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Performance and Design for Compost *Erosion Control* and Compost *Storm Water* Blankets

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Biographical Sketch

Dr. Britt Faucette is a Research Ecologist, Certified Professional Erosion & Sediment Control (CPESC), and the National Director of Research, Technical and Environmental Services for Filtrexx International, LLC. He has a PhD in Ecology from the University of Georgia where he researched soil-water-plant performance and relationships of various BMPs used in erosion and sediment control applications. Britt serves on technical committees with the American Society of Test Methods (ASTM), International Erosion Control Association (IECA), and Erosion Control Technical Council (ECTC) to create and evaluate new erosion and sediment control standard test methods and design criteria for BMPs. He also serves as a research manuscript reviewer for the Journal of Environmental Quality and technical reviewer for the Sustainable Sites Initiative led by the American Society of Landscape Architects (ASLA) and US Green Building Council's (USGBC) LEED Green Building Rating System. He is currently involved in 10 university and state/federal agency research projects utilizing compost in various storm water management applications and has helped to get compost based BMPs approved and specified by nearly 50 state and federal agencies. He has contributed to 20 peer-reviewed and over 40 popular publications on compost use and storm water management. Britt has worked with foreign governments, taught graduate students, and/or consulted on compost and storm water related projects in 12 countries.

Abstract

Recent peer reviewed research from major land grant universities has shown compost erosion control blankets reduce soil erosion, reduce nutrient loading (nitrogen and phosphorus), increase vegetation cover and biomass, reduce runoff volume and peak flow rates relative to conventional best management practices. This paper will review these research papers and utilize the reported results to establish design values for compost blankets used in slope stabilization (compost erosion control blankets) on disturbed soils and for runoff reduction (compost storm water blankets) for Low Impact Development (LID) design applications. Specifically this paper will report on the effects of particle size specifications on performance, single event cover management (C) factors (soil loss ratio), low impact development design objectives, initial abstractions, runoff curve numbers (CN), and runoff coefficients for compost erosion control and storm water blankets.

Key Words: compost blankets, low impact development, runoff, erosion control, storm water

Introduction

Recent published research has shown that compost blankets can be used effectively in both erosion control and Low Impact Development (LID) storm water design applications. Runoff control and nutrient loading from construction sites where vegetation is under establishment has become an increasing concern for environmental regulators and stakeholders where 303d listed (TMDL) watersheds for nutrient loading have been identified. Research from the University of Georgia has shown that compost *erosion control* blankets, relative to hydromulch/seed, can reduce total sediment loads by 80%, nitrate-nitrogen loads by 88%, and total and soluble phosphorus loads by 83% (Faucette et al, 2005). In a follow up study by the University of Georgia and Auburn University, compost *erosion control* blankets, relative seeded straw blankets, reduced total sediment loads by 81%, suspended solids load by 90%, total nitrogen by 92%, and total phosphorus by 97% when USEPA and state Department of Transportation specifications were followed. *Single event* cover management factors (C Factor) used for planning and design to predict erosion rates from construction sites using the Universal Soil Loss Equation (USLE) were reported between 0.002 and 0.015 (Faucette et al, 2007). Published research has also shown that compost blankets can improve the underlying soil quality and provide better vegetation establishment relative to other vegetation establishment BMPs. Relative to hydromulch, compost blankets increased vegetation cover by 40% after 3 months, and reduced invasive weed biomass by 85% after 1 yr. Additionally, compost blankets increased soil microbial carbon, organic matter, and neutralized soil pH more effectively than hydromulch (Faucette et al, 2006). Due to these benefits, coupled with the high initial hydrologic abstractions observed in these studies, compost blankets have been increasingly used to reduce *storm water* volume and increase infiltration in landscapes. Under 1 hr 50 and 100 yr return design storms (3.0 to 4.0 in/hr), compost blankets have been shown to absorb 80% of total rainfall, reduce runoff volume by 50 and 60% relative to hydromulch and straw blankets, respectively; reduce runoff rate by 36 and 42% relative to hydromulch and straw blankets, respectively; and delay the onset of runoff by 20 and 10 min relative to hydromulch and straw blankets, respectively (Faucette et al, 2005; Faucette et al, 2007). From theses studies initial hydrologic abstractions, runoff coefficients (rational formula) and runoff curve numbers used for post-construction LID storm water design applications have been developed. This paper will review the existing research literature and describe how and why compost blankets function for erosion control and storm water reduction/LID applications and compare performance and design values for compost blankets used in these applications relative to other best management practices (BMPs). This paper will specifically report on the effects of particle size specifications on performance, single event cover management factors (soil loss ratio), low impact development design objectives, initial abstractions, runoff curve numbers, and runoff coefficients for compost blankets.

