Contractor's Report to the Board

Method of Visual Characterization of Disposed Waste from Construction and Demolition Activities

October 2006

Produced under contract by:

Cascadia Consulting Group

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Publication #341-06-010
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Prepared as part of contract no. IWM-03027 (total contract amount: $1,034,700, includes other services not related to this report).

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Introduction and Background

In California, construction and demolition waste comprises a significant portion of the total disposed waste.[1] About half of this waste is thought to be readily recoverable.[2] In order to design effective programs that target abundant or valuable materials in this waste stream, local jurisdictions need to know the types and relative amounts of specific materials.

The standard method of characterizing construction and demolition (C&D) waste is to visually estimate the composition of individual loads of waste as they arrive at a disposal facility. The resulting data from many individual waste loads can then be used to create a composite profile that represents the general composition of C&D waste loads. This document outlines the methodology for characterizing loads of C&D waste in four steps:

1. Preparing to sample loads prior to arrival at the disposal facility;
2. Randomly selecting C&D waste loads at the facility;
3. Measuring the volume of the load; and
4. Visually characterizing the load by volume.

This visual estimation method was developed in 2005 under the auspices of the California Integrated Waste Management Board (CIWMB). It was developed to be a tool for local governments to use, not a requirement. It relies on certain **key assumptions**, which are listed below:

- The waste that is to be characterized comes primarily or exclusively from construction, demolition, or similar activities. Waste originating from other activities or sources (such as residential or commercial garbage) is often best characterized through other methods.
- Loads will be randomly selected by someone placed at the gatehouse or entrance to the facility.
- The waste can be examined after it has been tipped onto the ground. There must be adequate space for the estimators to walk around the tipped load, observing it from all sides.
- There are a sufficient number of waste loads available for observation to produce valid conclusions about the general composition of the C&D waste stream. Usually, at least 40 loads must be observed in order for the findings to be meaningful, and the preferred number of loads is 100. The loads may be observed as they arrive at the disposal facility over a period of several days or weeks.
- The method is designed to be used by two or more visual estimators who simultaneously observe the same loads of waste. While it is possible to implement the method using a single estimator, the results are expected to be far more accurate if two estimators are used.

Document Map

Following the introduction, this document is organized into two main sections: preparation and visual estimation procedures. Detailed appendices include material list and definitions, equipment list, safety guidelines, field forms, an example of a completed sample form, a visual estimation guide, and a visual estimation training exercise.

Preparation

Several steps are required to prepare for a visual characterization exercise. Some important steps are described here.

Define the waste stream that is being studied. Determine which types of vehicles are expected to carry the waste that the exercise is intended to address. Is the waste brought in by specific hauling companies? Is it brought in by the public? Typically, a C&D characterization study will address new construction, remodeling, demolition, roofing, and other types of construction. Establishing clear parameters at the start of the exercise will help ensure that the results are representative of the waste stream that is the target of study.

Schedule a time for the study when the targeted vehicles are expected to arrive at the facility. Consider whether the waste that arrives on weekends is part of the targeted waste stream, and if so, schedule one or more weekend days in addition to weekdays. If there is a busy season for construction in your area, consider scheduling the study then.

Establish a system for selecting the targeted vehicles and directing them to the area where the observations are to take place. Usually, it is helpful to get cooperation from the scalehouse operator in selecting the desired vehicles.

If necessary, develop a *random selection* method for the targeted vehicles. It is important to determine how many candidate vehicles are expected on each day of the exercise. If more vehicles are expected than the visual estimators can use, then it is important to develop an unbiased method of choosing only some of the candidate vehicles to be included. Choosing every 2nd, 3rd or 4th, etc., vehicle in the order they arrive is a simple, unbiased way of selecting vehicles. Usually it is helpful to get the assistance of scalehouse staff in counting and picking vehicles. If the number of vehicles expected is less than the sampling goal, it is not necessary to use a random selection method because all candidate vehicles will be used for sampling.

Establish a system for recording the net weight of each vehicle load that is included in the study. Usually this involves getting cooperation from scalehouse staff to record the incoming and outgoing weights of the vehicles. A numbering system should also be created that will allow the information about net weights to be matched with the information from the actual observations of loads. (It is sometimes helpful to have the scalehouse staff place a card with a printed sample number on the windshield of selected vehicles and record that number along with the vehicle's incoming and outgoing weight. The visual estimator can then record the same sample number on the form that is used to conduct visual sampling.)

Study the training examples that are shown in Appendix G and **the safety procedures** shown in Appendix C.

Become familiar with the standard CIWMB definitions of materials, as shown in Appendix A.

Prepare *vehicle selection form, sampling form, sample placards,* and *dashboard cards,* as shown in Appendix D.

Obtain the necessary equipment, using the list that appears in Appendix B.

Visual Estimation Procedures

Generally, the procedure for estimating the composition of loads of C&D waste involves measuring the volume of the load while it is still in the truck, and then tipping the load onto a bare patch of ground so all of the contents can be seen. The visual estimators then record the estimated percentage of the load corresponding to each *major material class*, and then record the estimated percentages for *specific materials* within the material classes. The step-by-step procedure is described below.

At the facility entrance:

1. **Select typical loads of C&D waste** that fit the definition that you have established, as they arrive at the facility entrance or scalehouse. Although more specific criteria may be included, C&D loads, in general, should contain at least 80 percent of construction and demolition debris.[*] Do not exclude individual loads from the study simply because you believe they contain the "wrong" kind of materials. This introduces bias into the results. If the load matches the target criteria in terms of its origin and the activity that produced the waste, it should be included (or the criteria should be rethought).

2. **Assign a sample number to the vehicle.** Record the sample number on a sample placard. Place the card on the vehicle's dashboard or windshield. This identifies the selected vehicle to the estimators at the tipping area.

3. **Determine how to get a net weight for the vehicle.** There are three methods for obtaining the net weight for a vehicle. It is best to discuss this process with the scalehouse attendants at the beginning of the day.

   - The vehicle has a tare weight so that it is possible to record the net weight from the weight ticket.

   - It does not have a tare weight and the vehicle will weigh out. In this case, find out how the facility will track that vehicle. For example, it may be by ticket number that you can record and use to find the weight at the end of the day. If it is not possible to use the scalehouse system to track that vehicle, then place a **dashboard card**, identified with the sample number, on the vehicle's dashboard or windshield. If a dashboard card is used, it will need to be retrieved when the vehicle returns from the tipping area and the vehicle's outbound weight should be recorded on the card.

