



Construction and Demolition Waste Management Guideline

UNSW Sydney

Revision 1.0

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1 Introduction

Construction and demolition activities can generate a wide range of waste materials, which often consists of valuable recyclable items. This Construction and Demolition (C&D) Waste Management Guideline ('guideline') is based on a report by MRA Consulting Group and was developed to support UNSW meet its strategic target to achieve a minimum of 90% recycling rate of construction and demolition waste from capital projects across University campuses.

This guideline considers existing waste management and resource recovery legislation, state and national guidelines, UNSW strategies and plans, and best practice methods. It has been designed to support UNSW achieve its waste and environmental sustainability targets by:

- Minimising C&D waste by promoting sustainability in building design and focussing on end of life deconstruction;
- Encouraging early project planning, and supporting waste avoidance and reuse on site;
- Ensuring that where practicable, an efficient recycling procedure is applied to waste materials;
- Ensuring waste is transported, processed and disposed of in a lawful manner;
- Supporting achievement of UNSW sustainability targets; and
- Raising awareness among employees and subcontractors of their waste management responsibilities.

2 Strategic Context

The primary framework for waste management consists of:

- National Waste Policy
- NSW legislation (Acts and Regulations)
- NSW waste strategy and policy
- Randwick City Council plans and policies
- UNSW plans and policies
- The Green Building Council of Australia (GBCA)'s Green Star rating tools

2.1 National Waste Policy

The 2018 National Waste Policy provides a framework for collective action by businesses, governments, communities and individuals until 2030. Waste occurs at all stages of materials management and product development, from extraction, transformation and use, to reprocessing and disposal.

The aim of the National Waste Policy is to:

- Respond to challenges facing waste management and resource recovery in Australia.
- Reflect the global shift towards a circular economy, including the need for better resource-efficient systems, products and services to avoid waste, conserve resources and maximise the value of all materials used.
- Provide a framework for businesses to embrace innovation and develop technologies that create new opportunities.

The waste hierarchy is adopted in parallel with circular economy principals:

- Avoid purchasing products with excessive or unnecessary packaging.
- Repair or reuse items rather than throwing them away.
- Purchase products we can use multiple times and that are long-lived, rather than single use or poor-quality items that are thrown away quickly.
- Improve our recycling habits by sorting our waste appropriately into recycling and compost bins.
- Use products that are recyclable and include recycled content.

The role of businesses and industries, including manufacturers and brand owners, is critical in improving the design of products to both avoid waste and for reuse, repair and appropriate packaging.

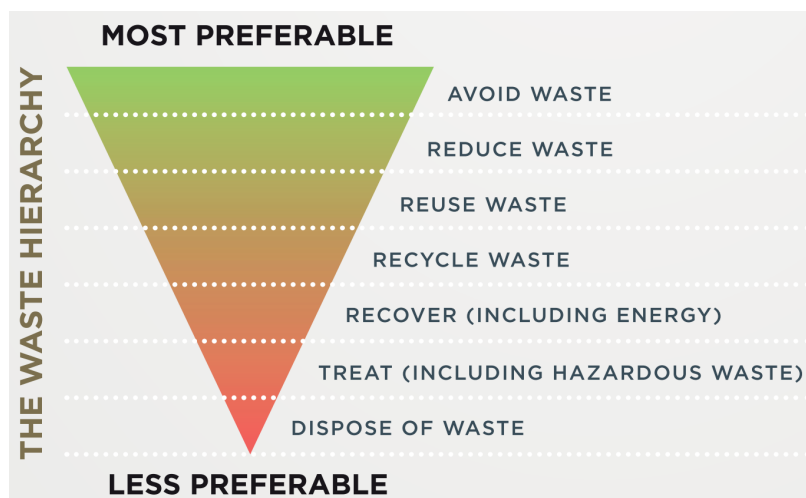


Figure 1: NSW EPA Waste Hierarchy (National Waste Policy, 2018)

2.2 Relevant NSW Legislation and Guidelines

The Environment Protection Authority (EPA) administers the majority of NSW legislation relating to the management of waste.

Protection of Environment Operations Act 1997

The Protection of the Environment Operations Act 1997 (POEO Act) promotes mechanisms which aim to protect the environment, reduce risks to human health and prevent environmental degradation. Some major features of the legislation include:

- Specifying requirements for licences and the regulation of various activities that have the potential to pollute or harm the environment;
- Integrating EPA licensing with the development approval procedures under the Environmental Planning and Assessment Act 1979;
- Providing for the issuing of clean-up notices, prevention notices and prohibition notices;
- The requirements for licensing, approvals, notices, waste tracking and offences and penalties apply to all construction and demolition activities.

Protection of the Environment Operations (Waste) Regulation 2014

This POEO Waste Regulation sets out provisions around the way waste is managed in terms of re-use, storage, and transportation as well as reporting and record keeping requirements for waste facilities. It also provides for:

- Setting special requirements for the management of certain special wastes including asbestos;
- Payment of waste contributions (also referred to as a waste and environment levy) by the occupiers of licensed waste facilities for each tonne of waste received at the facility or generated in a particular area;
- The records that must be kept by occupiers of waste facilities;
- Requirements imposed on consigners, transporters and receivers of waste;
- Requirements for transporters of waste to report to the Environment Protection Authority on the following: (i) the transportation interstate of waste generated in metropolitan areas, (ii) the transportation of waste tyres, (iii) the transportation of asbestos waste;
- Exemption of certain occupiers or types of waste from paying waste contributions and deductions to be claimed in relation to certain types of waste;
- Orders imposing conditions on generators of waste in relation to the supply of waste which falls under a resource recovery exemption.

The Protection of the Environment Operations Legislation Amendment (Waste) Regulation 2018¹ relating to C&D waste came into force on 16 November 2018. Significant reforms are listed in Table 1.

¹ Protection of the Environment Operations Legislation Amendment (Waste) Regulation 2018 under the Protection of the Environment Operations Act 1997, Published LW 16 November 2018 (2018 No 643).

Table 1: Key reforms enforced by the Protection of the Environment Operations Legislation Amendment (Waste) Regulation 2018

Reform	Details
Prohibition on exhuming waste	Applies to current and former landfills. Maximum penalties include \$44,000 for a corporation and \$22,000 for individuals.
Handling of asbestos waste	General requirements applying to the packaging, transportation, and disposal of asbestos waste to ensure safety. Increased penalty notice amounts for asbestos waste offences.
Transported waste deductions	Provisions with respect to waste contributions for waste received or transported for recovery, recycling, or processing.
Waste for bedding layers and biofilters	Permission for use of waste as biofilters or bedding layers in a landfill with approval of the EPA.
Monitoring waste activities	Video monitoring systems at scheduled waste facilities.
Definition of land pollution	Certain activities carried out for remediation of contaminated land is not land pollution.
Licensing requirements	Occupiers of a landfill site that receives only virgin excavated natural material are exempt from certain reporting requirements.
References to LGAs	Updating references to merged and renamed local government areas.

The Environmentally Hazardous Chemicals Act 1985

The Environmentally Hazardous Chemicals (EHC) Act provides the NSW EPA with the authority to declare chemical substances as chemical wastes, and to make chemical control orders relating to those substances that are declared as chemical wastes. Chemical control orders are made when chemicals or chemical wastes pose serious threats to the environment, and there are particular challenges in their management. Chemicals must be handled in accordance with the relevant Chemical Control Order. There are currently five Chemical Control Orders in place in NSW.

- Aluminium smelter wastes containing fluoride and/or cyanide;
- Dioxin-contaminated waste materials;
- Organotin waste materials;
- Polychlorinated biphenyl (PCB);
- Scheduled chemical wastes chemical control order 2004 (A list of 24 chemicals including a number of organochlorine pesticides which are no longer registered for use (e.g. DDT, dieldrin, heptachlor) as well as some industrial waste by-products).

The EHC Act also requires that an authorised licence be obtained for certain activities relating to the manufacturing, processing, keeping, distributing, conveying, using, selling, or disposing of an environmentally hazardous chemical or a declared chemical waste.

2.3 NSW Waste Management Strategy and Policy

NSW Waste Avoidance and Resource Recovery Act 2001

The Waste Avoidance and Resource Recovery Act 2001 (WARR Act) is the primary act governing resource recovery in NSW. The objectives of the WARR Act are to promote:

- The most efficient use of resources, including resource recovery and waste avoidance;
- A reduction in environmental harm, including pollution through waste;
- A consideration of the resource management hierarchy through avoidance of unnecessary resource consumption and disposal; and
- Resource recovery, which includes reuse, reprocessing, recycling, and energy recovery.

