

Issue Paper #3

Construction & Demolition Debris Recycling

3.1 Overview

Construction and demolition (C&D) debris represent a waste stream that poses materials handling challenges, yet also offers many diversion opportunities. The New York State Department of Environmental Conservation (DEC) defines C&D debris as:

“uncontaminated solid waste resulting from the construction, remodeling, repair and demolition of utilities, structures and roads; and uncontaminated solid waste resulting from land clearing. Such waste includes, but is not limited to bricks, concrete and other masonry materials, soil, rock, wood (including painted, treated and coated wood and wood products), land clearing debris, wall coverings, plaster, drywall, plumbing fixtures, non-asbestos insulation, roofing shingles and other roof coverings, asphaltic pavement, glass, plastics that are not sealed in a manner that conceals other wastes, empty buckets ten gallons or less in size and having no more than one inch of residue remaining on the bottom, electrical wiring and components containing no hazardous liquids, and pipe and metals that are incidental to any of the above.”

The composition of the C&D waste stream may vary over time and from region to region because quantities disposed are directly influenced by the national and local economy and, as a result, by the scope of residential and commercial building activities that are occurring in any given region. In a C&D visual waste characterization study conducted by R. W. Beck, Inc. for Bartow County, Georgia in 2008, the top five materials by weight in the C&D waste stream were:

1. Non-treated wood (29.6%)
2. Treated wood (16.1%)
3. Asphalt shingles (13.6%)
4. Pressboard and other sheet lumber (6.7%)
5. Gypsum Board (5.6%)

Wood waste comprised nearly 46 percent, with asphalt shingles at nearly 14 percent. Similarly, a study in 2002 for the State of Vermont¹ resulted in wood (treated and non-treated) comprising 43 percent of the C&D stream, asphalt shingles comprising 21 percent, and drywall comprising 5 percent. Based on these two studies, as well as

¹ Source: Vermont Waste Composition Study, Final Report, June 2002.
<http://www.anr.state.vt.us/dec/wastediv/solid/pubs/VTWasteCompReport.pdf>

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other sources, it is R. W. Beck's opinion that these percentages are representative of typical C&D waste stream composition.

Other recoverable materials include old corrugated cardboard (OCC) and metals, however they typically make up a small percent of the C&D waste stream. The quantities of OCC and metals that have been estimated in several C&D waste composition studies are shown in Table 3-1.

Table 3-1
C&D Waste Composition Data for OCC & Metals¹

	Bartow County, GA (2008)	State of Minnesota (2000)	State of California (2005)	Des Moines, Iowa (2002)
OCC	2.0%	5.0%	3.0%	6.0%
Metals	3.4	7.0	4.0	5.0

¹ Sources of data include R. W. Beck and "Minnesota Construction, Demolition, and Industrial Waste Study," Minnesota Solid Waste Management Coordinating Board, 2007.

Presently, C&D material is accepted at the Broome County Landfill (Landfill) and is not required to be separated, except for asbestos. Friable asbestos must be wetted down and double-bagged in accordance with New York State regulations, and each load must be accompanied with a manifest. The current tipping fee for friable asbestos is \$100 per ton. Non-friable asbestos must also be separated from other waste, but does not require a manifest. The tipping fee for non-friable asbestos is \$45 per ton. All other C&D material is currently disposed in the active cell at the Landfill along with the municipal solid waste (MSW). An estimate of the County's C&D waste composition is not known since C&D is not required to be separated from MSW. The Landfill tipping fee is currently the same for C&D and MSW, at \$40 per ton.

Many U.S. communities are actively focusing on recovery of select materials within the C&D waste stream. Approaches include upstream diversion through enactment of ordinances mandating source separation of recoverable materials (i.e., wood, OCC, metals, etc.) at the job site. These materials are then processed and transported to an end market. An additional approach is processing the materials downstream (at a landfill or transfer station) to identify and separate (mechanically and manually) recoverable materials.

This issue paper will discuss the various diversion opportunities for C&D waste available to Broome County (County).

3.2 Opportunities to Increase Upstream Diversion of C&D Debris

Separating C&D debris for recycling or reuse at the job site of a construction, demolition, or remodeling project may be the most direct way to divert C&D debris from being disposed in a landfill. In recent years, there has been more deconstruction taking place as an alternative to demolition. Deconstruction is when a building is dismantled in order to salvage the materials for reuse. Many developers are deconstructing buildings to earn Leadership in Energy and Environmental Design (LEED) credits as part of the U.S. Green Building Council's Green Building Rating System.

While separating C&D provides an opportunity for the contractor or builder to save money on disposal costs, the decision to separate C&D is most likely going to be determined by the following considerations:

- Are there space constraints? Space is often limited, so it is not always feasible to have separate dumpsters or roll-off containers for several different types of material on-site. The rental cost of having the collection containers on site for several days or weeks is also a financial consideration for the contractor.
- Will separating the waste require additional labor or take longer? Often a contractor is under a deadline to complete a project, and a time delay could result in lost rent on a piece of property. The extra time to separate waste may become an issue. Deconstruction, in most cases, takes longer than demolition.
- Does the material have value? A developer may choose to separate the C&D waste if there are large quantities of a material that has value. Deconstruction can be profitable, especially if the value of the salvaged material covers the cost of the labor to dismantle it.

