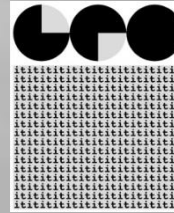


Eesti Maaülikool
Estonian University of Life Sciences



Linnaeus University

FROM GLASS DUMP TO TOURIST PARK

William Hogland

Faculty of Health and Life Sciences
Dept. of Biology and Environmental Science
Linnaeus University
SE-391 82 Kalmar, Sweden
E-mail: william.hogland@lnu.se

Mobile: +46 (0)70 58 58 352



Investing in your future



EUROPEAN
UNION
European Regional
Development Fund





**Who are stealing
our dumps??!**

**SAMEN MAKEN WE
MORGEN MOEDER**



The Science of Landfill Mining and Excavation of City Dumps

**First
Excavation
at Filborna
Landfill in
Sweden
1994**

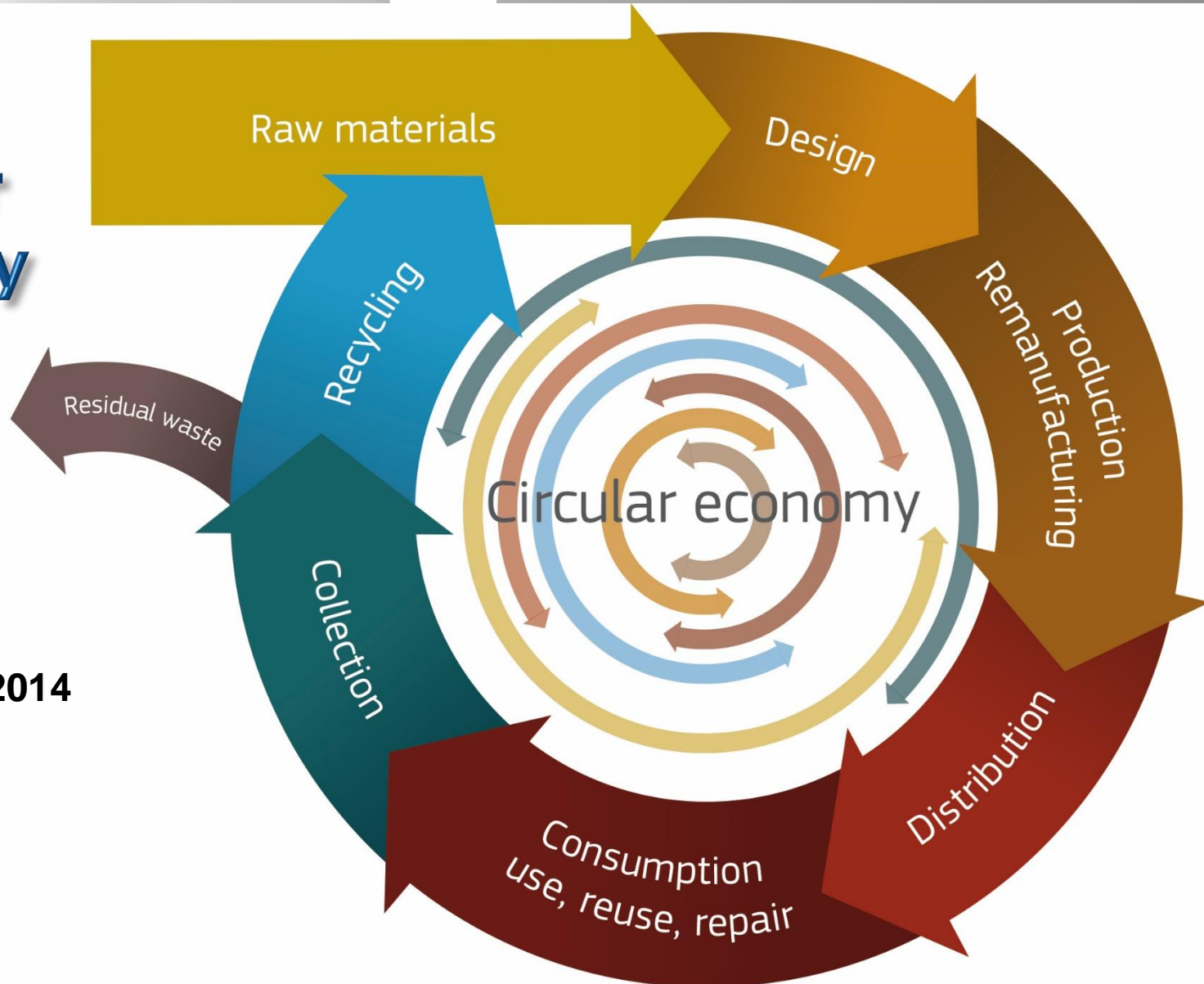


Professor **William Hogland**, Linnaeus University, Sweden

william.hogland@lnu.se



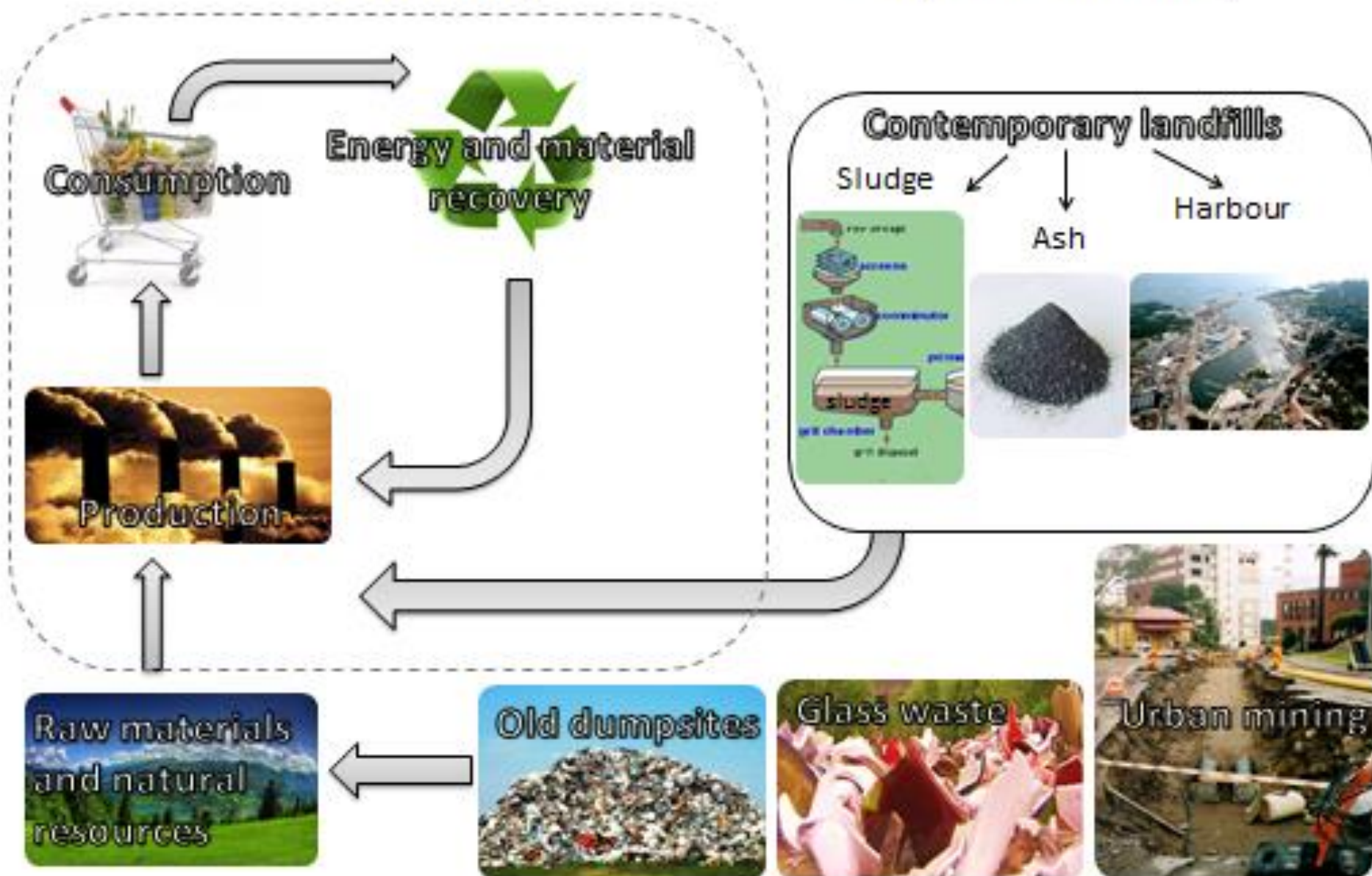
... to a circular economy



W. Bosmans, 2014

Zero waste concept

Beyond zero waste concept



Existing Landfills

- 4 000- 6 000 landfills in Sweden
- 75 000 – 100 000 landfills in the Baltic Sea Region
- 150 000 – 500 000 landfills in EU
- **1999/31/EC EU Council Directive**
 - 300 in Sweden
 - 366 in Finland
 - 371 in Estonia
 - 550 in Latvia
 - 800 in Lithuania
 - 2984 in Germany

