December 5, 2007

Ecological Reuse of Remediated Sites: Some Resources

Sara Rasmussen
Office of Solid Waste
United States Environmental Protection Agency

Ecological Restoration

- **The consideration of natural or ecological end-uses, as alternatives or supplements to conventional property development or redevelopment.**
- **It is encouraged, but not mandated.**
- **Can be achieved through**
  - **Natural or “Green” Technologies**
  - **Traditional Cleanup Remedies**

A-2

What it Ecological Restoration

- **Ecological enhancements**
  - **Create habitat for plants and animals (while protecting human health and the environment)**
  - **End-use is restoring or increasing ecological value of the land**
- **Can be used for**
  - **Whole site or**
  - **As part of "mixed use" approach**
- **Can include**
  - **Natural remediation technologies, or**
  - **Traditional remediation technologies**

A-3

Should not compromise risk reduction

- **Incorporating ecological elements or the designation of an ecological land reuse should not compromise the reduction or removal of contamination or the reduction of risk through remediation.**

A-4

Ecological Restoration and Corrective Action

- **The ultimate goal of corrective action is to satisfy the "protection of human health and the environment" standard.**
- **The protection standard can be achieved using engineered and institutional controls.**
- **The RCRA and CERCLA programs have issued guidance to facilitate the tailoring of remedies to site specific end-uses including ecological end-uses.**
- **The ''Guidance on Completion of Corrective Action Activities at RCRA Facilities" 68 FR 8757 (Feb 25, 2003) describes how corrective actions can be completed, with contaminants remaining, using controls tailored to protection for a specific end-use for the site.**

A-5

Some Considerations

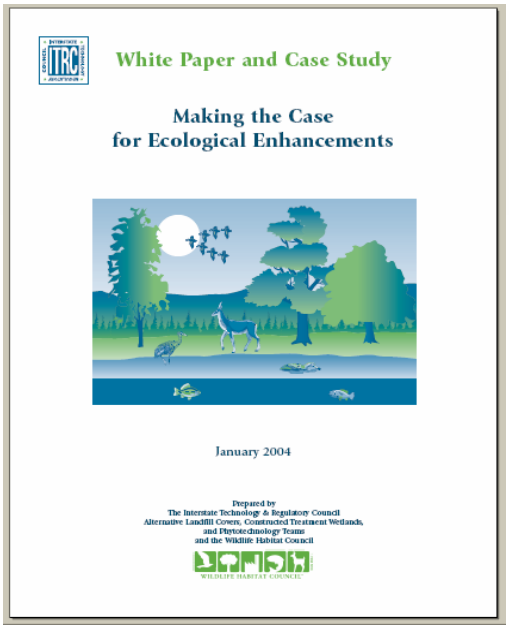
- There are no regulatory barriers to using ecological endpoints.
- Ecological re-use is not considered in lieu of protecting human health.
- Ecological enhancements should be proactively incorporated into remediation strategies.
- Seek stakeholder input on community needs.
- Quantify the value of ecological enhancements.

A-6

Some Ecological Restoration Documents and Resources

- 2004 White Paper – ITRC and WHC
- ITRC 2006 Guidance & Clu-In Sessions
- "Restoring Greenspace" Regional Meetings, EPA/Wildlife Habitat Council
- RCRA - Ecological Restoration Resources
- EPA's GreenScapes program

A-7


White Paper and Case Study
Making the Case
for Ecological Enhancements
January 2004
Prepared by
The Interstate Technology & Regulatory Council
Alternative Landfill Covers, Constructed Treatment Wetlands,
and Phytotechnology Teams
and the Wildlife Habitat Council

A-8

“Making the Case for Ecological Enhancements”

- Prepared by representatives of three ITRC teams and the Wildlife Habitat Council, January 2004
- White paper and case studies
- Identified benefits, incentives, and limitations

A-9

What is the Interstate Technology and Regulatory Council?

- ITRC is a state-led coalition working to achieve regulatory acceptance of environmental technologies. ITRC consists of 43 states, the District of Columbia, multiple federal partners, industry participants, and other stakeholders.

- ITRC accomplishes its mission in two ways:
  - it develops guidance documents and training courses to meet the needs of both regulators and environmental consultants
  - it works with state representatives to ensure that ITRC products and services have maximum impact among state environmental agencies and technology users.

http://www.itrcweb.org

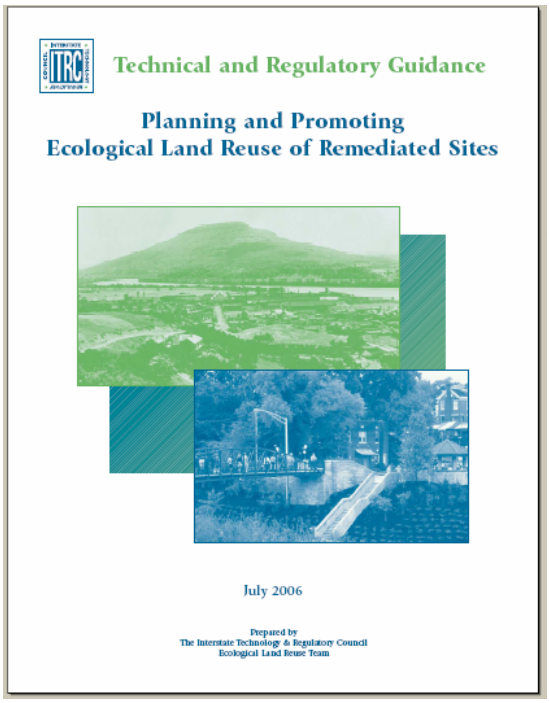
A-10

What is the Wildlife Habitat Council?

