Technical Memorandum

Construction and Demolition Debris (C&D) Report

Solid Waste Management Plan

Task 5

Pinellas County, Florida

April 2019

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1 Introduction

Construction and demolition debris (C&D) is generated from activities such as the construction, renovation, and demolition of buildings, roads, and bridges and is typically comprised of concrete, wood, metals, asphalt, drywall, masonry products, and land-clearing debris (LCD). According to the recent Solid Waste Management Report published by the Florida Department of Environmental Protection (FDEP), C&D comprises approximately 25 percent of the waste stream in Pinellas County, and a majority of C&D not comingled with MSW or Class III waste is recycled

C&D collection, processing, and disposal in unincorporated Pinellas County, and many of the municipalities within the county, are handled by the private sector through an open market. The County does not require annual registration for C&D transfer stations and processing facilities and County's flow control ordinance is currently not applicable to C&D debris generated within the county. (See Section 2.1.1 of the Baseline Task 5 Needs Assessment Report, relating to flow control.)

Based on the data compiled and provided by FDEP, only two C&D processing/recycling facilities that received and processed C&D debris originating from Pinellas County are located in the county (Sarnago & Sons and Waste Management of Pinellas MRF in Clearwater). However, the majority of Pinellas County C&D is processed/managed by Angelo's Recycled Materials in Pasco County (per the C&D debris data compiled and provided by FDEP).

The County's solid waste Disposal Complex receives limited quantities of C&D collected within the county. C&D can be delivered to a permitted facility as a segregated C&D load (referred herein as segregated C&D) or comingled with other Class III and Class I waste. Table 1-1 lists disposal and recycled amount of C&D that is collected and delivered to the facilities in and outside Pinellas County. As can be seen from Table 1-1, a large fraction of C&D collected was recycled and less than 8 percent was landfilled outside the county in 2017. Table 1-1 does not include the facilities (e.g., Bob Walker Transfer Station and Chase N' Green Recycling, both of which are located in Pinellas County) that either did not receive county-originated C&D debris or did not submit an annual report to FDEP in 2017.

Based on the data provided by the County, approximately 295,661 tons of asphalt pavement, concrete, and recovered screened fines were recycled primarily by JVS Contracting, Inc., Ajax Paving, Crushit, Cypress Gulf Development Corporation, and Sonny Glasbrenner, Inc.

Table 1-1 Recycled and disposal amounts of C&D in 2017

Facility	Location county	Total recycled (tons)	Disposal amount (tons)
Coastal Landfill Disposal Inc.	Pasco	735	33,729
Enterprise Landfill and Recycling	Pasco	226,173	0
Orange Blossom Disposal Facility	Polk	1	48
Pembroke South C&DD	Polk	0	1
Sarnago & Sons Recycling	Pinellas	5439	0
Sumter Recycling & Solid Waste	Sumter	0	728
Sun Country Materials	Hillsborough	0	4,865
Sunshine Grove Rd Phase I	Hernando	0	274
Waste Management Pinellas MRF	Pinellas	115	0
Various (non-certified tons)	Various	295,661*	0
Total		**528,124**	**39,645**

*The "Various (non-certified tons)" category is comprised of concrete, asphalt, and other C&D debris that entered the waste stream and was reported to be recycled.

Figure 1-1 presents the distribution of recycled amounts of various C&D materials based on the certified and non-certified amounts compiled by the FDEP and the County, respectively. Concrete and asphalt pavement constitute over 85 percent of the recycled C&D. No drywall or asphalt shingles were reported as recycled in the 2017 FDEP Annual Report.