Turkey - Lake an potential drinking water source



TURKEY - plan afterwards



Environmental and Economic Aspects

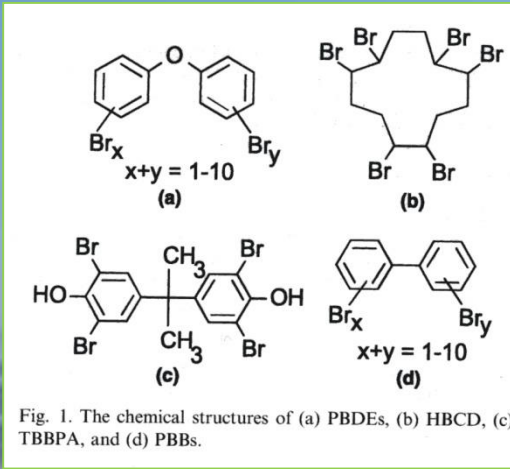
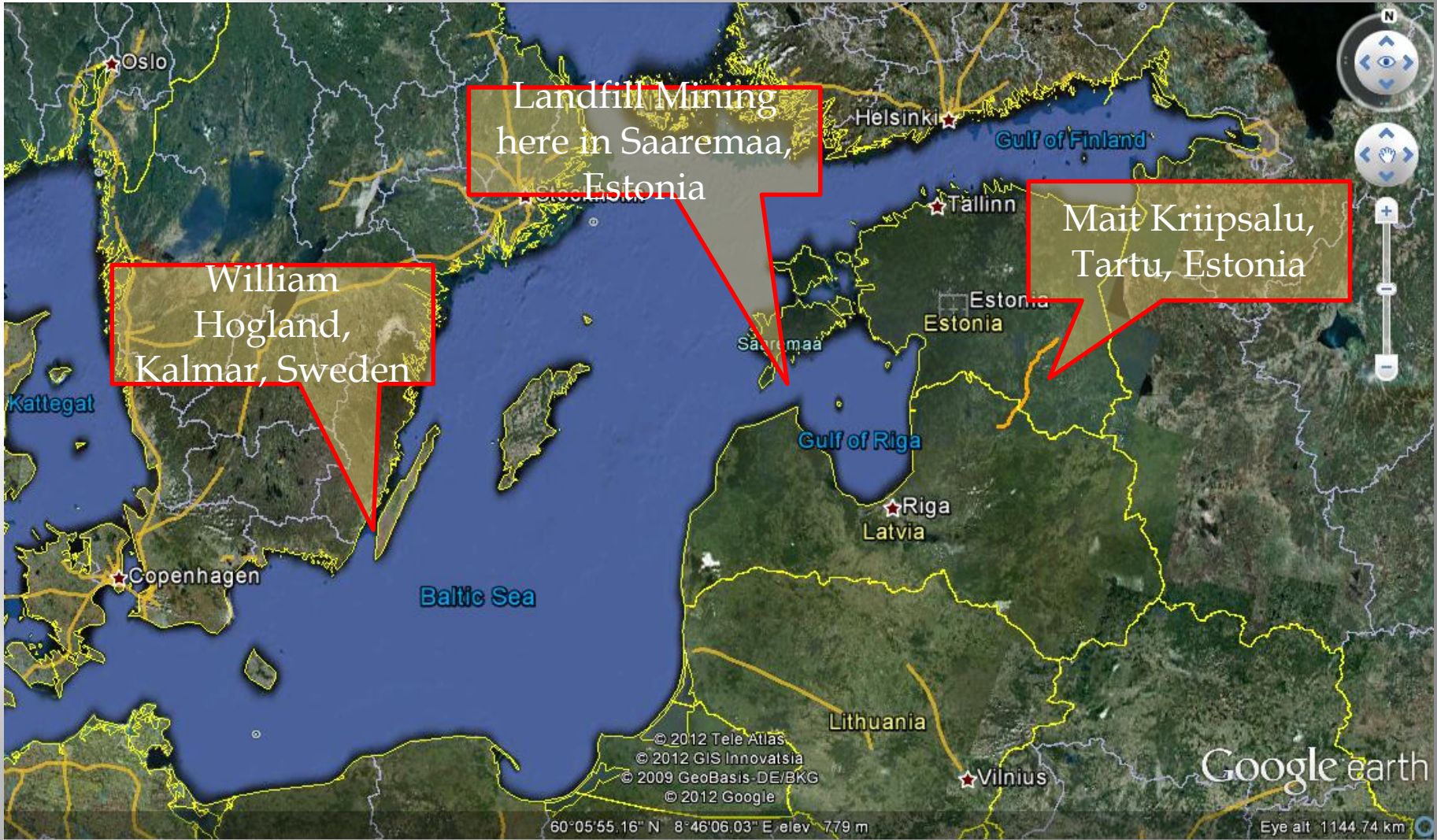


Fig. 1. The chemical structures of (a) PBDEs, (b) HBCD, (c) TBBPA, and (d) PBBs.

Mjösa



<http://www.turistinlandet.no/>



Landfill Mining
here in Saaremaa,
Estonia

William
Hogland,
Kalmar, Sweden

Mait Kriipsalu,
Tartu, Estonia

© 2012 Tele Atlas
© 2012 GIS Innovatsia
© 2009 GeoBasis-DE/BKG
© 2012 Google

60°05'55.16" N 8°46'06.03" E elev 779 m

Google earth

Eye alt 1144.74 km

ESTLAND

ÖSEL/SAAREMA



KURESSAARE

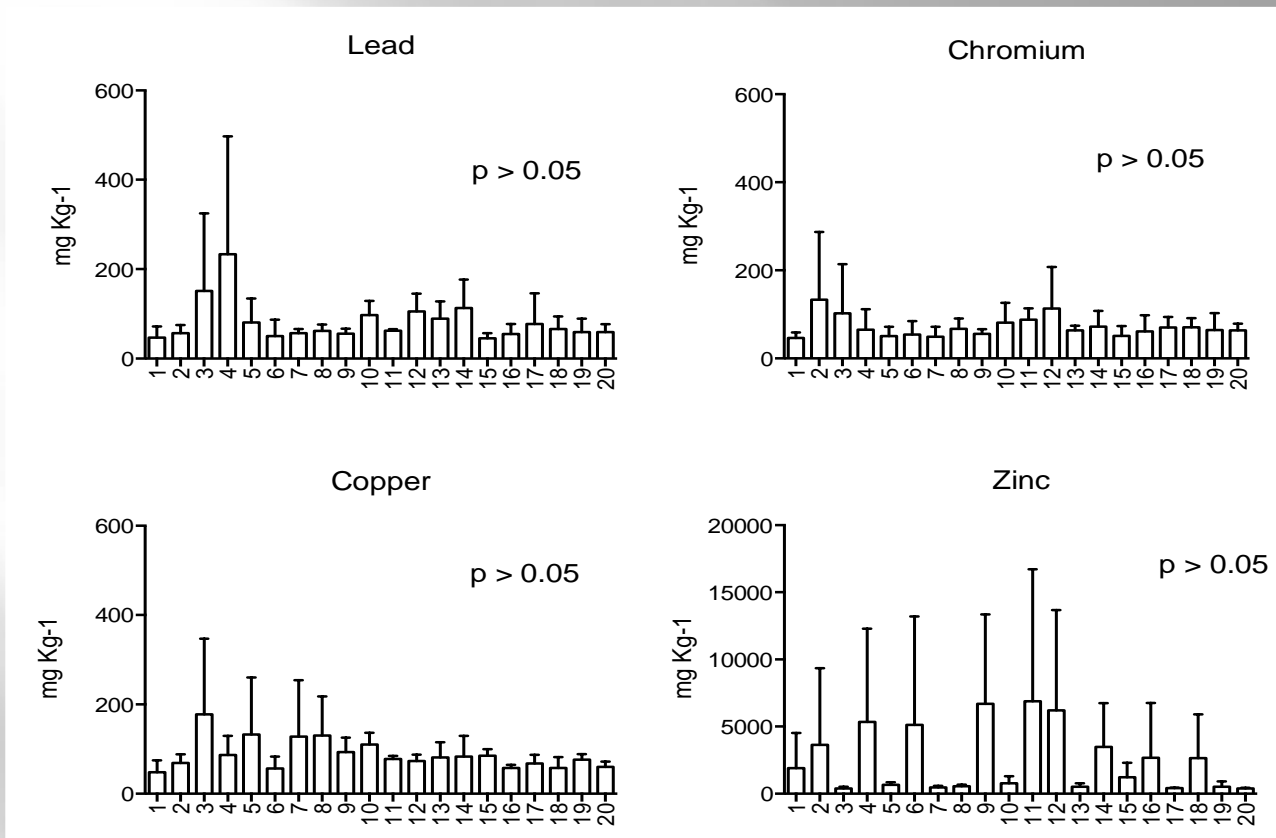


What is inside the heap?

How to use the material?



Kudjape Landfill, Saaremaa, Estonia



Metal concentrations (mg Kg⁻¹) in samples taken in different spots in the excavated fraction <40 mm of Kudjape Landfill, Saaremaa-Estonia. Error bars indicate one standard deviation. N=3



**Plastic
Plank**



**High Temp
in Plastic
Storage**



Plastic Storage



Leachate



Equipments

PhD/MSc Course

Sampling in heterogeneous material in Sweden

After Ergus, 2008

Minkkinen, 2004

$$FZ^2 = \frac{C_{\text{total}}^2}{M_{\text{c}}}$$
$$\beta = \sqrt{\frac{C_{\text{total}}}{C_{\text{min}}}}$$

Minkkinen, 2004

Mait will prepare a metal sampling tube.



What to do with this shit?



