Biosolids: A Local & Renewable Resource

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Right-of-Way as Habitat Working Group
January 19, 2016

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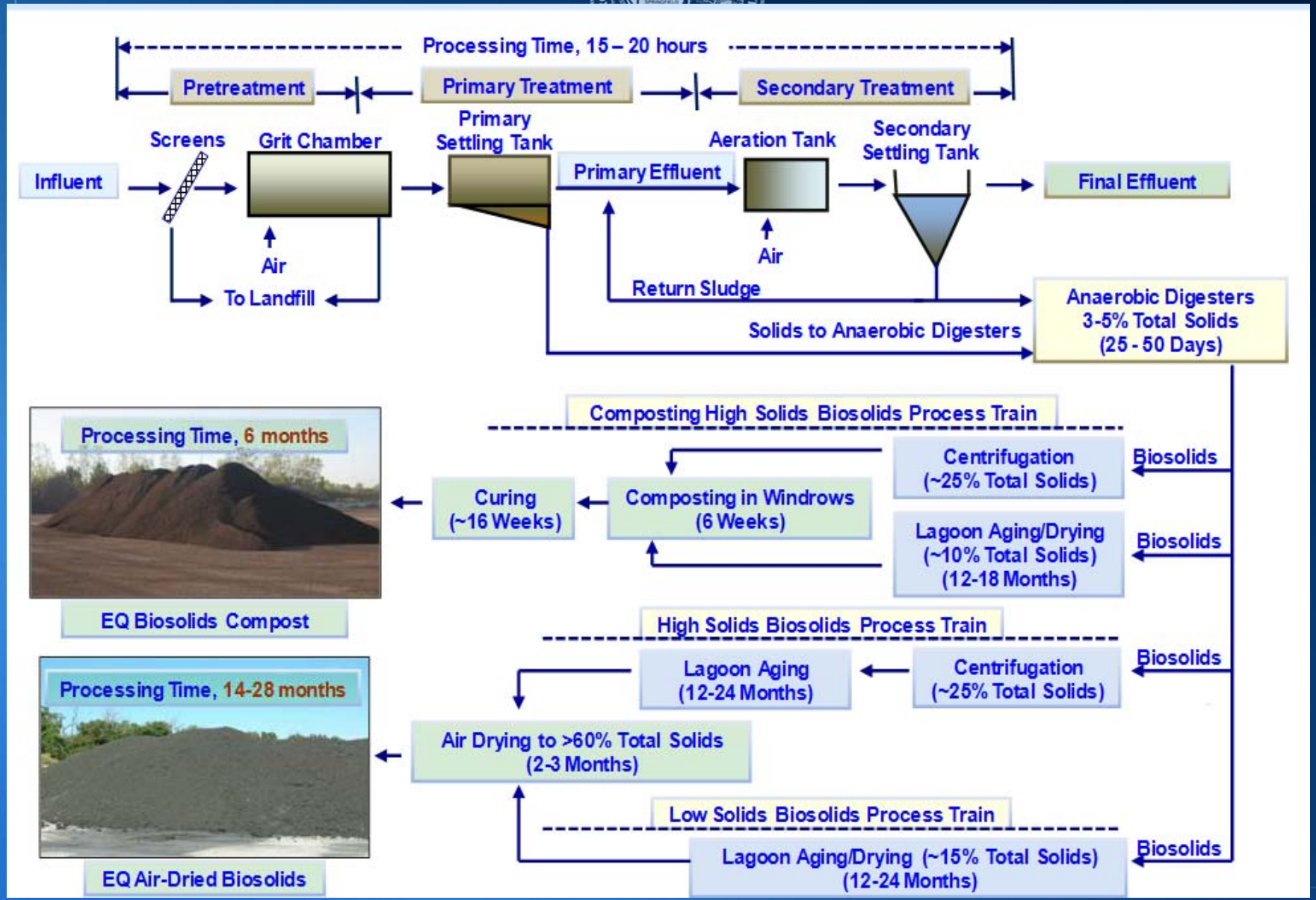
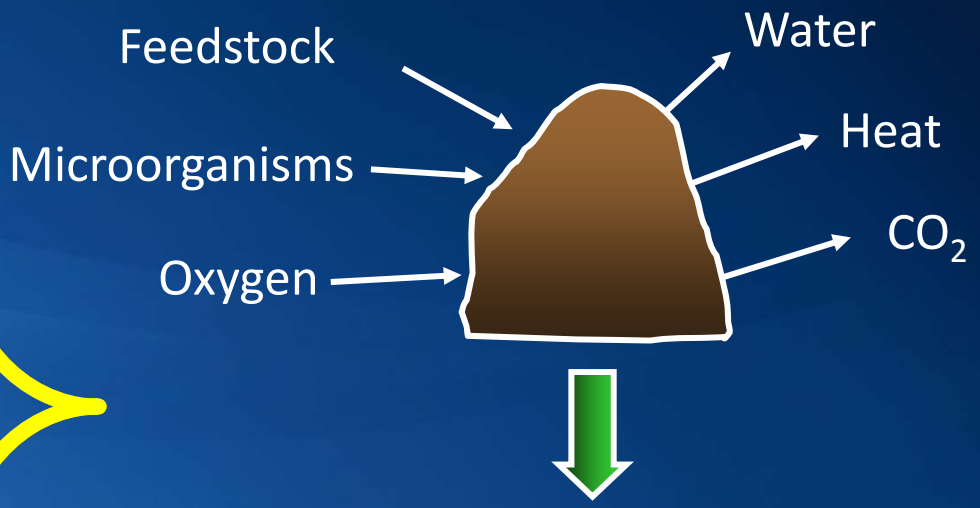
What are Biosolids and How are They Made?