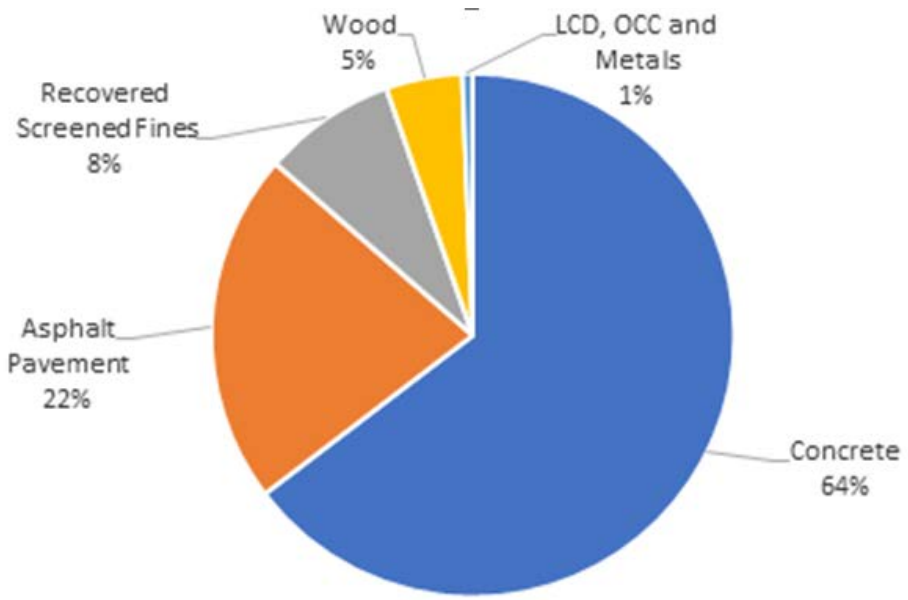

Figure 1-1 Estimated composition of the recycled C&D

Class III and Class I loads can also contain C&D. The waste composition study conducted in 2014 suggest that Class I waste, which is primarily managed at the Disposal Complex, contains approximately 3.8 percent (by weight) C&D. In 2017, according to County records filed with

FDEP, 192,974 tons of Class I waste and 3,500 of Class III waste was *landfilled* at the Disposal Complex. Using the 3.8 percent assumption, approximately 7,300 tons of commingled C&D in the Class I waste was landfilled at the Disposal Complex. As indicated, the quantities of C&D being landfilled at the Disposal Complex are not significant. Over the planning period, tonnages are estimated to increase by 17 percent overall and are estimated to be 53,282 tons by 2048.

The amount of unsegregated C&D included in the Class III waste going to landfills outside the county (a total of 215,849 tons of Class III waste in 2017) is not known. As this material is leaving the county and being managed it is not a target for disposal diversion in the county.

2 Opportunities/Needs

2.1 Overview

Most of the C&D within the county is being recycled, with the balance of unsegregated C&D materials contained in Class I and Class III wastes going to the Disposal Complex or to landfills outside the county.

Figure 2-1 presents the composition of C&D landfills based on data from several waste composition studies around the US (Jain et al. 2015). As shown, wood and roofing materials (primarily composed of asphalt shingles) constitute approximately 38 percent of the C&D landfilled. As discussed above, a large fraction of concrete and asphalt pavement generated in the county is already recycled. Gypsum drywall, which constitutes approximately 8 percent of the landfilled C&D, is currently not recycled. Gypsum drywall constitutes a large fraction of C&D fines, which are typically generated from C&D materials recovery facilities (MRFs). Based on a visual audit at the Disposal Complex, KCI (2016) reported untreated wood and drywall constituted approximately 13.9 and 9.8 percent of the C&D and bulky waste received at the site. The focus of the KCI (2016) study was to identify opportunities for processing and diverting bulky waste and C&D materials currently landfilled at the Disposal Complex.

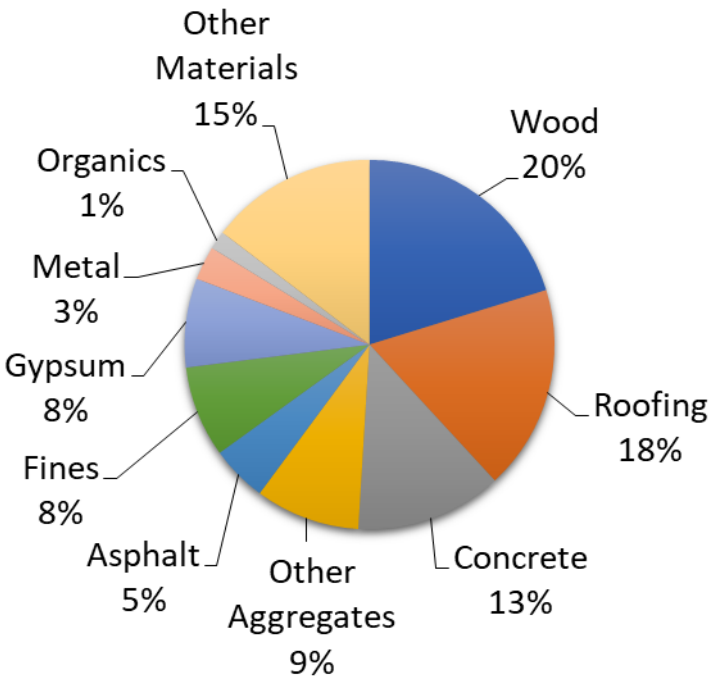

Figure 2-1 Weighted average composition of disposed of C&D based on results of five large-scale C&D waste composition studies (adopted from Jain et al. 2015)

Although a majority of the C&D that is being handled by the private sector is being recycled and only a small quantity of C&D is currently being delivered to the Disposal Complex, Class III debris disposed of at facilities outside the county may contain significant C&D. As discussed

above, data from several regional-scale waste composition studies suggest that wood, and roofing debris (which primarily consists of asphalt shingles) represent some of the major constituents of C&D landfilled. The recent C&D recycling data suggest that asphalt shingles and gypsum drywall are not recycled and wood was primarily recycled only by a single facility. While C&D currently landfilled may contain concrete, metals and other aggregates and there is a potential to enhance recycling of these materials, only a few facilities in and around the county are recycling these materials. The County could benefit from enhancing recovery and recycling of materials that are currently recycled such as concrete, aggregates, metals, cardboard, and developing capacity for processing materials that are not currently recycled, or recycled only in relatively small amounts compared to other materials.