   - If the vehicle will not weigh out, it is recorded as a "minimum" and you should use the facility's minimum weight for that vehicle.

[*] C&D debris is defined as "Building materials and solid waste from construction, deconstruction, remodeling, repair, cleanup, or demolition operations that are not "hazardous" (as defined in Public Resources Code section 40141). This term includes, but is not limited to: asphalt, concrete, Portland cement, brick, lumber, wallboard, roofing material, ceramic tile, plastic pipe, and associated packaging." http://www.ciwmb.ca.gov/LGCentral/Glossary.htm

At the tipping area:

1. **One of the visual estimators should have a *sampling form*** on which to record observations about the load.

2. **Record the date** on the *sampling form*.

3. **Record the vehicle's sample number** (from the sample placard) on the *sampling form*.

4. **Measure the three dimensions of the load** while it still in the vehicle. Determine the width, length, and height of the load to the nearest foot, and record the values on the *sampling form*. Measure only the load itself; not the vehicle that is carrying it. Record the dimension measurements on the *sampling form*.

5. **Tip the entire load** onto the ground. Watch the load as it is being dumped to verify that it is a C&D load. If possible, spread the load out so all of its contents can be seen more easily and break open bags if necessary.

6. **Take photographs** of the load from all four sides with the *sample placard* visible in each photograph.

7. **Both estimators should note which major classes of material are present.** Both estimators should walk entirely around the load, calling out to the other estimator the names of the *major material classes* they identify in the load. The estimator who has the *sampling form* should use checkmarks to indicate which major material classes are present in the load. (Major material classes include *paper, plastic, metal, organics, carpet, aggregates & dirt, roofing, insulation, wood, gypsum,* and *miscellaneous C&D*.) Any disagreement between the estimators about which *major material classes* are present should be resolved at this time.

8. **Both estimators should estimate composition by volume for each *major material class*.** It is important to only consider volume for this step and to disregard perceived weight of materials. Beginning with the largest *major material class* present by volume, both estimators should estimate the percent of the entire load that corresponds to the *major material class*. Repeat this process for the next most common *major material class*, and so forth, until the volumetric percentage of every *major material class* has been estimated. At each stage during this process of estimation, the two estimators should discuss their observations and agree on the percents corresponding to each *major material class*, and the agreed-upon figure should be recorded on the *sampling form*. Finally, the totals for this step should be calculated to ensure that they add to 100 percent.

9. **Both estimators should estimate the composition by volume for each *specific material* within each *major material class*.** Consider each *major material class* separately and estimate the percentage of it that is made up of each *specific material*. For example, within the "*Paper" major material class*, the volumetric percentages of each *specific material:*

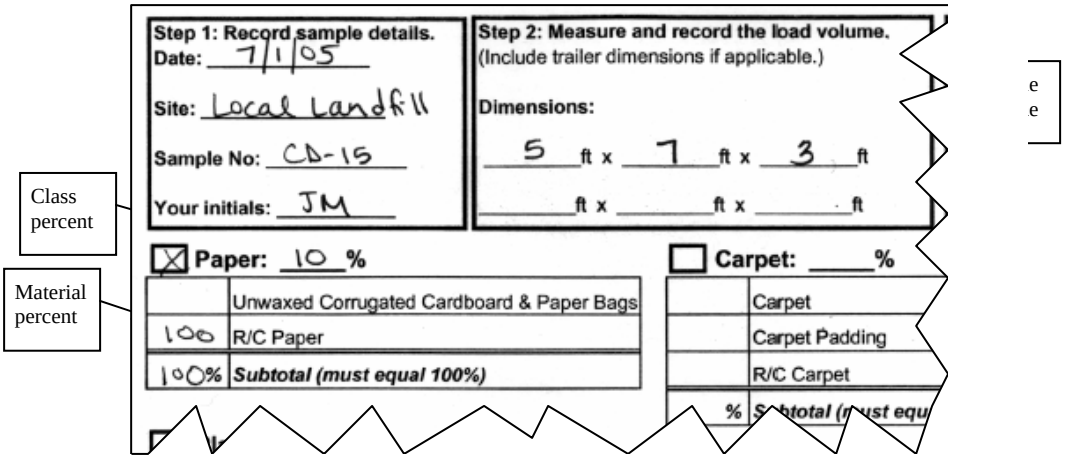
   - Uncoated corrugated cardboard & paper bags, and
   - Remainder/composite paper

   should be estimated, such that their total is 100 percent of the "*Paper" major material class*. The estimators should discuss their observations and agree upon the percent corresponding to each *specific material*. Repeat this process for each of the other *major material classes* and the *specific materials* that belong to them. Record the agreed-upon figures on the *sampling form*.

10. **Check and reconcile percentage data on the *sampling form*.** Verify that the percentage estimates for the *major material classes* add up to 100 percent. Also, the percentage estimates for the *specific materials* within each *major material class* must total 100 percent (see example field sheet in Appendix E).

Data Analysis Procedures

Data from visually estimated loads can be analyzed in three basic steps, using the following example field form. An analysis tool is available on the CIWMB website to conduct these calculations at www.ciwmb.ca.gov/WasteChar/Calculator/Default.htm.



1. **Calculate volumes of materials present in each sample.** Multiply the *material* percentages by the *class* percentage, then by the load, or sample, volume. In the above example, the sample volume was about 3.89 cubic yards (5 ft x 7 ft x 3 ft = 105 ft^3 and 27 ft^3 = 1 cubic yard, so 105 ft^3 = 3.89 cubic yards). The volume of R/C Paper would be calculated using the following equation: 100% x 10% x 3.89 cubic yards = 0.389 cubic yards.

2. **Convert material volumes to weights using industry-accepted density estimates (Appendix F).** The R/C Paper in this example would be converted to weight as follows: 0.389 cubic yards x 53 pounds/cubic yard = 19.45 pounds.

3. **Calculate composition percentages for all materials.** Sum material weights for all samples and divide by the total of all sample weights to obtain composition percentages for each material. Using the example from the following table, the sum of all the R/C Paper in all the samples is 157 pounds. The total for all sample weights is 3,207. The R/C Paper portion, or composition percentage, of the samples is 157 lbs/3,207 lbs = 5 percent.

