Building Healthy Soils with Compost to Protect Watersheds

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Photo: MCS Inc. www.mcsnjinc.com

Summary

Healthy soils are essential for protecting local watersheds.[1] Naturally occurring (undisturbed) soil and vegetation provide important stormwater functions: water infiltration; nutrient, sediment, and pollutant adsorption; sediment and pollutant biofiltration; water interflow storage and transmission; and pollutant decomposition. These functions are largely lost when development strips away native soil and vegetation and replaces them with minimal topsoil and sod.[2] Organic matter is vital to soil quality and amending soil with compost is the best way to increase the organic matter in soil, which improves soil's ability to retain water.[3]

By improving soil ecosystems, compost can help states meet total maximum daily load (TMDL) limits.[4] In an effort to restore impaired water bodies throughout the country, the federal Clean Water Act requires states to develop TMDLs (i.e. the maximum amount of a pollutant that a water body can receive and still meet state water quality standards) as part of their Watershed Implementation Plans (WIPs). In 2010 the US Environmental Protection Agency established the Chesapeake TMDL, a historic and comprehensive "pollution diet" and largest TMDL ever established.[5] Many of the region's primary waterways, such as the Anacostia and Potomac Rivers in the Washington, DC metropolitan area, have become unfishable due to elevated levels of toxic pollution.[6] Because most of the Bay and its tidal waters are impaired due to excess nutrient pollution and sedimentation, the Chesapeake TMDL is designed to achieve significant reductions in nitrogen, phosphorous, and sediment. Specifically, the Chesapeake TMDL mandates a 25% reduction in nitrogen, a 24% reduction in phosphorous, and a 20% reduction in sediment by the year 2025. Restoring the Bay watershed to meet these targets requires effective non-point source pollution control. Runoff from agricultural, urban and suburban lands carry nutrients, sediment and other pollutants to local waterways, causing eutrophication and harming aquatic life.[7] Integrating compost and compost-based products into the region's soils is a key way to protect the watershed, while providing a number of additional benefits such as promoting higher crop yields, reducing greenhouse gases through carbon sequestration, diverting discarded biodegradable material from the waste stream, and creating "green" jobs.

The Institute for Local Self-Reliance (ILSR) is a national research and technical assistance nonprofit organization providing innovative strategies, working models, and timely information to support environmentally sound and equitable community development.

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For more information on ILSR and how to get involved in promoting composting and compost use, visit www.ilsr.org.

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Intense rain events can overwhelm traditional conveyance systems. Adding green infrastructure through compost-amended soils and bioretention systems help slow and clean runoff.

Photo: Seattle Public Utilities

Current Watershed Problems

Eutrophication describes the over enrichment of 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.[8] When the phytoplankton and algae die, bacteria decompose them, which consumes large amounts of oxygen that other aquatic life (such as crabs and fish) need for survival.[9] Runoff from agricultural, urban, and suburban lands cause the excessive nutrient levels found in the Chesapeake Bay today.[10]

Erosion & Sedimentation: During initial phase construction, land is cleared of vegetation and topsoil, making it very susceptible to erosion.[11] Erosion disturbs drainage areas and natural environments by transporting loose particles of clay, silt and sand into receiving water bodies (i.e. sedimentation). While weathering of rocks and erosion is a naturally occurring process, a surplus of sediment has detrimental aquatic effects, harming fish, oysters and underwater grasses in the Chesapeake Bay watershed.[12]

Water Consumption: In the United States, irrigation consumes approximately 67 percent of fresh groundwater withdrawals.[13] In the Chesapeake Bay watershed, there are 15 parts land to 1 part water (the Great Lakes watershed is 2 to 1) and more than 2.7 million acres of farmland in Maryland alone. The Chesapeake Bay must process much more land-based pollution than other water bodies, making water conservation critical to a healthy Bay.[14]

Chemical Use (e.g. Fertilizers, Pesticides, Fungicides): Chemical contaminants are chemicals or compounds that can potentially harm the health of humans, wildlife and aquatic life and are found in many common use agricultural and landscaping products. Toxic chemicals are constantly entering the Chesapeake Bay and its tributaries via wastewater, agriculture and stormwater runoff, and air pollution.[15]

Poor Soil Quality & Structure: Healthy soils, maintained to optimum quality and depth standards, are the key to a healthy watershed.[16] However, humans and other factors have impacted the region's soils in various ways such as: compaction from construction and farming practices, increased soil acidity, erosion and sedimentation, increased pollution, and diminished organic matter content. All negatively impact the soil's biological activity, plant and crop growth, and ultimately water quality.[17]

Added Costs: A degraded watershed has cost implications for municipalities, businesses, and citizens alike. Watershed maintenance and remediation projects, water treatment costs, and associated energy costs all equate to increased expenditures.[18]