Aged, Air-Dried Biosolids

Co-Composting Woodchips and Biosolids



EPA Standards For Biosolids

- Metals
- Pathogens (disease causing organisms)
- Vector Reduction

Science Behind Biosolids Recycling

- Pathogens removed
- Metals below levels of concern and further immobilized in soil
- Many metals are actually plant nutrients
- Organic contaminants generally not present or at very low levels

Regulatory Limits For Land Application

Trace Metal	Part 503 Limits Allowable	Part 503 Limits EQ	MWRD	Phosphate Fertilizers
		mg/kg		
Arsenic	75	41	5	11
Cadmium	85	39	3	65
Copper	4,300	1,500	380	57
Mercury	57	17	1.0	NA
Molybdenum	75	---	10	NA
Nickel	420	420	40	28
Lead	840	300	100	12
Selenium	100	100	5	NA
Zinc	7,500	2,800	725	240

*Essential nutrients for plants; EQ = Exceptional Quality; NA = Not available

Legislative Amendment

- Amended Illinois Pollution Control Act
- Biosolids were considered “sludge” and regulated as a waste:
  - “Sludge means any solid, semi-solid, or liquid waste generated from a municipal, commercial, or industrial wastewater treatment plant...”

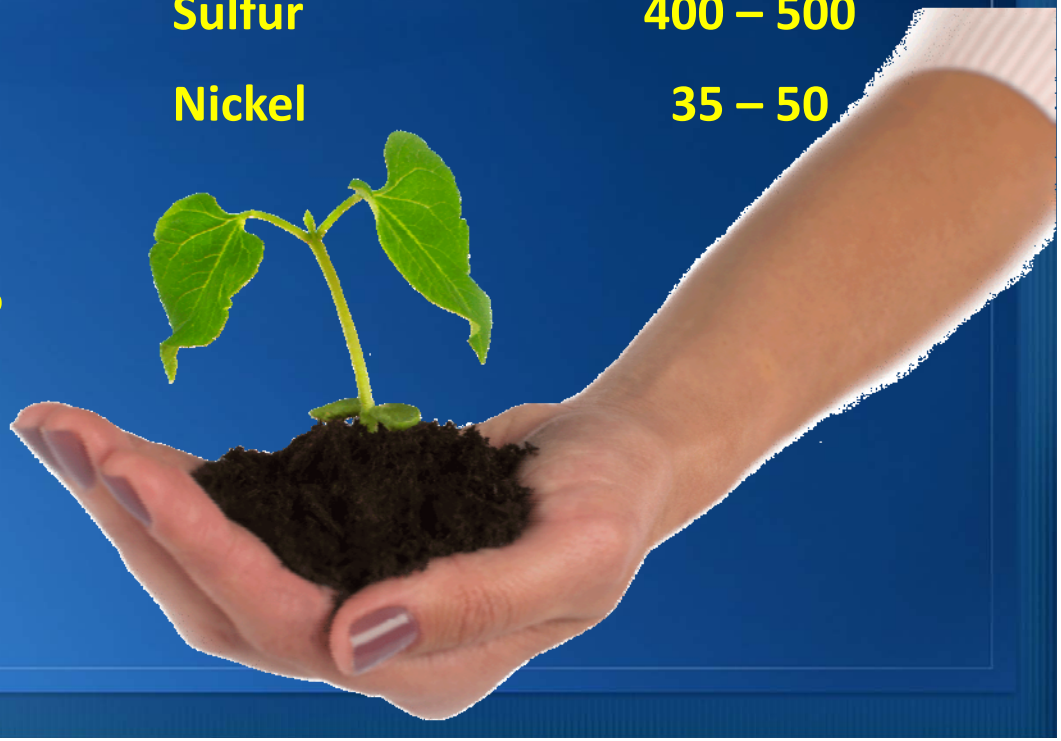
Governor Rauner signed Public Act 99-0667 on July 20, 2015

- Exceptional Quality (EQ) biosolids recognized as a resource to be recovered
- “To encourage and promote the use of EQ biosolids in productive and beneficial applications, to the extent allowed by federal law, EQ biosolids shall not be subject to regulation as a sludge or other waste…”

Nutrients in Biosolids

Organic Carbon	15 – 25 %
Organic Nitrogen	1.5 – 2.5 %
NO3+NH3-N	0.1 – 0.3 %
Total Phosphorus	1.5 – 2.5 %
Calcium	3.7 – 4.1 %
Magnesium	1.6 – 1.9 %
Iron	1.6 – 1.8 %

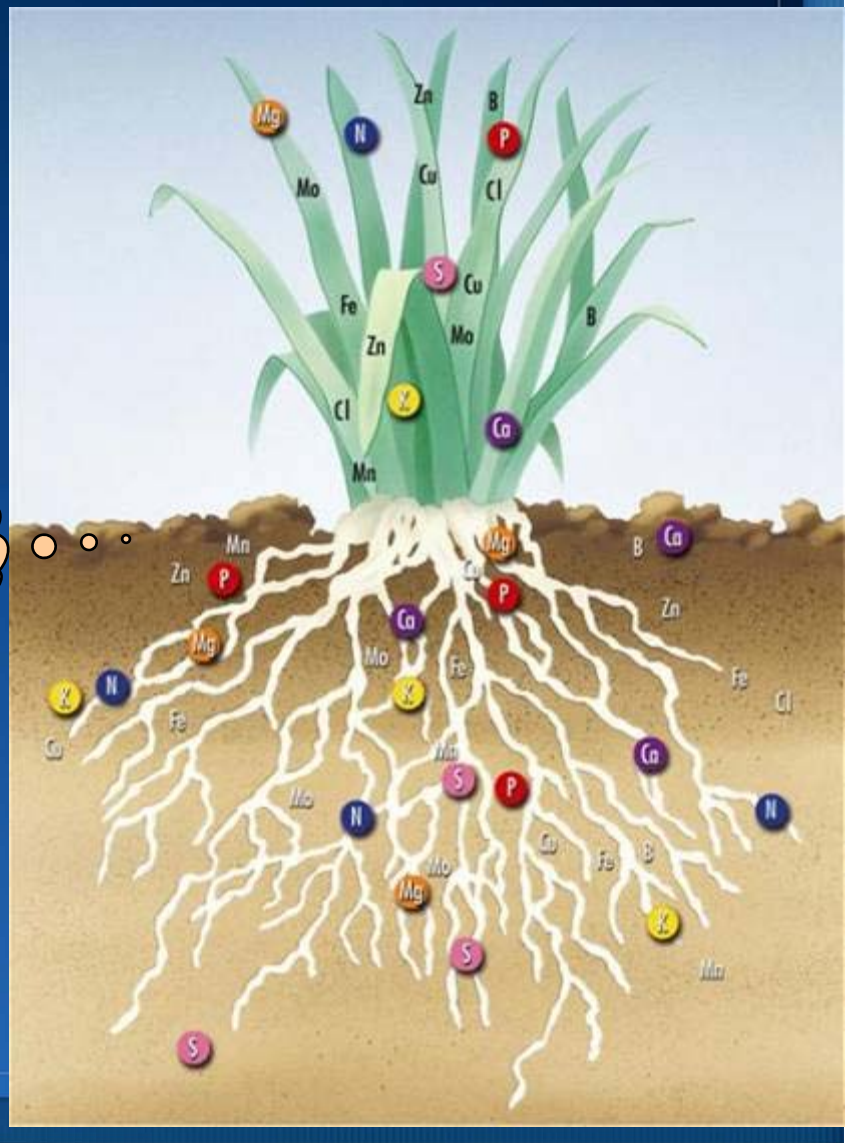
	mg/kg
Potassium	3,300 – 4,000
Zinc	760 – 900
Sulfur	400 – 500
Nickel	35 – 50



