

Report 7: November 2010

UPKEEP OF THE PROVINCIAL ROADS NETWORK BY THE MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE

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The Honourable Bill Barisoff
Speaker of the Legislative Assembly
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Dear Sir:

I have the honour to transmit herewith to the Legislative Assembly of British Columbia my 2010/2011 Report 7: *Upkeep of the Provincial Roads Network by the Ministry of Transportation and Infrastructure*.

John Doyle, MBA, CA
Auditor General

Victoria, British Columbia
November 2010

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AUDITOR GENERAL'S COMMENTS



JOHN DOYLE, MBA, CA
Auditor General

The provincial road network is an essential part of community and commercial well-being in British Columbia. Keeping our roads in good and safe condition over the long-term is a complex task requiring ongoing planning and investment.

My Office undertook this audit to assess the current state of the Ministry of Transportation and Infrastructure's planning and management of the ongoing routine and rehabilitative maintenance of British Columbia's road network. I am pleased to report that overall, these programs are being well managed, with an eye to cost, efficiency and effectiveness.

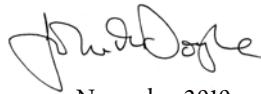
A number of years ago the ministry moved away from providing road and bridge maintenance work directly. Now, the ministry oversees the work performed by a number of contracted service providers. While we did note some opportunities for improvement in this area and made recommendations accordingly, overall we concluded that maintenance contracts are being managed adequately.

The results of this audit are, on the whole, quite positive. Nonetheless, we did identify areas where further progress could be made – specifically in the areas of long-term planning and in performance measurement – and have made 10 recommendations to improve the upkeep of the provincial roads network.

Roads and bridges have long life cycles that can be significantly extended with timely, periodic maintenance. Minimizing cost over the life-cycle of these assets requires long-term planning and action across the entire road network. The ministry does not yet have in place all of the tools necessary to bring this to life. And while the ministry has identified safety of the highway network as a key outcome, the impact of maintenance activity on safety is not adequately measured.

Going forward, I would like to see the ministry demonstrate conclusively that its long-term asset-management decisions will produce the greatest value for money – that is, providing British Columbians with the longest duration of service for the least overall cost. I would also like to see the ministry measure and report on safety-related performance objectives for its upkeep programs.

I would like to thank the many officials at the Ministry of Transportation and Infrastructure for their assistance and cooperation during this audit, and I look forward to receiving the ministry's action plan to address the report's recommendations.



November 2010

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EXECUTIVE SUMMARY

BRITISH COLUMBIA'S ROAD NETWORK is the most visible and widely used service that provincial and local governments provide to the residents of this province. Since people from every corner of the province - from private citizens to entire industries - rely on this road network, we all expect it be maintained in a safe and effective manner.

However, upkeep of B.C.'s road network requires ongoing attention in order to repair or replace components, delay deterioration, improve safety and capacity and achieve the best value from the investment in the road network.

The Ministry of Transportation and Infrastructure is responsible for planning this upkeep and for managing both routine maintenance and directed rehabilitation measures. The ministry hires the services of many independent contractors to carry out this work, but remains fully accountable for the results.

The purpose of this audit was to assess whether the ministry is managing its road upkeep programs in an economical, efficient and effective manner.

We wanted to discover whether the ministry is adequately planning road upkeep, managing contractors and establishing performance measures for these activities.

Overall, the ministry is doing a good job of managing its road upkeep programs and demonstrating careful regard for cost, efficiency and effectiveness.

We found that the ministry accepts full accountability for its contractors and takes the necessary steps to be sure that the required work is being done. This assurance is obtained as the ministry scores the contractors' results against set expectations and as it requires each contractor to prepare a Quality Management Plan.

Both the ministry and its contractors have well-defined roles with

the ministry acting as the *responsible owner* and the contractor being *responsible to the owner*. Furthermore, the distribution of risk between the ministry and the contractor is clearly established and the working relationship between the ministry and the contractors is positive and collaborative.

We found that the ministry runs a results-oriented management system and strives to continuously improve routine maintenance operations.

However, as we looked into the ministry's work backlog and asset management practices, we found opportunities to improve how the ministry plans upkeep work to achieve the greatest long-term value.

We also noted opportunities to improve the ministry's measuring and reporting practices. Although the ministry clearly sets out performance objectives for its contractors, we found that it does not adequately set out its own network-wide performance measures. Without such measures, it is difficult to gauge the ministry's success. We also urge the ministry to report the results of its network-wide assessments of condition and report relative to more comprehensive safety performance measures.

Finally, although ministry officials clearly value customer service and public engagement, having a process for analyzing and organizing public enquiries and complaints would help the ministry in its efforts at continuous improvement.

AUDIT CONCLUSIONS BY CRITERION:

Focus Point	Audit results		
	Not achieved	Partially achieved	Fully achieved
Planning 1: The ministry knows what its current and future maintenance requirements are, and these are reflected in the ministry's strategic planning and budget requests.		✓	
Planning 2: The ministry knows what roads it is responsible for maintaining and also knows that it is not maintaining roads for which it is not responsible.			✓
Planning 3: The ministry knows the condition of the roads and bridges to enable it to decide on the most appropriate means of preserving the infrastructure and keeping it safe for road users.		✓	
Planning 4: The ministry ensures that the performance standards in the contracts reflect the levels of reliability and safety that the ministry requires.			✓
Planning 5: The ministry maximizes the benefits derived from the investment in roads and bridges (such as through the use of a life-cycle costing model).		✓	
Planning 6: The information the ministry uses for road and bridge maintenance planning is sufficiently reliable for the purpose.		✓	
Planning 7: The ministry identifies the risks that could threaten the achievement of the program's objectives and the ministry mitigates these risks.		✓	
Managing 1: The ministry's choice of delivery vehicles and methods are the most cost-effective means of delivering the program.		✓	
Managing 2: The road maintenance tenders fully reflect accurate road inventories and current performance specifications.			✓
Managing 3: The risks that the contractor assumes and the risks that the ministry retains are unambiguously stated and clearly understood by both parties.			✓
Managing 4: The ministry knows that contractors are fulfilling the requirements imposed on them under the contracts.			✓
Monitoring 1: The ministry has set measurable goals and objectives for the road and bridge maintenance programs.		✓	
Monitoring 2: The ministry has chosen relevant performance measures for the road and bridge maintenance program.		✓	
Monitoring 3: The ministry monitors and reports its performance relative to its road and bridge maintenance goals.		✓	
Monitoring 4: The ministry seeks out and uses benchmarks for setting performance specifications and performance expectations.			✓
Monitoring 5: The ministry uses performance information to continuously improve its maintenance operations.		✓	

Source: Compiled by the Office of the Auditor General

SUMMARY OF RECOMMENDATIONS

WE RECOMMEND THAT THE MINISTRY:

- 1** identify the factors that could impede its success in meeting its road network condition standard. In addition, the ministry should periodically monitor the likely impact of such factors and determine when a comprehensive needs assessment is required to enable adjustments in condition standards, actions or funding.
- 2** set firm but attainable timelines for each highway district to have the Central Highway Resource Information System (CHRIS) fully functional and updated with the inventory of road and bridge assets.
- 3** make it a priority to complete the development of a network level life-cycle costing model to improve the estimating process used in planning for network upkeep.
- 4** collaborate with the wider road-building industry to assess whether or not the performance incentives are effective in encouraging excellence and, if they are not, modify the system appropriately.
- 5** revise the stakeholder consultation part of its contractor assessment program to ensure that judging of contractor performance by ministry staff is done in a way that is clearly fair and objective.
- 6** reassess its current service area configuration to determine if there are opportunities to improve efficiency.
- 7** set safety-related performance objectives and measures for its road upkeep programs so that Legislators and the public can better assess how well the programs are contributing to the ministry-wide goal of providing a safe environment for travel.
- 8** provide the results of network-wide assessments of road and bridge condition, and options for future funding, to personnel responsible for planning and overseeing upkeep work at the district and regional levels. In addition, a summary of those results and the funding options provided should be presented to Legislators and to the public as a report card on ministry efforts at network upkeep.
- 9** create a set of service-related objectives and performance measures to assess its own contributions to the success of contracted routine maintenance services.
- 10** analyze customer complaints and enquiries, and use this information to identify areas for making improvements in the road upkeep programs and in results reporting.

THE MINISTRY APPRECIATES the hard work of the Auditor General and staff in auditing the ministry's road upkeep programs. We value the learning offered by independent audits, and the significant time and effort that went into this report by all those that contributed.

The ministry is pleased with the many positive acknowledgements of Auditor throughout the report regarding the management and delivery of road and bridge maintenance services on Provincial roadways. Additionally, the ministry appreciates the numerous positive acknowledgements of the Auditor throughout the report regarding the level of professionalism, dedication, knowledge and service by both ministry staff and maintenance contractor personnel.

The findings reflect the ministry's commitment to providing high quality maintenance services that ensure the safe and efficient movement of people and goods throughout British Columbia.

Our staff and contractors are located in dozens of communities throughout the Province; from Fort Nelson to Victoria and Cranbrook to Atlin. As such, we recognize the importance of the services we provide to the public and strive each and every day to ensure we engage our stakeholders regularly and listen to feedback on ways to provide better service in the future.

The ministry also wants to thank the Auditor for identifying opportunities for improvement relating to some areas of our maintenance and preservation programs. As continual improvement is part of the ministry's culture, the Auditor's recommendations provide our organization an opportunity to reflect on areas of our program.

The ministry will review the recommendations and put in place a plan of appropriate actions to ensure continuous improvement of road and bridge maintenance in British Columbia.