The WARR Act defines a Waste Hierarchy, which ranks waste management options in order of environmental desirability. Generally, managing waste at a higher level in the hierarchy results in a lower impact and risk to the environment and communities. The waste hierarchy is intended for use alongside other assessment tools, such as cost benefit analysis, to guide decision-making.

NSW Waste and Sustainable Materials Strategy 2041

The NSW Waste and Sustainable Materials Strategy 2041 (20-Year Strategy) supersedes the NSW Waste Avoidance and Resource Recovery Strategy 2014-21 (WARR Strategy) and provides the framework for waste management in NSW for the next 20 years. As of June 2021, Stage 1 of the 20-Year Strategy has been released, addressing goals for waste management and resource recovery in NSW to 2027.

Stage 1 of the 20-Year Strategy *“focuses on the environmental benefits and economic opportunities in how we manage our waste”* emphasising the principals of the circular economy model. The document outlines a number of key objectives which are outlined as follows:

- Endorsement of the National Waste Policy Target of 80% diversion from landfill by 2030;
- Reduce total waste generated by 10% per person by 2030;
- Have an 80% average recovery rate from all waste streams by 2030;
- Significantly increase the use of recycled content by governments and industry;
- Phase out problematic and unnecessary plastics by 2025; and
- Halve the amount of organic waste sent to landfill by 2030.

C&D recycling has performed the best at a rate close to 80% (greater than 77% since 2016), the 20-Year Strategy has set targets to achieve 80% recovery for C&D waste and increase the proportion of all waste diverted from landfill to 80%, in line with the National Waste Policy Target.²

This Construction and Demolition Waste Management Guideline is consistent with the 20-Year Strategy and has adopted the waste management hierarchy established under the Waste Avoidance and Resource Recovery Act 2001 and the circular economy principals emphasised in the NSW Waste and Sustainable Materials Strategy 2014.

² NSW EPA (2021) Waste and Sustainable Materials Strategy – https://www.dpie.nsw.gov.au/_data/assets/pdf_file/0006/385683/NSW-Waste-and-Sustainable-Materials-Strategy-2041.pdf, accessed 3 September 2021

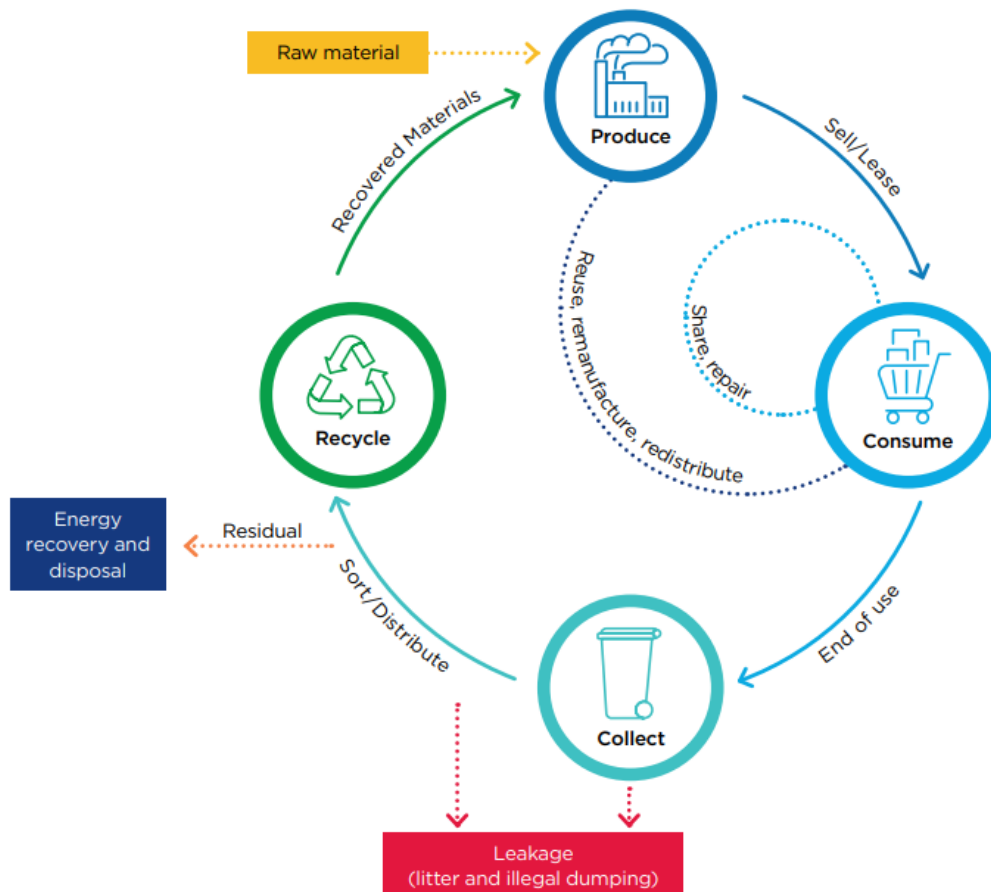


Figure 2: NSW EPA Circular Economy Principals

It sets out the preferred order of waste management practices from the most preferred to least preferred as follows:

Waste Avoidance: Take action to firstly avoid the generation of waste and to be more efficient in its use of resources. If unable to avoid generating waste, then reduce the amount of waste generated, reduce the toxicity or potential harm associated with its generation and management, and invest in recycled content or easily recoverable materials in infrastructure where practicable.

Resource Recovery: Maximise the reuse, reprocessing, recycling and recovery of energy from materials.

Disposal: Disposal is the least desirable option and must be carefully handled to minimise negative environmental outcomes.

Remanufacture: Replacement of raw material inputs with reprocessed recycle for input back into manufactured product.

NSW Asbestos Strategy

Asbestos is common in the NSW built environment. The NSW EPA is responsible for regulating asbestos waste under the POEO Act and the POEO (Waste) Regulation 2014.

In early 2019, the NSW EPA released the Asbestos Waste Strategy 2019-2021 after several months of public consultation on the draft strategy document. The strategy is focused on reducing illegal dumping and unsafe disposal, as well as promoting appropriate disposal of asbestos waste including asbestos in soil. The reforms to managing asbestos handling, transport and disposal proposed in the draft strategy are:

- Making asbestos waste disposal easier;
- Making asbestos waste disposal cheaper;
- Increasing awareness and changing behaviour;
- Closing loopholes and increasing transparency;
- Disrupting unlawful business models; and
- Monitoring and evaluating of the above reforms' performance against baseline data.

The asbestos strategy is anticipated to increase lawful disposal of asbestos. There is no current baseline for lawful disposal of asbestos. A baseline will be determined in the first year of the NSW Asbestos Waste Strategy 2019-21³.

Standards for managing construction waste in NSW

In April 2019, "Standards for managing construction waste in NSW" (Standards) were implemented to improve inspection and screening processes at C&D facilities, and ensure removal of contaminants from mixed loads that are particularly sent off site for disposal⁴. The main requirements from the Standards include⁵:

- Two-stage inspection process to ensure asbestos and other contaminants do not enter the facility;
- Sorting and waste storage requirements to improve the quality of recovered resources and avoid cross- contamination of materials;
- Ensure that construction waste is only transported from the facility if it has been handled in accordance with the Standards on-site; and
- Ensure that all staff managing, supervising or undertaking tasks required by the Standards have been appropriately trained (including in asbestos awareness).
- The standards apply to C&D facilities that receive in excess of 6,000 tonnes of C&D waste per year from the metropolitan levy area.

Resource Recovery Orders and Exemptions (RRO&Es)

Clause 92 of the POEO (Waste) Regulation 2014 enables the EPA to grant exemptions to the licensing and payment of levies for the land application or use of waste. The EPA has issued general resource recovery orders and exemptions for a range of commonly recovered, high volume and well characterised waste materials that allow their use as fill or fertiliser at unlicensed, off-site facilities (refer to Appendix C).

Advice from the NSW EPA provided on 2nd September 2021 indicates that the EPA intends to cease permitting Resource Recovery Order and Exemption for Recovered Fines (fine skip bin material) from being applied to land due to the risk of asbestos being present. In its place, a general Order and Exemption for Recovered Soil is expected to be produced. UNSW will continue to monitor NSW RRO&Es to ensure waste management practices and contractor obligations are in line with current guidance and strategic focus.

