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# a best practices guide to solid waste reduction

**Canadian Construction Association**

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# FORWARD

As part of an ongoing effort to serve its 20,000 member firms the Canadian Construction Association (CCA) developed this Solid Waste Reduction Best Practices Guide for those interested in reducing, reusing and recycling construction waste.

Over the past decade, there has been a shift in outlook in the area of waste management planning and waste products are progressively being considered by construction, renovation, and demolition (CRD) industries for their abilities (asset/resource) rather than for their associated liabilities (cost/waste). More industries are relying on reused and recycled materials for new construction, and builders and demolition companies are discovering that it is possible to divert, for reuse or recycling, significant quantities of the waste generated from CRD projects

In addition to protecting the environment and preserving raw resources, sound waste diversion strategies and practices can result in a number of financial benefits. These include reduced haulage and tipping fees as a result of less waste and more efficient use of materials, a reduction in new material costs, and the potential to create revenue from the sale of used equipment and materials. Other indirect benefits of CRD waste diversion include reduced stress on landfills and energy conservation at the harvest, manufacture and transport levels and reduced greenhouse gas emissions.

This guide provides some helpful hints and suggestions for reducing, reusing and recycling construction waste, and addresses, among other topics:

- Benefits of CRD waste diversion;
- Overview of federal, provincial, and municipal waste guidelines and the CCA's Waste Management Code of Practice;
- Opportunities and barriers to reducing, reusing, and recycling CRD waste such as wood, metal, asphalt, corrugated cardboard, drywall, concrete and plastics
- Considerations for collecting, handling, storing and removing CRD waste including advantages and disadvantages of source separating and commingled recycling;
- Hazardous waste management, liabilities and abatement;
- Waste audits as a project management tool;

- The benefits of waste management planning during the early stages of a project;
- Developing and implementing a workplan including team building and communication, site set-up, hauling options, construction waste agreements, on going monitoring and program evaluation and improvement.

At the back of the guide there is a glossary of processing equipment, useful contacts for reuse and recycling and a sample construction waste agreement.

# 1.0 Waste as a Resource in Construction

Activities in the area of new construction, renovation, demolition (CRD) and road construction have a wide spectrum of direct and indirect effects on the environment, and ultimately on our health and communities. Currently, CRD waste equals up to 35% of total waste stream in Canada, representing 11,000,000 tonnes in weight. The nature and extent of their impacts, however, flows in large part from the specific choices we make when it comes to resource planning and waste management.

There exists great potential for CRD and road building industries to become involved in displaying sound stewardship and conservation of our environment, without necessarily compromising their economic growth.

A shift in outlook has been observed in the past decade in the area of waste and environmental management planning: waste products are progressively being considered by CRD industries for their *ABILITIES* (asset/resource) rather than for their associated *LIABILITIES* (cost/waste). As a result, industries are striving to preserve raw resources in new construction or road-related construction by relying on reused and recycled materials. With this approach will come heightened environmental awareness among clients, cost efficiency and better public image.

## 1.1 The Impact of Waste Management Planning on the Construction Industry

The level of awareness and confidence of consumers, tenants and building owners in environmental matters is driving CRD industries to respond adequately to changing trends. While several factors affect the environmental impact of a project one of the critical areas where CRD industries can start to set environmental goals is the process of materials selection.

Remarkably, approximately 40% of national annual resource expenditure is consumed by the construction industry. The main cause of this is traditional material selection procedures. Other than structural suitability, the current criteria for selecting building materials has been largely capital cost (usually only "first cost" and not operating, maintenance, environmental degradation, disposal or other monetary costs) and aesthetics.

The environmental impact of the manufacturing process, the durability and recyclability of a particular material, as well as a product's toxic emission level, will all need to be included in future construction considerations. The importance of waste management within CRD industries is even greater given the context of the Kyoto Protocol on reducing the emission of greenhouse gas emissions (GHG).

## 1.2 Benefits of CRD Waste Diversion

Historically the cost of disposal (landfill, incineration etc.) have generally been low in comparison to recycling. This has acted as a disincentive to 3Rs initiatives. A large percentage of CRD waste is recyclable. However, since real world applications must take into consideration such things as volumes generated, labour costs, processing capacity, transportation requirements, and market demand, it is often realistic to target those materials that have the greatest diversion potential.

Many of the materials recovered from demolition projects can be incorporated into new construction projects. Markets for recovered resources are strongest when the construction industry is economically healthy. By far the most accessible market for source-separated demolition debris is the construction project under way at the site itself. Minimal or no marketing overhead is related to such use, and transportation, processing and storage costs are minimized.

Sound waste management strategies and practices can result in a number of financial benefits as following:

- Reduced haulage and tipping fees, as a result of less waste and more efficient use of materials.
- A more accurate calculation of materials needed and, therefore, a reduction in new material costs.
- Increase in productivity due to the fact that it takes less time to complete a project that has been designed to use materials efficiently.
- The potential to create revenue from the sale of used equipment and materials.

Proven examples:

- Diversion of waste from the renovation of the East Memorial Building in Ottawa achieved an 89% diversion through reuse and recycling.
- Approximately 95% of construction waste was diverted during the development of the C.K. Choi Building at the University of British Columbia.
- The Harvey Barracks (part of Canadian Forces Base Calgary), decommissioning project required that waste minimization practices be incorporated into the project. It was estimated that the volume of material diverted from landfill was approximately 90% compared to traditional demolition and landfill disposal.

Other indirect benefits of waste management include: reduced stress on landfill capacities, resource conservation, and energy conservation at the harvest, manufacture and transport levels.

As an example of foreseeable potential benefits, the American Institute of Architects' Environmental Resource Guide points out that for every pound of steel produced from recycled steel, rather than raw materials, 5.7 MJ (5,450 BTUs) of energy are conserved. Similarly, the reuse of scrap steel results in a 47% reduction in oil use, an 86% reduction in air emissions, a 76% reduction in water contaminants, a 40% reduction in water use, and a 97% reduction in mine wastes.

## 1.3 Landfills and Regional Variables

Canada ranks second only to the United States in per capita generation of solid waste per year. In today's global economic environment, competitive advantage realized through efficient use of resources will become an increasingly strategic advantage. The federal and a number of provincial governments have made a commitment to reducing solid waste generation by 50% by the year 2000.

Many municipal landfills are expected to reach capacity in the near future, and space for additional landfill sites is at a premium. Land use conflicts in highly populated areas and the environmental concerns of local citizens are making the management and replacement of current landfills extremely difficult and expensive. As a combined result of these factors, landfill-tipping fees have generally risen and will continue to increase, as the problems become more critical. In the past, landfill disposal of waste was relatively inexpensive due to large landfill capacities and ease of expansion. This is no longer the case. Landfill capacity is limited and planning for new sites has become a very expensive and arduous process, as a landfill is not simply a hole in the ground but an engineered system.

## 1.4 Overview of Regulatory Frameworks and Guidelines

Compliance with federal and provincial *regulatory standards* as set forth within *legislated acts*, and associated regulations is compulsory while federal and provincial *guidelines* contained within the acts can either be compulsory or voluntary in nature, depending on the wording and content of the act. Generally, these guidelines are meant to provide direction to the CRD industry with respect to waste management practices. The municipal equivalent is by-laws. Compliance with municipal by-laws is also compulsory and because they relate to municipal waste management practices, they are more specific to CRD wastes such as concrete, metals, drywall and cardboard.

Currently there are very few pieces of legislation, which directly regulate CRD waste management practices. Indirectly, however, there is a substantial amount of legislation, which does affect the industry in different ways such as those, which govern the transportation, and disposal of waste, hazardous waste treatment, and greater environmental protection.

In addition to standards set by the various levels of government the CRD industry, in cooperation with various provincial and municipal governments, have generated voluntary codes of practice and programs. These codes of practice are typically not compulsory, however they are meant to foster and encourage environmentally sound practices within the industry.

### 1.4.1 Provincial & Municipal Overview

Waste management facilities for CRD wastes such as landfills or recycling operation are provincially licensed. Ontario is the only province regulating the necessity of waste management programs for CRD projects. In 1994, the Ontario Ministry of the Environment (MOE) passed the 3Rs Regulations. The 3Rs Regulations are intended to ensure that municipalities, and industrial, commercial and institutional (IC&I) sectors, develop programs to reduce the amount of material being sent to landfill. The goal of the regulations is to reduce the amount of waste material requiring disposal in landfill, by at least 50% by the year 2000 compared to the base year of 1987.

The most commonly encountered provincial legislation in the CRD industry involves the handling, storage, transportation and disposal of solid, liquid and gaseous hazardous substances. Therefore, it is a good idea to become familiar with regulations pertaining to these substances. It should be understood that the research undertaken to compile the following summary information is not to be considered exhaustive.

At the provincial level, the emphasis is on stewardship programs for products and packaging such as used tires, packaging, beverage containers and used oil. Alberta is in the developing stages of a provincial CRD waste strategy and it is likely that other provinces will follow suit in the future. The CRD industry must be aware and actively participate in the development of these programs.

Some municipal and regional landfills have also instituted disposal bans for certain materials. Authorities such as Halifax Regional Municipality, Greater Vancouver Region District and many Ontario communities have implemented disposal bans for materials such as cardboard, scrap metal and drywall. Check with you local municipal waste management authority.

### 1.4.2 Federal Overview

***Auditor Generals Act:***
Amendments to the Act (December 15, 1995) require federal government departments to develop "Sustainable Development Strategies" to improve environmental performance. Departments are also

required to develop and implement Environmental Management Systems for their operations. Waste management is an important criterion in accomplishing overall performance objectives.

***Canadian Environmental Assessment Act:***
The Act requires federal departments, agencies, and crown corporations to conduct environmental assessments for proposed projects where the federal government is the proponent. It also requires environmental assessments when the project involves federal funding, permit or license.

***Canadian Environmental Protection Act:***
The Act is concerned with the protection of the environment and the health of Canadians from toxic substances and other pollutants. This includes:

- Pollution prevention.
- Managing toxic substances.
- Controlling pollution and wastes: trans-boundary movement of hazardous wastes and recyclables and of non-hazardous wastes.

***Transportation of Dangerous Goods Act:***
The Act applies to the transportation of hazardous wastes. The generator, carrier and receiver of the hazardous wastes are responsible for manifest requirements in order to ensure the proper documentation and tracking of hazardous wastes.

