1.0 Dust

Dust and emissions from demolition and construction works can impact on air quality, but through careful planning and good management, these impacts can be reduced.

1.1 Dust Sources

Construction activities are significant source of dust emissions that may have a substantial temporary impact on local air quality. Dust emission during the construction phase of a project are associated with land clearing, drilling and blasting, ground excavation and cut and fill operations (i.e., earth moving). Dust emissions can vary substantially from day to day, depending on the level of activity, the specific operations, and the prevailing meteorological conditions.

1.2 Effects of Dust Emission

a. Soiling and Amenity Value Effects

Clearly, there is no simple method for quantifying this effect, and it would need to be assessed on a case-by-case basis.

The most common areas of concern include: the visual soiling of clean surfaces, such as cars, window ledges and household washing. Dust deposits inside the house are often the impact of greatest concern in residential areas, followed by soiling of the outside of the house and the effects on paintwork.

Dusty conditions can also affect people's ability to enjoy their outdoor environment, making activities such as barbecues and sports unpleasant and unappealing.

For most people, a major effect of a dust nuisance problem is annoyance at the increased requirement for cleaning. However, this can also involve a financial aspect, through the use of cleaning materials, water and possibly paid labor. Another related effect of dust nuisance is the potential impact on property values. This is a more difficult and often more emotive subject than soiling effects, but it is also a matter of common concern.

b. Visibility

Visibility effects from dust are usually only a concern in the immediate vicinity of a specific source, whereas smoke effects can accumulate across a much wider area.

Visibility effects are largely a matter of aesthetics. However, it should also be recognized that visibility is one of the main ways by which people commonly judge air quality.

Loss of visibility is also a safety concern under extreme conditions, especially for road traffic or aircraft.

c. Effects on Plants

Dust deposits can have significant effects on plant life, though mainly at high dust loadings. This can include:

- Reduced photosynthesis due to reduced light penetration through the leaves. This can caused reduced growth rates and plant vigor.
- Increased incidence of plant pests and diseases. Dust deposits can act as a medium for the growth of fungal diseases. In addition, it appears that sucking and chewing insects are not affected by dust deposits to any great extent, whereas their natural predators are affected.
- Reduced effectiveness of pesticide sprays due to reduced penetration.
- Rejection and downgrading of produce.

1.3 Dust Control Methods and Technologies

Control methods for the management of nuisance dust sources are described below. The following measures (as applicable) must be adopted by the contractors during the construction phase to prevent the generation of dust:

a. Paved Surfaces

Dust deposits on paved surfaces can be thrown into the air by wind or by vehicle movements. Dust pick-up by wind is usually only significant at wind speed above 5 meters per second, but vehicle re-entrainment can occur under any conditions. Dust emissions from paved surfaces can be minimized through the use of the following procedures:

- Movement and handling of fine materials should be controlled to prevent spillages onto paved surfaces.

- Minimize mud and dust track-out from unpaved areas by the use of wheel wash facilities.

- Regular cleaning of paved surfaces, using a mobile vacuum sweeper or a water flushing system.

- Speed controls on vehicle movements.

- Wind reduction control.

Dust emissions from paved surfaces can be reduced by factors of 90% or more, but this is highly dependant on the above procedures being applied rigorously and consistently.

b. Unpaved Surfaces

Dust emissions from unpaved surfaces are caused by the same factors as for paved surfaces, but the potential emissions are usually much greater. Dust emissions can be controlled using the following procedures:

- Wet suppression of unpaved areas should be regularly applied using a water cart and/or fixed sprinklers.

- Chemical stabilization can also be used in conjunction with wet suppression. This involves the use of chemical additives in the water, which help to form a crust on the surface and bind the dust particles together. Chemical stabilization reduces watering requirements, but any savings can be offset by the cost of the additives. (Note: chemical additives to be used for dust suppression should be shown to have no adverse effects on the environment)

- Re-vegetation of exposed surfaces. This should be done wherever practicable. Techniques such as hydro-seeding and the use of geotextiles should be used on sloping ground and other difficult surfaces.

- Surface improvements. These include paving with concrete or asphalt, or the addition of gravel or slag to the surface. Paving can be highly effective but is expensive and unsuitable for surfaces used by very heavy vehicles or subject to spillages of material in transport. In addition, dust control measures will usually still be required on the paved surfaces. The use of grave or slag can be moderately effective, but repeated additions will usually be required.

- Speed controls on vehicle movements.

- Wind reduction controls.

Unpaved surfaces can be a significant cause of dust problems on adjacent paved surfaces (e.g., roads) if there is no control over carry-out of mud and dirt. This can be controlled by the use of wheel wash facilities.

