

The University of Calgary

MANAGEMENT OPTIONS FOR THE SAFE TRANSPORTATION OF
DANGEROUS GOODS THROUGH AND WITHIN THE CITY OF CALGARY

by

Susan R. Nishi

A Master's Degree Project

submitted to the Faculty of Environmental Design
in partial fulfillment of the requirements for the degree of
Master of Environmental Design
Urban and Regional Planning

Calgary, Alberta

January, 1989

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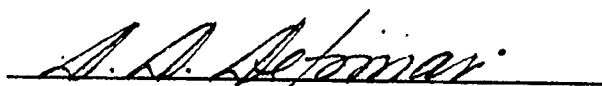
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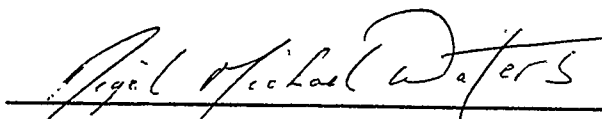
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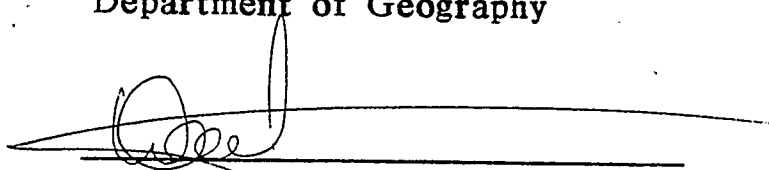
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ABSTRACT

MANAGEMENT OPTIONS FOR THE SAFE TRANSPORTATION OF DANGEROUS GOODS THROUGH AND WITHIN THE CITY OF CALGARY

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January, 1989

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the M.E.Des degree in the
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Supervisor: Dr. Don Detomasi

Issues related to the transportation of dangerous goods are introduced. The responses to these issues, by three levels of government and industry are described. The concept of risk and related subjects is described within the context of the transportation of dangerous goods. The City of Calgary is examined in detail and an assessment is made with respect to the level of safety at present. An approach to the management of risk associated with the transportation of dangerous goods is outlined and justified for use in the City of Calgary. The suggested options include:

- an overall assessment of Calgary's dangerous goods routes system be performed, using the "Hazardous Materials Routing Method"
- a public perception survey be conducted, based on a similar one performed in the Toronto area
- a public awareness campaign be initiated, using several media
- the City Planning Department play an integral role in public awareness advancement and in decision-making as regards the transportation of dangerous goods
- a position be established within the Transportation Department for a dangerous goods co-ordinator responsible for dangerous goods planning
- training be standardized for all emergency response personnel in Calgary
- more types of data must be collected as relates to dangerous goods transportation
- an interdepartmental co-ordinating committee be established to provide a forum for discussion about future development

Key Words: transportation, dangerous goods, risk, Calgary, management

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CHAPTER ONE

INTRODUCTION

On Saturday, November 10, 1979, almost at midnight, 250,000 lives were placed in jeopardy by the derailment of a train that was transporting a variety of dangerous goods through the heart of Mississauga, Ontario. Some of the railcars overheated and three explosions occurred within half an hour of the derailment. One car went streaking like a missile almost a mile to the northeast, landing in an open field. Three great fireballs were sent into the sky, showering train car bodies as far as 2,500 feet away. Despite these spectacular events, the most dangerous condition was the potential release of toxic gas from a chlorine tanker. Downwind, fire and police personnel were forced to wear self-contained breathing apparatus. Chlorine can quickly corrode the lungs and is fatal to humans at concentrations of 1,000 parts per million. It is also highly corrosive and can burn the skin.¹ Lower concentrations can be very harmful and result in various respiratory ailments. This critical situation resulted in the evacuation of 75% of the population of Mississauga and three large hospitals. Miraculously, there was no loss of life. Had conditions been different, (wind movements for example), the event not only would have been serious in terms of property

¹ Mr. Justice Samuel G.M. Grange, Supreme Court of Ontario, Commissioner, Report of the Mississauga Railway Accident Inquiry Dec 1980, (Ottawa: Minister of Supply and Services Canada, 1981) 1.

damage, but the possibility existed for it to be a major catastrophe, with thousands killed or injured.²

The country breathed a sigh of relief when the emergency was over, and it realized how many lives could have been lost. No one could imagine such an occurrence in this age, when we rely on government, armed with technology, to ensure our safety and comfort. Although events of this magnitude are rare, their probability is increasing and everyone should be made aware of it.³ Since the demand for dangerous goods is increasing, there are more vehicles involved in their transport and therefore, the probability of accidents is also increasing.⁴ A "dangerous good" is any substance that presents a risk to life, property or the environment. This definition includes toxic chemicals, and highly flammable or explosive products. This broad categorization does not enable the layman to identify clearly the simple household necessities that are dangerous goods, such as batteries or butane lighters, and even perfume. All too often, the public thinks of "nuclear waste" when the topic of dangerous goods arises. Though the long term hazard may be greater than a dangerous goods accident, radioactive materials account for less

² Alberta Disaster Services, "Chlorine: Product Profile", H.O.T.line, Vol.2 No.4, (Winter 84/85): 6.

³ No clear hard copy statistics are available to prove that volumes or incidents are consistently rising in Canada. However, numerous authorities federally and provincially have indicated such.

⁴ Alberta Public Safety Services, "Anhydrous Ammonia: Product Profile", H.O.T.line, Vol 1 no 2 (February 1983): 5.

than 1% of all dangerous goods shipments in Canada.⁵

Increasingly, articles appear in newspapers and magazines which indicate that dangerous goods transportation safety may need some improvement. In Alberta alone, such headlines as "Trucker Dies in Overpass Inferno", "Aren't You Glad You Weren't Involved?" and "Cochrane Disaster Narrowly Averted" have increased annually and they do not give a very optimistic picture.⁶ The following description recounts a local accident.

On August 11, 1979, at 16th Ave. and Deerfoot Trail N.E., a tanker truck rolled over, spilling 32,700 litres of gasoline onto the overpass and down onto the highway below. As the rig slid along on its side, sparks ignited the fuel which instantly resulted in a blazing inferno. The Calgary Fire Department arrived to confront a fireball reaching dozens of metres into the air and streams of fire draining onto the highway below, setting it and the surrounding boulevard on fire. The heat was so intense that the concrete, steel and pavement of the overpass collapsed. The roads had to be closed for days for major structural repairs.⁷

It is the responsibility of government at all levels to

⁵ W.R. Taylor, "Transporting Hazardous Materials, Comparing Notes With the Nuclear Industry", in A.J. Borner (Chm.), Proceedings of The First Hazardous Materials Management Conference of Canada", (Wheaton, Illinois: Tower Conference Management Co., 1987) 194.

⁶ These headlines were found in various issues of the H.O.T.line magazine issued by APSS.

⁷ Alberta Disaster Services, "Trucker Dies in Overpass Inferno", H.O.T.line, Vol.1 No.2 (February, 1983): 1.

ensure that all possible measures are taken to safeguard the public from any harm that may result from the transport of dangerous goods. The underlying hypothesis of this Masters Degree Project (MDP) is that, despite the great progress that has been made by the City of Calgary in this area, there are further steps that should be taken to provide greater safety for the city's citizens.

This MDP will investigate and evaluate Calgary's efforts to reduce the incidence of, and improve the emergency response to, dangerous goods accidents and will ultimately suggest how these can be improved. The result is a set of management options designed to reduce, either directly or indirectly, the risks associated with the transportation of dangerous goods travelling within or passing through the city. It will be argued that this reduction in risk will be achieved primarily through increased interdepartmental co-ordination and greater public awareness. In particular, practicing responsible development planning to prevent similar safety problems in the future, seems most appropriate. Future development planning would consider the flow of dangerous goods through the city just as seriously as it considers engineering standards and other forms of regulation. Further, both the planner and the community should be better acquainted with dangerous goods and how hazardous they can be, as well as how vital they are in our lives. Finally, the public should be more involved in how its communities are affected by dangerous goods. They should be educated about emergency

response and the role of the individual in the event of evacuation.

What is termed as "management options" should be clarified here. There are a number of means to improve safety in any given situation, and many of these may attempt to achieve this through technological advancements. These are distinctly different from management means to improve safety, though they are not mutually exclusive. A management approach seeks to make better use of the resources that are immediately available, particularly human and information resources. A technological approach seeks to improve specific technical parameters that are important in reducing the probability or the impact of a dangerous goods accident. Technological options are beyond the scope of this study.

The prevention or reduction of risk may involve improvements to dangerous goods' packaging, the removal of the cause by prohibiting the transport and/or storage of certain substances, or the regulation of dangerous goods containers, routes and what times they may be used to minimize exposure to dangerous substances. The first example is technology-based, the second is management-oriented and the third is a combination of the two.

Background

The increasing number of accidents that involve dangerous goods can be attributed, in part, to the significant increase in consumer demand for products which are dependent on dangerous substances for their production. It is difficult for most

Canadians to understand how dependent we are on such products and, in turn, on dangerous goods. J.P. Kelsall developed a scenario which illustrates this:

You have just selected a couple of thick, juicy steaks from the local supermarket. You drive home, park in your driveway and, while walking toward the backyard, you deftly avoid the collection of kids' toys strewn along the walk. The kids are happily splashing away in their new pool and, wonder of wonders, your eldest son has finally gotten around to spreading the fertilizer on the lawn. Your spouse is in the kitchen preparing the salad dressing. You fire up the barbecue, slap on the steaks, grab the Sunday paper and, finally collapse into your favorite lawn chair.

The steaks were wrapped in plastic on Styrofoam platters, both produced using petroleum by-products. Your car is a wealth of all kinds of other plastics and vinyls--which also require petroleum products as feedstock in their manufacturing process. More obvious examples are the highly-flammable gasoline in the tank; and the brake, transmission and wiper-washer fluids. You parked the car on an asphalt laneway--more petroleum. Yours kids' toys were mostly plastic. So was the lining of their new pool. Your son was using a lawn fertilizer produced with anhydrous ammonia. The salad dressing was made with vinegar--also known as acetic acid. And, of course, it was a propane barbecue. Your favorite lawn chair had plastic webbing. The newspaper? Well, back to chlorine, which was used in producing the newsprint. Printer's ink is classified all by itself as a dangerous commodity.⁸

This scenario shows how vital dangerous goods are in our lives and that we cannot eliminate their use. This does not preclude the development of different methods or substitute resources to manufacture the same products, without the use of dangerous goods. However, such innovations may be far in the future.

Experience and accident data indicate that most dangerous

⁸ J.P. Kelsall, "Risk Reduction and Economic Efficiency in the Railway Industry", in Shortreed, J. (ed.), Dangerous Goods Movements: Proceedings of the 1984 Waterloo Workshop, (Waterloo: University of Waterloo Press, 1985) 111-112.

goods shipments are handled safely. The overall national transportation safety record for dangerous goods is quite good.⁹ However, accidents involving some commodities and types of shipments have the potential to cause loss of life and damage to property and the environment. Risk management strategies need to be developed and employed to minimize or avert the potential losses caused by the transportation of dangerous goods.

