SESSION FOUR

C&D WASTE REDUCTION

One way to reduce the amount of waste in the waste stream is to ensure that it does not become waste in the first place.

Waste Diversion by Design and Planning

A Green Building is a building that is "environmentally friendly." It has been purposefully designed to reduce both the direct and indirect environmental consequences associated with its construction, occupancy, operation, maintenance and eventual decommissioning.

- The site should be environmentally preferable. Wherever a facility or building is constructed, it is important to consider mass transit availability.

- The building should conserve water/energy. Steps should be taken to limit the amount of resources required to operate a building. Ideas such as installing a self-supporting filtration unit will limit the amount of water that must be sent to off-site facilities for treatment.

- Environmentally preferable or recycled construction materials should be used. Using recycled materials for construction limits the amount of resources that must be disturbed--for example, using decking materials made from recycled plastics and reclaimed wood instead of traditional wood. Using materials that are obtained or manufactured locally reduces the energy consumed in shipping and transporting of these materials.

- Indoor air quality should be considered. The amount of materials in the building that contain Volatile Organic Compounds (VOCs) should be limited. After construction, adequate ventilation must be provided to protect occupants from the risks of VOC and radon after the building is occupied. Radon is a colorless, radioactive, inert gas formed from the disintegration of radium that sometimes enters homes and buildings.

- Non-toxic materials should be used throughout the design and construction processes. Paints, paint strippers, glues, adhesives and wood preservatives often contain high levels of solvents and VOCs. Consider finding alternatives to these products. There are

many products available that have low- or no-VOC content. Using these products will limit the adverse health effects associated with these harmful compounds.

- Landscaping should be beneficial. Beneficial landscaping uses native plants that require little or no pesticides, irrigation, etc. to maintain. It is also used to shade buildings, which reduces the amount of energy needed to cool them. Also, beneficial landscaping can reduce the amount of runoff generated at a site.

The Wampanoag Tribal Multi-Purpose Building, located on Tribal trust lands in Gay Head, Mass, was the first building the Wampanoags had built as a Tribe for hundreds of years. It was designed as a "green" building and reused some C&D debris. Daylighting was carefully introduced and distributed throughout the building and artificial lighting dimmed in conjunction. Steep roofs with south facing surfaces allowed installation of solar water heating and future solar electric. The building materials included ceramic tiles made from recycled automobile windshields; carpet made from recycled PET plastic bottles; old growth Redwood salvaged from discarded beer and wine vats; old growth Douglas fir salvaged and re-manufactured from dismantled warehouse buildings; carpet underlayment made from compressed recycled newspapers; framing and sheathing materials which use wood by-products efficiently; doormats made from recycled truck tires; and toilet partitions made from recycled plastic.

Ideas for Integrating Waste Reduction in Designs, Bids, Purchasing, and Site-Management

Renovation/Design. Phase

- Ensure that the client and design team share the same environmental goals.

- Involve the general contractor early in the design process.

- Reuse existing buildings. Regularly assessing office needs and identifying opportunities to use under-utilized space in existing buildings may yield alternatives to new construction. Opportunities for reuse can also be found through the use of value-engineering--a systematic process involving planners, architects, and consultants aimed at achieving the best value and most effective operation at the lowest overall cost.

- Link a deconstruction project with a concurrent construction project to facilitate reuse of salvaged materials. (See Deconstruction below).

- Use advanced wall-framing techniques. Advanced framing refers to a variety of framing techniques designed to reduce the amount of lumber used and waste generated in the construction of a wood-framed house.

- Design for durability and adaptability. Ensure a building's maximum ability to accommodate future technological advances and other changing needs.

- Design for disassembly. Buildings that can be altered easily are more likely to be renovated than torn down and replaced. Designing spaces for easy disassembly also facilitates the reclamation of construction materials for reuse and recycling.

- Include C&D recovery plans in the project design. Some recovery options may be lost if not considered at the project design stage. Use the same sizes and types of wall panels, ceiling panels, doors, and other materials before and after a building is renovated to encourage. reuse of existing materials.

- Minimize the number of blueprints and reproductions necessary during the design and construction process.

- Ask your architect for building designs that use standard material sizes. Design floor plans to make efficient use of standard lengths of heating duct materials, metal pipes, wiring, siding and gutters. Lumber, masonry block, plywood, and other products cut to standard sizes reduce "cutoff" waste and optimize materials use and reuse. Inform framing contractor of your plan.

- Designing floor plans to make efficient use of whole 4'x 8' panels and standard lumber lengths. Developing incentives for framing contractors and crew to reduce wood waste. Design interiors to make efficient use of whole 4'x 8'drywall sheets.

Bids and Permits

- Build waste prevention and resource management requirements into all bid documents and contracts. Require bidders to submit C&D waste management plans that include waste prevention goals for every construction project. Set minimum requirements to

encourage "best practices" and prevent architects and demolition/construction contractors that adopt waste prevention practices with an initial cost from losing out to lower bidders. A waste prevention plan should identify materials targeted for waste reduction, salvage, reuse, or recycling; detail arrangements for recycling, reuse, storage, shipping, and disposal of materials; and estimate the costs of waste management.

- Include Waste Disposal Costs in Bids. Require subcontractors to include the cost of removing their waste in their bids to give them an incentive to produce less waste.

- Consider requiring contractors to pay a construction waste fee as part of the building permit process. The fee is returned to contractors that can demonstrate on-site reuse of materials or provide receipts for materials from recycling facilities.

Specifying and Purchasing Materials

- Specify goods and services that provide the best value over the long run. Calculate the potential lifecycle savings of waste prevention--in terms of energy, operational, maintenance, and disposal costs. For example, investing in durable construction materials and furnishings can reduce future procurement, maintenance, and disposal costs. Coordinate the operations and capital budgets of government or business units planning new construction.