***3Rs Regulations:***
The federal government has also adopted the Ontario 3Rs Regulations 102/94 and 103/94 for use on CRD projects for one or more buildings with a total floor area of at least 2,000 square metres.

### 1.4.3 CCA Code of Practice

The CCA has developed a Code of Practice[1] to encourage improved waste management practices in the construction industry:

- Adopt a waste management policy and implement it on all projects;
- Promote this policy to all employees and stakeholders;
- Select and purchase durable products and construction materials;
- Purchase only the amount of materials necessary to meet requirements;
- Adopt techniques which minimize construction wastes;
- Reuse waste products on site whenever possible;
- Implement source separation on site for recycling purposes;
- Identify markets for recycled goods;
- Identify potential users of waste materials;
- Use landfill sites only where no other options are available.

[1] Source: "A Guide on Construction Environmental Management Planning ", Standard Construction Document Number 27, CCA 1997.

# 2.0 Reduction, Reuse, and Recycling: Opportunities & Restrictions

## 2.1 Composition of CRD Waste

In Canada, CRD materials represent approximately 35% of municipal solid waste. Recycling markets for CRD waste in areas of the country can be somewhat limited. However, opportunities to recycle portions of this waste are increasing, especially in the urban centres.

Table 1.0 shows the national breakdown of industrial, commercial and institutional (IC&I) CRD related waste in 1992. Although the figures illustrate the types and quantities of material being produced, they should probably not be considered to be the full picture. For example, significant amounts of metals are cited as being disposed of (unlikely as metals are widely recycled).

**Table 1.0 – Canadian CRD Waste Generation, Diversion and Disposal**

| | Generated | | Diverted | | Disposed | |
|---|---|---|---|---|---|---|
| | **Tonnes** | **%**(1) | **Tonnes** | **%** | **Tonnes** | **%** |
| **Asphalt** | 3,875,623 | 35 | 2,808,559 | 25 | 1,067,064 | 10 |
| **Concrete** | 2,348,138 | 21 | 1,702,074 | 15 | 646,066 | 6 |
| **Wood** | 1,630,968 | 15 | 88,162 | 1 | 1,542,807 | 14 |
| **Rubble** | 1,700,987 | 15 | 0 | 0 | 1,700,987 | 15 |
| **Paper** | 315,232 | 3 | 0 | 0 | 315,232 | 3 |
| **Gypsum** | 355,118 | 3 | 117,042 | 1 | 238,076 | 2 |
| **Bldg. Materials** | 354,637 | 3 | 0 | 0 | 354,637 | 3 |
| **Metal** | 330,174 | 3 | 0 | 0 | 330,174 | 3 |
| **Other** | 275,828 | 2 | 0 | 0 | 275,828 | 2 |
| **TOTAL** | **11,186,706** | **100** | **4,715,837** | **42** | **6,470,871** | **58** |

Source: "Construction and Demolition Waste in Canada: Quantification of Waste and Identification of Opportunities for Diversion From Disposal" - Environment Canada, 1993
(1) Percentages for diverted and disposed waste are expressed as a percentage of total CRD waste generated.

## 2.2 Waste Diversion Opportunities for Non-Hazardous CRD Waste

The following is a look at the most common types and sources of waste materials generated by the CRD industry. Each of the descriptions is intended to provide insight into the current state of each material's reusability and recyclability. It should be realized that many factors contribute to the diversion of each material from landfill including:

- the status of local reuse and recycling markets;
- hauling and tipping fees;
- landfill material disposal bans;
- workforce sensitivity to waste reduction issues;
- degree of on-site source separation effort and enforcement;
- the price of new materials;

- and project scheduling (tight time-lines restrict material salvage rates).

To outline diversion options, each of the materials are divided into an overview followed by a general 3Rs checklist and disposal suggestions and information.

### 2.2.1 Landclearing and Site Excavation

Materials produced include topsoil, fill, trees, stumps, and brush which is generated at the start of new construction projects.

| **3Rs Checklist: Landclearing / Site Excavation** | |
|---|---|
| REDUCE | • Retain trees and other existing vegetation by developing a retention plan prior to project start.<br>• Minimize disruption to existing vegetation by limiting the use of large machinery. |
| REUSE | • Replant small trees during final landscaping of the site.<br>• Mulch removed vegetation and use for landscaping at the end of the project.<br>• Stockpile stripped topsoil and fill and reuse in final landscaping and grading. |
| RECYCLE | • Send large trees for processing as lumber, pulp or firewood.<br>• Send landclearing materials to a processing facility to be chipped or ground up for use as animal bedding, mulch or fuel for industrial boilers.<br>• Send landclearing materials to a composting facility.<br>• Topsoil and fill can often be sent to another construction site which has use for it. |
| DISPOSAL | • Leaf and yard waste as well as compostable materials are banned from many landfills and incinerators. |

### 2.2.2 Wood

CRD wood waste is generally made up of the following components: pallets, wood building materials and site excavation wood. Potential markets for recycled wood waste include feedstock for wood composite materials (e.g. panelboard), building materials (e.g. shingles, roof felt), paper pulp, processed and raw fuels, animal bedding and litter, mulch, soil amendment, compost, landfill cover, road stabilization, park trails and firewood. Currently, the largest market for recycled wood waste is feedstock for the production of landfill or landscape cover. Reuse opportunities also exist for high quality materials such as beams, posts, trusses, and millwork.

There are a large number of CRD reuse/ recycling facilities that accept wood for a fee.

| **3Rs Checklist: Wood** | |
|---|---|
| REDUCE | • Reduction begins at the design stage where designers and builders can:<br>• Review floor plans and elevations to ensure optimal use of lumber, sub-flooring and sheathing.<br>• Provide detailed framing layouts to allow for more accurate lumber ordering. Where possible, have studs and joists precut to reduce on-site waste.<br>• Plan for the salvage of demolition lumber. A growing number of small companies buy recovered wood. |

| | |
|---|---|
| | • Use prefabricated wood, roof and floor systems where most of the waste is produced in a central location rather than on site.<br>• Buy kiln dried lumber and store properly to reduce waste from warping and shrinking. |
| REUSE | • Organize a central cutting area where reusable off-cuts can be kept for bridging, blocking and back framing.<br>• Transport leftover lumber to other job sites.<br>• Reuse salvaged timbers and other dimensional lumber recovered from demolition.<br>• Send all pallets to a repair facility where they can be rebuilt for reuse. |
| RECYCLE | • Wood can be recycled into products such as panelboard (e.g. pressboard, chipboard), pressed logs, animal bedding, landscaping cover, absorbent for oil spills, and as a bulking agent for composting.<br>• Hardwood and a smaller percentage of softwood waste can be recycled as kindling or, if collected in large enough quantities, as fuel for central heating plants.<br>• Most wood chippers / grinders accept wood embedded with nails, staples and fasteners. |
| DISPOSAL | • To discourage excessive dumping of dimensional lumber, certain landfills raise tipping fees if the volume of any given load exceeds a certain percentage of wood content. In fact, some municipalities rarely accept wood waste from the CRD industries and divert the debris to CRD reuse/ recycling facilities. |

### 2.2.3 Ferrous and Non-Ferrous Metals

Sources of waste metals (e.g. steel, aluminum, copper, etc.) in the CRD industry consist primarily of structural steel, steel studs and tracks, electrical and mechanical systems, flashing, aluminum siding, and re-bar.

Although the market for metals fluctuate often, metals can represent a significant opportunity to generate recycling revenue. A variety of arrangements can be made with local metal recyclers. These include the provision of various sized recycling bins, haulage and separation (e.g. ferrous and non-ferrous metals). Some metal recyclers provide equipment, such as mobile metal shears, that can be placed on-site if required. To optimize metal recycling revenues, check with local recyclers regarding specifics, such as preferred size requirements of waste metals.

| **3Rs Checklist: Metals** | |
|---|---|
| REDUCE | • Order material efficiently to minimize waste.<br>• Measure and cut materials accurately.<br>• Plan mechanical and electrical runs to reduce material.<br>• Locate electrical panel near area of greatest need.<br>• Keep an inventory of all surplus materials to reduce over-supply at future job sites. |
| REUSE | • Store cuttings in a central location for reuse.<br>• At project completion, remove surplus materials and take to next job or store off site. |
| RECYCLE | • Scrap dealers commonly pay for and recycle metals. Investigate pick up and transport options of each facility to obtain the best deal. |
| DISPOSAL | • Well-established metal recycling infrastructures in most regions generally prohibit the disposal of large quantities. Metals are accepted at some CRD reuse and recycling facilities at no charge, and, sometimes, depending on the metal, a credit or payment may be made. |

### 2.2.4 Asphalt

Asphalt is a mixture of bitumen and sand, gravel, clay, or other inert mineral filler, such as limestone. It is used in paving materials, roofing shingles, protective sealants for foundations, and some types of floor tiles. Asphalt may be stripped from a road surface, crushed and used as granular or hot-mix on the same or future road construction projects. There can be several economic and environmental benefits in using this process. However, the biggest advantages result from reductions in the amount of virgin aggregate and petroleum based products used. The number of asphalt roads which are recycled is significantly larger than that of concrete roads, mainly because asphalt can be rejuvenated with oil additives and used in pavements, significantly reducing the cost of the finished road. On-site surface recycling involves removing and replacing the top layers of a pavement structure for the purpose of repairing a wide range of pavement distress (surface cracking, ravelling and rutting). Advanced pavement recycling equipment can be used to recycle the bottom lift and place virgin hot-mix for the final lift.

Until recently, recycling opportunities for most sources of waste asphalt have been relatively limited. This has changed in the last few years as a few processors (private and municipal) now provide both stationary and mobile crushing services. There are several factors that point to recovery rates for asphalt recycling increasing over the next few years. This is due in part to diminishing supplies of aggregate in some areas and also to a growing acceptance throughout the industry of the quality and applicability of recycled asphalt. It may also make economic sense to stockpile recovered asphalt, which can later be processed to suitable specifications, and substituted for, or blended with, virgin aggregates in the production of new asphalt.

