – Building 32 waste enclosure

Empty backup bins for all waste streams will be stored at the Building 32 waste enclosure.

5.7 Waste Transfer

Transport times between holding areas and collection points will vary depending on waste room space provisions and bin numbers, and therefore waste generations by waste type and associated collection frequencies. At Building 32, the transfer of bins to collection points generally occurs every 2 to 3 days. Transport times will be considered as part of the laboratory workplace health and safety program.

The faculty staff will be responsible for transfer of any controlled waste bins while the cleaners will transfer remaining general waste and recycling bins.

All waste from the MLS Building will be transferred via a goods lift to Level 1, across the bridge link to Building 32 and then to the ground level for storage at the Building 32 waste enclosure area. This includes waste generated on the ground floor which will need to be transferred up to the bridge link. Any waste and recycling generated at loading dock will leave directly from dock. Refer to Figure 4 for the overall Waste Flow Diagram for the MLS Building.

Wheeled MGBs will be utilised where possible. Where wheeled bins are not available, receptacles will be transferred using trolleys to reduce the risk of spills and manual handling requirements.

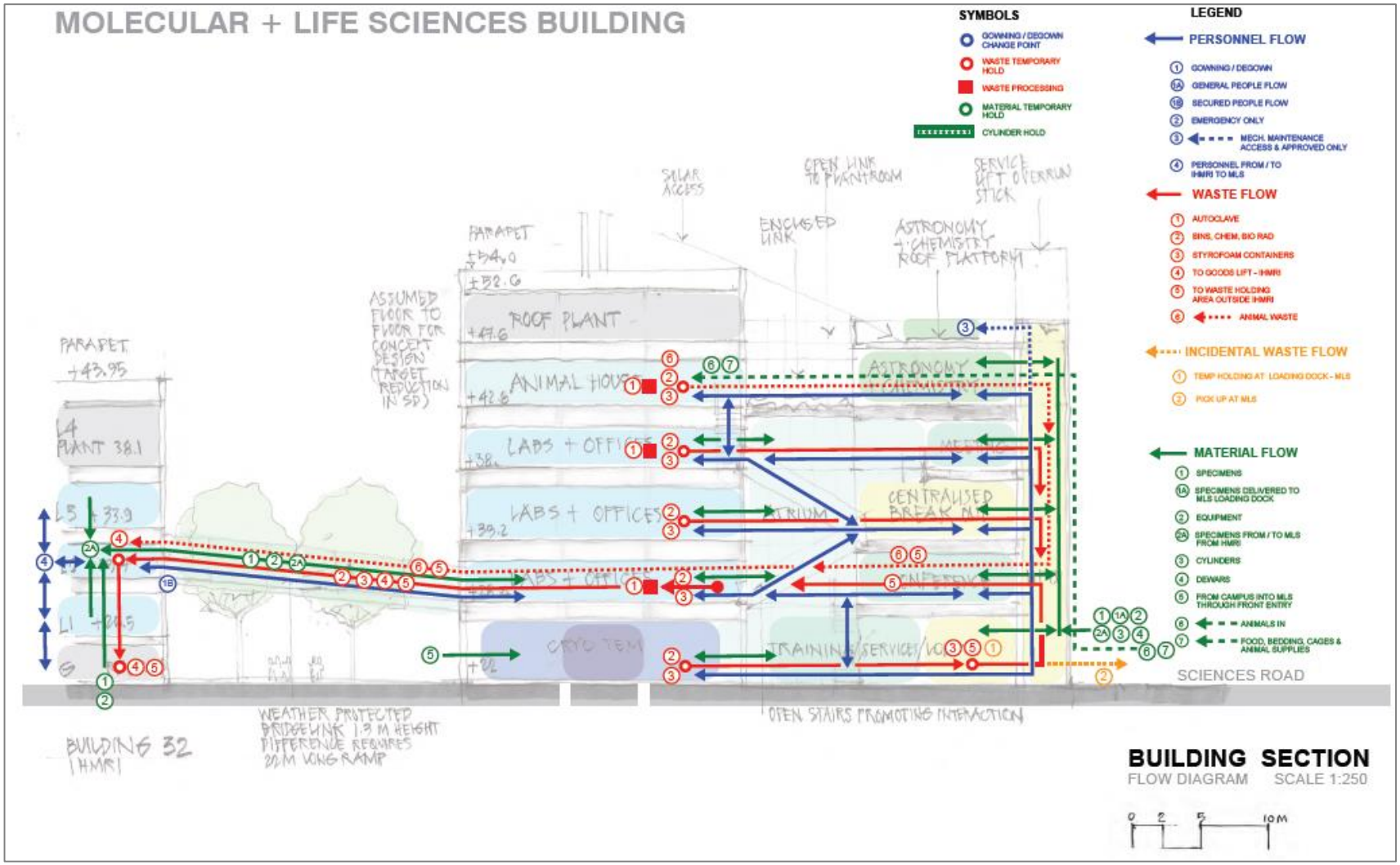
The NSW EPA's Better Practice Guidelines (2012) specify the following workplace health and safety requirements for bin transfer pathways:

