

Sustainable Operations & Maintenance Policies for Victor Valley Transit Authority

Hesperia, CA

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INTRODUCTION

Victor Valley Transit Authority decided to make the VVTA Administration, Operations and Maintenance Facility buildings sustainable by using the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) green building rating program which focuses on sustainable design and construction practices. These policies were developed to ensure that after the building is constructed, that sustainability continues to be maintained through sustainable operation and maintenance practices. They were developed through review of LEED Existing Building policies for applicability to the facilities, as well as, incorporation of sustainable policies that VVTA has in place for their facilities. To maintain the Innovation Credit for Sustainable Operations and Maintenance Policies in the LEED rating system, these policies must be used on any future repair and alternation projects, tenant finish, or new construction projects, and on all maintenance and operations practices that takes place in the building.

The intent of this publication is to create a unique set of sustainable practice policies for the VVTA Maintenance and Administration Facility. These policies were developed based on the LEED for Existing Buildings program. If these policies are maintained it may be possible for the Victor Valley Transit Authority to apply for LEED-EB in the future.

Victor Valley Transit Authority shall designate one representative of their staff to track theses policies on an on-going basis and to keep quarterly reports of these and others related to LEED for Existing Buildings to make sure that the sustainable design goals established for the VVTA Maintenance and Administration Facility are being maintained.

GREEN POLICIES

The following Policies are adopted by
Victor Valley Transit Authority on July 15, 2009 [date].

Signature of Head of Organization: _____

Name of Head of Organization: Kevin Kane

Title: General Manager

Low mercury-containing light bulb purchasing policy

Objective:

As part of maintaining a toxic material source reduction program for the VVTA Maintenance and Administration Facility, reduction of the amount of mercury brought into the building will be made by consciously purchasing light bulbs that contain an average mercury content of less than or equal to 80 picograms per lumen hour of light output.

Implementation:

Any changes in bulb purchasing will be documented and changes should never result in average mercury content of over 80 picograms/lumen hour.

Documentation:

Changes in bulb purchasing will be documented in VVTA Maintenance and Administration Facility Policy Manual and quarterly reports will be filled out identifying any problems or areas of improvement.

Sustainable materials purchasing policy

Objective:

The VVTA Maintenance and Administration Facility is committed to using sustainable office supplies, equipment, and building materials.

Implementation:

If price, quality, and performance permit, salvaged, refurbished, or recycled materials will be utilized at the VVTA Maintenance and Administration Facility. The goal is to have at least 10% of total purchases (on a dollar basis) meet the performance criteria of:

- Recycled materials – contains at least 10% post-consumer or 20% post-industrial material. Examples of common recycled materials include: paper, carpet, acoustical ceiling tile, cellulose insulation, and gypboard.
- Rapidly renewable materials – at least 50%. Rapidly renewable materials are those materials that replenish themselves faster than traditional extraction demand. Examples of rapidly renewable materials include: Bamboo flooring, wheatgrass cabinetry, sunflower seed board, poplar OSB, wool carpet, linoleum flooring, and cotton batting insulation.
- Salvaged materials – contains at least 70% salvaged materials from off site or outside the organization
- Salvaged materials – contains at least 70% salvaged materials from an internal materials and equipment reuse program
- Wood products – Forest Stewardship Council certified wood

Location – at least 50% of materials are harvested, processed or extracted and processed within 500 miles of [Project Location].

Documentation:

For all covered materials, the date of purchase, cost or value and the type of material and description of how it does or does not meet the sustainability criteria shall be documented. This documentation will be maintained by the VVTA Maintenance and Administration Facility in the Policy Manual and calculations of total sustainable purchases will be performed using LEED methodology.

Sustainable cleaning products policy

Objective:

Billions of pounds of paper (e.g. toilet tissue and paper hand towels) are used every year in the restrooms. The impacts of the paper consumption and bleaching processes on our forests are substantial. The chemicals involved in bleaching contribute significant amounts of toxic materials, including dioxins into our environment. Thus, the VVTA Maintenance and Administration Facility can make an important contribution to environmental health by utilizing paper containing 100% recycled content, a minimum of 30% post-consumer recycled content and which are manufactured without the additional use of elemental chlorine or chlorine compounds (Processed Chlorine Free).

Implementation:

The following sustainability criteria shall apply for cleaning materials purchases:

Environmentally Preferable Cleaning Products

Purchasing efforts shall standardize on Green Seal Standard GS-37 (Green Seal, 2000). Green Seal completed their Standard in a consensus process, which included product users, cleaning product manufacturers, industry trade associations, janitorial contractors, environmental organizations, and more. Products not covered by GS-37 should meet or be less volatile than the California Code of Regulations maximum allowable VOC levels for the appropriate product category. Cleaning products that meet the Green Seal GS-37 standard, or if GS-37 is not applicable (e.g., for products such as carpet cleaners, floor finishes or strippers), must comply with the California Code of Regulations maximum allowable VOC (volatile organic compound) levels. See www.greenseal.org for specifications and green seal products.

Janitorial Supplies

Disposable janitorial paper products and trash bags meet the minimum requirements of U.S. EPA's Comprehensive Procurement Guidelines. The VVTA Maintenance and Administration Facility or janitorial contractor will ensure the usage of sustainable cleaning materials in the VVTA Maintenance and Administration Facility at all times. The goal is to have at least 90% of total purchases (on a dollar basis) meet the above sustainability criteria.

Documentation:

To keep track and ensure the sustainable cleaning materials policy is being followed, the VVTA Maintenance and Administration Facility or janitorial contractor will inventory and report quarterly on the cleaning materials used in and around the building. Any changes in materials will be documented and problems or opportunities for improvement identified. Strategies for improvement will be discussed within the team and acted upon accordingly. Materials documentation – including date of purchase, type of material, description of how it meets sustainability criteria, and the cost or value - will be documented on a regular basis by the VVTA Maintenance and Administration Facility or janitorial contractor. The calculation will be performed using LEED methodology.

Construction IAQ management policy

Objective:

The VVTA Maintenance and Administration Facility is committed to preventing indoor air quality problems resulting from any construction or renovation project to help maintain the comfort and well being of construction workers and building occupants.

Implementation:

For any construction or renovation project this Construction IAQ Management Policy shall be included in the specifications of the project. Each project shall:

- During construction, meet or exceed the recommended Design Approaches of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guideline for Occupied Buildings Under Construction, 1995, Chapter 3.
 - Protect absorptive materials from moisture damage while being stored on-site and after installation.
 - Use a filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 at each return air grill of air handlers used during construction. MERV is determined in ASHRAE 52.2-1999.
 - Replace all filtration media immediately prior to occupancy.
 - Remove contaminants that may be remaining at the end of the construction period either by
 - Conducting a minimum two-week building flush out with new filtration media with 100% outside air after construction ends and prior to occupancy of the affected space. After the flush out, replace the filtration media with new except for filters solely processing outside air.
- OR
- Conducting a baseline indoor air quality testing procedure after construction ends for the affected space in the building that demonstrates that the concentration levels are below specified levels. The testing procedure and maximum concentration levels shall follow LEED-EB methodology. For each sampling point where the maximum concentration limits are exceeded, conduct a partial building flush out for a minimum of two weeks, then retest the specific parameter(s) that were exceeded to indicate the requirements are achieved. This procedure shall be repeated until all requirements have been met.

Example IAQ Plan (courtesy of Hines Construction)

The VVTA Maintenance and Administration Facility considers factors of IAQ that may be affected during building construction, remodeling, or renovation, which include but are not limited to:

- The selection of building materials and interior finishes that have reduced chemical emissions
- Area isolation and ventilation during interior construction, remodeling or renovation of occupied buildings
- The time allowance for off gassing from construction materials and furnishing to be flushed out of the building.
- Provisions of the HVAC system, including sufficient air volume distribution to the occupants, adequate outside air delivered to the occupant, ease of air system balance, and adequate start-up commissioning with follow-up documentation and verifications.
- Benefits of informing the occupants of steps taken to provide acceptable IAQ to promote a positive attitude about their new or remodeled environment.

- Pre-bid construction documentation to provide a commitment by the contractor within the bidded scope work.
- A budget to support the program. The development of a cost and implementation plan that is appropriate for the property and the circumstances.
- Be sure the products actually used in the building are those submitted to the architect and approved by the contractor, and for which VOC compliance certification test results were provided.
- Review the general contractor's schedule for timing of construction activities so heavily polluting activities, typically "wet" material applications, i.e. painting, will occur before absorbent materials, carpet, and furniture are installed.
- The selected IAQ ventilation procedure should be followed as closely as practically possible so that the bulk of emissions are removed before exposing the occupants to off gassing.
- Review the operating procedures with the contractor so that the contractor to determine that the IAQ procedures were followed can easily keep records.
- Require the contractor to produce complete set of records as a condition to substantial completion.

Reporting:

Each construction project shall develop a Construction IAQ plan and document how this plan was followed. This documentation shall be maintained by the VVTA Maintenance and Administration Facility.

Low environmental impact pest management policy

Objective:

The VVTA Maintenance and Administration Facility is committed to a low environmental impact pest management policy.

Implementation:

VVTA Maintenance and Administration Facility Staff/contractors shall:

- Utilize sustainable cleaning products and materials – if possible, these materials shall meet Green Seal GS-37 standards.
- Promote safer alternatives to chemical pesticides while preventing economic and health damage caused by pests.
- Ensure that clear and accurate notification concerning the use of pesticides, when necessary, be made available so that measures may be taken to prevent and address pest problems effectively without endangering occupants, janitorial workers or visitors.
- Utilize a communication strategy that provides notification of the integrated pest management system. The communication strategy should include information and notice to staff or directly to occupants in an owner-occupied building; a description of the integrated pest management system and a list of all pesticides, including any least toxic pesticide that may be used in the building as part of the integrated pest management system; the name, address, and telephone number of the contact person of the building; and a statement that the contact person maintains the product label and material safety data sheet (MSDS) of each pesticide used by the building, that the label or MSDS is available for review upon request, and that the contact person is available for information and comment. • The communications strategy should also address “Universal Notification,” which requires notification not less than 72 hours before a pesticide, other than a least toxic pesticide, is applied in a building or on surrounding grounds that the building maintains and address under what circumstances an emergency application of pesticides in a building or on surrounding grounds being maintained by the building can be conducted without complying with the earlier provisions. In addition, address notification strategies to ensure that occupants and janitorial workers are notified 24 hours in advance of the pesticide application.

INTEGRATED PEST MANAGEMENT – EXAMPLE (courtesy of Hines Construction)

Pest Services

To eliminate existing infestations and prevent future infestations of cockroaches, ants, silverfish, pillbugs, spiders, rats and mice in an orderly fashion. To control occasional invaders during the course of normally scheduled service.

Ectoparasites (i.e. fleas, ticks, mites, etc.), flying insects and wood destroying insects are included as a standard part of this agreement.

- Ants

Ants are the most common invading pests. The concern of biting ants must have prompt responses.

Proactive service for ants if a problem is identified will be made on a quarterly basis by applying a bait product to the exterior of structures. These applications will be made by determining when the buildings are shut down for holidays or summer breaks. Research on pesticide products is constantly being improved and the specific product to be used will be determined by the IPM Coordinator.

Ants reported in a facility will be reported on a Tracking Form and responded to by a day porter.

1. The day porter will try to determine where the ants are foraging and remove anything that may be attracting them (foods, etc.)
2. Vacuum all found ants and determine where they are entering the building.
3. Using caulk, seal the spot or area they are entering from.
4. Determine if there is a mound on the exterior nearest the location where the ants were sighted.
5. Follow up that all required written entries are made to the Tracking Form.
6. Contact the approved pest applicator to service the exterior mound if determined to be needed.

- Rodents

There are three main types of rodents that are a concern. These are the Norway rat, roof rat and the house mouse. Each has specific characteristics and habits, which could cause problems including the destruction of property health issues. Only approved monitoring and basis, or catch devices will be used for control. The IPM Coordinator must approve any infestations beyond the written guidelines.

1. **Norway rats**
These are best-controlled and monitored using tamper resistant bait stations. Stations will be placed only where evidence of Norway rats are found. This may require continued placement because of exterior environmental conditions or temporary until a specific problem is removed. Stations will be monitored and serviced on a monthly basis with written notes made on condition and findings. The IPM Coordinator must first approve any other control methods. All sightings must be recorded on a Tracking Form.
2. **Roof rats**
This rodent usually enters structures from openings high up. These openings need to be closed as identified by inspection. This usually requires some sort of mechanical alteration. This could include trimming trees and shrubs, or placing hardware cloth over holes. When this rodent is identified the proper placements of a catch device either snap, glue board, or live is the best solution. Many times this pest is only identified by its droppings. A licensed technician should only make placement of catch devices. All sighting of droppings or rodents need to be recorded on a Tracking Form.
3. **House mouse**
This rodent could enter a structure from an outside opening as small as a dime or be brought into a structure with deliveries. Usually control is not monitored or needed until a sighting or droppings are found. If either sighting is made, a tracking form is to be completed paying particular attention to removing unauthorized food from a location. If continued sightings are found, snap, glue or live traps are to be placed to best remove the mouse. This is only to be placed by a licensed technician.

- Spiders

This pest is often the most feared because of erroneous information concerning health risks. There are two main spiders that are of concern. These are the Black Widow and the Brown recluse. May times rashes or bites from other insects are blamed on spiders.