Sorting of the fine fraction





RDF to Energy



▣ Sieving

10 – 40 mm

15-17 MJ/kg



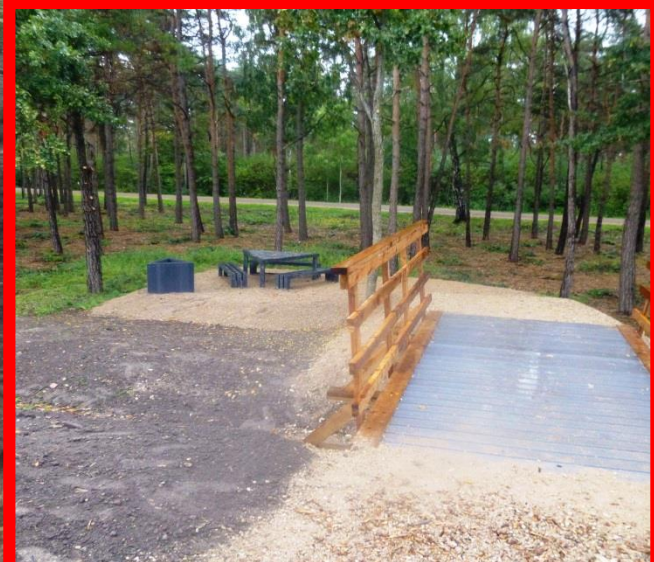
The Estonian landfill before and after excavation







Reuse of old plastics



The Kindom of Crystal, Småland, Sweden



**Glass
factory
dump**

Glass Mining?

Introduction



IRON
 Fe^{2+}



IRON-SULFUR
 Fe-S



COPPER
 Cu^{2+}



CHROMIUM
 Cr^{3+}



NICKEL
 Ni^{2+}



GOLD
 Au



COPPER-TIN
 Cu-Sn



MANGANESE
 Mn^{3+}



COBALT
 Co^{2+}



URANIUM
 U^{4+5+6+}



NEODYMIUM
 Nd^{3+}



ERBIUM
 Er^{3+}



SELENIUM-CADMIUM
 Se-Cd



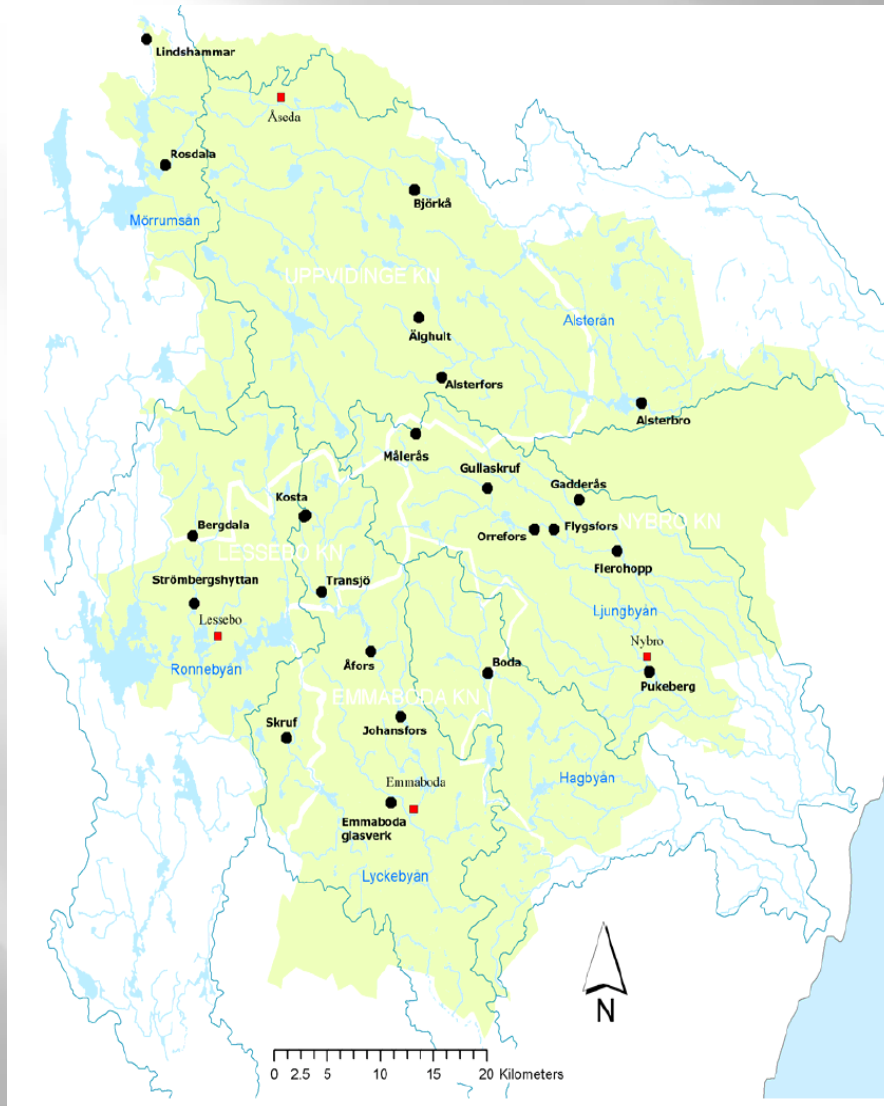
CADMIUM
as CdS

These are typical colours, and can be affected by the type of glass as well as the concentration of the colourant. Combination with other elements and compounds can also have an effect on the final colouration of the glass.

- ❖ Network/Glass formers
 - ❖ SiO_2 - 50% to 75%
 - ❖ $\text{B}_2\text{O}_3, \text{P}_2\text{O}_5$ - up to 5%
- ❖ Fluxes
 - ❖ SiO_2 - 50% to 75%
 - ❖ $\text{B}_2\text{O}_3, \text{P}_2\text{O}_5$ - up to 5%
- ❖ Stabilisers/Modifiers
 - ❖ PbO (24% to 32%)
- ❖ Refining Agents
 - ❖ As_2O_3
- ❖ Colouring/ decolouring Agents



The Problem



- ❖ Over 40 contaminated sites (As, Cd, Pb, etc)
- ❖ > 1,000,000 m³ of contaminated masses (soil and glass)
- ❖ 420,000 m³ contaminated masses in 22 sites:
 - ❖ As – 420 tonnes

The Problem



- ❖ Over 40 contaminated sites (As, Cd, Pb, etc)
- ❖ > 1,000,000 m³ of contaminated masses (soil and glass)
- ❖ 420,000 m³ contaminated masses in 22 sites:
 - ❖ As – 420 tonnes



 **Stopp!**
Området
Får ej bryddas
renad mark
Fastighetsägaren

The Problem



Excavation



Transportation



Landfilling



**Where are the
excavated
masses going?**

**How to create bank
account cells?!**



How to make it?



Vision

Contaminated sites

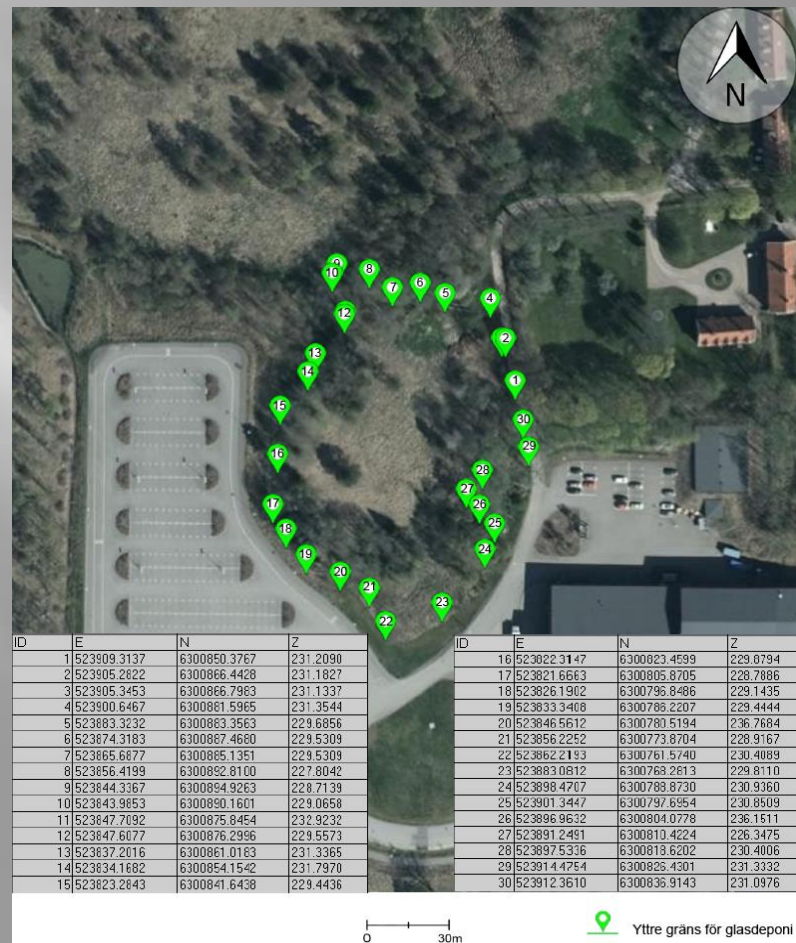
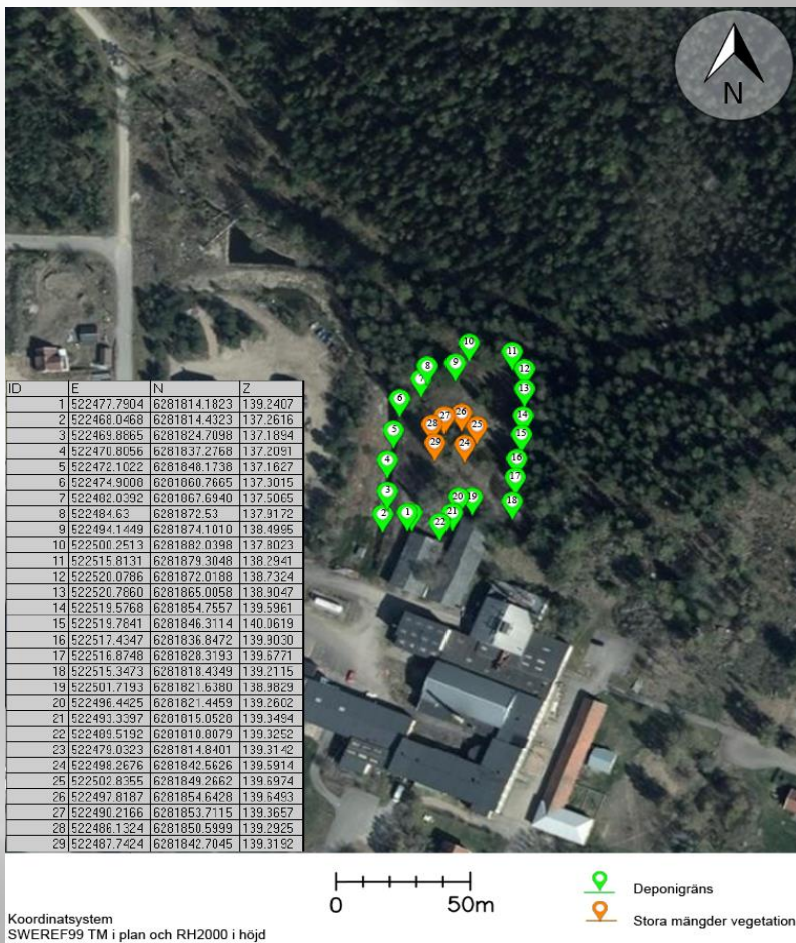