Peter Milburn
Deputy Minister

BACKGROUND

In British Columbia, the Ministry of Transportation and Infrastructure is responsible for planning and managing the upkeep of the province's entire public road network, including the bridges – the equivalent of 91,487 single-lane kilometres in length. This network reaches into nearly every corner of the province, overseen by three highway regions: South Coast, Southern Interior and Northern (Exhibit 1).

A key goal of the ministry in meeting its mandate in this area is to preserve roads and bridges both to ensure public safety and to maximize the value obtained from the original construction investment. The ministry hires the services of many independent highway contractors to accomplish this work.

Exhibit 1: British Columbia's public road network and the three highway regions of the Ministry of Transportation and Infrastructure



Source: Ministry of Transportation and Infrastructure

A safe and reliable road network is critical to the daily well-being of British Columbians and to the province's economy overall

Roads have been important to British Columbia governments since settlement expanded in the province in the mid-19th century. Serviceable roads encouraged and facilitated relocation of people from the coast to inland areas, in the process advancing economic and social development – in industry and commerce, education, health care and communications. Today, with well over 2.7 million motor vehicles registered in British Columbia, provincial roads continue to serve these purposes, to ever greater degrees.

Just building a road is not enough to meet increased public expectations for safety and reliability. Whether it is a dirt road or a freeway, every road requires ongoing remedial attention to offset its rate of deterioration and preserve its safety and reliability. At the same time, while good engineering and better technology in recent decades have improved the quality of road surfaces, layout and safety features, these improvements have in turn increased and accommodated the public's appetite for going from point A to point B faster. The result is society's assumption that roads will meet even higher levels of reliability and safety than were provided before.

In this dynamic situation, effective ongoing upkeep of roads matters a lot.

Every component of the highway network has a service life that can be extended to some degree by intervention before the component eventually has to be replaced. Bridges, for example, have a theoretical service life of 50–75 years, but if their loading and design capacity is not exceeded they can last well past a century with adequate maintenance. Asphalt pavement may have a service life of 15 years or more, but that can be halved if traffic loads and the degradation rate are high.

FACT

It costs \$65,000 to resurface one km of highway after 12 years of use - but the cost rises to \$400,000 if the same stretch is left for just eight more years.

Excerpt from *Opening Up BC: A Transportation Plan for British Columbia* (BC Ministry of Transportation and Infrastructure, 2003)

Timely maintenance of roads is critical to achieving best value from the investment in the road network

Health care and education may be the largest categories of public expenditure in British Columbia, but in fact the average citizen uses those high-cost services only intermittently over his or her lifetime. Most citizens, however, depend on the road network almost daily and many will use the provincial network for much of their entire lifetime.

As with any physical structure, the road network's components break down over time with constant use.

Getting full value from roads and bridges over the years takes significant dollars. The public investment is large: the amortized value of highway infrastructure approximates \$8 billion. To protect this investment, small-scale repairs and planning for larger projects to stop deterioration must start soon after the road component is constructed and must continue to the end of the service life of the component.

The ministry recognizes several categories of activity in the upkeep of the existing road network. However, for ease of explanation, we have broadly divided this work into two types of activity, both of which are part of a continuum of effort:

1. Maintenance work that is continually ongoing – This includes repairs, treatments and minor renovations on roads and bridges that contribute to accessibility and safe driving conditions. This work involves payments to maintenance contractors of about \$380 million each year, according to the ministry.
2. Rehabilitation project planning and contracting – This includes periodic, significant work to restore roads and bridges to an almost new condition. Some projects in this category are undertaken to facilitate economic activity. According to the ministry, this work involves payments to road construction contractors of about \$270 million each year.

Both kinds of work slow the rate of deterioration of highway network components. However, rehabilitation is eventually required no matter how well routine maintenance is managed day-to-day.

Deciding when to do routine and rehabilitation measures, and at what scale and intensity, is critical to slowing deterioration, whether that means filling a pothole or renovating a bridge deck. A “deterioration curve” (a graph in which loss of condition is plotted against age) shows that loss of condition of a component accelerates over time, falling at a much faster rate well before the midpoint in the component's condition is reached.

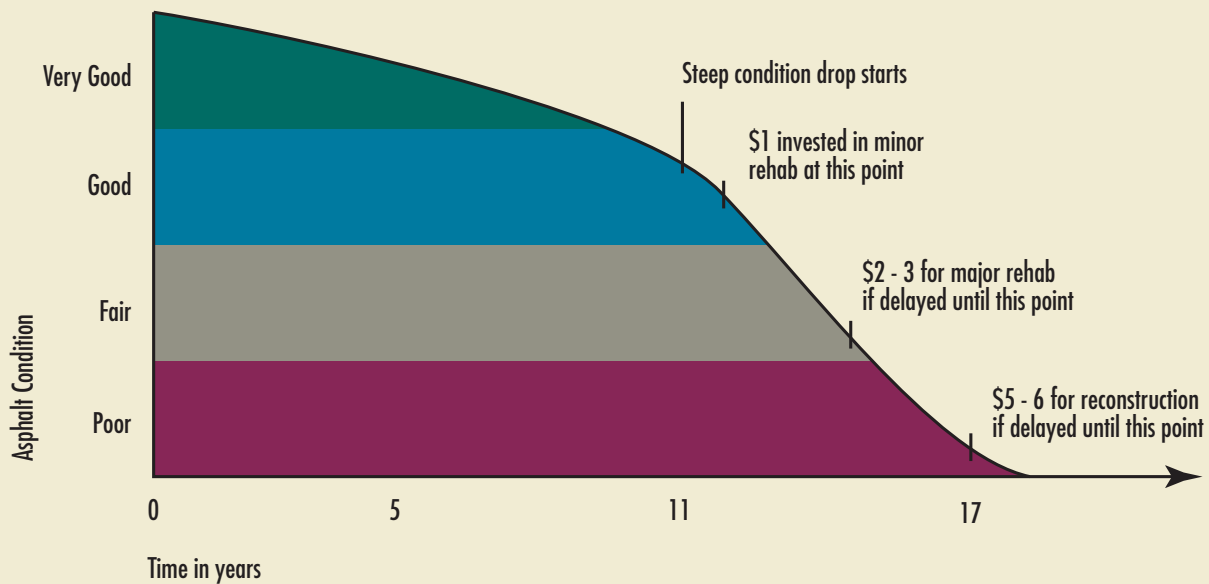
DETAILED REPORT

For instance, maintenance work on pavement, such as crack-sealing, can slow the road surface's deterioration if applied at the right time. Sooner or later, though, rehabilitation of the surface is needed. As Exhibit 2 shows, each type of intervention has an optimal range until deterioration requires more intensive and costly measures. Generally speaking, remedial attention applied to the component at a 40% decline in quality restores the condition to somewhere further back up the deterioration curve. Remedial attention applied after an 80% decline in quality requires a far greater restoration effort time and budget for the amount of condition restored. At some point along the steepest part of the curve, complete replacement of the component becomes more economical than application of a range of upkeep efforts.

It is therefore most economical to do upkeep before the deterioration curve accelerates near a component's half-life because the longer the delay to intervene, the more expensive effective intervention becomes. Ideally, upkeep activity starts right after construction and proceeds indefinitely. This way, components provide the most service to highway system users before they have to be replaced.

For this reason, planning for maintenance and rehabilitation work should always be ongoing so that the ministry is aware of funding needs and can budget accordingly. Even when needs are well-known, money to maintain and rehabilitate highways is not always made available at levels that will ensure the most service is derived from network components.

Exhibit 2: Costs of rehabilitation by stage in deterioration of pavement over time

