



# Drop-In Specifications

GEOSYNTHETIC CLAY LINER



The following specification is a sample guideline to be customized by the engineer for preparing a site specific specification. This information is provided for reference purposes only and is not intended as a warranty or guarantee. Agru assumes no liability in connection with the use of this information.

## Part 1 GENERAL

### 1.1 SCOPE

This drop-in specification covers the technical requirements for the Manufacturing and Installation of fabric encased geosynthetic clay liner (GCL). All materials shall meet or exceed the requirements of this specification, and all work will be performed in accordance with the procedures provided in these project specifications.

### 1.2 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. ASTM D 5993, "Standard Test Method for Measuring Mass Per Unit of Geosynthetic Clay Liners"
2. ASTM D 5261, "Standard Test Method for Measuring Mass Per Unit Area of Geotextiles"
3. ASTM D 5887, "Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter"
4. ASTM D 5888, "Standard Guide for Storage and Handling of Geosynthetic Clay Liners"
5. ASTM D 5889, "Standard Practice for Quality Control of Geosynthetic Clay Liners"
6. ASTM D 5890, "Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners"
7. ASTM D 5891, "Standard Test Method for Fluid Loss of Clay Component of Geosynthetic Clay Liners"
8. ASTM D 5993, "Standard Test Method for Measuring Mass Per Unit of Geosynthetic Clay Liners"
9. ASTM D 6102, "Standard Guide for Installation of Geosynthetic Clay Liners"
10. ASTM D 6243, "Standard Test Method for Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method"
11. ASTM D 6496, "Standard Test Method for Determining Average Bonding Peel Strength Between the Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners"
12. ASTM D 6768, "Standard Test Method for Tensile Strength of Geosynthetic Clay Liners"

B. Geosynthetic Research Institute

1. GRI GCL 3, "Test Methods, Required Properties, and Testing Frequencies of Geosynthetic Clay Liners (GCLs)"

### 1.3 DEFINITIONS

- A. **Geosynthetic Clay Liner (GCL)** - A factory manufactured hydraulic barrier consisting of granular sodium bentonite clay, sandwiched between, supported and encapsulated by two geotextiles, held together by needlepunching.
- B. **Geotextile** - A semi-permeable woven or nonwoven fabric used to contain the bentonite used in a GCL.
- C. **Sodium Bentonite** - The high swelling clay component of GCLs consisting primarily of the mineral Montmorillonite.
- D. **Needlepunching** - A GCL manufacturing process whereby boards of barbed needles incorporate the staple fibers from a non-woven geotextile, through a sodium bentonite clay layer, into the matrix of a second geotextile layer.
- E. **Burnishing** - A needlepunching enhancement process utilizing heat to bond the needlepunched fibers and more permanently lock them into the second geotextile to increase the internal shear strength characteristics.

- F. **Minimum Average Roll Value (MARV)** - The minimum average value of the material in a particular lot calculated as the mean of the tested values minus two standard deviations providing a 95% confidence level.

## 1.4 SUBMITTALS POST-AWARD

### A. Pre-Award

1. Manufacturer's Quality Control Manual
2. Manufacturer's Product Datasheet for proposed material
3. Project Reference List for GCL consisting of at least ten projects totaling 10 million square feet in size.
4. A representative sample, approximately 3" x 5" of proposed GCL

### B. Post-Award

1. Prior to shipping material to site
  - a. Certification of quality control tests from manufacturer on GCL product
  - b. Certification of quality control tests from manufacturer on Bentonite
2. Prior to installing GCL
  - a. Certification signed by the Contractor and CQA Inspector of subgrade acceptance
3. Upon completion of GCL installation
  - a. Certification by Installer that the GCL was installed per project specifications
  - b. Material and Installation Warranties

## 1.5 CONSTRUCTION QUALITY ASSURANCE (CQA)

A. The OWNER/CONTRACTOR will engage and pay for the services of a third party CQA inspector and lab for monitoring the quality and installation of the GCL.

B. The specific CQA inspector designated by the OWNER/CONTRACTOR shall be responsible for all aspects of the QA program, including the documentation and monitoring of the manufacturing and installation processes.