Photos Clockwise from Top Left:

1. A compost sock is a mesh, compost-filled, tubular stormwater and sediment control device used to protect storm drains and curb inlets. The heavy duty socks filter soluble pollutants (e.g. phosphorus) and sediment from runoff. *Photo: Filtrexx International, LLC* www.filtrexx.com
2. The socks can be used for many purposes, such as vegetated retaining walls, and filled with different types of compost best suited for the application. *Photo: Denbow* www.denbow.com
3. Green gabions combine the benefits of soft and hard armor technology for shoreline bank stabilization and habitat restoration. Media grows through compost socks and into the bank, acting as "nature's velcro," for maximum erosion control. *Photo: Filtrexx International, LLC* www.filtrexx.com
4. Applying a compost blanket (i.e. loose 2 inch layer of compost) to a steep hillside improves vegetation growth and reduces erosion. *Photo: Denbow* www.denbow.com

The Benefits of Compost-Amended Soils

Top Photos: A severely eroded stream bank is rebuilt using Filtrexx FilterSoxx, providing superior soil retention and eliminating the need for hard armoring products like concrete and steel. The right photo shows vegetation growing on the now stabilized slope. This natural system is an effective alternative to conventional restoration means and creates an optimum environment for vegetation establishment to prevent further erosion problems.

Photo: Filtrexx International LLC

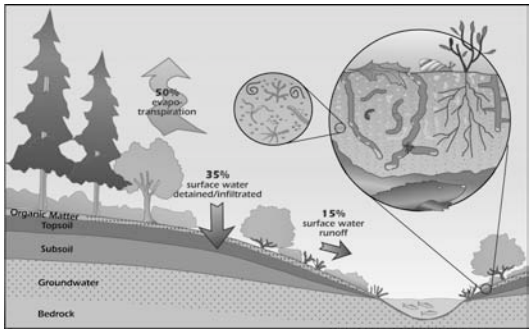
Benefit 1: Non-Point Source Pollution Prevention (Agricultural Runoff & Urban/Suburban Stormwater) – One of compost's greatest benefits is its ability to treat non-point source pollution. Compost can manage nutrient stormwater and agricultural runoff by serving as a filter and sponge. Its high porosity and permeability allow contaminated stormwater to infiltrate at much higher rates than most existing soils; especially those compacted via human development.[19] Once in compost-amended soil, toxins and pollutants begin to break down. Compost immobilizes and degrades pollutants, improving water quality and has the ability to bind heavy metals, pesticides, herbicides, and other contaminants, reducing both their leachability and absorption by plants.[20] Biofiltration media like compost reduces contamination of urban pollutants by an astounding 60 to 95%.[21]

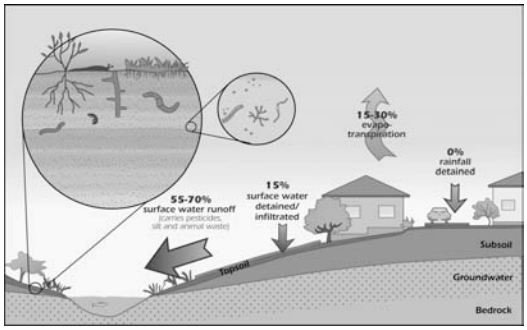
Benefit 2: Erosion & Sedimentation Control – Using compost as a soil amendment significantly reduces erosion and sedimentation. This is in large part attributed to a material in compost called humus. Humus functions as a glue that keeps soil particles stuck together and resistant to eroding forces. Thus, adding compost to existing soil changes its properties, improving its binding ability.[22] As the soil properties are altered, the surface structure becomes stabilized and "less prone to crusting and erosion."[23] Best management practices recommend amending landscape beds with a minimum organic matter content of 10% dry weight (or 30-40% by volume of compost), and turf grasses with a minimum organic matter content of 5% dry weight (equivalent to 15-25% by volume of compost).[24] Mixing in the proper amount of compost into native soils provides resistance to erosion and minimizes sediment-carrying runoff by as much as 50%. In addition to soil stabilization, the improved soil structure enables greater infiltration, capturing water runoff and sediment.[25]

Benefit 3: Improved Water Retention – The high organic matter content in compost (40-60%) increases water infiltration and the soil's ability to retain water.[26] Microbial organisms in the soil create pore spaces for air and water, increasing permeability and storage capacity. Furthermore, the same binding properties in humus that reduce erosion retain water. Compost can hold 3 to 5 times its weight in water.[27] It can also "increase water storage by 16 thousand gallons per acre foot for each 1 percent of organic matter."[28] This allows rainwater that would normally be lost through evaporation or runoff to remain in and replenish ecosystems. Thus, integrating compost into existing or rebuilt landscapes lowers irrigation requirements (by up to 50% in the summer) and runoff rates, which are typically higher in developed zones.[29] Compared to other soil amendments, compost has a higher absorption and storage rate than raw manure, anhydrous ammonia, and commercial fertilizer.[30]

Benefit 4: Reduced Chemical Needs (Fertilizers, Pesticides, Fungicides) – Because the type and amount of organic matter present in the soil impact plant health, compost can reduce the need for fertilizers and pesticides.[31] First, the improved cation exchange capacity (CEC) of compost makes nutrients available to plants over a broader

Compost can hold 3 to 5 times its weight in water





Top: Native soil and vegetation absorb almost all the rain that falls.

