Challenges & Pragmatic Solutions for the Design and Construction of a 300-Acre CCR Landfill Located in the Southwestern US - A Case Study

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ABSTRACT

Every CCR landfill closure is unique and each design poses its own challenges. Site grading, mass balance of materials, stormwater, final cover, and project schedule are just a few of the key design elements to consider when closing a landfill. As the size of the site increases, so do the effects (and the resulting severities) of these design selections.

An overview of the closure design of a 300-acre landfill and the unique design challenges posed will be presented. The project site is located in an arid region in the southwestern United States. Limited on-site soil borrow volume, stormwater (existing "flat" areas), vertical sandstone highwalls, landfill access during post-closure period, and site retirement requirements necessitated unique design solutions at the site. A unique solution was developed and implemented at the geomembrane termination at the vertical sandstone highwalls.

Practical lessons and insights will be shared based on "lessons learned" in pursuit of material management and the elusive "mass balance", as-built conditions, discovering and managing "field fit conditions", project timelines and cost analysis considerations, remote working environments, and finally client expectations and effective collaboration during project execution.

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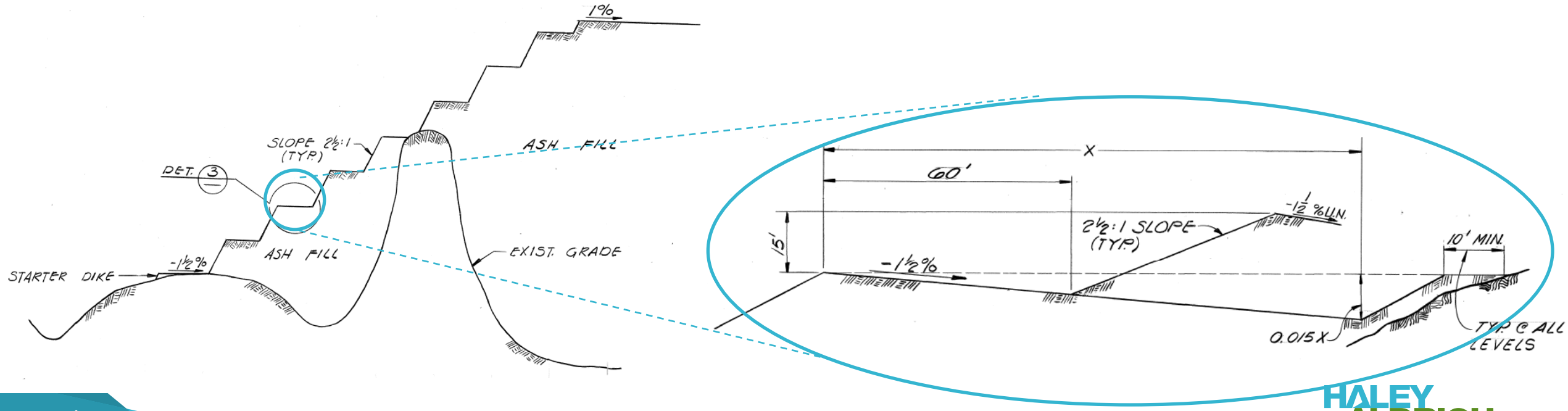
Presentation takeaways

1. Landfill operations issues
2. Regulatory requirements
3. **Project challenges**
4. **Design solutions**
5. Construction complexities

Landfill operations issues

Issues identified

- **Improper placement of material** - 50-years of bottom ash, fly ash, and FGD placement without clear adherence to design

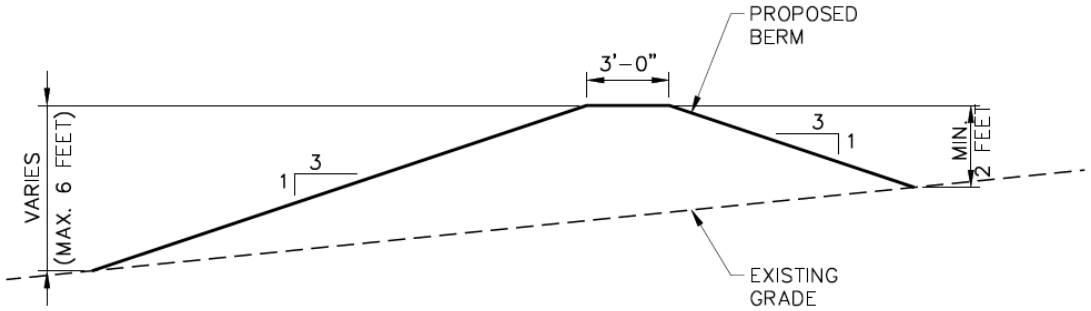


Issues identified (cont'd)

