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# ***Applying GSI at Brownfield Sites***

## ***11 February 2020***

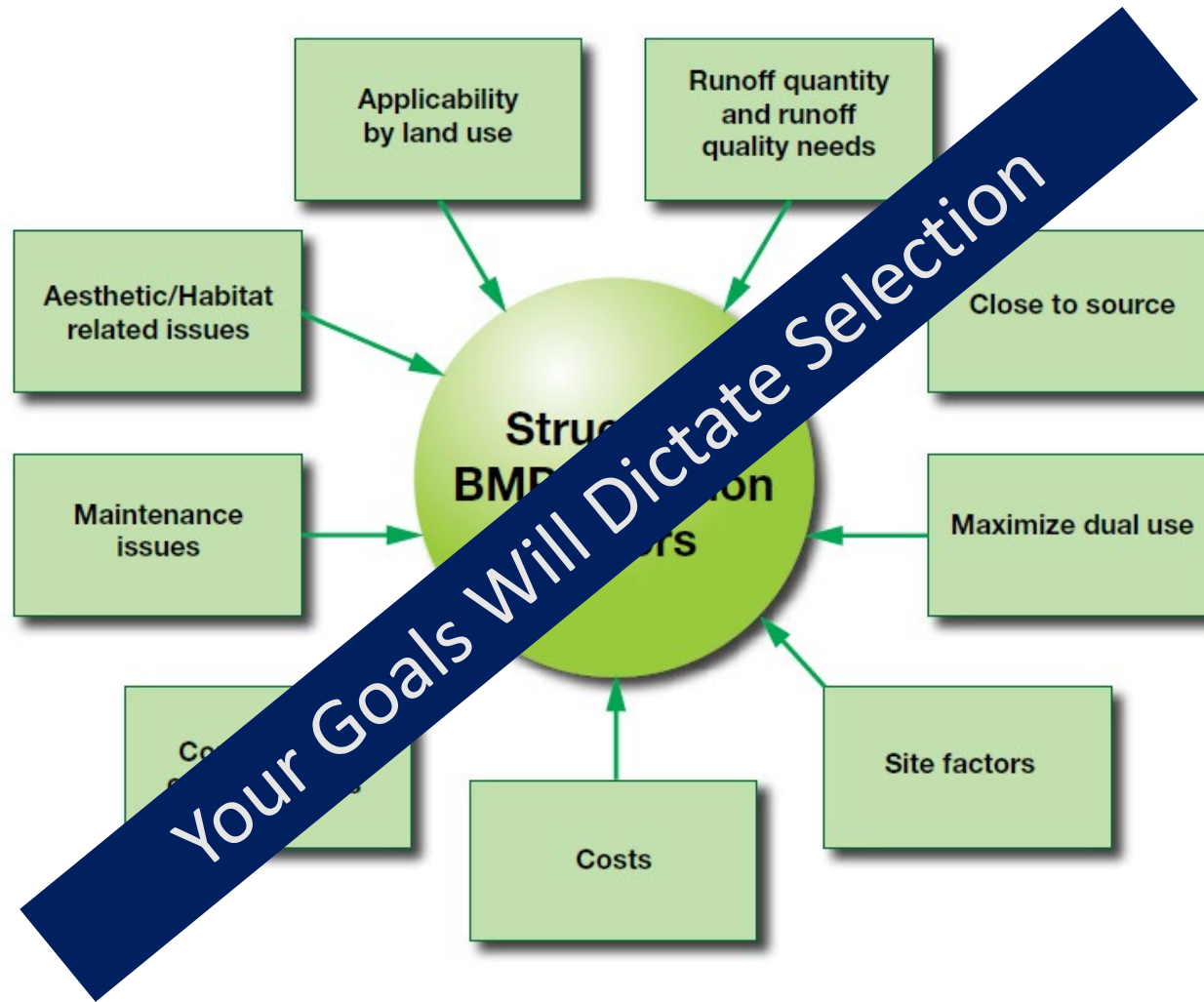
**Donald D. Carpenter, PhD, PE, LEED AP**