- Buy less-toxic building materials. When undertaking a new construction or renovation project, specify environmentally preferable building materials instead of ones that contain hazardous substances. Avoid thermostats that contain mercury, pressure-treated lumber, and any products made of polyvinyl chloride (PVC, commonly known as vinyl). (See Session Seven.) Identify and specify products that do not contain PBTs or other toxic chemicals, that are derived from renewable resources, that can be easily recycled or reused, and that contain recycled content. The EPA's Comprehensive Procurement Guidelines for construction include numerous building material categories, case studies, and sample specifications.

- Buy materials, such as ceiling tiles, made from recycled paper fibers

- Select prefabricated materials. Modular or prefabricated materials such as trusses, wall sections, and pre-cut studs and joints eliminate waste from on-site fabrication.

- Incorporate previously used/salvaged materials. Work with reputable third-party contractors to find used materials appropriate for construction.

- Search out and contract with suppliers that will take back materials (such as ceiling tiles or worn-out carpeting) for future reuse or recycling.

- Consider leasing certain materials. Paint and carpet manufacturers are both exploring strategies for leasing their products or the functions they provide. Companies that expect to see their products again at end of life or earlier are more likely to make them reusable or recyclable.

- Estimate material needs carefully to avoid waste by ordering only quantity needed, such as masonry, vinyl siding, flooring and countertop materials

- Avoid excessively packaged materials and supplies. However, be sure packaging is adequate to prevent damage and waste.

- Ask manufacturers to reduce unnecessary paper packaging on the materials you buy from them.

- Convince manufacturers to deliver items in reusable packaging that can be hauled back to the manufacturer for reuse.

Pre-Construction/Demolition

- Establish a clear numerical waste reduction goal for the project.

- Host a pre-construction meeting and site meetings early in the construction process in order to educate the contractor and workers on the benefits of materials recovery.

- Provide source reduction, reuse, and recycling forms to project managers and waste haulers to make data reporting easier.

Reducing Waste During Construction and Renovation

- Plan ahead so that fewer emergency supply runs need be made to local suppliers. Also, store leftover supplies and materials for your next project.

- Plan for efficient purchase and delivery of materials to minimize emergency supply runs.. Coordinate with project managers, contractors, subcontractors, and suppliers to ensure that the correct amount of each material is delivered at the optimum time. This facilitates bulk deliveries (reducing both packaging/shipping waste and fuel use) and helps prevent material loss, theft, and damage.

- Work with suppliers to minimize shipping waste. Ask suppliers to remove packaging before shipping materials to your site, wrap materials in reusable blankets or padding, or take back the packaging after the materials have been delivered. Supplier take-back of packaging and other shipping materials (such as wooden pallets and other reusable containers) for reuse or recycling reduces on-site waste disposal costs.

- Store lumber on level blocking under cover to minimize warping, twisting, and waste.

- Set-aside lumber and plywood/OSB cut-offs that can be used later as fire blocking, spacers in header construction, etc.

- Keep all drywall cut-offs in a central, dry location that is easily accessible to workers until every room is fully drywalled.

- Large drywall scraps can be set aside during hanging for use as filler pieces in areas such as closets.

- During construction, collect, stack, and cover brick and other masonry materials to prevent soiling or loss.

- Save unused portions of paints, stains, solvents, and sealants for your next job.

- Ask Tribal homeowners if they would like to keep scrap for their own future projects.

- Remove the metal parts of damaged construction materials and reuse them on other construction materials.

- Train employees to save unused metal items for future use.

- Coordinate with manufacturers to take or buy back unused metal products. Contact local scrap/salvage yards to ask if they can accept your unused metal.

- Prevent stormwater runoff from construction/demolition sites. Keep stockpiled materials under cover. If necessary, use absorbent booms or hay bales, or construct a berm below stored materials to prevent runoff to gutters, streets, storm drains, or local water bodies.

Reducing Demolition or Deconstruction Debris

At the end of the building's life, debris can either be recycled following demolition or reused after "deconstruction."

Deconstruction is the systematic disassembly of buildings. A complement to demolition, it allows crews to enter a building and take it apart, from appliances to floorboards to stair treads to roof joists, down to the bricks. The recovered materials are then reused or resold for use in new construction and renovation projects or for remanufacture (i.e., turning wood framing into fireplace mantles). Items that cannot be reused are recycled - by turning damaged wood into mulch, or cement foundations into aggregate for new foundations and sidewalks.

Deconstruction provides an alternative to landfilling the C&D debris, a way to take down buildings while building Tribal economies, creating new jobs, and preserving natural resources.

Deconstruction helps reduce waste generation, and therefore reduces the amount of waste disposed in landfills and incinerators.

In addition, deconstruction provides a supply of durable, low-cost materials for reuse in construction and renovation projects. Reducing the need for virgin materials abates the pollution related to extraction and processing -such as cyanide leaching from hardrock mining sites, much of which is done on Native American lands and has been linked to substantial groundwater pollution.

For example, THE REBUILDING Center in Portland, Oregon was established by Our United Villages, a nonprofit organization that provides educational, financial and human resources to Portland neighborhoods that want to address social, economic and related issues. Our United Villages formed an operation called DeConstruction Services to increase the volume of materials coming to the Rebuilding Center. Largely due to this enterprise, the store has diverted 300,000 to 350,000 tons from Portland's waste stream since it opened.