Waste Tracking

Consistent with the POEO (Waste) Regulation 2014 the following wastes potentially encountered/generated are required to be tracked within NSW:

³ NSW EPA (2019) NSW Asbestos Waste Strategy 2019 -21 –, <https://www.epa.nsw.gov.au/your-environment/waste/industrial-waste/asbestos-waste-strategy>, accessed 16 August 2021

⁴ NSW EPA (2019) Standards for managing construction waste in NSW, <https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/waste/19p1542-standards-for-managing-construction-waste-in-nsw.pdf>, accessed 16 August 2021.

⁵ NSW EPA (2018) Waste management reforms commence on 16 November 2018, <https://www.epa.nsw.gov.au/your-environment/waste/industrial-waste/construction-demolition/construction-and-demolition-waste>, 16 August 2021.

- Hazardous Wastes as defined by Table 3 in the NSW EPA 'Waste that must be tracked' guideline;
- Liquid Waste (Category 1 trackable waste);
- More than 100 kilograms of asbestos waste or more than 10 square meters of asbestos sheeting in any single load;
- More than 200kg of waste tyres, or 20 tyres (whichever is heavier);
- Waste oil/water, hydrocarbon/water mixtures or emulsions; and
- Wastes listed in Table 1 of the NSW EPA 'Waste that must be tracked' Guideline.

It is noted that there is an exemption in place (Notice of Exemption from Clause 79: Reporting on transportation of asbestos waste solely within NSW) for the transport of Asbestos contaminated soil and this does not need to be tracked.

The NSW EPA Waste Locate system is to be used to track asbestos waste and waste tyres, whilst the online waste tracking system developed by EPA will be utilised to track all other trackable waste.

2.4 Randwick City Council Plans and Policies

The Randwick Development Control Plan 2013 (DCP) provides detailed planning and design guidance for new development, which supplements the provisions of Randwick [Local Environment Plan](#) (LEP) 2012. The DCP refers to the UNSW campus under the section 'Randwick Education and Health Specialised Centre', which requires that waste management plans are prepared for all non-exempt developments, ensuring that suitable waste management processes and waste storage areas that support the principles of waste avoidance, reuse and recycling are incorporated into the design of buildings.

Waste management plans are to include projected waste generation rates for the end use of the development and the development plans are to include facilities to support this waste generation, e.g. appropriately sized and accessible waste storage areas, integrated with waste collection systems.

All waste storage areas are to be graded and drained to the sewer to the requirements of Sydney Water.

For new campus projects (redevelopment or other capital works), key planning, design and development requirements include to ensure all new buildings and refurbishments target a 5 Star rating under Green Star rating scheme.

Table 2 describes relevant planning controls for other UNSW campuses that specify similar requirements for waste management plans and design considerations.

2.5 UNSW Plans and Policies

UNSW 2025 Strategy Update

Environmental sustainability is a key element of UNSW's updated 2025 Strategy, released in 2020. The Environmental Sustainability Plan 2019-21 supports the 2025 Strategy, particularly:

Theme 03 - Sustainable Development

- Objective 2. Reduce our environmental footprint by using natural resources more efficiently, reducing waste and ensuring investments are consistent with the United Nations Sustainable Development Goals (UN SDGs).

Enabler 04 - Enhance Our Campuses

- Objective 2. Position our campuses and the activities they support as leaders in sustainability practices. We can do this by minimising our environmental footprint and improving resource efficiency; and

UNSW Environmental Sustainability Plan 2019-21

The Environmental Sustainability Plan includes the following targets that are relevant to management of construction and demolition waste:

- Buildings & Campus: Design and build new buildings to minimum 5 Star Green Star Design & As Built or equivalent.
- Waste & Recycling: Achieve minimum 90% recycling of construction and demolition waste.

This guideline aims to support project teams by providing guidance about how capital projects can achieve and demonstrate UNSW's target of recycling 90% of construction and demolition waste.

Capital Projects Sustainability Framework

The Capital Projects Sustainability Framework (CPSF) provides guidance for project teams on how to deliver outstanding sustainability performance in a way that is specific to UNSW and an expression of the unique character and history of UNSW campuses. The CPSF aligns with the UNSW Environmental Sustainability Plan 2019-21 focus areas and provides a way to map the outcomes for each project.

The CPSF includes a set of templates for use on projects. The Sustainability Evaluation Matrix is the primary template for tracking sustainability performance through the project cycle, including construction and demolition waste recycling rates.

Waste Management Plan

The Waste Management Plan (WMP) sets out the direction for the management of UNSW waste, including C&D waste, in support of UNSW strategic and operational objectives. The WMP:

- Outlines the methodology for responsible waste management at UNSW;
- Defines responsibilities for waste management; and
- Presents an action plan to improve waste segregation and management practices and deliver improved stakeholder satisfaction and sustainability outcomes.

2.6 Green Star

Green Star is a national and voluntary rating system for buildings and communities that is managed by the Green Building Council of Australia. Green Star assesses the sustainable design, construction and operation of buildings, fit-outs and communities. UNSW is committed to achieve minimum 5 Star Green Star Design & As Built or equivalent for new buildings, but not to certifying projects under any Green Star or other sustainability rating system.

All Green Star rating tools include a Construction and Demolition Waste credit which aims to encourage and reward management practices that minimise the amount of construction and demolition waste from base building and/or interior fit-out works that is disposed to landfill. The credit requires the use of waste contractors and waste processing facilities that have been independently verified for compliance with minimum standards of reporting.

The reporting criteria⁶ ensure that:

Waste contractors (transport and handlers) servicing Green Star buildings:

- Provide accurate reporting on waste collection and diversion from landfill; and
- Take all of a project's construction and demolition waste to waste processing facilities that meet the Reporting Criteria.

⁶ Green Building Council of Australia, Green Star Construction and Demolition Waste Reporting Criteria, https://www.gbca.org.au/uploads/237/34797/C-D_Waste_Reporting%20Criteria_FINAL_210613.pdf (accessed 10 May 2021)

Waste processing facilities that accept Green Star project construction and demolition waste do so under three criteria:

Criterion 1: To ensure that waste processing facilities servicing Green Star building sites are legitimately operating businesses that are recognised by the relevant regulatory authorities

To comply with this criterion, Green Star waste processing facilities must operate legally with approved Development Approvals (DAs), and the relevant environmental licenses.

Criterion 2: To ensure that waste processing facilities servicing Green Star building sites have the capacity to prepare accurate reports on the source and fate of all inbound waste received as well as all outbound waste diverted from and to landfill.

To comply with this criterion, the following requirements would be met:

- 1) Clear separation of waste processing facility from landfill. Waste processing facilities would operate separately to landfill to ensure that waste input and recyclables are clearly traceable to and from the waste processing facility.
- 2) Clear tracking system. The waste processing facility must have a weighbridge to quantify waste and provide an auditable trail for inbound and outbound materials.
- 3) Certified weighbridge operating procedure. The waste processing facility must have a current weighbridge operating certificate and be able to provide the following information for materials received, outgoing recyclables and residual waste:
 - vehicle registration and date and time received;
 - weight of vehicle and material incoming;
 - source of material incoming (for example customer numbers);
 - weight of vehicle and material outgoing;
 - fate of material outgoing (by product type, including residual waste to energy recovery, or
 - landfill and the entity/customer removing it); and
 - any rejected loads.
- 4) Source and fate of inbound and outbound waste. The waste processing facilities must be able to account for the source of all inbound waste and fate of all outbound recyclables and residual waste.

Criterion 3: To encourage waste processing facilities that service Green Star building sites to provide independently verified publicly available reports on the percentages of gross waste diversion from landfill and residual waste committed to landfill on an annual basis.

To comply with this criterion, the following requirements must be met:

- 1) The waste processing facility must undergo an independent annual facility-wide audit to establish and verify its:
 - a. Gross diversion rates of input waste from landfill; and
 - b. Percentage of residual waste output that is committed to landfill.
- 2) The waste processing facility must make these performance figures publicly available or, at a minimum, make them easily available upon request from Green Star customers or waste contractors acting on behalf of Green Star projects.