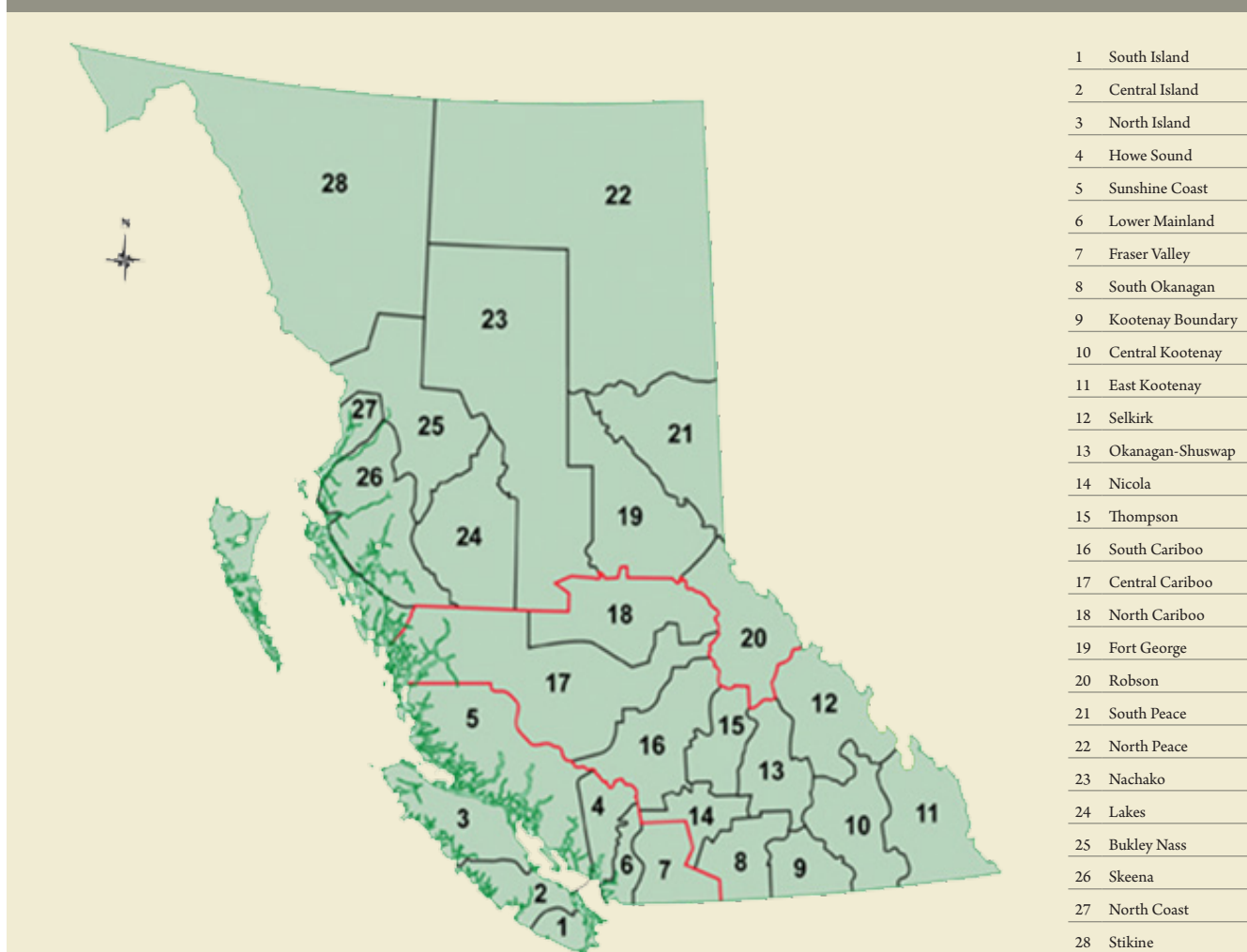


Source: New Brunswick Department of Transportation

Spending on maintenance contracts within the road network varies by service area

The successful bids for the ministry's 28 maintenance contracts have different dollar values that reflect the relative size and maintenance challenges in each respective service area (Exhibit 3). Knowledge of these challenges comes from the ministry's historical experience in managing each area. One service area's higher frequency of snowfall and variable micro-climates, for example, present a greater cost challenge in terms of appropriate and timely maintenance response than do another service area's typically few snowfall events.

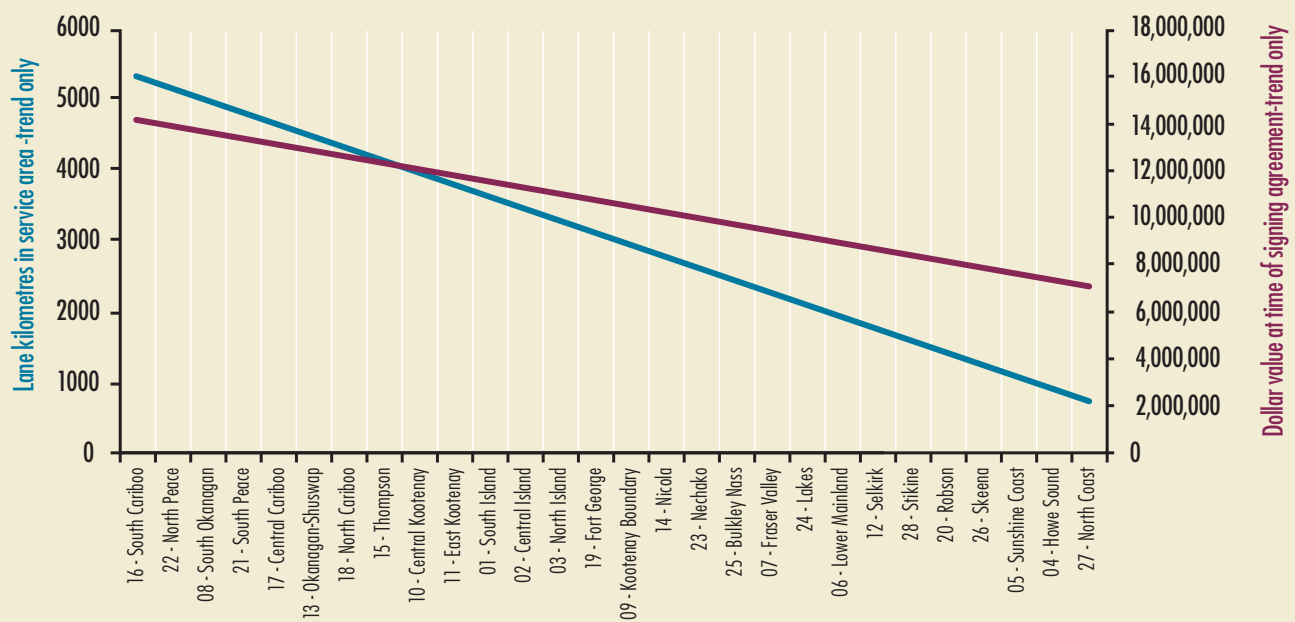
Exhibit 3: Location of the 28 highway maintenance service areas in British Columbia



Source: Ministry of Transportation and Infrastructure

In spite of the wide differences in maintenance challenges among service areas, there are some common trends. As Exhibit 4 shows, for example, the greater the road surface in a service area, the higher the value of the maintenance contracts in the area. While the dollar value represented on the right-hand axis does not include larger rehabilitation work, it does reflect the kind of service delivery pattern to be expected in a province with extensive minor roads connecting many isolated settlements.

Exhibit 4: Number of kilometres maintained within each service area and dollar value



Source: Office of the Auditor General of British Columbia using data from the Ministry of Transportation and Infrastructure

Topography, distance and weather across the province affect road maintenance significantly

Those responsible for road upkeep in British Columbia have significant challenges from the terrain and the weather. The effects of either on established roads can often only be mitigated, not eliminated. For example, road geometry is not always optimal, subjecting drivers on some trips to extreme grades, multiple curves or switchbacks. However, straightening or leveling a road route to adjust its geometry may be technically feasible but cost-prohibitive to do.

The impacts of climate on roads and their drivers are highly variable within the province. Because of mountainous terrain and coastal effects, variations in temperature and moisture range widely, and often within small localities. Micro-climate variability in coastal areas in particular can mean that fog, rain or heavy wet snow is intermittent or unpredictable.

Both cooler parts of the province and mountainous areas tend to suffer long periods of winter driving conditions. Maintenance effort directed to reducing the effects and associated hazards is costly and often does not result in entirely dry, clear roads when drivers expect them. Again, micro-climate variability, particularly in the mountains, means it can be snowing in one place and sunny but icy in an adjacent stretch. The effects of elevation alone can be dramatic: for example, commuters leaving Rock Creek on a sunny March day might well see all of rain, sleet, heavy snow and blue skies during one relatively short trip to Trail on the Columbia River.

In addition to surface conditions, what happens under the roadbed in colder regions can impact travelers' plans. In the Interior and in northern British Columbia, ground-frost thawing can force load restrictions or closures on many important routes in the very early spring. It is the responsibility of road maintenance managers to restrict access to ensure roads and bridges are not damaged by inappropriate loads in these conditions or at any other times.

Levels of road safety also rely on the experience and alertness of drivers

Well-maintained roads are only one dimension of providing road safety. Drivers in the province are often required to adapt to a variety of obstacles on a typical journey. They can face, for example, obstructed sightlines on curves, hills that demand good judgement in following and overtaking, and even natural hazards that can range from icy conditions or rock falls to sudden encounters with livestock or wildlife on the road.

Drivers can also add to their own safety risks when they get behind the wheel without being adequately prepared, experienced or self-disciplined. Long distances with few settlements can induce tired drivers to continue driving. Long waits and volume tie-ups, typical of suburban commuter driving, can result in impatient and preoccupied drivers. And simple poor judgement can lead some individuals to drive too fast or while impaired – both common causes of serious accidents.

AUDIT PURPOSE AND SCOPE

The purpose of our audit was to assess whether the Ministry of Transportation and Infrastructure is managing its road maintenance programs with careful regard for cost, efficiency and effectiveness.

We wanted to find answers to the following three questions:

- ◆ Is the province planning adequately for roads upkeep?
- ◆ Is the province adequately managing the activities of the contractors who deliver the upkeep?
- ◆ Is the province able to tell how well it is meeting its responsibilities for roads upkeep?

We audited the ministry's actions for the period April 2009 to March 2010, visiting ministry workplaces and sites where work was underway on roads and bridges. We also contacted a range of contractors and highway users to get their thoughts about highway upkeep in the province. We did not look at the contractors' own management practices and we did not look at capital expansion projects that the ministry undertakes.

We carried out the audit according to the standards for assurance engagements established by the Canadian Institute of Chartered Accountants.

After we completed our work, we discussed our findings with ministry staff and requested them to develop plans for addressing our concerns.

KEY FINDINGS AND RECOMMENDATIONS

The ministry is adequately planning road and bridge upkeep at the regional level but lacks sufficient capability to plan across the entire provincial road network

Cost-effectively planning for upkeep of the road and bridge network is a significant challenge. Success depends on having:

- ◆ **performance standards** – that is, choosing a desired general standard for focusing short- and long-term planning;
- ◆ **inventories** – that is, maintaining a complete and accurate inventory of roads, bridges, other structures and equipment to ensure that all assets are considered;
- ◆ **inspections** – that is, knowing the condition of each of the inventory’s components, through inspection, to identify the nature and timing of needed maintenance and rehabilitation; and
- ◆ **costing** – that is, maintaining a system that helps determine, based on the condition of the inventory, the “least cost over life-cycle” of maintaining the major components of the network to the condition standard required.

We expected to find that the ministry has reliable systems and data input processes, combined with adequate analysis to support the elements above.

We concluded that the ministry has a medium-to-long-term standard for assessing road and bridge condition of the network. It also commissions comprehensive assessments of condition for comparison. However, we found that the ministry does not always follow through on what this comparison reveals because conflicting factors stand in the way. As a consequence, a road and bridge rehabilitation backlog exists, and the ministry has no plan to eliminate this.