The materials that are most often recycled from new construction projects include wood, metal, drywall, and cardboard while renovation projects tend to generate more concrete and rubble in addition to the other materials.

Often during renovation projects, there are items which can be reused. Habitat for Humanity operates building supply outlets called ReStores which accept donated materials including fixtures, cabinets, countertops, plumbing, drywall, doors, windows, etc. and re-sells them with the proceeds benefiting Habitat for Humanity. The nearest ReStore to Broome County is in Syracuse². Other reuse options in the County include:

- Binghamton Freecycle – Internet site that allows people to post items to be given away or find items they need. All items must be free.
<http://groups.yahoo.com/group/binghamtonfreecycle/>
- Preservation Association of the Southern Tier (PAST) – Non-profit organization serving Broome and Tioga Counties working to preserve historic architecture.

² Source: <http://www.habitat.org/cd/frame/frameset.aspx?url=www.syracuserestore.org>

The group will salvage/reclaim certain materials from buildings before they are torn down.

www.pastny.org

- Western/Central New York Materials Exchange – Internet site for businesses to exchange unwanted or unusable products that would otherwise be discarded, and/or locate free or inexpensive materials that can be used in daily business operations.

<http://www.mat-ex.org/>

Some cities and counties have passed ordinances mandating source separation of recoverable C&D materials at the job site. While this can be a significant step to increasing diversion, it is imperative that there are adequate end markets or C&D recycling facilities in the area to process the types and quantities of C&D material collected. An in-depth market assessment should be conducted prior to adopting an ordinance because management alternatives need to be available if diversion mandates are implemented. Section 3.3 of this paper explores local end-markets for the C&D materials that typically comprise the largest part of the C&D waste stream.

Section 3.11 (Resources) provides examples of C&D separation ordinances and tools used by other jurisdictions for increasing upstream C&D diversion.

3.3 Opportunities to Increase Downstream Diversion of C&D Debris

When considering implementing a C&D diversion program for materials that are not separated before disposal, the County should not only determine what comprises the largest portion of the C&D waste brought to the Landfill, but also what markets are available in the region for recycling or reusing the material and the costs of processing the materials.

Per the NYS DEC website, there are nine registered C&D processing facilities located in DEC Region 7 (Broome County is in Region 7). The majority of the companies listed below process either aggregate or wood waste.

1. Earth Blends, Inc. in Jordan (biosolids and yard waste)
2. Alpha Portland Cement in Jamesville (concrete, asphalt, clean soil, rock)
3. Clifton Recycling, Inc. in Syracuse (wood pallets and crates)
4. Crushed Products, Inc. in Syracuse (concrete, brick, rock)
5. Kinsella Barrett Plant in Jamesville (no waste type listed)
6. Kinsella Quarry in Fayetteville (asphalt, concrete, rock clean soil)
7. RE-UZ-IT Recycling, Inc. in Syracuse (asphalt, concrete, brick)
8. McIntosh Box & Pallet Co. in Bernhards Bay (wood pallets and crates)
9. Superior Disposal C&D Processing in Newfield (no waste type listed)

R. W. Beck created two categories for analyzing the marketability of materials. The two categories are designed to focus on the materials with the greatest potential impact to the diversion of C&D debris. The material categories, Tier 1 and Tier 2, are based

on prevalence in the waste stream as identified in field observations from other studies. Tier 1 materials as those that typically represent five percent or greater of the waste stream, by weight and Tier 2 materials as those that represent less than five percent of the waste stream, by weight.

3.3.1 Tier 1 C&D Materials

The list of Tier 1 materials is presented in Table 3-2. From the results of C&D studies conducted by R. W. Beck and others, there are typically five material categories that comprise more than five percent of the C&D waste stream, as shown below.

**Table 3-2
Tier 1 C&D Materials**

Material
1. Non-Treated Wood
2. Treated Wood
3. Asphalt Shingles
4. Pressboard and other sheet lumber
5. Gypsum Board

Possible markets for each of these materials are described below.

3.3.1.1 Non-Treated Wood

The end-markets identified for recovered non-treated wood include:

- Mulching and Composting – where the wood material is ground into mulch and used for horticultural or agricultural purposes.
- Pallet Recycling – where intact pallets are refurbished and reused as pallets.
- Energy Generation – where wood material is accepted at facilities that burn the wood for its fuel value (e.g., industrial boilers, power plants, or biomass³ facilities).

