

USGBC White Paper

Planning for Construction Waste Reduction

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INTRODUCTION

Impending regulations in Massachusetts will mark a major change in the handling of construction and demolition (C&D) waste. As planned, a ban will be enforced by mid-2004 that will prevent landfill deposits of asphalt, brick, cardboard, concrete, wood and metal coming from commercial construction sites. These regulations will directly address one of the major sources of landfill waste in Massachusetts, and are expected to be a model for other states.

Consigli Construction Co., Inc., a Massachusetts-based construction manager and general contractor, has been involved in a voluntary pilot study of C&D source separation and recycling since 2001. Consigli is providing data on waste reduction results for five projects that will be published as case studies for other builders to follow once the regulations are in place. Consigli is also providing data to Northeastern University for use in the development of a software simulation model that will help to predict construction waste streams.

To date Consigli has found little adverse impact as a result of its waste reduction efforts. It is believed that in most circumstances, waste reduction can be achieved at marginal additional cost, given proper advance planning. Consigli has implemented a company-wide source separation program, encompassing all of its projects, and has remained competitive against contractors not currently required to recycle.

Symmes Maini & McKee Associates is a Massachusetts-based architecture and engineering firm that has taken a strong role in advocating sound environmental practices in design and construction. One role of the designer is to help establish a proper project team mindset early in the project development process, to ensure later adherence and optimum results.

THE C&D PROBLEM: NATIONALLY AND IN MASSACHUSETTS

The impact of construction and demolition (C&D) debris on the environment is staggering. More than 135 Million tons of debris from construction sites is brought to U.S. landfills every year, making it the single largest source in the waste stream.

Figures developed by the U.S. EPA are helpful to the building owners, designers and contractors in understanding the magnitude of C&D waste. In commercial construction, a typical new building generates an average of 3.9 pounds of waste per square foot of building area. To put this in perspective, a new building of 50,000 square feet – a typical college residence hall or mid-size suburban office building – will produce 195,000 pounds, or almost 100 tons of waste.

Change the activity to demolition and the figures increase dramatically. In this case commercial buildings yield an average of 155 pounds per square foot of building area. Turn the same 50,000 square foot building in to a demolition project and the result will be almost 4,000 tons of waste.

In Massachusetts the proportionate impact of C&D is similar to national figures. Overall, roughly one million tons of C&D goes from Massachusetts construction sites to landfills. Of this amount, 660,000 tons are deposited at in-state landfills while some 320,000 tons are exported. C&D accounts for roughly 25% of all Massachusetts landfill deposits and fully 95% of the non-municipal solid waste (MSW) stream.

PENDING MASSACHUSETTS REGULATIONS

With landfills nearing capacity and heightened environmental concerns, the Commonwealth of Massachusetts Department of Environmental Protection is now drafting regulations on C&D waste that should take effect by 2004. While other county and municipal governments have imposed C&D bans, the Massachusetts regulations will constitute the country's first statewide initiative on C&D handling. As currently proposed in draft form, the regulations will initially ban asphalt, brick, concrete, wood and metal from landfills. An existing ban on corrugated cardboard will be enforced in conjunction with the newly banned materials. It is anticipated that other materials will be added to the ban once the regulations are in place. The stated goal of the DEP program is an 88% non-MSW reduction (diversion from landfills) by the year 2010.

The DEP C&D subcommittee is currently preparing a draft of the regulations for public hearing and comment. The subcommittee has a recommended effective date for the disposal ban of nine months following the promulgation of regulations. The current timetable would appear to put the bans in to effect sometime in mid-2004.

The detailed C&D recommendations of the Massachusetts DEP can be found in the document Beyond 2000 Solid Waste Master Plan, which is accessible on-line at www.state.ma.us/dep/bwp/dswm/mplan.swmp.doc.

