

MEASURING THE PERFORMANCE OF NOVA SCOTIA'S HIGHWAY MAINTENANCE PROGRAM

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ABSTRACT

The Province uses three different, yet related, methods of measuring the effectiveness of Highway Maintenance activities. The primary tool is the Department's Highway Maintenance Standards that includes field audits to monitor compliance with the standards. In addition NSTPW conducts two annual surveys, a Road Condition Survey and Customer Satisfaction Survey, both covering the Provincial Highway System.

The Highway Maintenance Standards (HMS) consist of specifications for each maintenance activity including what constitutes a deficiency and how long NSTPW forces have to repair the deficiency. A working group of four field managers and a head office staffer, to coordinate the process, formulated the maintenance standards in-house. The HMS contain "response tables" associated with each type of maintenance deficiency which stipulate how much time can elapse prior to repair, based on the class of roadway that has the deficiency. With these standards in place the Department developed an audit procedure to measure compliance with the standards. This involves selecting four operational areas and doing monthly field audits of a representative sample (25-30%) of the roads in each operational area.

The Road Condition Survey (RCS) is performed by nine crews who conduct detailed inspections of randomly selected 200 meter sections of roadway. This covers four different classes of roads, high volume arterial, trunks & routes, local paved roads and local gravel roads. The RCS takes place each Spring and approximately 1,700 sections are selected randomly using a statistically valid sampling procedure. Deficiencies in road surface, drainage, line painting, etc are recorded and tabulated and reports are produced assigning letter "grades" to different roadway types in different areas.

The annual Customer Satisfaction Survey is contracted out to a market research firm that conducts a telephone survey to monitor and assess satisfaction levels of Nova Scotians regarding Provincial highways. The 2002 survey was the fifth year the survey was done for the Department. This allows the Department to compare results with those of previous years in order to track which services are improving and which are not.

HIGHWAY MAINTENANCE STANDARDS

In 1999 the Department's Highway Operations section convened a committee to develop highway maintenance standards. The committee consisted of four Area Managers (field maintenance engineers) and one Highway Operations head office staff member to coordinate and assemble the work of the committee. The Area Managers represented the four operating Districts. Their mandate was to review all of the Department's maintenance activities (summer and winter) and formulate standards for each activity that were realistic and could be met with the current level of highway maintenance funding. The starting point for development of the standards was to review maintenance standards from other Canadian jurisdictions (MTO, Alta Transportation & OGRA) and customize them to Nova Scotia's requirements. For each activity the following parameters had to be defined:

- General information about the maintenance activity
- Frequency of inspection by the field supervisor
- Establish the time limits for repair of deficiencies after they are noted
- Definitions of deficiencies pertaining to each particular maintenance activity
- Define how accomplishments under the maintenance activity are measured

The maintenance standards establish levels of service for maintenance activities on Provincial Highways. The following table defines highway maintenance levels of service based on road classification and traffic volumes.

LEVEL OF SERVICE TABLE 1

Level of Service	1A	1B	2	3	4
Type of Roads	- All 100 Series (arterials) and -Selected high volume highways	- All Trunks and - Selected highways as per AADT limits	- All Routes and - Selected highways as per AADT limits	- All Local Roads	- All Gravel Roads
AADT Limits	Greater than 7,500	Between 7,500 – 4,000	Between 4,000 – 1,500	Less than 1,500	not applicable

The routine Road Patrol Frequency Table, shown below, sets out the minimum frequency of inspections necessary to ensure reasonable levels of service on sections of highway, which have not been inspected during the normal course of other duties.

ROUTINE ROAD PATROL FREQUENCY TABLE 1

LEVEL OF SERVICE	PATROL FREQUENCY
Level 1A	2 times/week
Level 1B	1 time/week
Level 2	1 time/2 weeks
Level 3	1 time/month
Level 4	1 time/month

MAINTENANCE AUDITS

As part of the ongoing review process, specific geographic areas are audited throughout the summer seasons. These audits are intended to compare present field practices with the Department's Maintenance Standards. Winter maintenance standards are in place, but the Department is still in the process of formulating a methodology to audit compliance with the winter standards.