Wet suppression of unpaved areas can achieve dust emission reductions of about 70% or more, and this can sometimes be increased by up to 95% through the use of chemical stabilization. Re-vegetation and paving can achieve up to 100% control efficiencies, but have only limited application.

c. Vehicles

Vehicles traveling over paved or unpaved surfaces tend to pulverize any surface particles and other debris. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong air currents due to turbulent shear between the wheels and the surface. Dust particles are also sucked into the turbulent wake created behind the moving vehicles. The loads carried by trucks are potential source of dust, either through wind entrainment or spillages.

Dust emissions due to vehicles can be minimized with the following control measures:

- Limiting vehicle speeds. A speed limit of 10 – 15 km/hr is commonly applied
- Limiting load size to avoid spillages
- Covering loads with tarpaulins or the use of enclosed bins to prevent dust re-entrainment from trucks
- Minimizing travel distances through appropriate site layout and design
- The use of wheel and truck wash facilities at site exits

Speed controls on vehicles have an approximately linear effect on dust emissions. In other words, a speed reduction from 30 km/hr to 15 km/hr will achieve about a 50% reduction in dust emissions.

d. Material Stockpiles

Fine material stored in stockpiles can be subject to dust pick-up at winds in excess of about 5 m/sec. Dust emissions can also occur as material is dropped onto the stockpile from a conveyor. The options for dust control can include the following:

- Wet suppression using sprinklers.

- Covered storage of fine materials. This is an expensive option but should be seriously considered for use in especially sensitive locations, and for storage of finely divided material with a high dust potential, such as fertilizer, gypsum and other industrial minerals.

- Limiting the height and slope of the stockpiles can reduce wind entrainment. For example, a flat shallow stockpile will be subject to less wind turbulence than one with a tall conical shape. Consideration should also be given to the effect of other site features. For example, it may be possible to reduce wind effects by keeping the stockpile heights below the level of the site noise bund.

- Limiting drop heights from conveyors.

- Use of wind breaks. Wind speed near the pile surface is the primary factor affecting particle uptake from stockpiles. Although a large, solid windbreak is the most effective configuration, aesthetic and economic considerations may preclude that from being appropriate. A study by Stunder and Ayra (1988) found that 50% porous windbreak was almost as effective as a solid wall in reducing wind speeds over much of the pile, when constructed to the following specifications:

  ⇒ Height equal to the pile height;

  ⇒ Length equal to the pile length at the base; and

  ⇒ Located at a distance of one pile height from the base of the pile.

Wind breaks can be constructed using horticultural cloth supported on poles, or by planting trees.

e. Conveyors

Dust emissions from conveyors can be caused by wind pick-up and through losses during loading, discharge and at transfer points. The following options should be considered for minimizing these emissions:

- Used of enclosed conveyors for fine material.

- Use of water sprays or sprinklers at conveyor transfer points.

- Minimizing the heights at transfer points, including use of conveyors that can be raised and lowered.

- Regular clean-up of spillages around the transfer points and any other place where this might occur.

f. Other Materials Handling

Materials handling using front-end loaders or mechanical grabs are another potential source of dust emissions. These mainly occur when the load is dropped into a truck or hopper, but can also be caused by spillages during handling. Similar problems can occur when dusty loads are transferred by gravity discharge from hoppers into trucks.

These problems are addressed by minimizing drop heights, and regular clean-up of any spillages. In some cases (such as wharves or irregular surfaces) covering of the potential spill areas may be necessary to facilitate clean-up. Regular maintenance of hydraulic grabs is important to ensure complete closure. Hopper load systems should be designed to ensure a good match with truck size, and should be fully enclosed on the sides.

g. Wind Protection

Wind is a major cause of dust emissions from many sites. The effects can be partially mitigated through the use of shelterbelts or temporary screening. It may also be possible to make use of natural land features, or artificial features such as noise bunds, to provide a degree of wind protection. This option should be considered in the initial development of the site layout and design.

Continuous monitoring of wind conditions should be considered when dusty activities are to be carried out in a sensitive location. The information can be used as a trigger for increased dust control activities or even as a signal for work to cease.

2.0 Odor

An odor is a volatilized chemical compound, generally at a very low concentration, that humans or other animals perceive by the sense of olfaction. Normally, it is the result of inorganic gaseous emissions (e.g., hydrogen sulfide or ammonia) or organic vapors, often in quite small concentrations, which are released or escaped into the local environment.

2.1 Sources of Odor

Potential sources that may emit odors during construction activities include equipment exhaust and architectural coatings. Odors from these sources would be localized and generally confined to the immediate area surrounding the project site. The proposed project would utilize typical construction techniques, and the odors would be typical of most construction sites and temporary in nature. The proposed project construction activity would not cause an odor nuisance, and construction odors would result in a less-than-significant impact.

