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# Transportation: Emerging Realities

# Les Transports: realités en puissance

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# The State of the Canadian Intercity Highway System, 1986-1993

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## Introduction

This paper reports on an attempt to improve the state of knowledge about intercity road transport in Canada. The motivation has grown out of dissatisfaction with conventional statistical sources which are inadequate for making in-depth analyses of the structure and trends in intercity road transport. This unpleasant reality has forced the adoption of a new data source, specifically, the planning information collected by provincial highways departments. This data source, hitherto unexploited, is remarkably rich in detail. Unfortunately, no one has undertaken the task of combining these separate sources into a regular, comparable set of *national* statistics. This was partially rectified with the recent creation of a Special Infrastructure Project by Transport Canada.[2]

This paper, an extension of the previous work, will examine the state of our intercity highway network by presenting facts relating to the level and composition of vehicle traffic as well as to the current condition of the highway infrastructure. In particular, two important qualities of the highway facilities will be evaluated: 1) the level of capacity utilisation of the system and 2) the ride quality of network. It will also be shown that the way in which the data are represented spatially provides not merely statistics but powerful tools in the development of future policy on highways.

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[1] Transport Canada. The views expressed in this paper are those of the author and do not necessarily reflect the views of Transport Canada. I should like to thank the provincial and territorial highways departments whose cooperation made this project possible.

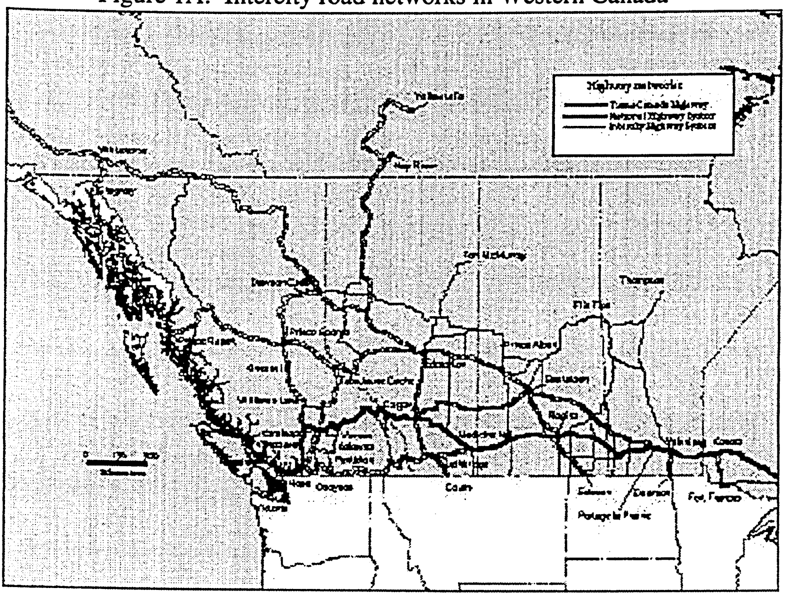
[2] The Special Infrastructure Project (SIP) was created in 1995 to study various highway-related issues to inform future federal policy in this area. A series of analytical reports, summarising this research, was published in the summer of 1996 under the direction of David Stambrook. Some road data discussed in this paper have also appeared in the author's SIP report, "An Economic Model of Inter-Urban Travel on the Canadian Highway Network," TP-12800E, June 1996.

## Scope of the project

Owing to the active cooperation of the provincial and territorial highway authorities, the following road data were supplied to Transport Canada: 1) vehicle traffic counts represented by the average annual daily traffic (AADT) passing over the road network; 2) the percentage of the traffic stream represented by commercial vehicles (effectively heavy trucks); 3) the capacity of the network represented by the number of lanes; 4) the quality of the pavement for each road segment in the provincial network as represented by the ride roughness.

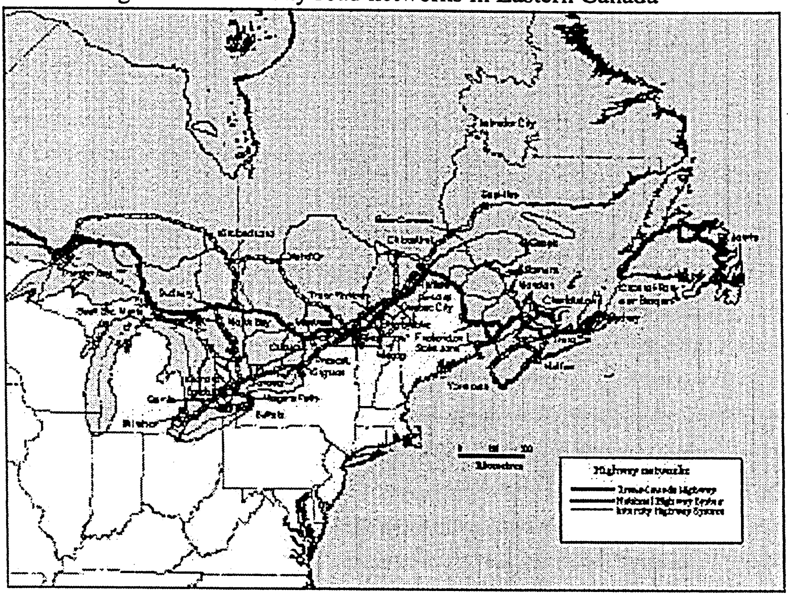
These data were very extensive in scope covering literally all provincial numbered highways. Although statistics could have been assembled for the entire system, time constraints forced the selection of a smaller, more manageable, yet no less significant, sub-network. After very careful consideration, a base network was chosen for analysis joining all major urban areas in Canada. This network, which includes the busiest highways and those most important to Canada's trade and tourism, is termed the Intercity Highway System (IHS).