- The Wildlife Habitat Council (WHC) is a nonprofit, nonlobbying 501(c)(3) group of corporations, conservation organizations, and individuals dedicated to restoring and enhancing wildlife habitat.
- Created in 1988, WHC helps large landowners, particularly corporations, manage their unused lands in an ecologically sensitive manner for the benefit of wildlife.
- More than 2 million acres in 48 states, Puerto Rico, and 16 other countries are managed for wildlife through WHC-assisted projects.

www.wildlifehc.org

A-11


Technical and Regulatory Guidance
Planning and Promoting
Ecological Land Reuse of Remediated Sites
July 2006
Prepared by
The Interstate Technology & Regulatory Council
Ecological Land Reuse Team

A-12

Planning and Promoting of Ecological Land Re-Use of Remediated Sites

- **July 2006 guidance document can be found at: http://www.itrcweb.org/gd_EE.asp**
- **Prepared by the Ecological Land Reuse Team of the ITRC** (Team Members include: Federal, State, Industry, Community Representatives)
- **Occasional Clu-In Sessions presenting Guidance**
- **Archived Clu-In Sessions presenting Guidance**
- **http://www.clu-in.org/conf/itrc/ecoreuse_092806/**
- **There may be archives of more recent presentations**

A-13

The Guidance Includes…

- What are ecological enhancements
- Recommendations for the successful design of ecological elements at environmentally impacted properties
- Benefits, incentives, and limitations for implementing ecological elements at environmentally impacted sites
- Case studies where the ecological elements are incorporated into the remedial design and/or end-use
- Recommendations for improvements to foster greater acceptance and flexibility for the incorporation of ecological elements as components of remedial actions and end-use
- Areas where additional scientific research is needed

A-14

Programmatic Applicability

- Active sites
- Inactive sites
- CERCLA
- DOE: Radiological
- DoD: Base Closure
- RCRA
- Solid waste Voluntary cleanup
- Brownfields
- Mining sites
- Underground storage tank sites
- Real estate development/ redevelopment

A-15

Ecological Land Re-Use – Rules of Thumb

- Remove immediate threats to human health
- Do not compromise protecting human health or cleanup goals
- Contain offsite migration
- Provide net benefit to the region
- Weigh ecological benefits vs. ecological risk
- Sustainable without excessive maintenance
- Ecological re-use should not create a connection to risk pathways
    - Burrowing animals

A-16

Potential Environmental Benefits

- Attract wildlife / Provide habitat
- Biodegrade environmental contaminants
- Enhance natural attenuation/biodegradation remedies
- Control sediment and erosion
- Improve groundwater recharge
- Improve environmental stability
- Provide harvestable resource
- Provide migratory bird pathways

A-17

Potential Economic Benefits

- More efficient use of limited resources
- May generate revenue
- Cost competitive
- Provide marketing and competitive advantage
- Increase property value
- Provide opportunity to obtain environmental offsets
- Possible tax advantages

A-18

Potential Public Benefits

- Educational opportunity
- Recreational opportunity
- Quality of life
- Good will and good neighbor
- Increased reputation
- Aesthetics
- Increased natural resources

A-19

Constraints

- Regulatory acceptance
  - Lack of familiarity
- Evaluation of site-specific, unique solutions
- Allergies
- Plant use
- No readily accepted valuation system
- Remedial creativity
- Cleanup standards applicable to habitat creation can require complex analyses
- Cleanup goals for ecological protection are often more stringent than for protection of human health

A-20

“Restoring Greenspace” Meetings

Wildlife Habitat Council/ EPA Regions

Upcoming Meeting

- **Region 9 - May 14-15, 2008, Concord, California**

Previous Meetings

- **Region 4 - May 22-23, 2007, in Atlanta, GA**
- **Region 10 – May 3-4, Seattle, WA**
- **Region 6 – May 17-18, New Orleans, LA**
- **Regions 2-3 – June 23-24, 2004, Philadelphia, PA**
- **Region 5 - September 15-17, 2003 Chicago, IL**

- **Proceedings of previous meetings can be found at:**
  http://www.wildlifehc.org/events/restoringgreenspace_summary.cfm

A-21

Examples of Case Studies posted on WHC Site, November 2007

(http://www.wildlifehc.org/brownfield_restoration/case_studies.cfm

- Chicago Pocket Parks Case Study, BP
- Cleveland Case Study, BP
- Closed Refinery in Hooven, Ohio Case Study, Gulf Oil Corporation
- College Park Landfill Compost and Vegetative Cap Pilot Study, USDA
- Dohlgren Case Study, Navy
- EPA and Wildlife Habitat Council Partner to Foster Reuse of Abandoned Gas Stations for Parks, Wildlife Habitat and Green Space (U.S. EPA)
- Fernald Case Study, DOE
- Ford Rouge Center, Ford Motor Company
- Former Ford Michigan Casting Center Landfill, Ford Motor Company
- Heifer International New World Headquarters
- Jamaica Island Landfill Case Study, Navy
- Joliet Army Ammunition Plant (JOAPP)
- Joliet Case Study, BP
- Low Impact Development Techniques on Residential Subdivision, USDA
- Milan Army Ammunition Plant (MAAP)
- New Beginnings- The Woodlawn Wildlife Area
- Phytoscapes Case Study, BP
- Rochelle Case Study, BP
- Tall Grass Prairie Case Study, BP
- Texas City Prairie Planting Case Study, BP
- Tibetts Road Superfund Site, Ford Motor Company
- Upper Arkansas River Tailings Operation
- West Coast Phytoremediation Case Study, Anonymous
- West Coast Refinery Wetland Case Study, Anonymous
- West Page Swamp Case Study, Bunker Hill CERCLA Site
- Whiting Alkaline Fen Case Study, BP
- Whiting Prairie Planting Case Study, BP
- Wood River Case Study, BP

A-22

RCRA Resources

- **Examples of Ecological Reuse of RCRA sites (2002)**
  http://www.epa.gov/swerosps/rcrabf/pdf/ecolinks.pdf
- **General RCRA Revitalization success stories (includes some ecological revitalization projects)**
  http://www.epa.gov/epaoswer/hazwaste/ca/success.htm
- **December 3, 2002, Clu-in Session - Presenting case studies of ecological and/or recreational reuse at RCRA sites. Presentations, additional (non-RCRA) case studies and resources presented at the Clu-in sessions:**
  http://www.epa.gov/swerosps/rcrabf/ecoreuse.htm

A-23

EPA's GreenScapes Program

- GreenScapes is a multi-media program that is designed to provide cost-efficient and environmentally friendly solutions for landscape design, construction, and maintenance - large and small. The goal is to preserve natural resources and prevent waste and pollution by encouraging organizations and individuals to make more holistic decisions regarding their land care practices and purchases.
- The goal is to help preserve natural resources and prevent waste and pollution, GreenScapes encourages companies, government agencies, other entities, and homeowners to make more holistic decisions in their land care regarding waste generation and disposal and the associated impacts on land, water, air, and energy use.
- Currently have over 140 partners and allies.

