

Innovative Farm Windbreaks Projects: *Improving the Safety of Winter Highways*

During the winter season, blowing snow accumulates on provincial highways in rural areas, which require constant maintenance to ensure the safety and mobility of motorists. A special project partly supported by the Ontario Public Service Innovation Fund is currently underway in West Region to build partnerships with agencies and groups who plant farm windbreaks such as Ontario's Conservation Authorities. The Farm Windbreaks project is expected to improve the safety and maintenance of highways while also providing benefits to property owners and the environment.

Developed by the Ministry of Transportation along with the Ministry of Agriculture, Food and Rural Affairs (OMAFRA), the Ministry of Natural Resources (MNR), Conservation Ontario, and the Ontario Soil and Crop Improvement Association (OSCIA), this project is aimed at diminishing blowing and drifting snow on highways by establishing tree windbreaks on adjacent private lands.

Virtually all snow drifting problem sites in Ontario are located downwind of large, level open fields with low or no ground cover. Snow is most susceptible to drifting during the first three days following a snowfall, before the surface of the snow bonds into a crust. Winds lift snow particles from the surface and begin a process called saltation in which they are carried with the wind and fall to the ground again, freeing and mobilizing more snow particles from the surface to continue the saltation process. In very strong wind conditions the accumulated snow particles may be carried for tens or hundreds of metres, potentially causing white-out conditions. Windbreaks slow the wind and cause saltating snow to be deposited in a drift on the downwind side.

It is estimated that blowing and drifting snow is responsible for approximately 30 percent of plowing, salting and sanding, or about \$3,000 per two-lane kilometre per year in winter maintenance in rural areas. While the ministry's winter maintenance program focuses on state-of-the-art equipment and technology, which improve road conditions, farm windbreaks complement these efforts while offering additional significant agricultural and environmental benefits.

During the winter of 2009-2010, ministry maintenance staff in West Region experienced the benefits of farm windbreaks firsthand. "The snow that is trapped by living snow fences is snow that doesn't reach the roadway and build up the snowbanks. Less snow on the highway means fewer snowplow and sander trips as well as less material used," stated Tom Reid, a Maintenance Coordinator in Owen Sound. Farm windbreaks provide the ministry with an opportunity to improve the safety and maintenance of highways without purchasing the property required to install these living snow fences. Additional benefits include decreased accidents, fewer road closures, and reduced corrosion of steel and bridge structures due to salt.

Well-designed windbreaks and shelterbelts can boost crop yields on your farm.

Break wind. Make money.

We'll help you plan your windbreak project for maximum effectiveness, choose and source the right tree species, help you search out funding for your project, and put you in touch with other farmers who have completed similar projects. Call us today. We're ready to help.

Conservation Ontario OSCIA

Contact Conservation Ontario at 905-895-0716 or visit our web site at www.conservationontario.ca to find out more about getting your tree project growing.

Ontario

Print ad for the Farm Windbreak project

The agronomic benefits of farm windbreaks, including increased crop yields of 5 to 25 percent, have been known for many years and are widely supported in agricultural windbreak literature. Farm windbreaks also control soil erosion, provide habitat for wildlife, improve air quality, and have a cooling effect on climate. According to the 1996 Census of Agriculture, 13 percent of Ontario farms reported having windbreaks or shelterbelts.

The windbreaks can be single rows of one species, typically conifers, or multiple rows of mixed plantings of several woody species, including hardwoods and shrubs. Adjustments in height and porosity of windbreaks, achieved through plant species selection, and/or adjustments to the amount of snow storage provided in highway ditches, allow them to be placed 20 to 100 metres from the edge of pavement. This flexibility allows partnering agencies many alternatives to develop a farm windbreak plan that works for the individual landowner.

To help raise awareness, James Corcoran, an Environmental Planner in West Region, led a communications project in collaboration with Conservation Ontario, OMAFRA, MNR and OSCIA. Funding was secured through an Ontario Public >

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Service Innovation Fund Grant to hire a professional agricultural communications firm to develop a communications program. An advertisement campaign was launched in the fall of 2009 to get farmers' attention, including a brochure featuring the slogan "Break Wind, Make Money" that is currently being distributed to farmers across Ontario at farm shows, grower meetings, conferences and workshops.

West Region is also providing support to frontline agencies and groups that deliver farm windbreak planting programs by identifying problem snow drifting locations near highways and participating in the cost of plantings. Windbreaks have been planted for about two kilometres along Highway 21 between Tiverton and Kincardine by volunteers from Bruce Power, as well as five kilometres along Highway 401 in Essex County by the Essex Region Conservation Authority. More plantings are planned adjacent to Highway 21 near Kincardine, Hwy 6 in the Arthur area and Highway 401 in the Counties of Essex and Chatham/Kent.

