Biosolids Use in Parkland Development at the Former U.S. Steel Southworks Brownfield Site

Lakhwinder Hundal, Ph. D.
Overview

- **Background**
  - Beneficial Uses of The District’s Biosolids
  - USX site – A Steel Mill Slag Brownfield
  - Development Plans for The USX Site
  - Problems and Solutions

- **Research and Demonstration Project**
  - Amendments Evaluated
  - Turfgrass and Trees Evaluated
  - Parameters Monitored
  - Summary and Conclusions

- **Biosolids use in the City of Chicago**
  - Chicago Department of Environment (DOE) Policy
  - Chicago Park District’s (CPD) Needs
Beneficial Use Program

Beneficial Use of Aged, Air-dried EQ Biosolids

- Biosolids distributed under Controlled Solids Distribution permit
- Illinois Environmental Protection Agency (IEPA) approval through a user information form for each project
- IEPA requires biosolids monitoring and management practices to ensure the protection of environmental and public health
- Biosolids Utilization and Soil Science staff provides technical support to all biosolids users
Potential Beneficial Uses

- **Soil Amendment or Soil Conditioner**
  - Improve soil fertility or soil tilth

- **Substitute for Commercial Fertilizers**
  - Top dressing golf courses

**Examples:** Construction of parks, golf courses, athletic fields

**Example of Projects in Chicago:** Saint Rita High School; De LaSalle High School; Chicago River Sculpture Park

**Eden Place Nature Center; Harborside International Golf Club**
Eden Place Nature Center Before Using Biosolids
Two Truck Loads of Biosolids Transformed the Site Completely!

Eden Place Nature Center
Harborside International Golf Club

- 453-acre site including two 18 hole courses and golf academy
- Over 500,000 dry tons of District’s biosolids used in final cover of landfill
- Hosted Georgia-pacific senior PGA pro Am and SBC senior open
- Voted third best municipal golf course in USA by the golf week magazine
Harborside International Golf Club

Hmm...
Maybe it'll rain and I can wear my Dewgooders
Brownfields are abandoned and under-utilized properties that plague many metropolitan cities in the U.S.

Example: USX Site – a 570-acre steel mill slag brownfield in metropolitan Chicago

- USX site, formerly known as U.S. Steel Southworks, is located near 86th Street and South Shore
- Steel mill ceased operations in late 1970s
- The site was created by filling Lake Michigan with slag, iron ore, and construction rubble
Development Plans for USX

- **Chicago Park District**
  - Extend the lakefront park system
  - Convert 120 acres of slag into **parkland**

- **City of Chicago**
  - Residential development
  - Commercial/industrial development
  - Create some **green space - landscaped area**
Top View of USX Site
Problems

- Slag is poorly suited to support any type of vegetation because it has
  - Poor fertility and productivity
  - High porosity
  - Extremely heterogeneous nature
  - Poor water holding capacity
A Conceptual Soil Profile

- **Surface Soil**: Light texture, high organic carbon, root zone, highly fertile, stores moisture, plant nutrients.
- **Subsoil**: Zone of clay accumulation, regulates water movement.
- **C Horizon**: Parent material.
Solutions

Slag needs to be capped with topsoil to support any plant growth

- Large quantities of topsoil needed
  - Need 1-ft thick cap for Turfgrass
  - Need 4-ft thick cap for Trees

Require $\approx 387,000$ cu. yard Topsoil for making 2-ft cap on a 120-acre slag site

- Cost @ $24 per cu. yard = $9.7 million
Solutions

The Cost Can Be Reduced?

- By using by-products such as BIOSOLIDS

Use of 25:75 Biosolids:Topsoil mixture could save $2.4 million

Why Biosolids?