GreenScapes
Environmentally Beneficial Landscaping

A-24

Info on Greenscapes Website

- **GreenScapes for Large-scale Landscapes** - GreenScapes for Large-scale Landscapes offers commercial and government land managers information and resources to GreenScape their large-scale landscapes.
- **GreenScapes for Homeowners** - GreenScapes for Homeowners provides homeowners with information and resources to improve the health and appearance of their lawns and gardens.
- **Where You Live** - Includes links to state and EPA regional information.
- **Benefits** - GreenScaping can help you save money, reduce waste, conserve water, save energy, reduce greenhouse gas emissions and reduce your environmental footprint.
- **How to GreenScape** - Includes tips to GreenScape large-scale landscapes.
- **GreenScape Alliance Partners and Allies** - The GreenScapes Alliance is a voluntary partnership program that aims to combine government and industry into a powerful, unified influence over the reduction, reuse, and recycling of waste materials in large land use applications.
- **Success Stories** - Learn about public agencies, private companies, and commercial landscapers using environmentally beneficial landscaping techniques.
- **Newsroom** - Provides news, highlights a GreenScapes partner or ally, lists any upcoming conferences and events, and contains links to periodical articles.
- **Resources** - Contains publications, guidance, and research documents as well as on-line calculator tools that can aid in your decision making and implementation of more sustainable landscape design, construction, and operations & maintenance.
- **Links** - Provides web links to additional information related to sustainable landscape design, construction, and maintenance.

A-25

A few examples of GreenScape Projects

- Projects can be found at:
  http://www.epa.gov/epaoswer/non-hw/green/success.htm
- **Benefits of Native Landscaping** With WinterCreek Restoration's native landscaping, the Century Park retail complex in central Oregon is nearly maintenance-free—and water, installation, and maintenance costs are significantly less expensive than traditional projects of a similar size.
- **Innovative Landscaping Techniques at Two EPA Facilities**
  At two EPA facilities, innovative landscaping techniques conserve water while helping the facilities meet federal environmental goals. Sustainable landscaping at EPA's National Computer Center in Research Triangle Park, North Carolina, and EPA Region 8's laboratory in Golden, Colorado, reduce the need for irrigation by using water-efficient designs and native plants suited to local conditions.

A-26

Examples Continued

- **Improving Turf with Compost** The soil on the North Shore Country Club (Glenview, Illinois) golf course had elevated sodium levels—too high to maintain quality turf. Standard procedure called for the installation of a well, but this project came with a quarter million dollar price tag. With a little research, North Shore found compost to be the economical alternative to enhance the quality of its soil.

- **Erosion Control Through Revegetation** GreenCover America, Inc. has succeeded in keeping the highway open. The company's organic and environmentally friendly compost-based erosion control techniques have stabilized a steep, sandy slope where traditional erosion control methods had previously failed. Within months of installing a compost blanket, the site was covered

- **Controlling Erosion with Compost** Filtrexx International LLC, has created a toolbox of erosion control methods utilizing compost. A great environmentally preferable product, compost is organic, biobased, annually renewable, recycled, and locally made. In addition, using compost to control erosion can be cheaper and more aesthetically pleasing than traditional methods. Compost is a lot more than just a fertilizer!

- **Roadside Composting** Texas Department of Transportation (TxDOT) has found that virtually barren roadsides became fertile grounds when compost was applied. This helped prevent the erosion of roads and surrounding grounds in many locations, and TxDOT has gone on a tour throughout the state to prove it!

A-27

Short note about Ecological Restoration and Sustainability

- “Sustainability” becoming popular focus
- Many looking to identify “sustainable land revitalization” opportunities
- Brings added focus/benefits of Ecological Restoration projects
- Several EPA projects in the sustainability area – keep an eye out for further resources.

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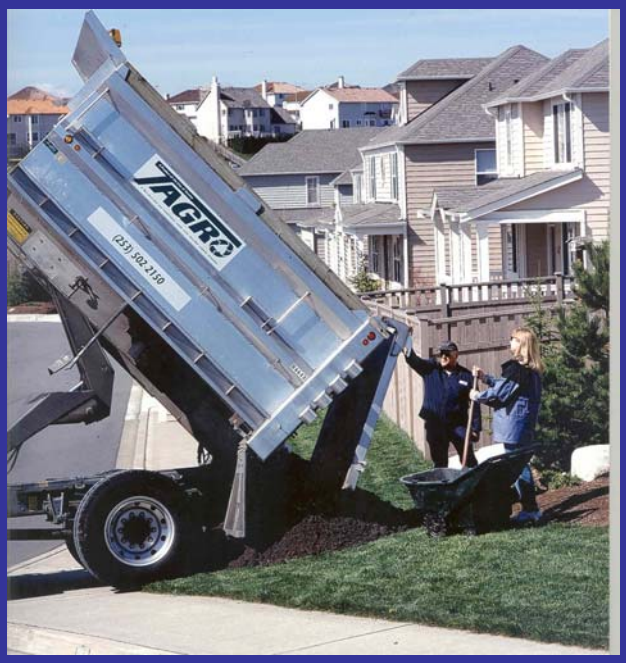
Use of Biosolids for Restoration of Contaminated Sites/ Reclamation of Drastically Disturbed Lands

Bob Bastian
Office of Wastewater Management

B-2



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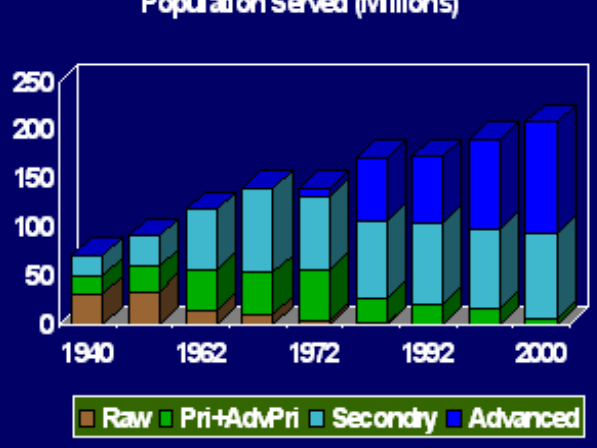
Increasing Proportion of the U.S. Population Served by POTWs



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Biosolids Use/Disposal Practices by EPA Region

