Rationalization of Low Volume Roads in New Brunswick

Peter Allaby, P.Eng. M.A.Sc.
Transportation Engineer
Exp Services Inc.
602 Rothesay Avenue
Saint John, NB E2H 2H1
Ph: (506) 646-8020
peter.allaby@exp.com

Jennifer Logan
Senior Project Manager, Planning & Land Management
New Brunswick Department of Transportation and Infrastructure
Jennifer.Logan@gnb.ca

Tyrone Parsons, P.Eng.
Assistant Director, Planning & Land Management
New Brunswick Department of Transportation and Infrastructure
Tyrone.Parsons@gnb.ca

Paper prepared for presentation at the
"Innovations and Opportunities in Maintenance Methods and Practice" Session

of the 2012 Conference of the
Transportation Association of Canada
Fredericton, New Brunswick

October 2012

Abstract

The New Brunswick Department of Transportation and Infrastructure (NBDTI) has over 1,700 km of designated unsurfaced roads totalling more than 3,100 km in length. The majority of these roads are low volume roads in rural environments and serve various functions including access to residences, resources, and seasonal recreation. Until recently, the Department did not have a formal system to document and manage the function of these roads or their physical condition. This lack of information represented a gap in the Department's asset management system. As a first step in quantifying the function and condition of its unsurfaced roads, the Department retained Exp Services to develop a procedure for classifying and rating the unsurfaced road network and to determine what level of upgrades are required to meet a desired standard.

This paper describes the development of the classification and rating system and presents a number of interesting results regarding the inventory of the Province's unsurfaced road network. It also presents a number of challenges and limitations encountered. It is the intent that the information and experiences presented in this paper will be of interest to other jurisdictions attempting to better manage their inventory of low volume roads.

Introduction

In 1995, the New Brunswick Department of Transportation and Infrastructure (NBDTI) adopted a new highway classification system for all designated highways. This system remains in place today. The classification system includes Arterials, Collectors, Primary Locals, and Other Locals (all roads no longer designated as Primary Locals). Arterials, Collectors, and Primary Locals are designated *numbered* highways, while the Other Locals category includes designated *named* highways. Other Locals are sub-classified as Class A, which are hard surfaced roads, and Class B, which are unsurfaced roads.

NBDTI has over 1,700 km of Class B roads totalling 2,900 km in length. The Department also has an additional 242 km of numbered local highways that are gravel surfaced, generally located between hard surfaced sections. The majority of Class B and gravel numbered highways are low volume roads in rural environments and serve various functions including access to residences, resources, and seasonal recreation. NBDTI has not had a formal system to document and manage the function of these roads or their physical condition. This lack of information represented a gap in the Department's asset management system.

As a first step in quantifying the function and condition of its unsurfaced roads, NBDTI engaged **exp** to develop a procedure for classifying and rating the unsurfaced road network and to determine what level of upgrades are required to meet a desired standard. This classification system will enable the Department to rate unsurfaced roads and determine if the roads meet current standards, require upgrading, or should be removed from designated highway status. This is part of an ongoing effort by the NBDTI to manage its infrastructure assets and apportion maintenance funds across the road system in a cost-effective manner.

Project Approach

The project was completed on an aggressive schedule over a period of five months, from November 2010 to April 2011. The general approach for the study was as follows:

- **Information Assembly** – The Project Team was provided the following key sources of information:
    - A database listing of all designated and public highways in the province, including roadway limits and control section kilometre points;
    - Existing NBDTI practices related to roadway classification and standards;
    - GIS database and mapping for the Class B road network; and
    - Access to the NBDTI's geo-referenced (GEO3D) video logs of the Class B road network.

- **Industry Scan of Practices** – An industry scan was completed to identify best practices in the classification and evaluation of low volume roads, with a particular focus on gravel roads. The scan covered the practices of most Canadian provinces, and also included several American jurisdictions as well as national transportation organizations. This information, as well as NBDTI's current policies and practices, were used to develop a draft classification and rating system for the Department's Class B roads.

- **Develop Draft Classification and Rating System** – Based on the results of the best practices review and input from NBDTI, a draft classification and rating system was developed. The classification system focuses on the functional aspects of the roadways,

such as number of homes, seasonal camps, or resources accessed. Several classification categories were developed. The rating system focuses on the physical condition of the road as it relates to the function it is providing. A numerical rating system was developed, including weighting factors for various physical characteristics, such as road width, surface condition, drainage, and clearing limits.

- **District Meetings** – New Brunswick has six regional transportation districts that oversee roadway construction, maintenance, and other local matters related to provincial roads. Meetings were held with staff from each district to review the project and discuss the characteristics of Class B roads in their districts as well as the proposed classification and rating system. Specific information collected for each road included the number of permanent homes, the presence of camps or cottages, maintenance practices, and if the road serves any resource areas or trucking needs. The Project Team relied heavily on the information obtained from these meetings to determine the function of the Class B roads.

  District staff also identified roads that have been chipsealed in recent years that should be updated to Class A roads in NBDTI's database. Staff also suggested roads that might be considered for non-designated status.

- **Develop Classification Inventory of Class B Roads** – Producing the inventory of Class B roads was the most time intensive task of this project. The inventory development included four parts:

  - Assembling functional data for each roadway and determining its functional classification;
  - Viewing GEO3D video logs to assess and document the physical condition of each road;
  - Relating the physical condition of each road to a numerical rating score based on the rating system and the road's functional classification; and
  - Determining a "Level of Improvement" requirement for each road to bring it to a desired standard.

  The end product was a comprehensive database of all Class B roads with their functional classification, average condition rating, and level of improvement recommendation.

Existing Design Standards in New Brunswick

NBDTI has three design standards for gravel surface property access roads (PARs). These standards were introduced in 1995. The application and design guidelines for each standard are summarized in **Table 1**.