- Locally available – abundant supply
- No cost
- Desirable properties – nutrients, organic matter
## PHYSICAL & CHEMICAL PROPERTIES OF DISTRICT BIOSOLIDS AND TOPSOIL SOLD IN CHICAGO AREA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Biosolids</th>
<th>Topsoil</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td></td>
<td>6.0 – 7.5</td>
<td>5.4 – 11.3</td>
</tr>
<tr>
<td>EC</td>
<td>dS/m</td>
<td>3 – 10</td>
<td>0.5 – 4.2</td>
</tr>
<tr>
<td>Organic C %</td>
<td></td>
<td>15 – 25</td>
<td>1.3 – 24.0</td>
</tr>
<tr>
<td>TKN %</td>
<td></td>
<td>1.5 – 2.5</td>
<td>0.05 – 2.2</td>
</tr>
<tr>
<td>NO₃+NH₃-N mg/kg</td>
<td></td>
<td>1,000 – 3,000</td>
<td>1.0 – 2,000</td>
</tr>
<tr>
<td>Total P %</td>
<td></td>
<td>1.5 – 2.5</td>
<td>0.02 – 0.3</td>
</tr>
<tr>
<td>Bulk Density g/cm³</td>
<td></td>
<td>0.7</td>
<td>1.18</td>
</tr>
<tr>
<td>Permeability ln/hr</td>
<td></td>
<td>17 – 30</td>
<td>0.07</td>
</tr>
</tbody>
</table>

*Data from R&D Report Number 03 – 19.*
## Research and Demonstration Project

### COOPERATIVE AGENCIES

<table>
<thead>
<tr>
<th>AGENCY</th>
<th>DEPARTMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>District</td>
<td>R&amp;D and M&amp;O</td>
</tr>
<tr>
<td>City of Chicago</td>
<td>Planning and Development Dept. of the Environment Streets and Sanitation</td>
</tr>
<tr>
<td>Chicago Park District</td>
<td>Landscape Architecture</td>
</tr>
<tr>
<td>USX Corporation</td>
<td>Realty Development</td>
</tr>
</tbody>
</table>
Project Goals

- Demonstrate that the quantity of expensive topsoil needed for capping the slag at USX site can be reduced by using biosolids
- Demonstrate the benefits of using biosolids for establishing quality turf and trees at USX
- Demonstrate that use of biosolids at the USX site is environmentally safe
Project Design

- Project was designed to test and compare effectiveness of:
  - Topsoil
  - Biosolids
  - 50% Biosolids/50% Topsoil mixture
  - 25% Biosolids/75% Topsoil mixture
Evaluated 4 turfgrass mixtures

- **Standard CPD mix** – 70% Kentucky bluegrass, 15% creeping red fescue, 10% perennial rye, 5% redtop
- **Standard MWRDGC mix** – 70% tall fescue, 30% Kentucky bluegrass
- **IDOT 1 B mix** – 75% tall fescue, 15% perennial rye, 10% creeping red fescue
- **VIDOT 1 mix** – 50% perennial rye, 30% Kentucky bluegrass, 20% creeping red fescue
Tested Six Shade Tree Species

- Maple v. Marmo
- White Ash v. Autumn Purple
- Honey Locust v. Skyline
- Cottonless Cotonwood v. Siouxland
- Red Oak
- Elm v. Homestead

Tested Five Ornamental Tree Species

- Amur Maple
- Apple Serviceberry
- Thornless Cockspur Hawthorn
- Crabapple v. Zumi
- Crabapple v. Donald Wyman
Subsurface Water Sampling Devices

- Installed 9 lysimeters, 5-ft beneath the surface
- Installed 9 lysimeters, 10-ft beneath the surface
- Installed 7 wells, 20-ft beneath the surface

Lake Michigan Water Sampling

- Lake water samples taken from 3 locations – 50-ft off shore corresponding to north end, midpoint, and south end of plots

- The Project was Approved By The IEPA
Letters L & W in subsurface water sampling device designations represent lysimeters and wells.

