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SALT MANAGEMENT PLANNING: KEY TO SNOWFIGHTING SUCCESS IN RENFREW COUNTY

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Renfrew County, a large rural jurisdiction near Canada's capital of Ottawa, has translated its new Salt Management Plan (SMP) into a hugely successful snow and ice management program.

Salt is still one of our best defenses on the road against inclement winter weather. The benefits of using salt on the roadways have always outweighed its damaging effects to vehicles and roadside vegetation. But as with all things, salt must be used in moderation. When used in excess, the potential side effects can harm the people and things it is trying to protect. Salt use should be carefully controlled and used as part of a larger plan, which includes the proper tools and proven guidelines. Just as a doctor diagnoses a health problem, winter maintenance operations staff identify road problems caused by winter weather and develop treatments. It is often helpful to use diagnostic tools and follow proven guidelines to ensure that the treatment is appropriate to the problem. Pouring more salt on a winter road is not going to make it safer. The first step to safer winter roads is an effective SMP.

Renfrew County, a large rural municipality in eastern Ontario north of Ottawa, features diverse topography and weather across its wide extent. Renfrew County encompasses 17 municipalities and has an area of 7,600 sq. km. During the winters of 2000/2001 through 2002/2003, the county consumed an average of 12,900 tonnes of salt and 8,000 tonnes of sand. Total winter maintenance operations costs were \$2.4m (Canadian), and the annual collision rate, excluding animal hits, was 214. Most of its constituents travel significant distances every day. These people want to feel safe on the road.

As population in this area increased, there was a greater need to respond more quickly to conditions caused during bad weather. Renfrew County's initial response to this growing need caused a steady increase in salt consumption through the late 1990s. This increase in salt use raised budgetary and environmental concerns. The county tried prewetting, but the attempt was unsuccessful with little salt saved and no improvement in service levels and was abandoned.

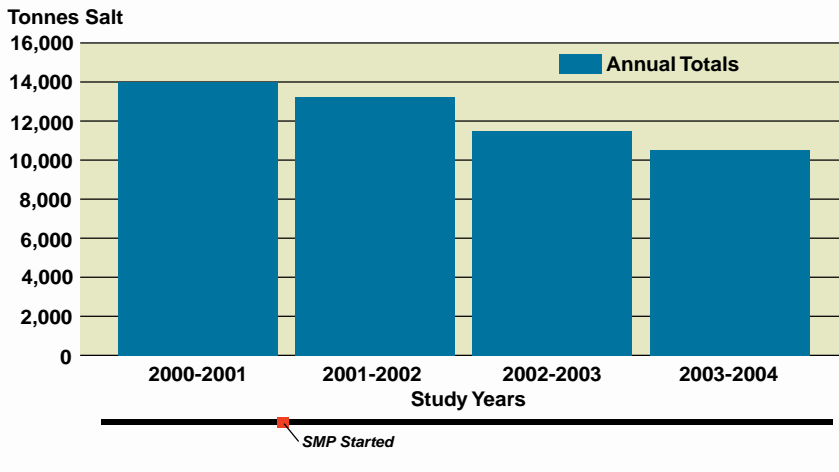
The county recognized that tinkering approach could not work without being part of a bigger salt management plan that provided the proper diagnostic tools, detailed documentation of treatments, and education and training for its personnel. Such a plan would also need constant monitoring and tweaking. Starting in 2001, Renfrew began a plan to revamp its entire winter maintenance approach, while at the same time county road administrators began implementing some early winter projects. Did it work? See Figure 1 top of next page.

To analyze the effectiveness of their salt management efforts, county road managers reviewed their year-to-year performance in salt consumption, winter maintenance costs and number of collisions. However, since every winter is different in its severity, it was difficult to determine whether their performance improved, or the subsequent winter was less severe. Environment Canada data was reviewed, however this data only provided information related to daily temperature minimums and maximums and total

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Chart 1

Salt Use for the County of Renfrew All Yards



depth of snowfall, which might be adequate for the laymen, but for the winter maintenance staff, provided only half the story. Instead, it was necessary to gather information on the number of treatable events from the county's own patrol records. A treatable event might be 150 mm of snow; a frost event, 2 cm of snow, or a couple of mm of freezing rain. Each of these events must be deiced differently and each is dangerous to people traveling on the roads. This information on treatable events is not available from Environment Canada.

Logic suggests that the number of treatable events will be an indicator of the volume of salt used (i.e. more events = more salt). During the 2002/2003 study period, however, there was a 15% increase in the number of treatable events relative to the first two years, yet the county used 13% less salt than in previous years. This indicated that less salt was being used to treat each event. Renfrew's plan was making significant progress! But what were they doing differently? How were they able to use less salt and still have better results?