The best control of spiders is the removal of their food source, which are insects. Additionally, may indoor spider issues will be removed with proper vacuuming paying particular attention to cracks, crevices and corners where webs are made.

1. Spider sightings are to be recorded on a Tracking Form.
2. The day porter is to respond by vacuuming or removing the individual spider.
3. Inspection is to be made on entry points for spiders or insects, such as broken screens or cracks, which can be repaired or caulked.
4. Pesticides should not be used to control spiders.

- Flying Insects

Any reported flying insects are to be reported and recorded on a Tracking Form.

1. The day porter is to respond and attempt to control with a fly swatter if possible.
2. Inspect and determine if they are entering from the outside and if a mechanical change can be made (repairing screens, weather stripping or caulking).
3. If the insect is not easily identified, collect a specimen for identification by a trained technician.
4. Pesticide applications will only be made when a completed tracking report is provided and based on the identification of the specific pest using non-pesticide applications whenever possible.

Possible flying insects could be houseflies, gnats, drain flies, termites, wasps or bees to name a few.

Inspect / Treat storage closets and telephone junction areas in order to avoid infestations that could either build to an overflow into common areas or simply be a breeding ground for “hitchhiking pests” ready to disturb staff.

Inspect / Treat mechanical room(s) to avoid allowing pests entry to mainstream building areas via pipe chases, conduit, etc. which inevitably causes staff frustration that result in complains to the management office.

Inspect /Treat custodial closets, mop sin rooms, etc. to lessen the odds of pests bothering adjacent staff and equally import keeps building housekeeping personnel from being frightened by their presence as they start to work.

Inspect / Treat all building entry / exit points in order to repel invasion that cause staff anxiety which many times result in negative conversations that at minimum reflect badly on building management’s reputation.

APPENDIX A

Green Garage

Reduction, Recycling, Re-Use

Background/Benefits

As was touched on in the procurement section, a green strategy that creates a culture of reduction, recycling (in use and purchasing), and re-use provides value that are significant. Reducing, reusing and recycling the materials you use reduces the amount of waste, pollution, and even the greenhouse gasses your garage operations generates.

For example, making equipment from recycled metals, plastics and other materials saves at least 2 lbs. of greenhouse gas per 1 lbs. of product. Using recycled paper saves trees. Every 100 reams of recycled paper that is printed double-sided saves two trees, more than a ton of greenhouse gas and almost 35 cubic feet of landfill space compared to 100 reams of paper that is not recycled or printed double-sided.

Likewise, it helps to “close the loop” on waste, feeding materials such as glass, aluminum, and paper back into production processes rather than sending them to the landfill. True recycling means using the material to make a product of equal or higher value than the original product, as opposed to “down cycling” where the material is used in a lesser value product which reduces the value of the resource. Using rubber from waste tires to make high-grade flooring is one example. Burning them for energy is down cycling.

Waste reduction and recycling are actions that, although performed in the individual shop operation, can and will have immediate and measurable impacts, both locally and in the environment as a whole. Specifically, benefits are achieved through:

- *Saving energy:* Using products [manufactured] from recycled materials generally saves a considerable amount of energy. On average, manufacturing with recycled materials requires 17 times less energy per ton of product than making products using virgin raw materials. Some recycled materials save even more.
- *Conserving natural resources:* Using recycled, rather than virgin, resources reduces the need for mining, drilling, harvesting, logging, and other means of resource extraction that cause environmental damage. It also tends to require far less water and energy in manufacturing.
- *Saving money:* Rather than having to pay for waste removal, some organizations have found that they can profit by selling their recyclable materials or, at the very least, reducing/eliminating waste removal costs.

- *Reducing pollution:* When industries use recycled materials rather than virgin ones, they tend to create fewer harmful emissions to air, water, and soils in their production processes.
- *Reducing the need for more landfills:* By sending fewer materials to landfills, we can reduce our need for more landfill space.
- *Creating jobs:* The recycling industry has created nine times more jobs than the landfill industry.

Waste Reduction Technique for Fleet Management Wastes

- *Solvents*
 - Shops use solvents in a variety of operations, including:
 - Parts cleaning
 - Degreasing
 - Painting
 - Many of these solvents may be classified as hazardous waste, requiring costly treatment and/or disposal.
 - Several pollution prevention strategies can be used to reduce both the toxicity and the quantity of spent solvents requiring disposal:
 - Try to find one multipurpose solvent that can serve a variety of uses, rather than having a different solvent for each operation.
 - This will minimize the number of waste streams and increase the recycling potential of the spent solvent.
 - Replace solvent cleaners with less hazardous substitutes.
 - Consider water-based cleaners or water-soluble cutting fluids.
 - Install a pressure wash system if feasible.
 - Extend the life of solvent baths. Methods include:
 - Pre-cleaning parts with rags before placing them in the bath (then have the rags cleaned for reuse).

- Use old solvent as a pre-soak to remove most of the dirt or grease before introducing the parts into the fresh bath.
- Minimize the amount of cleaning solvent lost during drainage of cleaned parts.
 - Remove parts from the bath slowly to prevent spillage.
 - Install drip trays or racks near the bath for draining cleaned parts; return the drainage to the bath.
- Use on-site recovery techniques to make solvents reusable.
 - Consider leasing or purchasing solvent recovery equipment.
 - Common methods of recovery are:
 - Decanting -- drawing off liquids from the settled sludge. (Alternatively, the bottom sludge may be drained out.)
 - Filtration -- passing solvent through a porous medium to remove the solids.
 - Distillation -- separating liquids from each other by taking advantage of their different boiling points.
 - If the solvents cannot be made reusable, try to find a way to recycle them. One possibility for accomplishing this is to purchase solvents from a company that will pick up and recycle the spent solvent.
- *Oils*
 - Used oil is a valuable resource.
 - Handled improperly, though, it can cause serious environmental problems and result in significant financial liability for the generator of the waste oil.
 - Tips to help avoid such problems:
 - Use drip pans to catch lube oils for reuse.

- Handle oils carefully to avoid spillage.
- Contract with a reputable recycler to collect your used oil.
 - Obtain information about oil recycling from the EPA at www.epa.gov/epaoswer/hazwaste/usedoil/index.htm
- *Other Wastes*
 - Substitute detergent-based solution for caustic cleaning solution.
 - Clean parts mechanically, rather than chemically, whenever possible.
 - Use paints with higher solids content, or water-based paints with no solvent, whenever possible.

Recycling Fleet Management Wastes

- Many of the wastes generated by transportation companies can be recycled.
- It takes a little work to find reliable, reputable recyclers for some materials, but the effort will usually pay off in the long run by reducing the company's disposal costs and future liabilities.
- Materials to be considered for recycling include:
 - Scrap metal -- take to a metal recycler, or arrange for pick-up.
 - Freon -- make sure it is properly handled and recycled.
 - Even small amounts of Freon pose a serious environmental threat because of their tremendous potential for destruction of stratospheric ozone.
 - The Clean Air Act requires the recycling of Freon.
 - Waste antifreeze -- arrange to have it picked up by a recycler or reclaimed on site.
 - Scrap tires -- depending on the shop's location and the number of tires collected, it is cost effective and more environmentally-friendly to contract with a tire re-treader or recycler to take the tires, rather than send them to a landfill.

- Batteries -- for information about handling and recycling used batteries, contact the Battery Council International (800) 658-1200.
- Sludge from drains and sumps -- dewater the sludge and test for hazardous waste characteristics.
 - If the material is found to be non-hazardous, some of its components may be reusable the petroleum components as industrial fuel, and the sand or grit as aggregate in the production of asphalt.

Quick Results (with little or no cost)

- Improving certain inventory control methods and operating procedures can begin to pay off almost immediately in terms of reducing waste and conserving resources.
- Make these practices a part of the normal routine:
 - Keep storage and work areas well organized and as clean as possible.
 - Keep all containers properly labeled.
 - Inspect materials upon delivery, and immediately return unacceptable materials to the supplier.
 - Keep accurate records of materials usage so that you can measure reductions in use.
 - Mark the purchase date on each container and adopt a "first in, first out" policy so that older materials are used up before new ones are opened
 - Assign someone to distribute and keep track of the materials.
 - Locate and repair all leaks to prevent loss of materials.
 - Practice preventive maintenance to avoid future losses.
 - Keep all containers covered to prevent evaporation and spillage.
 - Keep waste streams separate to increase their potential for reuse, recycling, or treatment;

- Don't allow non-hazardous materials, to become contaminated with hazardous materials, as this will result in all of the waste needing to be treated as hazardous waste.
- Install flow meters, flow control devices, and shut-off nozzles to cut down on water usage.

Maintenance offices/support areas

- [For a more detailed description, please see Section 6 of the 'Green Office Advantage' manual.]
- *Paper use:*
 - Offices use nearly 1.5 pounds of paper per person per day. You can cut this number by using less paper, reusing paper where appropriate, and recycling.
 - General practices that help reduce paper use and/or utilize recycling strategies include:
 - Investigate using floppy, zip and compact disks or tape instead of paper filing systems and email and storing the information communicated on floppy, zip and compact disks
 - Optimize electronic communication methods including email, forms and transactions.
 - Reduce the number of printed copies you make by communicating through circulation lists, notice boards.
 - This reduces the financial and environmental costs of paper manufacture and supply, imaging, and transporting hard copy documents by mail or courier.
 - Improving in each of these areas will bring paper cost savings and cut the need for storage space.
 - Paper is bulky to store in boxes or file cabinets. By using fewer sheets, you can put storage space to more productive use.
 - Also, fewer sheets mailed may mean reduced postage.

- If possible, bookmark web-pages rather than printing them out, and print and/or copy e-mails and internet documents only when necessary.
- Use recycled paper
 - Post-consumer fiber content is what really counts. Look for post-consumer content that is at least 30 percent or more. There are a number of paper products with 100 percent post-consumer content.
- Recycle the paper you have used
 - Nearly all paper products are recyclable. Letterhead and white copy paper have the most value, but you can also recycle colored paper, magazines, newsprint, and corrugated cardboard.
 - Almost all of the waste stream from a typical office can be recycled.
- Paper used in printing:
 - Reduce margin settings and type sizes on your computer so that the printer uses less paper.
 - This still allows ample margins for binding and make sure you need a printed copy before you print the document.
 - Use paper with the highest recycled content the manufacturer or supplier will recommend for your printer.
 - Print double-sided whenever you can
 - Paper costs can be almost halved simply by printing double-sided.
 - Use the Print Preview function to check layout and style instead of printing.
- Paper used by photocopiers
 - Paper (including toner) is the biggest cost of a photocopier and has the most environmental impact.

- Reduce the number of sheets needed to print a given amount of information by:
 - Using double-sided copying.
 - Reducing two pages to fit on one sheet.
 - Loading paper already printed on one side into an extra paper supply bin.
- *Practices for consumables, materials, and components used in the maintenance offices*
 - Buy goods in returnable containers that can be recycled when they begin to wear out.
 - Buy products shipped with recycled/recyclable packaging.
 - Avoid disposable items and buy products that can be refilled and reused. Tape dispensers, mechanical pencils, pens, and reusable coffee filters are a few examples.
 - Reduce the amount of waste that you generate by using only what you need and using products until the end of their useful lives.
 - Reuse products whenever possible.
 - Reuse packaging.
 - If you have paper that cannot be recycled, consider shredding it and using it for packaging material.
- *Disposal practices*
 - Aluminum
 - Make every effort to ensure aluminum waste is recycled.
 - Making aluminum products from recycled aluminum requires about 95% less energy than making products from raw bauxite. The same energy that it takes to make one can out of new materials may be used to make 20 cans from recycled aluminum.
 - Recycle cans, paper, toner cartridges, newspapers, corrugated cardboard and other materials that are picked up at the facility.

- Try to repair broken products before buying new ones.
- Arrange vendors and/or public entities for special pick-ups or to drop off recyclable products that are not picked up at work regularly, such as computers and equipment, appliances, and compact discs (CDs).
- When you no longer need or want a product, donate it to a charity or the community rather than throwing it away.

Essential Elements of a Successful Program

- You can increase your company's chances of having a successful waste reduction program by following these recommendations:
 - Make a commitment to pollution prevention. This commitment must start at the top, with the owner or manager of the company, and extend to every employee.
 - Involve the employees in designing and implementing pollution prevention measures.
 - Provide training in waste reduction techniques and practices. Don't let this be a one-shot effort -- periodic "refresher courses" will help to increase employees' awareness of the importance of waste reduction.
 - Establish incentives to encourage workers to use waste reduction techniques and to suggest changes in design or operating procedures that would further reduce waste generation.
 - Assess the business's waste. Identify sources, types, and amounts of waste being produced. This will make it easier to pinpoint areas where waste reduction techniques can be applied and to measure the success of your efforts.
 - Follow up. Reassess the vehicle maintenance shop's operations and waste handling practices periodically. A successful waste reduction program requires diligence so as to avoid the temptation of slipping back into old, more wasteful ways of doing things and to identify additional waste reduction possibilities.
 - Stay alert for new developments. As long as wastes are being produced, there is the potential for waste reduction. Less-polluting materials, equipment, and procedures are constantly being

developed, so that wastes that are difficult or costly to control today may be easily eliminated tomorrow.