	Sample 1	Sample 2	Sample 3	Sample 4	Total Weight Across all Samples
R/C Paper	19 lbs	133 lbs	5 lbs	0 lbs	**157 lbs**
All other materials	1,000 lbs	500 lbs	800 lbs	750 lbs	**3,050 lbs**
Total Sample Weight	**1,019 lbs**	**633 lbs**	**805 lbs**	**750 lbs**	**3,207 lbs**

Below is a sample printout of the waste stream composition as provided by the analysis tool.

Estimated Composition by Weight for All Loads

Paper	**1.0%**	
Unwaxed OCC		1.0%
RC Paper		0.0%
Plastic	**0.0%**	
Non-bag Film		0.0%
Polystyrene Packaging		0.0%
Rigid Plastic		0.0%
RC Plastic		0.0%
Metal	**0.0%**	
Major Appliances		0.0%
HVAC Ducting		0.0%
Other Ferrous & Non-Ferrous		0.0%
RC Metal		0.0%
Organic	**1.0%**	
Prunings, Trimmings, Branches, Stumps		1.0%
RC Organic		0.0%
Carpet	**0.0%**	
Carpet		0.0%
Carpet Padding		0.0%
RC Carpet		0.0%
Aggregates & Dirt	**85.2%**	
Dirt, Sand, Soil		26.9%
Concrete		24.9%
Asphalt Paving		0.0%
Brick, Ceramic, Porcelain		33.3%
Rock, Gravel		0.0%
RC Aggregates & Dirt		0.0%
Roofing	**0.0%**	
Roofing		0.0%
RC Roofing		0.0%
Insulation	**0.3%**	
Insulation		0.3%
RC Insulation		0.0%
Wood	**6.5%**	
Clean Recyclable Lumber, Pallets, Crates		0.7%
Other Untreated & Recyclable Wood		5.9%
Painted, Stained, Treated Wood		0.0%
RC Wood		0.0%
Gypsum	**0.0%**	
Clean Gypsum Board		0.0%
Painted Gypsum Board		0.0%
RC Gypsum		0.0%
Misc. C&D	**4.0%**	
Glass	**0.0%**	
Electronics	**0.0%**	
HHW	**0.0%**	
Special	**0.0%**	
Mixed Residue	**1.9%**	
TOTAL	**100.0%**	

Appendix A:
Material List and Definitions

General Rules:

1. A material should be classified according to a specific material category if it fits the definition and/or is similar to the examples for that category.
2. If a material is not similar to any definition or examples listed, is unknown, or is a combination of two or more materials, it should go in the appropriate Remainder/Composite category.
3. The predominate weight of a material that is combined with another material determines which Remainder/Composite category it goes into (e.g. If it is 60% Metal and 40% Plastic, it goes in Remainder/Composite Metal).

PAPER

1. **Uncoated Corrugated Cardboard & Paper Bags:** typically brown fiberboard consisting of a wavy layer sandwiched between two outer smooth sheets. Includes paper bags/sheets made from Kraft paper.

   INCLUDES:
   - Cardboard containers/boxes, unwaxed
   - Sheets & pieces of boxes/cartons
   - Grocery, fast food, or department store bags
   - Heavyweight sheets of kraft packing paper
   - Unlined empty cement bags

   DOES NOT Include:
   - Waxed paper/cardboard
   - Chipboard
   - Plastic-lined bags
   - Partially filled bags

   Rules: No food contamination

2. **Remainder/Composite Paper:** items not included above or made mostly of paper but combined with other materials.

   INCLUDES:
   - All other paper such as newspaper, office paper, etc.
   - Plastic-lined empty cement bags

PLASTIC

3. **Non-Bag Film:** film plastic used for large-scale packaging or transport packaging as well as plastic film used for purposes other than packaging.

   INCLUDES:
   - Shrink-wrap
   - Mattress bags
   - Furniture wrap
   - Film bubble wrap
   - Agricultural film (silage greenhouse films, mulch films, wrap for hay bales)
   - Plastic sheeting/drop cloths
   - Building wrap/house wrap (e.g. Tyvek).

   DOES NOT Include:
   - Rigid plastic items
   - Expanded polystyrene (i.e. styrofoam)
   - Plastic bags

4. **Expanded Polystyrene Packaging & Insulation:** Styrofoam, and similar materials.

INCLUDES:
- Packaging peanuts
- Meat & vegetable packaging trays
- Expanded polystyrene packaging blocks
- Expanded polystyrene insulation

DOES NOT Include:
- Film
- Rigid plastic items
- Fiberglass insulation

5. **Rigid Plastic:** any hard plastic container or material.

INCLUDES:
- Plastic buckets
- Plastic pipes/tubing
- Plastic bottles & containers
- Car parts
- Toys
- Plastic outdoor furniture
- Vinyl window frames
- Plastic/vinyl siding

DOES NOT Include:
- Film
- Expanded Polystyrene

6. **Remainder/Composite Plastic:** items not included above or made mostly of plastic but combined with other materials.

INCLUDES:
- Plastic bags
- Astroturf
- Plastic strapping
- Vinyl flooring
- Plastic lumber

METAL

7. **Major Appliances:** discarded major appliances of any color, often enamel-coated.

INCLUDES:
- Clothes washers & dryers
- Hot water heaters
- Stoves
- Furnaces
- Refrigerators & freezers
- Heating & cooling equipment

DOES NOT Include:
- Electronics
- Televisions
- Stereos

8. **HVAC Ducting:** sheet metal tubing and ducting, typically galvanized, used for ventilation air and heating and cooling systems.

9. **Other Ferrous & Non-Ferrous:** any magnetic or non magnetic metal.

INCLUDES:
- Iron, stainless steel, or steel
- Structural steel beams
- Boilers
- Metal pipes & clothes hangers

DOES NOT Include:
- Major appliances
- HVAC ducting

Steel cookware
Security bars
Uncoated copper wire
Shell casings
Brass pipes
Scrap ferrous & galvanized items (i.e. nails)
Aluminum window frames or siding
Aluminum foil
Tin/steel cans
Aluminum cans
Dry, empty paint cans

10. **Remainder/Composite Metal:** items not included above or made mostly of metal but combined with other materials.

    INCLUDES:
    Insulated and coated wire

ORGANICS

11. **Prunings, Trimmings, Branches, & Stumps:** plant material from any public or private landscape.

