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National Development Plan 2007 - 2013

Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

STRIVE
Report Series No.26

Development of an Audit Methodology to Generate Construction Waste Production Indicators for the Irish Construction Industry

STRIVE

Environmental Protection
Agency Programme

2007-2013

SSTI
Strategy for Science, Technology and Innovation

Comhshaol, Oidhreacht agus Rialtas Áitiúil
Environment, Heritage and Local Government

Environmental Protection Agency

The Environmental Protection Agency (EPA) is a statutory body responsible for protecting the environment in Ireland. We regulate and police activities that might otherwise cause pollution. We ensure there is solid information on environmental trends so that necessary actions are taken. Our priorities are protecting the Irish environment and ensuring that development is sustainable.

The EPA is an independent public body established in July 1993 under the Environmental Protection Agency Act, 1992. Its sponsor in Government is the Department of the Environment, Heritage and Local Government.

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- the contained use and controlled release of Genetically Modified Organisms (GMOs);
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- Office of Environmental Enforcement
- Office of Environmental Assessment
- Office of Communications and Corporate Services

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EPA STRIVE Programme 2007–2013

Development of an Audit Methodology to Generate Construction Waste Production Indicators for the Irish Construction Industry

(2001-WMWS-MS-1)

STRIVE Report

Prepared for the Environmental Protection Agency

by

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The EPA STRIVE Programme addresses the need for research in Ireland to inform policymakers and other stakeholders on a range of questions in relation to environmental protection. These reports are intended as contributions to the necessary debate on the protection of the environment.

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Executive Summary

Construction and demolition waste production has seen a phenomenal increase from 1.52 million tonnes in 1995[1] to 16.82 million tonnes in 2006[2]. The latter estimate establishes construction and demolition waste as the second-highest waste-producing sector behind agriculture, accounting for 55% of all non-agricultural waste produced in Ireland. The improvement in regulatory control with the implementation of the Waste Management Act, 1996 demanding improved reporting procedures, coupled with the exceptional economic activity in the country during this time, can go some way to accounting for this massive increase in waste production. The methodologies employed to generate these estimates were primarily based on data submitted by licensed and permitted facilities throughout the country. The EPA has identified serious deficiencies in the data submitted that undermine its confidence in the estimates produced[2]. Reliable waste production estimates are essential to benchmark industry's performance against the target set out in the *Waste Management: Changing Our Ways* policy document[3] of recycling 85% of construction and demolition waste by 2013.

In order to establish reliable benchmarks for industry, this Synthesis Report examines the generation of waste production indicators by directly auditing new construction projects. An audit tool was developed and tested on 57 new construction projects over a 2-year period (2004–2005) with the aim of providing individual waste production indicators for each audited site. These data were collated into three categories generating the following waste production indicators (kg/m^2) for new construction:

1. 70 kg/m^2 for new residential construction

2. 87 kg/m^2 for new private non-residential construction

3. 139 kg/m^2 for new social infrastructure construction.

A compositional analysis of the audited sites identified wood/timber, paper, plastics and packaging, and mixed construction waste as the major contributors to the construction waste stream. The report concludes that there are some limitations in the audit methodology used, especially the snapshot nature of each audited site. Despite this, the audit format proved to be a practical tool for use on Irish construction sites and the units of analysis used (m^3/m^2 or kg/m^2) provided a useful benchmark against which site management could measure waste performance based on the composition and quantity of waste fractions disposed of in skips on-site.

It is recommended that the audit tool should be integrated into construction and demolition waste management plans, providing a basic methodology to measure waste performance on-site for projects exceeding the thresholds outlined in the *Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects*[4]. These data sets should then be submitted to the local authorities in the form of audit reports during the construction phase in fulfilment of the planning requirement. Concurrent with this is the need for the EPA to enforce a standard reporting format for construction and demolition waste data submitted in the annual environmental reports by licensed facilities. This would maximise the benefit of benchmarking construction and demolition waste indicators at the

---

[1] EPA, 1996. *National Waste Database Report 1995.* Environmental Protection Agency, Johnstown Castle Estate, Wexford, Ireland.

[2] EPA, 2007. *National Waste Report 2006*, Environmental Protection Agency, Johnstown Castle Estate, Wexford, Ireland.

[3] DoELG (Department of the Environment and Local Government), 1998. *Waste Management: Changing Our Ways.* Department of the Environment and Local Government, Custom House, Dublin 1, Ireland.

[4] DoEHLG (Department of the Environment, Heritage and Local Government), 2006. *Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects.* Department of the Environment, Heritage and Local Government, Custom House, Dublin 1, Ireland.

point of generation by enabling comparisons with data obtained from regulated waste management facilities.

Further work is required in extrapolating to national estimates as there is a lack of available data from a number of activities including demolition and refurbishment projects and on the actual construction output *per annum*.

A paradigm shift is required in construction and demolition waste management from end-of-pipe solutions to prevention and minimisation. The reduction of waste production through design will maximise resource use efficiency and minimise the environmental impacts associated with the transport, recycling, treatment and disposal of the construction and demolition waste fraction.

1 Introduction and Background

1.1 Introduction

The *Waste Management: Changing Our Ways* policy document (DoELG, 1998) set out specific targets for the construction industry to recycle 50% of construction and demolition waste (C&DW) by 2003 and 85% by 2013. The industry responded with the formation of the National Construction and Demolition Waste Council (NCDWC) and the establishment of a voluntary construction industry initiative to provide a framework to achieve compliance with these targets.

Estimates of C&DW suggest that production has increased from 1.52 million tonnes in 1995 (EPA, 1996) to 16.82 million tonnes in 2006 (EPA, 2007). The latter estimate includes a recovery rate of 89% for soil and stones and 36% for all other C&DW fractions (concrete and rubble, wood, glass, metal and plastic). These figures are based on data submitted to the local authorities by the waste industry. They do not measure actual waste production on-site and therefore may not provide a reliable benchmark of actual waste management practices 'on the ground'.

This report presents results from a study of waste production at 57 construction sites over a 2-year period (2004–2005).

1.2 Definition

The *National Waste Database Report 1998* (EPA, 2000) defined C&DW as:

"*All waste that arises from construction, renovation and demolition activities and all wastes mentioned in Chapter 17 of the European Waste Catalogue. This includes surplus and damaged products and materials arising at construction works or used temporarily during on-site activities ... and dredge spoil.*"

This is the definition used when reviewing C&DW production estimates. This evolved during the study as the audit methodology used to generate the waste production indicators defined C&DW as all waste fractions deposited in audited waste skips. No excavated material was deposited in this manner and so the definition of 'inert waste' used excludes excavated materials but includes concrete, bricks, tiles and ceramics and mixtures thereof. This is the definition used when outlining the generation of waste production indicators.

1.3 Objectives

The main objectives of the study were to:

- Review existing methodologies used to estimate Irish C&DW production
- Develop and test an original audit tool on Irish construction sites
- Generate waste production indicators (kg/m^2) for new construction projects in Ireland.

1.4 Expected Benefits

The main benefit of C&DW production indicators is that they provide a benchmark for the industry. The production of reliable C&DW flow data at the point of generation will enable comparisons with data obtained from regulated waste management facilities.

The methodology used and the data generated are intended to aid the construction industry in the implementation of a voluntary documented waste management system to effectively manage and control the flow of materials arising from each construction project.

2 Review of Existing Audit Methodologies Used to Generate Construction and Demolition Waste Estimates

The review was carried out in two parts:

1. Examination of the methodologies used by the Environmental Protection Agency (EPA) to produce Irish C&DW estimates from 1995 to 2006.

2. Investigation of the use of the UK C&DW audit tools to develop guidelines for the production of a new audit model for use on Irish construction projects within the scope of this study.

2.1 Construction and Demolition Waste Production Estimate Methodologies Used in Ireland

The methodologies employed by the EPA over the past decade to estimate C&DW production have consisted of:

- Questionnaires, paper based and/or electronically based, sent out to relevant parties in the construction, demolition and waste management industries and local authorities.

- Data collected from all licensed waste collectors and facilities or sites licensed or permitted to accept C&DW, obtained *via* questionnaires and environmental reports.

- Conversion of US unit waste factors (Franklin Associates Ltd, 1998) applied to construction output data to produce national estimates.

Each of these methodologies has been used in the production of the *National Waste Reports* (EPA, 1996, 2000, 2003a, 2005, 2006, 2007), which are the definitive resource for waste statistics in Ireland (Table 2.1).

The national estimates indicate over an elevenfold increase in C&DW production from 1995 to 2006, including more than a 300% increase in a 6-year period from 2001 to 2006. The improvement of regulatory control with the implementation of the Waste Management Act, 1996 demanding improved reporting procedures coupled with the phenomenal economic activity in the country over the past decade, can go some way to accounting for this massive increase in waste production.

The EPA has acknowledged in each of the reports that the methodologies used during this period have led to inconsistent waste production estimates, mainly because the data collected from the local authorities do not provide a reliable data set. This is due, in part, to the limited verification checks carried out by local authorities on the data as reported by authorised collectors (EPA, 2007).

Table 2.1. National waste reports construction and demolition waste estimates 1995, 1998, 2001, 2004, 2005 and 2006.

Report	Published	Quantity (t)
National Waste Database Report 1995	EPA, 1996	1,520,000
National Waste Database Report 1998	EPA, 2000	2,704,958
National Waste Database Report 2001	EPA, 2003a	3,651,411
National Waste Report 2004	EPA, 2005	11,167,599
National Waste Report 2005	EPA, 2006	14,931,486
National Waste Report 2006	EPA, 2007	16,819,904

There were no unit waste factors based on Irish construction projects available to generate C&DW production estimates. The only attempt to use site measurements was in the *National Waste Database 2001 Factsheet Series 4 – Construction and Demolition Waste* (EPA, 2003b), where US EPA unit waste factors were applied to estimated construction output for that year. However, the EPA did recognise that the robustness of this methodological approach in an Irish context was questionable. The current report aimed to address that significant gap by auditing Irish construction sites and deriving data directly from them.

The first step was to examine C&DW audit tools previously used on construction projects in the UK.

2.2 Assessment of UK Construction and Demolition Waste Audit Tools

The use of UK C&DW audit tools was examined to develop a basis for the development of a new audit model for use on Irish construction projects. Three systems were investigated:

1. The waste accounting system developed by Skoyles (1978)
2. The Site Methodology to Audit, Reduce and Target Waste (SMARTWaste) system consisting of SMARTAudit and SMARTStart developed by the Building Research Establishment (BRE) (undated)
3. The skip volume analysis form developed by the Construction Industry Research and Information Association (CIRIA) (Coventry *et al*., 2001).

Each system's methodology was tested on-site and the limitations of each system were identified (Grimes, 2005; Kelly, 2006). The main limitations of each system were as follows:

- The Skoyles waste accounting system required a full-time auditor on-site and was based on a comparison of materials delivered and work measured rather than on a skip analysis.
- The SMARTAudit data collection system was a difficult and time-consuming process requiring an Internet connection. It was also prohibitively expensive within the scope of this study.
- The SMARTStart system also required an Internet connection and a lot of paperwork. It too was prohibitively expensive within the scope of this study.
- The CIRIA model involved a lot of documentation and was a time-consuming process.

It was decided that the best strategy was to develop and test an original audit tool on sites in Ireland using the best aspects of the examined UK tools and guidelines developed by Patterson (1999).

