Reducing Storm Water Infrastructure Costs Through Better Soil Management

Gary Gittere
NC Composting Council Board Member & Treasure
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Which one would YOU choose?

Clean Water?  Fertile Soils?

What if we could have Both!
Soil Ecosystem Challenges

Despite 90+ years of US research, soil erosion continues to be a serious issue, with an estimated cost of 400 billion US dollars worldwide.

Soil loss rates from construction sites are 10 to 20 times that of agricultural lands with 60% of lost soils deposited into our aquatic systems, polluting them with nutrients, pesticides, and other contaminants.

“Soil erosion is second only to population growth as the biggest environmental problem the world faces.”

David Pimentel-Cornell University

The Natural Resources Conservation Service has recognized that soils with good infiltration and permeability can significantly reduce stormwater runoff rates and volumes...reducing sediment & nutrient runoff.
Healthy soil is one of nature’s key tools in recycling, cleaning, and preserving our environment.

By improving soil ecosystems & creating clean storm water runoff will help states meet total maximum daily (TMDL) limits.

### Storm Water Challenges

- **850 billion gallons of untreated water** are discharged into the nation’s water bodies every year.
- As much as 90% of city surfaces are impervious, causing the US to lose some **5 BILLION tons** of top soil each year to soil erosion.

A one-inch rainfall event drops more than **27,000 gallons of water** per acre.
• Straw & Tack is the most economical and commonly used temporary erosion control method

• Hydro-seeding or hydro-mulching is a planting process that uses a slurry of seed and mulch

• Fiber mulch accelerates the growing process by maintaining moisture around the seeds thereby increasing the rate of germination

The addition of synthetic chemicals may be required to add nutrients or lime to increase the soil’s pH for germination resulting in increased cost.
The use of surface applied organic amendments has been shown to reduce runoff and erosion through enhanced vegetation growth and soil quality characteristics.

Soil and Water Conservation Society

Photo courtesy: Eco Express Solutions

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Erosion Control for the Future

- Seed infused directly into the compost and applied by blower truck
- Compost blankets are typically applied at 1” to 2” depth up to 2:1 slopes
- Compost blankets establish turf quicker reducing soil loss for better erosion control than traditional methods

Photo provided by TNRCC
Erosion Control for the Future

Compost blanket great results!

Hydro seeding & straw - limited germination

Results after ½-inch of rain, six weeks later

Source: Filtrexx International, LLC

<table>
<thead>
<tr>
<th>Type of Plot (Hwy Environment)</th>
<th>Vegetation Cover</th>
<th>Sediment Loss (kg/10m²) 1:3 slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compost on Sand</td>
<td>92%</td>
<td>3.88</td>
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<tr>
<td>Compost on Clay</td>
<td>99%</td>
<td>.34</td>
</tr>
<tr>
<td>Wood Chips w/Terra Tack SC on Sand</td>
<td>48%</td>
<td>11.27</td>
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<tr>
<td>Wood Chips w/Terra Tack SC on Clay</td>
<td>95%</td>
<td>.15</td>
</tr>
<tr>
<td>Wood Chips w/RMB Plus on Sand</td>
<td>50%</td>
<td>10.97</td>
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<tr>
<td>Wood Chips w/RMB Plus on Clay</td>
<td>57%</td>
<td>.30</td>
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</table>

The compost plots produced 92% vegetation cover on sand and 99% vegetation cover on clay!

Source: Texas DOT
Soil loss after two 3” storm events

Source: University of GA

Is Your Soil “Healthy”?  

Soil health is teeming with life and activity. It’s rich in organic matter, insects, earthworms, air, water and nutrients. Healthy soil is a must for thick, strong turfgrass establishment.

Soil is created at a very slow rate, about 1-5 tons per acre per year, while it erodes at an average of 40-140 tons per acre per year

Susan McCabe - Colorado State University Cooperative Extension, Denver
What are the Causes of Unhealthy Soils?

A Vicious Circle

Healthy Soil Breakdown

- Root proliferation
- Water retention
- Water infiltration & transmission
- Aeration
- Erosion prevention

- Nutrient retention & release
- pH
- Energy (C) storage
- Toxicity prevention

- Pest suppression
- N mineralization
- OM decomposition
- Habitat protection
Healthy Soil Layers

- 0-2 inches – decaying biota
- 2-10 inches – supports plant life
  - 5-10% organic matter
  - 40-45% minerals
  - 25% air
  - 25% water
- 10-30 inches – mostly mineral with inert properties, cannot sustain life and what is left after construction.

Organic matter is vital to soil quality

Healthy vs. Damaged Soil

Research resource: www.SoilsforSalmon.org
Benefits of Soil Organic Matter

- A well aggregated soil has a range of pore sizes
- This medium size soil crumb is made up of many smaller ones
- Very large pores occur between the medium size aggregates

Reducing compaction and improving soil over time

Benefits of Soil Organic Matter

One percent increase in SOM results in about 20,000 to 25,000 more gallons of available soil water per acre!

