V. EROSION CONTROL

This section describes three different types of erosion control applications where geotextiles can be used in conjunction with some form of stone or other energy dissipating material for the control of erosive forces due to the presence of water:

-Drainage swales separation
-Under rip-rap protected
-Under rip-rap unprotected

Read each description to determine which most closely parallels the application or site conditions you are anticipating on your project. The corresponding description and specification addresses the geotextile requirements, from material selection to installation necessary to perform the geotextile intended function.

Each specification is written to select a geotextile that will serve one or more of the following functions of:

Installation survivability
Separation of dissimilar materials
Filtration

These specifications make certain design assumptions, as outlined in the sections which follow. If you have questions, or your application does not fit into one of these erosion control categories, contact the LINQ QA line (1-800-543-9966) for assistance.

V. EROSION CONTROL

A1. DRAINAGE SWALES SEPARATION - DESCRIPTION

This specification includes geotextiles used for erosion control applications where the geotextile performs primarily as a permeable separator, keeping rock from sinking into the underlying subgrade. It assumes minimal water movement through the geotextile.

Subgrade condition:	-Graded swale or ditch along highway roadside -Subgrade fairly firm when saturated -Prepared to smooth grade with no sharp protrusions
Erosion control material	-Aggregate or stone of 3-6 inches maximum diameter -Blocks or other man made erosion control product
Geotextile function	-Separation
Installation conditions:	-Low rock drop height (less than 1 foot) -Small or no equipment on top of the stone -Key in Geotextile at top of swale, minimum
Examples:	-Roadside swales -Drainage areas requiring stone for water energy dissipation -Pipe outlet drop structures

DRAINAGE SWALES SEPARATION

SECTION 26*****

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Product specifications, installation and method of payment for geotextile installation in swale applications.

1.02 RELATED SECTIONS

A. Section 02207 - Aggregate materials.

1.03 UNIT PRICE - MEASUREMENT AND PAYMENT

MEASUREMENT
a) Geotextiles will be measured to the nearest square yard of surface area actually covered in accordance with the plans or as required by the Engineer. This shall include geotextiles used in any crest and toe of slope treatments.

b) Slope preparation, excavation and backfill, bedding, and cover material are separate pay items.

PAYMENT
a) The accepted quantities of geotextile shall be paid for per square yard in place.

b) Payment will be made under:

Payment Item	Pay Unit
Erosion Control Geotextile	Square Yard

The measurement for payment excludes the geotextile used for overlapping.

1.04 SUBMITTALS

A. Certificate of compliance: The contractor shall submit to the engineer a certificate of compliance which shall include the following information:

- Full product name by trademark and style number
- Geotextile polymer type(s),
- Geotextile physical properties,

B. The manufacturer shall maintain test records of the production of this lot of material. These records shall be made available to the Engineer upon request.

If more than one style or product code number has been produced under the same product name, the style, or product code number of the geotextile to be approved must be specifically identified. The certificate of compliance shall be attested to by a person having legal authority to bind the company.

C. Samples: Sample(s) of the geotextile shall be submitted to the testing laboratory for source approval as stipulated by the owner or the engineer. Each sample shall have minimum dimensions of 1.5 yards by the full roll width of the geotextile.

The geotextile machine direction shall be marked clearly on each sample submitted for testing. The machine direction is defined as the roll length direction.

D. Seams: At the Engineers option, when seams are to be used, at least one sewn sample, with a minimum of 2 yards of seam length per sample and with a minimum of 18 inches of geotextile width on each side of the seam shall also be submitted.

1.05 QUALITY CONTROL TESTING

A. Samples may be randomly taken by the Engineer at the job site to confirm that the geotextile meets the property values specified. Sampling shall be in accordance with ASTM D4354.

B. Approval will be based on testing of samples from each lot. A “lot” shall be defined for the purposes of this specification as all geotextile rolls within the consignment (i.e., all rolls sent to the project site) which were manufactured at the same manufacturing plant, have the same product name, and have the same style, merge, or product code number.

C. All geotextile which has defects, deterioration, or damage, as determined by the Engineer, may also be rejected. All rejected geotextile shall be replaced at no cost to the owner.

1.05 ACCEPTANCE REQUIREMENTS

Acceptance/rejection of geotextiles shall be determined in accordance with ASTM D4759 “Standard Practice for Determining the Specification Conformance of Geosynthetics.”