THE NEW ERA IN MASSACHUSETTS

When the new Massachusetts regulations go in to effect, there will be three options for handling of C&D waste:

- 1) Waste management planning, centered on direct reuse and on-site source separation and recycling.
- 2) Continued deposit of all materials in mixed C&D dumpsters. This will require later separation of the banned materials by the a 3rd party at a remote site, prior to landfill transfer.
- 3) Continued deposit of all materials in mixed C&D dumpsters, with subsequent hauling by truck and/or rail to out-of-state landfills.

THE DESIGNER’S ROLE: ESTABLISHING A MINDSET

Our first and foremost objective to assure a successful process, especially with LEED certification, is to set the “mindset” of the team – Owner, Architect/Engineer, and Contractor – to maximize the integration of sustainable design. This often requires an initial effort of the design team to educate the owner towards LEED and sustainability practices.

As the expectations and objectives are set through the programming phase, the designers must start including the appropriate language in the drawings and specs to insure that a C & D waste management plan is captured in the early budget estimates. This also gives time for assimilation by team participants that aren’t familiar with C & D management and recycling.

Construction Waste Management can earn up to 2 LEED points under the MRc-2 guidelines. In addition, the construction waste management plan and recycling effort often contribute to generate momentum for the Resource Reuse credit, MRc-3, with 2 potential points as well. Note that materials used in credit MRc-3 can not be included in credit MRc-2.

Different types of buildings/projects might make this early stage construction waste management effort difficult. For example, public schools projects, which in Massachusetts are administered under the cumbersome filed sub-bid process, can be challenging, especially when it comes to the implementation of a non-traditional activity such as a waste management plan. Currently, on the east coast, most contractors working on public projects are not familiar the C & D recycling. The combination of a client not familiar with construction practices and a lack of understanding of the process on the part of the contractor can make C&D management a seemingly difficult task. There is a risk the effort will be overpriced, and therefore eliminated or value engineered out of the project by a client facing strict budget restrictions.

Pilot studies such as those being specified by Symmes Maini & McKee and administered by Consigli will help to establish realistic precedents for both contractors and owners.

THE CONSIGLI WASTE REDUCTION PROGRAM

Working with the Massachusetts DEP, Consigli Construction has entered into a voluntary pilot study to help determine the realities and possibilities of construction waste recycling. Consigli has implemented a company-wide source separation and recycling program, ranging from renovations in congested urban locations to new construction on greenfield sites. The six materials targeted in the C&D regulations are being regularly recycled, and ceiling tile, new scrap gypsum, carpet and other materials are also being included in the program.

Consigli began the pilot program in the fall of 2001. Initially three projects were targeted for case studies, with findings to be published by the DEP; this group has since been increased to five. The projects were chosen to give situational analyses of a variety of circumstances. Variable conditions include new construction vs. renovation; urban, suburban, and rural sites; public vs. private procurement; building and material types; and lump-sum vs. negotiated contracts.

Consigli is also supplying data to the Civil Engineering Department at Northeastern University in Boston, for use in developing a simulation model to predict construction site waste streams. The model will help builders to determine approximate quantities by type and weight, based on

variables such as building type, material type, new construction vs. renovation, building area, etc.

Once the initial pilot studies were underway, Consigli determined that it was more effective to treat waste reduction as a company-wide program rather than an isolated activity on select job sites. In the latter approach, it became necessary to differentiate policies, creating confusion among employees and subcontractors. With a uniform policy, the method of waste handling could be standardized. Consigli established a source separation program on all job sites in mid-2002.

THE THREE TIER SYSTEM

Based on the waste management hierarchy (going from best to worst option, in environmental terms) of reduce, reuse, recycle/compost, incinerate or deposit in a landfill, Consigli has established a three tier system:

Tier I: Direct Reuse and Recycling

- Materials 100% reused or recycled
- Materials recycled by Consigli on the same job site or another Consigli site
- Materials recycled with plant or manufacturer
- Typically Consigli equipment used
- Avoid outside cost of disposal and haul

Directly recycled materials include wood, concrete, asphalt, brick, metal, ceiling tiles, carpet, new scrap gypsum board, plastics, oil filters, fuel filters, antifreeze, and paper.