This report presents strategies that the County can use to enhance recovery and recycling of materials that are currently being recycled, as well as options for recover and recycle wood, asphalt shingles and gypsum drywall, materials that are currently landfilled at the Disposal Complex and the other facilities outside the county.

2.2 Waste Prevention and Reuse

Examples of recovered C&D materials include asphalt, which can be crushed and recycled back into new asphalt and gypsum wallboard, which can be removed and included in recycled gypsum drywall. Although wood components are occasionally removed from a building for eventual reuse in new construction or renovation, this application is not the primary market for recovered wood products from C&D (the primary markets being boiler fuel and colored mulch). The recovered shingles and drywall are typically not reused for new construction. The waste prevention opportunities for these materials are limited.

Habitat ReStore, a nonprofit retail center operating in and around the county with locations in Clearwater, Palm Harbor, New Port Richey, Lakeland, Winter Haven, Zephyrhills, Tampa, and Brandon, sells new and gently used building materials and home furnishings at discounted prices. (See Section 4.1.1 of the Task 5 Needs Assessment Report, regarding Habitat ReStore.) As part of waste reduction educational strategies or programs, contractors can be encouraged to strategically remove materials during demolition or remodeling projects that may be of value for resale. While the economics of selective removal of materials is variable, there are companies in the demolition industry that specialize in this approach.

2.3 Collection and Transfer

C&D debris hauling in the county is currently an open market and is expected to be driven by the project location with respect to permitted C&D facilities and tipping fees. Roofing loads typically collected and transferred by roofers from reroofing projects, are expected to be the largest source of asphalt shingles. The opportunity to impact C&D collection and transfer is limited absent ordinance(s) and/or a franchise system for C&D collection. While franchising is legally feasible, examples in Florida are limited.

2.4 Processing

2.4.1 Wood

Enterprise Landfill (Dade City, FL), which is owned and operated by Angelo's Recycled Materials, recovered and recycled approximately 21,000 tons of C&D wood originating from Pinellas County in 2017. As discussed above, C&D comingled with Class I and Class III waste is currently landfilled at the Disposal Complex and other facilities outside the county. Although county-specific composition of the landfilled Class I and Class III waste are not available, the regional-scale studies suggest that wood constitutes approximately 20 percent of the landfilled C&D debris (Jain et al. 2015).

Wood products are extensively used for building construction and outdoor structural applications (fences, decks, utility poles) in the United States. Wood products enter the C&D stream both as scrap from new construction and from the demolition of in-service wood structures. Wood products in C&D typically include dimensional lumber, engineered wood [e.g., plywood, oriented strand board (OSB), and poles (Figure 2-2)]. Depending on the application, some wood products may be treated with chemicals to delay biological decay. Wood in the C&D stream is generally commingled with other building components and needs to be separated using manual and mechanical techniques. Source-segregated wood from construction projects or wood product manufacturing plants may be processed at facilities that solely process wood (Figure 2-3). Wood recycling facilities do not process treated wood as discarded treated wood products require special handling; FAC 62-701.300(14) restricts the options for processing treated wood.

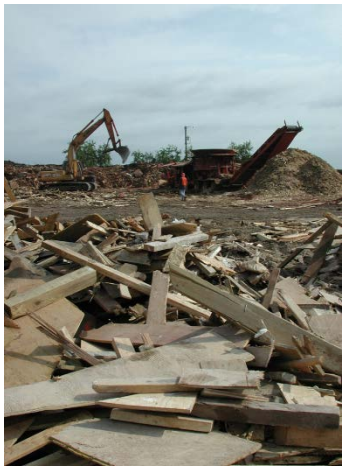

Figure 2-2 C&D wood includes dimensional lumber, plywood and OSB

Figure 2-3 C&D wood grinding operation

The wood is typically ground in accordance with intended end-use specifications. The ground material then may be passed through a screen to remove wood fines. The remains from the screen are conveyed under a magnet to extract any ferrous materials such as screws, hinges, and nails. Larger wood chips can be used as a boiler fuel, and the clean lumber is often used to produce mulch. Two C&D facilities reported recycling approximately 25,000 tons of wood in 2017. Due to the small number of processing steps for production of boiler fuel and mulch, the processing capacity can be readily expanded depending on these end-use demands.