Bottom: Disturbed Soil. Urban development typically strips topsoil and compacts subsoils; rain then rushes off carrying pollutants into the nearest water body. Protecting soils and restoring them with compost helps restore soil functions.

Images: Washington Organics Recycling Council

range of pH than soils without compost.[32] Amending soil with compost creates a controlled, slow-release of phosphorous, potassium, sulfur and various other "micronutrients" critical to plant survival. These nutrients are also less likely to be lost through leaching as the stable organic matter in compost steadily allows plants to take what they need.[33] This offers low-maintenance attractive landscapes for home and property owners while reducing polluted runoff. In sum, an active sub-soil food web and reduced soil compaction create an overall healthy ecosystem, resulting in fewer required chemicals.[34]

Benefit 5: Improved Soil Quality and Structure – Compost's organic matter is the catalyst for the overall health of the entire soil ecosystem. Organic matter can be considered the soil's fuel source, as it feeds billions of microorganisms. This microbial process allows for stormwater infiltration, drainage, and moisture-holding capacity and a strong, stable soil structure.[35] These passageways and a higher bulk density also allow plant roots to establish and expand.[36] This is particularly important for disturbed and compacted soils where compost amendment rejuvenates degraded soils to native-like conditions, providing food and shelter for beneficial organisms, and "restarting the soil ecosystem."[37] Because soil organic matter consists of 10 to 1,000 times more water and nutrients than soil minerals, the many microbes and organisms can thrive.[38] In addition, compost makes the soil more fertile for plant growth by controlling pH levels, increasing buffering capacity against pH change. Research also shows that the type of organisms found in compost can curtail soil-borne diseases and plant pathogens like pythium and fusarium as well as nematodes.[39]

Benefit 6: Reduced Costs – Amending soils with compost produces significant cost savings. A recent study indicated that under a 3-inch/24-hour period storm, a typical 10-acre development with a compost blanket (i.e. a layer of loosely applied compost) would reduce runoff volume as compared to an impervious site and avoid $181,428 per year in water treatment costs. If the runoff was treated on-site with a stormwater management pond, the compost blanket application equates to a cost reduction of $697,800, avoiding the need for a larger pond to accommodate an increased volume of water.[40] Municipal government can realize "tax collection gains from increased land values and lower water treatment costs."[41] Many other compost products can reduce the cost of erosion and overburdened stormwater management systems – a cost totaling $44 billion each year in America.[42]

Benefit 7: Job Creation – Composting in Maryland sustains twice as many jobs on a per-ton basis as landfilling organic discards, but four times more than incineration. Using compost in green infrastructure such as to control soil erosion and reduce stormwater runoff sustains even more jobs. For every 10,000 tons per year of material diverted from incineration to compost production and local use, nine times more jobs are created and across multiple industries.[43] Filtrexx, the leading producer of compost-based erosion control and stormwater management systems, alone supports over 100 Filtrexx certified businesses.[44] In Texas, when the Department of Transportation specified compost for highway maintenance projects, it created the nation's largest compost market, giving rise to an entire new industry of contractors specializing in innovative methods to apply compost to roadsides.[45]

Portland Green Streets

Portland, OR, street planters, curb extensions, and simple green strips in the medians along city streets:

- **Reduce peak flow cost-effectively 80+%**
- **Filter pollutants**
- **Recharge groundwater**
- **Rehabilitate soil**
- **Improve pedestrian safety**
- **Beautify neighborhoods**
- **Provide volume detention to handle most rain events**
- **Provide more space to plant trees**
- **Increase home values**
- **Alleviate urban "heat island" effect**

Source: David Elkin, landscape architect, GreenWorks, Portland, OR. www.sustainablecitynetwork.com

Photo: © City of Portland, courtesy Bureau of Environmental Services

Model Initiatives & Policies

Washington State: "Soils for Salmon" Project – Developed by the Washington Organic Recycling Council (WORC), the project implements guidelines, best management practices, and policy change to protect western Washington's Puget Sound. By educating the public about the soil to water connection, the program drives landscapers, builders, developers, and citizens to use compost-based low impact development (LID) to reduce stormwater runoff.[46] Soils for Salmon program criteria is being implemented into the Sustainable Sites Initiative™ (SITES™), a LEED equivalent national benchmark for sustainable site development which will be launched in 2013.[47]

