

C&D Debris Recycling Study: Final Report

Executive Summary

- Construction and demolition (C&D) debris recycling became a matter of controversy in the 2000 legislative session. [House Bill 2163](#) (Appendix A, a web link) would have created a new class of materials called “recoverable construction and demolition materials” (RCDM), which would have been exempt from local government solid waste franchises. The bill failed to be considered. However, House Environmental Protection Committee chair Paula Dockery requested, and Speaker of the House John Thrasher subsequently directed, that the Committee staff conduct an interim study of C&D debris recycling. This report was prepared by the Florida Department of Environmental Protection to assist the Committee in its task.
- Construction and demolition debris is defined in [403.703](#) (Appendix AL, a web link), F.S. as
“...discarded materials generally considered to be not water-soluble and nonhazardous in nature, including, but not limited to, steel, glass, brick, asphalt roofing material, pipe, gypsum wallboard, and lumber, from the construction or destruction of a structure as part of a construction or demolition project or from the renovation of a structure, and including rocks, soils, tree remains, trees, and other vegetative matter that normally results from land clearing or land development operations...”
- The C&D debris waste stream is comprised of four major sub-categories: *land clearing* debris, *transportation related* debris, *building* construction, demolition debris and *disaster* debris (not evaluated in this report).
- *Land clearing debris* is comprised of root balls, non-merchantable timber, brush, rocks, muck and other soils. *Transportation derived debris* includes portland cement concrete and asphalt concrete paving for roadways, curbs, sidewalks, bridges and other primarily concrete debris, usually with imbedded pipe or steel. *Building related C&D debris* includes: wood, concrete, brick and other masonry, roofing, drywall, and miscellaneous paper, plastics and metals. It can come from construction, renovation or demolition of residential and non-residential or commercial buildings and varies widely depending on the type of building and activity. According to the United States Environmental Protection Agency (USEPA), renovation and demolition accounts for 88% of all C&D debris from residential and commercial buildings.
- In a volume-based composition study sponsored by [the Florida Center for Solid and Hazardous Waste Management \(FCSHWM\)](#) (Appendix AG, a web link), it was found that dimensional wood (44%), cardboard (11%), gypsum wallboard (8%) and roofing shingles (6%) account for over two-thirds of C&D debris by volume. Weight based studies, which will be much more accurate, are currently underway. Other FCSHWM studies relevant to

C&D debris recycling include: commercial solid waste franchises, leaching from recycled asphalt paving (RAP), analyses of recovered screened material (RSM) management and disposal of chromated copper arsenate (CCA) treated wood, and drywall recycling.

- In 1998, Florida generated nearly 25 million tons of municipal solid waste (MSW), of which C&D debris accounted for 5.9 million tons, or 25% of the total. However, not all C&D debris generated in the state is included in the term “municipal solid waste” as defined in 403.706 F.S. Large fractions of the C&D debris stream, especially transportation derived debris, are not counted as MSW. The total amount of C&D debris generated in the state from all sources in 1998 is estimated to be 9.4 million tons or 33% of all MSW.
- Of the 9.4 million tons of C&D debris generated in 1998, 3.3 million tons, or 36% of C&D Debris was recovered for reuse or recycling. Concrete was the most widely reused material, accounting for 1.9 million tons or 58%. Asphalt accounted for 1.1 million tons or 33% and wood accounted for 240,000 tons or 8%.
- There are currently 430 permitted solid waste management facilities, of which 343, or 80% conduct some type of C&D debris recovery. These include C&D debris disposal sites, materials recovery facilities (MRFs), transfer stations and others. In addition, there are an estimated 32 non-permitted construction related companies that recover concrete or asphalt. MRFs and non-permitted construction related companies that recover concrete or asphalt are responsible for 90% of all C&D debris recovered in Florida.
- A wide range of materials are recovered from C&D debris and reused, or recycled into other products. These include:
 - ◆ Crushed concrete and brick used in road construction, drainage
 - ◆ Concrete, block, masonry and other clean debris used as borrow pit fill
 - ◆ Concrete truck washout used to make onsite containing walls and bins
 - ◆ Reusable building supplies such as lumber and whole bricks
 - ◆ Remanufacture of wood chips into engineered wood
 - ◆ Wood fuels used in co-generation plants and industrial boilers
 - ◆ Horticultural mulches made from natural woody material
 - ◆ Dyed, decorative mulches made from construction debris wood
 - ◆ Wood chips used as bulking agent in biosolids, compost, animal bedding
 - ◆ Planks and other dimensional lumber sawn from whole trees
 - ◆ Corrugated cardboard containers
 - ◆ Metals (steel, aluminum other non-ferrous)
 - ◆ Recovered screened material (RSM) for DEP approved uses
 - ◆ Processed C&D debris used as daily cover
- An analysis of the Florida statutes indicates that there are few substantive provisions that specifically promote C&D debris recycling. The most significant is the requirement that

C&D debris be separated from other MSW during disposal, and an exemption from solid waste permitting for use of clean debris as fill. Significant disincentives include: restriction on the amount of C&D debris recycling which can be applied towards the recycling goal, the definition and regulation of recovered materials, which excludes most C&D debris, and the strict burden faced by FDEP to require liners at C&D debris disposal sites, thus keeping disposal costs low.

- The role commercial solid waste franchises play in discouraging C&D debris recycling is not clear. Some C&D debris recycling companies have complained that they cannot access the C&D debris waste stream in some jurisdictions to recycle it because the C&D debris is covered by an exclusive franchise. A cover story article in the November [2000 Florida Trend entitled “Dumped On”](#) (Appendix F, a web link) is critical of exclusive commercial franchises and the discouraging effect they have on recycling. Yet the extent of exclusive franchises in Florida is not clear. The Florida Trend article included a survey of the 15 largest counties in Florida and found open market conditions in all or parts of 9 counties. A survey conducted by the Florida League of Cities of 25 Florida cities found that 19 had no commercial franchises, or non-exclusive franchises.
- There are several developments in other states, which have impacted C&D debris recycling. In [San Jose California](#) (Appendix L, a PDF file), C&D waste is exempt from franchise fees if the local who collect it take it to recovery facilities. Also, building and demolition contractors will remit a deposit based on the square footage of their project prior to the City issuing a permit.. The deposit is refunded if the contractor can demonstrate that the C&D waste was taken to a City-certified recovery facility. In Ohio, a state law prohibits local governments from including C&D debris and other non-MSW in solid waste franchises. In [Massachusetts](#) (Appendix U, a PDF file), a policy is being considered which would require that all C&D debris be processed prior to disposal. Several states require liners for C&D debris disposal sites.
- A range of options is available to local and state governments to encourage C&D debris recycling. These include:

Local Government:

- ◆ Open market for C&D debris collection
- ◆ Permits for roll-off box haulers, but no franchise
- ◆ Non-exclusive commercial franchises
- ◆ Separate C&D debris franchises
- ◆ Rebate portion of franchise fee if recycling occurs

State Government

- ◆ Enact a “Recyclable Construction and Demolition Debris” (RCDM) bill
- ◆ Prohibit solid waste franchises from covering C&D debris (Ohio, RCDM bill)

- ◆ Conduct a comprehensive statewide survey of commercial franchises
- ◆ Make a distinction between MRFs and non-recycling processing facilities
- ◆ Require C&D debris to be processed before disposal (Massachusetts)
- ◆ Require liners for C&D debris disposal facilities
- ◆ Provide sales tax exemption for recycling equipment
- ◆ Provide grants to local governments to improve C&D debris recycling
- ◆ Provide Low interest loans to recycling businesses
- ◆ Provide grants directly to private recycling businesses
- ◆ Continue conducting research on C&D debris composition, reuse

Introduction

Report Purpose and Scope

After the 2000 Legislative session, Speaker of the House John Thrasher directed legislative staff to conduct an interim study of C&D debris recycling. The Florida Department of Environmental Protection prepared this report to assist in that task.

This report is a snapshot in time of C&D recycling in Florida. Basic statistical data is included, as well as information about relevant state and local laws and regulations. Also listed are options for increasing C&D recycling.

Legislative and Regulatory Background (Pre-1998 to present)

Before 1988, there was little or no official state legislative or regulatory interest in C&D debris recycling. The Legislature's passage of the 1988 Solid Waste Management Act marked the beginning of the state's role, albeit somewhat limited, in the support and promotion of C&D debris recycling.

The 1988 legislation set solid waste recycling goals for counties. C&D debris recycling was allowed to count towards those goals (though there was a cap on just how much it could count, so that counties would recycle more materials than just C&D debris).

In 1997 Florida's C&D disposal regulations were strengthened. This purportedly caused a decrease in the number of such facilities resulting in additional interest in C&D debris recycling as an alternative to disposal. As additional information about the nature of certain constituents of the C&D debris stream becomes available, further strengthening of related environmental regulations may occur. This could result in even further interest in and incentives for C&D debris recycling.

The Legislature has also set basic ground rules for local government solid waste franchises. For information about this, please see the section in this report about [the impacts of local government solid waste franchises](#) on C&D debris recycling.

Background on Construction and Demolition Debris

Florida Definition of Construction & Demolition Debris

According to 403.703, Florida Statutes (F.S.), construction and demolition debris is currently defined as:

"...discarded materials generally considered to be not water-soluble and nonhazardous in nature, including, but not limited to, steel, glass, brick, concrete, asphalt roofing material, pipe, gypsum wallboard, and lumber, from the construction or destruction of a structure as part of a construction or demolition project or from the renovation of a structure, and including rocks, soils, tree remains, trees, and other vegetative matter that normally results from land clearing or land development operations for a construction project, including such debris from construction of structures at a site remote from the construction or demolition project site. Mixing of construction and demolition debris with other types of solid waste will cause it to be classified as other than construction and demolition debris. The term also includes:

- (a) Clean cardboard, paper, plastic, wood, and metal scraps from a construction project;
- (b) Except as provided in s. [403.707\(12\)\(j\)](#), unpainted, nontreated wood scraps from facilities manufacturing materials used for construction of structures or their components and unpainted, nontreated wood pallets provided the wood scraps and pallets are separated from other solid waste where generated and the generator of such wood scraps or pallets implements reasonable practices of the generating industry to minimize the commingling of wood scraps or pallets with other solid waste; and
- (c) De minimis amounts of other nonhazardous wastes that are generated at construction or destruction projects, provided such amounts are consistent with best management practices of the industry.

For the purposes of understanding the data presented in this section, it is important to recognize and understand the differences between municipal solid waste (MSW) and Non-MSW. As it relates to C&D debris, MSW C&D debris includes building related construction, renovation, and demolition debris. Conversely, non-MSW C&D debris includes roadways, bridges, and other non-building related C&D debris generation. Non-MSW C&D debris represents, by far, the largest percentage of C&D debris generation and recovery (as compared to MSW C&D debris).

C&D Debris as a Larger Component of the Florida MSW Stream

Construction and demolition debris is quickly gaining attention throughout Florida. As Florida's population continues to grow, large-scale developments continue to spring up throughout the state. The development and redevelopment associated with this growth is causing a tremendous increase in the C&D waste stream. In 1998, Florida generated nearly 29 million tons of solid waste. As shown in Figure 1, C&D accounted for 9.4 million tons or 33 percent of the solid waste generated. Construction and demolition debris now represents the second largest portion of Florida's solid waste stream.