Table 10 Restrictions on Bin Transfer Gradients and Transfer Distances

Mobile Garbage Bin (MGB) Size	Gradient Restrictions	Transfer Distances
240L bins	no steep ramps	should not exceed more than 75m to collection point
360L up to 660L	no more than 1:14	can not be moved more than 75m to collection point
660L up to 1.5m^3 bulk bins / skips	no more than 1:30	can not be moved more than 5m
1.5m^3 skips	no more than 1:30	can not be moved more than 3m

These workplace health and safety gradient and transfer distance restrictions should be followed for the protection of the health and safety of personnel responsible for moving bins.

Figure 4 MLS Building Waste Flow Diagram



Source: Denton Corker Marshall and Jacobs (dated 24/11/16)

5.8 Waste Servicing

Waste servicing will take place from the Building 32 loading dock as identified in Figure 3. Review of swept path diagrams for Heavy Rigid Vehicle (HRV) of 12.5m in length show that all waste collection vehicles will enter Ring Road and use this road to reverse back into the loading dock for collections.

Reversing of waste collection vehicles does not follow best practice so safety provisions including designated pedestrian walkways, pedestrian rails and reversing mirrors will need to be designed into this area for maintenance of public health and safety. In addition, reversing back on to Ring Road is not supported. As such, all vehicles collecting waste and recycling from this area will need to be capable of rear- or side-loading.

As proposed truck movements to the loading dock will occur adjacent to a UOW shuttle bus stop, waste collections will need to be coordinated so as not to pose a potential conflict with shuttle bus services. The shuttle buses travel regularly along Ring Road (approximately every 10 to 30 minutes during the study semester).

Refer to the Traffic and Parking Assessment Report for further information.

5.9 Waste Collection Frequencies and Bin Footprints

5.9.1 MLS Building and Building 32 Waste Area

The estimated additional bin footprint requirement according to waste streams generated at the MLS Building is outlined below. Detailed calculations, bin dimensions and conservative assumptions are outlined in Appendix C. As noted in Table 9, it has been assumed that waste collection frequencies at the MLS Building will align with Building 32 waste collection frequencies where possible, assuming similar waste streams will be generated.

The calculations include the assumption that polystyrene bale bags and the cardboard 1100L MGBs will be shared between the MLS Building and Building 32 with increased collection frequencies (as required) to avoid the need for additional bale bags and bins to be stored at this location. The cardboard skip will need to be replaced with smaller receptacles so that rear-loading vehicles can be utilised in place of front-loading vehicles.

Table 11 Estimated Additional Bin Footprints* – Building 32 Loading Dock and Waste Enclosure

Waste Type	Bin Type	Bin Footprint (including 15%) (m^2)*	Assumed Collection Frequency	No. of Bins (B32)	No. of Bins (MLS)	Total No. of Bins (B32 + MLS)	Bin Footprint (B32, m^2)	Bin Footprint (MLS, m^2)*	Total Bin Footprint (B32 + MLS, m^2)
Garbage	240L MGB	0.50	Daily (Each weekday)	6	9	15	3.0	4.5	7.5
Co-mingled Recycling	240L MGB	0.50	Twice weekly (Thursday and Monday)*	4	6	10	2.0	3.0	5.0
Paper Recycling	240L MGB	0.50	Twice weekly (Wednesday and Monday)*	5	9	14	2.5	4.5	7.0
Confidential Recycling	240L MGB	0.50	Weekly (Tuesday)	10	14	24	5.0	7.0	12.0
Clinical Waste	240L MGB	0.50	Fortnightly (Thursday)	2	3	5	1.0	1.5	2.5
Cytotoxic Waste (where applicable)	240L MGB	0.50	Fortnightly (Thursday)	1	1	2	0.5	0.5	1.0
Polystyrene Recycling	1m^3 Bale Bag	1.4	Fortnightly (or as required)	2 (bags)	Nil	2 (bags)	2.8	N/A	2.8
Cardboard Recycling	1100L MGB	2.0	Weekly	2[1]	1	3	4.0	2.0	6.0
Total	-	-	-	**32**	**43**	**75**	**20.8[2]**	**23.0[2]**	**43.8[2]**

Note 1: Estimated number of 1100L MGBs required to replace the existing 1.5m^3 skip.

