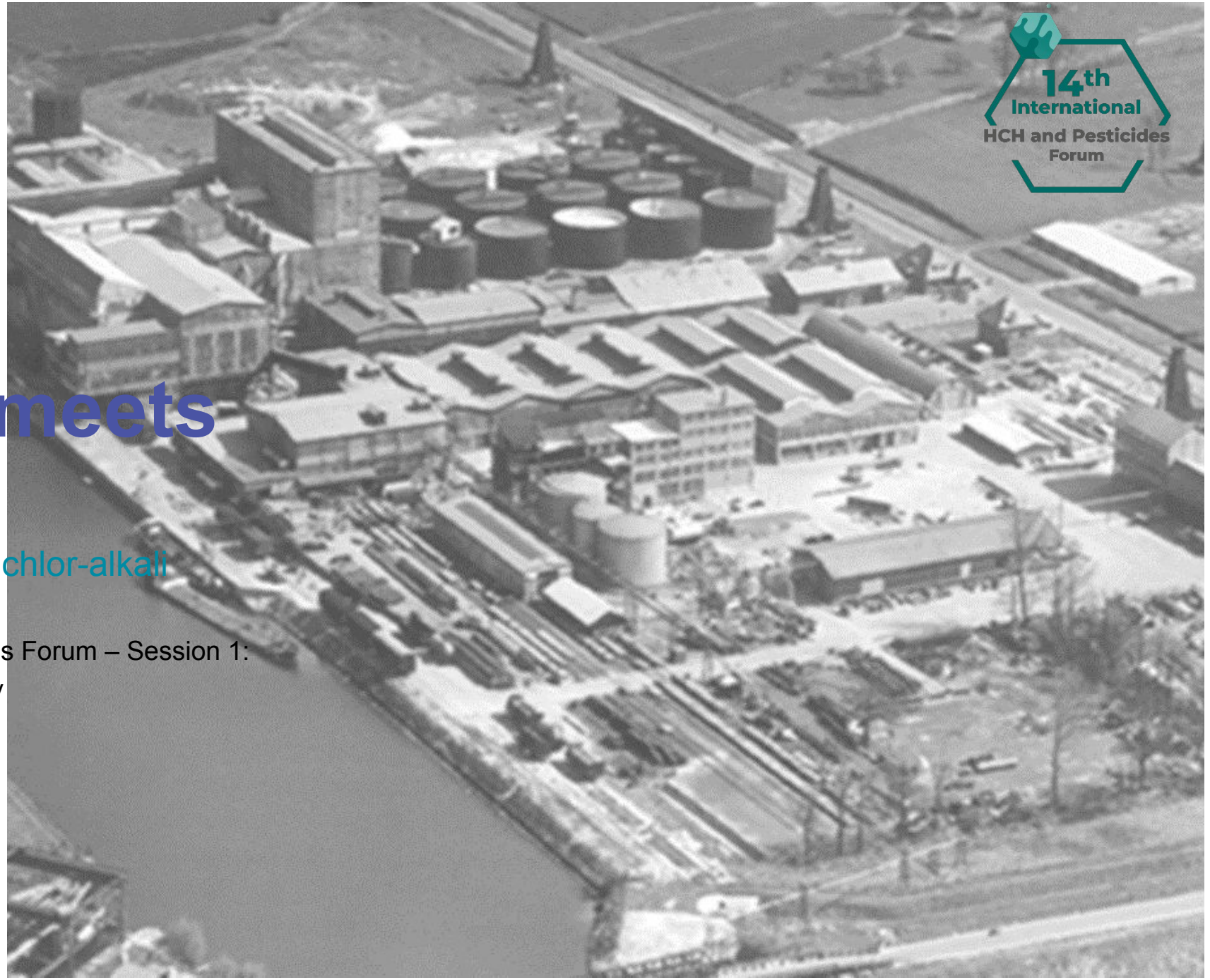
Where Stockholm meets Minamata

Mercury and HCH issues at chlor-alkali facilities

14th International HCH and Pesticides Forum – Session 1:
Dealing with Chlor Alkali and Mercury