Green Garage

Procurement

Introduction/Basic Principles

Resource-intensive activities are typically associated with factories and manufacturing processes, but modern shops and garages also require significant amounts of energy, water, maintenance products, engine/system fluids, cleaning products, and paper, just to name a few items. Any and all personnel involved in the areas of specification and procurement need to find out what the environmental and sustainable impacts are, assess the options, and reach an informed decision. There is rarely a generic 'right' answer but usually, taking the particular circumstances into account, it is possible to distinguish between the better and the poorer options.

For instance, considerable cost savings can be achieved by using resource- and energy-efficient products and practices. Likewise, the costs associated with waste stream generation and subsequent processing and pick-up fees can, and should be, considered as part of the procurement decision-making exercise.

To that end, the process of making more sustainable decisions is often made more effective by defining basic criterion and/or using an assessment tool that defines those elements desirable in a product, component, or system. More sustainable options will usually have some of the following characteristics (many of which overlap):

- *Low embodied energy* – The sum of energy used in the extraction of a raw material, and the processing, manufacturing, and distribution of the resulting product.
- *Recycled content* – Specifying recycled materials can reduce the embodied energy of an item and help mitigate the problems associated with waste disposal.
- *Recyclable content* – Thinking ahead to the eventual decommissioning of an item can help reduce its lifecycle impact. Composite and highly processed materials, for instance, can be hard to recycle. (See notes below.)
- *Renewable material content* – Natural biological materials (such as timber, wool, bamboo, or seashells) managed responsibly and harvested at a sustainable rate, tend to have a much lower environmental impact than mineral alternatives. Although coal and oil originate from life forms, they are formed over a long geological timeframe and could not, therefore, be classified as renewable.
- *Non-polluting and non-toxic content* – Consideration should be made for all processes; that is, in manufacturing, installation, use, and disposal.

- *Use of local goods* – Specifying locally sourced, locally manufactured or locally grown goods reduce transport requirements and will also help support the local economy.
- *Responsible supply chain* – Selection of vendors and products from those companies that also emphasize environmental and sustainable responsibility; for example, using a manufacturer with a certified Environmental Management System.
- *Durability* – This is generally a sustainable quality, except when it arises from over-specification; for instance, when specifying a material that will last for centuries but is likely to be disposed of within 20 years.
- *Straightforward maintenance and cleaning requirements* – Maintenance should be considered when calculating lifecycle costs.
- *Flexibility in components and parts* – When purchasing a new system and/or component, check with your supplier that the equipment can be upgraded easily, that spare parts are easily available, and that components and cases can be recycled. Consider first if a current item of equipment can be upgraded, rather than being completely replaced.
- *'Energy Star' logo* – In addition, make sure the 'power save' feature is activated; equipment is often set up with this function disabled. In general it is worth selecting equipment with low energy consumption levels.
- *Packaging* – Choose minimally packaged products or ask your suppliers to provide products that have less packaging. Where possible return packaging to the suppliers for reuse. Industry and commerce alone generate 150 million tons of packaging waste each year.

Procurement for Green Garage Operations

The advice given in this section expands on the general principles for buying given in the previous section in more detail for the basic components and systems common to shop operations.

- ***For the shop:***
 - Parts Cleaning Systems
 - Traditional approach
 - Uses a mineral spirits-based parts cleaning solvent system

- Although it is effective for cleaning, mineral spirits raises significant environmental and human health concerns:
 - Mineral spirits contains volatile organic compounds (VOC) that contribute to smog formation and may be toxic when inhaled.
 - Mineral spirits evaporates quickly, making worker exposure difficult to control.
 - Spent mineral spirits is a hazardous waste and the shop owner/operator is responsible for proper disposal of all hazardous wastes, with all the associated costs.
 - Some areas of the country have already restricted use of solvents in parts cleaning operations.
- Using solvents creates unnecessary environmental, worker health, and fire liabilities for your shop.
- Alternative 'green' approach
 - Minimize your costs and liabilities by switching to aqueous solutions.
 - Aqueous cleaners are water-based solutions that, unlike petroleum-based solvents, are typically nonflammable and contain little or no VOCs.
 - Aqueous cleaners are defined as water-based cleaners that contain less than 5% (50 grams per liter) of VOCs.
 - Instead of dissolving grease and solids, aqueous cleaners rely on heat, agitation, and soap action to break dirt into smaller particles.
 - Although they clean differently, aqueous cleaners perform as well as solvents.
 - Types of aqueous cleaners:
 - Spray Cabinets
 - For heavily soiled or large volume of parts.

- Clean parts by spraying high-temperature solution at high pressures within an enclosed cabinet.
- Unit selection considerations:
 - Costs: \$1,700 to \$5,500.
 - Pump power, spray pressure, flow rate, and number of nozzles.
 - A 220-Volt power source is often required.
 - Temperature adjuster helps to optimize performance.
 - Insulated cabinets are more energy-efficient.
- Microbial Sink-top Units
 - Manual cleaning of parts in the same manner as conventional solvent sink-top units.
 - Microbes degrade oils and organic contaminants, significantly extending solution life.
 - Unit selection considerations:
 - Ensure unit is at comfortable height for workers.
 - Greater sink-top size allows for the cleaning of larger parts.
 - Higher pump pressure increases cleaning action.
 - Workers may react negatively to certain odors.

Aqueous cleaning cost worksheet *

CURRENT SOLVENT CLEANING COSTS (leased units with servicing)	your facility	sample
A Number of solvent units leased		2
B Current cost per service visit per unit		\$159
C Number of times unit serviced per year		6
D Total annual solvent service cost (A x B x C)		\$1,908
E Cost of electricity used per year per unit		\$280
F Total cost of electricity used (A x E)		\$560
G Loaded hourly labor rate of shop worker		\$50
H Total number of cleaning labor hours per week		5
I Total yearly labor cost (G x H x 52)		\$13,000
J Total annual cost for solvent cleaning (D + F + I)		\$15,468
CONVERSION TO MICROBIAL SINK-TOP CLEANING UNITS		
	your facility	sample
K Number of microbial sink-top units to be purchased		1
L Unit purchase price		\$1,295
M Total capital cost of sink-top units (K x L)		\$1,295
N Cost per gallon of aqueous cleaner		\$6
O Estimated aqueous cleaner use per year in gallons		48
P Aqueous cleaner purchase cost per year (N x O)		\$288
Q Cost per replacement filter		\$10
R Number of replacement filters per year		4
S Total cost for replacement filters (Q x R)		\$40
T Cost of electricity use per year per unit		\$300
U Total number of cleaning labor hours per week		2
V Total yearly labor cost (G x U x 52)		\$5,200
W Total sink-top unit operation and maintenance (O&M) cost ((P + S + T) x K + V)		\$5,828
CONVERSION TO AQUEOUS SPRAY CABINET CLEANING UNITS		
	your facility	sample
X Number of spray cabinets to be purchased		1
Y Spray cabinet purchase price		\$3,000
Z Total capital cost of spray cabinets (X x Y)		\$3,000
AA Cost per gallon of aqueous cleaner		\$6
BB Estimated aqueous cleaner use per year in gallons		48
CC Aqueous cleaner purchase cost per year (AA x BB)		\$288
DD Cost per gallon of spent solution (including sludge) disposal		\$3
EE Gallons of solution in spray cabinet		35
FF Number of solution changes per year		2
GG Total cost for spent solution disposal (DD x EE x FF)		\$210
HH Cost of electricity use per year per unit		\$500
II Number of cleaning hours per week (typically reduced by 80%)		0.6
JJ Total yearly labor cost (G x II x 52)		\$1,560
KK Total yearly spray cabinet O&M cost ((CC + GG + HH) x X + JJ)		\$2,558
RESULTS		
LL Total capital cost (sink-top and spray units) (M + Z)		\$4,295
MM Total cost savings (including labor) (J - W - KK)		\$7,082
NN Payback period in years (LL/MM)		0.6

* Use this worksheet to estimate costs and savings associated with switching from solvent to aqueous cleaning. This worksheet can be used to estimate costs to convert from one or more solvent units to a microbial sink-top unit, a spray cabinet, or both a microbial sink-top and spray cabinet. The sample calculations provided are for a shop with two solvent units that converts to one microbial sink-

top unit, which handles 40% of the original cleaning workload, and one spray cabinet, which handles 60% of the original workload. So, for true comparison it would be best to double the bottom line of the aqueous-based sink option to determine procurement options. [The values provided in the sample column serve only as an example, as actual costs and savings will vary according to shop-specific conditions.]

Specific example from a shop in Glenmoore, California

PARTS CLEANING COSTS COMPARISON					
Glenmoor cost summary					
<u>One Solvent Unit</u>		<u>Aqueous Spray Cabinet</u>		<u>Aqueous Microbial Sink-Top</u>	
Annual costs		Annual costs		Annual costs	
Leasing, waste management	\$690	Purchase price (one-time)	\$1,700	Purchase price (one-time)	\$1,300
Electricity (est.)	\$120	Chemicals	\$24	Chemicals	\$24
Cleaning labor	\$2,600	Solution disposal	\$240	Filters	\$20
Total costs	\$3,410	Electricity (est.)	\$480	Electricity (est.)	\$360
		Cleaning labor	\$494	Cleaning labor	\$130
		Total costs	\$2,938	Total costs	\$1,834
Total Capital Cost: \$3,000 • Annual Savings: \$1,638 • Payback Period = 1.8 Years					

- Battery-run equipment
 - Specify equipment that uses replaceable, rechargeable batteries
 - Offers another opportunity to reduce an unnecessary waste stream: single-use batteries.
 - Although an initial investment in batteries and chargers is required, the long-term, positive environmental and cost consequences could be significant.
 - When purchasing battery operated equipment, avoid products designed for disposal when the rechargeable battery or battery pack expires.

- Endeavor to purchase and install bulk dispensers.
 - Do this for cleaning products and automotive maintenance products such as oils and greases, as well as for cleaning products.
 - In addition to a possible per unit cost reduction, you will recognize a reduction in the costs to manage and dispose of smaller containers and their associated packaging.
- Develop a closed-loop delivery system with those vendors who service your garage on a regular basis.
 - Special consideration should be given to vendors that are willing to deliver your purchases in reusable containers and to backhaul pallets and empty containers from previous deliveries.
 - This approach may actually reduce vendor costs; something to consider in your contract negotiations.
- Purchasing for Waste Prevention.
 - Checklist (Questions to ask)
 - Is there any way to eliminate the use of the product by changing the way the job is performed or implementing new technology?
 - Is a more durable, multiple-use product available?
 - Is there a reusable product available that will eliminate the purchase of a disposable product?
 - Is there a remanufactured or rebuilt product that will serve the same purpose?
 - Can the product be leased or rented?
 - Is there an opportunity to reduce the materials associated with the packaging and delivery of the product?
 - Can the spent products, product containers, and/or packaging be recycled in your current recycling program?

- Purchasing recycled products and/or products with recycled content:
 - General/Background
 - With increased market demand, today's recycled products offer excellent quality.
 - Many industry standards do not distinguish between virgin and recycled products.
 - Recycled products are close to or equal in price to products made from virgin materials.
 - Manufacturing new products from recovered materials saves resources, energy, and water, while reducing air pollution and disposal costs.
 - By further increasing the demand for products made from recycled materials, your Agency will help to keep these products price competitive.
 - Buying recycled products is critical to your green garage program.
 - Recommended approach
 - Staff may need product performance information and hands-on experience to become comfortable with recycled content products
 - Consider purchasing a small quantity of a recycled content product and conducting a pilot project.
 - This pilot can be designed to ask employees to knowingly test a recycled content product against its virgin counterpart, or to test the product on a small scale, and wait to see how staff responds to the recycled content product.
 - Regardless of the approach, it is important to test the product to confirm that it meets performance expectations before making a decision to substitute a recycled content product for a virgin product.

- U.S. EPA's Comprehensive Procurement Guidelines (CPG) assure that:
 - There is more than one vendor selling the product.
 - The product meets [Federal Agency] performance criteria.
 - The product is cost competitive with its virgin counterpart.
- U.S. EPA provides the recommended recycled material content level, recycled product specification language, and a list of manufacturers and suppliers for 58 products in eight product categories.
 - Each Comprehensive Procurement Guideline (CPG) and its companion Recycled Material Advisory Notice can be reviewed at www.epa.gov/epaoswer/non-hw/procure.
- Purchasing products that are less toxic
 - Your purchasing program can help to protect employee health and safety by reducing or eliminating the purchase of products whose ingredients are highly toxic, carcinogenic, flammable, or cause skin irritation, respiratory problems, or allergic reactions.
 - You also can reduce the broader potential environmental impacts of chemicals that might end up in local wastewater systems or contribute to ozone depletion.
 - You may wish to develop a protocol for obtaining, testing, and comparing potential substitutes for products with toxic constituents.
 - Protocol elements/steps:
 - Start with the product label.
 - It will not tell the whole story, but it will have basic information about safe use and any health risks.
 - For example, the words *caution* or *warning* on the label, indicate a hazardous substance. If you see the word *danger*, the product is highly flammable, corrosive, or toxic.