2.4.2 Asphalt Shingles

The C&D debris recycling amounts tracked by FDEP and the County suggests that none of the asphalt shingles generated within the county are currently recycled. Although county-specific composition of the landfilled Class I and Class III waste is not available, the regional-scale studies suggest that roofing debris, which primarily consists of asphalt shingles, constitute approximately 18 percent of the landfilled C&D debris (Jain et al. 2015).

Asphalt shingles consist of an asphalt-impregnated mat, with the bottom coated with a fine mineral surface and the top coated with a colored coarser mineral fraction. Asphalt shingle roofs are typically replaced after about 20 years (NCHRP, 2013). The old shingles are typically removed (along with the roofing felt and other materials, as required) and replaced with new materials for re-roofing. In some cases, new asphalt shingles will be placed on top of the older shingles. Re-roofing projects produce a relatively large amount of uniform material over a short time. Asphalt shingles constitute a large fraction of the roofing loads (Figure 2-4).

Figure 2-4 Typical asphalt shingles re-roofing load

The asphalt content of an asphalt shingle is 19 to 36 percent by weight (US EPA, 2016). Due to their substantial asphalt content (approximately 20 percent in fiberglass shingles), the use of asphalt shingles in asphalt paving mix production has increased significantly in recent years from 0.7 million tons in 2009 to two million tons in 2014 (NAPA 2015). In addition to asphalt, shingles also provide aggregate needed for paving mix production; on average, asphalt shingles represented approximately 0.5 to 1.5 percent of pavement mixes.

Unwanted materials (e.g., roofing paper, wood pieces) are removed from the load before it is size reduced using a grinder. Nails are extracted from the ground material with a magnet. The material is then screened to obtain the desired size of end products to meet the end user's demand (Figure 2-5). Currently, shingles are not recycled in Pinellas County.

Figure 2-5 Asphalt shingles grinding operation

2.4.3 Drywall

Although county-specific composition of the landfilled Class I and Class III waste are not available, the documented studies suggest that gypsum drywall constitutes approximately 8 percent of landfilled C&D debris (Jain et al. 2015).

Gypsum drywall (also referred to as wallboard or plaster board) is a primary interior wall material in residential and commercial buildings in the United States. Drywall consists of a gypsum core, which constitutes 90 percent of the weight of the drywall product, covered on each side with a paper backing. Due to its characteristics (rigid, subject to breakage during handling) and use, partial pieces of drywall are wasted during construction, as drywall must be cut to meet the interior wall dimensions and openings of the building (US EPA 2017). A relatively large amount of drywall scrap is produced over a short timeframe as drywall is installed by a specialized subcontractor after completion of framing and electrical wiring and plumbing (Figure 2-6). Drywall from a demolition project is generally mixed with other debris as the structure is torn down.

Figure 2-6 Typical drywall load from a new construction project

Typical recovery operations involve removing the paper from the drywall followed by size reduction suitable to market demand. This separation can be accomplished with a combination of grinders and screens. Some markets where drywall recycling has been established can accommodate a small amount of clean paper without deleterious effect. Tub grinders or horizontal mills are most commonly used to reduce the size of drywall. A dust suppression or collection system is needed as part of this operation and may be regulated by air permit depending on equipment, enclosures and other operational considerations. The size-reduced drywall is then passed through a screen to separate any remaining paper from the rest of the material (Figure 2-7). Drywall recovery facilities typically produce powdered gypsum (Figure 2-8).

Figure 2-7 Drywall processing operation

Figure 2-8 Recovered powdered gypsum stockpiles

2.5 End Markets

2.5.1 Wood

Fuel source for industrial boilers or other energy production facilities including WTE and biomass facilities such as the former Ridge facility in Polk County, and colored mulch products for landscaping, are the primary markets for recovered wood. Unwanted materials are removed before processing through a wood grinder. Other uses include manufacture of new engineered wood products (e.g., OSB, fiberboard, and particle boards), compost feedstock, animal bedding, and erosion control material (Reinhart et al. 2011). Although wood components are occasionally removed from a building for eventual reuse in new construction or renovation, this application is not the primary markets for recovered wood products from C&D. The recovered wood can be combusted at WTE facilities in and around the county. There are several composting facilities that are registered/permitted to process vegetative debris and source-segregated organics. C&D wood can be processed at these facilities with minimal modifications/impacts to their current operation.