## 1.6 QUALIFICATIONS

### A. MANUFACTURER

1. GCL shall be manufactured by the following:
  - a. AGRU America, Inc.
  - b. Engineer approved equal
2. MANUFACTURER shall have manufactured a minimum of 10 million square feet of GCL during the last year.

### B. INSTALLER

1. Installer shall have experience installing GCLs on at least 5 projects and have installed a minimum of 2 million square feet of GCL materials.

## 1.7 MATERIAL LABELING, DELIVERY, STORAGE AND HANDLING

- A. General: Conform to the MANUFACTURER'S requirements and ASTM D5888 unless otherwise specified.
- B. Delivery:
1. Deliver material to the site only after the CQA Inspector accepts required submittals.
  2. Material shall be covered with a waterproof plastic covering resistant to ultraviolet degradation.
  3. Ship less than one month prior to scheduled installation unless otherwise approved by engineer.
  4. Each roll shall be marked with the following information
    - a. manufacturer's name
    - b. product identification
    - c. roll number
- C. Handling:
1. The QCA inspector shall verify that proper handling equipment exists which does not pose any danger to installation personnel or risk of damage or deformation to the liner material itself. Suitable handling equipment is described below:
    - a. **Spreader Bar Assembly** - A spreader bar assembly shall include both a core pipe or bar and a spreader bar beam. The core pipe shall be used to uniformly support the roll when inserted through the GCL core while the spreader bar beam will prevent chains or straps from chafing the roll edges.
    - b. **Stinger** - A stinger is a rigid pipe or rod with one end directly connected to a forklift or other handling equipment. If a stinger is used, it should be fully inserted to its full length into the roll to prevent excessive bending of the roll when lifted.
    - c. **Straps** - A properly structured and supported pole or "carpet puller" can be used to unload GCL rolls onsite. As an alternative, straps that are appropriately rated and located across the roll can be used as an approved lifting method to unload GCL rolls.
- D. Storage:
1. Store rolls in space allocated by ENGINEER. Space should be at high ground level or elevated above ground surface.
  2. Stack no more than 3 rolls high.
  3. Protect rolls from UV, precipitation, other sources of moisture, mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions.
  4. Preserve integrity and readability of roll labels.
  5. Bagged bentonite material shall be stored and tarped next to GCL rolls unless other more protective measures are available. Bags shall be stored on pallets or other suitably dry surface which will prevent undue prehydration.
- E. GCL Inspection upon Delivery:
1. Each roll shall be visually inspected when unloaded to determine if any packaging or material has been damaged during transit.
  2. Repairs to damaged GCL shall be performed in accordance with Section 3.7 of this specification.
    - a. Rolls exhibiting damage shall be marked and set aside for closer examination during deployment
    - b. Minor rips or tears in the plastic packaging shall be repaired with moisture resistant tape prior to being placed in storage to prevent moisture damage.
    - c. GCL rolls delivered to the project site shall be only those indicated on GCL manufacturing quality control certificates.
    - d. For needlepunched GCLs, the presence of free-flowing water within the packaging shall require that roll to be set aside for further examination to ascertain the extent of damage, if any. Free-flowing water within the packaging of unreinforced GCLs shall be cause for rejection of that roll.
  3. Preserve integrity and readability of roll labels.

## 1.8 WARRANTY

- A. Material shall be warranted, on a pro-rata basis against Manufacturer's defects for a period of 1 year from the date of geomembrane installation.
- B. Installation shall be warranted against defects in workmanship for a period of 1 year from the date of geomembrane completion.

## Part 2 PRODUCTS

### 2.1 QUALIFICATIONS

- A. The GCL product supplied to the project shall be in full accordance with the requirements of this section.
- B. The GCL shall be manufactured by mechanically bonding the geotextiles using a needlepunching process as described in Section 1.3 to enhance frictional and internal shear strength characteristics.
- C. The needlepunched GCL shall thermally heat set the nonwoven fibers where they protrude from the second geotextile (woven or nonwoven depending upon product) to more permanently secure the reinforcement in place. Other means may be used to lock the fibers in place if the process demonstrates similar performance to the thermal heat set process.
- D. In order to maintain these characteristics, no glues, adhesives or other non-mechanical bonding processes shall be used **in lieu of** the needlepunch process. Their use to **enhance** the physical properties of the GCL is permitted.