3 Development and Testing of an Original Waste Audit Tool on Selected Snapshot Construction Projects in Ireland

The first step in the development of a site-based waste audit methodology was to apply the guidelines adapted from Patterson (1999) to determine the scope of the proposed study. Each guideline was first considered individually before being integrated into an overall design.

3.1 Project Framework

It was decided that the primary resource of the study would be the students of the Department of Building and Civil Engineering at the Galway–Mayo Institute of Technology (GMIT). The B.Sc. (Honours) Degree in Construction Management consists of a mandatory module of work placement during the third year. The placement runs from February to August each year and formed the basis of the data collection, providing snapshots of a wide range of project types which displayed a variety of waste management practices. Four case studies were also examined, where a more in-depth analysis was produced over a longer time period (Grimes, 2005).

3.2 Waste Measurement

Three methods of assessment were considered:

1. Visual characterisation
2. Mass sorting
3. Photogrammetric sorting.

The visual characterisation method was selected as it was the most cost-effective and efficient process with minimal direct exposure to or contact with the waste materials. Studies have shown that an experienced auditor can produce estimates comparable with physical sorting on-site (Coventry *et al*., 2001). Reinhart *et al.* (2002) also concluded that the visual characterisation method could analyse between approximately 10 and 50 times as many waste loads as photogrammetric or mass sort techniques for the same analytical cost.

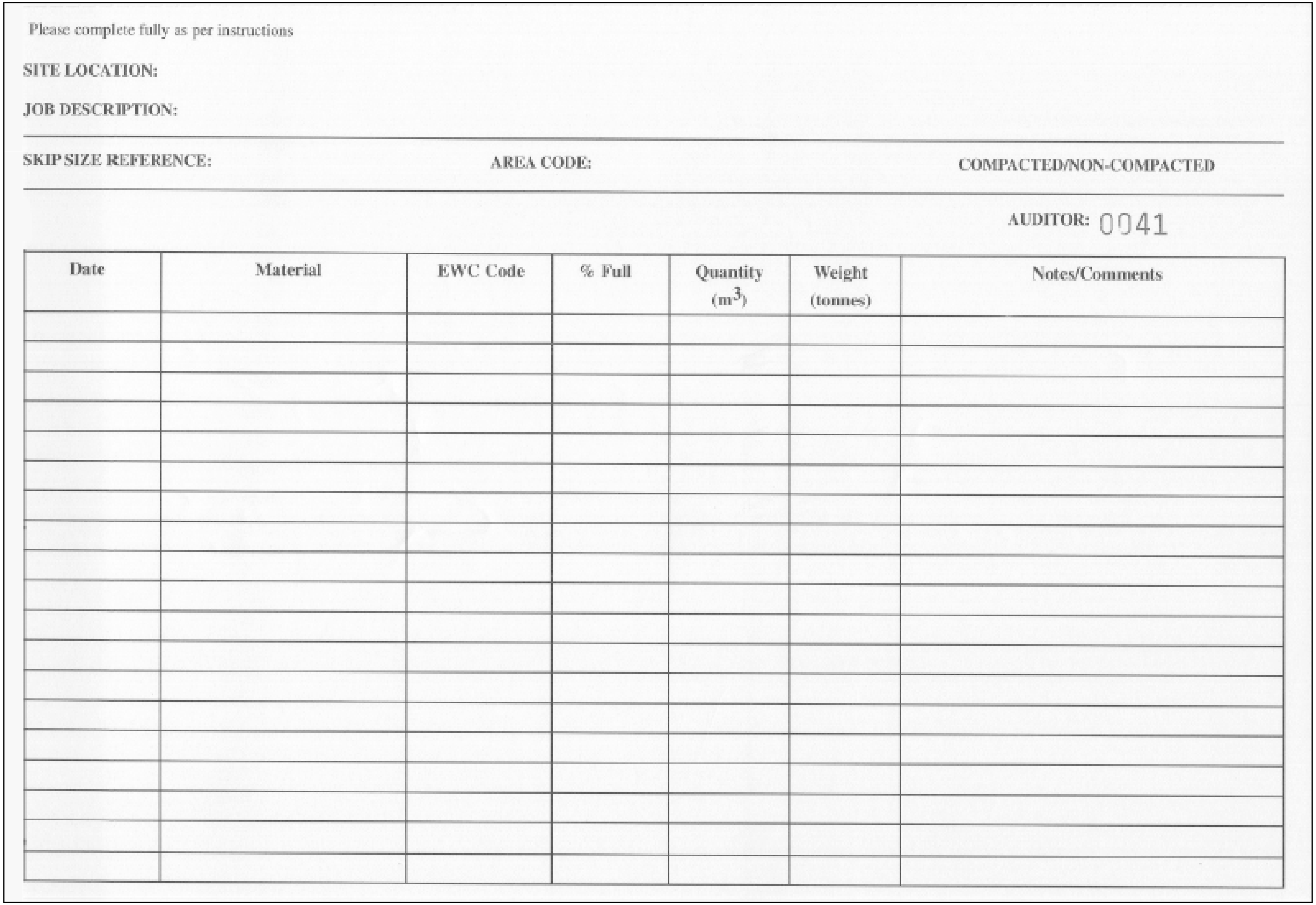
3.3 Working Definition of Construction and Demolition Waste

The C&DW definition used was all waste fractions deposited in waste skips on the audited sites. This did not include excavated materials or materials left around the site.

3.4 Audit Format

The audit format developed for use on-site had to provide basic criteria for interpreting the data collected and had to be user friendly. A paper-based audit sheet (Fig. 3.1) was developed to include the following information:

- Site location, including exact postal address
- Job description, including the project category and method of construction
- Skip size reference. This was used to track the skips on-site. Each skip was given a unique reference number consisting of the skip number (e.g. **03**), the supplier’s initials (e.g. Kelly Waste would be **KW**) and skip size (e.g. **12** yd^3), giving a reference number of **03KW12**. The skip number correlated with the audit sheet number
- Area code. The site layout was divided into area codes, e.g. A1, A2, B3, etc., to determine the exact location of the skips
- Compaction or non-compaction of skip contents
- Auditor name
- Date
- Material description as accurately as possible
- Appropriate European Waste Catalogue (EWC) (EPA, 2002) code (if available)
- Percentage full by visual assessment in 5% intervals



Please complete fully as per instructions

SITE LOCATION:

JOB DESCRIPTION:

SKIP SIZE REFERENCE:

AREA CODE:

COMPACTED/NON-COMPACTED

AUDITOR: 0041

Date	Material	EWC Code	% Full	Quantity (m^3)	Weight (tonnes)	Notes/Comments

Figure 3.1. Audit sheet example.

- Conversion to volume (m^3)
- Conversion to weight (t)
- Notes/Comments identifying any waste management practices.

The audit sheets were individually numbered and provided in triplicate format, each one a different colour, i.e. the white audit sheet was sent to the author, the pink audit sheet was given to the participating contractor (if requested) and the blue audit sheet was retained by the student until the placement was completed. A set of 50 audit sheets in triplicate format was integrated into a hardback A4 audit book with a waterproof cover (Fig. 3.2).

The audit book provided the student with all the information required to carry out the point source assessments (PSAs) on-site and simplified the data collection process. Each audit book contained the following information:

- Useful contact numbers of the research team, EPA, waste contractors and local authorities
- A copy of the elements of the EWC and Hazardous Waste List which relate to C&DW
- Project categories as used in the *National Waste Database Report 2001 Factsheet Series 4 – Construction and Demolition Waste* (EPA, 2003b)
- A set of conversion factors for the different skip/container sizes, i.e. volume percentages to m^3
- A set of conversion factors based on the Waste Management (Landfill Levy) Regulations, 2002 to convert volumes (m^3) to weights (t)
- Procedures for carrying out an audit on-site and the submission of the collected data.

Figure 3.2. Hardback A4 audit book.

3.5 Waste Categories

The on-site auditor provided a detailed description of the components of the skip and their appropriate EWC code.

3.6 On-Site Arrangements

Prior to the commencement of the students' site placements, a letter was sent to the relevant companies to inform them that all data collected on-site would be confidential. Each student was advised to carry out the PSAs at an appropriate time so as not to interfere with their general duties. The average time taken to carry out the audit depending on project type and size was 30–45 min.

3.7 Data Analysis

The auditor collated the data to prepare a monthly audit report. A simple pie chart drawn in Microsoft Word, expressing the composition of the monthly waste production in percentages, was also included (Fig. 3.3).

3.8 Audit Cost

There was no cost associated with carrying out the PSAs on-site except for the time it took to carry out the audit.

3.9 Methodology to Test the Audit Tool

The methodology of the basic waste skip analysis is shown in Fig. 3.4. It had two main objectives:

1. To identify the composition of the C&DW stream on-site
2. To quantify all the materials being taken off site in containers/skips.

Each numbered audit sheet represented one skip, i.e. each skip had its own individual audit sheet. This enabled the accurate recording of the number of skips used throughout the project.

There were three phases in carrying out the PSAs on-site:

1. Acquisition of pre-audit information
2. Audit data collection
3. Post-audit data analysis.

3.9.1 Acquisition of pre-audit information

The data collection preparation included:

- An accurate description of the site location, i.e. full postal address to facilitate site visits
- A detailed site description including project category and method of construction. The category options were:
  - Residential (new private and public housing)
  - Private non-residential (private and semi-state industry, commercial, agricultural, tourism and worship)
  - Productive infrastructure (water and sanitary services, airports, ports, harbours, energy and telecommunications)
  - Social infrastructure (education, health, public buildings, local authority services and the Gaeltacht)
- Identification of skip size. Each skip size was obtained from the delivery docket (usually in cubic yards) and converted to cubic metres. Random checks were carried out on the skips by physically measuring the skip volume when delivered to ensure correlation with the documentation. Each skip was referenced as outlined previously to ensure accurate tracking of the skips on-site or, alternatively, the site layout was divided into area codes to identify the position of the skips on-site. This was suitable when there was no movement of skips around the site, i.e. central skip area arrangement.

3.9.2 Audit data collection

The basic skip analysis was done on a daily basis and involved recording the following:

- The date on which the audit took place
- An accurate material description of the components of the skip, with associated EWC code if applicable
- A percentage estimate (5% intervals) of each component in the skip by visual assessment. It

Project description:	Residential development of 125 units		
Completed floor area:	2,850	**Project stage:**	35%
Total waste (m^3)	110	**Total waste (t):**	33
Unit waste factor (m^3/m^2)	0.039	**Unit waste factor (kg/m^2):**	12
Date:	01/04/05	**Auditor:**	

Materials	**EWC code**	**Volume (m^3)**	**Conversion factor**	**Weight (t)**
Paper, Plastics & Packaging	170203	68.200	0.15	10
Plasterboard	170802	7.164	0.40	3
Canteen/Office Waste		5.500	0.40	2
Timber/Wood	170201	4.100	0.60	3
Mixed C&DW	170904	19.458	0.60	12
Metals	170400	1.800	1.00	2
Insulation materials	170604	3.434	0.40	1
Total		**109.656**		**33**

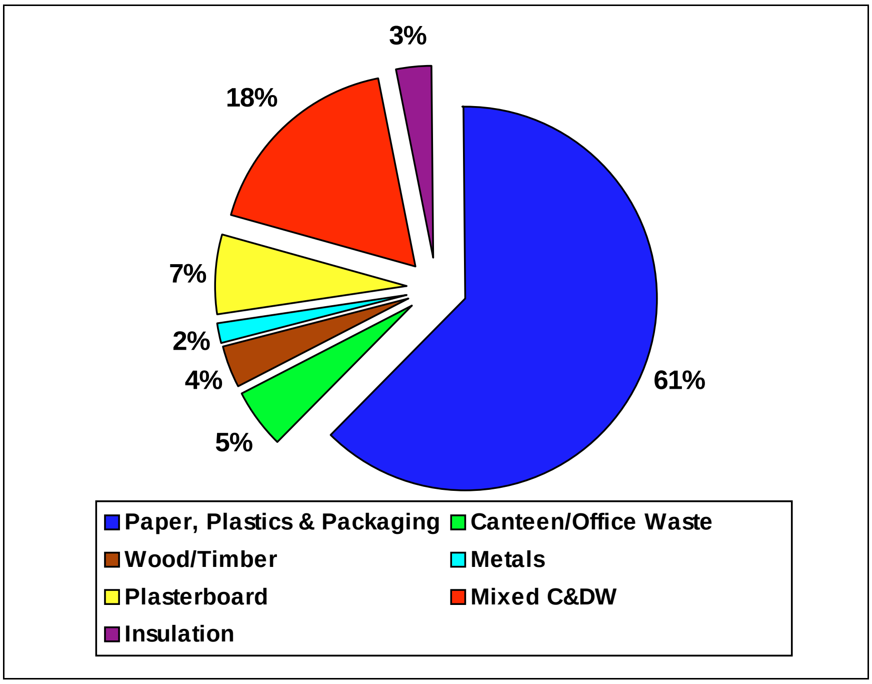


Figure 3.3. Example of monthly report. (EWC, European waste catalogue; C&DW, construction and demolition waste.)