- The label also can provide a preliminary list of ingredients that you can compare to U.S. EPA's target chemicals.
- As part of a voluntary effort to reduce the use of industrial toxics, U.S. EPA has established a list of 17 chemicals and metals targeted for elimination, whenever possible.
- Typical operations that might involve toxic products (consider them as "target areas" when making procuring decisions):
 - Janitorial
 - Janitorial products are often stronger than household cleaners.
 - In 1997, USEPA and the General Services Administration (GSA) published the results of a comparative risk management assessment of 19 cleaning products.
 - This document is available from the USEPA Pollution Prevention Information Clearinghouse at (202) 260-1023. Request Document # EPA 742-R-97-002 or visit the website at www.cleaningpro.com/toxic.cfm.
 - Maintenance (Vehicle and Building)
 - Purchasing strategies can help you minimize or eliminate the use of vehicle and building maintenance products that can pose health hazards to your staff and to waste handlers.
 - Staff responsible for purchasing solvents and degreasers can access U.S. EPA's Integrated Solvent Substitution Data System to help identify less toxic substitutes for specific solvent applications. The system can be accessed on the web at <http://es.epa.gov/issds>.
 - Another resource is the Solvents Alternative Guide (at <http://clean.rti.org>) which provides descriptions of solvent and process alternatives for parts cleaning and degreasing, including case studies and economic and environmental information.

- Paint and paint equipment
 - Volatile organic compounds (VOCs) have been identified as a contributing factor in the production of ground-level ozone, a common air pollutant and a public health hazard.
 - Specify low or no VOCs when preparing to purchase paint for your facility.
 - VOC paints also have less odor—a benefit both to Agency staff applying the paint and to staff who have to continue to work in areas where fresh paint is being applied.
 - It is important to note that the cost, performance, coverage rate, ease-of-application, finished look, and durability of environmentally preferable paint is comparable to that of conventional paint.
 - New paint stripping technologies offer alternatives to chemical agents.
- ***For the shop office:***
 - Maintenance shops will typically have one or more office spaces. For more specific information on office-related procurement items see Chapter 4 of the Green Office Advantage manual.

Green Building Lighting

Energy Efficient Lighting

- **Primary Strategy/Considerations:**

- Using a design that recognizes what will occur in the area to be lit and sizes the lighting to that task. It is also important to consider the quality of the light, which can affect the level of comfort.
- The amount of energy needed to produce that amount of illuminance depends on the distance to the light source. With a shorter distance more illuminance will be available in a defined area which is the reason task lighting can serve as a conserving strategy.
- Selection of the appropriate electric light source depends on installation requirements, life-cycle cost, color qualities, dimming capability, and the effect desired.
- Select the appropriate type and *quantity* of lamps and light fixtures based on the following criteria:
 - Fixture efficiency
 - Lamp lumen output
 - Reflectance of surrounding surfaces
 - Light losses from lamp lumen depreciation and dirt accumulation
 - Room size and shape
 - Availability of natural light
- With regard to *quality* of illumination, there are three issues that should be considered: glare, uniformity of illumination, and color rendition:
 - **Glare:** A visual discomfort caused by an excessive bright light source. A bright object in front of a dark background usually will cause glare. Too much contrast causes glare and makes visual tasks more difficult.
 - **Uniformity of illuminance:** Addresses how evenly light is spread over a task area. Two factors may compromise uniformity: improper fixture placement, and fixtures that are retrofitted with reflectors that narrow the light distribution.
 - **Color Rendition:** Ability to accurately reflect the true colors of people and objects. A measure of this ability is the color-rendering index (CRI). The color-rendering index is a scale from 1-100, where higher CRI represents better color rendering.

- **75-100:** Excellent

- **65-75:** Good
- **55-65:** Fair
- **0-55:** Poor

- **Types/Characteristics:**

- **Incandescent:**

- Incandescent lamps are one of the oldest and, typically, least energy-efficient electric lighting technologies available.
 - Reduced wattage lamps are offered by several manufacturers. These use approximately 15% less power due to improved manufacturing technology.
 - Incandescent lamps with *reflectors* have improved light output:
 - Ellipsoidal reflector (ER) lamps outperform reflector (R) lamps because of the way the light is reflected out of the fixture.
 - Parabolic aluminized reflector (PAR) lamps are available with improved performance from reflector designs. PAR lamps are suitable for exterior applications.
 - Halogen lamps will consume about 60 % less power than standard incandescent bulbs and provide longer service. Some are made for low voltage applications.
 - The tungsten-halogen lamp is the most efficient type of incandescent. The presence of halogen gas within the bulb produces more light, with less energy use, as well as increasing the rated life of the lamp (1000-5000 hrs). A tungsten-halogen consumes about 30 percent less power than a standard A-lamp.
 - Diodes and thermistors are electronic components that can be added to incandescent lamps to improve their efficiency:
 - Diodes are wave rectifiers that cut 60-hertz AC cycles in half. The results are similar to using a dimmer. Although power consumption is reduced by 42 percent, light output is reduced by 70 percent. Lamp life is typically extended but color rendition is poor and the economics are generally unfavorable.
 - Thermistors limit the inrush current and reduce the voltage. Power consumption is reduced by 2-4 percent and light output is reduced by 7-16 percent.

- **Fluorescent:**

- General:

- Fluorescent lamps are the most commonly used commercial light source in North America.
 - About four times as much of the input energy in fluorescents is converted to visible light as with incandescent lights.
 - Have relatively high efficacy, diffuse light distribution, and long operating life.
 - Phosphor coating of fluorescent lamps have improved color rendering and made fluorescent lamps acceptable in many applications previously dominated by incandescent lamps.
 - More energy-efficient, 1" diameter (T8) lamps are now the industry standard.
 - Because the T8 lamps operate at reduced current (256mA), they require compatible ballast. T8 lamps with electronic ballasts produce from 90 to 100 lumens per watt.
 - Select lights with a mid range temperature. This is given in the color temperature K (for Kelvin) shown for lighting products. A range of 3500-5000K is best.
- Compact Fluorescent Lamps:
 - Compact fluorescent lamps (CFLs) are energy-efficient, long lasting substitutes for incandescent lamps.
 - CFL lamp life is usually rated around 10,000 hours and ballast life is typically 20,000 hours.
 - A Color Rendering Index (CRI) is often the only information available for compact fluorescents. Select a CRI closest to 100, which is the best.
 - HID (high intensity discharge) lamps
 - These resemble incandescent bulbs in appearance and in compactness with concentrated and directed light output. However, they operate similarly to fluorescents. These lamps are most suitable for outdoor/security lighting
 - HID lamps require time to warm up, usually from 2 to 6 minutes depending on the lamp.
 - *Mercury vapor lamps* have the lowest efficacy of the HID family, rapid lumen depreciation, and a low CRI. Because of these characteristics, mercury vapor lamps would not be a green choice.
 - *Metal halide lamps* are similar to mercury vapor but use metal halide additives inside the arc tube along with mercury and argon.

- Sodium in HID lamps gives greater efficiencies. It is suitable where the light is needed for visibility only such as in security lighting.

- **Lighting Controls**

- Control systems should take into account the different patterns of occupancy and make the best use of controls, rather than simply aiming to minimize energy consumption.
- The installation of a control system that dims electric lights in a gradual fashion will help to avoid frequent switching.
- The use of T-8 fluorescent fixtures driven by *dimnable electronic ballasts* that permit continuous dimming:
 - Can dim light output down to 10 percent while saving up to 80 percent in energy.
 - The ballast receives its operating signal via control wiring that snaps in with a standard RJ-11 phone jack
 - A closed-loop control system dims the fluorescent fixtures in response to available daylight.
 - Lighting zones may be used with each sensor connects directly to a group of several fluorescent fixtures by control wiring with RJ-11 connections. The sensor dims its group of fixtures in response to the available daylight.
- Timers turn lights on and off at predetermined times.
- Photocells respond to light levels and do not need rescheduling.
- Motion detectors may be used to activate the lights when the room is occupied and turns them off when room is not in use.

Daylighting

- **Primary Strategy/Considerations:**

- The primary goal in daylighting is to bring in indirect light (light that is reflected and not in a direct line to the sun).
- Siting:
 - The long axis of the building should face north and south to maximize available daylight and reduce glare. East and particularly west facing glazing should be eliminated to the extent practical.
 - An overhang will not help block direct light adequately in east and west orientations.

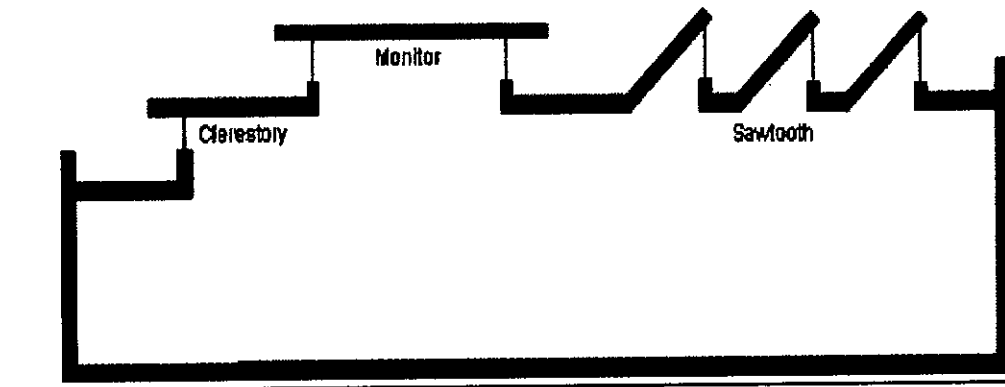
- For good daylighting penetration, the depth of rooms should be kept shallow.
- The daylighting factor (DF) is the illuminance at a point indoors, usually on the working plane, expressed as a percentage of the illuminance outdoors.
 - The recommended average DF for ordinary visual tasks is 1.5-2.5%.
- Sidelighting and Interior Colors
 - Sidelighting from a window is the most common source of daylighting.
 - North and south facing windows will provide the best light since the light can be controlled from these sources.
 - South facing windows can be protected by an overhang while north windows receive direct light for a very short time in the summer.
 - Horizontally-oriented windows high on a wall will permit the best penetration of light into a room.
 - Reflected light makes a significant contribution to the quantity of light available within a building. The amount of light reflected depends on the reflectance of the surfaces.
 - Light colored walls and ceilings that can reflect light in a diffuse manner will aid the effectiveness of the natural light.
 - Reflected light can be achieved with light shelves and louvered window coverings.

Engineering/Structural

- **Clerestory:**
 - The clerestory is a windowed raised section of roof, typically consisting of operable windows, for light and ventilation.
 - The most appropriate orientation is north or south.
 - When light enters the clerestory, it illuminates from the highest area in the center of the building.
 - See page 6.
- **Monitor**
 - Same basic principle as clerestory (see page 6).
- **Saw-tooth**
 - See page 6.

- **Skylight**

- Skylights can be sources of excessive heat gain. They can also cause excessive heat loss in the winter.
- The following guidelines will help you use skylights advantageously:
 - Use a translucent glazing which reduces glare.
 - If using clear glazing, use a ceiling diffuser at the bottom of the skylight shaft to improve light distribution.
 - At the minimum, use double glazing.
 - Provide an interior insulating shade or panel to seal off the skylight shaft from nighttime winter heat loss unless special highly insulating glass is being used.
 - Use an exterior shading system over the skylight during the summer.
- There is a skylight product specifically designed for daylighting purposes. It uses a pipe with a reflective interior to bounce the light down the pipe to a ceiling diffuser from an acrylic dome skylight on the roof. This is a method to bring natural light to a dark interior area of a building without constructing a costly light well.



Green Building

Building Construction and Re-modeling (General)

Introduction:

Creating a green building means matching the products and materials to the specific design and site to minimize the overall environmental impact. A new or remodeled green building will maximize the use of all construction materials and will minimize waste. It will incorporate as few nonrenewable and precious materials as possible. The best green building takes all of these life-cycle factors into account.

Yet all good green building relies on integrated design and a systems approach to the building. Even in the greenest of projects it is likely that many products will be used that are not themselves green—but they are used in a manner that helps reduce the overall environmental impacts of the building. In fact, green building practices generally spend more on the human cost of design in order to reduce the costs of resource use.

Nowhere in the green building consideration is the above approach and difficult balancing act more evident than in the discussion of building materials used in the construction process. Basic philosophies and economic/environmental/regional variables are as unique and varied as the number of buildings being planned and built. This section, more than any other, can appear contradictory at times and is intended to provoke thought and questions only, as opposed to specific recommendations or final answers.

Materials/Component Considerations

- **Concrete:**

- Concrete is considered environmentally-friendly in all stages of its life span, from raw material production to demolition, making it a natural choice for use in sustainable building construction. Specifically:
 - *Resource efficiency:* The predominant raw material for the cement in concrete is limestone, the most abundant mineral on earth. Concrete can also be made with fly ash, slag cement, and silica fume, all waste byproducts from power plants, steel mills, and other manufacturing facilities.
 - *Durability:* Concrete builds durable, long-lasting structures that will not rust, rot, or burn. Life spans for concrete building products can be double or triple those of other common building materials.
 - *Thermal mass:* Buildings built with concrete walls, foundations, and floors are highly energy efficient because they take advantage of concrete's inherent thermal mass or ability to absorb and retain heat.