Note 2: Not all bins will be stored in the waste enclosure at the same time.

*The bin footprint calculations do not allow for space provisions required for waste flow (i.e. bin movements, collection, emptying and cleaning).

Bin cleaning provisions (a wash pit and water taps for hose attachment) are currently provided with in the loading dock and waste enclosure area. A minimum of 2m^2 should be allowed for future MGB cleaning requirements.

It is noted that bins from around the campus are transported to this waste enclosure for cleaning once yearly on a campaign basis, with about 10 bins cleaned at a time. The waste enclosure will need to continue to support this function unless alternative arrangements can be made.

Other permanent waste storage provisions will need to be continued for location of the cardboard recycling bins and polystyrene bale bags and a bale frame, as well as any empty (backup) bins provided for contingency or for replacement of full bins as required. Other static structures within this waste enclosure area will include the existing generator and a new gas store. The bin wash area will also require a pit with a raised lip so this must be located away from bin transfer pathways. Bulky waste storage cages should also be located in this area.

The scenario representing the highest number of bins that could be stored together at the same time within the waste enclosure is (a) garbage bins and confidential paper recycling bins which are currently collected on the same day of the week or (b) garbage bins, co-mingled recycling and office paper recycling bins (assuming twice weekly collections).

The number of backup bins that will potentially need to be stored in the waste enclosure for the MLS Building, including those already stored for Building 32, is estimated to be in the range of 41 x 240L MGBs. This assumes a breakdown of 15 x 240L MGBs for garbage, 10 x 240L MGBs co-mingled recycling and paper recycling, 4 x 240L MGBs for clinical waste and 2 x 240L MGBs for cytotoxic waste (i.e. approximately double the number of bins allowed for collection for these waste streams). No backup bins have been assumed for confidential (secure) documents. It is considered that this represents a worst case scenario applying conservative assumptions. Waste audits should be undertaken to determine efficiencies and reductions in the number of empty (backup) bins required to be stored in the waste enclosure.

The total area of the loading dock and waste enclosure is 266m^2. This includes the area reserved for the generator (6.8m^2) and the placement of the new gas store (27.8m^2) for Building 32. Excluding the generator and gas store leaves 226.9m^2 for vehicle movements, bin storage and handling.

Designated bays for each waste stream should be provided within the waste enclosure, with markings painted on the ground (at minimum) indicating where each type of waste bin should be stored and appropriate colour coded signage attached to adjacent walls or fencing. Markings and signage should be well-maintained throughout the operational phase of the development. Backup bins should be stored to the same side of these bays each time they are replaced.

Should space limitations exist, collection days for confidential (secure) paper recycling may need to be alternated for the MLS Building and Building 32.

An indicative drawing of the loading dock and waste enclosure area (entitled “Waste Yard RevC”) has been generated to demonstrate the anticipated (worst case) space requirements and configurations during storage are adequate and allow sufficient room for loading operations and collections via contractor vehicles (either rear- or side-loading vehicles) to be carried out. Refer to Appendix C for indicative arrangements.

5.10 Monitoring and Reporting

Regular compositional and/or observational waste audits, staff and student surveys, and inspections of waste storage areas and procedures should be undertaken as per UOW's Waste Management Action Plan 2015 - 2018 requirements.

The waste handling and holding areas, and the loading dock and waste enclosure area will be closely monitored during the first few weeks of operation and peak operation to ensure space provisions are adequate during collections and to incorporate any efficiencies or reduced number of backup bins where possible.

As a guide for carrying out density conversions for reporting by weight, the volume of each material within a bin must be taken into account excluding the unused "air" component of the bin (i.e. do not divide by the volume of the total bin capacity, use density conversion factors taking compaction or no compaction into account). Using the material density conversion factor (kg/m^3):

Weight of material (kg) / volume of the material within the bin (m^3)

The material density conversion factors for a range of common waste streams are provided below:

- garbage (dry, excluding organics) - 70 kg/m^3
- mixed container recycling – 60 kg/m^3
- paper – 115 kg/m^3
- secure (confidential) paper – 300 kg/m^3
- food waste – 350 kg/m^3
- toner cartridges – 190 kg/m^3

5.11 Incident Response

- All environmental incidents must be responded to in a prompt manner.
- An incident register must be maintained on site at all times.
- The contact details of the Appropriate Regulatory Authority in case of pollution incidents causing or threatening environmental harm should be placed in a visible location and must be easy for personnel to read. This should include relevant contacts at Wollongong City Council (as primary ARA), SafeWork NSW and the EPA.
- The contact details of the EPA 24 hour Pollution hotline should also be placed in a visible location and must be easy for personnel to read.

