Cost-Effective Snow Fence Usage—D.I.M.E.

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ABSTRACT

Over the past 20 years or more, the authors of this paper have developed a management system that has been employed to use snow fencing efficiently. This paper outlines a cost effective process to correctly **D**esign, **I**nstall, **M**onitor and **E**valuate **(D.I.M.E.)** snow fences at highway sites that experience snow drifting problems. This system combines both scientific and practical methods to assess the types of problems at a site and to justify using snow fences or eliminating their future installation.

Key words: snow fences, snow drifting, highway.

INTRODUCTION

Every year thousands of metres of temporary snow fencing is installed in North America using traditional methods and practices. In recent years, due to budget restrictions, many roads departments in the Province of Ontario have been forced to reduce the amount of snow fencing. In some cases, eliminating the use of snow fences has been considered. However, roads departments are still expected to provide the same level of service the public has experienced.

Figure 1. The fence in this example is not collecting snow because of a small upwind fetch and ground cover that will contain most driftable snow. There is not likely a severe problem at this site. The discontinuation of the use of the this fence will not affect snow accumulation on the road and save in the order of $500 annually.

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Figure 2. In this case the fence material used is intended for crowd-control and is not dense enough for snow fencing. The problem should be evaulated and if the severity warrants, install a fence with higher density. In this case $500 was wasted because an ineffective fence was installed. Opaque material (center) was used in this photo on billboard.

Discontinuing the use of snow fencing is sometimes considered at a site with a recurring problem where temporary fences are perceived as not being worthwhile because "they don't work". As illustrated in Figures 1 and 2 their failure is usually because one or more of the **D.I.M.E.** parameters were not followed.

However, as demonstrated in Figure 3, if thought is given to a problem and a workable solution, savings can be achieved which still provide the expected level of service.

Before the discussion of the methodology of **D.I.M.E.** it is important to know the cost of a typical snow fence installation .

To determine a general range of annual costs to install and remove conventional 4 ft (1.2m) high snow fences in Ontario, (excluding material costs) ten roads departments were interviewed by telephone and their relevant costs for the 1994 - 95 winter were obtained.

Figure 3. The discontinuation of the use of snow fencing at this site in favour of a permanent row of trees eliminates the annual installation of fencing. Annual savings for 300m of the road shown could be $1,500.

The majority of these sources are from Southwestern Ontario while the Regions of Sudbury and Ottawa - Carleton represent Northern and Eastern Ontario statistics (respectively). A summary of the data are plotted in Figure 4. As can be determined from this graph the average installation and removal costs in Southwestern Ontario is $3.74/m, while Eastern Ontario is $8.00/m and Northern Ontario is $10.45/m. The combined average of all sources (Province) is $4.96/m.

The usual method of determining the cost savings associated with the installation of snow fencing is to compare the cost to maintain a problem site before and after the installation of the fence.

In this document the assumption is that a solution is needed at a site and the focus is on the most cost effective method to achieve this end.

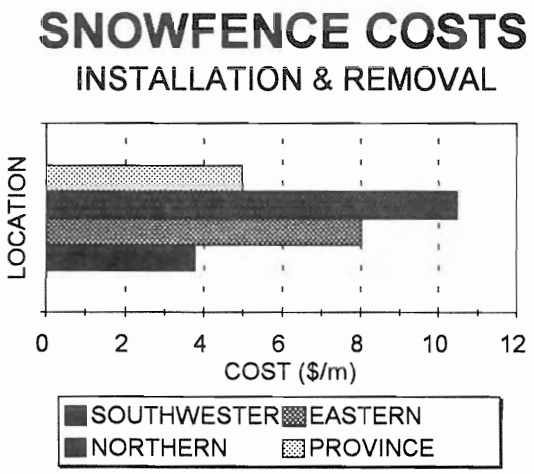

Figure 4. Snow Fence Costs in Ontario

METHODOLOGY

The primary focus of this paper is to present a management system for snow fence use and therefore technical background for issues such as fence design will not be discussed at length. Most of the technical approaches referred to below were developed through a study for Transport Canada(Baker and Williams 1990).

As the name suggests there are four basic components to the **D.I.M.E.** system of cost effective snow fence usage. **D.I.M.E.** offers a basis to justify discontinued use of snow fencing. Discontinuing the use of snow fencing without proper evaluation through a management system such as **D.I.M.E.** may lead to unsafe road conditions that could have been cost effectively avoided. The key elements of each component needed for a successful snow fence installation are described below.