Figure 1A: Intercity road networks in Western Canada



As can be seen in Figures 1A and 1B, the IHS is a very dense network comprising approximately 45,000 km of numbered highways. Contained within the IHS are two other significant networks which will also be examined here: 1) the National Highway System (NHS) of approximately 24,000 km joining provincial capitals, and 2) the 7,300 km Trans-Canada Highway (TCH), the nation's main street, linking Vancouver Island with Newfoundland.

Figure 1B: Intercity road networks in Eastern Canada



## The Geographical Imperative

A notable innovation introduced for this project was the use of a Geographic Information System (GIS) to organise and analyse the data. The compilation of road transport statistics at the level of detail contemplated here would not have been practical without a GIS. The power of the GIS approach is its unique blending of traditional database tools with the visual representation of spatial objects. For any transport application this is an absolute must since knowing *where* the activity is located is just as important as knowing the magnitude of such activity. A GIS is ideal for answering both types of questions; sadly, most road authorities have yet to introduce such a system. In fact, only Ontario was able to send geo-referenced road data. This meant that the rest of the provinces had to have their statistics geo-referenced manually.

The solution to the lack of spatially referenced data was to obtain a digital map of the North American highway network and match the provincial data to the objects on this map. The map used in this project was obtained from the company American Digital Cartography (ADC). Its Worldmap product is a variant of the well-known Digital Chart of the World (DCW), formatted specially for use in the popular cartographic program MapInfo. Although it has its flaws, Worldmap s finely segmented depiction of the highway network is a suitable platform for capturing the rich provincial databases.[3] In almost all cases, road segment distances on the digital map matched closely with corresponding distances on official provincial highway maps, thus allowing a realistic depiction of the structure and trends in road travel.

## Traffic levels on the Intercity Highway System (IHS)

The most important variable supplied by the provincial authorities was the vehicle traffic counts by road segment. Traffic counting has advanced enormously in recent years with the introduction of sophisticated machines capable of counting and classifying vehicles continuously. Although this new technology has done much to improve the accuracy and reliability of counting, continuous counting has yet to become a standard practice throughout the network. Most of the counting is still short-term in nature and vehicle classification is largely a manual process conducted in daylight hours. In general, however, there is sufficient confidence that counts are accurate and classifications reliable enough that at least basic inferences about the characteristics of the traffic stream can be made.

For the IHS, count data were attached to over 4,700 separate line segments for the years 1986 and 1993. Once assigned, it was possible to tabulate aggregate traffic levels nationally and for each jurisdiction by computing an estimate of vehicle-kilometres. Vehicle-km, which are the product of a traffic count and its associated segment length, are the basic summary statistic for road traffic in our system. Table 1 summarises these levels by province and territory.

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[3] For example, the multi-lane Coquihalla highway in B.C. did not appear on the map and had to be drawn in manually from a paper map.

Table 1: Traffic levels on the Intercity Highway System, 1986 and 1993

| Province/ territory | 1993 route-kilometres ('000s) | Vehicle-kilometres (billions) | | Average annual growth in veh-km | Average annual daily traffic (AADT) | | Percentage distribution | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Route-km | Vehicle-km | |
| | | 1993 | 1986 | | 1996 | 1986 | | 1993 | 1986 |
| Nfld. | 1.1 | 0.8 | 0.7 | 1.5% | 2,000 | 1,800 | 2.4 | 0.8 | 0.9 |
| P.E.I. | 0.2 | 0.3 | 0.3 | 3.2% | 3,800 | 3,100 | 0.5 | 0.3 | 0.3 |
| N.S. | 1.4 | 2.9 | 2.4 | 2.9% | 5,700 | 4,700 | 3.1 | 2.8 | 2.9 |
| N.B. | 1.8 | 3.1 | 2.7 | 1.9% | 4,800 | 4,200 | 3.9 | 3.0 | 3.3 |
| Que. | 7.6 | 25.5 | 19.4 | 3.9% | 9,200 | 7,000 | 16.9 | 24.9 | 23.9 |
| Ont. | 9.5 | 38.4 | 30.1 | 3.5% | 11,100 | 8,700 | 21.0 | 37.5 | 37.1 |
| Man. | 3.0 | 2.3 | 2.0 | 1.6% | 2,100 | 1,900 | 6.6 | 2.2 | 2.5 |
| Sask. | 5.1 | 4.0 | 3.4 | 2.2% | 2,200 | 1,900 | 11.2 | 3.9 | 4.2 |
| Alta. | 6.2 | 9.7 | 8.0 | 2.7% | 4,300 | 3,600 | 13.7 | 9.5 | 9.9 |
| B.C. | 7.8 | 15.2 | 11.8 | 3.6% | 5,300 | 4,100 | 17.4 | 14.8 | 14.6 |
| Yuk. | 0.9 | 0.2 | 0.2 | 1.4% | 600 | 500 | 2.0 | 0.2 | 0.2 |
| N.W.T. | 0.5 | 0.04 | 0.04 | 0.1% | 200 | 200 | 1.2 | 0.03 | 0.04 |
| Total | 45.0 | 102.3 | 81.1 | 3.4% | 6,200 | 4,900 | 100.0 | 100.0 | 100.0 |

In 1993, a little over 100 billion vehicle-km were generated on the IHS, an average of over 6,000 vehicles per day. Vehicle traffic was especially concentrated in Ontario and Quebec which together accounted for over 60% of the total even though their road networks accounted for less than 40% of the IHS's route-km. Their daily averages were roughly twice as high as any other province. All the other regions of Canada had traffic shares less than their shares of route-km, a reflection of the dispersed settlement patterns throughout the West and Atlantic Canada.