    INCLUDES:
    Branches
    Stumps
    Tree trunks
    Roots
    Grass
    Shrubs
    Leaves

    DOES NOT Include:
    Soil
    Dirt
    Sand
    Sod

12. **Remainder/Composite Organic:** items not included above or made mostly of organic matter but combined with other materials. Example: hay or straw waddles ("sausages" used for erosion control), sawdust, wood chips.

CARPET

13. **Carpet**: flooring applications consisting of natural or synthetic fibers bonded to some type of backing material.

    INCLUDES:
    Carpet
    Indoor/outdoor carpet

    DOES NOT Include:
    Carpet padding
    Carpet tack board
    Astroturf

14. **Carpet Padding**: materials used under carpet to provide insulation and padding.

INCLUDES:
Plastic carpet padding
Foam carpet padding
Felt carpet padding
Other carpet padding

DOES NOT Include:
Carpet

15. **Remainder/Composite Carpet:** items not included above or made mostly of carpet materials but combined with other materials.

AGGREGATES & DIRT

16. **Dirt, Sand, Soil:** nutrient rich decayed organic matter or very fine pieces of mineral matter.

INCLUDES:
Dirt
Sand
Soil
Sod
Non-hazardous contaminated soil

DOES NOT Include:
Hazardous contaminated soil

17. **Concrete:** a hard material made from sand, gravel, aggregate, cement mix, and water.

INCLUDES:
Pieces of building foundations
Concrete paving
Cinder blocks
Concrete with re-bar (steel internal structure)
Concrete with metal mesh
Concrete roofing tiles (usually dark brown or gray)

DOES NOT Include:
Bricks
Ceramic tile
Clay roofing tiles (usually orange and curved)
Rock

18. **Asphalt Paving:** a black or brown, tar-like material mixed with aggregate used as a paving material.

19. **Brick, Ceramic, Porcelain:** clay-fired products.

INCLUDES:
Bricks
Masonry tile
Ceramics
Porcelain toilets & sinks
Clay roofing tiles (usually orange and curved)

DOES NOT Include:
Corian
Cultured stone
Manufactured stone products

20. **Rock & Gravel:** pieces of mineral matter, rock, or gravel.

INCLUDES:
Landscaping rock
Paving stones
Pathway gravel
Other natural or mechanically crushed material

DOES NOT Include:
Soil
Dirt
Sand

21. **Remainder/Composite Aggregates & Dirt:** items not included above or made mostly of aggregate and dirt materials but combined with other materials.

ROOFING

22. **Roofing** means any type of asphalt/tar roofing material.

INCLUDES:
- Composition roofing
- Asphalt shingles
- Three tab roofing
- Tar & tar paper/building paper
- Built-up roofing

DOES NOT Include:
- Wood shake shingles
- Tile roofing (ceramic or cement)

23. **Remainder/Composite Roofing:** items not included above or made mostly of roofing materials but combined with other materials.

INSULATION

24. **Insulation:** any of the various types of synthetic or natural fiber insulation used in ceilings, walls, and around ducting.

INCLUDES:
- Fiberglass insulation, including "tubes" and blown-in forms
- Faced & unfaced batts
- Cellulose (paper) blown-in insulation

DOES NOT Include:
- Plastic polystyrene sheet or board insulation
- Ceiling tiles

25. **Remainder/Composite Insulation:** items not included above or made mostly of insulation materials but combined with other materials.

WOOD

26. **Clean Recyclable Lumber, Pallets, & Crates:** unpainted new or demolition dimensional lumber, pallets, and crates.

INCLUDES:
- Dimensional lumber, such as 2 x 4s, 2 x 6s, & 2 x 12s
- Pallets
- Crates
- Packaging made of dimensional lumber
- Residual materials from framing and related construction activities
- Large wooden spools

DOES NOT Include:
- Painted/Stained/Treated wood
- Engineered wood
- Plywood
- Strandboard
- Particle board

Rules: Does not have other materials, such as gypsum board, tile, mortar, or metal, attached.
May contain nails, paint, or other trace contaminants.
Not contaminated (i.e. with tar)

27. **Other Untreated/Recyclable Wood:** unpainted, unstained, or untreated recyclable wood not included in any other category. May be recycled into ethanol, adhesives or other engineered wood products.

INCLUDES:
Plywood
Sheet board
Wafer board
Particle board
Oriented strand board
Furniture or cabinets that have not been treated with paint, stain, or other finish
Untreated/unpainted wood roofing or siding, including untreated shakes and shingles
Unpainted wood molding

DOES NOT Include:
Clean recyclable lumber
Painted/Stained/Treated wood
Dimensional lumber

Rules: May contain nails, paint, or other trace contaminants.
Not contaminated (i.e. with tar)

28. **Painted/Stained/Treated Wood:** wood that has had an external coating applied or has been pressure treated, chemically treated, or treated with creosote.

INCLUDES:
All painted, stained, or varnished wood
Finished wood furniture
Pressure treated wood
Chemically treated wood (with copper etc.)
Finished wood flooring
Painted wood or engineered wood molding
Treated shakes and shingles
Wood treated with creosote such as
- Railroad ties
- Marine timbers and pilings
- Landscape timbers
- Telephone poles

DOES NOT Include:
Clean recyclable lumber
Untreated wood

Rules: Includes wood with wallpaper attached.
May be contaminated with materials such as tar.
Treated wood may have many small incisions in the surface of the wood, or may be identified if a fresh cut shows penetration of a preservative in from the surface.

29. **Remainder/Composite Wood:** items not included above or made mostly of wood materials but combined with other materials.

GYPSUM

30. **Clean Gypsum Board:** unpainted gypsum wallboard or interior wall covering made of a sheet of gypsum sandwiched between paper layers.

INCLUDES:
Clean sheetrock
Clean drywall
Clean plasterboard
Clean gypboard
Clean wallboard

DOES NOT Include:
Painted gypsum board

Rules: Material does not have wall paper attached.

31. **Painted Gypsum Board:** painted gypsum wallboard or interior wall covering made of a sheet of gypsum sandwiched between paper layers.

INCLUDES:
Painted sheetrock
Painted drywall
Painted plasterboard
Painted gypboard
Painted wallboard

DOES NOT Include:
Clean/unpainted gypsum board

Rules: Material may have wall paper attached.