DESIGN

Before a solution can be designed, it is essential to know and understand the background of the problem. Then, after analysis, a solution can be established. When viewing a problem site the following are important features to examine : a) road characteristics, such as details of cut and/or fill sections, surrounding terrain, vegetation, etc.; b)prevailing wind direction(s) and; c) source of snow caused by upwind fetch and average annual snowfall.

Once the above parameters are known, the details of a snow fence installation can be calculated. By using data about the available driftable snow, the fence height and setback distance can be determined. Using the prevailing wind direction(s) the fence orientation and layout can be determined. A manual (Baker and Williams 1990) should be used to develop these design details.

INSTALLATION

Once a satisfactory solution to the problem condition is established it is critical to have the fence properly erected. With the introduction of light weight plastic fences, it is especially advisable to have seminars to train staff in the proper installation methods. The key issues of training should include: a) fence post spacing; b) fence attachment to the upwind side of a post using wire ties for wooden fences and nylon ties or backer with wire ties for plastic fences; c) elevate fence above grade; d) anchor the ends of fence to provide appropriate tensioning and; e) anchor the sides to provide lateral resistance to overturning loads created by the wind.

MONITORING

In order to ensure that the installed solution is working effectively a check sheet (similar to the example included on Figure 5) should be created for each site and/or fence installation. This check sheet will serve as a reminder to view each site, as well as provide a future reference for the performance of the solution, and assist in the annual evaluation of the fence at the end of the winter. In addition, the check sheet provides a document to demonstrate maintenance procedures in cases of accidents and to protect potential liabilities.

The check sheets can be completed by a patrolman or someone who regularly travels the road, perhaps for other inspections. This should be done on a weekly basis and after each snow event. Along with the inspection, regular repairs to damaged fences need to be done. It is important to record: the nature of damage;

type of repair; and method of repair as this may assist in the evaluation of the site.

CHECK SHEET TO MONITOR SNOW DRIFTING CONDITIONS

SITE NAME:
LOCATION:
MUNICIPALITY:

OBSERVATION #	: 1	:
DATE:	:	:
TIME OF OBSERVATION:	:	:
LENGTH OF SNOW DRIFTING EVENT:	:	:
TEMPERATURE:	:	:
AMOUNT OF RECENT SNOWFALL:	:	:
GROUND SNOW COVER	:	:
IN ADJACENT FIELD:	:	:
WIND DIRECTION:	:	:
WIND SPEED (SLOW, MODERATE, FAST):	:	:
WAS ROAD CLOSED?	:	:
WAS EXTRA EQUIPMENT USED	:	:
TO CLEAR ROAD?	:	:
DOES SNOW FENCE APPEAR	:	:
TO BE WORKING?	:	:
WAS FENCE DAMAGED?	:	:
IF DAMAGED, WAS IT REPAIRED?	:	:
DESCRIBE REPAIR	:	:

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RECOMMENDED ACTION FOR FUTURE WINTERS:

1) **CONTINUE TO USE THE SAME AS CURRENT WINTER.**
2) **DISCONTINUE USE (DESCRIBE WHY)**
3) **CONTINUE TO USE WITH FOLLOWING MODIFICATION**

Figure 5: Example Check Sheet

Evaluation

At the end of the current winter, check sheets should be reviewed and a plan of action established for the following winter while the events of the recent winter are still fresh in the minds of the observer. This process also minimizes the effect of staffing changes from one winter to the next on the installation procedures.

The check sheet should have space for clear direction for future action. The decisions will be centred around: a) Continue to Install as in Previous Winter(s); b) Discontinue Use or; c) Continue to Install with Modifications.

Case Histories:

To illustrate the effectiveness of the **D.I.M.E.** system and how costly it can be if a snow fence management system is not used the following case histories have been prepared.

1. Woolwich Street - City of Waterloo

In 1985, the City of Waterloo had a study conducted to assist them in controlling snow drifting on Woolwich Street which services a satellite subdivision. As shown in Figure 6, this road is narrow and is constructed with no ditches.

This method of construction does not allow for the storage of plowed snow as illustrated in Figure 7. Typically, when a road with an outdated design exists it is usually upgraded with an elevated cross section which also has large ditches to store plowed snow similar to the section in Figure 8. However, the deeds for the neighbouring properties indicated that, in some areas, a public right-of-way did not exist, and their property lines aligned with the centre of the road. Therefore, the most straight forward approach to a solution was to use temporary snow fencing in the neighbouring fields after the crops were harvested each fall.