The growth in vehicle traffic was also noteworthy. Between 1986 and 1993, traffic grew at a brisk average annual rate of 3.4%. The pattern of growth was especially intriguing. The busiest provinces were also the fastest growing with Quebec and Ontario traffic both growing faster than the national average, Quebec at nearly 4% per annum. British Columbia was also relatively rapid at 3.6% per annum. In contrast, the slowest growing provinces were Newfoundland, New Brunswick, and Manitoba all growing by less than 2% per annum.

As all traffic data are geo-referenced, we can also examine the spatial pattern of traffic volumes on the broadly defined IHS. Figures 2A and 2B show the network broken down by selected traffic ranges. The maps reveal immediately that private vehicle travel is a local phenomenon clustering around the largest urban areas in Canada. The traffic in and around the three largest cities, Toronto, Montreal, and Vancouver was especially heavy with 1993 average annual daily traffic exceeding 100,000 vehicles per day over many highway sections. Other than the concentrations in the Big-3 and in other large cities such as Quebec City, Ottawa, or Winnipeg, traffic over the bulk of the network was extremely sparse, usually averaging less than 5,000 AADT.

Figure 2A: Traffic volumes on the IHS, Western Canada, 1993

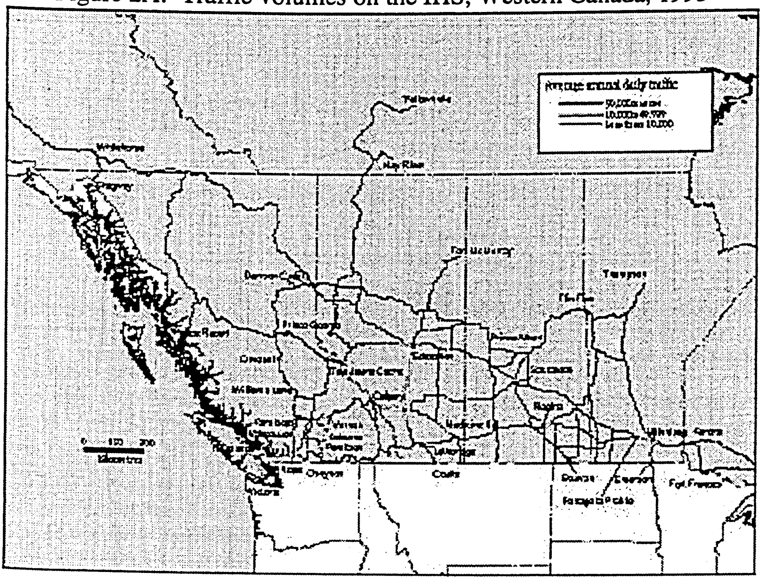
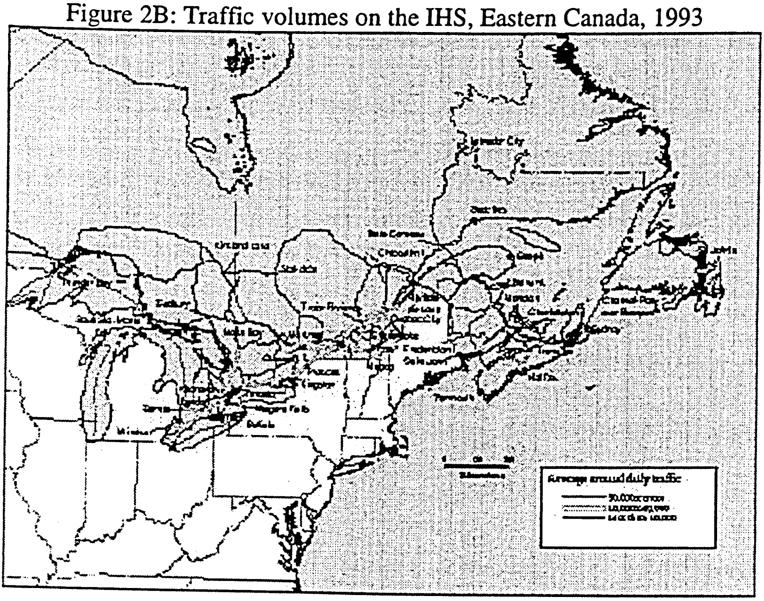


Figure 2B: Traffic volumes on the IHS, Eastern Canada, 1993



This wide disparity in traffic levels is seen more clearly in Table 2 where the data are grouped into AADT bands. Roads with less than 2,500 AADT accounted for 50% of the network in 1993 but only 9% of the vehicle-km. This is in stark contrast to the busiest sections above 50,000 AADT, located largely inside the urban boundaries of the Big-3. These roads made up less than 2% of the route-km but accounted for almost 30% of the traffic. One can also see in Table 2 that the busiest segments of the distribution have begun to hit some capacity constraints. Road sections with AADT over 100,000 actually had below-average growth, no doubt a reflection of growing congestion.