The three types of PARs are functionally characterized (in general terms) by length of road, the number of properties accessed, and the potential for truck traffic. These PAR standards are intended to be used for new roadway construction. At the time of this project, it was not the intent to replace the PAR standards, but to develop a classification system that could be used to create an inventory of the existing road network.

Table 1 – NBDTI Standards for Property Access Roads

PAR Standard	Applicable Situations	Lane Width	Finished Top Width	Side-slope	Base Thickness
Standard #1	– Access road is short and provides access to a small number of properties – Little potential for truck traffic	3 m	6 m	2:1	150 mm
Standard #2	– Access road serves several properties over moderate length – Moderate potential for truck traffic for removal of wood or other products from adjacent land	3 m	6 m	2:1	300 mm
Standard #3	– Access road serves substantial number of properties over a significant length – Potential for substantial volume of truck traffic or public traffic (non-property owner) or mixture of both	4 m	8 m	2:1	300 mm

The evaluation methodology for Class B roads was created with the aim to have a similar scope to, and achieve the same level of productivity and reliability as, NBDTI's Visual Inspection Rating for Hard Surfaces.

Review of Industry Practice

Overview

An industry scan was completed to identify best practices in the classification and evaluation of low volume roads, with a particular focus on gravel roads. The scan covered the practices of most Canadian provinces, and also included several American jurisdictions as well as national transportation organizations. The results of the industry scan, as well as NBDTI's current policies and practices, were used to develop a draft classification and rating system for Class B roads. Three aspects were focused on to identify best practices:

- Roadways classification systems, categories and criteria for low volume roads, and specifically, gravel roads;

- Design standards for gravel roads; and
- Processes for rating the condition of low volume/gravel roads and identifying the level of improvements required.

Commentary on the standards or best practices identified for each of the above is provided in the following sections.

Functional Classification Framework for Low Volume and Gravel Roads

Low volume roads are commonly defined as roads with maximum volumes ranging from 200 to 500 vehicles per day. Gravel roads are often distinguished as a subset of low volume roads, with specific functional classes and geometric design standards.

Provinces with the most comprehensive guidelines for the classification and design of low volume roads include Saskatchewan, Alberta, and British Columbia. Common classification criteria are land use and service function, traffic volume (AADT), and traffic composition (truck volumes). These criteria are discussed below, with examples from jurisdictions included in the industry scan.

Land Use and Service Function

The 1986 version of the Transportation Association of Canada Geometric Design Guide (TAC 1986) included *Chapter H: Low-Volume Roads*. The objective of this chapter was to establish uniform national standards for the classification and geometric design of low volume roads, which were defined as roads with an ADT of 200 vehicles or less. TAC 1986 divided low volume roads into the following three categories based on land use and service function:

- **Category A: Rural System Roads** – These roads provide access to farms, residences, businesses or other properties, as well as access to and within isolated communities. Traffic consists of light and medium vehicles and occasional heavy trucks.

- **Category B: Recreational Roads** – These roads comprise Primary Roads, which connect to the external road network, perimeter roads around the recreation area, or internal roads. Traffic consists of cars, trailers, camper-truck units and maintenance vehicles.

- **Category C: Resource Development Roads** – These roads include all resource related roads such as forest and mining roads. Traffic on these types of roads is predominantly large, heavily loaded trucks.

The above classification system has been adopted by British Columbia in the Low Volume Roads chapter of its Highway Engineering Design Manual (BC MoT 2007).

Saskatchewan also has a comprehensive system for classifying rural roads. The system comprises seven roadway classes, defined by the function of a roadway and its role in the highway network. Classification criteria include the size of communities served, level of industrial activity, size of parks served, network spacing, and traffic volumes. For example, Class 1 rural roads serve inter-provincial travel and regional service centres, while Class 7 roads provide direct land access only. The majority of Class 4 through Class 7 roads are gravel surfaced and have very low traffic volumes.

Traffic Volumes

Traffic volume is a criterion common to most classification systems; however, its definition is often vague within the low volume road categories. In general, throughout North America, low-volume roads tend to include roadways with Average Daily Traffic (ADT) volumes of 400 vehicles or less; however, there are variations in these classification criteria on a jurisdiction-by-jurisdictional basis. In Canada, low volume roads are defined as roadways with ADT ranging from 25 or less to 400 or less. Some Canadian jurisdictions have several ADT ranges for LVR, with specific design criteria for each ADT category.

Although AADT is a widespread criterion, it requires significant data collection efforts. Most provinces do not collect traffic volumes on low volume roads due to the cost of the data collection and the low priority of these roads. Therefore, the use of ADT as a primary classification criterion has practical limitations.

In New Brunswick, no traffic volume data are available for Class B roads, so ADT cannot be used as a criterion at this time. Surrogate criteria, such as the number of properties accessed and industrial or recreational activity, are required to estimate roadway usage.

Truck Traffic

The presence of frequent truck traffic typically requires the need for a higher standard of road. In the case of low volume roads, this usually means an increase in surface width or base material thicknesses. TAC 1986 as well as design guidelines in the western provinces have specific guidelines for gravel road widths based on truck traffic:

- TAC 1986 recommends up to 8.0 m wide gravel roads if truck volumes exceed 15 trucks per day. This guideline is also used by British Columbia;
- Saskatchewan recommends at least 8.0 m wide gravel roads if truck volumes exceed 25 trucks per day; and
- Alberta recommends widening gravel roads, typically by 1 m, if daily truck traffic comprises more than 20% of total daily traffic (Alberta Transportation 1999).

New Brunswick's guidelines for public access roads follow a similar approach. PAR Standard #3 is applicable to roads with a "substantial volume of truck traffic" and requires an 8 m gravel surface width versus the 6 m width in Standard #1 and #2 where the potential for truck traffic is light to moderate.

