

# Reduce Costs and Protect the Environment in Civil Infrastructure Projects

Transportation Infrastructure Construction



**TITAN**

BUILD YOUR LEGEND

# Introduction

Civil infrastructure consists of structures that facilitate our day-to-day lives. A large portion of civil infrastructure projects fall under civil works, which involve the construction of transportation networks.

As a leader in geosynthetics, Titan works with civil engineering consulting firms and contractors to provide product solutions that seamlessly integrate into design and construction of a variety of civil infrastructure projects.

This is a guide to reducing costs and environmental impacts associated with transportation-related civil infrastructure applications by using 2 innovative products: Geogrids and Concrete Canvas®.

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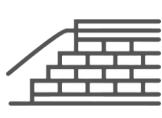
Geogrids and Concrete Canvas® are versatile products that can be specified for several applications:



GRAVEL AND  
PAVED ROADS



SIDEWALKS



ROAD  
EMBANKMENTS



MSE WALLS  
AND SLOPES



BRIDGE  
ABUTMENTS



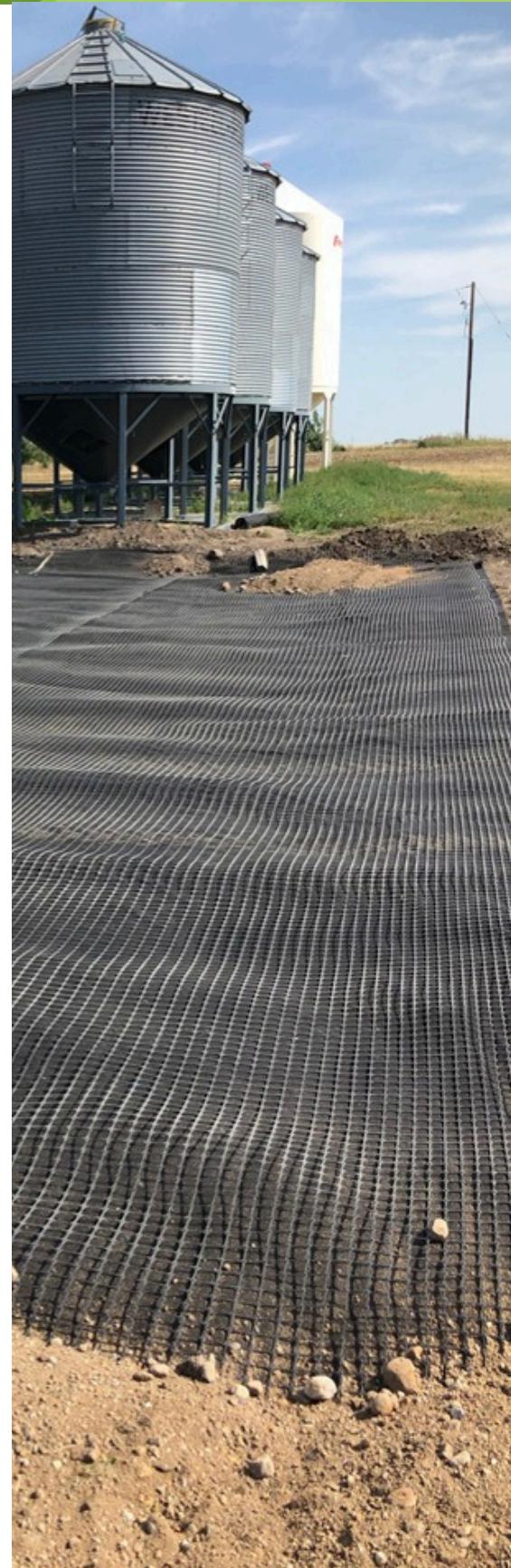
RAILWAYS



OUTFALLS



DITCHES AND  
CHANNELS



## What are Geogrids?

Soil conditions and properties are important considerations in the design of civil infrastructure projects. Poor soil properties can either make construction impossible or lead to performance failures that can be costly. Geogrids ensure proper soil reinforcement and/or stabilization. They work to do 2 critical things:

- 1.Improve mechanical properties of soil by reducing stress-strain behaviour.
- 2.Improve the mechanical behaviour of granular material by minimizing movement and allowing for effective load distribution.



