

**Improving Construction and Demolition Waste
Recycling in Ireland**

by

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Abstract

This dissertation investigated how construction and demolition waste recycling could be advanced in Ireland. Interviews and surveys were carried out with key professionals within the construction and demolition industry and a literature review was undertaken. The primary research tool used was a survey of Construction Industry Federation members including builders, civil engineers and specialist contractors. The aim of this survey was to determine the extent of waste recycling taking place on building sites in Ireland, to establish if recommended instruments were being used and to question how the Construction Industry Federation members believe construction and demolition waste recycling could be driven in Ireland. The establishment of a National Waste Management Authority is recommended as a result of this research. This authority would prepare a single national waste management plan, co-ordinate waste management infrastructure and advise the Irish Government on regulatory controls such as landfill bans and on financial controls such as raw material taxes and recycled material subsidies. In the short term, it is recommended that Waste Management Plans for construction and demolition projects be made statutory and that a tax be placed on virgin aggregate.

SECTION 1

INTRODUCTION

1.1 Background

Construction and demolition waste is now the second largest waste category in Ireland after agricultural waste (EPA, 2004). The National Waste Report 2004 published by the Environmental Protection Agency reported that 11.2 million tonnes of construction and demolition was collected in 2004. This reflected a trebling of the 2001 estimate of 3.6 million tonnes within three years.

In 1998, the Department of Environment and Local Government issued a policy statement entitled "Waste Management – Changing our Ways". In this statement, targets of at least 50% recycling of construction and demolition waste within a five year period (by 2003), with a progressive increase to at least 85% over fifteen years (by 2013) were set.

85 % construction and demolition waste was recovered in 2004 (EPA, 2004). However, when soil and stone were excluded from the figures used in this report, only 69% of construction and demolition waste was recovered (EPA, 2004).

The waste hierarchy promoted by the Department of the Environment, Heritage and Local Government is Prevention, Minimisation, Reuse,

Recycling, Energy Recovery and Disposal. Prevention is the preferred option with disposal being the most unfavourable option. The reuse and recycling of waste are therefore among the more favorable options in this waste hierarchy. Fortunately, there are already a number of beneficial uses of construction and demolition waste. Excavated spoil/topsoil can be used as landscaping material; waste timber can be recycled as shuttering or hoarding; waste concrete as fill material for roads or in the manufacture of new concrete when arising at source. Aggregates can be reused as fill for roads and other construction projects.

Ireland has the advantage of being able to explore the best waste management practices that exist in Europe. Instruments and tools such as regulatory controls, financial controls and education programs already tried and tested in other countries are investigated in this research with the aim of establishing how the recycling of construction and demolition waste in Ireland can be achieved.

1.2 Targets and Objectives

The following are the three main aims and objectives of undertaking this research:

- 1.2.1 Determine what Construction and Demolition waste types are being and are not being recycled
- 1.2.2 Establish if recommended instruments are being used on Irish building sites

1.2.3 Determine how Construction and Demolition Waste Recycling can be advanced in Ireland

1.3 Proposed Methodology

It is proposed that these objectives will be achieved through the following means:

- Literature Review
- Interviews
- Questionnaires

The methodology used in this research is further discussed in Section 4.

SECTION 2

AIMS AND OBJECTIVES

The following are the three main aims and objectives of undertaking this research:

- 2.1 Determine what Construction and Demolition waste types are being and are not being recycled
- 2.2 Establish if recommended instruments are being used on Irish building sites
- 2.3 Determine how Construction and Demolition Waste Recycling can be advanced in Ireland

SECTION 3

LITERATURE REVIEW

3.1 Introduction

A literature review was undertaken in order to determine what is already known about construction and demolition waste recycling. Irish policies and developments were reviewed as well as research carried out in other countries. In particular, instruments recommended for driving construction and demolition waste recycling were researched. These instruments can include regulatory measures such as landfill bans, economic measures such as virgin aggregate taxes and educational measures such as awareness campaigns. In this review, the use of Waste Management Plans and economic instruments are researched.

This Literature Review is divided into the following five sections:

- 3.1.1 Waste Management Policies and Studies in Ireland
- 3.1.2 Waste Management Infrastructure Issues in Ireland
- 3.1.3 Regional Waste Management Plans in Ireland
- 3.1.4 Waste Management Plans for Construction and Demolition Projects
- 3.1.5 The Use of Economic Instruments


Each of these five sections will now be discussed in detail.

3.2 Waste Management Policies and Studies in Ireland

In 1998, a policy statement entitled “Waste Management – Changing our Ways” was issued by the Department of Environment and Local Government and was addressed chiefly to local authorities. It stressed the importance of the waste hierarchy - Prevention, Minimisation, Reuse, Recycling, Energy Recovery and Disposal. Prevention is the preferred option with disposal being the most unfavourable option. Targets of at least 50% recycling of construction and demolition waste within a five year period (by 2003), with a progressive increase to at least 85% over fifteen years (by 2013) were set. These ambitious targets prompted this research into construction and demolition waste recycling.

The policy statement strongly endorsed -

- meaningful strategic planning, on a regionalised basis,
- a dramatic reduction in reliance on landfill, in favour of an integrated waste management approach which utilises a range of waste treatment options to deliver effective and efficient waste services and ambitious recycling and recovery targets,
- greater participation by the private sector in the provision of waste management services,
- a more effective and equitable system of waste charging which incentivises waste minimisation and recovery,
- greater utilisation of legislative instruments extending the scope of producer responsibility initiatives, and
- the mobilisation of public support and participation.



The National Construction and Demolition Waste Council was established in 2002 and its role was to provide a framework to achieve compliance with the policy and targets as set out by the Minister for Environment, Heritage and Local Government in the Policy Document 'Changing our Ways' (National Construction and Demolition Waste Council, 2004).

The National Construction and Demolition Waste Council (2004) reported that an objective of Local Authorities in order to help achieve these targets should be to

- identify an 'expert' in each Authority who can advise on and fast track permit applications.
- encourage the development of Construction and Demolition Waste Recycling Facilities within the regions e.g. in quarries or landfill sites.

Similarly, an Objective of Developers, Builders and Building Contractors should be to


- prioritise training programmes to promote awareness and enable members (of the Construction Industry Federation) to understand the 'true' cost of waste disposal
- commit to segregating waste into its main fractions or hire a waste management contractor who will undertake this activity
- train staff on waste management Best Practice and keep training records (National Construction and Demolition Waste Council, 2004)

The Environmental Protection Agency (2005) highlighted the following issues regarding the poor management of construction and demolition waste

- construction and demolition waste quantities growing every year
- poor record keeping at sites where construction and demolition waste is produced leading to underestimates of quantities arising
- evidence of significant mismanagement of the waste stream with construction and demolition waste the predominant material in known unauthorised landfills
- poor awareness within the industry about waste management issues
- inconsistent application of the waste permitting regulations in relation to land reclamation activities

Proposed actions included

- those involved in illegal disposal of construction and demolition waste should be pursued on indictment by the enforcement authorities
- local authorities need to ensure that they have up to date and reliable information on the quantities and fate of construction and demolition waste in their functional area
- the construction and demolition sector needs to provide much better and more reliable information on the quantities and fate of waste produced
- integrate the requirements of the draft guidelines for construction and demolition waste management with the planning and development process for developments that are likely to produce significant quantities of waste

- 
- radical improvements are required by the construction and demolition sector in relation to general site and materials management to minimise waste produced on site
 - more work is required by the construction and demolition sector on the development of end-uses, outlets and material specifications for construction and demolition waste
 - review the effectiveness of the voluntary construction and demolition waste industry initiative
 - finalise and consider placing on a statutory footing, the draft guidelines for construction and demolition waste management
 - sufficient outlets for the recovery and disposal of construction and demolition waste are required and should be planned for by the local authorities and the construction and demolition waste sector through the waste management planning process

This latter proposed action regarding Waste Management Infrastructure is discussed below.

The Environmental Protection Agency (2005) also reported that 110 additional waste enforcement staff were appointed in local authorities in the last two years which should progress successful prosecution of illegal collectors and illegal dumpers.

Mandatory reporting of enforcement activities by local authorities was introduced in the 2004 Department of the Environment, Heritage and Local

Government policy document entitled 'Taking Stock and Moving Forward, 2004'.

3.3. Waste Management Infrastructure issues in Ireland

The Dublin Chamber of Commerce (2004) highlighted the need to develop the infrastructure to deal with construction and demolition waste and stated that the Environmental Protection Agency has recommended that the network of facilities required nationally for construction and demolition waste, should be identified in a national strategy.

The Dublin Chamber of Commerce (2004) found that the overall planning process for waste management facilities is still slow and uncertain and needs to be streamlined. Strategic Development Zones or SDZs were introduced under the Planning and Development Act 2000. According to Section 166 of the Act, if specified development is of economic or social importance to the state, the government may designate one or more sites for the establishment, "of a strategic development zone to facilitate such development." An SDZ could perhaps suit a combination of waste treatment facilities with an industrial park where industries would be located in close proximity to waste management infrastructure (Dublin Chamber of Commerce, 2004). The Chamber recommended the establishment of a Critical Infrastructure Board with responsibility for processing planning applications for large infrastructure projects, including waste management facilities.