Number of Properties Accessed

Alberta's criteria for gravel road design designations include the number of properties being accessed. A lower design standard is acceptable if less than 3 residences are accessed by a roadway (e.g. 6 m width versus 7 m width).

This approach is similar to New Brunswick's criteria for PAR standards. Although, no specific threshold of properties is provided, Standard #1 is appropriate for a "small number of properties".

This type of criterion can play an important part in ranking and classifying gravel roads, as it is an indicator of roadway usage and relative importance in the network. It is especially important for road segments where traffic volume data are not available.

Geometric Standards for Gravel Roads

The Industry Scan revealed that TAC 1986 provided the most comprehensive design guidelines for low volume and gravel roads compared to any other guidelines available in Canada or the United States. Geometric parameters are provided for cross-section elements, horizontal and vertical alignment, superelevation, and sight distance. The parameter values are dependent on the design speed selection. Typically for gravel roads, design speeds range from 30-90 km/h. Design speeds in the higher range are appropriate for roads that are in flatter terrain, have longer trip lengths, and service low density populations.

Saskatchewan, Alberta, and British Columbia also provide comprehensive geometric design guidelines for low volume roads, including gravel surfaced roads. These guidelines are available as part of each province's geometric design guides. Many of these guidelines relate back to TAC 1986.

Not all design details have been repeated in this paper, but a summary of typical cross-section elements for gravel roads (two-lane, two-way) are provided in **Table 2**.

Table 2 – Cross-Section Elements from Other Provinces

Jurisdiction	Design Speed	Surface Width	ROW Width	Sideslope
TAC 1986	80 – 100 km/h	7.0 – 7.8 m	20 – 30 m	2:1 – 3:1
	60 – 70 km/h	6.6 – 7.4 m		
	30 – 50 km/h	5.6 – 6.6 m		
Saskatchewan	Up to 90 km/h	7.6 – 8.0 m	30 – 44 m	3:1 – 4:1
Alberta	60 – 90 km/h	7.0 – 10.0 m[1]	30 – 40 m	3:1 – 4:1[2]
	30 – 50 km/h	6.0 – 8.0 m[1]	20 – 30 m	
British Columbia	80 – 90 km/h	7.5 – 80 m	Not Provided	2:1
	30 – 70 km/h	7.0 – 7.5 m		

[1]Surface width varies by AADT
[2]2:1 sideslopes are acceptable for lower design speeds if soil is stable.

The above design standards are similar to NBDTI's existing standards for PARs. The PAR surface widths range from 6.0 to 8.0 m, depending on function and usage, and sideslopes are 2:1. Right-of-way widths for PAR standards are not provided. PAR standards are based on a minimum design speed of 50 km/h.

It should be noted that most gravel roads in Alberta and Saskatchewan are generally located in flat terrain and are on average much longer than gravel roads in New Brunswick. The flat terrain makes it more economically feasible to provide the desirable sideslope of 3:1 to 4:1 than in New Brunswick, where most terrain is rolling. Also, the longer roadway lengths in Alberta and Saskatchewan require a greater need for higher design speeds and there are fewer vertical and horizontal constraints.

Condition Rating Procedures

Saskatchewan was found to have the most comprehensive procedure for rating the condition of low volume roads. This procedure is documented in the *Guidelines for Upgrade Low Volume Roads* (Retzlaff et al., 2007). It should be noted that the Saskatchewan approach is very comprehensive and requires significant efforts, including an assessment team, field investigations and report preparations for the review of each roadway; however, the basic

principles can be applied in the proposed rating system for New Brunswick. Two elements of the Saskatchewan process that are of particular interest are described below:

- **Rating Procedure** – Various geometric elements are evaluated and given a rating value of 1 to 6. The rating values are based on conditions of Poor (1-2), Fair (3-4), or Good (5-6). A weighted value is also assigned to each geometric element that reflects its importance in the need for upgrades (e.g. lane width has a weight factor of 1.5 while backslope has a factor of 0.7).

- **Level of Improvement (LOI)** – The scoring results of the rating system correspond to a specific LOI for a road segment. For example, the higher the score, the less the LOI required. Three levels of improvement of are:
    - Minor Upgrading (e.g. surface upgrades and minor widening);
    - Major Upgrading (e.g. changes to subgrade, minor alignment improvements, but within the existing ROW); and
    - Reconstruction (e.g. significant changes to alignment and subgrade and a need for additional ROW);

In addition to the results of the rating system, the combined effects of various geometric elements are also considered in the selection of a LOI.

Proposed Classification and Rating System for New Brunswick

Classification Categories

Classification categories for New Brunswick's unsurfaced road network were developed based on the results of the industry scan and the functional characteristics of the road network. The proposed classification system for NBDTI includes five classification categories to describe the Class B roadway system. A general description of each proposed Class B classification category is as follows:

- **Type I: Rural Road** – This class of road serves a connective function in the highway network and/or provides access to isolated communities or directly to multiple residences, farms, or other permanent properties. Traffic consists of light and medium vehicles but there is potential for heavy trucks. Generally, these roads feature higher design criteria.

- **Type II: Direct Access Road** – This class of road provides direct access to a small number of permanent properties. Traffic volumes are low and generally consist of light vehicles. Trucks are rare. Generally these roads feature lower design criteria than Type I roads.

- **Type III: Seasonal/Cottage Road** – This class of road serves non-permanent residences such as camps or cottages or other seasonal uses such as access to woodlots, waterfront, recreational areas, fields, or small farms. These roads may be impassable during certain times of the year or in poor weather conditions.

- **Type IV: Resource Road** – This road provides access to a specific resource such as logging, mining, or fisheries. Access to residences on this road would be limited. Design features are similar to a Type I road.

- **Type V: Consideration for Public Non-Designated Status** – This is a Class B road that should be changed to a public non-designated road, based on its characteristics. A public non-designated road would no longer fall under the responsibility of NBDTI for maintenance. Type V roads will only be classed temporarily until removed from the Class B system.