Essential Elements for Proper Plant Growth

Carbon (C), Hydrogen (H), oxygen (O)

- **Major Nutrients**
  - Nitrogen (N)
  - Phosphorous (P)
  - Potassium (K)
- **Minor Nutrients**
  - Calcium (Ca)
  - Magnesium (Mg)
  - Sulfur (S)
- **Micro Nutrients**
  - Iron (Fe)
  - Manganese (Mn)
  - Boron (B)
  - Chlorine (Cl)
  - Molybdenum (Mo)
  - Zinc (Zn)
  - Copper (Cu)



Urban Soil Remediation

- Urban soils are generally:
  - Unproductive – Lack fertility
  - Compacted – Poor infiltration
  - Lack organic matter and plant available nutrients

- Urban soils can be contaminated
  - DePaul University analyzed soil from four vacant lots in Chicago's Greater Grand Crossing neighborhood and reported total soil lead concentrations ranging from 46 – 3,023 mg/kg

Urban Soil Remediation

- Biosolids immobilize heavy metals in soils due to complexation with Fe and Al oxides*
- Uptake of lead and arsenic by carrots, lettuce, and tomatoes from biosolids amended soils was reduced by 50-71% for lead and 46-80% for arsenic**

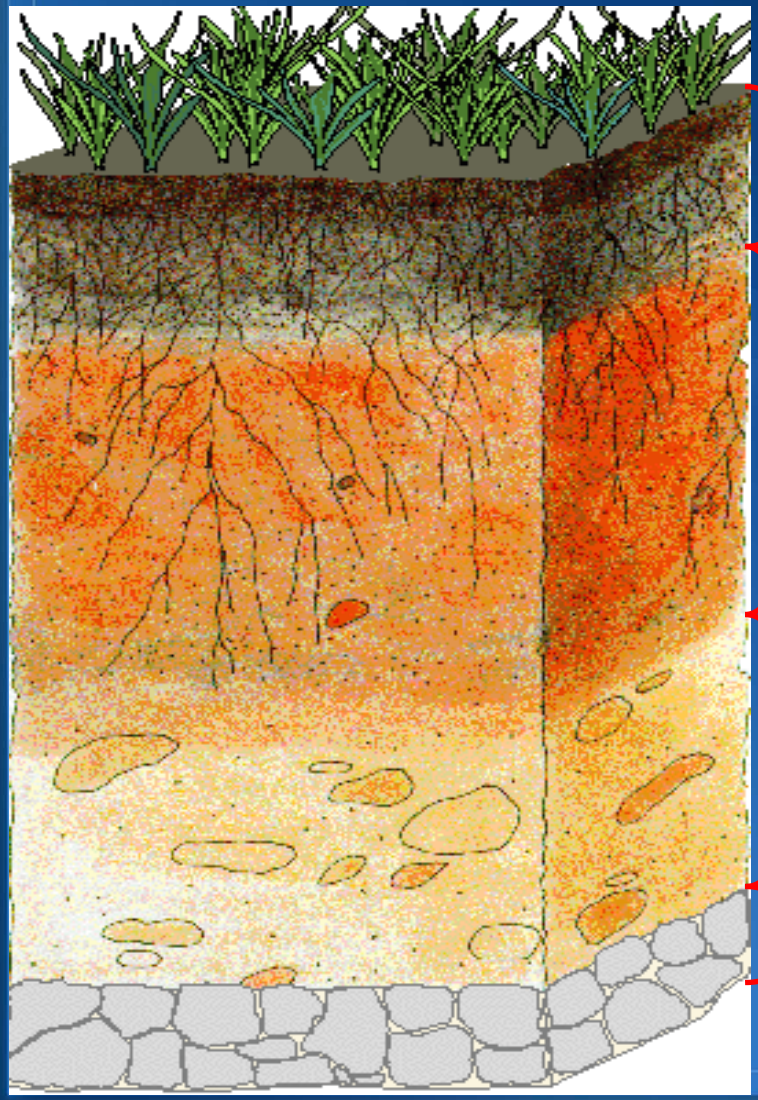
*Brown, et al. 2003. *J. Environ. Qual.* 32(1): 100-108.
*Chaney, R.L. 1994. American Soc. Agronomy, Crop Sci. Soc. America, and Soil Sci. Soc. America. Madison, WI. pp 27-31.
**Defoe, et al. 2014. *J. Environ. Qual.* 43(6): 2064-2078.