An "incident" is any reported occurrence or event, from a small box falling off a truck, to a large scale accident.¹⁰ The word incident is thought to be less foreboding than accident and, thus, has been adopted by Alberta Public Safety Services (APSS). Similarly, such events are referred to as occurrences at the federal level. Since February 1, 1986, Alberta legislation has required that any such incident must be formally reported to APSS. Prior to this date many incidents were left undetected, so earlier data are considered sketchy, at best.¹¹

⁹ David Friend, "Public Concerns and Hazardous Materials Transportation Safety: Closing the Gap" in Transportation Research Board, National Research Council, Recent Advances in Hazardous Materials Transportation Research: An International Exchange, State of the Art Report 3, (Washington D.C.: 1986) 189, from conference held in Lake Buena Vista, Florida on Nov 10-13, 1985.

¹⁰ A large scale accident would be one where conditions such as the type of product(s), the volume(s), the type of container(s) in use, the population density and other factors in situ are such, that the resulting explosion, release of gas or fire would result in maximum damages in terms of lives, property and/or the environment.

¹¹ This comment, made by Alberta Public Safety Services, is interesting because incident data provided by them since 1986, indicate fewer incidents.

When incidents do occur, they are usually in areas where the local authorities are responsible for implementing emergency response plans. Though catastrophic events involving dangerous goods are rare, they have the potential to devastate communities with minimal resources, or where a substantial portion of their population is at risk. What may be just an incident statistic provincially or nationally, can be of major importance and have a great impact at the local level.

The following statistics for Alberta illustrate the number of incidents which involved dangerous goods between January, 1978 and the end of April, 1988. Due to the downturn in the oil industry, which still accounts for much of what is transported in Alberta, the incident figures drop after 1982. This is an assumption because data are available only for incidents and not for volumes or numbers of vehicles that transported dangerous goods during the time period. If such data were available it would be easy to calculate accurately whether or not accidents have risen, relative to the number of shipments or volumes of dangerous goods transported. There was a lapse in data collection for dangerous goods incidents during 1984 and 1985.¹²

¹² Alberta Transportation, Transportation Safety Branch, Planning and Program Support, "Collisions Involving Heavy Trucks and Tractor Trailers Carrying Hazardous Loads, Alberta: 1978-1983", Edmonton, 1985 and Alberta Public Safety Services Incident Statistics provided for 1986, 1987 and 1988. Apparently, data for 1984-85 is unreliable because there were no clear responsibilities regarding data collection after Alberta Transportation passed the duties over to APSS.

TABLE 1 : INCIDENTS RECORDED IN ALBERTA, 1978-1988*

1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
355	457	588	432	355	278	-	-	267	307	106

* To April 30, 1988

An average of 25% of these incidents occurred in urban areas and, over the same period, 62 people were killed in dangerous goods transportation incidents and another 601 people were injured.¹³

Studies have revealed some shocking facts such as, nationally, there is believed to be an 85% violation rate on the part of dangerous goods carriers.¹⁴ This means that only 15% of those vehicles that were inspected were in complete compliance with the Transportation of Dangerous Goods Regulations. In Alberta, a series of inspections during 1986 found a compliance rate of 69.2%.¹⁵ These two figures conflict significantly and serve to illustrate how much variation exists in data bases and in inspection and enforcement, at different levels of government.

It is obvious that there are a number of issues to be resolved in the field of transportation of dangerous goods. The

¹³ Alberta Transportation, *ibid.*, 4.

¹⁴ M. Matthews, "Roundtable Discussion of Strategic Planning for Hazardous Materials Transportation Safety", in Transportation Research Board, *op. cit.*, 207.

¹⁵ R. Wolsey, "Transportation of Dangerous Goods: The Act vs. The Reality, The Provincial Perspective", from A.J. Borner (chm), Proceedings of The First Hazardous Materials Management Conference of Canada, (Wheaton, Illinois: Tower Conference Management Co., 1987) 204.

City of Calgary is not exempt from these problems. In Calgary, during 1986, there were 63 dangerous goods incidents; during 1987, there were 70 incidents and from January to the end of April, 1988, there were 22.¹⁶ This represents an average of more than one incident per week. Perhaps this record will change in the future with the implementation of the management options suggested in the final chapter of this document.

During the oil boom years, roughly from 1970 through 1980, the City of Calgary grew very rapidly. The population soared from 385,000 in 1970 to 623,00 in 1982.¹⁷ Competition for real estate of all kinds was very keen and timing was crucial in order to be successful. The City was swamped with applications for development and the system was clearly stressed. A peak of 21,396 building applications were approved in 1981 just prior to the downturn in the oil industry in Calgary.¹⁸ This led to some poor planning decisions. Development occurred swiftly without enough regard for minimizing the public's vulnerability to dangerous goods travel or for emergency response planning requirements in the event of a dangerous goods accident. Homes and businesses were developed too close to roadway and rail corridors that carried significant volumes of dangerous goods,

¹⁶ Unpublished Alberta Public Safety Service statistics, op. cit.

¹⁷ Calgary Economic Development Authority, Calgary in Fact: A Profile 1987/88, (Calgary: City of Calgary, 1987) 37.

¹⁸ Unpublished documentation provided by the City of Calgary Planning Department Library, May 1988.

and street patterns were designed in such a way that they would hinder rather than facilitate evacuation. Equally unsafe, is the situation where an evacuation is required and the residential transportation network twists and turns, with cul-de-sacs, few cross streets and parking allowed on either side of the roads. This situation could cause massive traffic congestion, confusion and panic which have the potential to cause injuries or loss of life. It is unfortunate that some of these problems were not foreseen, or apparently not considered, in the planning stages of various subdivisions and development projects in Calgary.

The City of Calgary concentrates a lot of effort and money on limiting and mitigating the existing problems or difficulties concerned with dangerous goods incidents. More effort is needed, however, to limit the possibility of situations where an incident will have a large impact. Many of the suggested means to further reduce or eliminate those problems that exist in the city are just too costly or complicated to implement at this time, especially when the entire province has been experiencing an economic downturn.¹⁹ This MDP deliberately avoids venturing into Calgary's two most problematic areas, the east-west rail line that passes through the Central Business District (CBD) or the TransCanada Highway, (16th Ave. N.), which runs roughly parallel to the rail line about one mile to the north.

Virtually all great Canadian cities have grown up around the

¹⁹ For example, several officials commented about schemes that have been presented to reroute the main rail line around the city.

railroad and Calgary is no exception. The city owes much to the railroad but it now presents serious risks to the people who live or work in the Central Business District (CBD). The major east-west rail line through the CBD of Calgary is of great concern to City officials and businesses alike. Aside from a complete rail line relocation or the technical improvement of the rail system itself, there are no foreseeable ways to reduce further the risk in this area. Similarly, the TransCanada Highway, which is the main east-west roadway, is of concern due to high population densities and its proximity to the Bow River watershed which is a source of drinking water. The difficulties in addressing either of these major problems are beyond the scope of this MDP.

Objectives and Relevance of the MDP

The objectives of this study are first, to develop a set of management options to make the transportation of dangerous goods through the City of Calgary safer and, second, to suggest ways to minimize or avoid similar public safety problems in the future.

The prospect of a large scale accident involving dangerous goods is very disturbing. However, Calgary must face increasing volumes of dangerous goods traffic and the greater probability of such an accident. To ban dangerous goods from the city entirely is not an option because of our dependance on them. There are mechanisms in place to positively affect the movements of dangerous goods, but are they exhaustive? Are there instances where we might be unreasonably trading off public safety risks

(lives) and money? It would be useful to determine whether Calgary is a front runner in this area and/or whether it can still benefit from further efforts to make the transportation of dangerous goods a safer endeavour.

The management options suggested in the final chapter should provide favourable results, by reducing the probability of a dangerous goods accident or the magnitude of damage caused by one. In both the short and the long term, it is likely that less manpower and fewer dollars would have to be spent than estimated for other redevelopment ideas aimed at increasing public safety. This notion of "economically balanced"²⁰ actions may not suffice indefinitely as risks mount, but it is suitable given the economic pressures at present. This is relevant for many cities.

²⁰ "Economically balanced" is an approach which attempts to set limits or values on the risks and subsequently makes economic tradeoffs between risk reduction, changes in transportation costs, management costs, and the ultimate value of the goods. A second approach would be "as safe as technically possible" which attaches a very high value to the particular risk relative to tradeoffs such as the benefits of the movement of the actual goods, the cost of the movement of the goods (in monetary terms), the value of the risk and/or perceived risk, and the cost of risk management (in monetary terms). As taken from John Shortreed, "Risk Management and Hazardous Goods Movements: An Overview" in Shortreed, J. (ed.), Dangerous Goods Movements: Proceedings of the 1984 Waterloo Workshop, (Waterloo: University of Waterloo Press, 1985) 2.

Methodology and Overview of Subsequent Chapters

In order to fulfill the objectives of this MDP, it was necessary to carry out the required tasks in three phases.

Phase I - research into areas related to the transportation of dangerous goods.

Phase II - assessment of the Calgary situation pertaining to local flows of dangerous goods.

Phase III - generation of management options to be applied in Calgary.

In **Phase I** it was necessary to investigate the following areas:

- 1. LEGAL** - Legal institutions affecting the transportation of dangerous goods in the country, the province and the municipality. This included regulation and enforcement of the applicable legislation and by-laws;
- 2. RISK** - The concept of risk and the various methods of risk analysis and management with regard to the transportation of dangerous goods;
- 3. EMERGENCY RESPONSE** - Typical emergency response training requirements and procedures as well as the information and assistance available to Calgarians enabling them to respond to dangerous goods incidents with the greatest efficiency;
- 4. ROLES** - Current roles and responsibilities of the various actors involved in the transportation of dangerous goods and those affected by the transportation of dangerous goods; and
- 5. CITY RESPONSE** - The City of Calgary's attempts to reduce the problems it has recognized with regard to the transportation of dangerous goods.

These areas of research cover a wide range of expertise. For a paper of this size and nature, it would not be possible, nor is it necessary, to possess complete knowledge of each topic

area. The level of research has been limited to the extent whereby the concepts are understood and the ability to use them for the study of the Calgary situation was achieved. For a greater understanding of the topics covered, the reader may wish to consult the various references listed in the bibliography.

Investigation into the first three areas of research (legal, risk and emergency response) was conducted simultaneously, primarily through an extensive literature review. This review included literature from Canada, the U.S. and the U.K. and covered information from a national level down to the local level. I also participated in a risk course and workshop at The Banff Centre, School of Management which brought in a number of speakers who were well versed in risk analysis and its application towards the management of risk.