### 2.2 MATERIALS

- A. Acceptable Products
  - 1. AGRU Geoclay (NN66, WN36, and other such varieties as required)
  - 2. Engineer approved alternative
- B. Alternative Materials
  - 1. Prior to considering an alternative GCL material, the Contractor shall submit certified test results and statements of quality from the proposed GCL supplier to the engineer, indicating without exception that the proposed GCL meets the requirements of this specification. Submittals shall be delivered to the engineer a minimum of five business days in advance of the bid.

### 2.3 GCL PHYSICAL PROPERTIES

- A. The GCL material shall be in accordance with the test methods, test frequencies and material physical properties as listed in the following data sheets.
- B. Dimensions - The minimum acceptable dimensions for the GCL panels shall be 15 feet wide and 150 feet long. Short rolls (rolls less than 125 feet long) may be supplied, but at a rate not to exceed 5% of the total square footage produced for this project.
- C. Overlap Markings - A minimum overlap guide-line and a construction match-line delineating the overlap zone shall be imprinted with non-toxic ink on both edges of the GCL panel to ensure the accuracy of the seam. These lines shall be used during CQA to ensure the minimum overlap is achieved. The minimum overlap guideline shall indicate where the edge of the panel must be placed

in order to achieve the correct overlap for each panel.

D. The GCL will have seam overlaps a minimum of 6 inches for all woven/nonwoven GCLs. GCLs comprised of a nonwoven/nonwoven geotextiles will have a minimum seam overlap of 6 inches for scrim reinforced and 12 inches minimum for all non-scrim reinforced nonwoven GCLs. End of panel or butt end seams shall be a minimum of 12 inches for all woven/nonwoven GCLs, 12 inches for all scrim-reinforced double nonwoven GCLs, and 24 inches for non-scrim reinforced double nonwoven GCLs.

E. Accessory Bentonite - Any accessory bentonite used for sealing seams, penetrations, or repairs, shall be the same granular bentonite as used in the production of the GCL itself.

Table 2.3A: AGRU Geoclay WN33

Tested Property	Test Method	Frequency	Minimum Average Roll Value
<b>Geotextile Property</b>			
Cap Nonwoven, Mass/Unit Area	ASTM D 5261	1/200,000 ft <sup>2</sup>	3.0 oz/yd <sup>2</sup>
Carrier Woven, Mass/Unit Area	ASTM D 5261	1/200,000 ft <sup>2</sup>	3.1 oz/yd <sup>2</sup>
<b>Bentonite Property<sup>(1)</sup></b>			
Swell Index	ASTM D 5890	1/100,000 lb	24 ml/2 g min
Moisture Content	ASTM D 5993	1/100,000 lb	12% max
Fluid Loss	ASTM D 5891	1/100,000 lb	18 ml max
<b>Finished GCL Property</b>			
Bentonite, Mass/Unit Area <sup>(2)</sup>	ASTM D 5993	1/40,000 ft <sup>2</sup>	0.75 lb/ft <sup>2</sup>
Tensile Strength <sup>(3)</sup>	ASTM D 6768	1/40,000 ft <sup>2</sup>	30 lb/in
Peel Strength	ASTM D 6496	1/40,000 ft <sup>2</sup>	1 lb/in
Hydraulic Conductivity <sup>(4)</sup>	ASTM D 5887	1/270,000 ft <sup>2</sup>	5 x 10 <sup>-9</sup> cm/sec max
Index Flux <sup>(4)</sup>	ASTM D 5887	1/270,000 ft <sup>2</sup>	1 x 10 <sup>-8</sup> m <sup>3</sup> /m <sup>2</sup> /sec max
Internal Shear Strength <sup>(5)</sup>	ASTM D 6243	Periodically	150 psf Typical

NOTES:

- <sup>(1)</sup>Bentonite Properties tests performed at a bentonite processing facility prior to shipment to GCL production facility.
- <sup>(2)</sup>At 0% moisture content.
- <sup>(3)</sup>Tested in machine direction.
- <sup>(4)</sup>Deaired, deionized water @ 5 psi maximum effective confining stress and 2 psi head pressure.
- <sup>(5)</sup>Typical peak value for specimen hydrated for 24 hours and sheared under a 200 psf normal stress.
- Rolls are 15.5' x 150' and weight approximately 2,600 lbs. Supplied with two straps and wound on a 4.75" core.