Washington State: Best Management Practice (BMP) T5.13 in Western Washington and King County Code (KCC) 16.82 – BMP T5.13: "Post-Construction Soil Quality and Depth" is the guideline influencing stormwater management policy and practice throughout Washington State and other parts of the country. This guideline is the standard with which Western Washington jurisdictions will comply and amend their regulations over the next several years.[48] The BMP establishes the following minimum soil quality and depth standards, which are met by amending soils with organic matter (e.g. compost): "A topsoil layer with a minimum organic matter content of 10% dry weight [30-40% compost amendment by volume] in planting beds, and 5% [15-25% compost amendment by volume]… in turf areas, and a pH from 6.0 to 8.0… or matching the pH of the original undisturbed soil. The topsoil layer shall have a minimum depth of eight inches…"[49] King County, Washington is one jurisdiction that has adopted this guideline as policy in King County's Code 16.82 – "Clearing and Grading Regulations," which can serve as a model for other local governments.[50]

Montgomery County, Maryland: RainScapes Compost-Amended Soil Requirement – Montgomery County is implementing policies to reduce non-point source pollution and enhance stormwater management through its RainScapes Rewards Rebate program. The initiative was set forth to comply with the EPA's National Pollution Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit Program, as part of an overarching effort to meet the goals of the Clean Water Act.[51] The RainScapes Rewards program currently calls for amending soil with compost as a best management practice for rain garden projects, and requires a 3-inch layer of compost for all conservation landscapes.[52] RainScapes offers property owners a rebate for low impact development (LID) installations, and has been replicated by the City of Rockville and City of Gaithersburg.[53] The Montgomery County Department of Environmental Protection is the lead department coordinating a multi-agency effort to comply with the stormwater permit issued to the County by the Maryland Department of the Environment.[54]

District of Columbia: RiverSmart Homes Program – Similar to the RainScapes program in neighboring Montgomery County, Maryland, the Washington D.C. Department of the Environment's (DDOE) RiverSmart initiative offers incentives to homeowners looking to reduce stormwater pollution leaving their property.[55] To protect the Chesapeake watershed, RiverSmart uses low impact development such as constructing rain gardens with 15% compost and conservation landscapes with native vegetation as part of its BayScaping program.[56] All new property developments and major renovations are now mandated to implement stormwater pollution reduction strategies. Because most homes in the District were built without stormwater control measures before the 1980s, incentive programs like RiverSmart help transition the city toward greater stormwater management while using compost-based best management practices.[57] DDOE also encourages DC residents to begin composting at home and recommends placing finished compost on gardens or flowerbeds.[58]

District of Columbia: DC Municipal Regulations Title 21, Chapter 5 – The District of Columbia is also currently in the process of amending and enhancing its stormwater regulations and soil erosion and sediment control regulations.[59] The City will be adopting a new stormwater management guidebook (SWMG) to ensure compliance with the proposed rules, which include the use of compost in various applications such as: impervious surface disconnection (i.e. diverting runoff to a "compost-amended filter path" with 2 to 4 inches of compost at a depth of 6 to 10 inches), green roof growing media (i.e. 20% "well-aged compost" organic matter), and bioretention filter media for tree planting areas (i.e. 20% aged leaf compost).[60]

The Montgomery County, MD RainScapes Rewards Rebate program requires 3 inches of compost for its conservation landscape projects, incorporated to create a 6-12 inch improved soil layer. *Photo: Montgomery County Department of Environmental Protection*

Incorporating compost into rain gardens is part of the RiverSmart Homes initiative to reduce non-point source pollution in Washington, DC. *District Department of the Environment* (DDOE) constructed this rain garden at its headquarters in Northeast DC. *Photo: DDOE*

The above bioswale is a shallow landscape depression or channel used to convey, slow, and filter stormwater. Bioswale installation uses organic matter and vegetation to create low impact developments (LID) that can serve as pre-treatment or post-treatment for stormwater containment systems while reducing runoff volume and peak flows.

Above, a tubular check dam intercepts stormwater to slow the flow velocity, while filtering sediment and pollutants. The water below the check dam is noticeably clearer and cleaner.