In the ten-month period that concluded in February 2001, retail sales totaled $350,000 and contracts from deconstruction amounted to about $650,000 - a total of $1 million, which far exceeds expectations. The monthly payroll for a work force of about 40 for the deconstruction crews and store amounts to $65,000 to $70,000/month. Specifically, items recovered for resale include: kitchen and bath cabinetry and fixtures; new or nearly new carpeting; clean lumber that is at least four feet long; flooring, siding, trim and moldings; unbroken windows; plywood, chipwood and oriented strand board; masonite kitchen and bath sinks with no chips or cracks; interior, exterior, security and screen doors; reusable tiles, bricks, paving, etc.; faucets and plumbing; hot water heaters made in 1994 or later; electrical and HVAC supplies; bathtubs and toilets without chips or cracks; and other building/remodeling materials. Special products often available at the Rebuilding Center include wavy glass windows, weathered five-panel doors, antique cabinet doors and four-by-eight or larger laminate sheets.

Standard drop boxes are placed at job sites to separate clean lumber and wood scrap from painted or finished wood. Undersized or damaged wood pieces from a home generally fill up one 30-cubic yard container, which is trucked to mulch producers for a tipping fee of $40/ton, compared to $63/ton at the landfill.

The project estimates that about 85 percent of the material from deconstructed houses can be reused or recycled. In addition to the more than 70 houses that DeConstruction Services has disassembled, the crew has handled many garages, pole barns and kitchens. When it is not feasible to harvest recyclables from a structure, the group refers the owner to a demolition contractor

To demonstrate how quickly a significant structure can be disassembled, DeConstruction Services held a deconstruction "blitz" in August 2001 at A Piece of Cake, a house built at the turn of the 20th century and renovated into a bakery about seven years ago. Despite no site preparation work, the crew completed the job in one day. Every board had been denailed and loaded up on the truck and the site was broom clean.

Military base officials are using deconstruction to reduce disposal costs for obsolete facilities. When the Naval Security Group at Sugar Grove, West Virginia dismantled an antenna array, it saved over $650,000 by arranging for reuse of 17,500 linear feet of creosote-coated poles. The West Virginia Department of Transportation bought the poles for use as bridge supports and shoring up riverbanks in a flood protection effort. The Navy avoided transportation costs and the high labor expense of cutting the poles into smaller sizes prior to landfilling in a hazardous waste facility.

In the Oakland/San Francisco Bay area, community-based nonprofits and for-profit companies - including the Youth Enterprise Project, Treasure Island Homeless Development Initiative, San Francisco Community Recyclers, Beyond Waste, Inc., East Bay Depot for Creative Reuse and the Materials for the Future

Foundation-have received permission to deconstruct obsolete buildings on nearby military bases. These organizations have recovered hundreds of thousands of board feet of Douglas fir and redwood. Much of this high quality wood is unavailable from any other source. Scores of low-income workers have been trained and placed in the construction trades sector in the Bay area, which is booming.

In all deconstruction sectors, the most active material is wood. At a project in Riverside, Maryland, over 60 cubic yards (32 percent) of the materials recovered were wood, including framing lumber and sheathing, hardwood flooring, stair treads, shelves and cabinets. In the Oakland/San Francisco Bay Area, deconstruction of military buildings is yielding over 90 percent wood recovery rates. The value of recovered wood is rising, because many species of wood are no longer available from forests. Furthermore, older wood typically is stronger and of higher quality than new growth wood, and it has already shrunk to its permanent size. Another key factor is landfill tipping fees, which lead companies to pursue mulching, groundcover, firewood, and chip boiler fuel as less expensive alternatives to disposal.

Reuse

Finally, reuse of building-related material--which is a component of green building and deconstruction--can, in and of itself, keep C&D debris out of the waste stream.

Common reusable building materials:

- Appliances
- Bathroom Fixtures
- Bricks
- Carpeting
- Doors
- Flooring
- Pipes
- Siding
- Tile
- Lumber
- Windows
- Trim
- Lighting Fixtures
- Insulation
- Shelving.

As an example of the concept of reuse, the Hualapai Tribe of northwestern Arizona received an EPA Jobs Through Recycling grant in 1995 for its "Earthship Housing Demonstration Project" which constructed the reservation's first

Earthship structure. Earthship buildings use tires filled with compacted soil as the primary building material in load-bearing walls. Aluminum cans, as well as cardboard and glass bottles, serve as decorative filler in nonbearing walls. In building the structure, the tribe diverted 500 tires and 500 pounds of aluminum that might otherwise have been landfilled from the waste stream. In the Hualapai Earthship, the Tribe achieved additional reuse by installing surplus windows from an Air Force base. The Tribe arranged filled tires in three-foot-thick walls, which provide durability and excellent insulation. The insulating quality of the walls, installation of south-facing windows for winter warmth, and setting the building in the side of a hill for temperature moderation, keep the Earthship building comfortable without the use of heating and cooling systems. This reduces construction costs, saves energy, and avoids a gas utility connection. Photovoltaic panels on the structure generate solar electricity, a water collection system on the building's roof obviates a well or municipal water hookup, and diversion of gray water to planters in the house allows for production of food. These advantages appealed to the Tribe, since only about five percent of the reservation has full utility service. The Hualapai Earthship, a 1,000 square foot office building, opened in January, 1997 and now houses the Tribe's Geographic Information Systems Program.

On a regular basis, appliances, bathroom fixtures, lumber, and other material from renovation, remodeling, or demolition projects can be removed from the structures and set aside for reuse--either in a particular project or for general use by Tribal members as the need arises. Of course, in the latter instance, storage becomes an issue. And whether such material is reused, waste screening should be part of the process (See Session Seven.)

