
Guidelines for C&D Debris Removal and Recycling

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This course is based on a compilation of the United States Environmental Protection Agency's Green Building Publications listed.

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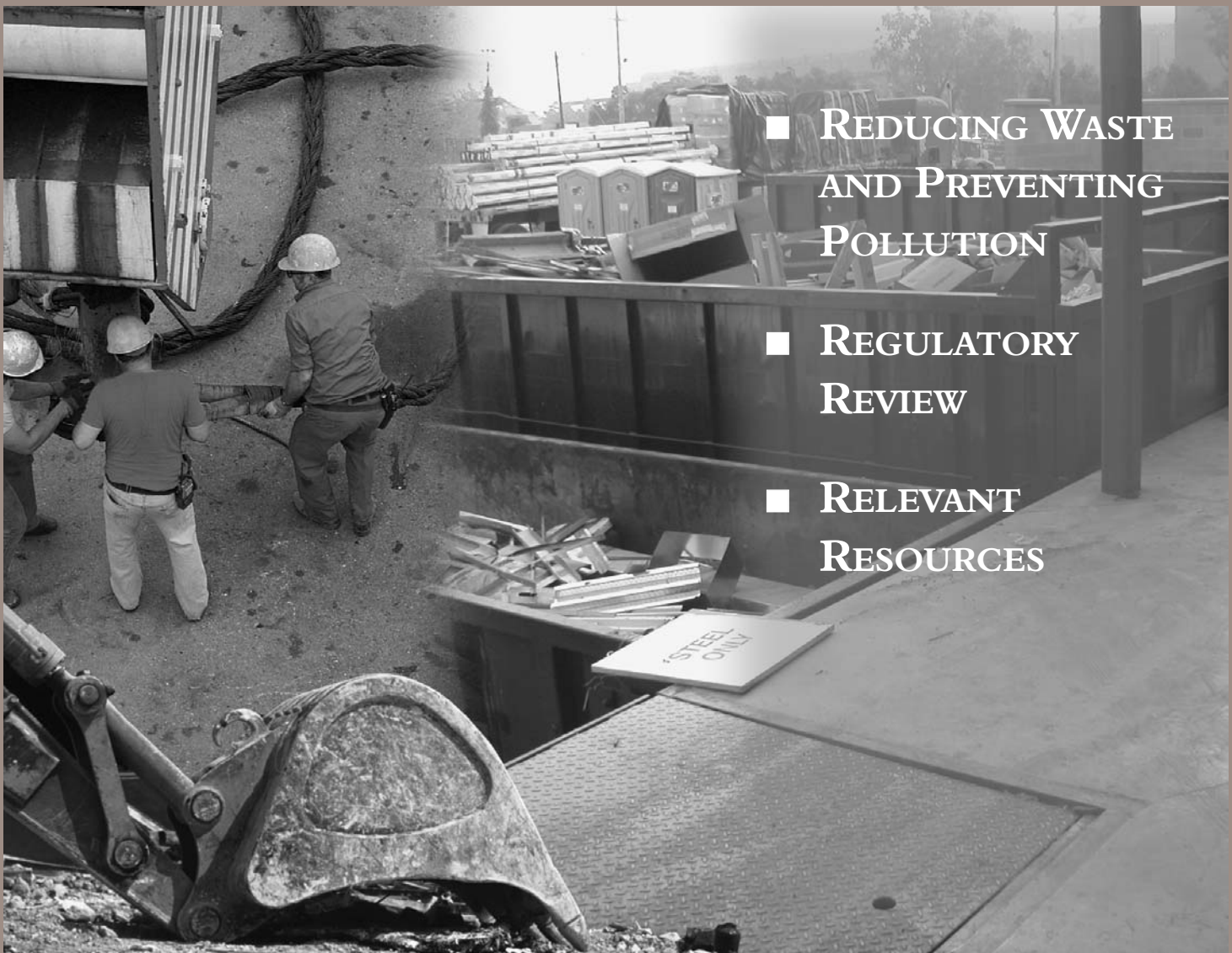
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FOREWORD

Foreword

If you are involved with building construction, demolition, or renovation, your company creates construction and demolition (C&D) debris. These materials can consist of three types of waste: (1) Inert or nonhazardous waste; (2) hazardous waste as regulated by the U.S. Environmental Protection Agency (EPA) under the Resource Conservation and Recovery Act (RCRA); and (3) items that contain hazardous components that might be regulated by some states.

Most C&D debris is nonhazardous and is not regulated by EPA. Under RCRA, however, if you generate hazardous waste you are required to follow certain procedures when generating, storing, transporting, or disposing of it. In addition, many states have specific definitions of C&D debris that effectively determine what materials are allowed to be disposed of in nonhazardous waste landfills, C&D landfills, or incinerators. Even if federal or state regulations do not apply to your business, you should make efforts to keep the hazardous components of the wastes you generate out of landfills to conserve natural resources and protect human health and the environment. Follow the suggestions outlined in this issue for ways to reduce, reuse, and recycle your waste.

A large fraction of C&D debris generated in the United States ends up in C&D landfills. (See 40 CFR 257.) Since much of this waste stream is inert, states do not require these landfills to provide all of the same environmental protections as those licensed to receive municipal solid waste. Therefore, C&D landfills generally have lower tipping fees and handle a large amount of the C&D debris generated in the United States. Most states regulate C&D debris, although programs vary widely. For example, some states require liners or leachate collection systems; a few require both; and others require neither. Visit www.cicacenter.org for more information.

C&D DEBRIS

C&D Debris

C&D debris is one type of solid waste. It is a large and varied waste stream that includes concrete, asphalt, wood, gypsum, and asphalt shingles generated from the construction, renovation, and demolition of buildings, roads, bridges, and dams. Total C&D waste was estimated to be 325 million tons in 2003.

C&D debris is not federally regulated, except to the extent that solid waste landfills must follow a few basic standards outlined in the *Federal Register* at 40 CFR Part 257. States, therefore, have the primary role in defining and regulating the management of C&D debris.

Depending on your state's specific definition, C&D debris can include the following discarded materials:

- Concrete, cinder blocks, drywall (sheetrock, gypsum, or plaster), masonry, asphalt and wood shingles, slate, and plaster.
- Forming and framing lumber, plywood, wood laminates, wood scraps, and pallets.
- Steel, stainless steel, pipes, rebar, flashing, aluminum, copper, and brass, residential and commercial steel framing, structural steel, steel utility poles.
- Brick and decorative blocks.
- Siding.
- Doors and windows.
- Plumbing fixtures.
- Electrical wiring.
- Non-asbestos insulation.
- Wood, sawdust, brush, trees, stumps, earth, fill, and rock and granular materials.

Many states exclude certain materials from the legal definition of C&D debris, using terms such as "hazardous," "unacceptable," "potentially toxic," or "illegal". These wastes might or might not meet the federal definition of hazardous waste (see page 5). Those that do meet the legal definition of hazardous waste are required to be treated and/or disposed of in a manner consistent with the federal or state requirements for hazardous waste. Examples of these wastes can include:

- Waste paints, varnish, solvents, sealers, thinners, resins, roofing cement, adhesives, machinery lubricants, and caulk.
- Drums and containers that once contained the items listed above.
- Treated wood, including lumber, posts, ties, or decks, and utility poles.
- Asbestos-containing items, such as certain older types of floor tile, insulation, or other materials containing asbestos. (Regulated by the Toxic Substances Control Act [TSCA—see page 18])
- Lead-based paint, or lead flashing or solder.
- Products containing mercury.
- Other items that have inseparable hazardous constituents.

Generators of C&D Debris

Many of those involved in generating C&D debris can save money by reusing, exchanging, recycling, donating, and otherwise reducing the amount of C&D debris they throw away. Donations to charitable organizations classified as 501(c)3 are tax-deductible.

The National Association of Home Builders (NAHB) estimates that as much as 8,000 pounds of C&D debris is produced for every 2,000 square feet of house. A 1995 NAHB survey estimated that builders pay an average of \$500 per home for waste removal.

While states have the primary responsibility for regulating nonhazardous C&D debris, they sometimes also have primary responsibility for regulating hazardous waste. States can receive legal permission, known as authorization, to implement EPA's RCRA hazardous waste program. State hazardous waste programs are consistent with, and are at least as stringent as, the federal hazardous waste program. Always contact your state authority to determine which state requirements apply to your business.

FREQUENTLY ASKED QUESTIONS ABOUT RCRA

What Is RCRA?

RCRA is a federal law that encourages environmentally sound methods for managing commercial and industrial waste as well as household and municipal waste. It regulates facilities that generate, transport, treat, store, or dispose of hazardous waste.

The term "RCRA" is often used interchangeably to refer to the law, the regulations, and EPA policy and guidance. The law describes the waste management program mandated by Congress that gave EPA authority to develop the RCRA program. EPA regulations carry out the Congressional intent by providing explicit, legally enforceable requirements for waste management. EPA guidance documents and policy directives clarify issues related to the implementation of the regulations.

All of the RCRA hazardous waste regulations can be found in the *Code of Federal Regulations* (CFR), Title 40, Parts 260 to 279. The CFR can be purchased through the U.S. Government Printing Office (GPO).

Who Is Regulated?

Any business that generates hazardous waste is potentially subject to RCRA. You must conduct tests required by the regulations or use your knowledge of and familiarity with the waste you generate to determine whether it is hazardous waste. You might be subject to substantial civil and criminal penalties if you fail to properly or completely identify hazardous waste generated by your business.

How Are Generators Regulated?

If your business generates hazardous waste, you must manage it according to regulations for your specific generator type. Hazardous waste generators are divided into three categories, according to how much they generate in a calendar month:

- **Large Quantity Generators (LQGs).** LQGs generate greater than or equal to 1,000 kg (approximately 2,200 lb) of hazardous waste per month or greater than 1 kg (approximately 2.2 lb) of acutely hazardous waste per month.
- **Small Quantity Generators (SQGs).** SQGs generate greater than 100 kg (approximately 220 lb) but less than 1,000 kg (approximately 2,200 lb) of hazardous waste per month.
- **Conditionally Exempt Small Quantity Generators (CESQGs).** CESQGs generate less than or equal to 100 kg (approximately 220 lb) of hazardous waste per month and less than or equal to 1 kg (approximately 2.2 lb) of acutely hazardous waste per month.

Most construction, demolition, and renovation companies are considered CESQGs. CESQGs must comply with three basic waste management requirements to remain exempt from the full hazardous waste regulations that apply to generators of larger quantities of hazardous waste (SQGs and LQGs).

Some states do not recognize the CESQG class. Contact your state environmental agency to find out if the CESQG status is recognized. **To find your appropriate state contact, visit <www.cicacenter.org>.**

Under the federal RCRA requirements, your generator status might change from one month to the next as the quantity of waste you generate changes. State requirements vary widely. You must comply with whichever standard is applicable for a given month. In many cases, small businesses that fall into different generator categories at different times choose to always satisfy the more stringent requirements (usually state requirements) to simplify compliance. Generators must "count" the amount of waste generated, which involves adding up the total weight of all quantities of characteristic and listed waste generated at a particular facility. Certain wastes, such as those that are reclaimed or recycled continuously on site, may not be counted for the monthly total calculation under the federal regulations.

Asked Questions

What Is Hazardous Waste?

To be considered hazardous waste, a material first must be classified as a solid waste. EPA defines solid waste as garbage, refuse, sludge, or other discarded material (including solids, semisolids, liquids, and contained gaseous materials). If your waste is considered solid waste, you must then determine if it is hazardous waste. Wastes are defined as hazardous by EPA if they are specifically named on one of four lists of hazardous wastes (listed wastes) or if they exhibit one of four characteristics (characteristic wastes). Each type of RCRA hazardous waste is given a unique hazardous waste code using the letters D, F, K, P, or U and three digits (e.g., D001, F005, P039). See page 6 for additional information on relevant C&D waste codes.

Listed Wastes. Wastes are listed as hazardous because they are known to be harmful to human health and the environment when not managed properly, regardless of their concentrations. The lists include the following three types of waste:

- **Non-Specific Source Wastes.** These are material-specific wastes, such as solvents, generated by several different industries. Waste codes range from F001 to F039. Examples include ethyl benzene, methylene chloride, and toluene.
- **Specific Source Wastes.** These are wastes from specifically identified industries. Waste codes range from K001 to K161. C&D debris does not typically include specific source wastes.
- **Discarded Commercial Chemical Products.** Off-specification products, container residuals, spill residue runoff, or active ingredients that have spilled or are unused and that have been, or are intended to be, discarded. Waste codes for acutely hazardous chemicals range from P001 to P205 and U001 to U411. An example is U159, unused methyl ethyl ketone.

Characteristic Wastes. Even if your waste does not appear on one of the hazardous waste lists, it still might be regulated as hazardous waste if it exhibits one or more of the following characteristics:

- **Ignitability.** Ignitable wastes create fires under certain conditions or are spontaneously combustible, and have a flash point less than 60°C (140°F). One example is spent solvents. The waste code for these materials is D001.
- **Corrosivity.** Corrosive wastes are acids or bases that are capable of corroding metal containers, such as storage tanks, drums, and barrels. The waste code for these materials is D002. C&D debris does not typically include corrosive wastes.
- **Reactivity.** Reactive wastes are unstable under “normal” conditions. They can cause explosions, toxic fumes, gases, or vapors when mixed with water. The waste code for these materials is D003. C&D debris does not typically include reactive wastes.
- **Toxicity.** Toxic wastes are harmful or fatal when ingested or absorbed. When toxic wastes are disposed of on land, contaminated liquid might drain (leach) from the waste and pollute ground water. Toxicity is defined through a laboratory procedure called the Toxicity Characteristic Leaching Procedure (TCLP). Examples include trichloroethylene, asphalt wastes, and lead pipe. The waste codes for these materials range from D004 to D059.