Table 2.3B: AGRU Geoclay WN36

Tested Property	Test Method	Frequency	Minimum Average Roll Value
<b>Geotextile Property</b>			
Cap Nonwoven, Mass/Unit Area	ASTM D 5261	1/200,000 ft <sup>2</sup>	6.0 oz/yd <sup>2</sup>
Carrier Woven, Mass/Unit Area	ASTM D 5261	1/200,000 ft <sup>2</sup>	3.1 oz/yd <sup>2</sup>
<b>Bentonite Property<sup>(1)</sup></b>			
Swell Index	ASTM D 5890	1/100,000 lb	24 ml/2 g min
Moisture Content	ASTM D 5993	1/100,000 lb	12% max

Fluid Loss	ASTM D 5891	1/100,000 lb	18 ml max
<b>Finished GCL Property</b>			
Bentonite, Mass/Unit Area <sup>(2)</sup>	ASTM D 5993	1/40,000 ft <sup>2</sup>	0.75 lb/ft <sup>2</sup>
Tensile Strength <sup>(3)</sup>	ASTM D 6768	1/40,000 ft <sup>2</sup>	30 lb/in
Peel Strength	ASTM D 6496	1/40,000 ft <sup>2</sup>	3.5 lb/in
Hydraulic Conductivity <sup>(4)</sup>	ASTM D 5887	1/270,000 ft <sup>2</sup>	5 x 10 <sup>-9</sup> cm/sec max
Index Flux <sup>(4)</sup>	ASTM D 5887	1/270,000 ft <sup>2</sup>	1 x 10 <sup>-8</sup> m <sup>3</sup> /m <sup>2</sup> /sec max
Internal Shear Strength <sup>(5)</sup>	ASTM D 6243	Periodically	500 psf Typical

NOTES:

- <sup>(1)</sup>Bentonite Properties tests performed at a bentonite processing facility prior to shipment to GCL production facility.
- <sup>(2)</sup>At 0% moisture content.
- <sup>(3)</sup>Tested in machine direction.
- <sup>(4)</sup>Deaired, deionized water @ 5 psi maximum effective confining stress and 2 psi head pressure.
- <sup>(5)</sup>Typical peak value for specimen hydrated for 24 hours and sheared under a 200 psf normal stress.
- Rolls are 15.5' x 150' and weight approximately 2,600 lbs. Supplied with two straps and wound on a 4.75" core.

Table 2.3C: AGRU Geoclay NN66

Tested Property	Test Method	Frequency	Minimum Average Roll Value
<b>Geotextile Property</b>			
Cap Nonwoven, Mass/Unit Area	ASTM D 5261	1/200,000 ft <sup>2</sup>	6.0 oz/yd <sup>2</sup>
Carrier Scrim Nonwoven, Mass/Unit Area	ASTM D 5261	1/200,000 ft <sup>2</sup>	6.0 oz/yd <sup>2</sup>
<b>Bentonite Property<sup>(1)</sup></b>			
Swell Index	ASTM D 5890	1/100,000 lb	24 ml/2 g min
Moisture Content	ASTM D 5993	1/100,000 lb	12% max
Fluid Loss	ASTM D 5891	1/100,000 lb	18 ml max
<b>Finished GCL Property</b>			
Bentonite, Mass/Unit Area <sup>(2)</sup>	ASTM D 5993	1/40,000 ft <sup>2</sup>	0.75 lb/ft <sup>2</sup> MARV
Tensile Strength <sup>(3)</sup>	ASTM D 6768	1/40,000 ft <sup>2</sup>	50 lb/in MARV
Peel Strength	ASTM D 6496	1/40,000 ft <sup>2</sup>	3.5 lb/in MARV
Hydraulic Conductivity <sup>(4)</sup>	ASTM D 5887	1/270,000 ft <sup>2</sup>	5 x 10 <sup>-9</sup> cm/sec max
Index Flux <sup>(4)</sup>	ASTM D 5887	1/270,000 ft <sup>2</sup>	1 x 10 <sup>-8</sup> m <sup>3</sup> /m <sup>2</sup> /sec max
Internal Shear Strength <sup>(5)</sup>	ASTM D 6243	Periodically	500 psf Typical