Plot Layout and Water Sampling Locations

1West
100% TOPSOIL

2West
25% BIOSOLIDS + 75% TOPSOIL

3West
50% BIOSOLIDS + 50% TOPSOIL

4West
100% BIOSOLIDS

1East
100% TOPSOIL

2East
25% BIOSOLIDS + 75% TOPSOIL

3East
50% BIOSOLIDS + 50% TOPSOIL

4East
100% BIOSOLIDS

LAKE-N
Equidistant from N. end of Plot & Mouth of USX Slip

LAKE
Equidistant from S. end of Plot & Mouth of Calumet River

REMOTE lysimeters
200 ft. S. of Plots

Test Plots
Road

Plots without Clay Layer
Plots with Clay Layer
Plot Set-Up
Installation of Water Sampling Devices
Plots Seeded in Fall 2000
## Monitoring Schedule

<table>
<thead>
<tr>
<th>Sampling Type</th>
<th>Frequency</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lysimeters, Wells, &amp; Lake</td>
<td>Monthly, Quarterly</td>
<td>Nutrients, Fecal Coliform, Trace Elements, Soluble Salts, Organic Priority Pollutants</td>
</tr>
<tr>
<td>Soils</td>
<td>Twice Annually</td>
<td>Nutrients, Trace Elements, Organic Carbon, pH, EC</td>
</tr>
<tr>
<td>Turf</td>
<td>Twice Annually</td>
<td>Growth, Macro/Micro Nutrients, Trace Elements, Turf Performance (appearance, color, coverage)</td>
</tr>
<tr>
<td>Trees</td>
<td>Annually</td>
<td>Growth, Macro/Micro Nutrients, Plant performance (height, stem diameter)</td>
</tr>
</tbody>
</table>
## Soil Fertility Status of The USX Plots

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Topsoil</th>
<th>25% BS</th>
<th>100% BS</th>
<th>Prairie Soils</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic C %</td>
<td>%</td>
<td>2.3</td>
<td>6.2</td>
<td>15.7</td>
<td>4.6</td>
</tr>
<tr>
<td>pH</td>
<td></td>
<td>7.4</td>
<td>7.1</td>
<td>6.4</td>
<td>6.2</td>
</tr>
<tr>
<td>EC</td>
<td>dS/m</td>
<td>0.3</td>
<td>0.6</td>
<td>2.0</td>
<td>0.13</td>
</tr>
<tr>
<td>TKN</td>
<td>mg/kg</td>
<td>1,575</td>
<td>4,780</td>
<td>13,340</td>
<td>4,150</td>
</tr>
<tr>
<td>Inorg.-N</td>
<td>mg/kg</td>
<td>5.2</td>
<td>48.4</td>
<td>227.2</td>
<td>6.9</td>
</tr>
<tr>
<td>Avail. P</td>
<td>mg/kg</td>
<td>20</td>
<td>245</td>
<td>520</td>
<td>21</td>
</tr>
</tbody>
</table>

BS = Biosolids
Research Plots About A Month Later

100% Soil

25% Biosolids 75% Soil

50% Biosolids 50% Soil

100% Biosolids
An Aerial View of The USX Plots

(Photo taken on 4/10/02)
Research Plots In Late Summer 2003
Turfgrass In Late Summer 2003
Performance of Turfgrass Mixes

Performance Score = 0.75 x turf density score + 0.25 x turf color quality score

![Graph showing performance scores for different biosolid concentrations in turfgrass mixes.](chart.png)
Performance of Ornamental and Shade Trees

Growth Index = Tree trunk diameter (ft) x tree height (ft)

<table>
<thead>
<tr>
<th>Tree Type</th>
<th>0% Biosolids</th>
<th>25% Biosolids</th>
<th>50% Biosolids</th>
<th>100% Biosolids</th>
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</thead>
<tbody>
<tr>
<td>Ornamental</td>
<td>0.0</td>
<td>0.5</td>
<td>1.0</td>
<td>1.5</td>
</tr>
<tr>
<td>Shade</td>
<td>2.0</td>
<td>2.5</td>
<td>3.0</td>
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</table>
### Trace Metals in Leaves of Ornamental Trees from the USX Plots and a Local Park

<table>
<thead>
<tr>
<th>Parameter</th>
<th>USX Plots</th>
<th>Local Park</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topsoil</td>
<td>25% BS</td>
<td>100% BS</td>
</tr>
<tr>
<td>Zn</td>
<td>26</td>
<td>29</td>
</tr>
<tr>
<td>Cd</td>
<td>0.03</td>
<td>0.09</td>
</tr>
<tr>
<td>Cu</td>
<td>7.8</td>
<td>4.7</td>
</tr>
<tr>
<td>Cr</td>
<td>0.74</td>
<td>0.83</td>
</tr>
<tr>
<td>Ni</td>
<td>0.95</td>
<td>0.78</td>
</tr>
<tr>
<td>Pb</td>
<td>1.06</td>
<td>1.19</td>
</tr>
<tr>
<td>Mo</td>
<td>0.68</td>
<td>1.09</td>
</tr>
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</table>
# Trace Metals in Leaves of Shade Trees from the USX Plots and a Local Park