THE ROAD TO SUCCESS

Planning alone, and even provision of Road Weather Information Sys-

tems (RWIS) doesn't result in salt reductions. Only changes in approach and application in the field will get desired results. There is a long road to navigate to improve salt consumption. The road taken by Renfrew County involved many stages, but as improvements were made at each stage of completion, the county was reassured to continue:

IMPLEMENTATION OF THE PLAN

- Stage 1:** Salt Management Plan 2001-2002
- Stage 2:** Winter Roads Condition Model 2001-2002
- Stage 3:** Training 2001-2002
- Stage 4:** Route Optimization 2002
- Stage 5:** Road Weather Information System-2 of 4 RWIS sites operating 2003
- Stage 6:** Prewetting started 2003-2004
- Stage 7:** Updated Salt Management Plan 2003
- Stage 8:** Revised Operational Plan 2003

SALT MANAGEMENT PLAN

Prior to undertaking salt management planning in 2001, Renfrew was still relatively advanced by compari-

son to its peers. In the mid-1990s, the county outfitted its trucks and tried onboard prewetting with calcium chloride, but ran into operational problems. The following year, the county removed all the equipment and abandoned the trial.

Having recognized that technologies and approaches likely can be put in place only with a proper plan, and having heard of Environment Canada's forthcoming legislation mandating salt management, Renfrew County decided to take a proactive approach and develop its own plan. This facilitated planning, budgetary approvals, and implementation to achieve some early winners and demonstrate the benefits of salt management to those in doubt within the county. The county hoped to realize some of the published benefits of salt management by reducing salt consumption between 20 and 30% and reducing collisions by 75%, freeing up the savings for capital improvements.

To facilitate planning, they rolled the project together with an RWIS installation. This allowed them to combine a planning exercise with a capital project. Having completed their salt management plan and RWIS strategic plan, the county was able to use this information to obtain funding from the Federation of Canadian Municipalities (FCM) under the Municipal Green Enabling Funds (MGEF) to pay for half of the RWIS deployment and evaluation.

WINTER MAINTENANCE ROAD MODEL

Selecting representative site locations was the key to successfully implementing the Road Weather Information network. Consultants developed a GIS model that allowed the team to determine which roads shared similar characteristics and road conditions, and therefore would require similar winter maintenance applications.

SALT MANAGEMENT TRAINING

With input from county management and staff, a consultant developed the SMP, winter maintenance model, and RWIS site selection. All field staff and management were provided with SMP 101 introduction courses to start off the planning for each activity. Each roll out involved field staff and the training was repeated.

ROUTE MODELING AND OPTIMIZATION

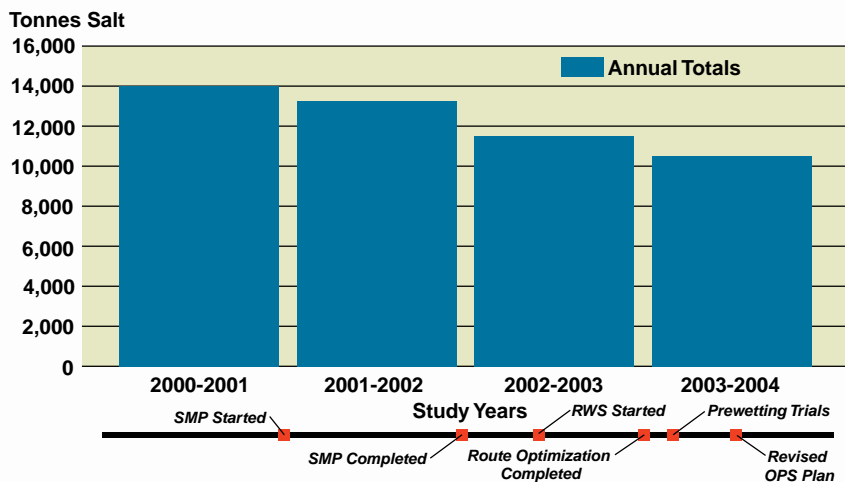
Route modeling and optimization allowed the municipal staff to make decisions regarding the most effective manner to deploy their vehicles. Several scenarios were developed, some of which would have reduced the fleet size by 15% while maintaining the same level of service specified by the Council. The modeling was completed based on data from the winter maintenance model.