2.5.2 Shingles

The use of asphalt shingles in asphalt paving mix production is its major beneficial end use. Minor markets for ground asphalt shingles include pothole patch and surfacing material for

unpaved roads. Asphalt shingles have a relatively high BTU value and thus have the potential to be combusted for energy in waste-to-energy facilities or industrial facilities such as cement kilns. However, these practices are not common in the United States. Due to its significant energy content, shingles can be combusted for power generation at the County-owned WTE plant but are often restricted as a segregated waste under Title V permits. In Pinellas County this restriction is three percent of the daily facility load. While a suitable material for combustion, due to its higher heating value this material can displace other materials disproportionately, often 3:1 (one ton of shingles is roughly equivalent in heating value to two or three tons of MSW). Due to lack of composition data for Class III waste currently landfilled at facilities other than the Disposal Complex, the amount of asphalt shingles currently landfilled is unknown. The roofing permits issued by the County can also be used to estimate the amount of shingles generated from re-roofing projects, which are the primary sources of shingles in C&D stream. Markets for recycling into hot mix asphalt (HMA) are not readily available or active in Florida and would require development to encourage other diversion programs for shingles.

2.5.3 Drywall

Recycling markets have been developed for scrap drywall nationally, although in many cases these markets are limited to scrap from new construction. In some areas of North America (particularly the Northwest), scrap drywall is used in the manufacture of new drywall. Drywall manufacturing facilities often recycle a small amount of their scrap into the manufacturing process, and thus they can accommodate some amount of recycled material. As gypsum is an ingredient in the manufacture of Portland cement (Reinhart et al. 2011), some cement plants have attempted to incorporate gypsum from recovered drywall. This practice has been limited in the United States because of the need for a large and constant supply of uniform material. In areas where local and state governments allow the use of recovered gypsum from wallboard in land applications, gypsum from drywall has been used as a soil and plant amendment. Some recyclers (e.g., Taylor Montgomery LLC[1]) engaged in recycling drywall have marketed a gypsum powder in bulk to end-users, while others (e.g., USA Gypsum) produce specialty agricultural products (e.g., gypsum pellets) (Figure 2-9). Other markets for recovered drywall have included stucco additive, as a bulking agent for sludge, animal bedding and compost amendment (Reinhart et al. 2011). As markets in Florida are limited to non-existent, any program supporting drywall recycling will need to address market development.

[1] http://www.taylor-montgomery.com/recycled-products-stone-mulch/gypsum-paper/

Figure 2-9 Bagged gypsum

3 Potential Strategies

Potential long-term strategies that the County could consider for increased C&D recycling are to (1) enhance recovery and recycling materials such as asphalt, concrete, metals and aggregates that are currently being recovered and recycled by several facilities in and around the county, and (2) investigate the opportunity to recover and recycle wood, asphalt shingles and gypsum drywall commingled with Class I and Class III waste that is currently landfilled at the Disposal Complex and other facilities outside the county. The following programmatic options could be considered for implementation.

3.1 Implement Ordinances

Although a majority of the C&D that is currently landfilled is disposed of at facilities (in and outside the county) that are not operated by the County, the County could implement policies and ordinances to enhance recovery and recycling of C&D that is currently not managed by the County. Cochran et al. (2007) identified a number of policy options that a local community can implement to promote C&D recycling. These included disposal bans, disposal taxes, sustainable subsidized recycling, a percentage recycling requirement, advanced disposal fee/deposits, and green building initiatives. Cochran et al. (2007) also surveyed counties and cities that have implemented these programs to identify their cost and impact. This section summarizes some key policies and ordinances that the County could implement to enhance the recovery of wood, asphalt shingles and drywall.

3.1.1 Waste Prevention- Implement an Ordinance Requiring Salvage and Deconstruction

Although the waste prevention opportunities for wood, shingles, and drywall are very limited, demolition and renovation projects may offer salvage opportunities for other C&D materials. The County may require demolition contractors to post notices for impending demolitions to allow salvage of materials from the building by interested parties before demolition. The City of Cotati (California) requires that, before any public or private demolition, all materials that can be recycled shall be made available for salvage (CIWMB 2002). Seattle Public Utilities (SPU) requires a deconstruction and salvage assessment for any demolition project and construction/renovation project that includes demolition (Department of Planning and Development, 2014).

3.1.2 Deposit/Advanced Disposal Fee System

Many cities and counties in California have used a deposit/advanced disposal fee system approach to increase C&D recycling (CIWMB 2002 Cochran et al. 2007). The program has increased the C&D recycling rate by 10 percent in five counties/cities in California (Cochran et al. 2007). An ordinance would be needed to implement this system. The California Integrated Waste Management Board provides sample ordinances and gives guidelines for developing specific legislation to encourage the recovery of C&D

(https://www.calrecycle.ca.gov/lgcentral/library/canddmodel/about). The ordinance may require contractors to place a deposit for receiving a construction, demolition, or renovation permit. The deposit amount would depend on the size of the job. The terms of the deposit system would list

the amount of materials that would have to be recycled as part of the job (typically 50 to 75 percent). The County would need a verification/certification system to ensure that haulers are taking materials to recycling facilities and a reasonable assurance that the recycling facility is recycling the materials. If the contractor demonstrates that it is recycling at or above the stated goal, the deposit is returned. If not, cumulative deposits can be used to fund recycling infrastructure or other recycling efforts.

