

Reduction, Re-use and Recycling of Construction Waste: A Project Management Guide

Ten actions for project managers

- 1 **Establish** a company or site benchmark (or use ours) against which to measure results.
- 2 **Contractually** oblige sub-contractors to co-operate in waste minimisation as part of their tender.
- 3 **Ensure** that all suppliers of materials provide returnable or practicably recyclable packaging.
- 4 **Ensure** that sub-contractors and site operatives are briefed on project aims for waste reduction and segregation.
- 5 **Engage** all site workers with toolbox talks, briefings and canteen poster campaigns.
- 6 **Identify** the key waste products likely to arise during construction and implement waste reduction plans for these key waste products.
- 7 **Partner** with a waste management contractor to maximise recycling and reduce disposal costs.
- 8 **Agree** on-site re-use and recycling as part of quality management.
- 9 **Monitor** and publish waste performance figures on site and elsewhere.
- 10 **Compare** performance with other sites in your company/area/ industry sector.

Main lessons learnt at Greenwich

Measure to manage

A greater understanding of quantity, type and cause of waste proved fundamental to monitoring performance and driving change. So:

- What are the key waste products likely to be?
- When in the construction process are they likely to arise?
- What changes need to be implemented to achieve reduction, re-use and recycling?
- Who needs to be engaged in making this happen?
- Monitor performance across sites through SMARTStart.

Engage the whole supply chain

- Engage sub-contractors in requirements to minimise waste at tendering stage and oblige them contractually.
- Make sure everyone on site is aware and committed to achieving targets for improvement.
- Partner with a waste management contractor.
- Talk to suppliers about packaging waste and possible take-back of product off-cuts.

Design out waste

- Design to reduce waste needs to be considered from the outset.
- The incorporation of offsite manufactured products can reduce traditional waste but may increase packaging waste – check with your supplier.
- Consider the incorporation of recycled and reclaimed materials in new construction (especially if arising on-site).

Develop systems of good practice and build upon them within the development and on future projects.



Introduction

The total annual material resource requirement for UK construction is estimated to be 424 million tonnes. Around 94 million tonnes of waste is produced annually by construction and demolition.

Primary material and waste disposal costs (landfill in particular) will increase for the following reasons:

- Tighter regulation of waste management throughout the EU.
- Landfill taxes increasing from £14 to £35 per tonne by 2013.
- Taxes on primary materials such as the Aggregates and Climate Change Levy.
- Obligations to recycle packaging waste.

These factors make a strong commercial case for reducing waste and for re-use or recycling of unavoidable waste. It also plays an essential part in improving environmental performance, staying competitive and in maintaining and improving profits.

The whole supply chain needs to shift towards new site practices that maximise material use and keep waste to a minimum.



Greenwich Peninsula land-use plan

Greenwich Millennium Village

The Greenwich Millennium Village (GMV) construction waste benchmarking and minimisation research took place over a period of three years, from May 2000 to April 2003. It was made possible through Landfill Tax funding from the Hanson Environment Fund and matching funding from Greenwich Millennium Village Limited.

Greenwich Millennium Village is a joint venture development by Countryside Properties and Taylor Woodrow in association with English Partnerships. Greenwich Millennium Village forms part of the redevelopment of Greenwich Peninsula.

The key theme of the development is the promotion of sustainable urban development, embracing latest developments in design, innovation and technology.

Phase 1a of GMV provides 100 apartments at the northernmost part of the site beside the River Thames and adjacent to the man-made lake and Ecology Park.

The buildings have a concrete structural frame, with the envelope comprising lightweight dry-lined timber studding finished with a slim-line wet applied render.

The two buildings have an overall area of 10,226m² and were completed in September 2001.



Phase 1a

Phase 2a is a mixture of low and high rise building forms. The high rise (88) units are in situ concrete frame with rainscreen cladding.



Becquerel Court: Private units

The low-rise units (98) are two to four storey timber frame buildings with rainscreen cladding and timber windows.

Total floor area is 15,256m² and the units were completed between December 2000 and January 2003.



Edison Court: Mixed tenure apartment building

Client commitment to sustainability

From the outset English Partnerships and Greenwich Millennium Village Limited required that the key sustainability targets be met over the duration of the development, with interim milestones for review.

The targets included:

- Reducing primary energy.
- Reducing embodied energy.
- Reducing water consumption.
- Reducing construction cost.
- Reducing project duration.
- Zero defects.
- Reducing construction waste.
- Integration of tenures.
- Promotion of a mixed use development.
- Positive encouragement of a sustainable development.