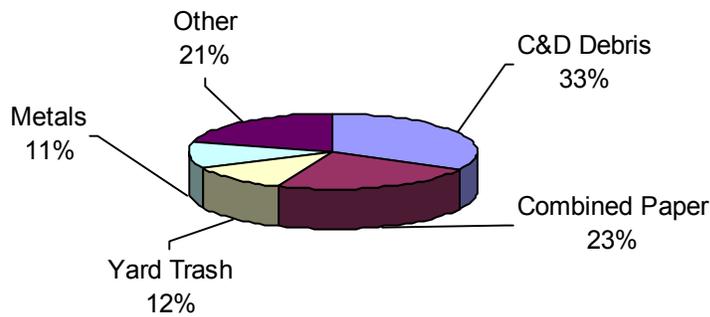


Figure 1. Components of Florida's Waste Stream in 1998

The U.S. EPA sponsored a study to estimate the amount of building-related C&D debris waste in the U.S. in 1996. The study was performed using census bureau statistics and using known information on waste generation from different types of construction projects. This study provided much needed information on the amount of C&D waste produced in the U.S. The study also provided a methodology for estimating building-related C&D waste. Research funded by the Florida Center for Solid and Hazardous Waste is currently underway to perform a similar estimate for Florida.¹ Initial results indicate that the relative contribution of construction is much higher in Florida than the national estimate. If the contribution of C&D waste is added to the remainder of the municipal solid waste stream in the U.S., C&D waste is found to account for 37 percent of the total municipal waste generated.

¹ "Generation and Composition of Construction and Demolition Waste in Florida." Investigators: D. Reinhart (UCF), H. Heck (FIT), T. Townsend (UF)

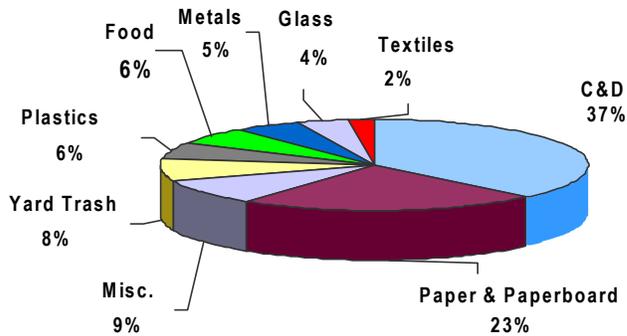


Figure 2. Municipal Waste Composition in U.S. 1996 (EPA data)

Management of C&D Debris in Florida

Figure 3 below shows that of the total 29 million tons of solid waste generated in Florida, approximately 9.6 million tons (34 percent) was recycled, 3.9 million tons (14 percent) was combusted into energy, and 15.1 million tons (52 percent) was disposed. Please note the tonnage includes roadways, bridges, culverts, airport runway, etc., and other non-municipal waste sources.

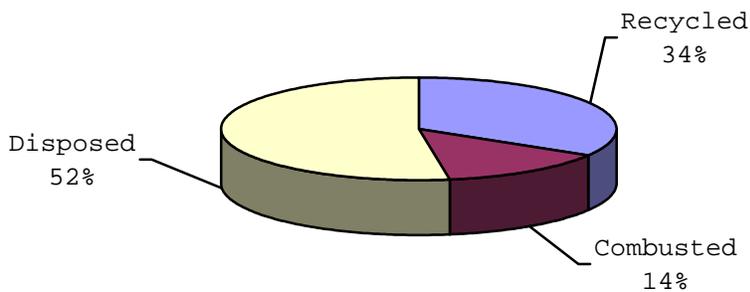


Figure 3. Management of Florida's Solid Waste in 1998

Of the 9.4 million tons of C&D debris generated in the State during 1998, 3.3 million tons (36 percent) was recovered for reuse and recycling purposes. Figure 4 below shows that C&D debris accounted for 6.1 million tons (41 percent) of the total solid waste disposed in 1998.

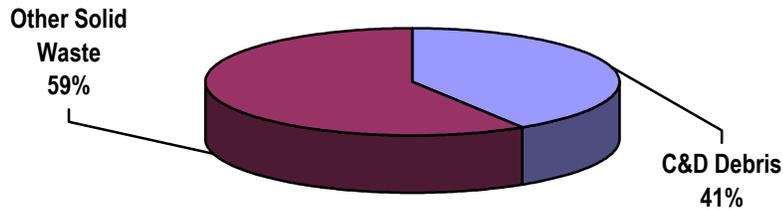


Figure 4. C&D Debris Contribution to Statewide Solid Waste Disposal

Composition of Recovered C&D Debris

In 1998, Florida recovered 3.3 million tons (35 percent) of the 9.4 million tons of C&D debris that was generated. Concrete (58 percent), asphalt (33 percent), and wood (8 percent) constituted, by far, the largest portion of overall C&D debris recovered in 1998. Figure 5 below depicts the C&D debris materials that accounted for the largest portion of C&D debris recovery.

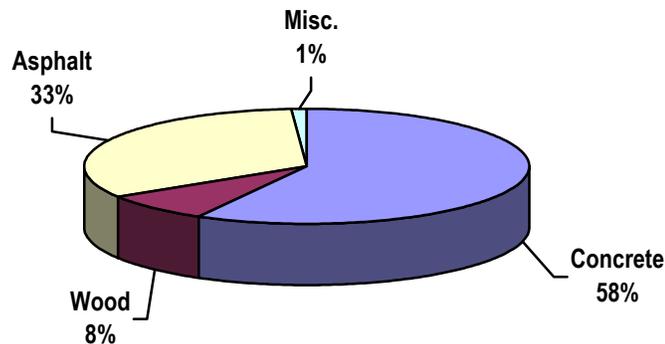


Figure 5. 1998 Composition of C&D Debris Recovered in Florida

For the purposes of developing a better understanding of how Florida’s MSW and Non-MSW C&D debris stream is managed (including both disposal and recovery), Figure 6 depicts the C&D debris management method and materials that accounted for the largest portion of C&D debris generated during 1998.

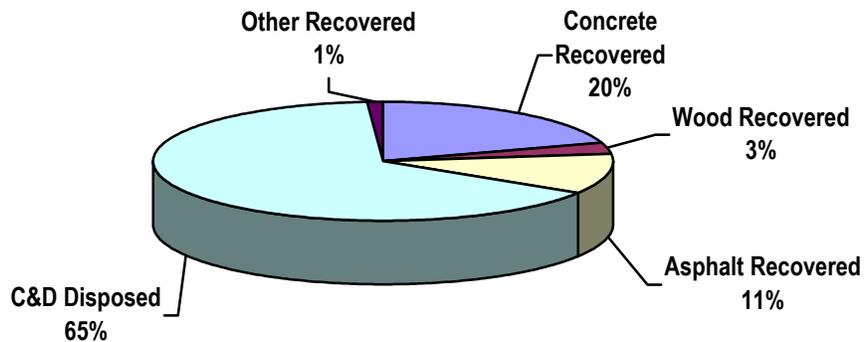


Figure 6. Florida C&D Debris Disposal and Recovery in 1998

A comprehensive analysis of solid waste generation, recycling, and disposal in Florida based on information compiled by each county for 1998 can be found in [the 2000 Solid Waste Management Annual Report](#) (Appendix B, a web link).

[The Florida Center for Solid and Hazardous Waste Management](#) (FCSHWM) (Appendix AG, a web link) has completed a volume-based composition study of Florida’s C&D debris disposal stream. Due to significant differences in densities among C&D debris materials, the results of this study would more than likely vary significantly from the results presented below if the characterization were weight-based (instead of volume-based). The Center has recently kicked off a new study that will examine C&D debris composition by mass.

As shown in the figure 7, dimensional wood (44 percent), cardboard (11 percent), and gypsum drywall (8 percent) were the largest contributors (based on volume) to Florida’s C&D debris stream.

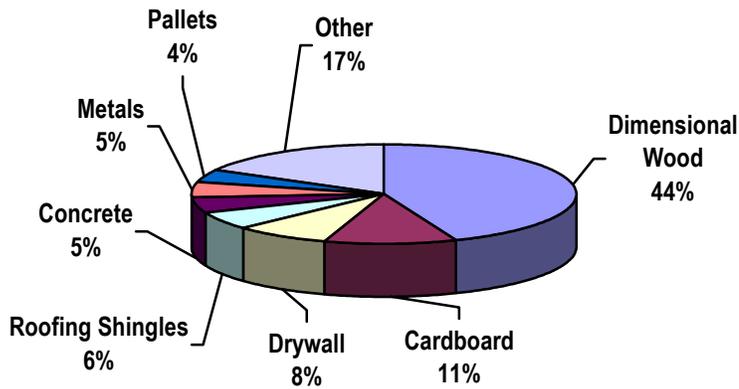


Figure 7. FCSHWM Florida-Specific C&D Debris Volume Survey

Several weight-based C&D waste composition studies have been performed in Florida. These are presented on the following pages. The residential construction project consisted of two wood frame houses being constructed side-by-side in Alachua County. The commercial construction project was a chain pharmacy store constructed in Gainesville. The demolition project was a supermarket in Gainesville. The composition study results are presented as both a function of weight and volume.

Another composition study performed in Florida was conducted as part of a study to collect the average bulk density of C&D waste (ton/cubic yard)². This number was needed by the C&D facility operators who did not have scales so that the volumes of waste they recorded could be converted to weight. As part of this study, the composition of 144 loads of C&D waste at several C&D waste facilities were visually characterized for their composition (by volume). These data represent a mix of many sources of C&D waste. The results of this study follow the figures of the site-specific composition studies.

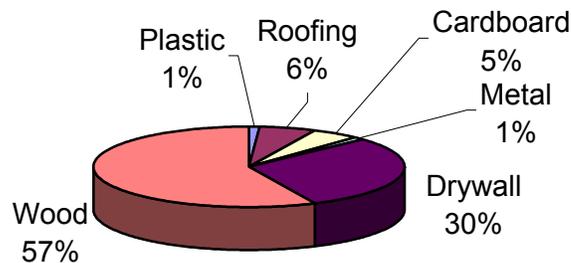


Figure 8. Composition of Residential Construction Waste by Mass (Residential Construction, Alachua County)

² “Construction and Demolition (C&D) Debris Conversion Study.” Investigator: T. Townsend (UF)

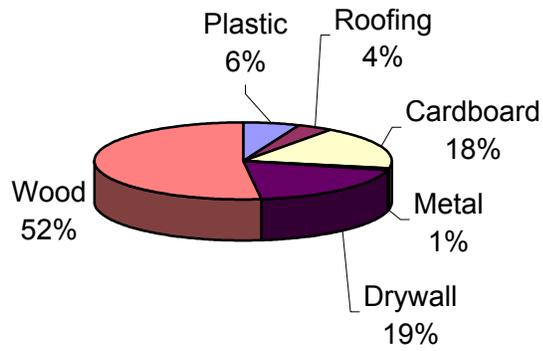


Figure 9. Composition of Residential Construction Waste by Volume (Residential Construction, Alachua County)

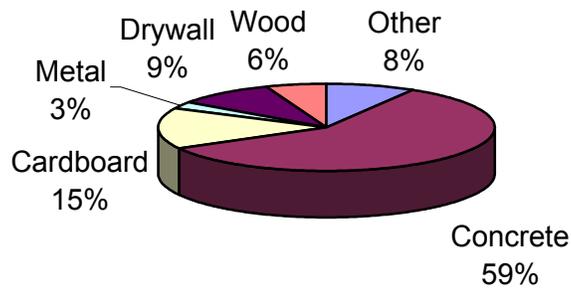


Figure 10. Composition of Commercial Construction Waste by Mass (Commercial Construction Site in Gainesville)