- ✓ Remediation
- ✓ Land reclamation
- ✓ Pollution prevention
- ✓ Enhanced quality of life
- ✓ Resource recovery
- ✓ Green spaces creation
- ✓ Income generation
- ✓ Job creation



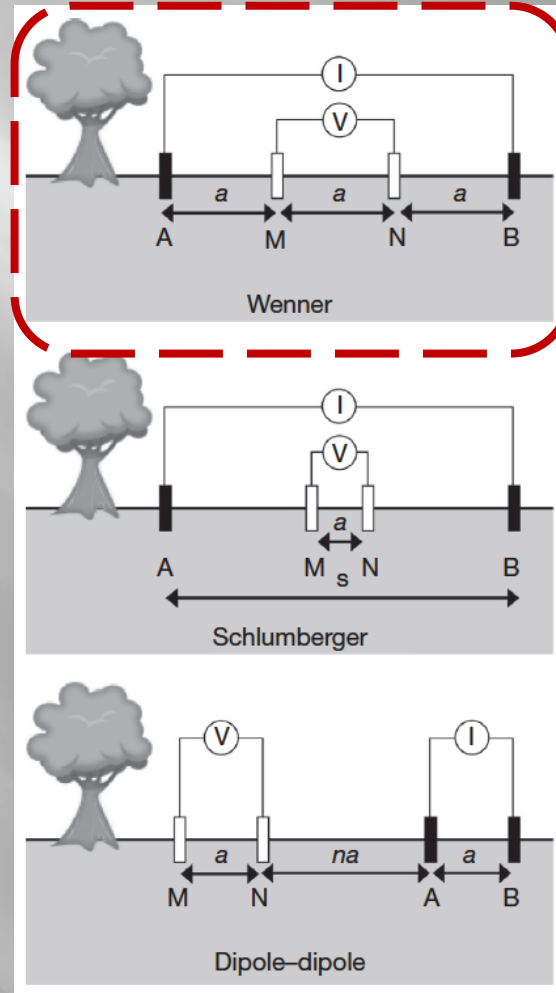
Phase 1: Dumpsites Mapping

Geocoding



Geophysics

Phase 1: Dumpsites Mapping



$$V = \frac{I\rho}{2\pi r}$$

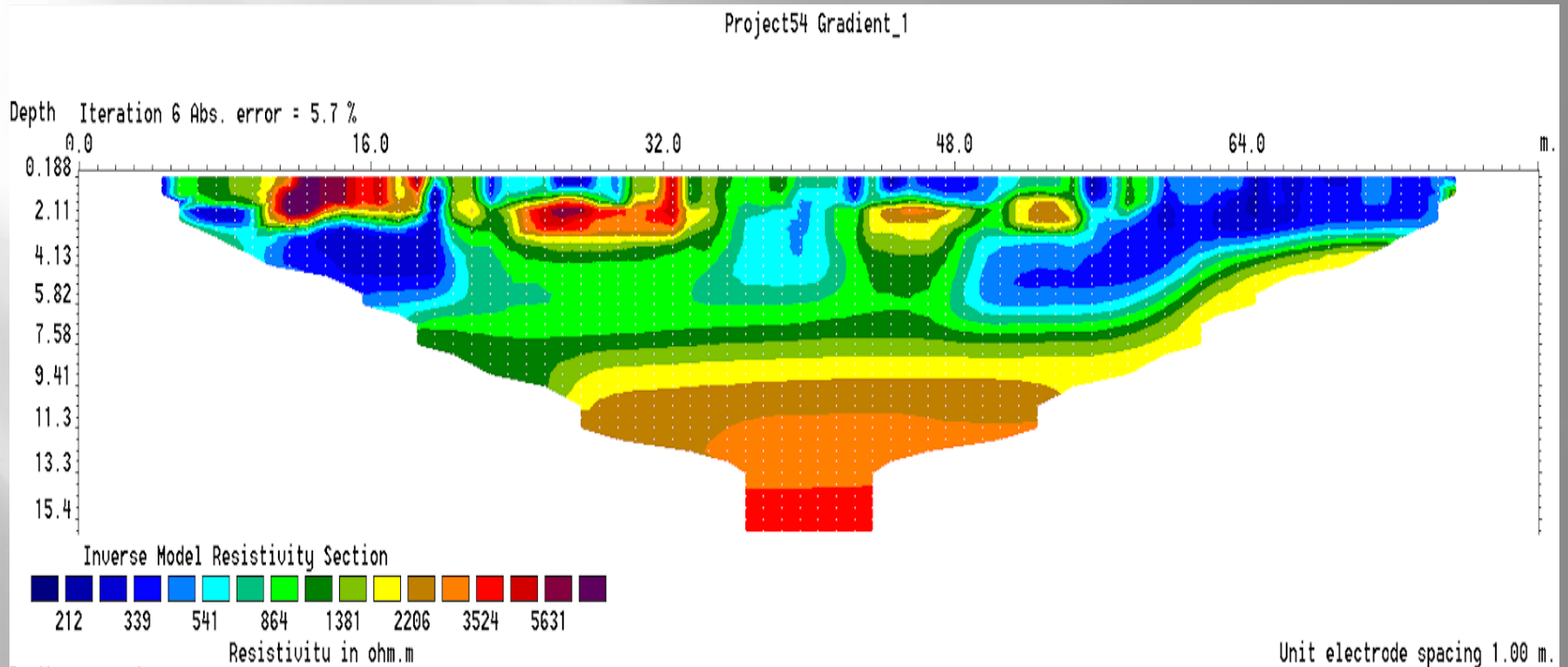
$$V = \frac{I\rho}{2\pi r_{C+}} - \frac{I\rho}{2\pi r_{C-}}$$

$$\rho_a = \frac{2\pi a \Delta V}{I}$$



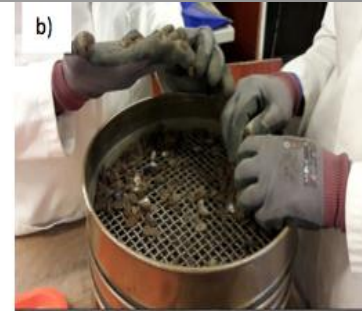
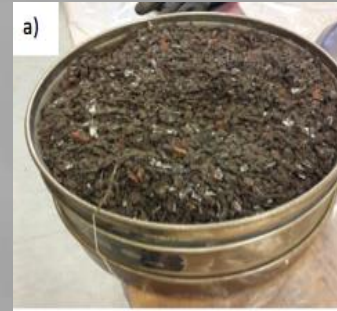
Phase 1: Dumpsites Mapping

Geophysics





Phase 2: Waste Physico-chemical Characterization



Physico-chemical Characterization

Methodology

- ❖ **Test Pits (TPs) Excavation**
 - ❖ 8 TPs: 2m deep, 0.5m sampling intervals
 - ❖ Composites: L1 and L2
- ❖ **XRF Analysis:**
 - ❖ Elemental composition of waste
- ❖ **Sieving & Hand-sorting:**
 - ❖ Waste composition
 - ❖ Particle Size Distribution
- ❖ **Leaching tests (Swedish Standard - SS-EN 12457-4; 10 l/kg, < 4 mm):**
 - ❖ Waste leaching behaviour
- ❖ **Acid digestion (7M HNO₃) :**
 - ❖ Leaching potential under low pH
 - ❖ ICP-MS Analysis