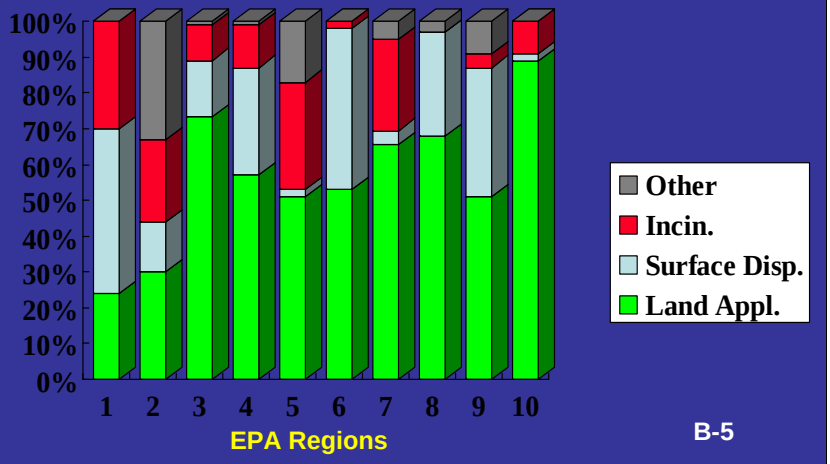

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Figure 1. U.S. biosolids use and disposal practices, 2004

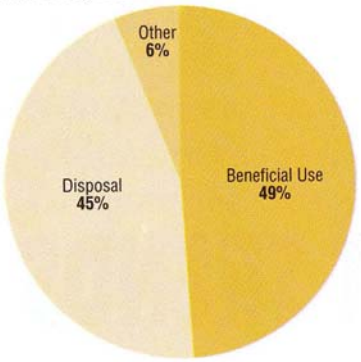
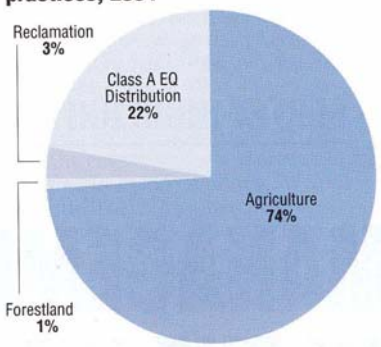


Figure 2. U.S. beneficial use practices, 2004



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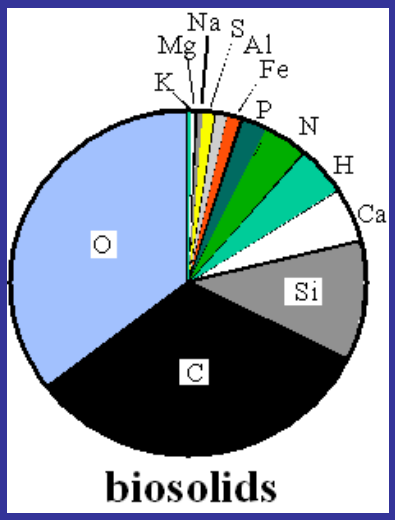

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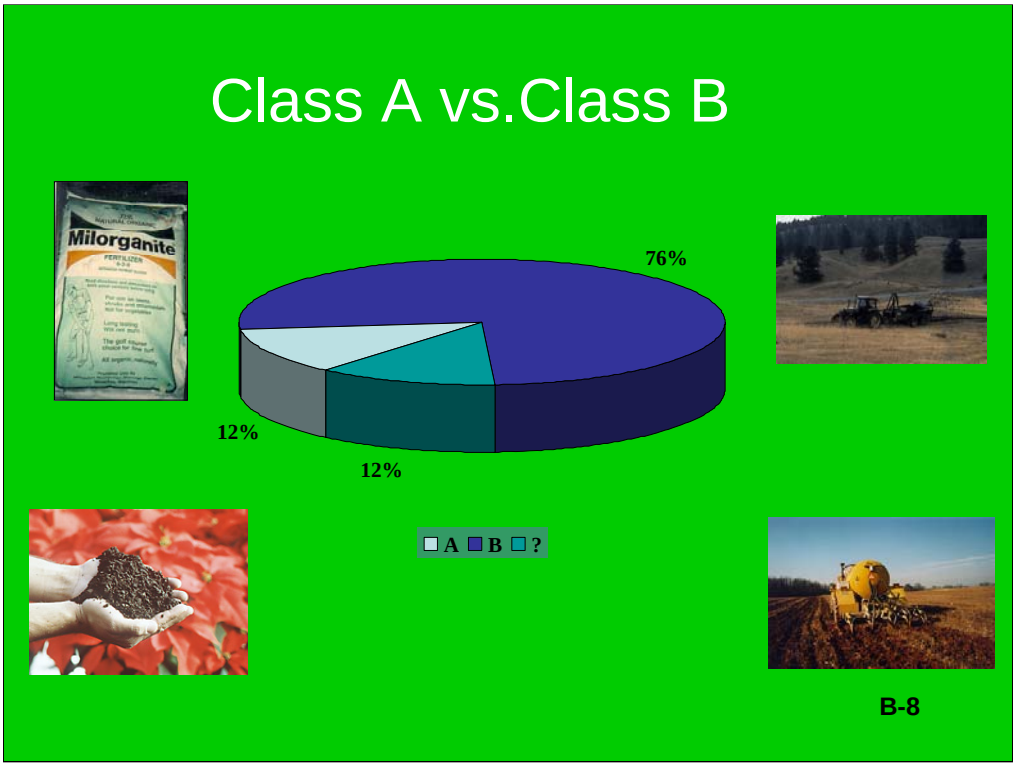
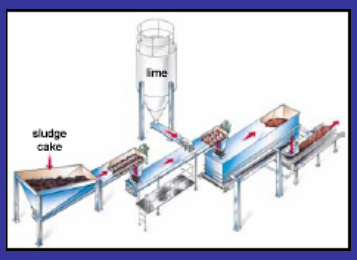


Recent estimates by the USEPA's Biosolids Data Management System (BDMS) of the percentage of facilities using Class A processes are 12.4%, while a recent article in the *BioCycle* Journal estimated national usage at 14.5%; with usage within individual states ranging from 0% to 90% (Goldstein, N. 2000). Eighteen states did not provide information



B-9


B-10


B-11

Area north of Penn State impacted by a high temperature fire and three years later the dramatic response of native vegetation to a single application of biosolids.