SESSION FIVE

C&D RECYCLING

The recycling of construction waste and demolition debris (C&D) is important because it conserves many of the world's resources—wood, stone, and petroleum, to name a few. The activity involves many millions of tons more material than the better known tin can, plastic, and newspaper recycling. The C&D waste stream is made up of concrete, asphalt, wood, gypsum, and asphalt shingles generated from construction and demolition activities involving road and bridge building, and home and building renovation and construction.

Recycling C&D dates from the time of the Romans, who, when rebuilding their vaunted set of roads, would reuse the stones from the previous road. Centuries later, 12th century Europeans took the stones from Roman roads and buildings for new roads, new buildings, and even cathedrals. Tribal lifestyle has been to reuse and not waste.

The C&D recycling industry became well established in Europe at the end of WWII when crude aggregate crushers were used to recycle the rubble left over from bombed-out buildings and roads. It remains a growing industry on that continent as landfill space is at a premium. Netherlands, for example, has a C&D recycling rate of 75%. In many countries, especially Germany and Belgium, the rate is more than 50%.

The C&D debris recycling market is a growing, vibrant, but relatively young industry that will continue to expand because of the continuing problems of decreased landfill space, increase environmental awareness, and the opportunity for entrepreneurs to profit.

Recycling Specific C&D Components

- Concrete—both from the foundations of homes and from highway and airport repair work. The finished products are used largely as a base material for road products, over which either a concrete or asphalt finish is placed. The Construction Materials Recycling Association estimates that more than 100 million tons of concrete is recycled annually;

- Asphalt—almost exclusively from roadwork. The old and broken asphalt is almost exclusively is placed right back in the hot mix to be placed on the road again. Recycling asphalt and concrete are well-established industries throughout North America, and many operations can and do handle both materials. A very large and

established industry exists that recycles asphalt exclusively, and it is estimated that more than 150 million tons are recycled;

- Wood— Scrap lumber and pallets can be processed and used for landscaping, compost, animal bedding, fuel for boilers and cogeneration plants, or engineered building products. Both wood and plant waste can be composted, which will result in a value-added product if contaminants are kept to a minimum. Overall, C&D wood is made up largely of building demolition and waste from new construction. It is important to distinguish and separate treated and untreated wood. Recycling C&D wood presents many challenges because of contamination from paint, creosote, caulking, and even arsenic (see Session Seven). Removal of these contaminants is very difficult and limits the uses of the final product. Main products produced are boiler fuel and mulch, although some more advanced recyclers have discovered value-added uses such as pressed lumber and door panels on automobiles. Also, usually these recyclers are dealing with commingled debris, from demolition and construction sites, which makes sorting the material a major challenge.

- Old Corrugated Containers (OCC)-- Corrugated boxes are named for the fluted inner layer that is sandwiched between layers of linerboard. Known in the paper recycling industry as "old corrugated containers" or "OCC," these boxes are used to ship products to factories, warehouses, retail stores, offices and homes. More than 90 percent of all products are shipped in corrugated containers. Corrugated packaging is the largest segment of the packaging industry, with more than 1,600 plants producing OCC. The extensive use of corrugated boxes in the American economy makes them the No. 1 waste stream component by weight. But OCC is easily recyclable, which also makes it the most recycled product by weight. Corrugated's MSW market share has increased by more than 50 percent since 1960, and its recycling rate doubled within the same period. Nationally, 20.3 million tons are recycled, for a 65.1% recycling rate. If shredded properly, corrugated boxes are compostable. Bailing increases efficiency of transportation.

- Gypsum Drywall (also called wallboard, sheetrock, or gypboard)--It is problematic material that is recovered from wallboard at demolition projects, leftovers from construction, and rejects from wallboard factories. Gypsum in streams has been known to result in fish kills. Some parts of Canada have already banned this material from landfills altogether. There are, however, a few systems out there to process it.

- Asphalt shingles—Although the finished product usually is placed back into the hot mix for roadwork, several innovative final products have been developed. It's a difficult material to handle and only a handful of plants in North America exist. But shingles will become a major problem as some areas are limiting or banning them from landfills;

- Other C&D Waste--Materials such as plastic, fiberglass, foam, or other packaging materials can be recycled, but local market conditions will determine the cost effectiveness of the program. Transportation costs may exceed the reclamation value of most of these materials. Also, metals are recovered from demolition jobs and recycled, but that market has been well established for years. Recently prices paid for scrap metal have fluctuated considerably.

There are no official counts on the number of C&D debris recycling companies in North America. Nobody knows for sure, but the CMRA estimates that there are slightly more than 3,100 concrete and asphalt recycling plants in that area, owned by nearly 1,000 companies. Only two or three companies own more than five of the plants, meaning that the industry is very fragmented. The CMRA estimates there are about 600 either single material or mixed waste recycling waste facilities, several dozen asphalt shingle recyclers, and about the same number of gypsum recyclers.

Just like there is no official number for C&D recycling plants, there is no clear number as to how much tonnage is recycled and how much revenue is produced. No government agency or association tracks it, unlike most other products. Not all plants run year-round, some don't always run at full capacity, while others go full bore constantly. The average sale price per ton for recycled concrete is about $2.50 to $6.00.

Source separation of C&D material generally yields the highest rate and the best price for materials. The material is separated on site into separate containers, with recyclable materials are sorted out. The best opportunities for source separation tend to occur during the demolition and excavation phases of a project. Demolition and excavation work can generate relatively homogenous waste streams--asphalt, clean fill, metal.

What is more likely is that the C&D materials will be mixed, which are then hauled as single loads to a processing facility or transfer station.