Using methods which were originally developed to calculate snow transport in Arctic and Prairie conditions (Tabler 1986) 3 rows of conventional snowfences were recommended and installed during the winter of 1985/86 (1 in Figure 9). The resultant conditions were monitored over that winter and the installed solutions were evaluated. Revisions were recommended and accommodated during subsequent winters (1A and 1B in Figure 9).

The initial method of calculation did not allow for the freeze/thaw cycles that occur in this region of Ontario. As a result a conservative design was achieved which allowed an over estimated amount of snow that drifts towards the road. Since the installation of the snow fences at this site, new work (Baker and Williams 1990) and the monitoring done by the City of Waterloo indicate that 2 rows of conventional snow fences were adequate to collect the volume of driftable snow (Figure 10).

Figure 6. Woolwich Street Site - Waterloo

Figure 7. Snow Accumulation Along Woolwich Street Without Snow Fences

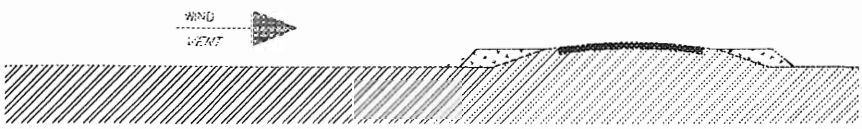

Figure 8. Modern Road Cross-Section

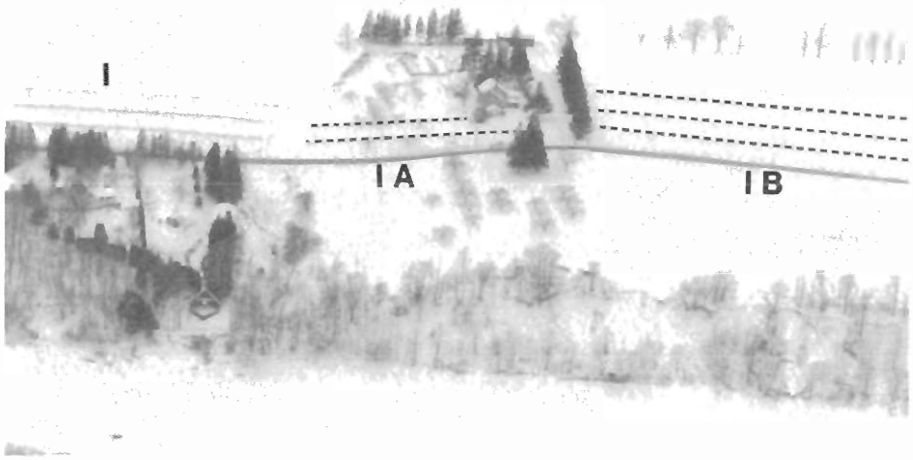

Figure 9. Typical Recommended Solution - Woolwich Street

Figure 10. Recommended Solution - 2 Rows of snow fence

This process produced a reliable solution and reduced the cost of installation/removal by 1/3. It is estimated that this results in a reduction of 1000 m of fence to be erected and removed annually. Using the current average rate ($4.96 per m) this reduction in the amount if snow fence installed translates into a $5,000 savings each year.

2. Region of Waterloo

The Regional Municipality of Waterloo had numerous sites studied to determine potential solutions to recurring problems. The solutions in this case were not exclusively centred around snow fencing. However, they tended to use snow fencing in areas of recurring snowdrifting in locations that are remote from the patrol yard in an effort to minimize extra patrols.

An example site is shown below in Figure 11 where the cut section at the highway caused snow accumulations on the road.

