

Case Study

application	Basal Reinforcement Embankment Over Soft Ground
location	Vanscoy, Saskatchewan, Canada
product	Mirafi® HP770PET

job owner
engineer
date of installation

Saskatchewan Ministry of Highways & Infrastructure
WSP Canada Inc.
2019

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

Highway 7 is a busy corridor for the transportation of goods to national and international markets. This is a key trade route for the Province of Saskatchewan and connects the communities of Kindersley, Rosetown, Delisle with Saskatoon and ultimately with ports on the west coast. Over the past 10 years, traffic volumes along the entire highway have increased around 20%, generating safety concerns and impeding the efficient flow of goods. Saskatchewan Ministry of Highways & Infrastructure contracted WSP Canada Inc. to design the third and final phase of the highway twinning to bypass around the Town of Vanscoy. As part of the preliminary engineering, WSP investigated two alignment options:

- Option 1 required highway construction around Vanscoy and a large slough south west of Vanscoy.
- Option 2 shortened the route by rejoining the existing highway alignment at an earlier point.

Option 2 would require 6 fewer lane kilometers of road construction. However, the challenge with the Option 2 alignment was that 800 meters of 2 lane highway would need to be constructed through the large slough, presenting significant construction and permitting challenges such as:

1. Embankment constructability on highly organic subgrade
2. Embankment constructability in a 3-meter deep water body
3. Significant permitting process for construction within a water body
4. Mitigation to siltation impacts on aquatic wildlife and habitat.

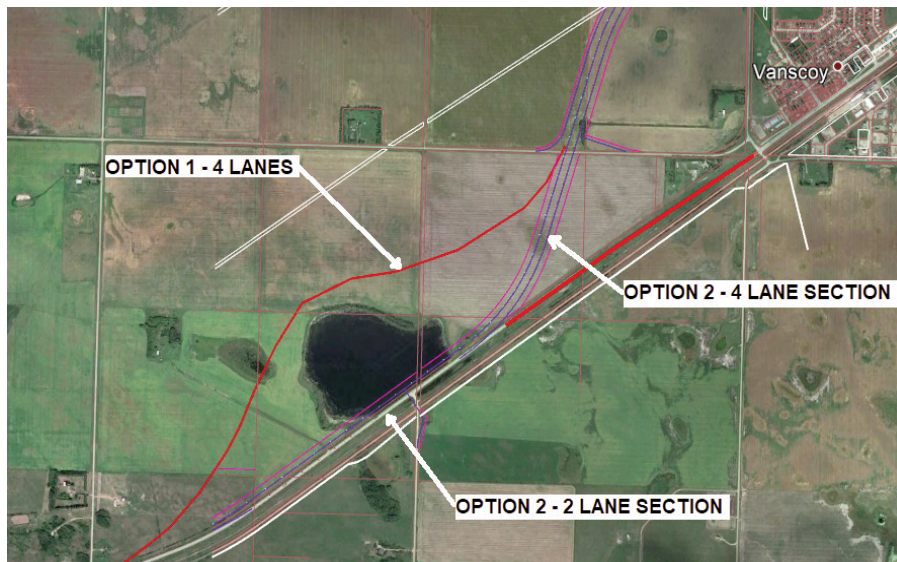


Figure 1 - Alignment Options

THE DESIGN

The design engineer for WSP had worked on a very similar project located on Highway 11 near Neuanlage, Saskatchewan. This experience resulted in the knowledge that some innovative use of geosynthetics and taking advantage of winter weather could result in significant time and cost savings for the owner. First, the embankment construction would be shifted from traditional summer and fall construction window to a winter program. Winter construction provided several advantages:

1. Increased bid participation from contractors during a traditionally slow work period. This benefits both parties; it inherently correlates to a competitive bid environment for the owner and a revenue stream for contractors during a low-revenue season
2. Embankment construction on the surface of the ice. This avoids in-water disturbance and siltation from construction activities. It also eliminated all the access challenges of marine construction over highly organic saturated sub-grade soils.



Figure 2 - Existing two-lane highway alignment and slough

3. Increased strength of the embankment above the slough bottom as compared to if construction occurred in a submerged marine environment.

The challenge with this type of construction is that the grade constructed on the ice needs to settle uniformly. Inclusion of a high modulus woven geosynthetic helps to achieve this goal. The previous Neuanlage project had incorporated a high strength woven geotextile at the base of the embankment and demonstrated



uniform settlement as the ice melted. The embankment settled as a block during the Spring thaw and showed no noticeable secondary settlement or issues with differential settlement in subsequent years.

The Vanscoy highway embankment would be built to be approximately 4 meters high to meet the design grade while accounting for settlement in the organics and the depth of the slough. TenCate recommended installing a high tenacity and high survivability Mirafi® HP770PET woven geosynthetic to withstand the potentially very high stresses and resist differential settlement. Mirafi® HP770PET is a combination of polypropylene and polyester yarns woven to form a highly stable matrix and is often utilized for basal reinforcement applications. Because Mirafi® HP770PET is a relatively biaxial geosynthetic (it has the similar tensile strengths in both the machine and cross-machine directions) and rolls can be seamed together, the direction of deployment and the seam strength are not limiting factors to the design or construction.

Seaming of the Mirafi® HP770PET woven geotextile also eliminated wastage and the potential for adjacent panels to separate. Separation of adjacent panels would cause non-uniform support of the overlying embankment and result in significant distress in the structure. Standard rolls were factory seamed into 32m wide x 91.4m long panels to minimize field seaming requirements. The total finished panel area was 58m x 806 meters once all seams were completed in the field.

THE CONSTRUCTION

An unanticipated construction challenge was that the thicker embankment structure provided greater insulation than anticipated for the underlying ice. The ice had not completely thawed by early May and the contractor elected to open-up the embankment. Opening the embankment up reduced the insulating layer thickness, speeding up the melting of the ice layer, and permitted the contractor to get ahead of schedule while mitigating settlement issues post-construction.



Figure 3 - Seaming panels being deployed over frozen slough surface



Figure 4 - Seaming panels being deployed over frozen slough surface



Figure 5 - Trenched embankment speeding up thawing of underlying ice

THE PERFORMANCE

A high-level cost comparison was conducted in the preliminary engineering stage based on 14 lane km of highway being required for option 1 and 8 lane km of highway required for option 2. Option 2 realized a cost savings of \$5.6 million solely based on being the shorter route.



Figure 6 - Completed highway alignment

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