Welcome

Our Speaker

Mr Guido van de Coterlet

- Consultant Contaminated Sites and Hazardous wastes
- With TAUW bv for 17 years
- Experienced in both training and fieldwork at contaminated sites and working with hazardous wastes

TAUW

- Technical Consultancy of the Union of Water Boards
- Founded 1928
- Overall 1200 staff, in 6 European countries
- Involved with POPs and HCH since the 1990ties
- Proud sponsor of the 14th HCH forum

Introduction

Minamata and Stockholm Conventions

Minamata Convention Objective:

- To protect the human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds

Relevant actions:

- Chlor-alkali production facilities need to be phased out by 2025
- Mercury contaminated sites should be managed in an environmentally sound manner

Stockholm Convention Objective:

- To protect human health and the environment from persistent organic pollutants (POPs)

Relevant actions:

- Ensure that stockpiles and wastes consisting of, containing or contaminated with POPs are managed safely and in an environmentally sound manner (Article 6)

Chlor-alkali facilities

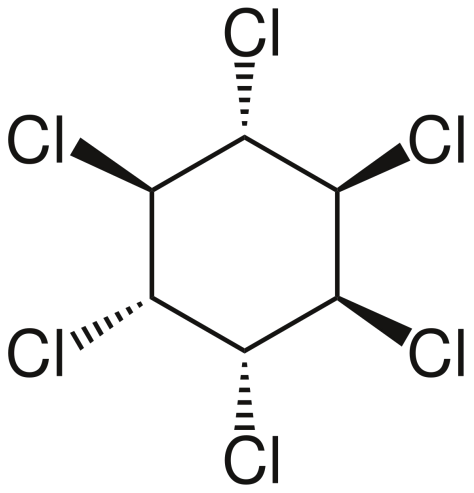
Chlor-alkali facilities and HCH

- Mercury cell technology was, until a decline set in after 1972, the main technology for the production of caustic soda
- The overall process involves a flow of purified saturated brine through an elongated, slightly inclined trough between a shallow co-current stream of mercury and an assembly of electrodes (graphite or metal)
- During production of caustic soda, Cl_2 is produced
- Large quantities of chlorine were needed for the production of HCH photo chlorinating benzene
- Production of HCH at chlor-alkali facilities was often a logical and easy to implement step

Waste and environmental issues

Environmental issues at mercury cell Chlor-alkali HCH production sites

- Photo chlorinating benzene results in technical HCH approximately 14 % γ-HCH (Lindane) and 86 % inactive isomers
  - Initially technical HCH was used as a pesticides. In later years, only the active isomer was used Resulting in approximately 8 tons of waste for each ton of Lindane
- Graphite anodes in the mercury cells would slowly wore away and needed replacing anodes are saturated with mercury and, due to suboptimal conditions for chlorine formation, could be source of dioxins
- Although on paper a closed system, on average chlor-alkali facilities lost several tonnes of mercury per year
  - Through evaporation
  - Brine sludges
  - Waste water
- Asbestos
- PCB



Waste and environmental issues

Where to look for at mercury cell Chlor-alkali HCH production sites

- Mercury is found:
  - At and underneath the Electrolysis plant
  - In the wastewater network
  - At the brine regeneration facilities
  - At the disposal of sludges
- HCH is found
  - In any dump of wastes
  - In the areas where storage and handling took place
- Asbestos is found
  - In most buildings
  - In dumpsites
- Dioxins
  - Are present in spend graphite anodes in dumpsite

So where is the pollution?