# Overview

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- Environmental Site Assessment
- Guidelines for Using GSI on Brownfield Sites
- GSI Techniques

# Ideas and Approach for Project



# Environmental Site Assessment

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- Phase I ESA
  - Visual site investigation
  - Historic property records and photos
  - Property ownership
  - EGLE database
- Phase II ESA
  - Soil sampling (boring or test pits)
  - Groundwater monitoring
- Supplemental Site Assessment
  - Intense monitoring
  - Horizontal and vertical mapping of contamination
  - Evaluation of remedial approaches

# Using GSI on Brownfield Sites

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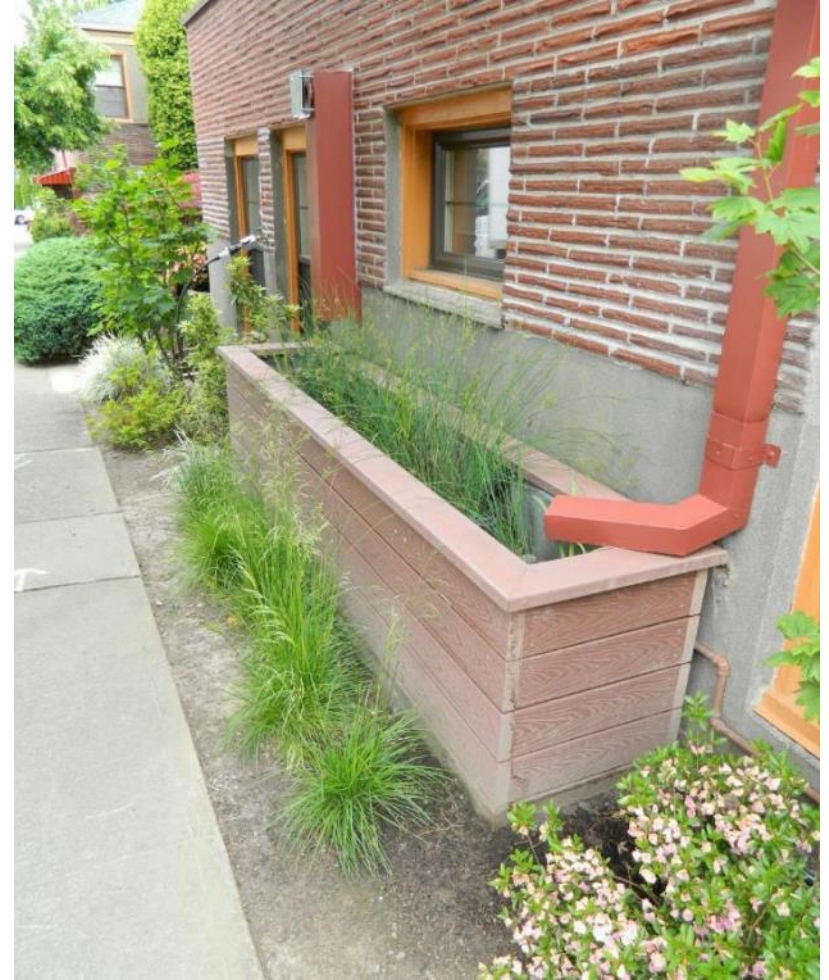
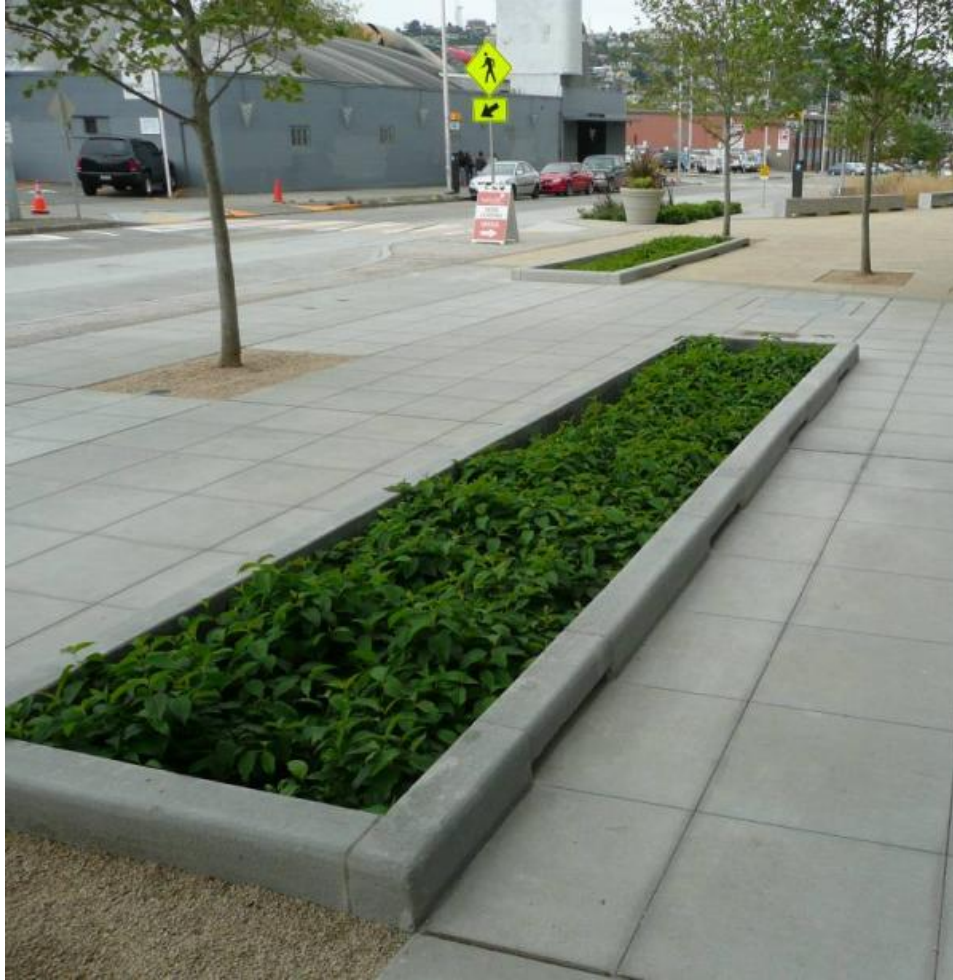
- Differentiate between types of contaminants (DNAPL, LNAPL, biodegradable, etc.) and map areas of contamination.
- Keep non-contaminated stormwater separate from contaminated water and soils. GSI can retain, treat, and release without contact with contaminated soils.
- Utilize trees and vegetation to promote ET.
- Brownfield redevelopment often requires capping (no impervious) – ideal for building footprint.
- Minimize infiltration on a Brownfield site that might impact remediation efforts on site or impact adjacent land uses.
- Minimize infiltration and runoff from new development adjacent to a Brownfield site.