**3Rs Checklist: Asphalt**

| | |
|---|---|
| REDUCE | • Review deliveries and return damaged materials to supplier.<br>• Review plans carefully to perform accurate take-offs and order only what you need. |
| REUSE | • Attempts to salvage shingles in reusable condition is a laborious task which is hindered by the brittle state of older shingles as well as the way in which shingles bond together over time.<br>• Reuse shingle off-cuts for end pieces and ridge capping before cutting from full shingles.<br>• Full asphalt shingles can be used as a starter strip or in other non-visible areas at the next site. |
| RECYCLE | • Recovered and crushed pavement and asphalt shingles can be recycled as granular road sub-base, new pavement, trench backfill, residential driveway base, engineered fill, unpaved parking areas, and gravel road rehabilitation.<br>• Although asphalt shingles have typically been difficult to recycle, many road construction companies now accept used shingles for use in the manufacture of asphalt paving material.<br>• Asphalt roofing shingles may be reclaimed for paving driveways and walkways. |
| DISPOSAL | • The growth of the asphalt recycling market is a result of landfill bans and the ability to include recycled asphalt into new asphalt shingles. The weight of asphalt pavement typically prohibits its disposal in landfills. Alternatively, at some CRD reuse and recycling facilities there are no tipping fees for clean asphalt. |

### 2.2.5 Corrugated Cardboard

Most cardboard waste comes from packaging. On a per volume basis, cardboard can make up a significant component of the waste stream. Although readily recyclable in most areas, efforts should be

made to reduce the amount generated on-site. The result will be reduced haulage and tipping fees as well as a cleaner, more organized site.

| **3Rs Checklist: Corrugated Cardboard** | |
|---|---|
| REDUCE | Purchase materials in bulk to minimize packaging wastes.<br>Require suppliers to deliver materials with a bare minimum of packaging.<br>Give preference to suppliers who will retrieve their material packaging after use |
| REUSE | Cardboard boxes can be reused to store tools or small amounts of material (nails, fasteners, caulking tubes etc.). |
| RECYCLE | Corrugated cardboard is extensively recycled to manufacture paperboard boxes and cores (e.g. carpet rolls), and in the manufacture of new corrugated boxed.<br>Cardboard is also being recycled as a component of building products such as roofing felt, fibreboard and floor underlay.<br>Many recycling companies will remove cardboard wastes if quantities justify. Certain companies will even place storage bins on job sites. Shop around to find the best deals.<br>Drywall compound boxes, with the plastic mud bag removed, can also be recycled. |
| DISPOSAL | Within most provinces, there are well-established cardboard recycling infrastructures. Provincial landfill bans may prohibit the disposal of large quantities. |

### 2.2.6 Drywall and Gypsum

Drywall is a significant contributor to the CRD waste stream. On residential construction drywall projects it is commonly discarded at the rate of about one pound of waste for each square foot of finished floor area. Some CRD reuse and recycling facilities accept clean drywall waste. Due to the production of hydrogen sulphide during the decomposition of drywall and existing recycling options, the cities of Vancouver and Toronto have banned the material from disposal in their landfill sites. Other regions may soon do the same.

| **3Rs Checklist: Drywall/ Gypsum** | |
|---|---|
| REDUCE | • Evaluate floor plans to see if room sizes can be standardized to minimize the off-cuts from board stocks.<br>• Purchase drywall in stock sizes consistent with room dimensions.<br>• Place delivered material in each individual room consistent with initial board count. |
| REUSE | • Due to the manner in which drywall joints are conventionally finished (with tape and plaster), joints are difficult to locate and the screws are hard to access. As a result, drywall panels are rarely salvageable in a condition suitable for reuse.<br>• Small pieces can be placed in the cavities of uninsulated interior wall partitions. Depending on the volume, this practice even has the potential to enhance the wall's sound transmission and fire retardant qualities. Always check with sub-contractors and inspectors to make sure this practice is acceptable on your project.<br>• Review cut-off pile before cutting pieces from a new sheet. |
| RECYCLE | • Drywall is, at this point in most parts of the country, difficult to recycle. Although facilities exist in Canada's largest urban centres which recycle new drywall off-cuts for use in the production of new wall boards, none accept used drywall due to the fact that it is typically |

| | |
|---|---|
| | contaminated by paint, plaster, wall paper, or vinyl.<br>• Due to its organic composition, certain municipalities will allow reasonable amounts of ground gypsum to be mixed with topsoil and driveway sub-base materials. Proper authorization should be obtained to ensure that groundwater quality is not compromised.<br>• Clean waste gypsum can be used for some types of animal bedding or applied as a soil amendment.<br>• Most gypsum board on the market today contains some post- consumer recycled gypsum, and most of the paper coating contains a high percentage of recycled paper. |
| DISPOSAL | • Some landfill sites prohibit disposal of drywall. To promote recycling, certain landfill sites will accept separated, clean drywall at a reduced rate. The site itself will then ship large quantities to recycling facilities.<br>• Although degradable, gypsum gives off hydrogen sulphide when breaking down. Disposal should occur only under proper conditions. |

### 2.2.7 Concrete

A mixture of stone, sand, cement and water, concrete is a highly desirable product for structural use because of its high and calculable strength, moldability and transportability. Since concrete is typically the heaviest component of the CRD waste stream, careful consideration must be given to its reduction, reuse and recycling. Like asphalt, concrete can be removed, crushed and recycled as aggregate road sub-base in the construction of new roads and as aggregate for fill. Some CRD reuse and recycling centres throughout the country also operate crushing facilities. The private operators provide both stationary and mobile crushing services. The weight and space requirements for on-site processing of concrete are the same as asphalt (see asphalt), however, processing costs are more expensive and vary depending on the amount of re-bar contained within the concrete.

| **3Rs Checklist: Concrete** | |
|---|---|
| REDUCE | • Reduce the use of forming lumber by avoiding wide use of concrete as a finish material<br>• If plywood forming is essential, use plan flat surfaces in modules of plywood dimensions to reduce waste. Use repetitive shapes, at any scale, so that formwork can be reused.<br>• Consult with a forming contractor during the design stage to help you develop an efficient approach to forming.<br>• Careful attention to quantities when ordering will eliminate leftover concrete.<br>• In place of concrete blocks, lightweight and mortarless blocks are available in which some of the aggregate has been replaced by foam pellets, wood chips, slag (cinder block), etc. Some of these alternatives also offer improved insulation value. They can be used as straight replacements for traditional concrete blocks or can be dry stacked and reinforced with a mortar and scrim coating. |
| REUSE | • Ensure that unused concrete blocks are promptly picked up on the job site or stored for reuse on another job.<br>• Consider the use of reusable forms (i.e. steel).<br>• Use excess concrete for things such as parking stops.<br>• Sell used forming lumber to other sites or reuse on your next project. |
| RECYCLE | • Crushed concrete can be used as aggregate in road sub-base or asphalt paving.<br>• Although not its best use in terms of value, concrete can be used as clean fill material.<br>• Separated re-bar can be sold to a scrap metal dealer. |
| DISPOSAL | • Clean concrete is accepted at most CRD reuse/ recycling facilities, often free of charge. |

### 2.2.8 Masonry

Similar to concrete, masonry can make up a significant portion (by weight) of the CRD waste stream. Like concrete and asphalt, damaged brick and block can be crushed and recycled. Applications include fill material for landscaping, road base construction, landfill cover, and land improvement. Crushed brick and block can also be used as an aggregate material in asphalt production. Bricks that possess unique heritage characteristics may have a substantial resale value and be made available to secondary users at local used building material outlets.

In addition to the above reuse and recycling initiatives, new masonry products are being manufactured that use an astonishing array of recycled materials. For example, a range of paving, fire and drain tile brick is available which uses fly ash reclaimed from pollution control scrubbers of municipal solid waste incinerators. As well, new masonry units made out of expanded polystyrene beads in a concrete mixture allow for greater design flexibility and a higher load-bearing capacity than traditional masonry bricks.

| **3Rs Checklist: Masonry** | |
|---|---|
| REDUCE | • Reducing the amount of discarded masonry on the construction site begins with improved take-offs and ordering procedures.<br>• Measure and cut brick and block carefully.<br>• Use standard sizes to eliminate unnecessary cutting. |
| REUSE | • Unused brick and block, such as half skids, should be picked up promptly on the job site, stored properly, and used for another job.<br>• Although extremely labour intensive, old brick can be separated from mortar and reused on-site or in the construction of chimneys and fireplaces. |
| RECYCLE | • Recycled brick is frequently preferred for its architectural qualities and visual appeal.<br>• Brick can be crushed and recycled as inert fill or as landscaping top cover. Note: Due to its structural inadequacy, recycled clay brick is not acceptable as granular road sub-base. |
| DISPOSAL | • Like concrete, clean brick is accepted at most CRD reuse and recycling facilities |

### 2.2.9 Plastics and Vinyl

Due to the large quantities of plastics entering landfill sites (a result of increased packaging) extensive research and development has been done to find ways of recycling. Sophisticated methods now allow for the recycling of all sorts of plastics into second generation products such as bags, park benches, drainage tiles, traffic cones, and various plastic wood products. Plastics typically found on CRD sites come in the form of packaging, floor tiles, siding, piping, and vapour barrier. Typically, there is a very low recovery rate for plastic materials generated on CRD sites. The primary barriers to recycling CRD plastics are the numerous types of plastic, the lack of identification on the plastic materials stating the specific type and the uncertainty as to whether the particular type of plastic is indeed recyclable. If you are unsure as to whether a particular plastic material is recyclable, consult a recycling service provider.

| 3Rs Checklist: Plastics and Vinyl | |
|---|---|
| REDUCE | • Wherever possible, require your suppliers to reduce or take back their plastic packaging.<br>• Use standard room dimensions to reduce cutting of vinyl flooring and siding.<br>• Design plumbing runs to reduce the amount of pipe required. |
| REUSE | • Building codes generally do not permit the reuse of polyethylene vapour barrier.<br>• Due to the large amounts of adhesive generally applied to install vinyl flooring, it is difficult to salvage in reusable condition.<br>• PVC piping can be reused for plumbing on future projects. Be sure to check with plumbing inspectors before installation. |
| RECYCLE | • Recycling is complicated by the need to segregate plastics by resin type and by the fluctuating markets for recycled plastic products.<br>• Recyclers usually only accept specific types of plastic, which is dictated by their recycling process.<br>• Generally, large quantities must be accumulated before a recycler will pick it up.<br>• Adhesives contaminate plastics and vinyl, making it impossible to recycle. |
| DISPOSAL | • Plastic wastes are high in volume and they do not degrade in landfills. |

### 2.2.10 Other Building Materials

These generally include potentially salvageable materials such as: tile, electrical materials, doors, windows, ceiling tiles, partitions, carpeting, insulation, plumbing fixtures, finishing materials, and roofing materials generated by building renovators, demolition companies and households.