B-13


B-14

B-15


B-16

Mine spoil area in Schuylkill Co., PA, where hybrid poplar are being planted in areas where biosolids are trenched in at 200+ tons/acre

Rangeland rehabilitation demonstration project in Utah utilizing biosolids

B-19

Sand dune stabilization project in Colorado using biosolids

Revegetation/Remediation of Disturbed or Heavy Metal Contaminated Soils: Problems Addressed by Biosolids Addition

- **Low soil pH or pH decline from pyrite oxidation**
  - Limestone & other alkali materials with the biodegradable organic matter in biosolids can help balance Ca and Mg, along with pH management
- **Nutrient Deficiencies, especially P and N**
  - High P addition with biosolids can precipitate metals, help to reduce metal availability, and aid in establishing and maintaining legumes to supply N for grasses long-term
  - Biosolids can provide N and reduce the need for supplemental fertilizer
- **Low organic matter and lack of microbes due to Zn or other metal Toxicity**
  - Biosolids, along with manures and composts, are an inexpensive source of Organic Matter and microbial inoculants
  - Fe, Mn hydrous oxides and phosphate in Biosolids helps increase Metal Adsorption Capacity and provide persistent reduction in metal toxicity and bioavailability of soil Pb, As, Cd, etc.

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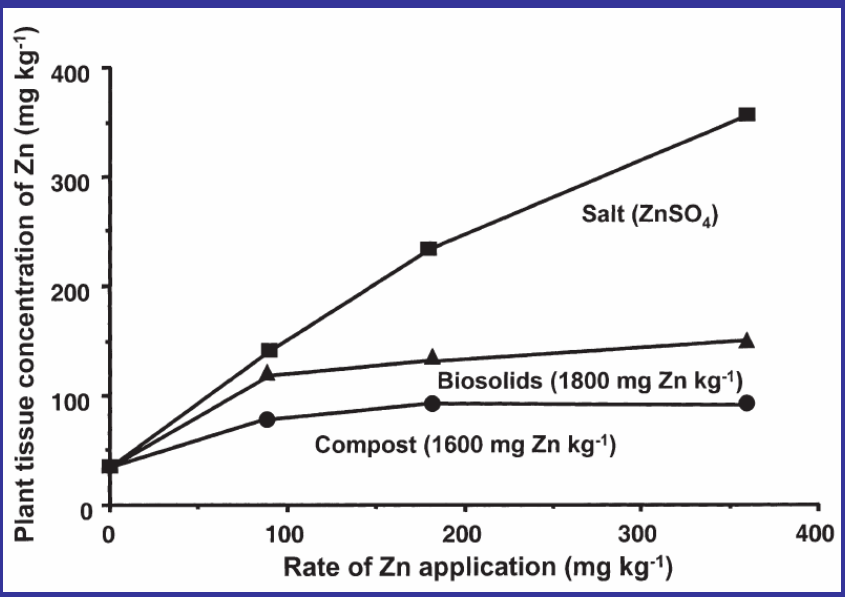
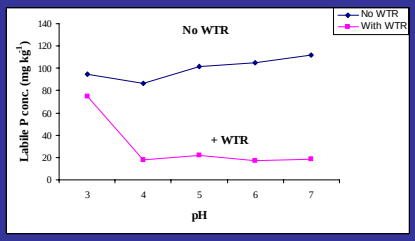
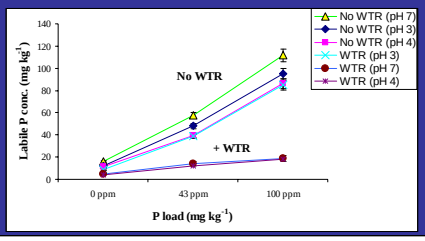


Effect of source of Zn addition on plant tissue concentration during a 5-yr field experiment B-21

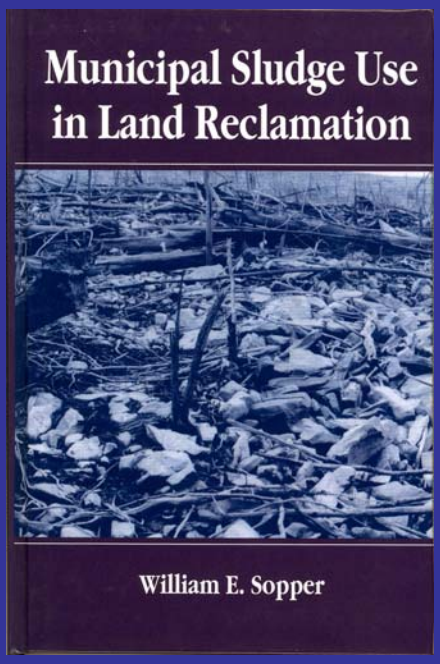
University of Florida/IFAS: Land Application of Residuals and Manures in the Lake Okeechobee Watershed: P Considerations





B-22

Old mine reclamation site in Central PA, where biosolids were used to revegetate mine spoils in the early 1970's (only on right side) and the same site 25years later