In 2006, a Planning and Development (Strategic Infrastructure) Bill was passed by the Minister of the Department of the Environment, Heritage and Local Government. As a result of this bill, applicants can now apply directly to An Bord Pleanála for classes of projects such as Waste Disposal Installations and Landfills, Incineration and Chemical Treatment Facilities for non-hazardous waste, Water Treatment Plants and Wind Power Installations. An Bord Pleanála is to be expanded rather than establishing a separate fast-track planning authority.

Duran *et al.* (2005) concluded that recycling centres benefit from economies of scale. The higher demand for aggregates and higher supply of waste in urban centres in addition to the high cost of extracting aggregates close to cities make markets for recycled construction and demolition waste in locations such as Dublin more economically viable.

The Dublin Chamber of Commerce (2004) reported that current regulations stipulate that only waste originating in region may be processed or disposed of within that region e.g. only waste originating in Dublin City and County will be processed at the planned Ringsend Incineration facility. However, on ground of economies of scale, there was a strong case for allowing waste arising in the Greater Dublin Area (Wicklow, Meath, Kildare) to be processed in Ringsend.

The Dublin Chamber of Commerce (2004) noted that the Economic and Social Research Institute have recommended that a centralised waste

disposal system of two to three facilities is sufficient for a country the size of Ireland and that a large number of smaller local waste disposal facilities would be a more expensive option.

The National Construction and Demolition Waste Council (2004) reported that some initial research performed on the economics of setting up recycling facilities has indicated Quarries or Landfill Sites may be the most suitable locations as equipment and expertise is more likely to be available. Virgin and recycled products should be available on the same site. Providing the widest possible product range would help attract customers and contribute to the efficient transport cost.

Robinson and Kapo (2004) reported that aggregate is a high-bulk, low unit value mineral commodity whose cost to the end user is strongly influenced by the cost of transporting processed aggregate from the production site to the construction site. A close proximity of recycling centers to road paving and other construction activities, that serve as both source sites and the final destinations for recycled aggregate material, reduces transport costs and ensures a viable market destination for the recycled aggregate products.

3.4. Regional Waste Management Plans in Ireland

Local authorities had been under a legal obligation to make waste management plans since the commencement of the Waste Management Act


in July 1996. However, some local authorities refused to adopt their regional plan. In order to resolve this issue, Section 4 of the Waste Management (Amendment) Act 2001 provides that the making of a waste management plan will become an executive (management) function.

Two Regional Waste Management Plans were investigated in detail. These plans were the Cork City Waste Management Plan and the Dublin Region Waste Management Plan.

Cork City Council (2004) aimed to divert at least 60% of the waste produced between 2004 and 2009 to other waste management methods by banning all construction and demolition waste from landfill and by constructing a Waste Recovery Facility. At the time of this research, no such ban is in place.

Cork City Council (2004) established a construction and demolition waste facility at the Kinsale Road Landfill site in partnership with Loftus Civil Engineering Ltd. Approximately 200,000 tonnes of waste per annum was recycling from 1997 to 2002 and the recycled material was used in the conversion of the landfill to a public park. However, due to the fact that there was no other market for recycled material, the facility is no longer in operation.

Dublin City Council *et al.* (2005) believed that reporting systems have improved with the introduction of the Waste Permit and Waste Collection Permit systems. In 2003, a remarkable 81% of construction and demolition waste was deposited at a permitted site, 14% is recovered at a licensed



facility, 4% is recycled and 1% is deposited at a landfill. Sites with a waste permit where material may be deposited were by far the largest outlets for construction and demolition waste from the Dublin Region. The permitted material was primarily soil/stones, however some inert construction and demolition waste may also be permitted. Soil/ stones deposited on land under Permit are mainly regarded as a 'recovery' operation and the sites are nominally using the soil for beneficial agricultural use. Dublin City Council *et al.* (2005) concluded that it is possible that significant quantities of concrete and other construction and demolition waste was deposited in these sites without authorisation in contravention to the waste permits under which they operate.

The draft Waste Management (Facility Permit and Registration) Regulations, 2005 published by the Department of the Environment, Heritage and Local Government allow for a certificate of registration for the recovery of inert waste for the purpose of land reclamation for up to 25,000 tonnes and a permit for up to 100,000 tonnes over the relevant certificate or permit period. The present regulations allow for the deposition of only up to 5,000 tonnes per annum.

Dublin City Council *et al.* (2005) reported that arguably a better approach would be to have a smaller number of construction and demolition waste disposal points, for example situated in old quarries. Any recoverable material (stones, concrete) could be screened out and the soil used to reinstate the quarry. Fewer sites would be easier to regulate: permitted sites for

construction and demolition waste are demanding on Local Authority resources and closely inspecting a large number of sites was challenging. An objective of this regional waste management plan was the restriction on the placing of construction and demolition waste in Permitted sites on agricultural land. The only material that will be considered is clean soil, where alternative larger authorised facilities are not already in place.

Dublin City Council *et al.* (2005) believed that the provision of skips on construction and demolition sites for source separation will not happen until there is an economic advantage in doing so.

Waste Collection Companies would be required to provide separate collection opportunities for recyclable wastes generated in construction/demolition, employing suitably labelled or coded bins and skips and to implement preferential charging for source-separated material in preference to mixed waste disposal (Dublin City Council *et al.*, 2005)

This plan stated that the Dublin Local Authorities will if necessary and/or appropriate for environmental or other reasons, direct that certain waste streams must be delivered to a certain tier in the waste hierarchy (e.g. reuse, recycling, biological treatment, energy recovery facility). This would be achieved by means of the Waste Collection Permit system or other appropriate regulatory or enforcement measures (Dublin City Council *et al.*, 2005)

3.5. Waste Management Plans for Construction and Demolition Projects

As discussed in Section 3.2 a proposed action was to finalise and consider placing on a statutory footing, the draft guidelines for construction and demolition waste management (EPA, 2005).

Symonds Group Ltd (1999) recommended requiring a construction and demolition waste plan as an effective but relatively simple administrative measure. According to this report, it was noticeable that in those Member States where demolition plans are required, construction and demolition waste recycling rates tend to be higher.

Shen and Tam (2002) concluded that establishing a waste management plan was the most effective environmental management measure in the construction industry.

The Department of the Environment, Heritage and Local Government (2004) has issued Draft Best Practice Guidelines on the Preparation of Waste Management Plans for Construction & Demolition Projects. The Guidelines provide advice on the application of waste management Best Practice in the five phases of a construction project, Project conception/Asset Management, Planning, Design, Pre-construction Demolition and Construction. The Guidelines provide detailed guidance on the essential components of a

construction and demolition waste management plan including tracking, through internal auditing.

The guidelines recommended that the preparation of a project construction and demolition waste plan begin in the early stages of project development to facilitate the proper and orderly management of the wastes and surpluses that are liable to arise in the course of the development works.

The guidelines recommended that construction and demolition waste management plans should be prepared for multi-residential or large commercial projects in excess of any of the following thresholds:

1. New residential development of 10 houses or more
2. New developments, other than (1) above, with an aggregate floor-area in excess of 1,250m²
3. Demolition projects generating in excess of 500 tonnes of construction and demolition waste
4. Civil engineering projects producing in excess of 500m³ of waste (equivalent to 1,000 tonnes), excluding waste materials used for development works on the site.

At the time of this research, planning authorities may attach a condition to permission for the types of development referred to above. Section 34(4)(1) of the Planning and Development Act, 2000 permitted the attachment of conditions relation to construction and demolition waste management.

3.6. The Use of Economic Instruments

Duran, Lenihan and O'Regan (1995) developed a model for assessing the economic viability of construction and demolition waste recycling. They noted two possible approaches to ensure that society does not incur a high environmental cost from waste disposal and aggregate extraction. These two approaches were Command and Control and Market Based instruments. In the Command and Control option the policy maker could for example impose a limit on the use of landfill space and primary aggregates use. However, this option required enforcement and so can be costly. Using the Market Based instruments option, the policy maker could try to internalise the externality by ensuring that the polluters (construction and demolition waste producer or primary aggregate user) incur the external costs. This situation summarises the 'polluter pays principle' and inspires most modern environmental legislation. Duran *et al.* (2005) concluded that in Ireland, market based instruments are likely to be the best option for policy makers who wish to create markets for recycled construction and demolition waste.

The research identified the large number of quarry sites supplying primary aggregates at a low cost as the main problem to creating markets for recycled construction and demolition waste. Surveys carried out among local authorities and quarries in the Republic of Ireland in 2003 found that landfilled waste was charged at on average €141.80/tonne and primary aggregates were charged at €7.40/tonne. Duran *et al.* (2005) concluded that the current low cost of disposing of construction and demolition waste in landfill sites

together with the low cost of primary aggregates makes it impossible for a sustained level of recycling to occur.