Do Exclusions Exist?

The RCRA regulations contain many exclusions for wastes and waste management practices that are not considered to be hazardous.

Frequently Asked Questions

What Are Some Typical RCRA Wastes in C&D Debris?

The following table shows some examples of C&D wastes that may be considered hazardous according to EPA's definition.

Most construction, demolition, and renovation companies are considered CESQGs. CESQGs must comply with three basic waste management requirements to remain exempt from the full hazardous waste regulations that apply to generators of larger quantities of hazardous waste (SQGs and LQGs).

(1) Identify all hazardous waste that you generate on site. Test procedures are described in an EPA document, *Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods*, SW-846. (See the SW-846 Web site at www.epa.gov/sw-846/sw846.htm for more information.) You can also use your knowledge of the waste to make this determination; for example, you might know that the spent solvent you are disposing of is an ignitable hazardous waste, and therefore, you would not have to test for the solvent's flashpoint.

(2) You may not store more than 2,200 lbs (1,000 kg) of hazardous waste on site at any time.

(3) You must ensure delivery of your hazardous waste to an offsite treatment or disposal facility that is:

- A state or federally regulated hazardous waste management treatment, storage, or disposal facility.
- A facility permitted, licensed, or registered by a state to manage municipal or industrial solid waste.
- A facility that uses, reuses, or legitimately recycles the waste (or treats the waste prior to use, reuse, or recycling).
- A "universal waste" handler or destination facility subject to the universal waste requirements of 40 CFR Part 273. (Universal wastes include certain batteries, recalled and collected pesticides, mercury-containing thermostats, and mercury-containing fluorescent bulbs.)

Note that some states require CESQGs to obtain an EPA identification number and comply with certain storage standards. For more information refer to the Code of Federal Regulations (DCFR) Title 40 Parts 260 to 279, or visit www.epa.gov/epaoswer/hazwaste/sqg/cesqg.htm.

Activity	Wastes Generated	Possible RCRA Waste Codes
Land-Clearing, Wrecking, and Demolition	Ignitable or toxic wreckage and debris, and lead pipe.	D001 (ignitable wreckage and debris), D008 (lead pipe, toxic wreckage and lead-based paint debris), D009 (mercury-containing fluorescent lamps), D023-D026 (toxic wreckage and debris containing cresols).
Heavy Construction	Asphalt wastes, petroleum distillates, and used oil. (Asphalt is widely recycled.)	D001 (asphalt wastes, petroleum distillates, used oil sent for disposal), D004 (arsenic), D006-D008 (used oil sent for disposal containing cadmium, chromium, or lead), D018 (asphalt wastes containing benzene).
Carpentry and Floorwork	Acetone, adhesives, coatings, methylene chloride, methyl ethyl ketone (MEK), methyl isobutyl ketone (MIK), mineral spirits, solvents, toluene, treated wood, trichloroethylene, and xylene.	D001 (acetone, adhesives, coatings, methylene chloride, MEK, MIK, mineral spirits, solvents, trichloroethylene, toluene, xylene), D004 (treated wood), D023-D026, D037 (treated wood), D035 (MEK), D040 (trichloroethylene), F001 or F002 (trichloroethylene, methylene chloride), F003 (acetone, xylene, MIK), F005 (toluene, MEK), U002 (unused acetone), U159 (unused MEK), U161 (unused MIK), U239 (unused xylene), U220 (unused toluene), U080 (unused methylene chloride).
Paint Preparation and Painting	Acetone, chlorobenzene, glazes, methanol, MEK, methylene chloride, paint, petroleum distillates, pigments, solvents, stripping compounds, toluene, and wastewater.	D001 (acetone, chlorobenzene, glazes, methanol, MEK, methylene chloride, paint, petroleum distillates, solvents, stripping compounds, toluene, wastewater), D007 (chromium pigments), D008 (lead pigments), D021 (chlorobenzene), D035 (MEK), F001 and F002 (chlorobenzene), F003 (acetone, methanol), F005 (MEK, toluene), U002 (unused acetone), U037 (unused chlorobenzene), U159 (unused MEK), U220 (unused toluene).
Specialty Contracting Activities	Acetone, adhesives, coatings, hexachloroethane, kerosene, MEK, MIK, pigments, solvents, toluene, wastewater, and xylene.	D001 (acetone, adhesives, coatings, MEK, MIK, kerosene, solvents, toluene, wastewater, xylene), D007 (chromium pigments), D008 (lead pigments), D034 (hexachloroethane), D035 (MEK), F003 (acetone, MIK, xylene), F005 (toluene, MEK), U002 (unused acetone), U131 (unused hexachloroethane), U159 (unused MEK), U161 (unused MIK), U220 (unused toluene), U239 (unused xylene).

SPECIAL ISSUES IN C&D DEBRIS

Special Issues

How Should I Manage C&D Debris Containing Mercury?

When preparing for demolition, contractors should be aware that some items inside buildings contain mercury, which is an extremely persistent and toxic human health and environmental threat. Contractors should carefully salvage these materials for proper recycling to prevent mercury contamination.

Mercury-containing wastes must be managed and disposed of as RCRA hazardous wastes if they meet the toxicity characteristic for mercury (waste code D009). Mercury-containing batteries, thermostats, and lamps may be managed under the Universal Waste Program, provided the state does not regulate the wastes more stringently. Items that contain mercury commonly found in buildings include:

- Fluorescent lamps, mercury vapor lamps, metal halide lamps, high pressure sodium lamps, and neon lamps. See <www.epa.gov/epaoswer/hazwaste/id/univwast.htm#lam>.
- Thermostat probes (found in gas-fired appliances with pilot lights such as ranges, ovens, clothes dryers, water heaters, furnaces, and space heaters).
- Thermostats, aquastats, pressurestats, firestats, monometers, and thermometers.
- Smoke detectors, emergency lighting systems, and security systems and alarms.
- Parts of sprinkler systems and coal conveyer systems.
- Elevator control panels.
- Exit signs.
- Barometers.
- Silent wall switches.
- Cathode ray tubes.
- Old paint.

Salvaging mercury-containing products not only keeps them from contaminating the soil and surface waters near building demolition sites, but it also prevents them from winding up in landfills or recycling systems. Waste combustors and hazardous waste treatment incinerators are tightly regulated and must comply with all EPA standards on air emissions.

Remember the following guidelines:

- Isolate items that contain mercury and take them to a mercury recycler or consolidation site. Contact your county or state environmental or solid waste office for services available in your area. Do not remove the mercury from items. Label and store the mercury-containing devices to ensure proper handling and disposal.
- Never crush fluorescent lamps because mercury could be released.
- Contractors should be aware that specialty buildings, such as hospitals, clinics, laboratories, and dental offices, might have additional mercury sources.

REMEMBER TO CHECK WITH THE APPROPRIATE STATE AND LOCAL AUTHORITIES ABOUT HOW TO PROPERLY HANDLE AND DISPOSE OF MATERIALS IN YOUR AREA.

WHAT IS THE UNIVERSAL WASTE PROGRAM?

The Universal Waste Program is designed to reduce the amount of hazardous waste items in the municipal solid waste stream, to encourage recycling and proper disposal of certain common hazardous wastes, and to reduce the regulatory burden on businesses that generate these wastes. Specifically, it streamlines the requirements related to notification, labeling, accumulation time limits, employee training, response to releases, offsite shipments, tracking, exports, and transportation of “universal waste.”

Wastes that are considered federal universal wastes include batteries, agricultural pesticides, thermostats, lamps, cathode ray tubes, and mercury-containing equipment. Construction companies that handle large quantities of these federal universal wastes can take advantage of these special requirements when handling hazardous materials. The rule does not apply to CESQGs (businesses that generate less than 100 kilograms of universal wastes per month), although EPA encourages these businesses to participate voluntarily in collection and recycling programs. Additionally, companies should check with their state agency regarding the implementation of the Universal Waste Rule in their state.

For more information, visit EPA's Universal Waste Web page at <www.epa.gov/epaoswer/hazwaste/id/univwast.htm>.

Special Issues

How Should I Manage Lead-Based Paint Debris?

Lead-based paint has been banned since 1978, but many older structures still have this paint on walls, woodwork, siding, windows, and doors. Construction and demolition workers can be exposed to lead contamination by cutting, scraping, sanding, heating, burning, or blasting lead-based paint from building components, metal bridges and metal storage tanks. In addition to exposure to workers, lead-based paint debris or dust can also make its way into soil, potentially contaminating surface waters. Lead poisoning is a serious health threat for adults and is especially damaging to young children. It can cause anemia, reproductive disorders, and damage to the kidney, liver, and brain. Lead is absorbed into the bloodstream, soft tissue, and bones and teeth, where it breaks down extremely slowly (from 50 days to 50 years).

C&D debris contaminated with lead-based paint must be managed in different ways depending upon where the debris came from and what it is.

C&D debris from commercial or industrial sites that is contaminated with lead-based paint must be managed as RCRA hazardous waste if a representative sample meets the toxicity characteristic (D008).

Lead-based paint waste from removal or remediation activities, such as debris, paint chips, dust, and sludges, that exhibit the toxicity characteristic must be managed and disposed of as a RCRA hazardous waste. However, lead-based paint being removed from households is excluded because it is considered household waste, not hazardous waste.

Contractors working to renovate, remodel, or abate lead-based paint in homes are allowed to dispose of lead-based paint waste as household garbage. Contractors who generate the waste in this manner do not need to determine whether the waste meets the toxicity characteristic under RCRA, but should contact their state agency for possible additional requirements. This waste normally consists of building parts, such as doors, window frames, painted woodwork, and paint chips.

Anyone handling lead-based paint or lead-based paint debris—even if it is not technically considered hazardous waste—should follow several guidelines to protect their health and safety:

- Collect paint chips, dust, dirt, and rubble in plastic trash bags for disposal.

- Store larger lead-based paint building parts in containers until ready for disposal.
- Use a covered dumpster (such as a roll-off container) to store lead-based paint debris until the job is completed.
- Contact your local solid waste agency to determine where and how to dispose of lead-based paint debris.
- Do not smoke, eat, or drink around lead-based paint work.
- Always wash your hands and face before smoking, eating, or drinking.
- Do not wear clothes home that have been covered in lead-based paint dust.

Contractors working for publicly funded rehabilitation or renovation projects in public housing must follow the Department of Housing and Urban Development (HUD) guidelines for lead-based paint. They must also follow EPA rules regarding training and certification and Occupational Safety and Health Administration (OSHA) rules regarding hazard communication, personal protective equipment, testing of blood lead levels, and other special procedures.



in C&D Debris

How Should I Manage Asbestos Debris?

Asbestos-containing materials (ACMs) have been widely used for fire resistance and insulation in building construction since World War II. ACMs are most commonly found in:

- Insulation (blown, rolled, and wrapped).
- Resilient floor covering (tiles).
- Asbestos siding shingles.
- Asbestos cement products.
- Asphalt roofing products.

Because it can cause a variety of health issues, including scarring of the lung tissue and certain types of cancer, asbestos is strictly regulated by both EPA and OSHA. The Asbestos National Emissions Standards for Hazardous Air Pollutants (NESHAP), promulgated under the Clean Air Act, is the regulation most commonly applied to the construction industry (see page 17). Under NESHAP, some types of ACM are regulated, while others are not subject to special disposal requirements. The Asbestos NESHAP places ACM in three distinct categories.

Friable ACM

Friable ACMs are able to be crumbled under hand pressure and include sprayed-applied fireproofing or insulation. Friable ACMs are always regulated under NESHAP when they are disturbed during demolition or renovation.

Category 1 Non-Friable ACM

These materials, including floor tiles, are not considered regulated ACM and do not need to be removed prior to demolition or renovation. However, if they are subjected to sanding, grinding, cutting, or abrading, are in poor condition and friable, or if they will be burned, Category 1 Non-Friable ACM is considered regulated ACM and must be removed accordingly.

Category 2 Non-Friable ACM

The treatment of Category 2 non-friable ACMs, which includes asbestos cement, should be evaluated on a case-by-case basis. If these materials are likely to be crushed, pulverized, or reduced to powder during demolition or

renovation, they should be removed prior to project start or treated as regulated ACM if exposed to these conditions.

If regulated ACM is present at a site designated for demolition or renovation, it must be properly packaged in leak-tight containers or wrapped and disposed of at an approved or licensed disposal site. State and local agencies that regulate asbestos removal can supply a list of disposal sites, and can be found in the government pages of local telephone directories. NESHAP also requires contractors to follow specific work practices when working with ACMs to ensure adherence to its zero visible air emissions standard for asbestos removal. Non-regulated ACM may be disposed of in landfills that accept ordinary demolition waste.