For mulching and composting, the County could elect to mulch wood as part of the C&D diversion process or deliver it unprocessed to a mulcher/composter. If the County elected to mulch wood prior to shipping it off-site, the County would incur operations and maintenance costs and possibly capital costs associated with such an operation. The Landfill does own a grinder, compost turner and screen. Further research would be required to determine the typical size of the incoming wood waste and the processing capacity of the County's grinder.

³ Biomass is organic matter produced by plants and animals and includes wood, crops, manure and some types of MSW.

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If the County elected to deliver the non-treated wood to a mulcher or composter, it is most likely the mulchers and composters would charge a fee for accepting unprocessed non-treated wood. In most instances, the County would be responsible for the delivery of the materials. Local mulchers and composters that may provide options for diversion include:

- Pro-Mulch, Inc.
<http://www.pro-mulch.com/>
- R&R Mulch Sand and Gravel
<http://www.rrlawnsvc.com/>
- Robinson Hill Nursery located in Johnson City, NY. (no website)

In contrast to mulching and composting end markets, some pallet recyclers pay for reusable pallets. Options for the County to consider include:

- Malchak Salvage Company in Binghamton.
- Wholesale Mulch & Sawdust in Owego.
- The Western/Central New York Materials Exchange. This on-line service is free and lists materials “wanted” and “available.” Often times there are listings under “Pallets Wanted.” The County may be able to find an outlet for reusable pallets through this resource.
<http://www.mat-ex.org/>
- U.S. Pallet Recycling Directory.
<http://www.palletbuyersguide.com/usa/index-newyork.html>
- Clifton Recycling, Inc. in Syracuse.
<http://cliftonrecycling.com/Index.html>
- McIntosh Box & Pallet Co. in Bernhards Bay.
<http://www.mcintoshbox.com/>

The processors in Syracuse and Bernhards Bay were listed for reference, however long-hauling pallets for reuse may not be cost effective.

Depending on the location of appropriate facilities, the most viable market for untreated wood may be energy generation. Some coal plants co-fire with biomass, so that could be an option for the County to consider. Most end-users of untreated wood require that the material have no nails, plaster or other building materials attached. For energy generation, the wood would most likely be required to be less than two feet in length. If used as an energy source, the wood should be a revenue generator, excluding transportation and processing costs. Local energy producers include:

- New York State Electric and Gas (NYSEG)
<http://www.nyseg.com/>
- National Grid
<https://www.nationalgridus.com>

3.3.1.2 Treated Wood

Because of the chemicals used to treat wood, it is typically not accepted for energy generation or mulching. The State DEC defines treated wood as “wood combined with chemical compounds (e.g., copper chromium arsenate (CCA) or pentachlorophenol (PCP) treated woods)” and unadulterated wood as “wood that is not painted or treated with chemicals such as glues, preservatives or adhesives. Any painted wood or chemically treated wood (e.g., pressure treated wood, treated railroad ties) or wood containing glues or adhesives (e.g., plywood, particle board) is considered adulterated wood.”⁴

Per the DEC, “In New York State, CCA-treated wood may be disposed of in construction & demolition (C&D) debris landfills and municipal solid waste landfills which are authorized to accept construction and demolition debris.”⁵

Thus, to market the non-treated wood to one of the markets described above, the County would need to take care to separate the treated wood from the untreated or unadulterated wood at the Landfill.

3.3.1.3 Asphalt Shingles

Because of their asphalt content (19 to 36%)⁶, shingles are often used in hot mix asphalt for paving or in pothole patch materials. Most state department of transportation specifications allow no more than 5% recycled asphalt shingles to be used in paving projects.⁷ The NYS DEC has granted four beneficial use determinations (BUDs) for using asphalt shingles in New York as shown in Table 3-3:

Table 3-3
Beneficial Use Determinations for Asphalt Shingles Granted by New York DEC¹

DEC Region	Facility Name	City	Beneficial Use
9	Natural Environmental, Inc.	Buffalo	Base (Road)
9	Modern Landfill, Inc.	Model City	Landfill Base (Road-Parking)
4	King Road Materials, Inc.	Albany	Asphalt (Hot-Mix) Concrete
9	Parker Bay Consultants, Inc.	Buffalo	Base (Road; Sub)

¹ Source: DEC BUD website: <http://www.dec.ny.gov/chemical/8821.html>

The New York State Recycling Markets Database⁸ provides listings of companies that collect, process, remanufacture, reuse or export asphalt shingles. The companies listed that are nearest to Broome County include:

⁴ Source: NY State DEC website: <http://www.dec.ny.gov/chemical/31238.html>

⁵ Source: NY State DEC website: <http://www.dec.ny.gov/chemical/8790.html>

⁶ Source: Northeast Recycling Council: <http://www.nerc.org/documents/asphalt.pdf>

⁷ Source: NAHB Research Center: http://www.epa.gov/osw/conserve/rrr/imr/cdm/pubs/roof_br.pdf

⁸ Source: NYS Recycling Markets Database website: <http://appcenter.nylovesbiz.com/esdrecycling/>

- Contento's in Cortland (collector and/or intermediate processor);
- Feher Rubbish Removal in Syracuse (collector and/or intermediate processor); and
- United Industrial Services in Syracuse (collector, intermediate processor, remanufacturer, reuse, and/or exporter).