Duran *et al.* (2005) suggested that policy makers should impose taxes on the use of primary aggregates or use subsidies to reduce the cost of recycled aggregates. Revenues resulting from taxes should pay the cost of subsidies and thus the public sector does not incur cost.

The implementation of the 'polluter pays principle' in the quarrying industry in Ireland is not as advanced as in the landfilling of waste. They point to the fact that aggregate taxes are used in the United Kingdom since April 2002 to reflect the true cost of using primary aggregates (Duran *et al.*, 2005).

3.7. Overview

This literature review established that taxes on virgin aggregates or landfill, subsidies on recycled materials and statutory Waste Management Plans are important instruments in achieving construction and demolition waste recycling. This review also highlighted issues with Regional Waste Management Plans (lack of economies of scale) and the lack of planned Waste Management Infrastructure in Ireland.

A further desktop study on the Danish and Norwegian experience with construction and demolition will be conducted as part of this research.

Denmark has a similar population to Ireland and Norway similarly to Ireland, is not traditionally a recycling country.

SECTION 4

METHODOLOGY

4.1 Overview

Both qualitative and quantitative approaches were used. This blending of qualitative and quantitative data within a study is referred to as triangulation. The following outlines how each of the three objectives identified in Section 2 were achieved.

Objective 1: To determine what Construction and Demolition waste types are being and are not being recycled

- Construction Industry Federation Members were surveyed as to which waste types are being recycled and which wastes are being re-used on site
- EPA Waste Database 2004 was reviewed with regard to Construction and Demolition Waste Recycling
- Roadstone Dublin Ltd, Belgard Quarry, Dublin was visited in order to inspect the construction and demolition recycling facility there and in order to ascertain whether there was preferential pricing in place for recyclable waste.

Objective 2: Establish whether recommended instruments are being used on Irish building sites

- Construction Industry Federation Members were surveyed on the following:

- Was source separation taking place on their sites
- Were Waste Management Plans used on their projects
- Was there a person who is responsible for Waste Management on their sites

Objective 3: Determine how Construction and Demolition Waste Recycling can be advanced in Ireland

- Construction Industry Federation Members were surveyed on the following:
 - What tools they believed should be put in place in order to drive efficient Construction and Demolition Waste Management
 - What concerns had they about reusing recycled materials
 - What were the most common waste management/environmental issues that arose on-site

- An interview was conducted with Dr. Vincent O'Malley, Environmental Manager of the National Roads Authority (NRA) in order to ascertain whether road specifications were restricting the market for recyclable construction and demolition waste

- A Desktop study was carried out in order to establish the number and location of construction and demolition waste licensed facilities by Waste Management Plan Region

- A Desktop study was carried out in order to determine how Construction and Demolition Recycling is driven in Denmark and Norway.

4.2 Data Collection

Data collection methods included interviews, surveys and desktop studies.

These methods are now discussed in more detail.

4.2.1 Interviews

Two types of interviews were conducted during this study. The first was an interview with Dr. Vincent O'Malley, Environmental Manager, NRA (refer to Appendix 4). This interview was conducted in order to ascertain whether road specifications were restricting the market for recyclable construction and demolition waste. This interview was structured around the set of questions in Appendix 4.

The second type of interview was that conducted with four construction companies. This interview was used to pilot test a questionnaire. An initial set of questions was created and interviews were undertaken using these questions as a structure (refer to Appendix 1). Four of Ireland's largest construction companies were visited in person. The initial questionnaire consisted of 12 questions, some of which used Likert Scaling.

Likert Scaling is a unidimensional scaling method (www.socialresearchmethods.net). It is possible to use a forced-choice response scale with an even number of responses and no middle neutral or undecided choice when using a Likert Scale. However, this was not used in this research as it was realised that the participant might not know the answer to the question and so the choice 'don't know' was included. Data is analysed using the median or mode rather than the mean and can be visualised using barcharts.

As a result of these interviews, this questionnaire was modified and reduced to 8 questions. Some clarification was necessary in a couple of questions and a greater variety of suggested controls were added.

4.2.2 Questionnaires

It was decided that the most appropriate respondents to the survey would be professionals involved in the industry. The final questionnaire was mailed and emailed to Construction Industry Federation (CIF) members. CIF members include builders, civil engineers, mechanical contractors, electrical contractors, specialist contractors (i.e. painters, plasterers, plumbers, tillers etc.), window fitters, shop fitters and demolition contractors. The questionnaire was two pages long and consisted of 10 questions in total (refer to Appendix 3). Typically, it took 4 minutes to complete.

Access to these members was acquired through the CIF and by returning the questionnaire they consented to be included in this research. Two questions

(questions 9 and 10) were added by the CIF and do not form part of this research. The questionnaire had been amended following the conduction of interviews as described above. The CIF also reviewed the questionnaire and made recommendations for adjustments. This feedback resulted in the use of 'never, rarely, don't know, sometimes, always' as potential responses instead of 'strongly agree, disagree, undecided, agree, strongly agree'. The CIF added a cover letter (refer to Appendix 2).

In total, 2153 CIF members received the questionnaire; 1250 by email and 903 by mail. 61 people completed the survey, which means that only 3% of recipients participated in the survey. Some questions were not answered. This data is referred to as 'missing'.

4.2.3 Desktop Study

The following databases were utilised

- University College Dublin, Belfield
- Institute of Technology, Tallaght
- Institute of Technology, Sligo
- The Internet in particular the following websites
 - www.ncdwc.ie
 - www.cif.ie
 - www.doe.ie
 - www.epa.ie
 - www.bre.co.uk
 - www.ciria.org

- www.irelandrecycling.ie
- www.msk.dk
- www.qjenbruksprosjektet.net

Keywords used focused on words or phrases such as 'construction and demolition waste', 'construction waste recycle', 'department of environment policy', 'danish model', 'norwegian road authority'.

European countries in particular, Denmark and Norway have carried out a significant amount of research into this subject as ambitious recycling targets were set in these countries and/or virgin aggregate and landfill space became limited.

Relevant Professionals were also consulted including Department of the Environment, Heritage and Local Government staff, FAS staff and the Environmental Manager, National Roads Authority.

4.3 Data Analysis

Data obtained from the interviews conducted with the four construction companies was useful in adjusting the questionnaire and in highlighting the greatest concerns and obstacles faced by the Construction Industry. This qualitative data is discussed in the results section but is not illustrated graphically.

Data obtained from the questionnaire was analysed using Microsoft Excel.

Piecharts and barcharts were used to illustrate the data.

4.4 Data Reliability and Limitations

The questionnaire was anonymous and therefore, it can be assumed that respondents had no reason to falsify answers. Participants of this survey were all members of the CIF. Therefore, the participants were very familiar with the day-to-day issues arising on building sites and had a valid interest in better waste management of construction and demolition waste.

As with any questionnaire, there was potential for the participant to provide incorrect or unhelpful answers. For example, referring to appendix 3, question 6 when asked which issue they considered to be their most important concern, some participants gave two rather than one main concern. In this case, the data was disregarded and referred to as missing. Some participants did not answer a couple of questions and these are also referred to as missing.

Other limitations include that the participant may have been for example a painting contractor and so would have no opportunity to recycle or reuse bricks. This would have the effect of reducing the percentage of participants involved in the recycling of bricks and would give a slightly skewed picture of the reality.

Limitations were reduced by using an as alternative 'other' option in case for example all possible controls had not been included in the question.

Some bias was introduced into the survey when for example possible concerns were suggested in appendix 3, question 6. The survey participant may not have been greatly concerned with these issues but selected them, as it was quicker and easier than thinking of an answer to the option 'other'.

However, these concerns were generated from pilot interviews conducted with four construction companies and were the most common concerns suggested by the interviewees. Similarly, controls suggested in appendix 3, question 7 were generated from a literature review and from the pilot interviews conducted four construction companies.

SECTION 5

RESULTS

5.1 Introduction

This section summarises the results obtained for the three objectives outlined in Section 2. Under each objective the results obtained are discussed and the method used to achieve them; interview, questionnaire or desktop survey is detailed. With regard to the questionnaire sent to the Construction Industry Federation (CIF) members, some questions were not answered. This data is referred to as 'missing'.

5.2 Objective 1: **To determine what Construction and Demolition waste types are being and are not being recycled**

5.2.1 CIF Members were surveyed as to which waste types are being recycled. Please refer to Figure 5.2.1 below. The question asked was which of the following waste types do you recycle at present. It was found that 49% of participants recycle stone. Only 8% of participants do not recycle any waste. Participants who answered 'other' stated that they recycle glass, paint cans, and green waste.

Which of the following waste types do you recycle at present?