Reducing construction waste contributes to reducing construction cost and embodied energy.

Waste reduction target

A 50m³ waste per dwelling benchmark was calculated by averaging skip waste returns from previous residential developments.

The target for the reduction of waste at GMV was set at 50% by the end of the project. This required the volume of site generated waste to fall from 50m³ per dwelling to 25m³. This was to be **achieved** through improved site practices and partnering with suppliers and sub-contractors.

The BRE SMARTWaste system was used to measure the underlying causes of construction waste and monitor the subsequent actions.

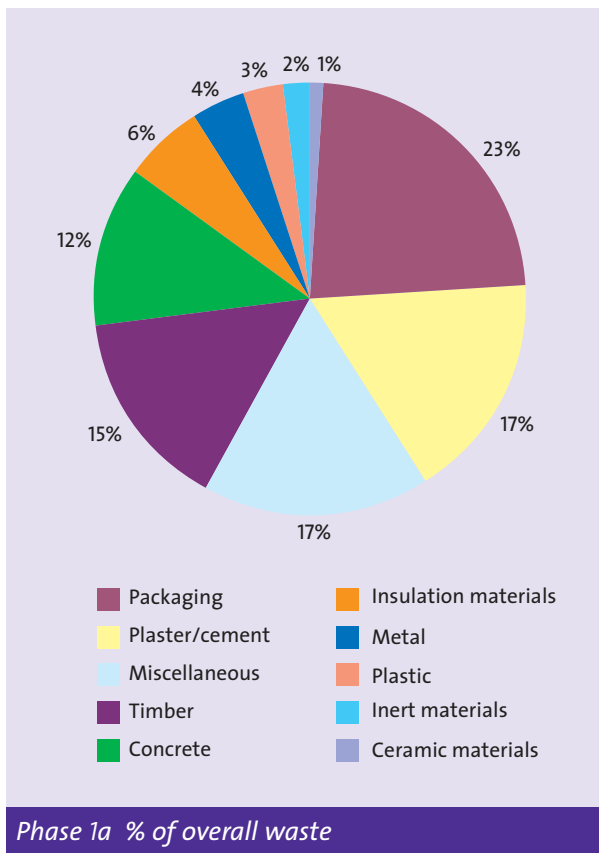
Throughout the construction of the 300 homes (over 33 months) in Phases 1a and 2a waste data was collected on:

- Type.
- Quantity.
- Location.
- Disposal.
- Cause of waste as it was being produced.

At the end of this time (2003), the overall amounts of waste and savings for Phase 1a and 2a were produced. Thanks to the efforts of the whole project team, the target to reduce waste going to landfill was exceeded.

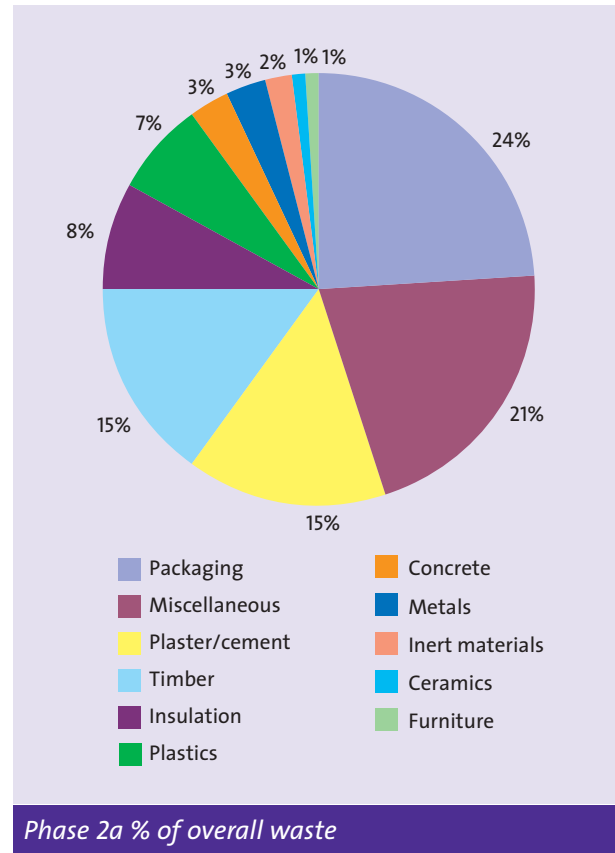
Phase 1a results

- The construction of individual apartments produced 23.4m³ of material waste per unit, excluding segregated waste.