Regardless of whether asbestos is present at a demolition or renovation site, NESHAP regulations require contractors to submit a written notice to the state or local pollution control agency or to the EPA Regional Office 10 working days prior to the start of construction activities. Some EPA Regions require that both EPA and the state or local office be notified. Additionally, the building site must be inspected by a certified asbestos inspector, and owners and operators must have samples of materials suspected of containing ACM collected and tested prior to the start of construction activities.

In addition to NESHAP regulations, some states also have additional asbestos requirements which should also be considered during demolition and renovation projects.

HAZARDOUS WASTE REQUIREMENTS CHECKLIST FOR CONSTRUCTION PROJECTS

Managers of construction projects can use the following checklist to determine hazardous waste requirements under RCRA. You should also check state and local hazardous waste requirements for construction projects.

What type of hazardous waste generator are you?

CESQG	If you generate less than 100 kilograms (220 pounds) of hazardous waste per month, you are a Conditionally Exempt Small Quantity Generator (CESQG). Most construction contractors do not fall under the federal definition. CESQG contractors may be subject to state and local requirements.
SQG	If you generate between 100 and 1,000 kilograms (220-2,200 pounds) of hazardous waste per month, you are a Small Quantity Generator (SQG).
LQG	If you generate more than 1,000 kilograms (2,200 pounds) of hazardous waste per month, you are a Large Quantity Generator (LQG).

REGULATORY REQUIREMENTS	SQG	LQG	REQUIREMENTS FOR HAZARDOUS WASTE GENERATORS
Hazardous Waste Identification	✓	✓	<ul style="list-style-type: none"> Identify whether you generate hazardous waste to determine if you are subject to RCRA hazardous waste regulations. Test procedures are described in "Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods, SW-846," or tests can be performed by a local laboratory.
EPA Identification Number	✓	✓	<ul style="list-style-type: none"> Obtain an EPA Identification number (i.e., a RCRA hazardous waste generator number) for each facility within your company. EPA and states use this 12-character identification number to track hazardous waste activities. To get an EPA identification number, submit Form 8700-12 (Notification of Regulated Waste Activity), which is provided by your state hazardous waste agency. This is a one-time notification. Contact your state regarding the need for renotification if circumstances at your facility change.
Hazardous Waste Accumulation	✓	✓	<ul style="list-style-type: none"> Waste must be properly accumulated in containers or tanks. Waste must be properly accumulated in containers, tanks, drip pads, or containment buildings. Hazardous waste containers must be closed, marked as "Hazardous Waste," and marked with the date accumulation began.
Hazardous Waste Storage	✓	✓	<ul style="list-style-type: none"> Store hazardous waste containers in a secure location. Perform weekly inspections of your hazardous waste containers. You must have secondary containment measures in your hazardous waste storage area. Hazardous waste storage areas must have fire suppression equipment. Hazardous waste storage areas must have available radio or telephone communication.

Preparation for Transport	✓	✓	<ul style="list-style-type: none"> • Use a licensed hazardous waste hauler for transport.
	✓	✓	<ul style="list-style-type: none"> • Before being transported, waste must be packaged, labeled, and marked in accordance with applicable Department of Transportation (DOT) requirements. Call the DOT hazardous materials information hotline at (202) 366-4488 for information.
	✓	✓	<ul style="list-style-type: none"> • Properly label and mark your hazardous waste prior to transport.
	✓	✓	<ul style="list-style-type: none"> • Make sure that the transporter has the proper placards to identify the characteristics and dangers associated with your waste.
	✓	✓	<ul style="list-style-type: none"> • Complete and sign the Uniform Hazardous Waste Manifest (see below).
Manifest Requirements	✓	✓	<ul style="list-style-type: none"> • Include the name, address, and EPA ID number of the hazardous waste generator (your site), the transporter, and designated TSDf on the manifest.
	✓	✓	<ul style="list-style-type: none"> • Include a description of the waste's hazards on the manifest as required by DOT rules.
	✓	✓	<ul style="list-style-type: none"> • Provide the quantities of the waste being transported and the types of containers on the manifest.
	✓	✓	<ul style="list-style-type: none"> • Complete the certification.
	✓	✓	<ul style="list-style-type: none"> • Obtain a copy of the signed and dated manifest from the TSDf within 45 days of shipment for LQGs or within 60 days for SQGs. If you did not receive a copy, you must submit an "exception report" to EPA.
Preparedness and Prevention	✓		<ul style="list-style-type: none"> • Your site must have a specified emergency response procedure. (Note: a written contingency plan is not required.)
	✓		<ul style="list-style-type: none"> • Your site's basic safety information must be readily accessible to employees.
	✓		<ul style="list-style-type: none"> • Site personnel familiar must be familiar with proper handling of hazardous waste and site emergency procedures.
		✓	<ul style="list-style-type: none"> • Your site must have an established personnel training program to educate workers on the proper handling of hazardous waste.
	✓	✓	<ul style="list-style-type: none"> • You must have an emergency coordinator on site or on call at all times.
Used Oil Standards	✓	✓	<ul style="list-style-type: none"> • If you generate used oil, you are subject to a separate set of management standards from the hazardous waste management standards if the used oil will be recycled. If the used oil is to be treated and disposed of, perform the hazardous waste identification step listed above.

THE LIFE CYCLE OF A TYPICAL RENOVATION/ CONSTRUCTION WASTE

This example details the life cycle of just one potential construction waste, solvents and paint, that might be regulated under RCRA. The steps below illustrate the most common scenario of activities a CESQG should conduct with this waste. Other hazardous wastes could be produced by construction, demolition, and renovation activities, and other life cycles could be different depending on the type and amount of waste, and the type of generator. You might be able to significantly reduce the amount of hazardous waste you must manage by reducing, reusing, and recycling C&D debris. If these options are not available, the following steps must be taken to ensure proper management of the hazardous waste.

1

IDENTIFY WASTE

By running tests or using knowledge of the waste, identify whether the waste solvents and paints are hazardous. Based on these analyses, you determine that the appropriate RCRA hazardous waste code is D001 (ignitable wastes).

5

PLACE WASTE IN ACCUMULATION UNIT

If the waste is not reusable, exchangeable, or recyclable, ensure that it is delivered to one of several types of facilities to which CESQGs may send wastes (e.g., hazardous waste TSDFs, certain state licensed or permitted municipal solid waste facilities, or recyclers).





COUNT WASTE

2

As a second step, determine how much hazardous waste you have produced in a calendar month. Do not include waste that may be exempt from regulation such as household hazardous waste, mercury-containing batteries, thermostats, and lamps managed under the Universal Waste Program. Also do not include waste that is recycled on site without prior storage or accumulation, and wastes discharged in compliance with the Clean Water Act directly to a sewer where the wastes mix with domestic sewage and then pass to a Public Owned Treatment Works (POTW).

3

DETERMINE GENERATOR STATUS

Based on the waste counted, determine your generator status. In this example, you have produced less than 100 kg in the past month, which means you are a CESQG in this calendar month. If the amount of waste you generate fluctuates from month to month, you might want to satisfy the more stringent requirements each month to simplify compliance.

4

OBTAIN EPA IDENTIFICATION NUMBER

Before shipping waste off site for treatment, storage, or disposal, you must package, label, and mark waste containers in accordance with all applicable DOT requirements. For more information, call the DOT Hotline at 800 467-4922.

REDUCE THE AMOUNT OF WASTE YOU GENERATE

REDUCE WASTE

A significant amount of money can be saved by those companies that take advantage of the various reuse, exchange, recycling, or donation opportunities that exist. By reducing the amount of C&D debris that is thrown away, companies also reduce their regulatory burden by avoiding the disposal of items that could be considered hazardous waste.

The following are several options for reducing the amount of C&D debris requiring disposal:

DECONSTRUCTION AND REUSE: Deconstruction means the selective disassembly of buildings to facilitate the reuse or recycling of valuable materials. This practice can involve the recovery of materials such as wood, structural brick, and highly functional finished components like windows, doors, cabinets, and decorative trim. Deconstruction is labor-intensive but can produce environmental, economic, and social benefits.

Reuse/Refurbish/Donate: Functional building or architectural components, in addition to scrap materials, can often be reused or refurbished. Some items could be used by your company for your next building job, and many items can be sold to used building materials stores, high-end salvaged architectural materials exchanges, salvaged wood distributors, scrap recyclers, individual homeowners, waste exchanges, or other outlets. Consider placing an ad in the local newspaper for excess salvage materials. If you can't sell the items you have salvaged, some of them may be donated to at least save money on disposal. Also, ask homeowners if they would like to keep clean, usable materials for their own future projects.

Recycle: Some materials, like the ones in the table on page 15, can be sold to scrap recycling businesses or through material exchanges. Sort materials as they are generated to maximize their recyclability and reuse. This practice is becoming increasingly cost efficient as processing and disposal costs rise. Visit <www.epa.gov/jtc/comm/construct.htm> for a complete list and more information.

Be sure to prevent hazardous contamination of materials destined for reuse or recycling. Consider accumulating various wastes separately to facilitate recycling. If you are storing waste that may be hazardous prior to recycling, you may have to comply with certain RCRA requirements.

PREVENT POLLUTION: Contractors can take several other pollution prevention and waste reduction measures as shown in the table. Some of these suggestions require contractors to make decisions prior to arriving at the job site, while others involve onsite activities.

BUYING GREEN: The recycling process is not complete until you've purchased products made with recycled content.

Note that RCRA specifies that the federal government and its contractors must purchase certain items with recovered material (recycled) content. Based on extensive research, EPA has designated several such construction products in the Comprehensive Procurement Guideline (CPG). Visit <www.epa.gov/cpg> for a complete list and more information. Many additional construction products are commercially available with recycled content or alternative, less toxic materials.

A QUICK GUIDE TO REDUCING C&D WASTE

<p>Sell or Donate for Reuse</p>	<ul style="list-style-type: none"> ■ Cabinets, doors, plumbing, lighting fixtures, tile carpeting, door hinges, wall paneling, mirrors, stairway bannisters, construction-grade lumber, ornamental wood trim, clay tiles and bricks, metals such as copper and aluminum electrical hardware or wire, and some plumbing hardware. ■ Historical fabric and architectural items from historic buildings. ■ Old-growth timbers. ■ Clean, uncontaminated concrete waste is used in some municipalities as aggregate for soil stabilization or reprocessed for use in roads, foundation stone, and other projects. Check with your local licensed landfill operator, earthmovers, or road construction personnel. Rubble (concrete, bricks, cinderblock, and certain types of tile) can be crushed and sieved for use as an aggregate.
<p>Reuse on Site</p>	<ul style="list-style-type: none"> ■ Joist cut-offs can be cut up and used as stakes for forming or for headers around floor openings. Wood scraps can be used as bridging, splicers, wall components, filler, scabs, and spacers. ■ Leftover rigid insulation can be used as ventilation baffles or installed into house envelopes at joist header assemblies. ■ Asphalt can be reused on site by heating pavement, injecting petroleum distillates, grinding, mixing, and rerolling. It is estimated that 86 million tons of asphalt are recycled each year.
<p>Recycle</p>	<ul style="list-style-type: none"> ■ Metal recyclers often take aluminum or copper wiring scrap, other wiring fixtures, conduit, iron, copper, brass, steel, lead piping, and appliances, such as refrigerators, freezers, washers, and stoves. ■ Uncontaminated scrap lumber or pallets can be recycled into furniture or chipped and used for landscape mulch, compost, animal bedding, boiler fuel, or engineered building products. Sometimes pallets can be returned to the vendors. ■ Gypsum scraps can be recycled in some locations. ■ Glass can be recycled into fiberglass or used in place of sand in paving material. ■ Asphalt shingles can be used in asphalt highway and road paving and pothole repair. (visit <shinglerecycling.org>). ■ Thermal insulation (fiberglass, cellulose, rigid foam, foam-in-place). ■ Floor tiles (heavy duty/commercial use). ■ Carpet and carpet cushion.
<p>Prevent Pollution and Reduce Waste</p>	<ul style="list-style-type: none"> ■ Ask drywall suppliers to back-haul scrap drywall for use in new drywall production. ■ Keep drywall cutoffs easily accessible to use for small spaces. ■ Replace toxic solvents, adhesives, and coatings with less hazardous products, such as water-based or low volatile organic compound (VOC) paint, adhesives, joint compounds, and sealants. ■ Reclaim solvents onsite for reuse, or contract with a recycling company. ■ To minimize spills while painting, clean spray guns by immersing only the front end in solvent. Clean spray guns by passing solvent through gun and into a container, rather than spraying cleaning solvent into the air. ■ Prepare smaller test batches of solvents and coatings. ■ Cover solvent, adhesive, and coating containers to prevent product evaporation. ■ Use solvent-based coatings with high levels of solids to reduce air emissions. ■ Arrange painting schedules to reduce wastes from cleaning equipment between tasks, shifts, or color changes.
<p>Buy Green</p>	<ul style="list-style-type: none"> ■ Thermal insulation (fiberglass, cellulose, rigid foam, foam-in-place). ■ Floor tiles (heavy duty/commercial use). ■ Carpet and carpet cushion. ■ Recycled-content siding (made of recycled cellulose fiber and concrete). ■ Salvaged wood floors and trim. ■ Recycled steel studs and steel roofing. ■ Strawboard for interior walls (made of straw pressed together with a low VOC, formaldehyde-free adhesive). ■ Recycled-content roofing materials. ■ Plastic lumber products.

