10 - The Importance of Vegetation and Soils

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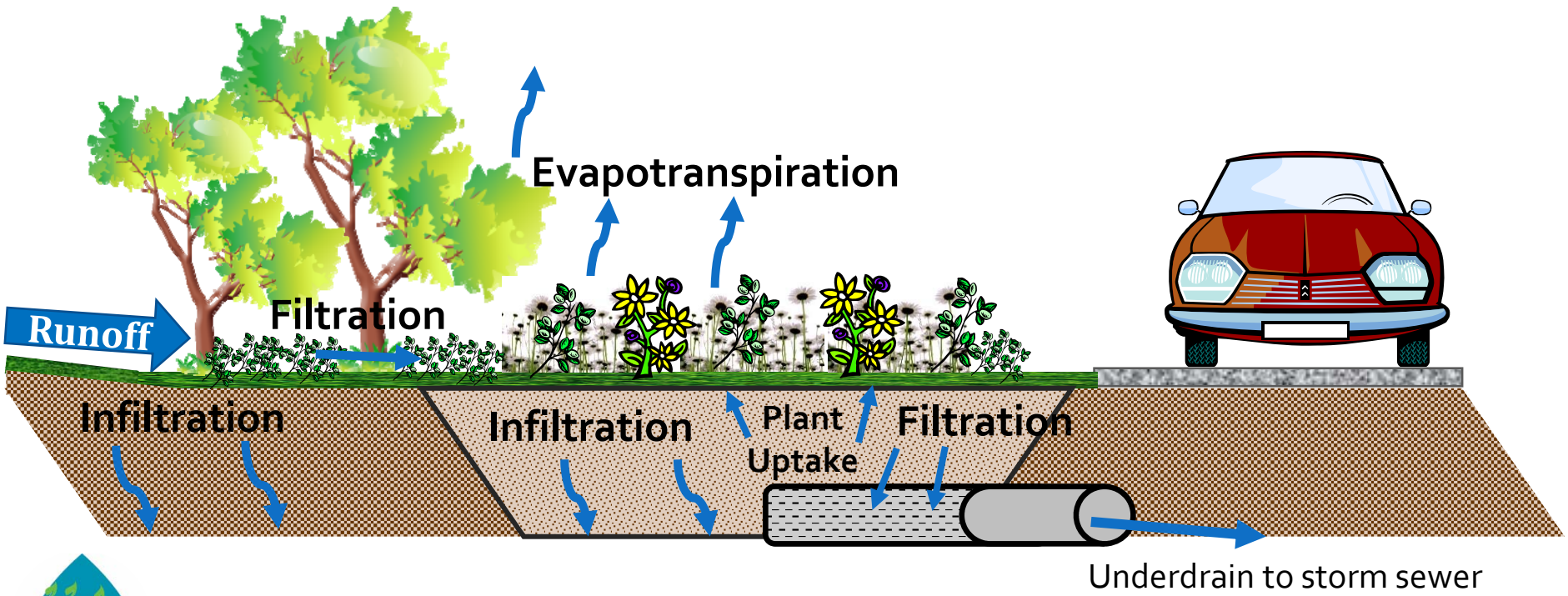
Module Content

- Vegetation and soil mechanisms for runoff reduction
- Vegetation requirements and guidance
- Soil requirements
- Soil amendment guidance

Vegetation & Soil Mechanisms

- **Infiltration (Soil)**: Runoff reduction & pollutant removal (all pollutants)
- **Evapotranspiration (Vegetation)**: Runoff reduction
- **Plant Uptake (Vegetation)**: Pollutant removal (nutrients)
- **Filtration (Soil and Vegetation)**: Pollutant removal (TSS, P, N, Metals)