Re-Vegetation of Brownfields

Brownfield - USX

Reclaimed and Vegetated with Biosolids

A Typical Soil Profile



A – Horizon

- Light texture, high organic carbon
- Root zone, highly fertile
- Stores moisture, plant nutrients

B – Horizon

- Zone of clay accumulation
- Regulates water movement

C – Horizon

- Parent material

- Bedrock

Restoring Soils Leads to Restored Habitat

Parameter	Unit	75% Soil + 25% Biosolids	Remnant Prairie Soil
pH		7.1	6.2
Organic C	%	6.2	4.6
Organic N	mg/kg	4,780	4,150
Inorg.-N	mg/kg	48.4	6.9
Avail. P	mg/kg	245	21

Wildlife Habitat

Vegetation

Environment

Soil

Water

"The Three-Legged Stool"

Right of Way – State of The Soil!

Background

- Mowed grass is groundcover of choice in the clear zone
- DOTs seed turfgrass mixes containing mostly fescue, ryegrass, and bluegrass
- Grasses look good for a few seasons and then the weeds invade

*Rebecca Brown, U. of Rhode Island and Josef Gorres, U. of Vermont

So What?

1. Perennial grasses are replaced by crabgrass
2. Slopes fail
3. Gullies form
4. Sediment clogs drains
5. Money is wasted

Setting the Stage

- 75-90% of de-icing salt enters the roadside environment, primarily within 10 m of the pavement
- The roadside is engineered to rapidly drain water from the pavement
  - The zone between pavement and swale receives 2-3x as much water as the zone beyond the swale

Median of I-95 in RI. Trees on the left mark the swale.

Shoulder of I-95 in RI. Swale is on right and there is no median.

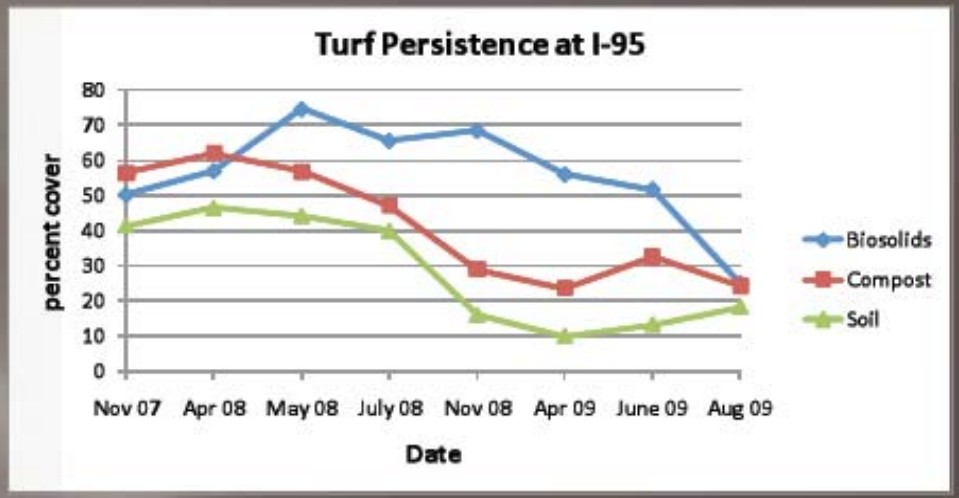
- Soil dries out quickly between rain events, exasperated by hot, dry, windy microclimate
- In New England roadside soil is often high in sand and gravel with low pH and CEC
- Grass receives no inputs following planting other than rough mowing