The ministry’s inventories are adequate and work is underway on improving them further. We concluded that the ministry has reliable systems for managing inventories and inspections information and uses the data it gathers on asset condition to plan individual upkeep projects. The ministry does well balancing the urgency of various renewal projects with stakeholder needs and policy considerations. However, the ministry’s analytical tools cannot yet tell whether the ministry is reaching the desired future state of the network as a whole at the least cost. Accordingly, the ministry is very good at knowing

what to do to decelerate the rate of deterioration of roads and bridges locally, but it does not yet have analytical structures in place to determine when best to take those actions, where and at what scale to achieve the most economical long-term payback for the taxpayer on the network overall.

Strategic planning for the road and bridge network targets a “maintain present condition” standard

In 1999 the ministry conducted a funding needs analysis with which to focus and direct network planning and funding for the coming years. Different funding options were considered, and the government chose the “maintain present condition” planning standard to define the desired future condition of the network for the next 10 years. A new analysis that started in 2008 was ongoing at the time of our audit. The process calls for a complete assessment of the condition of all roads, bridges and other structures in the inventory that will result in an estimate of the amount of work and funding needed to meet the revised planning standard for a ten-year period.

The 1999 funding needs analysis did not just contemplate upkeep needed to offset future deterioration, it also presented options for addressing a backlog of road and bridge rehabilitation activity that had not occurred in prior years. The decision was taken not to eliminate the backlog, but to re-prioritize preservation work each year, so that the backlog would get no worse.

Accordingly in 2003, in its *Opening up BC: a Transportation Plan for British Columbia*, the ministry reported that the Province had accumulated a rehabilitation backlog in the last decade, neglecting the timely maintenance that would prevent higher costs later.



Gravel roads need regular maintenance attention - Auditor General staff photo

An inability to sustain or improve on present condition jeopardizes the ministry's ability to maximize the benefits derived from its overall investment in roads and bridges. If pavement preservation is not carried out on a timely basis, a greater amount of money may need to be spent in the future to correct the premature deterioration of the pavement. The same principle applies to the upkeep of structures such as bridges and tunnels.

Responding to the challenges of an existing work backlog, volatile construction costs and a period of public sector austerity emphasizes the importance of having timely information about where the upkeep programs stand. The ministry needs to be able to establish priorities and take network-level decisions that make sense in both the short and long term. The procedure the ministry uses to address this need is the infrequent network-wide funding needs analysis.

When we asked the ministry why they conducted network-wide funding needs analyses approximately every ten years instead of more frequently, they reported they had no policy on the time interval between analyses and that they seldom conduct them. When we then asked the ministry what fundamental changes could trigger such analyses, they replied that there was nothing definitive.

RECOMMENDATION 1 - *We recommend that the ministry identify the factors that could impede its success in meeting its road network condition standard. In addition, the ministry should periodically monitor the likely impact of such factors and determine when a comprehensive needs assessment is required to enable adjustments in condition standards, actions or funding.*

The ministry's inventory of the network supports planning

We expected the ministry's inventory records to show the present age and relative service condition of each asset in the network so that upkeep efforts can be identified and adequately funded. Good records are those with sufficient detail to show the unique attributes of a structure, including service loads and ratings, and sufficient data so that accurate cost estimates and projections can be made. All instances of deterioration of wearing surfaces and moving parts, corrosion and fatigue in metal components, rot in wood structures, and deterioration of concrete and its reinforcing steel should be captured in records.

We found that the ministry understands that an accurate asset inventory is critical for sound maintenance planning and for the effective administration of the maintenance contracting process. The ministry is now working to create a one-stop geo-referenced inventory of all assets in the network, including all structures, roads, signage, drainage elements and equipment. The new Central Highway Resource Information System (CHRIS) is now being tested. CHRIS is using data from other highway asset management records, including the legacy data from the soon-to-be-obsolete Road Information Management System, a road features inventory that has been in place since the 1990s. For example, the Bridge Management Information System (discussed below) will continue to run independently but will be able to access the information contained within CHRIS.

One advantage that CHRIS will have over its predecessors is the use of global positioning reference points for various objects in the inventory. This adds a level of certainty that the former reference points practices could not achieve. At the time of our audit, the ministry's highway district technicians had plans to verify and update descriptions of items in the inventory and to set the GPS coordinates for each item and stretch of road. The ministry's objective is to update all information in CHRIS well before having to prepare tenders for the next round of maintenance contracts.

The ministry does not yet know whether its contractors will be given full access to CHRIS and whether they will have a role in updating the information when changes to components or their locations are made.

We noted that district technicians in the ministry responsible for updating information in CHRIS were not all making consistent progress on that work. However, the objective is to have CHRIS fully functional and updated to support upcoming contract administration activities, among other critical responsibilities that rely on accurate inventory records.

RECOMMENDATION 2 - *We recommend that the ministry set firm but attainable timelines for each highway district to have the Central Highway Resource Information System (CHRIS) fully functional and updated with the inventory of road and bridge assets.*

Inspections activity drives the local upkeep strategy within the network

We expected to find the ministry conducting road and bridge inspections regularly and thoroughly, and using the data to guide its upkeep planning programs throughout the province.

We found that inspections of network infrastructure are carried out by both ministry staff or agents and by maintenance contractors, and fulfill a number of key purposes:

- ◆ to identify inventory;
- ◆ to assess condition for preventive maintenance planning and to keep roads safe;
- ◆ to assess condition for medium to long-term rehabilitation planning and;
- ◆ to assess contractor performance.

Inspections of many components of the network are carried out by qualified inspectors employed by the ministry or hired for the purpose. In either case, the inspectors determine and document the condition of the asset, this information becomes part of that asset's inventory record.

These inspections are supplementary to those performed by highway maintenance contractors who must obtain enough information to be able to plan and prioritize maintenance activity on roads, bridges and other structures. Both the ministry and its contractors consider inspections activity to be critical for planning how they will meet their respective responsibilities.

Together, all of these inspections complement each other by identifying overall condition of the asset (needed for the ministry), identifying needed repairs and inspecting any repairs undertaken (done by the maintenance contractor), and inspecting the results of contractor repairs for the purposes of oversight (done by the ministry). Other inspections are carried out in emergency situations.

There are three main categories of inspections: paved roads, unpaved roads and structures such as bridges, tunnels and retaining walls. The following discusses these in more detail.

- ◆ *Paved roads* – Paved roads make up the largest network component and inspections of these are conducted regularly within each of the three highway regions. The frequency of inspections varies, depending on the class and function of

the paved roads in question. Surface condition surveys are conducted every two years on the primary highway system, every three years for secondary highways and on a four year cycle for selected paved side roads. Taken together, these local assessments are part of the province-wide inspections cycle that takes four years to complete. Maintenance contractors and Ministry Service Area Managers collaborate to identify pavement problems at the local level on an ongoing basis.



Data from high-speed pavement survey equipment is fed into on-board computers when portions of the road network are surveyed – Ministry of Transportation and Infrastructure photo

High-speed pavement surface conditions surveys help identify pavement distress

“High-speed pavement surface condition surveys” are performed on a cyclical basis for the provincial road network; every two years the primary roads are surveyed, but only a portion is covered annually. The surveys capture the severity and density of several surface distress types within each surveyed lane, as well as rut depth and roughness measurements in both wheel paths. Digital images of the right-of-way are also taken.

The objective of these high-speed network-level surveys is to obtain performance data that is sufficiently accurate, representative and consistent to support network level analyses. Included in a survey are the condition of the paved numbered highways and a representative sample of all paved side roads under the ministry's jurisdiction. The aim is to identify paved stretches that are deficient, according to defined levels of service, and to monitor trends in highway condition. The data is used to ascertain overall pavement rehabilitation needs and assess appropriate investment levels to support strategic asset management planning.

Excerpt From 2009 Pavement Surface Condition Rating Manual

At the overall network level, inspections focus on the chief indicators of deterioration, surface distress and pavement roughness. The ministry uses high-speed pavement surface condition surveys to generate a body of inspections data for pavement across the network (see sidebar). That data becomes part of the ministry's Roadway Pavement Management System, which supports network-wide strategic and operational planning for slowing deterioration of pavements.

- ◆ *Unpaved roads* – Unpaved rural roads are not subject to a prescribed inspection frequency. As they travel the road network on a regular basis, ministry officials and contractors constantly watch for emerging problems. Both are also responsive to public complaints and comments about the conditions of unpaved roads.
- ◆ *Bridges and structures* – The ministry regularly carries out rigorous inspections of bridges and other structures. Inspection records are reviewed by the regional bridge engineer and used to monitor wear, assess deterioration, and generate project work relative to those conditions.

The ministry's area managers for bridges conduct inspections themselves or use contractors retained to supply particular technical detection equipment or advice. These inspections of structures in both routine and annual inspection categories are more thorough than those of the maintenance contractor, being more systematic from one case to another, and better documented.

The province has 2,762 bridges and more than 400 tunnels and snow sheds in its road network. Inspections documentation for these is entered into Bridge Management Information System (BMIS), a management tool that supports planning, maintenance and rehabilitation of these structures.



Heritage bridges in the province's public road network are kept serviceable. - Auditor General staff photo

Calculating lowest life-cycle cost requires a number of elements

The following elements in place would enable the ministry to calculate the lowest life-cycle cost on a network-wide basis:

- ◆ identification of the current condition and likely rate of deterioration of each asset;
- ◆ breakdown of each maintenance and rehabilitation activity, from "cradle to grave" of the asset, into discrete elements;
- ◆ cost of each unit of upkeep identified;
- ◆ cost of eventual dismantling;
- ◆ cost of environmental remediation;
- ◆ formula for compensating for different costs of the same service by various contractors and calculation of the average cost for an activity;
- ◆ optimization of upkeep activities across the network;

The ministry does not have life-cycle costing capacity at the provincial network level

Since the 1990s, the ministry's objective has been to maintain assets in the highway network in a safe and reliable condition at a minimum life-cycle cost. Calculating lowest life-cycle cost allows the ministry to estimate and recommend the most economical programs of maintenance, rehabilitation and renewal for the various assets in the network.