Table 2: Local Government Planning Provisions

UNSW Campus	Location	Relevant Local Planning Control
UNSW College of Fine Arts	Paddington, NSW	Sydney Development Control Plan 2012 City of Sydney Guidelines for Waste Management in New Developments
UNSW Water Research Laboratory	Manly Vale, NSW	Warringah Development Control Plan (WDCP) and Waste Management Guidelines
Cliffbrook House	Coogee, NSW	Randwick City Council Development Control Plan
UNSW Canberra	Canberra, ACT	Australian Government Department of Defence Waste Minimisation Policy

3 Construction and Demolition Waste Types

C&D waste is defined as any waste or material generated or resulting from excavation, construction, fit-out or demolition work, including soils and processed C&D waste.⁶

In comparison to other waste streams, C&D waste is generally more homogenous and predictable. The composition of C&D is generally inert and dry in nature, with high levels of metals, plastics, brick, concrete and wood.

The development of UNSW sites for building has potential to produce a mixture of construction and demolition waste (including excavation waste), which generally includes any of the following:

Table 3: Classification of construction and demolition waste types

Waste Activity	Waste Generated	Classification
Waste produced from the strip- out of the existing structures	Carpet Kitchen facilities Appliances Windows (glass and panels) Internal fittings and fixtures	General Solid
Waste produced from the demolition of the existing structures	Concrete Metal (ferrous and non- ferrous) Brick Plasterboard Cables Green waste	General Solid
Waste from on-site maintenance and servicing of plant and equipment	Drained and crushed oil filters and grease tubes Used and defective parts Oil soaked rags Used oil absorbent materials Tyres	General Solid
Waste from crib sheds and office areas	Food scraps, waste wrappers, waste paper towels	General Solid Putrescible
Office and packaging waste (non-liquid)	Paper, cardboard, glass, plastic (no food scraps etc)	General Solid
Waste from construction activities (non-liquid)	Soil and sand Concrete pour residues	General Solid

⁶ NSW EPA, 2018, New minimum standards for managing construction and demolition waste in NSW, <https://www.epa.nsw.gov.au/~media/EPA/Corporate%20Site/resources/wasteregulation/nsw-managing-construction-demolition-waste-minimum-standards-160545.ashx> (accessed 10 May 2021)

Waste Activity	Waste Generated	Classification
	Aggregates Damaged and off cuts of PVC pipes Rejected or defective precast concrete Steel waste Used geotextile Timber waste (treated and non-treated)	
Any waste that meets the criteria for assessment as dangerous goods under the Australian Code for the Transport of Dangerous Goods by Road and Rail	Poisonous (toxic) substances and corrosive substances Non-sag epoxy mortar binder Synthetic rubber based adhesive Epoxy resins Batteries	Hazardous

4 Best Practice Guide - Onsite Construction and Demolition Waste Management

C&D activities should be designed and implemented to ensure that all waste is managed in an effective, safe and environmentally aware manner across the whole building lifecycle.

The following section aligns with the Environmental Sustainability Plan targets to achieve 90% recycling of construction and demolition waste, and ensure new buildings are designed and built to achieve Green Star Design & As Built (5 Star) equivalent by 2022 by fostering best practice waste management practice for campus development and refurbishment projects.

4.1 Pre-Construction and Demolition

The pre-construction and demolition stage of the development is one of the most important phases to ensure materials and components are identified, reused, and recycled multiple times during building lifecycles.

C&D waste avoidance and minimisation reduces the need for virgin materials, minimises the space and cost for disposal of waste, and ensures efficient use of materials.

The following planning and design elements offer maximum opportunity for resource optimisation and waste reduction⁷.

4.1.1 Design

Design for reuse and recycling

- Reuse of formwork and building components;
- Separation of off-cuts to facilitate reuse, resale or efficient recycling;
- Design for waste efficient procurement;
- Considered civil estimation and contingency provision so that the required quantities of materials are ordered with minimum wastage or surplus;
- Specifying the use of recycled content in new build; and
- Reuse and recovery of materials from excavations, demolition and refurbishment works.

Design for waste-efficient procurement

- Reduction in the need for off-cuts and wastage through appropriate specification to suppliers;
- Early stakeholder coordination and good project communication with clearly defined responsibilities; and
- Clear procurement guidelines for waste reduction.

Design for material optimisation

- Simplification and standardisation of building materials and components to facilitate reuse; and
- Prefabrication of materials where possible.

⁷ Mark Kelly, Donal Dowd, 2015, Review of Design and Construction Waste Management Practices in Selected Case Studies – Lessons Learned, EPA Research Report 146, <http://www.europeandemolition.org/library/eu-construction-demolition-waste-management-protocol> (accessed 4 December 2018)

Design for Offsite Construction

- Use offsite modular building systems; and
- Use offsite building envelope components and elements.

Design for deconstruction and flexibility

- Design accessible components that are removable considering the building layers and anticipated lifespan;
- Specify durability of materials to facilitate reuse opportunities;
- Avoid use of composites, resins, adhesives and coatings; and
- Plan services and building accessibility for convenient maintenance and replacement.

4.1.2 Planning

A Project Waste Management Plan (PWMP) is a management tool and resource that supports the minimisation and management of waste generated during planned construction and demolition activities. In accordance with the UNSW Waste Management Plan, for projects over \$300k in value, a site-specific Project Waste Management Plan (PWMP) should be developed at the 'Documentation' stage and made available to the EM Facilities Management and Sustainability teams.

The key objectives of a PWMP should be to:

- Minimise the amount of waste generated as part of the project;
- Maximise the amount of material which is sent for reuse, recycling or reprocessing; and
- Minimise the amount of material sent to landfill.

When developing and implementing the WMP there should be consideration of the following activities:

Waste Streams

- Classify wastes and management options (re-use, recycle, stockpile, disposal) (see Appendix C);
- Determine statutory approvals required for managing both on and offsite waste, or application of any relevant resource recovery exemptions;
- Estimate volume of waste by material type likely to be generated;
- Estimate likely condition of materials: cleaner material is easier to recycle and may affect the contractor price for recycling;
- Identify potential risks of contamination by hazardous materials like asbestos or lead. These materials will limit reuse /recycling options and require special disposal;
- Determine siting and design requirements for waste storage areas; and
- Determine access and collection requirements.

Services

- Select an appropriately qualified waste management contractor to provide recycling and disposal services for the waste streams generated and data on waste/recycling generation. Green Star accredited contractors are listed in a regularly updated online member directory (<https://www.gbca.org.au/members/>) managed by the Green Building Council Australia.

On-site

- Understand how the waste management system will work on-site, including bin placement and access.

Ease of use

- Ensure that containers are easily accessible by workers

4.1.3 Safety

- Ensure that the containers and storage can be managed safely, including limiting public access to the site

Engage

- Clearly assign and communicate responsibilities: ensure that those involved in the demolition are aware of their responsibilities in relation to the waste management plan;
- Clarity about how the various elements of the waste management plan will be implemented and ensure staff have an opportunity to provide feedback on what is/isn't working.

Monitoring and Evaluation

- Ensure the plan is being implemented and monitor on-site;
- Once the project is complete evaluate your estimates in the Plan against actual waste generated and consider feedback from personnel.

4.1.4 Training

All contractors working on UNSW sites should undergo site induction training (Part A & Part B).

The Head Contractor should ensure each subcontractor:

- Takes practical measures to prevent waste being generated from their work;
- Implements procedures to ensure waste resulting from their work will be actively managed and where possible recycled, as part of the overall site recycling strategy or separately as appropriate;
- Ensures that the right quantities of materials are ordered, minimally packaged and where practical pre-fabricated. Any oversupplied materials are returned to the supplier for reuse; and
- Implements source separation of off cuts to facilitate reuse, resale or recycling. The Site Manager should be responsible for;
- Ensuring there is a secure location for on-site storage of materials to be reused on site, and for separated materials for recycling off site;
- Engaging appropriate waste and recycling contractors to remove waste and recycling materials from the site;
- Co-coordinating between subcontractors, to maximise on site reuse of materials;
- Monitoring of bins on a regular basis by site supervisors to detect any contamination or leakage;
- Ensuring the site has clear signs directing staff to the appropriate location for recycling and stockpiling station/s. And that each bin/skip/stockpile is clearly sign posted; and
- Provide training to all site employees and subcontractors in regards to the WMP.

Site Employees should be responsible for:

- Attending site specific inductions; and
- Having a clear understanding of which products are being reused/recycled on site and where they are stockpiled.

Any procedures for non-conformance should be managed by the Head Contractors' Quality Management Systems.