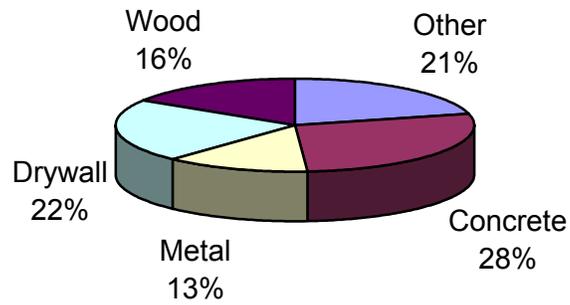


Figure 11. Composition of Commercial Construction Waste by Volume (Commercial Construction Site in Gainesville)

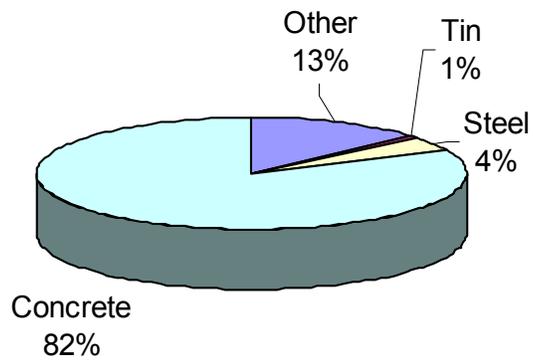


Figure 12. Composition of Demolition Waste by Mass (Commercial Demolition in Gainesville)

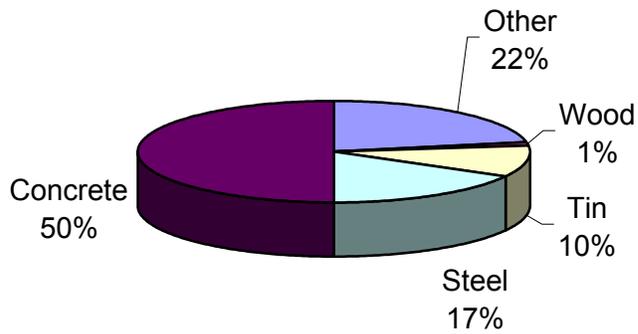


Figure 13. Composition of Demolition Waste by Volume (Commercial Demolition in Gainesville)

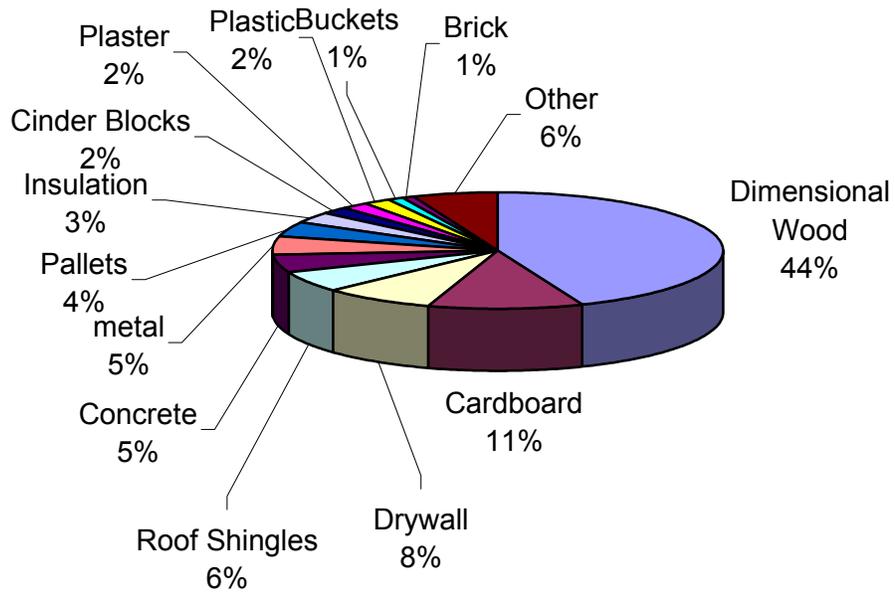


Figure 14. Results of C&D Waste Volume Survey at C&D Waste Facilities in Florida (average of 171 loads of C&D waste)

Sources of C&D Debris

Construction and demolition debris is generated from several different types of construction related activities. The C&D waste stream can be categorized in four several components: building construction and demolition debris; transportation related building and demolition debris; land clearing debris; and disaster debris.

Building and demolition debris can be divided into residential and non-residential. Residential building and demolition debris refers to new construction, renovation, and demolition activities of single and multi-family homes. The USEPA in the 1998 study, [“Characterization of Building-Related Construction and Demolition Debris in the United States”](#) (Appendix H, a PDF file) stated that residential construction accounts for only 11 percent of the total amount of C&D generated from residential structures; whereas, renovation accounts for 55 percent, and demolition activities accounts for 34 percent (see figure 15 below).

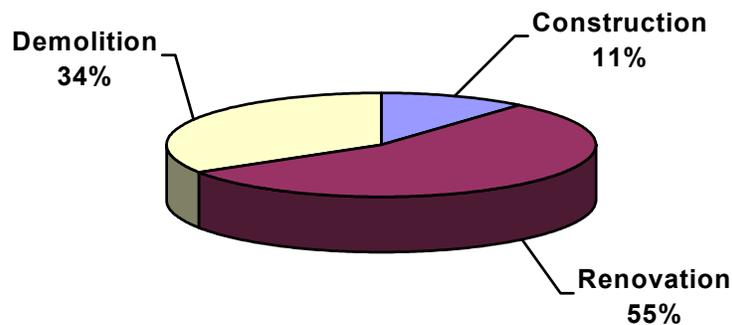


Figure 15. C&D Debris Generation from Residential Structures by Construction Activity

According to a study conducted by the National Association of Homebuilders (NAHB), wood and drywall were the two largest components from residential new construction. Concrete and wood were the two largest components from residential demolition debris (see figure below and on next page).

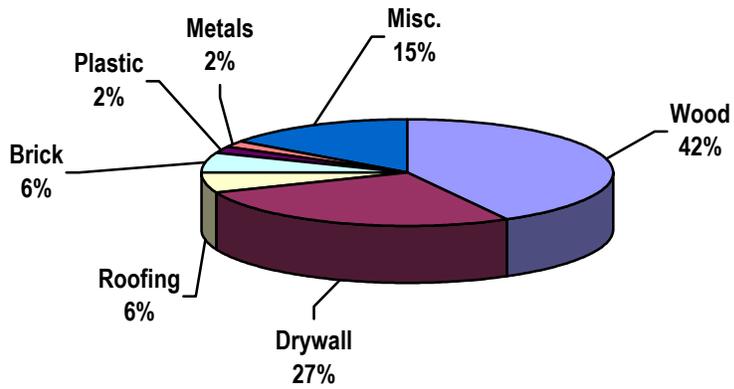


Figure 16. Composition of C&D Debris from Residential New Construction

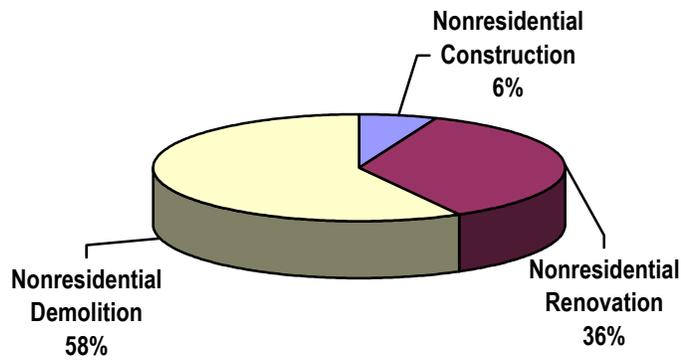


Figure 17. Composition of C&D debris from Residential Demolition

Non-residential buildings include hospitals, schools, hotels/motels, churches, offices, public and private industrial buildings, etc. The USEPA data suggests that non-residential new construction accounts for only 6 percent of C&D generated from nonresidential structures. Similar to residential building, renovation accounts for 36 percent and demolition accounts for 56 percent of the C&D generation (see figure 18).

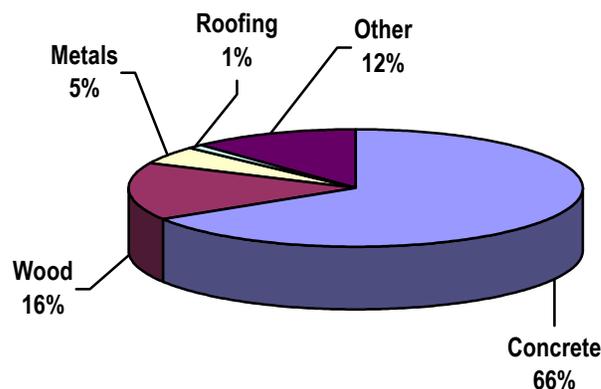


Figure 18. C&D Debris Generation from Non-Residential Structures by Construction Activity

Land clearing debris represents a major portion of total C&D waste. Land clearing debris is comprised of root balls, non-merchantable timber, brush, rocks, and dirt. Most land clearing debris is collected and recycled; however, some sites pile and burn it.

Disaster debris results from hurricanes, “no name” storms, and other natural disasters. Florida’s communities are currently receiving training in disaster debris estimation with the help of sophisticated debris estimating models as well as standard solid waste practices useful in emergency response to natural disasters. The Bureau, in conjunction with the Department of Community Affairs, has offered this training for the past three years and it has been well received. Now most of Florida’s communities have incorporated disaster debris staging, processing, recycling, and final disposal into their Comprehensive Emergency Management Plans. (FAC 9-; and FS 252).

Major Components of C&D Debris

Construction and demolition debris is made up of many components of the waste stream. The main components of C&D include concrete/asphalt, wood, masonry, drywall, metals, plastic, roofing material, and cardboard. The majority of these materials are recyclable.

Concrete, masonry, drywall, and roofing material are generated from the construction and demolition of building related structures. The majority of wood comes from land clearing debris at residential and non-residential construction sites. The bulk of metal comes from the structural support sections of building foundations, bridges, beams, etc. Plastic is generated from buckets, PVC, and wrap. Cardboard is generated from new appliances during the construction of homes.

The figure below was determined by a volume-based composition study of Florida’s C&D disposal stream conducted by The Florida Center for Solid and Hazardous Waste Management. It should be understood that due to significant densities among C&D materials, the results shown in Figure 19 would be significantly different if the study was based on weight.

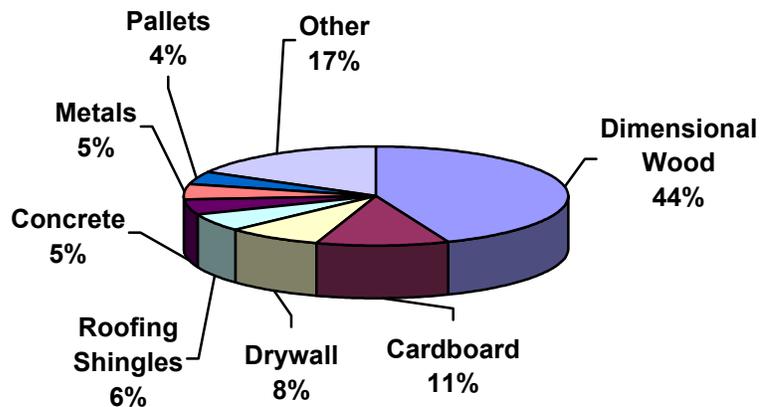


Figure 19. FCSHWM Florida-Specific C&D Debris Volume Survey

Current C&D Processes

Options for C&D Recycling

The recycling of materials from the construction and demolition (C&D) waste stream represents one of the rapidly growing areas in solid waste management. C&D waste constitutes a substantial fraction of waste generated from municipal activities. Many materials in the C&D waste stream, such as concrete and metal, lend themselves well to recovery. In addition, the cost of traditional C&D waste disposal methods is increasing as a result of new federal regulations placing stricter operating and siting requirements, and adding the necessity of groundwater monitoring. Such requirements have been in place in some locations for years. In some states (Maryland most recently) C&D waste disposal must occur only in lined landfills.