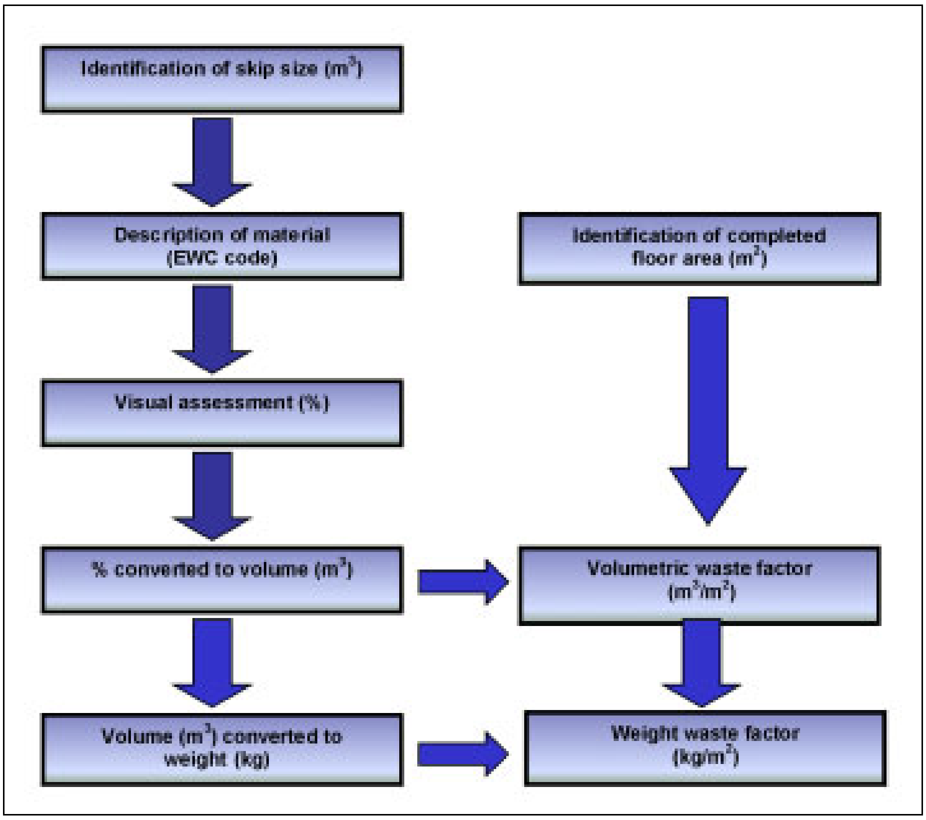


Figure 3.4. Site skip analysis procedure.

was essential to start this process when the skip was empty to estimate the percentage volume distribution of each component on a daily basis. The percentage volume estimates were converted into cubic metres using the skip size conversion factors

- The volume estimate (m^3) was converted into a weight estimate (t) using the Waste Management (Landfill Levy) Regulations, 2002 conversion factors

- Noting whether the skip was compacted or non-compacted.

The percentage estimates were expressed individually on a daily basis – not cumulatively (see Fig. 3.5).

3.9.3 *Post-audit analysis*

At the end of each month, the auditor produced a monthly report. It consisted of the following:

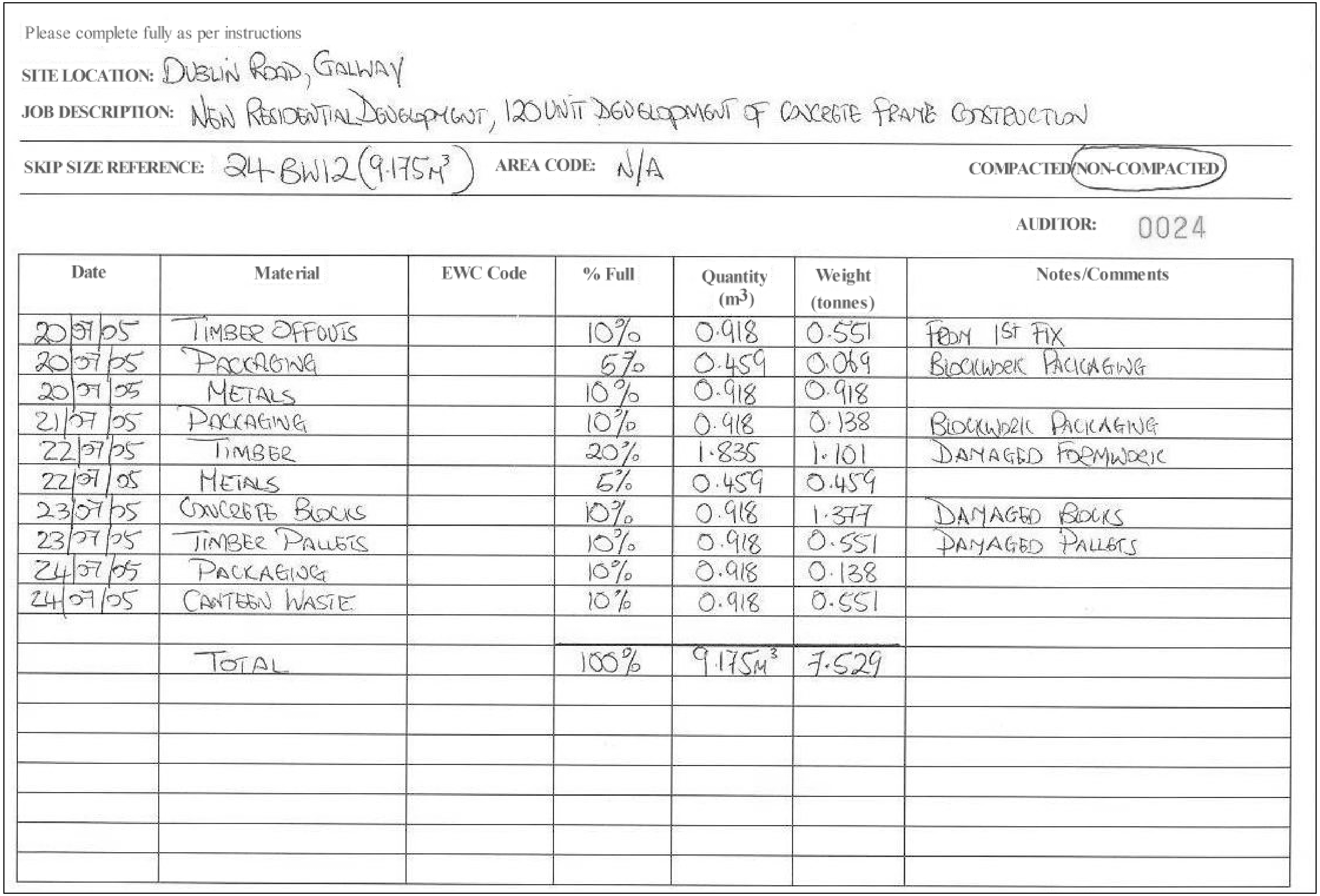
- Site description which included the project category and method of construction as described previously

- Total floor area expressed in cubic metres of the overall project

- The project stage expressed in percentages, i.e. 0% denoted the commencement with 100% implying completion

- The completed floor area expressed in cubic metres for relevant month. This was extrapolated from the percentage work done in any month multiplied by the overall project floor area, e.g. if 10% of the work was completed in the month of April and the total floor area was 15,000 m^2, then the completed floor area for the month of April is 1,500 m^2

- The monthly skip analysis totals, consisting of material description, EWC codes, volume (m^3) and weight (t)



Please complete fully as per instructions

SITE LOCATION: DUBLIN ROAD, GALWAY

JOB DESCRIPTION: NEW RESIDENTIAL DEVELOPMENT, 120 UNIT DEVELOPMENT OF CONCRETE FRAME CONSTRUCTION

SKIP SIZE REFERENCE: 24-BW12 (9.175M^3) **AREA CODE:** N/A **COMPACTED/**[✓ **NON-COMPACTED**]

AUDITOR: 0024

Date	Material	EWC Code	% Full	Quantity (m^3)	Weight (tonnes)	Notes/Comments
20/07/05	TIMBER OFFCUTS		10%	0.918	0.551	FROM 1ST FIX
20/07/05	PACKAGING		5%	0.459	0.069	BLOCKWORK PACKAGING
20/07/05	METALS		10%	0.918	0.918	
21/07/05	PACKAGING		10%	0.918	0.138	BLOCKWORK PACKAGING
22/07/05	TIMBER		20%	1.835	1.101	DAMAGED FORMWORK
22/07/05	METALS		5%	0.459	0.459	
23/07/05	CONCRETE BLOCKS		10%	0.918	1.377	DAMAGED BLOCKS
23/07/05	TIMBER PALLETS		10%	0.918	0.551	DAMAGED PALLETS
24/07/05	PACKAGING		10%	0.918	0.138	
24/07/05	CANTEEN WASTE		10%	0.918	0.551	
	TOTAL		100%	9.175M^3	7.529	

Figure 3.5. Example of a completed audit sheet for Skip No. 24.

- Total number of skips identifying skip volumes. This was easily calculated by counting the number of audit sheets that were used in the month
- Total waste expressed in cubic metres and tonnes
- Unit waste factors calculated by:

$$WF^{v} = V / FA^{c}$$

where WF^{V} is the volume waste skip factor (m^3/m^2), V is the volume of waste (m^3), and FA^{C} is the completed floor area (m^2)

and

$$WF^{M} = M / FA^{c}$$

where WF^{M} is the mass unit waste skip factor (kg/m^2), M is the mass of waste (kg), and FA^{C} is the completed floor area (m^2).

4 Generation of Waste Production Indicators from Snapshot Point Source Assessments and Case Studies on Irish Construction Projects

Fifty-seven construction sites were audited over a 2-year period (2004–2005). This chapter outlines the waste factors generated from 53 PSAs and the results of four case study assessments (Grimes, 2005). The PSAs provide a snapshot analysis of a 6-month period, whereas the case studies were conducted over a period of 15–22 months.