Photos: Filtrexx International LLC

Hennepin County, Minnesota: Hennepin County Department of Transportation Compost Pilot Project – From 2006-2007, the Hennepin County DOT conducted a pilot project using finished compost as an erosion control and surface water quality protection method. As compared to conventional practice, positive results included quicker seed germination and vegetation; easier movement, placement, and precision of compost logs (i.e. knitted mesh tubes filled with composted material and also known as compost filter socks) compared to silt fences (especially in difficult, awkward construction areas like highways); and an "all in one convenient operation" providing erosion control and slope stabilization with materials that would otherwise go to landfills or incinerators. The findings included a cost savings of $1,429 using the compost-based system versus a machine-sliced silt fence and sod option.[61]

Texas State Soil and Water Conservation Board "On Farm Composting of Dairy Cattle Solid Waste: Protecting Water Quality While Producing a Salable Product" – Texas A&M University-Commerce conducted a dairy farm cattle manure composting demonstration project that yielded the following water quality and economic benefits: By composting raw manure, 8,000 pounds of nitrogen and 3,000 pounds each of phosphorus and potassium were annually relocated and beneficially used in low-risk areas; production of a value-added compost product selling at a market price of $20 per cubic yard, earning dairyman $43,800 of total income and an annual net income of $20,150. Findings also indicate that this compost product is a good substitute for Canadian sphagnum peat moss as an alternative plant-growing medium and organic soil amendment.[62]

Leander, Texas: Leander Code of Ordinances, Chapter 14, Article VI, Section 1(c)(12-13) – Originally implemented as a water conservation ordinance, the current regulation promotes soil and watershed health by maintaining appropriate water consumption levels and creating more sustainable landscapes through minimum compost content and soil depth requirements. All new landscapes are required to have a minimum of 6 inches of soil depth in areas planted with turfgrass, consisting of 75% soil blended with 25% compost.[63]

Greeley, Colorado: Greeley Public Services – Section 14.08.195 – For over a century, the City of Greeley, Colorado has enforced water restrictions but in recent years has realized the added benefit of compost-amended soils.[64] Greeley's Public Services – Section 14.08.195 through 14.08.310 requires anyone installing a new lawn to use 4 cubic yards of compost per 1,000 square feet of area, incorporated at a depth of 6 inches.[65] According to Ruth Quade, the City's Water Conservation Coordinator, "you can drive through a new development (in March/April) and tell just from appearance the lawns that were amended and the ones that weren't."

24 Compost-Based Best Management Practices

Erosion & Sediment Control – Construction Activities

- Compost socks for sediment control
- Compost socks for inlet protection
- Compost socks for check dams
- Compost socks for concrete washouts
- Compost socks for slope interruption
- Compost socks for runoff diversion
- Compost vegetated cover
- Compost erosion control blanket
- Compost socks for sediment trap
- Compost socks for riser pipe filter

Storm Water Management – Post-Construction

- Compost storm water blankets
- Compost vegetated filter strip
- Compost engineered soil
- Compost socks for channel protection
- Compost socks for bank stabilization
- Compost sock biofiltration system
- Rain gardens
- Green roof system
- Compost socks for slope stabilization
- Compost for vegetated retaining walls
- Compost grout
- Compost socks for level spreaders
- Compost socks for vegetated gabions
- Compost bioswale

Source: **Rodney W. Tyler, Alexander Marks, Dr. Britt Faucette, *The Sustainable Site* (Santa Barbara: Forester Press, 2010).**

Can Compost-Amended Soil Reduce Nitrogen and Phosphorous Runoff Problems?

Yes, Compost Can Reduce N & P Runoff
Agricultural runoff, raw sewage, stormwater and other sources transport nutrients, namely nitrogen (N) and phosphorous (P), into aquatic ecosystems with devastating impacts. Agricultural runoff accounts for 40% of the N and 50% of the P entering the Chesapeake Bay due to farmland applications like raw manure and fertilizer.[66] Although compost itself contains N and P, it can mitigate nutrient problems by preventing soil erosion and runoff in the first place, and by converting N into a more stable and less mobile form and P into a less soluble form. Compost's pollution reduction qualities led EPA to include compost-based strategies on its National Pollution Discharge Elimination System menu of stormwater best management practices.[67]

Water Solubility: A Key Consideration
The water soluble percentage of N and P in soils is important. The higher the solubility of nutrients, the higher the ability of plants and crops to uptake them, but also the more potential water pollution through leaching and runoff.[68] In compost-amended soil, only a small percentage of the P and N is water soluble (typically less than 1% of P and less than 5% of N).[69]

The level of N and P in compost varies depending on the type of compost feedstock. For example, in leaf and yard trimmings compost, P levels tend to be lower (0.5-0.7%) than composts made from manures, biosolids, and food scraps (1-2%). Similarly, poultry litter and biosolids composts have higher N levels than yard trim-derived compost. (Composting methods and pH can also impact the level of N in compost.)[70] However, while compost has N and P, it is their availability to leach and runoff that is the critical factor.