New technology is a growing trend for C&D recycling, says CMRA's Turley. "Today C&D recycling techniques have really advanced. For those facilities processing mixed C&D, there are still simple dump-and-pick sites working. But all the new operations coming on-line have advanced sorting techniques that allow a more thorough separation of materials. This allows for creation of more added-

value products, which is where the industry should be headed in the future in order to be more profitable.

Sun Recycling's Pompano Beach processing facility is one of three systems now in operation in south Florida's active C&D market. The systems were designed by Sherbrooke O.E.M. of Quebec, Canada, with vibratory classification equipment by General Kinematics Corporation in Barrington, IL. The highly automated vibratory equipment gave Sun Recycling more capacity to rapidly process increased volumes of mixed C&D waste and to economically increase the production of clean aggregate. Each system includes a vibratory classifier to help resolve a rock and shingle contamination problem.

CMRA's Turley says, as is common with all recyclables, "markets do remain difficult to develop for recycled C&D products. Recycling always will have a strike against it in many eyes because it isn't virgin materials. What is needed is more research proving the engineering characteristics of recycled products."

City and Village Case C&D Recycling Examples

There are numerous innovative C&D programs throughout the country, and they can provide some examples for Tribal programs.

After passing its ordinance in 1996, Portland went from a negligible amount of C&D recycling in 1989 to recycling 40% of its C&D waste. This increase has diverted one-third of the city's waste from landfills each year. And the effort continues. The Home Builders Association (HBA) of Metropolitan Portland and Metro Regional Environmental Management announced in September 2002 that they are joining forces to help promote recycling of construction-site debris in the area. By 2005, Metro would like to reduce the amount of construction waste by more than 50,000 tons, says Kevin Curry, HBA director of communications and public relations. The HBA will distribute a recycling toolkit that the Metro agency has put together, place regular columns in the association's newsletter, hold occasional educational meetings in the area, and provide tips and techniques to its members on how to boost recycling.

EPA awarded a grant to CMRA to conduct a large public education and training program to increase the reuse and recycling of C&D waste in Claremont, CA. The grant program is funded at $75,000 for one year from July 2002 through June 2003. The purpose of the grant is to implement at least seven projects throughout the US that would be model programs for diverting C&D debris from landfills and creating markets for recycled C&D materials. Under the program, participants join the EPA WasteWise Building Challenge Program; implement a corporate or local government policy to reuse and recycle C&D debris on eligible C&D projects; incorporate reuse and recycling into construction or demolition

documents, including contractor requirements and specifications; include contractor or subcontractor training on best practices for reusing or recycling C&D debris; provide CMRA and EPA with C&D diversion data and project information to be included in a case study for the grant program; and incorporate a holistic sustainable design approach for the project that would include reused or salvaged materials, recycled-content products, and other sustainable design measures as applicable to the project scope.

Claremont, 20 mi. east of Los Angeles, is a small community with 10 Claremont College campuses. Claremont Village is a commercial area that includes restaurants, banking, and other small businesses in the city's central business district. The village decided to expand the downtown area, which would involve 200,000 ft.2 of demolitions on 41 ac. The city is required, under California's AB 939, the Integrated Solid Waste Management Act adopted in 1989, to divert 50% of its waste from landfills as of 2000. Claremont is unusual in that it is the sole hauler for solid waste generated in the city; private haulers are not allowed to handle residential, commercial, or institutional waste within the city limits. Recyclable materials, however, can be hauled by commercial recyclers.

An initial goal of the project is to assist the city in developing a C&D reuse and recycling and diversion ordinance applicable not only to the village expansion project but also to other public works and private residential, commercial, industrial, and institutional developments within the city. This will reduce the city's work effort and help it take advantage of the most successful ordinance programs.

It is estimated that the Claremont Village expansion project will require 78,832 ft.2 of building demolition on about 35 ac. Completed to date is the work at Johnny's Tree Service, 4,000 ft.2; Quonset Hut, 1,856 ft.2; Manzur property, 1,500 ft.2; and the Gottuso Property (Century 21), 3,300 ft.2 As of this writing, work is in progress at the west end of the Packing House, 40,500 ft.2 (13,500 per floor with three floors), and scheduled soon is the Ice House, 27,676 ft.2

In the initial results of the project, the recycling figures are very good, says CMRA's Kelly McArthur Ingalls. A September 16, 2002, report by Laird Construction Co. Inc. in Rancho Cucamonga, CA, for work on six buildings that were demolished as part of the village expansion, shows 2,016 tons generated, 1,931 to be used or recycled and 85 tons to be disposed, for a landfill diversion rate of 95.7%.

Examples of How Tribes Deal with C&D Debris

Fond du Lac Tribe of Lake Superior Chippewa, Cloquet, Minn. The Fond du Lac Construction Division separates out concrete, brick, and asphalt wastes and

crushes them for fill for new housing projects. Old buildings are deconstructed, and the materials are reused, sold, and recycled.

Coleville Business Council, Nespelem, Wash. The Coleville Business Council requires all contractors on the reservation to specify what C&D waste they will have and where it is being sent. The Council has on one occasion used C&D waste for fill.

Nez Perce Tribal Council, Lapwai, Idaho. The Nez Perce Tribal Council has a 40-yard rolloff at one container site for inert wastes.

Oneida Tribe of Indians of Wisconsin. The Tribe is currently meeting with its land management program, environmental health & safety area, and zoning department to evaluate and implement C&D waste management. One of the departments has implemented a temporary agreement to use a grinding and crushing machine as a test market.