Particle Size Distribution Effects on Performance

Compost erosion control blankets used for slope stabilization and vegetation establishment have been evaluated in research and field demonstration projects more widely than compost used for sediment control (Ettlin and Stewart, 1993; Demars and Long, 1998; Glanville et al, 2001; Kirchhoff et al, 2003; Mukhtar et al, 2004; Faucette et al, 2004; Faucette et al, 2005). While specifications for compost erosion control blankets have been accepted and published by the Texas Department of Transportation (TX DOT), the American Association of State Highway Transportation Officials (AASHTO), the US Environmental Protection Agency (USEPA), Indiana Department of Natural Resources (IN DNR), Coalition of Northeast Governors/Connecticut Department of Transportation (CONEG), and many other public agencies, no research has been conducted to evaluate the most critical section of the specifications, the particle size distribution of the compost used to make the erosion control blanket. Of the 23 compost blanket treatments evaluated by Demars and Long (1998), Glanville et al (2001), Kirchhoff et al (2003) and Faucette et al (2004, 2005) none met any of the particle size specifications for compost erosion control blankets. Mukhtar et al (2004) reported that TX DOT specifications were followed, however, particle size distribution was not determined (Faucette et al, 2007).

We understand that the larger particles (overs or blended mulch) are the primary material that prevents soil loss, while the small particles (compost fines) are the primary material that prevents runoff. Large particles, prevent splash erosion and soil dislodgement by reducing the energy of raindrop impact, additionally, they reduce sediment transport in overland runoff by reducing runoff rates due to their size and weight. The small particles in compost can hold a significant amount of moisture (from rainfall), which likely increases infiltration and evaporation, additionally, it is the small particles that provide the nutrients and structure for plants (and their roots) to establish and maintain a healthy cover (which is generally the end goal of erosion control). It is also likely that any benefit of increased soil quality (over time) will result mainly from the small particles in the compost erosion control blanket (and biota in the soil and compost) (Faucette et al, 2007).

Table 1: Particle size specifications for compost erosion control blankets (Faucette et al, 2007)

Specifying Agency	% Pass 2 in	% Pass 1 in	% Pass ¾ in	% Pass ¼
TX DOT*	95	65	65 (5/8 in)	50 (3/8 in)
AASHTO	100 (3 in)	90-100	65-100	0-75
US EPA	100 (3 in)	90-100	65-100	0-75
IN DNR	100	99	90	0-90
CONEG	100	100	100	70 (1/2 in), 50 (1/12 in)

* 1:1 blend of compost and untreated wood chips (termed Erosion Control Compost)

Research conducted in 2005 at the University of Georgia Institute of Ecology Field Test Site, in Athens, GA evaluated the influence of particle size distribution of compost used as an erosion control blanket. Four 2 in thick compost blankets, with different particle size distributions, were tested on a 10% slope, on a compacted sandy clay loam subsoil, under 4 in/hr for 60 minutes of simulated rainfall, on plots 3 ft wide by 16 ft long. Test methods and analysis followed methods developed by the USDA National Soil Erosion Research Lab Water Erosion Prediction Project (WEPP) and those published by Faucette et al (2005) in the *Journal of Soil and Water Conservation.*