2.2 Odor Control and Management Techniques

Odor control is an important consideration for protecting the environment. There are several methods of dealing with odorous gases and each method should be considered based on its inherent advantages and disadvantages for the specific treatment system required. The contractor must adopt the following measures (as applicable) to manage odor due to construction activities.

a. Earthwork

- Improving site drainage and preventing standing water from remaining in excavated areas.
- Covering stockpiles of excavated material with polyethylene sheeting and securing it with sandbags or an equivalent method to prevent the cover from being dislodged by the wind. Contractors shall repair or replace covers whenever damaged or dislodged.
- Reduce the amount of time that excavated material if exposed to the open atmosphere.
- Chemically treating excavated areas and stockpiled material. This method shall be used only when other methods are impractical.
- Maintain the construction site free of trash, garbage and debris.
- Fully cover and secure haul truck cargos during material transport.
- Cleaning-up and properly disposing excavated material that is deemed odorous. If odorous material is located on public roadways or walkways, clean-up methods shall consist of wet spray sweeping or vacuuming only.

b. Diesel Emission

- Turn-off diesel combustion engines on construction equipment not in use and on trucks that are idling while waiting to load or unload material.
- Establish a staging zone for trucks that are waiting to load or unload material at the contract area, in a location where the diesel emission from the trucks will be noticeable to the public.
- Locating combusting engines away from sensitive receptors such as fresh air intakes, air conditioners and windows.

- In addition to the above diesel emission control measures, all off-road diesel powered equipment used for this contract shall contain oxidation catalyst emission control equipment on the exhaust system side of the equipment.

c. General Management

- Ensure odor sources are adequately enclosed and that equipment is accessible for cleaning.
- Have a regime of good housekeeping of hygiene facilities, waste management and materials storage areas.
- Incorporate and monitor process operating conditions to minimize odor and monitor parameters that are important for good performance.
- Implement a preventive maintenance program to minimize equipment failure and unplanned downtime.
- Educate staff about the importance of regulatory compliance and good management for achieving compliance.
- Conduct odorous operations during weather conditions that are most favorable for dispersion where no other mitigation option is available (e.g., avoid early morning and evenings, consider wind direction in relation to sensitive areas, avoid hot humid weather).
- Remove waste from construction sites frequently to prevent odor generation.
- Locate sewage / septic tanks on a regular basis.
- Store and ventilate fuels and hazardous materials appropriately.
- Undertake effective and rapid dewatering and ventilation of excavations with groundwater generating hydrogen sulfide and other odorous gases.
- Implement effective ventilation and management of compost heaps.
- Implement correct sighting and storage of fertilizer and administer fertilizers appropriately to landscaped areas – with community notification, as appropriate.
- Monitoring exhaust emissions and maintain equipment as required.

3.0 Noise

Community response to noise and vibration is subjective and variable. Noise and vibration that is considered acceptable by a neighbor one day may provoke complaints the next. Similarly, the noise and vibration that may be tolerated by one neighbor may be a source of complaint for another.

3.1 Sources of Noise

On construction worksites there are many different noise sources and these sources exhibit many differing types of noise such as background noise, idling noise, blast noise, impact noise, rotating noise, intermittent noise, howling, screeches and squeals that need to be controlled.

The generation of noise and vibration is associated with the use of assets and the carrying out of activities. Assets and activities include construction and maintenance, and the operation of fixed and mobile plant and equipment, transformers, utility compressors and pumps, and ventilation and air conditioning.

3.2 Noise Control and Management Techniques

Every construction project is different and constantly changing. Therefore, noise control solutions have to be tailored for the situation. Fortunately, there are a variety of ways by which construction equipment and worksite noise can be controlled. The following is a list of ways to control noise level in worksites.

a. Quieter Equipment

A cost-effective way to reduce noise at construction worksite is to buy quiet equipment. When buying equipment, always ask if there is a quieter way of doing the job. All things being equal, most contractors would choose quieter machine or process. Quieter machines or processes can cost more. Manufacturing tolerance are tighter, gears mesh better, quieter cooling fans are used, etc. because of this, when contractors buy quieter equipment the final determination often depends on whether the noise reduction justifies the extra expense.

In addition, equipment in use should be the most suitable for the job. Avoid using equipment that is over-powered and, conversely, avoid using under powered equipment. Whenever possible the quietest equipment alternative should be used. In general, electronic powdered equipment is quieter than diesel powered equipment and hydraulically powered equipment is quieter than pneumatic power. Below are examples of ways quieter construction equipment can be introduced into the worksite to reduce noise levels.

- Buying quiet saw blades. Choose a saw blade with the greatest number of teeth, of the smallest width. Choose a saw blade with gullets as small as possible and with built-in vibration dampening.

- Compressors and generators rank second behind trucks of all onsite construction equipment in terms of daily sound energy produced. Newer heavy duty diesel generators are designed to emit low noise and vibration. Some units are up to 15dB (A) quieter than older diesel-powered generators and quieter than most gasoline sets. The units are totally enclosed and damped, including cooling, exhaust and intake systems.