REDUCE THE AMOUNT OF WASTE YOU GENERATE

REDUCE WASTE

How Should I Manage My Oil?

In the construction and demolition industry, many types of vehicles and equipment require the use of motor oil. Recycling is the preferred way of handling used oil to protect the environment and to conserve natural resources. Used oil can be re-refined into lubricants, re-processed into fuel oil, and used as raw materials for the refining and petrochemical industries. Used oil filters contain reusable scrap steel that producers can use as scrap feed. If you maintain your own vehicles, take the following steps to ensure the environment is protected by recycling this valuable resource:

- Follow good housekeeping practices and your state's used oil management standards.
- Do not mix used motor oil with anything.
- Keep clean-up materials such as rags, sand, booms, or clay kitty litter close at hand.
- Contain spilled oil by spreading sand or other clean-up material over and around the used motor oil.
- Buy and maintain reusable clean-up materials when possible.
- Recycle used oil clean-up materials or send them to an energy recovery facility when possible.
- Reduce waste and save money by using extraction devices (e.g., centrifuges, wringers and compactors) to recover used motor oil from reusable clean-up materials.
- Remove used motor oil from rags or other clean-up materials and recycle the motor oil as you normally would.
- Put used cleaning materials in the trash when they do not contain any free-flowing oil and when they can no longer be reused or recycled.
- Send used motor oil to a re-refiner whenever possible.
- Send used oil filters to a recycler whenever possible.

The recycling loop isn't complete until the materials that

are sent for recycling are remanufactured into new products and purchased by consumers. Whenever possible, purchase re-refined motor oil for vehicles and equipment. Search EPA's Comprehensive Procurement Guidelines database for a listing of re-refined motor oil dealers in your area <www.epa.gov/cpg>.

How Should I Manage My Used Tires?

Typically, the many vehicles used in the construction and demolition industry will outlive their tires, requiring users to find replacements when the original tires are no longer functional. Discarded tires have always been and continue to be a serious disposal problem, taking up large amounts of landfill space and posing threats to human health and the environment. Salvaging used tires not only keeps them out of landfills, but provides the opportunity to save money on the replacements.

When tires become worn, take them to a retreader or other tire recycler. Technically, all types of tires can be retreaded. Retreading involves adding a new layer of tread to a used tire. Retreading tires not only saves landfill space, but also conserves the oil and energy used to make new tires. Retread tires cost between 30 percent and 50 percent less than a new tire. Search EPA's Comprehensive Procurement Guidelines database for a listing of retread tire manufacturers in your area <www.epa.gov/cpg>.

If tire retreading is not an option, look into the various state and private organizations that offer tire recycling programs. Recycled tires can be used in creating running tracks, playground surfaces, and shoe soles. Scrap tires can also be used in flooring/matting and as a soil amendment. Ground tires provide cushioning and maintain traction and shape; for this reason, they are increasingly used by highway departments as an asphalt additive to help extend the life of roads, and as low density aggregate in embankment and fill applications. See EPA's consolidated tire web site at <www.epa.gov/epaoswer/non-hw/muncpl/tires>.

OTHER ENVIRONMENTAL LAWS AFFECTING THE CONSTRUCTION INDUSTRY

CFR GUIDE TO HAZARDOUS WASTE REGULATIONS

To review the RCRA regulations referred to in this document, consult the following citations in 40 CFR:

- Part 260—Hazardous waste management system: general.
- Part 261— Identification and listing of hazardous waste.
- Part 262— Standards applicable to generators of hazardous waste.
- Part 263— Standards applicable to transporters of hazardous waste.
- Part 264— Standards for owners and operators of hazardous waste and specific types of hazardous waste management facilities.
- Part 265— Interim status standards for owners and operators of TSDFs.
- Part 266— Standards for the management of specific hazardous wastes and specific types of hazardous waste management facilities.
- Part 268— Land disposal restrictions.
- Part 270— EPA administered permit programs: the Hazardous Waste Permit Program.

THE CLEAN WATER ACT

The Federal Water Pollution Control Act, commonly known as the Clean Water Act (CWA), is the federal program designed to restore and maintain the integrity of the nation's surface waters. CWA controls direct discharges to surface waters (e.g., through a pipe) from industrial processes or stormwater systems associated with an industrial activity. It also regulates indirect discharges, or discharges to publicly owned treatment works (POTWs) through a public sewer system, by requiring industrial facilities to pretreat their waste before discharging to a public sewer. Industrial pollutants from the construction industry that might be regulated by CWA include solvents and adhesives.

CWA Resources:

- 40 CFR Parts 100 to 129 and 400 to 503.
- Internet access: <www.epa.gov/OW/>
- EPA Office of Water: (202) 564-2240
- Your state water authority, Regional EPA office, and local POTW.

OIL POLLUTION PREVENTION UNDER THE CWA

The Oil Pollution Prevention regulations were promulgated under the authority of the CWA. These regulations establish requirements for facilities to prevent oil spills from reaching the navigable waters of the United States or adjoining shorelines. The regulations apply to non-transportation-related facilities with a specific aboveground or underground oil storage capacity that, because of their location, can reasonably be expected to discharge oil into the navigable waters of the United States.

Oil Pollution Prevention Regulation Resources:

- 40 CFR Part 112
- Internet Access: <www.epa.gov/oilspill/>

THE CLEAN AIR ACT

The Clean Air Act (CAA) regulates air pollution. It includes national emission standards for new stationary sources within particular industrial categories. It also includes national emission standards, which are designed to control the emissions of particular hazardous air pollutants (HAPs). Construction sites generate some HAPs, such as volatile organic compounds in organic solvents and paints. The CAA also seeks to prevent the accidental release of certain hazardous chemicals and to minimize the consequences of such releases.

CAA Resources:

- 40 CFR Parts 50 to 99
- Control Technology Center, Office of Air Quality, Planning and Standards, EPA, General Information: (919) 541-0800; Publications (919) 541-2777
- Internet Access: <www.epa.gov/ttn/catc>

ASBESTOS NATIONAL EMISSIONS STANDARDS FOR HAZARDOUS AIR POLLUTANTS (NESHAP)

The Clean Air Act also regulates asbestos renovations and demolitions. The Asbestos National Emissions Standards for Hazardous Air Pollutants (NESHAP) relating to demolitions and renovations is a work practice standard, meaning it does not place specific numerical emission limitations for asbestos fibers on asbestos demolitions and removals. Instead, it requires specific actions to be taken to control emissions. For more information about the asbestos NESHAP, asbestos-related renovation or demolition in buildings other than schools, or transport and disposal of asbestos waste, contact the Small Business Asbestos Ombudsman at (800) 368-5888 or <www.epa.gov/sbo>. For questions regarding asbestos in private homes, contact your state or regional EPA asbestos representative at <www.epa.gov/opptintr/asbestos/contacts.htm>.

- Part 271— Requirements for authorization of state hazardous waste programs.
- Part 272— Approved state hazardous waste management programs.
- Part 273— Standards for universal waste management.
- Part 279— Standards for the management of used oil.

FOR MORE INFORMATION

For additional information on any of these laws, visit www.cicacenter.org.

OTHER ENVIRONMENTAL LAWS AFFECTING THE CONSTRUCTION INDUSTRY

COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT (CERCLA OR SUPERFUND)

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, commonly known as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment, that might come from any source. Superfund also grants EPA the authority to force parties responsible for environmental contamination to clean it up or to reimburse response costs incurred by EPA. The most important part of this act applicable to construction sites is the hazardous substance release reporting requirement. The person in charge at your business must report to the National Response Center (800 424-8802), any release of a hazardous substance that exceeds a designated “reportable quantity” for that substance within a 24-hour period.

Superfund Resources:

- Internet Access: www.epa.gov/superfund/

THE EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW ACT

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created the Emergency Planning and Community Right-to-Know Act (EPCRA). This law was designed to improve community access to information about potential chemical hazards and to facilitate the development of chemical emergency response plans by state and local governments. The EPCRA regulations establish several types of reporting obligations for facilities that store or manage specified chemicals. Certain notification requirements apply to construction sites that use or store extremely hazardous substances. Also, many of the chemicals used by the construction industry, such as solvents, adhesives, and pigments, may be considered hazardous chemicals as defined by the Occupational Safety and Health Act (OSHA). Contact your local OSHA office if you have questions about whether the

chemicals used in your construction business are considered hazardous under OSHA.

EPCRA Resources:

- 40 CFR Parts 350 to 372
- The State Emergency Response Commission www.epa.gov/ceppo/serclist.htm.
- Internet Access: www.epa.gov/opptintr/tri/index.htm and www.epa.gov/swercepp/

SAFE DRINKING WATER ACT

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants present in drinking water. Under the authority of the SDWA, EPA developed national drinking water standards and created a joint federal-state system to ensure compliance with these standards. EPA also regulates underground injection of liquid wastes under the SDWA to protect underground sources of drinking water.

SDWA Resources:

- 40 CFR Parts 141-148
- SDWA Hotline: (800) 426-4791
- Internet Access: www.epa.gov/ogwdw/

TOXIC SUBSTANCES CONTROL ACT

The Toxic Substances Control Act (TSCA) allows EPA to collect data on chemicals to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing, and use. Construction sites may be affected by some of the TSCA requirements.

TSCA Resources:

- 40 CFR Parts 702 to 799
- TSCA Hotline: (202) 554-1404
- Internet Access: www.epa.gov/internet/oppts/

CONTACTS AND RESOURCES

Contacts and Resources

U.S. EPA RESOURCES

EPA's Construction and Demolition Debris Web Page

Web: www.epa.gov/epaoswer/non-hw/debris

Defines construction and demolition debris, provides background information, and provides a link to EPA's report, entitled "Characterization of Building-Related Construction and Demolition Debris in the United States."

Web: www.epa.gov/reg5rcra/wptdiv/solidwaste/construction.htm

The Region 5 web site provides information on recycling waste at construction and demolition sites.

Managing Your Environmental Responsibilities—A Planning Guide for Construction and Development

Available at www.cicacenter.org

RCRA Hazardous Waste Resources

Web: www.epa.gov/osw/topics.htm

Provides an alphabetical, clickable index of waste topics. Links to other sections of the EPA site for more information.

RCRA Information Center

U.S. Environmental Protection Agency
RCRA Information Center (5305W)
1200 Pennsylvania Avenue, NW
Washington, DC 20460
Phone: (703) 603-9230
Fax: (703) 603-9234
E-mail: rcra-docket@epamail.epa.gov

Holds and provides public access to all regulatory materials on RCRA and distributes technical and non-technical information on RCRA issues.

Envirosense

Web: www.epa.gov/envirosense/index.html

An EPA site containing technical, policy, and general information on pollution prevention topics.

Headquarters Library

U.S. Environmental Protection Agency
Headquarters Library
1200 Pennsylvania Avenue, NW (3404T)
Washington, DC 20460
Phone: (202) 566-0556
Fax: (202) 566-0562
E-mail: library-hq@epa.gov
Web: www.epa.gov/natlbra/hqirc/about.htm

Maintains environmental reference materials for EPA staff and the general public, including books, journals, abstracts, newsletters, and audiovisual materials generated by government agencies and the private sector. Also provides access to online computer service bulletin boards and CD-ROM systems.

Jobs Through Recycling Construction Web Page

Web: www.epa.gov/jtr/comm/construc.htm

Section of EPA's Jobs Through Recycling Web Site that addresses recycling of construction materials. Provides information on recycling markets for construction and demolition debris.

Comprehensive Procurement Guidelines

Web: www.epa.gov/cpg

EPA's Comprehensive Procurement Guideline Program specifies recycled-content products, including construction materials, for federal government use.

National Lead Information Center

Phone: (800) 424-LEAD (5323)
Fax: (301) 585-6151
Web: www.epa.gov/lead/nlic.htm

Distributes information about lead hazards and their prevention.

Pollution Prevention Information Clearinghouse (PPIC)

U.S. Environmental Protection Agency
Pollution Prevention Information Clearinghouse (PPIC)
1200 Pennsylvania Avenue, NW (7407)
Washington, DC 20460
Phone: (202) 260-1023
Fax: (202) 260-4659
Email: ppic@epamail.epa.gov

A free, nonregulatory EPA service dedicated to reducing or eliminating industrial pollutants through technology transfer, education, and public awareness. Provides links to EPA pollution prevention resources.

Small Business Ombudsman Clearinghouse/Hotline

U.S. Environmental Protection Agency
Small Business Ombudsman (2131)
1200 Pennsylvania Avenue, NW
Washington, DC 20460
Phone: (800) 368-5888
Fax: (703) 305-6462
Web: www.smallbiz-enviroweb.org

Helps private citizens, small businesses, and smaller communities with questions on all program aspects within EPA.

OTHER FEDERAL AND STATE GOVERNMENT RESOURCES

Other Federal Resources

Army Corps Construction Engineering Research Lab

ERDC-CERL
PO Box 9005
Champaign, IL 61826-9005
Web: www.cccer.army.mil

CERL, a part of the U.S. Army Engineer Research and Development Center, conducts research and development to support environmentally sustainable military installations. To carry out its mission, CERL works extensively with the academic community and public industry, facilitating technology and knowledge transfer between the private and government sectors.