The rising cost of disposal and the growing recognition of the recovery potential of C&D waste have opened the door for C&D waste recycling opportunities. States and communities across the United States are beginning to emphasize this waste stream as the next major target in municipal waste recycling. In some areas, material recovery is already widely practiced (for example, large demolition projects in urbanized areas). In other arenas, the recycling of C&D waste has not been pursued because of inexpensive disposal costs and the lack of information on C&D waste recycling methodology and markets for recovered materials.

Two basic approaches are employed for recycling C&D waste. One involves separating materials at the point of generation for direct transport to available markets. The other approach involves the sorting of mixed C&D debris at a central processing facility or materials recovery facility (MRF). Each process possesses distinct advantages and disadvantages. This chapter aims to outline both of these approaches, comparing and contrasting the methods.

Recycling at Central Processing Facilities

The approach most widely used to date is the practice of a central processing facility. Facilities that crush concrete, masonry, and asphalt pavement for aggregate production have served the construction and demolition industry for many years. These facilities accept waste from demolition and roadwork construction activities, and are equipped to perform crushing, size separation, and ferrous metal recovery. A new breed of processing facilities that process all facets of the C&D waste stream are now in operation. These facilities use technologies from the aggregate production industry, and add other unit operations employed in residential solid waste separation and recycling.

Approaches for C&D MRF Operation

While each C&D recycling facility differs somewhat, some general approaches may be described. Mixed C&D waste is tipped and targeted materials are removed. Such materials include large items that may prove incompatible with processing equipment and materials that are easily removed and have good market value. Large pieces of lumber that may have a future reuse value are an example. Loads of waste consisting of primarily one component may be routed to a specific tipping area.

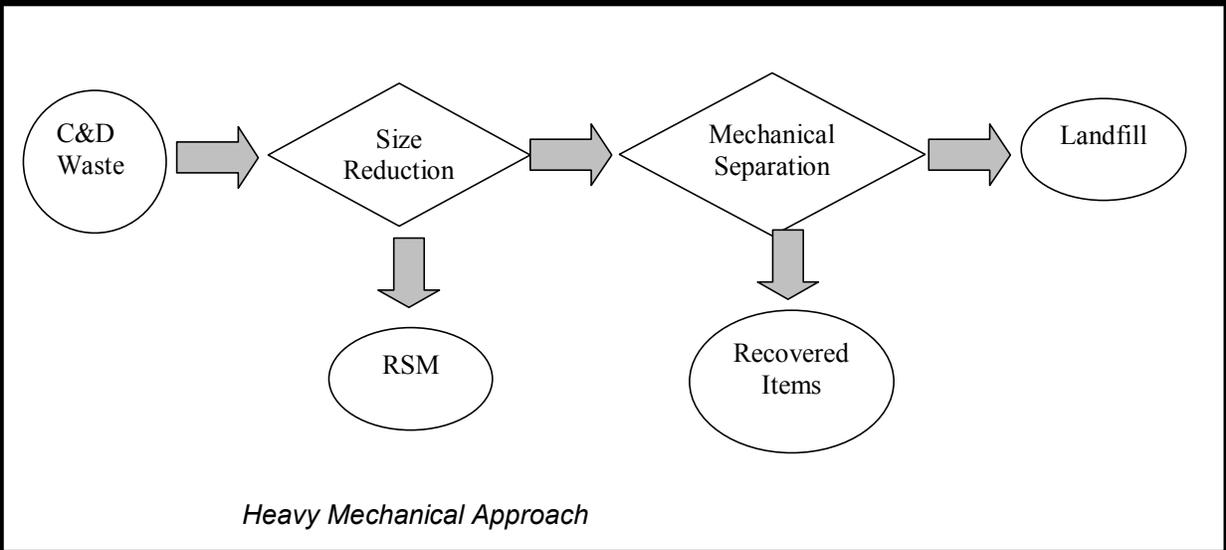
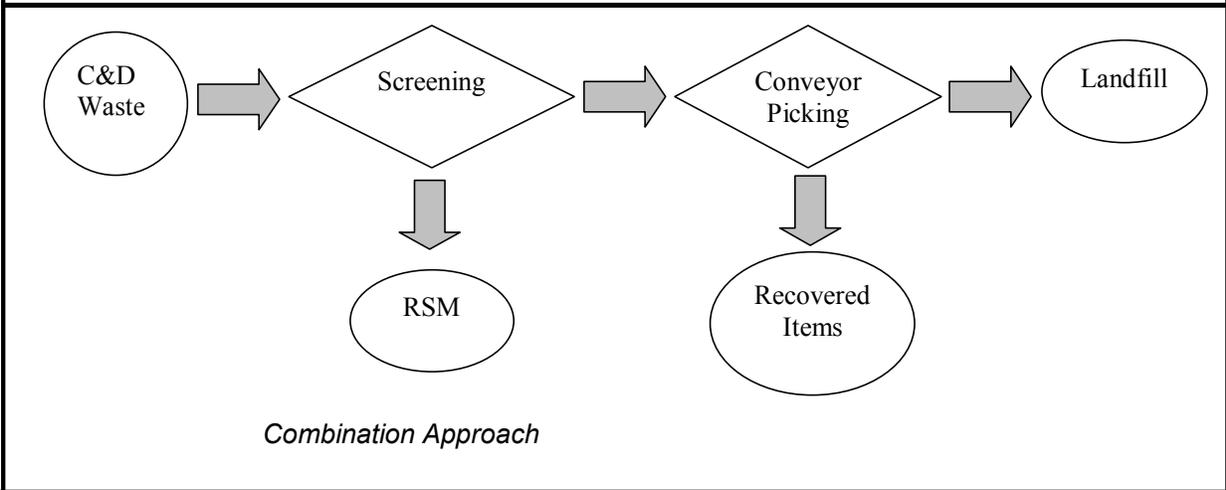
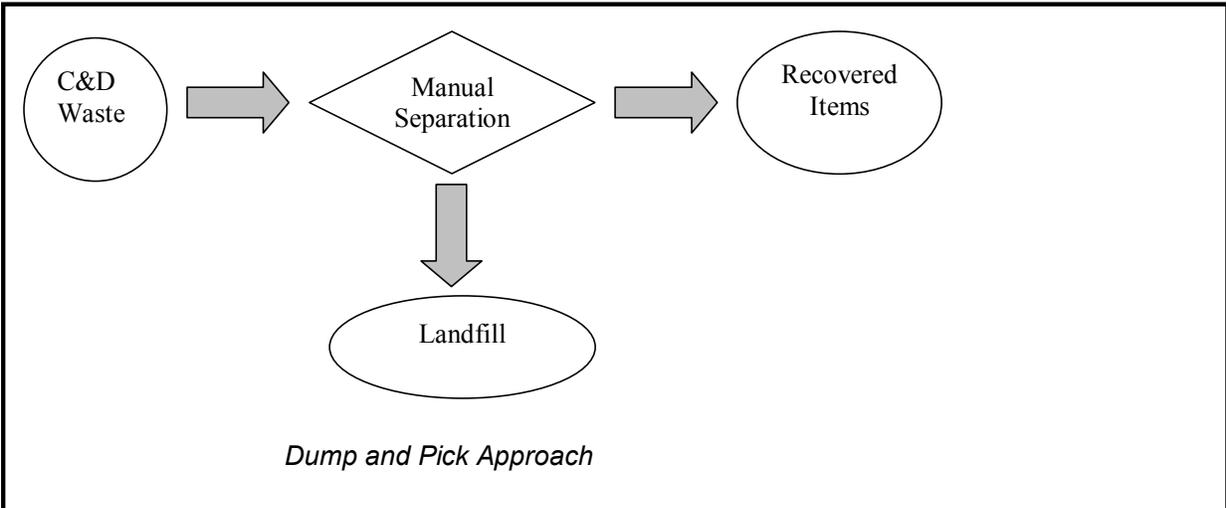
The mixed C&D materials are then processed following one of several general methodologies. One method involves the size-reduction of the mixed waste by mechanized crusher or impactor. Size reduction is also sometimes performed using heavy equipment such as dozers or compactors. The size-reduced fraction is then processed through a series of screens, magnets, and other separation equipment. The small and relatively uniform particle size makes the use of conveyors and specialized recovery equipment feasible. For example, an air classifier may be utilized to take advantage of the fact that for roughly equal particle sizes, an air stream of a given velocity will transport a piece of wood to one conveyor, while a piece of concrete drops to a different one. Even in highly mechanized operations, some manual picking to remove contaminants may need to be employed.

An alternative method involves processing the waste in as close to its original form as possible. Size-reduction is avoided. Screens and magnets are employed, but the rest of the separation relies primarily on manual labor. Waste is transported past a picking line of laborers who selectively remove materials and deposit them in specific containers. The presence of the waste components in their original form allows removal by visual recognition. Some materials that would be very difficult to recycle once size-reduced, such as cardboard, may be recovered. Some facilities avoid using mechanical equipment all together and simply operate on a dump and pick principal. First waste is tipped, and then large materials with ready markets are separated by hand and the rest is sent to a landfill. The following table and figures describe the different options for processing C&D waste further.

Table 1.

Approach	Description	Reject Volume
Manual Separation Only	Waste is tipped. Large identifiable materials with ready markets are removed by hand. The remaining material is landfilled.	High (>50%)
Combination Manual and Mechanical Separation	Waste is tipped and then screened. Manual labor remove components via a conveyor belt system.	Medium (25-50%)
Heavy Mechanical Processing and Separation	Waste is tipped and then processed (often crushed) and sent through a complex train of mechanical equipment for separating the materials.	Low (<25%)

Note: All three approaches are used. Combined process is currently most widely used.



C&D Management Practices

The primary management practices for C&D waste in Florida are landfilling and recycling. Most of the recycling occurs at large processing facilities in South Florida (although more processors are opening up in North Florida). A number of concrete and asphalt processing facilities also operate throughout the state. While concrete or asphalt from road work, parking lots, or large building demolitions meets the definition of C&D waste in general, these materials do not necessarily meet the definition of municipal solid waste, and thus are often not counted in waste generations estimates.

Landfills

Sanitary landfills are the most common means of managing C&D waste. Referred to in the past as “dumps,” modern landfills are operated to meet regulations placed to protect human health and the environment. Landfills that receive household and commercial waste must have elaborate liner systems to protect the groundwater from contamination. C&D landfills currently do not require liners in most areas of the state.

When solid waste is placed in a landfill, the action of rainfall percolating through the waste creates a liquid referred to as “leachate.” If a hazardous chemical is present in the waste stream, it may “leach” from the landfilled material into the leachate that is produced. The leachate migrates through the landfill, and without any liner, ultimately comes in contact with the underlying soil and groundwater. Leachate contaminated groundwater may migrate away from the site resulting in the possible contamination of nearby groundwater wells.

C&D waste landfills are currently required by the State to meet certain requirements regarding location and operation. Rules are in place, which require location restrictions, operator training, groundwater monitoring and financial assurance. A number of Florida counties have more strict requirements for C&D disposal than the State. These counties include Palm Beach, Dade, and Broward. In some counties, C&D waste may not be disposed in unlined landfills. Waste is either disposed in a lined class I or class III landfill or sent to a C&D processing and recycling facility. The added requirements for C&D landfills have raised the cost of landfilling, and thus created opportunities for recycling.