- Built-in solutions: improved intake/muffler system, suitable enclosure with damping cladding and improved cooling fan.

b. Modifying Existing Old Equipment

The most common way to reduce the noise levels of construction equipment is through worksite modifications. Some common worksite modifications consist of retrofitting existing equipment with damping materials and mufflers. Below are examples of ways common construction equipment and worksites can be modified to reduce noise levels.

Modifying front end loaders, pneumatic nail gun and excavator.

c. Barrier Protection

An effective way of reducing noise is to locate noisy equipment behind purpose built barriers. The barriers can be constructed on the work site from common construction building material (plywood, block, stacks or spoils) or the barriers can be constructed from commercial panels which are lined with sound absorbing material to achieve the maximum shielding effect possible. To be effective, the length of the barrier should be greater than its height. The noise source should not be visible and barrier should be located as close as possible to either the noise source or the receiver.

The distance between a noise source and noise receiver can be considered a barrier as well. Doubling the distance from the noise source lowers the noise level by 6 dB.

d. Work Activity Scheduling

Work activity scheduling are administrative means to control noise exposure. Planning how noise sources are sited and organized on a work site can reduce noise hazards. Whenever possible, stationary sources like generators and compressors should be positioned as far as possible from noise sensitive receivers (workers, schools, residential buildings). When possible, stacks, spoils and other construction material can be placed or stored around noise sources to reduce the hazard to

receivers. Advantage should be taken of the screening effect any nearby object, such as cooling tanks, trailers or temporary site offices.

Jobs can be rotated so that exposure time is limited. Transferring workers from a high exposure task to a lower exposure task could make the employee's daily noise exposure acceptable. Administrative controls include activity planning, for example, scheduling pavement breaking operations so as to reduce the number of work site workers exposed. In addition, noisy equipment should not be run for periods longer than necessary and should be switched off when not in use.

e. Maintenance

Increased attention to maintenance of tools and equipment will reduce worksite noise levels. Maintaining your plant and equipment in good order not only increases its life, but makes it safer to use and quieter. In many cases, a noise hazard will be created or made worse by a lack of maintenance. Parts may become loose, creating more noise because of improper operation or scraping against other parts. Grinding noises may also occur as the result of inadequate lubrication. It is especially important to provide proper maintenance of noise control devices which are added or built into machinery. Loose and worn parts should be fixed as soon as possible.

Always check and see if there are any problems starting to appear with a machine or equipment. Check for signs of wear of if the machine's performance is down. Some problems will appear as looseness or increased vibration. Listen for new noises, especially tonal ("whining") sounds, repeated impacts, or high frequency ("screech") sounds. Also, slipping belts will cause a screech at start-up, while a damage bearing may appear as a clunk during run-down.

Ideally, the worksite should have a system in place for checking and servicing the various machines and power tools. Below are examples of ways maintenance and servicing can make equipment safer and quiet.

Why machines get noisier with use?

- Worn or chipped gear teeth – will not mesh properly. The shiny wear marks are often visible on the teeth.
- Worn bearings – bearing wear creates vibration and noise, as flat spots or cracks appear in the balls.
- Slackness between worn or loose parts – causes rattling noises, squealing from slack drive belts, "piston slap" in motors, air leaks, etc.

- Poor lubrication – causes squeaking noises due to friction or impact noise in dry and worn gears or bearings.

- Imbalance in rotating parts – imbalances with fan impellers or motor shaft will show up as excess vibration.

- Obstruction in airways – a build-up of dirt or a bent/damaged piece of metal in an airway or near a moving part, e.g., a bent fan guard, can cause whistling or other "air" type noises.

- Blunt blades or cutting faces – blunt or chipped saw teeth, drill bits, router bits, etc. usually make the job noisier as well as slower.

- Damaged silencers – silencers for air-driven machines or mufflers for engines may become clogged with dirt, rusted our or damaged, so losing their ability to absorb noise.

- Removal of a noise-reducing attachment – mufflers, silencers, covers, guards, vibration isolators, etc. which reduce noise should never be removed except during maintenance, and then must be replaced.

f. Noise Perimeter Zones

Noise perimeter zones (NPZ) are another administrative control to limit exposure to noisy processes or equipment to as few workers as possible. NPZ can be set up using a sound level meter to find the safe distance from the source and the NPZ can be set up at that distance. Noise does not radiate from the source at the same level in all directions. Noise from machinery can be higher in one direction than another because the noise can also be either absorbed or reflected from surfaces it contacts, such as the ground or a wall. Therefore, measurements should be taken at several points in an area where people might be working. Rope off the area as the Noise Perimeter Zone within the acceptable noise levels. Exclude all workers who do not need to be in that zone. All workers who need to work within the zone must wear hearing protection. The area can be marked "Noisy Area – Hearing Protection Required" in the same way that a "Hard Hat Area" is marked off. Of course, the entire site can be inside a noise perimeter zone. Then everyone on site must wear hearing protection.