Brine and Hg-Na amalgam treatment

Brine sludges – contaminated and(illegally) disposed in vincinity – 500 mg/kg Hg

Concrete floors saturated with mercury – up to 80.000 mg/kg

Roofs often made from asbestos – absorbs mercury

High mercury concentrations in walls. Higher in the building – higher concentrations Up to 5.000 mg/kg

HCH wastes, pure HCH with mostly inactive isomers mixed with other wastes

Groundwater contaminated with mercury, chlorobenzens and HCH – Hg concentrations up to 1100 ug/l
- HCH concentrations > 10.000 ug/l
- High concentrations of (Chloro)benzenes

Irregular spread of mercury in the soil – concentrations up to 1200 mg/kg

Pure mercury in sewers, pipes, underneath floors and along foundations

Expect the unexpected

No Plan Survives First Contact With the Enemy!

- Mixed HCH and Mercury contaminated wastes where sludges have been dumped together with HCH wastes
- Mixed mercury and asbestos roofs of the buildings, where mercury has evaporated into the building materials
- Mixed HCH and Asbestos where asbestos has been dumped in HCH waste piles
- Mixed dioxins and mercury Graphite anodes

Various ashes encountered during excavation

Heavily impacted constructions materials

Typical mercury impacted materials. More sandy in nature, slightly white/gray

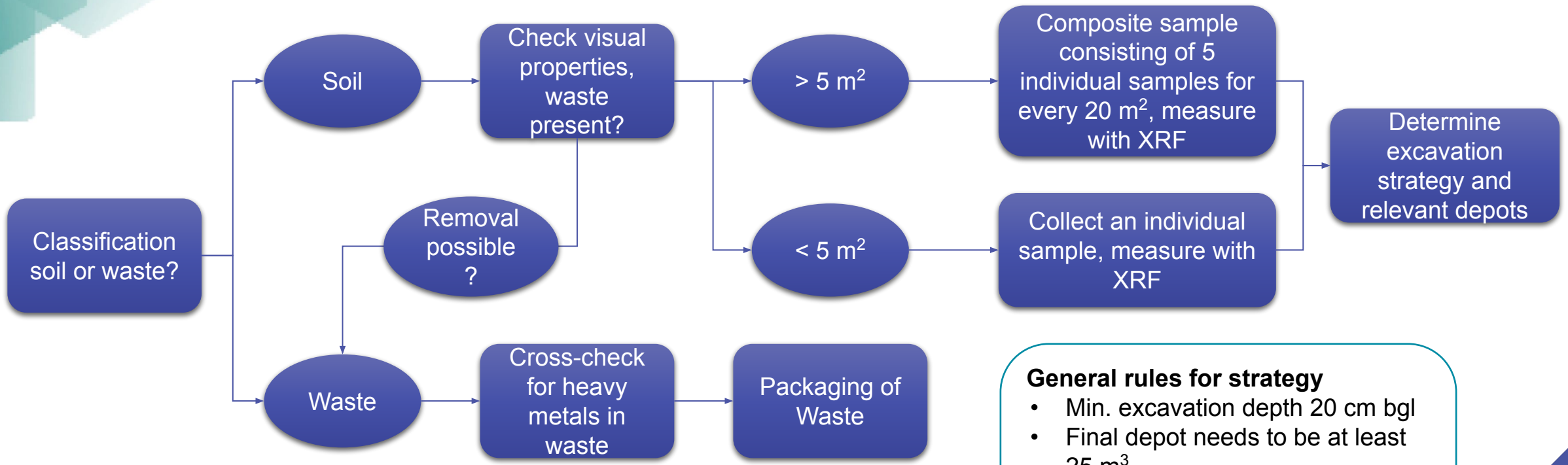
How to deal with the unexpected?

Built variability into your execution

- A good balance between minimising mixing of different soil/ waste classes and practically feasible
- Minimise risk of non-acceptance by treatment facility at the gate
- Strategy should be understandable and compliable
- Optimize project process without compromising on project aims
- Includes flexibility for surprises during excavation (e.g., dumped barrels, mercury contaminated waste)

How to deal with the unexpected?