Although it may not be economically feasible to divert asphalt shingles at this time, the opportunities to recycle shingles continue to grow and the County should monitor these markets in the future.

3.3.1.4 Pressboard and Other Sheet Lumber

Similar to non-treated wood, the primary end markets for pressboard and other sheet lumber is energy generation. This material can be sorted with clean lumber.

3.3.1.5 Gypsum Board

Some states have considered banning gypsum board (also called drywall, wallboard, or plasterboard) from landfills because of the development of hydrogen sulfide gas when gypsum is mixed with moisture. While the gas is not lethal at low levels, the strong sulfur odor can be a nuisance and generate complaints from residents living or working nearby.

Currently, wallboard is viewed as one of the more difficult materials to recycle in the C&D waste stream because some wallboard has more contaminants than others. For example, construction wallboard is typically free of contaminants, while some demolition wallboard may be contaminated with lead-based paint, asbestos, or other toxins.

R. W. Beck researched gypsum recycling in New York and found two gypsum wallboard recyclers in New York and one in Pennsylvania:

1. Gyp-Pak Container in Tonawanda, NY;
2. Taylor Recycling Company in Montgomery, NY; and
3. Agri-Marketing in Reinholds, PA.

Andela Products located in Richfield Springs, New York manufactures gypsum board recycling equipment and may be a resource for the County in finding local end-users of drywall.

The County's local market area for recovered gypsum board appears to be undeveloped, therefore landfilling this material appears to be the most cost effective disposal option at the current time. The County should continue to monitor the market for drywall recycling and if it becomes economically feasible, the Landfill could consider recovering this material (most likely uncontaminated wallboard) in the future.

3.3.2 Tier 2 C&D Materials

Table 3-4 lists the Tier 2 materials that R. W. Beck has defined as those that represent less than five percent of the C&D waste stream, by weight, based on field sampling. Most of these materials typically comprise less than one percent of the total C&D debris disposed.

Many of the materials listed in Table 3-4 are recyclable, however small amounts have been found in C&D field observations, so are listed here. It should be noted that the Broome County Landfill does not permit the landfilling of office paper, newspaper, OCC, phone books, yard waste, tires, etc.

Table 3-4
Tier 2 C&D Materials

Material
Yard Waste
Ferrous Metal
Carpet
Non-Reinforced Concrete
MSW
OCC
Rubber
Other Masonry
Soil
Glass
Plastic - Other Plastic Products
Brick
Reinforced Concrete
Expanded Polystyrene
Textile
Durables - Electrical Appliances, Computer, TV's
Office Paper
Tile
PVC
Other Paper
Crushable Inerts
Asphaltic Concrete
Linoleum
Plastic Film/Wrap/Bags
Other Inerts
Insulation
Tires
Non-Ferrous Metal
Newspaper
Aluminum
Wood Packaging
Phonebooks
Food Waste
Brush

**Table 3-4
Tier 2 C&D Materials**

Material
Dirt/Fines
Drywall/Sheetrock
Household Hazardous Waste (HHW)
Magazines
Other Non-C&D
Other C&D
Rock

3.3.2.1 Materials with Existing Markets

R. W. Beck identified the C&D materials in which markets typically exist. However, because individually these materials comprise such a small amount of the C&D waste stream, it may be difficult to stockpile any one material at the Landfill until marketable quantities are collected. For some materials, such as metal or paper, it may be more feasible for different grades of a material to be combined and marketed as a mixed-grade material (e.g., newspaper, magazines, office paper). Additionally, there are certain fixed and variable costs (e.g., sorting personnel) associated with recovering material. Thus, although recoverable, the cost of recovery for many of the Tier 2 materials may exceed the revenue and/or cost avoidance associated with the material. Table 3-5 lists local market locations or uses for certain Tier 2 materials.

Table 3-5
Materials with Existing Local Markets or Uses

Material	Market Location
Yard waste	Onsite (at Landfill)
Ferrous and Non-Ferrous Metal, Aluminum	Haul to Local Processor
OCC	Haul to Local Processor
Office Paper, Other Paper, Newspaper, Phone Books, Magazines	Haul to Local Processor
Tires	Onsite (at Landfill)
Glass bottles	Haul to Local Processor
HHW	Onsite (at Landfill)
MSW	Onsite (at Landfill)
Soil	Onsite (at Landfill)

3.3.2.2 Materials That Can Be Used At the Landfill

Aggregate materials from the incoming C&D (including reinforced and non-reinforced concrete, bricks, and asphalt concrete), could be sorted at the Landfill. Collected aggregate of a suitable size could be used to off-set some of the Landfill's purchase of gravel or stone, or possibly reduce the amount of shale currently being mined for use on Landfill access roads. Recycled concrete is sometimes marketed as an alternative to mined gravel. Because the quality of the aggregate material is not fully known, it will not be assumed to generate revenue but could prove useful for landfill operations.