Table 2: Particle size distribution of compost and soil loss from erosion control blanket (Faucette et al, 2007)

Treatment	Soil Loss (g)	Suspended solids (g)	Turbidity (NTU)	Particle size % passing		
				1 in	½ in	1/4 in
Compost 1	46	25	36	99	64	30
Compost 2*	62	29	60	99	85	67
Compost 3*	100	31	87	99	89	76
Compost 4**	196	136	288	99	99	95

*Did not meet TX DOT specification for erosion control compost particle size distribution.
**Did not meet TX DOT, USEPA, IN DNR, or CONEG specification for erosion control blanket particle size distribution.

Based on this research total soil loss can 4 times as high, suspended solids can be 5 times as high, and turbidity can be 8 times as high if particle size specifications are not followed. Additionally, depending on which specification is followed (TX DOT, AASHTO, US EPA, IN DNR), total soil loss and turbidity can be twice as high from one compost specification relative to another (Faucette et al, 2007).

Cover Factors for Compost Erosion Control Blankets

A C Factor or *Cover Factor* is one of 6 factors used in the Universal Soil Loss Equation (USLE), the Revised Universal Soil Loss Equation (RUSLE) or the latest version, RUSLE2. The C Factor indicates how an erosion control practice, erosion control product, or conservation plan will affect average annual soil loss. The Universal Soil Loss Equation was originally developed in 1965 by the USDA to help predict or estimate water soil erosion using site, soil, rainfall, and management factors. The RUSLE and RUSLE2 have revised the USLE to include water soil erosion from sites beyond agriculture, including construction activities. All equations use the same factors (it is the sub-factors and supporting database that have been revised) to predict soil loss:

$$A = r\ k\ l\ s\ c\ p$$

Where **A** equals predicted soil loss (mass/area) of interill (sheet flow) and rill (small gullies where interill deposits flow) erosion from detachment (rainfall impact) and transport (runoff flow) on hill slopes up to the point of a concentrated flow area (channels); **r** is the *erosivity factor* for a given region (range = 8 to 700), which is based on historic rainfall rate/intensity averages; **k** is the *soil erodibility factor*, which is based on soil characteristics including texture, structure, organic matter content, permeability, and runoff potential; **l** is the *length of the slope*; **s** is the *steepness of the slope*; **c** is the *cover management factor*; and **p** is the *support practice factor*, which is attributable to practices that slow runoff such as terraces and slope interruption devices or cause sediment deposition such as silt fence or filter soxx. Currently, product manufacturers have not tried to determine P Factors for their products for use with the RUSLE, however, this is not the case for C Factors.

The C Factor in the USLE only allowed for types of agricultural management practices (such as cover cropping), in RUSLE one can input a specific C Factor for a particular erosion control tool or product, such as hydraulic mulch or a single net straw mat (usually determined through product testing and reported by the manufacturer not the USDA or RUSLE modelers). In RUSLE2 one can no longer input a specific C Factor but is required to input characteristics (sub-factors for determining the C Factor) of the erosion control practice, tool, or product. This creates less potential bias from manufacturer testing and reporting, particularly since there is no standard test method for determining C Factors for erosion control products. RUSLE2 sub-factor inputs used to determine C Factors are: percent canopy coverage of soil, percent contact with soil surface, surface roughness, amount of cover applied (tons/ac) – which is used to determine thickness of blanket, decomposition rate of materials (how long will it last), and historic soil disturbance/tillage.