- *Reflectivity:* Concrete minimizes the effects that produce urban heat islands. Light-colored concrete pavements and roofs absorb less heat and reflect more solar radiation than dark-colored materials, such as asphalt, reducing air conditioning demands in the summer.
 - *Ability to retain stormwater:* Paved surfaces tend to be impervious and can block natural water infiltration into the soil. This creates an imbalance in the natural ecosystem and leads to problems such as erosion, flash floods, water table depletion, and pollution.
 - Pervious concrete is a special type of structural concrete with a sponge-like network of voids that water passes through readily.
 - When used for driveways, sidewalks, parking lots, and other pavements, pervious concrete can help to retain stormwater runoff and replenish local water supplies.
 - *Minimal waste:* Concrete can be produced in the quantities needed for each project, reducing waste. After a concrete structure has served its original purpose, the concrete can be crushed and recycled into aggregate for use in new concrete pavements or as backfill or road base.
- Flyash:
- Flyash is a byproduct of coal-burning power plants that has binding properties similar to cement, and can be substituted for a large portion of the cement usually used to make concrete.
 - Substituting flyash, a waste material, for manufactured cement saves natural resources used in cement production and often saves money as well.
 - Flyash also makes concrete stronger, more waterproof, and more durable, although it can slow curing time.
- Uses/Considerations:
- Foundations:
 - Reinforced concrete presents a great combination of strength, durability, and fire resistance, and can be green, too.
 - Because foundations carry the entire weight of the building and suffer wetness and microbial action from the ground, they are almost invariably made of reinforced concrete.

- Walls:

- There are four different concrete wall systems you can use to form the basic structure of a sustainable building:
 - Cast-in-place concrete walls (where the forms are removed once the concrete hardens).
 - Pre-cast panels
 - Concrete blocks
 - Insulating concrete forms (ICFs)
 - The concrete is pumped between two layers of polystyrene foam insulation, so they offer outstanding insulating values (R-17 to R-26, compared with R-9 to R-15 for a typical wood-frame wall).
 - Several types of ICF systems are available, but all offer similar benefits
 - The superior insulation, air-tightness, and mass of the walls cut the amount of energy needed for heating by as much as 44% and cooling by as much as 32% when compared with wood-frame homes, according to Portland Cement Association.
 - ICF buildings also are less drafty and maintain more even temperatures.
- Other benefits of concrete walls:
 - They keep out noise. About one-sixth as much sound travels through an ICF wall compared with an ordinary wood-framed wall.
 - They can be covered with most standard exterior finishes (including siding, stucco, brick, and stone) to blend seamlessly with other homes in the neighborhood.

- Floors

- Concrete floors, when left exposed, can function both as the foundation slab and finished floor.
 - This eliminates the need for carpeting and other floor coverings that would eventually require replacement.
 - To enhance the appearance of the floor and make it easier to maintain, it can be stained and sealed with nontoxic products.

- Because of their thermal mass, concrete floors also are key elements in passive solar home designs, which use high-thermal-mass materials to collect and store radiant energy:
 - In winter, concrete's thermal mass absorbs heat by direct sunlight through properly oriented windows.
 - At night, the concrete releases the stored heat to warm rooms.
- Roofing
 - Pre-cast concrete roof tiles need minimal maintenance and provide long-lasting protection from the elements.
 - They have a life span of 50 years or longer, compared with 25 years or less for standard asphalt- or fiberglass-based shingles.
 - More important, the tiles are noncombustible and won't burn when exposed to flames or sparks.
 - Concrete tiles are available in a variety of classic styles such as barrel, shake, and slate profiles.
- Exterior finishes
 - Stucco (or Portland cement plaster) has been used for many decades as an exterior finish material for homes and buildings. Benefits include:
 - Fire resistant
 - Excellent weathering characteristics
 - Low maintenance
 - Resistant to rot, mold and termite infestation
 - Cement-based cladding material
 - Called fiber-cement siding (a composition of cement, sand, and cellulose fiber) this product offers performance benefits similar to stucco yet looks like traditional wood clapboard siding.
- Exterior flatwork:
 - With the advent of green building has come a heightened interest in pervious concrete pavements.
 - Rather than building them with conventional concrete or asphalt, more and more communities,

municipalities, and businesses are switching to pervious concrete, a material that offers the inherent durability and low life-cycle costs of a typical concrete pavement while retaining stormwater runoff and replenishing local watershed systems.

- Pervious concrete mixes combine Portland cement, coarse aggregate, water and admixtures.
- Instead of preventing infiltration of water into the soil, pervious concrete assists the process by capturing rainwater in a network of voids and allowing it to percolate into the underlying soil.
- In many cases, pervious concrete roadways and parking lots can double as water retention structures, reducing or eliminating the need for traditional stormwater management systems such as retention ponds and sewer tie-ins.
- Using cast-in-place concrete or decorative interlocking concrete pavers to build sidewalks, driveways, and patios offers a multitude of environmental benefits:
 - Installing a concrete patio rather than a wood deck saves lumber and eliminates the need for regular maintenance with solvent-based wood stains and sealers.
 - Because of their light color, concrete slabs also have higher light reflectivity than asphalt pavements, reducing urban heat-island effects.

- **Wood Framing**

- Building requires a broad range of natural resources, such as limestone, clay, iron ore, sand, gypsum, wood fiber, resins, coal and more. The process of constructing uses energy in the form of electricity, diesel fuel, gasoline, wood, coal, or nuclear power. The cumulative impact of using all these natural resources and energy can be significant in ways that are not always apparent - everything from the electricity used in running a steel mill to the mining of raw materials or the diesel fuel that powers a truck hauling logs.
- New studies look at the total "life-cycle assessment" of different construction products and techniques, considering such issues as how materials are grown, mined, processed, produced, used and ultimately disposed of, to give a better picture of their overall impact on the

environment. It considers effects on energy use, air and water emissions, global warming and other topics.

- The research showed that wood framing used 17 percent less energy than steel construction for a typical house built in Minnesota and 16 percent less energy than a house using concrete construction in Atlanta. And in these two examples, the use of wood had 26-31 percent less global warming potential.

- NOTE: Energy that would be used for heating and cooling during the useful life of the houses was calculated separately.

- Uses/considerations:

- Use spacing, sizes and modular dimensions that minimize lumber use and optimize performance:
 - Conventional wood construction uses many redundant members and can result in a substantial amount of waste.
 - Planning carefully can allow the use of fewer or smaller structural members such as studs, joists, and window headers. "Optimum value engineering" is a term that refers to this kind of planning.
 - Reducing inefficiencies in wood design saves time, money, and trees — smaller members are cheaper and easier to install, and building with fewer members goes faster.
 - Savings from this approach can amount to more than \$3,000 per house or over \$1 per square foot.
 - Use engineered lumber or metal stud framing to replace solid-sawn lumber:
 - Engineered lumber:
 - Made from small pieces of wood glued together: common examples are glue-laminated beams, plywood, oriented strand board ("OSB"), finger-jointed studs, and wood truss joists ("TJI"s).
 - Engineered lumber is made from wood from small trees, reducing the cutting of the larger trees that supply joists.
 - Engineered lumber is also straighter, less likely to shrink or warp, and often stronger than dimensional lumber.
 - Most engineered wood products are made to directly replace solid wood pieces: joists, studs, and beams all have engineered counterparts.

- Sheet metal studs:
 - These are long folded sheet metal pieces that are arranged the same way as studs and joists and connected with self-tapping screws instead of nails.
 - Steel studs replace wood framing entirely, and if they contain significant recycled content, can be an environmentally beneficial solution. (See above discussion on life-cycle studies, however)
 - Steel studs can be substituted for solid-sawn lumber but cannot easily be combined with wood pieces.
- Use sustainably harvested lumber (FSC certified) for wood framing:
 - The Forest Stewardship Council ("FSC") is a nonprofit organization that sets environmental standards for timber harvesting. Timber companies can certify their operations to its standards and then sell their wood as "sustainably harvested," or "FSC certified."
 - The FSC system is a good step in the green building direction; purchasing FSC wood supplies crucial positive encouragement to timber companies to transform their management practices.
- Use reclaimed or salvaged lumber:
 - Reclaimed lumber is wood that was used in structures that have fallen out of use, such as old barns or railroad trestles. Salvaged wood also refers to previously cut and used wood, reclaimed by a salvage yard rather than a lumber company.
 - While old-growth trees have the highest-quality lumber, it is not only environmentally devastating to cut them down but increasingly hard to find available trees.
 - Reclaimed lumber is often of high-quality old-growth stock, but can be reused without damaging living forests.
 - The structural performance of reclaimed lumber can be greater than wood from harvested trees, and the aging process can produce distinctive and beautiful wood pieces.
- Avoid wood treatment:
 - Wood treatment refers to protecting wood from damage caused by insects, moisture and decay, and fungi.

- In wood-framed walls, treated wood is used as the base plate in contact with a concrete slab.
- Treated wood is also used in outdoor applications where the wood will be exposed to harsh conditions. These applications include decks, walkways, and direct ground contact.
- At present, there is not an environmentally sound method for disposal of treated wood.
- Every effort should be made to minimize the use of treated wood by using alternate materials or designing alternative methods. For instance:
 - Use building methods that reduce moisture access to and/or build-up on wood products.
 - One method is to build a high enough foundation (at least 8-12 inches, frame grade) to reduce the chances of water-retaining soil building up against it.
 - Another method is to use a sturdy sheet of polyethylene plastic under the concrete slab to reduce moisture wicking up from the ground and through the concrete.
 - For pier foundations, be sure to remove water-absorbing forms that can retain water or attract termites.
 - In addition, it is good practice to place a non-absorptive material between the concrete pier and wooden beams such as a plastic or metal anchor or plate.
 - Proper building design and installation of building materials have the largest effect on opportunities for moisture to affect wooden building materials.
 - Comprehensive understanding and maintenance of the thermal envelope of the building, including the HVAC and ventilation systems, also has a great effect on the control of the inevitable movement of moisture within the building.
 - Use building methods that hinder the attraction of termites to wood within the home.

- The use of termite shields and barriers as well as other integrated pest management methods.
- Use alternative materials to wood where possible and appropriate.
 - For wood frame buildings, building material alternatives such as lumber made of recycled plastic or wood/plastic composites are good options for moisture-prone areas such as sill plates, doorframes and thresholds, porches and outdoor decks, and stairs.
 - Fiber/cement or fiber/plastic materials for siding, roofing, soffits, and fascias are also good low-maintenance alternatives to wood because they do not rot or attract termites.
 - Alternatives to wood framing such as steel, concrete, structural insulated panels, earth, and straw are also methods that eliminate most of the termite and some of the moisture problems associated with wood frame construction.
- Use naturally pest resistant woods, such as Black Locust for fence posts, or high resinous cedar.
- Inorganic compounds of the naturally occurring element, Boron, have long been known to prevent or eradicate fungal and insect attack in timber.
 - Use of inorganic borates is an answer to all those concerned about the health and environmental impact of conventional timber preservation.
- **Exterior Materials/Roofs/Siding**
 - Because a building's exterior must endure rain, big swings in heating and cooling, and ultraviolet rays, durability is a central concern for exterior materials.
 - So are moderating heat gain and stormwater runoff, and repelling microbial attack.

- Unfortunately, many durable, natural woods are endangered, and some durable synthetic materials are the products of toxic manufacturing processes. Green alternatives range from high-tech new "cool roofs" to time-tested standards such as stucco or stone.
- Uses/Considerations:
 - Roofs
 - Use durable roofing materials
 - Roofing can be considered durable if it has a life span of 40 years or more.
 - Durable roofs include high-end single-ply membranes and composite shingles, stone or clay tile, and sheet metal.
 - Roofs that wear out rapidly are often made of cheap asphalt shingles or built-up tar and gravel rolled layers.
 - Get the longest possible warrantee from your roofing subcontractor, and write durability into your contract and specifications.
 - Use a cool roof
 - Cool roofs are designed to reflect the heat that comes with sunshine.
 - They can be bright white membrane roofs, paint-on coatings (for retrofit applications), or light-colored or specially designed tiles and shingles.
 - While metal roofs are reflective, they will only release heat gain if specifically coated to do so.
 - A cool roof alone can decrease the air conditioning costs of the space below by 20% or more and increase comfort dramatically.
 - Cool roofs are also more durable than hotter roofs because there is less degradation from heating/cooling and UV exposure.
 - Lastly, they reduce the heat island effect for the surrounding region.
 - Use a green or living roof.
 - Green roofs have a layer of soil and living plants on top of root barriers, waterproofing layers, and a structural roof deck (usually made of concrete).
 - They range from a thin soil layer that supports groundcover plants to gardens that include shrubs and even small trees.

- Green roofs reduce heat gains inside (as with cool roofs), and protect your roof's waterproofing layers, adding great durability.
 - They prevent stormwater runoff.
 - They can even replace habitat for species that is lost under the footprint of new construction.
 - Many can be used as beautiful outdoor garden spaces for building occupants.
 - Plan early for a green roof, because it has a significant impact on your building. It can change building height, and often requires a somewhat stronger structure to carry the soil weight (heavy trees can be located directly over columns).
 - A number of manufacturers offer complete green roof systems including waterproofing, drainage layers, soil-holding layers, and even plantings.
- Siding
 - Use sustainable siding materials.
 - Green choices for siding include salvaged or FSC certified wood, brick and stone, stucco, fiber cement panels and boards, and non-PVC plastics such as polypropylene boards.
 - FSC certified wood reduces loss of old-growth trees and keeps forest ecosystems healthy.
 - Fiber-cement or stucco are lower-maintenance than wood siding, which requires frequent painting.
 - Fiber-cement materials are made from cement, silica and sawdust.
 - Reconstituted and recycled-content (engineered) siding materials offer superior longevity over wood siding. The increased density of the materials resists cracking and other deterioration.
 - Fiber-cement materials, for example, offer very long warranties and have zero flame spread.
 - Steel and aluminum siding materials are predominantly fabricated from recycled material.