The quantitative and compositional results are outlined separately as different methodologies were used. The case studies compared the use of the Skoyles waste accounting system, the BRE SMARTWaste tool and the CIRIA skip volume analysis form with the audit tool developed by this study. The PSAs exclusively used the audit tool developed by this study.

4.1 Project Categories

Each project audited in 2004 and 2005 was divided into project categories as used by the EPA in the *National Waste Database 2001 Factsheet Series 4 – Construction and Demolition Waste* (EPA, 2003b):

- Residential (new private and public housing)
- Private non-residential (private and semi-state industry, commercial, agricultural, tourism and worship)
- Productive infrastructure (water and sanitary services, airports, harbours, energy and telecommunications)
- Social infrastructure (education, health, public buildings, local authority services and the Gaeltacht).

A number of developments audited consisted of residential and commercial units, e.g. housing schemes combined with retail units, supermarkets, etc. They were categorised as new residential construction as in each case the primary construction activity was residential development. The numbers of PSAs and case studies are given in Tables 4.1 and 4.2, respectively.

Table 4.1. Number of point source assessments per category.

Project category	2004	2005	Total
Residential construction	11	8	**19**
Productive infrastructure construction	0	3	**3**
Social infrastructure construction	5	4	**9**
Private non-residential construction	12	10	**22**
Total			**53**

Table 4.2. Number of case studies per category.

Project category	2004	2005	Total
Residential construction	2	0	**2**
Social infrastructure construction	1	0	**1**
Private non-residential construction	1	0	**1**
Total			**4**

4.2 Results of Audited Snapshot Point Source Assessments

4.2.1 *New residential construction*

The residential construction category consisted of all forms of residential construction, e.g. detached and semi-detached units, apartments, town houses, duplexes and mixed facilities. Residential construction waste factors were generated from 19 snapshot projects (see Table 4.3) producing sample mean indicators. These are shown in the final two columns as 70 kg/m^2 and 0.107m^3/m^2.

Figure 4.1 outlines the sample distribution of new residential waste factors (kg/m^2) for 2004 and 2005, highlighting the key outliers of 318 kg/m^2 and 289 kg/m^2 around the mean of 70 kg/m^2.

4.2.2 *New private non-residential construction*

Private non-residential construction waste factors were generated from 22 snapshot projects (see Table 4.4) producing sample mean indicators. As can be seen, these averaged at 87 kg/m^2 and 0.131 m^3/m^2.

Figure 4.2 outlines the sample distribution of new private non-residential waste factors (kg/m^2) for 2004 and 2005, highlighting the key outliers of 296 kg/m^2 and 288 kg/m^2 around the mean of 87 kg/m^2.

Table 4.3. New residential construction results (2004 and 2005).

Reference	Total waste (m^3)	Total waste (t)	Completed floor areas (m^2)	Waste factor (m^3/m^2)	Waste factor (kg/m^2)
PSA 1	110	33	2,850	0.039	12
PSA 2	391	141	13,104	0.030	11
PSA 3	200	135	9,000	0.022	15
PSA 4	86	56	2,800	0.031	20
PSA 5	22	9	234	0.094	39
PSA 6	281	144	4,158	0.068	35
PSA 7	198	82	2,295	0.086	36
PSA 8	98	83	5,400	0.018	15
PSA 9	377	313	7,290	0.052	43
PSA 10	210	144	454	0.463	317
PSA 11	755	577	2,000	0.378	289
PSA 12	103	63	960	0.107	66
PSA 13	164	63	1,375	0.119	46
PSA 14	38	26	1,375	0.027	19
PSA 15	298	211	2,057	0.145	103
PSA 16	90	65	486	0.185	134
PSA 17	505	436	6,942	0.073	63
PSA 18	118	59	1,688	0.070	35
PSA 19	737	833	21,400	0.034	39
Totals	**4,781**	**3,473**	**85,868**	**2.041**	**1,337**
Total weight waste factors (kg/m^2)/no. of sites = 1,337/19 =					**70 kg/m^2**
Total volume waste factor (m^3/m^2)/no. of sites = 2.041/19 =					**0.107m^3/m^2**

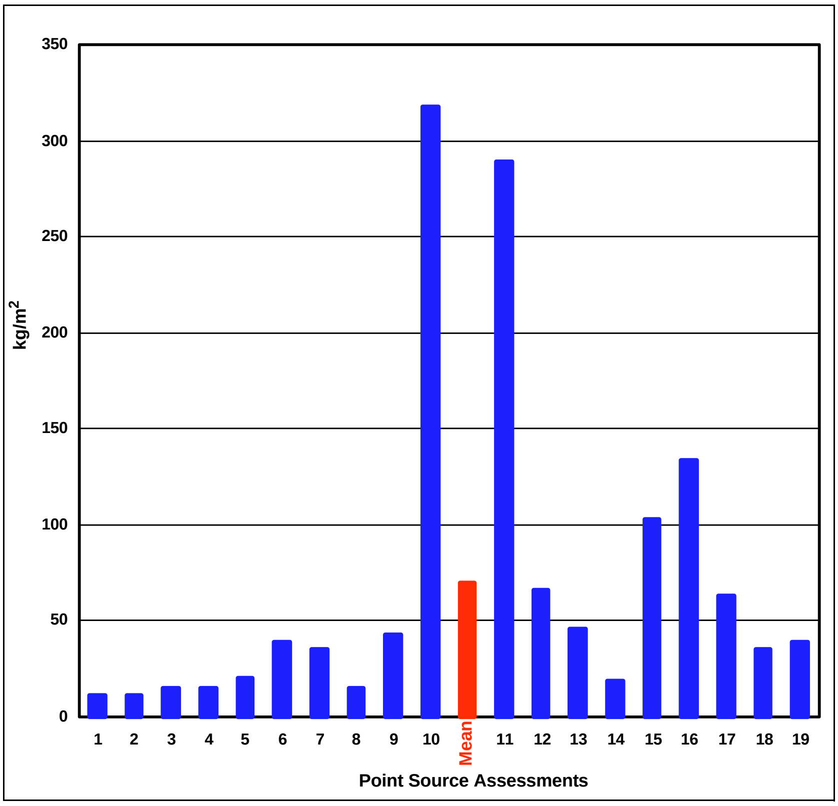


Figure 4.1. Sample distribution of new residential waste factors (kg/m^2) for 2004 and 2005.

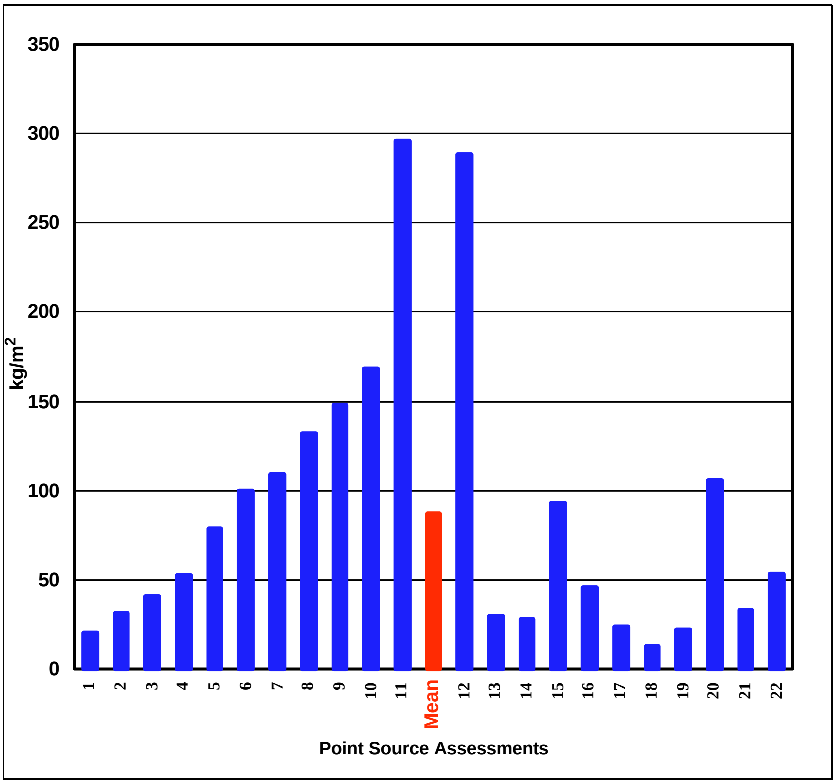


Figure 4.2. Sample distribution of new private non-residential waste factors (kg/m^2) for 2004 and 2005.

Table 4.4. New private non-residential construction results (2004 and 2005).

Reference	Total waste (m^3)	Total waste (t)	Completed floor areas (m^2)	Waste factor (m^3/m^2)	Waste factor (kg/m^2)
PSA 1	221	86	4,391	0.050	20
PSA 2	664	442	14,300	0.046	31
PSA 3	1 163	690	16,920	0.069	41
PSA 4	416	273	5,227	0.080	52
PSA 5	81	46	576	0.141	80
PSA 6	138	88	880	0.157	100
PSA 7	320	218	2,000	0.160	109
PSA 8	352	240	1,814	0.194	132
PSA 9	980	838	5,670	0.173	148
PSA 10	276	370	2,200	0.126	168
PSA 11	455	266	900	0.506	296
PSA 12	283	201	700	0.404	287
PSA 13	480	230	7,820	0.061	29
PSA 14	59	49	1,725	0.034	28
PSA 15	71	37	400	0.178	93
PSA 16	415	234	5,090	0.082	46
PSA 17	140	133	5,456	0.026	24
PSA 18	21	11	900	0.023	12
PSA 19	35	19	867	0.040	22
PSA 20	344	240	2,256	0.153	106
PSA 21	27	9	285	0.095	32
PSA 22	301	182	3,425	0.088	53
Totals	**7,242**	**4,902**	**83,802**	**2.886**	**1,909**
Total weight waste factors (kg/m^2)/no. of sites = 1,909/22 =					**87 kg/m^2**
Total volume waste factors (kg/m^2)/no. of sites = 2.886/22 =					**0.131 m^3/m^2**

4.2.3 New social infrastructure construction

Social infrastructure construction waste factors were generated from nine snapshot projects (see Table 4.5), producing sample mean indicators. The averages are 139 kg/m^2 and 0.194 m^3/m^2.

Figure 4.3 outlines the sample distribution of new private non-residential waste factors (kg/m^2) for 2004 and 2005, highlighting the key outliers of 358 kg/m^2 and 265 kg/m^2 around the mean of 139 kg/m^2. This sample is less reliable than the previous categories due to its sample size.

4.2.4 New productive infrastructure construction

Productive infrastructure construction waste factors were produced from three snapshot projects (see Table 4.6) producing sample mean indicators. The averages are 49 kg/m^2 and 0.098 m^3/m^2. A sample distribution graph is not outlined as the sample size was deemed to be insufficient.

Table 4.5. New social infrastructure construction results (2004 and 2005).