Through proper planning, salvaging building materials can be an integral part of the renovation/demolition process. Reuse markets for several types of these building materials are steadily expanding as pre-renovation/demolition salvaging is becoming more of an established practice. As a result, there has been an increase in the number of outlets which re-sell building materials both to professionals and the general public. Given enough notice, crews from the used building material outlets will go into the building prior to the scheduled renovation or demolition and carefully remove materials which have a resale value. Alternatively, these building materials can be transported to the used building material outlets.

## 2.3 Material Handling Options

### 2.3.1 Identify Local Reuse and Recycling Opportunities

Be sure to use resources such as the yellow pages, local construction and home builders associations, recycling industry directories, landfill site staff, and municipal solid waste departments to build a comprehensive and up to date list of local reuse and recycling opportunities. Local construction or home building association may also be aware of recycling and reuse vendors. Appendix B provides a list of some additional provincial resource contacts.

### 2.3.2 On-Site Processing of Material — Creating a Source Separation Program

It is possible, in many cases, to process certain CRD materials on site. The processing of materials may involve the compaction, size reduction and separation of materials. Mobile crushers, grinders and chippers are available for concrete, masonry, wood, and glass. The capabilities of this type of machinery varies, so it is a good idea to carefully research your needs before shopping around.

Be sure to consider the effects of noise, dust and debris if you are crushing or grinding materials on site. Check with local by-law limits and restrictions by calling the relevant municipality and be considerate of your neighbours.

When contemplating on-site processing materials for reuse or recycling on site consider the following:

- Spatial requirements for the equipment and materials
- Whether the volume of materials makes on-site processing cost effective
- Cost and availability of processing equipment
- Proximante end use markets and reuse opportunities

## 2.4 Considerations for Collecting, Handling, Storing and Removing CRD Waste

***General On-Site Considerations:***

- Post the Waste Management Workplan (refer to Section V) on-site so that it is available to all workers for reference and guidance.
- Planning for bin size, material type designation and hauling should be done beforehand based on the various phases of the project.
- Carefully plan where bins are located. If possible, they should be close to where the waste is generated. A decision must also be made as to when the materials should be separated. For example, on a high rise construction project should one separate the waste on the individual floors or only when it has reached ground level? If the material is separated at ground level, has it been handled twice and has the labour cost been doubled?
- Recovered materials may tend to stockpile in certain locations to avoid inefficient trips to the bins. However, this may cause a cluttered and unsafe site. A balance should be struck by workers to minimize inefficient handling but maintain an organized and safe site.
- Availability of space on the job-site is a key factor in setting up the Source Separation Program. Provisions should be made to allow for adequate bins and collection space. This may, however, create additional costs in terms of encroachment permits and should be thoroughly investigated prior to project start.
- It is important to monitor material contamination (commingling of various materials). Many materials will become worthless or will not be picked up if the load has been seriously contaminated. It is important, therefore, to have an ongoing monitoring and education program. Many workers are still not used to separating materials and in fact may resent the extra work. Be prepared to work towards adjusting such attitudes.

### 2.4.1 Advantages & Disadvantages of Commingled Recycling

On sites where, due to lack of space a source separation program is difficult to implement, recycling of commingled waste may be an option. It should be understood, however, that commingled waste processing is less common than source separation due to higher costs and difficulties in generating high-quality, clean products and materials.

Advantages include:

- Little or no builder involvement
- Does not require the compliance of subcontractors to control contamination
- No jobsite separation which lessens impact of drive-by contamination
- Less containers on site

Disadvantages include:

- Invisible system – does not promote reduction or recycling
- Typically available only where tipping fees are greater than $50.00/ tonne

## 2.5 Overview of Hazardous Waste Management

Hazardous wastes should be understood to mean: Dangerous substances, dangerous goods, hazardous commodities and hazardous products, such as poisons, corrosive agents, flammable substances, ammunition, explosives, radioactive substances, or any other material that can endanger human health or well being or the environment if handled improperly.

### 2.5.1 Liabilities

Guidelines for the handling, treatment and disposal of hazardous wastes should be obtained from regulatory bodies with proper authority prior to the start of any work. As a means of establishing context, the following are general points that you should consider:

- The generator (e.g. builder, contractor, etc.) of the hazardous waste is required to determine and follow the proper management methods for handling, treatment and disposal of all hazardous wastes. Sources of assistance include:
    - The manufacturers' Material Safety Data Sheet (MSDS) provided with the material or equipment.
    - The manufacturer of the material or equipment.
    - Applicable guidelines and regulations.
    - Waste management consultants and associations.
- Ensure all measures are taken to remove and properly dispose of all wastes designated to be hazardous prior to the start of any work on site.
- Do not dispose of hazardous waste or volatile materials such as: mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers.
- Do not burn or bury hazardous wastes on site.
- Different types of hazardous wastes should not be mixed together in the same container. It is important to control the quality of waste to ensure it can be recycled or disposed of properly.
- Long term storage of hazardous wastes is not an acceptable method of treatment or disposal.
- All parties involved in the removal, hauling or disposal of hazardous wastes should possess all required permits, certificates and licenses.
- All parties responsible for hazardous waste management must fulfill all regulatory reporting and manifest requirements. If hazardous wastes are encountered unexpectedly during the course of work, workers should be instructed to cease working, take precautionary measures necessary, and notify the proper authorities for instruction on how to proceed.

### 2.5.2 Asbestos Abatement and Other Hazardous/Designated Substances

Testing for and identification of hazardous materials should precede all retro-fit and demolition work. Appropriate measures should be taken to identify all substances designated to be hazardous by regulatory bodies with proper authority. Findings of the investigation should be communicated to the contractor through a *Designated Substance Report* made available to all relevant parties prior to the start of work on site.

Lists of substances designated to be hazardous should be obtained from authorities with proper jurisdiction. To provide example, substances that are common to CRD activities which typically require special removal, handling and disposal procedures include:

- Asbestos based materials.
- Materials with lead based finishes.
- Fluorescent light ballasts manufactured prior to 1978 containing PCBs.
- Electrical transformers containing PCBs.
- Fluorescent lamps containing mercury vapour.
- Batteries containing lead, acid or mercury.
- Heating and refrigerant equipment containing CFCs.
- Fire protection system equipment containing Halons.

Others areas of potential concern to those involved in retro-fit and demolition projects include:

- Underground storage tank removal.
- Toxic spill containment.
- Contaminated site remediation.
- Toxic emission levels.
- Wastewater treatment.

## 3.0 Conducting a Waste Audit

The purpose of a waste audit is to estimate the types and quantities of waste generated from a project or job-site. Waste audits assist managers in identifying the areas of greatest waste diversion potential. Waste audits can be used to identify:

- weight of volumes of wastes generated and can potentially be diverted;
- waste management requirements, costs and potential savings;
- potential to reuse, recycled or reduce (or eliminate);
- potential regulatory requirements such as local disposal bans or provincial waste regulations (e.g. PCB's);
- waste handling and storage requirements.

### 3.1 Quantifying and Qualifying Waste

The following examples provide a demonstration of how to use available information from manufactures, sub contractors, waste service providers and even your own previous project experience to calculate anticipated quantities of waste. Keep in mind that there are many ways to estimate material quantities! Your method may need to change from project to project based on size, type and the time you have available to complete the audit.

**EXAMPLE #1**
**DETERMINING A GENERAL WASTE FACTOR FOR NEW MATERIALS**

If one is aware of the general waste factor for a particular material, one can anticipate the amount of waste that will be generated.

By contacting subtrades for a particular project, vital information may be obtained which will assist you in determining a general waste factor.

**SAMPLE CALCULATION**

Brick waste factor = 10% of the total material
Average weight per unit = 2.3 kg.
10,300 units X 2.3 kg/unit = 23960 kg or 23.7 tonnes

**EXAMPLE #2**
**WASTE FROM A WALL DEMOLITION/ RENOVATION**

Break up a demolition/ renovation into its components/ assemblies, and audit those assemblies.

Wall Length = 10'
Wall Height = 8'

The wall is composed of:

2" X 4" Steel Studs @ 16" o.c
¾" Drywall/ Gypsum

The quantities of materials can be calculated for this particular wall.

**SAMPLE CALCULATION**

10' wall length/ 1.33' (16" 0/c) = 8 studs
(8 studs X 8' wall height) + (10' track X 2) = 84 linear ft of steel studs and tracks
&
10' wall length X 8' height X 2 sides = 160 sq ft of drywall
160 sq ft X 0.063' (3/4") thick = 10 cu ft of drywall

**EXAMPLE #3**
**DETERMINING THE VOLUME OF MATERIALS IN A BUILDING BEING DEMOLISHED**

Knowing the square footage and height of a building as well as the average amount of void space (space not being utilized by materials) the amount of material and/ or waste material can be calculated.

Although somewhat less accurate than a complete inventory, it does provide an estimate of the materials to be generated.

20' X 20' X 10' building
50% typical void space
43% typical wood waste
11% typical drywall waste

**SAMPLE CALCULATION**

(20' X 20' X 10') – 50% void space = 2 000 cu ft of materials
2 000 cu ft X 43% wood = 860 cu ft of wood
2 000 cu ft X 11% = 220 cu ft of drywall

**OR**

Similar project has generated roughly 2.15 cu ft of wood waste per square foot of demolition.

**SAMPLE CALCULATION**

20' X 20' = 400 sq ft building
400 sq ft X 2.15 cu ft/ sq ft = 860 cu ft of wood

**EXAMPLE #4**
**DETERMINING THE AMOUNT OF WASTES ON A NEW CONSTRUCTION PROJECT**

By keeping track of your waste on past projects, you can estimate the amount of waste that will be generated on a new project.

10 storey apartment building with 8 units per floor

On a similar past project it was determined that the construction of each unit generated 2.5 tonnes of waste per unit. Of that waste, 5% was ceramic tile off-cuts.