32. **Remainder/Composite Gypsum:** items not included above or made mostly of gypsum materials but combined with other materials.

MISCELLANEOUS CONSTRUCTION & DEMOLITION

33. **Other C&D:** items not included in above C& D categories (Carpet, Aggregates & Dirt, Roofing, Insulation, Wood, and Gypsum).

INCLUDES:
Corian & similar products
Cultured marble
Fiberglass tubs & sinks
Laminate flooring (made of more than one type of material)
Mirrors
Formica
Ceiling tiles
Linoleum
Unused, dry, bagged cement or concrete mix
Drywall compound, sealants, caulking, mudding compounds, and other non-hazardous construction products
Fiberboard

OTHER MATERIALS

34. **Glass** includes glass of any type including remainder/composite glass.

35. **Electronics** includes brown goods, such as microwaves and VCRs; computer-related electronics; small consumer electronics, such as cell phones, computer games, and digital cameras; and televisions and other items containing a CRT.

36. **HHW** includes paint, vehicle and equipment fluids, used oil, batteries, and any other household hazardous waste such as fluorescent lights, pesticides, and caustic cleaners.

37. **Special Waste** includes ash, sewage solids, industrial sludge, treated medical waste, tires, bulky items, and remainder/composite special waste. Examples of special waste include asbestos-containing materials, such as certain types of pipe insulation and floor tiles, auto fluff, auto-bodies, trucks, trailers, truck cabs, untreated medical waste/pills/hypodermic needles, non-wood furniture such as upholstered chairs and couches, mattresses, box springs, base components, and artificial fireplace logs.

38. **Mixed Residue** includes non-C&D MSW (household garbage) and/or material that cannot be put in any other type or subtype in the other categories. This category includes mixed residue that cannot be further sorted. It also includes clay and other fines.

Reverse Materials List

The following reverse materials list is included for use as a field guide to aid in material identification. The visual estimator should use this list by first identifying in what major material class they believe the item in question belongs: *paper*, *plastic*, *metal*, *organics*, *carpet*, *aggregates and dirt*, *roofing*, *insulation*, *wood*, *gypsum*, *miscellaneous construction & demolition*, or *other materials*. If the item is listed within that major material class, the visual estimator can then identify the corresponding material type on the right. If it is not found in that major material class, it may be in another class. If not listed, the item should be classified according to a similar item in the list or in the appropriate remainder/composite material type.

Reverse Materials List

Class	Item	Material Components
Paper	Cardboard containers/boxes, uncoated	Uncoated Corrugated Cardboard & Paper Bags
	Chipboard	R/C Paper
	Heavyweight sheets of kraft packing paper	Uncoated Corrugated Cardboard & Paper Bags
	Plastic-lined bags	R/C Paper
	Unlined empty cement bags and other paper bags	Uncoated Corrugated Cardboard & Paper Bags
	Waxed paper/cardboard	R/C Paper
Plastic	Agricultural film: Wrap for hay bales, mulch/greenhouse films	Non-Bag Film
	Astroturf	R/C Plastic
	Buckets, bottles & containers	Rigid Plastic
	Building wrap/house wrap (e.g. Tyvek)	Non-Bag Film
	Expanded polystyrene packaging blocks & insulation	Expanded Polystyrene Packaging & Insulation
	Film Bubble wrap	Non-Bag Film
	Furniture wrap & mattress bags	Non-Bag Film
	Plastic bags	R/C Plastic
	Plastic car parts	Rigid Plastic
	Plastic outdoor furniture	Rigid Plastic
	Plastic pipes/tubing	Rigid Plastic
	Plastic sheeting/drop cloths	Non-Bag Film
	Plastic/vinyl siding & vinyl window frames	Rigid Plastic
	Shrink-wrap	Non-Bag Film
Metal	Aluminum cans & foil	Other Ferrous & Non-Ferrous
	Aluminum window frames or siding	Other Ferrous & Non-Ferrous
	Boilers	Other Ferrous & Non-Ferrous
	Brass pipes	Other Ferrous & Non-Ferrous
	Clothes washers & dryers	Major Appliances
	Dry, empty paint cans	Other Ferrous & Non-Ferrous
	Furnaces	Major Appliances
	Heating & cooling equipment	Major Appliances
	Hot water heaters	Major Appliances
	Insulated and coated wire	R/C Metal
	Metal pipes	Other Ferrous & Non-Ferrous
	Refrigerators & freezers	Major Appliances
	Security bars	Other Ferrous & Non-Ferrous
	Sheet metal tubing and ducting	HVAC Ducting
	Stoves	Major Appliances
	Structural steel beams	Other Ferrous & Non-Ferrous
	Tin/steel cans	Other Ferrous & Non-Ferrous
	Uncoated copper wire	Other Ferrous & Non-Ferrous
Organics	Hay/straw waddles	R/C Organic
	Roots	Prunings, Trimmings, Branches, & Stumps
	Shrubs	Prunings, Trimmings, Branches, & Stumps
	Tree trunks	Prunings, Trimmings, Branches, & Stumps
Carpet	Felt, foam, plastic, and other carpet padding	Carpet Padding
	Indoor/outdoor carpet	Carpet
Aggregates & Dirt	Asphalt Paving	Asphalt Paving
	Bricks	Brick, Ceramic, Porcelain
	Ceramic tile	Brick, Ceramic, Porcelain
	Cinder blocks	Concrete
	Clay roofing tiles (usually orange)	Brick, Ceramic, Porcelain
	Concrete paving	Concrete
	Concrete roofing tiles (usually dark brown or gray)	Concrete
	Concrete with metal mesh	Concrete
	Concrete with re-bar (steel internal structure)	Concrete
	Masonry tile	Brick, Ceramic, Porcelain
	Paving stones	Rock & Gravel
	Pieces of building foundations	Concrete
	Porcelain toilets and sinks	Brick, Ceramic, Porcelain
	Sod	Dirt, Sand, Soil
Roofing	Asphalt shingles	Roofing
	Built-up roofing	Roofing
	Composition roofing	Roofing
	Tar & tar paper/building paper	Roofing
	Three tab roofing	Roofing

Reverse Materials List (cont.)