Table 2: Distribution of IHS traffic by traffic range, 1986 and 1993

| AADT range | 1993 route-kilometres ('000s) | Vehicle-kilometres (billions) | | Average annual growth in veh-km | Average annual daily traffic (AADT) | | Percentage distribution | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1993 | 1986 | | 1996 | 1986 | Route-km | Vehicle-km 1993 | Vehicle-km 1986 |
| 0-2,500 | 22.2 | 9.2 | 8.2 | 1.7% | 1,100 | 1,000 | 49.2 | 9.0 | 10.1 |
| 2,501-5,000 | 11.0 | 14.4 | 12.3 | 2.4% | 3,600 | 3,100 | 24.4 | 14.1 | 15.1 |
| 5,001-10,000 | 6.3 | 15.8 | 12.6 | 3.3% | 6,900 | 5,500 | 13.9 | 15.5 | 15.5 |
| 10,001-50,000 | 4.9 | 34.9 | 25.9 | 4.3% | 19,600 | 14,600 | 10.8 | 34.1 | 32.0 |
| 50,001-100,000 | 0.4 | 9.7 | 7.2 | 4.3% | 68,600 | 51,100 | 0.9 | 9.5 | 8.9 |
| Over 100,000 | 0.3 | 18.2 | 15.0 | 2.9% | 146,400 | 120,300 | 0.8 | 17.8 | 18.4 |
| Total | 45.0 | 102.3 | 81.1 | 3.4% | 6,200 | 4,900 | 100.0 | 100.0 | 100.0 |

## Traffic levels on the other sub-networks

By comparing Figures 1 and 2, we can see that all the important concentrations of traffic, with the exception of the Okanagan region in B.C., lie along the National Highway System. As Table 3 shows, over 70% of the IHS traffic in 1993 was carried by NHS highways; moreover, this sub-network was much busier with average volumes 35% higher than the IHS. Traffic was even more concentrated in Ontario and Quebec where the two provinces possessed 32% of the NHS network but 62% of the vehicle traffic. Their overall AADTs where again two to three times larger than the other provinces.

The Trans-Canada Highway, on the other hand, is a curious mix of extremes. It represents a shortest continuous path from coast to coast and thus bypasses most of the busiest parts of Canada, including Southern Ontario, the busiest of all. As a result, Ontario accounts for only 18% of the system s traffic while it possesses 30% of the kilometrage. The TCH does manage, though, to pass through the heart of Quebec following Autoroute 20, one of the busiest highways in the country. Not surprisingly, Quebec dominates TCH traffic accounting for 30% of the total on only 8% of the route-km. Its average AADT for 1993, a gargantuan 30,000, is five to six times higher than all provinces except B.C. Since low-density rural highways are over-represented in this network, traffic growth since 1986 has been less strong compared with the larger networks, with the exception of Quebec which managed a compound growth rate of 3.8%.

Table 3: Traffic levels on important sub-networks, 1986 and 1993

| Province/ territory | 1993 route-kilometres ('000s) | Vehicle-kilometres (billions) | | Average annual growth in veh-km | Average annual daily traffic (AADT) | | Percentage distribution | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Route-km | Vehicle-km | |
| | | 1993 | 1986 | | 1996 | 1986 | | 1993 | 1986 |
| **National Highway System** | | | | | | | | | |
| Nfld. | 0.9 | 0.8 | 0.7 | 1.4% | 2,400 | 2,100 | 3.6 | 1.0 | 1.2 |
| P.E.I. | 0.1 | 0.2 | 0.1 | 3.2% | 4,200 | 3,300 | 0.5 | 0.2 | 0.2 |
| N.S. | 0.9 | 2.2 | 1.8 | 3.1% | 7,100 | 5,700 | 3.6 | 3.0 | 3.1 |
| N.B. | 0.9 | 2.2 | 2.0 | 1.4% | 6,400 | 5,800 | 4.0 | 3.0 | 3.4 |
| Que. | 2.8 | 18.5 | 13.9 | 4.1% | 18,000 | 13,600 | 11.7 | 25.2 | 23.8 |
| Ont. | 5.0 | 27.1 | 21.5 | 3.3% | 14,800 | 11,800 | 20.9 | 36.9 | 36.8 |
| Man. | 0.9 | 1.3 | 1.2 | 1.8% | 4,300 | 3,800 | 3.6 | 1.8 | 2.0 |
| Sask. | 2.1 | 2.8 | 2.4 | 2.4% | 3,700 | 3,100 | 8.8 | 3.8 | 4.1 |
| Alta. | 3.5 | 7.6 | 6.3 | 2.8% | 5,900 | 4,900 | 14.7 | 10.4 | 10.7 |
| B.C. | 5.3 | 10.5 | 8.3 | 3.3% | 5,400 | 4,300 | 22.3 | 14.2 | 14.3 |
| Yuk. | 1.0 | 0.2 | 0.2 | 1.5% | 600 | 500 | 4.1 | 0.3 | 0.3 |
| N.W.T. | 0.6 | 0.04 | 0.04 | 0.3% | 200 | 200 | 2.3 | 0.1 | 0.1 |
| Total | 24.0 | 73.5 | 58.5 | 3.3% | 8,400 | 6,700 | 100.0 | 100.0 | 100.0 |
| **Trans-Canada Highway** | | | | | | | | | |
| Nfld. | 0.9 | 0.8 | 0.7 | 1.4% | 2,400 | 2,100 | 11.9 | 3.3 | 3.6 |
| P.E.I. | 0.1 | 0.1 | 0.1 | 2.8% | 3,700 | 3,100 | 1.4 | 0.6 | 0.6 |
| N.S. | 0.4 | 1.0 | 0.8 | 2.8% | 6,600 | 5,500 | 5.7 | 4.4 | 4.4 |
| N.B. | 0.5 | 1.2 | 1.2 | 0.3% | 6,100 | 6,000 | 7.5 | 5.3 | 6.4 |
| Que. | 0.6 | 6.7 | 5.2 | 3.8% | 30,800 | 23,700 | 8.2 | 29.2 | 27.5 |
| Ont. | 2.1 | 4.2 | 3.4 | 2.8% | 5,400 | 4,400 | 29.0 | 18.1 | 18.2 |
| Man. | 0.5 | 1.0 | 0.9 | 2.0% | 5,600 | 4,900 | 6.7 | 4.4 | 4.7 |
| Sask. | 0.7 | 1.1 | 0.9 | 2.2% | 4,400 | 3,800 | 8.9 | 4.6 | 4.8 |
| Alta. | 0.5 | 1.5 | 1.2 | 3.4% | 7,700 | 6,100 | 7.3 | 6.5 | 6.3 |
| B.C. | 1.0 | 5.5 | 4.4 | 3.2% | 15,400 | 12,400 | 13.3 | 23.7 | 23.3 |
| Total | 7.3 | 23.1 | 18.8 | 2.9% | 8,600 | 7,000 | 100.0 | 100.0 | 100.0 |