4.0 Vibration

Vibration refers to mechanical oscillations about and equilibrium point. The oscillations may be periodic. More often, vibration is undesirable, wasting energy and creating unwanted sound – noise. Such vibrations can be caused by imbalances in the rotating parts, uneven friction, the meshing of gear teeth, etc. careful designs usually minimize unwanted vibrations.

Construction often generates community vibration complaints despite the limited time frame over which it takes place. Construction activity can result in varying degrees of ground vibration, depending on the equipment and methods employed. Operation of construction equipment causes ground vibrations which spread through the ground and diminish in strength with distance. Buildings founded on the soil in the vicinity of the construction site respond to these vibrations, with varying results ranging from no perceptible effects at the lowest levels, low rumbling sounds and feelable vibrations at moderate levels and slight damage at the highest levels.

4.1 Sources of Vibration

Various types of construction equipment have been measured under a wide variety of construction activities with an average of source levels reported in terms of velocity levels. Although the table gives one level for each piece of equipment, it should be noted that there is a considerable variation in reported ground vibration levels from construction activities. The data provide a reasonable estimate for a wide range of soil conditions.

Vibration Source Levels for Construction Equipment			
Equipment		**PPV at 25 ft (in / sec)**	**Approximate L_v at 25 ft**
Pile Driver (impact)	Upper range	1.518	112
	Typical	0.644	104
Pile Driver (sonic)	Upper range	0.734	105
	Typical	0.170	93
Clam shovel drop (slurry wall)		0.202	94
Hydromill (slurry wall)	In soil	0.008	66
	In rock	0.017	75
Large bulldozer		0.089	87
Caisson drilling		0.089	87
Loaded trucks		0.076	86
Jackhammer		0.035	79
Small bulldozer		0.003	58

4.2 Vibration Control and Management Techniques

Mitigation of construction vibration requires consideration of equipment location and processes, as follows:

a. Design Considerations and Project Layout

- Route heavily loaded trucks away from residential streets, if possible. Select streets with fewest homes, if no alternatives are available.

- Operate earthmoving equipment on the construction lot as far away from vibration-sensitive sites as possible.

b. Sequence of Operations

- Phase demolition, earthmoving and ground-impacting operation so as not to occur in the same time period. Unlike noise, the total vibration level produced could be significantly less when each vibration source operates separately.

- Avoid nighttime activities. People are more aware of vibration in their homes during the nighttime hours.

c. Alternative Construction Methods

- Avoid impact pile driving where possible in vibration-sensitive areas. Drilled piles or the use of a sonic or vibratory pile driver causes lower vibration levels where the geological conditions permit their use.

- Select demolition methods not involving impact, where possible. For example, sawing bridge decks into sections that can be loaded onto trucks results in lower vibration levels than impact demolition by pavement breakers, and milling generates lower vibration levels than excavation using clam shell or chisel drops.

- Avoid vibratory rollers and packers near sensitive areas.

Pile driving is potentially the greatest source of vibration associated with equipment used during construction of a project. However, there are some additional vibration effects of sonic pile drivers that may limit their use in sensitive locations. A sonic pile driver operates by continuously shaking the pile at a fixed frequency, literally vibrating it into the ground. Vibratory pile drivers operate on the same principle, but at a different frequency. However, continuous operation at a fixed frequency may be more noticeable to nearby residents, even at lower vibration levels.

5.0 Construction Waste

Construction waste is anything generated as a result of construction and then abandoned, regardless of whether it has been processed or stockpiled. It comprises of surplus materials

from site clearance, excavation, construction, refurbishment, renovation, demolition and road works. There are two types of construction waste: inert construction waste and non-inert construction waste. Non-inert construction waste is around 20% of the total and usually comprises bamboo, timber, vegetation, packaging waste and other organic materials. Some of these can be recycled while others are disposed of at landfills. In contrast, inert waste – otherwise known as public fill – mainly includes construction debris, rubble, earth, bitumen and concrete, which can be used for land formation. Materials like concrete and asphalt can also be recovered for construction use.

Construction waste is a complex waste stream, made up of a wide variety of materials including concrete, plasterboard, wood, steel, brick and glass. Much construction waste can be reduced, reused and recovered dramatically reducing the amount thrown away.