The Farm Windbreaks project is aligned with the Ontario government priorities of promoting sustainability, decreasing greenhouse gas emissions, mitigating the effects of climate change, reducing environmental contamination by road salt and improving the safety and operational effectiveness of transportation infrastructure. As MTO continues to strive to improve road safety and incorporate sustainable practices in highway maintenance activities, innovative ideas such as the Farm Windbreaks project will continue to be evaluated and tested. ●

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The History of Farm Windbreaks

Farm windbreaks have their origins in the mid-1400's when the Scottish Parliament urged the planting of tree belts to protect agricultural production (Brandle 2004). Today in North American agricultural systems, windbreaks contribute to both producer profitability and environmental quality by increasing crop production while simultaneously reducing the level of off-farm inputs.

The first well-documented use of a windbreak in the transportation industry in North America was a rock snow fence erected in 1868 to protect a railroad cut on the first trans-continental railroad (Tabler 2003). By the 1880's, a tourist guide book reported innumerable wooden snow fences along the Union Pacific Railroad in Wyoming (Tabler 2003). After automobiles came into general use, the construction of snow-fences expanded rapidly in Wyoming. Research on snowdrift control methods also began in the United States in the 1930's with F.A. Finney's wind tunnel experiments at Michigan State College (Tabler 2003).

A 15 year study on Interstate Highway 80 in Wyoming found that windbreaks reduced snow removal expenditures by one-third to one-half and collisions in blowing snow conditions have been reduced by over 60% (Tabler 2003). Benefit-to-cost ratios for windbreaks based only on reduced cost for snow removal typically range from 50 to 100:1 depending on the quantity of blowing snow (Tabler 2003). Living snow fences, properly designed, are as effective as structural fences and are less costly (Tabler 2003).

Brandle, J.R. (2004). *Windbreaks in North American agricultural systems*, Nebraska: Kluwer Academic Publishers.

Tabler, R.D. (2003). *Controlling blowing and drifting snow with snow fences and road design*. Niwot, Colorado: NCHRP.

The 407 East Community Value Plan

Innovative program enhances public consultation on EA projects

As part of the Ministry of Transportation (MTO) Central Region's 407 East Individual Environmental Assessment (EA) Study, the ministry's project team developed a Community Value Plan (CVP); a new and innovative program designed to enhance public consultation on EA projects.

The CVP is a component of a broad context sensitive solutions concept incorporated as part of the 407 East EA, which became known as the Proactive Involvement Plan. The Proactive Involvement Plan outlined the various methodologies and when and where they would be applied during the EA process.

Context sensitive solutions (CSS) is a theoretical and practical approach to transportation decision-making and design that takes into consideration the communities and lands which streets, roads, and highways pass through ("the context").

At MTO, public consultation is an essential component of the provincial EA process, as it allows the project team to better identify and address potentially significant issues early on in the decision-making process.

One of the main objectives of the new CVP is to gather and understand cultural, social, historical and/or environmental concerns of the stakeholders living in communities adjacent to, and/or in close proximity to the transportation corridor. This is achieved by holding a series of workshops with interested members of the public. The project team worked directly with the participants to:

- identify key areas of concern (cultural, social, historical, environmental, etc.) within the communities located adjacent to and in close proximity to the proposed corridor; >