In the US, irrigation consumes approximately 67% of fresh groundwater withdrawals.

USDA’s Natural Resources Conservation Service
Kansas State’s Ag Extension study
Using Compost to increase Soil’s Organic Matter will improve the soil’s Cation Exchange Capacity (CEC)

- CEC = total amount of cations soil can retain
- Soil Organic Matter is negatively charged, but binds both cations and anions
- The higher the soil CEC the greater ability it has to store plant nutrients – which impacts the soil’s long-term fertility

Humus is a very well stabilized part of organic matter that has a great ability to retain nutrients in the soil

Benefits of Soil Organic Matter

- Antibiotic production
- Competition for nutrients
- Predation against pathogens
- Activation of disease-resistance genes

Compost does not kill the pathogens that cause disease as fungicides do, it controls the pathogens by keeping the beneficial microorganisms active and growing.

University of FL Study by Dr. Monica Ozores-Hampton
Compost as a Soil Amendment

• A humus-rich soil amendment made by the controlled biological decomposition of organic materials
• Made from organic residuals like yard trimmings, organic by-products, industrial residuals, food scraps, animal manures, biosolids
• Must go through an aerobic heating process to be biologically stable and mature
• Effective in improving the biological, physical and chemical characteristics of soils

Compost Can Produce Significant Cost Savings!

Compost as a Soil Amendment

After a 10 year study, the use of 3% organic matter from compost resulted in 50% less fertilizer use.
–University of Florida Study by Dr. Monica Ozores-Hampton
Compost as a Soil Amendment

Eutrophication: describes the over enrichment of our aquatic systems from excessive inputs of nutrients, resulting in increased populations of phytoplankton and algae, and ultimately lowering dissolved oxygen (DO) in the water to a level that cannot sustain life.

-Chesapeake Bay Commission

Institute for Local Self Reliance: Building Healthy Soils with Compost to Protect Watersheds

Organic matter may be a beneficial amendment when soils have high sand or clay contents.

Sandy soils lose water and nutrients quickly, thus, a good source of organic matter amended into these soils improves water and nutrient retention, reducing the need for irrigation and fertilizer.

Clay soils typically are poorly drained and lack sufficient aeration for good root growth. Organic matter additions to clay soils will provide better water and air movement through the soil, thereby improving turf root growth.

-Penn State Center for Turfgrass Science

Compost is arguably the best source of organic matter
Compost as a Soil Amendment

Studies have shown that as much as 50% of the synthetic derived nitrogen applied to the soil will be leached out and the half that does reach the plants may do more harm than good. Other studies have shown that only 5-10% of the N makes it to the plant and the rest is wasted potentially causing damage to the environment.

– Alabama University

Compost typically has a lower inorganic Nitrogen content converting it into a more stable less mobile form

Compost as a Soil Amendment

Despite the application of considerably higher-than-needed phosphorus in five consecutive years of compost application, the study measured no significant increase in runoff phosphorus compared to a control treatment fertilized according to soil testing recommendations, because the high rates of compost increased infiltration and decreased runoff and erosion.

– VA Tech-Spargo et al. (2006)

An understanding of how compost use affects soil properties that influence nutrient transport is also important
Compost as a Soil Amendment

Runoff from vegetated test plots contained lower total masses of soluble phosphorus and potassium than was found in the runoff from un-vegetated plots. Again, the total mass of pollutants was much lower in runoff from test plots treated with compost than from conventionally-treated test plots.

—Iowa State University

Using compost to help establish vegetation can lead to reduce nutrient run-off

Compost as a Soil Amendment

The higher the solubility of nutrients, the higher the ability of plants and crops to uptake them, but also more potential water pollution through runoff. In soils amended with compost, only a small percentage of P and N is water soluble typically less than 1% of P and 5% of N.

—Longwood University

Compost’s ability to bind heavy metals, synthetic chemicals, & other contaminants, provides for it to be used as a filter for storm water control.
Not All Compost is the Same!

✓ A dark uniform color with a consistent texture
✓ A pleasing, soil-like aroma
✓ Finer screening with no sticks, twigs or foreign matter for a consistent product
✓ Free of Pathogens and Weed Seeds

How is Compost Quality Determined?

- Total nutrients
- pH levels
- Organic matter content
- Dry & wet moisture content
- Heavy metals levels
- Particle size
- Existing pathogens & more

USCC’s Seal of Testing Assurance Program
A Better Way to Specify

<table>
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<tr>
<th>OM % (dry wt.)</th>
<th>Desired</th>
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</tr>
<tr>
<td>0.0</td>
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</table>

Always use a STA Certified Premium Compost

Green Infrastructure & LID

It is important that both quality soil and vegetation be viewed together as an essential part of a dynamic system used to control stormwater quantity and quality.