Reference	Total waste (m^3)	Total waste (t)	Completed floor areas (m^2)	Waste factor (m^3/m^2)	Waste factor (kg/m^2)
PSA 1	54	35	2,080	0.026	17
PSA 2	120	98	5,780	0.021	17
PSA 3	357	271	6,853	0.052	40
PSA 4	290	120	1,817	0.160	66
PSA 5	164	145	404	0.406	359
PSA 6	124	87	328	0.378	265
PSA 7	151	89	2,584	0.058	34
PSA 8	469	351	1,344	0.349	261
PSA 9	613	399	2,071	0.296	193
Totals	**2,342**	**1,595**	**23,261**	**1.746**	**1,252**
Total weight waste factors (kg/m^2)/no. of sites = 1,252/9 =					**139 kg/m^2**
Total volume waste factors (m^3/m^2)/no. of sites = 1.746/9 =					**0.194 m^3/m^2**

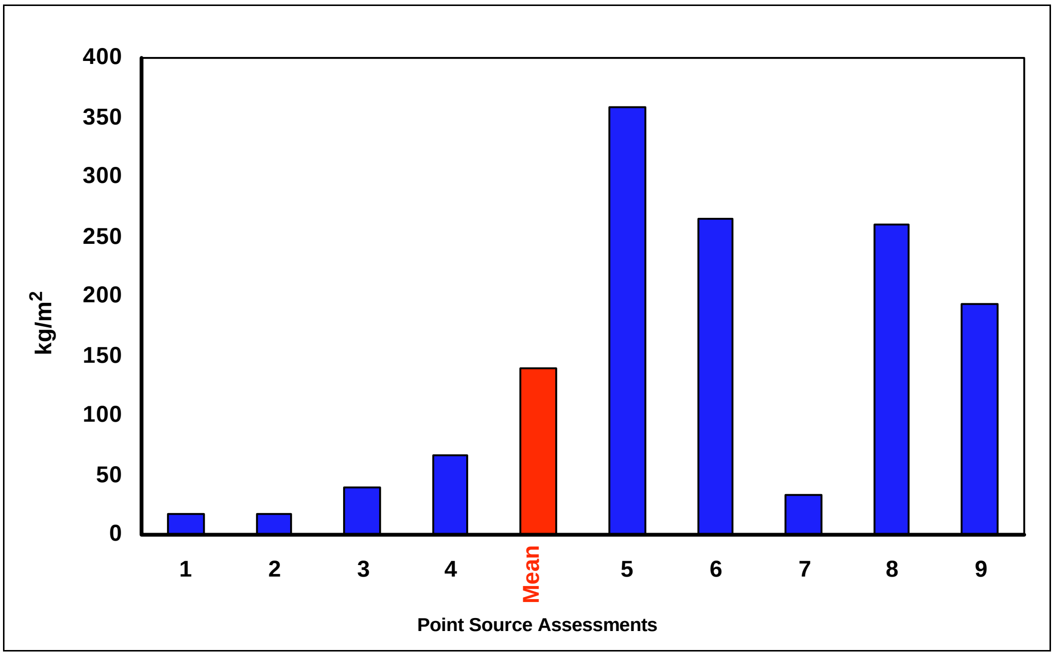


Figure 4.3. Sample distribution of new social infrastructure waste factors (kg/m^2) for 2004 and 2005.

As can be seen from the results, the presence of extreme values relating to a small number of construction sites in some of the categories skewed the average values. It was decided to include these outliers as the audit methodology aimed to provide a reflection of both good and poor waste management practices. The exclusion of these outliers would have considerably reduced the calculated average means for each category but would not have provided a complete picture of what was audited. This limitation could be addressed by the further collection of additional data.

Table 4.6. New productive infrastructure construction results (2004 and 2005).

Reference	Total waste (m^3)	Total waste (t)	Completed floor areas (m^2)	Waste factor (m^3/m^2)	Waste factor (kg/m^2)
PSA 1	54	23	295	0.184	79
PSA 2	84	54	975	0.087	56
PSA 3	52	26	2,349	0.022	11
Totals	**190**	**103**	**3,619**	**0.293**	**146**
Total weight waste factors (kg/m^2)/no. of sites = 146/3 =					**49 kg/m^2**
Total volume waste factors (m^3/m^2)/no. of sites = 0.292/3 =					**0.098 m^3/m^2**

4.3 Case Studies

Grimes (2005) undertook four case studies in the Galway region focusing on the management of waste on-site. Each project selected was in the early stages of construction, allowing a more complete audit of the waste production than the snapshot PSAs described above. The case studies were used to test the Skoyles accounting system, the BRE SMARTWaste tool and the CIRIA skip analysis form. In each case, the unit mass skip waste factor was compared with the results from the snapshot PSAs.

4.3.1 Case Study 1

Case Study 1 was a residential development consisting of 225 units. The project duration was 30 months. The audit duration was 19 months. The following waste management practices were recorded in Case Study 1:

- The volume of C&DW segregated for recycling was 611 m^3 (19.5% of total waste), consisting of 598 m^3 of timber waste and 13 m^3 of metal waste. This resulted in a total saving of €7,234.

- The volume of C&DW disposed of by waste skip was 2,529 m^3 (80.5%). The number of skips used during the audit period was 394, resulting in a total skip cost of €78,083 (including the total saved from the segregated skips).

There was no formalised waste management strategy implemented in Case Study 1. As the work progressed, a waste manager was appointed but the implementation of the segregation policy proved difficult. The calculated unit mass waste skip factor of **66 kg/m^2** was comparable with the snapshot sample mean of 70 kg/m^2 for new residential construction.

4.3.2 Case Study 2

Case Study 2 was a residential development consisting of 148 units. The project duration was 24 months. The audit duration was 15 months. The following waste management practices were recorded in Case Study 2:

- The volume of C&DW segregated for recycling was 632 m^3 (37% of total waste), consisting of 423 m^3 of timber waste, 196 m^3 of insulation waste and 13 m^3 of metal waste. This resulted in a total saving of €11,255.

- The volume of C&DW disposed of by waste skip was 1,087 m^3 (63%). There were 211 skips used during the audit period, resulting in a total skip cost of €41,290 (including the total saved from the segregated skips).

A waste management strategy was adopted in Case Study 2, with the appointment of a waste manager and the implementation of a source segregation policy. A waste management operative was employed to collect and segregate all of the site's wastes. This involved the use of a 6-t dumper to transport the waste from various parts of the site to the central skip area. This incurred a cost of €55,895 for plant and labour over the audit period.

The calculated mass unit waste skip factor of **64 kg/m^2** was comparable with the snapshot sample mean of 70 kg/m^2 for new residential construction.

4.3.3 *Case Study 3*

Case Study 3 was a private non-residential development consisting of a petrol filling station, retail units, offices and a hotel. The project duration was 21 months. The audit duration was 15 months. The following waste management practices were recorded:

- The volume of C&DW segregated for recycling was 510 m^3 (37% of total waste), consisting of 396 m^3 of timber waste and 114 m^3 of metal waste. This resulted in a total saving of €5,257.
- The volume of C&DW disposed of by waste skip was 865 m^3 (63%). There were 137 skips used during the audit period, resulting in a total skip cost of €31,250 (including the total saved from the segregated skips).

There was no formal C&DW strategy employed in Case Study 3. It was, however, the policy of the company to position smaller skips (2 yd^3) around the site, the contents of which would be disposed of in the larger skips (12 yd^3) positioned centrally. In addition, the main subcontractors provided their own skips to collect any wastes arising from their work packages. This resulted in some source segregation.

The calculated unit mass waste skip factor of **38 kg/m^2** contrasts with the snapshot sample mean of 87 kg/m^2 for new private non-residential construction.

4.3.4 *Case Study 4*

Case Study 4 was a social infrastructure development consisting of an educational building. The project duration was 22 months. The audit duration was 19 months. The following waste management practices were recorded:

- The volume of C&DW segregated for recycling was 111 m^3 (28% of total waste), consisting of 100 m^3 of timber waste and 11 m^3 of metal waste. This resulted in a total saving of €250.
- The volume of C&DW disposed of by waste skip was 289 m^3 (72%). There were 46 skips used during the audit period, resulting in a total skip cost of €11,273 (including the total saved from the segregated skips).

There was no formal waste management strategy employed in Case Study 4. One major difference from the other three case studies is that the contractor was charged for waste disposal by weight and not by skip size (volume). There was some segregation of waste timber and metals, resulting in minimal cost savings.

The calculated unit mass waste skip factor of **205 kg/m^2** contrasts with the snapshot sample mean of 139 kg/m^2 for new social infrastructure construction.

There is a correlation between the social infrastructure results for Case Study 4 and the snapshot sample mean in that they are higher than the residential and private non-residential case studies and snapshot factors. However, it should be noted that the sample size for results for this sector was relatively small.

4.4 Composition

4.4.1 *Classification of snapshot projects*

The composition of the C&DW stream varies according to project type/activity. The identification of the individual components is essential in establishing waste prevention and minimisation targets. The methodology developed aimed to identify the composition by utilising a general material description and the appropriate EWC code for each material. The composition results of the 53 PSAs and four case studies were divided into the following nine categories:

1. Inert waste (excluding excavated materials)
2. Paper, plastics and packaging
3. Timber/Wood
4. Plasterboard
5. Canteen/Office waste
6. Mixed C&DW
7. Metals (including their alloys)
8. Insulation materials
9. Miscellaneous waste.

It must be noted that no excavated material was included in the audits as none was deposited in the waste skips. All of the excavated material was either reused on-site or sent to permitted sites. Figures 4.4–4.7 illustrate the composition per project category.

The compositional analysis of the skips on the 53 sites studied suggested that the most common waste types at all the PSAs were wood/timber (30% by volume), paper, plastics and packaging (17% by volume), and mixed C&DW (13% by volume).

The individual breakdown of each category is as follows:

The main waste fractions in **new residential construction** (Fig. 4.4) were:

- Inert waste (24% by volume)
- Wood/Timber (25% by volume)
- Paper, plastics and packaging (17% by volume).

The main waste fractions in **new private non-residential construction** (Fig. 4.5) were:

- Timber/Wood (31% by volume)
- Paper, plastics and packaging (18% by volume)
- Metals (16% by volume)
- Inert waste (13% by volume).

The main waste fractions in **new social infrastructure** (Fig. 4.6) were:

- Timber/Wood (29% by volume)
- Mixed C&DW (26% by volume)
- Metals (13% by volume)
- Paper, plastics and packaging (13% by volume).

The main waste fractions in **new productive infrastructure construction** (Fig. 4.7) were:

- Timber/Wood (34% by volume)
- Canteen waste (21% by volume)
- Paper, plastics and packaging (18% by volume)
- Metals (13% by volume).

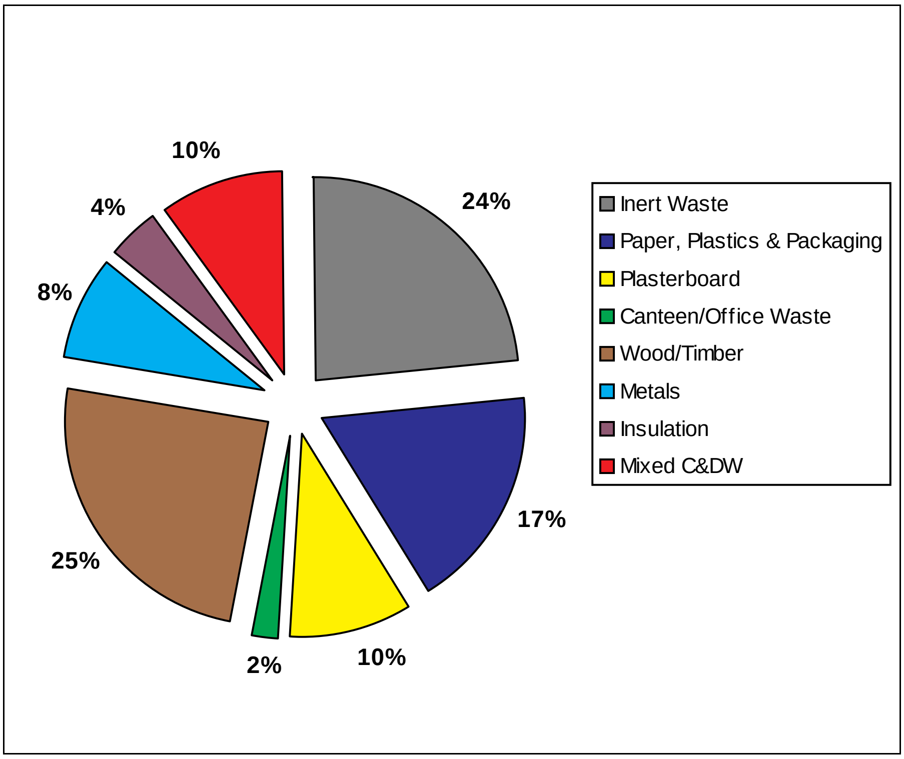


Figure 4.4. New residential construction composition by volume (m^3). (C&DW, construction and demolition waste.)