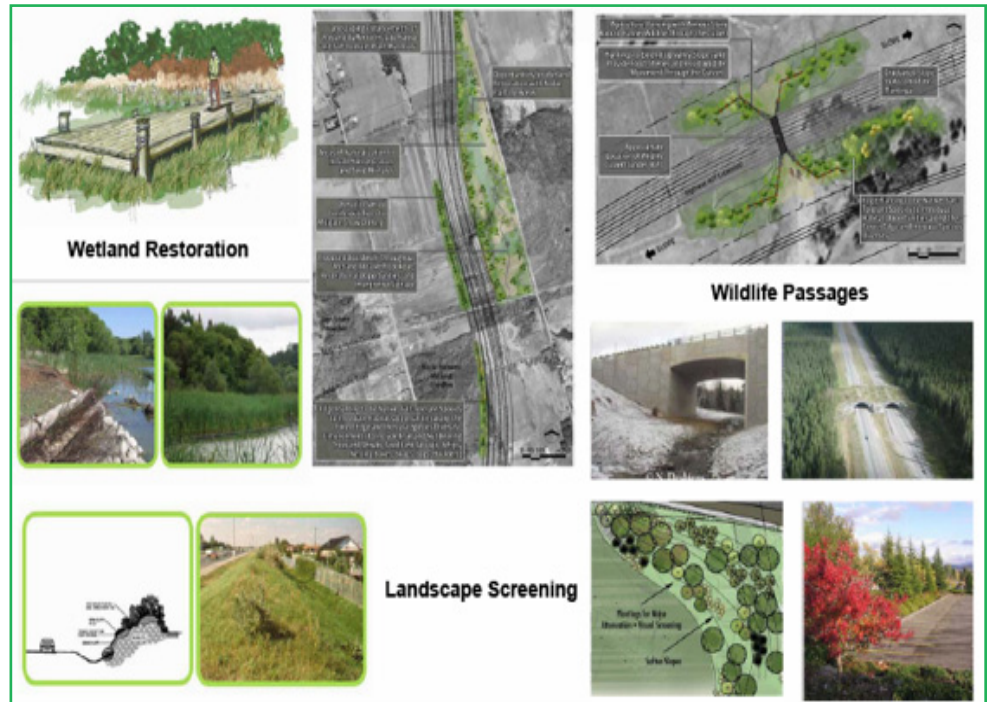
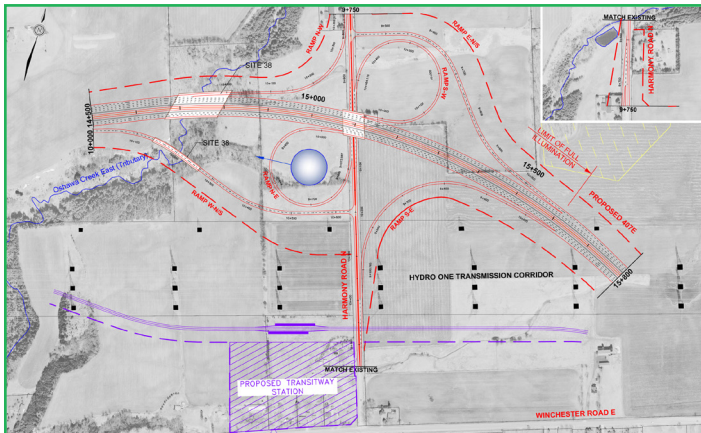


Figure 1: Proposed Additional Mitigation

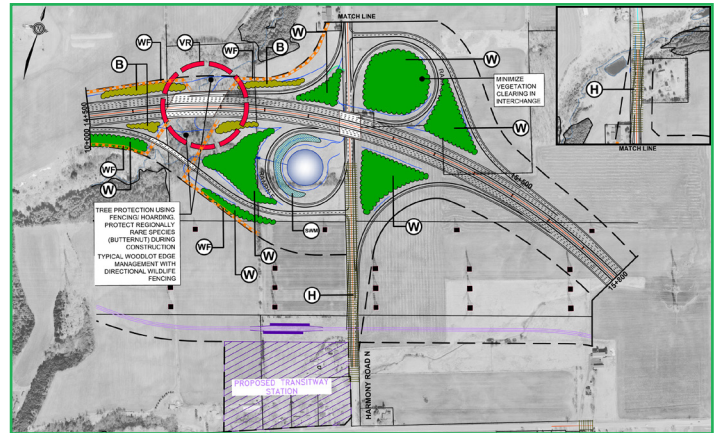


Figure 2: Proposed Bridge Relief Work

The 407 East Community Value Plan



Pre-CVP



Post-CVP

Figure 3: Transformation of the Transportation Corridor
(Harmony Road Interchange in Oshawa)

- actively promote and encourage input from potentially affected communities;
- maintain open, timely and honest communication regarding the decision-making process;
- promote and facilitate early and continuous stakeholder involvement to ensure timely input to the decision-making process;
- consider strategies that will retain and/or enhance the character of potentially affected communities; and
- document discussions and decisions in an open, transparent, and accessible format.

Based on the valuable input received from these workshops, the project team was able to identify opportunities to improve some of the design features within the ministry's right-of-way.

Additional mitigation measures included: enhanced wetland restoration; landscaping screening; and strategic placement of wildlife crossings (Figure 1). Other enhancement techniques discussed at the workshop included the addition of community gateway features within the right-of-way, and bridge relief art work on local road overpass structures.

An artist's rendition of the proposed bridge relief art work on the Simcoe Street overpass in Oshawa can be seen in Figure 2. This example reflects the equestrian heritage of Windfield's Farms, the home and resting place of Northern Dancer.