Class	Item	Material Components
Insulation	Cellulose (paper) blown-in insulation	Insulation
	Faced & unfaced batts	Insulation
	Fiberglass Insulation, including "tubes" & blown-in forms	Insulation
Wood	Crates	Clean Recyclable Lumber, Pallets, & Crates
	Dimensional lumber (2x4s, 2x6s, 2x12s)	Clean Recyclable Lumber, Pallets, & Crates
	Finished wood flooring	Painted/Stained/Treated Wood
	Finished wood furniture	Painted/Stained/Treated Wood
	Furniture or cabinets (untreated/unfinished)	Other Untreated/Recyclable Wood
	Landscape timbers	Painted/Stained/Treated Wood
	Large wooden spools	Clean Recyclable Lumber, Pallets, & Crates
	Marine timbers and pilings	Painted/Stained/Treated Wood
	Packaging made of dimensional lumber	Clean Recyclable Lumber, Pallets, & Crates
	Pallets	Clean Recyclable Lumber, Pallets, & Crates
	Particle board	Other Untreated/Recyclable Wood
	Plywood	Other Untreated/Recyclable Wood
	Pressure treated or chemically treated wood	Painted/Stained/Treated Wood
	Railroad ties	Painted/Stained/Treated Wood
	Shakes and shingles (treated/painted)	Painted/Stained/Treated Wood
	Shakes and shingles (untreated/unpainted)	Other Untreated/Recyclable Wood
	Sheet board	Other Untreated/Recyclable Wood
	Strand board	Other Untreated/Recyclable Wood
	Telephone poles	Painted/Stained/Treated Wood
	Wafer board	Other Untreated/Recyclable Wood
	Wood molding (painted or engineered)	Painted/Stained/Treated Wood
	Wood molding (unpainted)	Other Untreated/Recyclable Wood
	Wood roofing or siding (untreated/unpainted)	Other Untreated/Recyclable Wood
Gypsum	Clean drywall, gypboard, plasterboard, sheetrock, wallboard	Clean Gypsum Board
	Painted drywall, gypboard, plasterboard, sheetrock, wallboard	Painted Gypsum Board
Misc. C & D	Caulking	Other C&D
	Ceiling tiles	Other C&D
	Corian & similar products	Other C&D
	Cultured marble & stone	Other C&D
	Drywall compound	Other C&D
	Fiberglass tubs & sinks	Other C&D
	Formica	Other C&D
	Laminate flooring (made of more than one material)	Other C&D
	Linoleum	Other C&D
	Manufactured stone products	Other C&D
	Mirrors	Other C&D
	Partially filled bags	Other C&D
	Sealants	Other C&D
	Unused, dry, bagged cement or concrete mix	Other C&D
	Unused/partially used spackle, caulking, mudding compounds, etc.	Other C&D
Glass	All glass	Glass
Electronics	Computer-related electronics	Ewaste
	Microwaves	Ewaste
	Televisions	Ewaste
HHW	Batteries	HHW
	Fluorescent lights	HHW
	Motor oil & other vehicle fluids	HHW
	Paint	HHW
	Pesticides	HHW
Special	Ash	Special
	Mattresses/box springs	Special
	Non-wood (upholstered) furniture	Special
	Tires	Special

Appendix B:
Equipment List

Personal Equipment:

- Coveralls or protective outer wear (*required)*
- Steel-toed or steel shank boots (*required)*
- Heavy-duty gloves; puncture proof and moisture resistant (*required)*
- Safety eye protection glasses (*required)*
- Hard hat (*required)*
- Safety vest (*required)*
- Rain gear
- Dust mask
- Ear Plugs
- Back-support belts
- In cold weather, extra clothing, such as balaclava, is recommended
- In hot weather, clothing which allows sweat to evaporate is recommended

Site Safety Equipment:

- Cell phone
- First aid kit with eye-wash kit
- Paper towels and wet wipes hand cleaners
- Water
- Food
- Sunscreen
- Insect Repellent
- Health & Safety plan
- Emergency contact list for facility
- Traffic cones — to mark the sorting area
- Yellow caution tape — to mark the sorting area
- Fire extinguisher
- Heaters (either gas or electric), if necessary
- Wind blocks, if necessary
- Tent, if necessary to keep warm, cool, or out of the wind

Sampling Equipment:

- Measuring tape
- Magnet
- Clipboard — letter size
- Data and sample ID sheets
- Pens/pencils/permanent markers
- Camera
- Calculator
- Shovels with large scoop (like a snow shovel), pitchfork, and hand held claw
- Bolt cutter, wire cutter, needle-nose pliers
- Knife with a fixed blade

Appendix C:
Safety Guidelines

The purpose of this section is to provide safety guidelines for performing visual sorts of non-hazardous solid waste at transfer stations and/or sanitary landfills.

Visual solid waste characterization safety guidelines

Basic requirements of workers:

- All workers should be in good physical condition. They should maintain a current tetanus booster and Hepatitis B shot and not be over sensitive to odors and dust.
- All workers should be able to read warning signs/labels and communicate in English.

Before you arrive at the site:

- Make sure you have everything listed on the safety equipment list.
- Be prepared for the weather:
  - In extreme heat, make sure there are plenty of fluids available (preferably in an ice chest) and the workers have breathable clothing.
  - In extreme cold, workers should have adequate clothing. Wind blockers, and electric or gas heaters (gas heaters should be properly ventilated) should be set up to lessen the cold.
- Make sure that arrangements for toilet facilities and a “break” area have been made.

When you arrive at the site:

- Always wear a safety vest, hard hat, steel toed boots, and gloves while at the site.
- Locate the Site Supervisor and learn the traffic patterns and dumping schedule of the site.
- Learn what the safety procedures are at the host’s site. Follow them, along with the listed safety guidelines, carefully.
- Have the Site Supervisor announce to his staff your location and purpose.
- Become familiar with local emergency services, and maintain a list of emergency phone numbers.
- Make sure that the designated tipping area is in a location that is as far away from vehicle traffic as possible and that minimizes interference with normal operations at the facility.
- Make noise when approaching the waste site to allow any insects/pest animals time to flee. Keep an eye out for any snakes, bees, wasps, or poisonous spiders around the sorting area.
- Place traffic cones and/or high visibility warning tape around the active sorting area.

When a vehicle is moving near your location:

- Make eye contact with driver. You might see the driver but he might not see you.

- Make sure that you are a safe distance from the dumping area.

After the truck empties its load:

- Use a snow shovel, pitchfork, knife, or hand held claw to move sample around.
- Use a rake or other equipment to break open bags and expose material. Do not open red (medical waste) bags.