Wollongong City Council: General number and after hours Council-related emergencies (02) 4227 7111

SafeWork NSW: Main number is 13 10 50

EPA 24 hour Pollution Hotline:

Environment Line: 131 555 (NSW only)
Environment Email: info@environment.nsw.gov.au

5.12 Roles and Responsibilities

All personnel have a legal responsibility for their own environmental performance and compliance with waste legislation. Proposed roles and responsibilities are outlined below.

Table 12 Roles and Responsibilities Table

Facilities Management Division (Environment Unit) / Building Manager	• Roll out of compliant and consistent waste management systems across UOW • Implementation of this WMP (or equivalent measures to those contained within this WMP) for general office and staff common areas, as well as outdoor areas • Consultation with Green Lab Programs personnel and waste minimisation measures • Training of personnel • Ensuring plant and equipment, and signage are well maintained • Ensuring building wastes are appropriately sorted to maximise resource recovery • Monitoring and tracking of performance against UOW and State resource recovery targets • Engaging and liaising with waste collection contractors • Approval of off-site recycling and disposal locations • Checking of off-site disposal site licensing requirements • Record-keeping and inspection of waste bins/receptacles and waste storage areas • Investigating and establishing further waste avoidance, and local reuse and recycling opportunities
Environmental Coordinator (Green Labs)	• Compliance, as appropriate, with UOW waste management system requirements • Preparation of laboratory waste management procedures • Training of laboratory personnel • Ensuring laboratory plant and equipment, and signage are well maintained • Ensuring laboratory wastes are appropriately sorted to maximise resource recovery • Monitoring and tracking of performance against UOW Green Lab Program resource recovery targets • Laboratory record-keeping and inspection of bins/receptacles and waste storage areas • Liaising with clinical waste and other laboratory waste collection contractors • Investigating innovation and emerging opportunities for waste diversion from landfill • Establishing further waste avoidance, and local reuse and recycling opportunities through the Green Labs Program including consultation with UOW Facilities Management to ensure collection arrangements are appropriate
Employees / Visitors	• Compliance with site waste management procedures and signage • Compliance with legal requirements in relation to litter and illegal dumping, and reporting of environmental incidents • Compliance with workplace health and safety requirements – untrained staff and students are not to handle hazardous wastes.

5.13 Submission Requirements Prior to Occupation Certificate

Prior to occupation of the new MLS Building, UOW will order required bins/receptacles, and establish appropriate waste storage and collection arrangements, as well as develop contingency measures in case greater than anticipated waste volumes are generated.

Training and awareness of new waste transfer and collection arrangements for Building 32 and the new MLS Building will commence prior to and within the first week of occupation.

A Waste Management Plan addressing any refurbishment and/or fit-out wastes will also be prepared as relevant to ensure space provisions for the storage of refurbishment wastes (such as furniture, electronic waste, housekeeping wastes) are adequate for the number of bins/receptacles required during this time.

Appendix A. Template WMP

MATERIALS				
Type of waste generated	**REUSE**	**RECYCLING**	**DISPOSAL**	**Specify method of on-site or off-site reuse, contractor and recycling outlets and/or waste depot to be used**
	Estimate Volume (m3) or Weight (t)	Estimate Volume (m3) or Weight (t)	Estimate Volume (m3) or Weight (t)	
Excavation Material				
Timber (specify)				
Concrete				
Bricks / Pavers				
Tiles				
Metal (specify)				
Glass				
Plasterboard				
Furniture / Fixtures				
Floor coverings				
Packaging (used pallets, pallet wrap)				
Garden Organics				
Containers (cans, plastic, glass)				
Paper / cardboard				
Hazardous / special waste e.g. asbestos (specify)				
Residual garbage				
Other (specify)				