4.2 Construction and Demolition Phase

4.2.1 Reuse and Recycling

Waste separation and segregation should be promoted on-site to facilitate reuse and recycling as a waste management priority.

The following options may apply

Waste segregation onsite – Waste materials can be separated onsite into dedicated bins/areas for either reuse onsite or collection by a waste contractor and transport to offsite facilities. Source separation is particularly important in minimising damage to salvaged materials. C&D waste that is separated at source can be sold directly into the marketplace and any residual unsold waste is then landfilled.

Waste separation offsite – Wastes can be deposited into one bin where space is not available for placement of multiple bins. This material is then collected and delivered to a processing plant where they will be sorted mechanically for recycling, reprocessing or disposal to landfill.

In general, the contract between a waste service provider and construction and demolition waste generator is on a project-by-project basis and lasts the duration of the construction and demolition phases of a project.

Figure 3: Typical C&D waste processing and disposal material flow

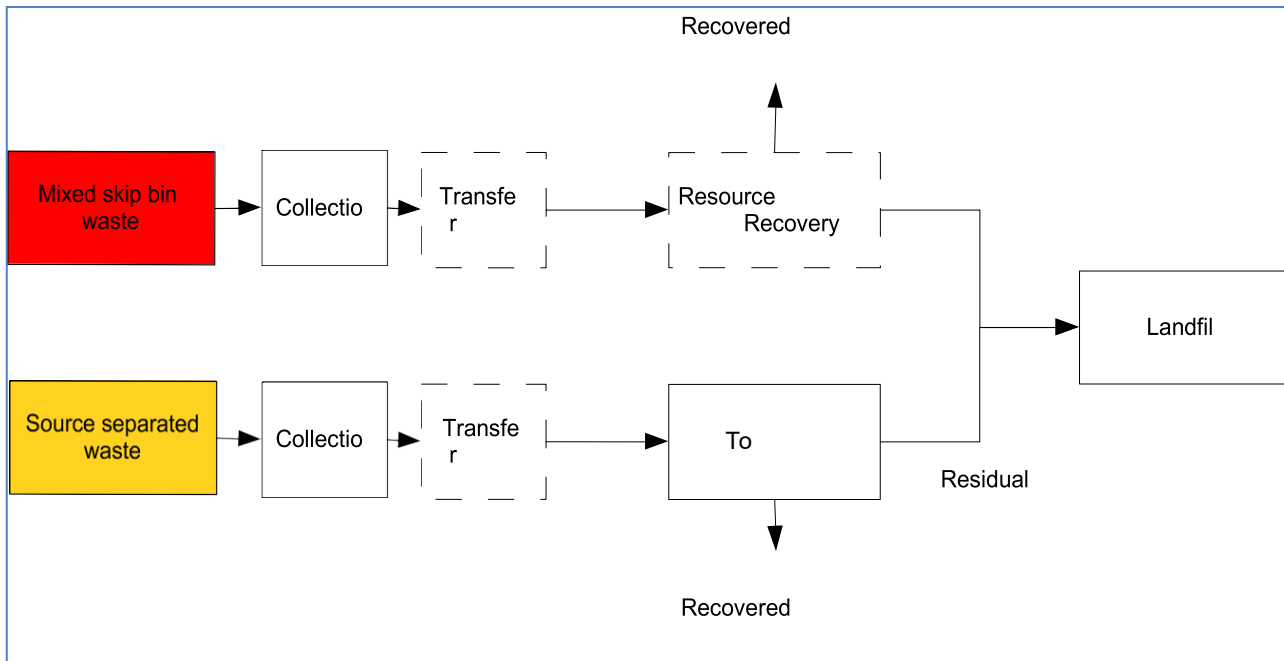


Table 4 outlines general waste management onsite and offsite options for common construction and demolition wastes generated during a project. Specific contract arrangements for recycling, processing and disposal would be determined upon appointment of a contractor and should comply with Green Star requirements for certification.

Unused material should be taken back by supplier for reuse where possible, and waste materials should be separated on site wherever possible to enhance resource recovery.

Table 4: General waste management options by site material type

Type of material	On site Management	Off-site Management
Concrete	Reuse on site for filling or under gravel carpark	<p>Collected by a contractor and processed at concrete recycling facility.</p> <p>Concrete recycling involves the use of crushing machines similar to those used for other materials such as rock and larger aggregate. Crushed concrete can be used as a substitute for virgin aggregates such as gravel, limestone and rock.</p>
Timber	No on-site reuse	<p>Collected by a contractor and processed at timber recovery or disposal facility.</p> <p>Untreated timber can be reclaimed, reused, or potentially re-processed into flooring or mulch according to regulatory standards.</p> <p>Most timber is generated from the demolition sector. Recovery depends on several factors – size, type, condition and treatment or paint.</p>
Brick and tiles	Bricks can be cleaned, stockpiled and reused wherever possible	<p>Collected by a contractor and disposed at brick recycling facility</p> <p>These can be recovered whole for resale, or crushed and used as raw material for re-firing into bricks or used as landscaping material, general fill, drainage, road pavement, structural concrete or pavement concrete.</p>
Plasterboard	No on-site reuse	<p>Collected by a contractor on a weekly basis (or as required) for recycling. Possible use as soil improver with gypsum etc removed by recycler</p> <p>Plasterboard is not readily separated from mixed loads using mechanised demolition processes. For this reason, it is one of the most challenging materials when seeking to improve the recovery of mixed C&D loads.</p>
Metals	No on-site reuse	<p>Collected by a contractor for recycling.</p> <p>The majority (about 90 per cent) of metals recovered from the C&D sector comes from commercial demolition sites. Of this material, up to 95 per cent is</p>

Type of material	On site Management	Off-site Management
		<p>steel and the remaining materials (about 5 per cent) are non-ferrous metals.</p> <p>Metals coming from the C&D sector are also sourced from concrete reinforced with steel (known as reo).</p>
Glass and glazing	No on-site reuse	<p>Collected by a contractor for recycling.</p> <p>Glazing in buildings comes in many forms depending on the building type, the frame materials used, the installation period, locations (construction code),</p> <p>Dismantling of the window, glazing or other flat glass products from a building and sorting at early stages supports recovery and decreases potential breakage and contamination from other building components.</p>
Carpet/Underlay	No on-site reuse	Collected by a contractor for recycling if of the required quality or disposal to landfill
Plastics (e.g. plumbing fixtures)	No on-site reuse	Contractor appointed to collect and send to appropriate facility for processing or disposal.
Excavation material	Where feasible, removed earth can remain on-site for reuse.	<p>Contractor appointed to collect and send to appropriate facility for processing or disposal.</p> <p>Stringent sampling standards apply to determine options for beneficial reuse.</p>
Insulation material	No on-site reuse	Collected by a contractor for appropriate disposal at principal licensed waste facility.
Fixtures and fittings		Collected by a contractor for recovery and recycling of metals in fixtures and fittings and disposal of unrecoverable materials to principal licensed waste facility
Hazardous/special waste (e.g. spills and contaminated wastes)	No on-site reuse	Appropriate management methods specified by a licensed asbestos and/or site hygienist should hazardous or special waste be found at the site.
Green waste	All green waste material can remain onsite (shredded and or composted), and be reused in landscape areas around the development if possible.	Contractor appointed to collect and transport the materials off-site for mulching or composting.
Comingled Recyclables	No on-site reuse	Collected by a contractor for recycling.
General waste	No on-site reuse	Collected by a contractor and disposed at designated waste facility.

4.2.2 Storage and Access

It is important to understand how the waste management system will work on-site, including bin placement and access.

The following measures should be considered;

- Separate collection bins or waste storage areas are to be provided giving consideration to slope, drainage, vegetation, access and handling requirements and may include:
- Landfill waste;
- Recyclable waste; and
- Materials to be re-used on-site; and/or excavation materials
- Storage of reuse materials in lined and covered piles as appropriate, and marked with signage that indicates uses for waste types;
- All storage areas should be located within the UNSW property boundary and identified on the site plans as part of the project waste management plan;
- Where on-site space is limited, approval may be granted by Council to place a skip bin on a footpath or other public;
- Asbestos and other hazardous material is to be managed under the Protection of the Environment Operations Act 1997 and Council's Asbestos Policy 2005;
- Easy vehicular access to waste and recycling material storage areas must be provided; and
- All waste and recycling is to be stored in way that prevents damage from the elements and reduces odour, health risks and windborne litter.