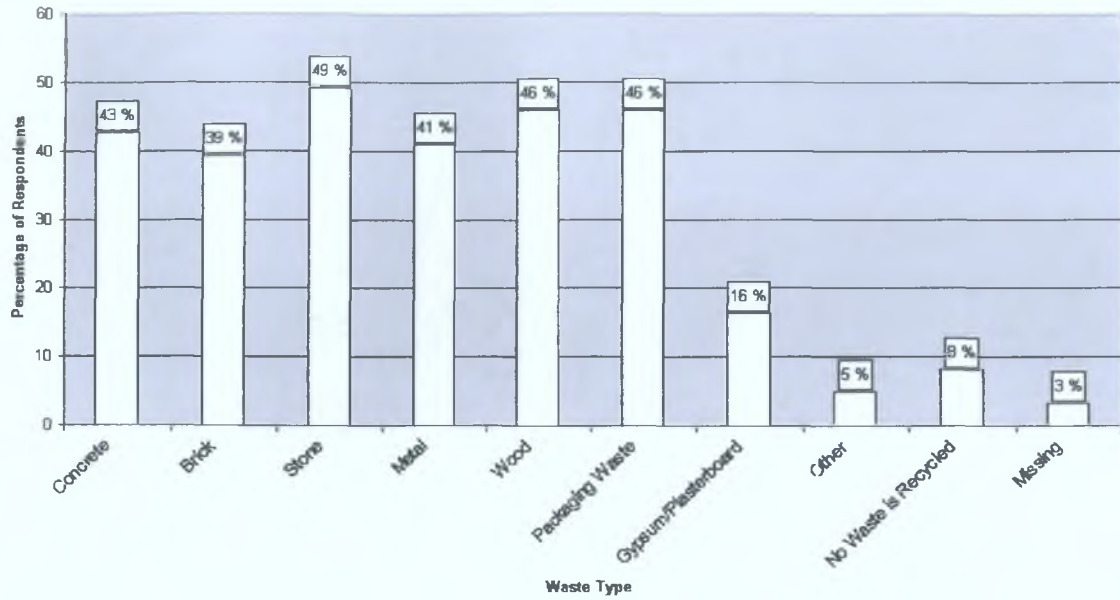


Figure 5.2.1: Response to Survey Question 3 'Which of the following waste types do you recycle at present?'

5.2.2 Survey Question 5 asked CIF members are any of the following wastes re-used on site? Please refer to Figure 5.2.2 below. It was found that the most common waste reused on site is recycled aggregate (52% of participants reuse it). Participants who selected 'other' waste type included green waste, metal and soil as waste types, which are reused on site.

Are any of the following wastes re-used on site?

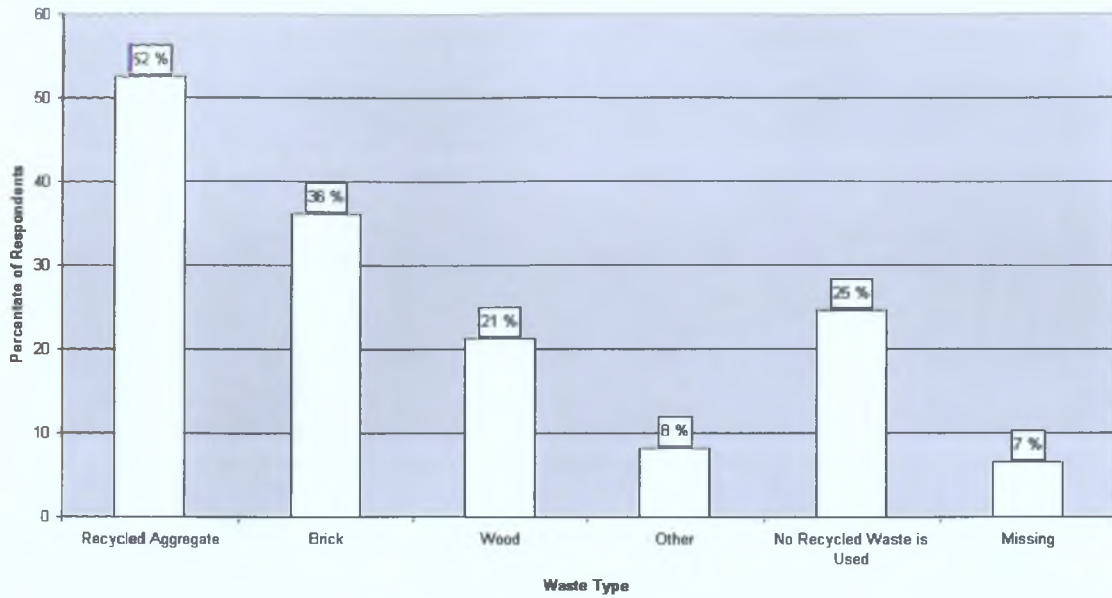


Figure 5.2.2: Response to Survey Question 5 'Are any of the following wastes re-used on site?'

5.2.3 The Environmental Protection Agency (EPA) National Waste Report 2004 was reviewed with regard to Construction and Demolition Waste Recycling. This report states that 11.2 million tonnes of construction and demolition was collected in 2004. This reflected a trebling of the 2001 estimate of 3.6 million tonnes.

This report stated that 85 % construction and demolition waste was recovered in 2004. Recovery included the use of construction and demolition waste for cover landscaping and engineering purposes as well as use of this waste in waste permitted sites. Soil/ stones deposited on land under Permit are mainly regarded as a 'recovery' operation and the sites are nominally using the soil for beneficial agricultural use. The target set in the policy document 'Changing Our Ways', Department of the Environment and Local Government, 1998 was

85% recovery of construction and demolition waste by 2013. When soil and stone were excluded only 69% of construction and demolition waste was recovered.

Alarming, 1.6 million tonnes of construction and demolition was reported as having gone missing. More than 11 million tonnes of construction and demolition waste was reported as collected by authorised waste collector permit holders while 9.5 million was reported to be recovered and disposed by waste licensees and permit holders.

The EPA recommended that the responsibility for maintaining and reporting waste records should shift from the waste industry to the construction and demolition industry itself. The EPA suggested that consideration should be given to making the maintenance and reporting of waste data mandatory for all construction and demolition operations over a certain size.

5.2.4 Roadstone Dublin Ltd, Belgard Quarry, Dublin was visited in order to inspect the construction and demolition recycling facility there and in order to ascertain whether there was preferential pricing in place for recyclable waste.

Approximately 180,000 tonnes of construction and demolition waste was recycled at this facility in 2005. There was a cost incentive in place as it cost €5-€6/tonne to deliver waste to this site for recycling in comparison with €120-€150/tonne to dispose of waste at a landfill. This translated to a saving of 90-96% of landfill disposal cost. Both virgin and secondary aggregate were on

sale at this facility with the secondary aggregate priced at one third of the virgin aggregate price. This allows for cost effective back loading of recycled or virgin product. The material produced is suitable only as fill material and is not true recycled aggregate as it cannot be used as a substitute for virgin aggregate.

5.3 Objective 2: Establish whether recommended instruments are being used on Irish building sites

5.3.1 CIF Members were asked was source separation taking place on their sites. Only 15% replied that waste was rarely separated on site and 7% replied that waste was never separated on site.

Are wastes separated on site on your projects?



Figure 5.3.1: Response to Survey Question 1 'Are wastes separated on site on your projects?'

5.3.2 Survey Question 2 asked CIF members were Waste Management

5.3.3 Plans used on their projects. A substantial 25% replied that Waste Management Plans were never used on their projects. 16% replied that Waste Management Plans were rarely used on their projects.

Are Waste Management Plans used in your projects?



Figure 5.3.2: Response to Survey Question 2 'Are Waste Management Plans used in your projects?'

5.3.4 CIF members were asked if there was a person who is responsible for Waste Management on their sites. A significant 33% of participants replied that this was only sometimes the case. 15% replied that this was never the case while 10% replied that this was rarely the case.

Is there a person who is responsible for Waste Management on your sites?

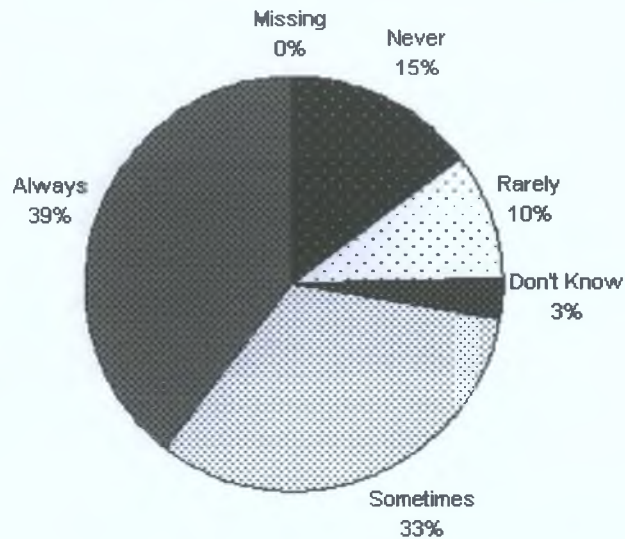


Figure 5.3.3: Response to Survey Question 4 'Is there a person who is responsible for Waste Management on your sites?'