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Topsoil</th>
<th>25% BS</th>
<th>100% BS</th>
<th>Local Park</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zn</td>
<td>83</td>
<td>81</td>
<td>99</td>
<td>208</td>
</tr>
<tr>
<td>Cd</td>
<td>0.83</td>
<td>0.85</td>
<td>1.25</td>
<td>5.83</td>
</tr>
<tr>
<td>Cu</td>
<td>9.6</td>
<td>5.8</td>
<td>6.7</td>
<td>10.5</td>
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<tr>
<td>Cr</td>
<td>0.69</td>
<td>0.71</td>
<td>0.60</td>
<td>0.72</td>
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<tr>
<td>Ni</td>
<td>1.24</td>
<td>0.78</td>
<td>0.84</td>
<td>0.91</td>
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<tr>
<td>Pb</td>
<td>2.15</td>
<td>1.67</td>
<td>0.98</td>
<td>1.10</td>
</tr>
<tr>
<td>Mo</td>
<td>0.94</td>
<td>1.47</td>
<td>1.42</td>
<td>0.90</td>
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</table>
## Trace Metals in The District Biosolids & Part 503 EQ Limits

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Stickney SWRP</th>
<th>Calumet SWRP</th>
<th>Part 503 EQ Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zn</td>
<td>765</td>
<td>1023</td>
<td>2,800</td>
</tr>
<tr>
<td>Cu</td>
<td>381</td>
<td>397</td>
<td>1,500</td>
</tr>
<tr>
<td>Cd</td>
<td>3</td>
<td>4</td>
<td>39</td>
</tr>
<tr>
<td>Ni</td>
<td>61</td>
<td>35</td>
<td>420</td>
</tr>
<tr>
<td>Pb</td>
<td>126</td>
<td>114</td>
<td>300</td>
</tr>
<tr>
<td>Mo</td>
<td>17</td>
<td>15</td>
<td>75</td>
</tr>
<tr>
<td>Hg</td>
<td>0.6</td>
<td>0.6</td>
<td>17</td>
</tr>
<tr>
<td>As</td>
<td>9</td>
<td>7</td>
<td>41</td>
</tr>
<tr>
<td>Se</td>
<td>2</td>
<td>6</td>
<td>100</td>
</tr>
</tbody>
</table>
Trends in Trace Metals Concentrations Since Enactment of The Clean Water Act of 1972

- **Zn**: Part 503 EQ Limit 2800 mg/kg
- **Cd**: Part 503 EQ Limit 39 mg/kg
- **Cu**: Part 503 EQ Limit 1500 mg/kg
- **Ni**: Part 503 EQ Limit 420 mg/kg
- **Pb**: Part 503 EQ Limit 300 mg/kg
- **Hg**: Part 503 EQ Limit 17 mg/kg
NO$_3$+NO$_2$ in 5-ft Deep Lysimeters

Clay Layer Present

- 100% Soil
- 25% Biosolids + 75% Soil
- 50% Biosolids + 50% Soil
- 100% Biosolids

NO$_3$ + NO$_2$ Concentration, mg/L

Sampling Period

Clay Layer Absent

- 100% Soil
- 25% Biosolids + 75% Soil
- 50% Biosolids + 50% Soil
- 100% Biosolids

Sampling Period
NO$_3$+NO$_2$ in 10-ft Deep Lysimeters

Clay Layer Present

- 100% Soil
- 25% Biosolids + 75% Soil
- 50% Biosolids + 50% Soil
- 100% Biosolids

Clay Layer Absent

- 100% Soil
- 25% Biosolids + 75% Soil
- 50% Biosolids + 50% Soil
- 100% Biosolids
NO$_3$+NO$_2$ in 20-ft Deep Wells