3.3.2.3 Materials with Underdeveloped Markets

Currently, many Tier 2 materials have underdeveloped markets. Some examples are carpet, plastic film, and expanded polystyrene (Styrofoam). Even though the Tier 2 materials with underdeveloped markets may not be recovered initially, the County may recover them in the future if the tonnages and available markets make it feasible to recover the material.

Potential processors include:

- North Brook Farms in Auburn, NY (carpet)
<http://www.northbrookfarms.com/>
- CNY Resource Recovery Inc. in Syracuse, NY (plastic film)
<http://www.cnyresourcerecovery.com/index.php>
- Plasticsycle in Auburn, NY (polystyrene)
<http://www.plasticsycle.com/>
- Thermal Foams, Inc. in Cicero, NY (polystyrene)
<http://www.thermalfoams.com/>

3.4 Implementation Requirements

The County should consider a dual approach, focusing on both potential upstream and downstream C&D debris diversion program options. Upstream diversion would most likely require increased public education, possible ordinance changes, and political will. Downstream diversion would require increased equipment and processing costs.

It is recommended the County establish a task force composed of stakeholders including C&D generators (developers and contractors), haulers, C&D recyclers and processors, etc. The task force should be charged with identifying barriers to recovery of C&D materials and recommended approaches to foster recovery. The task force could also be asked to make specific recommendations related to the County's ordinances for fostering upstream source separation and recovery.

Implementing an upstream C&D diversion program would require additional staff time to research the issues, find markets, possibly develop ordinance language, etc.

Implementing a C&D debris diversion program at the Landfill would require additional staff time to research equipment options and determine capital expenditures and operating costs. Section 3.6 of this paper discusses public/private ownership and operation options. If the County considered this option, staff time would be needed to develop and distribute a Request for Information (RFI) to firms with capabilities and interest in providing the services of processing mixed C&D for recovery.

3.5 Capital and Operating Expenses

The capital and operating expenses to implement a C&D diversion program would be dependent on the extent of the program. Estimates are provided below for both upstream and downstream diversion programs.

3.5.1 Upstream Diversion of C&D Debris

As mentioned in Section 3.4, Implementation Requirements, an upstream diversion program would require additional staff time for program and policy development, public education, possible C&D waste audits, possible ordinance creation and enforcement, etc. It is not anticipated that there would be a need for many capital expenditures, however the additional staff time would result in higher program operations costs.

3.5.2 Downstream Diversion of C&D Debris

3.5.2.1 Capital Expenses

A large capital expense for diverting C&D materials at the Landfill would be the purchase of a wood or tub grinder. Based on information provided by C&D processing equipment manufacturers, and information from other sources, it is estimated that a grinder may cost between \$250,000 and \$750,000, depending on the size and horsepower. A portion of the capital cost for equipment may be eligible for

funding under the NYS DEC's Municipal Waste Reduction and Recycling (MWR&R) grant program.

An array of rolling stock and heavy equipment may be required to separate C&D debris at the Landfill. Some items may not be necessary if the Landfill already owns certain pieces of equipment, but Table 3-6 lists the basic rolling stock required.

Table 3-6
C&D Diversion
Heavy Equipment and Rolling Stock Cost Estimates¹

Description	High Acquisition, Each	Low Acquisition, Each
Front-end loader	\$350,000	\$250,000
Excavator with grapple	\$305,000	\$175,000
Skid-steer with bucket	\$45,000	\$35,000
Roll-off truck	\$138,000	\$90,000
Roll-off containers	\$6,000	\$4,500
Road tractor	\$120,000	\$90,000
Transfer trailer	\$80,000	\$65,000

¹ Source: R. W. Beck research.

The road tractor and transfer trailer would be necessary if the County were to transport processed materials to a local end market. Other expenses that were not estimated but should be considered include equipment acquisition costs and annual debt service.

3.5.2.2 Operating Expenses

The operating expenses to implement a C&D diversion program at the Landfill would be dependent on the extent of the program.

Personnel

Operating expenses may include the following staff positions:

- Heavy equipment operator – loader
- Heavy equipment operator – excavator
- Roll-off driver
- Spotter/general site laborer

The use of labor from community service workers, sentence-to-serve, or prison inmate labor could significantly reduce the operating expenses.

Processing Equipment Operating Cost Estimate

Grinders and shredders typically have relatively high operating costs because they use high horsepower motors and have cutting teeth or other wear parts that need to be regularly replaced.

Based on information supplied by equipment manufacturers and information obtained from operators of similar facilities, it is estimated that the operating costs could range from \$2 per ton processed to \$4.50 per ton processed.

