

# Improving Pipeline Stability with Geosynthetic Reinforcement

By James Arnold, Blue Stone Supply

(P&GJ) — You probably don't see pipelines in your daily life, but your standard of living certainly relies on them. Most days, they provide long-distance transportation routes for liquids and gases, usually from wells and refineries to market areas where consumers need them.

However, there are days when they make the news because of complications or issues with their service and supply.

Nearly every country on the planet has pipelines of some kind covering over 2 million total miles. Energy pipelines deliver fuels such as diesel, gasoline, propane and ethane.

Given the importance pipelines have for economic prosperity and security, it's crucial that they remain as stable as possible. Many modern engineers use geosynthetic materials to reinforce pipelines to achieve this.

Reinforcing pipelines with geosynthetic materials is called geosynthetic reinforcement. Pipelines are among the engineering structures that need stable soil to support them, and geosynthetic materials work well for this. They're man-made materials that can stabilize and improve soil conditions.



Soil stabilization can be achieved on steep embankments geosynthetic reinforcement.

Many are made using petrochemical-based polymers and plastics. Given their biologically inert nature, they don't decompose because of fungal or bacterial actions. These properties make them useful in solving geotechnical complications in transportation, civil engineering, and environmental geology.

Geosynthetics come in many categories. Geotextiles are woven or felted materials valuable due to their tensile strength, flexibility, filtration, and permeability. Geofoam is made using highly expanded polystyrene, featuring crush resistance, low weight, and drainage ability thanks to gaps between the foam particles. Geocells are another example of a rigid composition that boosts the load capacity of pavement structures, including pathways, parking lots, and roadsides.

## Enhancing Stability

Pipelines are usually responsible for moving resources from their points of origin to refineries and then toward consumer markets. Still, they can go offline or be compromised by multiple problems.

When they fail, they stop delivering critical assets necessary for economic activity and sustained living standards. This can happen due to operator errors, criminal activity, vandalism, and acts of terror. However, they are also susceptible to equipment failure, excavation damage, and natural disasters.

Enhancing pipeline stability plays two roles in mitigating these risks. First, addressing these issues can help prevent these calamities and accidents from happening in the first place. Second, pipeline stability enhancements can contain the severity of incidents when they do occur.

Geosynthetic reinforcements are one way to enhance the stability of pipelines, and they're also used in other engineering applications, such as landfills, landscaping, and earthworks.

Geosynthetic reinforcements let engineers enhance pipeline stability, but they must identify and institute the right methods for each scenario.

Pipelines have to pass through many regions. Some feature cumbersome conditions, earthquakes, and fragile soils. Ground improvements are necessary for structural reliability.

Filling geotextile columns with locally sourced soils keeps the engineering consistent with surrounding conditions and provides load capacity that settles during construction. This technique is used globally for oil tanks and related infrastructure.

## Protecting Groundwater

Many pipelines run the perpetual risk of contaminating groundwater in the terrain that they pass through. Still, oil-absorbent matings placed in unpaved areas can keep any resource leaks contained to some degree. They can let rainwater pass through lower slopes so the downstream regions aren't deprived of vital [moisture](#) and hydration.

Geosynthetic materials for this particular application are often available in tools that are easily stored and quick to cut to the necessary size for prompt on-site installation.

## Slope Stability

Many human cities and population centers exist in areas where the land is relatively flat or has terrain with gentle slopes, but pipelines have to cross all kinds of geography to connect resources with consumption demand.

Soil slippage and erosion can damage environmental areas pipelines pass through and jeopardize the line. Geosynthetic meshes can retain engineered slopes so the soil remains in place and encourages plant growth. Strong roots offer more support over time, especially in rainy areas.

Pipelines sometimes have to cross terrain that's hard to navigate, and the equipment necessary to construct or maintain a [pipeline](#) might be heavier than local ground can safely tolerate. Pipeline crossings, working platforms, haul roads, and storage areas are all places where too much load is placed on the underlying soil, resulting in erosion and runoff or unstable ground later on.

Geosynthetic materials can be placed to temporarily accommodate high loads safely without deforming the existing terrain. They can be installed and removed quickly as necessary for temporary operations.

## Underwater Erosion

When pipelines need to cross a body of water, the answer is sometimes to go underneath the beds at the bottom. This preserves the visual aesthetics of these waterbodies and keeps the pipeline from disrupting the movement of wildlife and boat traffic. It can also help protect the pipeline from the elements, it can also increase erosion risk.

Underwater installation of geosynthetic materials can involve near-impermeable and permeable surfaces, depending on the local requirements. Reliable protection can be strong enough to withstand anchor impacts and keep a riverbed intact to maintain the safety of the waterway and the pipeline passing underneath.

The idea of geosynthetic reinforcement for enhancing pipeline stability is a broad category involving using geosynthetic materials to stabilize soil blocks so that pipelines are more durable and perform better.

Depending on the specific circumstances for each stretch of the [pipeline](#), engineers and construction crews can choose several different particular applications. Retaining walls might be something you're familiar with in your own community, and geosynthetics can help them from falling when pipelines on them.

Woven geotextiles are used to prevent erosion along streams, creeks, and rivers. Foundations placed on organic, soft, or loose soils often need reinforcement, and geosynthetics can keep water from seeping into them so they have more bearing capacity and width. Embankments are also frequently placed on soft soil, and geosynthetic materials can manage potential lateral sliding by reducing the stress load on the dirt underneath.

## Benefits

Geosynthetic reinforcements have several benefits when used to enhance [pipeline](#) stability, such as usability, stability, and cost-efficiency. In terms of usability, geosynthetic reinforcement can boost how much usable land is available along a pipeline route for broader design flexibility that utilizes otherwise marginal soils.

Stability features of geosynthetic reinforcements include increasing stress capacities and resisting loads placed on underlying terrain. Perhaps the most potent aspect of geosynthetic reinforcements is the ability to save money.

Soil-retaining solutions are possible that empower retaining walls but also sometimes avoid the need for them. Geosynthetics save time and money on construction and development projects because there is less need for equipment and labor.

## Conclusion

Pipeline operators need steady operations to protect their own business reputations and continuity, but they also need to manage risks and comply with regulations and legal stipulations covering their industries. However, everyone needs pipelines to be constantly effective for the energy security and economic stability necessary for collective prosperity.

Health hazards are always a concern, too, as pipeline integrity ensures community safety, social welfare, sustainability, and the preservation of surrounding environments. Geosynthetic materials protect pipeline engineering, the environment, and the economy across a multitude of applications.