Green Infrastructure Partnership

Topsoil: *Just How Do You* Obtain a Performing Topsoil Layer, to Advance Rainwater Management & Water Conservation Goals?

Technical Primer for Municipal Staff and Designers

February 2010

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Preface

An absorbent topsoil layer has emerged as a fundamental building block for achieving *water sustainability outcomes* through implementation of green infrastructure practices:

- **Rainwater Management:**
  An absorbent topsoil layer serves as a sponge when it is raining, results in healthier landscaping, and contributes to *sustainability of aquatic habitat*.
- **Water Conservation:**
  Well-rooted landscaping then requires less irrigation water, stays green longer during a drought, and contributes to *sustainability of water supply*.

In collaboration with three municipalities (City of Surrey, City of Courtenay and District of North Vancouver) that have pioneered absorbent topsoil requirements, the Green Infrastructure Partnership has developed two primers to assist local government staff and designers: this one deals with *Technical* aspects; while the other is a *Law and Policy Primer.*

The co-leads for this initiative were **Susan Rutherford** (Staff Counsel with West Coast Environmental Law Research Foundation) and **Rémi Dubé** (Acting Manager for Development Services, City of Surrey). Their efforts are greatly appreciated.

Raymond Fung, P.Eng., Chair
Green Infrastructure Partnership
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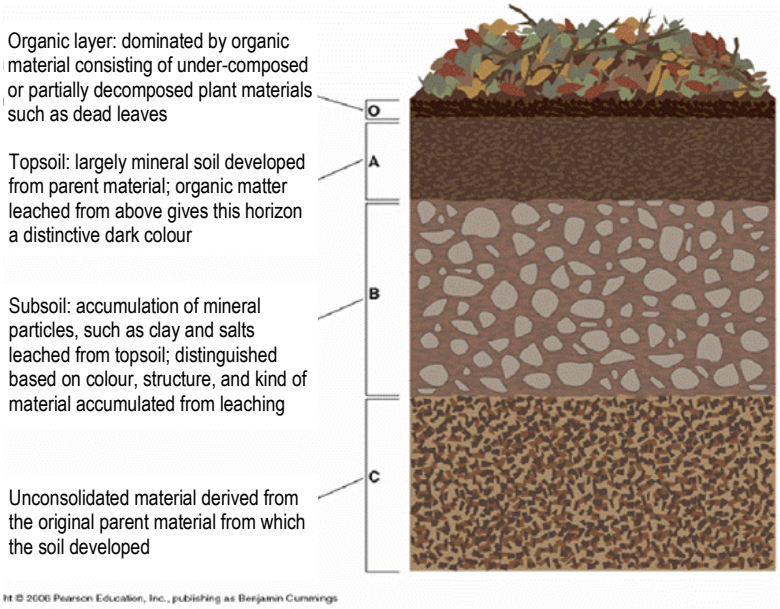
Introduction: Topsoil Implementation Procedures

Development changes the characteristics of a watershed. Everyone involved in the development process has the duty to take reasonable steps to reduce the negative impacts of development. The intent of this checklist is to provide a common ground for approving agencies and designers to produce minimum acceptable performance standards.

As part of a Green Infrastructure Partnership Topsoil Primer set that presents examples of acceptable mitigative measures and Best Management Practices (BMP's), this Technical Primer checklist outlines some of the field characteristics of the implementation of a topsoil objective. This document provides information that can be incorporated into design guidelines and specifications to define what is acceptable.

This Technical Primer provides design steps and implementation issues to provide an "on the ground" low impact development methodology. It supplements common sense and appropriate design procedures which always apply when designing and implementing site features.



Application /Suitability

Improving or adding a performing topsoil layer to a site, as a BMP for stormwater/rainwater management and water conservation, is one of the simplest and easiest of the BMPs to implement. It treats rainwater runoff through detention, exfiltration, and slowing down of flows.