- **<u>Water management</u>**
  - Areas within landfill that have received interim cover experience erosion due to direct precipitation. Forces consistent reworking of slopes and higher maintenance costs.
    - Pro: interim cover
    - Con: poor compaction on steep slopes

Issues identified (cont'd)

- **Water management**
  - Lack of stormwater controls offsite to minimize run-on to active portion of landfill. Solution was to add stormwater control berms in prior to closure design.
  - Offsite at top of ~100-ft. high vertical sandstone rock
  - Approximately 60 berms/evaporation ponds have been constructed
    - Effectively eliminate stormwater run-on
    - Control 25-yr., 24-hr storm event (1.89-in.)



Regulatory requirements

Regulatory requirements for closure of a landfill

- Final cover system & permeability
- Positive drainage
- Surface water management
- Erosion
- Inspections and associated access
- Groundwater monitoring

Project challenges & design solutions

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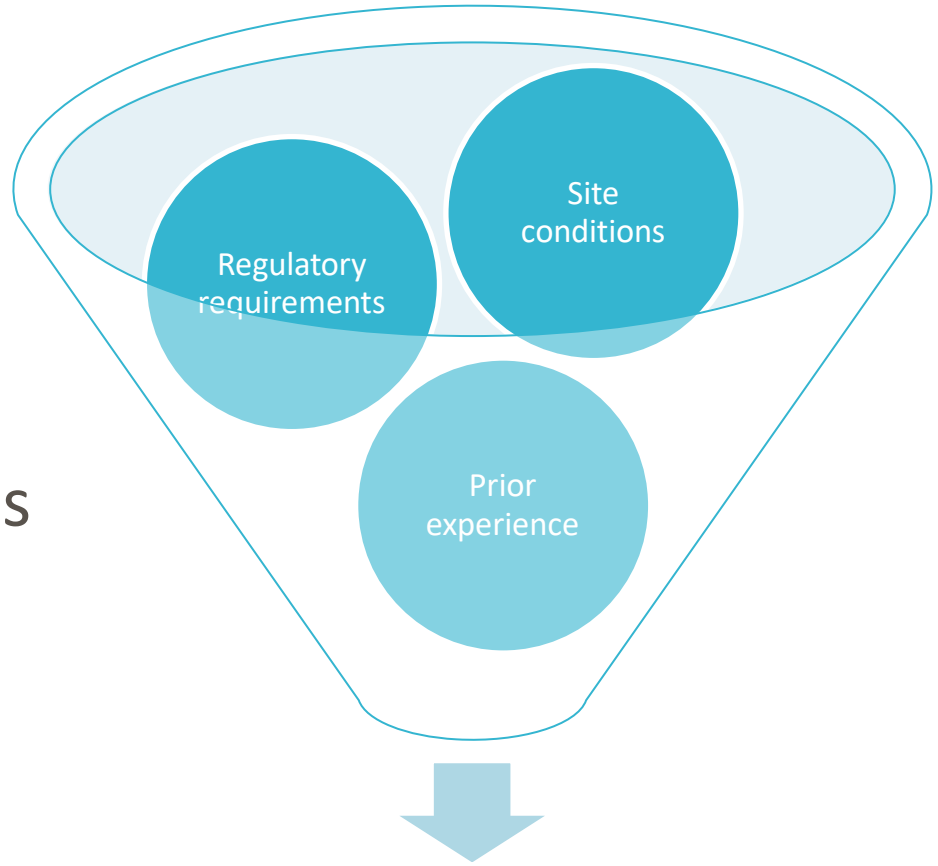
Project challenges