Tier II: Source Separated Materials

- Materials 100% recycled
- Materials source separated by Consigli in segregated dumpsters
- Waste haulers used to deliver materials
- Established reduced removal fees for source separated materials
- Standard haul rate incurred

Source separation includes the six materials proposed in the DEP ban: wood, concrete, asphalt, brick, metal, and cardboard. Other materials such as new gypsum scrap have also been included.

Tier III: Mixed C&D to Landfills

- When Direct Recycling (Tier I) and Source Separation (Tier II) are not possible
- Material goes to a mixed C&D dumpster
- Highest disposal fee and haul incurred
- Waste is deposited at a landfill



Figure 1 Chart featuring waste management hierarchy.

EMPLOYEE TRAINING AND COMPLIANCE

Consigli created an in-house Environmental Protection Committee, or “Green Team,” with representation from all company departments, to create and monitor the company’s environmental policies. One of its first tasks was to create a waste reduction plan with action items for implementation.

Orientation for all staff is mandatory. Before any ground is broken, project management teams develop a recycling plan for all materials expected to be generated. At each site, a Consigli employee is given responsibility to monitor compliance with the plan and status is monitored regularly and reviewed monthly.

SUBCONTRACTOR COMPLIANCE

Consigli conducts specific orientation and training activities for all subcontractors. The program description and goals are provided and standard recycling language is used in all contracts. Site and dumpster signage is mandatory. Subcontractors are notified by contract and in jobsite signage that penalties will be charged to any subcontractor for repeat contaminations.

THE CASE STUDY PROJECTS

St. Paul’s Cathedral - Worcester, Massachusetts

Consigli was the lead contractor for the renovation of the 10,200 square foot basement reception area of Saint Paul’s Cathedral. The church is a 130 year-old granite structure in a congested urban neighborhood in the center of Worcester, the Commonwealth’s second most populous city.

Through Consigli’s and St. Paul’s recycling efforts, \$16,371 was saved and 78% of waste was diverted from disposal at local landfills. Materials recycled include concrete and wood paneling. Unique to the project was a savings of \$5,500 by reusing wood paneling. The price of replacing the original woodwork with antique ash would have been three times higher than the price of the

careful rehabilitation of the existing woodwork. The architect emphasized the historic and economic value of preserving the original woodwork, as it was custom made for the cathedral, dating back to renovations done at the turn of the century. By saving the woodwork, the project not only reduced material costs but also preserved an important piece of the social room's history.

Keys to success on the project include:

- Talking to the client during the planning stage to review the materials currently in use to identify opportunities to reuse them in the renovation.
- When preparing a cost estimate for the client, make the benefits of reuse transparent. Include replacement costs and avoided transport of salvaged materials as part of a cost-benefit analysis.
- If the project does not provide an option to reuse materials on-site, then consider other options. Revenue can be generated through selling the rights to salvage materials to a salvage company, or by holding an onsite sale or auction. Alternatively, the building owner can get a tax deduction for donating the materials to a non-profit organization or municipal agency.



Figure 2 Photograph of recycle bins at St. Paul's Cathedral in Worcester, MA.

Douglas Schools - Douglas, Massachusetts

Continuing its long involvement with area institutions, Consigli is currently managing a major school building program for the Town of Douglas. This project entails virtually all new construction on a rural site. When work is complete at the end of Summer 2003, Douglas will have a new \$19 million, 130,000-sq.-ft. High School, as well as additions to the existing Elementary and Middle Schools. Symmes Maini & McKee Associates are the architects and engineers for the project.

The Douglas project was already underway when the Waste Reduction program began, and was one of the first projects where the policy was implemented. To date, the project has diverted 64% of waste from local landfills. In addition to the six banned materials, this is the first project where Consigli separated and recycled new gypsum scrap, recovering and diverting forty tons.