Investigation into the fourth and fifth areas (roles and city response) primarily involved the interviewing of various officials. Some were involved in the transportation of dangerous goods, through or within the City of Calgary. The interviews were conducted informally though there were a number of standard questions that were asked. A limited number of officials were interviewed because of time restrictions placed on the interview process by the research schedule. A representative from the following city departments was interviewed:

Planning Department; Engineering Department; Fire Department; Transportation Department; Emergency Medical Services; and the Calgary Police Department.

An inspector representing Alberta Public Safety Services was also interviewed. In addition, I spoke with many other officials to gather data relevant to dangerous goods transportation in Canada, Alberta and locally. These persons are identified in the "Personal Communications" section within the Bibliography..

Phase II consisted of an assessment of Calgary's performance in its attempt to ensure maximum safety of its citizens. This involved an extensive literature review, some comparison with other cities, and personal interviews with the actors involved. Although a structured dangerous goods routing analysis might have been educational, the applicable up-to-date information and data required have not been made available to enable me to carry this out thoroughly.

Phase III of this MDP is the generation of management options that will ensure greater safety of Calgarians in the future. These options are the result of an analysis of and thinking about the information obtained through the researching and writing of this MDP. They attempt to remedy the weaknesses and problems revealed by the research and interviews.

The result of these efforts is a five chapter document that introduces the reader to the issues of dangerous goods transportation in general and, in particular, to the situation in the City of Calgary. The suggested management options are designed to assist the City to build a risk management strategy.

The second chapter will describe the response of the various levels of government to the problems associated with the

transportation of dangerous goods. It will also introduce the role of industry in the effort to maximize public safety. The bases for this chapter were researched in Phase I.

Chapter Three describes the concept of risk, how it is determined and how risk analysis assists in risk management. It also describes a method for determining what routes would be safest for the transportation of dangerous goods in any city. The bases for this chapter were researched in Phase II.

Chapter Four is partly descriptive and details how dangerous goods are presently transported through Calgary, and who is involved. It includes an evaluation and assessment of how well Calgary has performed in response to the issues that deal with dangerous goods. The chapter was written based on information collected in both Phase I and II.

The final chapter contains suggestions which address the problems of transportation of dangerous goods in a management fashion. Conditions may be made safer by implementing changes to the existing scheme of things. This chapter also contains suggestions about how to avoid problems of the past, by planning for the future. A concluding section provides some comments on the transportation of dangerous goods in general and suggests how future research can affect the way we value our current lifestyles. This chapter is based on the information collected and analyses performed throughout all of the research Phases.

CHAPTER TWO

WHAT'S HAPPENING AND WHAT'S BEING DONE ABOUT IT?

Experience and accident data indicate that most dangerous goods are transported safely and that the overall transportation safety record for dangerous goods is good.²¹ However, when involved in transportation accidents, some commodities and types of shipments have the potential to cause enormous loss of life and/or property. Investigations into these accidents have established that additional safety precautions must be implemented in order to minimize or avert these losses.

Statistics from the Alberta Department of Economic Development indicate that in 1983 alone, dangerous goods volumes on the province's two major highways (Highway 2 running North-South and Highway 1 running East-West) were approximately 3,095,000 tonnes. By 1984, this figure had risen dramatically to 7,198,142 tonnes, 77.6% of which were classified as flammable.²²

It is difficult for most Canadians to fathom how dependent we are upon products that require materials which are classified as dangerous goods. Three simple examples of dangerous goods that cross our country in large volumes are chlorine, ammonia and gasoline. Chlorine is used to purify our drinking water. Ammonia is used to fertilize agricultural land and other plant

²¹ J.P. Kelsall, op. cit., 110.

²² This data was collected by a consultant for Alberta Economic Development. The report contains sensitive data and is not available for viewing.

products, and, of course, gasoline fuels our automobiles. It is clear that we cannot eliminate the use and, therefore, the transport of dangerous goods because they have become an integral part of our increasingly affluent society.

Dangerous goods incidents have increased dramatically in Canada over the past 20 years.²³ This is partly due to the increase in demand for products that depend on dangerous substances for their manufacture. Since the quantity of dangerous goods being consumed has risen, there are more vehicles involved in their transport. The probability of an accident involving them is increased, but not proportionately since, presumably, we are more aware and careful than in the past.

This chapter describes how the various levels of government have thus far approached the problems of dangerous goods transport within their respective jurisdictions. It also describes the role of industry and how it has become a significant contributor to dangerous goods safety programs. Table 2 summarizes this information, at the end of this chapter.

The Federal Response

Legislation

The development of a federal act governing the transport of dangerous goods was stimulated by Canada's most well known dangerous goods accident - the 1979 derailment of a train

²³ Personal communication with Don Learning, Head-Accidents, Transport Dangerous Goods Directorate, Transport Canada, February 1988.

carrying a variety of dangerous substances through the highly populated City of Mississauga, Ontario. The derailment was caused by an overheated bearing arrangement in the journal box which helps to support the axles of the train car.²⁴ The bearings were not properly lubricated and the increasing friction caused the journal to burn off and the assembly could no longer support the axle. Today, the types of bearings used on train cars differ and most newer cars are equipped with a different bearing arrangement that is less likely to overheat. Since 1979, more hot box detectors have been installed along all of Canada's rail lines to detect any instances where there might be a problem.

The accident in Mississauga resulted in the evacuation of approximately 250,000 people. The evacuation was initiated due to the presence of chlorine tankers that had been damaged. Exposure to chlorine is fatal at concentrations of 1,000 parts per million (ppm) and above. Exposure for one hour at concentrations of 40 ppm or above is considered dangerous. The recommended working level is 0.5 ppm. It rapidly destroys the respiratory system and is highly corrosive in the presence of moisture and it will react with perspiration to burn the skin.²⁵

Despite some confusion as to the assignment of duties, the evacuation and subsequent cleanup were a success. The municipality had recently updated their emergency contingency

²⁴ Mr Justice Samuel G.M. Grange, op. cit., 2-6.

²⁵ Alberta Disaster Services, "Chlorine: A Profile", op. cit.

plan, and had conducted an exercise to identify the weak areas in the plan only one week before the accident occurred. There was no loss of life, even though the potential risk was extremely high due to the density of the population in the immediate area where the accident occurred. This was due to several factors. At the point of the derailment, to the immediate south, only industrial property existed, and to the north and northeast, except on a strip of Mavis Road itself, there was a large area of undeveloped land. The derailment occurred just a few minutes before midnight so there weren't many people in the area. The country truly did breathe a sigh of relief afterward when it realized how many lives could have been lost. The accident jolted government into appreciating the need for a single set of standards to ensure nationwide consistency in dangerous goods transportation and emergency response. The differing ideas and opinions within government and industry about both of these processes and actions had resulted in delays or non-actions because of the anticipated potential for confusion and disagreement within the ranks.

The growing realization that the country needed to be safeguarded against the alarming increase in incidents involving dangerous goods, led to the introduction of Bill C-18 in Canadian Parliament. In 1980 it became The Transportation of Dangerous Goods Act: An Act to Promote Public Safety (TDGA).²⁶ The TDGA

²⁶ The Transportation of Dangerous Goods Act, 1980, S.C. 1980-81-82-83, c.36.

replaced parts of the Railways Act, the Canada Shipping Act, the Explosives Act and the Atomic Energy Control Board Act, just to name a few of the federal regulatory Acts which were used previously. The TDGA deals comprehensively with the subject of dangerous goods transport. It encompasses what the other Acts did and additional topics. It regulates the carriers and shippers of dangerous goods, the receivers of dangerous goods, and the manufacturers of packagings, containers and tanks into which dangerous goods may be placed. In addition, it deals with the import of dangerous goods, emergency response issues and the manner in which the government might recover any expenses that result from an emergency response exercise.

The jurisdiction over general transport activities is shared. The provinces have responsibility for transportation within their boundaries while interprovincial transportation is within the purview of the federal government.²⁷ The only exception to this is within the field of aeronautics, which comes solely under federal jurisdiction.

The Transportation of Dangerous Goods Regulations (TDGR) came into force on July 1, 1985.²⁸ It is the body of rules that complements the TDGA and includes what can and cannot be done, in terms of handling dangerous goods in Canada. A five month period was given to industry to comply with these new regulations, i.e.,

²⁷ P.W. Hogg, Constitutional Law of Canada, 2nd ed., (Toronto: Carswell, 1985).

²⁸ The Transportation of Dangerous Goods Act, Regulations, S.O.R./85-.

until December 1, 1985. Though industry had been preparing for the regulations, the limited amount of time provided for compliance proved to be very taxing. Simple problems arose that caused difficulties in meeting the deadline for compliance. Due to the sudden rush for certain items, such as labels and placards that were required on all vehicles, a bottleneck developed in their production. Consequently, many carriers did not receive them until after the date for compliance. In addition, more complicated problems unfolded, such as the incomprehensible legal language in which the regulations were written.²⁹ The jargon used makes them virtually meaningless to the average person who would have to abide by them. This latter problem is presently being addressed at the federal level by a Special Projects Working Group. The result will be The Transportation of Dangerous Goods Code in loose leaf binder format with amendment sheets to follow by subscription.³⁰

It is understandable that the scope of application of the regulations is very broad. They contain very specific requirements for such things as the classification of dangerous goods, documentation to be carried at all times, safety markings and placards that must be on the vehicle, and training certificates, reporting mechanisms, and special permit

²⁹ R.P. Beaudry, "The Reality of Compliance" in A.J. Borner (Chm.), Proceedings of The First Hazardous Materials Management Conference of Canada, (Wheaton, Illinois: Tower Conference Management Co., 1987) 191.

³⁰ Transport Canada, "The Transportation of Dangerous Goods Code", Dangerous Goods Newsletter, (November 1987): 4.

notifications. They also include explanations regarding definitions, exemptions, prohibitions, special permits and inspections. The regulations continue to be amended and parts have not yet been completed. Parts VI, VII, and VIII, which deal with packaging, handling, offering and transporting, still must be completed and additions to these sections will be dealt with in future amendment schedules. There is so much research going on in these areas that changes are inevitable. In the meantime, existing federal transport mode and commodity-specific regulations, such as those mentioned earlier, will cover those sections that have not been completed.

Intraprovincial transport of dangerous goods by road is the only mode which is not officially covered by the new TDGR. This has permitted the Provinces to develop their own dangerous goods transportation legislation as long as any current dangerous goods agreements are adhered to. As of July, 1986, all the Provinces and the Territories had adopted such legislation.

Federal legislation allows for some exemptions, if certain conditions are satisfied regarding the safety of operations. Exemptions include such activities as pipeline transport, which is governed by both the National Energy Board Act and the Oil and Gas Production and Conservation Act, and those which fall under the sole direction or control of the National Defense Department. Despite the exemptions permitted by the legislation, the regulations still apply to all persons who handle, offer for transport or transport dangerous goods from the moment that they

leave the manufacturer or packing plant until the time they arrive at the unloading point for ultimate use or disposal.