Municipal Sludge Use
in Land Reclamation

by

William E. Sopper

Penn State University

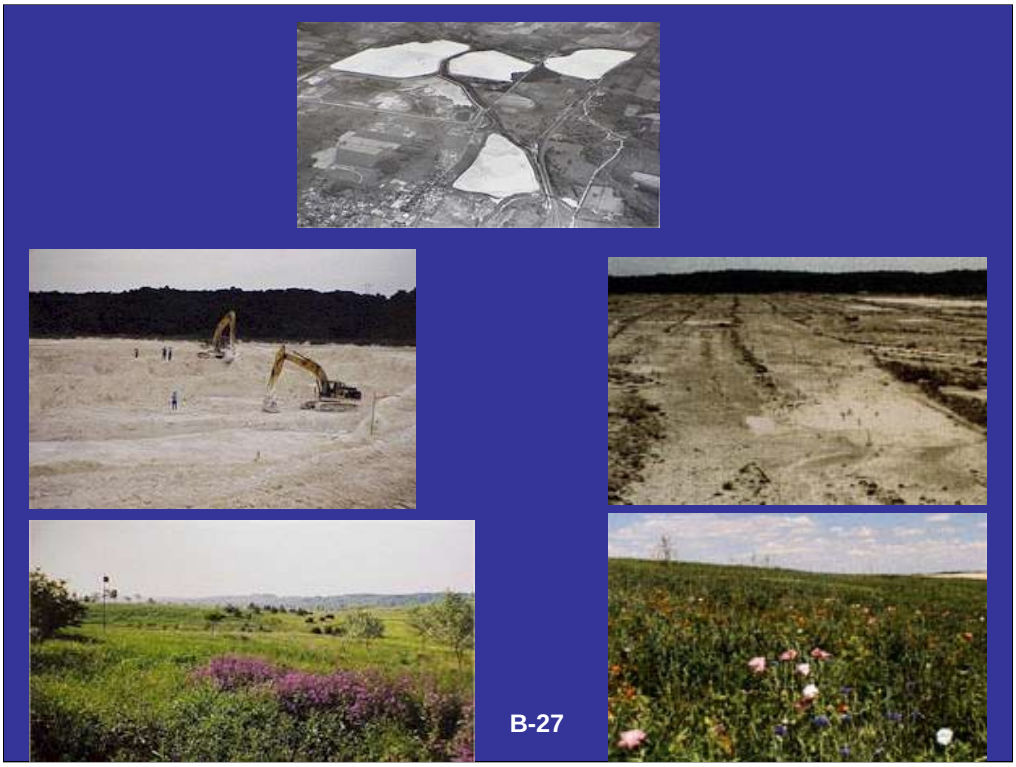
1993

Lewis Publishers

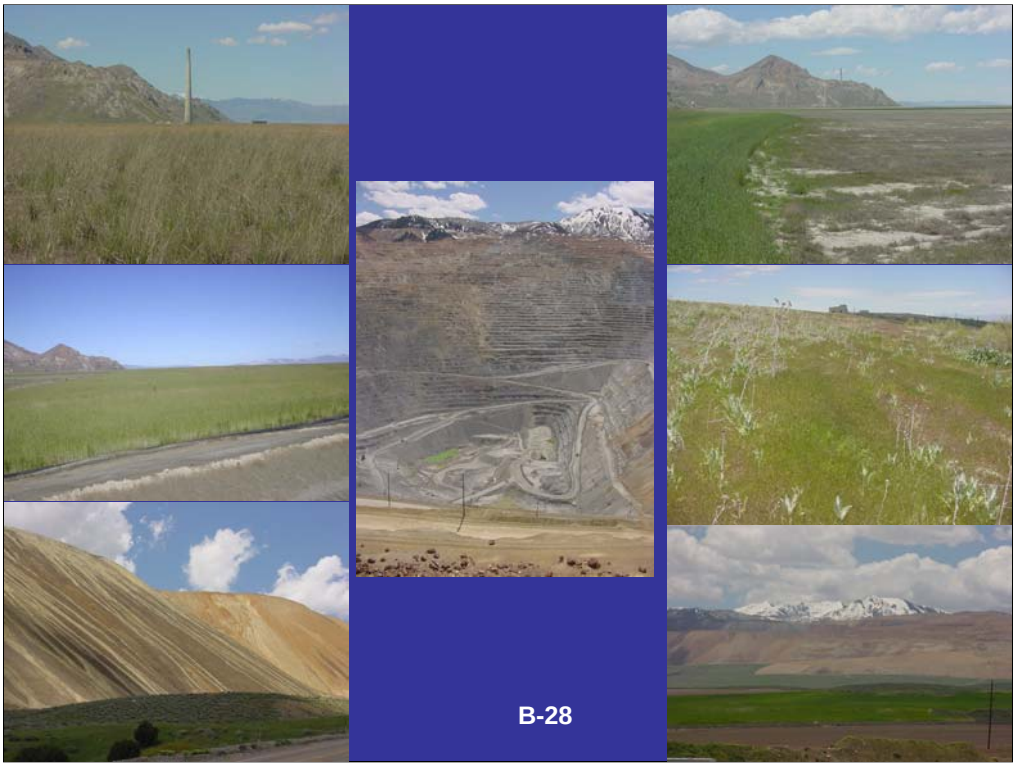
B-24

This is a picture taken in 2002 of a site in the Bituminous Coal Region in Pennsylvania where biosolids were applied as part of the mined land reclamation effort undertaken in 1993

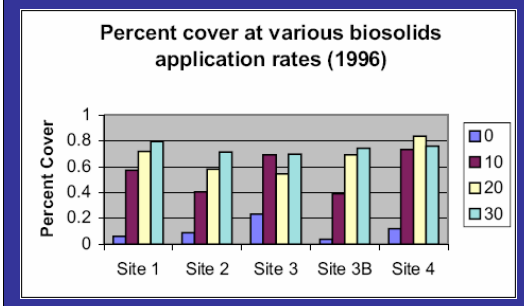
Upper left photo is the what the minded area soil/spoil looks like where biosolids was not used nearly 18 years earlier – it is still extremely sterile, with only some moss and a few legumes growing, contrasted with the lower right photo of the same minded area where biosolids were applied nearly 18 years earlier that is now dark and rich for about 6 inches, with a grass cover that remains dense with vigorous root growth

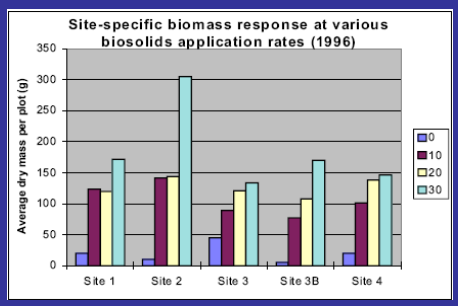


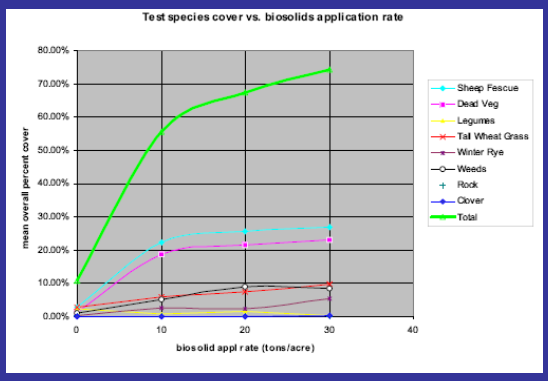
Beginning in 1985, near Barberton, Ohio, PPG had reclaimed 300 acres of their 500 acres of white lime spoils (soda ash from the production of glass), a wasteland known as the Lime Lakes, utilizing biosolids from several POTWs in eastern Ohio, by 2001 transforming the barren lakes into a haven for native plants and wildlife.