Clay Layer Present

- 100% Soil
- 25% Biosolids + 75% Soil
- 100% Biosolids

Clay Layer Absent

- 25% Biosolids + 75% Soil
- 50% Biosolids + 50% Soil
- 100% Biosolids
Total P in 5-ft Deep Lysimeters

Clay Layer Present

- **100% Soil**
- **25% Biosolids + 75% Soil**
- **50% Biosolids + 50% Soil**
- **100% Biosolids**

**Sampling Period**

<table>
<thead>
<tr>
<th>Sampling Date</th>
<th>Total P Concentration, mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>06/00</td>
<td>0.01</td>
</tr>
<tr>
<td>10/00</td>
<td>0.03</td>
</tr>
<tr>
<td>02/01</td>
<td>0.04</td>
</tr>
<tr>
<td>06/01</td>
<td>0.02</td>
</tr>
<tr>
<td>10/01</td>
<td>0.01</td>
</tr>
<tr>
<td>02/02</td>
<td>0.00</td>
</tr>
<tr>
<td>06/02</td>
<td>0.00</td>
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<td>10/02</td>
<td>0.00</td>
</tr>
<tr>
<td>02/03</td>
<td>0.00</td>
</tr>
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<td>06/03</td>
<td>0.00</td>
</tr>
<tr>
<td>10/03</td>
<td>0.00</td>
</tr>
</tbody>
</table>
Total P in 10-ft Deep Lysimeters

Clay Layer Present

- 100% Soil
- 25% Biosolids + 75% Soil
- 50% Biosolids + 50% Soil
- 100% Biosolids

Total P Concentration, mg/L

Sampling Period

06/00 10/00 02/01 06/01 10/01 02/02 06/02 10/02 02/03 06/03 10/03
Total P in 20-ft Deep Wells

Clay Layer Present

- 100% Soil
- 25% Biosolids + 75% Soil
- 50% Biosolids + 50% Soil
- 100% Biosolids

Sampling Period

Total P Concentration, mg/L

0.00
0.08
0.16
0.24
0.32

06/00 10/00 02/01 06/01 10/01 02/02 06/02 10/02 02/03 06/03 10/03
Trace Metals in the Lake and 5-ft Deep Lysimeters in the Plots

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Lake</th>
<th>Slag</th>
<th>Soil</th>
<th>100% Biosolids</th>
</tr>
</thead>
<tbody>
<tr>
<td>As</td>
<td>0.045</td>
<td>0.107</td>
<td>0.160</td>
<td>0.141</td>
</tr>
<tr>
<td>Cd</td>
<td>0.004</td>
<td>0.009</td>
<td>0.014</td>
<td>0.007</td>
</tr>
<tr>
<td>Cr</td>
<td>0.005</td>
<td>0.016</td>
<td>0.058</td>
<td>0.027</td>
</tr>
<tr>
<td>Cu</td>
<td>0.006</td>
<td>0.202</td>
<td>0.228</td>
<td>0.077</td>
</tr>
<tr>
<td>Hg (µg/L)</td>
<td>0.021</td>
<td>0.088</td>
<td>0.080</td>
<td>0.090</td>
</tr>
<tr>
<td>Ni</td>
<td>0.019</td>
<td>0.314</td>
<td>0.024</td>
<td>0.100</td>
</tr>
<tr>
<td>Pb</td>
<td>0.087</td>
<td>0.087</td>
<td>0.160</td>
<td>0.073</td>
</tr>
<tr>
<td>Zn</td>
<td>0.012</td>
<td>0.279</td>
<td>0.080</td>
<td>0.048</td>
</tr>
</tbody>
</table>

---
mg L^{-1}---
Organic Priority Pollutants In The Lysimeters

- **Water samples were analyzed for 111 organic Priority Pollutants.**
- **Most of the compounds detected were below the analytical detection limits except:**
  - Bis(2-ethylhexyl)phthalate = 380(2) and 6,133(1) ppb
  - Phenanthrene = 10(1) and 50(2) ppb
  - Anthracene = 14(1) ppb
  - Fluoranthene = 27(2) ppb
  - Phenol = 129(2), 79(2) and 167(3) ppb
  - Methyl Chloride = 6(2) ppb
  - Methylene Chloride = 4(1) ppb
  - 1,1,1-Trichloroethane = 2(1) ppb
**Summary And Conclusions**