## What is Concrete Canvas®?

Concrete Canvas® (CC) is part of a new class of construction material known as a Geosynthetic Cementitious Composite Mat (GCCM). A GCCM is a factory-assembled geosynthetic composite consisting of a cementitious layer contained within one or multiple layers of geosynthetic materials. The cementitious portion of the GCCM becomes hardened when properly hydrated to be used for erosion control and weed suppression in a variety of applications. CC can be used to remediate existing infrastructure, greatly increasing the operational life of assets and avoiding costs associated with asset replacement and future maintenance.

## Building on a Wall or Slope?

Mechanically stabilized earth (MSE) walls and slopes are composite structures consisting of alternating layers of compacted aggregate backfill and geosynthetic reinforcement, working as a system to create a stable earthen wall or slope structure.

We offer professional value-engineered MSE system solutions backed by our in-house MSE engineering team. We provide engineering support, drafting, and engineered stamped drawings to ensure your project and investments are protected.

## Choosing the right geogrid for your application.

### **Swamp Grid®**

Offers soil reinforcement with added soil filtration, soil separation, and sub-base drainage performance. This biaxial geogrid is extremely effective for stabilizing saturated soils that are susceptible to piping and preventing the loss of imported granular material into the soft subgrade.

### **Titan Earth Grid®**

Is a biaxial geogrid that works to increase the bearing capacity and stabilization of dry, low load bearing soils.

### **Pyramid Grid®**

Is a uniaxial geogrids are specifically designed for soil reinforcement in applications such as retaining walls and steep slopes where soil strength develops uniaxially. Can be used alone or with a range of facing elements.

### **Spartan Road Grid™**

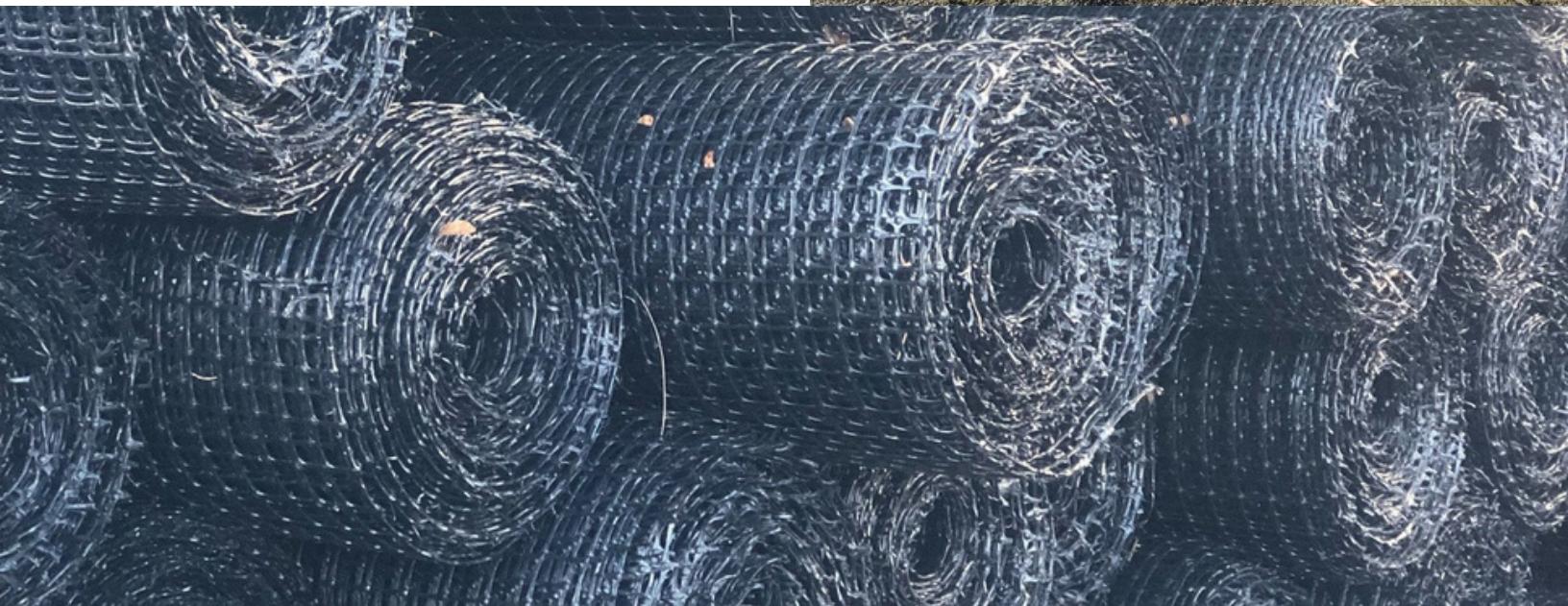
Is a line of fiberglass geogrids designed specifically as an interlayer for asphalt reinforcement.