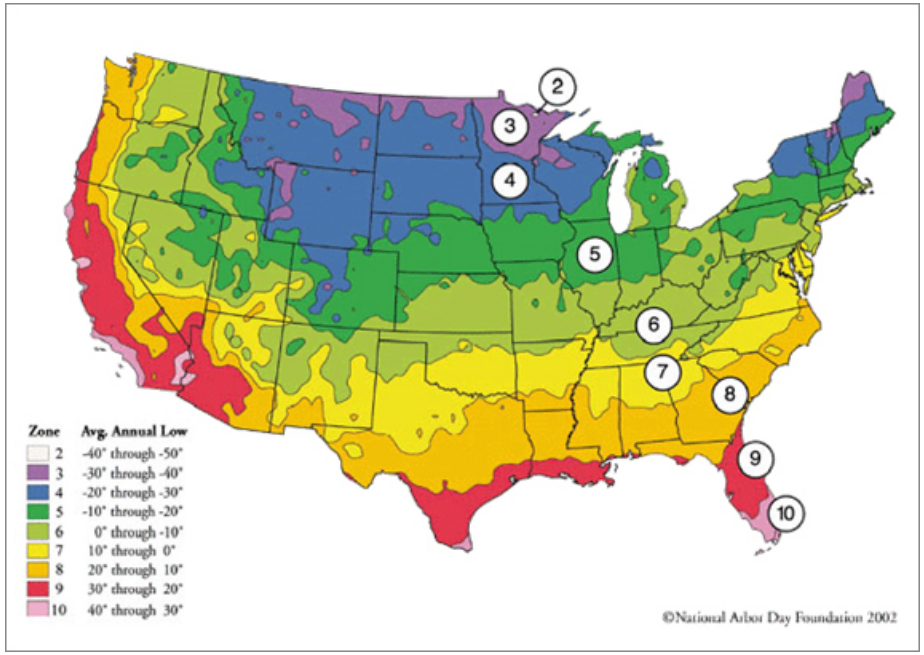
GIP Reliance on Soil and Vegetation

GIP	Mechanisms Used
Bioretention Urban Bioretention Water Quality Channel (Dry) Downspout Disconnection Sheet Flow	Infiltration (without underdrain) Evapotranspiration Plant Uptake Soil Filtration (with underdrain)
Infiltration Trench	Infiltration
Green Roof Grass Channel	Evapotranspiration Plant Uptake Surface Filtration
Permeable Pavement	Infiltration (without underdrain) Soil/Media Filtration (with underdrain)
Reforestation	Infiltration Evapotranspiration Plant Uptake Surface Filtration
Extended Detention	Infiltration (minor) Surface Filtration (minor)

Vegetation Guidance

Performance Standards

- <u>Vegetation</u>
  - Healthy
  - Growing
  - Perennial
  - 75% Survival > 1 year



- Preferences
  - Native
  - Zone appropriate
  - Low maintenance
  - Land use appropriate

General Vegetation Requirements

- Temporary stabilization must be replaced with perennial vegetation (or other permanent, non-eroding measure) before construction is complete

General Vegetation Guidance

- Native species preferred (low maintenance)
- Ornamental species may be used if not aggressive or invasive
- Native plant species table provided in Manual.

General Vegetation Guidance

- Plant Spacing guidance provided in Manual.

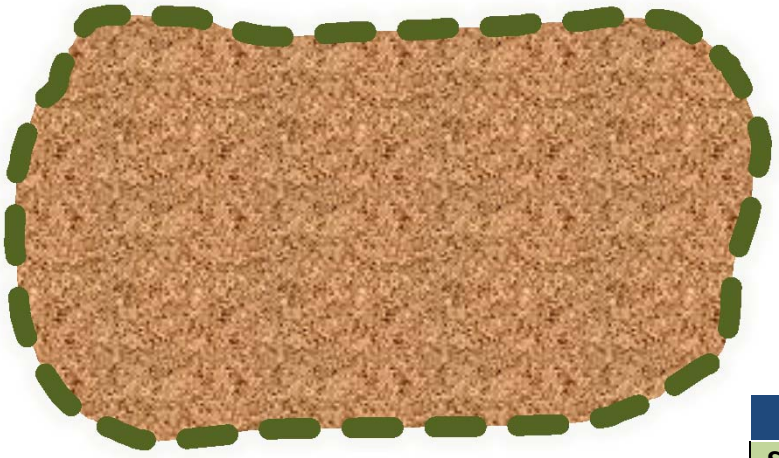


Table GIP-01-03 Plant Spacing for Perennials, Grasses, Sedges and Shrubs	
Spacing (O.C.)	**Plants per 100 sq.ft.**
18” o.c.	51.2
24” o.c.	29
28” o.c.	22
30” o.c.	18.5
36” o.c.	12.8
42” o.c.	10
4’ o.c.	7.23
5’ o.c.	4.61
6’ o.c.	3.2
8’ o.c.	1.8