**SAMPLE CALCULATION**

10 storeys X 8 units/ storey = 80 units
80 units X 2.5 tonnes of waste/ unit = 200 tonnes of waste
c tile waste

## 3.2 Steps to Achieve a Comprehensive Waste Audit

The following flowchart provides an overview of the three basic Materials Audit process steps. The three steps are explained in greater detail below the chart.

| **Step 1 – Assemble Basic Information** |
|---|
| • Type and size of construction, renovation or demolition project<br>• Use project schedule to anticipate when secondary materials will be generated<br>• Use tendering process to assist in estimating quantity of reusables, recyclables and waste.<br>• Examine previous purchasing and hauling records from similar projects<br>• Examine all areas of the project<br>• Review current materials management practices<br>• Identify recycled content of materials<br>• Identify resources required (i.e. management roles and responsibilities, bins, and equipment needed) |

| **Step 2 – Identify Material Streams** |
|---|
| • Review operations (e.g. collection and storage practices)<br>• Estimate quantity of materials that will be produces during construction |

| **Step 3 – Complete Summary Sheet** |
|---|
| • Keep track of what you have done |

### Step 1 - Assemble Basic Information

The following information and activities will assist you in preparing for the Materials Audit:

#### *A) Type and Size of Project*

Become familiar with the type and size of the project being undertaken by reviewing drawings and visiting the site. The size and type (residential or IC&I) will affect the quantities and types of materials generated throughout the project.

#### *B) Use of the Project Schedule*

Use the project schedule to determine the type of materials that will be generated at various stages of the project. (e.g. excavation, structural framing, interior finishing, etc.) This will help you to understand when various materials will be discarded, the number of bins that will be required for collection, and storage space requirements.

#### *C) Use of the Tendering Process*

If you are approaching the project from a design perspective, review any technical proposals submitted during bidding which identified expected quantities of waste. This will help in predicting the amounts of resources that will be generated during the project.

### *D) Examine Purchasing and Hauling Records*
Examining previous records from similar projects will assist in quantifying expected unused or left over materials. For example, by identifying materials that are packaged in corrugated cardboard, an estimation of the total quantity of waste cardboard can be calculated.

### *E) Examine all Areas of the Project*
It is important to review all areas of the project so that every opportunity for reuse and recycling of resources is examined. Often overlooked opportunities include landscaping, roads, sidewalks, site office, and the lunchroom.

### *F) Review Current Materials Management Activities*
A review of the following areas will assist in developing a complete understanding of the status of your waste management activity.

- Resource separation and recycling activities.
- Timing and frequency of waste collections.
- Methods of waste separation and collection to be employed, including internal and external waste handling.
- Quantities of wastes and recyclables to be collected.
- Waste collection contractor/recycling service contractor.
- Person responsible for waste management.
- Responsibilities of subcontractors for their own waste management.
- Gross costs of waste collection and disposal.
- Local reuse and recycling facilities and their capabilities.

### *G) Identify Potential for Recycled Content of Building Materials*
Examine purchasing specifications in order to identify the recycled content of purchased building products and raw materials. This will be useful in determining whether you can take steps to increase the use of items with higher recycled content. The *Environmental Choice Program*, for instance, identifies building materials that contain recycled content.

### *H) Identify Resources Required*
Identify the resources required in order to carry out the audit. Examine how much staff time, special equipment or storage space may be required.

## Step 2: Identify Material Streams

### *Review Operations*
The objective of this step is to determine the types of materials which will be left over and when they will be generated. During the operations review, collection and storage practices and any special site restrictions should be considered for future reference when the Waste Management Workplan is developed.

### *Estimate Quantity of Materials*
To estimate the quantities of wastes anticipated, your sources of information should include:

- Engineering estimates.
- Estimator's materials list and pre-bid estimates.
- Material purchasing records.
- Waste disposal invoices for similar projects.
- Records of materials produced at generation points in daily operations of other projects.

- Waste or Materials Audits of similar projects.

Wastes can further be identified by:

- Estimating materials generated through each stage of a project based on building construction and demolition methods, materials and efficiencies.
- Conducting a walk-through review of operations on similar projects, asking questions and looking inside waste containers.

The following sample forms, created by the Ontario Ministry of Environment, will assist you in identifying and prioritizing your own waste material streams.

| **Location:** Number 3 Office Tower<br>2000 One St. | | | **Date:** October 1994 | |
|---|---|---|---|---|
| **Sample Taken:** Portion of Demolition Phase | | | **Time Period:** Oct. to Dec. 1994 | |
| **Operation Characteristics:**<br>Nothing Unusual | | | | |
| **Material** | **Characteristics** | **Volume** | **Weight (Tonnes)** | **% Of Total Sample** |
| Wood | Off cuts, warped pallet forms | 60 cu. yd. | 9 | 16% |
| Concrete & Masonry | Rubble from concrete and brick | 120 cu, yd. | 40 | 71% |
| Plaster | | 30 cu. yd. | 4 | 7% |
| Cardboard | Packaging | 2 cu. yd. | 0.25 | 0.4% |
| Drywall | Clean drywall | 2 cu. yd. | 0.25 | 0.4% |
| Misc. | | 64 cu. yd. | 3 | 5.3% |
| **Totals** | | 278 cu. yd. | 56.5 | 100% |

| Ranking by Volume | | Ranking by Weight | | Ranking by Waste Cost | |
|---|---|---|---|---|---|
| **Material Type** | **Volume (cu.m)** | **Material Type** | **Weight (tonnes)** | **Material Type** | **Cost ($/tonne)** |
| Concrete | 120 | Concrete | 20 | Metal | Potential revenue |
| Wood | 60 | Wood | 9 | Cardboard | $25.00 |
| Roofing | 25 | Roofing | 2 | Concrete | 40.00 |
| Metal | 10 | Metal | .75 | Drywall | 75.00 |
| Cardboard | 2 | Cardboard | .25 | Wood | 110.00 |
| Drywall | 2 | Drywall | .25 | Roofing | 150.00 |

| Waste Material Type | Volume (cu. metres) | Weight (tonne) | Waste Costs |
|---|---|---|---|
| Wood | 60 | 9 | $110.00 |
| Concrete & Masonry | 120 | 40 | 40.00 |
| Cardboard | 2 | .25 | 25.00 |
| Drywall | 2 | .25 | 75.00 |
| Roofing Materials | 25 | .2 | 150.00 |
| Metal | 10 | .75 | Potential Revenue |

**Step 3: Complete a Materials Audit Summary Sheet**

The quantities calculated should be summarized into material categories which meet the specific needs of your project and operations as well as any regulatory requirements. The information will provide you with figures at a glance that will give you a foundation from which to work when creating your Waste Management Workplan. Your Materials Audit Summary Sheet should indicate specific quantities and be classified as follows:

- Materials that will be source separated for reuse.
- Materials that will be source separated for recycling.
- Waste material to be disposed of in a landfill site.

## 3.3 Waste Audits as a Project Management Tool

To promote continual improvement you should maintain records of what information was reviewed, which assumptions were made, the waste samples you examined (including the sample dates), and the material weights and/or volumes you calculated to create the audit.

In addition, to assess whether waste management goals are met on each project, waste generation should be related to a specific indicator, so that changes in production or activity can be accounted for. To account for variations in project size, calculate the total waste generated per unit floor area and compare this factor with those of other projects. The comparison will lead to observations about whether a change in overall waste generation is due to project size, type or other factors.

# 4.0 During the Delivery Process

## 4.1 Waste Management Priorities in the Early Stages of a Project

In order for waste management to be successfully incorporated into CRD projects, various issues need to be incorporated at the initial planning stage. Any requirements resulting from regulations or the desire to meet waste management objectives need to be clearly defined and stated in the owners' contracts and then in the general contractors' contracts. Such requirements clearly stated in contracts are key to implementing a successful waste reduction policy.

Currently, various contract authorities are developing specifications for non-hazardous waste and materials management. The Non-Hazardous Waste and Materials Management Specifications are typically not specific to any particular project application and include the following components:

- a generic set of specifications which may be applied to a variety of CRD related projects;
- a waste audit sample schedule;
- a waste reduction workplan sample schedule;
- generic source separation guidelines; and
- a cost/revenue analysis workplan sample schedule to determine the economic status of waste reduction efforts.

## 4.2 Understanding Project Expectations

To ensure that the waste management requirements set forth in the specifications are fulfilled, contractual legalities should be established prior to the start of any work. The following are several measures that can be taken to protect the interests of the owner and project managers, as well as to formalize the waste management requirements.

- Owners can review the qualifications of the bidders during the tendering process, and require that the successful contractor's waste management proposal will be made part of the contract documents.
- General Contractors can incorporate clauses into the contract and specifications which stipulate that trades will be back-charged for time spent managing wastes for which they are responsible.
- General Contractors can be asked to sign a Waste Management Agreement with the Client and all Subcontractors, Material Haulers and Material Processing Facilities. The agreement typically includes the following obligations and responsibilities:
    - Workmanship shall adhere to all conditions of the Waste Reduction Agreement.
    - The Subcontractor or Hauler or Processing Facility shall designate an individual to report to the Waste Management Coordinator and who shall report at the job site meetings on all matters concerning waste reduction activity.
    - The Waste Management Coordinator will communicate to the Subcontractor or Hauler or Processing Facility workforce the correct procedures for waste reduction and will clearly mark all bins.
    - The Waste Management Coordinator will communicate any problems, difficulties or alternatives to carrying out the work under this agreement to the Client or Client's agent immediately. All alternatives will require the consent and approval of the Client or Client's agent.
    - The Subcontractor or Hauler or Processing Facility will ensure that waste materials are placed in the properly marked bins. In the event that this term is not met, the Subcontractor or Hauler or Processing Facility will correct the situation at their own expense.

## 4.3 Bid Evaluation Frameworks and Waste Management

When the specification is completed and all of the tender documents in place, the project can be tendered to the General Contractor. Depending on the priorities and budget of the client there are essentially two avenues by which the contract can be awarded. In each scenario the Client and Consultant will conduct a site meeting prior to tender-close to clearly explain the typical project outcome along with waste management expectations or requirements of the project to all potential bidders.

### *Traditional*

The traditional tendering procedure involves the process which is widely used and familiar throughout the industry. Bidders receive tender documents which include such items as drawings, details, schedules and specifications and prepare bids based on the information provided as well as any preparation they invest (i.e. site visits).

### *Qualification of Bidders*

The traditional tendering procedure does not typically allow for any assessment of the bidder's qualifications to do the proposed work. The waste management oriented approach which is gaining credibility among contract administrators is a procedure in which bidders are required to submit technical proposals along with their tender amount. The proposal can either be included with the bid or, to maintain a truly objective evaluation system, the proposal and tender amount can be submitted in two separate and sealed envelopes. In each scenario the technical criteria and tender amount are evaluated and rated in a manner deemed appropriate to determine a successful bidder.

Past experiments into the qualification of bidders tendering process have proven that the following four proposal requirements will provide the information necessary to make an informed and judicial decision in awarding the contract.

