



## **Green Buildings Checklist**

**Capital Division, Treasury Board Staff  
Ministry of Finance and Corporate Relations  
Province of British Columbia**

**December 2000 Edition**

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## PREFACE

Treasury Board is a committee of Cabinet, chaired by the Minister of Finance and Corporate Relations (MFCR), responsible for financial matters including capital project approvals. Treasury Board Staff acts as the Secretariat to Treasury Board. The Capital Division within Treasury Board Staff is responsible for recommending to Treasury Board and Cabinet overarching policies and priorities in the preparation and delivery of the province's annual capital program.

The Capital Division has also been tasked with developing standards, guidelines and budgeting tools to ensure the maximum value from capital expenditures and the achievement of government objectives. As of April 1, 2000, Cabinet has directed that all new capital projects are to incorporate green principles in their design and construction.

**The Green Building Checklist is a first step in introducing the concept of Green design and its application.** This document consists of a compendium of green items that have relevance to provincial capital expenditures. Attached is an extensive glossary and a bibliography which indicate some of the definitions and sources used in this Checklist.

Concurrently to the introduction of the Green Buildings Checklist, the Green Buildings BC – New Buildings Program is working with the Ministry of Finance and Corporate Relations, to carry out a series of pilot projects to assist in the development of a more comprehensive long-term policy. These pilot projects will help identify issues, opportunities and barriers to sustainable development. Lessons learnt will assist in the creation of a long-term policy framework, instruments and delivery mechanisms for the program. More information on these pilot projects can be found at [www.greenbuildingsbc.com](http://www.greenbuildingsbc.com).

The Green Buildings Checklist will be amended from time to time in light of experience gained.

The Checklist will be distributed to School Districts, Health Authorities, Social Capital Facilities, Architects, Engineers and other consultants, and to Crown Corporations. It will also be available on the Capital Division website at: <http://www.fin.gov.bc.ca/cd/policies.htm>

Copies may be requested by writing to:

Ministry of Finance and Corporate Relations  
Capital Division, Treasury Board Staff  
PO Box 9474  
Stn Prov Govt, Victoria, BC  
V8W 9W6.

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## **INTRODUCTION**

### **Purpose**

The purpose of this document is to:

- introduce the concept of Green Design;
- specify Treasury Board's requirements in incorporating Green Design into provincially funded projects; and
- present a Green Checklist against which projects can evaluate their incorporation of Green Design principles.

### **Overview**

#### **Green Design**

Green Design is a process for ensuring that the environmental impact of the design, construction and operation (including demolition/salvage) of a capital facility is minimized while the needs of users are met. This includes improving the facility's economic performance both in life cycle and capital cost terms. It also means that these facilities will:

- be more resource efficient,
- require less energy to operate,
- make better use of materials and consume less water.

In addition these facilities will:

- improve the comfort of building occupants,
- generate cost savings and,
- foster the growth of a strategic industry in the province.

In short, Green Design encourages products and processes that are both cost effective and pose fewer threats to workers, consumers and the environment.

#### **Policy**

In the summer of 1999, Cabinet directed that all new capital projects, beginning with fiscal year 2000/2001 approvals be 'green', e.g. incorporate green design principles.

#### **Green Checklist Requirements**

Treasury Board, through the Capital Division, requires that all new major projects incorporate green principles *within* the approved budget. Agencies responsible for delivering projects should review the Green Checklist and incorporate as many of the suggestions as possible into their design and construction phases.

Design Development Reports now include a requirement to include a completed Checklist. None of the items contained in the Checklist are presently mandatory. However, in the future there may be requirements for projects to attain some

standard level of green performance. This Checklist provides an opportunity for agencies to become familiar with the concept.

Not all items in the Checklist are appropriate for every project; solutions will vary depending on the specific site, climate, geography and facility constraints, as well as the skills of the design team. The intention of this Checklist is to present design approaches that should be considered in the course of design and construction. This approach allows design teams flexibility in their choice of items to include for their project. Owners, design teams and contractors are encouraged to minimize their projects' environmental impacts; Checklist items are ways their projects may respond to this requirement.

The Province of British Columbia is not liable for any building processes or products used to meet the incorporation of Checklist items into design concepts. All parties using this checklist are expected to adhere to all other applicable standards, laws, and codes.