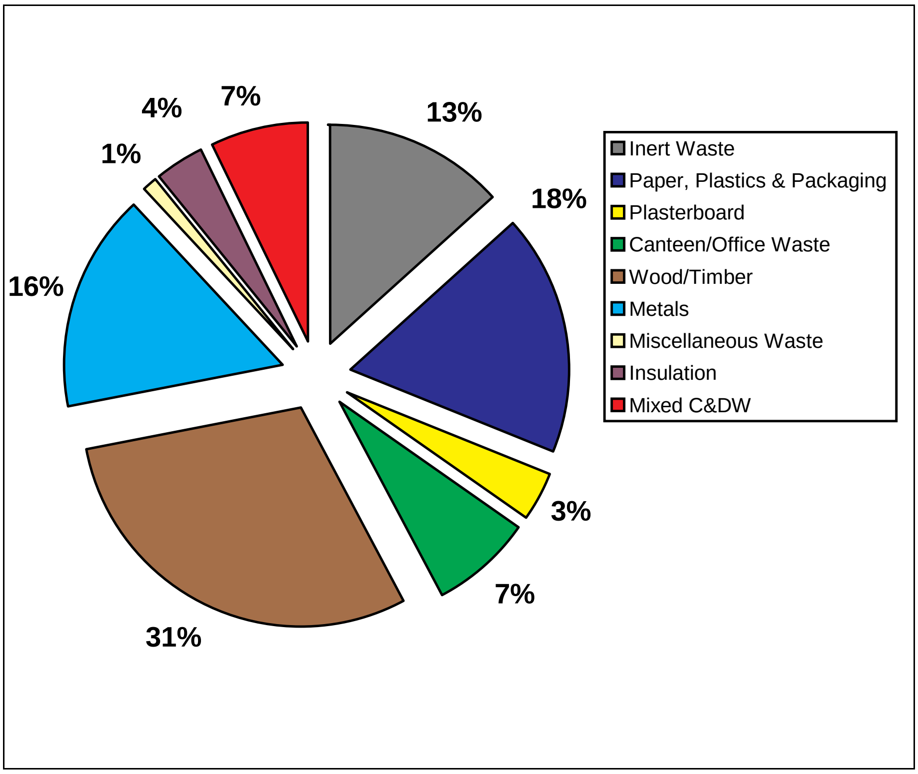


Figure 4.5. New private non-residential construction composition by volume (m^3). (C&DW, construction and demolition waste.)

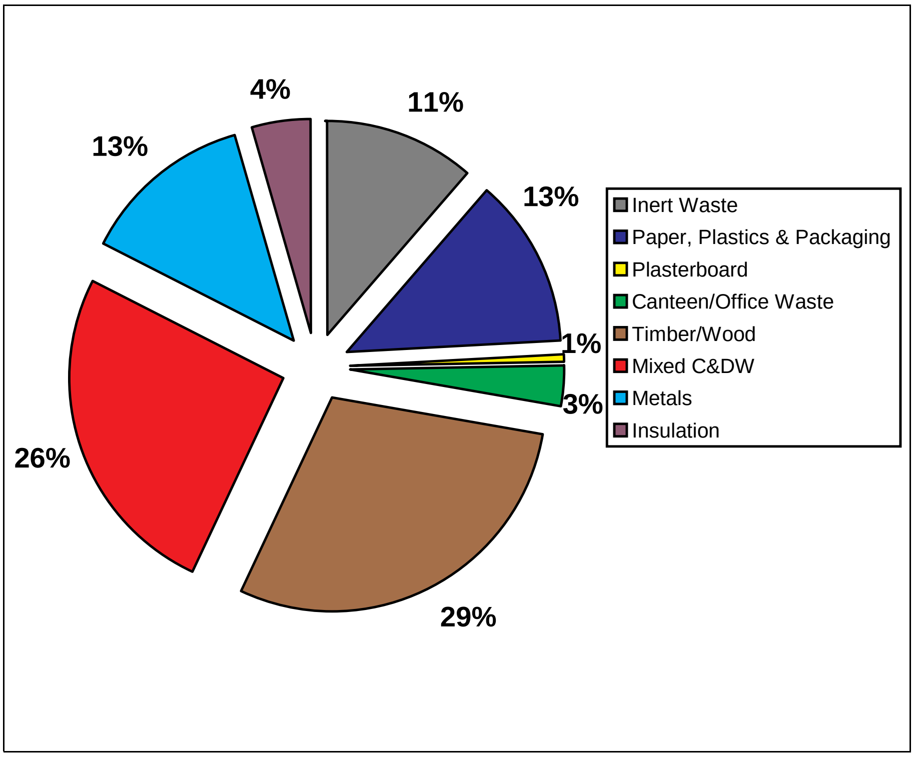


Figure 4.6. New social infrastructure construction composition by volume (m^3). (C&DW, construction and demolition waste.)

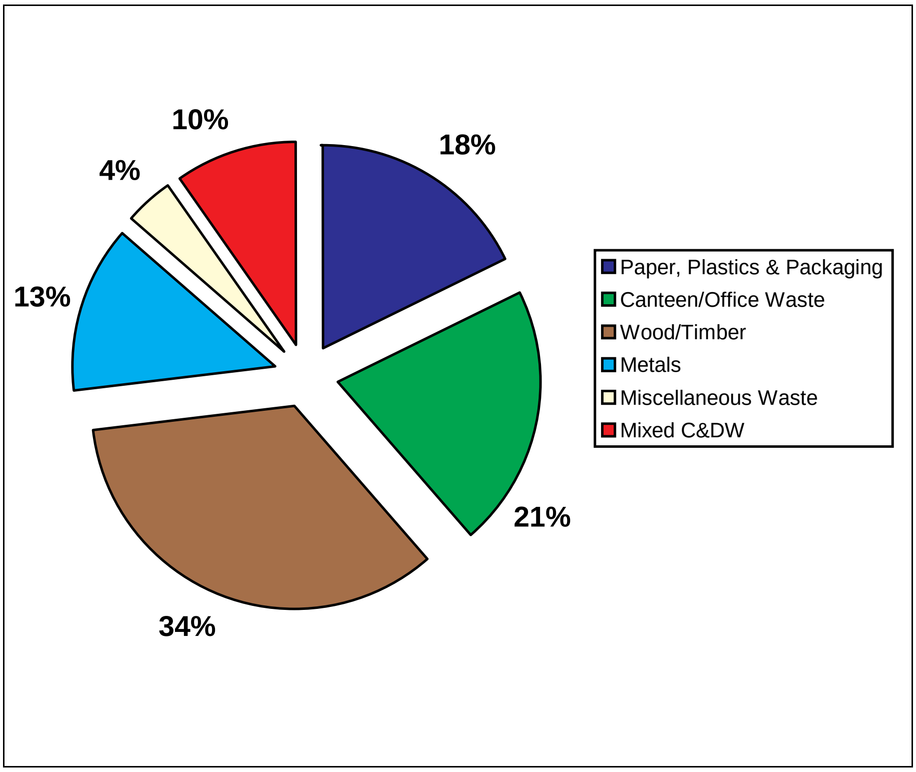


Figure 4.7. New productive infrastructure construction composition by volume (m^3). (C&DW, construction and demolition waste.)

4.5 Composition of Selected Case Studies

The case study results for the compositional analysis contrast with the snapshot projects in that there is a high degree of mixed C&DW in each one (Figs 4.8–4.11). The mixed C&DW category was used when it was impossible to differentiate the deposited waste into separate fractions by visual assessment. At the case study sites, a common practice was to ‘store’ the waste in a pile or to collect the waste around the site at the end of the week and then dispose of it into the skips. In this case, the auditor found it impossible to identify the separate fractions as the waste was placed in the skip all at once.

The compositional analysis of the four case studies identified mixed C&DW (48% by volume), timber/wood (25% by volume) and paper, plastics and packaging (8% by volume) as the most common waste fractions deposited in skips on-site.

Both sets of data from the PSAs and the case studies suggest that the most common waste types found on all 57 sites were:

- Wood/Timber
- Paper, plastics and packaging
- Mixed C&DW.

4.6 Limitations of Results

The results must be evaluated in the context of the following practical and methodological limitations:

- This new audit tool is based on a skip analysis using visual characterisation of the container’s contents. Naturally, this causes the accuracy of the results to be dependent on the auditor’s skill and diligence. Moreover, the presence of void space or waste bulking[1] in a skip can impair the accuracy of the measurements.

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[1] Waste bulking is where the consistency of a skip’s total contents varies due to the degree of compaction that the waste has undergone (if any), the poor placement of waste materials creating air voids, the irregular consistency of some waste types, and the irregular shape of some waste containers.

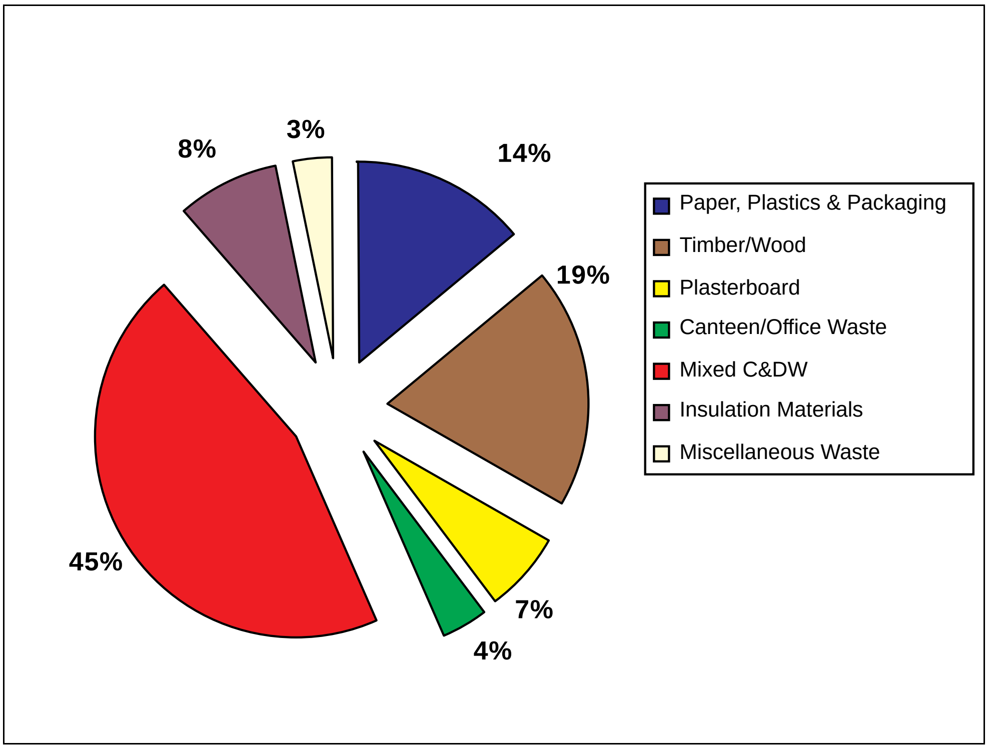

Figure 4.8. Case Study 1 composition by volume (m^3). (C&DW, construction and demolition waste.)