# Reduce Costs and Environmental Impact Using Geogrids

In the following table, “Conventional Solutions” is defined as various design and construction approaches that are traditionally selected for soil reinforcement and stabilization challenges in civil infrastructure projects, such as:

- Excessive use of aggregate base/backfill
- Lime or lime cement stabilization
- MSE wall/slope reinforcement elements such as steel strip polymeric straps
- Extensive milling and overlay/inlay for the rehabilitation of distressed asphalt pavements

These approaches can be successful, however they often cost more to install, have worse effects on the environment, and contribute to a shorter performance life than geogrids in the same applications.



# Comparison Tables

**SWAMP GRID® = BASE REINFORCEMENT AND STABILIZATION FOR SOFT, SATURATED SOILS**

	Swamp Grid®	Conventional Solution	Environmental Benefits
<b>Materials</b>	1 or minimal layers of Swamp Grid®. Reduced soil excavation, backfilling and granular layer thickness.	Multiple layers of aggregate, increased backfilling, and thicker granular layers to provide strength and stiffness required for structure.	Swamp Grid® is mechanically and chemically stable in aggressive soil environments and formulated to resist UV degradation. Not susceptible to hydrolysis, environmental stress cracking and micro-organism attack. Does not contaminate local soil. Less backfill = less environmental impact on site.
<b>Equipment &amp; Delivery</b>	1 truck, minimal equipment.	Multiple trucks, heavy-duty equipment.	Less heavy equipment = lower carbon emissions and minimal environmental impact.
<b>Labour &amp; Installation</b>	Simple installation and reduced maintenance. Swamp Grid® is unrolled and placed on site.	More timely to dump and spread aggregate installation than unroll and place geogrid. However, installation requires more layers of aggregate, bumping up project costs and carbon footprint.	Swamp Grid® has less of an environmental impact on site during installation. The amount of aggregate required for conventional solution produces significantly more carbon emissions.
<b>Schedule</b>	Project completed on time due to efficient delivery of materials, ease of installation and successful performance on heavily saturated subgrade.	Delays due to saturated subgrade that is unsuitable to build on, or excessive use of aggregate.	Quicker schedule = less time using carbon emitting equipment on site and shorter period of environmental disturbance.
<b>Structural Results</b>	Proven high survivability with coarse-aggregates. No damage from freeze-thaw conditions. Minimizes differential settlement & prevents upward movement of subgrade and pumping of fines = higher structural performance. Tested in North America and CE Certified.	Susceptible to higher differential settlement and freeze-thaw heaving.	Optimal structural integrity and longer performance = less maintenance that requires carbon emitting construction and environmental disturbance.

In a [mine haul road application](#), Titan's solution provided our client with cost savings of over \$1 million by allowing them to use far less aggregate base (0.7 m thick vs. 1.0 m), while helping to reduce impact on the environment. (Although this application was specifically for a mine site, it has significant implications on the cost savings that can be achieved in civil transportation applications).

In a [base reinforcement application](#) for CN Rail, Swamp Grid ® was installed successfully over significantly weak and saturated subgrade soils, creating a satisfactory foundation for the rail tracks trafficked by heavy rail cars.