Recycling

Several options exist for recycling C&D waste. Waste can be separated and processed at the C&D job site. This requires active participation by the C&D contractor. Tight economics and the need for rapid completion of construction and demolition projects have limited this practice, although education continues in this area. Most C&D waste recycling takes place at materials recovery facilities (MRFs) where waste stream materials are processed and separated. Waste materials are separated by a combination of mechanical and manual separation. The process

often involves crushing the waste in the early stages of the process to aid in the mechanical separation of the material.

Markets for wood, concrete, and metal exist and are available to accept these materials. The major markets for C&D debris materials are reviewed in the next section. A major factor in the success of a recycling operation is the degree of contamination of the material. Purity of the recovered product encourages higher resale prices. Product purity may be reduced at some processing facilities because of the aggressive handling of the mixed waste stream. One of the largest products of a typical C&D materials recovery facility is a recovered soil fraction (referred to in Florida as recovered screened material, RSM). This fraction accounts for 25% or more of the recovered waste stream at some facilities. This material may be used as clean fill in off-site operations, provided that the material is safe. The presence of hazardous chemicals in the C&D waste may limit the reuse options for RSM. Policy guidelines have been developed by FDEP to approve reuse projects for RSM.

Other Practices

Some C&D management practices act to divert materials from landfill disposal but are not always considered recycling. A common practice in South Florida is to use "clean" concrete as lake fill for the reclamation of borrow pits (where excavation has resulted in the creation of permanent surface water bodies). C&D waste components are also sometimes used as landfill cover. This is the most common reuse practice for screened C&D fines. Some facilities crush the entire C&D waste stream (or most of it) and use it as cover or road material in landfills.

Markets

Major Recovered Components of C&D Waste

A number of C&D waste components are recovered in most C&D recycling operations. Components most often recovered include concrete and brick, asphalt paving, wood, cardboard, and metal. Other components are recovered in some cases include asphalt roofing material, gypsum drywall, plastic, and insulation. At mixed C&D processing facilities, fines produced by the screening of mixed waste (referred to in Florida as recovered screened material) are also generated.

Outlets for Recovered C&D Waste Materials

A number of potential outlets are available for the marketing of materials recovered during C&D waste recycling. These outlets are outlined here.

Traditional Solid Waste Recyclers

The success of recycling in other areas of the solid waste stream (such as MSW) has resulted in the development of an industry based solely on the recycling of recovered waste materials.

Existing recyclers of cardboard and metal will also be the same companies accepting these waste materials from C&D recycling programs.

Reusable Building Supply Yards

An evolving business is the recovery and resale of used building supplies. This includes components such as lumber, whole bricks, and other materials with a potential for reuse in construction. Organizations such as Habitat for Humanity may also have an interest in reusable material. These organizations may come to the C&D sites to pick up material or help remove wanted items prior to demolition.

Construction

The reuse of materials generated during C&D activities in new construction projects is also a potentially large market. This not only includes reuse directly back into construction projects where the waste is generated, but also the use of materials derived from the recycling of C&D waste in other construction projects such as roads, foundations, and earth fill.

The recycling and reuse of construction materials in new construction can be encouraged by maintaining a storage area for discards and remnants that could possibly be used in other projects. This may be more feasible for projects with multiple structures under construction. Remnants and cutoffs of building materials can be maintained on site or in one central area, so that they can be readily identified and reused in construction in place of new materials.

Industry

Certain industries may represent a market for a number of recovered C&D materials. This includes the reuse of materials by an industry for the manufacture of the same product (e.g. the recycling of gypsum drywall in the manufacture of new drywall). Alternatively, unrelated industries may use C&D recovered materials as either a component in a manufacturing process or in the production of fuel (e.g. the use of recovered C&D wood fuel at sugar mills).

Concrete and Brick

Road Base and Construction Fill

Crushed concrete and brick are often used as base fill in the construction of roads. The crushed material is used in place of lime rock. This reuse option represents a large potential market. The economics of such reuse are often dictated by the local availability of lime rock deposits, as hauling costs are substantial. The purity (i.e. presence of wood, dirt, other contamination) of the material may also be an issue. Crushed concrete and brick may also be used as primary road surface material on unpaved roads in rural areas. The use of crushed concrete for driveways is also practiced. Concrete and asphalt crushing facilities are common in Florida. Portable crushing equipment is also available.

Aggregate In Concrete

Crushed concrete has been proposed for use as aggregate in the manufacture of new concrete. The manufacture of Portland cement concrete involves the mixing of proper amounts of Portland cement, water, and aggregate. The addition of crushed concrete fines has been used, but the quality does not always meet the same results as when using clean sand and rock aggregate.

Drainage Material

Crushed concrete that has been well screened of fine particles provides similar drainage characteristics as new rock or gravel. It is therefore often used for drainage applications in construction. Other possibilities include septic drain fields and landfill leachate collection systems. Crushed concrete does raise the pH of water in contact with it, so care must be taken if this presents a concern with regard to water quality (i.e. impact on a surface water or groundwater supply).

Lake Fill

While use as a road base and as a construction fill is the predominant market for crushed Portland cement concrete in the most of the state, in South Florida concrete is typically used as clean fill. The availability of lime rock for construction and the need to recover low land areas that have been previously dredged have resulted in this being the most economic manner of reusing this material.

Asphalt Concrete

Production Of New Asphalt Pavement

Asphalt concrete contains approximately 5% asphalt binder (bitumen) and 95% aggregate (sand and gravel). Asphalt concrete is removed from a road either by demolishing the road and recovering large pieces of asphalt concrete, or by milling the road surface. Reclaimed asphalt pavement (RAP) is already commonly recycled by incorporating into new hot mix asphalt. Milled asphalt from roadways may be directly reused in the asphalt manufacturing process. Large pieces must first be crushed. The quality requirements for RAP are more strictly controlled for state road projects relative to local roadways.

Road Base And Construction Fill

Crushed asphalt concrete may also be used for many of the same options as crushed concrete and brick. Research has shown that for the most part, crushed asphalt concrete does not leach

chemicals to the environment any more than would be expected with crushed portland cement concrete.³ Asphalt concrete from parking lots or heavily trafficked areas may need to be checked for leaching contaminants as a precaution. The same statement could be made of other crushed paving materials.

Wood

Fuel

The most common reuse option for wood recovered from C&D recycling is for fuel. Wood has a high heating value and it has been used by a number of industries as boiler fuel. It is the primary fuel of the Trail Ridge Energy facility in Polk County (along with tires) and is used by a number of industries (sugar refineries, pulp and paper mills). Most wood shipped for fuel is chipped prior to transportation. Higher prices are gained for wood that has minimal soil and other foreign objects, and a low moisture content. The presence of large amounts of treated wood creates air emission control problems and ash disposal problems. Treated wood⁴ should be removed from the recovered wood stream prior to grinding.

Engineered Wood

A number of engineered wood products are produced from chipped wood material. These products include fiberboard, oriented strand board, and particleboard. The wood chips are formed into boards by various pressing methods and adhesives. No foreign materials should be present. While treated wood may not harm product quality it is a sensitive issue that most engineered wood producers would like to avoid.

C&D wood has been suggested as a source of chipped wood for engineered wood manufacture (Donovan and Associates, 1998). A key characteristic of the wood is its particle size. Some manufacturers may accept larger pieces of wood if they maintain their own size-reduction equipment.

³ Research has been conducted at the University of Florida testing the leaching potential of reclaimed asphalt pavement (RAP) for a number of hazardous pollutants. Using standardized regulatory leaching tests, no trace hazardous chemicals were observed. When tested in leaching columns, small amounts of lead were observed in some samples, but the lead was attributed to vehicle emissions and not the asphalt itself. [See "Leaching Characteristics of Asphalt Road Waste." Final Report. Florida Center for Solid and Hazardous Waste Management.]

⁴ A number of different wood preservatives are used for treating wood, including creosote and chlorophenol, but the most common preservative encountered in construction is copper chromated arsenate (CCA). As part of a research study conducted by the University of Florida, it was determined that approximately 5 to 6% of the C&D wood stream at Florida C&D recycling facilities was composed of CCA treated wood. See "Generation, Use, Disposal, and Management Options for CCA-Treated Wood." Final report, Florida Center for Solid and Hazardous Waste Management.

Mulch

Chipped wood may be used for a mulch in horticultural and agricultural applications. The wood should be free of foreign material as much as possible and should contain no treated wood. The reuse possibilities of mulch from recovered C&D wood typically revolves around aesthetics. Foreign materials such as nails and plastic greatly limit appeal. Construction wood does not have the typical dark mulch color that is often preferred, but some companies market coloring agents for mulch. The colored mulch has grown in popularity in recent years and for a while was a prime market for C&D wood (1998-99). The market is somewhat saturated at this time, as other waste products (wood chips) are also colored as well. The National Association of Homebuilders has suggested that construction wood can be chipped at the construction site for use in landscaping (NAHB).

Animal Bedding And Compost Amendment

Two other applications for recovered C&D wood that are sometimes performed because of the moisture absorptive capacity of the wood are animal bedding and bulking agent in composting. These uses require a clean wood stream in terms of foreign material. No treated wood should be present.

Metal

A number of different metals are frequently encountered as part of the C&D waste stream. Metal is used as a structural support material in larger constructions. Large amounts are therefore likely to be recycled from the construction and demolition of those structures. Residential construction projects may encounter small amounts of metal associated with wiring, siding, fasteners, and roof flashing. When present in sufficient amounts, the recycling of metal is an attractive option because of the ready market for recycled scrap metal. In most large construction projects, workers already recycle valuable metals such as copper and aluminum.

Cardboard

Cardboard is one of the most commonly recycled components of the solid waste stream. It is advantageous to recycle cardboard from new construction projects because the cardboard recycling market is already so well developed and because cardboard can take up a substantial volume in a waste container because of its loose density. Every community should have a commercial recycler of cardboard who will place containers and pick them up. The market value for cardboard is extremely variable. During times of low market value a monthly flat rate may be charged for maintaining a cardboard container with pickup, but it should still save over disposal. Recycled cardboard is typically processed by mills into new cardboard products.

Gypsum Drywall

New Drywall

Gypsum drywall (or wallboard) is composed of the mineral calcium sulfate dihydrate ($\text{Ca}_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$). It is used as a material for interior walls of buildings because of its fire resistance properties. Gypsum drywall also contains a paper backing. Gypsum drywall can be recycled

into the production of new drywall, and some plants in the U.S. perform this. A few drywall plants are currently in operation in Florida (including Jacksonville and Tampa) and none currently have programs for routine acceptance of recovered drywall; however, the state has awarded an [Innovative Grant to Orange County](#) (Appendix Z, a web link) to attempt this process.

Agricultural Amendment

Gypsum is commonly applied in agriculture for the purposes listed in the following table. Also listed in this table are the ranges of rates at which gypsum is typically applied for these uses. Drywall must be crushed prior to application. The paper backing should biodegrade once applied in the environment.

The National Association of Homebuilders suggests that individual contractors can crush drywall on-site and land apply as part of landscaping (NAHB). It should be noted that sulfate will dissolve from wallboard in water. Sulfate is a secondary drinking water standard (250 mg/L) and under anaerobic conditions hydrogen sulfide (a noxious smelling gas) may be produced. Local environmental officials should be consulted.

Table 2. Typical Gypsum Land Application Rate

Gypsum Use	Typical Application Rate (lb/acre year)
Source of Ca	125-430
Source of S	50-80
Ameliorant for soil acidity	400
Ameliorant for crusting	100-200

Source: Sumner, M. (1995).