The ordinance can be structured so that requirements are met by simply taking the debris to facilities certified by the County. The certified facilities would have a County-specified diversion and recycling rate and would receive annual certification by the County. Lee County promulgated an ordinance with similar requirements that has substantially increased C&D diversion from landfills. The ordinance mandated diversion of at least 50 percent of the C&D generated from construction and alteration projects of more than $90,000 and $10,000, respectively, from landfills. A diversion fee is required before the issuance of a certificate of occupancy, or compliance if the documentation (e.g., receipts or gate tickets from the recycling facility) demonstrating compliance are not provided. Over 75 percent of applicable building project permit holders have opted to comply with the C&D diversion initiative (SWANA, 2011).

The County would likely need to appoint one-full time staff to provide education, training, and technical support to contractors who wish to start and maintain a recycling program. The County would need to identify enforcing agencies and develop plans for successful enforcement of the mandatory C&D recycling requirements. Cochran et al. (2007) reported that the program often resulted in net revenue to the counties/cities because not all contractors who received permits returned for reimbursement.

3.1.3 Mandatory C&D Processing

The County could implement mandatory C&D processing by requiring C&D generators and haulers in the county to only deliver materials to recycling facilities certified by the County. A facility would have to achieve a County-specified diversion annually to be a County-certified facility. Like Lee County, the City of Hawthorne (California) adopted a similar approach and required that no greater than 10 percent of C&D materials collected under the exclusive franchise should be taken directly to a landfill by a franchised hauler. C&D hauling in Pinellas County is currently an open market. The County may need to implement a franchised system for C&D hauling to proceed with this approach. The County would also have to identify and certify facilities that divert and recycle C&D so that haulers can meet the requirement. Starting in 1995, the City of Portland (Oregon) requires construction and demolition contractors to recycle at least 50 percent of C&D and mandates recycling of wood, cardboard, metal, rubble, and LCD (City of Portland, n.d.). In 2008, the City of Portland established a 75 percent C&D material recycling initiative. Lee County enforces recycling by approved recycling facilities by requiring routine reporting of waste receipt and recycled tonnage data to the County to demonstrate that at least 50 percent of the materials received at their facility are diverted from landfill. Enforcement of these ordinances can drive the success of the program. Programs that do not have an enforcement provision and rely on contractor diligence typically show poor compliance results. Enforcement agents can include code enforcement officers, public works construction inspectors, and/or dedicated solid waste enforcement personnel. Another key enforcement

vehicle is the community permit/building department as they collect and approve all permit activity.

Several California counties have implemented C&D diversion initiatives primarily to meet the state's targeted goal of 75 percent solid waste recycling by 2020. Some California jurisdictions set material-specific diversion goals. For example, in Alameda County, several local governments have required diversion of 100 percent of C&D concrete and asphalt and diversion of at least 50 percent of remaining C&D (StopWaste, 2016). All construction projects with costs above a specified threshold are required to meet the specified diversion goals. The County could implement mandatory recycling of project specific components for large commercial construction projects. Depending on the effectiveness of the mandate, the cost threshold can be progressively lowered to mandate recycling of C&D debris from smaller projects.

The Solid Waste Agency of Lake County (SWALCO), Illinois, amended its solid waste management plan in 2013, directing diversion of 75 percent of all C&D generated by new construction, renovation, demolition, entire re-roofing, or entire re-siding projects of 1,500 square feet or greater gross floor area within the unincorporated area of Lake County (SWALCO, 2013).

Starting in 2010, Madison, Wisconsin, established a directive for new construction projects that use concrete and steel supports to recycle 70 percent of their construction debris by weight (City of Madison, n.d.). New construction projects that use wood framing and remodeling projects valued more than $20,000 are required to recycle clean wood, clean drywall, shingles, corrugated cardboard, and metal. The city reported achieving an overall diversion rate of 66 percent for waste in 2011 (City of Madison, 2011).

Orange County, North Carolina has a regulated recyclable material ordinance that mandates recycling of clean wood waste (excluding treated, painted, or stained wood), scrap metal, and corrugated cardboard (Orange County North Carolina, 2004, 2015). The program resulted in a net cost to the County, and the County achieved a C&D recycling rate of 22 percent with the program (Cochran et al. 2007).

Similar to the other communities discussed above, Pinellas County could implement a goal-oriented universal C&D debris diversion/recycling program for materials that are currently recycled such as concrete, asphalt, metals, and wood.