NOTES:

- <sup>(1)</sup>Bentonite Properties tests performed at a bentonite processing facility prior to shipment to GCL production facility.
- <sup>(2)</sup>At 0% moisture content.
- <sup>(3)</sup>Tested in machine direction.
- <sup>(4)</sup>Deaired, deionized water @ 5 psi maximum effective confining stress and 2 psi head pressure.
- <sup>(5)</sup>Typical peak value for specimen hydrated for 24 hours and sheared under a 200 psf normal stress.
- Rolls are 15.5' x 150' and weight approximately 2,600 lbs. Supplied with two straps and wound on a 4.75" core.

## Part 3 INSTALLATION

### 3.1 GENERAL

A. Execution - The following installation procedures are as specific as possible while recognizing that the specific requirements of the project may necessitate minor modifications. Significant deviations from these procedures shall be pre-approved by the project engineer or other designated party.

### 3.2 SUBGRADE PREPARATION

The subgrade upon which the GCL shall be suitable for the placement of GCL material, subject to the applicable section of this specification Earthen - 3.2A.

A. Earthen Subgrade - The surface upon which the GCL material will be installed shall be inspected by the CQA inspector and certified by the earthwork contractor to be in accordance with the requirements of this document or the project specification.

B. The surface upon which the GCL is to be installed should be smooth and free of wheel ruts, debris, roots, sticks, and rocks larger than 1.0 in. Site specific compaction requirements should be followed in accordance with the project plans and specifications. At minimum, the site should be smooth rolled and the level of compaction shall be such that installation equipment and other construction vehicles traffic does not cause rutting greater than 1.0 in deep. Furthermore, all protrusions extending more than 0.5 in from the subgrade shall be removed, crushed, or compacted into the subgrade.

C. In applications where the product is the sole barrier, subgrade surfaces consisting of gravel or granular soils may not be acceptable due to their large void content. For these applications, the subgrade shall be greater than 80% fines and contain no particles larger than 1 in.

D. Immediately prior to deployment of the GCL, the subgrade shall be final compacted to fill in any remaining voids or desiccation cracks and to ensure that no sharp irregularities or abrupt elevation changes exist greater than 1.0 in. The surfaces to be lined shall be maintained in this condition and free of standing water. GCL can be deployed on a frozen subgrade, if the subgrade would meet all the conditions as previously outlined if unfrozen.

E. The subgrade surface and preparation should be inspected and certified by the CQA inspector prior to GCL placement. Upon approval by the CQA inspector, it is the geosynthetic installer's responsibility to communicate to the engineer of any changes in the condition of the subgrade that might render it out of compliance, with any of the requirements of the project specification or ASTM Standard D 6102.D.

F. Site specific compaction requirements should be followed in accordance with the project drawings and specifications. At a minimum, the level of compaction should be such that no rutting is caused by installation equipment or other construction vehicles which traffic the area of deployment (typically 85% of standard proctor or greater).

G. The surfaces to be lined shall be smooth and free of any debris, vegetation, roots, sticks, sharp rocks, or other deleterious materials larger than two inches as well as free of any voids, large cracks or standing water or ice.

H. Subsequent to the CQA inspector's approval, it shall be the installer's responsibility to indicate to the Engineer any change in the subgrade condition that could cause it to be out of compliance with any of the requirements of this section or the project specification.



### 3.3 ANCHOR TRENCH

An anchor trench shall be excavated by the earthwork contractor or liner installer to the lines and grades shown on the project drawings at the top of slopes.