> ***1) Project Management & Methodology*** - Listing key personnel, manpower, equipment, and subcontractors. This should include a description of how and when these wastes will be mobilized.
>
> ***2) Waste Management System*** - Describing the methods to manage the wastes generated as well as the expected composition of waste. This should include the preparation of a Materials Audit, Waste Management Workplan, demolition plan, and Source Separation Program.
>
> ***3) % Reuse & Recycling*** – A numerical description based on the waste material categories which outlines amounts of material that will be reused and recycled also including methods of verification.
>
> **4) Qualitative Reuse Evaluation** - Detailing efforts to promote maximization of reuse over recycling.

## 4.4 Fostering Awareness Through Good Communication

To promote awareness of the Waste Management Workplan and ensure its success, effective communication must take place. The workplan must be communicated to all employees and sub-contractors and their employees to ensure that source separation procedures, responsibilities, and equipment use are properly understood. Also, information about modifications to the workplan such as the addition of new materials to be separated, must be conveyed. Communication vehicles can take the

form of signs, meetings, personal instruction, distributed documentation, or other suitable methods you have available.

Employees should be trained in the proper use of source separation equipment and program procedures. Training should enable employees to recognize what materials must be source separated, assess their quality, indicate the locations of collection containers, and how to contact the Waste Management Coordinator.

## 4.5 Waste Management Coordinator

On all types of projects there should ultimately be one person responsible for every aspect of waste management operations and activity. Typically the site superintendent has assumed this responsibility. Experience indicates, however, that the scope and complexity of the tasks involved suggest that the position should be delegated to a separate full-time position. To ensure success, a good working relationship should be established between the Waste Management Coordinator, project managers, all workers and subcontractors, and material hauling personnel. The coordinator's duties should include:

- Overseeing the Waste Management Workplan and ensuring its proper implementation and efficiency.
- Ensuring that bins containing reusable and recyclable materials are well labeled and are not being contaminated.
- Ensuring that the appropriate personnel clean up the waste.
- Coordinating the safe storage of materials on the site so as to guard against theft and damage.
- Documenting all waste management activities, so that cost comparisons can be made between the different reuse and recycling alternatives. Informing the Waste Management Coordinator of cost accounting will increase their understanding of the relationship between recovered resources and construction costs.

Another method is to assign a separate, subcontracted company to be responsible for source separation and finding reuse and recycling markets. The advantage of this system is that it is easier for one company to assure that all recovered resources are properly sorted and diverted from the waste stream. The other method, where everyone pitches in, is sometimes more difficult if the workers are not motivated or do not recognize the benefits of recovering resources.

## 4.6 On-Site Separation of Materials

### *Creating a Source Separation Program*

Having established a Waste Management Workplan which fosters awareness and communication, your next step is to set up a Source Separation Program so that materials can be captured for reuse and recycling.

A Source Separation Program consists of a series of ongoing activities to separate reusable and recyclable waste materials into respective material types from waste at the point of generation.

Source separated materials can be reused or recycled to replace, or to substitute raw materials used in new construction. For example, recycled gypsum is used in new drywall and ground wood chips are used in the manufacture of oriented strand board and wafer board sheathing.

### *Collection, Handling and Storage*

When implementing a Source Separation Program it is important that there are sufficient facilities on site for the collection, handling and storage of the anticipated quantities of source separated wastes. If the

nature and configuration of the site restrict the ability to collect and store recovered materials, investigate the possibility of temporarily using adjacent properties or gain permission from the local municipality to utilize sidewalk or parking lane space.

Collection means that clearly labelled, adequately sized separate containers (for each material type) must be provided in convenient locations for workers to deposit recovered materials.

Adequately sized and approximate storage areas must be provided for the collected materials. Careful storage will help prevent damage to the materials and limit waste generation. Requirements for preparation and shipping will usually be in accordance with the requirements of the hauler.

### *Removal from Site*

Take measures to ensure that the collected materials are removed from the site and delivered to facilities capable of processing used building materials and which possess the appropriate permits and/or licenses. Typically, most of the materials recovered from demolition or renovation phases can be recycled. Each municipality, however, has different reuse and recycling capabilities and landfill restrictions. Ideally, recovered materials should be cleaned, stacked and separated at the job site. Check with local construction waste resource directories, ministries of the environment, municipal solid waste departments, and local recycling groups for the specifics in your region.

Where reuse and recycling are not possible, be familiar with local regulations governing material disposal. Municipal or regional solid waste departments can provide information about disposal fees and any landfill bans or restrictions. Changes in fees and rules can happen frequently so that it is a good idea to take the initiative to keep up to date or be put on their mailing lists.

### *Effective Use of Separated Materials*

The separated materials can be directed to beneficial use through intermediaries such as materials brokers or waste exchanges, or sent directly to end-users to reuse or recycle the materials into new products. If the materials are accepted at a depot located at a landfill site, or other type of waste disposal site, you should make an effort to ensure that they are eventually forwarded to a recycling site or end user.

Efforts can be made to market the materials for reuse or recycling such as contacting industry and trade associations, material waste exchanges, local municipal recycling coordinators or solid waste departments, and other agencies. These agencies can provide you with information on where the materials can be directed or whom to contact. In addition, there are private companies which can be subcontracted to collect your source separated materials on site and market them to reuse and recycling end users.

Further environmentally responsible efforts include steps to ensure that the separated materials are in fact reused or recycled by the end destination (i.e. the recycling facility, end-user, or manufacturer). You can take precautionary measures prior to entering into a contract with an end destination by obtaining and checking references or requiring a list of eventual uses. A contract may also contain provisions which enable the material generator to obtain facility audits, or written guarantees from the receiving facility stipulating the final use of the materials.

The following are points to consider which promote the effective use of separated materials:

- Ensure that source separated materials meets the specifications of the intended end destination. The specifications may include the types of recyclable materials that can be commingled, allowable contamination limits and storage methods.
- Minimize the prolonged storage of the materials. Materials that have aged may not be suitable for recycling. As well, some materials, such as plastics and papers, will degrade under lengthy

exposure to sunlight and moisture.

- Commingle materials only if necessary to solve storage problems. Avoid the commingling of incompatible material types. Commingling of various materials may ultimately reduce their end-use value.

### *Helpful Hints General On-Site Considerations*

- It is important that the Waste Management Workplan is posted on-site and available to all workers for reference and guidance.
- Planning for bin size, material type designation and hauling should be done beforehand based on the various phases of the project. For example, cardboard may not begin to be generated until midpoint in a construction project. It would not make sense to have a rented bin designated for cardboard at the beginning of the project if it will not get used until later.
- It is important to carefully plan where bins are located. If possible, they should be close to where the waste is generated. A decision must also be made as to when the materials should be separated. For example, on a high rise construction project should one separate the waste on the individual floors or only when it has reached ground level? If it is separated when it reaches ground level, the material has been handled twice and the labour cost has been doubled.
- Recovered materials may tend to stockpile in certain locations to avoid inefficient trips to the bins. However, this may cause a cluttered and unsafe site. A balance should be struck by workers to minimize inefficient handling but maintain an organized and safe site.
- Availability of space on the job-site is a key factor in setting up the Source Separation Program. Provisions should be made to allow for adequate bins and collection space. This may, however, create additional costs in terms of encroachment permits and should be thoroughly investigated prior to project start.
- It is important to monitor material contamination (commingling of various materials). Many materials will become worthless or will not be picked up if the load has been seriously contaminated. It is important, therefore, to have an ongoing monitoring and education program. Many workers are still not used to separating materials and in fact may resent the extra work. Be prepared to work towards adjusting such attitudes.

### *Helpful Hints and Suggestions for New Construction*

- If possible, centralize certain site operations such as the cutting of dimensional lumber. Off-cuts will be readily available for reuse and cleanups will be faster.
- Protect new materials on site to reduce waste caused by exposure to the elements or theft. Materials ordered just before they are needed are less likely to be stolen or damaged.
- Return wood pallets for refurbishment and reuse.
- There may be opportunities to recycle or reuse materials in ways not commonly recognized. For example, drywall pails make good tool caddies, and plastic sheets or wrap can be used as garbage bags or to protect materials. Be Creative!
- Check with suppliers to see if they will take back packaging or arrange to have the material delivered “just in time” without packaging.

### *Helpful Hints and Suggestions for Renovation and Demolition*

- Start by briefing everyone on the job site, including subcontractors, about the Source Separation Program.
- Have recovered materials cleaned and separated into bins. Although commingled materials can be separated following removal from the job site, the efficiency of recycling and the value of materials is increased if wastes are separated at source.
- On a small job site, where there may only be one bin, dividers can be placed in the bin to separate the different types of materials. Check periodically to make sure the dividers have not been

removed and that contamination is not occurring.

- Ensure that bins are clearly labeled in appropriate languages, indicating what kinds of materials they are designated for (e.g. WOOD ONLY! or CLEAN CARDBOARD!)
- When separating materials at source, it may be advisable to use bins with lockable lids. Recovered materials may otherwise become contaminated by passers-by in the evening and on weekends when the job site is closed down. Another alternative is to establish a collection area in a central part of the job site and enclose it with a temporary fence.
- Subcontractors should be required to clean up their waste and put recovered materials in the proper bins as they go through the site. To ensure cooperation, this requirement should be written into tender documents and contracts.

***Other Considerations***

- Consider the following when implementing your workplan:
- All employees need to be informed about the changes in procedures so that they are implemented correctly.
- An awareness program can be an effective means to encourage worker participation in waste minimization.
- Subtrades should be informed about the waste minimization initiatives on site and be encouraged to participate.
- Subtrades should be required to separate materials and reuse certain types.
- Subtrades may also be encouraged to use materials more efficiently and generate less waste if they do not have a labour-only contract, or if they are required to remove the wastes they generate.
- Make sure you have all the information you need such as: names and numbers of local recycling companies and haulers; local landfill requirements; fees and bans; and regulations governing hazardous wastes.

# 5.0 Waste Management Workplan

## 5.1. Elements of a Successful Waste Management Program

### 5.1.1 Team Building and Good Communication

A successful waste management program will require effective communication and the support and participation of all personnel and project partners. Making sure that they understand the program will be a continuous process. In many regions of the country, personnel have actively been separating materials for recycling as part of daily management practices.

Education may be the single most important component of the waste management program. For example, if workers are not properly informed or motivated to change their way of treating used or leftover materials, reusables and recyclables will end up in the trash.