## TITAN EARTH GRID ® = BASE REINFORCEMENT & STABILIZATION FOR DRY LOW LOAD BEARING SOILS

	Titan Earth Grid®	Conventional Solution	Environmental Benefits
<b>Materials</b>	1 or minimal layers of grid. Reduced soil excavation and backfilling.	Thick aggregate layer(s).	Titan Earth Grid® is mechanically and chemically stable in aggressive soil environments and formulated to resist UV degradation. Not susceptible to hydrolysis, environmental stress cracking and micro-organism attack. Does not contaminate local soil. Less backfill = less environmental impact on site.
<b>Equipment &amp; Delivery</b>	1 truck, minimal equipment.	Multiple trucks, heavy-duty equipment.	Less heavy equipment = lower carbon emissions and minimal environmental impact.
<b>Labour &amp; Installation</b>	Simple installation and reduced maintenance. Titan Earth Grid ® is unrolled and placed on site.	More timely to dump and spread aggregate installation than unroll and place geogrid. However, installation requires more layers of aggregate, bumping up project costs and carbon footprint.	Titan Earth Grid® has less of an environmental impact on site during installation. The amount of aggregate required for conventional solution produces significantly more carbon emissions.
<b>Schedule</b>	Project completed on time due to efficient delivery of materials and successful performance that compensates for installation process.	Delays due to higher material delivery quantities. Loss of aggregate into soft subgrades requiring additional material and installation time.	Quicker schedule = less time using carbon emitting equipment on site and shorter period of environmental disturbance.
<b>Structural Results</b>	Proven high survivability with coarse-aggregates. No damage from freeze-thaw conditions. Minimizes differential settlement & prevents upward movement of subgrade = higher structural performance. High tensile stiffness at low strains to resist environmental exposure. Tested in North America and CE Certified. Low construction damage.	Susceptible to UV degradation, construction damage, continual maintenance, grading and addition of aggregate to prevent rutting.	Optimal structural integrity and longer performance = less maintenance that requires carbon emitting construction and environmental disturbance.

When specified for the correct applications, using Titan Earth Grid® for base reinforcement can save up to 40% of granular thickness, significantly reducing carbon emission and costs of the project.

## PYRAMID GRID® = BASE REINFORCEMENT & STABILIZATION WHERE SOIL STRENGTH DEVELOPS UNIAXIALLY

	Pyramid Grid®	Conventional Solution	Environmental Benefits
<b>Materials</b>	1 or minimal layers of grid. Allows use of on-site fill. Provides up to 60% in material and time savings compared to conventional reinforced concrete and gravity structures.	Multiple layers steel polymeric strips, reinforced concrete and gravity structures, excessive backfill material.	Pyramid Grid® is mechanically and chemically stable in aggressive soil environments and formulated to resist UV degradation. Not susceptible to hydrolysis, environmental stress cracking and micro-organism attack. Does not contaminate local soil. Less backfill = less environmental impact on site.
<b>Equipment &amp; Delivery</b>	1 truck, minimal equipment	Multiple trucks, heavy-duty equipment	Less heavy equipment = lower carbon emissions and minimal environmental impact.
<b>Labour &amp; Installation</b>	Simple, faster installation and reduced maintenance. Pyramid Grid® is unrolled and placed on site.	More timely to dump and spread aggregate installation than unroll and place geogrid. However, installation requires more layers of aggregate, bumping up project costs and carbon footprint.	Easier installation = less environmental impact on site.
<b>Schedule</b>	Project completed on time due to efficient delivery of materials and successful performance that compensates for installation process.	Delays due to higher material quantities and working with difficult materials.	Quicker schedule = less time using carbon emitting equipment on site and shorter period of environmental disturbance.
<b>Structural Results</b>	Ability to withstand differential settlement = higher structural performance. High resistance to dynamic shock loading and seismic activity. High connection capacity strength between facing and the grid.	Susceptible to deformation and reinforcement failure in aggressive soil conditions.	Optimal structural integrity and longer performance = less maintenance that requires carbon emitting construction and environmental disturbance.

In an MSE wall and box culvert embankment application, Pyramid Grid® provided approximately 40% in material and time savings compared to conventional reinforced concrete and gravity structure.

## SPARTAN ROAD GRID™ = INTERLAYER FOR ASPHALT REINFORCEMENT

	Spartan Road Grid™	Conventional Solution	Environmental Benefits
<b>Materials</b>	1 layer of grid, reduced milling and inlay, reduced thickness of ACP.	Excessive milling and inlay, thicker ACP.	Spartan Road Grid™ is highly durable, biologically unaffected by soil micro-organisms, inert to all chemicals normally found in the soil, and formulated to resist ultraviolet degradation.
<b>Equipment &amp; Delivery</b>	1 truck, minimal equipment	Multiple trucks, heavy-duty equipment	Less heavy equipment = lower carbon emissions and minimal environmental impact.
<b>Labour &amp; Installation</b>	Reduced labour as there is less material being applied. Spartan Road Grid™ is unrolled and placed on site.	More timely to dump and spread asphalt aggregate installation than unroll and place geogrid. However, installation requires more layers of asphalt aggregate, bumping up project costs and carbon footprint.	Easier installation = less environmental impact on site.
<b>Schedule</b>	Project completed on time due to efficient delivery of materials and successful performance that compensates for installation process. Pavement reconstruction of distress pavements can be simplified by doing partial reconstruction and or pavement rehabilitation only, reducing cost and time.	Delays due to necessitated backfilling, replaced subgrade, barrier installation and/or excessive maintenance, excessive milling and additional asphalt layers.	Quicker schedule = less time using carbon emitting equipment on site and shorter period of environmental disturbance.
<b>Structural Results</b>	Increases the fatigue life of pavements with weak foundations. Reduces pavement rutting under high ambient temperatures and intense wheel loads. Composites reduce pavement water infiltration. Minimizes both thermal and stress-related reflective cracking. Extends pavement life. Reduces overlay thickness to a minimum of 50 mm.	Requires heavy maintenance over time. Susceptible to migration of reflective cracks and fatigue life of the asphalt overlay. Requires additional maintenance over the lifespan of the roadway.	Optimal structural integrity and longer performance = less maintenance that requires carbon emitting construction and environmental disturbance.