4.2.3 Litter Management

Daily site inspections should be conducted to identify litter, remedy the situation and investigate the cause so as to reduce the potential for the issue to occur in the future.

Litter prevention strategies can include:

- Ensuring sufficient quantities of bins (and/or bin space) will be made available so as to avoid dumping of materials outside bins;
- All waste/recycling bins place with covers so as to ensure that wastes cannot be blown out during windy conditions. This will also apply to relevant stocks of materials to be used in construction.
- Allocate personnel to that are responsible for litter management in that they will periodically inspect the site and surrounds for litter and if identified collect and dispose of it.

4.2.4 C&D Disposal and Processing

Where waste cannot be avoided, reused or recycled it should be classified and appropriate disposal should then occur.

All material that is imported to or exported from a project should be undertaken in strict accordance with the requirements of the POEO Act 1997 including:

- Ensuring waste is classified appropriately and in accordance with relevant guidelines;
- Waste materials are disposed of to appropriately licensed facilities; and
- Other materials are removed to facilities lawfully able to accept such materials.

No contamination incident should occur as a result of waste storage, transport or disposal, and no construction waste/litter should leave the site in an uncontrolled manner.

4.3 Site Documentation

For projects over \$300k in value, a site-specific Project Waste Management Plan (PWMP) should be developed at the 'Documentation' stage and submitted to the EM project manager or development manager for the project. The EM Facilities Management and Sustainability teams will check PWMPs on a periodic basis to review alignment with this Waste Management Guideline.

Responsibility for the PWMP and associated waste documentation during the construction and demolition phases should be with the demolition contractor or builder, as the key personnel present on the site and managing C&D waste generating operations.

A logbook that records waste management and collection should be maintained on-site, with entries including:

- Time and date;
- Description and waste quantity;
- Details of waste transporter (company name, ABN, vehicle registration and driver details, date and time of transport, description of waste); and
- Copies of waste receipts from the waste facility (date and time of delivery, name and address of the facility, its ABN, contact person).

The main contractor should provide waste reports including volumes and performance compared to the 90% recycling target to the EM project manager or development manager for the project on a regular basis, to be agreed prior to commencement of works. The EM Facilities Management and Sustainability units will perform periodic checks of waste records to confirm compliance with the 90% recycling target.

Other waste documentation could include;

- Waste assessment and categorisation reports, including sampling methodologies and laboratory analysis for potentially harmful materials such as contaminated soil;
- Written procedures and plans for managing waste, including handling and storage procedures, and incident response plans;
- Development applications, including waste management plans;
- Site assessments including contaminated site assessments, and environmental and geotechnical studies;
- Other documentation required for 5 Star certification under the current Green Star Design & As Built / Buildings rating tool such as:
 - copy of weighbridge operating certificate
 - source and fate of inbound and outbound waste from waste processing facilities
 - independently-verified publicly available reports on the percentages of gross waste diversion from landfill and residual waste committed to landfill on an annual basis.

Waste management documentation, the logbook and associated receipts should be made available for inspection at any time during site works.

4.4 Post-Construction and Demolition Activities

Once the project has been completed, it is important to evaluate the project waste management plan. The following questions should be asked:

- Were the expected amounts of waste generated?
- How did the bin placement on-site work out?
- What feedback was there from personnel on-site?
- Did any contractor compliance issues arise?

From this evaluation, issues can be avoided in future developments.

5 Summary of Best Practice Activities

C&D activities can generate a wide range of waste materials, which often consists of valuable recyclable items. Using the waste hierarchy as a guiding principle, this guideline promotes the following key actions across the construction and demolition waste management cycle:

Avoid and Reduce

Minimise the production of waste materials in the construction process by:

- Assessing and taking into consideration the type of waste, and potential for waste avoidance and minimisation from different design and construction plans;
- Prepare a waste management plan in accordance with local government planning guidelines;
- Purchasing materials that will result in less waste, which have minimal packaging, are pre-cut or fabricated;

Reuse

Ensure that wherever possible, materials are reused either on site or offsite by:

- Classifying and identifying all waste products that can be reused;
- Putting systems in place to separate and store reusable items;
- Identifying the potential applications for reuse both onsite and offsite and facilitate reuse.

Recycling

Ensure that wherever possible, materials are recycled by:

- Identifying all recyclable waste products to be produced on site;
- Providing systems for separating and stockpiling of recyclables (In some cases, it may be more economical to send the unsorted waste to specialised waste contractors who will separate and recycle materials at an offsite location);
- Providing clear signage to ensure recyclable materials are separated;
- Ensuring the chosen waste recycling contractor complies with regulatory and Green Star certification requirements.

Disposal

Waste products which cannot be reused or recycled should be appropriately disposed. The following will need to be considered:

- Ensuring the chosen waste disposal contractor complies with regulatory and Green Star requirements.
- Implementing regular collection of bins.

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7 Appendix A. C&D Waste Services and Facilities

C&D Processing Facilities

Some operators focus exclusively on processing specific C&D streams (e.g. concrete), some are skip bin collection companies seeking to offer vertical integration, while others are larger operations in which the C&D stream is one element of their waste management operations.

Emergence of Process Engineered Fuel Processing Facilities

A major upcoming competitor to C&D recovery facilities in Sydney is expected to be the emergence of Processed Engineered Fuel (PEF) processing facilities. PEF is a waste derived fuel that can replace fossil fuels, and PEF manufacture provides an economically and environmentally viable alternative to landfilling. In Australia, PEF has been used primarily in cement kilns for cement production. The C&D waste stream is a potential feedstock for PEF manufacture.

ResourceCo has recently opened a large PEF manufacturing facility in Wetherill Park plant that is licensed to receive up to 250,000 tonnes per annum of dry commercial and industrial and mixed construction and demolition waste. Non recoverable materials are processed and converted into PEF. The facility will provide a competitive alternative to typical C&D processing in the Sydney region.

Waste Management Contactors

To ensure best practice waste management for the site, appropriate contractors and facilities will be necessary to manage C&D waste. Based on proximity to the main Kensington campus site, the following table outlines several examples for waste contractors and management facilities.

Company details		Service	Recycling																						
Business name	Suburb	Drop-off or pick-up arrangement?	Handling	Facility accepts																					
				Asbestos	Asphalt & Bitumen	Bricks	Carpet & Carpet Underlay	Concrete	Excavation	Fibro - Non asbestos	Furniture	Garden Organics	Glass Sheets	MDF, Masonite & Villaboard	Metal	Packaging	Paint	Particleboard	Paper and Cardboard	Plasterboard	Sand	Tiles	Timber (untreated, pallets)	Whitegoods	
Dial-A-Dump-Industries (DADI)	Alexandria	Both	Collection only		✓	✓		✓	✓	✓		✓		✓	✓		✓	✓	✓	✓	✓	✓	✓		
Get Fast Waste Bins	Mortdale	Both	Collection only	✓	✓	✓		✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Recycled Resources	Silverwater	Both	Collection only			✓		✓						✓											
A&C Recycling Services	St Marys	Drop off	Collection only		✓	✓		✓	✓					✓				✓		✓	✓			✓	
Barter Town Salvage	Kemps Creek	Drop off	Collection only			✓		✓													✓				
SUEZ Elizabeth Drive Landfill Facility	Kemps Creek	Drop off	Collection only		✓	✓		✓			✓		✓	✓			✓	✓			✓	✓			
1300RUBBISH	Sydney City	Pick up	Collection only			✓		✓	✓		✓	✓	✓	✓			✓		✓	✓	✓	✓	✓	✓	
1800-Got-Junk?	Frenchs Forest	Pick up	Collection only		✓	✓		✓				✓	✓	✓	✓			✓				✓	✓	✓	
Anyfil Skip Bins	St Clair	Pick up	Collection only	✓		✓		✓		✓	✓	✓		✓				✓	✓		✓				
Budget Waste Control	Arndell Park	Pick up	Collection only			✓		✓			✓			✓				✓				✓			
G Bins	None	Pick up	Collection only			✓		✓			✓	✓		✓				✓			✓	✓	✓	✓	
Joe's Rubbish Removal	None	Pick up	Collection only			✓		✓						✓											
Just Bins Waste Services	Ermington	Pick up	Collection only			✓		✓						✓				✓				✓			
P&S Dumpsters Skip Bin Hire	None	Pick up	Collection only			✓		✓	✓		✓			✓				✓	✓		✓	✓			
Phillips Skip Bins	Holroyd	Pick up	Collection only	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Rubbish Away	Leppington	Pick up	Collection only			✓	✓	✓		✓	✓	✓		✓	✓	✓	✓		✓		✓	✓	✓	✓	
Western Bins	Wetherill Park	Pick up	Collection only	✓		✓		✓	✓		✓	✓		✓				✓		✓	✓	✓	✓		
Bingo Recycling Centre Auburn	Auburn	Both	Processing			✓			✓		✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	
Bingo Recycling Centre Banksmeadow	Banksmeadow	Both	Processing			✓	✓		✓		✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	
Bingo Recycling Centre Mortdale	Mortdale	Both	Processing			✓			✓		✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	
Bingo Recycling Centre St Marys	St Marys	Both	Processing			✓			✓		✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	
Lombos	Kingsgrove	Both	Processing															✓							
Remondis Australia Taren Point	Taren Point	Both	Processing			✓		✓		✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	
Hallinan's Recycling	Kemps Creek	Drop off	Processing			✓		✓										✓	✓		✓				
Resource Co	Wetherill Park	Drop off	Processing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	