Milford Fire Station - Milford, Massachusetts

Consigli was the lead contractor for the renovation (6,300 sq. ft.) and addition (10,500 sq. ft.) to the Milford Fire Station, a historic brick structure built in 1844, located in a congested business district in a town of 25,000.

Separating recyclables and disposal materials saved \$44,042. 555 tons of waste was reused and recycled and 70 tons was disposed, resulting and 81% diversion from disposal at local landfills. Materials reused and recycled include asphalt paving, concrete, metal, wood, brick and slate.

Consigli saved money on labor and materials by renting a silo filled with “pre-mix” concrete. Since the concrete is ready to use, workers avoided having to open bags, measure, and mix. In addition, workers were able to move the silo more easily through tight spaces rather than moving piles of ingredients from place to place. Material savings included no wasted batches due to improper mixing. This is an example of how a contractor can reduce waste by ordering materials with less packaging.

Keys to success on the project include:

- Dumpster strategies:
 - Consigli’s crew sorted demolition materials into separate containers (source separation) in a tight urban site by storing dumpsters in the bays of the fire station. In addition, the crew stored dumpsters off-site by coordinating with neighboring establishments to shift dumpsters around,
 - Using smaller dumpsters allowed for more source separation.
- The crew saved on labor costs by using a Lull (similar to a forklift) to transport loads of material and debris from the building to the dumpsters, rather than hand-carrying materials.
- The contractor scheduled demolition to handle certain materials separately (i.e., “wood day”).
- Consigli switched the debris hauling contract to a hauler who was more responsive (picking up loads more often and providing smaller dumpsters) in mid-project.

Cambridge City Hall Annex - Cambridge, Massachusetts

Consigli is currently performing comprehensive interior and exterior renovations at the Cambridge City Hall Annex. The project is targeting LEED Silver certification. Scheduled for completion in October 2003, it will potentially be one of the first LEED renovation projects in the country.

To date this project has recycled, reused, or salvaged 97% of the waste generated on-site. In a prime example of reuse, original wood planks were salvaged; some were used to create benches for the site, while the remainder was sold to a flooring supplier for use in residential projects.

Keys to the success of the project include:

- Waste management plan developed prior to project start.
- Waste management plan was reviewed and shared with owner and architect.
- All Consigli employees and subcontractors received a copy of the project-specific Waste Management Plan.

- Waste prevention and recycling activities are being discussed at each job site meeting with Consigli employees and subcontractors.
- Any incidence of contamination of source separated waste materials by a subcontractor will result in a \$750 fine (per the subcontract.)
- All recycling containers are clearly labeled.
- Consigli submits to the Owner (the City of Cambridge) detailed monthly reports documenting types and quantities (tons) of materials recycled, reused, salvaged, and disposed.
- Haulers have been selected on the basis of response time as well as pricing.

Clarke Distribution - Milford, Massachusetts

Consigli is currently in the construction phase for renovation and expansion work on an office, showroom, and warehouse facility in Milford, MA for Clarke Distribution. The project involves renovating an existing 60,000-sq.-ft. building which was previously owned by Dunkin' Donuts, and building two additions totaling 45,000-sq.-ft. of new space. Consigli will also be putting a new facade on the existing warehouse to match the design of the additions.

Consigli has implemented its innovative waste reduction program on site and to date has achieved greater than 98% diversion of materials coming out of the project from local landfills. Source separated materials include asphalt, brick, concrete, cardboard, wood, metal, glass, wiring, electrical fixtures, and ceiling tiles.

Keys to the success of the project include:

- Waste management plan developed prior to project start.
- There was a detailed review and walk-through of the waste management plan with the Owner and architect prior to construction, to develop a strategy and determine destinations for specific materials.
- All Consigli employees and subcontractors received a copy of the project-specific Waste Management Plan, and waste prevention and recycling activities are discussed at each job site meeting.
- Any incidence of contamination of source separated waste materials by a subcontractor will result in a \$750 fine (per the subcontract.)
- All recycling containers are clearly labeled.
- Consigli submits a detailed monthly report to the Owner documenting types and quantities (tons) of materials recycled, reused, salvaged, and disposed.
- Doors were donated to the Building Materials Resource Center.