**Benefits**

- Mixtures of biosolids and soil were very effective for capping slag materials to establish vegetation.
- Inclusion of biosolids in the soil cap significantly improved its fertility and productivity.
- Turfgrass and trees performed better in the plots amended with biosolids and soil mixtures.
- Use of 25% biosolids + 75% soil mixture for capping slag materials for vegetating a 120-acre parcel would save $2.4 million.
Summary And Conclusions

Little or No Environmental Impact

- Trace metals in plant tissues from the soil and biosolids plots and a local park were identical.
- Use of biosolids did not result in elevated levels of organic priority pollutants, trace metals, and fecal coliforms in the subsurface water.
- Biosolids use to cap the slag is environmentally safe and had little impact on the subsurface water quality and no impact on the lake water quality.
A large market for the District’s biosolids is available within the City of Chicago.

The City of Chicago DOE policy dictates that any material (soil or biosolids) used in the city must meet TACO.

Currently, the District is working with DOE to address biosolids/TACO issue.
TACO?

It’s not lunch time, yet!
TACO – Tiered Approach to Corrective Action Objectives

- Illinois Administrative Code Title 35 Part 742
- Voluntary program of clean-up objectives for contaminated sites in Illinois (results in issuance of NFR letter)
- Based on potential human exposure to soil and groundwater due to anticipated site redevelopment
- Compliance with any of the 3 tiers of standards:
  - Tier 1 - Default, based on worst case scenarios
  - Tier 2 - Based on site specific models
  - Tier 3 – Based on “Site Specific Risk Assessment”
Standards established for over 140 pollutants

- Inorganics – 24
- Volatile organic compounds – 37
- Semi-volatile organic compounds – 43
- Polychlorobiphenyls (PCBs) – 6
- Organochlorine pesticides – 23
- Other organic compounds – 7
TACO Analysis of Biosolids

• **General Findings**
  - Nearly 40 pollutants in TACO have levels below the laboratory reporting limits
  - Background soil levels of many pollutants exceed the TACO limit
  - TACO risk assessment is not specific to biosolids and is very conservative

• **Tier 1 Residential - Soil Ingestion Pathway**
  - Only 8 out of ~140 listed pollutants exceeded TACO limit
Biosolids Risk Assessment

Risk Assessment Model Evaluated

7 Potential Land Use Scenarios
- Athletic fields; Playgrounds; Picnic areas; Parking lots
- Community gardens; Multiuse trails; Park buildings

5 Potential Receptors
- Park District employee; Construction worker; Landscaping
- site preparation worker; Landscaping maintenance worker; Recreational visitor (both child and youth)

3 Exposure Pathways
- Soil ingestion; Inhalation of fugitive dust; Dermal contact with soil
### Biosolids Risk Assessment Results

- Evaluated 7 Polycyclic Aromatic Hydrocarbons (PAHs)

<table>
<thead>
<tr>
<th>PAH</th>
<th>Conc., mg/kg</th>
<th>Limit, mg/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzo[a]anthracene</td>
<td>0.7 – 5.7</td>
<td>4.7</td>
</tr>
<tr>
<td>Benzo[a]pyrene</td>
<td>1.1 – 7.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Benzo[b]fluoranthene</td>
<td>1.1 – 6.1</td>
<td>4.7</td>
</tr>
<tr>
<td>Benzo[k]fluoranthene</td>
<td>1.7 – 11</td>
<td>47</td>
</tr>
<tr>
<td>Chrysene</td>
<td>1.3 – 8.5</td>
<td>470</td>
</tr>
<tr>
<td>Dibenzo[a,h]anthracene</td>
<td>&lt;0.8 – &lt;2.2</td>
<td>0.47</td>
</tr>
<tr>
<td>Indeno[1,2,3-cd]pyrene</td>
<td>0.9 - 4.5</td>
<td>4.7</td>
</tr>
</tbody>
</table>
Everyone shall promote beneficial reuse of biosolids, because...
Questions?