Although determining C Factors can be complicated, the erosion control industry (not USDA or RUSLE modelers) has greatly simplified the process to quickly and inexpensively evaluate their erosion control products so equation users (designers, engineers, architects) can readily and easily insert specific product *single event* C Factors into RUSLE (currently the most widely used of the three). To do this, product manufacturers (and/or their third party testing labs) only determine the *soil loss ratio* of the specific erosion control product *relative to a bare soil* under the same test conditions. Therefore, the soil loss ratio is the total amount or mass of soil lost to water erosion from the erosion control product test plot area relative to a bare soil under the same soil type, rainfall, and slope conditions. The inverted soil loss ratio is the percent soil loss from the erosion control product relative to the bare soil (example: a straw blanket reduces soil loss by 80%, its soil loss ratio is 0.20, or reported as C Factor by most erosion control blanket manufacturers). As a reference, a bare soil with no erosion control practice has a C Factor of 1.0 (worst case scenario), while no soil erosion would be 0.00, generally a forest duff layer is considered to have the lowest C Factor. See Table 3 for a list of reported C Factors for compost erosion control blankets, rolled erosion control blankets, wood mulch, straw mulch, and natural forest duff. The lower the C Factor the better the erosion control practice/product is at preventing soil erosion, *however*, the test conditions can have a major influence on the C Factor – these include slope steepness, slope length, rainfall intensity, rainfall duration, soil type and soil conditions (Faucette et al, 2007).

Table 3: Reported C factors for various slope stabilization BMPs (Faucette et al, 2007).

Product/Practice (reference)	**C Factor**	**Influencing Factors**
Straw Blanket (Demars & Long, 1998)	0.08	2:1 slope; natural rainfall (max. 1.6/24 hr); 10 ft x 35 ft test plot; on silty sand
Straw blanket w/pam (Faucette, unpub)	0.19	10:1 slope; 4 in/hr 1hr rainfall; 3 ft x 16 ft test plot; clay subsoil; 2 in blanket
Mulch Blanket (Demars & Long, 1998)	0.075	2:1 slope; natural rainfall (max. 1.6/24 hr); 10 ft x 35 ft test plot; on silty sand; 3 in blanket
Mulch Fines (Faucette et al, 2004)	0.16	10:1 slope; 3.2 in/hr 1 hr rainfall; 3 ft x 3 ft test plot; clay subsoil; 1.5 in blanket
Mulch Overs (Faucette et al, 2004)	0.11	10:1 slope; 3.2 in/hr 1 hr rainfall; 3 ft x 3 ft test plot; clay subsoil; 1.5 in blanket
Wood chips @ 7 tons/ac (GA SWCC, 2000)	0.08	
Wood chips @ 12 tons/ac (GA SWCC, 2000)	0.05	
Wood chips @ 25 tons/ac (GA SWCC, 2000)	0.02	
Compost Blanket (Demars, 1998)	0.05	2:1 slope; natural rainfall (max. 1.6/24 hr); 10 ft x 35 ft test plot; on silty sand; 3 in blanket
Compost Blanket (Demars et al, 2000)	0.02	2:1 slope; natural rainfall, 10 ft x 35 ft test plot; on silty sand; 3 in blanket
Compost Blanket (Mukhtar et al, 2004)	0.008	3:1 slope; 3.6 in/hr 30 min runoff; 3 ft by 6 ft test plot; on clay soil; 2 in blanket
Compost Blanket (Faucette et al, 2005)	0.01	10:1 slope; 3.2 in/hr 1 hr rainfall; 3 ft x 16 ft test plot; clay subsoil; 1.5 in blanket
Compost Overs (Faucette et al, 2007)	0.01	10:1 slope; 4 in/hr 1hr rainfall; 3 ft x 16 ft test plot; clay subsoil; 1.5 in blanket
Compost Fines (Faucette et al, 2007)	0.065	10:1 slope; 4 in/hr 1hr rainfall; 3 ft x 16 ft test plot; clay subsoil; 1.5 in blanket
Compost Fines w/ biopolymer (Faucette et al, 2007)	0.03	10:1 slope; 4 in/hr 1hr rainfall; 3 ft x 16 ft test plot; clay subsoil; 1.5 in blanket
Forest duff layer (GA SWCC, 2000)	0.001-0.0001	

Low Impact Development Design
Low Impact Development (LID) is a, comprehensive land planning and engineering design approach with the goal of maintaining and enhancing the pre-development hydrologic regime of *post-development*, urban and developing watersheds. LID is a storm water management design approach that seeks to provide **on-site** management using a variety of **distributed** landscape features and engineering devices that, 1) reduce stormwater runoff, 2) slow down runoff, 3) enhance infiltration, 4) filter runoff pollutants, and 5) capture stormwater. LID uses a hybrid of engineering – technical design to meet specific runoff management targets (peak flow, volume, water quality), and architectural – functional design for aesthetics and increased value, design principles (LID Center Inc, 2005).