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Fibers used in the manufacture of geotextiles, shall consist of long chain polymers composed of at least 95% by weight of polypropylenes. They shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including selvages. These materials shall conform to the properties found in Section 2.02. Thread used for factory or field sewing shall be of contrasting color composed of polypropylene, polyester, polyamids, or polyaramids.

2.02 GEOTEXTILE PHYSICAL PROPERTIES

A. Geotextile property values should be expressed in terms of “Minimum Average Roll Values” and should be compared directly to the corresponding specification values. The minimum average property value of any roll within a shipment or lot of geotextile rolls shall meet or exceed the values required in the specification.

Property	Test Method	Property Value	
Elongation (%)	ASTM D4632	<50	≥50
Grab Tensile (lbs)	ASTM D4632	200	120
Trapezoid Tear (lbs)	ASTM D4533	90	40
Puncture (lbs)	ASTM D4833	100	40
U V Stability	ASTM D4355		
(% Strength retained)	500 hrs exposure	70	70
Permittivity (sec^{-1})	ASTM D4491	.03	.5
AOS (US Sieve#)	ASTM D4751	30	70

Product shall be LINQ GTF 200, LINQ 140EX or approved equivalent.

2.03 SHIPMENT

A. Packaging: Each roll of geotextile shall be packaged individually in a suitable sheet, wrapper or container to protect the geotextile from damage due to ultraviolet light and moisture during normal storage and handling.

B. Labelling: Each roll shall be identified by a tag or label securely affixed to the outside of the roll on one end. Identification shall be in accordance with ASTM D 4873.

C. Storage: The geotextile shall be stored to protect it from sunlight and damage. Storage shall be in accordance with ASTM D 4873.

PART 3 EXECUTION

Geotextile shall be installed in accordance with the project drawings and this specification. In the event of a discrepancy between the specification and the drawings, the drawings shall govern.

3.1 Installation

Unless otherwise specified in the construction plans, the geotextile shall either be overlapped a minimum of 2 feet at all longitudinal and transverse joints, or the geotextile shall be sewn together at all joints at the point of manufacture to form geotextile widths as required. If overlapped, the geotextile shall be placed so that the upstream roll of geotextile will overlap the next downstream roll. Where placed on slopes, each roll shall overlap the next downhill roll.

The geotextile shall be keyed at the toe and the top of the slope as shown in the construction drawings. The geotextile shall be secured to the slope, so as to make intimate contact with it. It shall not be so tight, however, as to cause tearing when the stone is placed on the geotextile. The geotextile shall not be keyed at the top of the slope until the riprap or stone is in place to the top of the slope. Placement of stone aggregate, rock riprap, or prefabricated armor systems, on the geotextile shall start at the toe of the slope and proceed upwards.

All voids in the riprap face that allow the geotextile to be visible to sunlight shall be backfilled with quarry spalls or other small stones, as designated by the Engineer, so that the geotextile is completely covered.

Grading of slopes after placement of the riprap will not be allowed if grading results in stone movement directly on the geotextile. Under no circumstances shall stones weighing more than 100 pounds be allowed to roll down the slope. If the geotextile is placed on slopes steeper than 2:1, the stones shall be placed on the slope without free-fall.

END OF SECTION

V. EROSION CONTROL

B1. EROSION CONTROL UNDER RIP-RAP PROTECTED - DESCRIPTION

Soil Type:	-Inorganic silts, ML -Silty gravels, poorly graded sand- silt mixtures including GP, GM, SM -All cohesive soils including CL, CLML, SC, (Care is to be taken when gap graded soils are present, or soils consisting of uniform fine silts)
Subgrade condition:	-Graded slope no steeper than 2H:1V up to 10 ft high -Subgrade fairly firm when saturated -Slope angle of 2.5H:1V for height >10 feet
Armor material:	-Armor, block or other man-made srosion control product (see table 1 below)
Geotextile function:	-Separation -Filtration
Installation conditions:	-See table 1 below -Small or no equipment on top of the stone
Examples:	-cut and fill slope protection, -protection of various drainage structures, -wave protection for causeways and shoreline roadway embankments, -scour protection for structures (bridge piers and abutments)

Table 1 -Survivability Table for Permanent Erosion Control Geotextiles For Protected Conditions

Maximum Armor Size	Slope Preparation and Armor Placement
250 lbs.	6” bedding with maximum 3 ft. drop, or “zero” drop height with no bedding
500 lbs.	6” bedding with “zero” drop height
2,000 lbs.	12” bedding with maximum 3 ft. drop
Greater than 2,000 lbs.	12” bedding with “zero” drop height

EROSION CONTROL UNDER RIP-RAP PROTECTED

SECTION 27***

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Product specifications, installation and method of payment for geotextile installation in erosion control.