Excavation of soil or waste



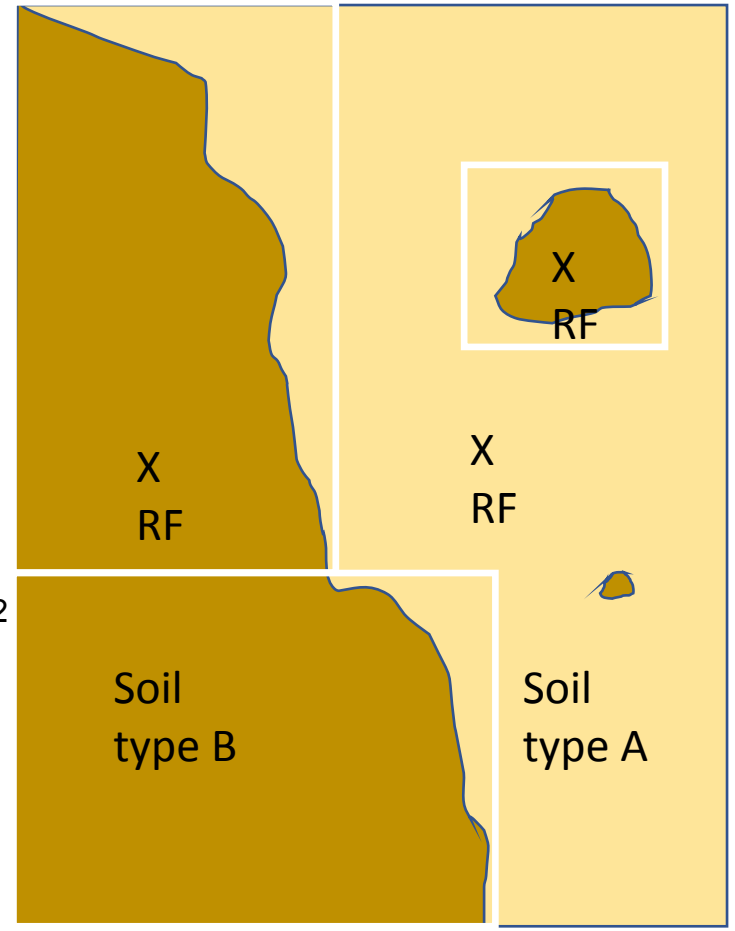
General rules for strategy

- Min. excavation depth 20 cm bgl
- Final depot needs to be at least 25 m^3
- Ensure buffer around waste and “cleaner” soil
- Soil quality of depot should be acceptable for treatment facility
- Minimise mixing of soil and waste

How to deal with the unexpected?

Excavation of soil

- For each layer; visual inspection of soil.
- Mixing of materials should be prevented by should also remain practical.
- Distinct soil type over an area smaller than 5 m^2
  - Individual sample (25-50, 50-57 cm below original surface or different soil properties)
  - Duplicate XRF-reading
- Distinct soil type over an area larger than 5 m^2
  - Composite consisting of 5 individual samples for every 20 m^2
  - Duplicate XRF-reading
- Excavation of soil for a minimum depth of 20 cm and maximum depth of 50 cm.