Portland Cement Manufacture

Reuse of gypsum as a raw ingredient in Portland cement manufacture is being practiced in some areas of the U.S. and holds promise for parts of Florida. Gypsum is used as a raw ingredient in cement production. It is added to the ball mill with the cement clinker to aid in setting properties of the cement concrete.

Animal Bedding And Compost Amendment

Crushed gypsum drywall has also been proposed for animal bedding material and compost amendment. Gypsum's ability to absorb moisture and control odors has been cited for animal bedding (Kalvin 1991, Turley 1998). As a compost amendment, gypsum wallboard provides a bulking agent to absorb moisture and allow airflow.

Asphalt Roofing

Asphalt roofing can be used in the manufacture of new asphalt shingles. The reuse of asphalt shingles has been proposed for a number of reuse options related to roadways. Crushed shingles can be used as a source of asphalt in the manufacture of hot mix asphalt concrete (Button et al. 1998). Processing into new hot asphalt mix is currently not being practiced in Florida; however, the State has awarded an [Innovative Grant to Charlotte County](#) (Appendix Z, a web link) to attempt this process.

Crushed shingles have also been used as a primary road surface material for rural roads. Recovered asphalt roof waste has been marketed for the patching of potholes and ruts in roadways. Asphalt shingle waste is often charged higher tipping fees than mixed C&D waste. A few facilities have been in operation, at times, in Florida for the production of products such as pothole filler.

Recovered Screened Material

Recovered screened material (RSM) is produced from screening mixed C&D waste at C&D processing facilities. This material is composed primarily of soil, but also contains small pieces of wood, rock, paper, drywall, and plastic. Regulatory guidelines should be consulted prior to reuse of this material.⁵

Construction Fill

One proposed option for the reuse of RSM is use in place of soil as construction fill. RSM could be reused as fill in roads, buildings, and landfill construction projects. Since trucks carry waste from the construction site to the recycling facility, the back haul of RSM has been proposed as an economically favorable alternative to using virgin soil.

Landfill Cover

RSM is commonly used in Florida as daily cover in landfills. The quality of RSM should not be an issue when applied as daily cover, other than that it should sufficiently protect against fires. Concerns have been raised in the Northeast U.S. that RSM in landfills does increase hydrogen sulfide content of the landfill gas when large amounts of gypsum drywall are present.

Plastic

A number of types of plastics may be encountered in C&D waste. Plastic components include plastic sheeting; containers such as brackets and caulk tubes; and flowerpots. In most cases it is not feasible to recycle plastics from C&D because of the wide variety of items and plastic resins encountered.

⁵ The reuse of RSM has been an issue of great debate in Florida. RSM has been found to contain small amounts of chemicals that may limit reuse in some scenarios (primarily arsenic). Proper monitoring must be employed. Local FDEP districts should be contacted for appropriate management practices.

Summary

The following table summarizes the markets for major materials in C&D waste, with specific respect to Florida. Table 3 represents the opinion of the author and is not the result of a formal poll or survey.

Table 3.

Component	Currently Recycling Rate	Potential Recycling Rate	Most Promising Markets for Florida
Portland Cement Concrete	6	8	Road Base, Construction Stone
Asphalt Concrete	9	9	New Hot Mix Asphalt
Wood	2	7	Fuel
Drywall	0	5	Cement, Agriculture
Asphalt Shingles	0	6	New Hot Mix Asphalt
Metal	5	6	Traditional
Cardboard	2	6	Traditional
Plastic	0	1	Traditional

Note: Recycling rates are provided on a qualitative relative scale, where 1 would be a very low recycling rate and 10 would be a high recycling rate. These numbers are not intended to represent percentages. They are intended as a means to compare current and potential recycling of different materials.

The “Counting Issue”

This year (2000), the Department implemented a Construction and Demolition material reporting mechanism which provided more accurate accounting of waste material being managed than in previous years. This new mechanism uncovered a greater amount of MSW being managed than was previously known. As a result, when that new data was factored into 1998 data, the calculations for the percentage of materials recycled showed decreases, while the percentages of materials disposed showed increases. A detailed explanation can be found in Chapter 2, under the *Materials Recycled* section, of the [2000 Solid Waste Management Annual Report](#) (Appendix B, a web link).

C&D Disposal Facilities and Requirements

Construction and Demolition Debris Disposal and Recycling Facilities (CDDRF)

A CDDRF is a state permitted solid waste management facility which serves as the final disposal point for C&D debris waste. CDDRF's are generally not required to have a liner. Only Class I landfills are required to have liners due to potential groundwater contamination from the materials allowed to be disposed at those facilities. CDDRF's may process and recycle C&D debris, however any recovery operations occurring on site must be described in their operating permit and approved by the FDEP. The owner or operator of a facility which accepts C&D debris for disposal and which also recovers materials from the C&D debris waste stream does not need to apply for a separate permit as a MRF or pay an additional fee. There are currently 91 CDDRF's operating in Florida. Of these 91 facilities, 66 actually recycled materials during 1998. The table on the next page lists the 15 largest state permitted CDDRF's based on total tonnage of material accepted (collected) at the facility 1998. Appendix B of the report "Review of Florida's Construction and Demolition Debris Recovery Infrastructure" developed by R.W. Beck for DEP provides a listing (by County) of all permitted CDDRF's in Florida. The figure on the below illustrates the concentration of the CDDRF's. The majority of these facilities are located in the Northwest Panhandle and North Central Florida.

Figure 20. Map of CDDRF Facilities in Florida



Table 4. Top 15 State Permitted CDDRF's in Florida for 1998

(ranked by tons collected)

Name Of Facility:	Location	Recycled	Disposed	*Collected
Old Kings Road Facility	Duval	18,200	320,400	338,600
672 Recovery, Inc.	Hillsborough	272	336,630	336,902
Mid-Florida Materials C & D Landfill	Orange	226	325,357	325,583
Saufly Landfill, Inc.	Escambia	10,835	298,000	308,835
Medley Landfill—WM	Dade	52,911	207,514	260,425
Pine Ridge Recycling & Disposal/Sanifill of FL	Orange	37,576	180,610	218,186
Continental Waste—Republic Ind.	Orange	41,311	142,234	183,545
Jones Road Landfill—BFI	Duval	7,990	156,231	164,221
Oviedo Materials C & D Landfill	Seminole	38,270	118,240	156,510
Ash-Len Fill Corp	Pasco	-	148,425	148,425
Dade Recycling	Dade	18,856	125,000	143,856
Material Exchange Corp/ West Coast Materials	Citrus	-	130,552	130,552
Pasco Lakes, Inc.	Pinellas	34	100,964	100,998
Aeon Church Rd. C & D Disposal Facility	Leon	37,138	59,373	96,511
Cone Road Landfill—BFI	Hillsborough	130	88,084	88,214

Source: FDEP Annual Reports

*Note: Recycled + disposed = Collected

The following table (5) lists the 15 largest CDDRF's based on tonnage recycled. These 15 facilities recycled approximately 354,676 thousand tons or 11 percent of the C&D recycled in Florida during 1998. Facilities appearing more than once have multiple facilities or collect C&D debris from more than one county. Please see Appendix C of the report "[Review of Florida's Construction and Demolition Debris Recovery Infrastructure](#)" (Appendix E, a 1.4 MB PDF file) developed by R.W. Beck for a detailed tonnage information on the recycled, disposed and collected C&D debris in 1998.

**Table 5. Top 15 State Permitted CDDRF's in Florida for 1998
(ranked by tons recycled)**

Name Of Facility:	Location	Recycled	Disposed	*Collected
Medley Landfill—WM	Dade	52,911	207,514	260,425
Continental Waste—Republic Ind.	Orange	41,311	142,234	183,545
Oviedo Materials C & D Landfill	Seminole	38,270	118,240	156,510
Pine Ridge Recycling & Disposal/Sanifill of FL	Orange	37,576	180,610	218,186
Aeon Church Rd. C & D Disposal Facility	Leon	37,138	59,373	96,511
G.E.L. Corporation	Orange	25,109	7,296	32,405
Cape Canaveral Air Station C&D Disposal Fac.	Brevard	19,453	32,940	52,393
Dade Recycling	Dade	18,856	125,000	143,856
Old Kings Road Facility	Duval	18,200	320,400	338,600
Oviedo Materials C & D Landfill	Seminole	16,425	50,674	67,099
Continental Waste—Republic Ind.	Orange	13,770	47,411	61,181
Saufly Landfill, Inc.	Escambia	10,835	298,000	308,835
Klenks's C&D Facility	Volusia	8,509	2,100	10,609
G.E.L. Corporation	Volusia	8,323	2,772	11,095
Jones Road Landfill—BFI	Duval	7,990	156,231	164,221

Source: FDEP

*Note: Recycled + Disposed = Collected

Regulations that pertain to CDDRF's are intended to establish standards for the construction and operation of the facility to minimize their threat to public health and the environment and to provide for the safe handling, storage, transportation and disposal of waste. Before CDDRF's can be approved for a solid waste management permit they must provide a detailed engineering report that includes a site plan, geotechnical/ hydrogeological investigation, planned active life of facility plan, operation and closure plan, and a financial responsibility and ground water monitoring plan.

Material Recovery Facilities (MRF)

FDEP defines MRF's as a permitted solid waste facility facility that provides for the extraction from solid waste of recyclable materials and materials suitable for use as a fuel or soil amendment, or any combination of such materials. MRF's do not dispose of solid waste onsite. After materials have been processed, quantities of C&D debris to be disposed are typically transfer-hauled via tractor-trailer truck to a state permitted landfill. The discussion on MRFs below will concentrate only on those MRF's whose waste stream is predominantly C&D debris.

There are currently 40 C&D MRF's operating in Florida. Of the permitted facility types listed in the report, MRF's typically recycle more C&D debris material than any other permitted C&D debris facility type. MRF's generally have a large assortment of capital-intensive processing equipment that grind, crush, shred, chip, sort, and bale C&D debris. Appendix D of the report ["Review of Florida's Construction and Demolition Debris Recovery Infrastructure"](#) (Appendix E)" developed by R.W. Beck includes a detailed list (by County) of the 40 C&D debris MRFs in Florida.



A large concentration Florida's C&D MRF's are located in South Florida. Broward, Dade, Collier and Palm Beach Counties include 21 (53 percent) of the State's 40 MRF's. The

concentration of C&D MRFs in South Florida is thought to be due in part to several factors, including the lack of C&D debris disposal facilities, the large population and development of these areas, and access to borrow pits or lakes.

Many of the South Florida MRF's have old borrow pits or lakes that they utilize to dispose of concrete (clean debris). Although not considered recycling by the State, utilizing C&D as fill does serve to reclaim property.

Regulations that pertain to MRF's are intended to establish standards for the construction and operation of the facility to minimize their threat to public health and the environment and to provide for the safe handling, processing, storage, and disposal of waste.

Before MRF's can be approved for a solid waste management permit from the FDEP they must provide a detailed engineering report. These reports typically include a description of solid waste to be collected, stored, processed or disposed; a description of the operation and functions of all processing equipment, loading, unloading, and processing areas; identification and capacity of temporary on-site storage areas; provisions for solid waste and leachate containment; and identification of potential ground water and surface water contamination. Other requirements that MRF's must comply with include financial responsibility for closure, stormwater management, and data reporting to FDEP.

Land Clearing Facilities (LCF)

LCF's are currently general permit sites whose primary purpose is to manage a waste stream that primarily consists of debris from the clearing of new residential or nonresidential construction sites. These sites may dispose of the material in and unlined area or process and recycle it. However, any recovery operations occurring on site must be described in their operating permit and approved by the FDEP.