Company details		Service	Recycling																				
Business name	Suburb	Drop-off or pick-up arrangement?	Handling	Facility accepts																			
				Asbestos	Asphalt & Bitumen	Bricks	Carpet & Carpet Underlay	Concrete	Excavation	Fibro - Non asbestos	Furniture	Garden Organics	Glass Sheets	MDF, Masonite & Villoboard	Metal	Packaging	Paint	Particleboard	Paper and Cardboard	Plasterboard	Sand	Tiles	Timber (untreated, pallets)
SUEZ Auburn Resource Recovery Centre	Homebush	Drop off	Processing									✓				✓		✓					✓
SUEZ Eastern Creek Resource Recovery Centre	Eastern Creek	Drop off	Processing			✓		✓				✓			✓	✓		✓				✓	✓
SUEZ Lucas Heights Resource Recovery Centre	Lucas Heights	Drop off	Processing	✓		✓		✓				✓			✓	✓						✓	
SUEZ Rockdale Resource Recovery Centre	Rockdale	Drop off	Processing									✓			✓	✓							
SUEZ Seven Hills Resource Recovery Centre	Seven Hills	Drop off	Processing									✓			✓	✓							
SUEZ Wetherill Park Resource Recovery Centre	Wetherill Park	Drop off	Processing									✓			✓	✓							
SUEZ Spring Farm ARRT Facility	Spring Farm	Drop off	Processing	✓								✓											
Genesis Xero Waste - Landfill and Recycling	Eastern Creek	Drop off	Processing	✓	✓	✓		✓				✓											✓
Horsley Park Waste Management Facility (Veolia)	Horsley Park	Drop off	Processing	✓																			
Cleanway Environmental Services	Minto	Pick up	Processing							✓						✓					✓		
BENEDICT Recycling Belrose	Belrose	Both	Recycler		✓	✓		✓		✓					✓	✓		✓		✓	✓	✓	✓
Concrete Recyclers	Camellia	Both	Recycler		✓	✓		✓														✓	
Cooke's Metal Recyclers	Silverwater	Both	Recycler												✓								
Davis Earth Moving & Quarrying	St Ives	Both	Recycler			✓		✓															
Dravin	Schofields	Both	Recycler		✓	✓		✓														✓	✓
Enviro Pallets	Penrith	Both	Recycler																				✓
Hassarati Has-A-Bin	Greenacre	Both	Recycler			✓		✓							✓						✓		✓
ReGyp	Kurnell	Both	Recycler																✓				
The Brick Pit	Smithfield	Both	Recycler			✓																	
Total Scrap Metals Recycling	Villawood	Both	Recycler												✓								
Abey Pallets	Wetherill Park	Drop off	Recycler																				✓
AE Biggs	Oxford Falls	Drop off	Recycler		✓	✓	✓	✓	✓		✓				✓	✓		✓		✓		✓	✓
Australian Native Landscapes Badgerys Creek	Badgerys Creek	Drop off	Recycler									✓								✓		✓	
Australian Native Landscapes Seven Hills	Seven Hills	Drop off	Recycler									✓								✓		✓	

Company details		Service	Recycling																					
Business name	Suburb	Drop-off or pick-up arrangement?	Handling	Facility accepts																				
				Asbestos	Asphalt & Bitumen	Bricks	Carpet & Carpet Underlay	Concrete	Excavation	Fibro - Non asbestos	Furniture	Garden Organics	Glass Sheets	MDF, Masonite & Villoboard	Metal	Packaging	Paint	Particleboard	Paper and Cardboard	Plasterboard	Sand	Tiles	Timber (untreated, pallets)	Whitegoods
Australian Native Landscapes Terrey Hills	Terry Hills	Drop off	Recycler									✓									✓		✓	
Back to Earth The Mulch Makers	Riverstone	Drop off	Recycler									✓											✓	
BENEDICT Recycling Chipping Norton	Chipping Norton	Drop off	Recycler		✓	✓		✓			✓				✓	✓		✓		✓	✓	✓	✓	
Blaxland Waste Management Facility	Blaxland	Drop off	Recycler	✓		✓		✓	✓			✓			✓			✓		✓	✓	✓	✓	
Boral Recycling	Wetherill Park	Drop off	Recycler			✓		✓							✓							✓	✓	
Brandown	Kemps Creek	Drop off	Recycler			✓		✓	✓						✓				✓				✓	
Cleanaway	Erskine Park	Drop off	Recycler			✓		✓								✓								
Fairfield City Council Sustainable Resource Centre	Wetherill Park	Drop off	Recycler		✓	✓		✓													✓	✓		
Gow Street Recycling Centre	Padstow	Drop off	Recycler		✓	✓		✓													✓	✓		
Kimbriki Resource Recovery Centre	Ingleside	Drop off	Recycler	✓	✓	✓		✓	✓		✓				✓				✓		✓	✓	✓	
Kurnell Landfill	Kurnell	Drop off	Recycler		✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Recycled Concrete	West Gosford	Drop off	Recycler		✓	✓		✓														✓		
Rock and Dirt Recycling	Windsor	Drop off	Recycler			✓		✓																
Roof Tile Recyclers	Smithfield	Drop off	Recycler																			✓		
Sell and Parker Banksmeadow	Banksmeadow	Drop off	Recycler												✓									
Sell and Parker Blacktown	Blacktown	Drop off	Recycler												✓									
Sims Metal Management Alexandria	Alexandria	Drop off	Recycler												✓									
Sims Metal Management Milperra	Milperra	Drop off	Recycler												✓									
Sims Metal Management St Marys	St Marys	Drop off	Recycler												✓									
Camel's Bins	St Marys	Pick up	Recycler			✓		✓											✓			✓		
Parramatta Scrap Metal	Parramatta	Pick up	Recycler												✓									
Thuroona Services	Parramatta	Pick up	Recycler	✓	✓	✓		✓		✓							✓					✓		
Grasshopper Environmental	Ardnell Park	Both	Site cleaning	✓		✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Hi Quality Group Kemps Creek	Kemps Creek	Both	Site cleaning			✓		✓	✓												✓	✓		
Hi Quality Group St Marys	St Marys	Both	Site cleaning			✓		✓	✓												✓	✓		

Company details		Service	Recycling																				
Business name	Suburb	Drop-off or pick-up arrangement?	Handling	Facility accepts																			
				Asbestos	Asphalt & Bitumen	Bricks	Carpet & Carpet Underlay	Concrete	Excavation	Fibro - Non asbestos	Furniture	Garden Organics	Glass Sheets	MDF, Masonite & Villoboard	Metal	Packaging	Paint	Particleboard	Paper and Cardboard	Plasterboard	Sand	Tiles	Timber (untreated, pallets)
All Trash Oz	Banksia	Pick up	Site cleaning			✓		✓	✓		✓	✓			✓	✓		✓	✓	✓	✓	✓	
All Types of Rubbish	Lane Cove West	Pick up	Site cleaning			✓		✓	✓		✓	✓			✓			✓		✓	✓		
Art Civil	Chullora	Pick up	Site cleaning	✓		✓		✓												✓	✓		
Habib & Sons Demolitions	Greenacre	Pick up	Site cleaning			✓		✓							✓					✓			
Jasa Bobcats	None	Pick up	Site cleaning			✓		✓	✓			✓			✓					✓			

8 Appendix B. Resource recovery orders/exemptions

These are general gazette exemptions that do not require approval. A specific exemption may be granted where an application is made to the EPA.