Appendix B. Waste Generation Calculations - Construction and Demolition

Demolition Waste Arisings – Demolition of Building 66

Waste Type	Waste Generation Rates (t/1000m² factory)	Total Waste Generated (t)	% Reused	% Recycled	Total Reused (t) (Rounded up)	Total Recycled(t) (Rounded up)	Total Disposed (t) (Rounded up)
Bricks	205	18	60%	15%	11	3	5
Concrete	448	40	0%	95%	-	38	2
Timber / Gyprock	4	0	50%	0%	<1	<1	<1
Steel	23	2	15%	85%	<1	2	<1
Other	18	2	1%	4%	<1	<1	2
Total		**62**			**12**	**43**	**8**

Construction Waste Arisings

Waste Type	Waste Generation Rates (t/1000m² office)	Total Waste Generated (t)	% Reused	% Recycled	Total Reused (t) (Rounded up)	Total Recycled(t) (Rounded up)	Total Disposed (t) (Rounded up)
Bricks	8.5	59	70%	20%	41	12	6
Concrete	18.8	131	0%	80%	0	105	26
Timber	5.1	36	50%	0%	18	0	18
Plasterboard	8.6	60	0%	95%	0	57	3
Soil / Sand	8.8	61	100%	0%	61	0	0
Metal	2.75	19	15%	80%	3	15	1
Other	5.0	35	0%	50%	0	17	17
Total		**402**			**124**	**207**	**71**

Assumptions list:

- Waste generation rates for the demolition of a “factory” and the construction of an “office” block have been sourced from The Hills Shire Council Development Control Plan (DCP) 2012, Appendix A Waste Management Plan document.
- The assumed reuse and recycling rates have been based on research undertaken in Melbourne sourced from Philip Crowther’s *Building Deconstruction in Australia* prepared on behalf of the Queensland University of Technology’s (QUT) (2000) (accessed 2017 and available at http://eprints.qut.edu.au/2883/1/Crowther-TG39-2000.PDF). Original source Tucker, S.N. et al, *The Environmental Impact of Energy Embodied in Construction*. Main report for the Research Institute of Innovative Technology for the Earth, Kyoto, 1993. Different assumptions have been applied to demolition and construction phases.
- Estimates for the amount of waste generated by car park demolition works have been provided by the Robert Bird Group.
- Estimates for the amount of wood chip waste generated by the removal of trees have been sourced from Farm Forest Line (accessed 2017 and available at http://www.farmforestline.com.au/pages/6.5_standing_tree.html). Calculations have been based on an average tree height of 8m and an average diameter at breast height of 100cm using the following calculation:

  Tree volume (m^3) = Tree Basal Area (m^2) x Tree Height (m) / 3 = (DBH/200)2 x 3.142 x Ht / 3.

Appendix C. Waste Generation Calculations - Operational

Building 32 Audit Results

Waste Stream	Type of Bin	No. (min) of Bins	No. (max) of Bins	Bin capacity (L)	Total Waste Generation (L per day)
General waste	240L MGB	6	6	240	1,440
Recycling	240L MGB	6	6	240	288
Office paper	240L MGB	4	8	240	384
Confidential waste	240L MGB	2	10	240	480
Clinical waste	240L MGB	1	2	240	48
Cytotoxic waste (where applicable)	240L MGB	1	1	240	24
Polystyrene recycling	1 cubic metre bale bag (and 1 bale frame)	2 (bags)	2 (bags)	1000	50
Cardboard recycling	1.5 cubic metre skip	1	1 (equivalent measure = 2 x 1100L MGBs)	1500	150
Total					**2,864**

Assumed GFA for Building 32 = 4,430m^2.

Estimated MLS Building Waste Generation and Bin Footprint Requirements

Waste Stream	Type of Bin	Bin capacity (L)	Total Waste Generation (L per day)	No. of Bins (B32)	Additional No. of Bins (MLS)	Total No. of Bins (B32 + MLS)	Bin footprint (B32)	Additional bin footprint (MLS)	Total bin footprint of (B32 + MLS)
General waste	240L MGB	240 x 90%	1,742	6	9	15	3.0	4.5	7.5
Recycling	240L MGB	240 x 90%	348	4 (assume increased collection frequency)	6 (assume increased collection frequency)	10	2.0	3.0	5.0
Office paper	240L MGB	240 x 90%	465	5 (assume increased collection frequency)	9 (increased collection frequency)	14	2.5	4.5	7.0
Confidential waste	240L MGB	240 x 90%	581	10	14	24	5.0	7.0	12.0
Clinical waste	240L MGB	240 x 90%	58	2	3	5	1.0	1.5	2.5
Cytotoxic waste (where applicable)	240L MGB	240 x 90%	29	1	1	2	0.5	0.5	1.0
Polystyrene recycling	1 cubic metre bale bag	60 x 70%	60	2	0 (assume shared arrangement and increased collection frequency)	2	2.8	0.0	2.8
Cardboard recycling	1100L MGB	1100 x 90%	181	2	1 (assume increased collection frequency)	3	4.0	2.0	6.0
Total			**3,465**	**32**	**43**	**75**	**20.8**	**23.0**	**43.8**

