



FactSheet

Extension

590 Woody Hayes Dr., Columbus, Ohio 43210

Using Geotextile Fabric in Livestock Operations

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Steve Ruhl
Jim Overmoyer
Dan Barker
Larry C. Brown

Wet soil conditions in animal feeding and high-traffic livestock handling areas cause problems for both animals and producers, as well as the environment. Ruminating animals, such as beef, dairy, and sheep, often concentrate at stream crossings, in paddock lanes, and in feedlots and barnyards. In association with animal production, there will be concentrated farm vehicular and equipment traffic. When the animal and/or equipment traffic is excessively high, the vegetation is destroyed. During and after rainy weather, the soil in these areas turns to mud, creating an unhealthy environment for optimal livestock production, poor traction for farm equipment, and potentially poor surface water quality. Once these areas dry, they may provide rough and possibly hazardous footing for the animals.

After the vegetation in these concentrated areas is destroyed, the soil is bare and subject to erosion. In addition, once wet soil that has been trampled by livestock dries, it has a greatly reduced infiltration rate, and thus a much higher potential for producing runoff of soil and manure. Both of these conditions are conducive to creating a water quality problem. However, all of the conditions summarized above cause problems for producers as they try to properly manage the many operations for a profitable livestock production system.

The use of geotextile fabric in these high-traffic livestock areas can substantially reduce the occurrence of adverse conditions (see Figure 1). The installation of

geotextile fabric combined with gravel can help provide a proper surface that animals, humans, vehicles, and equipment can travel on, and can also provide an erosion control benefit.

The purpose of this publication is to help producers, landowners, and agency and industry personnel who work with producers and landowners, understand the proper application, installation, and maintenance of geotextile fabric for agricultural applications. This publication provides an overview of a demonstration project (*Using Geotextile Cloth in Livestock Operations to Reduce Nutrient and Sediment Loading in the Olentangy Watershed*) on the use of geotextile fabric in high-traffic livestock areas. Some of the material provided is based on cooperative agency-industry-producer experiences from twelve project sites constructed in Morrow County, Ohio, during 1994.



Figure 1. Illustration of a site before geotextile fabric application (above) and a similar site after application of the geotextile fabric (below).



What are Geotextiles?

The ASAE (Society for Engineering in Agricultural, Food, and Biological Systems) defines a geotextile as a "fabric or synthetic material placed between the soil and a pipe, gabion, or retaining wall: to enhance water movement and retard soil movement, and as a blanket to add reinforcement and separation." A geotextile should consist of a stable network that retains its relative structure during handling, placement, and long-term service. Other terms that are used by the industry for similar materials and applications are geotextile cloth, agricultural fabric, and geosynthetic.



Figure 2. Non-woven (left) and woven (right) geotextile fabrics. (Illustration image provided courtesy of Amoco Fabrics and Fibers Company, Atlanta, Georgia.)

There are many different types of geotextile-type materials. Two geotextiles that have many potential applications in agriculture are woven and nonwoven geotextile fabrics (see Figure 2). The type of geotextile fabric that was selected for this project, and therefore the focus of this publication, is a nonwoven fabric (similar to that shown on the left side of Figure 2). (With the proper drainage, pore size, and strength characteristics, woven geotextile fabrics, as shown in Figure 3, also could have been used in this project.) The nonwoven fabric is made with 100 percent polypropylene fibers that are mechanically interlocked by needle punching and/or heat setting. This proprietary process creates very compact three dimensional fabrics that are highly permeable and extremely tough. Since geotextile fabric is a petrochemical-based polymer that is essentially chemically and biologically inert, it will resist decomposition by bacterial or fungal action. However, these fabrics are susceptible to deterioration from ultraviolet (UV) light.



Figure 3. Close-up view of a woven geotextile fabric. (Illustration image provided courtesy of Amoco Fabrics and Fibers Company, Atlanta, Georgia.)

Geotextile fabric is available in weights ranging from 3.5 to 18 ounces per square yard. The fabric comes in rolls much like carpet, and is stabilized for UV resistance. A typical roll of nonwoven fabric contains 500 square yards (range is 275 to 700 square yards), with dimensions typically 12.5 to 15 feet in width, and 120 to 450 feet in length. The roll comes covered with plastic to prevent UV deterioration and also to prevent the roll from becoming waterlogged before installation (it is much like a sponge). The proper weight range for high-traffic livestock area applications for the nonwoven fabric is 5 to 6 ounces per square yard. The shipping weight is in the range of 170 to 220 pounds, but geotextile fabric will weigh much more if allowed to take on moisture before installed. Therefore, the fabric should be stored in a dry location and out of direct sunlight until installation. A more complete description of the physical property requirements of nonwoven geotextiles is given in USDA Natural

Resources Conservation Service (NRCS) Design Note 24, *Guide for the Use of Geotextiles* (see Bibliography).