Table 5: Relevant Resource Recovery Orders and Exemptions

Order/Exemption	General Conditions
Effluent Exemption 2014	The effluent can only be applied to land for the purposes of irrigation or as a soil amendment material. The consumer must land apply the effluent within a reasonable period of time.
Excavated Natural Material Exemption 2014	The chemical concentration or other attributes of the excavated natural material listed in the Excavated Natural Material Exemption must not be exceeded. The excavated natural material can only be applied to land as engineering fill or used in earthworks. ENM handling, processing and testing requirements are outlined in detail in the exemption
Excavated Public Road Material 2014	The excavated public road material can only be stored within the road corridor at the site where it is to be applied to land. The excavated public road material can only be applied to land within the road corridor for public road related activities including road construction, maintenance and installation of road infrastructure facilities. This exemption does not apply to the land application of excavated public road material on any land outside the road corridor. The excavated public road material cannot be applied on private land. The consumer must land apply the relevant waste within a reasonable period of time.
Raw Mulch Exemption 2016	The raw mulch can only be applied to land with a risk management protocol in place. The consumer must ensure that they do not cause or permit the migration of leachate from the land application site. The consumer must land apply the raw mulch within a reasonable period of time.
Recovered Aggregate Exemption 2014	The chemical concentration or other attribute of the recovered aggregate listed in Recovered aggregate Exemption must be met. The recovered aggregate can only be applied to land for road making activities, building, landscaping and construction works. This approval does not apply to any of the following applications: -

Order/Exemption	General Conditions
Reclaimed asphalt pavement exemption 2014	<p>of dams or related water storage infrastructure; - Mine site rehabilitation; - Quarry rehabilitation; - Sand dredge pond rehabilitation;</p> <p>- Back-filling of quarry voids; - Raising or reshaping of land used for agricultural purposes; and - Construction of roads on private land unless: a. the relevant waste is applied to land to the minimum extent necessary for the construction of a road, and b. a development consent for the development has been granted under the relevant Environmental Planning Instrument (EPI), or c. it is to provide access (temporary or permanent) to a development approved by a Council, or d. the works undertaken are either exempt or complying e. development</p> <p>Reclaimed asphalt must not contain a detectable quantity of coal tar or asbestos. Reclaimed asphalt may be applied to land for road related activities including: - Use as a road base and sub base; - Applied as a surface layer or road shoulders and unsealed roads; and - Use as an engineering fill material Or used as an alternative input into thermal processes for non-energy recovery purposes in the manufacture of asphalt.</p>

Source: NSW Roads and Maritime Services, 2016, Management of road construction and maintenance wastes

9 Appendix C. Waste Classification Guidelines

EPA's Waste Classification Guidelines

The EPA's Waste Classification Guidelines provides a classification guideline for wastes into groups that pose similar risks to the environment and human health.

The following classes of waste are contained in the Guideline, as defined in Schedule 1 clause 49 of the Protection of the Environment Operations Act 1997 (POEO Act):

- special waste
- liquid waste
- hazardous waste
- restricted solid waste
- general solid waste (putrescible)
- general solid waste (non-putrescible)

The types of waste generated by the proposed development in accordance with the Waste Classification Guidelines are outlined in Table 6.

Further details on the classification of waste can be found in the OEH's Waste Classification Guidelines

Table 6: Waste Classification Guidelines

Waste Classification	Description
Special Waste	Special waste includes clinical and related waste, asbestos waste and waste tyres.
Liquid Waste	Liquid waste means any waste that: <ul style="list-style-type: none"> • Has an angle of repose of less than 5 degrees, or • Becomes free-flowing at or below 60 degrees Celsius or when it is transported, or • Is not generally capable of being picked up by a spade or shovel.
General Solid Waste (putrescible)	Household waste that contains putrescible organics waste from litter bins collected by local councils:
General Solid Waste (non-putrescible)	<ul style="list-style-type: none"> • Glass, plastic, rubber, plasterboard, ceramics, bricks, concrete or metal • Paper or cardboard • Grit, sediment, litter and gross pollutants from stormwater treatment devices, stormwater management systems that has no free liquids • Garden & wood waste • Containers previously containing dangerous goods, as defined under the Australian Code for the Transport of Dangerous Goods by Road and

Waste Classification	Description
	<ul style="list-style-type: none"> • Rail, where residues have been appropriately removed by washing or vacuuming drained • Oil filters (mechanically crushed), rags and oil-absorbent materials that only contain non-volatile petroleum hydrocarbons and have no free liquids • Drained motor oil containers that do not contain free liquids • Synthetic fibre waste from fibreglass, polyesters and other plastics and is packaged securely to prevent dust emissions, that is confirmed as not being asbestos waste • Virgin excavated natural material • Building and demolition waste • Asphalt waste, including asphalt from road construction and waterproofing works • Cured concrete waste from batch plants • Fully cured and set thermosetting polymers and fibre-reinforcing resins, glues, paints, coatings and inks
Hazardous Waste	<ul style="list-style-type: none"> • Waste with $\text{pH} \leq 2.0$ or $\geq \text{pH} 12.5$ • Containers that have not been cleaned and that contained dangerous goods as described in the Australian Code for the Transport of Dangerous Goods by Road and Rail • Coal tar or coal tar pitch waste, which is the tarry residue from the heating, processing or burning of coal or coke, being materials comprising of more than 1% (by weight) of coal tar or coal tar pitch • Waste lead-acid or nickel-cadmium batteries, being waste generated or separately collected by activities carried out for business, other commercial or community services purposes • Lead paint waste other than solely from residential premises or educational or child care institutions

10 Appendix D. Campus Context

UNSW has five campuses in the Sydney metropolitan area plus a presence at the Australian Defence Force Academy (ADFA) in Canberra.

UNSW Campus Sites

Kensington Campus

The Kensington campus is located in Sydney's inner south-eastern suburb of Kensington. It is the main campus and administration centre of UNSW and home to the Faculties of Arts and Social Sciences, Australian School of Business, Built Environment, Engineering, Law, Medicine and Science. Also located on the campus is the National Institute of Dramatic Art (NIDA) and a number of Research Centres and organisations associated with UNSW. The campus also has support facilities such as a library, parking stations, retail outlets, medical suite, gymnasium and swimming pool, and student accommodation in the form of seven residential colleges and two apartment complexes.

Established in 1949, the campus has grown to a freehold site of 38.9ha with more than 140 buildings of various ages and conditions and a gross floor area (GFA) of 600,000m².

Paddington Campus (UNSW Art & Design)

The College of Fine Arts (COFA) campus is located at Paddington and offers programs in the visual arts, design, digital media, art education, art history and theory. The campus occupies a freehold site of 8.5ha with eight buildings of various ages and conditions and a GFA of more than 16,500m², including student exhibition spaces. The campus is located within the Paddington Conservation Area and two of its buildings are listed as heritage items.

Randwick Campus

The Randwick campus is located 1km north of Kensington and houses the Institute of Languages, the UNSW IT Data Centre and several Research Centres. The freehold site has an area of 2.3ha with 18 buildings and a GFA of more than 16,000m².

Coogee (Cliffbrook)

The Coogee campus (also known as Cliffbrook) is located 2.5km east of Kensington at Coogee and is home to units of the Faculty of Medicine and UNSW Press. The freehold site has an area of 1.2ha with four buildings and a GFA of more than 2,500m².

Manly Vale

Water Research Laboratories are located on a site of 3.8ha (freehold and leasehold) at Manly Vale in Sydney's northern suburbs. The Laboratories are part of the School of Civil and Environmental Engineering and provide leading international research and consulting in water, ground water, coastal and environmental engineering.

UNSW@ADFA (Canberra)

Within the ADFA campus at Canberra, UNSW has established a college known as UNSW@ADFA under an agreement with the Commonwealth Government. The college is the centre for higher education for the Australian Defence Force and offers undergraduate courses to officer cadets and graduate study and research leading to higher degrees for military and civilian personnel. The campus has a full range of academic services, sporting and training facilities, housed in modern buildings.

Kensington Environs

UNSW owns more than 40 freehold properties on residential zoned land around the Kensington campus. Although they have functional links with the campus they are not considered part of the actual campus.