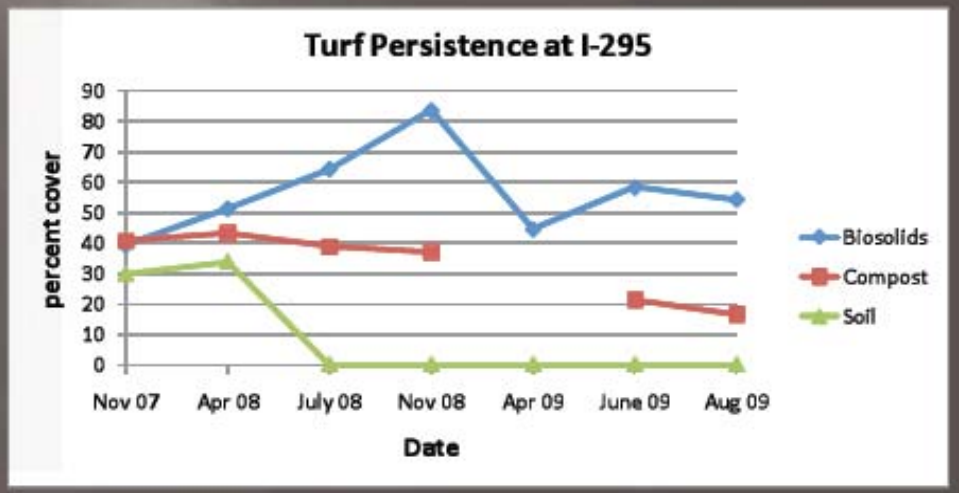
Median of I-95 in RI. Trees on the left mark the swale.

Shoulder of I-95 in RI. Swale is on right and there is no median.

Results – Soil Amendment

- Location x soil treatment effect is significant
- Compost and biosolids established better than soil at both locations
- Overall biosolids gave the most cover and plain soil the least
- Decline in August 2009 for biosolids at I-95 due to invasion by quackgrass





- With improved soil fertility and moisture retention moderate salt tolerance is sufficient
- Too much fertility creates weed problems, especially for grasses tolerant of low fertility and drought
- Ideal level of biosolids is probably <50% but would depend on location

Biosolids June 2009

Compost June 2009

IDOT Requirements: Topsoil and Compost

Article 1081 Requirements

	Texture	Debris	Size	pH
Topsoil	Loamy soil from A horizon	Free of large roots, sticks, weeds, brush, or stones larger than 1 in (25 mm) diameter	90% < No. 10 (2.0 mm) sieve	5.0 - 8.0
Compost	Thoroughly decomposed organic waste	No glass or metal. Any plastic or other man made material shall be no larger than 1/4 in (6 mm) diameter and sieved out to < 1% dry weight		N/A
Biosolids	Silty clay loam texture high in organic matter similar to A horizon	Free of any natural or man made debris	< No. 10 (2 mm) sieve when dry	6.0 - 7.5

Using Biosolids

- Biosolids and compost available to landscapers/contractors/ park districts/municipalities

- Agencies can incorporate biosolids into contract specifications
  - Gives landscapers/contractors information that biosolids can be used in awarded projects
  - Can result in overall cost savings for a project

- Contact MWRD soil scientists with project-specific questions (biosolids@mwrd.org)

Why Use Biosolids?

Biosolids Land Application offer Sustainable Solutions

Questions?

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