5.1 Benefits of Construction Waste Management

Recycling and reuse have long been associated with wise construction practices. Experienced contractors are now reaping the economic advantages of Construction Waste Management. Communities are also seeing the side benefits.

a. Trim Costs

Recycling, reusing, and salvaging construction waste can save money. Many of the contractors that have embraced Construction Waste Management have made changes to their operations and practices to take advantage of reduced waste disposal costs and revenues derived from recycle, reuse and salvage materials. Utilizing reuse and salvage methods on site reduce the need for new materials, reduces materials that end up in the landfill, creates a cleaner and safer project site, and improves community relations.

b. Establish a Market Advantage

A company's experience in waste prevention and recycling is a valuable marketing tool for bidding on projects in response to customer interest in Construction Waste Management. Efforts to prevent waste, to recycle, and to use recycled-content materials on a project can help the project team earn points towards qualifying for LEED and other local and national programs.

c. Create Environmental Benefits

Environmental benefits also result from recycling and waste prevention programs. In the long run, preventing waste reduces dependence on natural resources such as trees, oil, and minerals plus creates less pollution by reducing manufacturing and transportation related emissions. Reduction of the energy and water required to

produce building supplies from virgin materials contributes to reduced greenhouse gasses related to the manufacturing and transportation of those materials.

d. Help the Economy

Recycling and reuse of construction waste can also help the economy through the creation of jobs related to salvaging and recycling of construction waste. New products create jobs through the manufacture of recycled content materials.

5.2 Waste Prevention

The following considerations can minimize waste impacts on any size of the project. From the broad influences of design to the specific methods used on the job site.

a. Design to Prevent Waste

- Design with standard sizes for building materials
- Specify materials and assemblies that can be easily disassembled at the end of their useful life
- Design pre-cast concrete members for concrete construction
- Choose durable non-toxic interior finishes or materials
- Design spaces to be flexible for changing uses
- Consider reusing materials on-site or installing salvaged materials from off-site sources

b. Plan for Waste Prevention

- Target specific waste producing practices for waste prevention
- Include waste prevention measures in a Waste Management Plan
- Communicate your waste management plan at meetings and promote the result

c. Use Construction Methods that Prevent Waste

- For wood construction, use advanced framing techniques trusses for roof or floor framing, finger-jointed studs and trim, and engineered wood products

- Consider using wood frame wall panels prefabricated off-site

d. Practice Job-Site Waste Prevention Methods

- Set up central cutting areas for wood and other materials
- Reuse concrete forms or choose reusable metal or fiberglass forms
- Clearly mark areas key to waste prevention, such as the material storage, central cutting and recycling stations
- Practice material storage and handling procedures to prevent loss or damage

e. Purchase to Prevent Waste

- Purchase salvaged, recycled or recycled-content materials and equipment
- Check to ensure the correct amount of each material is delivered to site
- Maintain an up-to-date material ordering and delivery schedule to minimize the amount of time that materials are on-site and reduce the chance of damage
- Replace toxic materials with less toxic or non-toxic products to reduce hazardous packaging
- Choose products with minimal or no packaging
- Ask suppliers to deliver supplies using sturdy, returnable pallets and containers. Have supplier pick up pallets and empty containers
- Require suppliers to take back or buy-back substandard, reject or unused items

5.3 Salvage, Reuse and Recycle

There are many methods used to reduce waste and increase profits through salvage, reuse, and the recycling of construction waste. In the industry, salvage and reuse are terms that are often used interchangeably. For the purpose of this Guide, the term “reuse” denotes the materials that remain on the construction site to be used in their original form or converted to another use. Salvage, typically in its original form, is items that are removed from the site.

a. Survey the site before demolition or deconstruction

- Identify salvage and reuse items
- Identify recyclable materials
- Identify hazardous materials for special handling

b. Develop a Construction Waste Management

- List items being reused on-site
- List items for salvage, both resale and donation
- Plan for protecting, dismantling, handling, storing, and transporting items
- Schedule for the removal of salvage and recycle materials
- Consider using deconstruction

c. Identify reusable or salvageable items

- Identify material that can be removed and separated without undue damage
- Identify material of unique or antique feature that would make it worth saving
- Identify material with high resale value such as old true divided windows
- Identify material new enough to be reused easily
- Discuss reuse ideas and the project timeline with the owner and the designer
- Discuss reuse ideas with building departments if there are structural applications

d. Detect salvage removal alternatives

- Train your own or hire a deconstruction crew
- Contact a salvage company to come on-site to remove valuable materials
- Take materials to a salvage center in the area
- List the items in a materials exchange or advertise in the newspaper
- Conduct a “yard sale” at edge of the job-site to sell salvaged items
- Allow workers to remove salvageable items for their own use

- Ask subcontractors to reuse or recycle their materials

e. Plan for recyclable materials

- Investigate removal and separation techniques
- Select material with high resale value such as copper wire and HVAC coils
- Plan for collection procedures and allocate space on site

f. Consider other project costs and savings

- Compare the costs of reusing materials and salvaged items to purchasing new
- Compare costs to reuse materials and salvaged items (transportation, reconfiguration of equipment, storage, etc.) on-site
- What is the functional or aesthetic value of having reused material on-site?
- What are the marketing and public relations benefits to reuse and salvage?