Spartan Road Grid™ reduces overlay thickness to a minimum of 50 mm, providing significant cost savings in asphalt reinforcement applications.

# Reduce Costs and Environmental Impact using Concrete Canvas®

In transportation-related civil applications, Concrete Canvas® (CC) is a valuable tool for infrastructure remediation. Rather than demolish existing infrastructure, leveraging CC for remediation can provide significant cost savings and prevent environmentally impactful construction. In addition, CC is a cost-effective option for erosion control applications located near transportation infrastructure, such as:

- Ditches
- Culverts
- Channels
- Retaining Soil System (RSS)

The following table summarizes a [channel lining application](#) located in Rogers Pass Glacier Park, a remote area in British Columbia susceptible to high water flow in the spring that causes significant erosion issues around critical infrastructure (roadways and rescue helipads).

	Concrete Canvas®	Conventional Concrete	Environmental Benefits
<b>Materials</b>	375 sq m CC8. 1,280 sq m CC13.	1,655 sq m of concrete.	Unlike most concretes, CC is not classified as an irritant and is less damaging to the environment.
<b>Equipment &amp; Delivery</b>	1 excavator required in extremely remote location.	3 pieces of equipment in extremely remote location.	Less carbon emissions from 1 excavator during transportation.
<b>Labour &amp; Installation</b>	5 people. Efficient installation. Available in man-portable batch rolls suitable for remote applications. No site mixing or measuring.	7 people. Installation requires forming, mixing, placement, early finishing, troweling, final finishing and curing.	Low-mass, low-carbon technology enables CC to use up to 95% less material than standard concrete for many applications. A single pallet can cover the same area as two 17T mixer trucks, producing minimal waste.
<b>Schedule</b>	5 days required to install. The installation rate was approx. 340 sq m per day. CC can be laid at a rate of 200m <sup>2</sup> /hour, up to 10 times faster than conventional concrete solutions.	14 days required to install and set 1,655 sq m of concrete.	Less time spent using heavy equipment that emits carbon.
<b>Structural Results</b>	Resistance to heavy impact/loads that prevent cracking. 5x more abrasion resistant than standard concrete. Excellent chemical resistance, good weathering performance, and not susceptible to UV degradation.	Susceptible to corrosion of embedded metals, freeze-thaw deterioration, chemical attack, alkali-aggregate reactivity, abrasion/erosion, overload and surface defects.	Optimal structural integrity and longer performance = less maintenance that requires carbon emitting construction and environmental disturbance. Excellent option for remediation to increase the longevity of an aging but functional structure.

# Reduce costs and environmental impact in civil infrastructure applications with the right design approach and materials.

All product solutions are backed by comprehensive engineering and specialized technical support.