RESULTS TO DATE

Since implementing the program in the last quarter of 2001, Consigli has achieved an overall waste reduction rate of 72.7% on projects with source separation operations. The five DEP case study projects have accounted for a total of 3,682 tons of C&D waste, of which 3,365 tons, or 91.4%, have been diverted from landfills. The waste reduction rates on the individual case study projects range from 64% (Douglas Schools) to 98% (Clarke Distribution).

Table 1 Table showing the amount of materials recycled at Consigli’s case study job sites.

Consigli Construction Co., Inc.												
DEP Pilot Studies - Waste Reduction Summary Spreadsheet												
	Asphalt	Brick	Concrete	Wood	Metal	Cardboard	Gypsum	Other	Mixed	Recycling	Total	% Recycling
Douglas Schools	0.00	0.00	82.39	22.31	30.63	0.00	40.00	0.00	98.51	175.33	273.84	64.03%
St. Paul's Cathedral	0.00	0.00	139.57	0.00	0.00	0.00	0.00	0.00	38.70	139.57	178.27	78.29%
Milford Fire Station	328.95	0.00	191.97	19.98	7.70	2.37	0.00	18.00	130.68	568.97	699.65	81.32%
Cambridge City Hall	0.00	455.95	10.15	81.40	8.26	0.00	0.00	1.00	15.36	556.76	572.12	97.32%
Clarke Distribution Corp.	788.00	0.00	1,125.00	0.00	11.37	0.00	0.00	0.00	34.62	1,924.37	1,958.99	98.23%
	1,116.95	455.95	1,549.08	123.69	57.96	2.37	40.00	19.00	317.87	3,365.00	3,682.87	91.37%

PRELIMINARY FINDINGS

Preliminary findings show that construction recycling can prove to be cost effective. Companies can save money by separating construction debris efficiently on-site thereby paying less to dispose of material.

Compliance requires one person to be responsible for monitoring for the duration of the project. Advance planning is a must, and plans may differ for each project due to site conditions, location (urban vs. rural), size, and construction type (new vs. renovation).

Other significant benefits to the program have been employee involvement (enthusiasm is very strong), self-performance capabilities and centralized yard, as well as good subcontractor buy-in, with few problems or complaints to date.

CONCLUSIONS

Consigli Construction and Symmes Maini & McKee Associates have recognized the impact of the waste generated by their construction projects. The companies share the belief that waste reduction planning makes sense both environmentally and financially. By reducing the cost of disposal, the building team can potentially save money and help the environment.

The market for recycled construction materials should grow with industry acknowledgement and acceptance. Once the Massachusetts C&D ban takes effect, waste management planning and recycling will potentially become cost neutral or even cost beneficial vs. third-party separation and exporting, as hauling and tip-fee incentives are given to contractors that reduce processing labor by source-separating materials. Based on the results of the Massachusetts initiative, it is expected that other New England and Northeast states will follow suit with similar bans on C&D deposits at landfills, thus diminishing the viability of out-of-state exporting as an option for disposal.

By achieving an overall diversion rate to date of 72.7% and project-specific diversion rates of 90% or better, Consigli has demonstrated that the two LEED points available through MRc-2 can realistically be achieved with proper waste management planning.



Figure 3 Photograph of recycle bins at Cambridge City Hall Annex.

REFERENCES

Executive Office of Environmental Affairs. 2000. Beyond Solid Waste Master Plan - A Policy Framework. Commonwealth of Massachusetts, Department of Environmental Protection (Boston, Massachusetts).

Franklin Associates. 1998. Characterization of Building-Related Construction and Demolition Debris in the United States. The U.S. Environmental Protection Agency, Municipal and Industrial Solid Waste Division, Office of Solid Waste (Prairie Village, KS).