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## GREEN CHECKLIST<sup>1</sup>

### *Integrated Design Team*

#### **Integrated Design Team**

1. Function as an integrated, cross-disciplinary design team including all those impacted by the building from the outset of the project
2. Include on the design team an energy engineer with experience in computer energy simulation.

#### **Set Environmental Goals**

3. Hold a pre-design *Workshop*<sup>2</sup> to establish environmental performance targets for the building (this checklist can be used for approaches that may help meet these targets).

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<sup>1</sup> A list of Green Building Resources can be found at [www.ei.gov.bc.ca/greenbuildings/](http://www.ei.gov.bc.ca/greenbuildings/)

<sup>2</sup> Italicized words within the text are defined in the Glossary.

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## Energy

### Reduce Energy Use

4. Design building to use at least 25% less energy than the *MNECB* (preferably 50% less) and apply for the *CBIP* and other Federal financial incentive programs.
5. Build the least area suiting the needs of the project, that requires the least energy to maintain. Be space efficient, e.g. combine uses.
6. Design an energy-efficient envelope: appropriate insulation, tight construction and high-performance, *low-e* windows (when this reduces life cycle costs).
7. Control solar heat gain and glare by selecting glazing with appropriate ratio of visible light transmittance to solar heat gain coefficient.
8. Avoid *thermal bridges* in walls (use continuous insulation, or eliminate metal studs in outside walls, or otherwise ensure thermal break).
9. Use trees & plantings to reduce summer solar gain, to channel summer breezes, and to block winter winds (deciduous trees let winter sun through and shade summer sun).
10. Use light coloured roofs or green roofs to reduce *albedo*.
11. Use light coloured site surfaces (walkways, courtyards etc) or provide green space to reduce *albedo*.
12. Ensure windows have appropriate exterior shading (when this reduces life cycle costs).
13. Install high-efficiency heating and cooling equipment
14. Install high-efficacy lamps & fixtures (e.g.: compact fluorescents with T-8 lamps).
15. Install high-efficiency appliances.
16. Explore feasibility of *heat recovery* equipment.

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### **Energy (CONTINUED)**

#### **Optimize Renewable or Alternate Energy Use**

17. Use *demand control ventilation*. This is most appropriate for spaces with large but intermittent or short-duration occupancy loads.
18. Use motion- or CO<sub>2</sub>- detecting occupancy sensors for lights and HVAC systems. This is most appropriate for spaces with intermittent or short-duration occupancy loads.
19. Plan for independent *building commissioning* for optimum performance of all systems.
20. Maximise use of natural ventilation and passive energy to meet heating and cooling needs, especially during *shoulder seasons*
21. Maximize *daylighting* throughout the year.
22. Use solar water pre-heating, *photovoltaic panels*, wind power, *geothermal heat exchange*, local *microhydro*, *fuel cells*, or other benign energy sources.

#### **Encourage More Sustainable Transportation Energy Use**

23. Build *infill* and *mixed-use* development.
24. Locate building to have access to public transit, bike routes, and pedestrian routes.
25. Design safe, attractive, pedestrian and bike-friendly access within the site (e.g. covered, well-lit walkways, separate bikeways).
26. Build shower and changing facilities for cyclists and joggers.
27. Give carpool cars preferred parking.
28. Minimize car parking spaces.
29. Maximize bicycle parking spaces.
30. Use locally-produced materials.

## Water

### Reduce Water Use

Install (31 to 39):

31. Water closets with a maximum of 6 litres per flush.
32. Wastewater piping with a generous pitch to account for smaller water flows.
33. Lavatory and kitchen faucets with maximum of 9.5 litres per minute.
34. Public lavatory faucets with 2 litres per minute or less.
35. Public faucets to be self-closing, time-activated (5 second shut off) or motion-detecting.
36. Showers with a maximum of 9.5 litres per minute; public showers self-closing time-activated (1 minute shut off).
37. Urinals with a maximum of 3.6 litres per flush (use individual-flush urinals).
38. Dishwashers with a maximum of 27 litres on normal cycle (for non-industrial use).
39. Clothes washers that are energy and water efficient (e.g. horizontal axis).
40. Use one of the following strategies:
  - waterless toilets or urinals;
  - composting toilets; or
  - local biological wastewater treatment facilities.
41. Incorporate a *greywater* treatment system that reuses water in toilets or irrigation.
42. Capture & store rainwater for indoor and outdoor uses.
43. Plant new landscape and / or maintain native landscape that requires little or no watering.
44. Restrict water features that use potable water except when they perform another function such as cooling.