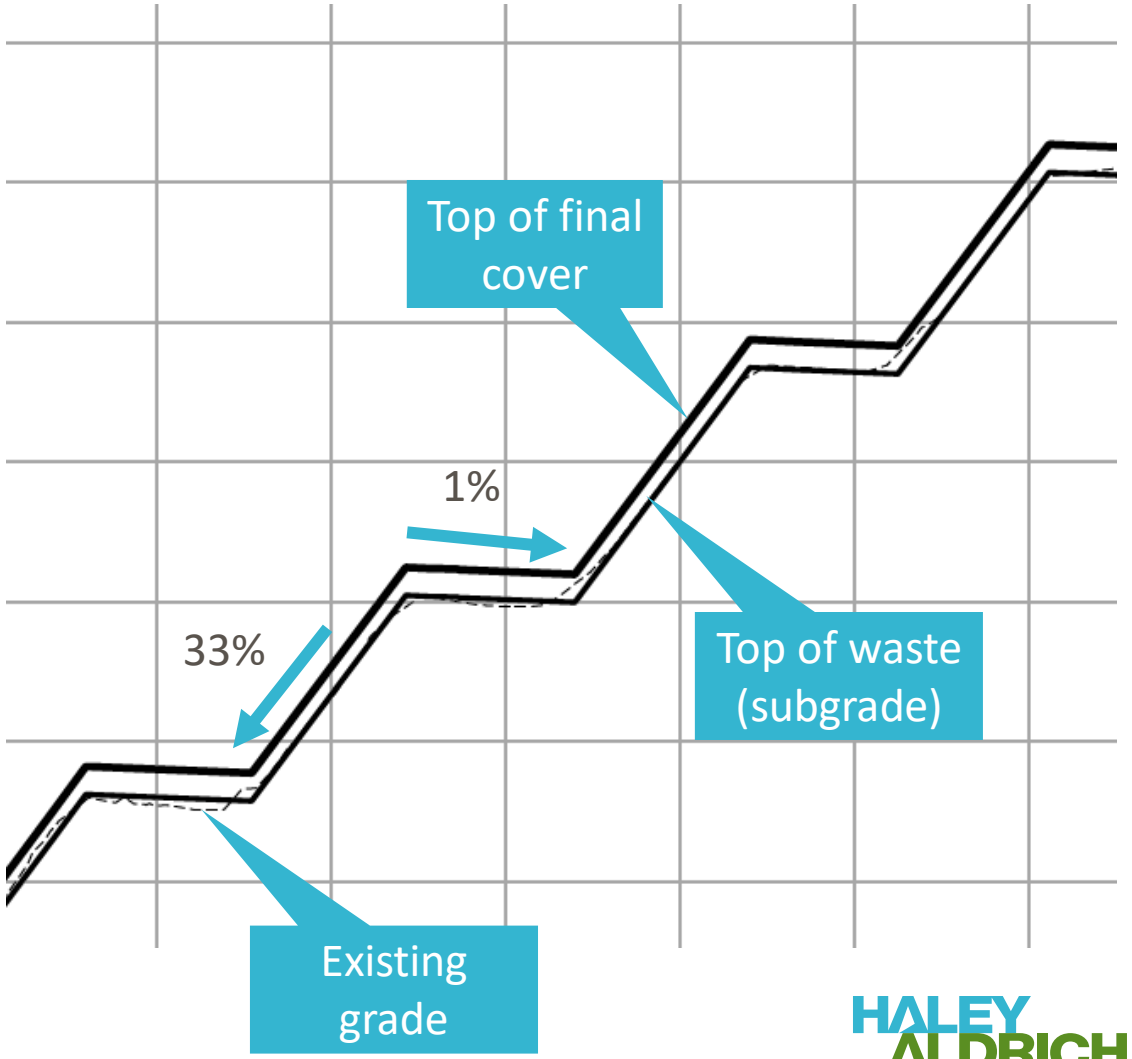
- Existing steep slopes within landfill
- Flat benches
- Soil borrow source
- Elevated bedrock/exposed rock outcrops
- Size of landfill
- Post-closure care