A. The anchor trench shall be constructed free of sharp edges or corners and maintained in a dry condition. No loose soil shall be permitted beneath the GCL within the trench.

B. The anchor trench shall be inspected and approved by the CQA inspector prior to GCL placement, back-filling and compaction of the anchor key material.

### 3.4 GCL PLACEMENT

A. GCL Material shall be placed in general accordance with the procedures specified below, or modified to account for site specific conditions.

1. GCL Orientation - GCL panels are typically placed with the nonwoven side up (heat burnished side down) to maximize the shear strength characteristics. However, the heat burnished side up if it maximizes the shear strength characteristics of a site specific interface. In base or flat areas, the GCL does not require any particular orientation.
2. GCL Panel Position - Where possible, all slope panels should be installed parallel to the maximum slope while panels installed in flat areas require no particular orientation.
3. Panel Deployment - GCL materials shall be installed in general accordance with the procedures set forth in this section, subject to site specific conditions which would necessitate modifications.
  - a. The GCL may be deployed on slopes by pulling the material from a suspended roll, or securing a roll end into an anchor trench and unrolling each panel as the handling equipment slowly moves backwards.
  - b. Deployment on flat areas shall be conducted in the same manner as that for the slopes, however, care should be taken to minimize "dragging" the GCL.
  - c. Slip sheets shall be required for use when installing over blown-film textured material or when the installation of blown film textured liner is performed over the GCL.
  - d. The GCL will have seam overlaps a minimum of 6 inches for all woven/nonwoven GCLs. GCLs comprised of a nonwoven/nonwoven geotextiles will have a minimum seam overlap of 6 inches for scrim reinforced and 12 inches minimum for all non-scrim reinforced nonwoven GCLs. End of panel or butt end seams shall be a minimum of 12 inches for all woven/nonwoven GCLs, 12 inches for all scrim-reinforced double nonwoven GCLs, 24 inches for non-scrim reinforced double nonwoven GCLs, and be free of wrinkles, folds or "fish-mouths".
  - e. The contractor shall only install as much GCL that can be covered at the end of the day. No GCL shall be left exposed overnight. The exposed edge of the GCL shall be covered by a temporary tarpaulin or other such water resistant sheeting until the next working day.

### 3.5 SEAMING

A. Overlap Line

1. Woven/Nonwoven and Scrim Reinforced Nonwoven GCLs
  - a. A 6 inch lap line and a 9 inch match line for scrim reinforced GCLs shall be imprinted on both edges of the upper geotextile component of the GCL to assist in installation overlap quality control. Lines shall be printed as continuous dashes in easily observable non-toxic ink.
2. Non-Scrim Reinforced Nonwoven GCLs
  - a. A 12 inch lap line and 15 inch match line for non-scrim reinforced GCLs shall be imprinted on both edges of the upper geotextile component of the GCL to assist in installation overlap quality control. Lines shall be printed as continuous dashes in easily observable non-toxic ink

B. Seams

1. Woven/Nonwoven and Scrim Reinforced Nonwoven GCLs
  - a. Overlap seams shall be a minimum of six inches on panel edges and one foot on panel ends.
2. Non-Scrim Reinforced Nonwoven GCLs
  - a. Overlap seams shall be a minimum of 12 inches on panel edges and 2 foot on panel ends.
3. Loose granular bentonite shall be placed between panel overlaps at a rate of 0.25 pound per lineal foot.

### 3.6 DETAILING

A. Detail work, defined as the sealing of the liner to pipe penetrations, foundation walls, drainage structures, spillways, and other appurtenances, shall be performed as recommended by the GCL Manufacturer.

### 3.7 DAMAGE REPAIR

A. Prior to cover material placement, damage to the GCL shall be identified and repaired by the installer. Damage is defined as any rips or tears in the geotextiles, delamination of geotextiles or a displaced panel.

B. **Rip and Tear Repair (Flat Surfaces)** - Rips or tears may be repaired by completely exposing the affected area, removing all foreign objects or soil, and by then placing a patch cut from unused GCL over the damage (damaged material may be left in place), with a minimum overlap of 12 inches on all edges. Accessory bentonite should be placed between the patch edges and the repaired material at a rate of a quarter pound per lineal foot of edge spread in a continuous six inch fillet.