How Geotextile Fabric Works

Geotextile fabric applications are designed to keep soil and gravel (or other earthen materials) separate. By keeping the soil and gravel separated, the fabric improves the stability, load bearing capacity, and drainage of the site.

A geotextile fabric installed as a layer between gravel and soil layers forms a barrier against the movement or intermixing of the soil and gravel (see Figure 4). In applications where gravel is placed on top of a soil layer, as in conventional driveways, farm roads, or graveled areas, the separation provided by the fabric helps the gravel maintain its position and design load bearing capacity throughout its life.

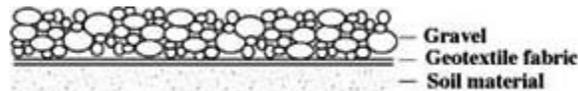


Figure 4. Illustration of a geotextile fabric separating a gravel layer from the underlying soil material (modified from Agricultural Engineering Soil Mechanics).

When properly designed and installed, the fabric can help distribute loads from animal and vehicular traffic (see Figure 5). When installed between two types of materials, or even between two layers of the same material, the fabric is placed into tension (see Figure 5, top), which helps reduce the impact of a localized load, and redistributes the localized pressures (see Figure 5, bottom) over a larger area of subgrade material (soil or other earthen material in the lower layer). Overall, there is great improvement in the support properties of the system. Subsequently, the need for additional gravel each spring is greatly reduced, if not eliminated. However, timely maintenance is important to the longevity of the application area.

Drainage is enhanced when the gravel and soil are kept separate, and the soil is not allowed to fill in the voids in the gravel layer. Water movement within the surrounding soil or earthen materials can be improved and managed since the fabric allows water to pass through it, and thus does not impede the vertical or horizontal movement of water. Also, if the soil layer above or below the geotextile is impermeable, the fabric may act as a conduit for water flow.

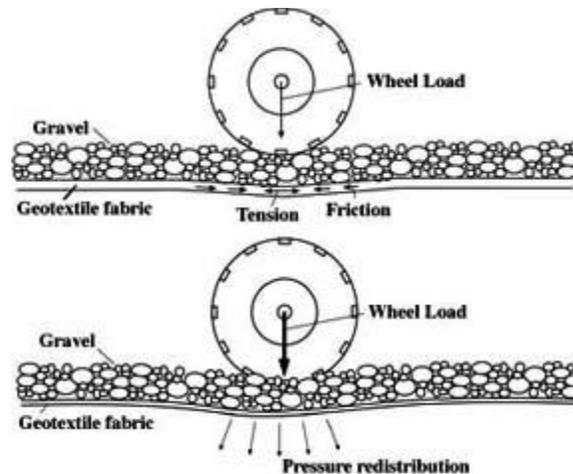


Figure 5. Stabilizing effect of a geotextile fabric (at top) and the subsequent redistribution of the wheel load (at bottom). (Modified from Agricultural Engineering Soil Mechanics).

Agricultural Applications for Geotextile Fabric

The original development of geotextiles focused largely on non-agricultural uses: subgrade, roadbed, and parking lot construction and stabilization; soil reinforcement; erosion and sedimentation control; and subsurface drainage and filters. However, there are many related agricultural applications, including: lanes to pasture paddocks, feedlots, and barnyards; livestock watering areas; silage bag and round bale storage and feeder areas; driveways for farmsteads and other farm roads; drainage ditch and stream crossing areas; subsurface drainage tubing connections; aprons for open-side livestock barns; and to extend existing concrete, paved, or graveled areas.

A word of caution should be noted here. Special considerations may need to be made in areas where livestock manure is stored and the soil material underlying or adjacent to the geotextile fabric is permeable. Since the fabric improves drainage, there may be some potential for rapid movement of manure, nutrients, bacteria, etc., into the surrounding soil, and possibly into an adjacent water supply.

Gravel Cover for Geotextile Fabric

Selecting the proper gravel to use on top of the geotextile fabric is very important. In Ohio, the most practical source of gravel is dolomite and limestone bedrock. A mixture of large (1.5 to 2 inch diameter) and small gravel sizes works best for vehicular traffic. For livestock traffic areas, if one well-mixed grade of gravel is not available, consider using two grades of gravel, one larger than the other, and increase the amount of fines. Place the larger gravel on the fabric first, then place the smaller gravel over the larger gravel.