At the individual project level, the ministry seeks to maintain assets in a safe and serviceable condition at a minimum life-cycle cost and has the capacity to achieve this.

However, at the network level, the ministry recognizes that it currently lacks the capacity to implement a fully developed life-cycle costing regime and cannot therefore benefit from the savings that such planning makes possible. The ministry has identified the need for life-cycle costing capacity in its infrastructure preservation and renewal programming, and set that as an objective in its 2009-2010 *Service Plan*.

RECOMMENDATION 3 - *We recommend that the ministry make it a priority to complete the development of a network level life-cycle costing model to improve the estimating process used in planning for the road network.*

Decisions made by the ministry to improve the network may not result in the least long-term cost

We expected the ministry to have processes in place to effectively prioritize maintenance and rehabilitation projects across the network. We also expected the ministry to be able to show the consequences of its choices on the network's condition.

We found that while the ministry has processes for evaluating and prioritizing road and bridge projects based on both ministry and broad government priorities, it lacks information to confirm that its choices represent the least cost over the long-run.

Prioritizing projects is a necessary output of planning, giving some projects the green light and holding off on others less urgent. However, this process is complicated for a number of reasons. There may not be enough industry capacity to do the work, or there may not be available public funding to address all remediation needs at once. And as a policy, the ministry may wish to ensure that all areas of the province equally see improvements to their roads and bridges. As a result, the final ranking of priority projects by the ministry may not necessarily reflect the original level of risk that highway engineers might recommend.

The ministry has adequate processes to assess priorities by reference to condition of roads and bridges based on technical issues, anticipated cost escalation and the factors just noted. For example, the sidebar shows the typical process for prioritizing bridge rehabilitation projects. It illustrates the significant role of inspections and systems information in optimizing upkeep results given the resources provided. However, it also shows that planning includes conflicting elements, such as regional allotments, that could defer some projects in favour of others considered less urgent from a strictly technical point of view.

The Ministry is confident that there is enough flexibility to fit in all the planning considerations without adding additional long-term cost. The assets generally deteriorate slowly enough that the Ministry can time its remedial actions to fall within the opportunity window, when its professionals reckon that deterioration can be corrected without adding significant additional long-term cost. The window is assumed to be large enough to make triage a good strategy: attend to the most urgent and get to others later.

Success depends on not running out of window, choosing the most effective treatments each time and keeping up with remediation demand among a large inventory of aging assets with varying rates of deterioration. We found the Ministry understood the pressures in this environment well.

The main steps in the process for prioritizing bridge rehabilitation projects in British Columbia

Each year, the ministry's Regional Bridge Engineers, in consultation with area inspectors and peers, establish a four-year priority for renewing existing structures through the following process, which takes as its premise limited funds being available:

- ◆ Each region's engineer generates the initial list by evaluating the region's own structures' records in the Bridge Management Inspection System. Each record has a score relative to its overall condition at last inspection.
- ◆ The engineers together look at the ministry's top 200 bridges needing work.
- ◆ The engineers go through their regional lists again and strike off the ones that are entirely irrelevant, such as a structures slated for replacement because the loads or capacity demands have changed.
- ◆ The engineers then apply historical cost factors to projects to arrive at a percentage distribution for each region.
- ◆ A final priority list is identified after a further winnowing (e.g., striking off structures that are not on priority routes or are likely to be serviceable without modification for a longer time given their location and load demands).
- ◆ Finally, a discussion follows to conclude on what the regional allotments of bridge project work will be.
- ◆ After funding is allotted regionally, each regional engineer takes the region's list and makes it her or his bridge program. In this final step, the engineer accounts for perceptions of local user groups, views of elected officials, emergency planning needs, and other such planning inputs.

Source: B.C. Ministry of Transportation and Infrastructure

While the Ministry has some flexibility in the timing of funding, it lacks sufficient feedback to be sure that the remediation and timing choices actually made result in the least cost over the long-run. Better performance monitoring, dealt with later in this report, would help the ministry clearly see the consequences of its choices.

THE MINISTRY IS ADEQUATELY MANAGING MAINTENANCE CONTRACTS

For over 20 years, the ministry has engaged independent highway maintenance contractors to plan and perform localized operations that preserve the service life of roads and bridges. In our audit, we therefore expected to find that the ministry:

- ♦ had set well-defined roles for each of its contractors and outlined clear and comprehensive responsibilities for those roles;
- ♦ was obtaining reasonable assurance that its contractors were fulfilling their contractual responsibilities;
- ♦ was using performance information to continuously improve maintenance operations, and was benchmarking its performance expectations against those of other jurisdictions or against some widely accepted set of standards;
- ♦ could still rationalize the geographic distribution of its efforts through the 28 highway maintenance contracts covering the province's road network; and
- ♦ was periodically reviewing its delivery model including the number and distribution of its maintenance contracts.

We concluded that overall, and within the service delivery structure it has chosen, the ministry is managing the maintenance of the province's road network well. The ministry has contracted out planning and delivery of routine and quantified maintenance operations for roads and bridges, but has retained full accountability for the results of the efforts of those contractors. The procedures within this arrangement have been refined to provide a results-oriented management system.

The ministry is ensuring that maintenance operations are continuously improved and benchmarks its performance results against widely accepted standards. The ministry has defined roles clearly and is obtaining reasonable assurance that the contractors are compliant with the contracts. However, the ministry has not evaluated the effectiveness of its performance bonus system or recently reviewed the overall ministry/contractor division of responsibility to identify duplication of activities and opportunities for better economies of scale.

Design and delivery of the routine maintenance program is adequate

The ministry has established 10-year contracts with independent contractors in all 28 service areas to conduct routine maintenance and emergency response tasks related to road conditions. Contractors are required to do specific types of maintenance activity, achieve a specified result and meet response times the ministry has set. Nevertheless, the ministry remains responsible to the public for the condition of the highway network and must therefore conduct a number of oversight activities to ensure that contractors are meeting or exceeding expectations. It does this through its District Managers and Service Area Managers who perform inspections, assessments and on-site discussions with contractors and road users to make sure contracts are being complied with. Regional management in the ministry also contributes to the oversight of contractors by participating in assessments of the results of contractor activity.



Sealcoating (applying a layer of bituminous material to a road surface to seal it) is a commonly used maintenance technique applied to many secondary roads in British Columbia. - Auditor General staff photo

Terms of agreements are clearly stated and well understood

The ministry invests in the careful design of contract documentation and in the quality assurance processes set out in it. The ministry specifies the results it expects from the full spectrum of maintenance contractor activities.

Roles must be well understood by both parties under this arrangement. There can be no presumption that contractors are agents for, or partners with, the ministry or the Province – and in fact the contract states this. Ministry officials we spoke with told us that they clearly understood the distinction between the contractor's limited responsibility for fulfilling a binding agreement and the Ministry's

wider accountability to the public for road maintenance. They described their role as that of being the responsible owner, and the contractors' role as that of being responsible to the owner for specific results. Contractors we spoke with also told us they were clear on their role and that of the ministry.

The distribution of risks between the ministry and its contractors is clearly set out in the agreements. Each contractor must post a performance bond and carry a specific level of insurance to offset the risks otherwise carried by the ministry for conducting and managing maintenance operations. The 10-year contracts currently in place produce a long-term tenure for the contractors in each community represented by the 28 highway service areas.

The service area contracts are administered using a common contract approach (see sidebar). The contracts contain a standard set of maintenance specifications, which are periodically reviewed and adjusted in order to achieve results needed in the road network. These specifications are often supplemented with additional local area specifications reflecting the unique maintenance needs of the service area. Contractual specifications for routine maintenance are based on historical operational patterns that have remained largely unchanged for over 20 years.

Pricing of maintenance contracts

Road maintenance contracts are "lump sum" contracts. Proponents bid a first-year contract price. Successful bidders (contractors) receive 1/12th of this price every month of the year. The contract includes an annual price adjustment process to take into account: changes in price indices for labour, fuel and non-residential construction; changes in inventory for which the contractor is responsible in a contract year; and changes in the level of service requested.

The contract specifications are the primary means by which maintenance activities address the goal of safety. We found that the specifications contain substantial safety-related content for the maintenance results that the ministry expects to be achieved. The safety-related content varies from the obvious (such as application of temporary line markings where work is interrupting normal traffic separation markings) to the subtle (such as the inspection and servicing of bridge components). The most prominent built-in safety

aspect evident in the specifications is the requirement that repairs or removal of hazards be completed within a specific timeframe.

The scope of contract work sometimes overlaps with activities that the ministry, in its oversight role, must also pursue. One example is public consultation that both the ministry and its contractors must do to improve their knowledge of public expectations and to encourage those expectations to be set at realistic levels. Another example is inspections of bridges. These are performed at different levels of rigour, at different times and for different purposes by the ministry and its maintenance contractors.

Contractors told us they saw the contract and the maintenance specifications as providing them with suitable guidance. Both the ministry and contractors we interviewed expressed their willingness to work toward reaching mutually agreeable resolution on areas of friction or emerging challenges. The ministry managers were clearly engaged in maintaining positive working relationships through frequent contact with their respective contractors and were well aware of the locations of contractor activities and planning schedules. For example, the review of contractors' weekly routine work plans by ministry area managers serves this purpose. Contractors must also clear plans for their work with the ministry, and this opens up another avenue for advice and negotiation.