g. Identify hazardous waste considerations

- Some building materials may be contaminated with hazardous materials
- Hazardous products include lead paint, asbestos, fluorescent lamps and PCB ballast, Freon, and Halon
- Special attention must be taken when handling hazardous wastes
- Qualified professionals may be needed for proper handling and disposal
- Hazardous materials must be disposed of at a hazardous waste facility or recycled
- Some materials can be recaptured. Freon and Halon have a market value for reuse

5.4 Design a Waste Management Plan

Successful and profitable job-site recycling begins with a Waste Management Plan.

a. Make a Waste Management Plan

- Identify materials to be salvaged, reused, recycled, and disposed of including materials subcontractors will be responsible for
- Outline procedures, expectations, and results for monitoring, collecting and promoting waste management planning
- Designate a coordinator responsible for implementing the plan
- Set waste management goals, such as "Reuse or recycle 75% of project wastes"
- Define types of wastes
- Estimate the amounts
- Indicate the disposal method for each material reused in place, reused on-site, salvaged, recycled, or landfilled
- Include handling procedures for removal, separation, storage, and/or transportation
- Communicate the plan to all crew members
- Document waste management requirements on project documents, including subcontracts and specifications
- Communicate the results

b. Decide which materials to recycle

- Determine potential recyclable materials and the recycling method
- Select what to recycle
- Determine cost and revenues for recycling different construction wastes (source separated and co-mingled)
- Determine costs for disposing of wastes
- Calculate potential costs and savings for recycling on a project
- Identify, based on calculations, the materials to be recycled most cost-effectively

5.5 Put the Waste Management Plan into Action

A well developed Construction Waste Management Plan combines good communication with attention to details. This will ensure success, maximize the benefits and provide a marketing edge.

a. Educate everyone about the waste management program

- Share the formalized plan with everyone involved in the project administration
- Discuss waste handling requirements with crew and subcontractors
- Share procedures for checking bin status and the system for notifying haulers for extra containers or pick-ups
- Post easy to read signs with written information about the recycling program
- Continue education by making recycling updates part of your safety program
- Clearly label the recycling drop boxes. Post lists of what is and what is not recyclable and use pictures for quick identification

b. Find the space

- Place garbage bins and recycling drop boxes close to the point of waste generation, but out of the traffic pattern
- Choose smaller containers and more frequent collection. There are a variety of container sizes and service options available from recycling services or haulers
- Use smaller containers to dump into large containers at the end of the day
- Ask recycling service providers about containers with multiple compartments to minimize the number of containers on site
- Rent a trailer for the major recyclable material generated in the first phase of construction and haul directly to the recycler
- If self-hauling, build custom containers to fit the space requirements using scrap or damaged plywood, concrete forms, or barrier fencing
- Use trash cans to collect recyclables generated in smaller amounts

c. Make it convenient

- Place the recycling dumpsters as close to the work as possible
- Always provide a container for trash near the recycling containers

- Consider co-mingling small quantities of wood, cardboard, and metals to make one larger load of recyclables
- Provide maps of the job-site to haulers for dumpster placement and pickup

d. Promote and Educate

- Treat waste management like a safety program. Integrate recycle training into the safety education, or design a separate recycling education program
- Create a name or slogan for the recycling program
- Provide incentives to make the plan work
- Use signage and simple clear instructions to communicate
- Be positive! When the crew and subcontractors are motivated and understand the goals, they will figure out creative ways to work efficiently
- Include everyone in the process. Encourage suggestions on more efficient methods, or additional materials that can be recycled

e. Prevent contamination

- Clearly label the recycling bins. Post lists with pictures of what is recyclable
- Provide trash bins to collect non-recyclable items. Have them emptied regularly so the overflow does not end up in the recycling bin
- Conduct regular site visits to verify that bins are not contaminated
- Consider bins with lids or locating bins in a locked or supervised area to discourage contamination
- Dump out contaminated loads and have the subcontractors and/or crew pull out the contaminants themselves
- Regularly check the wastes in the garbage dumpsters for recyclables
- Call the recycler before drop boxes are full to arrange for pick-up

6.0 Demolition Waste

Demolition activities, including renovation/remodeling works and complete or selective removal/demolishing of existing structures either by man made process or by natural disasters, create an extensive amount of wastes. In developing countries, it is estimated that demolition wastes comprise 20% to 30% of the total annual solid wastes.

Demolition wastes are heterogeneous mixtures of building materials such as aggregate, concrete, wood, paper, metal, insulation, glass that are usually contaminated with paints, fasteners, adhesives, wall coverings, insulation materials and dirt. The composition and quantities of demolition wastes depend on the type of structure being demolished, the types of building materials used, and the age of structure being demolished. The most common types of wastes generated from demolition activities are wood, rubble, aggregates, ceramics, metals and paper products. Although there is no typical percentage of each waste stream generated from demolition activities, the quantity of demolition wastes resulting from industrial structures is estimated to be 1.5 to 2.0 ton/m^2 of the total demolished area. In general, demolition wastes are estimated t be from 1.0 to 2.0 ton/m^2 of the total ground level area.