Phase 2a results

- The overall volume of waste produced during the construction of apartments was 20.5m³ per unit, excluding segregated waste.



Number of skips removed from site – Phase 1a

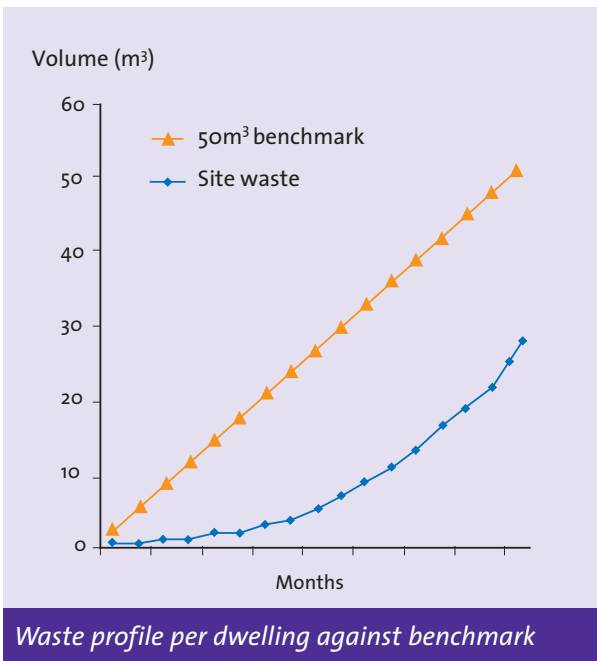
- 614 (4.5m³), this equals six skips per dwelling.
- General void space contained in skips was calculated as 52%. (Little compacting was done).
- Plasterboard was taken back by the supplier.

Number of skips removed from site – Phase 2a

- 855 (4.5m³), this equals approximately five skips per dwelling.
- The general void space in skips was calculated as 32%. (Compaction and careful skip loading significantly reduced waste volume).
- There was no plasterboard take-back on this phase.

Waste profile

The volume of waste increased sharply towards the end of the construction phase. This was mainly due to packaging and site clearance.



Costs and benefits

The reduction in skips leaving the site compared to the benchmark equalled a cost saving of around £150,000, over Phase 1a and 2a.

At the benchmark 50m³ per dwelling 3,178 skips would have been needed. The actual number of skips needed was 1,469, a saving of 1,709 skips.

When adding the further savings for segregated skips (charged at only £60 per skip), there is a further saving of around £4,000.

These cost savings will increase as the price of waste disposal rises, as it inevitably will, over the coming years.

There were also unquantified savings in the reduced volume of construction products required.

Further benefits were derived from cleaner, tidier and safer site conditions.

Waste reduction, re-use and recycling

The targets were met and exceeded through a series of waste reduction, re-use and recycling activities.

- **Reduction** – waste is not produced, e.g. length of timber is right size and doesn't need cutting.
- **Re-use** – waste finds another use on site, e.g. timber offcuts as noggins.
- **Recycling** – waste is processed to make something else, e.g. wood offcuts chipped and put into chipboard.

Design

In the design, both teams successfully achieved high EcoHomes ratings for the selection of products used and the construction process to be employed.

Design to reduce waste was considered from the outset with the incorporation of offsite manufactured products such as:

- Phase 1a – bathroom pods, cladding panels, balconies and precast stairs.
- Phase 2a – timber frame, precast concrete car park, precast stairs and rainscreen panels.

Phase 2b will take the concept further by establishing a pre-fabrication plant on site for lightweight structural components – metal sticks – where these elements will be manufactured to size with no waste in the process.

Procurement

Contractual

All successful sub-contractors appointed on Phase 1a were obliged to co-operate in waste minimisation. This resulted in the effective implementation of the site-wide material segregation scheme. Phase 2a was unable to include the segregation requirement into sub-contractor packages as they were introduced retrospectively in the project and negotiations with contractors resulted in a rise in costs. However, some site segregation was still possible.

Extract from waste method statement for sub-contractors

“ As the main contractor . . . on Greenwich Millennium Village, we are required to segregate waste arising on-site and reduce waste as part of the project’s ‘Innovation Targets’. Tenderers have been instructed to allow for segregation in their tender prices. This segregation scheme will be enforced and sub-contractors’ full co-operation is required at all times. In return, the BRE audit offers companies an opportunity to identify waste arising from works, reduce it (typically by 5% but can be as much as 30% reduction due to good practice) and reduce expenditure on materials. ”

Raising awareness

The whole site was kept up to date with achievements on the main site noticeboard.