## Composition of the traffic stream

With the aid of the vehicle classifications also supplied, the pattern of car and truck travel on the various networks can be investigated. In Table 4, the estimates of truck vehicle-km are provided by province and territory for 1993.[4] Clearly, the NHS is the primary network for truck activity handling about 75% of the truck traffic moving over the IHS. On balance, about 15% of the traffic stream in Canada, regardless of network, is occupied by heavy trucks and other commercial vehicles.

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[4] As the vehicle classifications were normally provided in the form of the percentage of commercial vehicles in the traffic stream, we show here the truck amounts. Car travel can be calculated as the difference between total vehicle-km and truck vehicle-km.

Ontario and Quebec are responsible for a larger share of total truck activity on the IHS and the NHS, about 65%, which is owing largely to the extensive industrial facilities located in the region, all heavy users of trucking services. Care should be exercised in using the B.C. figures which seem unreasonably low. Although similar definitions of commercial vehicles were sought, it seems likely that this discrepancy is more a measurement problem than a real phenomenon.

Table 4: Truck volumes by road network, 1993

| Province/ territory | Truck vehicle-kilometres (bill.) | | | Share of trucks in traffic stream | | | Average annual daily truck traffic | | |
|---|---|---|---|---|---|---|---|---|---|
| | IHS | NHS | TCH | IHS | NHS | TCH | IHS | NHS | TCH |
| Nfld. | 0.1 | 0.1 | 0.1 | 17% | 16% | 16% | 300 | 300 | 300 |
| P.E.I. | 0.0 | 0.0 | 0.0 | 10% | 10% | 11% | 300 | 400 | 400 |
| N.S. | 0.3 | 0.3 | 0.2 | 13% | 14% | 19% | 700 | 900 | 1,000 |
| N.B. | 0.5 | 0.4 | 0.3 | 19% | 21% | 28% | 800 | 1,100 | 1,300 |
| Que. | 3.0 | 2.1 | 0.9 | 13% | 13% | 15% | 1,100 | 2,000 | 4,100 |
| Ont. | 5.4 | 4.3 | 0.6 | 17% | 19% | 18% | 1,600 | 2,300 | 800 |
| Man. | 0.3 | 0.2 | 0.1 | 14% | 17% | 17% | 300 | 600 | 800 |
| Sask. | 0.6 | 0.4 | 0.2 | 17% | 18% | 18% | 300 | 500 | 700 |
| Alta. | 1.3 | 1.0 | 0.2 | 16% | 16% | 15% | 600 | 800 | 1,000 |
| B.C. | 1.3 | 0.9 | 0.4 | 9% | 9% | 8% | 400 | 500 | 1,100 |
| Yuk. | 0.0 | 0.0 | - | 4% | 5% | - | 20 | 30 | - |
| N.W.T. | 0.0 | 0.0 | - | 61% | 57% | - | 100 | 100 | - |
| Total | 12.9 | 9.7 | 2.9 | 14% | 15% | 15% | 800 | 1,100 | 1,100 |