Green infrastructure complements grey infrastructure to provide a holistic approach to soil and water management.
Soil amendments increase the soil’s infiltration capacity and help reduce runoff from the site. They have the added benefit of changing physical, chemical, and biological characteristics so that the soils become more effective at maintaining water quality. Soil amendments, which include both soil conditioners and fertilizers, make the soil more suitable for the growth of plants and increase water retention capabilities.

EPA Storm Water BMPs or “Integrated Management Practices”

*50% of the EPA’s 15 stated BMPs can include compost use*

Using Compost for Storm Water Management

- Economics dictate the use of soil amendments as the first step to storm water reduction; using compost as a storm water BMP has been shown to have significant water-holding capacity, with reduced to no runoff from low-to-moderate rain events.
- Study after study points to amending soils with compost as among the least expensive methods to control storm water
  - 28 cents per gallon of storage vs. $1.59 for rain gardens
  - $2.24 per gallon for bioretention ponds
  - Another suggests the cost of municipally-owned systems may be 5 to 10 times the cost of stormwater removed for a one-inch rain event using compost.

Source: MMSD Regional Green Infrastructure Plan

Compost is a “tool” for economic benefits in Green Infrastructure BMPs!
Both the US Green Building Council’s LEED2 and the Sustainable Sites programs (SITES)3 now offer credits for the use of compost in projects seeking certification. These credits are offered due to the variety of benefits that compost provides in the landscape for the uses described below.

6.1 Storm Water Design: Quantity Control
6.2 Storm Water Design: Quality Control
7.1 Control and retain construction pollutants (EPA-530-F-97-042)
7.3 Restore soils disturbed during construction & Restore soils disturbed by previous development

Include compost in your projects and realize these benefits and credits!

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Using Compost for Storm Water Management

Option 1 - Install 6” of topsoil over 5,000 sq. ft.
Topsoil required = 93 cubic yards
Unit price to install & amend = $30 per cubic yards installed------TOTAL COST: $2,790.00

Option 2 - Install 2” compost over 5,000 sq. ft.
Compost required = 32 cubic yards
Unit price to install & amend = $45 per cubic yards installed-----TOTAL COST: $1,440.00

TOTAL SAVINGS using compost = $1,350.00

Compost is often used as the source of organic matter in the engineered soil that is used to build these LID BMPs.
Initiatives in the United States

 Builders, developers, and landscapers are adopting practices that preserve and improve the soil on building sites, and protect waterways, and local governments are beginning to require it.

“Before a newly constructed premise may be occupied, property owners must amend their soil with compost...”

Soil Amendment Program

Initiatives in the United States

MARIN CARBON PROJECT

Our vision is for landowners & land managers of Ag ecosystems to serve as stewards of soil health and to undertake carbon farming in a manner that can improve on-farm productivity and viability, enhance ecosystem functions, and stop and reverse climate change.

Soils hold onto more carbon than all the vegetables, animals, and minerals sitting atop them, making them an enormous “climate sink.” In fact, increasing soils’ carbon content by 0.4 percent annually through conservation and better management could stabilize humankind’s dangerous carbon emissions—and improve crop yields, too.

National Geographic
Federal Organic Diversion Goals

Executive Order -- Planning for Federal Sustainability in the Next Decade

- Diverting at least 50 percent of non-hazardous solid waste, including food and compostable material but not construction and demolition materials and debris, annually, and pursuing opportunities for net-zero waste or additional diversion opportunities

- The USDA and the EPA joined calling for broad-based participation to achieve a 50% reduction in food waste by 2030.

March 19, 2015

Source: epa.gov/greeningepa

States Organic Diversion Success

Four surrounding states reporting total amount of organics diverted to composting in 2012

- South Carolina 246,624 tons
- Tennessee 500,000 tons
- Virginia 184,702 tons
- North Carolina 674,600 tons

At the Macro level, interest is growing rapidly in diverting more organic waste streams to composting. This is particularly true with the source separated food scraps stream.

Institute for Local Self Reliance-State of Composting in the US
What Is Needed?

Advancing composting and compost use in the U.S. is a key sustainability strategy to create jobs, protect watersheds, reduce climate impacts, improve soil vitality, and build resilient local economies.

Compost is the Economical and Sustainable Choice!

Changing regulations
• Water restrictions
• Nutrient management
• Storm water & erosion control

Sustainability mandates
• Carbon credits
• LEED
• Sustainable Sites
• Executive Order 13514
• Green purchasing

Economics
• Fertilizer prices rising
• Lime, pesticide value
• Reduced labor
• Reduced replacements

Certified STA Compost = Superior results!
I Appreciate Your Time and Interest!

Gary Gittere
Sales & Marketing Manager
McGill Premium Compost
ggittere@mcgillcompost.com
(M) 919-259-3666
www.mcgillsoilbuilder.com

We See Compost As The Missing Puzzle Piece