Specific BMP Vegetation Guidance

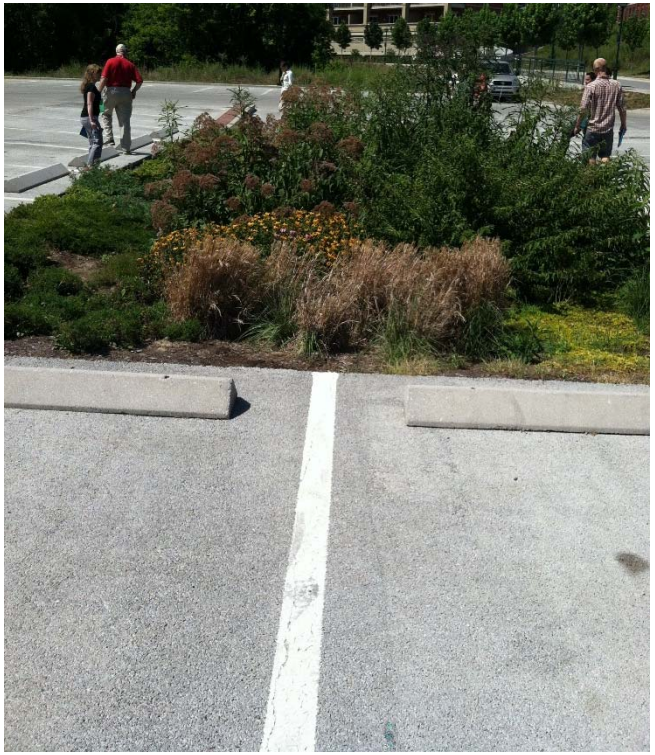
- Found in BMP Design Specifications
  - Section 5 - Hamilton County Stormwater Mgmt. Manual
- Most do not vary greatly
  - Reforestation is exception
- Three Planting Templates
  - Ornamental
  - Meadow
  - Reforestation
- Depends on scale and type of GIP

Ornamental Planting

- Perennials, sedges, grasses, shrubs and trees (optional) in a mass bed.
- Recommended for commercial and residential (common area) sites where manicured landscape and visibility is important.
- Highest maintenance template – reduced if native species are used

Ornamental Planting Examples

Ornamental Planting Examples



Ornamental Planting Examples

Meadow Planting

- Grasses are the primary vegetation, with limited numbers of shrubs or trees
- Resembles and wildflower meadow or prairie
- Ideal for areas where a more natural look is desired
- Low maintenance template, especially with native species

Bioswale in London Olympic Park
Source: greenroof.com

Meadow Planting Examples

Residential meadow in Vermont
Source: Linden Land Group

London Olympic Park
Source: greenroof.com

Reforestation Planting

- Trees are the primary vegetation, with or without natural understory growth and forest litter
- Goal: Establish a mature forest canopy
- Species distribution modeled on local forest ecosystems
- Best for large bioretention areas located at wooded edges or for wooded buffers
- Planting Template provided in Reforestation GIP specs

Urban Forest
Source: City of Virginia Beach

Reforestation Examples

Soil Guidance

Performance Standards

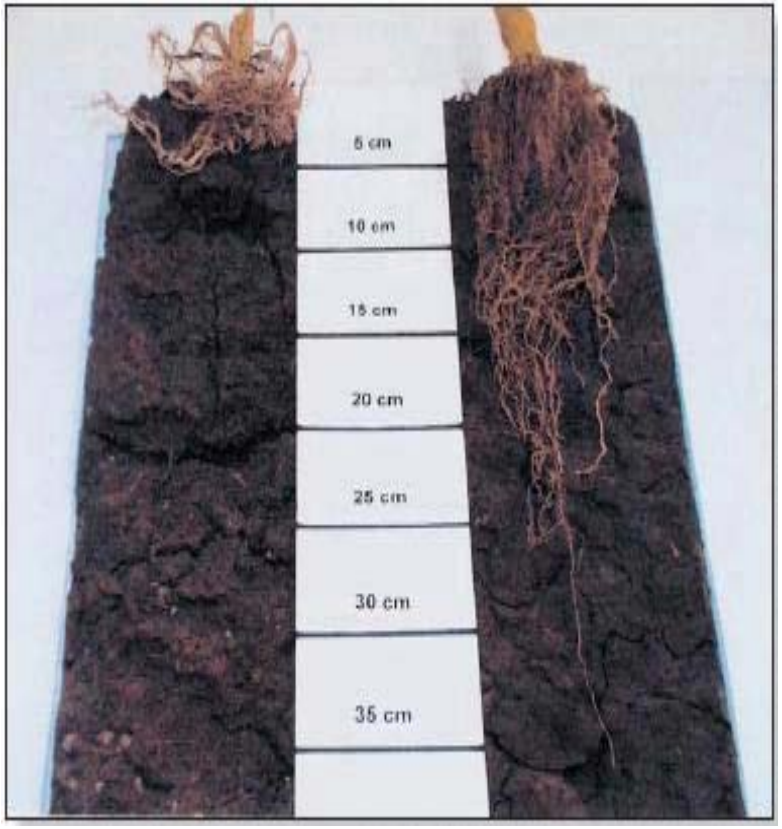
- <u>Soil for Plant Growth</u>
  - Healthy (pH, salts, nutrients)
  - Un-compacted
  - Supportive of long-term vegetative health
- Preference
  - Protected from compaction

- <u>Soil for Infiltration</u>
  - Native (not fill)
  - Un-compacted
  - HSG A, B, or some C, or compost amended
  - Infiltration Rate < 0.5 in/hr
- Preference
  - Protected from compaction

Native, Un-compacted Soil is Key

- High porosity provides
  - Greater infiltration rates
  - Better filtration ability
  - A good environment for strong root growth
  - A good environment for wildlife, bugs, worms, and microbes to break up soil and optimize pH, nutrients, etc.