Having spent many years routinely producing and disposing of these materials without concern for the environment, many workers have become desensitized to the whole issue of environmental stewardship. Some ideas to help foster team building and good communication include:

- Post copies of the waste management strategy and goals in places where workers at the site will see it (be sure it is available in all appropriate languages).
- Inform everyone on the job site (including subcontractors) about the waste management expectations. This can be facilitated by offering a 2-day trades training session at the beginning of the project.
- Hold weekly job site meetings which provide everyone on site with the opportunity to voice opinions on waste management activities. Use the meetings to encourage solutions to perceived difficulties.

Minutes of these meetings should be distributed to all participants to ensure accuracy and open communication.

- Assign one person the responsibility for waste management operations. This will provide workers with a single contact for all issues relating to waste management. Ideally, this should be a person who is interested in resource conservation and has sound knowledge and experience of company operations. See the last item for a checklist of tasks for this coordinator.
- For larger projects, set up a committee (similar in scope to common Health and Safety Committees) consisting of the Waste Management Coordinator, owner, consultants, general contractor and site supervisor, representatives of various subcontractors and the waste hauler. This will allow for greater input and will ensure that the program is designed to provide opportunities for everyone to participate.
- Responsibilities of the coordinator/committee include the following:
    - Identifying and interpreting requirements and regulations.
    - Supervising and/or conducting the Materials Audit (includes determining how much material is generated on site and targeting materials for recycling).
    - Establishing waste management objectives.
    - Developing and monitoring the Waste Management and Source Separation Programs.
    - Finding haulers and recyclers.
    - Setting up the recycling program on the site.
    - Working with new subcontractors to ensure they understand the program.
    - Tracking revenues and costs to evaluate the viability of the program.
    - Communicating with senior management and informing key people about the program.
    - Encouraging workers to waste fewer materials.

### 5.1.2 Site Set-up

To maximize waste recovery, the organization of the site is important. A site, on which workers and haulers are aware of the locations of all activities and materials to be separated and processed for reuse and recycling will go a long way towards enhancing your Waste Management Program. Site set up considerations include:

- Separating reusables and recyclables from waste materials works best on large sites with sufficient space for recycling bins.
- If space is a problem, you may want to consider targeting certain phases of construction for recycling. For example, by targeting wood waste during the wood-framing stage you can recycle most of it, yet only need a recycling bin on site for a limited time.
- Sites with storage space restrictions will require the coordination of stockpiling and hauling more carefully than if the site is a large, unrestricted property.
- The efficiency of diverting materials depends on a good flow of materials through recovery and processing (denailing, separating, stacking etc.).
- Whether materials are sold on site or transported elsewhere, consideration must be given to the logistics involved in handling and stockpiling.
- Expend adequate resources to maintain a clean, organized site.
- Depending on the size of the project, you may want to post a site plan and signs which indicate to workers, haulers and the public (if allowed on site) the location of such things as processing, stockpiling of each material, bins, and materials for sale.
- The size of the site and the building's proximity to property lines, pedestrian and vehicle traffic and adjacent buildings will help you determine the strategies necessary to recover and separate materials.
- Depending on the specifics of the project, a full-time attendant may be required to coordinate site set up and logistics.

- Making individual subcontractors responsible for hauling the materials which they generate.

### 5.1.3 Hauling Options

There are essentially three hauling options. It will have to be decided what works best for your project and circumstances. They include:

- Contracting a hauler to remove all the material in the traditional manner.
- Contracting haulers to remove reusable / recyclable materials.
- Self-hauling (general contractor responsible for this).

If you are contracting a hauler be sure to ask the following important questions:

- What recyclable materials are you willing to pick up?
- Is there a minimum size of load you will pick up?
- Do you offer a reduced tipping fee if recyclables are prepared in a certain way (i.e. clean wood separated from other waste)?
- What are your specifications for separating recyclable materials?
- Does your company provide education on how to prepare recyclable materials for pick up?
- How much contamination (i.e. waste materials) in the recycling bin is permissible?
- Will you pay for certain recyclable materials such as cardboard or metal?
- Do you supply signs for recycling bins?
- Can you provide documentation on the amount of recyclable materials and waste removed from the site?
- Can you provide itemized waybills and invoices which document that materials were recycled in an agreed way?
- How much advance notice is necessary before pick ups?
- Can you provide references?
- Is your company professionally qualified, bonded and/or insured?

### 5.1.4 Construction Waste Agreement

To ensure that your waste management priorities are properly considered, it is strongly recommended that you enter into a Construction Waste Management Agreement with all subcontractors and haulers. The agreement should specify that:

- Workmanship shall adhere to all conditions of local codes of practice or regulations as well as the Waste Management Workplan. Be sure to attach a copy of the workplan to the agreement.
- Weekly job site meeting will be held to discuss all matters pertaining to waste management activities. This creates an opportunity for problems to be discussed and resolved.
- Subcontractors will communicate to their workforce the correct procedures for waste management as specified in the waste management workplan.
- Subcontractors will communicate any problems, difficulties or alternatives to carrying out the waste management tasks to the prime contractor in a timely manner. Alternatives must be approved by the prime contractor at all times.
- The subcontractors will assure that waste materials are placed in the properly marked bins and will remedy the situation if this is not carried out properly.

A sample Construction Waste Agreement has been provided in Appendix C.

## 5.2 Implementing a Waste Management Workplan

The Waste Management Workplan, based on the information acquired from the Materials Audit, is a written report which addresses opportunities for the reduction, reuse or recycling of materials at a given job-site and outlines the actions you intend to take to capitalize on these opportunities.

The workplan is developed and finalized before the start of any work on site and clearly sets out who will implement each part of the plan, when each part will be implemented and what the expected results are.

To make the workplan meaningful to future projects, it is essential that you set waste reduction and waste recovery targets. Your targets should be realistically achievable and form the basis for 3Rs actions for each material on site.

## 5.3 On-going Monitoring Program Evaluation & Continual Improvement

To ensure success, monitor your waste management performance against your targets. This may lead to the discovery of additional 3Rs opportunities or that more effort is needed in certain areas. As well, operating procedures and reduction targets may need to be adjusted, ideally upwards.

### *Keep a Daily Log*

Your job site supervisor or Waste Management Coordinator should be responsible for keeping records (daily log) of all material brought to the job site and any left-overs. Copies of receipts from suppliers, reuse and recycling facilities, and waste disposal facilities should be kept to support the information reported in the log. Keeping track of vital information regarding the amounts, value and end destinations of materials will be useful when performing your post-project assessment. To be successful you should generate standard tracking forms (which suit your operations) that the Waste Management Coordinator is required to fill out, to keep track of all materials leaving the site.

Both the Materials Audit and Waste Management Workplan should be updated periodically and corrected throughout the project based on the information in your daily log. The daily log will provide the information needed to update and correct the audit and workplan.

### *Perform a Post-Project Assessment*

It is essential to assess the waste management performance of every project to gain a firm sense of what initiatives taken were effective and which were unrealistic. Things to consider when performing a post project assessment include:

- Compare the project's final results to ensure that all of the materials are accounted for in your audit.
- Determine the percentages of materials which were reused, recycled and landfilled.
- Examine the results to acquire a better understanding of the capabilities of local markets and the value of materials.
- Perform a rough cost-benefit analysis to determine the viability of your waste management program
- Review the daily log to determine the difficulties and achievements encountered throughout the project.

### *Conduct a Post Project Meeting*

To review waste management performance it is beneficial to conduct a meeting after the project has been completed. All personnel who were involved in waste management related aspects of the project should

be required to attend. Key participants would include: client, project managers (architect and/or engineer), general contractor, site supervisor, and all waste management coordinators. Topics of discussion should address the following issues:

- A review of the waste management performance results.
- The successes and failures of the approach undertaken with particular attention to changes that should be implemented with the next project.
- Address any concerns regarding on-site logistics, workmanship, communication, and contractual issues.
- The capabilities of local reuse and recycling markets.
- The viability of the waste management specification requirements.

***Apply the Lessons Learned***

Because CRD waste management is a relatively unprecedented process it is important to view each project as a learning experience. Proper post project analysis will allow for an evaluation of the waste management successes and failures. It is important to review the progress made throughout each project. Becoming aware of what is feasible and what is not will eliminate repetition of mistakes and allow for the development of a practical and effective waste management process.

# 6.0 Conclusions

As stated above, the development of CRD waste management, by individual contractors and by the industry as a whole, is a relatively unprecedented and therefore ongoing process that is continually be refined and improved. It is important to remember however, that this process is moving forward propelled by a variety of factors:

- The environment and associated issues including greenhouse gases, 3Rs and resource efficiency, are being pushed, out of necessity, to the forefront of many industries including CRD.
- Consumers and clients are more educated on the environment and expect greater performance with regards to building design, construction and management. Governments at all levels are legislating regulations that require a shift in the industry's thinking with regards to waste management.
- Landfills themselves are being filled to capacity while locating new sites is more difficult and costly.

Due to these conditions, new and better alternatives need to be discovered and implemented. The industry itself is seeing a rapid growth in the knowledge and experience with effective waste management. There is an increase in use of industry guidelines and codes of practice related to waste management. The bottom line of all this is that ultimately waste relates to money and less waste means cost savings.

This guide should be viewed as a starting point towards developing your company's waste management practices. Use it as a reference for ideas, opportunities, considerations and requirements that should be continued to be updated as new waste management practices, client demands and regulations/by laws develop.

# APPENDIX A: GLOSSARY OF PROCESSING EQUIPMENT

**FRONT-END LOADER/ TRACKED DOZER:** Both of these vehicles are used for the purposes of transporting materials. This includes source separation, stockpiling, loading of feed material into processing equipment, and loading reusable products and residue into trucks.

**JACKHAMMER:** This pneumatic impact tool is used to break rock and concrete into smaller, more easily processed pieces. It is often mounted on another piece of equipment depending on the jackhammer application.

**VIBRATING FEEDER/ GRIZZLY:** This piece of equipment allows for the separation of finely granulated material and prevents their entry into crushers and other processing equipment. Material fed into the hopper encounters evenly spaced vibrating heavy steel bars which results in the separation of finely granulated materials.

**JAW CRUSHER:** The jaw crusher is primarily used to reduce larger pieces of rock and concrete into smaller more manageable aggregate sizes. Upon entering the chamber, materials are crushed by the movement of the jaw in the confined space.

**IMPACT CRUSHER:** The impact crusher is useful when a smaller, finer aggregate size is required. Materials entering the processing chamber encounter a rotating shaft with hammers. The combination of this physical action eventually breaks the material into smaller particles.