RWIS DEPLOYMENT

The county undertook a strategic RWIS network planning exercise that combined information from the winter maintenance model and route optimization, such that each segment of the road network was assigned to a specific RWIS site. The design took into account RWIS available from neighboring jurisdictions. Information from the RWIS network enables the more accurate forecasting of pavement conditions that is necessary for proactive decision-making and more advanced technology and approaches such as prewetting. The plan specified four additional RWIS sites to address information requirements based on meteorological zones. Two of the four sites were installed and operational in early 2003. Pavement conditions forecasts were available starting that year to assist the maintenance staff.

Chart 2

Salt Use for the County of Renfrew All Yards



PREWETTING

With a better set of tools developed, better operator training, and the appropriate equipment now a part of their fleet, the county felt that they were better able to try prewetting again. It began in the winter of 2003/2004 with a single route controlled trial. The agency gathered data on whether the trial was successful in order to prepare for a larger scale deployment, subsequently expanding the project to place equipment on most of the vehicles and routes.

UPDATED SALT MANAGEMENT PLAN

In 2001, the County made its first attempt at developing a salt management plan, in advance of a pending environmental assessment of road salts from Environment Canada. Once Environment Canada's resultant Road Salts Code of Practice was approved in 2003, the county made several minor adjustments to its SMP. These changes included identifying and addressing salt vulnerable areas and adding monitoring and reporting requirements. At the same time, the county documented work completed and the anticipated next steps.

REVISED OPERATIONAL PLAN

As mentioned, having a plan is not enough to achieve salt reduction. Planning must be moved into implementation. Staff requires training. Comprehensive guidelines need updating to address the changes in approach and to exploit the opportunities of new information and technology. The previous operational plan was well documented, but was reactive and mandated that personnel wait for precipitation before beginning treatment. The new guideline was developed to take advantage of opportunities presented from pavement condition forecasts, including pre-emptive treatments like prewetting.

OTHER BENEFITS

The county has also noticed reductions in winter maintenance costs, collisions, fuel costs, and greenhouse gases in the study period. The tally is as follows:

- 25% reduction in chloride use in three years
- 16% reduction in chloride use on route 606-04 due to prewetting

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- 16% reduction in total winter season collisions not involving animals
- 32% reduction in winter patrol costs
- 30% reduction in diesel fuel consumption

These reductions are a result of the many salt management initiatives that Renfrew County undertook including SMP, Plow Route Optimization, revised operations, equipment upgrades, and RWIS.

MAINTENANCE DECISION SUPPORT SYSTEMS

The results are in and the investments made by Renfrew County have resulted in significant and measurable reductions in salt consumption, as well as numerous other benefits. Mark F. Pinet and Associates Limited has begun beta-testing a maintenance decision support system for Renfrew County to automate and assist in decision making for the county.

SALT MANAGEMENT PLANNING MAKES A DIFFERENCE

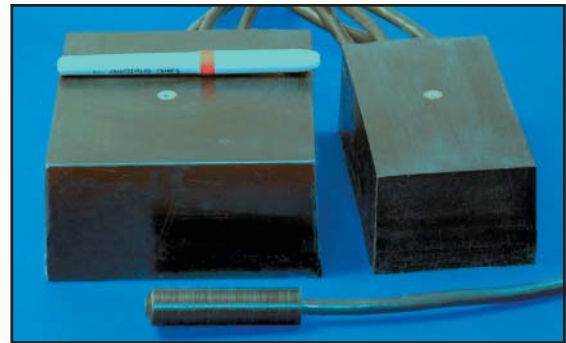
Comprehensive SMPs increase the likelihood for success in an agency's effort to upgrade their winter operations. Renfrew County's one-fourth reduction in chloride use and one-seventh reduction in traffic crashes is testimony that an integrated approach to investing in upgraded winter maintenance can pay rich dividends.

RWIS DEMANDS DEPENDABLE SENSORS

At the January 2006 Transportation Research Board annual meeting, researchers debated the effectiveness and reliability of various roadway surface sensors; none debated the consensus view that they are the essential foundation of a Road Weather Information System.

Sensors need to read roadway surface conditions and, if possible, provide air temperature, pavement moisture, humidity, dewpoint and coefficient of friction. Several vendors offer systems including Surface Systems, Inc. (<http://www.ssiweather.com/>), Campbell Scientific (<http://www.campbellsci.com/road-weather/>), Zydax (<http://www.zydax.com/>) and Traction Technologies (<http://tractiontech.ca>).

The pricetag on early RWIS systems discouraged some agencies who may want to take another look at the latest offerings. Zydax, for example, has developed a family of less expensive, but advanced, intelligent and open protocol sensors that collect road temperature and moisture readings. Traction Technologies also includes friction-reading sensors. The photo above illustrates the three Zydex sensors (left top: active/passive; right top, dual temperature — surface and sub-surface; and bottom, temperature only).



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