# GSI Techniques

# Planter Boxes

# Planter Boxes

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# Street Trees & Tree Box Filters

# Street Trees

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# Tree Box Filters

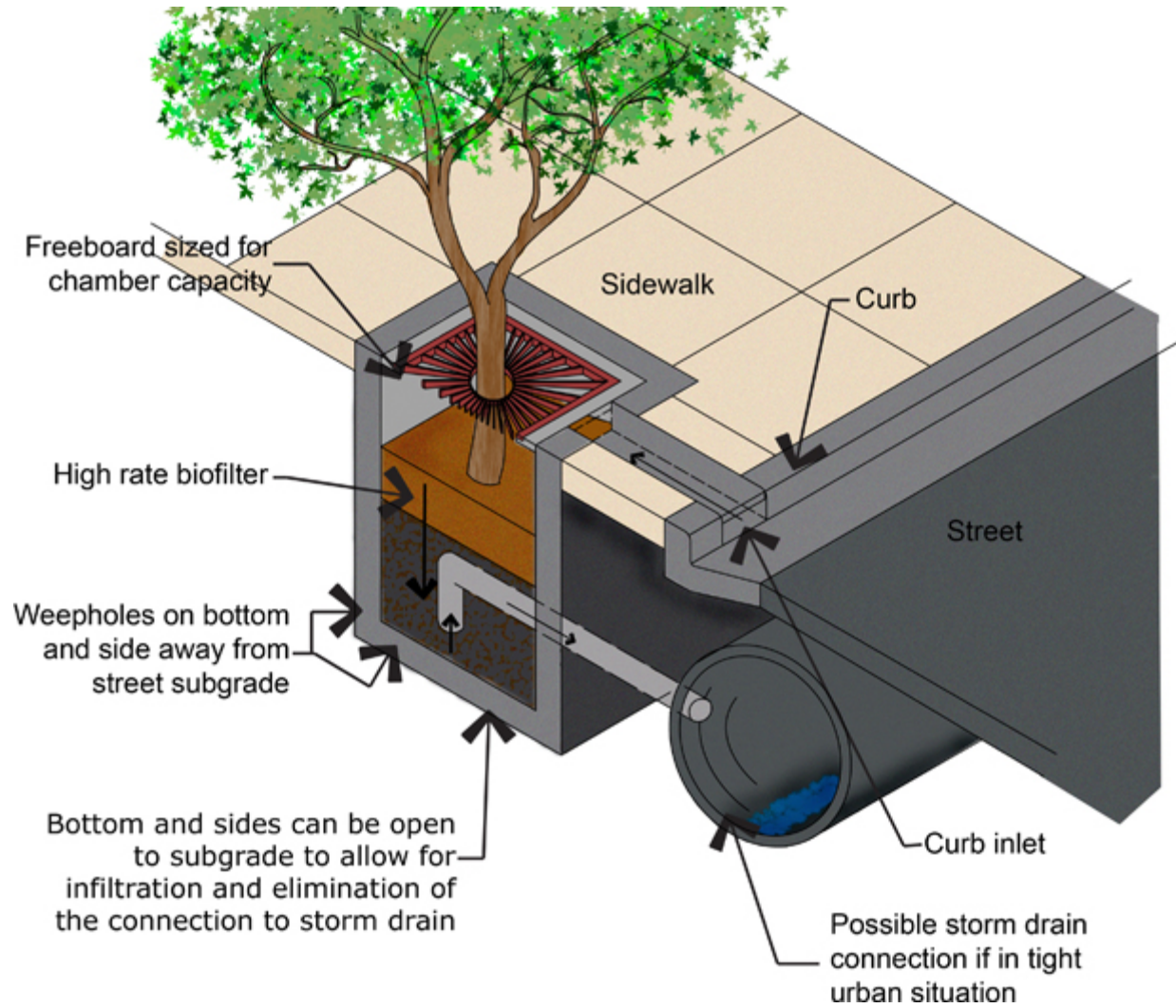
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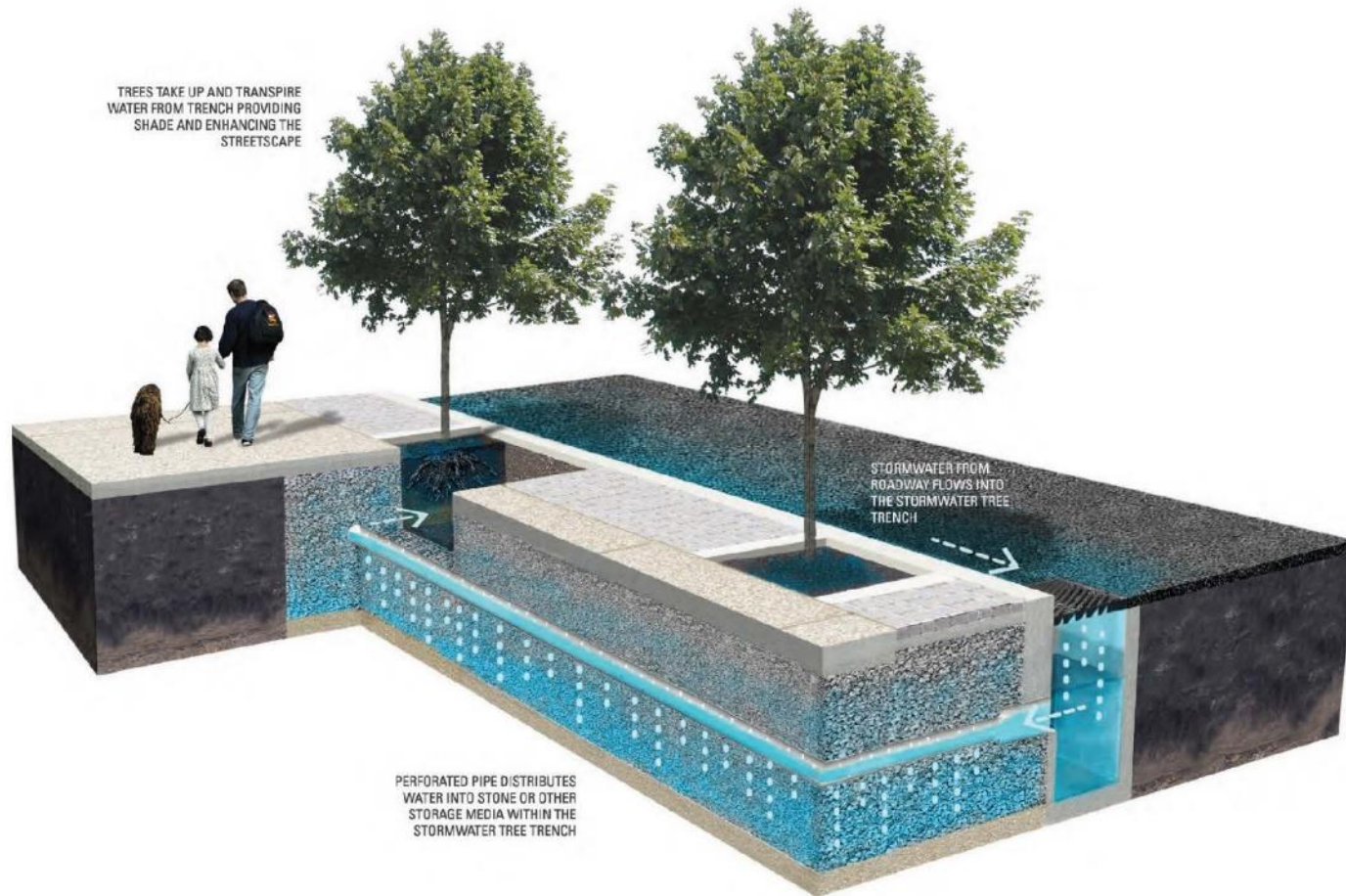