Code of Federal Regulations (CFR)

Superintendent of Documents
U.S. Government Printing Office
Phone: (866) 512-1800
(202) 512-1800 (DC area)
Web: <http://bookstore.gpo.gov>

Most of the RCRA requirements are contained in Title 40, Parts 260 to 299 contains. Order from the U.S. Government Printing Office.

Naval Facilities Engineering Service Center

Web: <http://enviro.nfesc.navy.mil>

Engineering Services section of the Naval Facilities Engineering Service Center.

U.S. Department of Transportation (DOT)

Hazardous Materials Information Center
Phone: (800) 467-4922
Web: <http://hazmat.dot.gov/>

Provides information about DOT's hazardous materials regulations.

U.S. General Services Administration's Construction Waste Management Database

Web: <http://cwm.gsa.gov>

Searchable online database contains nationwide information on companies that haul, collect, and process debris from construction projects.

USDA Forest Products Lab

One Gifford Pinchot Drive
Madison, WI 53726-2398
Phone: (608) 231-9200
Fax: (608) 231-9592
Web: www.fpl.fs.fed.us/documnts/recycling_wood.htm

The nation's leading wood research institute, recognized nationally and internationally as an unbiased source of information on wood science and use.

State Resources

Construction and Demolition Waste Recovery: Processing, Recycling, Burning and Transport

Web: www.dnr.state.wi.us/org/aw/air/reg/asbestos/asbes6.htm

Wisconsin Department of Natural Resources Web site outlines a number of issues related to construction and demolition waste.

Contacts and

Integrated Waste Management Board's Construction and Demolition (C&D) Recycling Program

Web: www.ciwmb.ca.gov/ConDemo

A California Web site that allows users to search a database of facilities within and outside of California that collect specific types of construction and demolition debris for reuse or recycling.

University of Florida Powell Center for Construction & Environment

Rinker Hall Room 304
P.O. Box 115703
Gainesville, FL 33711-5703
Contact: Dr. Charles Kibert
Phone: (352) 273-1189
E-mail: ckibert@ufl.edu
Web: <www.cce.ufl.edu>

Fosters the implementation of sustainability principles into the creation of the built environment, ensuring that energy, water, materials, and land are utilized efficiently and that renewable and recyclable resources are emphasized.

MATERIALS EXCHANGE RESOURCES

EPA's Listing of International, National, and State-Specific Material Exchanges

Web: www.epa.gov/jtr/comm/exchange.htm

Defines and describes materials and waste exchanges, and provides contact information for state, national, and international material exchanges.

Materials Exchange Organizations Index

Web: www.recycle.net/recycle/exch

Alphabetical listing of materials exchanges.

RecycleXchange

Web: www.recycleexchange.com/exchange

Classified advertisements for buying and selling various materials, including construction and demolition debris.

Recycling Exchange Links on the Small Business Environmental Home Page

Web: www.smallbiz-enviroweb.org/pollution/recycling_links.html

Listing of helpful resource links for small businesses interested in increasing their recycling efforts.

TRADE, PROFESSIONAL, AND ADVOCACY ASSOCIATIONS AND ORGANIZATIONS

Construction Industry Compliance Assistance Center (CICA)

www.cicacenter.org

The CICA Web site provides plain language explanations of environmental rules for the construction industry and links to detailed information, including state regulations.

Construction Materials Recycling Association

P.O. Box 644
Lisle, IL 60532
Phone: (630) 548-4510
Fax: (630) 548-4511
Email: turley@cdrecycling.org
Web: www.cdrecycling.org
Contact: William Turley

A national association that promotes the recycling and reuse of construction and demolition materials.

American Association of State Highway and Transportation Officials (AASHTO)

444 North Capitol Street, NW., Suite 249
Washington, DC 20001
Phone: (202) 624-5800
Fax: (202) 624-5806
Email: info@aaashto.org
Web: www.transportation.org

Association representing highway and transportation departments in all 50 states, the District of Columbia, and Puerto Rico.

Asphalt Recycling & Reclaiming Association

PMB 250
#3 Church Circle
Annapolis, MD 21401
Phone: (410) 267-0023
Fax: (410) 267-7546
E-Mail: MemberServices@arra.org
Web: www.arra.org

Serves as a network for asphalt recycling information exchange and technology transfer among professionals in the highway industry.

Associated General Contractors of America

333 John Carlyle Street
Suite 200
Alexandria, VA 22314
Phone: (703) 548-3118
Fax: (703) 548-3119
E-Mail: info@agc.org
Web: www.agc.org

Organization of construction contractors and industry-related companies dedicated to improving the construction industry by educating the industry about the latest skills, technology, and products. Select "Environmental Services" and "Environmental Publications."

Building Deconstruction Consortium

Web: www.denix.osd.mil/denix/Public/Library/Sustain/BDC/bdc.html

A network of building professionals working to maximize reuse of building materials. The network identifies and develops technical resources to encourage building material reuse that is fiscally, environmentally, and occupationally sound.

Center for Resourceful Building Technology

P.O. Box 100
Missoula, MT 59806
Phone: (406) 549-7678
Fax: (406) 549-4100
E-Mail: crbt@ncat.org
Web: www.crbt.org

Dedicated to promoting environmentally responsible construction practices and containing information on recycled-content building products and environmental building techniques.

Deconstruction Institute

1143 Central Avenue
Sarasota, FL 34236
Phone: (941) 358-7730
Fax: (941) 362-4290
Web: www.deconstructioninstitute.com

Web site provides educational materials, tools and techniques, networking, case studies, articles, facts, and many other downloadable and interactive modules about the environmental impacts of building deconstruction.

Institute for Local Self-Reliance

927 15th St. NW, 4th Floor
Washington, DC 20005
Phone: (202) 898-1610
Web: www.ilsr.org

Organization helping community groups, government leaders, and entrepreneurs develop environmentally friendly economic strategies that contribute to sustainable economic systems.

Resources

National Association of Demolition Contractors (NADC)

16 North Franklin Street
Suite 203
Doylestown, PA 18901-3536
Phone: (800) 541-2412
Fax: (215) 348-8422
E-mail: info@demolitionassociation.com
Web: www.demolitionassociation.com

The National Association of Demolition Contractors represents over 850 demolition contractors and 200 associated industry companies worldwide. NADC facilitates education and communication regarding safety and technology between industry members and regulators.

National Association of Home Builders (NAHB)

1201 15th Street, NW
Washington, DC 20005
Phone: (800) 368-5242 or (202) 822-0200 within the Washington, DC metropolitan area.
E-mail: info@NAHB.org
Web: www.nahb.org

Organization representing home builders. Participates in a partnership, known as Build American Beautiful, along with Keep American Beautiful, Inc., a national nonprofit organization dedicated to improving waste practices. Build American Beautiful recognizes contractors who keep construction sites clean and make efforts to recycle and reduce wastes.

National Association of Home Builders Research Center

400 Prince George's Blvd
Upper Marlboro, MD 20774
Phone: (301) 249-4000, (800) 638-8556
Fax: (301) 430-6180
E-mail: webmaster@nahbrc.org
Web: www.nahbrc.org

A wholly owned subsidiary of NAHB, which aims to keep government agencies, manufacturers, builders, and remodelers on the leading edge of home construction technology.

The Recycled Materials Resource Center

220 Environmental Technology Building
35 Calvos Road
Durham, NH 03824
Phone: (603) 862-4704
Fax: (603) 862-3957
E-Mail: rmrc@rmrc.unh.edu
Web: www.rmrc.unh.edu

National center that serves as the principal point of contact for the use of recycled materials (pavements, secondary waste, by-product materials) in the highway environment.

The Reuse People, Inc.

2100 Ferry Point #150
Alameda, CA 94501
Phone: (510) 522-2722
E-mail: info@TheReusePeople.org
Web: www.thereusepeople.org

A nonprofit corporation dedicated to reducing the solid waste stream entering our landfills by diverting and salvaging usable building materials and providing them to individuals, businesses and families, including low-income families in Mexico.

Shinglerecycling.org

Web: www.shinglerecycling.org

An online resource center developed by EPA, the University of Florida, CMRA, and the National Roofing Contractors Association, shinglerecycling.org provides comprehensive information regarding shingle recycling, including barriers to recycling, recycling markets, regulatory concerns, and links to other resources.

Steel Recycling Institute

680 Andersen Drive
Pittsburgh PA 15220-2700
Phone: (800) YES-1-CAN (937-1226)
E-mail: sri@recycle-steel.org
Web: www.recycle-steel.org

National trade association representing the steel industry and providing steel recycling information, links, and a database of steel recyclers in the United States.

U.S. Green Building Council

1015 18th Street, NW., Suite 805
Washington, DC 20036
Phone: (202) 82-USGBC (828-7422)
Fax: (202) 828-5110
Web: www.usgbc.org

The mission of this coalition is to accelerate the adoption of green building practices, technologies, policies, and standards.

Used Building Materials Association

1702 Walnut Street
Boulder, CO 80302
Phone: (303) 440-0703
Fax: (303) 441-4367
Web: www.ubma.org

A nonprofit organization that represents companies and organizations involved in the acquisition and redistribution of used building materials.



United States
Environmental Protection Agency
1200 Pennsylvania Ave., NW. (5305W)
Washington, DC 20460

Official Business
Penalty for Private Use \$300



Recover Your Resources

*Reduce, Reuse, and Recycle
Construction and Demolition Materials
at Land Revitalization Projects*



What's in Your Dumpster?



Don't waste your resources

Sustainable reuse of brownfield properties includes efforts to reduce the environmental impact by reusing and recycling materials generated during building construction, demolition, or renovation. Typical construction and demolition (C&D) materials include wood, drywall, cardboard, brick, concrete, metal, insulation and glass.



Preliminary estimates from the U.S. Environmental Protection Agency (EPA) show that the nation generated more than 160 million tons of building related construction and demolition (C&D) materials in 2003. According to the most recent data available (2003), nearly 53 percent of all building-related C&D materials are the result of demolition activities, 38 percent of the materials are produced by renovation activities, while approximately nine percent are the result of construction. Of the total building-related C&D materials generated, EPA estimates that only 40 percent were reused, recycled, or sent to waste-to-energy facilities, while the remaining 60 percent of the materials were sent to C&D landfills.

There are numerous opportunities to recover and use C&D materials at brownfields and land revitalization sites, including:

- Brownfields often have abandoned or unwanted buildings onsite in need of demolition. Materials recovered can be reused onsite, sold through local markets, or recycled offsite.
- Brownfields are frequently located in urban areas near transportation hubs. Being close to transportation corridors allows a developer to reuse current infrastructure and provides easy access to potential markets for C&D materials.
- Renovation or new construction on former brownfields provides owners/developers with an opportunity to buy recycled-content building products, return, sell or donate unused building materials, and send other materials for recycling.

Several brownfields and land revitalization projects have achieved significant C&D recovery rates through recycling, salvage for reuse or resale, composting, and other methods. These C&D material recovery activities are achieved at lower costs than landfilling, resulting in significant cost-savings and avoided associated environmental impacts. For example, the dismantlement of Nashville Thermal Transfer, a waste-to-energy facility in Nashville, TN, resulted in 98.5% reuse and recycling of its equipment and C&D materials. Over 100 internet auction events sold over 1,000 tons of equipment and materials, (bringing in over \$980,000 in revenue). In addition, thousands of tons of crushed aggregate were transferred off-site for use as backfill, and crushed asphalt was used off-site for a perimeter road.

Generation of Construction and Demolition Waste Materials

C&D materials are generated during new construction, renovation, and demolition of buildings, roads, and other structures. C&D materials include brick, concrete, masonry, soil, rocks, lumber, paving materials,

Integrate C&D Resource Recovery at Land Revitalization Projects

Pre-planning

- Include contractor language for RFP requiring C&D recycling



Planning

- Develop C&D recycling plan
- State recycling goals
- Identify materials for recovery
- Assign roles and responsibilities (who, what, when, how)



Demolition

- Salvage materials
- Deconstruct structures to maximize quantity/quality of recoverable resources
- Link a deconstruction project with a current construction or renovation project to facilitate reuse of salvaged materials
- Sell or donate recovered materials
- Reuse recovered materials onsite
- Send materials for recycling offsite

... recover them.



shingles, glass, plastics, aluminum (including siding), steel, drywall, insulation, asphalt roofing materials, electrical materials, plumbing fixtures, vinyl siding, corrugated cardboard, and tree stumps. If properly planned, a vast majority of C&D materials can be recovered through reuse and recycling, which conserves resources and energy.

What C&D Materials Cannot be Reused or Recycled?

A certain portion of the materials from construction and demolition projects are toxic or classified as hazardous waste. Materials generated in new construction that may require special handling include latex paint, chemical solvents and adhesives. The materials should be managed according to local regulations. Lead paint can be planed, removed, and recycled at a lead smelter or disposed of appropriately, while the remaining wood can also be reused or recycled.

The age of structures involved in demolition projects ranges considerably. Many older buildings may contain materials that are no longer allowed in new construction, such as asbestos and lead-based paint. Asbestos abatement is required prior to demolition. Asbestos must be handled appropriately and disposed in a landfill that accepts asbestos-containing material (ACM). Contact your landfill to find out if they accept ACM.

Main C&D Recovery Project Types

Deconstruction—A “soft” demolition technique, in which workers dismantle a significant portion of a building in order to maximize recovery of materials for reuse and recycling. In order for materials to be reusable, they must be removed intact (e.g., windows and frames, plumbing fixtures, floor or ceiling tails) or in large pieces (e.g., lumber).