The TDGA sets forth important principles regarding the implementation of the TDGR.³¹ It outlines what must be contained in the regulations and states that any proposed regulations must be published in Part I of the Canada Gazette for comment before they can be published in Part II, which makes them official. The TDGA also includes such details as responsibility for charges when a dangerous goods incident results in damages, and the training requirements for persons handling dangerous goods. Any handler must either be trained or be under the direct supervision of someone who is. There are no set training standards. Specific training depends upon the duties that are assigned to the employee. The onus is on the employer to ensure that the employee has received adequate training. All carriers are required to carry a certificate stating that they have received training prior to handling dangerous goods.³² The Transport Dangerous Goods Directorate has recently completed an emergency response training video and it is now available through Ottawa.³³

Safety violations or infractions of the TDGR may result in very severe fines and even prison terms. The TDGA obliges

³¹ Linda Hume, "Transportation of Dangerous Goods Regulations", in A.J. Borner, op.cit., 187.

³² Personal communication with George Diebert, Senior Inspector, Dangerous Goods Control Section, APSS, June 1987.

³³ Transport Canada, "Emergency Response Training Video", in Dangerous Goods Newsletter, Vol.7 No.3, 8.

persons responsible for dangerous goods to adhere to the strictest of safety standards and to take the emergency measures needed to reduce or mitigate property damages and/or injuries caused by dangerous goods involved in an accident. That is, if someone is responsible for, or owns, dangerous goods, he is presumed guilty if an accident occurs involving them, unless he is able to prove that he complied with the TDGA and the TDGR.³⁴

Federal Actors

Both the TDGA and the TDGR were developed by the **Transport Dangerous Goods Directorate** of Transport Canada which was established in 1978. The Directorate:

- 1) amends the TDGR,
- 2) compiles and analyzes statistics regarding the transport of dangerous goods in Canada,
- 3) has a force of compliance inspectors that function across Canada ensuring that the regulations are adhered to, and,
- 4) acts in an advisory capacity to anyone seeking information about the transportation of dangerous goods in Canada.³⁵

There are no federal compliance inspectors in the Province of Alberta. The provincial government has assumed the

³⁴ For a more complete review of the TDGA and the TDGR the reader may wish to consult "The Transportation of Dangerous Goods: Background Paper for Parliamentarians" by Jacques Rousseau and/or Constitutional Law of Canada by P.W. Hogg.

³⁵ Transport Dangerous Goods Directorate, "Highlights of Our Internal Organization", in Dangerous Goods Newsletter, Vol. 6, No. 1 (March 1986): 4-5.

responsibility to train and employ its own inspectors at the provincial and municipal levels.³⁶ The main office in Ottawa issues frequent bulletins that keep government and industry up-to-date respecting legislative amendments, ongoing research, new innovations and other relevant information. An important part of the Transport Dangerous Goods Directorate is the **Canadian Transport Emergency Centre** (CANUTEC). It provides advice and scientific data to those responding to emergencies involving dangerous goods such as fires, spills, leaks or human exposure.

When an emergency call is received by CANUTEC, the Emergency Response Advisor on duty obtains relevant information about the emergency and recommends appropriate response action for the protection of the public and for the stabilization and containment of the dangerous goods involved. The advisor: provides technical information regarding the physical, chemical, toxicological and other properties of the products involved; recommends remedial actions for fires, spills or leaks; provides advice on protective clothing and first aid; and, contacts the shipper, manufacturer or any other organization the caller requests, or the advisor deems necessary. CANUTEC can also contact product specialists to provide further assistance.

Emergency Preparedness Canada (EPC) is the agency responsible for co-ordinating emergency planning within federal departments. EPC makes sure that all plans are current and its regional directors provide liaison with the provincial emergency

³⁶ Personal communication with George Diebert, June 1987.

planning authorities and the regional staff of federal departments and agencies. In addition to co-ordinating federal plans and providing training, EPC has a general responsibility to make Canadians more aware of the need for emergency preparedness. It sponsors research and conferences on the topic of emergency response. It also administers federal plans that are designed to help provinces and municipalities to develop their own plans, and to train and equip their staff. One of its main goals is to have an adequate, uniform emergency response system across the nation. Toward this end, the agency administers the Joint Emergency Planning Program which contributes up to \$6 million a year to provinces to help with projects that will enhance their ability to respond to emergencies.

The EPC runs the Canadian Emergency Preparedness College, located on a 35 acre campus outside Arnprior near Ottawa. Courses in Exercise Design (scenarios), Emergency Operations, Emergency Site Management and others, are offered free of charge to participants, chosen for the training from various parts of the country. The college also offers seminars and workshops on issues of interest ranging from emergency health services to the transportation of specific dangerous goods.

In 1986 EPC managed to obtain a computer-aided exercise design system from the U.S. Federal Emergency Management Agency.³⁷ It is used to run exercises at the local level, with a

³⁷ Canadian Chemical Producers Association and WJS Conference Group, Proceedings from Dangerous Goods Emergency Response '86, held in Vancouver, B.C., September 14 - 18, 1986,

minimal requirement for detailed data. The current software is able to generate four distinct types of disaster scenario: a nuclear power generating station accident, a severe storm, a flood, or a train derailment involving a chemical spill. Local authorities will be able to select the type of exercise they want to carry out, give it some specific characteristics and then test their own response to it, all by computer. They can test themselves on a number of bases, such as the duration of the response phase, the resulting damages and the overall success of the emergency response.

The Provincial Response (Alberta)

Legislation

In response to federal initiatives, the Province of Alberta set out to develop its own legislation in 1980. The Transportation of Dangerous Goods Control Act (TDGCA) was assented to in 1982 and came into force on February 1, 1986. It adopts the federal TDGA and the accompanying regulations that were proclaimed in 1985, which apply to transportation by the roadway mode.³⁸ The TDGCA also provides for provincial regulation of packaging, placarding of vehicles and labelling containers, inspection procedures and documentation requirements, and the classification of dangerous goods.

(np: Beauregard Press Ltd., 1986) 167.

³⁸ The Transportation of Dangerous Goods Control Act, RSA 1980, Chapter T -6.5.

Provincial Actors

The **Dangerous Goods Control Division** of Alberta Public Safety Services (APSS) is the authority responsible for the administration of the provincial act.³⁹ Its prime objective is to maximize public safety without imposing undue economic burden on industry.⁴⁰ Roughly four times per year, the Dangerous Goods Control Division publishes an issue of its H.O.T.line magazine in which it informs its readers about news, events, and professional developments in the handling, offering and transporting of dangerous goods in Alberta. This publication provides insight into issues of importance and also contains informative reviews of dangerous goods incidents within the Province.

To fulfill its mandate, the Dangerous Goods Control Division operates two branches. The Inspection Services Branch is responsible for field operations that deal with the administration of the Dangerous Goods Control program. The Operational Support Branch provides technical support for the program in general. It conducts extensive research in a variety of areas affected by legislation, assists industry, enforcement and emergency response personnel in the interpretation of the more complex aspects of the legislation, and provides or obtains the expertise needed on specific products in the event of an

³⁹ Alberta Public Safety Services used to be Alberta Disaster Services prior to July 5, 1985.

⁴⁰ Personal communication with Ron Wolsey, Executive Director, Operational Support, Dangerous Goods Control Division, APSS, Sept 1986. This objective is stipulated by the TDGA.

accident. This branch also issues permits and processes municipal by-laws for Ministerial approval.

In 1986/87 there were 302 on-highway inspectors (48 in the Calgary Area) compared with 216 in the previous year.⁴¹ They are employed, through the Inspection Services Branch of the Dangerous Goods Control Division, by various law enforcement agencies within the province. They must successfully complete a training course developed and delivered by the Dangerous Goods Training Branch of APSS. Most inspectors have backgrounds involved with disaster services; i.e., from fire departments, the armed forces or police services. They conduct vehicle inspections to determine if carriers are complying with the legislation. They check for the placement of safety markings, the documentation which must accompany the shipment and the training certificates which must be carried by any driver who is transporting regulated dangerous goods. If they should discover anyone violating the legislation, they will either issue a warning, assess a fine or press charges. During the first year after legislation was proclaimed, non-compliance was dealt with on the basis of educating the violator and issuing a warning. A scheduled series of roadside inspections were carried out across the province between May, 1986 and April, 1987 inclusive. The information obtained showed that 69.2% of the vehicles transporting dangerous goods were in compliance with the regulations. This figure

⁴¹ R. Wolsey, "Transportation of Dangerous Goods: The Act vs. The Reality, The Provincial Perspective", in A.J. Borner (chm), op. cit., 204.

indicates a fair measure of success, though it must be noted that most of the inspections were scheduled, which is likely why fewer violations were found. The national compliance rate was significantly worse at 15%, as noted earlier. If, over a period of time, a series of warnings are laid on an individual carrier, an inspector may issue a different warning indicating that the matter will proceed to the courts and be dealt with at that level. The first charges were laid in February 1987, one year after the Act came into force.⁴²

There are five facilities inspectors in the province (two in Calgary). They are responsible for the inspection of shippers' facilities in an effort to ensure they satisfy standards set down in the legislation. In the case of non-compliance by a shipper, these inspectors will issue a warning and clarify how the regulation was violated. A second offence may lead to a fine or to criminal charges. Follow-up investigations are common, especially after a warning or a fine has been issued.

To assist industry in Alberta, the Operational Support Branch issued a set of Compliance Guidelines in 1986.⁴³ These guidelines are written in such a way that they are much more understandable than the actual legislation, without all the legal jargon that makes the TDGR so complicated. They are presented in a large binder format that can be easily updated as changes or

⁴² *ibid*, 203.

⁴³ Alberta Public Safety Services, Dangerous Goods Control Division, Compliance Guidelines, (Edmonton: APSS, 1986).

additions occur. These binders are made available to anyone interested in the legislation and especially to those involved in dangerous goods transportation. In addition to this manual for compliance, APSS provides a 24 hour compliance information service through a toll free number linked to The Compliance Information Centre located in Edmonton. This service acts in a manner similar to its federal equivalent, CANUTEC. Over the period of April 1986 through March 1987, it handled 7,615 enquiries dealing with dangerous goods.⁴⁴

The Regulatory Standards and Approvals Section (a subsection of the Operational Support Branch), issues permits in instances where there might be an irregularity or a special requirement for a dangerous goods shipment. These permits are granted only under special circumstances. This section also helps to draft and process municipal by-laws in relation to dangerous goods routes to ensure a measure of uniformity throughout the province. In addition, this section serves as a sounding board for industry, government and the public with respect to specific requirements for compliance with the legislation.