Four operational areas (out of a total of 66) are audited each year. One audit area is selected from each of the Department's four Districts, a different one is selected in each District, each year. Seven trips through each of the four audit areas are conducted, one each month from May through November, inclusive. In April an analyst from the Highway Operations Section begins the audit by driving all roads in each of the four operational areas to be audited. A "windshield survey" of the deficiencies is carried out and all observed deficiencies are recorded electronically. Deficiencies include such things as potholes, fallen/damaged signs, low shoulders, damaged guardrail, etc. This establishes a "baseline" for each area for audit purposes. Subsequent monthly inspections are done to determine if and when the deficiencies are repaired and whether they are repaired within the prescribed timelines. New deficiencies noted in subsequent months are also recorded. An example of the timelines is shown below.

POTHOLE CRITERIA TABLE 1

POTHOLE CRITERIA	Level 1A	Level 1B	Level 2	Level 3
Description	Potholes that are greater than 0.10m ² in area (ie: 0.3m * 0.3m) and greater than 100mm deep			
Action	Sign immediately and repair within 5 days	Sign immediately and repair within 7 days	Sign within 24 hrs and repair within 21 days	Sign within 24 hrs and repair within 60 days
Description	Potholes that are greater than 0.10m ² in area (ie: 0.3m * 0.3m) and between 50mm and 100mm deep			
Action	Sign immediately and repair within 14 days	Sign immediately and repair within 14 days	Sign within 24 hrs and repair within 60 days	Sign within 24 hrs and repair within 120 days

An example of the timeline allowed for correcting a deficiency such as a pothole that is 0.9m² in area and 0.12m deep on a road with a level of service of Level 2 is:

- Patrol frequency of 14 days (from patrol frequency table)
- Response time of 21 days (from pothole criteria table)
- Yields an allowable completion time of 35 days to repair the pothole

COMPLIANCE WITH MAINTENANCE STANDARDS

2003 is the third year that the maintenance audits have been performed. The results from 2001 show 79% compliance with the standards, while 2002 showed a decrease with a compliance rate of 67%. This compliance is actually a measure of whether the particular maintenance deficiencies have been repaired within the prescribed timelines; that is, whether they were completed on time. The table below shows how compliance with the maintenance standards is determined:

ALL ROAD SECTIONS AUDITED (12)		50% OF ROAD SECTIONS HAVE DEFICIENT RECORDS (6)		50% OF ALL DEFICIENT RECORDS WERE <u>NOT</u> COMPLETED ON TIME (3)
RTE306-1	50%	RTE306-2	50%	HWY103-1
RTE306-2		HWY103-1		TRK16-2
HWY103-1		HWY103-3		RTE344-4
HWY103-2		TRK16-2		
HWY103-3		RTE344-3		
TRK16-1		RTE344-4		
TRK16-2				
RTE344-1				
RTE344-2				
RTE344-3				
RTE344-4				

So, from the table above we have a “rate of non-compliance” of 25% (50% * 50%) yielding a “rate of compliance” of **75%** (1 – 25%).

ROAD CONDITION SURVEY

In the fall of 1999 the Department's Highway Operations staff, while researching maintenance practices in other transportation agencies, came into possession of a manual from the Washington State Department of Transportation (WSDOT) entitled "Maintenance Accountability Process". This process was an initiative to employ outcome based performance measures for evaluating the effectiveness of WSDOT's Maintenance program. At the core of the process was a methodology to do a road condition survey which assesses the maintenance service levels that exist at a given point in time. Having a clear picture of the maintenance service levels allows the agency to communicate to the Legislature the impacts of budget and policy decisions on program service delivery. As the Nova Scotia Department of Transportation & Public Works (TPW) strives to maintain and improve the level of their highway maintenance, an annual evaluation of the performance of their maintenance program is vital to support requests for retaining or increasing funding levels.

