Development of the Nyamasoga Hazardous Waste Landfill, Uganda

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Outline

1. Background & Aim
2. Project Description
   2.1 Geology
   2.2 Site Layout
   2.3 Geometry
   2.4 Barrier System
3. Problems Encountered & Innovations
1. Background & Aim

- Client: EnviroServ Uganda
- Procured a 44 ha plot of land in Nyamasoga village in Hoima district, Uganda

![Map of Uganda with Nyamasoga Landfill highlighted]
1. Background & Aim

- Location strategically chosen:
  - close to the exploratory oil drilling on Lake Albert
  - close proximity to a future proposed oil refinery site
1. Background & Aim

- Expected waste stream:
  - Initially, stabilised drilling mud cuttings, drilling fluids and other stabilised hazardous waste
  - In the future, may receive other industrial waste and waste from the proposed oil refinery
1. Background & Aim

- J&W were appointed to conduct the detailed design of:
  - Modular cell landfill site
  - Contaminated stormwater dam and other associated stormwater management systems
  - Office area with weighbridge, access roads, leachate collection and storage system
2. Project description

2.1 Geology

- Dominant soil on site:
  - sandy clays occasionally with some gravel
  - underlain by highly to completely weathered granite
- The weathered rock is encountered at a depth of about 4.5 m
- Maximum depth of the landfill and contaminated stormwater dam was set at 5m
- To limit hard rock excavation and possible perched groundwater interception
2.2 Site layout
Site office platform
2.2 Site layout
Access roads
2.2 Site layout
2.2 Site layout
2.3 Geometry

- Cells surrounded by berms
- Aid with stormwater separation and slope stability
Separation berm
Leachate Treatment Plant

- Liquids collected in these sumps are pumped up into storage tanks where they are treated
2.4 Barrier System

- No legislation was found regarding the disposal of hazardous waste to landfills in Uganda
- National Norms and Standards for Disposal of Waste to Landfill (Notice 636 of 2013)
- Waste was assumed to classify as a Type 1 hazardous waste
- May only be disposed of at a Class A landfill designed in accordance with section 3(1) and (2) of these Norms and Standards
Class A Landfill Barrier
2.4 Barrier System

- Same liner package in contaminated stormwater dam
- Leachate collection layer replaced with ballast and protection layer
- Ballast and protection layer ensure long term durability by:
  - Removing exposure to UV and heat from the sun
  - Removing exposure to mechanical damage by plant or fire
Contaminated stormwater dam
Compacted Clay Liner (CCL)

• Sampled of the clayey material on site
• Tested to determine whether its permeability would comply with the required specification of $1 \times 10^{-9}$ m/s
• Results showed material did not meet specification
• Needs to be enhanced with bentonite
Compacted Clay Liner (CCL)

- Tests of the clayey material mixed with different concentrations of bentonite
- Conclusion: an addition of 6 % bentonite (by mass) is required to achieve the specified permeability
Proposed liner package

- 300mm thick drainage layer, 53mm stone
- 150mm thick sand layer, particle size < 3mm
- 2mm mono-textured HDPE membrane
- 4x150mm bentonite enhanced soil layers with 6% bentonite powder
- Protection: geotextile 1 kg/m²
- Geocomposite drain: 1.5mm double textured HDPE membrane
- Geosynthetic clay liner
Leakage detection system
Top of primary liner
Leachate collection system
3. Problems encountered & Innovations

- Shallowest perched groundwater table level encountered in a borehole was at 5.2 m
- Some seepage was encountered on site during excavation
- As a result of this, a subsoil drainage layer was installed on the cell basin
3. Problems encountered & Innovations

- Difficulty sourcing natural filter materials, geocomposite drainage material was used
- General design theme: geosynthetic alternatives were predominately used due to their availability and speed of deployment
3. Problems encountered & Innovations

- Bentonite: not sourced locally in bulk quantities
- Incorporate GCLs in the primary composite liner
- Advantage:
  - expected faster construction time
  - less quality assurance required as opposed to the BES layer
3. Problems encountered & Innovations

- EnviroServ Uganda and J&W felt that a single GCL could not replace the 4 x 150 mm thick layers of BES
3. Problems encountered & Innovations

- Altered leachate collection trench

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September 2015
Conference & Exhibition
Landfill 2015
3. Problems encountered & Innovations

• More GCLs had to be ordered and shipped
• Lead time on this product was about six weeks and construction could not be halted
• Remaining quantity of GCL was carefully audited
• This quantity was utilised to estimate the extent to which the entire liner package could be constructed in Cell1A
• Cell1A was split again by aid of building a separation berm
Separation berm in Cell1A
3. Problems encountered & Innovations

• Complicated drainage aspect of splitting Cell1A...
• There would still only be one sump for each the subsoil and leakage detection systems for both cells in Cell1A
• Subsoil and leakage detection piping continued through under the separation berm
3. Problems encountered & Innovations

- Leachate collection pipe designed to go through the berm
- Allows separate leachate collection from the two halves of the cell
3. Problems encountered & Innovations

- MAP in Hoima is just under 1.2 m per year
- Splitting the cells also reduces the amount of leachate and contaminated stormwater generated during the commissioning phase of the landfill
Project status

- Cell1A and stormwater dam construction complete
- Treatment plant commissioned, Nov 2014
- Majority of Cell 1Ai has been filled with stabilised waste after the permit received from the Ugandan environmental authorities
Project status

- Jonathan Shamrock attended the official site inaugurated on the 23rd April 2015
Thank you for your attention.
Any questions?

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