- Although the embodied energy is high when the materials are originally made, they require much less energy in a recycled form.
 - They can also be recycled again after use in a building.
- The use of plastic products for exterior siding is also a building solution.
 - Since vinyl is significantly lighter in weight than some alternative materials, energy is saved during initial transportation.
 - Vinyl siding and accessories are recyclable, both pre-use (e.g., manufacturing off-cuttings and construction site waste) and post-use (e.g., removal at end of useful life).
 - Vinyl siding and accessories are also durable products, offering cost savings, as well as energy savings in terms of avoiding the need to manufacture replacement parts.
 - However, vinyl siding, made from polyvinylchloride (PVC), and the dioxins that come from manufacturing it are among the worst and most common environmental toxins in the United States.
 - Dioxins don't break down in the environment, and cause numerous health hazards.
 - PVC also creates toxic fumes in building fires and becomes non-recyclable solid waste once its service life ends.
- Use sustainable trim materials.
 - The use of domestic hardwoods for moldings and trim is noted since domestic hardwood trees are maturing at a faster rate than they are being removed (positive growth-removal rate).
 - Using recycled trim reuses trim in its same form, achieving the most resourceful recycling.
 - Since trim is not structural, it is acceptable to use it in new construction. It will require going to different sources for material such as salvage businesses, and finding a large enough quantity of the same style can be challenging.
 - *Finger-jointed* material is lumber made from short lengths (16 - 48 inches) of off-cuts from various milling processes that is finger-jointed and glued

together. Finger-joint lumber may be used as trim material.

- **Interior Materials**

- Use low- or no-VOC, formaldehyde-free paints, stains, and adhesives
 - Volatile Organic Compounds (VOCs) are a wide variety of potentially harmful gases.
 - VOC exposure produces complicated health risks because of the large number of gases involved, their potential interactions, and their low concentrations over long periods of time.
 - The full health effects of long-term, low-level VOC exposure is hard to study but is of significant concern to many health professionals.
 - The best way to avoid any potentially dangerous exposure is to reduce use of VOC-containing products. Choose and specify low- or no-VOC paints, stains, and adhesives such as those that meet Green Seal standards.
 - The drying of conventional paints, stains, and adhesives all produce VOCs.
 - People can tell the difference when VOCs are avoided, and they appreciate it; buildings finished without VOCs lack the unpleasant smells of drying paint.
- Use low- or no-VOC carpets, furniture, particleboard and cabinetry
 - Volatile Organic Compounds (VOCs), come not only from drying-out solvents (as discussed above), but also from the long-term off-gassing of glues and chemical coatings in solid materials ranging from carpets to plywood.
 - Avoid wood particleboard in cabinetry, doors, and furniture, with urea formaldehyde resin, choosing MDI or phenolic resins instead — substituting exterior plywood for interior grade plywood will achieve this.
 - Look for carpets with the Carpet and Rug Institute's Indoor Air Quality label, or other interior products such as wall coverings and furniture with GreenGuard certification.
- Use natural materials such as wool and sisal for carpets and wall coverings.

- Natural materials are produced from biological fibers, oils, and inert minerals. Wool comes from sheep, and sisal comes from sea grass.
- Natural materials add warmth and comfort to interior spaces, and tend to cause less damage to the environment than the processing of synthetic materials.
- They may also pose fewer health risks than synthetic materials, although some natural materials may not be suitable around sensitive individuals.
- Choose and specify finishes that include natural materials.
 - Many choices are available for carpets, mats, and wall coverings, as well as natural paints and sealants.
- Use sustainable materials for flooring, trim, and interior surfaces.
 - Many interior materials are produced from natural, renewable sources and contain no toxic components or byproducts.
 - Some commonly used materials for rolled sheet flooring and flooring tiles, such as vinyl (technically known as polyvinyl chloride or PVC), do entail significant environmental problems and are not sustainable.
 - Vinyl production is not sustainable because it produces dioxins that pose major environmental and human health risks in the areas where manufacturing occurs.
 - Also, additives that harden PVC can be hazardous, PVC releases dangerous gases during building fires, and it is not recyclable.
 - By contrast, purchases of other materials support industries that produce less environmental pollution.
 - Sustainable options for typical interior uses include real linoleum (made of linseed oil, sawdust and rock flour), sheet rubber, cork and stone for flooring; and rubber, sustainably harvested wood or recyclable plastics for trim (see above and below).
- Use reclaimed or salvaged, sustainably harvested (FSC certified), or engineered wood for flooring and trim, or use wood alternatives such as bamboo and cork.
 - Specify and choose FSC–certified wood for all interior uses where wood is to be used, or use wood alternatives.

- Sustainably harvested wood is certified by the Forest Stewardship Council (FSC — see Wood Framing).
- Engineered wood is made from small trees and scraps and is available for trim and flooring.
- Bamboo is a plant that grows much faster than trees, making it easier to harvest repeatedly, and cork is bark harvested from cork trees without killing the parent tree.
- Choose and specify recycled content interior materials
 - Many interior materials are available with recycled content.
 - As both environmental and monetary costs of waste disposal continue to increase, recycling is becoming more important. Using recycled-content products helps to accelerate the development of recycling technologies and support this transformation.
 - Use recycled-content floor tile, carpets and pads, cabinets, and countertops.
 - Recycled carpets often are made from old carpet fiber, while ceramic tiles contain glass waste and cabinets are made from wood scrap.

Vehicle and Equipment Washwater Discharges

Best Management Practices Manual

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Introduction

This guidance manual discusses the environmental concerns over discharges from washing the exterior surfaces of vehicles and equipment such as cars and/or trucks, and light or heavy equipment. It provides Best Management Practices (BMPs) for the collection, treatment, and disposal of waste water generated by large/commercial vehicle/equipment washing operations in Section 2. This document also provides guidance for pollution prevention by offering the “do’s and don’ts” of discharge control for some common types of operations in Section 3.

Why Should We Be Concerned With Vehicle Washwater?

Washwater from vehicle/equipment cleaning activities may contain significant quantities of oil and grease, suspended solids, heavy metals, and organics, as well as pollutants from detergents. These pollutants can be toxic and harmful to living organisms, including fish and people who ingest them. Oil and grease contain hydrocarbon compounds, some of which can injure or kill aquatic life even at low concentrations. Oil and grease can also coat fish gills and prevent oxygen from entering water, starving fish and other aquatic life.

Some detergents may contain metals such as arsenic; when dissolved, metals are toxic to living organisms. Detergents contain emulsifiers that break up oil particles; emulsifiers can also cause harm to aquatic life. Many detergents also contain nutrients such as phosphorous and nitrogen. High nutrient levels in streams and lakes can harm water quality by stimulating excess weed and algae growth, causing unpleasant odors and sights, and depleting oxygen levels necessary to support fish life.



What Types of Operations Are Covered By This Document?

The operations listed below are just a few that discharge washwater and have the opportunity to prevent pollution in Washington State waters. Best management practice recommendations for each operation are listed further on in this manual.

Section 2 covers:

- ❖ Businesses that regularly wash vehicle/equipment exterior surfaces other than those addressed in Section 3. Engine cleaning and the cleaning operations that use acids, caustics, or other metal brighteners should follow the BMPs for discharges to municipal sewerage systems or use closed-loop water recycling systems.

Section 3 covers:

- ❖ At-site rinsing of farm and construction vehicle/equipment;
- ❖ Mobile washers;
- ❖ Washing vehicle exteriors at new and used car/truck dealerships;
- ❖ Small dischargers (1 or 2 pieces of equipment and or vehicles per day and not to exceed 8 per week); and
- ❖ Charity car washes.

What Types of Operations Are Not Covered By This Document?

The washwater generated from the washing of tank truck interiors is not included in this guidance document. Washwater generated from cleaning of the tank truck interiors must be collected, treated, and disposed of in accordance with a treatment and disposal system approved by the State Department or a municipality with delegated pretreatment authority. The required treatment will vary with the cargo hauled by the tanker truck. In short, discharge of these washwaters to surface waters, municipal sewerage systems, or to the ground requires a permit or a discharge authorization.

The BMPs in this document may not be adequate to protect ground-water resources in sensitive areas, such as, sole source aquifer, well head protection areas, or other designated groundwater protection areas.

This document does not cover vehicle washwater discharges to surface water.

Washwater Discharge Options

There are four options available for the disposal of vehicle washwater.

- ❖ Preferred option: Zero discharge, or closed-loop water recycling;
- ❖ Second option: Discharge to a municipal sewerage system;
- ❖ Third option: Discharge to land or ground; and
- ❖ Fourth option (not recommended): Discharge to surface water.

Of these options, zero discharge, or the use of water recycling systems is the preferred option and is strongly encouraged. The second most preferred option is to discharge to a municipal sewerage system. The third option is to discharge to the ground.

Due to the high degree of treatment and extensive (and costly) monitoring that are required for discharges to a surface water body or storm sewer, this option is not recommended and will not be further addressed in this document. Such discharges must be authorized by a National Pollutant Discharge Elimination System (NPDES) Permit issued by Ecology. For more information, contact your closest Ecology regional office. (See list at end of this document.)

Zero Discharge or Closed-Loop Water Recycling Systems

A closed-loop system uses recycled water and has zero discharge. However, closed-loop water recycling systems may use chemicals to help remove solids from the waste. Systems that do use chemicals generate chemical sludge which must be handled safely and disposed of in a manner that will not cause pollution of the waters of the state. Also, the closed-loop recycling systems may have a reservoir to store the recycled water for reuse. It may be necessary to discard the reservoir water periodically as oil, grease, and other pollutants accumulate. The following steps should be followed for safe handling and disposal of the sludge and the contaminated reservoir water generated by these systems:

- ❖ The sludge generated in these systems seldom designates as a hazardous or dangerous waste, and it can usually be disposed of in a sanitary landfill. To be sure, check with your local health department and/or landfill operator. If still in doubt, test the sludge to determine if it designates as a hazardous or dangerous waste.
- ❖ If the sludge designates as a hazardous or dangerous waste, it must be disposed of through a permitted treatment, storage, and disposal (TSD) facility. Also, requirements for storage of dangerous wastes, such as secondary containment, would apply to a sludge that designates as a hazardous or dangerous waste.
- ❖ The contaminated reservoir water should be discharged to a municipal sewerage system with the prior authorization from the local sewer authority.

Discharges to a Municipal Sewerage System

Discharges to a municipal sewerage system receive treatment by the municipal treatment facility before they are finally discharged to the environment (rivers, lakes, sea water, or the land). Dischargers must obtain approval from the local sewer authority prior to discharge. Many local sewer authorities have limits on pollutant concentrations in the discharge that dischargers must meet. Local sewer limits are to:

- ❖ protect water quality of the receiving water body;
- ❖ protect sewage sludge quality, making sure that it is a usable product;

- ❖ prevent operational problems at the sewage treatment plant and in the collection system; and
- ❖ protect worker health and safety.

This manual contains some recommendations for the collection and treatment of the washwater prior to discharge to a municipal sewerage system (see Section 2).

Discharges to the Ground

Discharges to the ground must be treated to prevent ground water pollution. Section 2 of this manual contains the recommended treatment BMPs for washwater generated by large commercial operations prior to discharge to the ground. A grassy ground surface can provide treatment for small and infrequent discharges. Section 3 of this manual provides some do's and don'ts recommendations for such dischargers.

Regardless of the number and type of vehicle washing activity, all discharges to ground water must comply with state ground water standards . In some areas of the state, such as those over sole source aquifers, discharge to ground may not be allowed or may require further controls. In those sensitive areas, closed-loop water recycling or other options would be necessary. For more information, contact your nearest Ecology office or local government.



Section 2

Recommended BMPs for Collection, Treatment, and Disposal of Washwater

This section contains the recommended BMPs for collection, treatment, and disposal of washwater generated from large/commercial operations washing vehicle/equipment exterior surfaces. The following provide recommended BMPs for two treatment and disposal options. These are the BMPs for discharges to a municipal sewerage system and for discharges to the ground. Where a municipal sewerage system is accessible, the washwater should be discharged to such a system with the approval of the local sewer authority and following the treatment BMPs for discharges to municipal sewerage systems (see following page). Washwater discharges to the ground should be adequately treated so as not to cause violation of state ground water standards (Chapter 173-200 WAC). However, when feasible, the use of closed-loop water recycling systems to treat and reuse the washwater is strongly recommended over discharges to the municipal sewerage systems or the ground.

Washwater Containment and Collection

Vehicle and/or equipment washing should be conducted in a building or in one of the preferred designated areas described below.

1. At a commercial washing business in which the washing occurs in an enclosure and drains to a municipal sewerage system, a treatment facility, or a dead end sump.
2. In a building constructed specifically for washing of vehicles and equipment which is plumbed to drain to a municipal sewerage system, a treatment facility, or a dead end sump.
3. In an outside area without walls and/or roof designated as a wash area, meeting the guidance for uncovered wash areas outlined below.