The Dangerous Goods Control Division also acts in an educational and advisory capacity for the entire province. It will provide emergency response training for local fire departments or municipal officials and present seminars to educate the public about such things as dangerous goods

⁴⁴ R. Wolsey, op.cit., 205.

transport, natural disaster planning and the ever-evolving legislation that is relevant to public safety.

In the case of a severe emergency, APSS will draw upon other sources to provide emergency service personnel if local authorities are overwhelmed by the situation at hand.

The Local Response (Calgary)

Legislation

The transport of dangerous goods is a unique issue throughout Canada. While the federal government possesses almost all authority, save that delegated to the provinces, the municipalities have almost all the responsibility for preventing and dealing with disasters. The powers granted to the Provinces by the Federal government, as described earlier, enable the Alberta government to exert considerable legal influence on Calgary's policies. The Minister responsible for APSS must approve any changes to the by-law that affects dangerous goods routes through the city. This is done so that such activities can be overseen by a single authority and thereby exhibit some province-wide consistency.

The first Calgary by-law to cover the transportation of dangerous goods was the Truck Routes By-law. Additions were made to it in 1979 to incorporate vehicles travelling with dangerous goods cargoes (See Appendix 1). It served primarily to restrict dangerous goods movements to certain routes because this was the most obvious change that was needed at the time. This by-law has

evolved and is now titled The Transportation of Dangerous Goods By-law (See Appendix 2). The development of this by-law and the dangerous goods routes, which are a part of it, is described in detail in Chapter Three.

Local Actors

The **Hazardous Materials Section** within the Calgary Fire Department is an immediate response control unit. This means that, in most instances, they will arrive on-site at an accident and have it under control within ten minutes.⁴⁵ This team is comprised of emergency personnel who are trained to contend with incidents involving dangerous goods within the City of Calgary. In 1986 a document, Managing Dangerous Spills⁴⁶, was published by the City, as a reference guide for City officials detailing the lines of communication and responsibilities in the event of a dangerous goods accident. The determination of clear lines of communication and authority has been avoided many times in many cities. The actors involved often refuse to admit to a level of responsibility, higher or lower than they perceive it should be.⁴⁷ Calgary is unique in that it has formally addressed these responsibilities by formalizing the lines of communication and

⁴⁵ From answers to questions administered by mail to Al Borgardt, April 1988.

⁴⁶ The City of Calgary, Managing Dangerous Spills, (Calgary: City Publication, 1986).

⁴⁷ From the "Workshop Discussions: Summary" section, in J. Shortreed (ed.), op. cit., 196.

solidifying them in this document.⁴⁸

To ensure compliance with the TDGCA, 48 members of the Calgary Police Force are trained to inspect carriers of and industries involved with dangerous goods cargoes travelling within or through Calgary. The training is provided via APSS. A Police officer from Calgary is trained by attending courses offered in Edmonton or Calgary and this person carries this training and information on to the members of the force. APSS essentially trains the trainers only. The 48 individuals are known as On-highway Inspectors and they investigate shipments to confirm that they are complying with the regulations, in terms of documentation, placarding, vehicle maintenance and route selection. Their job is the same as that of the provincial inspectors who receive their training from APSS personnel. The police play a role in emergency response as well. It is their role to secure an accident site and to make sure that traffic and people can navigate around an accident safely.

The process of dangerous goods travel and the various responsibilities within Calgary will be described and critically assessed further in Chapter Four.

Industry's Response

The goal of government is to protect the health and well-being of Canadians and their environment. The chemical industry

⁴⁸ Personal communication with Al Borgardt, Co-ordinator Hazardous Materials Section, Calgary Fire Department, June 1987.

recognizes this and understands that government regulation, in combination with the self-initiated actions of industry, is necessary to ensure a sufficiently comprehensive, timely and orderly advance towards this goal.

The Canadian Chemical Producers' Association (CCPA) represents 90% of dangerous goods that travel through Canada.⁴⁹ Accordingly, the CCPA plays the most active industry role in assisting governments and selected organizations who deal with issues involving the transport of dangerous goods. The CCPA has a written Statement of Policy on Responsible Care.⁵⁰ All company members endorse the principles it contains. Most actions are taken in an effort to ensure that products do not represent an unacceptable level of risk to industry employees, customers, the public or the environment.

Perhaps this paints a rather rosy picture. It is important to note that this statement of industry commitment is not formalized at the lower level (subsidiaries or associates of members) and not all producers, shippers and transporters are members of the association. Therefore, it provides no absolute assurance that an individual company will exercise full precautions when dangerous goods are being stored, transported or disposed of. However, the industry in general, which includes

⁴⁹ Vito Volterra, "CCPA's Transportation Emergency Assistance Plan (TEAP): Growing From Strength to Strength", in A.J. Borner (chm.), op.cit., 315.

⁵⁰ Canadian Chemical Producers Association, Statement of Policy on Responsible Care, (Ottawa: np, 1985).

organizations outside of CCPA as well, recognizes that caution and responsible action develop good public relations. This, subsequently, should raise the chemical industry's image and reputation in the public eye.⁵¹

Transportation Emergency Assistance Program

In 1971 the CCPA established the Transportation Emergency Assistance Plan (TEAP).⁵² It began as an advisory and alerting system, with six volunteer response units from industrial sites in eastern Canada. When the advisory and alerting function was taken over by CANUTEC in 1979, TEAP was somewhat redundant. It evolved into a mutual aid, on-scene response plan, which began operations in 1983 with ten Regional Response Centres (RRC), each equipped with a vehicle and a prescribed inventory of emergency equipment. It has grown to include eleven well equipped RRCs from across the nation, as of fall, 1987. TEAP has 52 member companies and 172 subsidiary and associate companies active in the system of RRCs. These RRCs are situated within chemical industry plants such as Shell Canada, DuPont Canada and Dow Chemical Canada.

⁵¹ Canadian Occidental Petroleum Ltd. has one of the most reputable training programs in Canada, known as "Safe and Legal Transportation" or SALT. It provides training in all areas of dangerous goods handling.

⁵² M. Braet, "The TEAP Response: Sharing Knowledge and Resources to Protect The Public and Environment", in A.J. Borner (Chm.), Proceedings of The First Hazardous Materials Management Conference of Canada", (Wheaton, Illinois: Tower Conference Management Co., 1987) 216-217.

The CCPA's strategy behind the TEAP system is to work closely with actors involved in chemical transportation safety, whether they are government, police authorities, firefighters, or other emergency response organizations. The system was organized to provide on-scene assistance at a dangerous goods accident site which involved member companies' chemicals. Though not all CCPA members are involved in TEAP, the system is set up to respond to incidents involving any CCPA member's product. Every company involved in TEAP must sign a legal agreement which sets out its duties and responsibilities in general and those of the RRCs. This is to ensure that the company is well aware of the tasks and responsibilities it has taken on.

In the event of a dangerous goods accident involving a CCPA or subsidiary's product, the carrier activates the TEAP system by informing the shipper who then notifies the nearest RRC and a TEAP team is sent out if necessary. Not all accidents occur in areas that are accessible to a TEAP team at an RRC. In those cases TEAP will assist in an advisory capacity through communication links. The TEAP team is not in charge at the scene of an accident. Its role is to provide the on-scene commander with technical advice about specific products if needed, and to assist in the containment and/or control of any spill, release or potential release resulting from the accident.

Community Awareness and Emergency Response

To further their role in public safety and to enhance public relations, CCPA decided to develop a Community Awareness and Emergency Response (CAER) program, modelled after a similar program implemented by the Chemical Manufacturers of America in the United States.⁵³ The program was implemented in June, 1986 and has been well received by 30 of Canada's 200 chemical plants to date. The program goal is community participation and to enhance awareness of the role of the chemical industry in today's way of living and how we can safely live with it. The program provides interested CCPA members with a comprehensive package that assists individual chemical plants to initiate and ultimately implement a community awareness and emergency response program focussed specifically on their community. The responsibility for implementation of the program is placed on the individual chemical plant manager.

The major form of the program is a comprehensive handbook that is divided into two main sections: community awareness and emergency response planning.⁵⁴ The community awareness section covers public information about chemicals, media relations, how to plan for media management prior to an emergency and how to implement the plan in the event of an emergency. This measure of

⁵³ Alberta Public Safety Services, "CCPA's CAER Package", H.O.T.line, Vol.5, No.1 (Spring 1987) 3.

⁵⁴ Canadian Chemical Producer's Association and The Chemical Manufacturer's Association, Community Awareness and Emergency Response Handbook, (np: np, 1986).

public education is vital. It addresses the broader public concerns with respect to chemicals and the presence of a chemical plant near a community, such as how the plant operates, what it produces, what are the risks and why that particular community was selected for the plant. The emergency response planning section details the planning process, starting with preliminary planning to the evaluation process and how to revise plans when needed. The handbook also provides references and resource information to assist the plant manager throughout the process.

The CAER program is intended to result in a better understanding of rights, responsibilities, needs, resources and the mutual benefits to plant operations and to community members. The sharing of plans and actions which will inform and protect both the community and the company involved is definitely a positive move on the part of industry.

In summary, considerable efforts have been made in a short period of time by both government and industry to increase safety in the transportation of dangerous goods. It is a young field of research and many changes are suspected in the future to further reduce the negative impacts associated with dangerous goods. Table 2 provides a summary of this chapter.

**TABLE 2: SUMMARY OF THE LEGISLATION, ACTORS INVOLVED, AND FUNCTIONS
AT THE VARIOUS LEVELS OF JURISDICTION AND IN INDUSTRY**

	Federal	Provincial (Alberta)	Local (Calgary)	Industry
Legislation	*Transportation of Dangerous Goods Act, Nov. 1, 1980	*Transportation of Dangerous Goods Control Act, Feb. 1, 1986	*Transportation of Dangerous Goods By-law, Feb. 8, 1988	*Policy on Responsible Care
	*Transportation of Dangerous Goods Regulations, July 1, 1985			
Actors	*Transport Dangerous Goods Directorate (part of Transport Canada)	*Alberta Public Safety Services, Dangerous Goods Control Division	*Fire Dept., Hazardous Mats. Section *Police Dept. *Emergency Medical Services	*Canadian Chemical Producers Association and others
	*Emergency Preparedness Canada			
Programs/ Functions	*CANUTEC, advisory *Development of Federal Legislation and Regulation	*Legislation review province-wide *Provincial inspection and enforcement *Compliance Information	*All City planning and emergency response re: dangerous goods transportation *Enforcement of by-law *Paramedic service	*TEAP *CAER and others
	*Emergency Response training *Emergency Assistance *Co-ordinate and review emergency response plans within federal departments			

CHAPTER THREE

RISK AND THE SELECTION OF DANGEROUS GOODS ROUTES

It is now necessary to acquaint the reader with the concept of risk and the difficulties that may develop when risk analysis is applied to dangerous goods transportation. This information is important because the purpose of the options developed in the final chapter of this document is the reduction of risk and the improvement of safety, either directly, or as in most cases, indirectly.