# Tree Box Filters



# Trench with Trees

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# Permeable Pavement



# Permeable Asphalt





# Porous Concrete

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# Interconnected Concrete Pavers

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# Concrete Block Pavers

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# Vegetated Roofs and Walls



# Types of Vegetated Roofs

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Extensive



Intensive

# Vegetated Roofs





# Famous Vegetated Roofs

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# Vegetation

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# Live Walls



© Blue Brick



© Live Wall



# Cisterns, Water Harvesting and Reuse

# Rain Barrels

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# Cisterns

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# Cisterns

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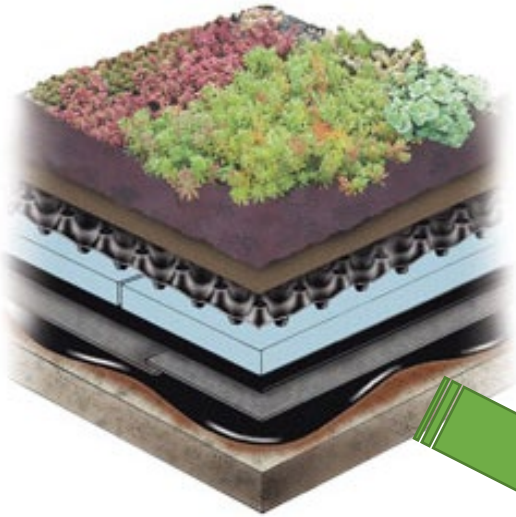
**The Taubman Center's 12,000-gallon cistern during installation**

# Treatment Train Approach



# Treatment Train Approach

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# Questions?