Demolition—The complete removal of a building. Generally, after extracting easily removable materials for reuse or recycling, workers complete the demolition with heavy equipment. Additional recyclables are often sorted from the rubble generated during these demolition activities. In order to be recycled, materials must be separated from contaminants (e.g., trash, nails, broken glass).

New Construction—Putting together all or part of a structure. Most construction site debris is generated from packaging and when raw materials are cut or sized. Workers can save large scraps for use in other projects. Durable packaging and unused materials can be returned to suppliers. Smaller scraps and non-durable packaging can be source separated when produced and recycled.

Renovation—Partial removal of a building’s interior and/or exterior followed by construction. Contractors can adapt the same recovery techniques as above for renovation projects.

Main C&D Recovery Streams

Reuse—Many materials can be salvaged from demolition and renovation sites and sold, donated, stored for later use, or reused on the current project. Typical materials suitable for reuse include plumbing fixtures, doors, cabinets, windows, carpet, brick, light fixtures, ceiling and floor tiles, wood, HVAC equipment, and decorative items (including fireplaces and stonework).

Recycling—Materials can either be recycled onsite into new construction or offsite at a C&D processor. Typical materials recycled from building sites include metal, lumber, asphalt, pavement (from parking lots), concrete, roofing materials, corrugated cardboard and wallboard.

Construction/Renovation

- Design building to facilitate future changes
- Reuse existing structure whenever possible
- Design for standard size building materials
- Buy environmentally preferable construction materials
- Sell or donate unused building supplies
- Contract with suppliers that will take back unused construction materials
- Send materials for recycling

Results

- Identify/quantify materials diverted from the waste stream
- Calculate cost-savings and other benefits
- Collect tax credits, rebates, green building certifications, and other incentives if applicable
- Communicate/report results

Commonly Recovered C&D Materials



Asphalt Paving

Asphalt is crushed and recycled back into new asphalt. Markets for recycled asphalt paving include aggregate for new asphalt hot mixes and sub-base for paved road. For more information on recycling asphalt, visit www.arra.org



Land Clearing Residuals

Trees and brush—can be recycled as compost or mulch; soil can be reused as fill and cover



Wood

Reuse timbers, large dimension lumber, plywood, flooring, molding, lumber longer than 6 feet. Clean, untreated wood can be recycled, re-milled into flooring, or chipped/ground to make engineered board, boiler fuel, and mulch.



Gypsum Wallboard

Remove and recycle gypsum drywall. Markets include new drywall manufacture, cement manufacture, and agriculture. Unused drywall can be returned to a supplier, donated, or sold. For more information on recycling drywall visit, www.drywallrecycling.org



Metals

Recycle metals found at a construction, demolition, or renovation sites. Common metals include steel, aluminum, and copper. Local metal scrap yards or recyclers that accept metal materials are typically accessible. Metals are melted down and reformed into metal products. Markets are well established for metals. For more information on recycling metal visit www.isri.org and www.recycle-steel.org.



Buildings

Reuse large portions of existing structures during renovation or redevelopment. Extending the life cycle of existing building stock will conserve resources, retain cultural resources, reduce waste, and reduce environmental impacts of new buildings as they relate to materials manufacturing and transport.

What's in Your Dumpster?



For all C&D materials, hazardous



Concrete

Concrete is commonly recycled. It is crushed, the reinforcement bar is removed, and the material is screened for size. Market outlets for recycled concrete include road base, general fill, pavement aggregate, and drainage media. For more information on recycling concrete visit www.concreterecycling.org



Roofing (non-asphalt shingles)

Reuse sheathing, terracotta, slate, or untreated cedar tiles. Metal materials can also be recycled.



Asphalt Shingles

Recycle asphalt shingles. After the removal of nails, asphalt shingles can be ground and recycled into asphalt mixes. For more information on recycling asphalt shingles, visit www.shinglerecycling.org



Brick

Reuse clean brick in historical restoration projects. Recycle clean brick by crushing material. Market outlets for recycled brick include aggregate, drainage media, and general fill.



Architectural Salvage

Salvage for resale and reuse, doors and door frames, windows, structural systems, millwork, fixtures, and other materials. Wood structural systems rate highly for end-of-life reuse potential. Old mill buildings framed with large wood timbers are now treasure troves of material for new construction. Markets are well established and easily accessible.

or toxic materials should be removed and managed according to local regulations.

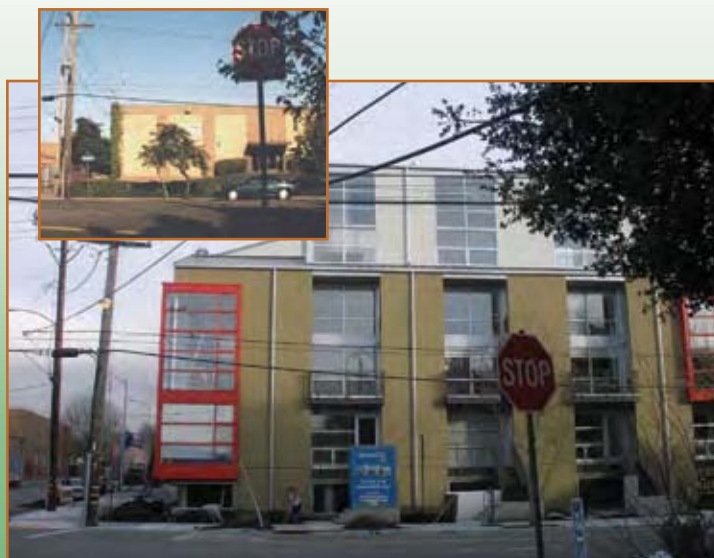
EPA C&D Recycling Success Stories



Richmond, VA

The former Lucent Richmond Works facility, a 120-acre RCRA facility, was fenced off and left idle, leaving behind over 700,000 square feet of old and dilapidated manufacturing buildings. With coordination between the developer, the previous site owner, EPA, and the Virginia Department of Environmental Quality, the property is being revitalized into *The Shops of White Oak Village*, a development that will feature several restaurants, a hotel, national retail stores, and several regional and local specialty shops. After demolishing the existing onsite buildings, the developer diverted 84,500 tons of material from landfills, achieving a 93 percent overall recycling rate. According to the project's demolition contractor, the amount of materials diverted from landfills could have filled two Richmond Coliseums. Cost-savings associated with recycling and reuse of demolition materials are estimated to be approximately \$3.6 million. The developer is now applying for Leadership in Energy and Environmental Design (LEED) certification from the U.S. Green Building Council, further demonstrating a commitment to sustainable development. For more information on this project, please visit:

www.epa.gov/reg3wcmd/ca/va/pdf/vad066000993.pdf



Emeryville, CA

In July 2003, the City of Emeryville provided \$1,175,000 in EPA Brownfields Revolving Loan funds to GreenCity LLC to assist with cleanup costs associated with the GreenCity Lofts property, a former paint factory. The GreenCity Lofts project team completed cleanup of the 0.9-acre property in December 2004 and 62 condominiums were constructed in 2005. Demolition of the former paint factory and warehouse buildings was necessary before construction of the lofts could begin. The project team employed C&D waste recycling practices including deconstructing (hand dismantling) the buildings on the former industrial property as an alternative to traditional demolition. *As a result, 94.6 percent of the demolition waste was recycled, exceeding the nearby City of Oakland's legal requirement by 45 percent.* In addition, 21,569 tons of excavated soil were diverted from disposal and used as Beneficial Cover at a local Class II Landfill reducing project cost by an estimated \$496,708 in eliminated tipping fees. For more information on this project, please visit:

www.epa.gov/brownfields/success/emeryvilleca_cd_ss_final.pdf

Brownfields Cleanup and Redevelopment

EPA's Brownfields Program empowers states, communities, and other stakeholders in economic redevelopment to work together to prevent, assess, safely clean up, and sustainably reuse brownfields. The Brownfields Program provides technical and financial assistance, including grants for environmental assessment, cleanup, and job training.

www.epa.gov/brownfields/

Federal Facilities

The Federal Facilities Restoration and Reuse Program works with other Federal and state agencies to facilitate the cleanup and reuse of the nation's Superfund Federal facilities, including Base Realignment and Closure (BRAC) sites.

www.epa.gov/fedfac/

Underground Storage Tanks

The Underground Storage Tanks Program supports States, territories, and other partners in the cleanup and reuse of properties contaminated by petroleum releases from underground storage tanks and works to better integrate eligible petroleum brownfields into ongoing restoration/revitalization activities.

www.epa.gov/swerst1/



Detroit, MI

In December 2005, the cleanup of a two-acre former automotive property in Detroit, Michigan was made possible through the leadership of a local nonprofit organization and funding assistance provided by EPA, in-kind services, and C&D waste recycling activities. Working within a tight budget, Focus: HOPE Revitalization conducted demolition and cleanup activities on the brownfields property for its intended reuse as a parking lot for a planned mixed-use development on the adjacent property. Largely, the C&D waste recycling activities made the project feasible by reducing the total project cost by 20 percent, a savings of \$150,000, through the recycling of approximately 1,200 tons of materials and over 13,000 gallons of waste water. As a result, the property's reuse provided a catalyst to revitalization in the surrounding neighborhood. For more information on this project, please visit:

www.epa.gov/brownfields/success/Detroit_MI_Success_012808.pdf



Worcester, MA

In June 2003, EPA awarded Main South Community Development Corporation (CDC) in Worcester, Massachusetts a \$200,000 Brownfields Cleanup grant to address contamination discovered on 7.8 acres of the Gardner-Kilby-Hammond Neighborhood Revitalization Project—an ambitious \$32 million dollar, 30-acre inner city neighborhood redevelopment project. Cleanup of contamination present in the soil and the abandoned industrial buildings was completed in March 2006. To help keep cleanup costs within Main South CDC's budget, McConnell Enterprises recovered multiple construction and demolition (C&D) materials from the abandoned industrial buildings, including: 10,000 cubic feet of concrete, 200 tons of steel, 50,000 broad feet of hard yellow pine, and several hundred tons of brick and granite. Salvaged materials were sold through local and global markets, reused onsite for new construction, or recycled, strengthening the local market for C&D materials. Main South CDC was able to reduce project costs significantly as a result of its C&D waste reduction strategies. Early planning and a phased approach to the cleanup and development of the property also allowed for a major phase of the Gardner-Kilby-Hammond Neighborhood Revitalization Project to move forward: the construction of a Boys and Girls Club and affordable housing for first-time homebuyers. For more information on this project, please visit:

www.epa.gov/brownfields/sslocat.htm#reg1

RCRA Corrective Action

The Resource Conservation and Recovery Act (RCRA) Corrective Action Program requires the investigation and cleanup of hazardous releases at operating facilities. The RCRA Reuse and Brownfields Prevention Initiative encourages the reuse and revitalization of RCRA sites so that the land better serves the needs of the community through more productive use or as greenspace.

www.epa.gov/swerosps/rcrabf/

Superfund

The Superfund Program manages cleanups of the nation's uncontrolled hazardous waste sites that pose a current or future threat to human health or the environment. EPA's Superfund Redevelopment Program encourages communities at every cleanup site to consider anticipated future reuses early so that cleanups can accommodate those uses, while maintaining standards that protect human health and the environment.

www.epa.gov/superfund/programs/recycle/

Benefits to C&D Recycling



- Reduces the production of greenhouse gas emissions and other pollutants by reducing the need to extract raw materials and ship new materials long distances.



- Conserves landfill space, reduces the need for new landfills and their associated cost.



- Saves energy and reduces the environmental impact of producing new materials through avoided extraction and manufacturing processes.



- Creates employment opportunities and economic activities in recycling industries.



- Saves money by reducing project disposal costs, transportation costs, and the cost of some new construction materials by recycling old materials onsite.

Expanding Markets for Deconstruction Materials

It's getting easier to find homes for your deconstruction materials and used equipment. Many deconstruction items can be reused "as is." Several cities now have stores that accept and resell donated surplus building materials and deconstruction materials. For instance Habitat for Humanity runs "Habitat ReStores" which are retail outlets where quality used and surplus building materials are sold at a fraction of normal prices. Many affiliates across the United States and Canada operate successful ReStores. There are several other independent stores as well. Some companies have found it useful to open up a building slated for demolition, partnering with non-profits or other groups to collect "deconstruction" items. There are also a number of auction or classified ad type websites where people can sell, donate, or advertise the need for materials and used industrial equipment. For more information on Habitat ReStores, please visit, www.habitat.org/env/restores.aspx. Other similar reuse stores and online materials exchanges can be found in the Building Materials Reuse Association's directory: www.building-reuse.org/.