There are currently 69 LCF's operating in Florida. Processing at LCF's is typically limited to chipping and screening wood for mulch or fuel. LCF's typically do not recycle significant amounts C&D debris. Some may have trommels or chippers on site to process debris into mulch. Appendix E of the report "Review of Florida's Construction and Demolition Debris Recovery Infrastructure" (Appendix E) developed by R.W.Beck includes a detailed list (by County) of the 69 LCF's in Florida.

Non-Permitted Concrete and Asphalt Facilities

There are roughly 32 non-permitted concrete and asphalt recovery sites operating in Florida. In addition, there are numerous companies that use mobile processing equipment to recover C&D directly on the construction/demolition site. This practice has become more popular over the past several years. When source separated from other C&D debris, concrete is not considered solid waste and therefore operators are not required by the FDEP to obtain a permit. Concrete that is generated from roadways, bridges, etc., is usually source separated when collected at the

site. Asphalt can be processed directly on-site; however, in some instances the material is taken back to a processing plant to be re-mixed.

The regulations that pertain to these types of facilities are minimal. Operators that are crushing concrete may have to apply for an air permit with the FDEP or have particulate controls at the site. Asphalt plants may also be monitored to ensure that stockpiles of material do not build without markets. Appendix F of the [report "Review of Florida's Construction and Demolition Debris Recovery Infrastructure"](#) (Appendix E) developed by R.W. Beck includes a detailed list (by County) of the 32 C&D debris concrete and asphalt companies in Florida.

Figure 22. Map of Non-Permitted Concrete and Asphalt Facilities in Florida



Transfer Stations

The FDEP currently defines a transfer station as a general permit site whose primary purpose is to store or hold solid waste for transport to a processing or disposal facility. Transfer stations are very similar to MRF's. They often process, recover, and consolidate solid waste for transportation to disposal facilities. However, TS's usually do not have major processing equipment to recover large amounts of material from the C&D debris waste stream. Some transfer stations may have compactors and balers for compacting metals, paper, and plastics. Although transfer stations can process and sort solid waste within their enclosed structures, they generally do not recycle significant amounts of C&D debris. However, a majority of transfer stations will remove metal, cardboard, and plastics out of the waste stream for sale to markets.

There are currently 105 transfer stations operating in Florida that recover C&D. Typically, transfer stations are located in more heavily populated areas that are not in close proximity to landfills. Appendix G of the [report "Review of Florida's Construction and Demolition Debris](#)

[Recovery Infrastructure](#)” (Appendix E) developed by R.W. Beck includes a detailed list (by County) of Florida’s 105 TS’s.

Figure 23. Map of Transfer Station Facilities in Florida



Transfer stations have similar regulations to other types of solid waste management facilities. Transfer stations must provide the FDEP with a detailed site plan that shows property boundaries, proposed structures, and adjacent properties. They also must provide the FDEP with an engineering report. Examples of required elements of the engineering report include an operating and drainage plan, a description of machinery to be utilized, and contingency plans for the disposal of waste delivered to the facility.

Class III Landfills

Class III landfills are FDEP permitted sites that are generally not required to have a liners. They can only receive yard trash, construction and demolition debris, waste tires, asbestos, carpet, cardboard, paper, glass, plastic, furniture other than appliances, or other materials approved by the FDEP.

Processing at Class III landfills is typically limited to sorting and grinding C&D debris such as wood and concrete. As a result, these facilities typically do not recycle significant amounts C&D debris. Most Class III landfills do not have major C&D debris processing equipment. There are currently 34 Class III landfills operating in Florida that recover C&D debris materials. Although some Class III landfills are located in large counties, the majority of these facilities are located in small, rural counties.

Figure 24. Map of Class III Landfills in Florida



Regulations that pertain to Class III landfills are slightly more stringent than those that apply to CDDRF's. Prior to permitting approval, Class III landfill operators must provide a detailed engineering report that includes elements such as a site plan, geotechnical - hydrogeological investigation, planned active life of facility, operation and closure plan, financial responsibility, and ground water monitoring plan. Appendix H of the [report "Review of Florida's Construction and Demolition Debris Recovery Infrastructure"](#) (Appendix E) developed by R.W. Beck includes a detailed list (by County) of the 40 C&D debris MRFs in Florida.

Construction and Demolition Recycling (CDR) Sites

Construction and demolition recycling (CDR) facilities are sites that recover materials from the C&D debris waste stream for purposes of recycling but that do not dispose of any wastes on-site. They are very similar to a transfer station and MRF, however CDR's are much smaller and do not process or transport a large amount of material. CDR's typically do not have large pieces of recycling equipment on site, but rather hand pick/sort cardboard, and metals. CDR's are monitored by the FDEP and must have a spotter on site at all times of operation.

Figure 25. Map of CDR's in Florida



There are currently 4 CDR facilities operating in Florida that perform some level of C&D recovery. Appendix I of the [report "Review of Florida's Construction and Demolition Debris Recovery Infrastructure"](#) (Appendix E) developed by R.W. Beck includes a detailed list (by County) of the 4 CDR's in the State.

Equipment Utilized by the C&D Debris Industry

The recovery of C&D debris is evolving into a significant industry in Florida. Millions of dollars in private investment have been placed in the land and equipment required to operate C&D debris recycling facilities. Equipment, such as separation systems, crushers, trommel screens, grinders, and bailing systems, can cost millions of dollars to purchase and operate. Figure 6 below provides some examples of the types, function, and cost of C&D recycling equipment. Please note that equipment price range varies with input and output of materials processed.

Figure 6. Examples of C&D Recycling Equipment

Equipment Type	Materials Processed	Usage Description	Price Range
Compactors	Drums, Pallets, Crates, Bulky Waste	Compacts waste with over 65,000 lbs. of force & displaces over 175 cubic yards per hour	\$10,700 to \$18,995
Pulverizes	Gypsum, Industrial Trash, Soft Metals	Punctured pieces of materials are dropped between rotating high teeth then screened	\$108,475 to \$153,275
Loading Cranes	Steel, C&D Debris, Land Clearing Debris	Used for the removal of debris in logging operations, and construction sites	\$32,000 to \$755,000
Separation Systems	All C&D Debris	Material is fed onto a vibrating screen in which the Trommel sorts and discharges waste	\$125,000 to \$230,000
Balers-Horizontal	Cardboard, Metal, Paper, Plastic	(see above) Designed with side fed units	\$13,800 to \$32,000
Granulators	Plastics, Rubber, Foam, Crates, Bins	Materials are broken up into pieces by rotors then reduced into pellets by rollers' teeth	\$18,500 to \$150,000
Tub Grinders	C&D Debris, Land Clearing Debris	Grinds materials from 120-320 cubic yds. per hour from a top feeder w/dual auger discharge	\$100,000 to \$300,000
Trommels	Yard Waste, Wood Chips, Sludge	From a conveyor the fed material is screened and dispersed evenly then outfed and stacked	\$51,800 to \$225,000
Hauling Trucks	Solid Waste, Scrap, Bulky Materials	For hauling SW materials that holds up to 44,000 lbs. (various types)	\$21,000 to \$61,000
Trailers	Solid Waste, Scrap, Sludge	For hauling SW up to 80,000 lbs. there are 3 types: Transfer, Roll-Off, and Walking Floor	\$27,900 to \$68,000

Provisions in Chapter 403 Which May Help or Hinder the Recycling of Construction and Demolition Debris

An analysis of the Florida Statutes indicates that there are several provisions that impact, both directly and indirectly, the state of C&D debris recycling in Florida. Below, we will attempt to discuss some of the more substantive provisions that both promote and discourage it. [Appendix J](#) (PDF file), lists all the provisions in Chapter 403 which may help or hinder its recycling in the state.

Few substantive provisions specifically promote C&D debris recycling. One of the most significant that does, is the requirement that C&D debris be separated from other MSW during disposal, [F.S. 403.706\(2\)\(a\) \(a web link\)](#). This requirement was intended to promote the economical recycling of C&D. In no way does it prohibit the disposal of C&D in a separate solid waste disposal facility. In fact, since tipping fees at C&D disposal facilities tend to be much lower than tipping fees for mixed solid waste, there is already an economic incentive to separate out the C&D waste. However, in those areas where C&D disposal is less expensive than C&D recycling, this provision may do little to encourage recycling.

A second provision which promotes C&D debris recycling is an exemption from solid waste permitting for use of clean debris as fill, F.S. 403.707(2)(f). Clean debris is defined in F.S. 403.703(33) as “solid waste which is virtually inert and which is not a pollution threat to groundwater or surface waters and is not a fire hazard and which is likely to retain its physical and chemical structure under expected conditions of disposal or use. The term includes uncontaminated concrete, including embedded pipe or steel, brick, glass, ceramics, and other wastes designated by the department.” This exemption alone is most likely responsible for the greatest percentage of concrete waste being recycled in Florida. The vast majority of this material comes from roads and bridges that are composed predominantly of clean concrete with embedded steel. With minimal processing, this waste becomes a valuable product. This provision does however create one problem. As clean debris it is neither a permitted waste nor a recovered material, it is prohibited from being identified as a municipal solid waste (MSW), and therefore not able to be counted toward the County’s mandated recycling/waste reduction goal.

There are also a few significant disincentives for the recycling of C&D debris found in the Florida Statutes. One of these, F.S. 403.706(4)(a), places a restriction on the amount of C&D debris recycling which can be applied towards a County’s recycling/waste reduction goal. This paragraph makes clear that recycling of C&D debris does count towards the goal, but limits it to no more than one-half the goal, combining with yard trash, white goods and tires. Because of this limitation, Counties near or over the cap have less of an incentive to recycle C&D debris or promote it’s recycling. The original intent of this provision was to help promote programs that

recycle materials from households and commercial businesses. If this limitation was eliminated, it might provide additional incentive for Counties to promote C&D recycling, although possibly at the expense of other curbside programs.

One provision which presents significant disincentives for the recycling of C&D debris is F.S. 403.703(7), the definition of recovered materials. This definition is so crucial because it excludes two of the most important materials found in this category of waste, wood and concrete. Not only do these two materials make up the vast majority of C&D debris, they are also some of the most marketable. Additionally, the exclusion of these materials in the definition has effected several other provisions in Chapter 403, further impacting the recycling of C&D debris. Prior to 1993, this definition included any materials that were being recycled, including C&D. After that year, the provision listed only metals, paper, glass, plastic textiles and rubber as recovered materials. As a result, it is not as clear that the Department can deregulate the recycled components of C&D.

Another disincentive to C&D debris recycling is F.S. 403.707(12)(b). This paragraph restricts the Department's authority to require liners at C&D disposal facilities. To the extent that this provision has kept the costs of disposal lower, it has also had the effect of making C&D debris recycling less economically competitive and less frequently pursued. As the Department learns more about the composition of C&D debris and the effects of it's disposal on the State's groundwater, it may see the need in the future to require liners at these facilities. This would not only prove beneficial to the environment, but also have a positive impact of the recycling of C&D debris statewide.

The Impacts of Local Government Solid Waste Franchises on C&D Debris Recycling

Background on Recovered Materials Regulation and 2000 Legislation

Since 1993, state law has forbidden cities and counties from issuing exclusive franchises for the collection of six types of "recovered materials", which are defined by statute as: paper, plastic, glass, metal, rubber and textiles. In other words, local governments cannot require a customer to use a specific company to pick up those materials. However, for all other materials in the waste stream, local governments have the power to issue exclusive solid waste franchises, thus mandating to customers what haulers they must use to collect those wastes.