This chapter will also describe the process of applying the "Hazardous Materials Routing Method" as devised by the U.S. Department of Transportation.⁵⁵ This particular method for determining where dangerous goods routes should be located in a community or a city, is a three part process and a risk analysis is one of the components of the second part.

What is Risk?

The Webster's New World Dictionary defines risk as "...the chance of injury, damage or loss". This definition indicates the two components commonly used to analyze risk; the chance of damage and the extent of damage. The result of these two components in a specific case scenario, defines the degree of

⁵⁵ U.S. Department of Transportation, Federal Highway Administration, Guidelines for Applying Criteria to Designate Routes for Transporting Hazardous Materials, (Washington D.C.: U.S. Government Printing Office, 1983).

risk associated with that particular scenario. Symbolically, risk can be written as;

Risk = the probability of an event \cdot X (multiplied by)
the potential damages associated with such an event.

This is a variant of expected value analysis and it is often used when attempting to place a monetary value on the potential risk of an event. It is simple to calculate the expected value by multiplying the probability of an event's occurrence by the dollar value of the loss or gain, if it were to occur. In reality, expected values can be quite deceptive because dollar values for many potential impacts are difficult to determine and they also cannot account for individuals' attitudes toward risks. Major problems can arise when the potential damages are very large but the probability of the event is very slim. In such an instance, the low probability contributes to a low expected value. Using expected values would obscure the fact that if the event did occur, it would be catastrophic.

Though different scenarios may result in equal values of risk by using the equation above, a low-probability, high-damage scenario does not equate with a high-probability, low-damage scenario. The equation is also unable to indicate that it matters whether someone is exposed to a risk involuntarily or takes a risk voluntarily, for instance, by smoking or driving a car.

The source of risk is the hazard involved in an action. The degree of risk depends upon the probability of an event and the potential loss associated with that event. Various safeguards may be applied to reduce the probability of the event, or to reduce the severity of losses, should the event occur. These may be management-oriented, technology-based or a combination of the two. However, no amount of effort can reduce the degree of risk (resulting from a given hazard) to zero, in any situation unless the activity ceases altogether.

Risk analysis⁵⁶ is a systematic means of describing the risk that surrounds a particular potential impact, resulting from a given event. This is an analytical process which involves two components; risk estimation and risk evaluation. Risk estimation attempts to identify the hazards, the potential outcomes, who or what will be exposed to the hazard and the probability that exposure to the outcome will actually occur. Risk evaluation places a social value on the estimated risk. The calculation of this social value takes into account both the analytical estimate of the risk and the public's perception of that risk.

Risk management⁵⁷ is the course of action taken by a community to reduce the probability of dangerous goods accidents

⁵⁶ Adapted from Concord Scientific Corporation, "Consultant Summary Report: Assessment of Risk", Toronto Area Rail Transportation of Dangerous Goods Task Force: Information Package, (Toronto: December 1987) 4.

⁵⁷ Adapted from Concord Scientific Corporation, "Consultant Summary Report: Management of Risk", Toronto Area Rail Transportation of Dangerous Goods Task Force: Information Package, (Toronto: December 1987) 15.

occurring and/or to minimize the impacts associated with dangerous goods accidents. There are many options or techniques to address these two areas. The problem is determining what combination of management techniques would be most effective. In addition to focussing on risks to public safety, the community must weigh economic and socio-political factors when it seeks to achieve greater safety. The first two factors clearly address the level of public safety and the dollar costs associated with potential improvements. However, the socio-political factor addresses such things as community impacts, natural environment impacts, emergency response preparedness and public perception, and these are much more difficult to incorporate.

The actions that a community takes to minimize the impacts can be called preparedness or measures to reduce community vulnerability. Vulnerability can be defined as the capability of being wounded or exposed to danger. It is assessed in such terms as state of emergency preparedness, (equipment, trained personnel), public awareness, preparation for evacuation, (a plan), readiness for evacuation, numbers of persons liable to be evacuated, and similar terms. The justification for using the term "preparedness" in lieu of "vulnerability" is that the word vulnerability has negative connotations and therefore might not find support among practitioners concerned about perception. Conversely, "preparedness" is a positive term and can be perceived as having clearer meaning.

The assessment of the preparedness of a community is

exclusive of risk analysis. There is no reliable way to relate directly the measurement of preparedness and the effect it may have on the degree of risk in any given situation, because of the human error factor that can affect preparedness during an emergency. However, a greater measure of preparedness can result in a reduction of the potential damages associated with a dangerous goods accident and, in turn, justifiably result in a better sense of community security.

A model has been proposed by R.D. Scanlon and E.J. Cantilli that attempts to relate community preparedness and risk to arrive at a measure of community safety.⁵⁸ It is called the Community Safety Assessment Model (CSA). The value of the CSA calculation reflects the overall community safety situation relative to dangerous goods transportation. Performing an assessment is beneficial primarily because it encourages a community to recognize the hazards it is exposed to each day and it assists in the determination of what areas of emergency response need to be improved within the community. It involves mathematical calculations using local data regarding traffic, population, property values, and other parameters. Appendix 3 describes this model as taken directly from Scanlon and Cantilli.

⁵⁸ R.D. Scanlon and E.J. Cantilli, "Assessing the Risk and Safety in the Transportation of Hazardous Materials" in Transportation Research Board, National Research Council, Improving Transportation of Hazardous Materials Through Risk Assessment and Routing, Transportation Research Record 1020, (Washington D.C.:The Transportation Research Board, 1985) 8-11.

Risk Perception

It is clear that people accept or reject a number of risks each day, often without knowing much about them. Since research, analysis and management of all risks would consume all of our resources, society's decision-makers must select the risks to be addressed and managed. A working definition of acceptable risk, often used by decision-makers, is "a risk whose probability of occurrence is so small, whose consequences are so slight, or whose benefits are so great that a person, group, or society is willing to take that risk."⁵⁹ However, the line that separates acceptable from not acceptable can be a fine one, at best, especially when one moves from the individual toward social consensus.

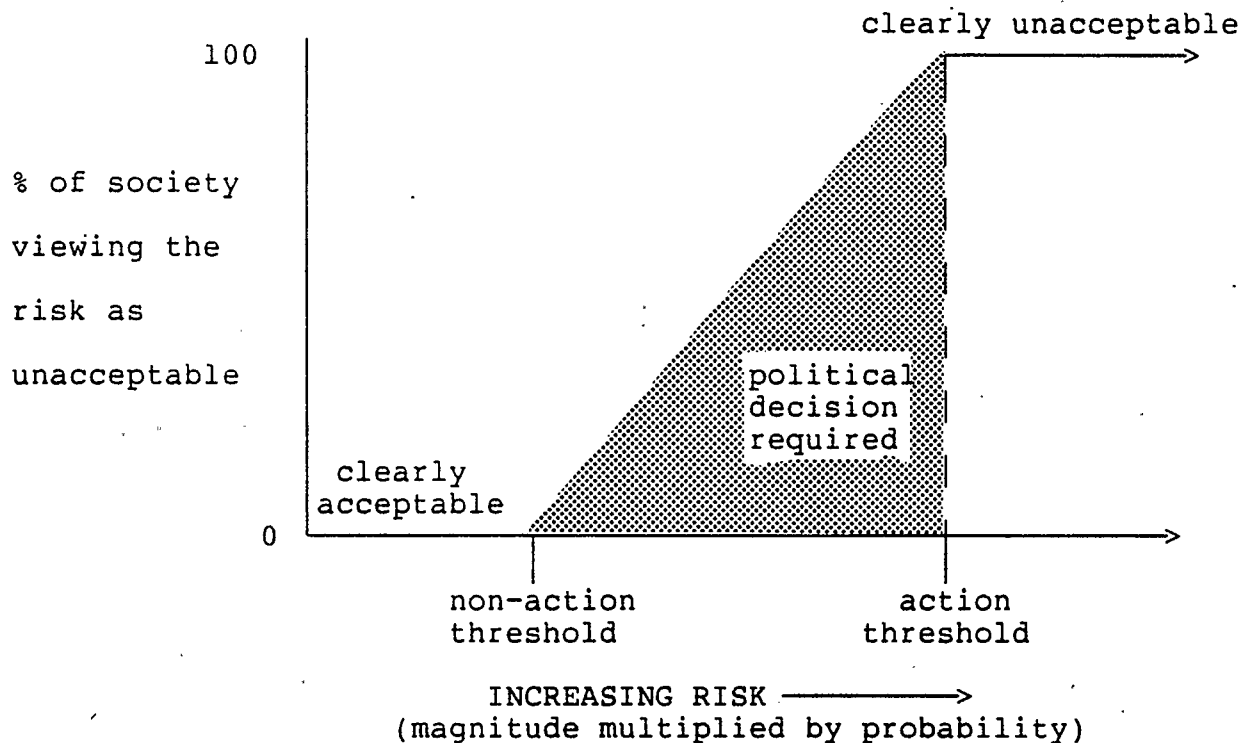
Figure 1 illustrates that a grey area exists between risks that are acceptable, and those that are unacceptable, to the public.⁶⁰ Up to a certain point, increasing risks are deemed acceptable to a population because they are considered to be so small that the expense of time and effort to reduce them would be of little benefit. Beyond this point, there exists a range of risk where the population will be divided in its opinions about how the risk should be handled. Some will feel that the risk is

⁵⁹ A.P. Grima et al., Risk Management and EIA: Research Needs and Opportunities, Background paper for the Canadian Environmental Assessment Research Council, 9.

⁶⁰ V. Nishi, The Management of Risk and Uncertainty for Large Scale Interbasin Water Transfers, (Unpublished Masters Degree Project, Faculty of Environmental Design, The University of Calgary, 1988) 89.

FIGURE 1 : RISK ACCEPTABILITY AND SOCIETY

As risk increases beyond some non-action threshold, the percentage of society opposing the risk increases until a consensus (100%) is reached and the risk is clearly unacceptable. Society's level of acceptable risk lies somewhere between these two extremes. Determination of that level is political, not analytical.



Source: Nishi, V., The Management of Risk and Uncertainty For Large Scale Interbasin Water Transfers, (Unpublished Masters Degree Project, Faculty of Environmental Design, The University of Calgary, 1988).

acceptable while others will feel that it is not. As risk continues to increase, it will reach a point where all persons are affected and there is unanimous agreement that actions to reduce or remove the risk must be taken. Many factors influence decisions within the range of the grey area that falls between these two action thresholds.

There may be instances where society views a risk as unacceptable despite studies that insist the risk is low related to a particular activity. An example might be nuclear power generation. The public still insists on the further reduction of safety risks even though the measure of safety is very high and the probability of an incident extremely low. There are also instances where society, despite warnings about high levels of risk, continues to engage in those activities. A very common example would be driving a car. These two cases would not necessarily fit the graph form, but both of them do fit into the grey area where a political decision is required when deciding to improve levels of safety.