Resources

- EPA Construction and Demolition—www.epa.gov/cdmaterials
- Construction Industry Compliance Assistance Center—www.cicacenter.org
- Building Material Reuse Association—www.buildingreuse.org
- Construction Material Recycling Association—www.cdrecycling.org
- National Recycling Coalition, Industrial Materials Recycling Council—www.industrialresourcescouncil.org/
- National Demolition Association—www.demolitionassociation.com
- EPA Industrial Materials Recycling—www.epa.gov/industrialmaterials



Printed on Recycled Materials



Using Recycled Industrial Materials in Buildings



Greening the built environment. This information sheet discusses the use of recycled industrial materials in buildings as an alternative to virgin materials and building products. Industrial materials are the byproducts of industrial processes. Each year in the United States, industries produce over half a billion tons of residuals that are potentially usable materials, such as coal combustion products (CCPs), construction and demolition (C&D) materials, spent foundry sand, used tires, and slags. Many of these materials have chemical and physical properties that make them valuable resources when recycled or beneficially reused, but they are often disposed of as waste. The U.S. Environmental Protection Agency (EPA) is committed to increasing the recycling of industrial materials as part of its *Resource Conservation Challenge*, a national effort to conserve energy and other resources and reduce greenhouse gas emissions by managing materials more efficiently. Industrial materials recycling (IMR) helps accomplish these goals by conserving natural resources and decreasing energy use and greenhouse gas emissions.

www.epa.gov/industrialmaterials

An Overview:

Why Use Industrial Materials in Buildings?

Environmental Benefits

Since many industrial materials are used to replace non-renewable virgin materials that must be mined and processed for use, IMR conserves natural resources and reduces the energy use and pollution associated with these activities. For example, substituting coal fly ash (an industrial material) for portland cement in concrete saves the energy and greenhouse gas emissions associated with producing cement. The beneficial use of industrial materials results in less material being sent to disposal facilities, which saves landfill space and further reduces greenhouse gas emissions and other pollutants.

Economic Benefits

Industrial materials are often less expensive than virgin materials, so they make good economic sense for builders and project owners. Further, reusing or recycling C&D materials onsite can reduce material hauling and disposal costs. These savings, applied to the total project cost, make it possible to do more work with the same budget. In addition, C&D recyclers will often charge less to accept recyclable materials that have already been separated from non-recyclable materials—a practice that can be encouraged at the building site by using separate containers for various materials.

Performance Benefits

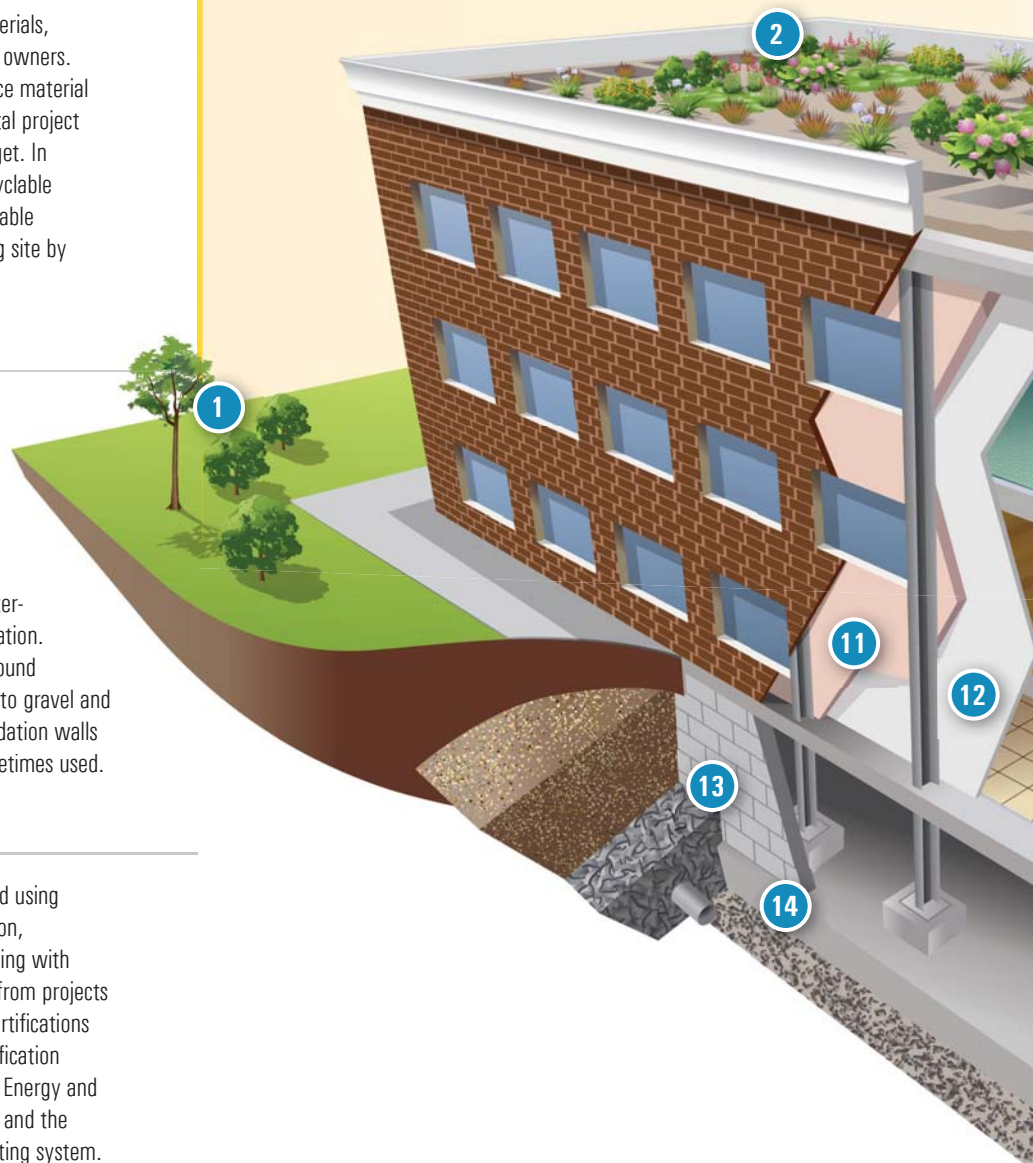
Some industrial materials, such as fly ash and slag cement used as supplementary cementitious material in concrete, offer significant performance benefits over virgin materials. Other industrial materials, such as foundry sand, perform just as well as—and in some cases better than—virgin materials in building applications. Coal bottom ash used as bedding material for green roofs is lighter-weight than alternatives, an important quality in this application. Tire shreds can not only provide more effective drainage around building foundations due to a greater gap structure relative to gravel and dirt alternatives, but also put less pressure on building foundation walls compared to the denser and heavier materials that are sometimes used.

Green Building

Green, or sustainable, building is the practice of creating and using healthier and more resource-efficient methods of construction, renovation, operation, maintenance, and demolition. Designing with industrial materials and recycling C&D materials generated from projects leads to more sustainable buildings. Most green building certifications give points for these practices; two of the best-known certification systems are the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED)[®] green building rating system and the Green Building Initiative's Green Globes[™] green building rating system.

Building Applications for Industrial Materials

This diagram illustrates a variety of common building applications for industrial materials. Note that the availability of specific industrial materials can vary regionally. The websites in the "Resources for More Information" section of this document may provide information on identifying suppliers of industrial materials in your region as well as local C&D materials recyclers.



1 2 Green Roofs & Landscaping

Green roofs are roofs covered with plants; they reduce storm runoff and provide insulation. Scrap tires can be used to make rubber tile for walkways. Bottom ash can be used as bedding material. Clean wood, recycled gypsum wallboard, and cardboard can be ground and used as soil amendments in both green roofs and landscaping applications.

3 Landscape Furniture

Benches can be made with plastic lumber containing fly ash or with recycled C&D wood.

4 Building Facing Material

Manufactured stone, which is concrete mixed with aggregates, is commonly used as building facing material. Fly ash can be used in the production of manufactured stone.

5 Sidewalks

Industrial materials can be used to make concrete sidewalks, and used tires can be recycled to create rubberized sidewalks. Asphalt concrete sidewalks can be made with recycled asphalt pavement and recycled asphalt shingles.

6 Ceiling Tile

Ceiling tile can contain flue gas desulfurization (FGD) gypsum (a material resulting from burning coal to produce electricity), fly ash, recycled gypsum wallboard, or air-cooled blast furnace slag.

7 Flooring

Industrial materials can be used in various flooring applications.

7a Carpet backing: Used tires, fly ash, or recycled carpet.

7b Wood flooring: Salvaged lumber or recycled wood.

7c Flooring tile: Fly ash, blast furnace slag.

7d Tile underlayment: Fly ash.

8 Backfill (Foundation Support)

Backfill surrounds the building foundation, supporting it and providing drainage. Scrap tires provide superior drainage, insulation, and wall pressure relief. Blast furnace slag and recycled concrete also can be used for drainage.

9 Foundation Structural Fill

Structural fill is an engineered fill that is constructed in layers and compacted to a desired density. Coal fly ash, bottom ash, slag, and spent foundry sand can all be used as structural fill. Concrete can be crushed and used onsite as structural fill.

10 Poured Concrete Foundation

Concrete, which is composed of cement, aggregate, and water, is used in a wide array of building applications. Industrial materials can be recycled in cement and concrete in many ways. Here are a few examples:

- Fly ash and ground granulated blast furnace slag can be used as partial cement replacements. Using these materials can produce stronger, longer-lasting concrete.
- Portland cement itself can be made with fly ash, FGD gypsum, foundry sand, recycled gypsum wallboard, blast furnace, and steel slag.
- Concrete aggregates can include bottom ash, foundry sand, crushed concrete, and blast furnace slag.

11 Insulation

Air-cooled blast furnace slag can be used to produce mineral or rock wool insulation (also known as slag wool insulation).

12 Drywall/Wallboard

FGD gypsum and recycled gypsum wall board can be used to manufacture drywall.

13 Mortars, Grouts, Stucco

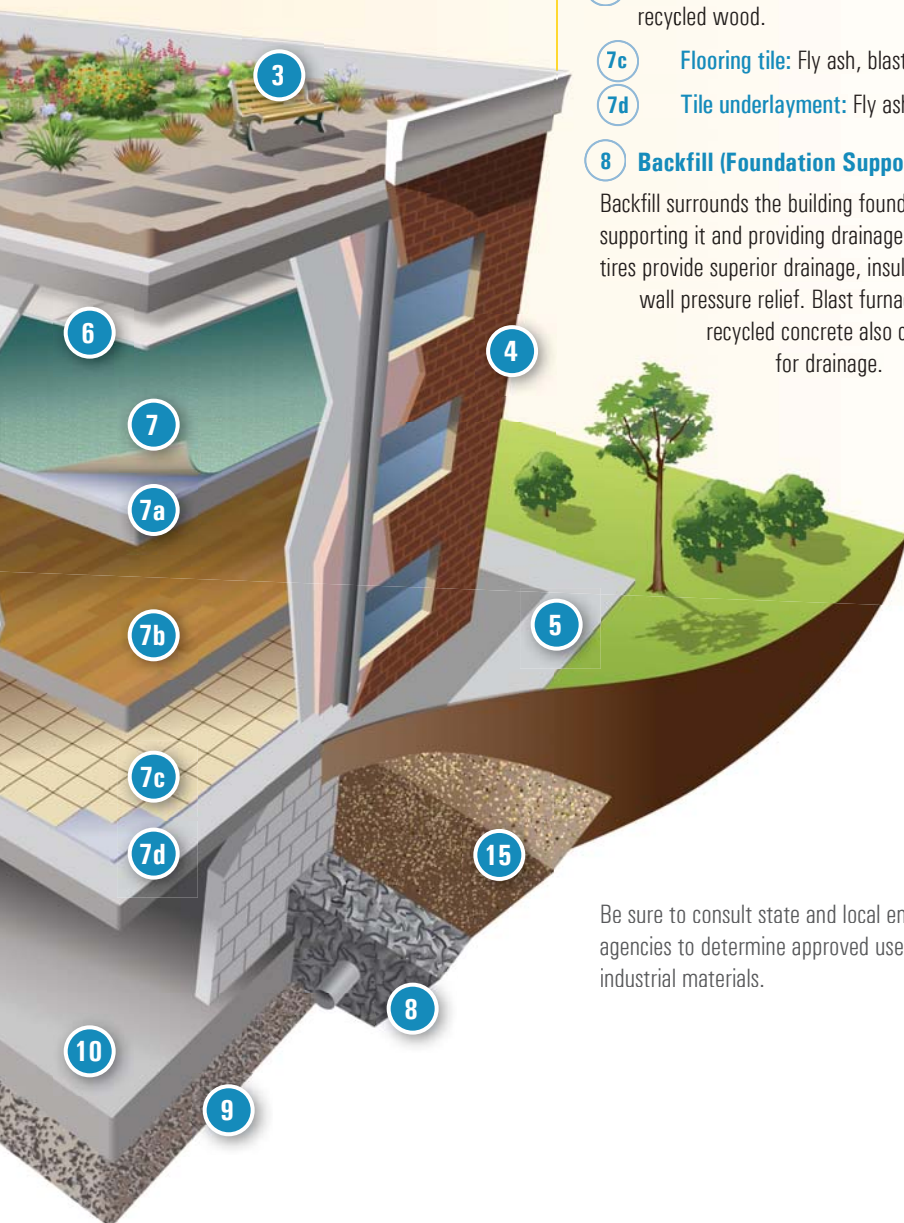
Mortars, grouts, and stucco contain aggregate (sand), binder, and water. Fly ash, foundry sand, silica fume, and slag cement can all be used as partial cement replacements.

14 Masonry Blocks

Masonry blocks are made from cement and aggregate. Slag cement, fly ash, or silica fume can substitute partially for cement. Bottom ash, blast furnace slag, and recycled concrete aggregate can substitute for newly mined materials.