The result of the CVP was the transformation of the proposed route into a transportation corridor that better suit its physical setting (Figure 3). The mitigation and enhancement techniques developed and applied to the route helped to preserve the scenic, aesthetic, historic and environmental resources of the area, while maintaining the mobility and safety of the road users. Also, to ensure that the ideas developed as part of the CVP were carried through the project during its subsequent design phases, the enhancement measures and techniques were included as commitments in the formal provincial Environmental Assessment Report submitted to the Ministry of the Environment for approval in August 2009. The ministry is currently awaiting an approval decision (spring 2010). •

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7-Year Pavement Warranty Projects: A Form of Design-Build

MTO's 7-year pavement warranty projects are unique. Ontario is the only North American jurisdiction where contractors can bid on the pavement portion of the project without the conventional specifications. The contractor is responsible for all aspects of the pavement design, materials and construction. The ministry does not approve the design of the pavement structure but relies on the performance requirements during the warranty period. These requirements motivate contractors to provide a durable pavement with an adequate design constructed with effective quality management systems.

A collaborative effort, the 7-year pavement warranty initiative involved numerous Regional Offices and Head Office. By combining their expertise, they developed innovative contracting requirements addressing the pavement design, construction and maintenance. It resulted in the award of two 7-year pavement warranty projects in 2006: Highway 94 near North Bay in Northeast Region and Highway 23 near Harriston in West Region.

These 2 projects represented a significant first step toward developing a full compliment of performance warranty specifications for highway construction.

Design-Build contracting and multi-year warranties on hot mix paving are not new concepts at the ministry. Both were tried during MTO's contract re-engineering era of the mid-90's. The difference today is that the two concepts are combined to create a design-build pavement with a warranty within a conventional design-bid-build contract.

Pavement warranty contracts don't specify how thick the pavement structure should be or what materials properties are required (e.g. what grade of asphalt cement to use, what aggregates properties are required), or what quality control tests need to be done. In fact, they don't specify any of the usual parameters covered in a normal tender for an asphalt pavement, except for some key requirements such as the surface course mix type and use of designated aggregate sources for premium mixes.

Bidders are pre-qualified the same way they are for conventional design-bid-build contracts. Contractors bid one critical piece of information – how much would it cost to build a road that is expected to last for 18 to 20 years. There are no proposals to be evaluated and the contract award is based on the lowest price.

The 7-year term of the pavement warranty represents a balance of ministry and contractor interests. It is considerably less than the typical 18 to 20 year design life of a pavement, but sufficient to ensure good long-term performance with reasonable risk for the contractor to manage.



Paving on Hwy 23, West Region

Evaluating Performance

Pavements are evaluated for smoothness, pavement friction, and signs of distress using established criteria. The highway is divided into 500 metre segments one lane wide and each lane is measured separately. An automatic road analyzer (the ARAN van) evaluates smoothness in all lanes and in every segment. Frictional properties are checked in each lane. Surface distress is checked in a minimum of 10% of the segments and evaluated based on both severity and extent. Surface distresses include wheel track rutting, coarse aggregate loss, rippling, shoving, flushing, and pavement cracking including alligator, longitudinal, transverse and meander cracking.

Industry Response

Contractors responded to the challenge with at least 3 bidders on each project. In all but one project, the pavement designs were similar to, or stronger than, what the ministry would have used. Contractors used established materials and construction methods and put a good effort into quality control. The pavements are still relatively young and are generally meeting the performance requirements, with the exception of one project that is experiencing some performance issues.

Contractors like the freedom resulting from reduced ministry oversight. As part of the learning process, contractors may be conservative in their bids because of the risks in meeting the performance requirements for 7 years. The ministry expects to see more competitive bids when contractors gain confidence that they can meet the performance requirements and better estimate the associate risks.

7-Year Pavement Warranty Projects: A Form of Design-Build

To help contractors understand the performance requirements and the associated risk, the ministry made several presentations to industry groups, opening the door to industry participation in its Pavement Condition Evaluation training program and is providing historical performance data to contractors who want to see how the projects they built have performed.

Completed 7-Year Pavement Warranty Projects

- Highway 23 - 9.1km, near Harriston
- Highway 94 - 9.3 km, near North Bay
- Highway 132 - 4.2 km, near Renfrew
- Highway 118 - 11.6 km, near Bancroft
- Highway 144 - 20.5 km, near Timmins
- Highway 11 Southbound, 9.5 km, near North Bay

Nearing Completion:

- Highway 28 - 8.6 km, near Peterborough

The Future

A 5-year effort resulted in the latest version of the 7-year pavement warranty specification, and associated project selection, design, estimating, contract oversight, and performance evaluation guidelines. These documents are now serving as a basis for the development of similar documents for use in design-build projects.

The ministry is evaluating automated performance data collection for surface distresses to improve the safety of data collection and the objectivity of the performance evaluations.

MTO will continue to gather cost and performance information on all the projects. When repairs are required during the warranty period, the contractor's response will be monitored to further enhance the warranty specification. This information will be used to determine the future use of the 7-year pavement warranty. ●

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