Assumptions List:

- Building 32 only is responsible for generating the waste amounts reviewed as part of the audit, and activities undertaken within Building 32 are of a similar in nature and scale to those undertaken in the MLS Building.
- Audit details are typical of average to peak waste generation rates for Building 32 provided by UOW.
- Wheelie bins for planned future arrangements have been assumed to remain as 240L MGBs for most waste streams given required transfer distances.
- Waste generation rates have been based on information provided from Building 32 audit, and scaled according to differences in Gross Floor Area (GFA) between the MLS Building and Building 32. To keep estimates conservative, it has been assumed that 100% of each bin/receptacle's capacity is currently utilised at collection.
- Level 5 and 6 have not included in floor area calculations for operational waste arising given these are plant areas and are therefore unlikely to contribute greatly to major waste streams.
- Cytotoxic waste has assumed to be equal to or less than that generated by Building 32 based on discussions with the UOW project team during Jacobs site visit.
- Cardboard recycling bins (1100L MGBs) will replace the 1.5m^3 skip as collection vehicles are required to be rear-loading.
- The polystyrene bale bags (2) and the cardboard recycling bins (3) will be utilised under a shared arrangement between Building 32 and the MLS Building to avoid the need for additional receptacles to be stored at the loading dock and waste enclosure area. Collection frequencies will instead be increased to accommodate for the increased recycling generation.
- Collection frequencies have been increased for co-mingled and office paper recycling to suit the planned space arrangements of the waste enclosure.
- The dimensions of the 240L and 1100L MBGs have been taken from the NSW EPA's Better Practice Guidelines (2012) document.
- The dimensions of the bale bag frame has been assumed to have the dimensions 1m x 1m + 15%.
- Bin capacities for estimations of bin numbers have assumed between 70% (polystyrene) and 90% (remaining waste materials) of the bin capacity is used (i.e. no compaction with the remaining space comprises of air / air pockets between waste items).
- Quality assurance checks have been provided through comparison with industry waste generation rates as published in the NSW EPA's Better Practice Guidelines (2012) document. The total waste volume (in litres) generated by Building 32 was calculated to be 69L per day per 100m^2 and this compares well with total industry waste generation rates (garbage and recycling considered together) for "Medical" which is 71L per day per 100m^2.

Appendix D. Architectural Drawing - Indicative Waste Enclosure Storage Arrangements

BUS / TRUCK ZONE

EXISTING TREE
TO BE REMOVED

REALIGN FIRE
EXIT PATHWAY

RELOCATED
SUB STATION 10

GRATE
22.22

NEW IHMRI GAS STORE

FIRE EXIT

NEW SLIDING
GATE

RL 23.314

22.30 RL

SCREENED LOADING + SECURE
WASTE ENCLOSURE FOR MLS + B32

HEAVY RIGID
VEHICLE

ON GRADE
PEDESTRIAN
ACCESS @ 1:14

CONFIDENTIAL
WASTE

CO-MINGLED
RECYCLING
BACKUP

CO-MINGLED
RECYCLING

OFFICE PAPER
WASTE

OFFICE BACKUP
BINS

GENERAL WASTE
BACKUP

GENERAL WASTE

NEW RAMP

RELOCATE BIN
WASH AREA

EMPTY
CYTOTOXIC
WASTE

3 x 1100L MGB
CARDBOARD RECYCLING

EXISTING GENERATOR

SPARE BALE
BAGS

POLYSTYRENE
BALE FRAME
(EXISTING)

BRIDGE LINK ABOVE

6 x FULL CLINICAL WASTE BINS
2 x FULL CYTOTOXIC BINS
STORED IN COOL ROOM
PRIOR TO PICKUP

EMPTY CLINICAL
WASTE

RETAIN EXISTING
SLIDING GATE

REMOVABLE
BOLLARDS

RL 22.411

BUILDING 32
IHMRI

PROPOSED WASTE STORAGE YARD EAST
OF BUILDING 32

SCALE: 1:150 @ A3
DATE: 25/05/2017
REVISION: C