Low Impact Development recognizes that impervious surfaces in a watershed or site, 1) generate runoff more quickly, 2) generate greater runoff volume, and 3) carry more pollutants in runoff to receiving water bodies. For example, in a natural watershed, average runoff is 10% of the total precipitation volume; with 10-20% impervious surface area it increases to 20%; 35-50% impervious surface area increases to 30% runoff; 75% + impervious surface increases to 55% runoff (Tourbier and Westmacott, 1981). Watersheds with greater than 10% impervious surface area have been directly correlated to impaired stream water quality, and watersheds with greater than 25% impervious surface have been correlated to long term stream water quality impairment. As an example, an average single family home site has a 25 to 60% impervious surface area.

LID Design Objectives
By focusing on prevention and reduction of storm water runoff rather than control and treatment, LID manages runoff at the source, as it is being generated and before it reaches large concentrated flows. The hydrological goal of LID design is to *mimic natural systems* to achieve natural (or predevelopment) levels of: landscape surface water storage, infiltration, filtration, runoff velocity, interception, evapotransporation, and thermal control. Principle LID design objectives include – storm water *quantity* management under all conditions (volume, peak runoff rate, frequency, duration); water *quality* control under all conditions (pollution prevention); aesthetics; safety; and low cost (design, construction, maintenance). To achieve these objectives, the key LID design strategies are to – minimize land disturbance, maximize roughness along water flow paths (Manning's n value) to maintain or reduce flow velocity, maximize infiltration rate, maximize retention, disperse runoff flow – maintain sheet flow/discourage concentrated flows, filter water above and below ground, minimize slope angles, disconnect impervious surfaces, and connect pervious and natural surfaces.

Table 4: Site Characteristics and LID Design Strategies

	Minimize Disturbance	Maximize Roughness	Maximize Infiltration	Maximize Retention	Filter Runoff	Minimize Slopes
Runoff Peak Flow Rate	↓	↓	↓	↓		↓
Runoff Volume	↓	↓	↓	↓	↓	↓
Time of Concentration	↑	↑	↑	↑		↑
Infiltration Rate	↑	↑	↑	↑	↑	
Pollutant Loading	↓	↓	↓	↓	↓	

Recreated from Low Impact Development Design Strategies – An Integrated Design Approach (Prince George's County, MD, 1999)

LID *Integrated* Management Practices
LID Integrated Manangement Practices (IMPs) are designed to reduce the hydrograph, or maintain predevelopment and/or natural hydrograph conditions, *and* to reduce pollutant loads in storm water. LID Integrated Management Practices include bioretention cells, rain gardens, vegetated filter strips, filtration

cells, bioretention swales, grassed swales, dry wells, level spreaders, infiltration trenches, engineered soils, soil amendments, green roofs, permeable pavement, rain barrels, and cisterns. Specifications are written using AASHTO and or ASTM criteria wherever possible. Standards, specifications, and design drawings for bioretention cells, bioretention swales, permeable pavement blocks, and soil amendments can be found at www.lowimpactdevelopment.org/resources.htm. An interactive, web–based LID IMP design tool can be accessed at www.lid-stormwater.net/intro/background.htm. Other design resources include Low Impact Development Design Strategies – An Integrated Design Approach at www.epa.gov/owow/nps/lidnatl.pdf and the USEPA LID Homepage at www.epa.gov/nps/lid.