1.02 RELATED SECTIONS

A. Section 02207 - Rip-Rap materials.

1.03 UNIT PRICE - MEASUREMENT AND PAYMENT

MEASUREMENT
a) Geotextiles will be measured to the nearest square yard of surface area actually covered in accordance with the plans or as required by the Engineer. This shall include geotextiles used in crest and toe of slope treatments.

b) Slope preparation, excavation and backfill, bedding, and rip-rap cover material are separate pay items.

PAYMENT
a) The accepted quantities of geotextile shall be paid for per square yard in place.

b) Payment will be made under:

Payment Item	Pay Unit
Erosion Control Geotextile	Square Yard

The measurement for payment excludes the geotextile used for overlapping.

1.04 SUBMITTALS

A. Certificate of compliance: The contractor shall submit to the engineer a certificate of compliance which shall include the following information:

- Full product name by trademark and style number
- Geotextile polymer type(s),
- Geotextile physical properties,

B. The manufacturer shall maintain test records of the production of this lot of material. These records shall be made available to the Engineer upon request.

If more than one style or product code number has been produced under the same product name, the style, or product code number of the geotextile to be approved must be specifically identified. The certificate of compliance shall be attested to by a person having legal authority to bind the company.

C. Samples: At the engineers option, sample(s) of the geotextile shall be submitted for source approval. Each sample shall have minimum dimensions of 1.5 yards by the full roll width of the geotextile.

The geotextile machine direction shall be marked clearly on each sample submitted for testing. The machine direction is defined as the roll length direction.

D. Seams: At the Engineers option, when seams are to be used, at least one sewn sample, with a minimum of 2 yards of seam length per sample and with a minimum of 18 inches of geotextile width on each side of the seam shall also be submitted.

1.05 QUALITY CONTROL TESTING

A. Samples may be randomly taken by the Engineer at the job site to confirm that the geotextile meets the property values specified. Sampling shall be in accordance with ASTM D4354.

B. If sampling is performed, approval will be based on testing of samples from each lot. A “lot” shall be defined for the purposes of this specification as all geotextile rolls within the consignment (i.e., all rolls sent to the project site) which were manufactured at the same manufacturing plant, have the same product name, and have the same style, merge, or product code number.

C. All geotextile which has defects, deterioration, or damage, as determined by the Engineer, may be rejected. All rejected geotextile shall be replaced at no cost to the owner.

1.05 ACCEPTANCE REQUIREMENTS

Acceptance/rejection of geotextiles shall be determined in accordance with ASTM D4759 “Standard Practice for Determining the Specification Conformance of Geosynthetics.”

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Geotextiles, shall consist of long chain polymers composed of at least 95% by weight of polypropylenes. They shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including selvages. These materials shall conform to the properties found in Section 2.02.

Thread used for factory or field sewing shall be of contrasting color composed of polypropylene, polyester, polyamids, or polyaramids.

2.02 GEOTEXTILE PHYSICAL PROPERTIES

A. Geotextile property values should be expressed in terms of “Minimum Average Roll Values” and should be compared directly to the corresponding specification values. The minimum average property value of any roll within a shipment or lot of geotextile rolls shall meet or exceed the values required in the specification.

Property	Test Method	Property Value
Grab Tensile (lbs)	ASTM D4632	120
Elongation (%)	ASTM D4632	50
Trapezoid Tear (lbs)	ASTM D4533	50
Puncture (lbs)	ASTM D4833	40
U V Stability	ASTM D4355	
(% Strength retained)	500 hrs exposure	70
Permittivity (sec^{-1})	ASTM D4491	.7
AOS (US Sieve#)	ASTM D4751	70

Product shall be LINQ 140EX or approved equivalent.

2.03 SHIPMENT

A. Packaging: Each roll of geotextile shall be packaged individually in a suitable sheet, wrapper or container to protect the geotextile from damage due to ultraviolet light and moisture during normal storage and handling.

B. Labelling: Each roll shall be identified by a tag or label securely affixed to the outside of the roll on one end.Identification shall be in accordance with ASTM D 4873.