Rolling Stock and Heavy Equipment Operating Cost Estimates

Based on information obtained from several sources, including equipment manufacturers and other public entities conducting similar operations, the operating costs in Table 3-7 were developed. For purposes of estimating rolling stock operating cost, it is assumed that rolling stock will be used to transport materials around the site and for hauling commodities to local markets (average about 20,000 miles per year initially). The County rolling stock is not expected to be used for long-haul trucking.

**Table 3-7
C&D Diversion
Heavy Equipment and Rolling Stock Operating Costs¹**

Description	High Operating, Each	Low Operating, Each
Front-end loader	\$77,000	\$63,000
Excavator with grapple	\$30,800	\$25,200
Skid-steer including bucket attachment	\$9,020	\$7,380
Roll-off truck	\$26,400	\$21,600
Roll-off containers	\$ 220	\$180
Road tractor	\$26,400	\$21,600
Transfer trailer	\$2,200	\$1,800

¹ Source: R. W. Beck research.

3.6 Evaluation of Public/Private Ownership and Operation Options

Public-private partnerships may be an option for the development of a downstream C&D diversion program. Typically, such partnerships would utilize the financing advantages of the public sector entity (i.e., lower cost of capital) and the operational expertise of the private sector.

One approach for the County to consider is to distribute a Request for Interest (RFI) to firms with capabilities and interest in providing the services of processing mixed C&D for recovery. The approach could include an incentive in which the County provides the land for use at a minimal cost and then contracts with a private firm to operate the processing facility. One example of this type of public/private partnership can be found in LaCrosse County, Wisconsin (website address is provided in Section 3.11, Resources).

3.7 Marketable Materials from Downstream Diversion

Based on the market assessment in Section 3.3 of this paper, a list of target materials was developed and consolidated into practical sorting categories. R. W. Beck assumed that only materials with a positive value or that have an immediate use (e.g., aggregate) would be separated at the Landfill. Material not sorted would be managed as residue and transported to the working face for disposal.

The values listed below for sorted materials are estimates based on national prices and published indices⁹ for certain materials.

- Clean Wood, to be marketed as boiler fuel: \$5 per ton.
- Aggregate: \$0 per ton marketed, however the County would benefit from avoided cost of purchasing gravel or stone to be used on-site.
- Ferrous/Non-Ferrous Metal to be marketed locally: \$80 - \$90 per ton.
- Cardboard, to be marketed through existing materials recovery facility (MRF): \$30 - \$35 per ton.
- Mixed Paper, to be marketed through existing MRF: \$5 - \$10 per ton.
- Plastic, to be marketed through existing MRF: \$0 - \$200 per ton.

At the time of this writing, the market prices for most recyclable materials are depressed and some commodities are at historically low prices, nationwide. A year ago, ferrous scrap metal would have garnered close to \$120 per ton and cardboard was also near \$120 per ton.

The price per ton received for cardboard, mixed paper and plastic will vary depending on the cleanliness of the materials and where the materials are delivered. The Waste Management (WM) Recycle America MRF in Binghamton accepts paper and plastic materials commingled (materials do not need to be separated by material type) and transports the materials to its sorting facility in Syracuse. Currently, the County has a contract with WM Recycle America and the County pays a processing fee but does not receive any revenue from the sale of the recyclable materials. There are three other MRFs in the region that process recyclable materials in two streams (fiber and containers), plus one company that exclusively handles scrap paper. It is possible the County could receive little, if any, revenue for the mixed paper and plastic from any of the local MRFs because of the market prices (especially at current market prices, first quarter of 2009) and the cleanliness of the materials, however the County should certainly receive revenue from the sale of corrugated cardboard diverted from the C&D waste stream.

⁹ Cardboard and mixed paper pricing source: Official Board Markets, New York Region, March 2009. Metal and plastic pricing source: Waste & Recycling News' Secondary Materials Online, March 2009.

3.8 Diversion Potential

Although the County does not require C&D debris to be separated from MSW, the Landfill does track the tonnage of mixed C&D debris that comes in as dedicated loads from area contractors. In 2007, the Landfill accepted approximately 22,400 tons of dedicated C&D debris. (The Landfill also received C&D mixed with MSW, however the quantities are unknown because the loads were recorded as MSW tons.) For planning purposes, R. W. Beck applied the C&D percentages from the 2008 Bartow County, Georgia visual C&D waste characterization study to Broome County's 2007 C&D debris tonnage, as shown in Table 3-8.