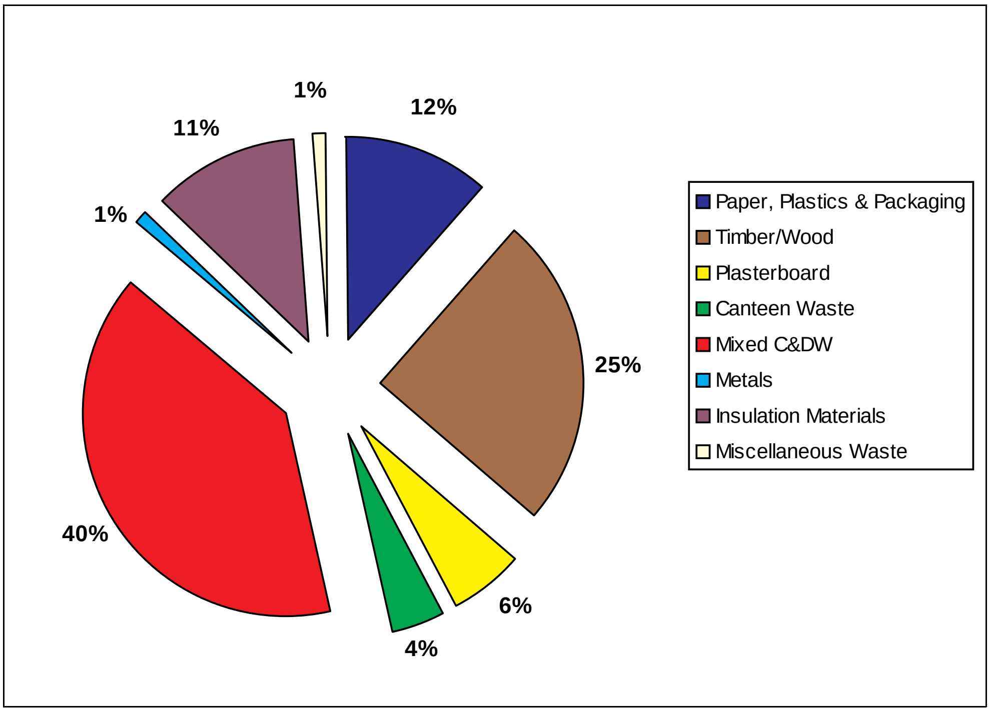

Figure 4.9. Case Study 2 composition by volume (m^3). (C&DW, construction and demolition waste.)

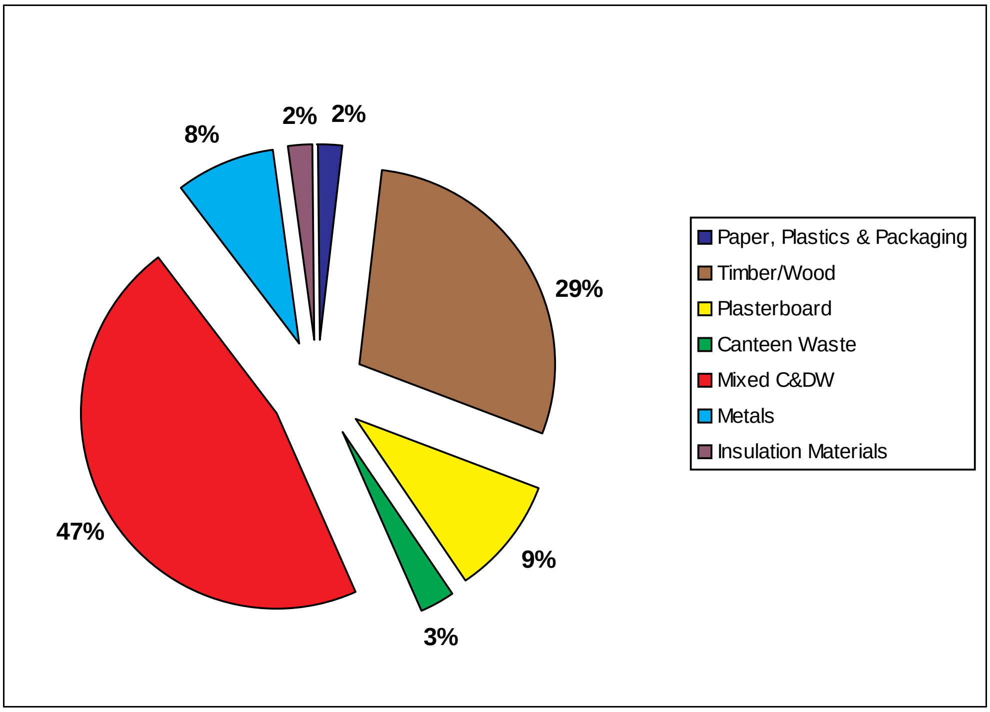

Figure 4.10. Case Study 3 composition by volume (m^3). (C&DW, construction and demolition waste.)

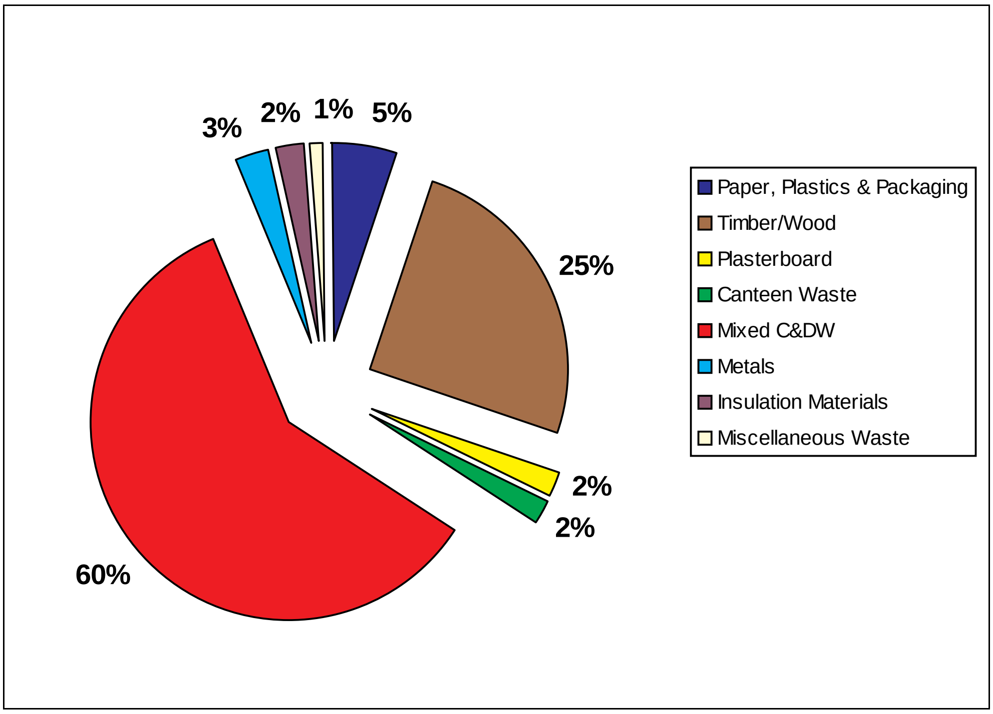

Figure 4.11. Case Study 4 composition by volume (m^3). (C&DW, construction and demolition waste.)

Levy) Regulations, 2002 was a limiting factor as they appear not to be based on a specific compositional analysis for C&DW.

- Each of the audited construction sites provided only a snapshot of overall waste production and composition, as the work was done over a 6-month period rather than covering the entire duration of construction work. The methodology would have benefited from the analysis of the whole life cycle of each site from inception to completion, as well as from increased sample sizes per category.
- The presence of extreme values relating to a small number of construction sites in some of the categories skewed the average values. The exclusion of these outliers would have considerably reduced the calculated average means for each category but would not have provided a complete picture of what was audited. This limitation could be addressed by the further collection of additional data.
- The sample mean unit waste skip factor for **new productive infrastructure construction** was based on a sampling size of only three projects.

5 Conclusions and Recommendations

This study should be seen as the first step in the continuing evaluation and improvement of C&DW data. The audit methodology tested seems to provide a reasonably robust way of measuring and reporting waste arisings generated from construction projects. The sectoral indicators produced provide the construction industry with an initial benchmark against which to measure its waste generation activities on-site.

5.1 Conclusions

The following conclusions can be drawn in relation to the current state of C&DW management in Ireland:

- Increasingly, waste legislation over the past decade is requiring the construction industry to actively participate in the implementation of national waste management policy. The ambitious target of 85% C&DW recycling by 2013 (DoELG, 1998) has provided the industry with a significant challenge.
- The initial response of the Irish construction industry was positive. The establishment of the NCDWC in 2002 brought a new focus on the need to raise awareness of the waste management issue within the sector. The industry now needs to transfer this awareness into significantly improving waste management practices on-site.
- There is a lack of reliable composition studies about wastes generated by construction and demolition activities in Ireland. The most recent estimate from data submitted by licensed and permitted facilities (EPA, 2007) calculates that C&DW (other than soil and stones) accounts for 17% of the waste stream with a recovery rate of 36%. These data contained no compositional studies of C&DW at construction projects.
- There has been a clear attempt to improve the reporting procedures used to collect waste production data since the *1995 National Waste Database Report* (EPA, 1996). This is one of the reasons for the dramatic increase in the estimates of the amount of construction waste produced, whereby totals have increased from 1.52 million tonnes in 1995 (EPA, 1996) to 16.2 million tonnes in 2006 (EPA, 2007).
- The reliability of the data being collected from the local authorities is still unsatisfactory and many of the limitations outlined in the *National Waste Database Report 1995* (EPA, 1996) still apply today.
- The testing and use of the visual characterisation method to assess C&DW arisings highlighted some limitations in the process. The most significant seem to be the difficulty in assessing air voids and the methodology's total reliance on the auditor's skill and diligence in data collection.
- The use of the Landfill Levy Regulations' conversion factors had some limitations as they were not specific to the C&DW stream.
- The audit format proved to be a practical tool for use on Irish construction sites.
- The 53 audited PSAs and four case studies provided a snapshot sample of waste production from new construction in 2004 and 2005.
- The use of the multiple snapshot case studies and the simplicity of interpreting the data in this research allowed the author to produce sample mean indicators for different categories of new construction.
- The units of analysis used (m^3/m^2 or kg/m^2) provided a practical benchmark against which site management could measure waste performance based on the composition and quantity of waste fractions disposed of in skips on-site.
- The results provide the industry with a set of indicators that can be used to benchmark waste production in new construction as follows:

- An average unit waste factor of 70 kg/m^2 for **new residential construction**
- An average unit waste factor of 87 kg/m^2 for **new private non-residential construction**
- An average unit waste factor of 139 kg/m^2 for **new social infrastructure construction**.