Unique design solution

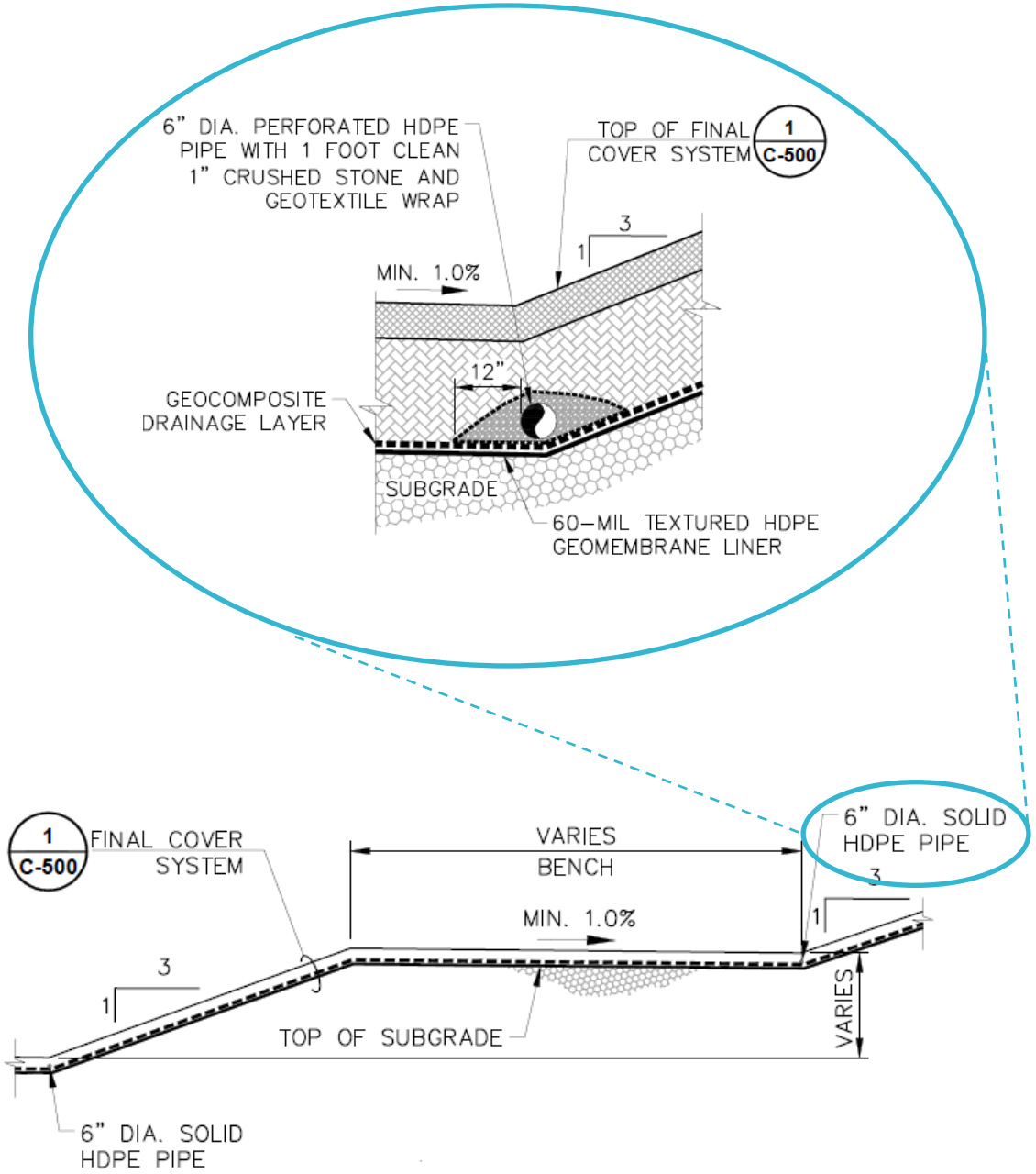
Existing steep slopes within landfill

- Geotechnical slope stability models
  - Flattened from 2.5:1 to 3:1
- Material mass balance on existing benches
- Sloped towards “groin” to limit overland flow lengths