It was decided that TPW would conduct a road condition survey, based on WSDOT's methodology, in June of 2000 and in subsequent years. This would allow an analysis of TPW's maintenance program through the use of a statistically valid, random sampling procedure that records results of work accomplished with key maintenance activities.

METHODOLOGY

The Highway Operations Group of TPW conducts the annual Road Condition Survey (RCS) of the Provincial road network's 23,000 kilometres. The road listing database is broken down into four database categories: arterials, trunks/routes, paved locals and unpaved locals. Sequential numbers are assigned to every 200m section in each of the databases. For instance, there are 1,500 kilometres of trunks /routes in Eastern District that equates to 7,500 ($5 * 1,500$) 200m sections. Statistically valid sampling dictates that we require a sample size of 113-200m sections. So 113 random numbers between 1 and 7,500 are generated in order to select the sample sections.

Eight two-person crews do a field analysis of 1,700 sections of roadway, each 200 metres in length. These crews use a set of guidelines which show how to record the roadway deficiencies. They collect detailed data on surface condition, drainage, sign, pavement markings and site obstructions. This takes place over a twenty-day period in May and June. This data is sent to Head Office where it is entered into a database and analyzed. Utilizing outcome based performance measures and a service level scale (A through F), service delivery results can be rated against established benchmarks.

Nova Scotia uses the same thresholds as the State of Washington. For example, if a paved road has between 500 and 1,150 m² of pavement deficiencies per kilometre, then it would be assigned a rating of between C+ and D-. Overall Nova Scotia's roads rate in the "D" to "F" range, while Washington were mostly in the "B" and "C" range. This survey has been performed in the Spring of 2000- 2003 and has yielded letter grades (A-F), corresponding to roadway deficiencies.

The four-year trend indicates improvement in pavement patching, ditching, brush cutting and guardrail/culvert maintenance. This improvement reflects the effect of the Rural Impact Mitigation (RIM) funding (\$10 million annually) which contributed added funds to the Department's maintenance budget.

CUSTOMER SATISFACTION SURVEY

METHODOLOGY

The Marketing Research Centre (MRC) was retained by the Nova Scotia Department of Transportation and Public Works to complete research in regard to customer satisfaction of highway services throughout the province. In an attempt to find out which areas needed improvement, overall satisfaction, importance, and quality of various service areas were examined.

Data was collected for the 2002 Customer Satisfaction Survey between November 1, 2002, and November 13, 2002. In-depth telephone interviews were completed with 2,068 residents, all of whom were 16 years of age or older and were residents of Nova Scotia. Interviews were completed using C.A.T.I. (Computer Assisted Telephone Interviewer) software. All calls were made between 9 am and 9 pm on weekdays and 10 am to 9 pm on weekends. Interviews covered a random stratified sample of Nova Scotia based on four provincial transportation districts; Central, Northern, Western and Eastern. The first Customer Satisfaction Survey was completed for the Nova Scotia Department of Transportation and Public Works in 1997. It was used to gain understanding of Nova Scotians satisfaction with regard to the provincial highways. Additional studies were conducted in 1998, 2000, 2001 with similar objectives. The objectives of the 2002 were specifically to:

- Monitor and assess satisfaction levels of Nova Scotians regarding provincial highways.
- Identify the most crucial areas of improvement.
- Specifically identify which service or services are most important using characteristics such as district, and expressed satisfaction.
- Compare results with those of previous years in order to track which services are improving, and which are not.

The report of the survey findings includes detailed tables with results broken down by demographic sub-groups including district, gender, having a drivers license, amount of km's driven per year, and household income.

Rankings were collected for both importance and quality for the 18 different services provided by the Department of Transportation and Public Works, which made it possible to conduct a Gap Analysis. The Gap Analysis compared the expectations that Nova Scotians had for the provincial highways with the overall quality of service being provided. It indicates which services the Department might focus upon to improve the current highway condition. Gap scores were calculated as the percentage of residents who rated a factor as "very important" and also rated that same factor as less than "excellent" in terms of quality service. The largest gap in performance occurred in terms of filling cracks and potholes, suggesting that this area needs the greatest improvement among all of the highway services offered by the Department. Satisfaction measures were similar (calculated by weighting importance ratings by quality ratings), indicating general dissatisfaction with most highway services, especially with filling in cracks and potholes.