- With protection, areas of porous soils can be largely **self-maintaining**



Plant roots in compacted soil (left) and un-compacted soil (right)

Soil Amendment

Soil Amendment

- Enhances the infiltration, filtration and porosity of compacted native or highly modified urban soils
- Well-suited for soils with low infiltration rates (some HSG B, HSG C and HSG D)
- Typically applied after construction
- Involves deep tilling of compacted surface soils then adding and mixing compost

Soil Amendment

Soil Amendment

Soil Amendment

- Performance
  - Runoff slows and infiltrates into the amended soil surface/subsurface layers
  - Recommended for sites that will experience mass grading of more than a foot of cut and fill across the site
  - Not recommended for:
    - Soils that have high infiltration rates (e.g., HSG A and B), although compost amendments may be needed at mass-graded B soils in order to maintain runoff reduction rates
    - Soils that are saturated or seasonally wet
    - Water table or bedrock is located within 1.5 feet of the soil surface
    - Slopes exceed 10% or downhill slope runs toward an existing or proposed building foundation
    - Harm roots of existing trees (stay outside the tree drip line)

Soil Amendment

- Special Considerations
  - Requires representative testing of soils to determine infiltration rate
  - Requires representative pre and post amendment soil testing to determine bulk density, pH, salts and soil nutrients (properties)
  - Key - contributing impervious surface area to be less than surface area of the amended soils.

Soil Amendment

- Soil Testing Requirements
  - Soil testing should be conducted by reputable laboratory
  - Representative sample of infiltration tests need to be conducted.
  - Representative sample of soils property tests need to be run at each test stage.
    - **Stage 1 -** First testing (bulk density, salts, pH) to ascertain pre-construction soil properties in proposed amendment area(s) to a depth of 1 foot
    - **Stage 2 -** Second testing (to determine further nutritional requirements, pH adjustment or organic matter adjustments ecessary for plant growth) is taken at <u>least one week after the compost has been incorporated into the soils</u>.

Soil Amendment

- Compost Material Requirements
  - Derived <u>from plant material only</u>
  - Well composted, free of viable weed seeds, and stable with regard to oxygen consumption and carbon dioxide generation
  - No visible free water or dust produced when handling the material (ideal moisture content)
  - Provided by a member of the U.S. Composting Seal of Testing Assurance (STA) program

Soil Amendment

- Mixing Depth and Compost Volume
  - Area and depth (impervious cover / surface area)

	Contributing Impervious Cover to Soil Amendment Area Ratio[1]			
	IC/SA = 0 [2]	IC/SA = 0.5	IC/SA = 0.75	IC/SA = 1.0 [3]
Compost (in) [4]	2 to 4 [5]	3 to 6 [5]	4 to 8 [5]	6 to 10 [5]
Incorporation Depth (in)	6 to 10 [5]	8 to 12 [5]	15 to 18 [5]	18 to 24 [5]
Incorporation Method	Rototiller	Tiller	Subsoiler	Subsoiler

[1] IC = contrib. impervious cover (sq. ft.) and SA = surface area of compost amendment (sq. ft.)
[2] For amendment of compacted lawns that do not receive off-site runoff
[3] In general, IC/SA ratios greater than 1 should be avoided
[4] Average depth of compost added
[5] Lower end for B soils, higher end for C/D soils

  - Compost volume

$$\mathbf{C}\ (\text{cyds}) = \mathbf{A}(\text{sf})\ \mathbf{x}\ \mathbf{D}(\text{in})\ \mathbf{x}\ \mathbf{0.0031}$$

Soil Amendment

- Construction Inspection
  - Test pit to verify the depth of mulch, amended soil and scarification
  - Penetration testing (rod penetrometer) should be used to establish the depth of un-compacted soil at one location per every 10,000 square feet

Soil Amendment

- General Construction Sequence
  - Deep till to a depth of 2 to 3 feet creating rips perpendicular to the direction of flow. (This step is usually omitted when compost is used for narrower filter strips.)
  - Second deep till to a depth of 12 to 18 inches after site final grading.
  - Mix compost into the soil a the volumetric rate of 1 part compost to 2 parts soil.
  - Graded and seed to establish a vigorous grass cover (or vegetate per Landscape Plan)
  - Temporarily stabilize amendment areas over 2,500 ft^2

Module Topic Summary

- Vegetation and soil mechanisms for runoff reduction
- Vegetation requirements and guidance
- Soil requirements
- Soil amendment guidance

Questions?