Proposed Classification Criteria

The classification criteria for Type I to Type IV Class B roads are summarized in **Table 3**, including suggested threshold values. Each roadway segment was reviewed with respect to these criteria and a functional classification was selected. Type V roads are not included in this table, but are identified as roads that do not meet minimum Class B road functions (no active properties, impassable, not maintained, etc.).

The data required to evaluate the functional classification were assembled using information received from each District. For example, the number of homes, recreational purpose, or industrial/resource based purpose. In some cases, aerial photography was also used to confirm the number of dwellings accessed.

All information was input to a spreadsheet database and a decision tree formula created to automate the assignment of the appropriate classification to each roadway.

Table 3 – Proposed Classification Criteria for Class B Roads

Criteria	Type of Class B Road			
	I	II	III	IV
Land Use and Primary Service Function	Connectivity and access to multiple permanent residences, farms, or other properties	Direct access to a small number of permanent residences or other properties.	Access to seasonal uses (e.g. recreation, cottages, woodlots and agricultural areas)	Access to a major resource area such as forestry, mining, fisheries or agriculture.
Year-Round Dwellings Accessed	≥ 3	< 3	Seasonal Properties Only	< 3
Estimated AADT Volume	25 - 300	< 25	< 25	N/A
Truck Traffic	Occasional to Frequent	Rare	Rare	Moderate to Frequent

Proposed Condition Rating System for Class B Roads

Saskatchewan's Guidelines for Upgrading Low Volume Roads was used as a model to develop a rating system for NBDTI's Class B roads; however, NBDTI's rating system needed to be less comprehensive (e.g. no field investigation), at least initially, to limit the resource and time requirements of completing ratings for all road segments. Descriptions of the process to rate roadway condition elements and calculate overall roadway condition scores are provided below.

Roadway Condition Elements

The roadway elements chosen were ones that could be evaluated with relative ease using geo-coded video logs or other record information. The following four roadway elements were selected for the rating system:

- Surface Width;
- Surface Condition;
- Drainage Condition; and
- Clearing Limits.

The roadway characteristics were rated using NBDTI's digital video logs. Each roadway video was viewed and evaluated at intervals of 500 m. The 500 meter intervals were chosen to be consistent with NBDIT's current data collection practices. Condition scores were recorded for each interval. For roadway segments less than 500 m, a minimum of two readings were recorded.

Surface Width

Surface width was measured directly from the GEO3D video using the software measuring tool. Therefore, the rating of this condition element was the least subjective of the four elements. Width criteria (shown in **Table 4**) were chosen for each roadway classification to determine if

the width measurement could be qualified as “Good”, “Fair”, or “Poor”. For example, width criteria for Type I and Type IV roads would be higher than for Type II or Type III roads.

Surface Condition
Surface condition was rated based on a visual inspection of the video recording. The following rating scores were utilized for the roadway surface condition:

- **Score of 1: Good Condition and Passable** – Selected when the roadway was in such a condition that it would not significantly impact a driver’s path or speed along the section. This would mean that there would be no large ruts or surface distresses.
- **Score of 2: Poor Condition but Passable** – Selected when the roadway was in such a condition that it would force a driver to lower their speed and change their driving path to avoid ruts and/or surface distresses. A roadway could also be in poor (passable) condition as a result of poor drainage.
- **Score of 3: Poor Condition and Impassable** – Selected when the roadway was in such a condition that it would be difficult to drive a motor vehicle on. Video was not available for impassable sections; however, some impassable sections were evident from viewing the upcoming roadway at the end of some of the videos.

Generally, the surface condition could be easily identified and scored appropriately; however, the time of year of the video recording could impact the results (e.g. surface condition could appear better than normal during a dry period or worse than normal during a wet period). Examples of various roadway surface conditions are shown in **Figure 1**.

Drainage
Drainage condition was rated based on a visual inspection of the roadway cross-section, presence of ditches and clear drainage channels, and evidence of ponding on the roadway surface. The following describes the rating scores that were applied for drainage condition:

- **Score of 1: Good Drainage** – Selected when the ditches were present on both sides of the roadway or with evidence of good sideslope contours that would remove water from the roadway surface. The roadway surface also had to be in good condition and not have significant amounts of ruts or surface distresses that would trap water before it would be cleared from the roadway surface.
- **Score of 2: Fair Drainage** – Selected when there was some evidence of drainage channels and the roadway appeared dry and free of ponding. This score may also be selected when there was no compelling evidence for selecting “Good” or “Poor” drainage.
- **Score of 3: Poor Drainage** – Selected when the roadway had no ditches and ponding was visible on the roadway surface. Poor Drainage was also selected when material was built up on the roadway edges as this would prevent the road surface from draining.

In many cases, the quality of the ditch contours were difficult to rate, particularly if the sideslopes were overgrown with vegetation. The time of year of the video recording could also impact the appearance of good or poor drainage. Due to these challenges, drainage was considered the most subjective element to rate. Fair or Unknown Drainage was the most common rating selection, given the difficulty in confirming “Good” or “Poor” drainage. Therefore,

the ratings resulting from this exercise may not be a true representative of the drainage quality, which is unfortunate given that good drainage is highly important for gravel road performance. Examples of various roadway drainage conditions are shown in **Figure 1**.