Contractors are required to receive and act on public inquiries and complaints and to keep records of these and how they were resolved. Many of these come through the 24-hour phone access numbers posted in phone directories and on the ministry's website. Others come via external requests and queries addressed to the ministry's district staff, but fall within the contractor's responsibility. We noted that both the ministry and its contractors welcomed interaction from the public on any road conditions issues and relied on this as important input for improving services.

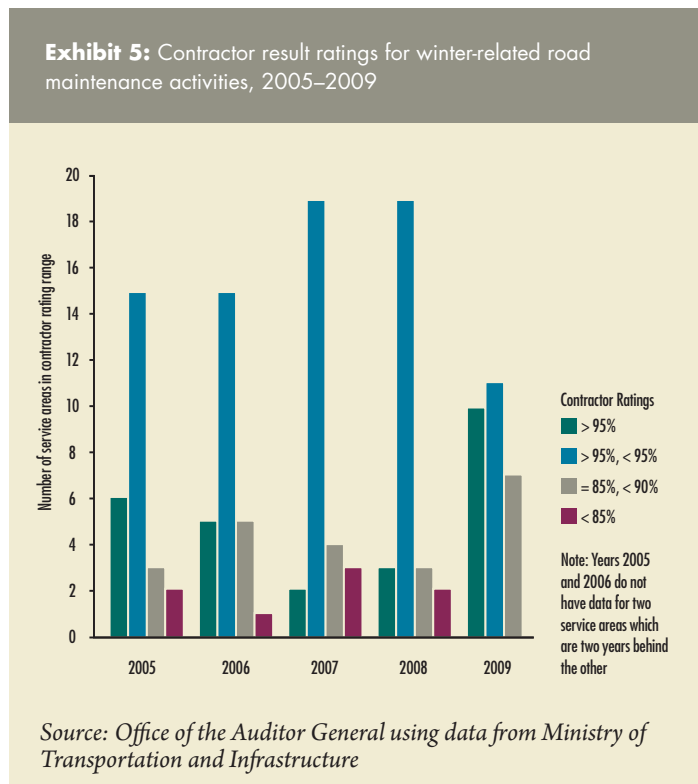
Performance of contractors is adequately assessed

The ministry continues to use a monitoring system to determine whether its contractors are achieving the results that the specifications intend and to direct the contractors to comply if they are not. In almost all respects, we found this system is working well.

The ministry knows that contractors are fulfilling the requirements of their contracts

The ministry derives its assurance that the required work is being done by evaluating the results contractors actually achieve and then scoring those results against contract expectations. These results are expressed in such terms as adequacy of road preservation treatments undertaken and timely response to safety threats, such as snow and ice accumulation during winter. Contractors failing to achieve the results identified in the agreements achieve lower ratings in their assessments than those who meet or exceed contract requirements. We looked at samples of documentation produced by this verification and assessment process and were satisfied that it was appropriate. We concluded that the ministry knows whether contractors are fulfilling contractual requirements.

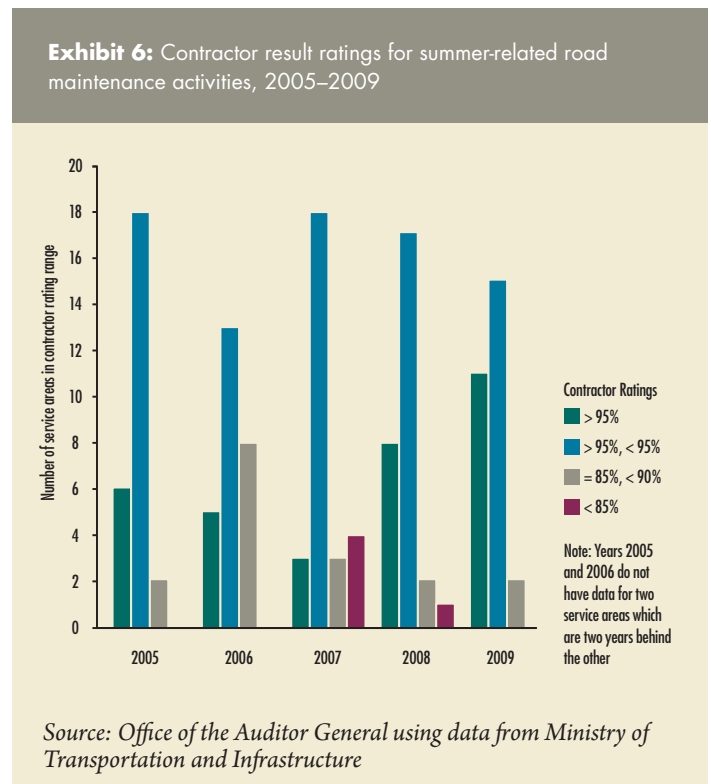
Ratings of road maintenance results by contractors for winter maintenance activities, such as snow clearing and summer activities such as pavement patching, are shown in Exhibits 5 and 6, respectively. A rating of less than 85% indicates that results obtained by the contractor do not meet the ministry's requirements. Both exhibits indicate that the majority of the 28 contractors are meeting or exceeding the requirements of their maintenance contract specifications.



The ministry requires its contractors to prepare a Quality Management Plan, based on international standards (ISO 9000), that address sound quality management practices. Part of the agreement that contractors sign with the ministry requires them to put an internal quality management system in place to monitor their own management operations. The contractors are to monitor and assess the outputs of their work to ensure compliance with the contract terms and conditions. The focus of this monitoring is on whether the contractor is meeting the maintenance specifications.

We determined that this monitoring and assessment strategy is being applied with reasonable consistency across the 28 contracts, and produces reliable documentation as to results relative to the maintenance specifications.

The ministry's approach to oversight is set out in its Quality Plan and Contractor Assessment Manual. This document is reviewed and updated as needed to fulfill both the verification and assessment parts of contractor oversight. We found that the ministry's management staff in the districts are following the requirements of the manual and producing the required documentation. As well, the contractors we spoke to all understood the need for the Quality Management Plan and a number of them told us that its implementation had improved their own management processes over time.





Grading of side roads is regularly required - Auditor General staff photo

The ministry expects contractors to contribute to improvement

Quality assurance applied to highway maintenance results goes beyond providing simple contract-related assurance. An important secondary impact is the opportunity it affords to focus on improvement – and in this case, improvement of results that will benefit highway users.

The drive for improvement comes from the need to upgrade roads and structures to reach a threshold that new engineering standards, technology and materials bring within reach. New construction, for example, will always incorporate the structural integrity, materials and safety standards that engineering practice accepts at the time, while upkeep on previously existing infrastructure plays catch-up to that standard. For this reason the ministry, in managing its maintenance and preservation programs, pursues improvement of a structure or road beyond the as-built condition whenever possible.

The ministry pursues two principles in this improvement approach, and requires its contractors to plan their work consistent with these principles:

1. *Combine preservation or renewal tasks in as large an aggregation as feasible* – Separate renewal or repair operations are combined so that maintenance intervention on the same structure or stretch of road is not needed for some time. Any upgrading to higher standards or installation of additional equipment, short of complete reconstruction, is worked in if funds allow. For example, renewal of a bridge deck and other bridge components may be combined with repaving bridge approaches and adjacent stretches of highway. In so doing, deterioration of that set of components is reset to a common starting place, which aids planning for future maintenance and renewal. This approach also benefits highway users because fewer detours, closures or construction speed zone postings are required.

2. *Make every intervention contribute the most value* – Routine maintenance activity, such as temporary patching, is withdrawn and deployed elsewhere some time before larger renewal or replacement projects are expected to start. This means that small-scale improvements or repairs are not torn up by the larger renewal project in the near future.

We noted that the ministry officials responsible for preparing and overseeing maintenance contracts understand that improvement of the network through routine maintenance and larger preservation and renewal projects is a reasonable operational objective. The philosophy known as “continuous improvement” that the ministry imposes on its maintenance contractors in the ISO 9000 management approach fits with this objective.

Incentives to encourage contractors to exceed performance may not be effective

In our Office’s March 1990 *Auditor General Annual Report to the Legislative Assembly of BC*, we noted that “contractors have little incentive to do more than meet the standards [of the maintenance specifications] because the monitoring process does not formally recognize above-standard performance.” Accordingly we recommended that performance incentives be incorporated into the maintenance contracts. We suggested that a way to do this was to “link the contract performance information generated by the Quality Assurance Program to the monthly payments made to the contractors.”

We were pleased to see that since 2003-2004, the ministry’s contractor assessment program has featured a performance incentive that is paid every fall to contractors whose demonstrated performance exceeded the terms of the maintenance specifications. The rating system used to calculate the bonus includes an assessment of summer season performance (weighted at 40% of the total) and winter season performance assessment (weighted at 60%).

The bonus is calculated as a percentage of the annual contract value. Every contractor who meets the requirements of the contract achieves a rating of 85%. Contractors who do not exceed this threshold receive no incentive payment. Those achieving a higher rating, up to 90%, receive a 1% incentive payment. Those achieving more, up to 95%, receive a 1.5% incentive payment. The highest incentive payment, 2% of the annual contract value, is paid to those contractors achieving an assessment rating over 95%. According to ministry records, this translates into a payment of \$342,572 for one of the larger service areas and \$181,926 for a smaller one.

We interviewed a number of contractors, all of whom had received incentive payments in November 2008. Both they and the many ministry staff we spoke to on this matter reported that performing beyond the strict requirements of the maintenance specifications was most often the simple result of doing a particular operation economically and effectively. Clearing snow and ice on a sidewalk adjacent to a road in order to meet a perceived need for access and safety of pedestrians is an example.