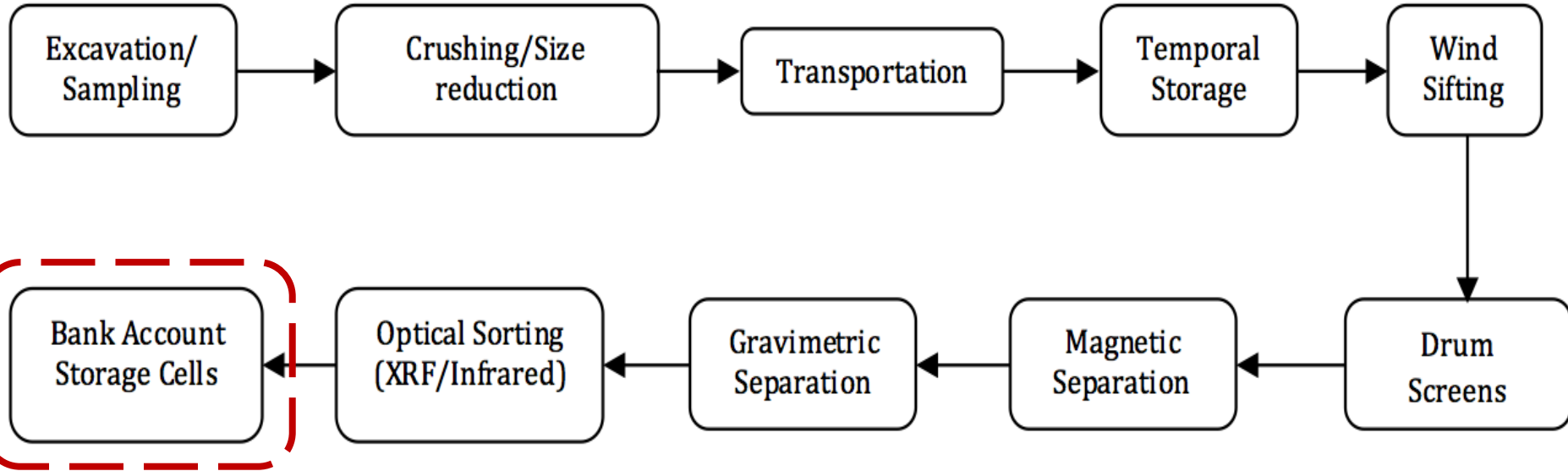
Phase 2: Waste Physico-chemical Characterization

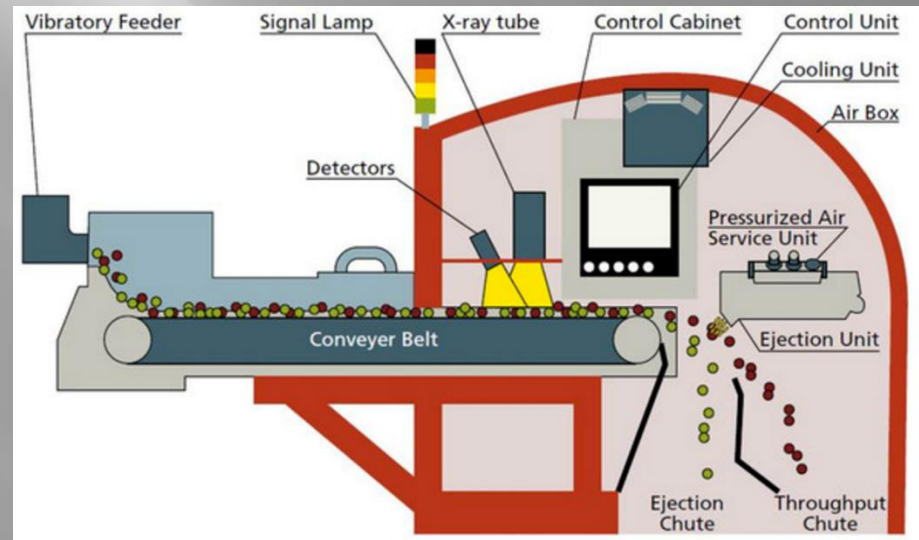
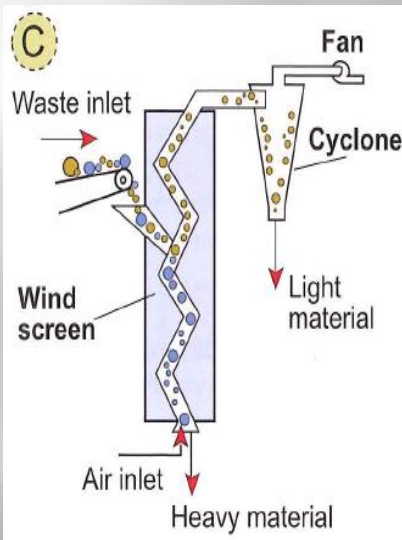
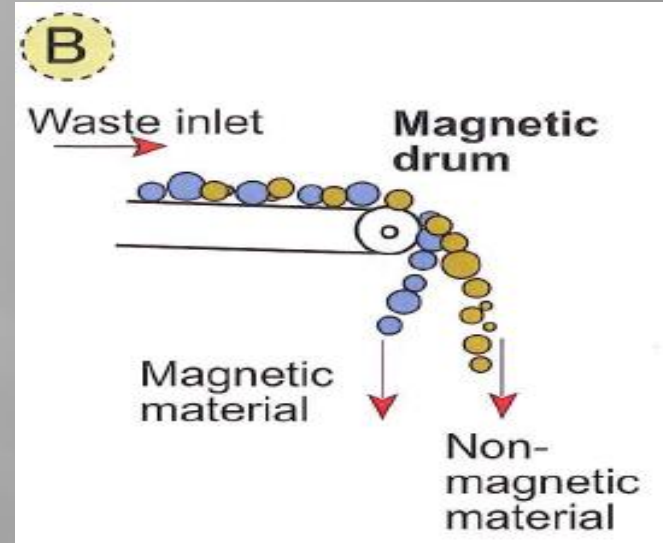
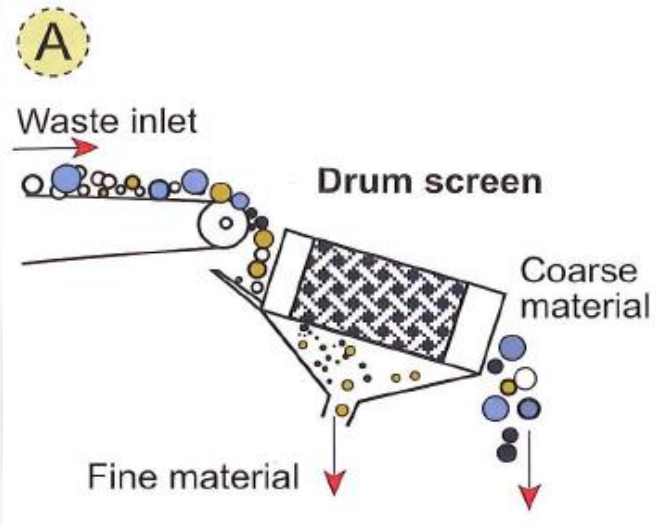
Conclusions



- ❖ Readily valorizable glass materials – **no complicated sorting requirements**
- ❖ **> 75%** of glass particles within the size requirement for efficient XRF-based sorting
- ❖ Glass and soil fractions **hazardous**
- ❖ Possibility for storage in a **hazardous waste 'bank account' cell**
- ❖ **Radionuclide dosage levels safe**

Phase 3: Glass Waste Sorting





Phase 3: Waste Sorting

MRF Glass Plant



Processed Glass



Raw MRF Material



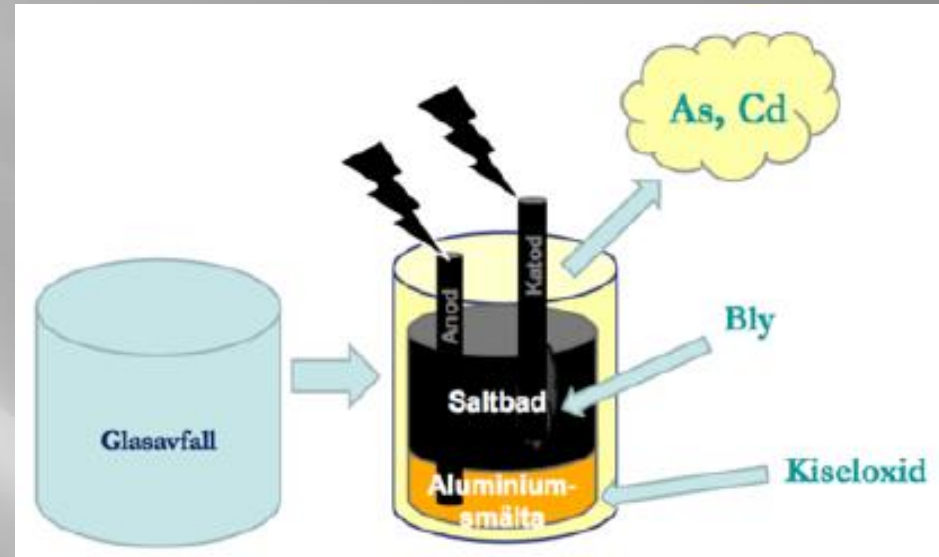
Float Material



Phase 4: Metal Extraction

▣ Reduction Melting:

- As = 99%; Cd = 100%; Pb = 99.9% (Jani & Hogland, 2017)



▣ Chemical Extraction:

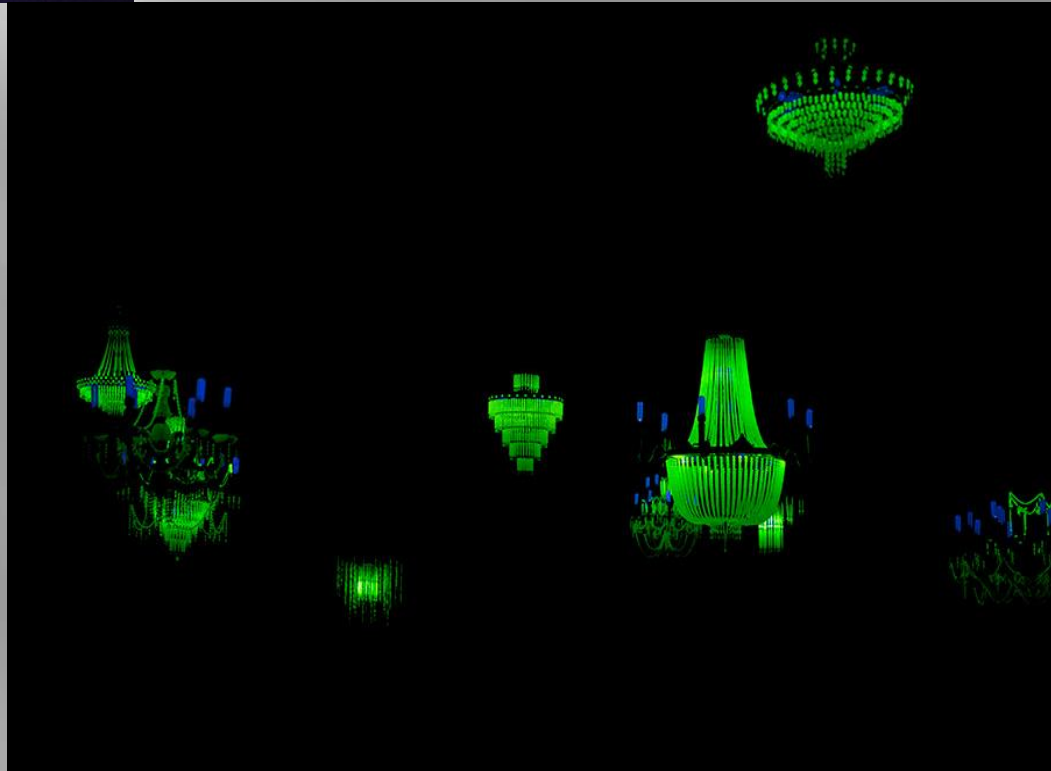
- EDTA, DTPA, NTA
- As, Cd, Pb, Zn < 41% (Jani & Hogland, 2017)





URANIUM IN GLASS.

CONTAINED
2-25% URANIUM. SO CALLED
DEPLETED URANIUM WAS
OFTEN USED.



Radioactivity?



**Here we shall construct the
"Tourist Phyto Park"**



International courses with up to 17 nations represented



Lnu.se



**Glassmining &
phytoremediation**

in collaboration with

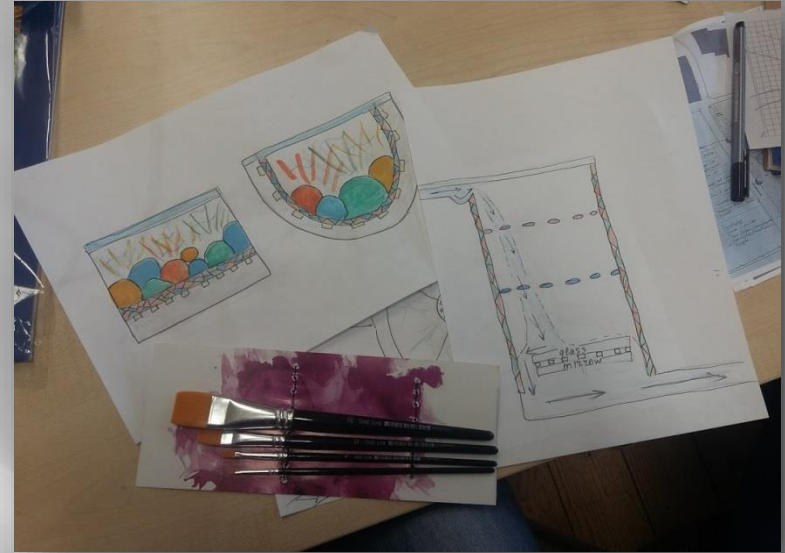
- Svenska Institutet
- Latvian University of Agriculture
- Estonian University of Life Science
- Orranäs Bruk
- Liljas Bil
- PhytoEnvitech

Linnæus University

Brainstorming

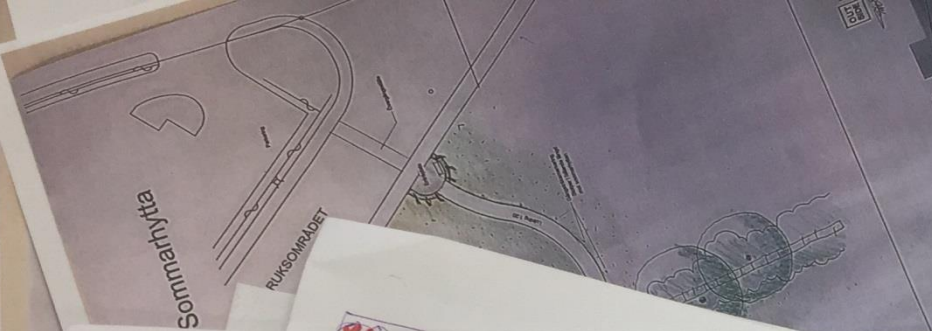


Discussion



Project of my

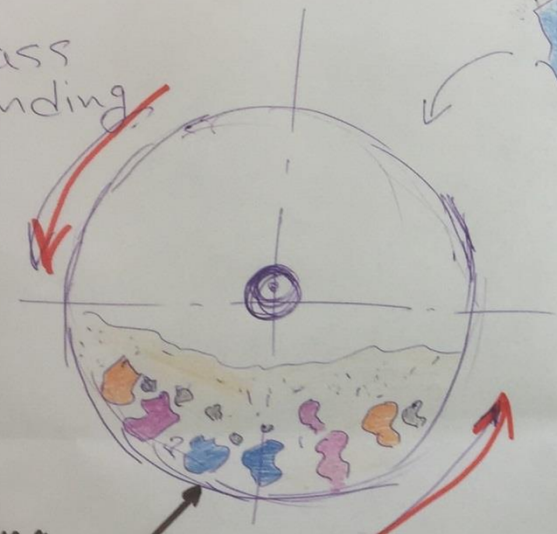




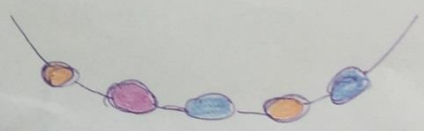
Waste glass

1.

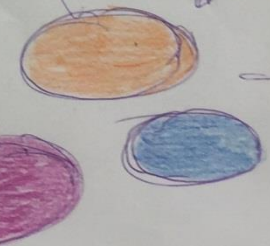
Glass grinding



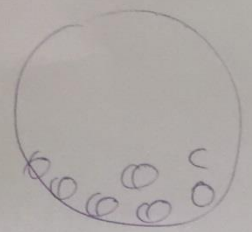
Rotating drum



Pebble-shaped glass



Glass sand powder





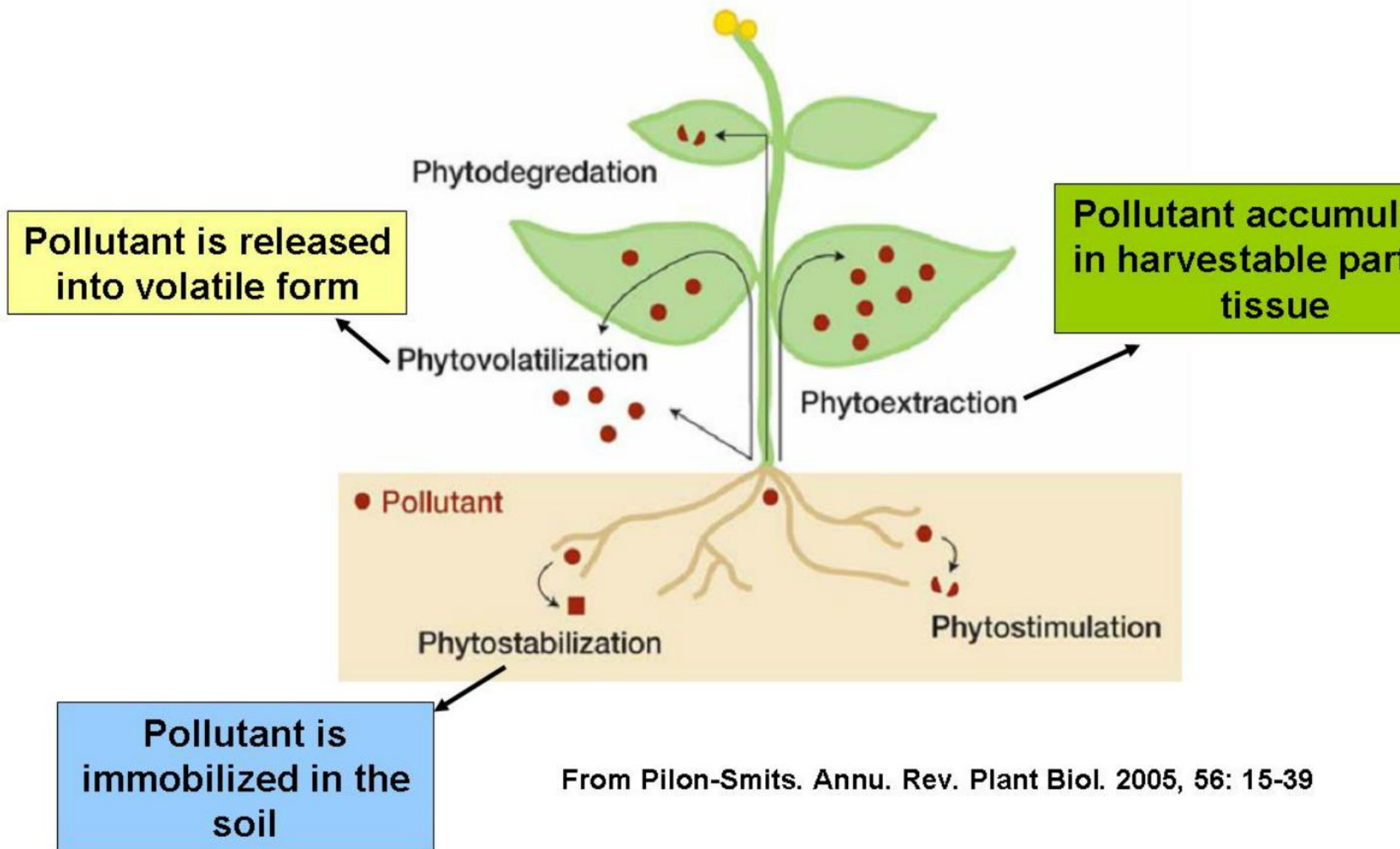
Phytoremediation of soil contaminated with petroleum hydrocarbons and trace elements