Uncovered Wash Areas

The following guidance is designed to prevent release of oil and grease, metals, and washwater into the environment and minimize the discharge of precipitation to the collection system. Designated uncovered wash area should be:

- ❖ Impervious and graded to collect all washwater in a drain system, and constructed as a spill containment pad to prevent the run-on of stormwater from adjacent pavement areas. The containment pad should be sized to extend out a minimum of four feet on all sides of the vehicles and/or equipment being washed.
- ❖ Discharging to a municipal sewerage system, a treatment facility, or a dead-end sump for transportation to the nearest treatment facility.
- ❖ Discharging through a pipe that has a positive control valve (manual or automatic) that is shut when washing is not occurring. This prevents the entry of stormwater. Signs should be posted to inform people of the operation and purpose of the valve.
- ❖ Cleaned before a rain event.

Also:

- A portland cement concrete spill containment pad is recommended for steam cleaning.
- The wash area should be well marked at gas stations, multifamily residences, and any other business where vehicles may be washed by nonemployees. Included in the posting will be a statement forbidding the changing of oil in the wash area and the location of the nearest oil recycling facility. See Figure 1 for an illustration of these requirements.

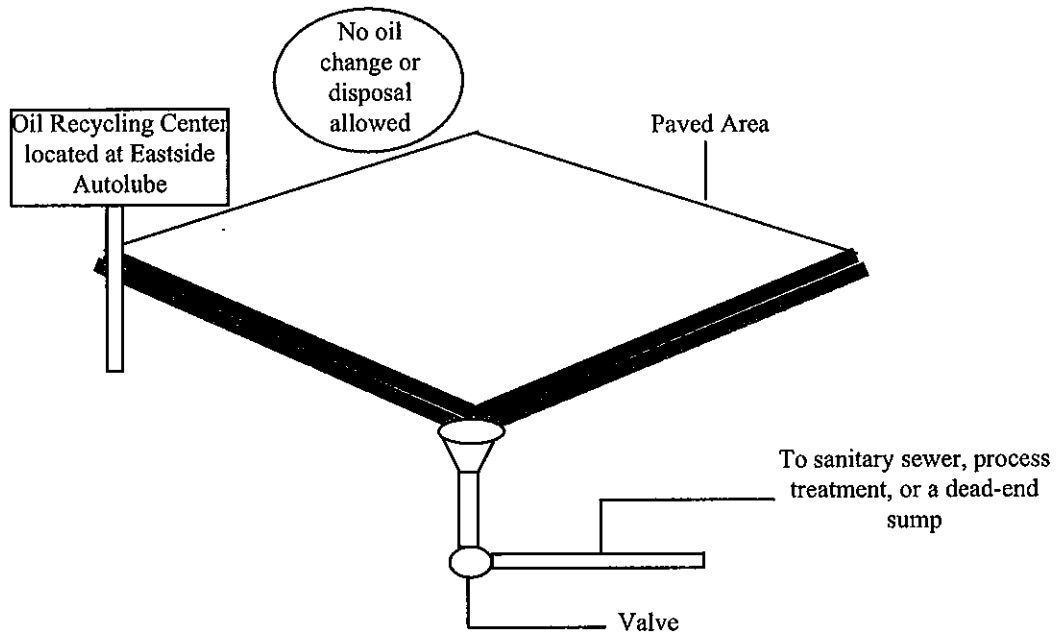


Figure 1. Requirements for an Uncovered Wash Area

Discharges to a Municipal Sewerage System

Treatment System

The washwater must be adequately treated to meet the local sewer authority's discharge requirements. In general, local sewer authorities have pollutant concentration limits for total suspended solids (TSS), oil and grease (O & G), and metals. A gravity separator such as an American Petroleum Institute separator (API, or baffle) or Coalescing Plate Separator (CPS) can be used prior to discharge to a municipal sewerage system. The expected effluent TSS and O & G concentrations are less than 100 ppm and 50 ppm, respectively. However, depending on the type and quantity of the detergent used, the efficiency of the gravity separation systems for total O & G removal may be reduced. Figures 2 and 3 show examples of the API and CPS systems. The API separator has a grit/sludge removal baffle allowing solids separation. A pretreatment unit for solids separation (e.g., a grit trap) may have to precede the CPS system. The flow residence time through the API system should not be less than 30 minutes at the highest expected discharge flow.

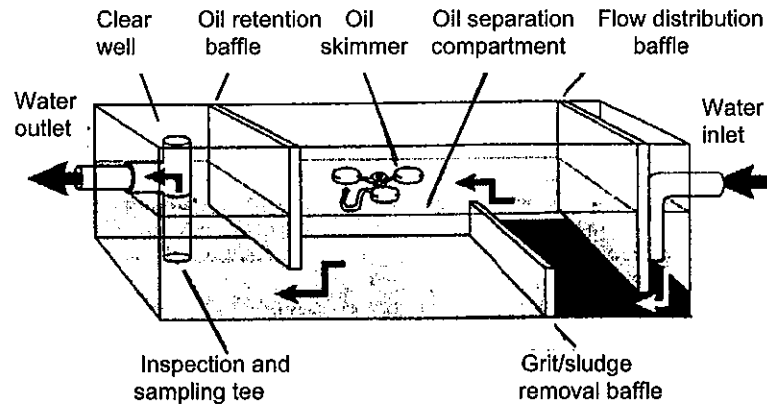


Figure 2. An API Separator

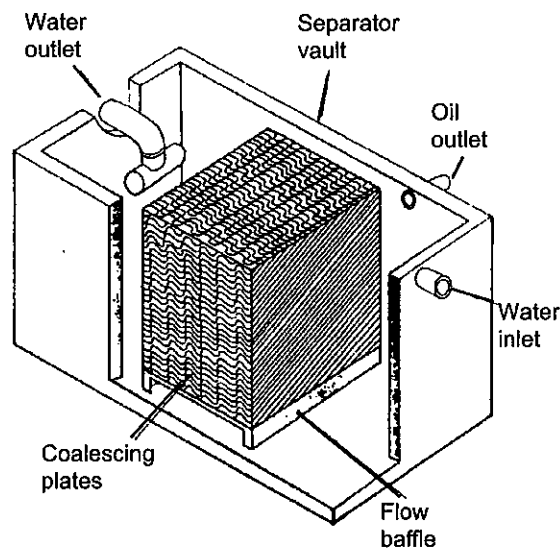
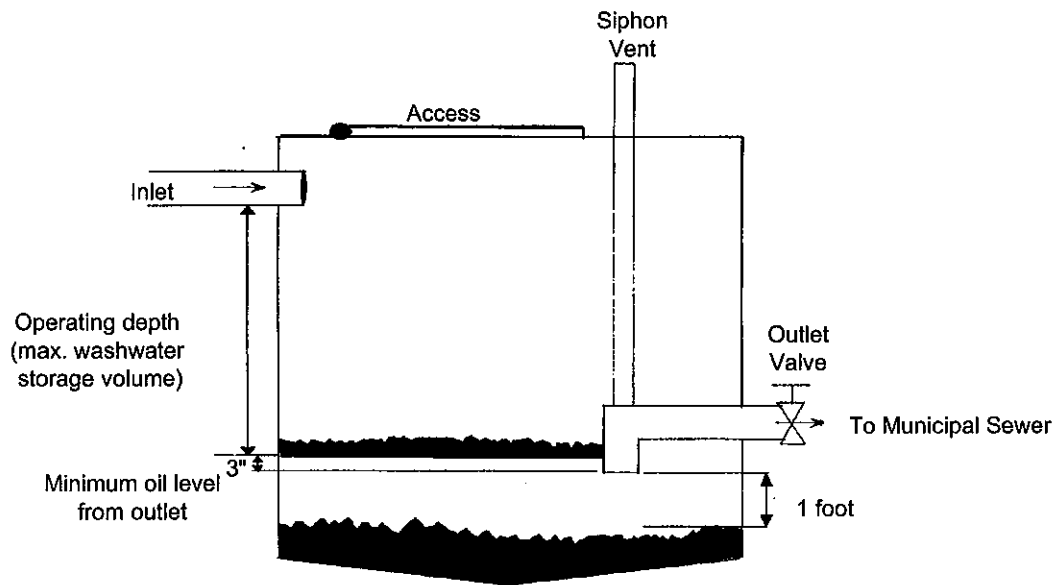


Figure 3. A Coalescing Plate Separator

Alternatively, washwater can be discharged to a containment sump, similar to that in Figure 4, with a gravity separation overflow and a positive control valve at the connection to the municipal sewer. The sump minimum containment volume should be sized to accommodate the maximum expected daily flow plus the sludge storage volume below the outlet pipe. The outlet valve will be shut during the washing operation and the washwater will be stored in the volume provided. The valve should remain shut at least two hours following the last washing operation to allow oil and solids separation under a quiescent condition. After this quiescent period, the valve can be opened to allow discharge to the municipal sewer. Such a containment sump is operated on a daily cycle. Larger containment volumes can be used to store more than one day's flow.



Operation: During the washing operation the outlet valve is shut. Washwater is stored in the sump. The valve should remain shut for at least 2 hours after the last washing operation. The washwater is discharged to the municipal sewer after the quiescent period by opening the outlet valve.

Figure 4. A Typical Containment Sump

The sludge volume generated in a containment sump can be quite variable. In an EPA study, the median TSS concentration from the wand type car wash facilities was 659 ppm (the range was from 106 to 2970 ppm). Based on this median TSS concentration and assuming a sludge solids concentration of 5 percent, the sludge volume generated from 3,000 gallons of washwater is approximately 40 gallons. The same EPA study reported the median TSS concentrations from the roll-over and the tunnel types car washes as 158 and 101 ppm, respectively (the ranges were 30-576 ppm for roll-over type and 36-848 ppm for tunnel type). To prevent resuspension and suction of the solids in discharge to the municipal sewer, the sludge depth should remain one foot below the outlet. Also, the floating oily layer should stay well above the outlet pipe to prevent its discharge to the municipal sewer.

Maintenance

Any grit traps used should be inspected daily and cleaned as needed, but not less than once per week. The gravity separation unit should be operated and maintained according to the manufacturer's recommended maintenance procedures at the specified frequencies or as needed. Oil accumulation in an API system should be checked at least once a week or more frequently as needed. If it exceeds three inches, the unit must be cleaned. Generally, the manufacturer's recommendations for cleaning of the horizontal coalescing plates in a CPS system is when the gap between the plates has been reduced by 40 percent. These requirements may be different for each case and, ultimately, the owner/operator is responsible for the proper and periodic maintenance and operation of the separator in use. The containment sump in Figure 4 should be inspected during each fill and discharge cycle and cleaned before the accumulating sludge and oil layers have reached the limits shown in the figure. A log of all maintenance activities should be kept on-site and made available to Ecology or the local sewer authority when requested. The log should include the type of activity, name of person responsible for the activity, and time and date of the activity.

Solids and other materials removed from the treatment system must be disposed at a location and in a manner so as to not cause pollution of any of the waters of the state. If the wastes do not designate as a hazardous or dangerous waste, disposal in a sanitary landfill with the approval of the jurisdictional health authority, may be a practical option. Waste disposal companies may be contacted for help in cleaning and disposal of the separator's content.

Discharges to Ground

The following describes components of an acceptable treatment system and the maintenance activities needed for wastewater discharges to the ground. Other treatment alternatives that provide an equivalent or better treatment of the wastewater may be used. Sanitary wastes (sewage) should not be discharged to the wastewater treatment systems.

Treatment System

The treatment system must produce an effluent that will not cause violation of the State ground water quality standards. The treatment system recommended includes a gravity separation unit such as those described for BMPs for discharges to a municipal sewerage system.

Also, additional treatment of the effluent from the gravity separation unit should occur for further removal of the residual oil and metals. It is recommended that a 4 to 5 feet deep multimedia filter as shown in Figure 5 be used to treat effluent from the gravity separation system. The selected media should provide treatment capacity for removal of colloidal and dissolved heavy metals. The multimedia filter in the Figure 5 includes a layer of peat over the sand media. Other organic

media, such as, compost, can be used in place of peat to achieve further removal of the residual oil and heavy metals. For the multimedia sand filter shown in figure 5, it is recommended that the calculation for the required filter area be based on a flow application rate of 20 gallons per square foot per day or less.

Sampling ports should be provided to sample the influent and effluent of the treatment system and effluent from the gravity separation unit. With proper operation and maintenance of the treatment system the average effluent TSS and O & G should be under 75 ppm and 10 ppm, respectively. The treatment system is expected to remove other pollutants of concern such as the heavy metals and oil or petroleum residues to levels that meet the ground water quality standards. However, it should be emphasized that data on performance of the above treatment system is lacking. If the effluent quality from such systems does not meet the applicable ground water standards, additional treatment options, such as the use of activated carbon columns, should be implemented.

Freezing temperatures could cause the filter media to freeze especially when they are dosed infrequently, therefore consideration should be given to locating the filter unit below the frost line.