Culture Change Workshops

Informal workshops were held with the sub-contractors participating in the delivery of waste minimisation on site. This dialogue between all parties helped balance policy and commercial reality.

Recommended actions for key waste products

BRE provided weekly updates from the waste measurement and monthly reports detailing recommended actions to reduce, re-use and recycle waste. Monthly meetings were attended by the ‘waste minimisation champions’ from Taylor Woodrow Construction (TWC), Countryside in Partnership (CiP), BRE and Richard Hodgkinson Consultancy (RHC).

The data for Phase 1a and 2a clearly show that the following were key waste products:

- Packaging waste
- Plasterboard
- Insulation
- Timber
- Concrete

Suppliers’ ‘Producer Responsibility’

Producer Responsibility is a requirement for manufacturers to consider end of life disposal and recovery of their products. This is increasingly becoming a legal obligation. Examples are packaging, vehicles, electrical and electronic equipment.

1 Plasterboard

Plasterboard offcuts that could not be used were segregated and placed into one cubic metre bags provided by British Gypsum at nominal cost. Filled bags were taken away by the supplier’s contract haulier. This plasterboard was processed and put back into the manufacturing process.



Wastecycle, Nottingham – Processing of GMV plasterboard waste

The benefits were not only a reduction in site waste but also a demonstration of the commercial practicalities of recycling. This process also demonstrated co-operation between supplier and sub-contractor and hence became a model for effective supply chain management within an environmental context. This has continued in later phases of the project.

2 Insulation

Where possible, insulation offcuts were used to fill gaps rather than cutting from a fresh roll (see quality management section).

For unusable offcuts, Rockwool Limited was prepared to collect waste Rockwool products from the site. An initial agreement was to bring back one full container load in a clean condition. To be cost effective in terms of transport cost to the manufacturing plant it was suggested that the company would take back 40m³ of materials in one load free of charge.

Space restrictions for storing the segregation containers and additional costs for segregating on Phase 2a meant that this was not actioned.



Unusable Rockwool offcuts

3 Packaging

Pallets

All the main suppliers were contacted in order to establish if they would be prepared to take back packaging materials. This practice especially makes sense with the return of standard sized timber pallets. As a consequence, all the timber pallets that arrived on site with plasterboard were returned to the local plasterboard merchant for further re-use.

The general consensus is that take-back of non-standard pallets would not be feasible as the white goods and door and window manufacturing companies are based abroad (Italy, Germany, Denmark). Furthermore, one-way transit packaging is not designed for re-use.

Polythene sheeting

Construction product suppliers stated that it would not be possible to offer a plastic packaging take-back scheme at the start of the project.

Polythene wrapping schemes are available via main plastic manufacturing companies such as British Polythene Industries (BPI) to other industries – but not as yet to construction – therefore an opportunity exists to pilot a project.

4 Specification

Project architects want to increase the use of green specification in later phases, particularly focussing on re-use, recycling and take-back schemes. It was felt that an improved awareness from the waste benchmarking and minimisation exercise enabled them to discuss with suppliers the issues of packaging in particular. They recognise that through specification they are able to deal with these issues at source more effectively than attempting to change suppliers further down the line.

Segregation and recycling

In addition to the initiatives detailed above, a comprehensive segregation and recycling scheme was set up on both sites.

This included:

- Timber
- Cardboard
- Paper
- Concrete
- Site metals
- Drinks cans



Segregated skips

Locating companies to collect segregated materials for recycling can be achieved by:

- Looking up 'recycling' in the Yellow Pages or www.yell.com.
- Accessing the recycling directory at www.smartwaste.co.uk from July 2003.
- Contacting the local council recycling officer.

Further innovation

Timber formwork could not be recycled and was generated in large quantities despite being re-used several times. This led the team to consider new ways of recovering this material and reducing its disposal. Shredding the material to form a ground covering mulch seemed a good re-use option.



Formwork

Timber formwork panels are coated with mould oil and traces of concrete, which deems these non-recyclable due to contamination. BRE conducted an experiment to establish if timber formwork leachate contains any hazardous chemicals, which would render it unsuitable for mulch.

The conclusion of this work demonstrated that the constituents of the mould oil and the levels leached out were not hazardous and did not pose a pollution risk.

To use waste material as mulch on site requires an exemption from waste management licensing from the local Environment Agency office.

Quality management

The specifier and designer have a key role in the determination and management of the levels of quality and workmanship acceptable within a project. Working alongside the main contractors' quality management teams they advise and intervene to set the standards. Where re-use and recycling is being implemented they are called upon to establish the acceptable standards for using recyclable material and off-cuts.