### **Water CONTINUED**

#### **Manage Stormwater Pollution and Flow Before it Leaves Site**

45. Install water meters to allow measurement of potable water consumption.
46. Install oil / water separators to treat run-off from parking lots (do not use them for run-off from fields or roofs).
47. Use *vegetative swales*, *filter strips*, or *vegetative buffers* to treat stormwater runoff from fields, roofs and roads, where soil conditions permit.

#### **Recharge Groundwater**

48. Design infiltration basins, *vegetative swales* and drywells instead of subsurface storm drains to absorb and filter rainwater, where soil conditions permit.
49. Design roads and parking lots without curbs or with curb cuts or openings that drain to stormwater treatment & infiltration measures.
50. Use pervious surfaces (e.g. ones which allow water to penetrate) for half of the surfaces that are usually paved (e.g.: roads, parking, courtyards and pathways), where soil conditions permit.

## Landscape

### Preserve and / or Encourage Biodiversity

51. Maintain the site's existing large trees wherever possible.
52. Minimize excavation and soil disturbance of natural landscapes.
53. Avoid building on environmentally sensitive areas like wetlands and endangered species habitat.
54. Build on *brownfield sites*, and avoid building on *greenfield sites* where possible.
55. Locate buildings to minimize impact on landscape and existing wildlife corridors.
56. Minimize development footprint (including parking, utilities, roads).
57. Cluster buildings to reduce site coverage.
58. Restore damaged ecosystems.
59. Plant native and well-adapted, non-invasive species.
60. Provide habitat that provides shade, shelter, food, and water to sustain desired wildlife.

### Use Integrated Pest Management

61. Reduce need for chemical use by designing the landscape to allow for *Integrated Pest Management* approaches.
62. Design the building using *Integrated Pest Management* techniques (e.g.: design details that are insect-resistant to ensure minimal pesticide use).

### Moderate the Microclimate and Reduce the Urban Heat Island Effect

63. Use site grounds, balconies, trellises, and rooftop gardens to maximize green space.
64. Design site to allow for food gardens and other planting.

### **Materials**

- Renovate** 65. Renovate an older building if it can be upgraded to operate efficiently.
66. Keep as much of the existing structure as possible.
- Design for Durability** 67. Use durable and low-maintenance materials to minimize replacement intervals and maintenance requirements (e.g.: concrete flooring).
68. Provide flexible floor plans, column spacings and floor-to-floor heights that can be easily adapted to many uses, to ensure long structure life.
- Salvage** 69. *Salvage materials* from an existing structure being demolished or purchase materials from a *salvage* depot.
70. Design for disassembly. Select building systems that can be deconstructed at the end of the building's useful life.
- Recycle** 71. Include products with high post-consumer *recycled* content (see glossary for examples).
72. Use materials that can be recycled once they have been used.
- Use Materials Efficiently** Use the following design strategies (73 – 77):
73. Value engineering.
74. Advanced framing techniques.
75. Multiple-use materials (for example those that serve as structure, finish and part of the energy strategy).
76. Standard-dimension materials.
77. Modular dimensions for structure and finishes.
- Use the following resource efficient materials (78 – 80):
78. Pre-cut materials.
79. Prefabricated materials.
80. Engineered structural products.

### **Materials CONTINUED**

#### **Wood**

81. Design with panel, precut and engineered construction products to minimize waste, e.g. wood studs come in 2' (610 mm) increments, panels are mm 8'x4' (2440 mm x 1220 mm).
82. Use optimum value engineering to build frame structures using carefully aligned, engineered wood products.
83. Use finger jointed studs, trusses top or bottom plates.
84. Use indigenous and local materials to reduce transportation costs.
85. Do not use rare or endangered wood species such as ebony, rosewood, teak, and Honduras mahogany which can contribute to de-forestation of tropical rainforests.