This demolition wastes section consists of five main sections: reduce, reuse, recycle and recover, and disposal. Each section exhibits strategies and roles for each member of the project tem to mitigate the generated demolition waste.

6.1 Reduce technique

Reduce is a precautionary technique aimed at minimizing the waste generated from the source before it becomes a physical problem. A selective demolition technique instead of complete demolition/removal of structure whenever possible is being recommended. In this case, some of the installations such as walls and ceilings can be retained while the interior systems of the structure can be renovated.

The demolition contractor should prepare a demolition plan. The plan should include a summary/brief of the following:

- An estimated time frame to fulfill the goals of the waste management plan
- The sequences of carrying out demolition works, such as demolition, segregation, loading, hauling, crushing, consolidation and then stockpiling materials on site.
- A survey of the building materials that could be reused, recycled and recovered throughout the project – by type and quantity.
- The quantities of disposed materials.

- The quantities of each waste stream generated by the project. The quantities could be estimated based on either data compiled from previous projects or from experience with similar types of projects.

- Identification of any hazardous materials and means of proper disposal.

- The on-site separation/sorting strategies to segregate recyclables from other waste materials.

- A list of all on-site recycling techniques.

The contractor should plan the demolition sequence in advance generating the least amount of wastes while maximizing reduce, reuse and recover endeavors.

6.2 Reuse Technique

The reuse technique is defined as re-employment of materials to be reused in the same application or be used in lower grade applications.

a. Collection Procedures

- Separation/segregation/sorting techniques should be implemented to the waste stream

- Labeled containers for each waste stream

- On-site storage areas to dump the containers should be designated. In order to prolong the waste life and extend the reusable abilities, the storage areas should be: remote enough from the site limit the access to the stored material and hence control its contamination; labeled by large signage to describe the purpose of the area and protected from the weathering conditions such as rain and dust.

b. Waste Management Personnel

A waste management team should be assigned to accomplish the tasks needed for the demolition activity.

c. Work Activities

- The sequence of demolition activity shall start by removing any valuable materials such as doors. Windows, hardwoods or flooring prior to demolition activity than can be reused, recovered or salvaged. Afterwards, the building

interior should be demolished manually, followed by demolition of the core of the structure using heavy equipment. Then excavators could be used to sort and compact recyclable and salvaged materials on site.

- Salvaged/recovered materials could be used in same or in other applications. Such materials include: wood, earth works, plastics, vinyl, foam, steel, concrete, masonry (e.g., blocks and bricks), tiles (e.g., ceramics, marble and granite), plasterboard, insulation materials, paints, solvents and carpets.

- A secured and safe storage area for recovered and salvaged wastes to avoid any loss or damage that may occur to these materials should be designated.

d. Documentation

- All waste management procedures documents should be recorded and controlled.

- Registry data should be updated periodically in order to prove or disprove the adequacy of the selected management techniques during the project execution phase.

- Costs or profits associated with various waste management methods should be tracked

- Develop learning curves to update the laborers' abilities in implementing waste management techniques

- Document all methods and techniques of mitigating the waste, quantities and types of generated wastes experiences through the completion of project

6.3 Recycle Technique

The recycle technique is defined as utilizing wastes as raw materials in other applications.

- Recycle wastes that cannot be reduced nor reused. Metals such as steel, copper and aluminum can be sold to factories in order to be recycled in producing new metals.

- Assure that the recycled materials such as recycled concrete or asphalt materials are uniform in quality, of adequate grading and free from any contamination

- Crush all materials on site such as bricks, concrete, stone and marble in order to maximize their reuse as recycled aggregates and fill materials

- Stockpile all crushed materials in separate and secured designated storage area to avoid contamination or deterioration by weathering

6.4 Recover Technique

The recover technique is a process of generating energy from waste materials that can not be reduced, reused or recycled. Recover techniques can be exhibited during the execution phase. Various waste recovery techniques such as briquetting, incinerating, pyrolysis, gasification and biodigestion.

6.5 Disposal Technique

The last category in the waste management hierarchy is disposal. Disposing of waste should be carried out in controlled landfills to prevent any contamination to water and soil. Therefore, there is a practical need to select, design, construct and operate the landfill sites with a proper environmental management system in order to protect the environment during the whole lifespan of the landfill.

7.0 Dewatering

Dewatering is the removal of water from solid material or soil by wet classification, centrifugation, filtration or similar solid-liquid separation processes. Removing or draining water from a riverbed, construction site, caisson or mine shaft by pumping or evaporation. This is often done during the site development phase of a major construction project due to a high water table. Usually involves the use of dewatering pumps. Methods of dewatering include: Well Point, Deep Well and Eductor systems.

For more details of specific dewatering guidelines, refer to the relevant EG.