Throughout the day:

- Be aware of your surroundings at all times.
- Make sure you are visible to site traffic.
- Take regular breaks throughout the day to prevent dehydration, carelessness, and fatigue.
- Look for possible slipping and tripping hazards.
- Never attempt to identify any unknown chemical substances present in the waste stream.
- Always know what you are picking up. Never reach into the middle of a pile and pick up something you can not see.
- Lift properly; ask for assistance when needed.
- Routinely check personal protective equipment and work clothing for proper fit and condition. Replace or repair immediately if defective.
- Wash hands and face with soap before eating and/or drinking.
- Smoke only in designated areas.
- In hot weather, drink plenty of fluids, take breaks throughout the day, and watch for signs of heat-related illness.
- In cold weather, drink plenty of liquids, wear proper clothing, and be alert for indications of cold-effects such as shivering and fatigue.
- If you feel ill, alert the Crew Chief and take a break.
- Injuries involving cuts or puncture wounds should be treated as follows:
    - Using sterile gloves, immediately clean the wound with antiseptic and wrap in gauze.
    - Place the needle or object causing the wound in a plastic bag.
    - If the wound is caused by a hypodermic needle or a metal object, or if it is believed to pose a health or safety risk to the worker for any other reason, the worker will be taken to the nearest hospital or clinic for evaluation and treatment.
    - Notify the Site owner/operator of any injuries.
    - Document the incident in writing.

- Similar steps should be taken if the worker has been exposed to potentially hazardous material and shows abnormal or unusual symptoms.
- Any accidents should be reported immediately to site personnel.

Safety Equipment List

Please refer to the equipment list provided in Appendix B.

Appendix D:
Field Forms

This appendix includes the following forms. Copies may be made from the pages in this appendix.

- Vehicle selection form
- Dashboard card
- Sample placard
- Volume-based Visual Estimating Form

Construction & Demolition Study
Vehicle Selection Form

Site: _____

Date: _____

Cross off one number for each load type entering the landfill.

Continue for each block, beginning at #1, on the next line until the required number of loads are sampled.

NEED ____ TOTAL - SAMPLE EVERY ____ VEHICLE

																				SAMPLE ID	NET WEIGHT
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		

Dashboard Card

Do not leave with this card! Give this card back to the gate attendant before you leave the landfill!

¡Muy importante! Deje la tarjeta con el attendent a la salida del landfill.

Inbound: _____

Outbound or tare: _____

Sample # _____

Date: _____

Sample# _____

DATE___/___

Volume-based Visual Estimating Form

Step 1: Record sample details.
Date: _____

Site: _____

Sample No: _____

Your initials: _____

Step 2: Measure and record the load volume.
(Include trailer dimensions if applicable.)

Dimensions:

_____ft x _____ft x _____ft

_____ft x _____ft x _____ft

Step 3: Identify all main material classes (in bold) that appear in the load.
Step 4: Estimate composition of load by volume for each main material class (in bold).
Step 5: For each material class, estimate composition by volume of each specific material component (non-bold text).
Step 6: Make sure main material class estimates AND material component estimates EACH total 100%.

☐ **Paper: _____%**	
	Uncoated Corrugated Cardboard & Paper Bags
	R/C Paper
%	***Subtotal (must equal 100%)***

☐ **Plastic: _____%**	
	Non-Bag Film
	Expanded Polystyrene Packaging & Insulation
	Rigid Plastic
	R/C Plastic
%	***Subtotal (must equal 100%)***

☐ **Metal: _____%**	
	Major Appliances
	HVAC Ducting
	Other Ferrous & Non-ferrous
	R/C Metal
%	***Subtotal (must equal 100%)***

☐ **Organics: _____%**	
	Prunings, Trimmings, Branches, & Stumps
	R/C Organic
%	***Subtotal (must equal 100%)***

☐ **Carpet: _____%**	
	Carpet
	Carpet Padding
	R/C Carpet
%	***Subtotal (must equal 100%)***

☐ **Aggregates & Dirt: _____%**	
	Dirt, Sand, Soil
	Concrete
	Asphalt Paving
	Brick, Ceramic, Porcelain
	Rock & Gravel
	R/C Aggregates & Dirt
%	***Subtotal (must equal 100%)***

☐ **Roofing: _____%**	
	Roofing
	R/C Roofing
%	***Subtotal (must equal 100%)***

☐ **Insulation: _____%**	
	Insulation
	R/C Insulation
%	***Subtotal (must equal 100%)***

☐ **Wood: _____%**	
	Clean Recyclable Lumber, Pallets, & Crates
	Other Untreated/Recyclable Wood
	Painted/Stained/Treated Wood
	R/C Wood
%	***Subtotal (must equal 100%)***

☐ **Gypsum: _____%**	
	Clean Gypsum Board
	Painted Gypsum Board
	R/C Gypsum
%	***Subtotal (must equal 100%)***

☐ **Miscellaneous C&D: _____%**	
	Other C&D
%	***Subtotal (must equal 100%)***

☐ **Glass: _____%**
☐ **Electronics: _____%**
☐ **HHW: _____%**
☐ **Special: _____%**
☐ **Mixed Residue: _____%**

Grand Total:_____%
(Must equal 100%)

Notes:

Appendix E:
Example of Completed Sample Form

Volume-based Visual Estimating Form

Step 1: Record sample details.
Date: 7/1/05
Site: Local Landfill
Sample No: CD-15
Your initials: JM

Step 2: Measure and record the load volume.
(Include trailer dimensions if applicable.)
Dimensions:
5 ft x 7 ft x 3 ft
_____ ft x _____ ft x _____ ft

Step 3: Identify all main material classes (in bold) that appear in the load.
Step 4: Estimate composition of load by volume for each main material class (in bold).
Step 5: For each material class, estimate composition by volume of each specific material component (non-bold text).
Step 6: Make sure main material class estimates AND material component estimates EACH total 100%.