SESSION SIX

C&D LANDFILLS

While greater efforts toward waste reduction can and should be made, not all C&D debris can be recycled or reused. The majority of C&D debris--approximately 75%--ends up in two types of landfills: municipal solid waste landfills, which handle household waste; and C&D landfills, which are devoted exclusively to C&D waste. While under federal law, MSW landfills must have liner and leachate collection systems, must test leachate, groundwater and surface waters; must have gas control system; must conduct random load inspections; and cannot accept hazardous wastes or yardwastes, not all of these requirements apply to C&D landfills. Depending on the type of waste being received and on specific state and Tribal regulations, C&D landfills may be required to have a groundwater monitoring plan, closure and long-term care and financial responsibility provisions, an operations, closure, and training plan, semi-annual groundwater monitoring reports, and annual record keeping.

Specifically, if the C&D landfill screens out conditionally-exempt small quantity generator hazardous waste (under Part 257, Subpart B), it will require

- Floodplains
- Endangered species
- Surface water
- Groundwater
- Food chain crops
- Disease vector controls (daily cover)
- Air controls (no open burning)
- Safety provisions (for explosive gases, fires, and bird hazards).

If the C&D landfill receives conditionally-exempt small quantity generator hazardous waste (under Part 257, Subpart A), then the landfill quires

- Floodplains
- Wetlands
- Groundwater monitoring
- Corrective Action
- Recordkeeping

As noted in Session Two, EPA cannot, under the BAD decision certify a landfill in Indian country. Complying with Part 257 will help to ensure the safety of the community and facilitate the long-term use of the landfill and opportunities for accepting off-reservation waste.

In a C&D landfill, waste acceptability is based on the source of the waste--only materials from construction, demolition, or renovation of a building or structure, or debris from land clearing.

Because C&D material generally is perceived to present less of a threat to the environment than normal MSW, C&D landfills have not been required under federal rules to have the strict liner and leachate collection system requirements found in regular MSW landfills. Managing C&D waste separately saves MSW landfill space as well as MSW landfill tipping fee costs for C&D debris.

Designs for C&D debris landfills vary. Even though liners and leachate systems are not required, C&D landfills must be placed in an environmentally sound location.

While these lesser requirements for C&D landfills have existed for some time, some recent studies indicate that leachate from C&D debris landfills may contain hazardous components. There is little data available regarding the quality of C&D leachate. However, since construction materials sometimes contain prohibited or hazardous materials and many C&D sites are old borrow-pits, without a liner, contamination can go directly to the groundwater.

Construction materials that can potentially cause contamination include:

- Paints, especially solvent-based paints
- Paint thinners and clean-up materials
- Demolition materials containing lead-based paint
- Adhesives and glues
- Roofing tar and "black jack"
- Fuels and oils from equipment
- Pool chemicals, cleaning chemicals

Research concerning C&D leachate quality continues to be conducted at institutions, such as the University of Florida Solid and Hazardous Waste Center.

C&D Landfill Costs

Siting, developing, maintaining, and closing a landfill are expensive propositions. For example, just dealing with the groundwater monitoring alone--preparing a groundwater monitoring plan, installing monitoring wells, sampling costs, analytical costs--could cost $10,000 in the first year and $5,000 a year subsequent, depending on site conditions.

Costs that will be part of a Tribal C&D Landfill will include

- Development costs
- Cost of site selection

- Cost of property acquisition (unless the property is already acquired)
- Cost of permitting and reporting (if applicable)
- Cost of site acquisition and preparation
- Capital costs
- Cost of Site Capital Equipment
- Cost of Site Facilities
- Facility and Equipment Replacement Costs
- Operating Costs
- --Structure Maintenance
- --Maintenance of Buildings and Grounds
- --Stormwater Management Structures
- --Equipment Maintenance, Operations Replacement
- --Personnel
- --Marketing
- --Insurance--general liability, workman's compensation.
- --Training costs

If the landfill accepts off-reservation waste, then revenue must be calculated on the basis of estimated incoming volume times the estimated tipping fee. Fluctuation of revenue streams should be accounted for.

A C&D landfill plan should include the landfill's estimated site life, which is calculated by the estimated volume and the rate that it will be filled.

How much a C&D landfill will cost to build will vary from region of the country to region and will depend on its size. Some rough numbers might be of help. A top builder of municipal solid waste landfills estimates that its average landfill will cost $400,000 acre and adds that C&D landfills, which have fewer regulatory requirements, may cost 1/4 of that. Waste Industries Inc. of Raleigh, NC bought a 108-acre C&D debris landfill in Atlanta from Waste Streams Inc. for $9 million, which would bring its *sales* price per acre to about $84,000. Of course, since the seller was trying to make a profit, this logically would have been more per acre than it cost to build.

Discussions by the authors of this workbook with people and firms who have constructed C&D landfills suggest that a range of $80,000-$100,000 an acre to build a C&D landfill is a reasonable estimate. Relatively small Tribal C&D debris landfill will be in the 25,000 cu. yd. range or 62 acres. Larger C&D debris landfills can be 100 acres or more, like the one in Atlanta mentioned in the preceding paragraph. By this estimate alone, a C&D debris landfill could cost a minimum of $5,000,000 to construct.

And, so, a Tribe must evaluate how large a C&D landfill it will need in order to determine its projected cost and whether a C&D landfill is feasible. You will need expert help in this. But you will already have done a great deal of the work

yourself with the annual C&D debris estimates you did in Session 3. Remember that you converted lbs. of C&D debris to cu. yd. using a multiple of 500-650. There are 1,613 cu. yds. per acre. Doing this math will give you a rough, very rough ballpark. Your C&D landfill will have depth as well as width, and landfill designers will work with you on its ultimate configuration.

Look at the Tribal C&D examples at the end of this session for more information on Tribal C&D landfills.