Table 3-8
Estimate of C&D Tonnage, by Material Type
Accepted at the Broome County Landfill

Tier 1 Materials	Projected Tonnage	Percent of Total
Non-Treated Wood	6,642	29.60%
Treated Wood	3,613	16.10%
Asphalt Shingles	3,052	13.60%
Pressboard and other sheet lumber	1,503	6.70%
Gypsum Board	1,257	5.60%
<i>Tier 1 Materials Sub-total</i>	<i>16,066</i>	<i>71.60%</i>
Tier 2 Materials	Projected Tonnage	Percent of Total
Yard Waste	808	3.60%
Ferrous Metal	740	3.30%
Carpet	516	2.30%
Non-Reinforced Concrete	494	2.20%
MSW	471	2.10%
OCC	449	2.00%
Rubber	314	1.40%
Other Masonry	292	1.30%
Soil	247	1.10%
Glass	247	1.10%
Plastic - Other Plastic Products	224	1.00%
Brick	224	1.00%
Reinforced Concrete	157	0.70%
Expanded Polystyrene	157	0.70%
Textile	135	0.60%
Durables - Electrical Appliances, Computer, TV's	112	0.50%

Table 3-8
Estimate of C&D Tonnage, by Material Type
Accepted at the Broome County Landfill

Tier 1 Materials	Projected Tonnage	Percent of Total
Office Paper	112	0.50%
Tile	112	0.50%
PVC	112	0.50%
Other Paper	90	0.40%
Crushable Inerts	67	0.30%
Asphaltic Concrete	67	0.30%
Linoleum	45	0.20%
Plastic Film/Wrap/Bags	45	0.20%
Other Inerts	22	0.10%
Insulation	22	0.10%
Tires	22	0.10%
Non-Ferrous Metal	22	0.10%
Newspaper	0	0.00%
Aluminum	0	0.00%
Wood Packaging	0	0.00%
Phonebooks	0	0.00%
Food Waste	0	0.00%
Brush	0	0.00%
Dirt/Fines	0	0.00%
Drywall/Sheetrock	0	0.00%
HHW	0	0.00%
Magazines	0	0.00%
Other Non - C&D (please Specify)	0	0.00%
Other C&D	0	0.00%
Rock	0	0.00%
<i>Tier 2 Materials Sub-total</i>	<i>6,328</i>	<i>28.20%</i>
Total	22,394	99.80%

Note: Totals may not sum due to rounding.

As stated previously, the composition of C&D debris in the waste stream varies over time and from region to region. The tons and percentages shown in Table 3-8 may provide the County with an approximation of what the Landfill's mixed C&D waste stream might consist of. R. W. Beck recommends the County conduct its own visual characterization of the mixed C&D loads disposed at the Landfill in order to provide a more accurate depiction. A C&D waste characterization would offer the County

insight to the types of materials that could potentially be diverted from the Landfill if local markets and end-users exist.

The diversion potential of a C&D debris program will be determined by how much staff time and financial resources the County plans to dedicate to the program. The County would certainly see an increase in diversion if either an upstream or a downstream diversion program were implemented.

Diversion potential will depend on the following implementation options:

- Increased public education;
- Mandatory C&D materials separation;
- Existence and throughput capabilities of local C&D processors;
- Existence of markets/end-users; and
- Public/private partnerships.

One of the reasons for implementing a C&D debris diversion program is to conserve remaining space in the Landfill. Because C&D is assumed to consume more air space per ton than MSW, the effective air-space savings of diverting C&D will be more pronounced.

Also, if the County can use shredded C&D as daily cover (discussed in Issue Paper #4), the life of the Landfill can be further increased.

3.9 Addressing Stakeholder Concerns

The stakeholders most impacted by a C&D diversion program include C&D generators (developers and contractors), haulers, C&D recyclers and processors, and the Landfill Citizen Advisory Committee. As mentioned in Section 3.4, Implementation Requirements, it is recommended that the County establish a task force to discuss the issues associated with establishing C&D diversion programs. The purpose of the task force meetings is to address concerns which may include, but not be limited to:

- Resistance from developers to a mandatory C&D debris separation requirement (if an ordinance were developed);
- Concerns from cities, towns and villages regarding potential increase in duties to monitor mandatory C&D debris separation (if an ordinance were developed);
- Concerns from developers regarding anticipated cost increases to provide roll-off containers or dumpsters for multiple C&D materials at job sites;
- Concerns from haulers required to collect and haul source-separated materials (if an ordinance were developed); and
- Concerns from processors regarding the cleanliness of recyclable materials recovered from C&D separation at the Landfill.

3.10 Benefits and Drawbacks

Diverting C&D debris from the waste stream has benefits as well as drawbacks to the County, as outlined below.

3.10.1 Benefits

- Conservation of natural resources by recycling C&D debris and making it available for reuse or making it into a new product, rather than using virgin materials;
- Avoided cost of purchasing materials for Landfill operations, such as gravel or stone (e.g., incoming C&D aggregate of a suitable size could be used by the Landfill for access roads rather than purchasing gravel or stone);
- Potential cost savings to developers and contractors by decreasing the amount of waste they generate, resulting in avoided landfill tipping fees;
- Potential cost savings to developers and contractors by off-setting landfill tipping fees with lower per ton processing fees at recoverable materials processing facilities;
- Potential revenue to developers and contractors from the sale of the recoverable/recyclable material diverted from construction projects;
- Potential revenue to processors from the sale of processed C&D or recyclable materials sold to end markets;
- Decrease in hydrogen sulfide gas generated at the Landfill from decaying gypsum board (if a local end market for gypsum was identified and materials were diverted); and
- A decrease in the amount of waste disposed at the Landfill, thus preserving the airspace for MSW and extending the life of the Landfill.