## Capacity utilisation

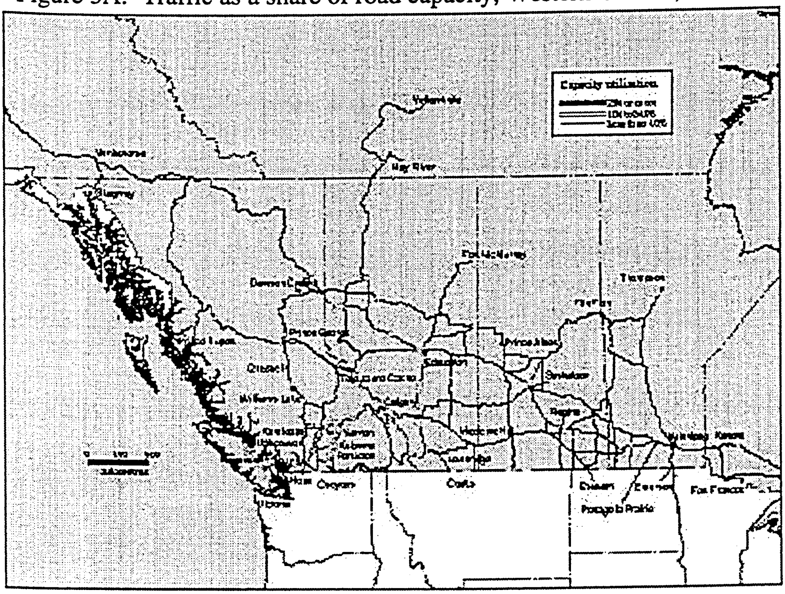
One of the benefits of using a GIS to collect road data is the ability to link traffic explicitly to infrastructure. This allows us to observe the pattern of capacity utilisation, an important qualitative dimension. Traffic engineers have developed convenient rules of thumb to assess highway capacity. For a multi-lane, controlled-access highway, such as the 401, capacity is normally 2,000 vehicles per lane per hour. For a two-lane rural highway without access control, such as Highway 17 in Northern Ontario, capacity is normally a little less at 1,400 vehicles per lane per hour.[5] Employing these facts, we can compute the capacity of our road system and determine its rate of utilisation. Figures 3A and 3B show these rates for the system as a whole, while Table 5 shows overall rates by province and traffic range. What is striking is the overall low

[5] Note that these general rules abstract from other physical characteristics (e.g. steep grades) which may also affect the capacity of a given facility.

level of utilisation for the vast majority of the network, particularly at the lower traffic ranges. Highways with traffic levels under 2,500 AADT use a little over 2% of available capacity.

As one moves up the traffic scale, the rate of capacity utilisation marches in step and accelerates once the traffic level gets above 50,000 AADT. At these ranges, one is again inside the major urban areas where daily commuting puts a tremendous pressure on road facilities. In many parts of the Big-3, daily traffic fills more than half the available capacity. This is remarkable given that commuting patterns cluster around rush hours and are not spread evenly throughout the day. This means that many urban highways are effectively busy for all the daylight hours. For example, the highest utilisation rate was observed along sections of the 401 through Toronto where traffic used up nearly 70% of road capacity. When we find that these road sections are twelve lane highways, we understand instantly the magnitude of the congestion problems faced daily in our big cities.

Figure 3A: Traffic as a share of road capacity, Western Canada, 1993

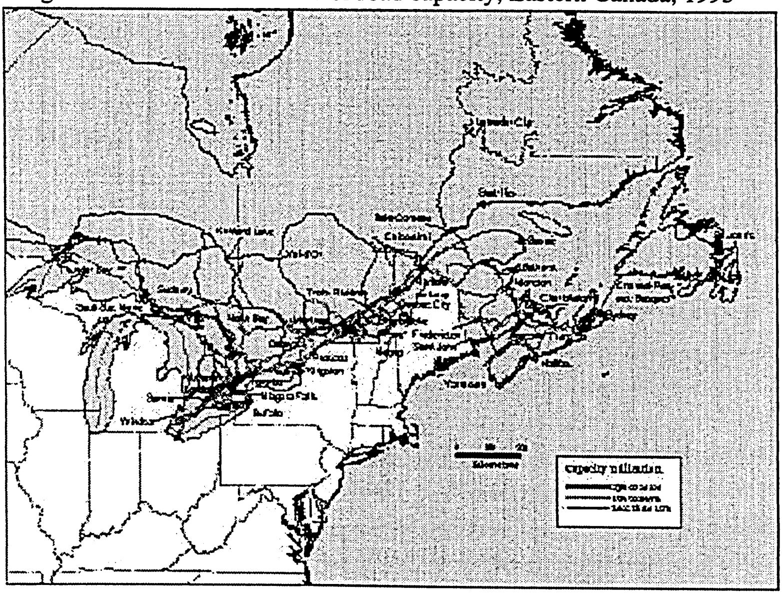


Ensuring adequate road capacity is, thus, largely an urban problem. For most rural highways there is more than adequate existing lane capacity to handle future traffic growth for many years to come.

Table 5: IHS capacity utilisation rates by province and traffic range, 1993

| | AADT range | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2,500 or less | 2,501-5,000 | 5,001-10,000 | 10,001-50,000 | 50,001-100,000 | 100,000 or more | Total |
| Nfld. | 2.7% | 5.2% | 5.2% | 14.3% | - | - | |
| P.E.I. | 3.8% | | 9.5% | 20.7% | | - | 8.7% |
| | 2.8% | 5.2% | | 10.0% | - | | 7.4% |
| N.B. | | 6.1% | 8.2% | | - | - | |
| Que. | 2.6% | | 9.2% | 14.5% | | 50.0% | 14.7% |
| | 2.7% | 6.3% | | 13.4% | 31.1% | | 20.0% |
| Man. | | 3.5% | 4.9% | | - | - | |
| Sask. | 2.1% | | 4.8% | 14.1% | | - | 3.3% |
| | 2.4% | 4.0% | | 10.8% | - | | 5.3% |
| B.C. | | 5.4% | 9.4% | | 33.9% | 52.4% | |
| Yuk. | 1.2% | | - | - | | - | 1.2% |
| | 0.4% | - | | - | - | | 0.4% |
| Total | | 4.9% | 8.2% | | 31.9% | 48.6% | |