5.4 Objective 3: Determine how Construction and Demolition Waste Recycling can be advanced in Ireland

5.4.1 CIF Members were surveyed on what tools they believed should be put in place in order to drive efficient Construction and Demolition Waste Management. The most popular control proved to be placing a subsidy on recycled material with 72% of participants advocating this control. Awareness campaigns were also well received at 57% followed by training at 56% and statutory requirement for separation of waste at source at 54%. The participant that answered 'other' suggested 'less stick more carrot'. Perhaps this refers to the preferred subsidy on recycled materials rather than landfill bans or taxes.

What Controls do you believe should be put in place by the Government in order to drive efficient Waste Management in the C&D Sector?

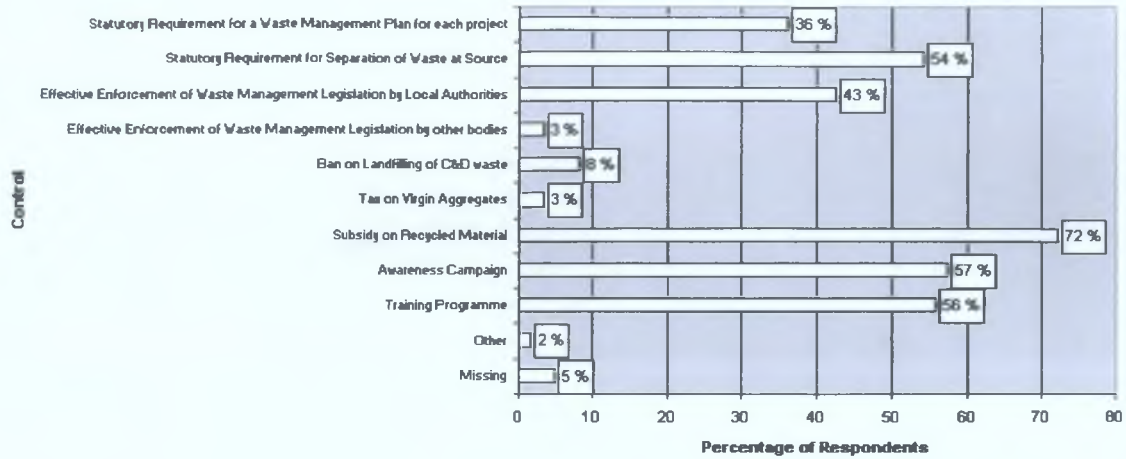


Figure 5.4.1: Response to Survey Question 7 'What Regulatory Controls do you believe should be put in place by the Government in order to drive efficient Waste Management in the C&D Sector?'

5.4.2 Survey question 5 asked CIF members what concerns they had about reusing recycled materials. The most common concern was the lack of agreed standards for recycled material at 39% followed closely by the lack of availability of recycled materials at 33%. One participant that answered 'other' replied that there was not enough practical information on how to implement the use of recycled materials. Another participant had concerns about possible contamination of recycled materials. Finally participants complained of delays caused by lack of understanding amongst council staff regarding the definition of waste as well as disagreement between the EPA and councils on waste and secondary engineering material definitions.

Have you concerns about reusing recycled material due to any of the following issues?

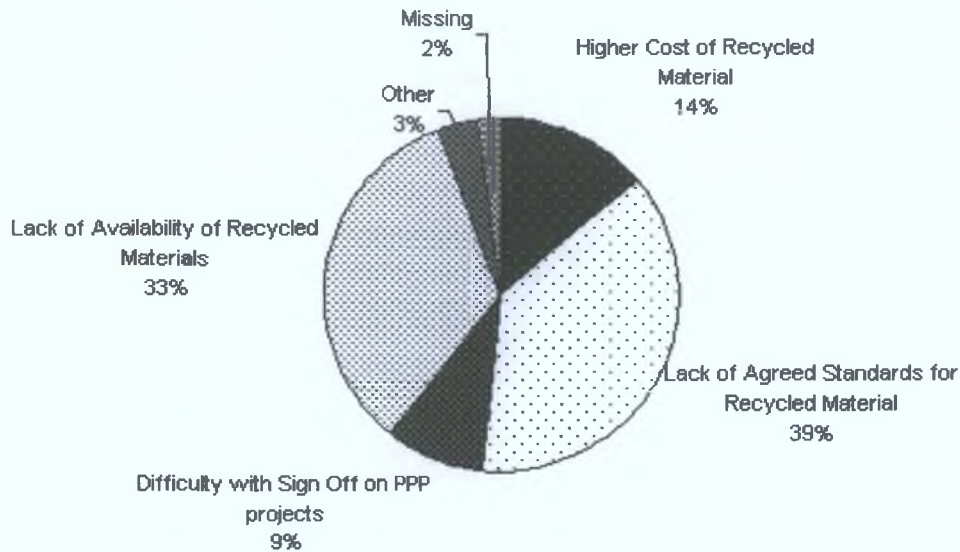


Figure 5.4.2: Response to Survey Question 6 'Have you concerns about reusing recycled material due to any of the following issues?'

5.4.3 Survey question 8 asked CIF members what the most common waste management/environmental issues that arose on-site were. 21% of respondents replied that they experienced difficulty in segregating waste. Reasons given were lack of space, contamination of skips by other materials, time taken to segregate and lack of control over site operatives. Other concerns were a lack of recycling facilities (10%) and lack of compliance by workers with site waste management (14%). There were no suggested answers listed for this question and a substantial 42% of respondents did make any comment.

What are the most common Waste Management/Environmental Issues that arise on-site?

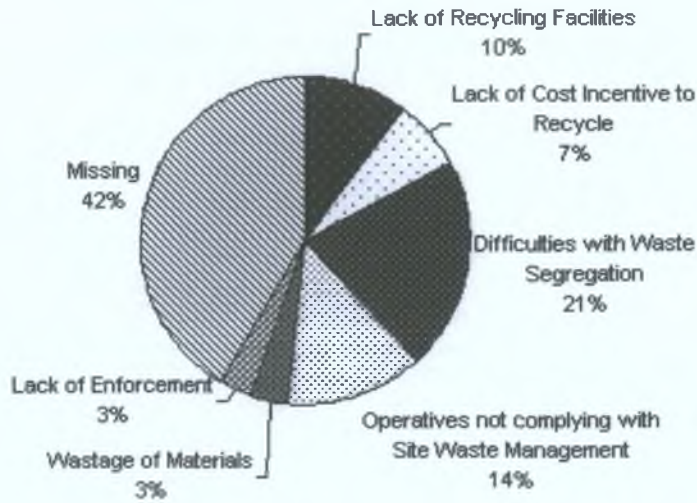


Figure 5.4.3: Response to Survey Question 8 'What are the most common Waste Management/Environmental Issues that arise on-site?'

This question was also answered through feedback received during the interviews conducted with four construction companies. These companies highlighted the frustration with delays in obtaining waste permits. Participants also questioned the need for a waste collection permit for materials that were to be reused.

5.4.4 An interview was conducted with Dr. Vincent O'Malley, Environmental Manager of the National Roads Authority (NRA) in order to ascertain whether road specifications were restricting the market for recyclable construction and demolition waste (refer to Appendix 4). It appears that no obvious barriers were in place.

The NRA would use recycled aggregate for embankment work, capping work and sub base work. Recycled aggregates were contained in the NRA Specification for Road Works as acceptable constituents for certain materials and as such could be used at will when compliance is demonstrated.

According to the NRA, potential barriers to the use of recycled aggregate included firstly the cost and method of handling and separating potential recycled aggregates to produce a useful engineering material. Secondly, contamination of material with organics or clay type material could substantially restrict the potential use of the aggregate. Thirdly, the lack of information on the durability/long-term performance of recycled aggregates was another possible barrier.

When questioned whether local authorities need to use the higher NRA specifications for local roads and some car parks, the NRA admitted that in some cases using the highest grade materials in the NRA specifications would be over-designing.

5.4.5 A Desktop study was carried out in order to establish the number and location of construction and demolition waste licensed facilities by Waste Management Plan Region (refer to Figure 5.4.5 below). The EPA waste licence database on the website, www.epa.ie was consulted in order to attain this data and only those facilities, which had been granted a licence at the time of this research, are included here.



Figure 5.4.5: Construction and Demolition Waste Licensed Facilities by Waste Management Plan region.

These waste licensed facilities were either Waste Transfer Stations or Materials Recovery Facilities. It was immediately apparent that the vast majority of these facilities were located in Dublin (8 facilities) and to a lesser

extent, Cork (4 facilities). In fact, some regions such as Donegal, Wicklow and the South East Region did not have any facility at the time of this research. Additionally, there were two waste permitted facilities for the recycling of construction and demolition waste in the Dublin region; at Belgard Quarry and at Huntstown Quarry. Roadstone Dublin Ltd operated these facilities. Both facilities accepted only clean inert pre-segregated construction and demolition waste such as concrete, mortar, blocks and paving. A recycled concrete product was produced for use as a granular fill.