C&D Landfill Siting Issues

C&D Landfill Criteria in 257 Subpart A are:

- Floodplains
- Endangered species
- Surface Water
- Ground Water
- Disease Vectors
- No Open Burning
- Safety--gases, fires, public access, bird hazards, etc.

While C&D landfills have traditionally been thought to be "less harmful" than other types of landfills, the possible dangers of contamination mentioned above will inevitably cause Tribal member concern. Also, any landfill will cause NIMBY (Not in My Backyard) reactions. Siting a C&D landfill on Tribal land must be done with special care.

In siting a C&D landfill,

- Sites that are reclaiming excavated areas should plan to control run-on and ponding water.

- Landfills with special protection or features require special attention or outright avoidance, including wetlands, protected uplands, lands overlying drinking water supplies, lands with cultural significance, and sinkholes.

- Tribes believe all life is precious. Some animals are especially endangered or threatened--scrub jays, bald eagles, red cockaded woodpeckers, and gopher tortoises.

- Other siting issues include site access, ease of access, and surrounding land use.

In siting a C&D landfill, construct a constraint map of the area under consideration that identifies areas to be avoided; areas outside of the constraint zone should be the focus on siting efforts.

Equipment required will include:

- landfill compactors;
- front-end loaders
- dozers
- earthmovers
- processing equipment
- miscellaneous support equipment

If it is operationally and economically feasible to process debris on site, additional equipment would include tub grinders and shredders

Groundwater/Surface Water Monitoring Issues

Landfills are a potential source of contamination. Unlined sites have no artificial barrier to prevent groundwater contamination, and the level of effective waste screening can very widely from site to site.

Leachate is a liquid that results from water collecting contaminants as it trickles through wastes. It may result in hazardous materials entering surface water, groundwater, or soil.

Some construction materials contaminants such as VOCs in paints, solvents, and adhesives; other organic contaminants in roofing tar, fuels, oils, and petroleum products; acids or caustics from cleaning chemicals, trace metals from copper wire and piping, galvanized (zinc) piping, and lead plumbing boots.

The groundwater monitoring for landfills varies from state to state.

Groundwater/surface monitoring can provide one mechanism for determining the effectiveness of landfill operations and screening operations, detects contamination from landfill operations, and requires proper well design and sampling/analysis procedures.

All surface bodies that might be affected by a contaminant release from a landfill should be monitored in accordance with a groundwater monitoring plan. A groundwater/surface water monitoring plan includes a hydrogeological report, well location diagram and piexometric surface map, well completion documentation, surface water sampling points, record of the frequency of sampling and parameters, reporting forms and other requirements.

Surface water flows downhill. Groundwater flows according to pressure gradients under the ground. In some cases, groundwater will flow uphill and flow from a high pressure to a lower pressure. Groundwater wells, usually constructed using PVC casings, should be placed to provide both up gradient (background) and down gradient (detection/compliance) wells for all potentially affected aquifers. Typically, C&D landfills sample only the surficial aquifer, unless site specific conditions dictate otherwise.

Sampling devices include bailers, centrifugal pumps, and air lift pumps.

Landfill Gas Management

Landfill gas is a gaseous by-product of the decomposition of organic materials in landfills. Major gases include methane, carbon dioxide, nitrogen, and oxygen.

Landfill gas has the potential in energy recovery, but it is also a pollutant and a safety risk. Methane is a combustible and explosive gas. Landfill gas can contaminant groundwater, and produce odors and smog.

Landfill gas generation at a C&D landfill will depend on the amount of organic material, such as vegetative debris, present. Gypsum wallboards when they decompose anaerobically create odors.

Passive landfill gas controls include vent wells and vent or barrier trenches, while active controls include extraction wells, horizontal extraction pipes, extraction trenches, air injection wells, and building protection.

It should be noted that, while a concern, since methane gas does take a while to build up and there is less organic material in C&D landfills than in MSW landfills, leachate, and the problems noted above, have been thought to be greater potential concern for C&D landfills.

Landfill Fires

The assumption that a C&D landfill is filled with brick and mortar might make the idea of a C&D landfill fire seem unlikely. And yet, as noted earlier, the components of a C&D landfill can include wood, gypsum, and even plant life from the demolition process, all highly flammable. Therefore, as is the case with MSW landfills, C&D landfill fires are possible, and preparations against them must be taken.

There are three elements in a fire: fuel, oxygen, and ignition, If one of the three is missing, there is no fire.

Those who have experienced landfill fires advise the following.

- Call the fire department, but be aware that they may take a while to come, may not have any more experience with landfill fires than you do—or less, and be trained to pour water on fires. The natural inclination to pour water on a landfill fire is sometimes a wrong one. Once the fire on the top layer is out, there still may be burning underneath. The pouring on of water creates steam and smoke, which simply makes it harder to see what else is burning.

- Dig trenches to create firebreaks to isolate the fire.

- Work upwind and use equipment to separate the burning material from the rest of the landfill, thereby cutting off the fuel. Dig out the burning section, push it away from the rest of the fire, and then smother it.

- Wet down areas adjacent to fire

- Stockpile dirt near the working face of the landfill to smother the fire once it is isolated from the landfill.

- Be aware that there is danger in this. For example, by putting the equipment in proximity to the fire, the equipment may stall out. See if the fire can be put out safely. But safeguard your personnel first.

- Above all, have a firefighting plan, involving all personnel; have briefings

- Watch for "hot" loads

Landfill Operations

C&D debris generation is calculated in tons. But from a collection and landfill perspective, weight is not the issue, volume is the issue as the debris fills a space. Most sites charge by volume.

Most C&D landfills do not have scales like MSW landfills. And the density of C&D materials can vary, depending on the dominant component. On the average, C&D debris usually runs between 500 and 675 lbs./cubic yd. Most trucks or rolloff containers have designated volumes--20 yds., 40 yds., etc.