Additional Information on Peat

The hydraulic conductivity or the flow velocity through the peat layer will probably control the flow application rate. For this reason, prior experience or testing of the peat to be used may be necessary. The most common type of peat is fibric peat (e.g. sphagnum moss) which is made up of mostly undecomposed fibrous organic materials. It is typically brown and/or yellow in color, has a high hydraulic conductivity (56 in/hr), and is extremely acidic. On the other hand, sapric peat is made up of highly decomposed organic materials and is typically very dark gray and has very low hydraulic conductivity (0.01 in/hr). Hemic peats are intermediate in their properties. The peat selected should be able to handle the flow application rate of 20 gal/ft²-d (about 1.3 in/hr). High acidity may cause mobilization of some metals and lead to a higher metals concentration in the effluent. For this reason the media pH should be near neutral. Mixing some crushed shells with peat may be one way of stabilizing the pH of an acidic peat at near neutral. On the other hand, some detergents are buffered at or near neutral pH which may prevent acidic pHs in the media. The use detergent should not cause the effluent pH to increase above 8.5.

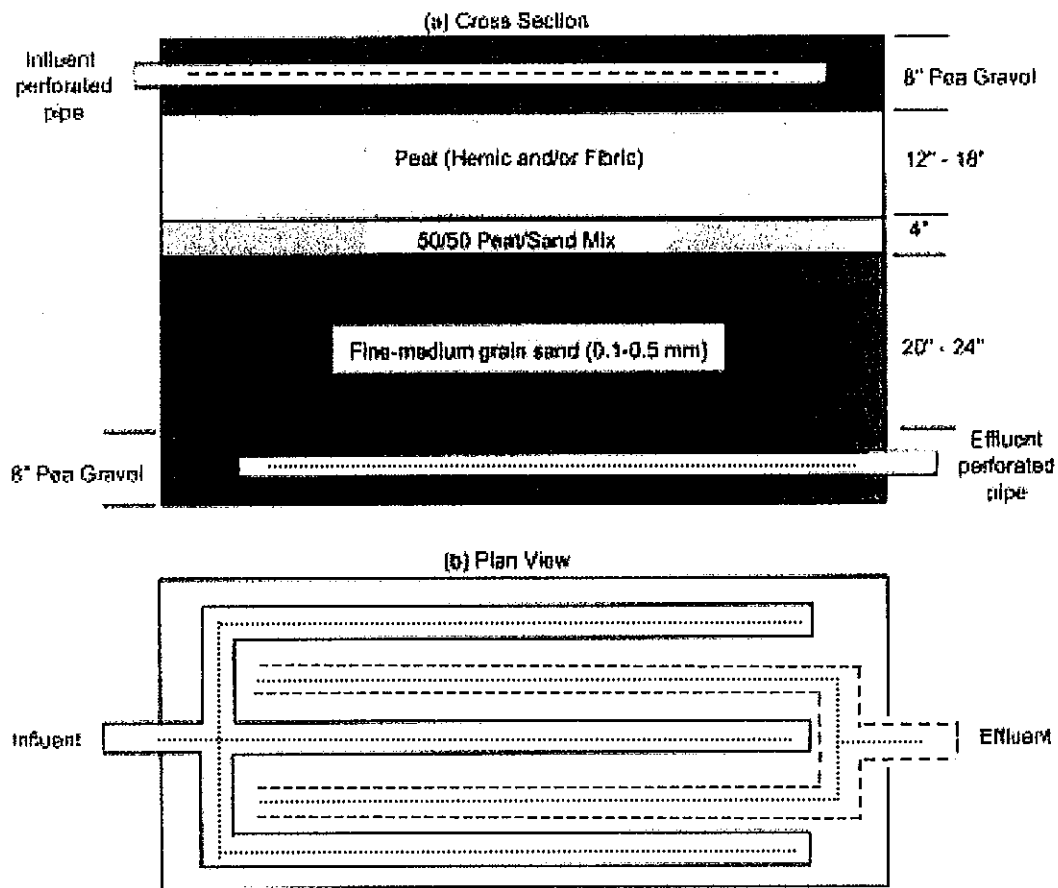


Figure 5. Multi-Media Peat Sand Filter

Drainfields

Following the treatment system, discharges to ground should be through drainfields designed in accordance with the State.

Approval of the local health department may also be required.

Maintenance

A maintenance program for the treatment system should include the following:

- ❖ Daily inspection of any grit traps used and cleaning as needed but not less than once per week.
- ❖ For gravity separation units, follow the manufacturer's recommended maintenance procedures at the specified frequencies or as needed.

- ❖ As part of the operation and maintenance procedure, regular monitoring of the treated effluent is recommended. To ensure that the system is properly operating and achieving the expected level of wastewater treatment, the treated effluent should be sampled.

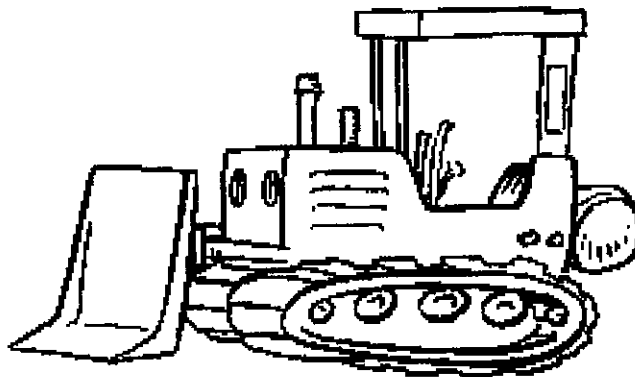
- ❖ Multimedia filters should be replaced as necessary to maintain adequate treatment capacity to ensure compliance with the water quality standards.
- ❖ Solids and other materials removed from the treatment system should be disposed at a location and in a manner that does not cause pollution of any of the waters of the state. Disposal in a sanitary landfill may be a practical option. Approval of the landfill operator should be obtained.
- ❖ A log of all maintenance activities should be kept at the site, and made available to Ecology or local sewer authority when requested. The log should include the type of activity, name of person responsible for the activity, and time and date of the activity.

At-site Rinsing of Farm and Construction Vehicles/ Equipment

The following applies when rinsing is performed to prevent tracking of dirt, sediment, and floatable materials and to remove pesticide residuals from farm and construction vehicle/equipment exterior surfaces.

- Do**
- ❖ Farm and construction vehicle/equipment should be field washed over a grassy ground or dirt area where it can soak into the ground, evaporate, or otherwise be kept out of surface waters or storm sewers.
 - ❖ Pesticide truck exterior should be rinsed with water at the field to remove pesticide chemical residues before they are brought to a central washing area.
 - ❖ Where washing occurs on impervious surfaces, a catch basin with a gravity separator (e.g. an oil/water separator) should be used. Discharge from the gravity separator should go to a grassy ground surface or dirt area, or it can be directed to a sanitary sewer where available.

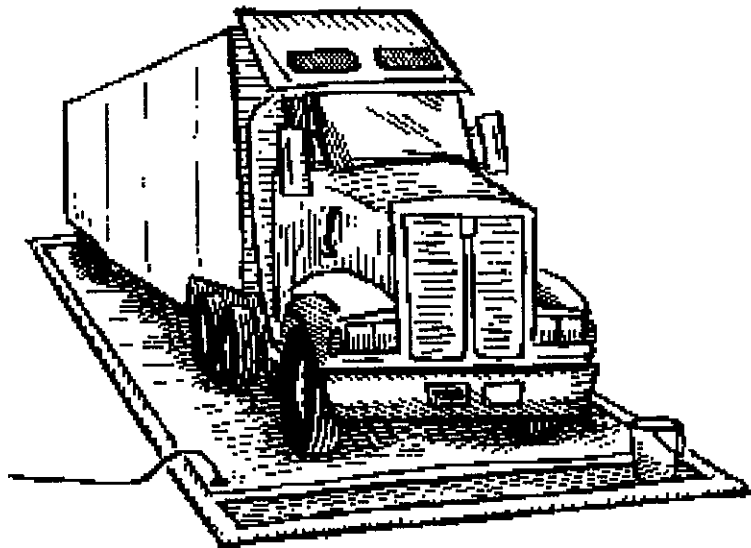
- Don't**
- ❖ Do not use soap, detergents, or cleaners.
 - ❖ Do not discharge to a storm sewer or surface water.
 - ❖ Do not pressure wash vehicles with other than cold water.
 - ❖ Do not steam clean.



Mobile Washers

- Do**
- ❖ Washwater should be collected and discharged to a municipal sewerage system; or reused in a closed-loop water recycling system; or hauled to a treatment facility.
 - ❖ Mobile washing operations must be performed on an impervious surface (i.e., concrete, plastic, or other) to contain and collect the washwater. The impervious surface must extend to a minimum of 4 feet on all sides of vehicle/equipment to trap overspray.
 - ❖ Mobile washers must use a portable impervious surface material when washing on a porous surface. A portable wash pit, vacuum recovery unit, or comparable device must be used to collect washwater for proper disposal.
 - ❖ Where washing is over an impervious area draining to a storm sewer, a temporary plug should be placed in the storm drain and the accumulated water pumped to the nearest sewerage system.
 - ❖ The wash area should then be cleaned or rinsed with water before a rain event and the washwater collected and discharged in a similar manner.
 - ❖ Consult your local sewer utility about diverting washwater to the sanitary sewer through collection and pumping.

- Don't**
- ❖ Do not discharge to storm sewers or surface waters.



Washing Vehicle Exteriors At New And Used Car/ Truck Dealerships

The following recommendations are for rinsing vehicles with cold water. Cleaning operations using soaps, detergents, or other cleaners should contain the washwater and discharge it to a municipal sewerage system with approval from the local sewer authority or use closed-loop water recycling systems.

- Do**
- ❖ Vehicles may be rinsed in the parking stalls as long as only cold water is used.
 - ❖ The rinse water must be directed away from storm drains to a grassy swale or a landscaped area.
 - ❖ If rinse water is allowed to run off to a storm drain, the drain should be retrofitted with catch basins to trap sediment and floating oils (see below).
 - ❖ Washing operations with soaps or detergents should discharge to a sanitary sewerage system.
- Don't**
- ❖ Do not use soap, detergents, or cleaners.
 - ❖ Do not discharge to surface water or a storm sewer without a catch basin or an equivalent treatment system.
 - ❖ Do not steam or pressure clean engines.

Catch Basins Design Information

- Each trapped catch basin serves up to one acre of an impervious (pavement, cement, etc.) surface area
- The inlet must have a shut off valve that is shut when washing is not occurring. This prevents the entry of stormwater.
- A catch basin's size is 2.5'x 2.5' by 48" deep. A steel grated cover on the basin must trap large floating debris and the outlet pipe must contain an inverted elbow.
- A sediment sump must be 24" minimum below the outlet pipe invert.
- Catch basins must be cleaned of solids and oil when 30 percent full with solids, or at least once a year. Catch basins should be cleaned during dry weather to prevent discharge of pollutants into the storm sewer. Solids and oil must be disposed of in a dumpster with prior notification of the local health department.

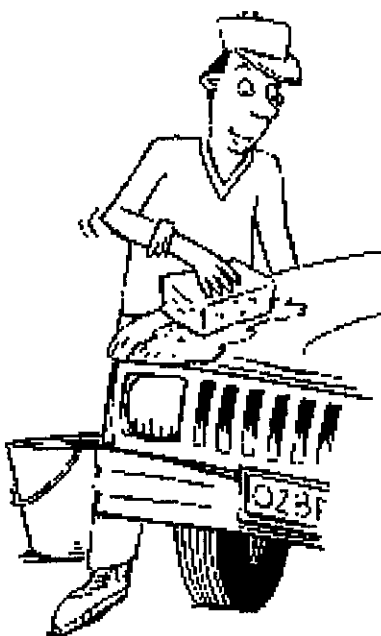
Small Dischargers

Small dischargers are defined as those where washing is carried out infrequently:

- Involving 1 or 2 pieces of equipment and/or vehicles per day, not exceeding eight during any week; and/or
- Discharging less than 100 gallons of washwater each day; and
- Washing of the vehicle/equipment is not the primary business activity of the discharges. For example, mobile washers are not small dischargers. Recommendations in this manual for "Mobile washers" should be followed.

- Do**
- ❖ Discharge to a sanitary sewerage system when possible. If you are not sure the nearby drain is a sanitary sewer, contact your local sewer utility.
 - ❖ If a sanitary sewerage system is not available, discharge to a landscaped, grassy ground surface, or dirt area where the washwater can soak into the ground or evaporate. Note: soapy washwater may adversely affect landscaping. Discuss this option with the building owner.
 - ❖ Keep a distance of at least 100 feet from a well head if discharging to ground.
 - ❖ Minimize the amount of soaps and detergents used.

- Don't**
- ❖ Do not discharge to a surface water or a storm sewer.
 - ❖ Do not clean engines or do any cleaning involving strong acids, caustics, or other metal brighteners.



Charity Car Washes

- Do** ❖ Discharge washwater to a sanitary sewer where available.
- ❖ Dispose washwater to grassy (preferred) or dirt areas where it can soak into the ground or evaporate.
- ❖ Keep a distance of at least 100 feet from a well head if discharging to ground.
- ❖ When washing is over an impervious area like pavement, that drains to a storm sewer or dry well, a temporary plug should be placed in the storm drain and the accumulated water pumped to the nearest sewerage system. Talk to your local sewer utility about diverting washwater to the sanitary sewer through collection and pumping.
- ❖ Minimize the amount of soaps and detergents used.
- Don't** ❖ Do not discharge to storm sewers or surface waters.