In most countries it has been found that the approach to a certain risk is largely dependent on the political, social and cultural situation at the particular time.⁶¹ Due to cultural heritage, different societies often focus on different risks and seek to remedy them first. Given this, researchers concede that

⁶¹ E. Vedung, "Politically Acceptable Risk from Energy Technologies: Some Concepts and Hypotheses" in G.T. Goodman, and W.D. Rowe (eds.) Energy Risk Management, (London: Academic Press, 1979) 313-321.

the resolution of risk situations is also a social and political process, rather than just a technical process, because the individual or the group finds a risk either acceptable, or not acceptable, due to ingrained perceptions. However, in general, accidents of a higher probability, statistically, tend to be addressed first to reduce the likelihood or frequency of their occurrence. Conversely, accidents with a lower probability are thought of so rarely that, essentially, they are considered no threat and little or no action is taken to reduce the likelihood of their occurrence. There are exceptions. For example, greater safety precautions are taken to avoid airplane crashes than to reduce the risk of death related to smoking, despite statistics that plainly show significantly more people die due to smoking-related diseases than in airplane accidents.⁶²

Therefore, it is clear that peoples' perception of risk often does not coincide with observed levels of risk. Many factors affect this perception, and risks are perceived to be more serious if:

1. they have immediate rather than delayed effects
2. their impacts have a direct effect upon people rather than through some complicated pathway
3. the hazard creates a feeling of greater fear or anxiety in the potentially affected public
4. impacts occur simultaneously rather than more evenly distributed over space or time

⁶² Statistics provided at risk course in discussion and also in Concord Scientific Corporation, "Management of Risk", Consultant Summary Report, (Toronto Area Rail Transportation of Dangerous Goods Task Force: Toronto, 1987) 16.

5. the mechanisms through which the impacts occur are poorly understood or incomprehensible to the public
6. the affected individual or group appears to have little power or control over the cause of the risk
7. the potential victims are an identifiable sub-group of the population rather than a statistical victim
8. the exposure to the risk is involuntary rather than voluntary
9. the majority of the benefits of the activity go to one identifiable group while the majority of the risks are borne by another
10. any similar adverse events have recently received public attention.⁶³

It is understandable how concerns are aroused and ensuing beliefs tend to be brought about by large death tolls in a plane crash or a natural disaster, or by association to the situation through family or friends. The random nature and rare occurrence of large scale accidents involving hazardous goods makes it extremely difficult to contend with the management of the risks associated with them.⁶⁴

The public's perception of risk is also affected by the way risk is presented, especially through the media, where the average person gets such information. Journalists tend to be

⁶³ V. Nishi, op. cit., 92.

⁶⁴ P. Slovic, and B. Fischhoff, "How Safe is Safe Enough? Determinants of Perceived and Acceptable Risk", in B. Fischhoff, S. Liechtenstein, P. Slovic, S. Derby, and R. Keeney, in Acceptable Risk, (Cambridge: Cambridge University Press, 1981) 39. There is a great body of literature on this topic. For further discussion regarding perceived and acceptable risk see C. Walker, L. Gould, and E. Woodhouse (eds), Too Hot to Handle? Social and Policy Issues in the Management of Radioactive Wastes, (New Haven: Yale University Press, 1983).

selective about the information they report and they often make use of sensationalism to sell news.⁶⁵ Despite these known facts, the public's perception usually reflects what is provided through the media.⁶⁶ In contrast, the technical analyses released by experts are often read with skepticism because they overstate the accuracy of their work and there are invariably other experts who will disagree with the original analysis.

Perceived risk should not be thought of as being more important, or more real than, the objective estimate of risk which uses empirical information and data. But, in the process of evaluating risk, it must be considered to be equally significant and, in terms of public behaviour, perceived risk may be more important than actual risk.

Risk Management Efforts in the Transportation of Dangerous Goods

The development of a risk management strategy for dealing with the transportation of dangerous goods, at the planning and operational levels, can be separated into three steps:⁶⁷

1. Identification and estimation of risks,
2. Actions for the prevention and reduction of risks, and
3. Mitigation measures to reduce vulnerability to risks.

Generally, community planners should be concerned with the

⁶⁵ D. Friend, op. cit., 190.

⁶⁶ D. Friend, op. cit., 189.

⁶⁷ W.D. Rowe, Risk Assessment Processes for Hazardous Materials Transportation, Report 103, Transportation Research Board, National Cooperative Highway Research Program, Synthesis of Highway Practice, (Washington D.C.: Transportation Research Board, 1983) 8-10.

question of "vulnerability" as it refers to a community's overall sensitivity, given the existing level of threat and its ability to cope in an emergency situation. However, planners should also be concerned with the further reduction and/or prevention of risks, i.e., reducing the probability part of the risk equation, in addition to community-related coping measures.

These three major steps toward the development of a risk management strategy will be explained and discussed in the following three sections.

Identification and Estimation of Risks

Considerable effort has been expended to provide a means of identifying and classifying dangerous cargoes. Nine classes have been formally identified in Canada and are listed in Table 3. The criteria that are used for classifying a dangerous good must take into consideration the level of hazard presented by the commodity itself, not the actual risk of it being shipped. This means that for the purpose of risk management, some way is needed to estimate the relative level of hazard of a specific substance and its potential for accidents during shipment.

The relative level of hazard is a simplified way of ranking different substances by their inherent hazardous proportions and characteristics without taking into account other situational risk parameters such as type of vehicle, traffic volumes, the type of traffic (highway, residential or central business district), route, and demographic or geographic patterns. Any

TABLE 3 : THE CLASSES OF DANGEROUS GOODS

Classes and Divisions of Dangerous Goods

Class	Division	Characteristics of Dangerous Good
1 Explosives	1.1 1.2 1.3 1.4 1.5	A substance or article with a mass explosion hazard A substance or article with a severe fragment projection hazard, but not a mass explosion hazard A substance or article which has a mass fire hazard along with a minor blast hazard and/or a minor projection hazard, but does not have a mass explosion hazard A substance or article which presents no significant hazard — explosion effects are localized to immediate surroundings A very insensitive substance which nevertheless has a mass explosion hazard like those substances in Class 1.1
2 Gases	2.1 2.2 2.3 2.4	A <i>flammable gas</i> which is easily ignited and burns A <i>non-flammable, non-toxic gas</i> A <i>poisonous gas</i> which is harmful to living beings through inhalation, swallowing or contact with skin A <i>corrosive gas</i> harmful to living beings through corrosion of the tissue of the respiratory tract upon inhalation or swallowing
3 Flammable Liquids	3.1 3.2 3.3	A flammable liquid with a closed-cup flash point of less than -18°C A flammable liquid with a closed-cup flash point between -18°C and 23°C A flammable liquid with a closed-cup flash point between 23°C and 37.8°C (23°C and 61°C for international shipments)
4 Flammable Solids, Spontaneously Combustible Substances, Flammable-When- Wet Substances	4.1 4.2 4.3	A <i>flammable solid</i> which is readily combustible and burns vigorously and persistently, or which may cause or contribute to fire through friction or from heat retained from manufacturing or processing A <i>spontaneously combustible substance</i> liable to spontaneous heating under normal conditions of transport — i.e., by heating up, upon contact with air, to the point where it begins to burn A <i>dangerous-when-wet substance</i> which emits flammable gas or becomes spontaneously combustible when it comes into contact with water or water vapor
5 Oxidizers, Organic Peroxides	5.1 5.2	An <i>oxidizer</i> which is not necessarily combustible but which, generally by yielding oxygen, may cause or contribute to the combustion of other material An <i>organic peroxide</i> , a strong oxidizing agent which releases oxygen very readily and may be liable to explosive decomposition, or sensitive to heat, shock and/or friction (substances which contain the bivalent “-O-O-” molecular structure)
6 Poisonous and Infectious Substances	6.1 6.2	A poisonous substance An infectious substance
7 Radioactive Materials	*	Radioactive materials within the meaning of the Atomic Energy Control Act.
8 Corrosive Substances	*	Both acid and alkaline materials are included in class 8.
9 Miscellaneous Dangerous Goods	9.1 9.2 9.3	A substance or product presenting dangers sufficient to warrant regulation in transport but which cannot be ascribed to any other class An environmentally hazardous substance that cannot be ascribed to any other class A dangerous waste that cannot be ascribed to any other class

* No divisions are assigned to these classes.

Source: Alberta Disaster Services, "How Much Do You Know About the Dangerous Goods You Ship?", In H.O.T.line, vol.2 no. 3 (Fall 1984) 6.

community can do this by identifying what dangerous goods are most prevalent in their vicinity and reviewing their characteristics, as listed in Table 3. In addition, any Canadian community can obtain detailed information about specific dangerous goods by contacting the CANUTEC centre in Ottawa. In Alberta, APSS is equally competent as an information source.

The identification of community risks is one of the most difficult tasks that must be accomplished in the pursuit of greater public safety. It must encompass the identification of any dangerous goods that may be produced, received, stored in, or transported through the community. Since there are thousands of dangerous goods, many routes and several different transport modes, let alone the storage of products in private homes, garages and small businesses, a complete identification is impossible. Once particular goods have been identified, the possible exposure of populations within the affected neighbourhoods or near to transportation routes, must be addressed. The type and extent of a threat, the geographic and demographic patterns, and the mode of transport, are examples of the variables that must be considered.

Actions for the Prevention and Reduction of Risks

To prevent or reduce a risk, there must be a decrease in either the probability of the event, the severity of the event, or both. The actions which may be taken to achieve this may be technology-based or they may be management-oriented. Prevention

or reduction of risks may involve improvements to vehicle design and storage facilities, the removal of the cause by prohibiting the transport and storage of certain substances (in extreme cases), or the regulation of traffic flow to minimize exposure to dangerous substances. The first example is technology-based, the second is management-oriented and the third is a combination of the two.

The regulation of the flow of dangerous goods as a means to reduce risk, is not a new concept. For many years, explosive and flammable materials have been restricted from tunnels and other similar corridors. The objective is to minimize exposure to vulnerable facilities and large or captive populations. The solution is not a simple one, since rerouting vehicles may increase travel distances over lower grade routes, and thus increase costs. In these instances, local or provincial authorities may have to conflict with the "unburdened commerce" requirement that is stipulated at the federal level. The rerouting of dangerous goods routes must include risk estimation and evaluation for alternative routes.

Other attempts to reduce risk include technical packaging design standards (which are set at the federal level), vehicle load restrictions, time of day travel restrictions, reduced speed limits and the availability of a detailed information system about dangerous goods, provided by the federal government and/or the provincial government in Alberta.

Mitigation Measures to Reduce Community Vulnerability to Risks

In the event that an accident occurs, communities must have the means to deal with it, such as being able to extinguish fires or contain toxic chemicals. During these periods, evacuation procedures or measures to prevent health problems, can mitigate the effects of the accident on the population. The ability of a community to implement mitigation strategies depends on the community's ability to respond to accidents, to take knowledgeable action and to control the movement of its population. This ability, in turn, depends on the resources and trained personnel available.