### **Waste**

#### **Make It Easy For Occupants to Recycle and Compost**

Provide a central location convenient to occupants and loading bays to collect and store:

86. *Recyclables.*

87. *Compostables.*

Create convenient storage and sorting facilities in use areas (e.g. under the sink, along-side the garbage) for:

88. *Recyclables.*

89. *Compostables.*

90. Provide *composting* facilities on site.

### **Construction**

#### **Reuse Construction and Demolition Waste**

Use the *GVRDs* Project Waste Management Master Specification (or equivalent) to ensure that (92 – 97):

91. Construction and demolition waste is minimized.
92. As much construction and demolition waste as possible is recycled, reused or salvaged.
93. The Contractor follows a formal Waste Management Plan (WMP).
94. This WMP identifies each material proposed to be salvaged, reused, or recycled.
95. This WMP shall ensure the recycling of:
  - corrugated cardboard,
  - clean dimensional wood,
  - palette wood,
  - concrete,
  - brick,
  - concrete block,
  - asphalt,
  - metal,
  - drywall,
  - land clearing debris,
  - paint.
96. For demolition projects, this WMP shall encourage the salvaging of:
  - dimensioned lumber
  - heavy timbers
  - wood siding
  - structural steel
  - wood panelling, moulding, trim and wainscoting
  - heritage architectural elements
  - cabinets and casework
  - brick and block
  - electric equipment and light fixtures
  - plumbing fixtures and brass
  - windows, doors and frames
  - hardwood flooring.

**Construction CONTINUED**

**Reuse Topsoil**

97. Save, protect and reuse all topsoil removed during construction.

**Protect  
Vegetation,  
Watercourses,  
and Wildlife  
Habitat**

98. Inventory vegetation, watercourses, and wildlife habitat on site before construction.

99. Fence off vegetation, watercourses, and wildlife habitat during construction.

100. Avoid major changes in surface grade during construction.

101. Minimize site stormwater runoff during construction, & treat minimal runoff for oils, greases, silt, etc..

102. Avoid or minimize use of pesticides and toxic chemicals during construction that could leach into groundwater. Choose least toxic options.

### *Indoor Environmental Quality*

#### **Minimize Air Pollutants**

103. Select *indoor finish materials* that are “Ecologo” or “Zero VOC” certified (or equivalent).
104. Avoid any material that will *off-gas* pollutants such as formaldehyde, *VOCs*, *CFCs* or *HCFCs*.
105. Avoid ozone-depleting chemicals in mechanical equipment, including *CFCs* and *HCFCs*.
106. Avoid fibrous (see *mineral fibre*) floor, wall, and ceiling finishes on any surfaces that are exposed to inhabited spaces, supply or return air.
107. Locate air intakes distant from sources of outdoor pollution.
108. Avoid materials and design details that act as *sinks* (traps, sponges) for pollutants.
109. Ensure that ventilation systems are pollution-free by:
  - Protecting ventilation systems & ductwork from pollution contamination during construction, AND / OR
  - Cleaning and verifying supply and return air duct systems and ventilation equipment before occupancy.
110. Design envelope details to minimize moisture entry, and allow passive drying to deal with any water that may enter to insure against mold and mildew.
111. Avoid ceiling plenums that expose the supply or return airstreams to artificial *mineral* or glass fibres.
112. Specify supply air filters at a minimum of 40% efficient according to *ASHRAE Dust Spot Method*.
113. Perform ventilation air effectiveness studies for typical spaces with high or prolonged occupancy.
114. Require independent *commissioning* of HVAC systems and equipment.
115. Provide adequate drainage of condensation and moisture from HVAC equipment, avoiding standing water in contact with supply or return airstreams.

### ***Indoor Environmental Quality CONTINUED***

#### **Provide Daylighting And Views**

- 116. Design details or systems to ensure that radon cannot enter a building, where radon and soil gasses are a potential indoor air pollutant
- 117. Ensure that *daylighting* is the primary light source in spaces that are used in the day.
- 118. Provide high quality *daylighting* and visual comfort by controlling glare, and providing even daylight distribution.
- 119. Provide visual access for occupants to the outdoors through eye-level glazing. .

### ***Life-Cycle Assessment***

Perform a *life cycle assessment* of:

- 120. The major components and systems.
- 121. The building as a whole, integrated system.