[X] Paper: 10 %

100	Uncoated Corrugated Cardboard & Paper Bags
	R/C Paper
100 %	*Subtotal (must equal 100%)*

[ ] Plastic: ____ %

	Non-Bag Film
	Expanded Polystyrene Packaging & Insulation
	Rigid Plastic
	R/C Plastic
%	*Subtotal (must equal 100%)*

[ ] Metal: ____ %

	Major Appliances
	HVAC Ducting
	Other Ferrous & Non-ferrous
	R/C Metal
%	*Subtotal (must equal 100%)*

[X] Organics: 4 %

100	Prunings, Trimmings, Branches, & Stumps
	R/C Organic
100 %	*Subtotal (must equal 100%)*

[ ] Carpet: ____ %

	Carpet
	Carpet Padding
	R/C Carpet
%	*Subtotal (must equal 100%)*

[X] Aggregates & Dirt: 50 %

30	Dirt, Sand, Soil
30	Concrete
	Asphalt Paving
40	Brick, Ceramic, Porcelain
	Rock & Gravel
	R/C Aggregates & Dirt
100 %	*Subtotal (must equal 100%)*

[ ] Roofing: ____ %

	Roofing
	R/C Roofing
%	*Subtotal (must equal 100%)*

[X] Insulation: 10 %

100	Insulation
	R/C Insulation
100%	*Subtotal (must equal 100%)*

[X] Wood: 20 %

10	Clean Recyclable Lumber, Pallets, & Crates
90	Other Untreated/Recyclable Wood
	Painted/Stained/Treated Wood
	R/C Wood
100 %	*Subtotal (must equal 100%)*

[ ] Gypsum: ____ %

	Clean Gypsum Board
	Painted Gypsum Board
	R/C Gypsum
%	*Subtotal (must equal 100%)*

[X] Miscellaneous C&D: 5 %

100	Other C&D
100 %	*Subtotal (must equal 100%)*

[ ] Glass: ____ %
[ ] Electronics: ____ %
[ ] HHW: ____ %
[ ] Special: ____ %
[X] Mixed Residue: 1 %

Grand Total: 100 %
(Must equal 100%)

Notes: lots of wood framing scraps; misc. C&D was plywood with attached formica

Appendix F:
Volume-to-Weight Conversion Factors

The visual characterization method described in this protocol produces percentages of material types present in each sample. The percentages should be converted to volumes as described in the section Data Analysis Procedures, and converted to weights using the following factors. Unless otherwise noted, density factors are in pounds per cubic yard.

Material	Density	Source *
Uncoated Corrugated Cardboard & Paper Bags	53	CIWMB 2006
Remainder/Composite Paper	364	U.S. EPA
Non-Bag Film	35	CIWMB 2006
Expanded Polystyrene Packaging & Insulation	32	CIWMB 2006
Rigid Plastic	30	U.S. EPA
Remainder/Composite Plastic	50	U.S. EPA
Major Appliances	145	CIWMB 2006
HVAC Ducting	47	CIWMB 2006
Other Ferrous & Non-Ferrous	225	CIWMB 2006
Remainder/Composite Metal	143	CIWMB 2006
Prunings, Trimmings, Branches, & Stumps	127	CIWMB 2006
Remainder/Composite Organic	225	CIWMB 2006
Carpet	147	CIWMB 2006
Carpet Padding	62	CIWMB 2006
Remainder/Composite Carpet	147	CIWMB 2006
Dirt, Sand, Soil	929	CIWMB 2006
Concrete	860	CIWMB 2006
Asphalt Paving	773	CIWMB 2006
Brick, Ceramic, Porcelain	860	CIWMB 2006
Rock & Gravel	999	CIWMB 2006
Remainder/Composite Aggregates & Dirt	929	CIWMB 2006
Roofing	731	CIWMB 2006
Remainder/Composite Roofing	731	CIWMB 2006
Insulation	17	Tellus
Remainder/Composite Insulation	17	Tellus
Clean Recyclable Lumber, Pallets, & Crates	169	CIWMB 2006
Other Untreated/Recyclable Wood	169	CIWMB 2006
Painted/Stained/Treated Wood	169	CIWMB 2006
Remainder/Composite Wood	219	CIWMB 2006
Clean Gypsum Board	467	CIWMB 2006
Painted Gypsum Board	467	CIWMB 2006
Material	**Density**	**Source ***
Remainder/Composite Gypsum	467	CIWMB 2006
Other C&D	417	CIWMB 2006
Glass	600	U.S. EPA

Electronics	385	CIWMB 2006
HHW	1671	CIWMB 2006
Special	140	CIWMB 2006
Mixed Residue	999	FEECO

*** Data Source Abbreviations**

CIWMB 2006 refers to the report “Targeted Statewide Waste Characterization Study: Detailed Characterization of Construction and Demolition Waste."

U.S. EPA refers to two sources. 1) Business Waste Prevention Quantification Methodologies - Business Users Guide: Washington, D.C. and Los Angeles: U.S. Environmental Protection Agency, Municipal and Industrial Solid Waste, and University of California at Los Angeles Extension, Recycling and Municipal Solid Waste Management Program: Grant Number CX 824548-01-0, 1996. 2) U.S. Environmental Protection Agency's "Measuring Recycling: A Guide for State and Local Governments," document no. EPA530-R-97-011, published September 1997.

FEECO refers to FEECO International, Complete Systems and Equipment Handbook, 9th printing.

Tellus refers to the Tellus Institute, Boston, Massachusetts.

Appendix G:
Visual Estimation Guide

In the following photographs, the indicated percent reflects the <u>percent by volume</u> that the red bricks make up of the entire pile of bricks.

5 %

10 %

15 %

20 %

25 %

30 %

40 %

50 %

60 %

70 %

80 %

90 %

Appendix H:
Visual Estimation Training Exercise

As a training exercise, estimate what percent of red bricks are in each photo. Turn to the last page for the answer. It may be helpful to focus your eyes only on the red bricks and to visually group them all on one side of the photo so that it is easier to estimate the relative percent by volume.

1)

_____%

2)

_____%

3)

_____%

4)

_____%

5)

_____%

6)

_____%

7)

_____%

8)

_____%

9)

_____%

10)

_____%

Answers:

1) 5%

2) 10%

3) 35%

4) 80%

5) 50%

6) 25%

7) 40%

8) 60%

9) 70%

10)15%

Source Reference Notes

[1] California Integrated Waste Management Board, *2004 California Statewide Waste Characterization Study*, prepared by Cascadia Consulting Group, Inc., 2004, p. 4.

[2] County of Orange, *County of Orange Self-hauled and Loose Roll-off Box Waste Characterization Study (2004)*, prepared by Cascadia Consulting Group, Inc., 2004, p. 41.