C. **Rip and Tear Repair (Slopes)** - Damaged GCL material on slopes shall be repaired by the same procedures above, however, the edges of the patch should also be adhered to the repaired liner with heat tacking or an adhesive to keep the patch in position during backfill or cover operations.

### 3.8 DISPLACED PANELS

A. Displaced panels shall be adjusted to the correct position and orientation. The adjusted panel shall then be inspected for any geotextile damage or bentonite loss. Damage shall be repaired by the above procedure.

### 3.9 PREMATURE HYDRATION

A. If the GCL is prematurely hydrated, installer shall notify the QA/QC technician and project engineer for a site specific determination as to whether the material is acceptable or if alternative measures must be taken to ensure the quality of the design.

### 3.10 COVER MATERIAL

A. The cover materials shall be compatible as well as suitable for use over the GCL, and placed in a manner appropriate to the particular subgrade. Regardless of the cover material, the uncovered edge of GCL panels shall be protected at the end of the working day with a waterproof sheet which is secured adequately with ballast.

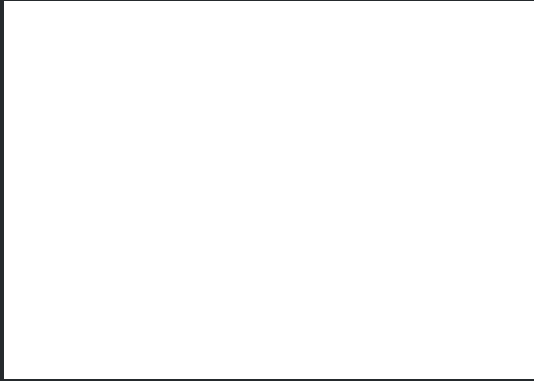
B. **Earthen Cover Soil** - If the cover material is soil or gravel, a minimum thickness of 12 inches shall be placed over the GCL. The soil cover shall be free of sharp-edged stones greater than 0.5 inches in size.

1. **Equipment** - Soil cover shall be placed with low ground pressure equipment. Care should be taken to avoid damaging the GCL by making sharp turns or pivots with equipment as well as sudden starts or stops.
2. **Placement** - Soils may be placed on the GCL by pushing with a track dozer or by carefully placing it with a loader or a back-hoe. The use of scrapers or pans directly over the GCL is strictly prohibited.
3. **Thickness** - A minimum thickness of 12 inches of cover shall be kept between heavy equipment and the GCL at all times. No heavy vehicles should be driven directly on the GCL until the proper thickness of cover has been placed.
4. **Compaction** - To prevent damage to the GCL, the initial lift(s) of soil cover shall not be compacted in excess of 85 percent Modified Proctor density or as specified by the engineer.

5. **Slope Placement** - When covering GCL on sloped areas, cover soil should be pushed up-slope to minimize tension on the GCL.

B. **Geosynthetic Cover** - Precautions shall be taken to prevent damage to the GCL by restricting the use of heavy equipment over the liner system.

1. **Equipment** - Installation of the overlying geosynthetic component can be accomplished through the use of light-weight, rubber-tired equipment such as a 4-wheel all-terrain vehicle (ATV) or low ground pressure rubber-tracked bobcat type equipment. This vehicle can be driven directly on the GCL, provided no sudden stops, starts, or turns are made.
2. **Placement** - Smooth HDPE may be dragged across the GCL surface with equipment or by hand labor during positioning. Similarly, the HDPE may be unrolled with the use of low ground pressure equipment.
3. **Use of Textured Liners** - If a blown-film textured geomembrane is placed over the GCL, a slip sheet (such as 20-mil smooth HDPE) should be placed over the GCL in order to allow the geomembrane to slide into its proper position. Once the overlying geomembrane is properly positioned, the slip-sheet shall be carefully removed paying close attention to avoiding any movement to the geomembrane.



Subject to errors of typesetting, misprints and modifications.  
Illustrations are generic and for reference only.

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