An average unit waste factor of 49 kg/m^2 for **new productive infrastructure construction** was also calculated. The reliability of this figure is less than the other categories as it was based on only three sites.

5.2 Recommendations

The following is a list of recommendations in relation to future research in the area of C&DW management in Ireland:

- The initial response of the construction industry to the requirements in the *Waste Management: Changing Our Ways* policy document to significantly improve the recovery of C&DW, although positive, now needs to be transferred more fully onto waste management practices taking place at all construction sites. The NCDWC road show in 2005 was successful in raising awareness among industry professionals. This initiative should be developed by bringing the road show to selected sites throughout the country in order to provide training on the preparation of waste management plans, the auditing of C&DW on-site, skip management, etc. This would raise the awareness of the site operatives and provide a starting point for individual projects to benchmark their waste production. In parallel, a series of demonstration projects employing sustainable site waste management practices should be identified and the results disseminated to the industry.

- The publication of the *Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects* (DoEHLG, 2006) provides an opportunity to integrate C&DW management throughout the duration of a project. Within this context, it can be used as a method of developing statistics on C&DW production by requiring, as a planning condition, the submission of audit reports during the construction phase.

- The paper-based audit tool developed in this study provides the construction industry with a basic methodology with which to audit waste management practices, their efficiency, etc. The tool should be integrated in C&DW management plans for projects exceeding the thresholds outlined in the *Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects* (DoEHLG, 2006).

- An improved set of C&DW-specific conversion factors would improve the reliability and accuracy of audited projects. This would involve the sorting and weighing of the individual components of a number of skips on different projects. This would also determine the presence of air voids and waste bulking in the skips examined.

- A comparative analysis of source segregation on-site *versus* the collection of mixed C&DW should be carried out to establish the economic viability of both options. The use of source segregation on-site would examine the skip management requirements including:
  - Size, quantity and type of skip
  - Training of staff
  - Site procedures
  - The role of supervisory personnel.

  This would be compared against the use of mixed C&DW skips focusing on the costs and environmental impact of each system.

- The EPA needs to enforce a standard reporting format for the data submitted in the annual environmental reports by licensed facilities in Ireland. This must consist of accurate quantities and a definitive compositional classification including EWC codes.

- Further work is required to develop reliable data sets to extrapolate waste production indicators into national estimates. There is a lack of available data on waste arising from a number of activities including demolition and refurbishment projects and on the actual construction output *per annum*.

The calculation of construction output as used in the *National Waste Database Report 2001* (EPA, 2003a) was based on a number of significant assumptions, producing variable and inconsistent results.

- A paradigm shift is required in the management of C&DW from end-of-pipe solutions to prevention and minimisation. The design process should recognise the need to maximise resource use efficiency while minimising environmental impacts. This will reduce the dependency on landfill, the unnecessary use of raw materials and the costs associated with unnecessary acquisition, transport, recycling, treatment and disposal.[2]

5.3 Summary

This study has designed and tested an original audit tool on 53 snapshot construction projects and four case studies over a 2-year period. Waste production indicators (kg/m^2) have been generated for different categories of new construction. These indicators can be used to facilitate the benchmarking of waste production at different construction sites across Ireland. It is recommended that the development of this audit tool, incorporated into waste management plans, will be used to assist in producing key waste performance indicators on-site.

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2. The Department of Building and Civil Engineering at the GMIT has recently commenced a STRIVE-funded project entitled *The Development of a Waste Prevention Design Tool for Architects and Designers*.

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Acronyms

BRE	Building Research Establishment
C&DW	Construction and Demolition Waste
CIRIA	Construction Industry Research and Information Association
DoELG	Department of the Environment and Local Government
DoEHLG	Department of the Environment, Heritage and Local Government
EPA	Environmental Protection Agency
EWC	European Waste Catalogue
NCDWC	National Construction and Demolition Waste Council
PSA	Point Source Assessment
SMARTWaste	Site Methodology to Audit, Reduce and Target Waste

An Ghníomhaireacht um Chaomhnú Comhshaoil

Is í an Gníomhaireacht um Chaomhnú Comhshaoil (EPA) comhlachta reachtúil a chosnaíonn an comhshaol do mhuintir na tíre go léir. Rialaímid agus déanaimid maoirsiú ar ghníomhaíochtaí a d'fhéadfadh truailliú a chruthú murach sin. Cinntímid go bhfuil eolas cruinn ann ar threochtaí comhshaoil ionas go nglactar aon chéim is gá. Is iad na príomh-nithe a bhfuilimid gníomhach leo ná comhshaol na hÉireann a chosaint agus cinntiú go bhfuil forbairt inbhuanaithe.

Is comhlacht poiblí neamhspleách í an Ghníomhaireacht um Chaomhnú Comhshaoil (EPA) a bunaíodh i mí Iúil 1993 faoin Acht fán nGníomhaireacht um Chaomhnú Comhshaoil 1992. Ó thaobh an Rialtais, is í an Roinn Comhshaoil agus Rialtais Áitiúil a dhéanann urraíocht uirthi.

ÁR bhFREAGRACHTAÍ

CEADÚNÚ

Bíonn ceadúnais á n-eisiúint againn i gcomhair na nithe seo a leanas chun a chinntiú nach mbíonn astuithe uathu ag cur sláinte an phobail ná an comhshaol i mbaol:

- áiseanna dramhaíola (m.sh., líonadh talún, loisceoirí, stáisiúin aistrithe dramhaíola);
- gníomhaíochtaí tionsclaíocha ar scála mór (m.sh., déantúsaíocht cógaisíochta, déantúsaíocht stroighne, stáisiúin chumhachta);
- diantalmhaíocht;
- úsáid faoi shrian agus scaoileadh smachtaithe Orgánach Géinathraithe (GMO);
- mór-áiseanna stórais peitreail.
- Scardadh dramhuisce

FEIDHMIÚ COMHSHAOIL NÁISIÚNTA

- Stiúradh os cionn 2,000 iniúchadh agus cigireacht de áiseanna a fuair ceadúnas ón nGníomhaireacht gach bliain.
- Maoirsiú freagrachtaí cosanta comhshaoil údarás áitiúla thar sé earnáil - aer, fuaim, dramhaíl, dramhuisce agus caighdeán uisce.
- Obair le húdaráis áitiúla agus leis na Gardaí chun stop a chur le gníomhaíocht mhídhleathach dramhaíola trí comhordú a dhéanamh ar líonra forfheidhmithe náisiúnta, díriú isteach ar chiontóirí, stiúradh fiosrúcháin agus maoirsiú leigheas na bhfadhbanna.
- An dlí a chur orthu siúd a bhriseann dlí comhshaoil agus a dhéanann dochar don chomhshaol mar thoradh ar a ngníomhaíochtaí.

MONATÓIREACHT, ANAILÍS AGUS TUAIRISCIÚ AR AN GCOMHSHAOL

- Monatóireacht ar chaighdeán aeir agus caighdeáin aibhneacha, locha, uiscí taoide agus uiscí talaimh; leibhéil agus sruth aibhneacha a thomhas.
- Tuairisciú neamhspleách chun cabhrú le rialtais náisiúnta agus áitiúla cinntí a dhéanamh.

RIALÚ ASTUITHE GÁIS CEAPTHA TEASA NA HÉIREANN

- Cainníochtú astuithe gáis ceaptha teasa na hÉireann i gcomhthéacs ár dtiomantas Kyoto.
- Cur i bhfeidhm na Treorach um Thrádáil Astuithe, a bhfuil baint aige le hos cionn 100 cuideachta atá ina mór-ghineadóirí dé-ocsaíd charbóin in Éirinn.

TAIGHDE AGUS FORBAIRT COMHSHAOIL

- Taighde ar shaincheisteanna comhshaoil a chomhordú (cosúil le caighdéan aeir agus uisce, athrú aeráide, bithéagsúlacht, teicneolaíochtaí comhshaoil).

MEASÚNÚ STRAITÉISEACH COMHSHAOIL

- Ag déanamh measúnú ar thionchar phleananna agus chláracha ar chomhshaol na hÉireann (cosúil le pleananna bainistíochta dramhaíola agus forbartha).

PLEANÁIL, OIDEACHAS AGUS TREOIR CHOMHSHAOIL

- Treoir a thabhairt don phobal agus do thionscal ar cheisteanna comhshaoil éagsúla (m.sh., iarratais ar cheadúnais, seachaint dramhaíola agus rialacháin chomhshaoil).
- Eolas níos fearr ar an gcomhshaol a scaipeadh (trí cláracha teilifíse comhshaoil agus pacáistí acmhainne do bhunscoileanna agus do mheánscoileanna).

BAINISTÍOCHT DRAMHAÍOLA FHORGHNÍOMHACH

- Cur chun cinn seachaint agus laghdú dramhaíola trí chomhordú An Chláir Náisiúnta um Chosc Dramhaíola, lena n-áirítear cur i bhfeidhm na dTionscnamh Freagrachta Táirgeoirí.
- Cur i bhfeidhm Rialachán ar nós na treoracha maidir le Trealamh Leictreach agus Leictreonach Caite agus le Srianadh Substaintí Guaiseacha agus substaintí a dhéanann ídiú ar an gcrios ózóin.
- Plean Náisiúnta Bainistíochta um Dramhaíl Ghuaiseach a fhorbairt chun dramhaíl ghuaiseach a sheachaint agus a bhainistiú.

STRUCHTÚR NA GNÍOMHAIREACHTA

Bunaíodh an Ghníomhaireacht i 1993 chun comhshaol na hÉireann a chosaint. Tá an eagraíocht á bhainistiú ag Bord lánaimseartha, ar a bhfuil Príomhstiúrthóir agus ceithre Stiúrthóir.

Tá obair na Gníomhaireachta ar siúl trí ceithre Oifig:

- An Oifig Aeráide, Ceadúnaithe agus Úsáide Acmhainní
- An Oifig um Fhorfheidhmiúchán Comhshaoil
- An Oifig um Measúnacht Comhshaoil
- An Oifig Cumarsáide agus Seirbhísí Corparáide

Tá Coiste Comhairleach ag an nGníomhaireacht le cabhrú léi. Tá dáréag ball air agus tagann siad le chéile cúpla uair in aghaidh na bliana le plé a dhéanamh ar cheisteanna ar ábhar imní iad agus le comhairle a thabhairt don Bhord.

NDP
National Development Plan 2007 - 2013

Science, Technology, Research and Innovation for the Environment (STRIVE) 2007-2013

The Science, Technology, Research and Innovation for the Environment (STRIVE) programme covers the period 2007 to 2013.

The programme comprises three key measures: Sustainable Development, Cleaner Production and Environmental Technologies, and A Healthy Environment; together with two supporting measures: EPA Environmental Research Centre (ERC) and Capacity & Capability Building. The seven principal thematic areas for the programme are Climate Change; Waste, Resource Management and Chemicals; Water Quality and the Aquatic Environment; Air Quality, Atmospheric Deposition and Noise; Impacts on Biodiversity; Soils and Land-use; and Socio-economic Considerations. In addition, other emerging issues will be addressed as the need arises.

The funding for the programme (approximately €100 million) comes from the Environmental Research Sub-Programme of the National Development Plan (NDP), the Inter-Departmental Committee for the Strategy for Science, Technology and Innovation (IDC-SSTI); and EPA core funding and co-funding by economic sectors.

The EPA has a statutory role to co-ordinate environmental research in Ireland and is organising and administering the STRIVE programme on behalf of the Department of the Environment, Heritage and Local Government.

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