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## Maintenance Technology Project

### 2002-2003: 7<sup>th</sup> Season

This season builds on past progress to improve practices for managing road salt and for providing road condition and operations information to MTO's contractors and contract administrators. Better management of road salt reduces both its effects on the environment and the cost of winter operations. Improved information will help MTO work with its contractors to improve service and reduce costs.

Specific objectives this season will include refining the already-reduced application rates for road salt, improving salt spreading guidelines and, investigating new performance measures and monitoring systems for winter operations.

Most activities continue to be conducted at Elsinore patrol yard on Highway 21 in the Ministry's Owen Sound District. MTO staff test and monitor the effectiveness of different products or systems using video cameras, environmental sensors and trailers which measure road surface friction. MTO ensures that safe conditions are maintained throughout test operations. Tests are conducted at other locations when specific conditions are required which cannot be achieved at Elsinore. Once proven under controlled test conditions, innovations are implemented across the province using a phased approach.

Several improvements to the testing equipment and infrastructure this year will help in obtaining accurate and repeatable data. These include four new spreader/plow combination trucks, expanded chemical storage facilities, a web-based roadside camera system, updated computer and mobile communication systems.

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## Project Test Site

### Location

A 50 km section of Highway 21, between Owen Sound and North Bruce, that includes the communities of Jackson, Alvanley, Allenford, Elsinore, Chippewa Hill, Southhampton and Port Elgin.

### Site Geography

- Affected by weather systems from Lake Huron and Georgian Bay, due to location at the



base of the Bruce Peninsula

- Highest snowfall in southern Ontario (annual average 2.5 to 3.5 meters, falling on 45 to 75 days per year), a shorter winter thaw than most area of southern Ontario, and areas of severe drifting
- A variety of snow and frost conditions representative of most severe winter areas of the province, partly due to diverse topography and land cover (rolling uplands, flat lowlands, forested and open areas, and swamps)
- Moderate traffic levels and highway speeds provide safer testing conditions than more densely populated areas of southern Ontario

### Test Sections

- Eight test sections with an automated measurement site at the midpoint of each
- Changes in snow cover and surface friction monitored intensively in all sections
- ARWIS sensors, video cameras and street lights at measurement test sites can be viewed remotely from the patrol yard
- Weather and snow conditions at all measurement sites are recorded ever 10 minutes

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## Key Results

1. **Pre-wetting, Anti-icing and Variable Salt Application Rates:** Additional test data were obtained to help determine the optimum rates for a given set of weather conditions and to define the temperature limits of different anti-icing chemicals. Field testing will continue through the 2002-03 season and the full data set will be analysed at that time. Data acquired to compare effectiveness of various de-icing and anti-icing treatments are being shared with the scientific community through the Aurora group (see ARWIS, below).

Pre-wetting has been implemented at 29 locations including 53 spreader units and 2 stockpiles. Field results show salt reductions from 6 to 29% through either fewer spreader trips or reduced application rates using variable rates, plus reduced sand application because more snow is removed under cold, snow-packing conditions. Anti-icing with Direct Liquid Application (DLA) from tanker trucks has been implemented on 4 highway sections including 2-lane and multi-lane. Objectives include prevention of early icing on bridge decks and, as a general application in advance of snowfall. Cost and benefits of DLA will be monitored over the next two seasons.

2. **Combined Operations and High Speed Spreading:** Through co-operation with the Bruce Nuclear Generating Station, a series of tests was conducted in July 2002 to better define the relationship between spreader travel speed and retention of salt within defined swath on the pavement. Tests were conducted on dry and pre-wet salt with the following spreaders: Epoke, Swenson Precise Placement with Force America controller, side and rear-facing chutes with Dickey-John controller. The results are being applied to revise Best

Management Practices for winter operations, resulting in reduced costs and environmental impacts while maintaining existing Quality Standards.

