Manufacturing Topsoil from Scratch

- Rudimentary process of blending inorganic and organic materials to create topsoil with similar chemical and physical properties to a nutrient-balanced agricultural soil with a healthy soil ecosystem
- Technically simple, but potentially complex relative to soil fertility and tilth
Compost or Short Paper Fiber as a Primary Component in Manufactured Topsoil

- Ideal organic matter component for manufactured topsoils
- Typical blend is 1 part residuals to 1 part sand/silt by volume

- Wood fiber and microbial biomass
- High organic matter content
- Higher C:N ratio
- Low to medium concentrations of macro-nutrients (N, P and K)
Carbon and Nitrogen Balance:

*Organic Matter with High C:N Ratio*

- Organic N
- Organic C (energy source)
- Microbial attack
- $N_{\text{Mineralization}}$
- $\text{NO}_3^-$
- Nitrogen Immobilization
  - Mature Soil Organic Matter (Soil Humus)
  - Minimal Plant Available N
  - Decreased Yields

Organic C and Nitrogen Balance:

Organic Matter with High C:N Ratio
Biosolids as a Nutrient Source to Complement Organic Matter sources in Manufactured Topsoil

• Low C:N ratio → High potential to mineralize plant-available nitrogen
• Also rich in phosphorous and micro-nutrients (copper, zinc, iron, etc.)
• Can help to jump start soil microbial activity
• Generally provides for better vegetative response while removing any additional costs associated with commercial fertilizers
Resource Management, Inc. used Topsoil Manufactured from Short Paper Fiber from a deink mill using heat dried biosolids as the nutrient source

Spent Gravel Pit – No Topsoil on Site
Reclaiming Flood-Disturbed Farm Land with Residuals

Alstead, NH – October storm
Manufactured Topsoil Placement and Seeding

Topsoil delivered to the field was placed at a 9” thickness on the five acres of fields adjacent to the re-directed (and now tamed) Warren Brook

Seeded the field with a cover crop late in the fall
Restored Fields

- Late Fall- seeded with a cover crop
- Next summer → harvesting hay
- Better success with raising vegetables than the natural soil that the manufactured topsoil replaced
- The manufactured topsoil was able to replace what would have taken centuries for nature to accomplish without help
Pasture/Scenic Vista – Killington, VT

Ottauquechee River
Same Pasture During Hurricane Irene

Ottauquechee River
Irene Cleanup Effort 9 Months Later
Restored Pasture Using Manufactured Topsoil
the Next Field Season
Re-vegetated the Following Field Season
This Manufactured Topsoil Does Not Look Like a Text Book
Topsoil

Soil Cation Exchange Capacity
with base cation contributions

Ca  Mg  K  Acidity

Cmol$_c$ kg$^{-1}$

Typical New England soil  Optimum agricultural soil  Over-limed soil
Building Organic Matter in Droughty Soils – Silage Corn

**Silage Corn Tissue Analysis**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Amended</th>
<th>Non-Amended</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Phosphorus</td>
<td>0.08</td>
<td>0.06</td>
</tr>
<tr>
<td>% Potassium</td>
<td>0.40</td>
<td>0.33</td>
</tr>
<tr>
<td>% Magnesium</td>
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<td>0.04</td>
</tr>
</tbody>
</table>

- SPF and biosolids were applied to soil surface and plowed in with dairy as potassium source
- 500 cubic yards per acre application rate
- Equivalent to 60 dry tons per acre of fresh organic matter and close to 60 tons of lime equivalence per acre
Pemi Baker Soccer Field

Summer 2011

Summer 2013
Carbon Sequestration at Reclamation Sites

Not accounting for the increase in biomass production

- 87 Mg/ha carbon sequestered (based on study by Trlica and Brown, U Washington)
Sludge Incinerator Ash

- Very high phosphorus availability
- Concentrated micro-nutrients
- Dense, clay-like material when dry

Manufactured topsoil containing
- Biosolids composted with high C ash
- Sludge incinerator ash
- Hydrosolids
- Low fertility, acidic sandy loam

Resulting in neutral pH, optimum nutrient levels, good cation balance, relatively high organic matter content