SURFACE CONDITIONS	**DRAINAGE CONDITIONS**
 **Good Surface Condition**	 **Good Drainage Condition**
 **Poor Condition but Passable**	 **Fair/Unknown Drainage**
 **Poor Condition - Impassable**	 **Poor Drainage**

Figure 1 – Example Surface and Drainage Conditions

Clearing Limits

Clearing Limits were defined as distance off the road edge that was free of trees and overgrown vegetation. Wider clearing limits provide motorists with better horizontal sight distance and the opportunity to see wildlife approaching the roadway. Clearing limits were rated as follows:

- **Score of 1: Good Clearing Limits** – Selected when the roadside environment was clear of hazards and trees and growth were cut back a good distance from the roadway edge (greater than 3 to 4 m, depending on road classification);

- **Score of 2: Moderate Clearing Limits** – Selected when the roadside environment was clear of hazards and trees and growth were cut back a moderate distance from the roadway edge (2 to 4 m, depending on road classification); and

- **Score of 3: Poor Clearing Limits** – Selected when trees and growth, or other roadway hazards, were up to, or within a very short distance of, the roadway edge (0 to 2 m, depending on road classification).

Generally, the clearing limits condition could be easily identified and scored appropriately.

Calculation of Overall Condition Rating

Rating scores were recorded in a spreadsheet for each measurement interval along a given roadway. Weighting factors for each condition element were selected for the calculation of an overall condition rating. The weighting factors were selected based on the element's overall importance in estimating physical performance or the reliability in the element's scoring. The weighting factor selection and rationale is described as follows:

- Both surface width and surface condition are considered highly important in a roadway's physical and functional performance and the rating selection was considered objective and reliable. Therefore, these elements were given a weighting of 1.0;

- Drainage is also very important in a roadway's performance and can directly impact surface condition. However, given that the visual rating of drainage conditions is somewhat less reliable than width or surface condition, it was given a lower weighting of 0.8.

- Clearing Limits, although relatively reliable in the visual rating, was considered of less importance to roadway condition than the other elements. Therefore, clearing limits was given a weighting of 0.5.

A complete matrix of the roadway condition element criteria and weighting factors by roadway class is provided in **Table 4**.

Each rating score was multiplied by its weighting factor. The overall roadway condition rating was then calculated in the spreadsheet for each interval based on the sum of the weighted element ratings. The overall rating scores range from 3.3 (poorest) to 9.9 (highest). The results can be verbally described as:

- Good – Rating 7.7 to 9.9;
- Fair – Rating 5.5 to 7.7; and
- Poor – Rating 3.3 to 5.5.

Table 4 – Proposed Rating System Matrix for Class B Roads

Element	Rating			Weighting Factor
	Poor (1)	Fair (2)	Good (3)	
Type I and IV Roads				
Total Surface Width	< 6.5 m	6.5 – 7.5 m	≥ 7.5 m	1.0
Roadway Condition	Impassable	Passable in Poor Condition	Passable in Good Condition	1.0
Drainage	No Drainage visible	Some Evidence of Drainage	Clear Drainage provided	0.8
Clearing Limits	< 2 m	2 - 4 m	> 4 m	0.5
Type II Roads				
Total Surface Width	< 5.5 m	5.5 – 6.5 m	≥ 6.5 m	1.0
Roadway Condition	Impassable	Passable in Poor Condition	Passable in Good Condition	1.0
Drainage	No Drainage visible	Some Evidence of Drainage	Clear Drainage provided	0.8
Clearing Limits	< 1 m	2 - 3 m	> 3 m	0.5
Type III Roads				
Total Surface Width	< 5.0 m	5.0 – 6.0 m	≥ 6.0 m	1.0
Roadway Condition	Impassable	Passable in Poor Condition	Passable in Good Condition	1.0
Drainage	No Drainage visible	Some Evidence of Drainage	Clear Drainage provided	0.8
Clearing Limits	< 1 m	2 - 3 m	> 3 m	0.5

An example of the calculation for the overall condition rating is illustrated in **Table 5**. The average score for each roadway control section was then calculated by averaging the scores of all intervals within the control section.

Table 5 – Sample Calculation for Overall Condition Rating (Type II Road)

Roadway Element	Video Assessment	Rating	Weight	Contribution to Overall Rating
Width	4.8 m	1	1.0	1
Surface	Good	3	1.0	3
Drainage	Fair	2	0.8	1.6
Clearing Limits	Poor	1	0.5	0.5
			Overall Condition Rating	**6.1 (Fair)**

Level of Improvement Selection

Level of Improvement (LOI) requirements for each Class B road were determined by comparing the overall condition rating of a roadway segment to the proposed geometric standards for each classification category. Four Levels of Improvement (LOI) categories were selected to describe the rehabilitation needs of a roadway:

1. **No Upgrading** – Roads identified for no upgrading means that the road condition is at the desired level and no action is required;
2. **Maintenance** – Roads identified for maintenance activities may only require improving clearing limits, localized surface improvements, etc;
3. **Minor Upgrading** – Roads identified for minor upgrading require minor widening of the road, improvements to surface condition and minor grading/construction to improve drainage; and
4. **Major Upgrading –** Roads identified for major upgrading are in poor condition and require significant widening, resurfacing, or major drainage improvements.

The above LOI's were selected for each Class B road based on its average overall condition rating. Note that a "Reconstruction" category was not included in the above LOI's, given that horizontal and vertical geometry were not assessed in this procedure.

Table 6 lists the condition rating criteria used to select the appropriate LOI for upgrading to a good standard. Recall that the rating scale ranges from 3.3 (poorest) to 9.9 (best).

Table 6 - Criteria for Selecting LOI based on Overall Condition Rating

Level of Improvement	Criteria for Upgrading to a Good Standard
No Upgrading	> 8.5
Maintenance	7.7 – 8.5
Minor Upgrading	5.5 – 7.7
Major Upgrading	< 5.5

The above rating thresholds were reviewed with respect to various combinations of physical condition elements to confirm that the LOI's being selected were practical. The LOI selection is illustrated through the examples in **Table 7.**

Table 7 – Example Selection of LOIs Based on Roadway Characteristics

Width Condition	Surface Condition	Drainage Condition	Clearing Limits	Overall Rating	Level of Improvement (LOI)
GOOD	GOOD	GOOD	FAIR	9.0	No Upgrading
GOOD	GOOD	FAIR	FAIR	8.2	Maintenance
FAIR	GOOD	FAIR	POOR	6.8	Minor Upgrading
POOR	FAIR	POOR	POOR	4.3	Major Upgrading

Limitations of Methodology

The process developed for assigning roadway classifications and ratings is fairly comprehensive; however, a limitation to the process is that most input data is somewhat subjective or requires some level of interpretation. Some specific examples of this are discussed below.

