

LANDFILL COVER SYSTEM CHECKLIST

The purpose of this checklist is to prompt the designer or reviewer to consider aspects of design for the different components of landfill final closure systems (FCS).

1. Vegetation.

- Is vegetation applicable at this site? Y _____ N _____ N/A _____
- Are locally adapted perennial plants specified? Y _____ N _____ N/A _____
- Will the roots disrupt the low-permeability layer? Y _____ N _____ N/A _____
- Will plant density be sufficient to minimize soil erosion to no more than 0.45 kg/m² (2 tons per acre) per year as determined by the Universal Soil Loss Equation? Y _____ N _____ N/A _____
- Is the vegetation capable of surviving and functioning with little or no maintenance? Y _____ N _____ N/A _____
- Do the contract documents adequately specify material and placement requirements? Y _____ N _____ N/A _____

2. Armored cover.

(soil/ erosion control mat/ cellular confinement system)

- Is an armored cover applicable for this site? Y _____ N _____ N/A _____
- Is the armored cover of controlling soil erosion to no more than 0.45 kg/m² (2 tons per acre) per year as determined by the Universal Soil Loss Equations? Y _____ N _____ N/A _____
- Have items such as durability, maximum particle size, gradation of the material been considered? Y _____ N _____ N/A _____
- If a synthetic material is used, have items such as durability, tensile strength, permissive shear strength and velocity of the been considered? Y _____ N _____ N/A _____

3. Topsoil.

- Is a top soil layer applicable at this site? Y _____ N _____ N/A _____
- Does the topsoil have a minimum thickness of 150 mm (6 in.)? Y _____ N _____ N/A _____
- Is a medium textured soil specified for the top soil layer? Y _____ N _____ N/A _____
- Is the topsoil representative of soils in the vicinity? Y _____ N _____ N/A _____
- Is traffic compaction specified using low ground pressure equipment? Y _____ N _____ N/A _____
- Is the final top slope, after allowance for settling and subsidence, no less than 3 percent to facilitate runoff? Y _____ N _____ N/A _____

4. Vegetative support layer.

- Is an appropriate soil type specified for the vegetative support layer? Y _____ N _____ N/A _____
- Is the maximum particle size specified? Y _____ N _____ N/A _____
- Is select fill material locally available? Y _____ N _____ N/A _____
- Is the select fill layer a minimum (including the 150 mm [6 in.] of topsoil) of 610 mm (24 in.) in thickness or maximum frost depth, whichever is greater? Y _____ N _____ N/A _____
- Is placement of select fill specified to proceed up the slope? Y _____ N _____ N/A _____
- Is the maximum drop height specified? Y _____ N _____ N/A _____
- Is the depth of the first layer specified? Y _____ N _____ N/A _____
- Is traffic compaction using low ground pressure equipment specified? Y _____ N _____ N/A _____

5. Geocomposite drainage layer.
(geonet with geotextile laminated to one or both sides)

- Will a geocomposite be used at this site? Y _____ N _____ N/A _____
- Have the soil retention properties of the geotextile been evaluated? Y _____ N _____ N/A _____
- Have the filtration requirements for the geotextile been evaluated? Y _____ N _____ N/A _____
- Has the survivability of the geotextile been evaluated? Y _____ N _____ N/A _____
- Has the transmissivity of the geocomposite been evaluated to limit the head within its thickness? Y _____ N _____ N/A _____
- Have the reduction factors for creep, intrusion, particulate clogging, biological and chemical clogging been considered in the hydraulic assessment of the geocomposite? Y _____ N _____ N/A _____
- Have load, gradient, seating period and boundary conditions been specified in the transmissivity requirements of the geocomposite? Y _____ N _____ N/A _____
- Has the interface frictional behavior of the geocomposite against adjacent layers been considered for stability analysis? Y _____ N _____ N/A _____
- Is tensile strength need to be considered during design? Y _____ N _____ N/A _____
- Do the contract documents adequately specify material and installation requirements? Y _____ N _____ N/A _____

6. Granular drainage layer.

- Will a granular drain be used at this site? Y _____ N _____ N/A _____
- Has the granular drainage layer been designed to prevent head build-up in the select fill? Y _____ N _____ N/A _____
- Is the hydraulic conductivity of the drainage material greater than 1×10^{-2} cm/sec? Y _____ N _____ N/A _____
- Does the granular drainage layer have a minimum thickness of 300 mm (12 in.)? Y _____ N _____ N/A _____
- Do the contract documents adequately specify material and installation requirements? Y _____ N _____ N/A _____
- Has a value engineering evaluation performed to replace the granular drainage layer with a drainage geocomposite? If yes go to item (5). Y _____ N _____ N/A _____

7. Collection piping system.

- Are drainage pipes sized and identified on the drawings? Y _____ N _____ N/A _____
- Has the equation for the piping spacing calculations been evaluated? (note that Moore's equation is outdated and its validity is questionable). Y _____ N _____ N/A _____
- Do the drainage layer collection points freely drain into perimeter ditches or natural drainage swales? Y _____ N _____ N/A _____
- Are the outlets of the drainage pipes placed above the bottom of the perimeter collection trench to prevent clogging? Y _____ N _____ N/A _____
- Have pipe material and installation requirements been adequately specified? Y _____ N _____ N/A _____