LID Design Values

Hydrologic abstractions

Hydrologic abstractions (initial), runoff coefficients, runoff curve numbers, peak runoff rates, runoff volumes, and unit hydrographs for compost blankets have been developed and can be used in selected storm water/runoff prediction models.

Ia = *hydrologic abstraction (initial)* – is the amount of precipitation absorbed by a landscape before initiation of runoff (influenced by antecedent soil moisture, vegetation density/cover, soil/surface roughness, soil type [organic content, bulk density, aggregation]). It is a storage volume capacity, and is correlated to infiltration rate, which consequently declines over the storm duration as the landscape reaches saturation. Runoff volume can also be correlated to abstraction, since the greater the initial abstraction the lower the runoff volume.

In a study conducted by the University of Georgia, initial abstractions for compost blankets, relative to bare soil, at the time of installation, on average were 51% greater and after one year were 65% greater (Faucette et al, 2005). Based on three 1 hr/50 yr (3.1 in/hr for 1 hr) storm events, initial abstractions averaged 2.5 in (78%) and were as high as 3.2 in (96%), and runoff commencement was delayed by an average of 20 min and as much as 60 minutes. In a follow up study, using two designed 1 hr/100 yr return (4 in/hr for 1 hr) storms, compost blankets held an average of 80% of the 132 gallons of rainfall applied, increased the time to runoff initiation by a factor of 6, and reduced runoff volume by 60%.

In a similar study, Iowa State University reported that a 2 in compost blanket on a 3:1 slope, under simulated rainfall of 1 hr/100 yr return (4 in/hr for 1 hr), delayed runoff commencement by 50 min relative to a 6 in topsoil blanket and a disk-tilled soil (Persyn et al, 2004).

Research conducted at Texas A&M, for the TX Commission of Environmental Quality, using 2 in compost blankets on a 3:1 slope of clayey soil, under a simulated rainfall of 3.6 in/hr for 1 hr (25 yr return) of runoff generation, found that prior to vegetation establishment compost blankets reduced runoff by 35% (and as much as 67%) relative to soils receiving commercial fertilizer (Mukhtar et al, 2004).

In the same study conducted by the University of Georgia, over one year, peak runoff rates for soils treated with compost blankets were reduced by 36% relative to bare soil and 27% relative to hydroseeded soil. In the same follow up study compost blankets without vegetation reduced peak runoff rates by 34% and with vegetation by 51%.

In the same Iowa State University study compost erosion control blankets reduced runoff rate by 79% relative a bare disked-tilled soil and 71% relative to a 6 in topsoil blanket.

Research performed by the University of Texas-Austin, for the Federal Highway Administration and the US DOT, found that 3 in compost blankets applied to a clay soil on a 3:1 slope reduced peak runoff rates 10 fold under a 3.45 in/hr simulated rainstorm for a 3 hr duration (Kirchhoff et al, 2003).

Runoff curve numbers

Runoff curve numbers are often used in design applications to predict or estimate potential storm water runoff flow from a designated post construction area or watershed. A runoff curve number (CN) is the number assigned, between 40 and 99, to the runoff potential of a hydrologic soil-cover complex (Soil Conservation Service USDA, 1972). A hydrologic soil cover complex (and its assigned CN) is determined by the hydrologic soil group (A, B, C, or D), the land use (fallow, row crop, pasture, forest, etc), land treatment class (straight row, contour, terrace), the hydrologic condition of the soil (poor, fair, good), and the soil moisture content. The hydrologic condition of the soil is a subjective measure and the hydrologic soil group has been predetermined for every soil classification in the US (where A represents a low runoff potential soil and D represents a high runoff potential soil). For example, an impervious surface, like pavement, is 99, a wooded area with sandy soil is 46, and a surface that produces no runoff under any circumstance theoretically is 1. Today runoff curve numbers are usually estimated based on published book values and databases. Curve numbers for compost *storm water* blanket can be estimated with sufficient site and soil information based on these published book values. When determining runoff curve numbers, compost storm water blankets can have a significant effect on storm water runoff potential and should be considered in the assignment of the correct CN. Additionally, if a low CN is the desired characteristic, particularly in Low Impact Development (LID) or Leadership in Energy and Environmental Design (LEED) projects, sensitive watershed environments, sediment and/or stormwater management pond catchment basins, or where storm water utilities are levied, inclusion of compost 'storm water' control blankets should be seriously considered.