Figure 3B: Traffic as a share of road capacity, Eastern Canada, 1993

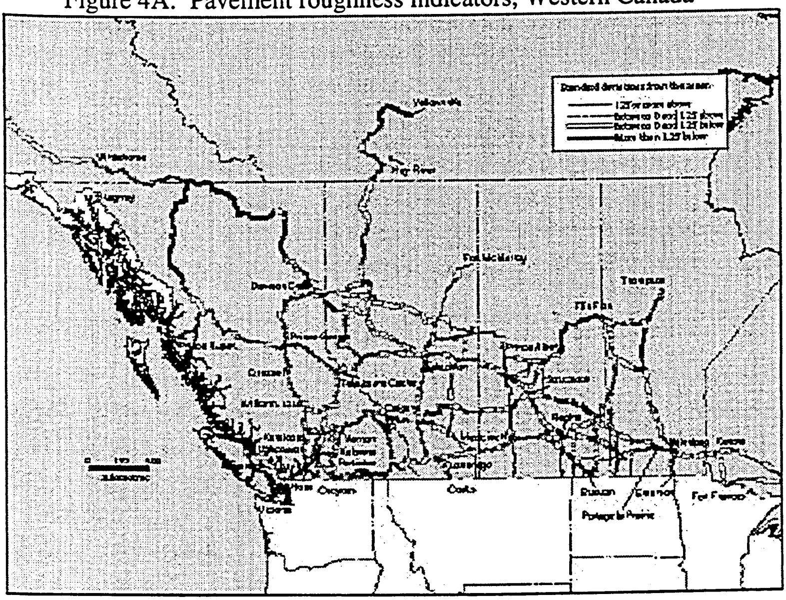


## Pavement quality

The remaining part of the data request dealt another qualitative indicator of the road infrastructure pavement roughness. The smoothness of the surface over which vehicles drive is a valuable added piece of information which has so far received no national treatment. A variety of pavement quality rating systems are in use, but most jurisdictions employ the Riding Comfort Index (RCI), which measures roughness on a scale of 0 to 10 with values under 6 considered to be of poor ride quality.

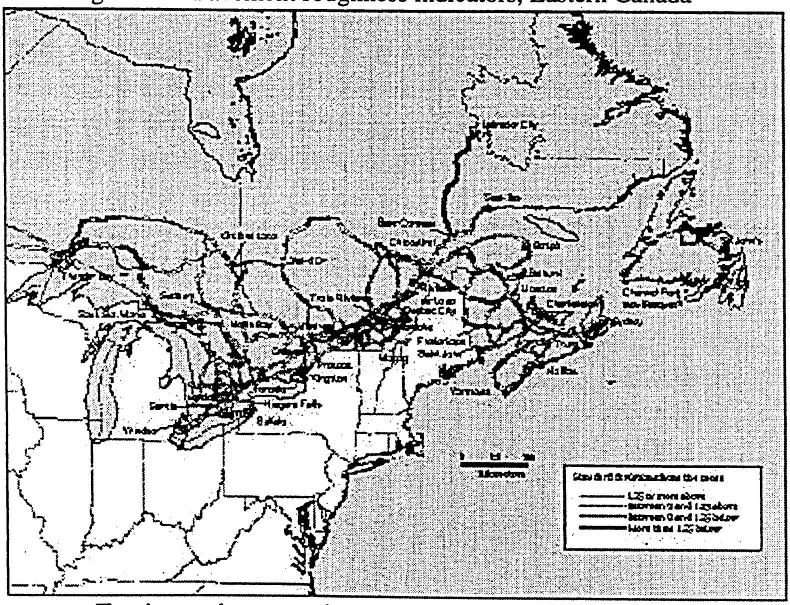
Although the RCI or close proxy was requested, some provinces were unable to supply data in this form. Manitoba, Ontario, and the N.W.T., for example, use a Pavement Condition Rating (PCR) with a scale running from 0 to 100. Since the PCR and RCI are not readily translated, all roughness data were converted into a standardised normal variable based on the mean and standard deviation of each jurisdiction s distribution of ride quality ratings. These values, expressed in units of standard deviation away from the provincial mean are mapped in Figures 4A and 4B.

Figure 4A: Pavement roughness indicators, Western Canada



Upon close inspection, it was found that 1.25 standard deviations below the mean was a convenient cut-off for determining an abnormally rough road. This threshold corresponded relatively well to an RCI of 5.5 to 6 in most provinces. As can be gleaned from Table 6, on the whole, the ride quality of the provincial networks was solidly average. Approximately 5,000 km or 12% of the intercity network had quality measures more than 1.25 standard deviations below the average, while about 4,000 km or 9% of the network had values in excess of 1.25 SDs above the mean. The rest of the road system, 35,000 km, had values fall somewhat closer around the averages which generally clustered in the mid-6 range on the RCI scale. New Brunswick, B.C., and Quebec appeared to have the best quality networks since about 60% of their route-km had RCI values above the mean. The poorest quality networks appeared to be Nova Scotia and Ontario which had only 44% and 47% of their route-km above average. In aggregate terms, the distribution was skewed to the right, with 54% of the IHS route-km above the mean values.

Figure 4B: Pavement roughness indicators, Eastern Canada



Turning to the maps, the worst sections of road were, not surprisingly, located in the more remote parts of the country such as northern B.C., the two Territories, or northern Quebec, where the roads in these areas are either gravel or have very thin pavements. Farther south, the poor quality of significant portions of the NHS highways such as Highway 16 in Saskatchewan between Yorkton and Saskatoon, the Trans-Canada highway through Northern Ontario, and Highway 4 on Cape Breton Island in Nova Scotia was noted. In addition, much of the QEW and 400-series highways in Southern Ontario were in below-average condition.