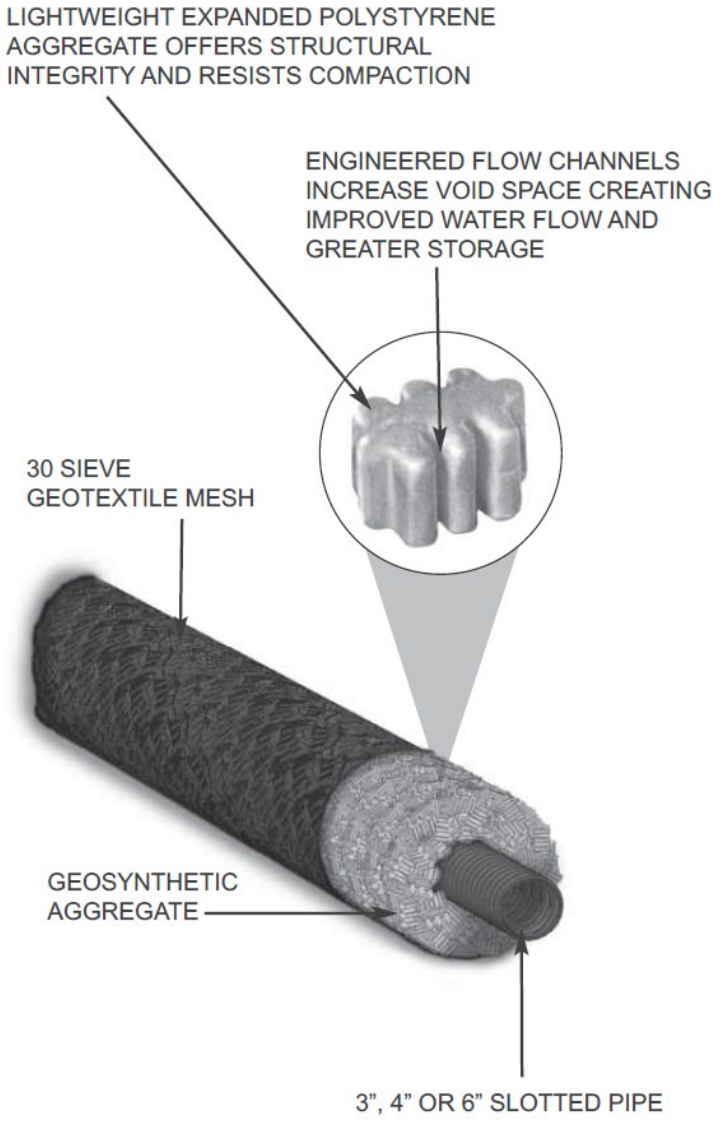
Flat benches

- Overland 1% slope towards groin
- Perforated pipe at groin
  - 0.1% cross-slope towards channels
  - Wrapped in geotextile
  - Surrounded by crushed stone (12-in. thick)
- Geocomposite used to facilitate drainage



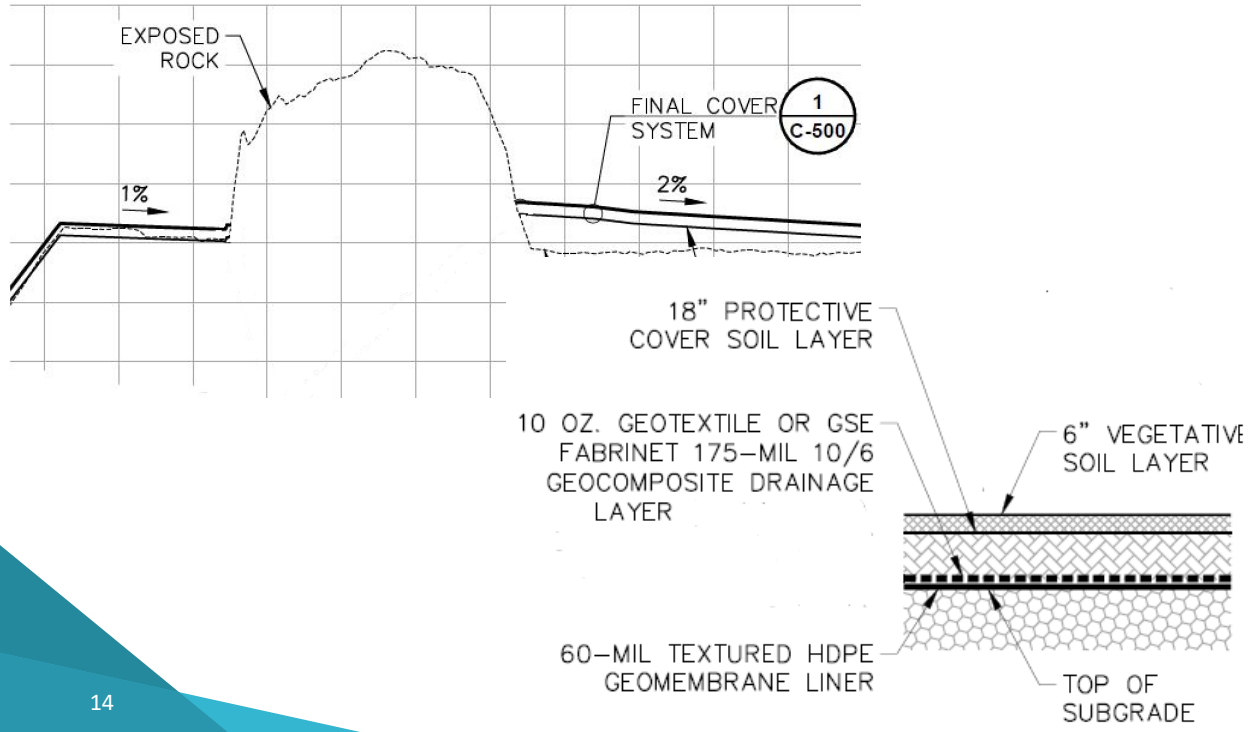
Flat benches (cont'd.)