Charlotte Marchand,
PhD dissertation defence
10 March 2017



Glass mining. Part 2





From Pilon-Smits. *Annu. Rev. Plant Biol.* 2005, 56: 15-39



Helianthus sp
Asteraceae (Compositae)



Leucaena leucocephala
(Mimosaceae)



Acacia sp.
Fabaceae (Leguminosae)



Tibouchina sp.
Melastomataceae



Glycine max
Fabaceae
soybean



*Brachiaria
brizantha*
Poaceae
(Gramineae)



Brassica napus
raps



Medicago sativa
alfafa



Ricinus communis
(Euphorbiaceae)
Castor bean

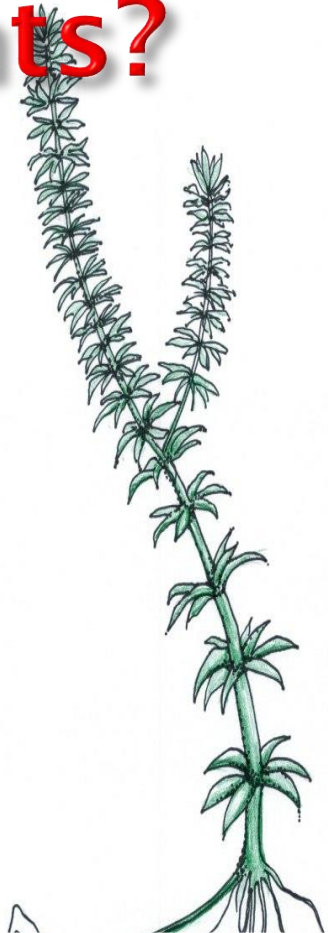
How to Choose Plants?



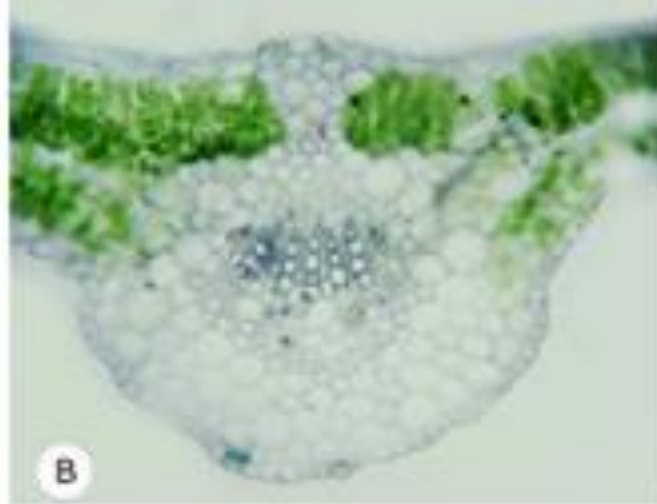
Name	<i>Festuca ovina</i> L.
Moisture	Dray
Soil	Sand, lime
Height	15-50cm
Vegetatio	Many seasons



Name	<i>Salix viminalis</i>
Moisture	wet
Soil	Sand...Loam
Height	200-500 cm
Vegetation	Many seasons



Name	<i>Hydrilla</i> <i>verticillata</i>
Moisture	WATER
Soil	-
Height	30-200 cm
Vegetatio	Many seasons



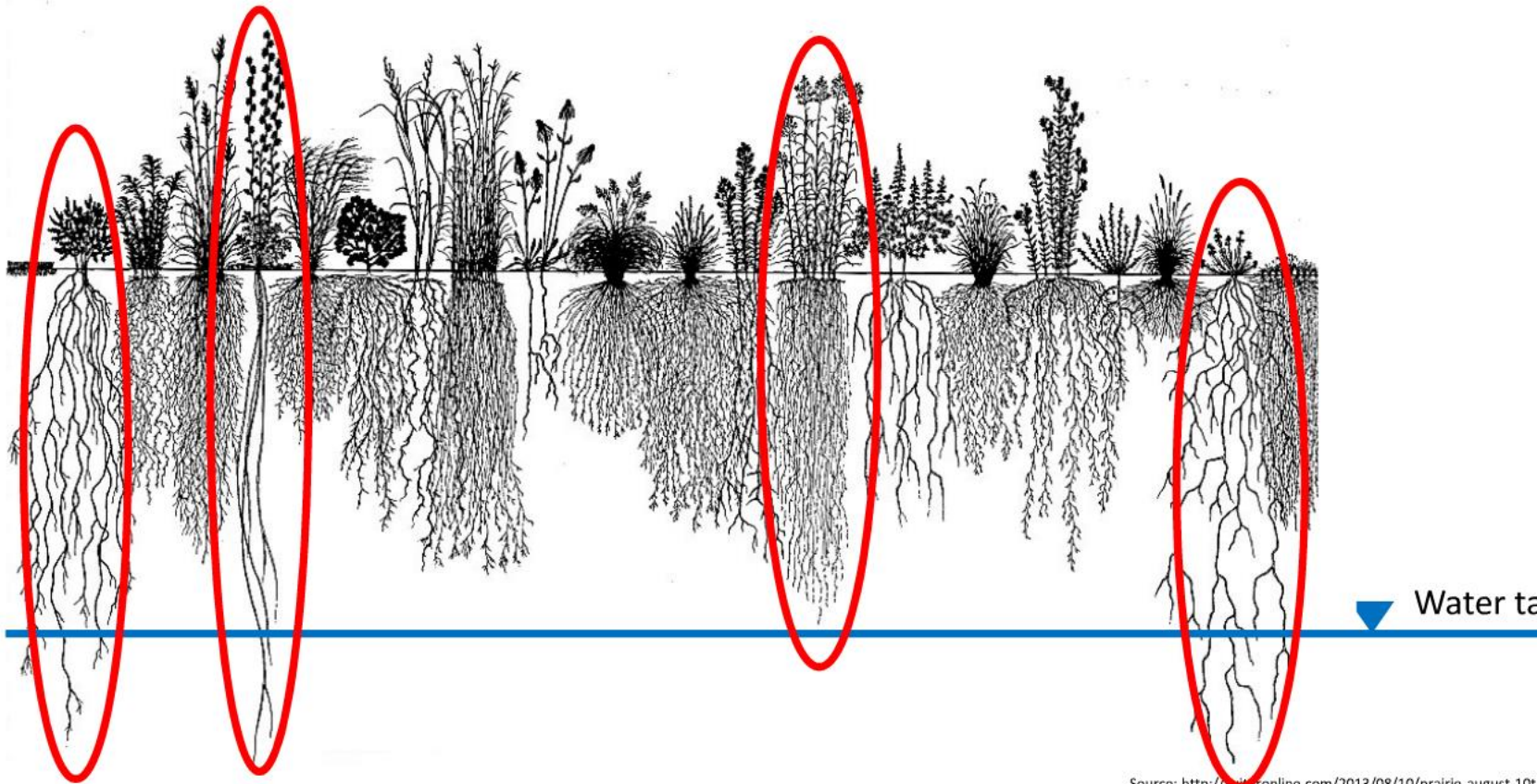
(A) G max - Control and contaminated soil (30 days)