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## GLOSSARY

- Albedo:** The proportion of reflected radiation to the total radiation falling on a surface. A highly reflective surface has a high albedo (see *urban heat island effect*). Roofs and other surfaces such as playgrounds, courtyards and paths should be designed with a high albedo (e.g. an albedo reflectance of 0.5). This can be accomplished either through the use of a light-coloured surfaces or using vegetation.
- Alternate energy:** Alternate energy may include *geothermal heat exchangers, fuel cells*, and other relatively benign energy sources.
- ASHRAE:** The American Society of Heating, Refrigeration and Air Conditioning Engineers
- ASHRAE Dust Spot Method:** Dust spot efficiency is measured by testing a filter's ability to efficiently collect fine particles of a mix specified by the ASHRAE filter test procedure.
- Biodiversity:** The complete range of biological organisms that exist in an undisturbed ecosystem.
- Brownfield sites:** Previously-used, under-used, or abandoned industrial and commercial facilities that are ecologically degraded or environmentally contaminated.
- Building commissioning:** A comprehensive plan and process that ensures all building systems perform according to the documented design intent and the owner's operational needs.
- Chlorofluorocarbons (CFCs):** These chemicals are used as coolant in mechanical equipment (refrigeration, air conditioning, packaging, insulation, or as solvents and aerosol propellants) and are now phased out due to their damaging effects. CFCs should be reclaimed whenever servicing or disposing of old equipment. Building materials that use CFCs or HCFCs should be avoided (or they will off-gas over the life of the material). (See *HCFCs*)
- Commercial Building Incentive Program (CBIP):** A program from Natural Resources Canada--Office of Energy Efficiency. Financial incentives of up to \$80,000 are given for new commercial / institutional buildings that are 25% more energy efficient than the *MNECB*. Code and CBIP compliance software is available. Contact Jim Clark (613) 947-1948 or Terri Scott (613) 943-9227 or visit: <http://cbip.nrcan.gc.ca/cbip.htm>
- Compost:** A process by which organic wastes break down into soil.
- Daylighting:** Lighting spaces within a building with natural light.

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<b>Demand control ventilation:</b>	Fresh air is supplied in response to actual number of occupants and occupant activity. This can be through occupancy sensors or user control.
<b>Filter strip:</b>	A landscaping feature that treats run-off by diverting it across a grassy area.
<b>Fuel cell:</b>	An electrochemical technology that converts energy into electrical power. Depending on what it is fuelled by it can generate less pollution than grid-connected power.
<b>Geothermal heat exchange:</b>	A technology that uses electricity to exchange heat with the ground. In colder times, it uses heat from below the ground to heat buildings. In warmer times, heat is extracted from the building and put into the ground.
<b>Greywater:</b>	The wastewater from faucets, showers, and clothes washing that does not contain sewage or faecal contamination. Kitchen sink and toilet water is called blackwater. Greywater can be reused for irrigation after it is filtered.
<b>Greater Vancouver Regional District (GVRD):</b>	A regional district that offers resources and information in the following areas: composting, recycling, salvaging, and job-site recycling.
<b>Hydrochlorofluorocarbons (HCFCs):</b>	HCFCs deplete ozone slower than <i>CFCs</i> , and can pose an environmental problem. A total ban on HCFCs is to be effective 2030. Building materials (e.g.: some insulation and carpet pad) which use CFCs or HCFCs should be avoided as due to off-gassing.
<b>Greenfield sites:</b>	Sites that have never been previously developed.
<b>Heat recovery systems:</b>	These are mechanical systems that are designed to capture waste heat from one system for use in another, avoiding having to generate heat from a primary energy source.
<b>HVAC:</b>	Heating Ventilating and Air Conditioning
<b>Indoor Air Quality (IAQ):</b>	Acceptable IAQ is defined by ASHRAE standards. Defined as air that is not likely to pose a health risk and if a substantial majority of occupants do not express dissatisfaction.
<b>Indoor finish materials:</b>	Paints, coatings, adhesives, architectural sealants, filler and surface areas.
<b>Infill:</b>	Infill development “fills in” empty lots of land (or empty portions of already partly used lots) within an urban area, helping to reduce urban sprawl.