3.1.4 Government Recycling Requirement

Sarasota County, Florida implemented a processor-based C&D recycling program, where a private sector contractor operating the C&D processing site at the County-owned landfill is required by contract to divert at least 50 percent of C&D delivered to the site. Although this option can be readily implemented for the Disposal Complex, the impact may be limited as the facility receives only a small quantity of C&D debris. This style of program would require a dedicated pad and support facilities as well as contractual terms regarding processing fees and consequences of not meeting diversion goals which could be bid. One additional consideration would include management of residual screened material (RSM) as often the generation of C&D fines is needed to meet these goals.

Pinellas County may find it difficult to make private-sector contractors dispose of C&D at specified locations without having an equivalent policy for all local government projects that generate C&D. This lead-by-example approach would require any new renovation, construction, or demolition work by the County to adhere to Leadership in Energy and Environmental Design (LEED®) standards for recycling. LEED is a green-building rating standard developed by the US Green Building Council (USGBC 2018). LEED is a voluntary certification program to promote a whole-building approach to sustainability by recognizing performance in key areas such as indoor-air quality, as well as, energy and water efficiency (USGBC 2018).

A number of local governments in the United States have required government buildings to meet LEED standards (http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1852). For example, in 2009, the City of Portland updated its Green Building Policy to direct recycling of at least 85 percent of all C&D from new construction and major renovations for city-owned facilities. The County could require contractors to develop a plan to recycle a percent of the C&D before starting construction, renovation, and demolition of a government building. LEED promotes the reduction of waste as well as reuse and recycling and takes into account the reduction of waste at a product's source. Pinellas County has implemented several energy conservation and climate change policies to encourage/require private "Green" development programs (http://www.pinellascounty.org/Plan/pdf_files/GreenPolicies.pdf). A strategy to lead by example would be to implement a mandatory C&D recycling goal for all construction, renovation, and demolition activities for County-owned buildings.

3.1.5 Disposal Ban

Under this strategy, the County would promulgate an ordinance banning disposal of certain C&D materials in landfills. Currently, this waste stream is hauled through an open market system, which means haulers can transport it as they see fit, including removing it from the county. A county-wide disposal ban, if implemented without flow control, would probably result in disposal of C&D in landfills outside the county unless the facilities in the county charge a competitive tipping fee for processing and recycling C&D. Examples of communities that have implemented material-specific disposal bans are the City of Seattle and King County, WA.

Seattle established a progressive ban on landfill disposal of recyclable C&D materials in 2012. Asphalt paving, brick, concrete, metal, cardboard, and new gypsum scrap were banned from disposal in a landfill within Seattle as of July 2014. Unpainted and untreated wood was banned by January 2015, and carpet, plastic film wrap, and tear-off asphalt shingles banned from disposal in 2017 (Department of Planning and Development, 2014; SPU, 2018). The materials that are painted, have hazardous constituents, are difficult to separate from others, and are present in very small quantities are exempt from the provisions of the ban (SPU, 2018).

King County banned the clean wood (clean, untreated, unpainted), cardboard, metal, gypsum scrap (new), asphalt paving, bricks, and concrete from landfill disposal in 2016. The County also required that mixed and non-recyclable C&D must be sent to County-designated material recovery facilities or transfer stations (King County, 2016).

The County could consider implementing a disposal ban on materials such as concrete, asphalt pavement, and aggregates that are currently recycled by several facilities in and around the

county to enhance recovery and recycling of these materials. The disposal ban could be progressively expanded to include materials that are not currently recycled. Material bans are difficult to legislate and may have the effect mentioned previously regarding out of county disposal.

3.2 Wood Recovery and Recycling Strategies

The primary market for recovered wood is as a fuel source for industrial boilers or other energy production facilities and colored mulch products for landscaping. These end-uses require grinding of the recovered wood. Enterprise Landfill in Pasco County, FL recovered and recycled approximately 21,000 tons of C&D wood originating from the county in 2017. This suggests that there is a market for C&D wood end-products. The County could consider engaging stakeholders (e.g., C&D recyclers, building construction contractors, landscapers) to understand and mitigate constraints for wood recovery and recycling. Ground-up clean wood can also be used as a bulking agent and composted with food waste.

The County could offer a lower tipping fee for source-segregated wood to promote wood recovery. Combustion at the County-owned WTE facility is a potential beneficial use option for the recovered wood until a higher value end-use market is available. The wood can also be processed and composted with the yard waste at the Disposal Complex.