(B) G max - Control
(C) G max - Cont soil: Transversal section of nerve

(D) G max - Control
(E) G max - Cont soil: Transversal section of the limb

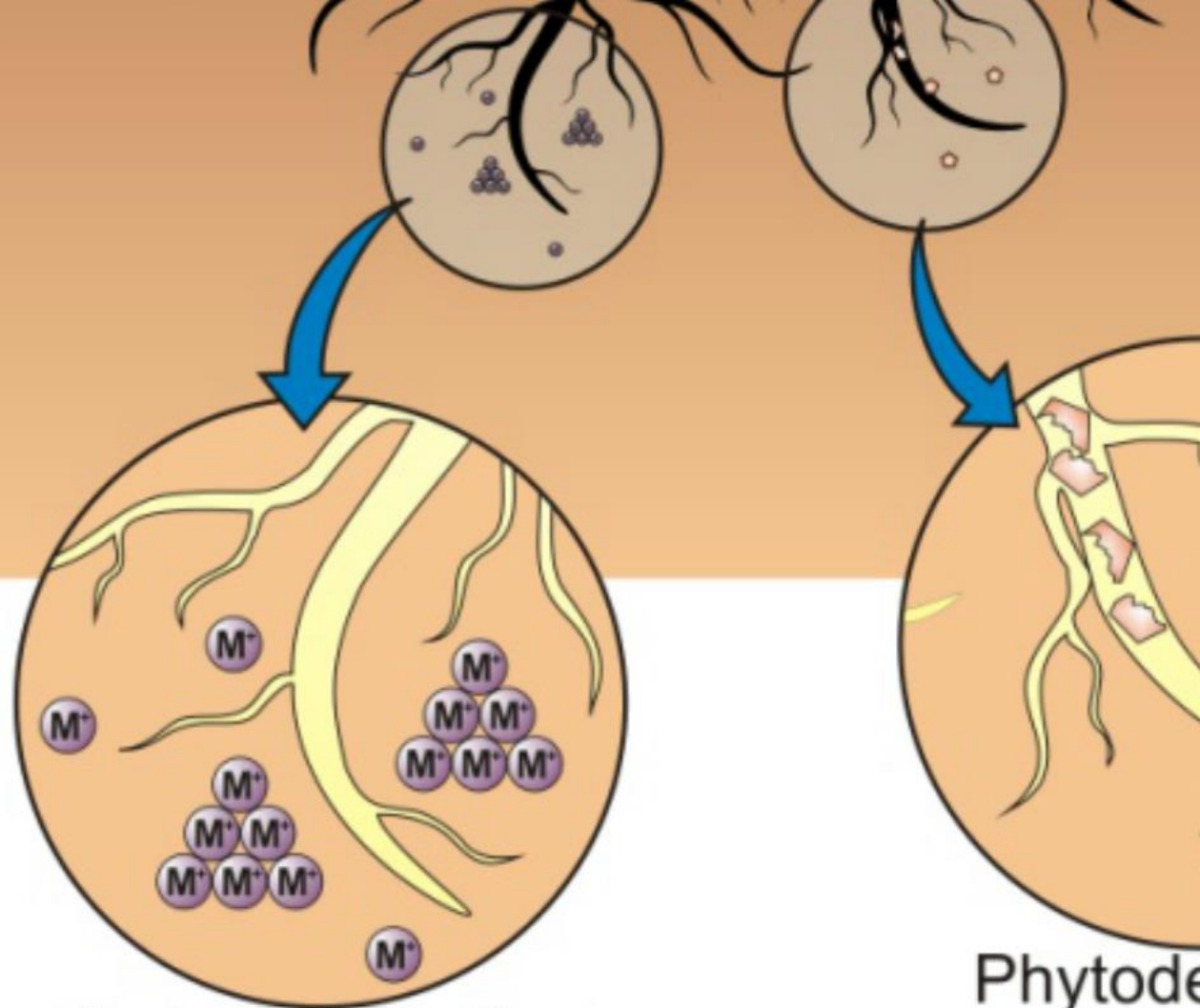
(F) B brizantha Control
(G) B brizantha Cont. soil: Transversal section of the limb

Is the contaminant in depth available for plants?





Phytoextraction



Phytostabilization

Phytodegradation



Old
types of
cereals
?
Dr
Kerstin
Fredlund





How to make the
plants to grow





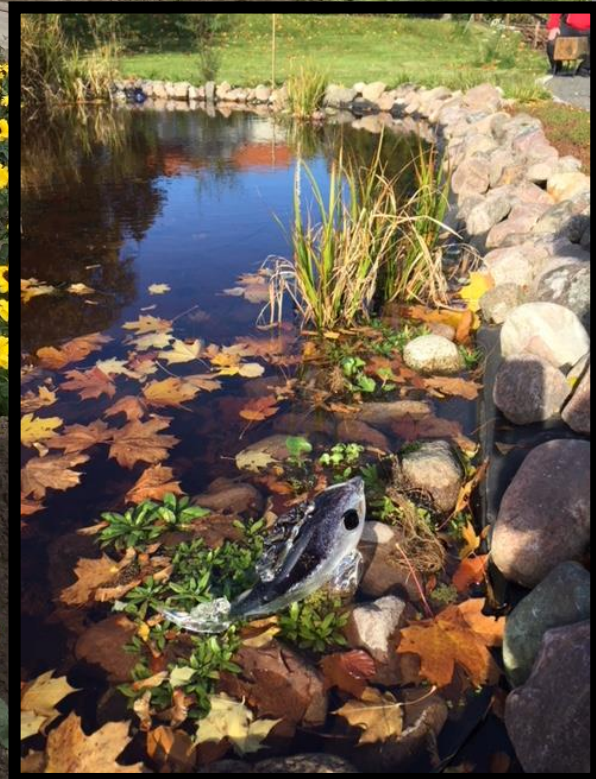




Teaching and education park



Glass in harmony with nature



Öland in the Sky for Ever!!???

Themes for the park

- Space
- Water
- Sound, light, glass,
Plants in hamony



Sand Sculptures



Lars Fager



KALMAR RINGVÄGDELLA
SANDSKULTURFESTIVAL
Kulturhuset 2014-06-20-21

SANDSKULTUR
Agnesa Eriksson
Anastasia Eriksson
www.kalmarringvagdella.se



Eva Ekdahl

PHILIPS



Zero Waste: Elsevier's - ATLAS Award



As the world population, economy and consumption grow, a complex and multi-dimensional approach is needed to manage a rising tide of solid waste



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- Health care policy should not focus on finance, says research
Value in Health
- No quick fixes for world's solid waste management crisis
Waste Management
- Quenching the world's thirst for seawater
Desalination
- Food security in Africa needs a tailored approach, suggests new research
Food Security

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Physical Sciences & Engineering

Platform for Triple Helix cooperation on industrial water handling in Småland and the Islands

Linnæus University

AESIS



€5.000,-



Linnaeus Eco-Tech 2018

11TH INTERNATIONAL CONFERENCE ON THE ESTABLISHMENT OF COOPERATION
AMONG COMPANIES AND INSTITUTIONS IN THE NORDIC COUNTRIES, THE BALTIC SEA REGION AND THE WORLD

19–21 November, 2018

Kalmar, Sweden

First Call for Abstracts

Researchers, scientists and students, professionals from business sector, municipalities and social enterprises, entrepreneurs and authorities from all countries are welcome



Linnaeus Eco-Tech



Linnaeus Eco-Tech 2018

19–21 November 2018

Kalmar, Sweden

Lnu.se/eco-tech

11th International conference on natural sciences and technologies for waste and wastewater treatment, remediation, emissions related to climate, environmental and economic effects

Investing in your future



EUROPEAN
UNION
European Regional
Development Fund

Linnaeus University 

Background

Linnaeus Eco-Tech has been an academic tradition since 1997. The conference is organized by Linnaeus University in Kalmar, Sweden, every second year. One of the main goals of the conference is to promote research and education cooperation among the countries around the Baltic Sea towards sustainability. It has been more and more obvious that the environmental issues have risen from local through regional to global concern.

Aims

The conference aims to promote knowledge and research within the areas of environmental science and environmental engineering. These aims are accomplished by plenary sessions, keynote speakers, workshops and oral presentation of scientific papers. The social environment created by the conference makes participants from different countries and fields to learn from each other.

Linnaeus Eco-Tech is based on cooperation between university, industry and policy makers, with the goal of improving relations between these sectors. The objective of such cooperation is to develop environmental technologies and sustainability in the Baltic Sea Region and the World.

LNU is already active in IWAMA project, and this time has joined the Baltic Sea Challenge network that has similar aims and over 250 committed cities, NGOs, universities, companies and other organisations implementing their own action plans and seeking for co-operation with other organisations.

Scientific topics

Water/Wastewater

Water distribution from source to tap (freshwater) • Water and wastewater treatment • Non-Conventional treatment systems • Leachate treatment • Water/Wastewater reuse • Constructed Wetland systems • Industrial Wastewater and Stormwater management • Ecotoxicology • Occurrence of Pharmaceuticals in water • Sludge management • Harbor/port, bay and lagoon-mining • Clean and safe ship transportation • Climate change and effects • Effects of waste waste transportation • Health & hygienic materials (sustainable sanitation) • Animals pasture and environmental aspects

Solid waste

Waste management policies, strategies and directives • Innovative waste minimization • Soil remediation • Beyond the zero waste • Hazardous waste • Waste to energy • Storage of recyclables, waste fuels and fire hazards • Modern landfills • Urban, landfill and glass mining – Closing the anthropogenic loops • Phytoremediation • Metal recovery • Waste management in developing countries

Environment and society

Triple/Quadruple Helix collaboration among university, industry, public sectors and civil society • Environmental economics, awareness and education • Effects of anthropogenic activities and environmental impact assessment • Circular economy concept – innovation and environmental entrepreneurship • Sustainable consumption and production pattern

Dates and Deadlines

For full instructions related to abstract and paper submission see the webpage: Lnu.se/eco-tech

Abstracts should be submitted by email to:
Prof. William Hogland, email: eco-tech@lnu.se
Tel: +46 (0)480 44 60 00 Mob: +46 (0)70 58 58 352

Deadline for abstracts: 1 Aug. 2018
Registration deadline: 1 Oct. 2018
Deadline for papers: 1 Oct. 2018

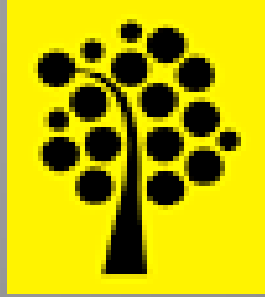


Linnaeus Eco-Tech



Linnaeus University 

Lets go on!



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EUROPEAN
UNION
European Regional
Development Fund

Sl.

Ragnsells-
stiftelse



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Mobile: +46 (0)70 58 58 352