Globeville Landing Outfall (GLO)
Geomembrane Cover / Liner

R. K. FROBEL & ASSOCIATES
EVERGREEN, COLORADO USA
Introductions

• Ron Frobel, P.E.
  – R.K. Frobel & Associates
  – Designer of GLO geomembrane and QA/QC for Denver
  – Over 30 years geosynthetics engineering experience
  – Past chair of American Society of Testing and Materials D35 Subcommittee on Geomembranes
  – Past team leader of USA Delegation, International Standards Organization Geosynthetics Team (1985-2001)
  – Editorial Board – Geosynthetics Magazine
  – Over 85 technical publications on geosynthetics
Contents

• Geomembrane background
  – What are geomembranes
  – Uses
  – Why geomembrane at GLO
• GLO design considerations
  – GLO site conditions
  – Selected design components
• GLO quality control and quality assurance
Geomembrane

“An essentially impermeable geosynthetic composed of one or more synthetic sheets”

Major Types of Geomembranes

• Thermoplastic Polymers
  – Polyvinyl Chloride (ex: PVC), Polyethylene (ex: HDPE, LLDPE)

• Thermoset Polymers (Elastomers)

• Thermoplastic Elastomers

• Others:
  – Prefabricated Bituminous
  – Spray Applied Polymer
  – Spray Applied Bitumin
  – Geosynthetic Clay Liners
Advantages of Geomembranes

- Uniformity (manufacturer quality control)
- Ease of installation
- Established methods and standards
  - design methods
  - quality specifications
  - test methods
- Extremely low permeability
- Proven historical performance
- 100 years life expectancy when buried
Primary Applications

- Municipal Waste Liners and Covers: 40.8%
- Mining / Industrial Containment: 14.2%
- Hazardous Waste Containment: 10.5%
- Water Reservoirs / Covers: 9.5%
- Recreation: 8.5%
- Water Conveyance (Canals): 3.5%
- Earth/Rock/Concrete Dams: 1.5%
- Agricultural: 3.0%
- Specialty Applications: 8.5%
Design Considerations

- Type of Containment
- Geotechnical Considerations
- Geotechnical / Slope / Soil Interaction
- Geomembrane Selection:
  - Properties, Durability, Constructability
- Connection / Anchor / Seaming Details
- Manufacturer/Construction Quality Assurance Program
- Electrical Leak Location Survey Final Acceptance
Type of Containment - GLO

- **Cover over buried waste**
  - Prevent contaminated groundwater from moving into storm water channel

- **Liner under storm water channel**
  - Prevent storm water from moving downward into buried waste
Geotechnical Considerations – GLO

- Buried waste does not provide solid foundation
- Structural support required for liner
- Design: Install stone columns to bedrock (soil stabilization)
- Design: Install stone/geogrid strengthening layer (settlement)
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Geotechnical / Slope Interaction Considerations - GLO

• Side slopes
  – Prevent cover soils from sliding
  – Prevent liner from sliding/ moving

• Design:
  – 3:1 sideslopes,
  – liner material textured to prevent slippage
Geomembrane Selection - GLO

- Geomembrane Properties
  - Select for mechanical properties
  - Don’t have chemical compatibility concerns

- Durability
  - Select for long-term durability
  - Liner will be buried so don’t have UV degradation concerns

- Constructability
  - Large panel (rolls) deployment
  - Thermal fusion welded seams
Connection / Anchor / Seaming Details

• Seams
  – Thermal fusion
  – Extrusion weld (patch)

• Anchors
  – Trench
  – Wall
Seam Detail

Cross Section of Seam

- Liner
- Fused Material
- Squeeze-Out
- Weld Tracks
- Edge of Track
- Air Channel
- Liner
Quality Assurance - GLO

- Manufacturer quality assurance
- Construction quality control – installer (QC)
- Construction quality assurance – engineer (CQA)
- Electrical leak location survey
This design shows how an impermeable barrier, or liner, will prevent storm water from merging with ground water.
Thank you

Questions?

R. K. Frobel & Associates