Higher C:N Composts Can Bind N
Compost's carbon to nitrogen (C:N) ratio is a critical factor, as composts with higher C:N ratios can result in microbial immobilization (or binding) of N in the soil to reduce potential leaching.[71] Feedstocks with a lower C:N, such as poultry manure (C:N of 10-18:1), grass clippings (C:N of 12-25:1), and food scraps (C:N of 18:1), tend to produce a lower C:N compost than a higher carbon feedstock such as leaves (C:N of 40-80:1).[72] Regardless of the feedstock, a proper composting process and mature compost greatly reduce potential N loss in compost-amended soils compared to soils amended with other nutrient applications such as raw manure and chemical fertilizers. Amending soils with higher C:N composts lets trillions of microorganisms stabilize and slowly release N, preventing ground or surface water N pollution during precipitation events. Conversely, N loss from chemical fertilizers increases the risk of water pollution as at least half of the fertilizer applied to fields is often lost to the air or water.[73]

Control Erosion to Control P
P is largely lost in erosion, which is why erosion and sedimentation lead to damaging P levels in waterways. If the soil doesn't erode, the chances of P loss are greatly reduced.[74] Compost prevents erosion, as its glue-like humus content keeps soil particles stuck together and resistant to eroding forces.[75] Compost applied at too high of a rate, however, can increase soil P to levels that exceed the soil's P-binding capacity, resulting in increased soluble P runoff.[76]

Enhanced Soil Physical Properties
While compost can increase potentially transportable soluble P, it can also improve soil physical properties that help reduce runoff. A Virginia Polytechnic Institute and State University study found that while a poultry litter-yard trimmings compost increased soil test P concentrations to near environmental thresholds, the risk of P loss through runoff and erosion was reduced threefold relative to an unamended soil control treatment and twofold relative to soils amended with synthetic fertilizer or poultry litter. Results reveal that improved soil physical properties (e.g. infiltration, water-holding capacity, aggregation, organic matter) in compost-mended soils can significantly reduce runoff containing P.[77]

Less Nitrate Loss with Compost
A 2005 study found the percentage of total N loss to be less for all four different composts tested compared to conventional seeding.[78] All composts also produced less nitrate (a highly mobile form of N) loss by the final simulated storm event than conventional seeding and over 50% less than the bare soil control. While composts with high nitrate contents may not be desirable for use near or in surface water, nitrate reductions (especially after initial storm events) are attributed to compost's ability to reduce runoff volume.[79]

Compost Outperforms Conventional Seeding for Pollutant Load Reduction

Four different experimental studies recorded significantly higher reductions in nutrient and sediment loads when using a compost blanket (i.e. a loose layer of compost applied to soil) as compared to conventional seeding methods.

Scientific Study	Type of Conventional Seeding Used	Percent of Pollutant Reduction When Using Compost Blanket vs. Conventional Seeding				
		Total N	Nitrate N	Total P	Soluble P	Total Sediment
Mukhtar et al., 2004	seed+fertilizer	88%	45%	87%	87%	99%
Faucette et al., 2007	seed+fertilizer	92%	ND	ND	97%	94%
Faucette et al., 2005	hydromulch	58%	98%	83%	83%	80%
Persyn et al., 2004	seed+topsoil	99%	ND	99%	99%	96%

ND = no data recorded

Source: Britt Faucette, Filtrexx LLC, "Designing with Nature: LID and Pollution Prevention with Compost BMPs." Compost BMPs, EPA-WIP/TMDL Challenge Seminar, Annapolis, MD, March 2013.

Frequently Asked Questions

Q: Is compost a fertilizer?

A: Compost is a soil amendment that enhances the chemical, physical, and biological characteristics of soils but is not typically characterized as a fertilizer.[80] However, because compost contains nitrogen, phosphorous, and potassium (N-P-K), Maryland's new nutrient management regulations will likely impede amending soils with compost as a watershed protection best management practice. Under the MD Department of Agriculture revised regulations, if a product has "fertilizer value" (i.e. N-P-K) and is used on agricultural lands (including sod and turf areas), its use will be restricted.[81] While compost is more normally applied as a soil amendment than a fertilizer, it can supplement fertilizer applications to reduce the amount of synthetic fertilizer use over time. This will reduce costs and potential N and P leaching by use of synthetic fertilizer.[82]

Q: Can compost-amended soils reduce runoff or leaching of nutrients such as nitrogen (N) and phosphorous (P)?

A: Yes. First, amending soils with compost adds organic matter to the soil that, unlike chemical fertilizers, facilitates a slow-release of nitrogen, allowing plants access to their needs, and reduces the risk of nutrient transport through leaching and runoff. This is more common in composts with higher carbon to nitrogen (C:N) ratios.[83] While compost applied at high rates, can raise P to levels that exceed the soil's capacity to immobilze P, applying compost can also improve soil physical properties (e.g. aggregation, infiltration, water-holding capacity) that reduce runoff volume and P-bound eroded sediment.[84] Furthermore, while composts with high nitrate concentrations may not be desirable for use in or around surface water, research indicates that compost's ability to reduce runoff volume results in lower nitrate losses particularly after initial rainfall events. Compared to conventional seeding and fertilizer, quality compost also typically has a lower inorganic N content (the N form more easily lost in stormwater runoff compared to organic N).[85]

This compost berm acts as a filter to remove sediment and pollutants (such as oil, grease, heavy metals, and suspended solids) from water traversing through it downstream. Compost filter berms are dikes of compost or similar compost product placed perpendicular to water flow.