Compost *erosion control* blankets have been shown to significantly reduce storm water runoff, so much that they may be considered a runoff reduction tool as much as an erosion control tool. The humus fraction of compost (15-35% of the carbon originally used to make the compost or 60-80% of the stable organic matter content of the finished compost) is known to hold up to 5 times its weight in water (Brady and Weil, 1996).

Research at the University of Georgia (Faucette et al, 2005) and at Iowa State University (Persyn et al, 2004) have shown that CECBstm used on hill slopes can significantly reduce runoff volumes during rain events.

Research at the University of Georgia showed that a 1.5 in thick CECBstm on a 10:1 slope, under a simulated rainfall of 3.1 in/hr for 60 min (50 yr return), could delay runoff commencement by up to one hour relative to bare soil conditions and by 45 minutes relative to a hydroseeded treated soil on a cecil sandy clay loam (hydrologic class B). CECBstm reduced cumulative stormwater runoff over 1 year by 65% relative to a bare soil and 50% relative to a hydroseeded soil, and reduced stormwater volume during a single large storm event by as much as 96%. Similarly, compost erosion control blankets reduced peak runoff rates by an average of 36% (and as much 67%) relative to bare soil and 27% relative to hydroseeded soil, over 1 yr duration. In a follow up study at the same site, under 2 simulated rainfall events of 4 in/hr for 60 min (100 yr return), compost erosion control blankets reduced total runoff by an average of 60% and retained an average of 80% of the total runoff applied.

Research from Iowa State University reported that a 2 in compost blanket on a 3:1 slope, under simulated rainfall of 4 in/hr for 60 min (100+ yr return), could delay runoff commencement by 50 min relative to a 6 in topsoil blanket or disk-tilled soil. CECBstm reduced runoff rate by 79% relative a bare disked-tilled soil and 71% relative to a 6 in topsoil blanket (Persyn, 2004).

Research performed by the University of Texas-Austin, for the Federal Highway Administration and the US DOT, found that erosion control compost blankets 3 in thick on a clay soil and a 3:1 slope could reduce peak runoff rates 10 fold under a simulated rainfall of 3.45 in/hr for 3 hr duration (5 yr return) (Kirchhoff et al, 2003).

Research conducted at Texas A&M, for the TX Commission of Environmental Quality, using 2 inch compost blankets on a 3:1 slope of clayey soil, under a simulated rainfall of of 3.6 in/hr for 60 min (25 yr return), found that prior to vegetation establishment the compost blankets reduced runoff by 35% (and as much as 67%) relative to soils receiving commercial fertilizer, prior to vegetation establishment (Mukhtar et al, 2004).

In similar studies, Agassi et al (1998) found that compost mulches percolated twice as much water as a bare soil under rainfall simulation; Meyer et al (2001) found that incorporating compost at 40 Mg ha-1 to gravely clay loam and gravely sandy loam soils on 10 to 16% slopes can reduce runoff by 77% under a simulated rainfall of 4 in/hr for 30 minutes (100+ yr return), while the percent of runoff from rainfall was reduced from an average of 36% to 6%.

Runoff curve numbers can be determined if rainfall and runoff volumes are known (GA Storm Water Management Manual, 2001). Using results from Faucette et al (2005) where three storms produced 10 inches of rainfall, and compost blankets (from yard debris) generated 2.6 in of runoff; and Pitts (1994) equation for determining runoff curve numbers when rainfall and runoff volumes known, where:

CN = 1000/[10 + 5(P) +10(Q) - 10(Q2 + 1.25QP)1/2]

CN = runoff curve number
P = rainfall volume (in.)
Q = runoff volume (in.)