- Perforated pipe alternative
  - Pros
    - Lightweight
    - Cheaper
    - Ease of construction (10-ft. with couples)
    - Can be customized to site
  - Cons
    - Limited soil cover
      - Traffic loadings
      - Exposure during post-closure
      - Potential wind displacement



Soil borrow source & final cover impacts

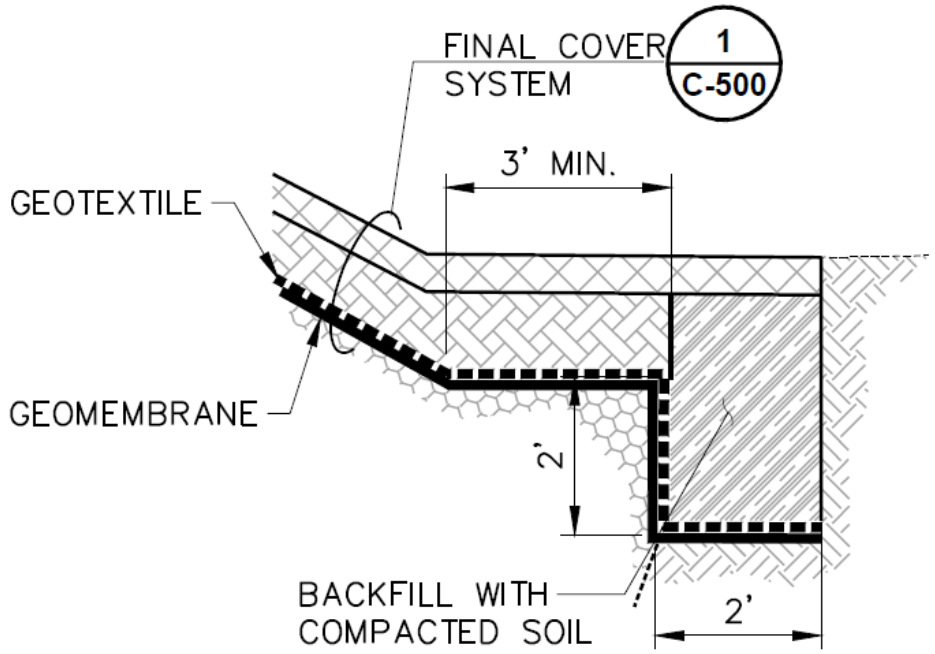
- Limited on-site borrow soil
- Elevated bedrock
  - Borrow
  - Final cover tie-in areas



- Final cover options considered
  - Evapotranspiration final cover system
    - Not enough borrow soil for thick enough cover
  - Soil only final cover system
    - No native clay borrow source
  - ClosureTurf/Lesser soil cover
    - Not viable option through local permitting agency
  - Geomembrane final cover ✓
    - Permeability equivalent to 18-in. soil @ $1x10^{-5}$ cm/sec
    - HDPE chosen over LLDPE due to puncture resistance

Elevated bedrock/exposed rock outcrops

- Borrow sources utilized as stormwater evaporation basins
  - Primary design input was soil borrow volume required
  - No impact to stormwater
    - 6.5-in. annual rainfall
    - 1.55-in. 10-yr., 24-hr. storm
  - Borings and seismic refraction
- Geomembrane anchoring
  - Traditional anchor trench
  - Vertical rock faces…



Elevated bedrock/exposed rock outcrops (cont'd.)

- Specifications required Contractor alternatives for anchoring
- Anchoring options not considered
  - Running the geomembrane up the slope and anchor to concrete plinth
    - High (~100 vertical ft.) rock faces
    - Geogrid underlying the geomembrane for slope reinforcement
  - Closure by removal along perimeter combined with standard anchor trench
    - Unknown bedrock elevations below grade
    - Cost impacts to inspect clean closed areas
    - Rainfall is directed to anchor trench from vertical rock face
  - Steel batten bars
    - Uneven, porous surface (sandstone vs. limestone)

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Landfill size

- Entire unit will be closed under single construction contract
  - 6-month closure completion timeline…
- Requires closure extension per *§257.102(f)(2)(ii)(C)* of EPA's CCR Rule
  - Subgrade preparation
  - Geosynthetic installation alone will requires 6-month duration
    - Geomembrane, geotextile, geocomposite
  - Stormwater management
  - Final cover soils and native vegetation