Photo: Texas Commission on Environmental Quality

Q: How can composting and using compost improve problems associated with raw manure such as handling and storage, pathogen contamination, disposal, and nutrient leaching caused by application to agricultural lands?

A: Composting reduces the weight and moisture content of manure and kills disease causing pathogens, while producing a value-added product. Because composting converts the nitrogen in manure into a more stable organic form, the finished compost is less susceptible to leaching when applied to soils.[86] There are a number of composting facilities in the Mid-Atlantic region that accept poultry, horse, and livestock manures.

Q: How much compost should be incorporated into soils to achieve a minimum soil quality and depth that can protect our watershed?

A: Recommend soil amendment rates call for "a topsoil layer with a minimum organic matter content of 10% dry weight [30-40% compost amendment by volume] in planting beds, and 5% [15-25% compost amendment by volume]… in turf areas, and a pH from 6.0 to 8.0… or matching the pH of the original undisturbed soil. The topsoil layer shall have a minimum depth of eight inches…"[87]

Q: Are compost-based best management practices (BMPs) more beneficial than traditional construction and maintenance practices?

A: Research has shown that compost-based products and practices outperform conventional methods on multiple erosion control and stormwater management parameters.[88]

Q: Is the implementation of compost-based soil systems more expensive than conventional construction and maintenance practices?

A: Because compost products and systems provide long-term benefits that improve the overall health of soil and watershed ecosystems, maintenance costs can be avoided and funds repurposed.[89] Research has also indicated that up-front savings can be realized as well. In a study comparing the cost of compost-based systems versus conventional sediment control devices, all four different compost filter sock treatments (i.e. mesh tubes

filled with composted material) were cheaper to implement than a standard straw bale application. The most expensive compost sock installation totaled $2.74/linear ft. compared to a maximum of $2.87 for the conventional straw bale.[90]

Q: Is compost made from food scraps a viable source for watershed protection products and practices?

A: Yes. The successful Soils for Salmon program model places no limit on the amount of food scrap derived compost used to amend soils. Certain low impact development (such as bioretention projects) can benefit from having higher concentrations of woody residuals to help absorb more water and filter pollutants; however, best management practice still specifies up to 35% food scrap compost in such instances.[91]

Resources

California Department of Resources Recycling and Recovery
Compost Use for Landscape and Environmental Enhancement
http://www.calrecycle.ca.gov/Publications/Documents/Organics/44207002.pdf

California Department of Transportation (Caltrans)
Erosion Control Standard Specifications
http://www.dot.ca.gov/hq/LandArch/ec/2010_StdSpecs_Section_21.pdf

Resources on using compost to improve stormwater quality
http://www.dot.ca.gov/hq/LandArch/ec/organics/compost_blanket.htm

City of Portland Environmental Services
Green Streets
http://www.portlandoregon.gov/bes/44407

District Department of the Environment
RiverSmart Homes Rebate Program
http://ddoe.dc.gov/riversmarthomes

Filtrexx International LLC
http://filtrexx.com/
Market leader for compost-based mesh containment systems for erosion control, stormwater management, and other applications. Offers an education and training program for professionals in the engineering, architecture, landscape architecture, and land planning fields.
www.filtrexx.com/certified_designers.htm
Filtrexx experts have also co-authored *The Sustainable Site: The Design Manual for Green Infrastructure and Low Impact Development*

Institute for Local Self-Reliance (ILSR)
Compost Amended Soil Rules
http://www.ilsr.org/rule/compost-amended-soil/

Montgomery County Department of Environmental Protection
RainScapes Rewards Rebate Program
www.rainscapes.org

National Capital Region Watershed Stewards Academy
Provides continuing education, tools, and resources to help community leaders address pollution problems in their local waterways.
http://www.anacostiaws.org/programs/education/watershed-stewards-academy

On-Farm Composting of Manure Resources
On-Farm Composting Handbook
http://watershedbmps.com/wp-content/uploads/2012/03/01744_FarmCompost.pdf
A Practical Guide for Composting Poultry Litter
http://www.deq.state.ms.us/mdeq.nsf/pdf/SW_PoultryLitterGuide09232009/$File/guide_poultry_litter.pdf?OpenElement

What Can I Do?