3. **AVL Monitoring:** The Automated Vehicle Location (AVL) system that tracks the location and operations of MTO and contractor vehicles was expanded to cover a higher percentage of the fleet. Its potential for contract administration was improved with automated report generation functions and by incorporating hand-held computers as a source of input data. Road surface temperature data measured at regular intervals by infra-red thermometers on patrol and spreader trucks is now recorded with other AVL data.
4. **Advanced Road-Weather Information System (ARWIS):** 25 new sites were added to bring the total up to 52. Continued expansion is planned. MTO continues to be a partner in the AURORA consortium of U.S., Canadian and European highway agencies. The Maintenance 2001 De-icing/Anti-icing Response Treatment (DART) test data is now available on the AURORA web site at [www.aurora-program.org](http://www.aurora-program.org)\*. MTO is also participating as a stakeholder in the Next Generation RWIS, known as the Maintenance Decision Support System (MDSS), under development by the U.S. Federal Highway Administration.
5. **Winter Sand:** Friction measurements on sanded, packed snow covered with sand at the fine, coarse and mid-range of the MTO gradation specification showed that coarser sands gave higher friction values. Additional analysis will be conducted to determine whether changes to the sand specification are warranted.

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## Overview of Implementation

### Implementation Strategies

New technologies and innovations that prove successful are incorporated in ministry operational practices through technology transfer to the private sector.

### Vary by Location and Type

Implementation strategies vary by location and type of service delivery, and are facilitated through:

- Innovation Proposals submitted by Area Maintenance Contractors (AMC's)
- Ministry direction to AMC or Managed Outsourcing (MO) contractors

## **Variable Salt Application Rates**

Salt application rates as low as 50 kg/2-lane km are now being used under suitable conditions when the salt is pre-wetted with a liquid de-icer. The lowest rate formerly recommended for dry rock salt was 130 kg/2-lane km.

Pre-wetting equipment is now installed on 122 spreaders at 50 patrol yards across the province. In addition, 13 spreaders at 9 patrol yards are outfitted for Direct Liquid Application (DLA). A special monitoring program is in place to help measure the benefits of pre-wetting and anti-icing and to identify and resolve practical problems with implementation.

A specification for liquid de-icing and anti-icing chemicals was developed to ensure that all liquids used are safe and effective and that tenders can be evaluated on a price per performance basis.

The original Fixed Automated Spray Technology (FAST) site is operating effectively and 3 more sites are under construction. More sites are planned for future years.

## **AVL**

Currently there are 150 winter maintenance vehicles equipped with AVL and can be tracked in real-time on an internet-based system. MTO will be adding 85 more units this year. All spreader and operations data collected by the AVL are archived and can be accessed on the web to generate reports for contract administration. Five automated patrol diary computers are being tested.

## ARWIS

Thirty new sites are being added this winter bringing the total to 82.



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## Test Plan

### Pre-wetting

**Objectives:** Continue acquisition of test data on the effectiveness of alternative anti-icing liquids and application rates. Analyse the data to

recommend minimum effective application rates and to improve chemical performance specifications.

## **Winter Sand**

**Objectives:** Continue evaluation of traction and retention improvement using different sand size gradations and with pre-wetting.

## **Direct Liquid Application (DLA)**

**Objectives:** Measure effectiveness of proactively applying anti-icing liquids in reducing total quantity of road salt and winter sand required to meet bare pavement standards on a storm by storm basis. Investigate cost-benefit ratio compared with standard pre-wetting operations.

## **Effective Spreading**

**Objective:** Reduce loss of salt to the environment through better control of spreader discharge patterns.

## **Plow Blades**

**Objective:** Investigate effectiveness and service life of innovative plow blades.

## **Plow/Spreader Lighting**

**Objective:** Continue evaluation of strobe and LED lighting for winter operations vehicles.

## **Smart Spreader**

**Objectives:** Continue feasibility investigation of automated control functions for combination plow/spreader including dynamic control of application rate and placement, plow position and surface condition monitoring.

## **ARWIS**

## Objectives:

1. benchmark the accuracy of Road Weather forecast products.
2. investigation of the variability of snow cover conditions using surface friction to measure snow cover.

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