15 Base Material

Spent foundry sand can be used in place of natural soil as base material for the building site. In cold weather climates, this strategy can extend the construction season because foundry sands do not freeze as readily as most soils. Recycled concrete is also commonly used as base material.



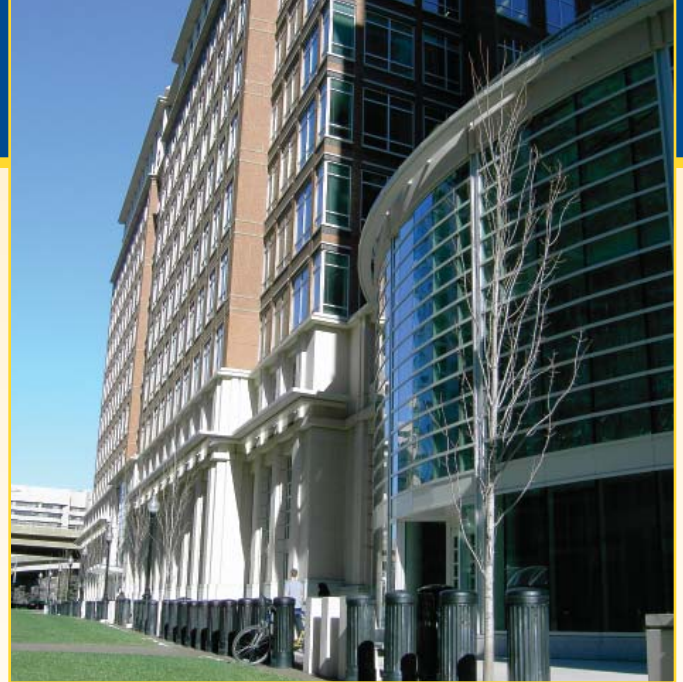
Be sure to consult state and local environmental agencies to determine approved uses of industrial materials.

Case Study

EPA Potomac Yards Buildings Maximize the Use of Recyclable Materials

The EPA buildings at One and Two Potomac Yard, located in Arlington, Virginia, are prime examples of how buildings can be constructed with resource management in mind. The buildings are U.S. Green Building Council LEED® Gold certified and contain, on average, 27% recycled content (as per LEED® calculations). Environmentally preferable products used in the buildings include slag concrete aggregate, fly ash, certified hardwood and softwood building products, recycled-content ceiling panels, carpet tile, and gypsum wallboard. Portions of the below-grade, poured-in-place concrete structure used 35% recycled-content concrete. This concrete contained approximately 670,000 pounds of slag for aggregate. Further, fly ash was used in concrete masonry unit blocks.

Prior to construction, the project team developed a C&D materials management plan. This included tracking the amount of C&D materials diverted from landfill disposal once construction commenced. The major groups of recycled materials were wood; steel; concrete, asphalt, and concrete masonry units; cardboard and paper; and drywall. An estimated 71% (about 2,000 tons) of the C&D materials generated during the construction of One and Two Potomac Yard was diverted from landfills. The



majority of these materials were separated in material-specific dumpsters at the jobsite, which were then taken to C&D recyclers.

The project won several awards for its green design, including the 2007 White House Closing the Circle Award, a 2007 award for best environmentally responsible building from the Northern Virginia Chapter of the National Association of Industrial and Office Properties, a 2005 Green ABBIE Award from the Arlington Economic Development Commission and Arlington Chamber of Commerce, and the U.S. General Services Administration (GSA) Lease Project of the Year Award (2004).

Did You Know?

The American Society for Testing Materials (ASTM) has studied and evaluated the benefits of using industrial materials in civil engineering applications. ASTM C 150, ASTM C 311, ASTM C 595, ASTM C 618, and ASTM C 989 are standard specifications for using fly ash and ground granulated blast furnace slag in cement and concrete in buildings. ASTM D6270-98 provides design guidelines for using scrap tires in civil engineering applications. Be sure to contact your state and local environmental agencies for more information about approved uses of industrial materials. See the ASTM website at: www.astm.org

Resources for More Information

EPA's Industrial Materials Recycling Homepage:

Provides an overview of industrial materials, their benefits, and opportunities for reuse and recycling: www.epa.gov/industrialmaterials

EPA's Comprehensive Procurement Guidelines (CPG):

Offers information about construction, landscaping, and other products containing recycled content. Though designed for procuring agencies using federal funds, these guidelines are also useful for the private sector: www.epa.gov/cpg

Construction Industry Compliance Assistance (CICA) Center:

Contains a C&D materials State Resource Locator, where you can find state environmental agency Web sites: www.cicacenter.org

Industrial Resources Council (IRC): The IRC is composed of industry trade associations representing coal combustion products, foundry sands, iron and steel slag, wood and pulp materials, rubber materials, and C&D materials. This Web site contains information about industrial materials and their applications: www.industrialresourcescouncil.org

The University of North Dakota's "Buyer's Guide for Coal Ash-containing Products": Provides links to suppliers of building materials containing coal combustion products: www.undeerc.org/carrc/BuyersGuide



U.S. Environmental Protection Agency
EPA530-F-08-022
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Detroit, Michigan

Recycling at Automotive Site Spurs Revitalization

A Construction and Demolition Waste Reduction Success Story



The former automotive site before cleanup and demolition activities.

Sustainable reuse of brownfields properties involves an emphasis on reducing the environmental impact of building renovation. One of the most effective ways of reducing these impacts is the recycling of construction and demolition (C&D) waste. Recycling of C&D waste can prevent loss of useful property, wasted materials, and embodied energy. It also helps to conserve raw materials through the use of existing materials, conserves energy and water, and reduces the production of greenhouse gas emissions and other pollutants. Furthermore, by providing materials to local vendors and processors, C&D recycling can create employment and economic activity that helps sustain local economies.

Project Highlights

In December 2005, the cleanup of a 2-acre, former automotive property in Detroit, Michigan was made possible through the leadership of a local nonprofit organization and funding assistance provided by the U.S. Environmental Protection Agency (EPA), in-kind services, and C&D waste recycling activities. Working within a tight budget, Focus: HOPE Revitalization conducted demolition and cleanup activities on the brownfields property for its intended reuse as a parking lot for a planned mixed-use development on the adjacent property.

Construction and Demolition Debris

Construction and demolition (C&D) debris is produced during new construction, renovation, and demolition of buildings and structures. C&D debris includes bricks, concrete, masonry, soil, rocks, lumber, paving materials, shingles, glass, plastics, aluminum (including siding), steel, drywall, insulation, asphalt roofing materials, electrical materials, plumbing fixtures, vinyl siding, corrugated cardboard, and tree stumps.

C&D materials can be recovered through reuse and recycling. In order for materials to be reusable, contractors generally must remove them intact (e.g., windows and frames, plumbing fixtures, floor and ceiling tiles) or in large pieces (e.g., drywall, lumber). In order to be recyclable, materials must be separated from contaminants (e.g., trash, nails, and broken glass).

C&D waste recycling activities essentially made the project feasible by reducing the total project cost by 20 percent, a savings of \$150,000, through the recycling of approximately 1,200 tons of materials and over 13,000 gallons of liquid waste water. The property's reuse has provided a catalyst to revitalize the surrounding neighborhood.

Background

HOPE Revitalization is a nonprofit corporation formed by Focus: HOPE, a 40-year old nonprofit civil and human rights organization in the City of Detroit. As a primary goal of Focus: HOPE Revitalization's community development initiative, the organization is spurring redevelopment in the neighborhood surrounding its campus, which has been devastated by blighting influences and a 1997 tornado that destroyed a number of homes.

Focus: HOPE Revitalization recognized that the 2-acre property with an abandoned, 80,000-square foot building, once used for the manufacturing of heavy sheet metal stamping presses for the automotive industry, was a blight to the community. A five-phase development project is underway for the area surrounding the campus; the cleanup and demolition of the abandoned industrial property was the critical first phase to redeveloping the area.

Process

Focus Hope: Revitalization obtained the abandoned automotive property through a donation from U.S. Real Estate. EPA Assessment grant funding through Wayne County and EPA cleanup funding through the City of Detroit's Revolving Loan Fund (RLF) program and a direct cleanup grant to Focus: HOPE Revitalization allowed for the assessment and cleanup of the property. The Phase I and Phase II environmental assessments revealed polychlorinated biphenyl (PCB), asbestos, mercury, sodium hydroxide, and residual polynuclear aromatic hydrocarbon (PNA) contamination which required cleanup of the property. Cleanup and demolition activities commenced in August 2005 and were completed in December 2005.

As part of the cleanup and demolition process, Focus: HOPE Revitalization incorporated C&D waste recycling as a key component, since the organization is keenly aware of the need for sustainability in all of its activities. Neither the local nor state government required C&D waste recycling for the project. To ensure that recycling was built into the project, Focus: HOPE Revitalization included C&D waste recycling early in the project design process by explicitly requiring specifications for recycling as part of the Request for Qualifications (RFQs) for environmental consulting services. As a result, the organization hired an environmental consultant, AKT Peerless Environmental Services, to provide oversight and a cleanup contractor experienced in C&D waste recycling.

Project Funding

EPA Assessment grant funding from Wayne County.....	\$30,000
EPA Cleanup grant funding to Focus: HOPE Revitalization	\$200,000
EPA RLF loan from the City of Detroit	\$350,000
In-kind expenditures from Focus:HOPE Revitalization.....	\$20,000
In-kind services from AKT Peerless	\$15,000
Material reuse savings through C&D material reuse	\$50,000
Disposal cost savings through C&D debris recycling	\$100,000



Demolition and cleanup complete at the former automotive site.

To implement and enforce the C&D waste recycling strategy, the environmental consultant provided daily monitoring and inspection oversight to verify material quantities and collect daily manifests. This attention to detail was extremely important to the success of the project due to a tight budget and the need to maximize the value of the steel and other recyclable materials (e.g., concrete, waste liquids and oils, light ballasts, and tubes/vapor bulbs) to offset costs. Focus: HOPE Revitalization received a credit for the value of the steel sold for reclamation, therefore, clear and accurate monitoring of the quantities was critical to receiving the maximum credit. The consultant and cleanup contractor worked diligently to maximize the value of the credit and extend the available budget by taking special care in segregating contaminated from non-contaminated areas so that overall disposal costs could be minimized.

Because the property was a brownfield, additional precautions were necessary to protect workers during the C&D process as well as to ensure that no exposure from demolition dust and debris would impact the public and surrounding community. To manage these issues, the cleanup contractor used water throughout the project for dust suppression and conducted air monitoring as necessary. Further, all demolition materials were evaluated through analytical testing and decontaminated, as necessary, and/or source separated prior to off-site disposal.

Results

As a result of the C&D waste recycling and reuse efforts of Focus: HOPE Revitalization and its team, approximately 1,200 tons of materials and over 13,000 gallons of liquid waste water were



Recycling of steel at the former automotive site.

Recycled Materials from the Former Automotive Site

- 738 tons of steel
- 469 tons of concrete footings and foundations
- 1,760 cubic yards of floor slab
- 13,100 gallons of liquid from an underground storage tank (UST)
- One 16,000-gallon steel UST
- 320 kilograms of PCB-containing light ballasts
- 101 kilograms PCB-containing capacitors
- 478 kilograms of non-PCB transformer, including oils
- 225 circular mercury vapor bulbs
- 176 fluorescent bulbs
- 110 gallons (two drums) of petroleum distillates/mineral spirits
- One 55-gallon drum of wastewater; two 55-gallon drums of waste oil; two 30-gallon drums of waste corrosive liquid; and 60 gallons of hydraulic oil.

Key Lessons Learned

- Project proved that brownfields cleanup and demolition is feasible and that recycling can be a valuable component of the cleanup and demolition effort.
- It is essential to have a committed environmental consultant providing oversight as well as a contractor who is familiar with the markets and methods for recycling.

separated from non-recyclable demolition debris and reclaimed and thereby diverted from landfills. Reuse of portions of the existing footings and foundations helped stabilize site soils. Because the nonprofit was working within such a tight project budget, the \$150,000 or 20 percent of the total project costs saved through material reuse and avoided disposal costs were critical to the project's success. Essentially, the recycling effort made this project feasible, by reducing the costs of the overall cleanup and demolition. See the sidebar for a detailed breakout of materials separated, transported off-site, and recycled.

Besides the inherit smart growth benefits associated with the redevelopment of previously used urban sites, the reuse of this former automotive property is providing a catalyst to neighborhood revitalization. A site that was previously a blight to the community now provides much needed parking for the area. As the first phase of a five-phase revitalization strategy, this C&D brownfields project paved the way for the construction of a nearby 55 unit apartment building for low income senior citizens which was completed in February 2007. These accomplishments resulted in the designation of the area as a "Cool Cities Neighborhood" by the State of Michigan, including a \$100,000 grant to develop a park, which will further catalyze the revitalization of the community.

More information on Construction and Demolition Debris and brownfields can be obtained at http://www.epa.gov/brownfields/tools/tti_assess_cleanup.htm#construction or by contacting the EPA Office of Brownfields Cleanup and Redevelopment (OBCR) at (202) 566-2777.

The EPA Brownfields Program provides grants to fund environmental assessment, cleanup, and job training activities. The Program is designed to empower states, communities, and other stakeholders in economic redevelopment to work together in a timely manner to prevent, assess, safely clean up, and sustainably reuse brownfields.