3.3 Shingles Recovery and Recycling Strategies

The use of asphalt shingles in asphalt paving mix production is its major beneficial end use. The County could engage stakeholders (public works department, HMA plant operators, roofers) to identify and mitigate constraints hindering the use of shingles for HMA production. While currently asphalt shingle recycling markets are limited, shingles represents a material that can boost diversion if incorporated into a program. Programs could offer incentives to roofers (e.g., lower tipping fee, recognition awards) to remove contaminants (e.g., wood, tar paper) during reroofing and haul clean loads of shingles to the Disposal Complex which would make materials more readiliy available to be processed. The County could rent a shingles grinder once an adequate amount of shingles are stockpiled and provide the ground-up shingles to HMA plant operators or clean shingles loads can be directly delivered to the HMA plants for further processing. A water supply may be needed for dust suppression and for controling shingles temperature during the grinding process (IWCS 2010).

Currently, the Florida Department of Transportation does not allow or have specifications on recycled asphalt shingles in their mixes. The lack of specification by FDOT is one of the major reasons for limited recycling of tear-off asphalt shingles in HMA in Florida. Some commercial and residential mixes do allow use. Highlands County (Florida) recycled asphalt shingles for production of hot mix asphalt at a County-owned plant (Germaine 2012).

Presence of asbestos and agglomeration of ground-up shingles are the key challenges for grinding roofing shingles. Based on a review of data from over 28,000 samples, IWCS (2010) reported that asbestos was detected in only 1.52 percent of the samples. The shingles processing facilities are typically required to routinely sample and characterize incoming shingles for asbestos. The sampling frequency is facility-specific and varies from state to state.

Fine sand is typically mixed with size-reduced shingles to minimize agglomeration before its use in HMA production. The use of recycled asphalt shingles (due to aging of asphalt in recycled shingles) has been reported to increase the HMA stiffness, which may result in pavement cracking (Bezadan et al. 2012).

3.4 Drywall Recovery and Recycling Strategies

The production of powdered gypsum (for use in production of new drywall and in agricultural operations) is one of the primary products of scrap drywall from new construction. The drywall from new construction is typically generated over a short span of time during building construction and is relatively clean until it is mixed with other C&D materials at the construction site. The County could engage stakeholders (e.g., drywall contractors, prime contractors, C&D disposal facilities, farmers) to understand and mitigate constraints for recycling scrap drywall from new construction projects.

4 Next Steps

The following steps are recommended to address the current data gaps and to assess the viability of recovering and recycling C&D materials that are currently recycled by several local or nearby facilities and the materials that are not currently recycled including shingles and drywall.

4.1 Implement Policies to Enhance Recovery and Recycling

The County could consider implementing programs and policies such as disposal bans, universal C&D debris processing and recycling, and a deposit/advanced disposal fee system to enhance the recovery of materials such as concrete, asphalt, metals, aggregates, and wood that are currently recycled by several local facilities. Depending of the effectiveness of these programs, the County could extend these for the materials that are not currently recycled.

4.2 Wood, Shingles, and Drywall Generation Rate Estimation

A small amount of C&D wood was recycled in 2017, and no drywall and shingles recycling was reported in 2017. This suggests that these materials are either landfilled or combusted. The recycling needs and strategies discussed above are based on the assumption that C&D constitutes a majority of the Class III waste that is currently landfilled. The County could consider the following assessment for developing a reliable generation rate estimate for wood, shingles, and drywall generated in the county.

1. Monitor the amount of Class III waste that leaves the county. Survey the haulers who deliver these loads out of county to confirm type of waste being disposed. A detailed characterization of Class III waste that is landfilled could be performed .
2. The re-roofing permits issued by the County and its municipalities could be analyzed to estimate the total roof area that is re-roofed on an annual basis. This data can then be used to estimate the annual asphalt shingles generation rate.

3. Pinellas County requires permit applications and approval of any building demolition[2]. The permit applications typically list the demolition area. This data can be used to estimate the C&D generated from demolition activity. This stream of debris may constitute a large fraction of Class III waste generated in the county.

4.3 Recovered Shingles Market Analysis

The production of HMA is one of the major uses of the recovered shingles. The County could consider engaging roofers and HMA plant operators within the county for exploring the technical feasibility of this end use. The end-user of HMA (Public Works Department) could be engaged to develop the specifications for allowing use of asphalt shingles (e.g., maximum shingles content) for the production of HMA for County road construction/resurfacing projects.

4.4 Recovered Wood Market Analysis

Fuel and colored mulch production are the largest markets for recovered C&D wood. One of the facilities that accepted C&D from Pinellas County reported recycling 21,000 tons of wood in 2017. The County could consider collaborating with this and other C&D facilities to explore opportunities to enhance wood recovery and recycling.

4.5 Recovered Drywall Market Analysis

The County could work with C&D recyclers in the county to explore opportunities and “appetite” (production of powered gypsum for use in production of new drywall and as agricultural operations) to recover and recycle drywall. As a market does not readily exist, part of the challenge in diverting drywall would be the establishment of a market either as a County activity or in collaboration with C&D processors.

[2] http://www.pinellascounty.org/build/faq.htm

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