In the 2000 Legislative session, [House Bill 2163](#) (Appendix A, a web link) would have created a new class of materials called "recoverable construction and demolition materials" (RCDM), which would have been exempt from local government solid waste franchises. The Legislature did not pass the bill. However, House Environmental Protection Committee chair Paula Dockery requested, and Speaker of the House John Thrasher subsequently directed, that the Committee staff conduct an interim study of C&D debris recycling. (This report was prepared by the Florida Department of Environmental Protection to assist the Committee in its task.)

Additionally, the 2000 Legislature passed House Bill 1529, which addressed "sham recycling" (discussed in the next section).

The "Sham Recycling" Issue

The issue of sham recycling arises because it is very difficult to totally separate recovered materials from the rest of the waste stream, even if there are separate containers set up to do just that. The result is that even boxes designated strictly for recovered materials will often also contain some items that are considered solid waste.

Local governments and franchise waste haulers say that at least some recovered materials haulers actually recover only a small portion what they collect, disposing the remainder at landfills. This is called "sham recycling." This results in revenue loss for local governments and franchise waste haulers, who assert that those recovered materials haulers are essentially disposing of waste without having to pay all the costs of and adhere to all the regulations connected with waste disposal.

In response to those concerns, the 2000 Legislature required that recovered materials collection containers must have no more than 10% of their load comprised of solid waste. Otherwise, the load will be considered solid waste rather than recovered materials, and will be subject to the franchise requirements and regulations of handling solid waste.

OPTIONS FOR INCREASING RECYCLING OF C&D DEBRIS

There are a number of options which local and state government could implement that would likely increase recycling of C&D debris. These are described below. While these options may increase C&D debris recycling, some may also have other significant, and potentially negative, impacts on local government finances, regulation of C&D debris, and other areas. Most will require substantial additional refinement to be implemented. This report makes no recommendations on the options and lists them only for further discussion and development.

LOCAL GOVERNMENT OPTIONS

Exempt C&D debris which is recycled from exclusive commercial franchises: existing commercial solid waste franchises could exempt any C&D which is recycled from commercial franchises.

Separate C&D debris franchises: when existing exclusive commercial franchise agreements come up for renewal, local governments could bid C&D debris separately, thereby allowing companies which collect and recycle just C&D to compete only for the C&D waste stream.

Non-exclusive commercial franchises: local governments that currently have exclusive commercial solid waste franchises could modify these to be non-exclusive franchises upon renewal. [Escambia County](#) (Appendix AF, a PDF file) is an example of a county which recently adopted a non-exclusive commercial franchise.

No commercial franchise; permits required for roll-off box haulers: under this alternative, there is no commercial franchise, but haulers of roll-off boxes placed at construction and demolition debris sites are required to obtain a permit from the local government and follow certain regulations governing placement of the boxes, transportation, and disposal of the waste. The [Palm Beach County Solid Waste Authority](#) has such a system (Appendix AK, a PDF file)

No commercial franchise; open market for C&D debris collection: A number of Florida local governments have an open market for commercial solid waste collection, including C&D, with no franchise requirement.

Deposits on C&D debris which are refunded if recycling occurs: In [San Jose, CA](#), (Appendix L, a PDF file) a rebate system is being established to reward recyclers of C&D waste. The system places a deposit on construction, demolition, and remodeling projects when the project permit is issued. The deposit rate will be based on square footage of and the type and quantity of material expected to be generated by the project, in conjunction with the costs of recycling or processing that material. Upon demonstration of diversion of a pre-established percentage of the C&D debris, the full deposit or appropriate portion will be refunded to the permitted participant. Information on San Jose's program can be found at <http://www.sjrecycles.org/business/cddd.htm>

Local ordinance mandating recycling of C&D debris: Local Governments can enact ordinances which require the recycling of C&D. [Sarasota County, FL](#) (appendix AE, a PDF file) and [Alameda County, CA](#) (Appendix M, a PDF file) have ordinances which require that C&D waste haulers recycle a majority of debris generated in their jurisdiction. The Sarasota County ordinance was enacted in 1991 and revised in 1998 (Appendix AE) Alameda County, CA designed an ordinance for cities to adopt (Appendix M) which states that: reusing and recycling C&D debris is essential to further City efforts to reduce waste and comply with goals; C&D debris waste reduction and recycling have been proven to reduce the amount of such material which is landfilled, increase site and worker safety, and be cost effective, and except in unusual circumstances, it is feasible to divert an average of at least fifty (50) percent of all C&D debris from construction, demolition, and renovation projects.

Require builders to recycle on site as a condition of being permitted: [The City of Portland, Oregon](#) (Appendix AB, AC, a PDF file) requires on-site recycling in all construction projects except for very small ones valued at under \$50,000. A business must complete a construction site recycling plan form to obtain a building permit.

Create recognition programs to encourage contractors to reduce and recycle: [King County, WA](#) (Appendix AD, a web link) has a recognition program called Construction Works. The Construction Works Recognition Program publicizes construction companies that

recycle, reduce waste and use recycled products on the construction job site. Companies are awarded Construction Works by job site and can apply for multiple awards. To become a Construction Works member, an organization must: Recycle 40 percent of its waste; practice at least three waste reduction strategies; use at least three recycled products. To become a Distinguished Construction Works member, an organization must meet the following criteria: recycle 60 percent of its waste; practice at least six waste reduction strategies Use at least six recycled products; and be involved in three additional activities that promote recycling, waste prevention, and buying recycled.

STATE GOVERNMENT OPTIONS

Exclude C&D debris from the definition of Solid Waste: State law could prevent C&D debris from falling under local government solid waste franchises. This has been done in Ohio for example, through statutory definition. Ohio's state [regulatory definition of solid waste excludes C&D Debris](#) (Appendix O, a web link) To date there have been no franchise agreements issued for the collection of C&D debris because local governments only franchise or contract for solid waste hauling. This effectively creates an open market for the handling of C&D debris.

Create a new category of "Recyclable C&D Debris Material (RCDM): In the 2000 legislative session, [House Bill 2163](#) (Appendix A, a web link) would have created a new class of materials called "recyclable construction and demolition materials" (RCDM), including concrete, masonry, wood and other materials designated by the FDEP, which would be exempt from local government solid waste franchises, if a majority of the RCDM was recycled.

Make distinction between MRFs and non-recycling processing facilities: A distinction could be made in the statute between "Material Recovery Facilities" or MRFs, which recycle a given amount of material and other solid waste facilities which only process waste, such as a transfer station. Such a distinction could aid recycling and assist local governments in discouraging so-called "sham recycling."

Require scales at all solid waste management facilities: current law requires scales at all solid waste management facilities operated by or on behalf of local governments. This law could be extended to all solid waste management facilities, particularly recycling facilities. This would further discourage sham recycling, as the recycling rate for a given facility could be specifically documented from scale data.

Require C&D debris to be processed before disposal: [Massachusetts](#) (Appendix R, a PDF file) is considering regulations that would ban many types of C&D debris from entering landfills. [A solid waste master plan](#) (Appendix U, a PDF file) that will be adopted by the state addresses C&D materials in several ways, including banning materials generated at construction and demolition sites from entering landfills except as residue after passing through a C&D recycling facility. Between now and 2003, when the proposed ban will take place, the Massachusetts Department of Environmental Protection intends to boost end markets for materials that do not have established recycling infrastructures, including wood, asphalt shingles, gypsum drywall and

carpeting. Regulatory officials have said they will only enforce the ban in 2003 if they conclude that an adequate infrastructure exists to recycle banned materials. The department has set a goal of an 88% recycling rate on C&D material by 2010.

Provide sales tax exemption for recycling equipment: Tax exemptions currently available are for the purchase of equipment for new and expanding businesses as stated in [212.08 \(5\)\(b\)F.S.](#) (Appendix V, a PDF file) This applies to machinery and equipment that recyclers use, but only after spending \$50,000 in sales tax during the year (= \$833,333 in equipment purchases). A competing “new” business would receive the tax exemption on the first dollars spent, a serious disincentive for existing Florida recyclers particularly if there is a loss of the state grants to local governments.

Exemptions are also provided in [212.08, F.S. \(7\)\(ff\) and \(7\)\(zz\)F.S.](#) (Appendix V, a PDF file) but these are specific to certain SIC codes which do not include 5093-Scrap and Waste Materials (even though language in (ff) specifically references “recycling equipment.”). The addition of [SIC 5093](#) (Appendix K, a web link) would enable companies to take advantage of these exemptions for recycling equipment.

In 1988 an addition was made to exempt certain machinery and equipment used for processing recyclable materials from taxes. This law, which sunset on October 1, 1991, was included as 212.08(5)(e). This exemption was intended for recycling businesses that increased consumption of recyclable materials. Companies had to demonstrate that recyclable materials consumption was increased by 10% and they had to provide receipts for taxes paid on equipment that contributed to this increase after one full year of use.

Provide Low interest loans to recycling businesses: Florida currently has [a Recycling Loan Program](#) (Appendix W, a web link) created in 1993 to provide access to capital for small businesses, for purchase of equipment and machinery to expand recycling capacity. The program offers long-term fixed-rate loans at interest rates two percent below prime. The maximum loan amount is \$200,000. The program is limited to for-profit small businesses that are legally licensed and operating in Florida, creditworthy start-up companies or out-of-state firms considering expansions into Florida. Eligible recycling companies must have a net worth less than \$6 million and have less than 100 employees. This program could be further funded and modified to specifically provide low interest loans for the start-up and expansion of C&D recycling businesses.

Provide grants to local governments and businesses to improve C&D debris recycling: Some of the [Innovative Recycling grant](#) (Appendix Z, a web link) funds FDEP currently provides to local governments (funded at \$4 million in Fiscal Year 2000-2001), have been targeted at recycling C&D debris, particularly drywall and roofing materials. This grant could be specifically targeted at further innovative C&D debris recycling projects, either by local governments alone or in combination with private recycling businesses.

San Jose has made \$750,000 available the past two years (FY99/00-01) to companies that will expand the C&D processing infrastructure by increasing mixed C&D processing, improve the quality of existing processes to enter other markets, or process harder-to-market materials.

Place a tax on the disposal of C&D Waste: [Iowa has extended the tax](#) (Appendix , a web link) on solid waste to apply to the disposal of C&D wastes. This has created an incentive to recycle more so that the tax will be reduced.

Conduct a comprehensive statewide survey of commercial franchises:

As noted previously, several surveys have been conducted on the use of commercial franchises in Florida. However, none have been comprehensive studies, particularly at the municipal level. Such a study could be funded by the Legislature and conducted by a neutral party in cooperation with the [League of Cities](#) and [Association of Counties](#) (web links).

Continue conducting research on C&D debris composition and reuse: As described in this report, the [Florida Center for Solid and Hazardous Waste Management](#) (Appendix AG, a web link) has conducted important research on the C&D waste stream to determine best management practices for these materials and identify reuse and recycling options. These research efforts should continue to be funded and pursued.

Support Documents Not Referenced in the Text

- Tim Townsend's Report "Construction and Demolition Waste Management, An Overview," Feb. 2001
[PDF](#)
- Tim Townsend's Power Point slides "C & D Debris in Florida" 1/18/01 (This is a very large, graphic intensive slide show)
[10MB PowerPoint](#)
[5.9MB PDF](#)
- [Dr. Droubay's Report](#) (web link to a pdf) on Franchises and Waste info in Florida
- League of Cities Franchise survey results
[Word](#)
[PDF](#)
- North Carolina C&D policies <http://wastenot.enr.state.nc.us/swhome/CDLCID.htm>
- Minnesota C&D Research Initiative, Call for hard copy (850) 487-4937

- Amendment to 403.703 and Additions to 403.704 Recoverable C&D materials
[MS word](#)
[PDF format](#)
- Triangle J Report
[Rich Text Format](#)
[PDF](#)