Waste permitted sites where material may be deposited were by far the largest outlet for construction and demolition waste. The permitted material was primarily soil/stones, however some inert construction and demolition waste may also be permitted. Soil/ stones deposited on land under Permit were mainly regarded as a 'recovery' operation and the sites were nominally using the soil for beneficial agricultural use. Dublin City Council *et al.*(2005) concluded that it was possible that significant quantities of concrete and other construction and demolition waste was illegally deposited in these sites.

5.4.6 A Desktop study was carried out to determine how Construction and Demolition Recycling is driven in Denmark and Norway

5.4.6.1 Denmark

According to the Symonds Group Ltd (1999), there were less than 8 construction and demolition waste crushing and sorting plants in Ireland

compared with approximately 30 in Denmark, a country of a similar population size.

In 1997, 91% of construction and demolition waste in Denmark was recycled, 8% was landfilled and 1% was incinerated (Danish EPA, 1998).

In 1987 the Danish Government introduced a waste tax for disposal of waste at landfills and at incineration plants. No taxes were paid on construction and demolition waste, which is reused. The waste tax was differentiated, with a lower tax on waste incinerated at incinerators generating combined heat and electricity and a higher tax on other incinerated waste (Hjelmar, 1996). The highest tax was imposed on landfilling.

A study was conducted by COWI (1998) into the initiatives and projects launched by Denmark in an effort to utilise potential resources in construction and demolition waste. COWI (1998) recognised taxes on waste and raw materials as being the most important instrument used to achieve high levels of recycling of construction and demolition waste. However, COWI (1998) cautioned that taxes cannot stand-alone and that according to Danish experience it was necessary

- To establish national policies and action plans for integrated resources and construction and demolition waste management
- To encourage recycling initiatives by grants or subsidies

- To implement local planning and regulation of raw materials and construction wastes according to the national policies and not necessarily according to local interests
- To ensure processing capacity of construction and demolition waste throughout the country
- To establish the necessary documentation and standards for use of the secondary materials
- To monitor the streams of raw materials and construction waste streams

5.4.6.2 Norway

Norway was not a typical “recycling country”, especially in regards to the recycling of construction and demolition waste. Nationally the level of recycling for this type of waste was roughly estimated to be 10-20%, which was well below the EU average of 25 % (Mehus et al., 2003). Similarly to Ireland, Norway has an abundance of rock and gravel.

In order to overcome some of the obstacles for the use of construction and demolition waste, the Norwegian Public Roads Administration initiated the “Recycled Materials Research and Development Program” in 2002 (Norwegian Public Roads Administration, 2006). In addition to the recycled materials produced from construction and demolition waste, research was carried out on the potential use of shredded tyres and cellular glass as lightweight fill materials (Norwegian Public Roads Administration, 2006).

As a result of this program, the Road Construction Manual 018 published by the Norwegian Public Roads Administration was amended to include the use of recycled concrete aggregate. Furthermore, a quality certification scheme and a code of practice were developed for recycled concrete aggregate. Similarly, a code of practice was developed for asphalt. Annually some 300,000 – 500,000 tons of asphalt are removed from Norwegian roads as a result of plane milling, which removes ruts caused by asphalt wear (Norwegian Public Roads Administration, 2006).

Norway set a national goal of 70% recycling of Construction and Demolition waste by the end of 2005. This goal proved to be too ambitious but it became clear that achieving a high level of recycling in Norway did not depend on technical knowledge and facilities, but on the administrative and legal framework given by the central authorities (Norwegian Public Roads Administration, 2006).

SECTION 6

DISCUSSION AND CONCLUSIONS

6.1 Overview

This section discusses the results obtained for the three objectives outlined in Section 2.

6.2 Objective 1: Determine what Construction and Demolition waste types are being and are not being recycled

The National Waste Report 2004 published by the EPA reported that 85% construction and demolition waste was recovered in 2004. This high rate of recovery was not reflected in the results of the survey conducted in this research. 49% of participants reported that they recycle stone and this was the highest rate of recycling reported of any waste type. Similarly the reuse of materials was significantly lower than might be expected based on the National Waste Report 2004. Only 52% of participants reported that they use recycled aggregate on site.

However, once soil and stone are excluded from the figures used by the National Waste Report 2004, the recovery rate of construction and demolition waste drops to 69%, which appeared to be a more realistic figure when compared with this research.

Furthermore, according to the National Waste Report 2004, 1.6 million tonnes of construction and demolition was reported as having gone missing (EPA, 2004).

The inspection conducted at Roadstone Dublin Ltd established that there was preferential pricing in place for recyclable waste at their facilities. This preferential pricing translated to a saving of 90-96% of landfill disposal cost.

6.3 Objective 2: Establish if recommended instruments are being used on Irish building sites

Only 15% of participants reported that waste is rarely separated on their site and only 7% reported that waste is never separated on their site. There was a financial reward from some waste collectors for segregated waste and this appeared to be reflected in the adequate levels of source separation of waste.

A substantial 25% of participants reported that Waste Management Plans are never used in their projects. The Department of the Environment, Heritage and Local Government (2004) has issued Draft Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects. These guidelines were due to be finalised by the end of 2005.

However, they remain in draft at the time of this research.

Shen and Tam (2002) conclude that establishing a waste management plan is the most effective environmental management measure in the construction industry. However, it appears that there is poor voluntary take up of this

recommended instrument in Ireland. It should be considered that Waste Management Plans for Construction and Demolition Projects be placed on a statutory footing. This was recommended in the Environmental Protection Agency report entitled 'The Nature and Extent of Unauthorised Waste Activity in Ireland, 2005.

33% of participants replied that there is only sometimes a person on site responsible for Waste Management. The Draft Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects recommended the appointment of a dedicated Waste Manager on site. This requirement could be linked into placing Waste Management Plans for Construction and Demolition Projects on a statutory footing i.e. in addition to the required plan there a person responsible for implementing the plan must be on site at all times so that effective inspections by the local authorities can take place.

6.4 Objective 3: Determine how Construction and Demolition Recycling Waste can be advanced in Ireland

39% of participants were concerned about the lack of agreed standards for recycled material. The interview conducted with Dr. Vincent O'Malley, Environmental Manager of the NRA confirmed that recycled aggregates were contained in the NRA Specification for Road Works as acceptable constituents for certain materials and as such could be used at will when compliance is demonstrated.

However, there is no agreed standard for the use of recycled aggregate as building foundation. This severely limits the marketability of recycled aggregate.

33% of participants felt that there was a lack of availability of recycled material. Of the eighteen construction and demolition waste licensed facilities in Ireland, eight of these are located in the Dublin region according to the desktop survey carried out for this research. Additionally, there were two waste permitted facilities for the recycling of construction and demolition waste in the Dublin region. Clearly, there must be a shortage of recycled material particularly in areas outside of Dublin if there is no facility in close proximity to the builder.

A subsidy on recycled material at 72% was the most popular measure that the Irish Government could introduce in order to drive construction and demolition recycling. This is as expected as the building contractor can expect to make a saving if subsidies are introduced on recycled product. A ban on the landfilling of construction and demolition waste at 8% was unpopular as was a tax on virgin aggregate at 3%. Again this is as expected as these measures may cost the building contractor time or money.

Training at 56% and Awareness programs at 57% were also popular measures to drive construction and demolition waste recycling. FÁS run a Construction and Demolition Waste Management Course and the Dublin

Institute of Technology are currently running a module entitled 'Management of Construction and Demolition Waste' aimed at Design Professionals. However, basic waste management training for operatives appears to be lacking in Ireland.

The most common waste management/environmental issues that arose on-site were difficulties with waste segregation (21%), a lack of recycling facilities (10%) and lack of compliance by workers with site waste management (14%). The first and last of these issues could be solved through training and awareness programs. The lack of recycling facilities could be alleviated by the creation of a Waste Management Authority, which was recommended by Forfas, 2001. This concept is discussed later in this section.

Both the Danish and the Norwegian experience demonstrate that technical expertise alone is not sufficient to drive construction and demolition waste recycling. The most important controls were reported to be regulatory and financial controls.

Financial controls including taxes on waste and raw materials were recognised as being the most important instrument used to achieve high levels of recycling of construction and demolition waste in Denmark (COWI, 1998).

However, COWI (1998) cautioned that taxes cannot stand-alone and that according to Danish experience it was necessary to

- establish policies and action plans,
- ensure adequate infrastructure and adequate recycling capacity
- use grants or subsidies to encourage recycling initiatives,
- use local planning and regulation of wastes according to the national policies and not according to local interests and
- establish standards for the use of recycled material

The Norwegian construction and demolition recycling experience confirmed that the most important instruments were not technical knowledge or facilities but were in fact administrative and legal controls by authorities (Norwegian Public Roads Administration, 2006).

6.5 Conclusions

This research leads to the conclusion that there is a low rate of waste recycling taking place on construction sites in Ireland. There is also a poor uptake in the use of recycled material. This is despite the fact that there is preferential pricing in place for recyclable waste at facilities such as Roadstone Dublin Ltd. However, these waste recovery facilities are not in close proximity to builders outside of Dublin as can be concluded from the study of construction and demolition waste licensed facilities in Ireland.