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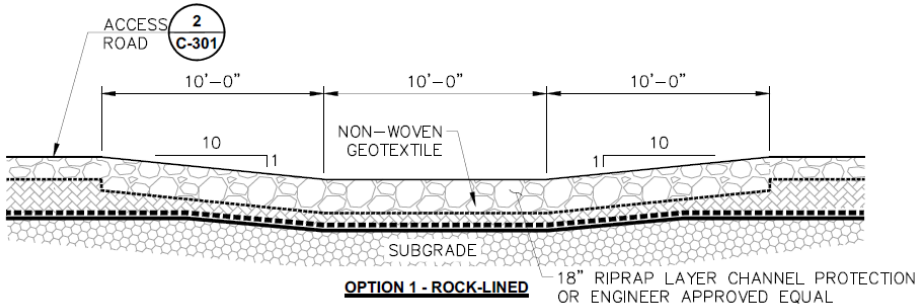
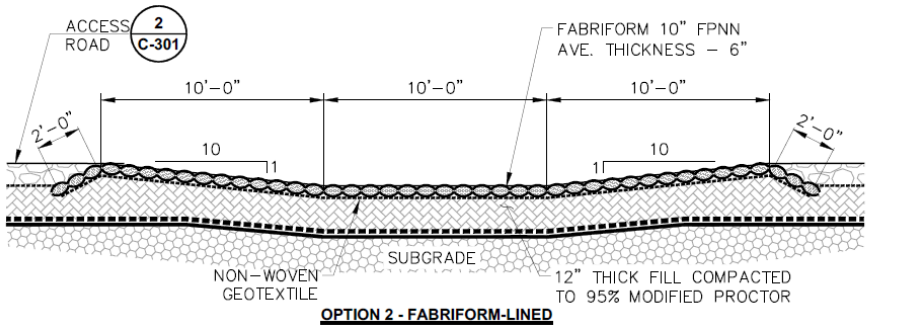
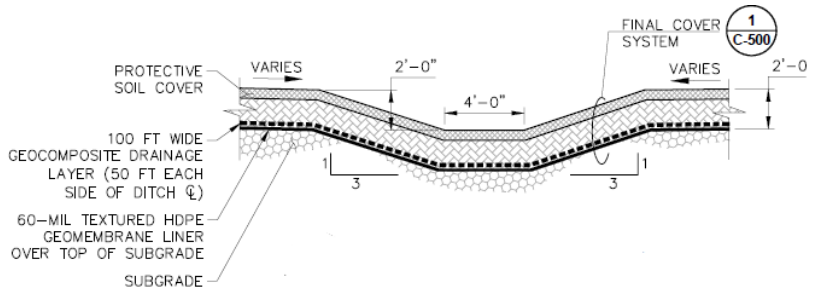
Post-closure care

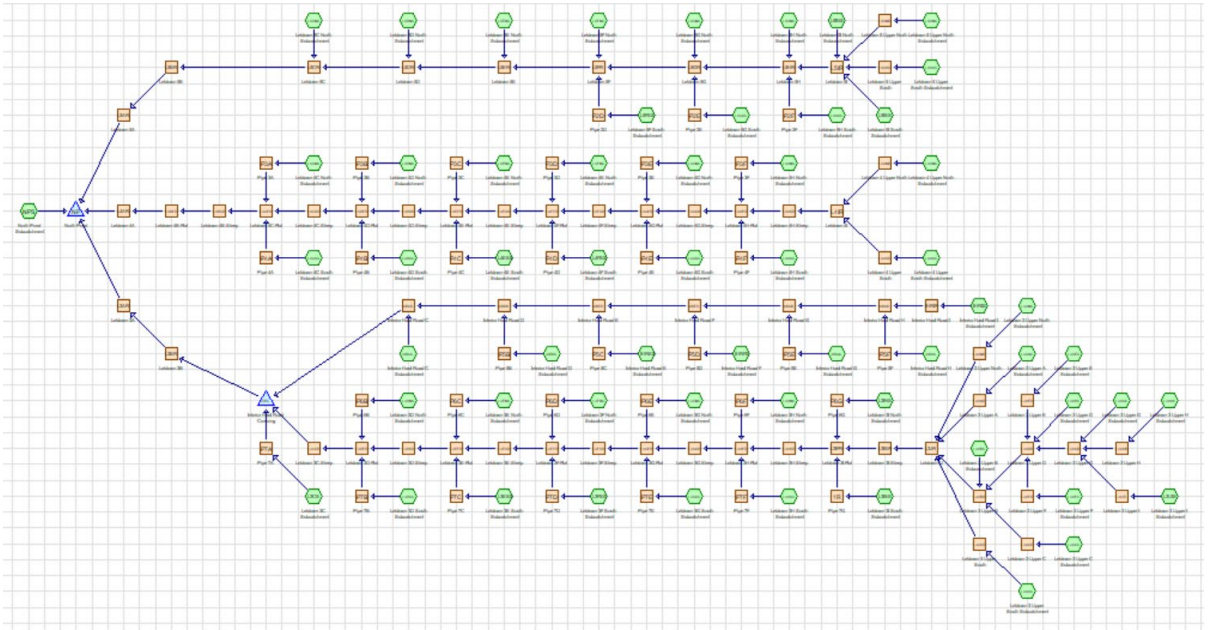
- Access roads for monitoring and inspections
  - Channel/road intersections





