



## Case Study

**application** Reinforced Embankment  
**location** Canal Street, Milwaukee, WI  
**product** Mirafi® HS800 & PET600

**job owner** City of Milwaukee  
**engineer** HNTB, Milwaukee  
**contractor** Schneider Excavating

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

The reconstruction of I-94 in Milwaukee called for a traffic relief road to be built to accommodate the diverted traffic caused by the new construction. The project consists of reconstructing the existing 1.3 miles (2.0 km) of Canal Street as well as the new construction of approximately 1.2 miles (1.9 km) of the Canal Street extension. The site of the new road is an old industrial and railroad yard dating back to the 1800's. The existing soil was a granular fill approximately 8 to 10 ft (2.4 to 3 m) deep, consisting of foundry sand and cinders. Beneath this fill is between 20 to 70 ft (6 to 21.3 m) of a soft organic clay material. The site also lies in an existing flood plain. The entire site will be raised an average of 8 ft (2.4 m) to bring the new road out of the flood plain. The challenge was to construct the new roadway over these soft soil conditions. Adding to the already difficult situation, a fast tracked

time frame for the I-94 reconstruction pushed the project start time ahead.

### THE DESIGN

A number of design options were investigated for the new road construction. These included stone columns, piles, geo-piers, excavation and replacement or geotextile reinforced construction. The latter was chosen because it was the most cost-effective approach and also met the time constraints of the project. The original design without reinforcement showed deep failures at the top of the organic layer resulting in safety factors less than one. To accommodate the loads of the approach embankments, the project was designed using high strength geotextiles for reinforcement and also to aid in the control of differential settlement. First the embankment was designed, and then the fabric parameters necessary to achieve the recommended factor of safety for global stability were determined. Two different types of high strength polyester geotextiles were chosen. A total of 28,350 sy (23,704 m<sup>2</sup>) of Mirafi® HS 800 with a LTDS of 4553 lbs/ft

kN/m) was specified for the low fill areas and 5,340 sy (4,464 m<sup>2</sup>) of PET 600/100 with a LTDS of 21,378 lbs/ft (311 kN/m) was used for the higher fill areas. Due to the pressed construction schedule it was necessary to surcharge the embankments to accelerate consolidation.

### THE CONSTRUCTION

The contractor initially had to excavate 18 in (457 mm) of fill soil with variable organic content off of the site. The subgrade was compacted prior to the fabric being installed. The fabric was laid out in one continuous panel. This was necessary to reduce the possibility of differential settlement. Large master rolls of geotextiles were utilized to minimize waste. The fabric was deployed using a spreader bar attached to an excavator. A total of 12 in (300 mm) of a silty sand material was placed on top of the fabric and compacted to 95% modified proctor. This layer also acted as a drainage layer for the embankment. Strict criteria were prescribed for the fill placement.



High strength geotextiles aid in the control of differential settlement.



Large master rolls of Mirafi® HS800 were laid out in one continuous panel.

The surcharge was added in 8 in (200 mm) lifts from material stockpiles brought on site and then compacted. Much of this material came from the construction of the new Miller Park. Two inspectors monitored the compaction process to insure proper density was met. The surcharge was added to achieve a final height of 23 feet (7.0 m) at the tallest point.

**THE PERFORMANCE**

Based on the analysis performed by HNTB, it is estimated that the surcharge will need to be in place for 14 months to allow the majority of the primary consolidation to occur. The embankment is expected to settle 14 in (355 mm) over this time. Settlement plates, piezometers and inclinometer cosines are being used to gage the progress on site. Once the settlement has occurred, the surcharge will be removed, the embankment will be brought to final grade and road construction can begin in the late Summer of 2005. After final construction, the site will be turned into a light industrial development.



One foot of silty material was placed on top of the geotextile and compacted to 95%.



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