3.10.2 Drawbacks

In addition to the potential stakeholder concerns discussed in Section 3.9, other drawbacks to a C&D diversion program include:

- An increase in County staff time to develop diversion programs and policies;
- An increase in multiple departmental staff time to monitor and enforce a mandatory C&D debris separation requirement (if an ordinance were developed); and
- An increase in capital and operating expenses if the County were to implement a C&D debris diversion program at the Landfill.

When considering the “cost” of diversion programs there are both “economic” considerations and “non-economic” considerations. Under economic considerations, the County must compare the cost of a diversion program with the cost of landfill disposal, including transportation costs and long term disposal obligations after the

landfill is closed (post-closure obligations). For “non-economic” considerations there are factors such as environmental sustainability, carbon footprint, public desire for and participation in diversion, and New York State Rules and Regulations. These factors should all be considered as the County formulates its integrated solid waste management planning efforts.

3.11 Resources

There are many resources available on C&D debris diversion, recycling and reuse. Some of the references used in this paper are listed below.

- California Integrated Waste Management Board (CIWMB). In 2002, the State of California passed a law that required the CIWMB to offer assistance to jurisdictions for diverting C&D waste. One of the results was the development of a model C&D ordinance which can be found, along with other sample ordinances, on the CIWMB’s C&D Recycling website. Jurisdictions must also report their progress in implementing C&D waste-related diversion programs in an annual report to the CIWMB.
 - <http://www.ciwmb.ca.gov/LGLibrary/CandDModel/Default.htm#Introduction>
- King County, Washington. King County developed a Recycling Economics Worksheet that allows the user to calculate their savings from recycling and diverting materials instead of using traditional disposal methods.
 - http://your.kingcounty.gov/solidwaste/greenbuilding/documents/economics_worksheet.xls
- Santa Cruz County, California. An example of a simple, yet effective public education piece is the “Re-Thinking C&D” brochure created by the Santa Cruz County Department of Public Works.
 - http://www.dpw.co.santa-cruz.ca.us/www.santacruzcountyclub/PDF/CD_Brochure_8-06.pdf
- Andela Products, Ltd. (gypsum board recycling equipment)
<http://www.andelaproducts.com/products/drywall.html>
- CIWMB, Wallboard (Drywall) Recycling website
<http://www.ciwmb.ca.gov/conDemo/Wallboard/>
- Construction Site Recycling Guide, Recycleworks.org – San Mateo County, CA
http://www.recycleworks.org/pdf/CD_office_guide.pdf
- King County, Washington, Construction Recycling website
<http://your.kingcounty.gov/solidwaste/greenbuilding/construction-recycling/index.asp>
- LaCrosse County, Wisconsin Landfill website
<http://www.co.la-crosse.wi.us/solidwaste/landfill/services.asp>

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- Minnesota Pollution Control Agency, C&D Waste website
<http://www.pca.state.mn.us/oea/greenbuilding/waste.cfm>
- NERC Fact Sheet, “Asphalt Shingles Waste Management in the Northeast,” February 2007
<http://www.nerc.org/documents/asphalt.pdf>
- NERC Fact Sheet, “Carpet Recycling Infrastructure in the Northeast,” July 2008
http://www.nerc.org/documents/carpet_recycling_infrastructure_in_northeast.pdf
- NERC Fact Sheet, “Gypsum Wallboard Waste Management in the Northeast,” July 2006
http://www.nerc.org/documents/gypsum_wallboard_waste_management_fact_sheet_2006.html
- New York State Recycling Markets Database
<http://appcenter.nylovesbiz.com/esdrecycling/>
- ShingleRecycling.org website
<http://www.shinglerecycling.org/content/asphalt-shingle-recycling-resources>
- Taylor Recycling Company in Montgomery, NY (wallboard recycling)
<http://www.taylorrecycling.com/company/newyork.php?id=2&sid=3>
- USA Gypsum (Agri-Marketing in Reinholds, PA)
<http://www.usagypsum.com/recyclingimportance.aspx>
- U.S. EPA, C&D Materials website
<http://www.epa.gov/epawaste/conserve/rrr/imr/cdm/index.htm>
- U.S. EPA, C&D Materials Factsheets and Case Studies
<http://www.epa.gov/epawaste/conserve/rrr/imr/cdm/factsheet.htm>
- U.S. EPA Region 2, C&D Debris, Regional Initiatives
<http://www.epa.gov/region02/demolition/initiatives.htm>
- Vermont Department of Environmental Conservation, Construction Waste Reduction website
<http://www.anr.state.vt.us/dec/wastediv/recycling/CandD.htm>
- Waste Age, “When Recycling C&D: Makes Sense,” by Sharon Colley, May 1, 1998.
http://wasteage.com/mag/waste_recycling_cd_makes/