[*] **These Green Infrastructure Partnership (GIP) Primers** are built on the experience the GIP has gained, since 2004, in promoting green infrastructure approaches to development in British Columbia, through series such as its "Showcasing Innovation – Celebrating Green Infrastructure" series. In spring 2009, following the Surrey Water Balance Model Forum, the GIP Steering Committee and other Forum organizers realized there could be a benefit to providing municipal staff and the professional design community with a succinct statement of all of the legal, policy and technical "essential elements" necessary to successfully implement a specific green infrastructure objective. The Topsoil Primer set is the fruit of that idea, and the first in what the GIP hopes will become a series of Primers. The Primers are premised upon the theme of *shared responsibility* – essentially recognizing that the responsibility for ensuring that development is sustainable rests with *all* who make decisions or take actions that impact the development process, from elected representatives, to staff and consulting professionals. The GIP thanks the City of Surrey, the City of Courtenay and the District of North Vancouver for their support and sharing of lessons learned in preparing the Topsoil Primer set.

Paying simple care to some of the following details will optimize the benefits and the long term performance and acceptability of this form of water management.

This primer provides general technical steps to implement topsoil as a stormwater/rainwater BMP. Law and policy implementation issues are addressed in the accompanying **Law and Policy Primer**. The main technical considerations are application and suitability, proper sizing and design, **materials and placement, and inspection and quality control**. The main difference between traditional landscaping and topsoil as a BMP is the consideration by the designer, owners and installers of the importance of quality control and proper installation.

Areas covered by existing tree canopy and undisturbed areas maintain the existing infiltration and storage qualities of a site. While undisturbed areas could benefit from additional topsoil to increase storage, the designer will need to balance the suitability of disturbing areas compared to the potential benefits. Tree cover provides another form of BMP that is not addressed in this technical primer but the benefits of tree cover are significant and the designers are encouraged to maintain or increase canopy cover where feasible.

Determining Existing Conditions:

Total Site Area	A_{Total} m^2
Undisturbed areas, not receiving flows from impervious areas	B m^2
Net Design Area	$A_{Net} = A_{Tota} - B$
Existing topsoil Depth	d1 mm
Pervious Landscape Area (Excludes B)	Pv m^2
Impervious Area draining to Pervious Landscape (Pv)	Ip m^2
Pervious ratio**	P1= Pv/ A_{Net}
Impervious ratio	I1= Ip/ A_{Net}

****** Pervious surfaces able to infiltrate water into the subsoil that will always remain pervious, discount areas that may be paved or built upon in the future.

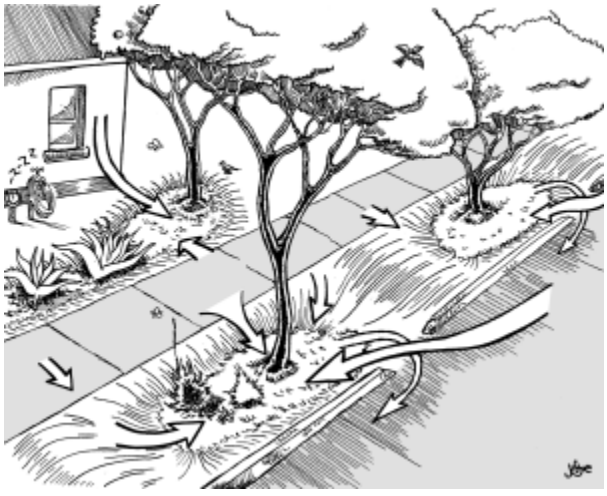
Enhanced Topsoil Depth d2 = d1 + (d1 x I1/P1) mm

(d2 is depth required to match existing volume and infiltration)

Sizing and Design:

Topsoil, as a BMP, is forgiving in its design with failsafe performance if basic sizing guidelines are observed.
Sizing is limited to the available pervious surfaces of the site, so the site layout should maximize the site areas that can be covered with topsoil.

- Maximize topsoil areas as part of site design.
- Pervious areas that do not receive water from impervious areas should be subtracted from the total site area when determining the topsoil depth.
- Pervious areas that remain undisturbed by the development can be subtracted from the total site area.