It can also be concluded that there is a case for making the maintenance and reporting of waste data mandatory for all construction and demolition

operations over a certain size as alarmingly, 1.6 million tonnes of construction and demolition was reported as having gone missing (EPA, 2004).

There are adequate levels of waste separation taking place on construction sites. It can be concluded that this may be due to the financial reward in place for segregated versus non-segregated waste. In contrast to this, there is poor uptake of the use of construction and demolition waste management plans and waste managers in Ireland. It can be concluded that there is an argument for making these plan statutory in order to increase their uptake.

Training and Awareness campaigns were popular measures to drive construction and demolition waste recycling and basic waste management training for site operatives appears to be lacking in Ireland.

Similarly, there seems to be a lack of awareness of the new NRA specifications for Road Works as 39% of survey participants were concerned about the lack of agreed standards for recycled material. However, at the time of this research, there is no agreed standard for the use of recycled aggregate as building foundation despite the establishment of the National Construction and Demolition Waste Council in 2002. This severely limits the marketability of recycled aggregate.

A tax on virgin aggregate while unpopular in the survey conducted is nevertheless an important instrument. It can be concluded from the Danish

experience that taxes on raw materials helps to achieve high levels of recycling of construction and demolition waste.

The literature review conducted in Section 3 leads to the conclusion that the Waste Management (Permit) Regulations, 1998 should be amended to exclude the permitting of sites where material can be deposited for beneficial agricultural use. A better approach would be to have a smaller number of construction and demolition waste disposal points, for example situated in old quarries as already recommended by Dublin City Council *et al.* (2005).

As discussed earlier, the lack of recycling facilities could be alleviated by the creation of a Waste Management Authority. This authority would plan and coordinate waste management in Ireland. At present, regional waste management plans are being created every five years. These regional plans review areas as small as Donegal and are being implemented at a very slow pace. Economies of scale are also limited, as at present, waste produced in a region must be treated in the same region. Additionally, local authorities have no statutory requirement to collect commercial and industrial waste and so regional plans do not necessarily plan infrastructure for the recycling of construction and demolition waste.

At the time of this research, there was no authority responsible for presenting an overview of what waste infrastructure is required and where it is best located in Ireland. Also, a regional plan may state that a construction and demolition recycling facility is required in their region but there are no specific

plans to ensure that one is built and built in a specific timeframe. Site selection is being driven by private developers rather than by a national strategy.

This National Waste Management Authority would implement the recommendations made by COWI above. It would

- prepare a single national waste management plan
- provide guidance to the Department of the Environment, Heritage and Local Government on implementing landfill taxes or bans and recycled material subsidies or grants for recycling initiatives
- ensure adequate infrastructure and adequate recycling capacity through the single national waste management plan
- initiate planning schemes for Waste Management Centres
- ensure that standards are established for recycled materials

The planning schemes for Waste Management Centres would use a concept contained in the Planning and Development Act, 2000 (Forfas, 2001).

Potential sites would be identified and a planning scheme and EIS developed.

Developers could apply to establish Waste Management projects and would be approved provided they comply with the requirements of the scheme

(Forfas, 2001).

SECTION 7

SUMMARY OF RECOMMENDATIONS

The establishment of a National Waste Management Authority is recommended as a result of this research. This authority would prepare a single national waste management plan, co-ordinate waste management infrastructure and advise the Irish Government on regulatory controls such as landfill bans and on financial controls such as virgin aggregate taxes and recycled material subsidies. The most important duty of this authority would be the provision of critical waste infrastructure. The lack of recycling facilities and the lack of recycled material were major concerns of survey participants.

At the time of this research, there is no agreed standard for the use of recycled aggregate as building foundation despite the establishment of the National Construction and Demolition Waste Council in 2002. 39% of survey participants were concerned regarding this lack of agreed standards for recycled material. This National Waste Management Authority would ensure that standards are established for recycled materials.

In the short term, two measures should be used. These measures are the creation of a tax on virgin aggregate and statutory Waste Management Plans for construction and demolition waste recycling.

Firstly, a tax on virgin aggregate is necessary in order to drive construction and demolition waste recycling in Ireland. Duran *et al.* (2005) concluded that

the current low cost of disposing of construction and demolition waste in landfill sites together with the low cost of primary aggregates makes it impossible for a sustained level of recycling to occur. This tax would implement the 'polluter pays principle' in the quarrying industry in Ireland, which is not as advanced as in the landfilling of waste (Duran *et al.*, 2005).

Secondly, it is recommended that Waste Management Plans for construction and demolition projects be made statutory. 36% of survey participants favoured this control. In addition to the required plan, a person responsible for implementing the plan should be on site at all times so that effective inspections by the local authority can take place as discussed in Section 6. This should be made an additional legal requirement.

Furthermore, the maintenance and reporting of waste data should be made mandatory for all construction and demolition operations over a certain size as outlined by the EPA (2004). Alarming, 1.6 million tonnes of construction and demolition was reported as having gone missing (EPA, 2004).

The Waste Management (Permit) Regulations, 1998 should be amended to exclude the permitting of sites where material can be deposited for beneficial agricultural use. Unfortunately, this does not look likely to happen soon as the draft Waste Management (Facility Permit and Registration) Regulations 2005 allow for a certificate of registration for the recovery of inert waste for the purpose of land reclamation for up to 25,000 tonnes and a permit for up to 100,000 tonnes over the cert or permit period.

A better approach would be to have a smaller number of construction and demolition waste disposal points, for example situated in old quarries as already recommended by Dublin City Council *et al.* (2005).

The landfill levy on construction and demolition waste could possibly be increased. There has been no increase since the introduction of this levy in 2001 with the Waste Management (Amendment) Act 2001. However, this measure should be investigated in the overall context of a national strategy co-ordinated by the National Waste Management Authority. A greater recycling capacity is first required in Ireland before measures such as taxes on landfill or landfill bans can realistically and reasonably be used.

Similarly, the use of statutory separation of waste at source and recycled material subsidies should be reviewed in the context of a national strategy co-ordinated by the National Waste Management Authority.

Basic waste management training for site operatives is lacking in Ireland and needs to be addressed. 56% of survey participants supported this measure. An awareness campaign similar to the 'Race against Waste' run by the Department of the Environment, Heritage and Local Government should be run for construction and demolition waste. 57% of survey participants supported this measure. Training programs and awareness campaigns would alleviate difficulties experienced with site segregation experienced by 21% of survey participants and lack of compliance by workers with on site waste management experienced by 14% of survey participants.

The weakness of the main research tool used in this dissertation, the questionnaire was that members of CIF come from a range of backgrounds including builders, civil engineers, mechanical contractors, electrical contractors, and specialist contractor. Therefore, for example a painting contractor would have no opportunity to recycle or reuse bricks. This would have the effect of reducing the percentage of participants involved in the recycling of bricks and would give a slightly skewed picture of the reality.

It is recommended that if further research is conducted in this field, that it should focus on markets for recycled construction and demolition waste.

Another area deemed worthy of research is the use of on-the-spot fines in waste management legislation in countries such as Australia.

The target of 85% construction and demolition waste recycling by 2013 set by the governmental policy document, Changing our Ways is ambitious and the measures outlined here must be implemented without delay if effective recycling of construction and demolition waste is to be advanced in Ireland.

REFERENCES

Cork City Council (2004)

The Cork City Waste Management Plan 2004 – 2009

COWI, Consulting Engineers (1998)

Lessons to be learned from Denmark on Recycling of Construction and

Demolition Waste. Paper presented on the Second Aggregates Advisory

Services Seminar in Leeds 19th May 1998 by COWI, Consulting Engineers.

Denmark.

Danish EPA (1998)

Waste 21 Waste Management Plan 1998 – 2004. Internet Reference:

<http://www.mst.dk>

Department of the Environment and Local Government (1998)

Waste Management: Changing Our Ways, a policy statement.

Department of the Environment, Heritage and Local Government (2004)

Waste Management: Taking Stock and Moving Forward, a policy statement.

Department of the Environment, Heritage and Local Government (2005)

Waste Management (Facility Permit and Registration) Regulations, 2005

Dublin Chamber of Commerce (2004)

A Review of Waste Management in the Greater Dublin Area: The Business Perspective.

Dublin City Council, Dun Laoghaire – Rathdown County Council, South Dublin County Council and Fingal County Council (2005)

Waste Management Plan for the Dublin Region.

Duran, X., Lenihan, H. and O'Regan, B. (2005)

A model for assessing the economic viability of construction and demolition waste recycling – the case of Ireland. Resources, Conservation and Recycling, IN PRESS

Environmental Protection Agency (2004)

National Waste Report 2004

Environmental Protection Agency (2005)

The Nature and Extent of Unauthorised Waste Activity in Ireland.

