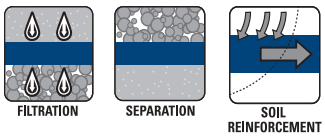
TENCATE Mirafi®



Case Study

application	Embankment on Soft Subgrade	engineer	Canada Pacific Railway (CPR)
location	Telford Marsh, Kenora, Ontario, Canada	engineer	KGS Engineering Group
product	Mirafi® PP300	contractor	Hugh Monro Construction

TenCate develops and produces materials that function to increase performance, reduce costs and deliver measurable results by working with our customers to provide advanced solutions.

THE CHALLENGE

Canadian Pacific Railway (CPR) is renowned for building rail lines through some of North America's toughest terrain. Just east of Kenora, Ontario, near the Manitoba/Ontario border, a main CPR track crosses the Telford Marsh, an area of weak organic soil. A 250m (285ft) section of track located at mile 45.2 required frequent tamping of the ballast to maintain proper alignment. Typically a slow order will be issued if there is a horizontal differential of 19-32mm (0.75-1.25in) between rails.

THE DESIGN

In March 2005, CPR contracted with KGS Engineering Group, a Manitoba-based geotechnical consultant with extensive railway experience, to solve this ongoing alignment problem. To further complicate matters, access to the area for both site investigation and construction had to be by rail from a level crossing 1.6km (1mi) away. In addition, the engineered solution would have to be constructed during a series of 7-hour blocks to not disrupt rail traffic.

KGS engineers determined, upon review of their bore hole logs, that a toe berm would be required on the north side of the track to prevent further movement of the existing rail embankment. The stratigraphy at the marsh consists of 2.5 to 3.5m (8-11.5ft) of soft, saturated, organic soil with a shear strength of 6kPa (125psf) over 1.5 to 2.0 m (5-6.5ft) of lose fine-grained sand overlying 1m (39in) of soft, intermediate plasticity clay with a shear strength of 15kPa (312psf).

KGS also looked at the possibility of relocating the track onto the new berm in the future. A major consideration was the failing of the soft foundation soils under the increased loads if the railway track was moved. A conceptual berm design was generated incorporating a biaxial polypropylene geogrid for reinforcement with a nonwoven geotextile to provide separation between the granular and in-situ organic soils. However, there was concern regarding the strength provided by this geogrid/nonwoven combination. A detailed stability analysis was performed to determine the safety factor for the berm with and without geosynthetic reinforcement. It was determined that the berm would need to be 1m (39in) height by 250m (820ft) long by 10m (33ft) wide.

A geosynthetic reinforcement material, having a minimum wide width tensile strength of 300kNm (20,556lbs/ft), to provide an acceptable factor of safety, was also proposed. Another recommendation was that the berm should be constructed of 13mm (0.5 in) diameter granite crusher fines, a waste product of the railway's ballast production operation.

KGS turned to Armtec, TenCate Mirafi®'s Canadian distributor, in a search for potentially better geosynthetic solutions. Armtec's recommendation was Mirafi® PP300. This geotextile provides the benefit of both separation and high tensile strength at low strains (5%).

High permeability was also required in order to reduce pore pressures in the foundation soils.

This requirement was important because the designers were relying on increased shear strength of the foundation soils through the consolidation process. This geotextile also has low construction damage value, an important plus when used in contact with the railway ballast reject (the crusher fines).

THE CONSTRUCTION

The geotextile was factory-sewn into 6 panels of 10 x 50m (33 x 164ft). Each panel weighed approximately 400kg (880lb) and was folded in a concertina fashion. This would ultimately simplify the installation process. A butterfly seam using a type 401 double thread "lock stitch" with approximately 4 stitches per 25mm (1in) was used to sew the geotextile pieces together. Seam strength was 25kNm.

Construction was scheduled for July 2005. Before deploying the geotextile panels, contractor Hugh Munro Construction, dug a 600 x 1000 mm (24 x 39in) anchor trench along the length of the existing railway embankment. A front-end loader was used to unfold each panel ontop of the existing tracks and then deployed over undisturbed ground, assisted by an excavator and five men. The panels were placed with the seams running perpendicular to the

existing embankment, extending into the anchor trench.

Adjacent panels had a minimum overlap of 1.5m (5ft). Side-dump rail cars were used to bring in the granular material. Before placing any fill on the geotextile, the anchor trench was backfilled and nominally compacted to lock in the material. Once locked in place, backfilling could commence.

Working from a pad constructed on the geotextile, a large excavator was used to place the granular fill to its design height. Compaction was achieved by walking the excavator back and forth over the granular as the berm was constructed.

THE PERFORMANCE

As with most railway projects, the construction had to be completed without disrupting rail traffic. At the Telford Marsh site, that meant a series of 7-hour time blocks from 4:00am - 11:00am. The entire construction sequence took three weeks to complete, working three 10-hour days a week.

The geotextile fabricated panels used in this project helped to provide a successful completion of the berm on time and as designed.

Location: Kenora, Ontario, Canada
Start date: March 2005
Completion date: July 2005

Mirafi® PP300 Geotextile
Dimensions: 1m height x 10m width x 250m length

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