C. Storage: The geotextile shall be stored to prevent exposure to sunlight or other damage. Storage shall be in accordance with ASTM D 4873.

PART 3 EXECUTION

Geotextile shall be installed in accordance with the project drawings and this specification. In the event of a discrepancy between the specification and the drawings, the drawings shall govern.

3.1 Installation

Unless otherwise specified in the construction plans, the geotextile shall either be overlapped a minimum of 2 feet at all longitudinal and transverse joints, or the geotextile shall be sewn together at all joints at the point of manufacture to form geotextile widths as required. If overlapped, the geotextile shall be placed so that the upstream roll of geotextile will overlap the next downstream roll. Where placed on slopes, each roll shall overlap the next downhill roll.

The geotextile shall be keyed in at the toe and the top of the slope as shown in the construction plans. The geotextile shall be secured to the slope, so as to make intimate contact with it. It shall not be so tight, however, as to cause tearing when the riprap is placed on the geotextile. The geotextile shall not be keyed at the top of the slope until the riprap is in place to the top of the slope. Placement of stone aggregate, rock riprap, or prefabricated armor systems, on the geotextile shall start at the toe of the slope and proceed upwards.

All voids in the riprap face that allow the geotextile to be visible shall be backfilled with quarry spalls or other small stones, as designated by the Engineer, so that the geotextile is completely covered. When a sand or stone aggregate protection or bedding layer between the geotextile and riprap is required, it shall have a minimum thickness of 6 inches.

Grading of slopes after placement of the riprap will not be allowed if grading results in stone movement directly on the geotextile. Under no circumstances shall stones weighing more than 100 pounds be allowed to roll down the slope.

END OF SECTION

V. EROSION CONTROL

C1. EROSION CONTROL UNDER RIP-RAP UNPROTECTED - DESCRIPTION

Soil Type:	-Inorganic silts, ML -Silty gravels, poorly graded sand- silt mixtures including GP, GM, SM -All cohesive soils including CL, CLML, SC, (Care is to be taken when gap graded soils are present, or soils consisting of uniform fine silts)
Subgrade condition:	-Graded slope no steeper than 2H:1V up to 10 ft high -Subgrade fairly firm when saturated -Slope angle of 2.5H:1V for height >10 feet
Armor Material:	-Stone, block or other man-made erosion control product (see table 1 below)
Geotextile function:	-Separation -Filtration
Installation conditions:	-0 rock drop height -Small or no equipment on top of the stone
Examples:	-cut and fill slope protection, -protection of various drainage structures, -wave protection for causeways and shoreline roadway embankments, -scour protection for structures (bridge piers and abutments)

Table 1 -Survivability Table for Permanent Erosion Control Geotextiles For Unprotected Conditions

Maximum Stone Size	Slope Preparation and Armor Placement
250 lbs.	Maximum 3ft. drop
500 lbs.	6” bedding with maximum 3ft. drop, or “zero” drop height with no bedding
2,000 lbs.	8” bedding with maximum 1 ft. drop height
Greater than 2,000 lbs.	12” bedding with 1ft. drop height

EROSION CONTROL UNDER RIP-RAP UNPROTECTED

SECTION 027***

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Product specifications, installation and method of payment for geotextile installation for erosion control applications.

1.02 RELATED SECTIONS

A. Section 02207 - Stone materials.

1.03 UNIT PRICE - MEASUREMENT AND PAYMENT

MEASUREMENT
a) Geotextiles will be measured to the nearest square yard of surface area actually covered in accordance with the plans or as required by the Engineer. This shall include geotextiles used in crest and toe of slope treatments.

b) Slope preparation, excavation and backfill, bedding, and cover material are separate pay items.

PAYMENT
a) The accepted quantities of geotextile shall be paid for per square yard in place.

b) Payment will be made under:

Payment Item	Pay Unit
Erosion ControlGeotextile	Square Yard

The measurement for payment excludes the geotextile used for overlapping.

1.04 SUBMITTALS

A. Certificate of compliance: The contractor shall submit to the engineer a certificate of compliance which shall include the following information:

- Full product name by trademark and style number
- Geotextile polymer type(s),
- Geotextile physical properties,

B. The manufacturer shall maintain test records of the production of this lot of material. These records shall be made available to the Engineer upon request.

If more than one style or product code number has been produced under the same product name, the style, or product code number of the geotextile to be approved must be specifically identified. The certificate of compliance shall be attested to by a person having legal authority to bind the company.