The classification inputs relied on District input for the number of homes, camps, and roadway usage. It is presumed that, given the time constraints of the data requests, much of this input came from memory and has not been confirmed in the field. Also, the definition of a "resource road" is a bit subjective and may be interpreted somewhat differently by different individuals (e.g. what level of industry constitutes a "resource" or frequent trucking). Due to the high volume of roads included in this study, there was not an opportunity to discuss and confirm data for each individual road section, particularly in the larger Districts.

Appropriate changes in classification throughout a road section were not always captured. Much of the data obtained for residences only included the number of residents on a road and not where the residences ended. For example, a 7 km road might have 6 homes, but only on the first 500 m. Therefore, the first 500 m should be classed a Type I and the rest a Type III or possibly Type V. If this information was not readily available, the whole 7 km would be classed a Type I. Districts did provide some information where homes were located, but it is suspected that many situations have not been identified. It would be worthwhile to update the database over time with these more detailed data.

The ratings of physical elements also relied on an interpretation of road condition via video images. Drainage condition was particularly difficult to assess accurately by video alone. The quality of ditching was not always evident and drainage issues were not always noticeable under dry conditions.

Several geometric elements were not included in the rating procedure, due to the effort required in gathering the data. The elements are described below:

- Cross-section dimensions, such as sideslope and ditch width could not be accurately measured using the video logs. These were captured qualitatively in the drainage condition. A more detailed assessment would require field reviews.
- Horizontal and vertical alignment data were not readily available. If these become available in the future, the following geometric elements could also be added to the system:
    - Horizontal Curve Radius;
    - Vertical Crest and Sag K-Values; and
    - Gradient.
- Bridge width and condition were not in a format that could be quickly evaluated. Therefore they were not included in the process.

Inclusion of the above elements would significantly increase the level of effort required to evaluate each roadway, but a more accurate and well-rounded picture of the roadways' physical and geometric conditions could be produced.

Class B Inventory Results

The product of this exercise is a database of every Class B road in the province, assigned classification inputs, classification category, condition element ratings, overall average condition rating, and an LOI recommendation. This database is also compatible with the province's GIS and could be used to map the road network by classification, rating, and LOI. The province-wide results have been summarized for this paper.

Classification Summary

Figure 2 and **Figure 3** show the Province wide results for functional classification of Class B roads, broken down by the number of road sections and the number of kilometres for each classification, respectively.

The classification results show that there is a relatively even distribution of Type I to IV roads by road section; however, when broken down by kilometre, Type I and Type IV roads are significantly higher. This reflects that Type I and Type IV roads are longer on average than Type II and Type III roads.

Note that there were 101 road sections (59 km) identified with a hard surface (chipseal) that should be designated as Class A roads and removed from the Class B system. There were also 151 road sections (135 km) classed as Type V, which should be considered for non-designated status.

Condition Rating Summary

The overall road condition ratings are summarized in **Figure 4** for all roads in the province. The majority of roads are in "Fair" Condition. Roads in "Good" condition comprise 10% of the total and roads in "Poor" condition comprise 15% of the total. Type V and Class A roads are omitted from condition ratings. There are also a number of road sections where the condition rating is unknown, due to video not being available.

Note that it is suspected that there is some bias towards the "Fair" rating category, given that it would be the rating of choice if the visual assessment did not produce a clear determination of a "Good" or "Poor" road element condition.

LOI Summary

A breakdown of the LOI's to bring the Class B road network to a minimum desirable standard is provided in **Figure 5**. The LOI's are shown for each road classification grouping. A significant amount of Minor Upgrading is recommended for Type I and Type IV roads to meet the proposed geometric design standards. Type IV roads also require a considerable amount of Major Upgrading. For these Type IV roads that are in poor condition, it is unclear at this point what type of resource they are serving. If it is not a major resource, then the roads could possibly be reclassified as a Type II or III road, which would reduce the level of improvement required.

The scope of improvements on Type II and Type III roads is much less. This is mainly because these classes of road are serving a lower function and have more relaxed design standards than Type I and Type IV roads.

The LOI results provide an opportunity for NBDTI staff to identify roads with the highest LOI's and complete more focused and detailed reviews with respect to deficiencies and the required upgrades.

Summary

The outcome of this project was the development of a classification and rating procedure for New Brunswick's network of Class B roads. This procedure includes five roadway classes to describe the function of a road and a rating scale to describe its physical condition. The results serve to quantify the state of the Class B road network and aid NBDTI in identifying if roadways meet desired standards, require upgrading, or should be removed from designated highway status. This system will contribute to the ongoing effort by NBDTI to manage its infrastructure assets and apportion maintenance funds across the road system in a cost-effective manner.

The classification and rating procedure was applied to the 3,100 km of unsurfaced roads in the Province. The following key observations can be made from the results of the inventory:

- The majority of unsurfaced road sections in the Province serve either a multi-residential function (access to 3 or more homes) or a resource/trucking based function;
- The majority of roads are in "Fair" Condition. Roads in "Good" condition comprise 10% of the total and roads in "Poor" condition comprise 15% of the total;
- A significant amount of Minor Upgrading is recommended for Type I and Type IV roads to meet the proposed geometric design standards. Type IV roads also require a considerable amount of Major Upgrading.
- 151 road sections (135 km) were identified as impassable, not maintained, or serving no known purpose. These roads were classed as Type V and should be considered for non-designated status upon further review by NBDTI personnel.