No contractors we spoke with identified the incentive as effective inducement to perform beyond the contractual requirements. Ministry managers explained to us that their contractors, being rational business managers, will tend to exceed performance expectations only to the extent that the incremental costs of doing so are covered by the incentive. Moreover, some contractors may be challenged to meet contract requirements in service contract areas where very high levels of maintenance effort are required in the winter months. Striving to perform beyond expectations in these circumstances, when it is only a financial disadvantage to do so, is only self-defeating in a for-profit firm.

RECOMMENDATION 4 - *We recommend that the ministry, collaborating with the wider road-building industry, assess whether or not the performance incentives are effective in encouraging excellence and, if they are not, to modify the system appropriately.*

Stakeholder consultation needs fine-tuning

The contractor assessment program in the ministry requires that each District office conduct a periodic road-user consultation exercise. The results of the consultation complement the findings of the regional and district audits to determine the eligibility of each contractor to receive a performance bonus. Those consulted represent user groups and authorities in a position to comment on the condition of the roads in the region and on the responsiveness and results achieved by the service area maintenance contractor. Typical of the stakeholders the ministry chooses are local RCMP and emergency services officers, regional district representatives, trucking industry user-group representatives, local ICBC loss control officers, and school bus administrators.

Stakeholder assessments are commonly conducted by the same ministry officials who oversee the contractors whose results are being assessed. We found the recorded answers to questions often were not as specific as they should be in this assessment process. Records also varied widely: some districts provided us with hand-written records of interviews; others provided records in digital format.

Stakeholder consultation is a valuable process for facilitating organizational learning. We were therefore left with three concerns about the ministry's current practices:

1. The ministry's district officers administering the assessment have an ongoing working relationship with the contractor and thus there is the risk that the assessment process could be perceived as lacking the objectivity needed to obtain a fair, impartial assessment of contractor performance and results. The high standard of conduct we observed ministry officials exhibiting does not offset the risk that the ministry interviewer might be perceived as having a vested interest in reporting positive results. These weaknesses in the assessment process potentially impair the credibility and value of the process.

The ministry believes that it should be the one to assess its own contractors. However, we point out that the ministry is no less responsible for the assessment process when it delegates administration of the assessment to an independent agent skilled in designing and delivering survey services.

2. The assessment method and response collection techniques are weak. Efficient and reliable survey tools should be considered to replace telephone-based surveying and hand-written records. More appropriate techniques may facilitate the analysis of stakeholder feedback so that themes could be identified and disseminated efficiently.
3. The assessment questions lack rigour. For example, because safety and reliability of highway access are the overall ministry service plan objectives, the questions in the assessment should be keyed to reflect and explore these objectives in ways that make sense to the stakeholders.

RECOMMENDATION 5 - *We recommend that the ministry revise the stakeholder consultation part of its contractor assessment program to ensure that judging of contractor performance by ministry staff is done in a way that is clearly fair and objective.*

Finding opportunities to streamline the design of service delivery could pay off

The division of road maintenance service delivery into the 28 service area contracts reflects a longstanding model that has been in place for two decades. We expected that the ministry would periodically evaluate whether 28 service areas was the right level of contractual

deployment and consider whether fewer and larger service areas might reduce administrative workloads and possibly offer other efficiency gains.

The most obvious risk in having too few service areas is that the service disruptions and related costs associated with possible contractor default would be hard to contain. The ministry recognizes the wisdom of distributing the risk of contractor default across many contracts.

The ministry places great importance on making sure that contractors understand expectations and meet their obligations long before serious non-compliance patterns emerge. Partly because of this investment of effort, and largely because of prequalification screening, there have been only four contractor defaults since the current delivery model was conceived.

The ministry has created efficiency in the design of its service delivery model. It built in flexibility on the contracting side in that companies may be awarded contracts for as many as four service areas. As well, the ministry will consider clustering contracts so that the resulting proximity could translate into efficiency gains.

The last time the ministry conducted a review of the present configuration of service areas was before the renewal of a number of maintenance contracts in 2003 and 2004. Management staff specifically looked at the rationale for the current number of service areas and examined how other jurisdictions approach questions of size and contract value and the implications of these relative to the availability of qualified contractors. Next they considered the potential for savings in administration costs borne by the contractor and considered the configuration of service boundaries relative to the contractor's yard locations. In the end, after looking for any potential gains in operational efficiency if changes were made, the ministry concluded that there was not a sufficient basis for changing the longstanding configuration of service areas.

Meantime, there have been many changes in the technical side of maintenance delivery in the last two decades. Winter maintenance techniques, for example, have evolved significantly since the emergence of pre-treatment with salt solutions. Both GPS technology and better weather assessment tools have also facilitated planning, management monitoring and strategic deployment of workers and machinery in other parts of the transportation industry, such as trucking. We think that the effect of these developments on contractor capacity and the extent of ministry oversight needed might today alter views about

whether the size and location of current service areas create the most efficient structure to deliver the routine maintenance program.

Given these considerations, it may be time now for an independent assessment to be done to determine whether the existing balance of activity between ministry and contractor resources provides for the most effective way of delivering the service.

RECOMMENDATION 6 - *We recommend that the ministry reassess its current service area configuration to determine if there are opportunities to improve efficiency.*

The ministry is preparing for staff succession and values learning

For both the ministry and contractors, the loss of expertise through demographic-related changes in the workforce presents a growing challenge. Many of the most senior ministry people, with oversight responsibility related to the contracts, gained critical knowledge while in junior positions and actually performing the road work that the contractors now do. Many ministry staff nearing retirement have valuable operations experience that has enhanced their competence as overseers. Because the ministry has not done maintenance operations itself since 1988, the loss of this accumulated knowledge represents significant operational risk. In 2008, for example, the ministry reported that 44% of ministry staff were eligible to retire within five years and 65% were eligible to retire within 10 years.

The ministry has been reporting on succession management issues since 2002 and knows which of its occupations are most at risk. This plan has driven succession-related actions such as recruitment and development. The ministry's Human Resource Succession Report 2008 supports what we learned from District and Regional Managers – namely, that the ministry is aware of the risk of loss of know-how and is training and recruiting to fill both anticipated and actual vacancies.

The ministry's contractors also maintain their own human resource talent pool, which is likely facing similar demographic forces. The ministry expects its maintenance contractors to have a succession plan in place, and the topic was discussed with contractors during the most recent round of maintenance contract tendering. We did not audit contractor practices to determine whether this requirement was being followed.

The ministry learns from peer organizations

One principle of continuous improvement is learning from other like organizations. In the case of the ministry's routine maintenance program, comparing road maintenance results with those of other organizations can yield particularly useful insights into how tools and techniques can be improved and overall better results might be obtained. Interacting with peers and stakeholders in the roads management and construction industry can provide opportunities for study and collaboration when specific challenges appear.

We concluded that the ministry is aware it can learn from peer organizations and constantly makes the effort to do so.

We found that the ministry influences, or is influenced by, several external peer organizations. This happens through at least three pathways:

1. *Technical culture is standards-oriented by default* – Engineers and technicians involved in construction and maintenance management in the ministry are accustomed to adapting to new engineering and materials standards and protocols. These are quality improvement influences originating outside the ministry.
2. *A roads industry forum meets regularly* – Both ministry staff and its contractors benefit by the ministry's ongoing dialogue with the BC Roadbuilders and Heavy Construction Association on issues of mutual interest or challenge. A good example of an issue that affected all participants was the quick rise in the price of asphalt when petroleum prices spiked in 2008.
3. *A national transportation authorities' forum meets regularly* – Discussions about standards and other matters are ongoing at the Transportation Association of Canada (TAC), whose members include the ministries of transportation (or equivalent) from each province as well as suppliers and consultants doing similar work in the area. TAC coordinates research projects and sets national highway standards.

The unique range of topographic and climatic challenges facing road maintenance in British Columbia does not reduce the value of knowing how other jurisdictions in Canada manage this responsibility themselves.

THE MINISTRY DOES NOT MEASURE AND REPORT ON SOME KEY AREAS OF PERFORMANCE OF THE MAINTENANCE PROGRAMS

Public expectations about the safety and accessibility of the province's roads and bridges are high. At the same time, the ever increasing numbers of registered vehicles, pedestrians and cyclists using the provincial network present the ministry with ever greater challenges in coordinating access and ensuring safety. The scarcity of public dollars available to invest in preserving and renewing the existing network adds to the challenges. If the ministry is to report on its progress in light of these conditions and set realistic targets for performance, it must have a clear idea of how it defines success.

We therefore expected the ministry to have identified goals and objectives for its maintenance and preservation of the road and bridge network, and to have established performance measures to assess the extent to which it is succeeding in meeting its objectives.

We concluded that while the ministry has set reasonable high-level goals for its road and bridge maintenance program, the lack of network-wide performance objectives and measures makes it difficult to fully assess how effectively maintenance efforts are achieving ministry goals. For example, the ministry has identified safety as a high-level goal for the existing road network, but has done little about setting clear, detailed objectives against which to measure performance. By not doing this, the ministry is unable to monitor and communicate how its efforts and expenditures related to maintaining the province's road network are benefiting British Columbia's citizens.

Several of the ministry's high-level goals pertain to road maintenance

A well-maintained public road network is one that provides a safe environment for motorists and pedestrians, facilitates mobility of people and freight, and preserves the network to obtain an optimal service life from the components.

We found that the ministry has accepted its responsibility to strive to accomplish all of these things in its road maintenance programs. Three of the ministry's five high-level goals call directly or indirectly for effective maintenance and preservation efforts:

- ♦ Goal 1, that *key infrastructure is improved to drive economic growth and trade*, focuses attention on planning for effective

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road network maintenance and preservation results. This goal encompasses:

- ❖ identification of maintenance and rehabilitation projects,
 - ❖ development of business plans for those projects,
 - ❖ wise use of dollars invested in existing roads and bridges, and
 - ❖ improvement of rural parts of the network.
- ◆ Goal 4, that *the province is provided with a safe and reliable highway system*, is consistent with public expectations about the existing road network. The significant planning, expenditure and range of activities dedicated to winter road conditions, for example, contribute to achieving this goal.
 - ◆ Goal 5, that *excellent customer service is provided*, is consistent with the considerable effort invested by the ministry in responding to public concerns and in working to provide all road users with a safe and reliable road and bridge network.