C. Samples: At the engineers option sample(s) of the geotextile shall be submitted for approval. Each sample shall have minimum dimensions of 1.5 yards by the full roll width of the geotextile.

The geotextile machine direction shall be marked clearly on each sample submitted for testing. The machine direction is defined as the roll length direction.

D. Seams: At the Engineers option, when seams are to be used, at least one sewn sample, with a minimum of 2 yards of seam length per sample and with a minimum of 18 inches of geotextile width on each side of the seam shall also be submitted.

1.05 QUALITY CONTROL TESTING

A. Samples may be randomly taken by the Engineer at the job site to confirm that the geotextile meets the property values specified. Sampling shall be in accordance with ASTM D4354.

B. If sampling is performed approval will be based on testing of samples from each lot. A “lot” shall be defined for the purposes of this specification as all geotextile rolls within the consignment (i.e., all rolls sent to the project site) which were manufactured at the same manufacturing plant, have the same product name, and have the same style, merge, or product code number.

C. All geotextile which has defects, deterioration, or damage, as determined by the Engineer, may be rejected. All rejected geotextile shall be replaced at no cost to the owner.

1.06 ACCEPTANCE REQUIREMENTS

Acceptance/rejection of geotextiles shall be determined in accordance with ASTM D4759 “Standard Practice for Determining the Specification Conformance of Geosynthetics.”

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Geotextiles shall consist of long chain polymers composed of at least 95% by weight of polypropylenes. They shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including selvages. These materials shall conform to the properties found in Section 2.02. Thread used for factory or field sewing shall be of contrasting color composed of polypropylene, polyester, polyamids or polyaramids.

2.02 GEOTEXTILE PHYSICAL PROPERTIES

A. Geotextile property values should be expressed in terms of “Minimum Average Roll Values” and should be compared directly to the corresponding specification values. The minimum average property value of any roll within a shipment or lot of geotextile rolls shall meet or exceed the values required in the specification.

Property	Test Method	Property Value
Grab Tensile (lbs)	ASTM D4632	200
Elongation (%)	ASTM D4632	50
Trapezoid Tear (lbs)	ASTM D4533	75
Puncture (lbs)	ASTM D4833	80
U V Stability	ASTM D4355	
(% Strength retained)	500 hrs exposure	70
Permittivity (sec^{-1})	ASTM D4491	.1
AOS (US Sieve#)	ASTM D4751	70

Product shall be LINQ 180EX or approved equivalent.

2.03 SHIPMENT

A. Packaging: Each roll of geotextile shall be packaged individually in a suitable sheet, wrapper or container to protect the geotextile from damage due to ultraviolet light and moisture during normal storage and handling.

B. Labelling: Each roll shall be identified by a tag or label securely affixed to the outside of the roll on one end. Identification shall be in accordance with ASTM D 4873.

C. Storage: The geotextile shall be stored to protect it from sunlight or other damage. Storage shall be in accordance with ASTM D 4873.

PART 3 EXECUTION

Geotextile shall be installed in accordance with the project drawings and this specification. In the event of a discrepancy between the specification and the drawings, the drawings shall govern.

3.1 Installation

Unless otherwise specified in the construction plans, the geotextile shall either be overlapped a minimum of 3 feet at all longitudinal and transverse joints, or the geotextile shall be sewn together at all joints at the point of manufacture to form geotextile widths as required. If overlapped, the geotextile shall be placed so that the upstream roll of geotextile will overlap the next downstream roll. Where placed on slopes, each roll shall overlap the next downhill roll.

The geotextile shall be keyed at the toe and the top of the slope as shown in the construction drawings. The geotextile shall be secured to the slope, so as to make intimate contact with it. It shall not be so tight, however, as to cause tearing when the riprap is placed on the geotextile. The geotextile shall not be keyed at the top of the slope until the riprap is in place to the top of the slope. Placement of stone aggregate, rock riprap, or prefabricated armor systems, on the geotextile shall start at the toe of the slope and proceed upwards.

All voids in the riprap face that allow the geotextile to be visible shall be backfilled with quarry spalls or other small stones, as designated by the Engineer, so that the geotextile is completely covered.

Grading of slopes after placement of the riprap will not be allowed if grading results in stone movement directly on the geotextile. Under no circumstances shall stones weighing more than 100 pounds be allowed to roll down the slope.

END OF SECTION