It has been recommended that NBDTI adopt this classification and rating system as a first step in formally managing its network of designated unsurfaced roads. It is recommended that the data inputs and roadway characteristics be reviewed periodically and refined as required to increase the accuracy of results. Over time, this system could also be made more robust to include more specific land use information, field condition investigations, and additional roadway characteristics.

NBDTI is currently reviewing the study results to consider implementation. In addition, the roads that were identified as moving to Class A are being vetted by their District staff for further recommendations."

References

1. Alberta Transportation. Highway Geometric Design Guide, 1995 (Updated 1999)
2. British Columbia Ministry of Transportation (BC MoT). Highway Engineering Design Manual, BC Supplement to TAC Geometric Design Guide, 2007 Edition.
3. Retzlaff, H., Kent, S., Podborochynski, D., and Krawec, J. Guidelines for Upgrading Low Volume Roads in Saskatchewan. Presented at the 2007 Annual Conference of the Transportation Association of Canada, Saskatoon, Saskatchewan.
4. Transportation Association of Canada (TAC). Geometric Design Guide for Canadian Roads, 1986 Edition.

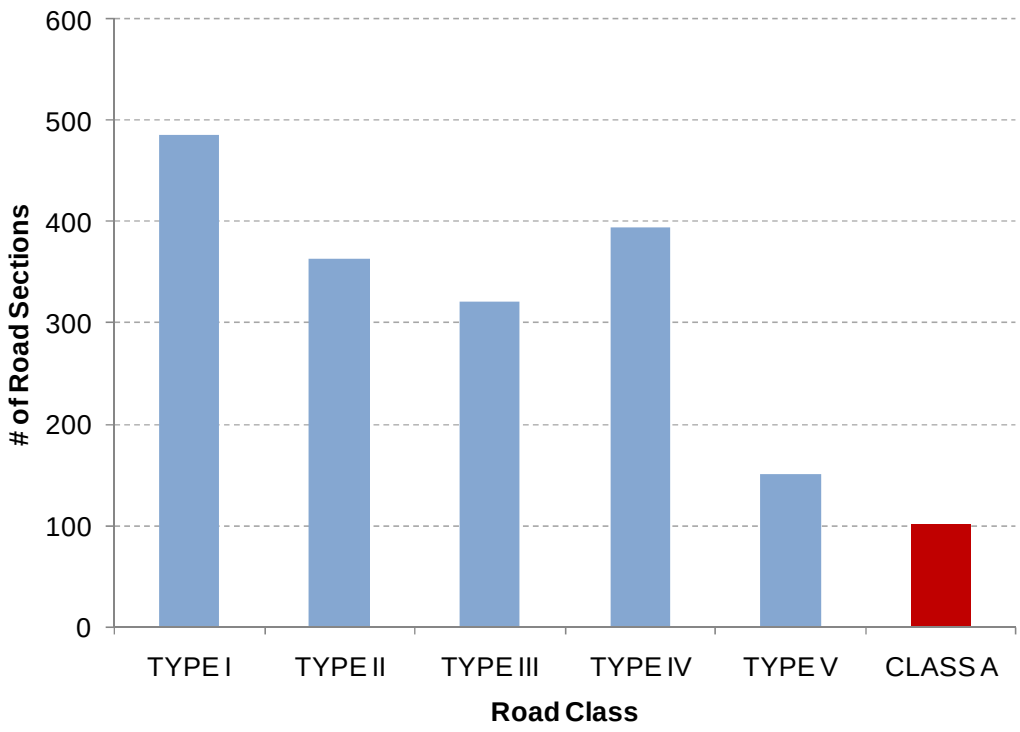

Figure 2 – Road Classifications by # of Road Sections

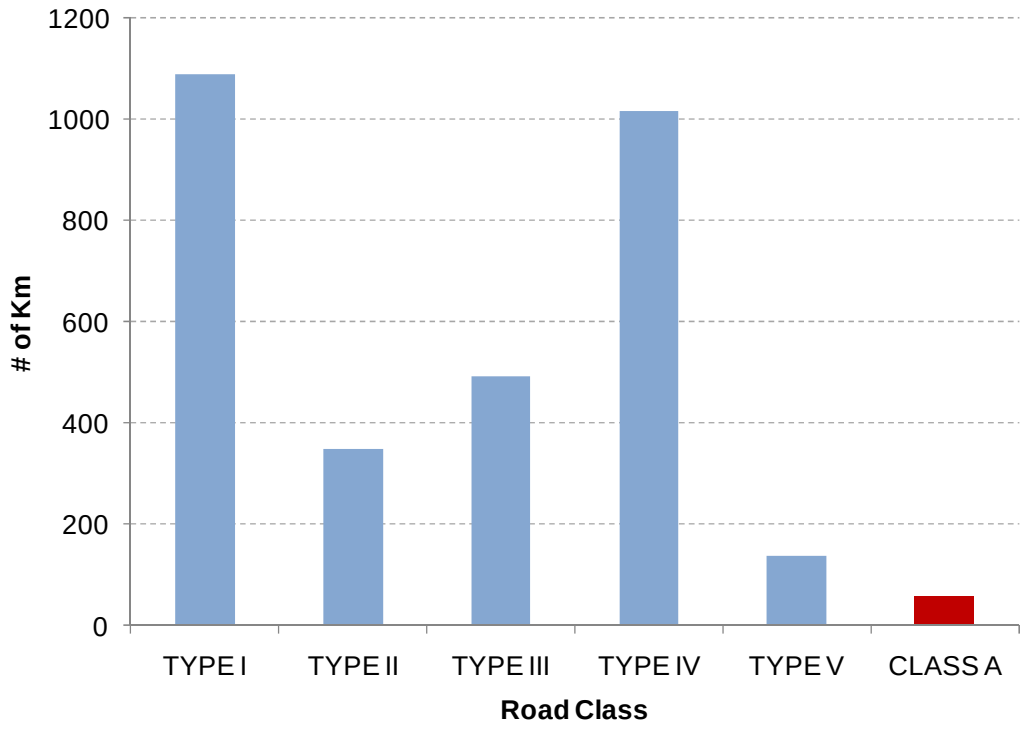

Figure 3 – Road Classifications by # of Kilometres

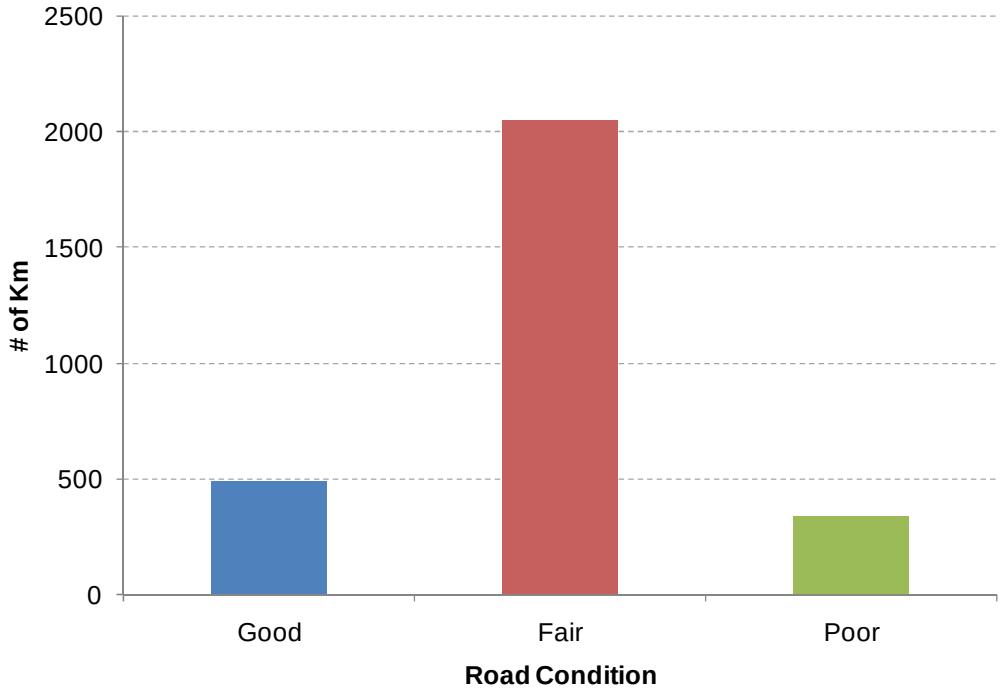

Figure 4 – Road Condition by # of Kilometres

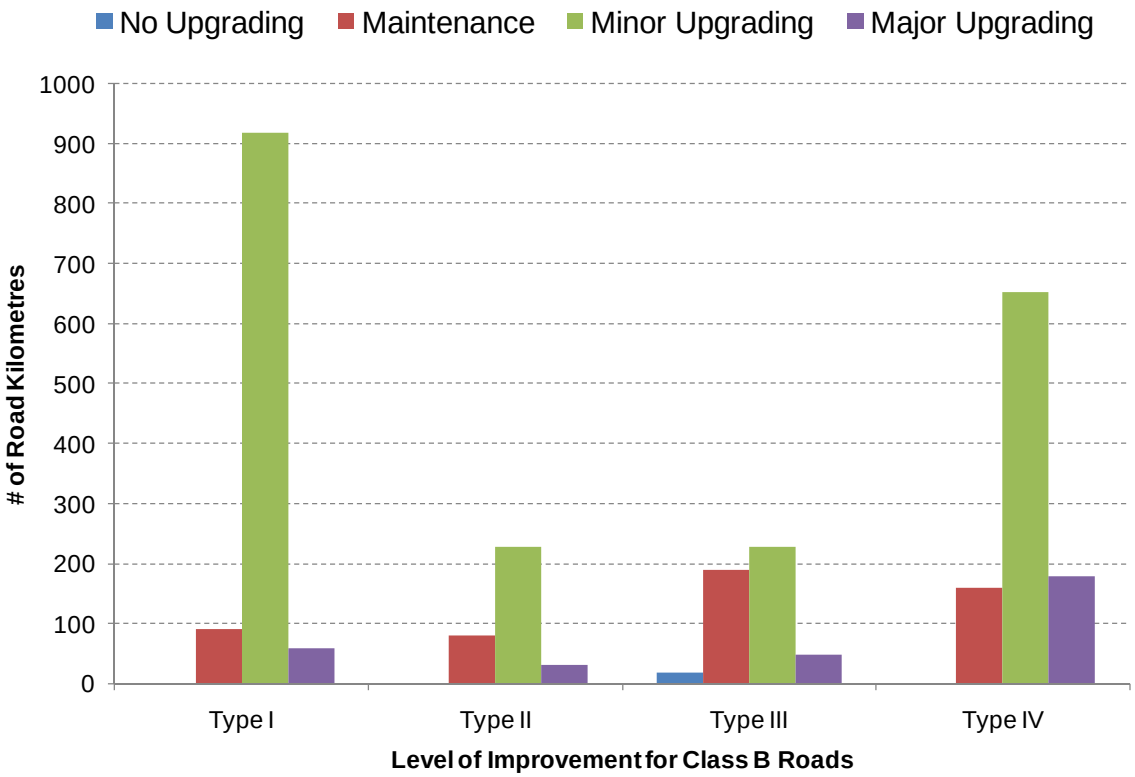

Figure 5 – Level of Improvements Recommendation by # of Kilometres