8. Geomembrane.

- Will a geomembrane be used at this site? Y _____ N _____ N/A _____
- Does the membrane need to be textured? Y _____ N _____ N/A _____

- Do the contract documents adequately specify material and installation requirements? Y _____ N _____ N/A _____

9. Compacted clay liner (CCL).

- Will a clay layer be used at this site? Y _____ N _____ N/A _____
- Is the entire clay layer designed so that it is below frost depth? Y _____ N _____ N/A _____
- Is the clay layer a minimum of 600 mm (2 ft) in thickness? Y _____ N _____ N/A _____
- Has a clay borrow source been identified and tested? Y _____ N _____ N/A _____
- Do the contract documents adequately specify material and installation requirements? Y _____ N _____ N/A _____

10. Geosynthetic clay liner (GCL).

- Will a GCL be used at this site? Y _____ N _____ N/A _____
- Will regulators allow the use of a GCL at this site? Y _____ N _____ N/A _____
- Do the contract documents adequately specify material and installation requirements? Y _____ N _____ N/A _____

11. Gas collection and removal system.

- Is a gas collection and removal system applicable at this site? Y _____ N _____ N/A _____
- Have analyses been performed to determine the landfill gas types and emission rates? Y _____ N _____ N/A _____
- Do vertical or lateral migration routes or barriers exist? Y _____ N _____ N/A _____
- Have the state requirements for gas control and treatment been determined? Y _____ N _____ N/A _____
- Are there nearby residences or structures (within 300 m (1,000 ft)) that could be adversely impacted by migration of landfill gases? Y _____ N _____ N/A _____
- Are gas monitoring probes needed between the landfill and structures? Y _____ N _____ N/A _____
- Is an active gas control system needed due to the volume of gas being generated? Y _____ N _____ N/A _____
- Is a gas collection well system most appropriate for this site? Y _____ N _____ N/A _____
- Is a gas collection blanket system most appropriate for this site? Y _____ N _____ N/A _____
- Is a perimeter collection trench needed? Y _____ N _____ N/A _____
- Is the granular collection layer at least 300 mm (12 in.) thick? Y _____ N _____ N/A _____
- If a geosynthetic gas collection layer is used, does it have adequate flow capacity? (see also item 12) Y _____ N _____ N/A _____
- Are the vertical outlet vent pipes located at the highest elevation of a gas collection blanket? Y _____ N _____ N/A _____
- Are slip couplings required? Y _____ N _____ N/A _____
- Are the number of vent pipe penetrations minimized? Y _____ N _____ N/A _____
- Are temporary vents required during construction to allow placement of select fill? Y _____ N _____ N/A _____
- Are all components of the collection system compatible with the gas? Y _____ N _____ N/A _____
- Is exposed piping for the gas collection system UV resistant? Y _____ N _____ N/A _____
- Is a condensate collection system provided for the header piping? Y _____ N _____ N/A _____
- Have material properties and placement procedures been specified for the gas collection system? Y _____ N _____ N/A _____
- Is a monitoring schedule and contingency plan specified for the collection system and monitoring probes? Y _____ N _____ N/A _____

12. Geosynthetic gas collection and removal system.

- Have load, gradient, seating period and boundary conditions been specified in the transmissivity requirements of the geosynthetic? Y _____ N _____ N/A _____
- Have the reduction factors for creep, intrusion, particulate clogging, biological and chemical clogging been considered in the hydraulic assessment of the geosynthetic? Y _____ N _____ N/A _____
- Was it water or air used while performing the transmissivity test? If water was used, has the gas/water transmissivity ratio been considered? (Research shows that air transmissivity much lower than water transmissivity) Y _____ N _____ N/A _____

13. Random fill and regraded refuse.

- Has a random fill borrow source been identified? Y _____ N _____ N/A _____
- Have materials and placement requirements for random fill been specified? Y _____ N _____ N/A _____
- Is a procedural method specified for placement of the initial lifts placed on the refuse material? Y _____ N _____ N/A _____
- Is the refuse material to be regraded? Y _____ N _____ N/A _____
- Has the excavatability of the refuse material been evaluated? Y _____ N _____ N/A _____
- Have lift thickness, compaction, and daily cover requirements been specified for refuse regrading? Y _____ N _____ N/A _____
- Have health and safety issues been addressed? Y _____ N _____ N/A _____
- Have air monitoring and surface runoff control requirements for refuse regrading been specified? Y _____ N _____ N/A _____
- Are compaction requirements specified for the landfill surface? Y _____ N _____ N/A _____

References

- Department of the Army, U.S. Army Corps of Engineers Washington , DC 20314-1000, ELT 1110-1-162. CEMP-RT. Technical Letter No. 1110-1-162 Engineering and Design “*Checklist for Hazardous Waste Landfill Cover Design*”. APPENDIX C: LANDFILL COVER DESIGN CHECKLIST
- Giroud, J.P., Zornberg, J.G., and Zhao, A. (2000), “Hydraulic Design of Geosynthetic and Granular Liquid Collector Layers”, *Geosynthetics International*, special issue on Liquid Collection Layers, Vol. 7, Nos. 4-6.
- Thiel, R.S. (1998), “Design Methodology for a gas Pressure Relief Layer below a Geomembrane Landfill Cover to Improve Stability”, *Geosynthetics International*, Vol. 5, No.6.