Lack of performance measures prevents the ministry from adequately reporting on results either internally or publicly

Despite having suitable high-level goals, we found that the ministry is unable to determine how effectively its maintenance and preservation



Highway 97 is central British Columbia's backbone . - Auditor General staff photo

efforts are meeting those goals because the performance measures it has are inadequate.

Exhibit 7 summarizes the goals, objectives and performance measures related to road maintenance, as published in the ministry's 2010–2013 Service Plan.

In the following sections, we provide our findings related to the goals, objectives and measures shown in Exhibit 7.

Exhibit 7: Ministry goals, objectives and performance measures related to road maintenance

Goal	Objective	Performance measures
Goal 1: Key infrastructure is improved to drive economic growth and trade	Objective 1.4 Improved road access for resource industries and rural residents (roadway rehabilitation, in particular, applies)	None
Goal 4: British Columbia is provided with a safe and reliable highway system	Objective 4.1 Contractors maintain the provincial highway system to a high standard	Rating of maintenance contractor performance using Contractor Assessment Program
	Objective 4.2 The main highway system is rehabilitated on a lowest life-cycle cost basis	None
	Objective 4.3 Improved highway safety and reliability	Crash reduction after construction on safety improvement capital projects.
Goal 5: Excellent customer service	Objective 5.2 Excellent customer service is provided to all British Columbians	Customer satisfaction survey: Stakeholder satisfaction with existing ministry services and delivery processes, rated on a scale of 1 to 5 (includes, but not with specific reference to, maintenance activities)

Source: Ministry of Transportation and Infrastructure, Service Plan 2010/11-2012/13

Safety results are not being effectively measured by the ministry

As identified by the ministry in its own service plan, the safety of the highway network is a key outcome. It is only logical, then, that efforts should be made to measure it.

Since 1989, the ministry has largely operated on the premise that if safety-related specifications are met by the contractors, then the roads must be safe (assuming that driver competence and other vehicle safety factors are in place).

The ministry has not sought to establish a direct relationship between upkeep standards and safety, believing that it is difficult to establish enough of a link between road incidents and road conditions that could then support a fair assessment of the extent to which upkeep standards affect overall safety. In the ministry's view, the best way to ensure safety is to write contract specifications with safety in mind. It also monitors its contractors to ensure those specifications are followed. For example, the maintenance objective for maintaining steel and aluminum structures combines structural integrity with safety outcomes: "To restore and maintain the integrity and durability of steel and aluminum structures; to ensure the safety of Highway Users; and to maximize the functional life of the structures."

The ministry connects conditions and safety outcomes in another way. Ministry objective 4.3, improved safety and reliability, names three strategies designed to identify existing hazards that routine maintenance activity may not cover:

1. Identify high-risk locations
2. Work with stakeholders to find solutions to unsafe conditions
3. Perform safety focused enhancement projects

The success of these strategies is assessed through performance measure 5, crash reduction after safety improvements have been made. This, however, only provides information about the success of rehabilitation projects undertaken to solve safety concerns. Moreover, it only evaluates results of ministry decisions to rehabilitate – it does not evaluate subsequent experience in situations where the ministry concluded that rehabilitation was not needed.

We found this to be the ministry's only performance measure related to the safety objective, and a limited one at that: it does not give a sense of safety success relative to the wider public road network. The ministry needs another measure to enable it to conclude on safety

across the entire network. Reporting incident rates selectively in places within the network, leaving aside safety-focused enhancement sites, would be a good intermediate step.

We heard strong support from ministry staff for the primacy of road safety and there was adequate internal safety-related reporting. Everyone we talked with said that safety is the first consideration with respect to improvement and innovation, such as that captured in the sidebar. This suggests to us that there is appetite within the ministry for another, more robust, publicly reported measure of safety.

The ministry's DriveBC web cam service

A clear expression of innovation with safety spinoffs is the ministry's well used DriveBC website (samples of which are shown here)



Web cam image of Pine Pass on Highway 97, north of Mackenzie Junction at Powder King access road, looking north (Source: www.drivebc.ca/)



Web cam image of south approach to George Massey Tunnel, Highway 99, north of highway 17 overpass looking north. (Source: www.drivebc.ca/)

Drivers can observe for themselves online, in real time, road conditions at key points throughout the network. During our fieldwork, some maintenance contractors, school bus administrators and ministry officials told us how useful this service has become for them.

At any time of day, they can check on road conditions and plan accordingly.

RECOMMENDATION 7 - *We recommend that the ministry report safety-related performance objectives and measures for its road upkeep programs to Legislators and the public.*

The success of the ministry's preservation activities is difficult to measure

As well as promoting safety, upkeep work – such as minimizing premature degradation in pavement condition and attending to minor failures such as pothole repairs – helps preserve the network and thus its reliability.

Measuring the success of specific efforts at the network level is not easy. The upkeep effort required can depend on the original construction design and quality, as well as on the degree of reliance the organization places on rehabilitation as a condition-sustaining tool. The success of these variables can therefore often only be inferred from the success of all three working together.

A key indicator of success of road and bridge programs is the ability to maintain a desired state of network-wide condition over a period of time. This “future state” consideration acts as a focus for designing the strategies for preserving, renewing and replacing network components. If this desired state is achieved, one may conclude that a successful combination of construction, preservation and timely rehabilitation measures has been implemented. Life-cycle costing can provide the additional benefit of ensuring that the combination of elements used is optimal for ensuring that the result is both successful and cost-effective. However, outside the discipline of life-cycle costing, it is difficult to identify the success of the unique contribution that each element brings to the process and whether that contribution is being provided cost-effectively.

As noted earlier, the ministry initiated a network-wide assessment of highway conditions only twice, in 1999 and in 2008. It does not use this assessment as a measure of the effectiveness of its own activities or as a means of reporting on its performance either internally or externally.

RECOMMENDATION 8 - *We recommend that the ministry provide the results of network-wide assessments of road and bridge condition, and options for future funding, to personnel responsible for planning and overseeing upkeep work at the district and regional levels. In addition, a summary of those results and the funding options provided should be presented to Legislators and to the public as a report card on ministry efforts at network upkeep.*

The ministry is not attempting to measure its own performance in contributing to the success of its routine maintenance contractors' results.

While routine maintenance work on the ground is performed by independent contractors, the ministry's oversight control, leadership and unique responsibilities are critical to success of the results they achieve.

As previously discussed, the ministry has set measurable performance objectives for its contractors to assess their contribution to providing safe and reliable highways (goal 4). But it is not doing the same for its own performance, either in support of public reporting or internal management reporting.

The ministry's work to achieve effective road maintenance and preservation provides a significant public service, employing well over a hundred skilled professionals. They contribute in a wide range of ways, providing, for example:

- ♦ inventory control and planning for maintenance and preservation needs;
- ♦ contractor oversight and performance assessment;
- ♦ leadership, technical and engineering expertise;
- ♦ financial administration and control, risk assessment, and management of legal claims;
- ♦ public and stakeholder expectations management and education;
- ♦ emergency management and intra-agency coordination; and
- ♦ allocation of funding.

The ministry business units involved in planning and overseeing larger scale road and bridge preservation projects report internally on their results through Annual Performance Agreements with the Assistant Deputy Minister. The level of specificity in these agreements does not capture key ministry contributions to the success of routine maintenance activity.

Because of these significant contributions to the maintenance contractors' results and the resources invested in them, the ministry should know how effective its efforts actually are. However, without service objectives and performance measures related explicitly to its part in achieving these results, the ministry has no way of realistically assessing its contributions – even if it chose not to report these results publicly.

One way the ministry could generate the performance information is to apply to itself the same continuous improvement assessment and reporting structure that it applies to its independent contractors.

RECOMMENDATION 9 - *We recommend that the ministry create a set of service-related objectives and performance measures to assess its own contributions to the success of contracted routine maintenance services.*

The ministry values public input, but is not using the information to improve performance overall

Goal 5 and objective 5.2 of the 2010–2013 Service Plan aim for excellent customer service. Those officials whose responsibilities involve public consultation or handling public complaints and input, are essential to the ministry’s strategy for continuous improvement. This also dovetails with quality assurance required of the maintenance contractors with respect to their own public consultation and response practices.

We found that ministry officials at all levels understand the importance of goal 5. District officials confirmed that responding to external inquiries and liaising with elected officials, municipal officials, land owners, legislators and other stakeholders formed a significant part of their work day and was strongly supported by ministry leadership.

At a deeper level, staff have taken the approach that every inquiry deserves an answer from the most senior locally informed person about the matter at hand. This level of public engagement is, in our view, a sign that ministry personnel accept:

- ♦ the role of responsible owner that districts have taken in the communities they serve; and
- ♦ the high level of public and political interest in public road issues.

While we commend this approach and found that the management practices associated with it resulted in good local awareness of issues as they arose, we found little analysis of complaints data overall. Our inspection of a number of public complaint records maintained by the ministry’s district offices, and several maintained by contractors, turned up no evidence of a process at the district level to track patterns in the complaints or to organize issues thematically. We consider this a lost opportunity for the kind of learning that characterizes an organization with a commitment to continuous improvement.

RECOMMENDATION 10 - *We recommend that the ministry analyze customer complaints and enquiries, and use this information to identify areas for making improvements in the road upkeep programs and in results reporting.*