A choice of solutions was given which included adding snow fences or regrading the upwind cut. During the first winter after the study snow fences were installed as the chosen solution. Part way through the winter the site was viewed when it was reported that the fence was not working efficiently. As can be seen in Figure 12, the fence that was installed was parallel to

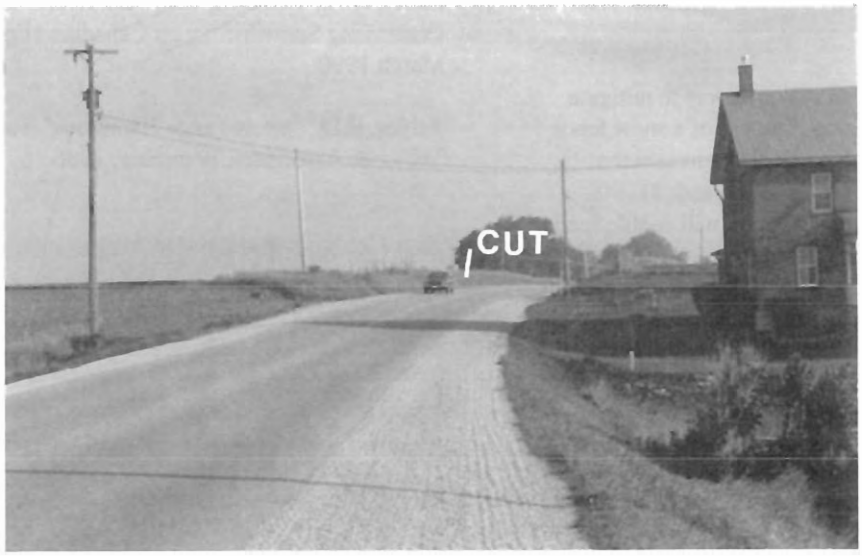

Figure 11. Site at Waterloo Regional Road 22

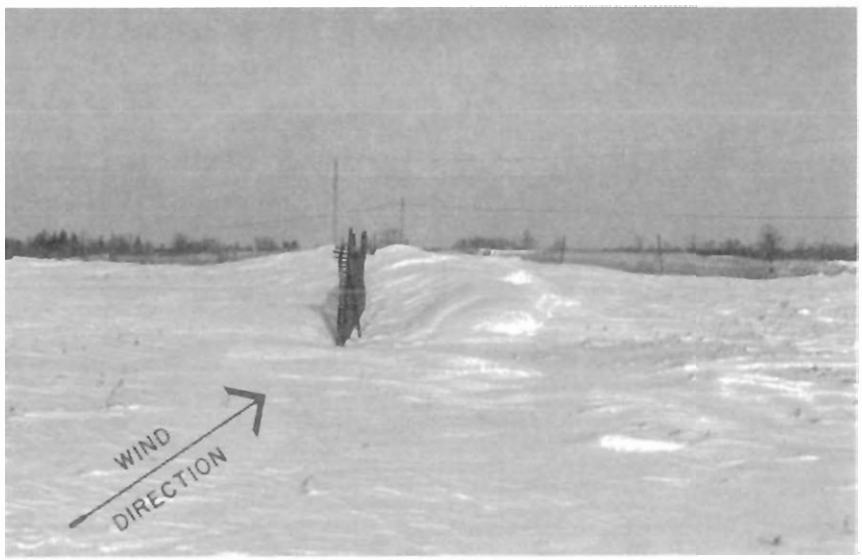

Figure 12. Snow Accumulations at Misaligned Fence

the prevailing winds instead of perpendicular to the wind as recommended. As a result of this misalignment, minimal snow accumulated at the fence thus allowing more snow to drift towards the highway than with the recommended alignment. During subsequent winters a correctly aligned fence was found to work more effectively.

As a part of a recent upgrade of this road the cut section was modified. Through the highway department's monitoring program it was determined that resultant drift conditions with the revised road configuration were manageable by routine plowing. Their most recent evaluation of the site recommends that fences not be erected. The typical snow fence installation at this site involved the use of approximately 300 m fence. This results in an annual savings of $1500.

During the winter of 1993/94, in an effort to eliminate snow fence costs, the Region of Waterloo chose not to install any fences at all. While this move saved dollars in the budget, this increased the potential for hazardous conditions. Through close monitoring of the resultant snow accumulations on the road it was determined that certain fences could be eliminated safely while others needed to be re-installed.
As part of their preparation for winter maintenance a

regular evaluation of all fence installations is conducted. This has proven to be cost effective.

Conclusions:

Snow fencing provides an effective way to mitigate snow accumulation problems. The use of a snow fence management system which correctly addresses the: 1) **D**esign; 2) **I**nstallation; 3) **M**onitoring and; 4) **E**valuation (**D.I.M.E.**) of the solution will enable roads departments to optimize maintenance costs. The preceding case studies have shown that $avings can be achieved without sacrificing safety if properly implemented.

References

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