Table 6: Summary recent pavement condition statistics by province

| | Mean values | | | Standard deviation | | | IHS route-km less ferries ('000s) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | More than 1.25 SD below | Within 1.25 SD below | Within 1.25 SD above | More than 1.25 SD above | Total route-km |
| | IHS | NHS | TCH | IHS | NHS | TCH | | | | | |
| **Riding comfort index (RCI) or equivalent** | | | | | | | | | | | |
| Nfld. | 6.7 | 6.8 | 6.8 | 0.8 | 0.7 | 0.7 | 0.1 | 0.3 | 0.4 | 0.1 | 0.9 |
| P.E.I. | 6.7 | 6.7 | 6.7 | 0.7 | 0.8 | 0.7 | 0.0 | 0.0 | 0.1 | 0.0 | 0.2 |
| N.S. | 5.6 | 5.6 | 5.4 | 1.0 | 1.0 | 0.8 | 0.2 | 0.6 | 0.4 | 0.2 | 1.3 |
| N.B. | 6.3 | 7.0 | 7.0 | 1.3 | 0.5 | 0.5 | 0.3 | 0.3 | 1.2 | 0.0 | 1.8 |
| Que. | 6.7 | 6.9 | 7.0 | 0.8 | 0.7 | 0.7 | 1.0 | 1.9 | 4.0 | 0.5 | 7.5 |
| Sask. | 6.3 | 6.7 | 6.3 | 1.3 | 0.8 | 0.7 | 0.6 | 2.0 | 2.0 | 0.4 | 5.1 |
| Alta. | 6.5 | 6.3 | 6.4 | 0.7 | 0.7 | 0.4 | 0.4 | 2.7 | 2.5 | 0.6 | 6.2 |
| B.C. | 7.1 | 7.2 | 7.5 | 0.9 | 0.8 | 0.5 | 1.4 | 1.4 | 4.5 | 0.3 | 7.7 |
| Yuk. | 5.4 | 5.2 | n.a. | 0.4 | 1.1 | n.a. | 0.0 | 0.5 | 0.3 | 0.1 | 0.9 |
| **Pavement condition rating or index** | | | | | | | | | | | |
| Ont. | 70.0 | 69.9 | 67.0 | 14.8 | 15.7 | 16.5 | 1.0 | 4.0 | 3.0 | 1.5 | 9.5 |
| Man. | 74.4 | 78.7 | 80.0 | 11.3 | 8.6 | 7.7 | 0.3 | 1.1 | 1.3 | 0.2 | 3.0 |
| N.W.T. | 57.5 | 57.3 | n.a. | 19.5 | 18.7 | n.a. | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total | | | | | | | 5.4 | 14.9 | 19.7 | 4.0 | 43.9 |

Some of the best stretches in Western Canada were located in B.C., especially Highways 1 and 19 on Vancouver Island, the Coquihalla Highway, and the Trans-Canada highway between Kamloops and the Alberta Border. In Eastern Canada, the 401 near London, Highway 400 north of Toronto, Highway 40 near Trois-RiviŁres, the Trans-Canada highway in New Brunswick, and Highway 104 in Nova Scotia between Amherst and Wentworth Centre were in above-average condition.

## Summary and recommendations for future action

Based on the information developed for this project, it is safe to say that Canada has erected a road system that, on balance, functions adequately. The population is served with a dense network of highways that permit virtually unfettered interaction; the majority of the roads are of sufficient capacity to meet the demands placed on them for many years to come; and, the pavement surfaces over which much of the traffic moves is acceptably smooth. In many respects, this network is a great success story; yet, in other areas we face serious and, increasingly, pressing challenges that threaten its integrity. For one, ensuring an adequate level of maintenance will always be difficult task given the extent of the system and our harsh climate. There can really be no real relaxation on this front either since work delayed is more costly work later on. The most critical challenge of all, though, is how we collectively meet the growing demands for more and more road capacity in our major cities. Much of the urban highway facilities are literally bursting at the seams, clogged with traffic all day long, imposing substantial delays not only on commuters but truckers carrying goods to their markets. The policy question we will need to face is whether we can continue to stay on top of this inexorable growth by simply adding more lanes. I should say that the odds are stacked heavily against the planners. Even at 2% annual growth, traffic on the busiest parts of the 401 will be at 500,000 AADT by 2011. Will we also see 18, 20 or even 24 lane freeways in 20 years? Do we really want to? Clearly, new and imaginative solutions will have to be implemented or else the system will quite simply implode under its own weight.

In the short-term, it will be crucial, nay imperative, that we develop a much more elaborate and robust set of traffic statistics and other performance indicators. The first concrete step down the road to better statistical systems would be for all jurisdictions to advance with due diligence to geographically-referenced road data. The spatial dimension, so important to this project, must become the number one priority for all parties concerned. This advance should then be followed quickly with a serious attempt to make the collection of traffic counts, especially classified traffic counts, a more systematic and continuous process throughout the entire network. It is true that road authorities have been under enormous pressure lately to scale back their counting activities. This is an egregious and counter-productive move that risks undermining all the progress achieved in recent years. It must become policy at the highest-levels of government to preserve and enhance the collection of road information. Only in this way will we finally have a base of knowledge commensurate with the road mode's importance, and the confidence to make informed decisions about the future direction of road transport in Canada.