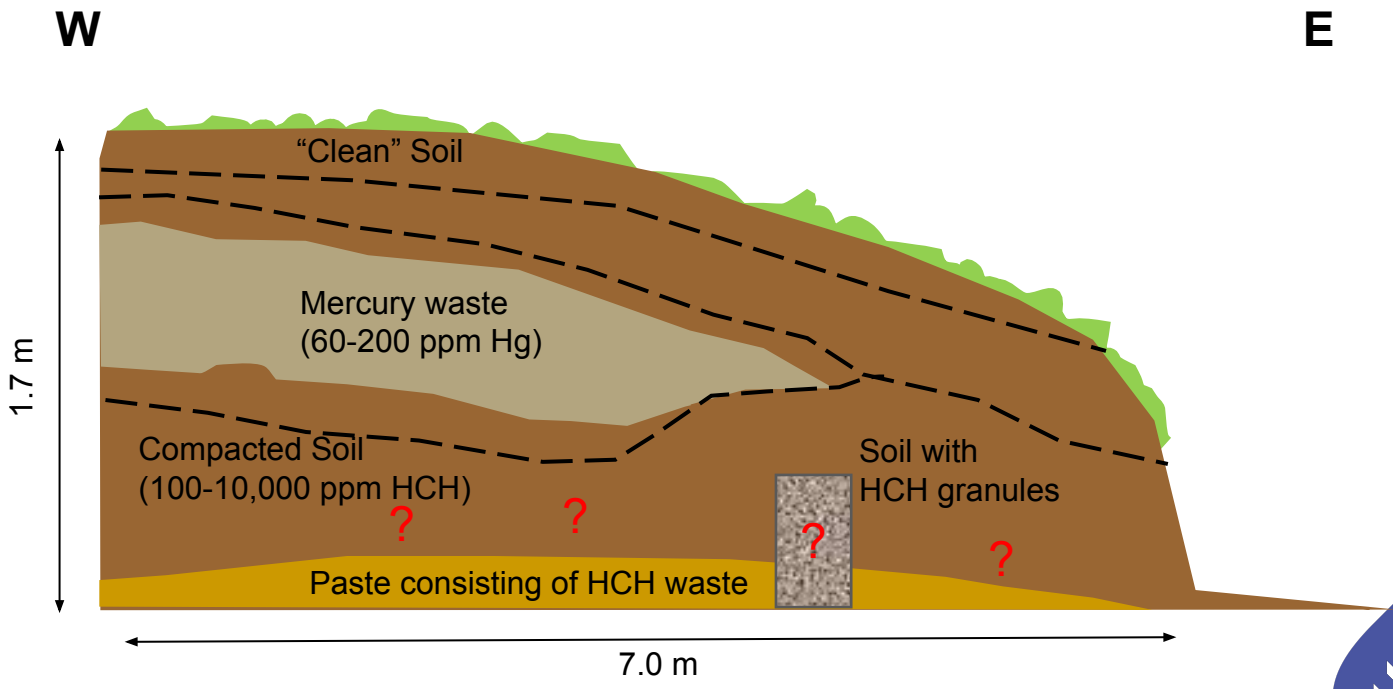


How to deal with the unexpected?

Example of excavation strategy

- Vegetation layer needs to be removed based on XRF-readings
- Removal in thin layers of visual clean soil
- Measure visually contaminated soil before proceeding excavation
- Mercury containing waste (or soil) to different depot
- Soil with chlorine content from 100 ppm to 8,000 ppm measured with XRF is going to a different depot
- Pure waste will be immediately packaged

Cross-section trial pit Lot 1



How to deal with the unexpected?

Create tabular form of possible depots based on disposal/treatment options

Soil	Chloride concentration Low < 100 ppm	Chloride concentration low to middle (100 to 8,000 PPM)	Chloride concentration midle to High (8,000 PPM to 55,000 PPM)	Chloride concentration High (> 55,000 PPM)
Heavy Metals < Class Industry (i.e., acceptance level thermal treatment)	“Clean” soil Depot 1 outside the tent	Contaminated soil Depot 2 inside the tent	Contaminated soil check for concentrations with analysis for HCH - To ATM? - To Tredi? Depot 5	Contaminated soil repack as wastes
Metals > 1 * thermal treatment /incinerator acceptance limits; Metals < 2 * thermal treatment /incinerator acceptance limits	Contaminated soil Depot 3	Contaminated soil Depot 3	Contaminated soil - To ATM? - To tredi? - Remain on site Depot 6	Contaminated soil to be analyzed - To Tredi - Remain on site Repack as wastes
Heavy Metals > 2 x thermal treatment /incineratoracceptance limits	Contaminated soil -> cannot be included in the project depot 4	Contaminated soil cannot be included in the project depot 4	Contaminated soil -> cannot be included in the project Depot 7	Contaminated soil -> cannot be included in the project repack as wastes

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THANK YOU FOR YOUR ATTENTION

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