Forfas (2001)

Key Waste Management Issues in Ireland. Internet Reference:

<http://www.forfas.ie>

Hjelmar, Ole (1996)

Waste Management in Denmark. Waste Management, 16, 389-394.

Mehus J., Petkovic G., Engelsen C. J., Karlsen J. and Lillestøl B., 2003.
Recycled Aggregates a Viable Alternative for the Norwegian Building and Construction Industry. In: G. Ortiz de Urbina and H. Goumans (Editors), WASCON 2003 Progress on the Road to Sustainability. 5th International Conference on the Environmental and Technical Implications of Construction with Alternative Materials, 4-6 June 2003, San Sebastian, Spain. INASMET, San Sebastian, pp. 753-763.

National Roads Authority (2004)

Manual of Contract Documents for Road Works (NRA MCDRW) May 2004 Revisions.

National Construction and Demolition Waste Council (2004)

Annual Report 2003/2004

Norwegian Public Roads Administration (2006) *Recycled Materials Research and Development Program*. Internet Reference:

<http://www.gjenbruksprosjektet.net>

Robinson, G.R. Jr., and Kapo, K.E. (2004)

A GIS analysis of suitability for construction aggregate recycling sites using regional transportation network and population density features. Resources, Conservation and Recycling, 42, 351-365.

Shen, L.Y., and Tam, V.W.Y. (2002)

Implementation of environmental management in the Hong Kong construction industry. International Journal of Project Management, 20, 535-543.

Symonds Group Ltd (1999)

Construction and Demolition Waste Management Practices, and their Economic Impacts. Report to DGXI, European Commission

APPENDICES

Appendix 1:

Interview Questions used for four major construction companies

Appendix 2:

Cover letter to questionnaire utilised by the Construction Industry Federation

Appendix 3:

Questionnaire utilised by the Construction Industry Federation

Appendix 4:

Interview Questions used for the National Roads Authority

APPENDIX 1

INTERVIEW QUESTIONS USED FOR FOUR MAJOR CONSTRUCTION COMPANIES

Part 1: Waste Management

1. Waste is separated at source on our projects (please circle)

1=strongly disagree 2=disagree 3=undecided 4=agree 5=strongly agree
1 2 3 4 5

2. Which of the following waste types do you recycle at present?

- No Waste is Recycled
- Concrete
- Brick
- Stone
- Metal
- Wood
- Packaging Waste
- Other (please specify) _____

What do you see as the barriers to recycling waste?

3. Which of the following recycled waste types are used?

- No Recycled Waste is used
- Recycled Aggregate
- Brick
- Wood
- Other (please specify) _____

What do you see as the barriers to using recycled waste material?

4. Have you concerns about using recycled material due to any of the following issues?

- Higher Cost of Recycled Material
- Lack of Agreed Standards for Recycled Material
- Difficulty with Sign off on PPP projects
- Lack of availability of Recycled Materials
- Other (please specify) _____

Please detail which issue you consider to be your most important concern?

5. Waste Management Plans are used in our projects (please circle)

1=strongly disagree 2=disagree 3=undecided 4=agree 5=strongly agree
1 2 3 4 5

Any Comments:

6. There is one person responsible for Waste Management on our sites (please circle)

1=strongly disagree 2=disagree 3=undecided 4=agree 5=strongly agree
1 2 3 4 5

Any Comments:

7. In the Draft Waste Management (Facility Permit and Registration) Regulations, 2005, a waste permit may be used for a mobile crushing plant at more than 1 facility. I would now consider applying for a waste permit and using a mobile crushing plant once these regulations are finalised (please circle)

1=strongly disagree 2=disagree 3=undecided 4=agree 5=strongly agree
1 2 3 4 5

Any Comments:

Part 2: Regulatory Issues:

8. What regulatory controls do you believe are required for efficient Waste Management in the Construction and Demolition Sector?

- Statutory Requirement for a Waste Management Plan for each project
- Statutory Requirement for Separation of Waste at Source
- Effective Enforcement of Waste Management Legislation by Local Authorities?
- Any other controls (please specify)?

9. What current incentives are there to separate waste at source?

10. What current incentives are there to recycle waste?

11. I believe that there is sufficient Waste Management Infrastructure available with regard to Recovery/Recycling Facilities (please circle)

1=strongly disagree 2=disagree 3=undecided 4=agree 5=strongly agree
1 2 3 4 5

Any Comments:

12. I believe that there is sufficient Waste Management Infrastructure available with regard to Disposal Facilities (please circle)

1=strongly disagree 2=disagree 3=undecided 4=agree 5=strongly agree
1 2 3 4 5

Any Comments:

APPENDIX 2

**COVER LETTER TO QUESTIONNAIRE UTILISED BY
THE CONSTRUCTION INDUSTRY FEDERATION**

28 March 2006

Re: Environmental & Waste Management Services at CIF

Dear Member,

Firstly, I would like to introduce myself for those of you who are not aware of who I am. My name is Caitriona Carter and I am the Environmental Services Executive here at the CIF.

My role at the CIF includes the following:

- Provide information to members on all environmental and waste management issues that may apply to the construction industry
- Represent the interests of members by liaising with the Department of the Environment, Heritage and Local Government and the regulatory bodies with regard to legislation and environmental enforcement etc.
- Represent the CIF on the National Construction and Demolition Waste Council (NCDWC). I am currently the secretariat of the Council.

During 2006, I plan to re-examine and enhance the environmental and waste related information available to members. In order to do this, I would appreciate some feedback from yourselves on the difficulties that you experience within this area.

As part of this information gathering process, I am working with Loretta Joyce who is preparing a thesis as part completion of an M.Sc in Environmental Protection from Sligo IT. Together we have prepared a survey (see attached), which will be used to assess the current needs of the industry with regard to environmental and waste management. Once I have established the information deficiencies I can begin to disseminate specific information on these topics to all members.

I would really appreciate if you could complete the attached 2-page survey and return it to me by **Friday 14th April** (my contact details are outlined on page 2). Some of the information gathered will also be forwarded to Loretta Joyce for completion of her thesis, but I would like to assure you that company name etc. will not be included.

I would like to take this opportunity to thank you for your co-operation. If you have any specific queries in the meantime please feel free to call me directly on 01-4066066.

Yours sincerely,

APPENDIX 3

QUESTIONNAIRE UTILISED BY THE CONSTRUCTION INDUSTRY FEDERATION

CONSTRUCTION & DEMOLITION WASTE SURVEY

"Recycling Construction and Demolition Waste in Ireland".

1. Are wastes separated on site on your projects?

	Please Tick
Never	
Rarely	
Don't Know	
Sometimes	
Always	

2. Are Waste Management Plans used in projects?

	Please Tick
Never	
Rarely	
Don't Know	
Sometimes	
Always	

3. Which of the following waste types do you recycle at present?

	Please Tick
Concrete	
Brick	
Stone	
Metal	
Wood	
Packaging Waste	
Gypsum/Plasterboard	
Other (please specify)	

No Waste is Recycled	

4. Is there a person who is responsible for Waste Management on your sites?

	Please Tick
Never	
Rarely	
Don't Know	
Sometimes	
Always	

5. Are any of the following wastes re-used on site?

	Please Tick
Recycled Aggregate	
Brick	
Wood	
Other (please specify)	

No Recycled Waste is used	

6. Have you concerns about reusing recycled material due to any of the following issues?

	Please Tick
Higher Cost of Recycled Material	
Lack of Agreed Standards for Recycled Material	
Difficulty with Sign Off on PPP projects	
Lack of availability of Recycled Materials	
Other (please specify)	

Please detail which issue you consider to be your most important concern:



7. What regulatory controls do you believe should be put in place by the Government to drive efficient Waste Management in the C&D Sector?

	Please Tick
Legal:	
Statutory Requirement for a Waste Management Plan for each project	
Statutory Requirement for Separation of Waste at Source	
Effective Enforcement of Waste Management Legislation by Local Authorities	
Effective Enforcement of Waste Management Legislation by other bodies (please specify)	

Financial:	
Tax on Virgin Aggregates	
Subsidy on Recycled Material	
Education/Awareness:	
Awareness Campaign	
Training Programme	
Other (please specify)	

8. What are the most common waste management / environmental issues that arise on-site? (please specify)

9. Do you have difficulty obtaining useful information on these issues as they arise?

	Please Tick
Never	
Rarely	
Don't Know	
Sometimes	
Always	

10. If there is any specific topic that you would like to receive further information on please provide details below:

PLEASE RETURN COMPLETED SURVEYS

BY FRIDAY 14th APRIL 2006 TO: CIF



APPENDIX 4

INTERVIEW QUESTIONS USED FOR THE NATIONAL ROADS AUTHORITY

1. Would you use recycled aggregate for

a. Embankment work

Yes No

b. Capping work

Yes No

c. Sub base work

Yes No

If no, please detail why not?

2. Do you have any pilot schemes/ any plans to use recycled aggregate in Irish roads?

3. What do you see as the barriers to the use of recycled aggregate?

4. Is there a need for local authorities to use the higher NRA specifications for local roads and some car parks?