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<b>Integrated Pest Management (IPM):</b>	A comprehensive method of pest management intended to minimize impacts on the environment and on human health. For more information, contact the Integrated Pest Management Division, Ministry of Environment, Lands and Parks. Contact Linda Gilkeson, IPM Coordinator: phone: (250) 387-9410.
<b>Life cycle assessment:</b>	An economic analysis that includes capital costs, transportation costs, installation costs, operating costs, maintenance costs, and disposal costs.
<b>Low-e windows:</b>	<i>Low-emissivity windows</i> are designed to reflect heat but admit light. This keeps buildings warmer in winter and cooler in summer, saving energy.
<b>Microhydro:</b>	A small-scale, site-specific, renewable resource of electricity using small scale hydro generators.
<b>Mineral fibres:</b>	Minute insulation fibres made from glassy minerals. They are formed by melting and spinning glass fibre.
<b>Mixed-use:</b>	Development that combines many uses, like institutional and residential with retail or commercial.
<b>MNECB:</b>	Model National Energy Code for Buildings.
<b>Off-gassing:</b>	Any material that emits gaseous chemicals into the air. See VOCs.
<b>Photovoltaic panels (PVs):</b>	A technology that uses semiconductor material in photovoltaic (PV) solar panels to convert sunlight to electric power.
<b>Recyclables:</b>	Materials that are able to be collected and recycled in the vicinity they are collected.
<b>Recycled materials:</b>	Materials that are bought new but have used some recycled content in the manufacturing process. There are several main categories. Some products are labelled as having post-consumer content: material that has been used as a consumer item and then recycled. Pre-consumer recycled content (also called post-industrial and secondary material) is material that has been part of an industrial process and is then recycled. Standard examples include: drywall, steel framing, insulation (cellulose, polystyrene, fiberglass, and mineral wool insulation are all available with recycled content), ceiling tiles, concrete aggregate, compost, carpet and pad, floor tile, paint, glass cullet, playground surfacing, roofing (shingle, tile, and panel roofs all are available with recycled content) parking stops.
<b>Renewable energy:</b>	Energy from sources that are continuously being renewed like wind energy, solar energy, <i>mirco hydro</i> .

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<b>R-value:</b>	The thermal resistance of a material.
<b>Salvaged materials:</b>	Materials that have been used before and have not been remanufactured, but may require some minor processing. Standard examples include: floors, landscaping materials, brick, masonry, sinks, bathtubs, windows, doors, hardware, tile, millwork, dimensional lumber, timbers, electrical fixtures, insulation.
<b>Shoulder Seasons:</b>	Spring and autumn, when a building requires both heating and cooling in the course of daily operation.
<b>Sick Building Syndrome (SBS):</b>	A condition that includes impacts on health and comfort experienced by occupants of some buildings.
<b>Sink:</b>	Some carpets, drywall and insulation can act like sponges or a trap for pollutants. They can absorb gases, vapour, moisture, mildew and other pollutants. They will then re-emit these pollutants later.
<b>Stack effect:</b>	Thermal buoyancy induced by a temperature difference between the outdoor air and the indoor air.
<b>Thermal bridge:</b>	A pathway for heating energy flow through with little resistance. Any highly conductive element like a metal stud, spacer or channel in the building envelope that penetrates or bypasses the insulation will act as a bridge through which heat can escape.
<b>Thermal flywheel:</b>	The cyclical pattern that is established when a building element like a solid masonry wall collects heat during one period and discharges it during another period.
<b>Urban heat island effect:</b>	The replacement of vegetative cover with artificial surfaces has resulted in increased local temperatures. This phenomenon can increase urban air temperatures by up to 10 O F compared to air temperatures over adjacent rural areas.
<b>Variable air volume (VAV):</b>	A method used to deliver heating or cooling used in some <i>heating ventilating and air conditioning (HVAC)</i> systems. VAV systems vary the air flow to a space in proportion to its demand for cooling or heating. Other systems vary supply air temperatures, and keep airflow constant.
<b>Vegetative buffer:</b>	A strip of heavily vegetated landscape that is designed to absorb, filter and treat runoff water.

**Vegetative swale:** Also known as a grassy swale or a bio-swale, this is an earthen depression that channels and treats stormwater, and promotes infiltration. This long, gently-sloped landscape feature is like a ditch except that it is planted with grasses or native wetland plants selected for stormwater treatment, and is sized for specific infiltration and detention capacities.

**Volatile organic compounds (VOCs):** Carbon-containing chemicals that evaporate from material surfaces into indoor air at normal room temperatures. This process is described as *off-gassing*. Symptoms of VOC exposure include dizziness, eye irritation, respiratory irritation, nasal congestion and headaches.

**Workshop:** A workshop, or workshops, in which all project team members come together in the early phase of the project's design to set goals and generate design ideas.

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