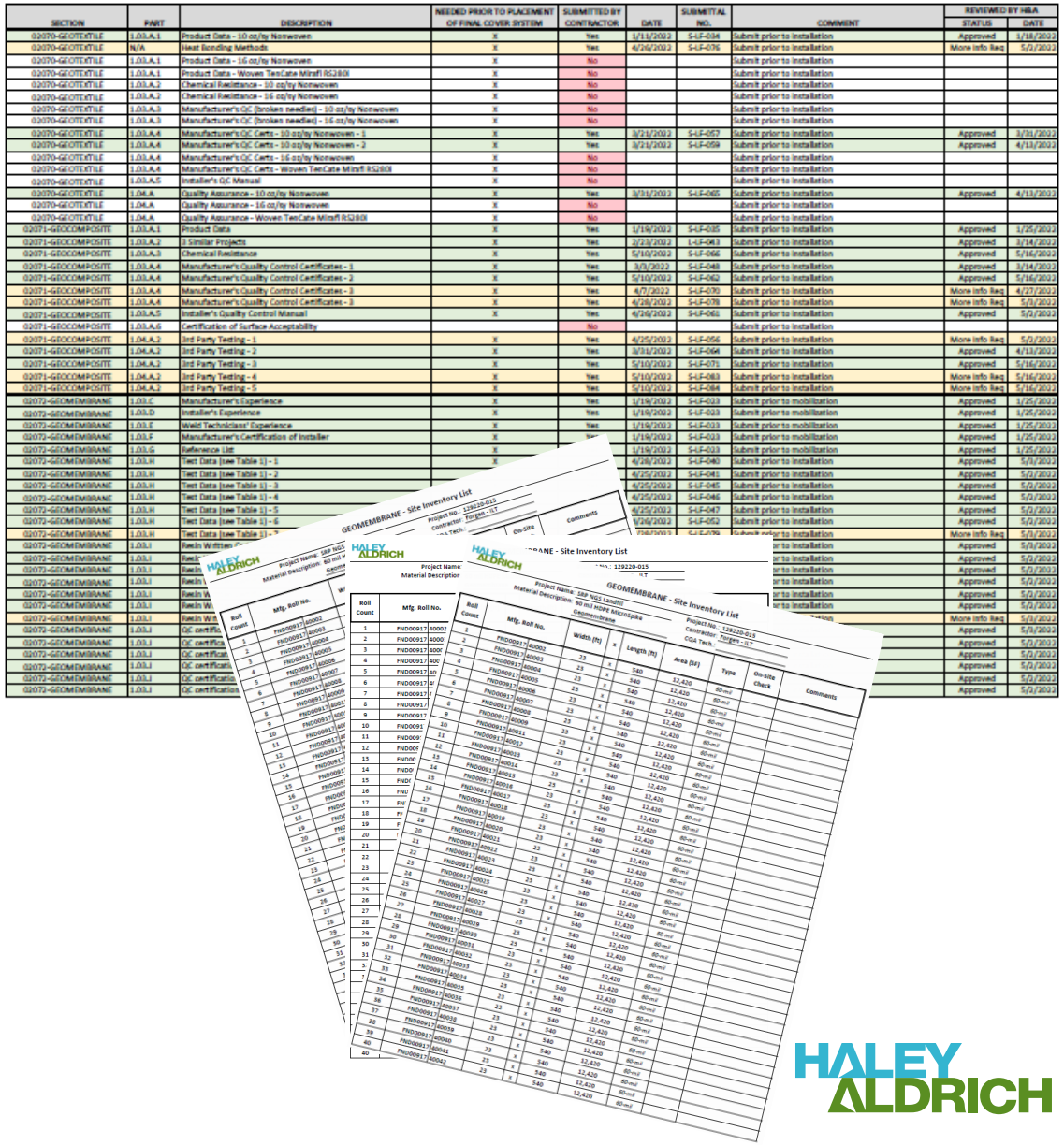


- Erosion
  - HydroCAD
  - Tensar NA Green



Construction Complexities

- Large construction site
  - Multiple work areas at given time
  - Multiple designers, contractors, and subcontractors involved
- Thousands of rolls of geosynthetics
  - Cataloging and CQA checks
  - Fighting the monotony
- Construction equipment
  - Large site vs. LGP requirement



QUESTIONS?

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