Once properly placed on the fabric, smoothed and packed, the gravel mixture forms a hard packed surface that supports both equipment and animal traffic. Larger stone alone will not pack easily, will contain large open voids, and will not allow ease of travel by livestock. Gravel that is too small will not provide sufficient structural support. When the gravel layer is saturated, animals and equipment can sink into the layer.

For livestock operations, a minimum of six inches of gravel should be placed on top of the fabric. A 411 grade of gravel (gradation of gravel sizes from 1.75 to 0.5 inch with fines) works well for livestock traffic. In areas where round bales are fed to livestock, and in feedbunk areas, the gravel depth should be increased to eight inches. For driveways with heavy truck or tractor traffic, a minimum gravel depth of eight inches is recommended. Gravel grade 304 (gradation of sizes from 1.25 to 0.5 inch) is recommended for driveways, and bale and silage bag storage areas. Although grade 310 is sometimes recommended for these applications, the size gradation can be highly variable and inconsistent. Check with your local gravel supplier about the quality of the 310 grade. Approximately 110 tons of gravel will cover one 500 square yard roll of geotextile fabric with a six-inch thick layer of gravel.

Installation

Proper installation of geotextile fabric with gravel, soil, or other earthen material as a topcoat is best accomplished when the soil at the site is dry. The following is a series of tips to ensure proper site preparation, geotextile fabric installation, and cover material application at the site. The first step, however, is to select the proper geotextile fabric for the application.

Additional considerations can be found in *Guide for the Use of Geotextiles* (DN 24).

- Clear the area of any sharp objects, stumps, and debris.
- Grade the existing soil surface to provide adequate, but not excessive, surface drainage.
- Unroll the geotextile fabric over the application area. On a windy day, the fabric will need to be secured with pins, sod, stones, etc.
- Place the gravel on the fabric. It is best to back dump when unloading and spreading the gravel on the fabric with a truck. Then complete the final spreading and smoothing with earthmoving equipment like a dozer, front-end loader, skid loader, or scraper.
- Care should be taken when backfilling and compacting the gravel. Geotextile fabric is tough, so it can be driven on. However, truck tires may pull the fabric, causing it to wrinkle. This condition may affect the proper installation and

performance of the system since less area may actually be covered by the fabric.

- If it is necessary to overlap the fabric in order to cover a larger area, a minimum of a one foot overlap is required for proper use. In order to ensure a minimum of one foot of overlay after the placement of the gravel or other topcoat, it is recommended that the fabric be laid out with a two-foot overlap before placing the gravel on the fabric. Once placed, the gravel should be spread in the same direction as the geotextile fabric overlap to avoid separation between the two pieces of fabric. Staples are available to help hold the fabric in place.
- Compact the gravel using earthmoving equipment, a tractor, or farm trucks.

Maintenance

Since geotextile fabric provides separation between soil and gravel, or other earthen materials, the annual addition of gravel is usually not necessary as with conventional driveways and farm roads. If the area where the geotextile fabric was installed receives manure, it can be scraped periodically with a skid loader or box scraper. Gravel is sometimes removed during this process, and it should be replaced. The original depth of gravel should be maintained throughout the life of the system. Repairs should be made on an as needed, but timely, basis.

The Morrow County Project

Livestock producers were selected from the Olentangy River watershed within Morrow County, Ohio. Twelve cooperators were selected: six were beef producers, four were dairy, one was both dairy and poultry, and one was a producer of horses and llamas. Table 1 provides a summary of additional information about these twelve sites.

Table 1. Producer information for the Morrow County geotextile demonstration project for 1994.

Cooperator	Producer	Animal Type	Application Area	Number of Rolls Applied
D. Barnett		Beef	Feedlot	4
			Lane to water trough	
R. Beck		Beef	Barn apron	1
E. Dreyer		Beef	Stream crossing	1
J. Dreyer		Beef	Bunk feeding	1
D. Gompf		Beef	Feedlot/Barnyard	1
S. Gompf		Beef	Silage bag storage	1
			Bunk feeding	
J. Higgins		Dairy	Traffic lanes to	1
			rotational paddocks	
H. Leonhard		Dairy	Traffic lanes to	5
			rotational paddocks	
			Round bale feeding	
			Heifer barn floor and apron	
J. Patterson		Dairy	Silage bag storage	4
K. Stauffer		Dairy	Round bale feeding	1
			Traffic lanes	
E. Ruhl		Dairy	Driveways	3
			Poultry	
C. Ross		Horses	Traffic lanes to	1
		Llamas	rotational paddocks	

Economics

For application on the twelve Morrow County sites, one roll (500 square yards) of the 5 to 6 oz./sq. yd. geotextile fabric cost between \$290 and \$371 (1994 prices), and gravel costs were between \$6.00 and \$8.52 per ton. Average values from all twelve sites was \$3.24 for a 500 square yard roll of fabric, and \$7.21 per ton of gravel. The cost for site preparation, labor and smoothing varied greatly by location. From the information collected on the twelve sites during 1994, cost breakdowns were further developed for the four sites with the lowest costs, and the four sites with the greatest costs. These values are provided in Table 2.