- Design topsoil areas to accept runoff from impervious areas.
- Design impervious areas to drain to topsoil and pervious areas.
- Pervious areas receiving runoff should be 20% or more the size of the impervious area draining to it.
- Flow velocity of water entering topsoil areas should be less than 0.3 m/s for planters and 1.0 m/s for turfed areas (control tributary surface types, area and slopes to reduce flow velocities).
- Topsoil areas should be gently sloping (2%) or dished for ponding.
- Ponding time should be less than 48 hours.
- Provide overflows and/or under drains to maintain desired performance.
- Ponding depth should be limited to 150 mm.
- Overflow should be designed so as to allow safe conveyance from ponded areas after large rain events.
- Avoid concentrating flows to landscaped areas unless inlets are well designed to manage flow velocities, debris and sediments.
- Provide 150mm elevation difference from pavement to landscaped areas to allow for sediment build-up and plant growth at the interface.
- Do the topsoil placement and planters meet the residents' expectations for functionality and aesthetics?
- Minimum topsoil depth should be 150 mm.
- Maximum topsoil depth should be 450 mm.
- Where the topsoil depth needed is greater than 450 mm, additional sustainability measures may be required (e.g. detention, infiltration galleries, green roofs, tree canopy, rain gardens, and pervious pavements).
- Does the subsoil infiltration rate require the addition of sub-drains to provide adequate drainage? (infiltration < 0.5 mm/Hr)
- Do subsoil infiltration rate and available infiltration area allow for a reduction in the amount of topsoil required? (Infiltration > 75 mm/Hr)

Material Products and Placement

Proper selection and preparation of materials is essential for the successful implementation of the Topsoil BMP. Topsoil contains organic material subject to variability between suppliers and production methods. A proper balance of quality control for hydraulic performance, structural stability and plant support is critical.

- First, identify if the topsoiled/landscaped area is a low traffic lawn, high traffic lawn, or planters, shrub or groundcover.
- Second, once the use is determined, ensure the topsoil meets the specifications appropriate to that use, and amend soil as necessary:
  - for lawn areas, topsoil should meet or exceed the MMCD specification for growing medium with the organic content amended to be 8%, and
  - for planters, shrub and groundcover areas, topsoil should meet the MMCD specification for growing medium with organic content of 8 to15%.

- Protect existing subsoil and placed topsoil from compaction during construction.
- Rip or till subsoil prior to placing topsoil to a depth of 150 mm (do not use heavy machinery).

- Till the subsoil and topsoil to transition soil textures (this avoids potential barriers to water flow between the soil layers).
- Cover the topsoil with vegetative cover or mulch to improve infiltration properties, reducing crusting and erosion.
- Provide effective erosion control of topsoil and upstream areas to protect from excess sediment onto the topsoil areas.
- Transport, store and place topsoil in a manner that preserves the desired structural qualities of the materials.

Inspection and Quality Control

Well designed and placed topsoil is effective and resilient. Quality control and follow-up are crucial to the long-term success of this measure. Designers should ensure that mechanisms are in place through municipal or existing inspection requirements as described in the accompanying **Law and Policy Primer**, or determine if additional requirements need to be set up as part of the individual project.

Jordmån: Kulturjordmån Foto: Åke Nilsson

- Ensure your topsoil supplier is familiar with the intended objectives and structural requirements of the soil in all aspects of the process: manufacture, storage, shipping, and placement.
- Ensure installation crews are aware of the importance of proper placement techniques and grading.
- Ensure the site construction supervisor is aware of the function of the topsoil and has quality assurance procedures in place.
- Topsoil storage, handling and movement must protect the materials, structural integrity, and quality and prevent contamination that may affect the materials performance.
- Topsoil, once placed, should be protected from compaction by other trades or construction practices. Alternatively, measures should be put in place to remediate compaction after all of the construction work has been completed.
- Where topsoil is placed as a requirement for sustainability, consider how its properties will be protected over the long term. (Consider the use of restrictive covenants, education programs, and signage. For more details, see the **Law and Policy Primer**.)
- Procedure should be put in place to confirm the final topsoil depth meets or exceeds required depth during installation, with measures in place to certify the correct placement.
- Follow-up inspection procedures should be implemented to allow for certification of the installation, including as-built drawings and material specifications used.
- Does the landscaping require special maintenance and long term monitoring? Are the requirements set out in a maintenance manual?
- Confirm that inlet and outlets are working and will remain functional and sustainable over the long term.
- Have you taken financial security to ensure the proper long term functioning of this BMP?