Kennecott Copper mine site near Salt Lake City, UT, where biosolids were applied to help revegetate mine spoils in the late 1990s.


Percent cover at various biosolids application rates (1996)
Percent Cover
1
0.8
0.6
0.4
0.2
0
Site 1
Site 2
Site 3
Site 3B
Site 4
0
10
20
30


Site-specific biomass response at various biosolids application rates (1996)
Average dry mass per plot (g)
350
300
250
200
150
100
50
0
Site 1
Site 2
Site 3
Site 3B
Site 4
0
10
20
30

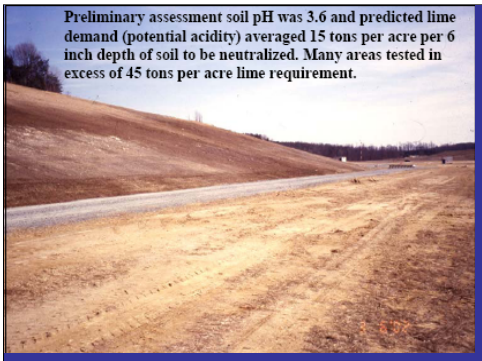

Test species cover vs. biosolids application rate
mean overall percent cover
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
0
10
20
30
40
biosolid appl rate (tons/acre)
Sheep Fescue
Dead Veg
Legumes
Tall Wheat Grass
Winter Rye
Weeds
Rock
Clover
Total

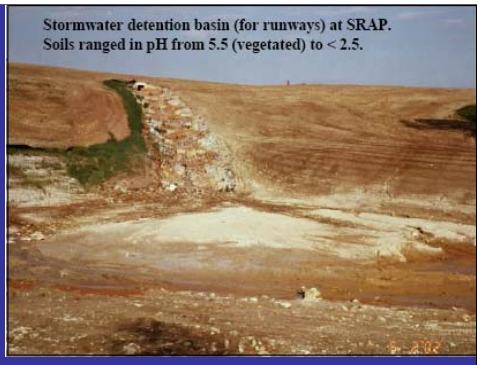
B-29

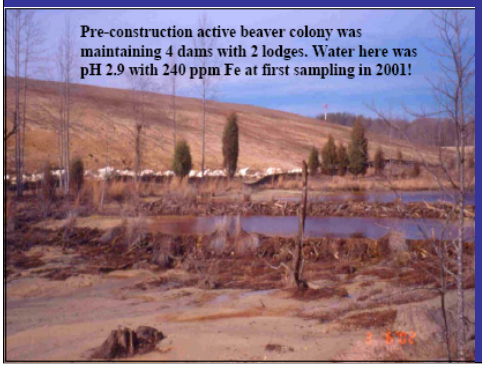
Stafford Airport Reclamation

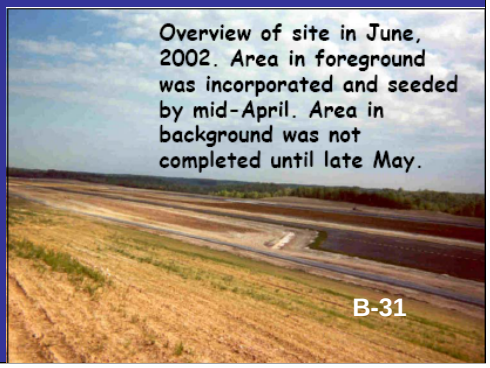
The Airport Authority faced importing topsoil at cost of several million dollars for the 300+ acres of acidic (pH ~2) soil at the new Stafford County Airport in 2001. In the first season after biosolids application, grass began to grow, then became so long, the Airport Authority now has to worry about wildlife and mowing.

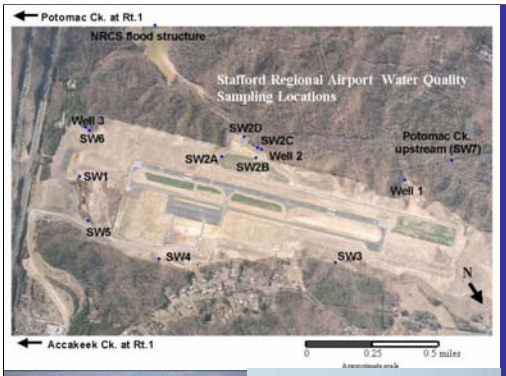
B-30


Preliminary assessment soil pH was 3.6 and predicted lime demand (potential acidity) averaged 15 tons per acre per 6 inch depth of soil to be neutralized. Many areas tested in excess of 45 tons per acre lime requirement.

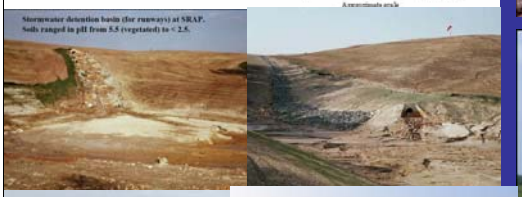

Stormwater detention basin (for runways) at SRAP. Soils ranged in pH from 5.5 (vegetated) to < 2.5.

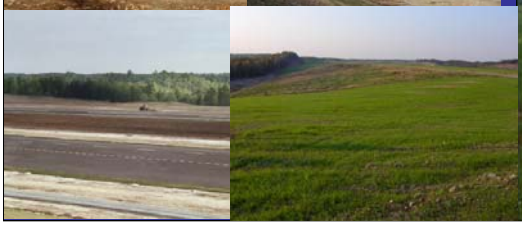

Pre-construction active beaver colony was maintaining 4 dams with 2 lodges. Water here was pH 2.9 with 240 ppm Fe at first sampling in 2001!


Overview of site in June, 2002. Area in foreground was incorporated and seeded by mid-April. Area in background was not completed until late May.
B-31


Potomac Ck. at Rt.1
NRCS flood structure
Stafford Regional Airport Water Quality Sampling Locations
Well 3
SW6
SW2D
SW2C
SW2A
Well 2
SW2B
Potomac Ck. upstream (SW7)
SW1
Well 1
SW5
SW4
SW3
N
Accakeek Ck. at Rt.1
0
0.25
0.5 miles


Area revegetated in late May as it appeared in July, 2002. Unfortunately, April through October of 2002 was the hottest/driest period on record.