Table 2. Materials and installation cost breakdown for the Morrow County geotextile fabric demonstration project (1994 prices).			
	Smallest Cost for 4 Sites	Greatest Cost for 4 Sites	Average Cost for 12 Sites
Geotextile fabric ¹	\$290	\$371	\$324
Gravel (\$/ton)	\$6.05	\$8.52	\$7.21
Gravel (tons)	91	135	21
Site Preparation	\$110	\$820	\$403
Total Cost	\$1,068	\$2,210	\$1,501
¹ Cost per one 500 square yard roll.			

In some situations, geotextile fabric and gravel may be an alternative to concrete. Generally, the cost for the fabric and gravel will be 25 to 33% of the cost of concrete. For instance, a 500 square yard area of five inch concrete would require 69 cubic yards of concrete. The total cost with concrete priced at \$50 per cubic yard, and installation at \$25 per yard would be \$5,175. When comparing this estimated cost to those of the demonstration sites, the installation of geotextile fabric becomes a cost effective alternative to concrete for some applications.

Evaluation

Evaluation of the Morrow County project included producer acceptance of the practice of installing geotextile fabric in high-traffic areas. The twelve producers participating in the project during 1994 were pleased with the results of installing geotextile fabric on their farms (see Figure 5). One participant stated "It seems to be a very effective way to keep animals out of the mud. I will use geotextile fabric again." Another stated "I'm not the least bit disappointed with how it's working. Before when it rained, we were in it this deep" (pointing to their knees). Although producer acceptance is a positive result, the long-term evaluation of these twelve systems is very important. The project team will continue to assess the impact of these twelve systems, and track the implementation of this practice on other farms in the county.



Figure 6. Producers and technical agency personnel discussing the recent installation of a geotextile fabric at a livestock feeding area.

A few potential problems are worth noting. As mentioned earlier in this publication, the issue of water quality should always be evaluated for situations where livestock wastes are handled, collected, or stored. In areas where livestock use stream crossings to move from one field to another, the combination of fencing and geotextile fabric can provide protection for the stream as well as provide a stable, low water crossing for the livestock. Another area of potential concern is locations where silage drainage, which may be acid, moves into and partially dissolves the gravel. It is important to look for such potential problems, and the authors welcome readers' comments and observations.

Summary

High-traffic areas used by livestock and farm equipment have little chance to support vegetation. Without vegetation or other stabilizing structures, these areas are subject to erosion and accelerated runoff. Protecting these areas with geotextile fabric and gravel systems helps to control erosion, and provides a surface that both livestock and equipment can effectively use.

The purpose of this publication was to help producers, landowners, and agency and industry personnel who work with producers and landowners, understand the proper application, installation, and maintenance of geotextile fabric for some agricultural applications. This publication provided an overview of a project that demonstrated the use of geotextile fabric in high-traffic livestock areas. Some of the material provided is based on cooperative agency-industry-producer experiences on twelve project sites constructed in Morrow County, Ohio, during 1994. Other uses of geotextile fabrics that have been documented by the authors include wrapping plastic tubing joints for subsurface drainage installation, providing a stable and well-drained foundation for a composting facility, and a parking lot and farm road for a Christmas tree farm.

More Information

The USDA NRCS has several publications that provide specifications and guidelines for geotextile applications. This information, and information concerning geotextile fabric applications in high-traffic livestock areas and the Morrow County demonstration project can be obtained by contacting the Morrow County office of Ohio State University Extension, the Morrow Soil and Water Conservation District (SWCD) office, and/or the USDA NRCS office. All three offices are located at 871 W. Marion Road, Mt. Gilead, Ohio 43338. Additional publications are listed in the Bibliography.

Where to Obtain Geotextile Fabric

There may be several sources of geotextile materials in your county. Depending on local conditions, some sources are: highway construction companies, construction materials and supply companies, drainage contractors, drainage materials and supply companies, and farm supply stores. The two companies in Ohio that cooperated with the Morrow County project were: Advanced Drainage Systems (ADS), P.O. Box 111, St. Rt. 142, London, OH 43140 (1-800-733-9554), and Valley Asphalt, 1901 Dryden Road, Dayton, OH 45439 (513-293-4119). At the national level, additional information on all types of geotextiles can be obtained through the Industrial Fabric Association International, 345 St. Paul, MN 55101 (612-222-2508) and its Geotechnical Fabrics Report (see Bibliography).

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