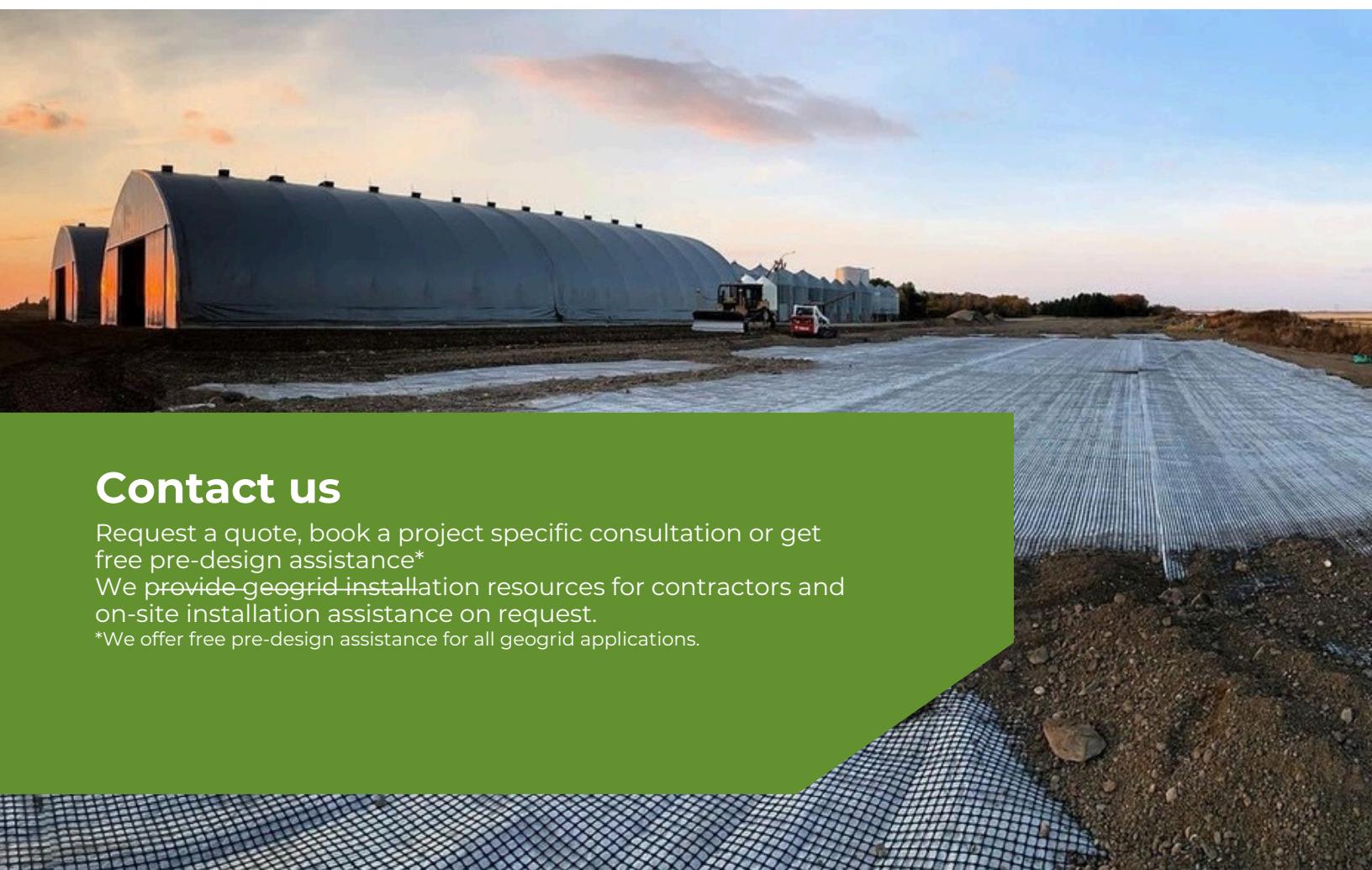
Product Brochures:

[Swamp Grid®](#)

[Titan Earth Grid®](#)

[Pyramid Grid®](#)

[Spartan Road™](#)



## Contact us

Request a quote, book a project specific consultation or get free pre-design assistance\*

We provide geogrid installation resources for contractors and on-site installation assistance on request.

\*We offer free pre-design assistance for all geogrid applications.

**Titan Environmental supplies proven geosynthetics and specialty civil engineering construction solutions designed to extend the life of vital infrastructure while protecting precious natural resources.**

We push limits with creative solutions. Our product lines include geomembranes, geotextiles, geogrids, primary & secondary containment systems, stormwater management solutions, drainage solutions, MSE wall & slope systems, and erosion & sediment control products. We service the road construction, agricultural, waste management, water resources, mining, oil and gas, and hydroelectric industries that support essential infrastructure worldwide. By providing engineers with a resilient foundation for building better, we've become North America's fastest-growing-end-to-end geosynthetics supplier, fabricator and installer.

We do more than help manage environmental impact, we help improve how that's done. With a team of audacious innovators and agile problem-solvers, we're trusted to adapt to change, respond quickly, and support you at every stage. When you build with Titan, you strive for your very best.