CN = 50

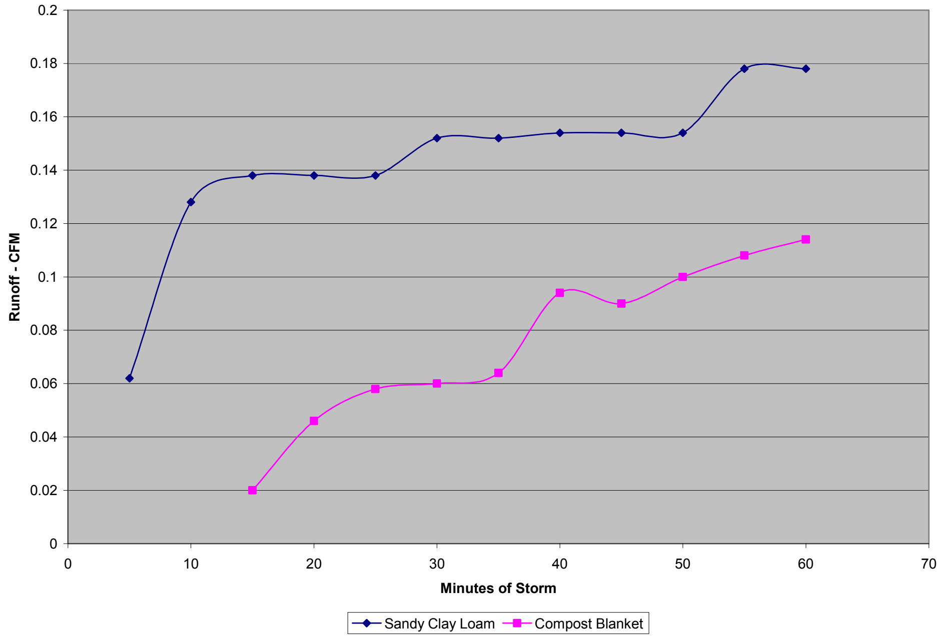
NOTE: this CN is representative of the site and soil conditions at the research site. Runoff CNs assigned to soils that are predominantly sand, silt, not severely compacted, or belong to a different hydrologic soil group will have a different CN. For accurate curve numbers that reflect your site and soil conditions, please consult the SCS National Engineering Handbook for Hydrology or a similar reference.

Runoff coefficients
C = *runoff coefficient*, in the Rational Formula (see below), is the ratio of runoff to rainfall. For example, C = 1, or 100% of the rainfall volume in a designated area or watershed becomes runoff. Impervious services (e.g. asphalt, concrete, roof) have a runoff coefficient of 0.95, undisturbed forests have a runoff coefficient of 0.15, lawns are 0.1 to 0.35 (depending on soil type and slope), pasture is 0.1 to 0.3, graded and unvegetated soil are 0.3 (sandy) to 0.6 (clay), gravel is 0.5, downtown areas are 0.95, neighborhoods are 0.7, single family homes are 0.5, and apartment areas have a C of 0.7 (GA Storm Water Management Manual, 2001). Compost blankets have a runoff coefficient of 0.05 to 0.35 (depending on soil type underneath). Based the literature presented here, the author believes designers should use a conservative value of 0.28.

Rational formula
Where:
Q = C x i x A

Q = peak runoff rate (cubic feet/sec)
C = runoff coefficient
i = rainfall intensity (in/hr)
A = area of watershed/drainage area (acres)

Unit hydrograph
A hydrograph allows you to visually compare runoff flow rate over the duration (time) of a storm. Below is a single event hydrograph for a compost blanket and a sandy clay loam without vegetation. This is based on a constant 4 in/hr storm for 60 minutes duration (1 hr 50 yr return for this site), on a 10% slope.



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