SURVEY RESULTS

Overall, Nova Scotians were generally satisfied with the Department of Transportation and Public Works. Half of all residents were from “Somewhat Satisfied” to “Very Satisfied” with the provincial highway system. Those dissatisfied indicated the most dissatisfaction with potholes in the roads, the roads being poorly paved/maintained and poor repair/condition. Sixty-nine percent of residents indicated that they felt either very safe (13%) or somewhat safe (56%) when driving on provincial highways. Those who indicated feeling unsafe while driving on the highways stated that the overall condition of the roads was the main reason for feeling that way.

Nova Scotians placed high levels of importance on virtually all highway services. However, residents felt more strongly at present, than in 2001, about the importance of the various highway services. Residents in 2002 also felt more strongly that the various highway services were of better quality than they were in 2001. Very few residents rated highway services as being “Excellent” although many felt most services were “good”.

Those services that were rated the highest by residents were: helpfulness, maintenance and amount of non-commercial signs, all pavement markings and highway design. Those services receiving the lowest ratings were filling in cracks and potholes, resurfacing sections of the highway, grading and dust control of gravel roads, the amount of four-lane highways and the surface condition of highway shoulders.

When residents were asked for their highway improvement priorities, they felt that a major priority should be upgrading the roads/new roads. Twinning/4 lane/Divided highway was also looked at as important and needing to be improved. The majority of Nova Scotians were in favour of The Department of Transportation and Public Works improving existing roads rather than building new ones.

Overall, the majority of Nova Scotians felt that the staff at the Department of Transportation and Public Works were either “good” or “excellent, therefore showing satisfaction with the workers. Only 15% of all residents indicated contacting the Department in the past year. Of those 15% that had contacted the Department, they were likely calling attention to a problem or seeking to have work done. Customers (60%) indicated satisfaction with the service that the staff provided. Those who were dissatisfied felt this was due to the Department not dealing with a particular problem.

SUMMARY

The results of the three different methods of measuring the effectiveness of Nova Scotia's highway maintenance program, Highway Maintenance Standards, Road Condition Survey and the Customer Satisfaction Survey are compared on a yearly basis to determine the trends in each measurement methodology and also to reveal any correlations among their results.

The result of this comparison, for the years 2001 and 2002 are summarized in the table below:

RESULTS COMPARISON TABLE 1

Maintenance Activity	Highway Maintenance Standards Audit	Road Condition Survey	Customer Satisfaction Survey
Pavement Patching	Declining Compliance	"D" rating Local roads poorest	Very important & poor quality Showing some improvement Needs more attention
Shoulders	Poor and declining compliance	"D" to "F" rating Trunks poorest and decreasing	3 rd poorest gap score Trend worsening
Signs	Poor and declining compliance	"F" rating Decreasing condition	Average concern Trend slightly worsening
Grading	Meeting standards	Decreasing condition	Low concern Average satisfaction
Ditching		"F" rating Improving in 2002	Low concern Average satisfaction
Brush Cutting	Poor and declining compliance	"F" rating Improving in 2002	Low concern Average satisfaction
Guard Rail	Poor and declining compliance	"F" rating Improving in 2002	Low concern Average satisfaction
Summary	Poor compliance that is declining from previous year with local roads having the most deficiencies	"D" to "F" ratings with local roads showing worst condition with general improvement	Public regards potholes and shoulders as most important and least satisfied

Comparing the results of the three different performance measuring methodologies has shown some apparent correlations. For example, the maintenance standards audit shows declining compliance with the standards while both the road condition survey and the customer satisfaction survey indicate a poor rating for the condition of our paved roadways.