The site also holds a quality management forum where re-use and recycling issues can be discussed with the managers and suppliers. This allows a regular review of segregation schemes to take place and the sharing between projects of relevant best practice techniques.

ISO 14001

Within this approach all companies are vetted as much for their environmental performance as their technical suitability to be a partner. In the future it is envisaged that companies like TWC and CiP will have a refined list of partner organisations that operate to the same standards and hold the same accreditation, such as ISO 14001. This list of approved suppliers will include waste management companies and material suppliers. This will allow closer co-operation between those involved to provide effective environmental solutions. The standard will also require companies to set specific environmental standards for their suppliers.

Continuous improvement

Although the waste reduction targets have been met it is clear that further phases of the development should build upon this success. This means maintaining existing good practice and applying the targets across both sites in a systematic and consistent manner.

Opportunities to develop more reduction, re-use and recycling activities now need to be explored and adopted if possible.

These include:

- Ensuring all sub-contractors are contractually obliged to participate in waste minimisation.
- Partnering with a waste management contractor to integrate re-use and recycling across both sites with reduced costs.
- Further incorporation of offsite manufactured elements.
- Ensuring all suppliers of materials provide returnable or practicably recyclable packaging.
- Recycling of formwork into mulch (following exemption from the Environment Agency).
- Take-back scheme for insulation (Rockwool). This could become a cost effective option during times of peak activity if both sites are involved.
- Waste minimisation induction courses for all site personnel.
- Toolbox talks throughout the construction phase.

SMARTStart

The continuing, and hopefully improving, performance of waste reduction, re-use and recycling at GMV will be measured by the main contractors for the rest of the project.

This quick and easy tool provides automatic updates of:

- Number of skips
- Number of segregated skips
- Estimate of key waste products
- Other recycling activities

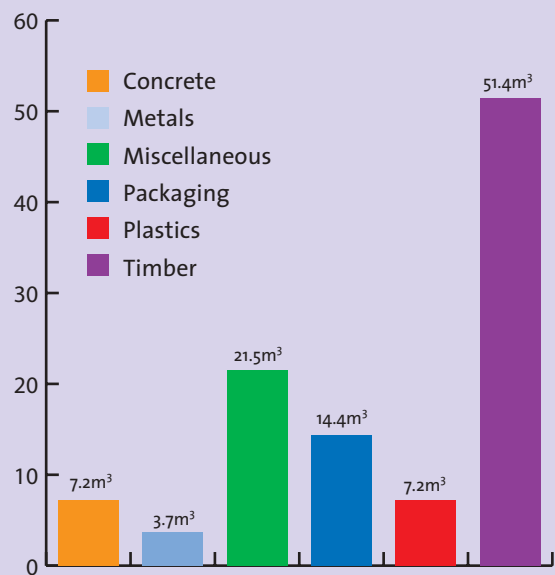
This information was collected by the main contractor's personnel and entered into the web-based data bank.

Data is collected by forklift drivers or whoever signs out skips from the site.

SMARTStart has been developed on the GMV site and is accessible to any organisation following a simple registration on www.smartwaste.co.uk

Summary Information

Total volume of waste generated to date	105.3m ³
Number of skips to date	59
Percentage segregated	32%
Project EPI (m ³ /100m ²)	0.3
Company EPI (m ³ /100m ²)	0.3



SMARTStart typical report

Further information

For further information see the companion guide: 'Reduction of Site Construction Waste, Recycling and Re-use of Materials – a Site Guide'. This sets out the main lessons learnt in the implementation of improved site practices on the GMV development.

Other sources of information

Rethinking Construction and Construction Best Practice Programme have now joined forces under the banner of 'Constructing Excellence'. Under this joint remit they provide information in:

- Best Practice Clubs, guidance, case studies and key performance indicators.
Construction Best Practice Programme:
www.cbpp.org.uk
- Cluster groups, demonstration projects and guidance on subjects relating to innovation and performance improvements.
Rethinking Construction:
www.rethinkingconstruction.org

AggRegain provides a good focus for recycled and secondary aggregates. For case studies and technical advice:

www.aggregain.org.uk

Free helpline 0808 1002040

Timber recycling

www.recyclewood.org.uk

General recycling and waste management news, jobs and prices.

www.letsrecycle.co.uk

Guidance and contacts

www.wrap.org.uk

Legislation

www.environment-agency.gov.uk/netregs/

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