**CONE CRUSHER:** A cone crusher is similar to a large motorized mortar and pestle. The mandrel/pestle moves around the conical chamber and effectively crushes material into small aggregate pieces that then exit from the bottom. Its usual application is as a secondary crusher.

**SHEAR SHREDDER:** Unlike other size reducing equipment, the shear shredder uses a cutting action to reduce the size of materials. Ideal applications are wood, trees, and lighter gauge metal. Heavy-duty versions of the machine will process some rock, concrete and asphalt, however, large quantities of these materials are not recommended.

**VIBRATING SCREEN:** This unit consists of a horizontal screens each with different sized holes, mounted on a frame. Oversized material from each screen is discharged into a chute. The smallest material passes through the smallest hole of the bottom screen.

**TROMMEL:** A trommel is a variation of the vibrating screen. This screen uses a large, rotating, perforated drum mounted on incline. Unlike the vibrating screen, oversized materials are discharged from the lower end of the unit.

**DISC SCREEN:** The disc screen is configured in the shape of a box and consists of a series of rotating shafts and discs that interface. The combination of the rotating shafts and discs create the screening area. The rotating actions of the shafts move the material from the entry to the discharge point.

**MAGNETIC SEPARATOR:** The magnetic properties of ferrous and non-ferrous metal are used to separate the ferrous metal. Ferrous metal on a conveyor belt passing below a large magnet become attached to a belt or drum placed between the magnet and conveyor belt.

**FLOAT-SINK TANK:** The float-sink tank uses the principle of buoyancy and gravity to separate commingled materials such as rock and wood in a water medium. Non-buoyant or heavy material sinks to the bottom whereas buoyant light material floats to the top. The buoyant material is skimmed from the surface and the material resting on the bottom is removed by a drag chain type device.

**AIR CLASSIFIER:** The air classifier separates materials based on their different densities. A flow of air, either vertically or horizontally oriented is introduced into the chamber. When the materials being separated are introduced to the chamber, lighter materials are deposited in one section and the heavier in another.

**MANUAL PICKING STATION:** used to separate a variety of materials. It consists of a platform, conveyor belt, and catwalks on both sides of the conveyor belt. As materials travel along the conveyor belt, individuals at designated stations remove the desired materials.

# APPENDIX B: USEFUL CONTACTS

## *National Canadian Sources:*

Canadian Construction Association
75 Albert Street, Suite 400
Ottawa, ON
K1P 5E7
(613) 748-2984
www.cca-acc.com

Canada Mortgage and Housing Corporation
700 Montreal Road
Ottawa, ON
K1A 0P7
(613) 748-2984
www.cmhc-schl.gc.ca

Canadian Association of Recycling Industries
50 Gervais Street,
Toronto, ON
M3C 1Z3
(416) 510-1244

Used Building Materials Association
1096 Queen Street, Suite 126
Halifax, NS
1-877-221-8262
www.ubma.com

**Alberta**

Alberta Environmental Protection Info Centre
Petroleum Plaza, South Tower
9915 - 108th Street
Edmonton, AB
T5K 2G8
(403) 427-2739
www.gov.ab.ca

The Alberta Recycling Information Line
1 800 463-6326

Recycling Council of Alberta
P.O. Box 23
Bluffton, AB
TOC 0M0
(403) 843-6563
www.recycle.ab.ca

**British Columbia**

Ministry of Environment Lands and Parks
P.O. Box 9360 STN PROV GOVT
Victoria, BC
V8W 9M2
(205) 387-9422

Waste Reduction Commission Soils and Hazardous Waste
770 South Pacific Blvd., Suite 303
Vancouver, BC, V6B 5E7
(604) 660-9550

Recycling Council of British Columbia
#201-225 Smithe Street
Vancouver, BC, V6B 4X7
1-800-667-4321
(603) 683-6009
www.rcbc.bc.ca

Greater Vancouver Regional District
Thomas Mueller
604-436-6818

**Manitoba**

Manitoba Environment
Building 2, 139 Tuxedo Avenue
Winnipeg, MB
R3N 0H6
(204) 945-7100
www.gov.mb.ba

The Clean Environment Commission
284 Reimer Avenue Box 21420
Steinback, MB, R0A 2T3
(204) 326-2395

**New Brunswick**

Department of the Environment
364 Argyle Street, Box 6000
Fredericton, NB, E3B 5H1
(506) 453-3827
www.gov.nb.ca/elg-egl/

**Newfoundland**

Department of Environment
Confederation Building, Box 8700
St. John's, NF, A1B 4J6
(709) 729-2664
www.gov.nf.ca

**Northwest Territories**

Department of Renewable Resources
Scotia Centre Building, Box 215102
50th Avenue
Yellowknife, NT, X1A 3S8
www.rwed.gov.nt.ca

**Nova Scotia**

Department of the Environment and Labour
5151Terminal Road, 5th Floor Box 2107
Halifax, NS, B3J 3B7
(902) 424-4125
www.gov.ns.ca/enla

Clean Nova Scotia
126 Portland Street
Dartmouth, NS, B2Y 1H4
(902) 420-3474
Waste Reduction hotline:
1-800-665-LESS (5377)
www.clean.ns.ca

**Nunavut**

Department of Sustainable Development
P.O. Box 1000, Station 1100
Iqaluit, NU, X0A 0H0
(867) 975-5925
www.nunatsiaq.com

**Ontario**

Ministry of Environment
135 St. Clair Avenue West
Toronto, ON, M4V 1P5
(416) 325-4000
www.ene.gov.on.ca

Recycling Council of Ontario
489 College Street, Suite 504
Toronto, ON, M6G 1A5
1-800-565-4923
(416) 960-1025 www.rco.on.ca

**Prince Edward Island**

Department of Environmental Resources
Jones Building
11 Kent Street, 4th & 5th Floor, PO Box 2000
Charlottetown, PE
C1A 7N8
(902) 368-5000
www.gov.pe.ca

**Quebec**

Ministère de l'Environnement et de la Faune
Edifice Marie-Guyant, r-d-c
675 boul. René-Lévesque
Québec, PQ
G1R 5V7
1-800-561-1616
(418) 521-3830
www.merv.gouv.qc.ca

Conseil de la conservation et de l'environnement
800 Place d'Youville, 19e étage
Québec, PQ
G1R 3P4
(418) 643-3818

**Saskatchewan**

Saskatchewan Environment and Resource Management
3211Albert Street
Regina, SK
S4S 5W6
(306) 787-2700
www.serm.gov.sk.ca

Saskatchewan Waste Reduction Council
115 2nd Avenue North, Suite 203
Saskatoon, SK
S7K 2B1
(306) 931-3242

**Yukon**

Environmental Protection and Assessment
Branch
Department of Renewable Resources
PO Box 2703
Whitehorse, YT, Y1A 2C6
(403) 667-5683
www.renres.gov.yk.ca

## US and International Sources:

Alameda County
777 Davis Street, Suite 200
San Leandro, CA
94588
(510) 614-1699
www.stopwaste.org

Construction Materials Recycling Association
P.O. Box 644
Lisle, IL
60532-0644
(630) 548-4510
www.cdrecycling.org

Environmental Protection Agency (US)
401 M Street SW (2127)
Washington, DC
20460
(202) 260-8331
www.epa.gov

Kings County Washington
Solid Waste Division
130 Nickerson Street, Suite 100
Seattle, WA
(206) 263-3051
www.metrokc.gov

National Recycling Coalition (US)
1727 King Street, Suite 105
Alexandria, Virginia
22314
(703) 683-9025

# APPENDIX C: SAMPLE CONSTRUCTION WASTE AGREEMENT

This Waste Management Agreement shall be recognized on _____day of _____, 20 ____ by and between:

Company Name: _____

Address: _____

Phone/ Fax: _____

(hereinafter called the *General Contractor*)

and

Company Name: _____

Address: _____

Phone/ Fax: _____

(hereinafter called the *Subcontractor* **OR** *Salvage Dealer* **OR** *Recycler*)

The *General Contractor* will have entered into an agreement dated the _____ day of _____ , 20 ____ with _____ (hereinafter called the *Client/Owner*) for the demolition and construction of _____ _____ (hereinafter called the *Project).* The *Client/Owner* appoints _____ (hereinafter called the *Consultant*) as an agent of the *Client/Owner*. The *General Contract* includes the work to be performed under this Waste Management Agreement in accordance with the Waste Management Workplan (attached) prepared by the *General Contractor* in cooperation with the *Consultant.*

The *General Contractor* appoints _____ , a qualified individual, as outlined in the *Project* specification _____ , hereinafter called the *Waste Management Coordinator.*

The *Subcontractor* **OR** *Salvage Dealer* **OR** *Recycler*, in carrying out the work of the project, agrees to the following terms:

1) Workmanship shall adhere to all conditions of the Waste Reduction Workplan as prepared by the *General Contractor* in cooperation with the *Consultant.*
2) The *Subcontractor* **OR** *Salvage Dealer* **OR** *Recycler* appoints _____ _____ , who will report to the *Waste Management Coordinator* and who shall report to the job site meetings on all matters concerning waste reduction activity where all related problems will be discussed and resolved.
3) The *Waste Management Coordinator* will communicate to the *Subcontractor* **OR** *Salvage Dealer* **OR** *Recycler* workforce the correct procedures for waste reduction and will clearly mark all bins as outlined under term number one above and the *Project* specification section _____ .

4) The *Waste Management Coordinator* will communicate any problems, difficulties or alternatives to carrying out the work under this agreement to the *Client/Owner* and *Consultant* immediately. All alternatives will require the consent and approval of the *Client/Owner* and *Consultant*.

5) The *Subcontractor* **OR** *Salvage Dealer* **OR** *Recycler* will assure that waste materials are placed in the properly marked bins. In the event that this term is not met, the *Subcontractor* **OR** *Salvage Dealer* **OR** *Recycler* will correct the situation at their own expense.

IN WITNESS WHEREOF the parties hereto have executed this Agreement under their respective corporate seals and by the hands of their proper officers hereunto duly authorized.

SIGNED, SEALED AND DELIVERED

| *General Contractor* | *Subcontractor* **OR** *Salvage Dealer* **OR** *Recycler* |
|---|---|
| _____ | _____ |
| Name | Name |
| _____ | _____ |
| Title | Title |
| _____ | _____ |
| Signature | Signature |
| Witness | Witness |
| _____ | _____ |
| Name | Name |
| _____ | _____ |
| Title | Title |
| _____ | _____ |
| Signature | Signature |