Good compaction of the debris extends the life of the site, provides better access to the working site, limits the spread of fire, and results in less cover being required. Larger pieces of concrete and wooded construction should be broken into smaller pieces, shredded or crushed, and then buried in a uniform distribution.

Landfill cover reduces litter, reduces the infiltration of water and leachate production, reduces access to the debris by rats, birds, and insects; reduces odor, and prevents the spread of fire.

Tribal C&D Landfills

Bois Forte Tribe. The Bois Forte Tribe was committed to correcting the hazards and receptive to outside assistance. Today, with the cooperation of tribal residents and public and private agencies, the reservation has the infrastructure necessary to collect, transfer, recycle, and dispose of its waste. With two transfer stations, a new demolition landfill, and plans for a composting facility under way, the Tribe has hauled in a cleaner future.

Increased new home construction on the reservation, coupled with the demolition or refurbishing of old buildings, necessitated the development of a landfill for construction and demolition debris. The IHS helped to locate and design the 25,000 cu. yd. landfill based on federal and state regulations. In addition to providing disposal for construction and demolition debris, the landfill, which opened in 1998, generates income from disposal charges levied on building contractors. The landfill, which is located across from the Nett Lake transfer station, already has accepted more than 520 tons of debris.

Shoshone Paiute Tribes of Duck Valley. As part of the 10-acre waste disposal complex of the Shoshone-Paiute tribes of Duck Valley in Owyhee, NV, there is a transfer station and monofill areas for scrap wood, scrap metal, and demolition debris. Marcie Phillips, the tribes' environmental director, says the C&D monofill is five years old and has diverted thousands of tons of debris. "It's one of our most successful operations," Phillips says of the quarter-acre area, "although we have to watch it really carefully to keep sheetrock and fiberglass insulation out and keep the monofill successful. Mostly it's concrete rebar-type waste, some asphalt, and some leftover concrete. We have a number of older buildings being demolished and new construction. There is a huge need to segregate C&D waste." In consolidating its waste disposal complex, the tribes have created a new C&D monofill in collaboration with a construction company client.

Nambé Pueblo. The High Mesa Environmental Facility is located in the 19,076 acre Nambé Indian Reservation 17 miles northwest of Santa Fe. The project goal is the construction and operation of a 100-acre combination MSW and C&D waste landfill. Initial construction is a C&D-only waste cell in the southwest portion of the site with an operations area and site well. The landfill will be

constructed in a progression of the single C&D cell and five approximately six-acre MSW cells in a counterclockwise fashion starting with cell #1 and ending with cell #5. (See Figure 3 for landfill layout.)

FIGURE 3

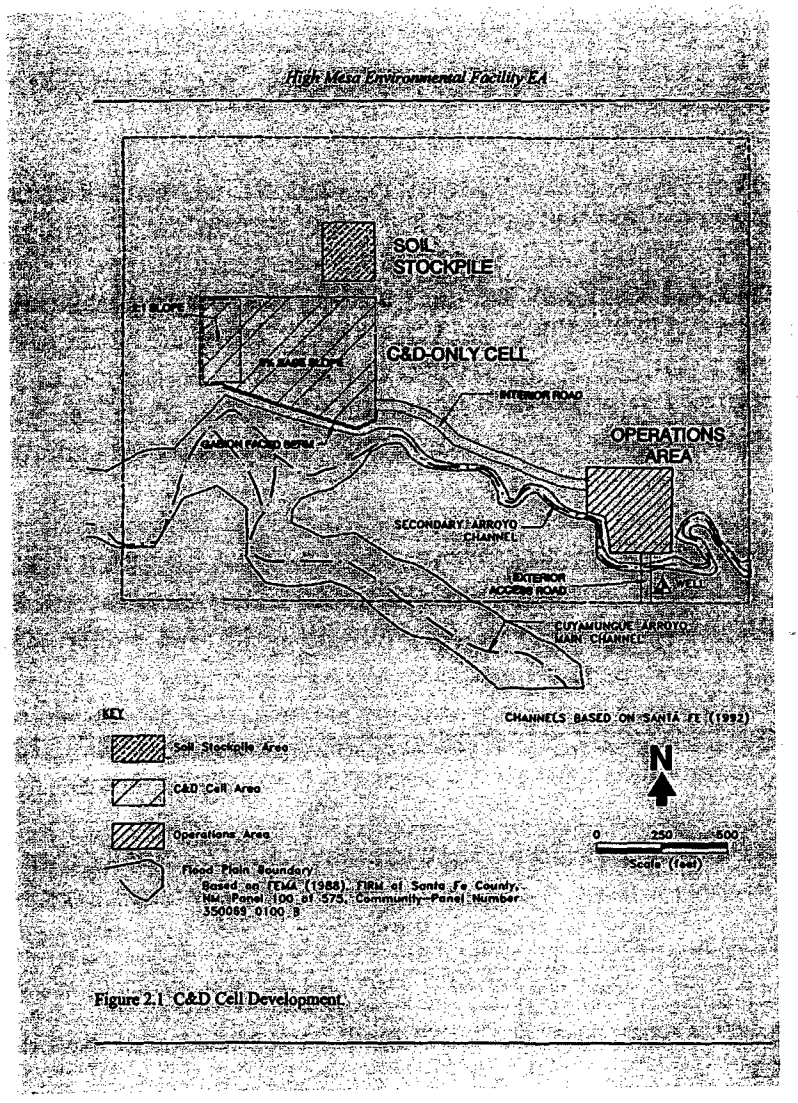

Figure 2.1 C&D Cell Development