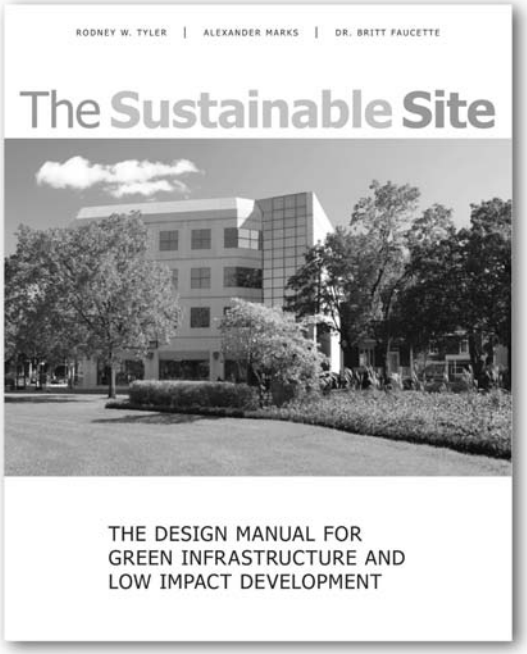
Advocate for policies and industry standards that require a minimum soil quality and depth standard. Find more on the "Soils for Salmon" project, an exemplary model program that can be replicated in the Chesapeake Bay region.

Support state and local efforts to compost properly and to use compost and compost products to control soil erosion and stormwater runoff.

Promote the expansion of programs like Montgomery County's RainScapes Rewards Rebate program to other jurisdictions.

Encourage local design, construction, and landscaping companies and associations to support green infrastructure and implement best management practices that require minimum soil quality and depth standards.

Participate in seminars, workshops, and training programs that provide education on compost-based best management practices and low impact development.



The Sustainable Site **is a low-impact development and green infrastructure handbook for engineers, designers, regulators, planners, contractors, consultants, water resource managers, and landscape architects.**

Filtrexx International LLC

On-Farm Composting of Poultry Litter
https://utextension.tennessee.edu/publications/Documents/Info%20319.pdf
A Guide to Composting Horse Manure
http://whatcom.wsu.edu/ag/compost/horsecompost.htm

State Stormwater Management Manuals

Georgia Stormwater Management Manual (a three-volume document which specifies the use of composted organic material) and *Coastal Stormwater Supplement*, First Edition, April 2009
http://www.atlantaregional.com/environment/georgia-stormwater-manual/

Pennsylvania Stormwater Best Practices Manual
http://www.elibrary.dep.state.pa.us/dsweb/View/Collection-8305

2012 Stormwater Management Manual for Western Washington,
State of Washington Department of Ecology
https://fortress.wa.gov/ecy/publications/publications/1210030.pdf

The Sustainable Sites Initiative
http://sustainablesites.org/
The Sustainable Sites *Guidelines and Performance Benchmarks 2009* manual
http://www.sustainablesites.org/report/Guidelines%20and%20Performance%20Benchmarks_2009.pdf
The *SITES Reference Guide 2013* (due for release mid 2013) will replace the *Guidelines and Performance Benchmarks 2009*

U.S. Composting Council (USCC)
http://compostingcouncil.org
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Using Compost Can Reduce Water Pollution
http://compostingcouncil.org/admin/wp-content/uploads/2010/09/Using-Compost-for-Reducing-Water-Pollution.pdf

U.S. Department of Agriculture (USDA)
USDA Natural Resources Conservations Service (NRCS) Soil Quality Institute
http://soils.usda.gov/sqi/
NRCS *Soil Quality Technical Note No.5*
http://soils.usda.gov/sqi/concepts/soil_organic_matter/files/sq_tn_5.pdf

U.S. Environmental Protection Agency (EPA)
Current State Departments of Transportation Success Stories (compost use case studies)
http://www.epa.gov/composting/highway/highwy3a.pdf
Benefits To Compost Use On Roadside Applications
http://www.epa.gov/composting/highway/highwy2.pdf
Innovative Uses of Compost: Reforestation, Wetlands Restoration, and Habitat Revitalization http://www.epa.gov/composting/pubs/reforest.pdf
Innovative Uses of Compost: Erosion Control, Turf Remediation, and Landscaping
http://www.epa.gov/composting/pubs/erosion.pdf
Stormwater Runoff Control Best Management Practices (BMPs) Fact Sheets as part of its National Pollutant Discharge Elimination System (NPDES) resources:

Compost Blankets available at
http://www.epa.gov/npdes/pubs/compostblankets.pdf
Compost Filter Berms
http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=119
Compost Filter Socks
http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=120
Compost Use on State Highway Applications
http://www.epa.gov/composting/highway/index.htm

EPA GreenScapes Program
http://www.epa.gov/region9/organics/greenscapes/composting.html
Publications on composting and compost use
http://www.epa.gov/composting/pubs/index.htm

Washington Organics Recycling Council (WORC)
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Full text of the *Building Soil* manual
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