Same view in summer of 2004 after site had been mowed four times.
B-32
14. 7. 2004

Palmerton, PA, 1980; Dead Ecosystem on Blue Mountain B-33

Palmerton, PA, Zinc Smelter site

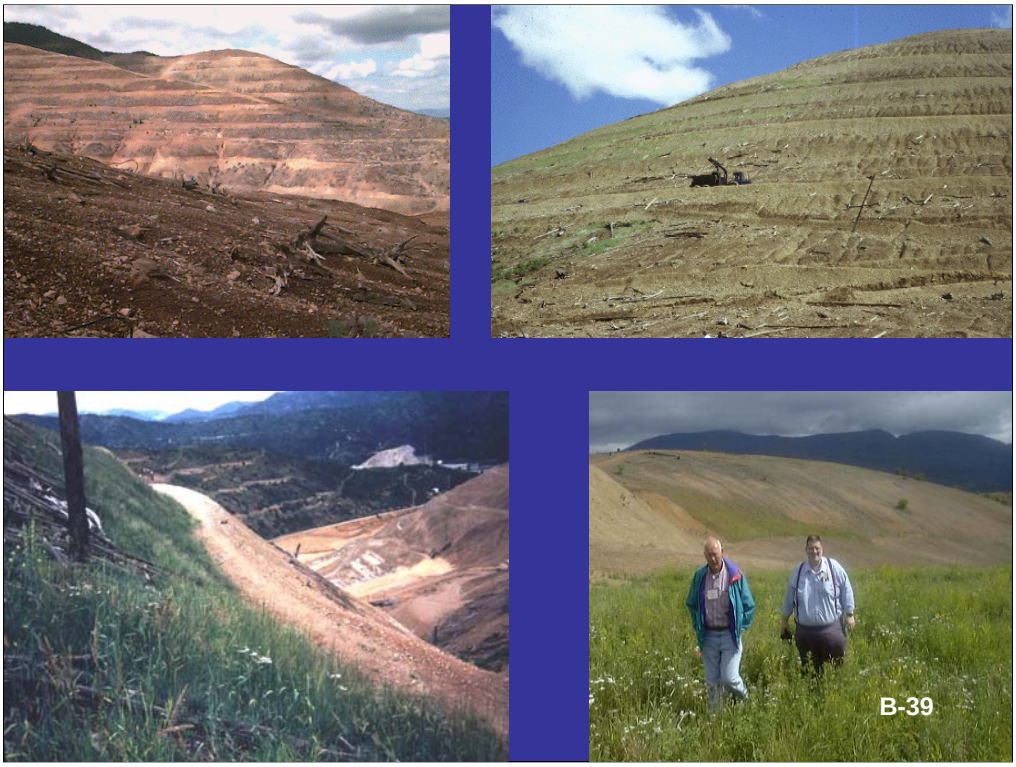
Palmerton, PA, 1999: Looking down revegetated Blue Mountain

B-35

B-36

B-37

Untreated Stoney Ridge (North Palmerton), still barren today B-38



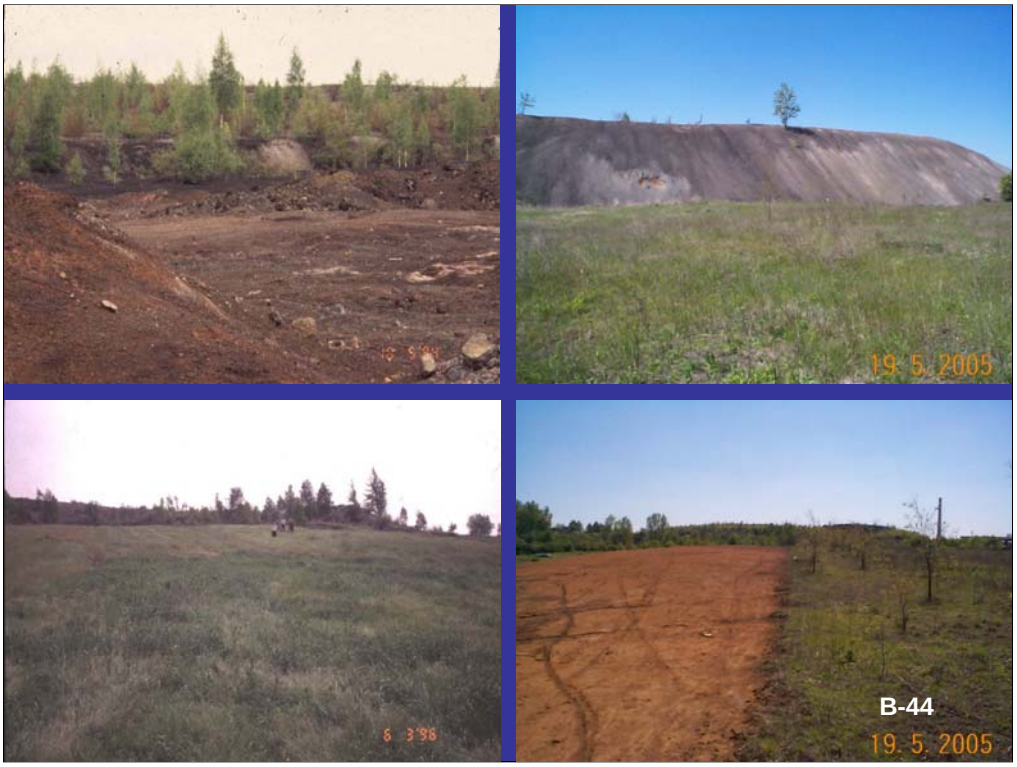
Bunker Hill upland environment … Application of Biosolids and Wood Ash … Two years after application

Leadville, CO

Joplin, MO,lead mine


SWEDEN
Bornholm
(DENMARK)
Baltic Sea
0 50 100 km
0 50 100 mi
LITHUANIA
RUSSIA
POLAND
BELARUS
Warsaw
Katowice
CZECH
REPUBLIC
AUSTRIA
SLOVAKIA
UKRAINE
B-42

Katowice in Upper Silesia, Poland … vegetating smelter waste piles


19. 5. 2005
6 3'98
B-44
19. 5. 2005

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B-45

Thank You

After viewing the links to additional resources, please complete our online feedback form.

Links to Additional Resources

Feedback Form

B-46