Considerable effort has been spent on these concerns by federal and provincial authorities, industry, academia, municipal authorities and communities themselves. These efforts provide the basis for the development of useful methods to assist communities to determine how well they could cope in an emergency situation involving the release of dangerous goods.

Means to mitigate the consequences of traffic accidents are applied throughout the transportation industry. Thermal and tank-head protection for railroad tank cars and low-centre-of-gravity designs for tanker trucks are examples of design aids. In situations where an accident occurs, these containers are less likely to sustain damage that would result in the release of a dangerous product. Regulations for these designs are under the purview of Transport Canada for all forms of transportation. Storage facility design is a different matter because these

designs depend on local and provincial building, fire and safety codes and may, of necessity, be of local concern where codes do not exist or are improperly enforced.

Emergency preparedness is a major approach in minimizing community vulnerability. All federal agencies that deal with the transportation of dangerous goods, for example, Environment or Energy and Natural Resources, may provide varying levels of assistance to mitigate accidents after they occur. However, in all cases, the responsibility for and co-ordination of emergency response activities rests on the local authorities, elected and appointed officials, police, fire, public works and others. The local authorities are responsible for the implementation of the emergency response plans that are developed.

The main problem facing a community is determining its needs for emergency response and then training personnel to deal with dangerous goods accidents. The scope of the problem, the need for emergency response, and the means for obtaining resources for planning must be determined by the local authorities. In many cases, resources and training are co-ordinated and shared at the regional and provincial levels. In Alberta, Alberta Public Safety Services makes training available in emergency response planning and related activities through seminars and courses.

In addition to emergency response, a community must have a legal authority responsible for inspection and enforcement of any regulations they establish for their community.

Problems Associated with Risk Determination for the Transportation of Dangerous Goods

As stated in the introduction to this chapter, a risk analysis is a two part process; the estimation of a risk and the evaluation of that estimated risk. Acknowledging that there are limitations to a risk analysis is important because of the wide range of uncertainty that is involved in the judgements and measurements that are made, particularly in the evaluation stage. The transportation of dangerous goods presents a variety of problems in the attempt to determine levels of risk.

An examination of the potential consequences of a dangerous goods accident provides some insight into the difficulties of estimating and evaluating risks associated with the transportation of dangerous goods. The first obvious consequence is that of human injury or death. This is probably the most significant problem in the calculation of risk. To assign a certain dollar value to human life or suffering is virtually impossible, yet such a value is essential in calculating the complete costs of an accident. Since people rarely will pay the additional cost for added safety features, when purchasing an automobile for example, it might be justifiable to say that the public's perception of the monetary value of their own life or suffering, is not infinite. However, measures of this value are made all the time in the form of life insurance policies, in the case of death and through the calculation of loss of potential earnings, in the case of disability.

The most common valuation of human life is based on human capital theory.⁶⁸ People enhance their capabilities as producers and contributors to society as well as their capabilities as consumers, when they invest in themselves through activities that influence their future monetary and psychic incomes. They do this through education, health and financial investment. It follows then, that a person would be "worth more" if he/she has extensive education, excellent health and sound financial investments. Given adequate data regarding lifetime earnings, participation rates in the labour force, mortality rates, among other things, it is possible to estimate the value of the expected future earnings of individuals in any age group. In the case of injury resulting in partial or complete disability, the individual's stream of future earnings represents his human capital value. Those earnings are then discounted to convert their value into present value terms. This means that the value at the present time of future earnings is less than similar earnings now. Various adjustments are made for mortality rates, expected growth in real earnings through time and various periods of likely unemployment.⁶⁹ Despite these calculations, there is

⁶⁸ G.H. Mooney, The Valuation of Human Life, (London: MacMillan Press Ltd., 1977) 50-56.

⁶⁹ There are a number of criticisms of this method of valuing human life and others, which are discussed in Chapter 2, "The Value of Life and Safety Improvement: a Survey" in The Value of Life: An Economic Analysis by M.W. Jones-Lee. There are many complicated considerations to be included in life-saving decision-making. G.H. Mooney's book, The Valuation of Human Life, provides a good review of them and also supplies information and references on the theories upon which many decisions are made.

no widely accepted manner of estimating the human/social costs such as pain and suffering or loss of livelihood, associated with accidents.⁷⁰

A second consequence is the loss or damage to property, be it equipment, cargoes, private or public lands, personal goods or other things. Most of these items can be described and measured financially and, therefore, a value can be assigned to the loss.

Another consequence is damage to the environment. Accidents may result in the loss of wildlife habitat, water contamination, decreased animal populations or the eradication of plant species. All of these losses are significant, many are quantifiable but hard to express in monetary terms.

Some accidents may result in socio-political costs even though they may not incur other costs. For instance, an industry or company may develop a bad name due to adverse publicity provided by the media (which may or may not be justified). The industry may have to bear political pressures to adjust their operating procedures or to relocate. Consumers might refuse to deal with the firm and individuals might take legal action for potential damages. All of these costs will inevitably affect the industry's profitability and result in financial costs that may far outweigh the costs directly associated with an accident.⁷¹

Any accident may affect the public's perception of the risk involved in dangerous goods transportation and this could have

⁷⁰ M. Matthews, op.cit., 5.

⁷¹ ibid.

socio-political implications as well. The public is more willing to accept risks with which it is familiar or which it chooses to take, than those which are uncertain or forced upon it.⁷² This is evident for such risks as smoking or driving a car, for example. These activities pose risks which have been made clear to the public through various means, yet many people continue to do both. On the other hand, the risks of nuclear power are unfamiliar and many people request complete safety even though the probability of death or injury is much lower than that from smoking or driving a car.

There are a number of problems associated with the consequences just described. One, which is exclusive to accidents involving dangerous goods, is that different types of dangerous goods present widely different hazards.⁷³ The dangers resulting from an accident involving a combustible liquid are different from those resulting from a release of poisonous gas. The hazards presented by radioactive materials would be different again. These different hazards require the calculation of risk based on commodity or class type in which hazard severity can be rated. So, it is often necessary to conduct a series of risk analyses for each similar condition where only the commodity type changes.

Another problem involves the calculation of risk as influenced by the type of container. Containers of different

⁷² *ibid.*

⁷³ *ibid.*

sizes and construction can be expected to have different probabilities of failure. Smaller containers can be expected to release less product than larger ones. The consequences of a spill could, therefore, be less severe with smaller containers (all other things being equal). The probability and consequences of a spill might be modified when the container types change. It is very possible that a certain container type or size may be chosen to reduce the probability of an occurrence but not the severity of the consequences. For example, a larger container may be used resulting in fewer containers on the road, which reduces the probability of an accident. Yet, should that carrier have an accident, the potential amount of product released is much greater and the severity of damages, increased many times.⁷⁴

Container type also affects transportation costs because the selection of one container over another may preclude economies of scale.⁷⁵ The cost implications of container choice are an important factor in the cost of practicing safety. More vehicles carrying smaller loads are more costly due to the cost of the vehicle and its maintenance, as well as the hiring of drivers for them.

The current state of a data base can result in further difficulties when trying to determine risks. The reporting of dangerous goods transportation accidents became mandatory in 1985 with the proclamation of the TDGA. Data collected prior to this

⁷⁴ *ibid*, 6.

⁷⁵ *ibid*.

were gathered from whatever sources were available, including newspaper articles, reports from television and radio newscasts and reports filed from the accident scene by the people involved or by those who responded to the accident.⁷⁶ Since these historic data are incomplete, the relative frequency approach to assigning probabilities is weakened. It could lead to a bias in estimations of risk due to unrealistic probabilities assigned to the occurrence of an event. This bias could swing in either direction, depending on the motives or assumptions of the estimator.

Many of these problems can be overcome through analyses that consider the worst possible accident scenario, based on an understanding of the engineering aspects of the transportation system or of the loading/unloading areas of the manufacturing plant and terminals involved. Such an approach, while able to determine the requirements for safety procedures, is not able to evaluate risk accurately and could result in "everywhere" being off limits to dangerous goods travel.⁷⁷

To estimate accurately the risk due to an accident during the transportation of dangerous goods, it is helpful to understand where in the transportation network and at what stage during the transportation process, accidents generally occur. For example, accidents at the loading or unloading stage are different from those that may occur during transit. At the

⁷⁶ *ibid.*

⁷⁷ *ibid.*

loading dock it is relatively easy to provide for emergencies because the environment is static. These provisions include containment areas for spilled materials, medical supplies, fire-fighting equipment and other materials. In contrast, accidents that occur during transit might be expected to have very different cost implications. It is far too difficult to provide such things as containment areas or fire-fighting equipment due to the unlimited number of potential accident sites. The accident may occur near populated or environmentally sensitive areas, or it may not.

Further research is needed to understand where accidents are most common and where they are not. This work could take the form of engineering studies or more in-depth statistical analysis of historical data. However, undertaking a statistical study would have to wait until sufficiently detailed and representative data were made available. Such data do not yet exist in Canada because legislation has not been in effect for very long.

Another limitation that makes the determination of risk difficult is the shortage of transportation of dangerous goods data regarding mode of travel, (road, rail, air, pipeline, marine), distances travelled, routes travelled and the specific goods being transported.⁷⁸ These types of data would provide information on the exposure of different parts of the country to potential accidents. They would also help to determine where the accidents are likely to occur and would assist in putting the

⁷⁸ *ibid*, 7.

number of actual accidents into perspective. This information would be particularly useful if mandatory route changes were imposed. It would then be possible to estimate more completely what the socio-economic impacts of the change would be and to determine if, in fact, the risk were lowered significantly.

The measurement of a risk, or at least the probability of an event, can be extremely difficult, especially for rare events or those that have never happened because data do not exist. This means that models of risk, such as regression or network distribution, will have to be used to establish a surrogate criterion.⁷⁹ This surrogate is a parameter that can be measured in terms of both performance and compliance, i.e., it can estimate what the risk is and thus be used to test the risk reduction measures in place. (In effect, it estimates the probability part of the risk equation.) The model becomes the vehicle for converting surrogate performance into risk performance. Depending on the quality of the data available, these models can be good estimators of actual risk, but it must be understood that the actual relationship the model yields cannot be established empirically. Risk analysis models will be discussed next.

Risk Analysis Models

Risk can be forecasted by applying mathematical models that historically relate the risk of accidents to some observable parameter in operational output such as number of accidents per

⁷⁹ W.D. Rowe, op. cit., 11-12.

tonne-kilometres of cargo transported, or number of shipments made, or other variables.⁸⁰ Yet, there is no single measure of risk because each of the variables used to forecast the number of accidents is likely to produce a different end figure. Each type of measure will tend to favour a certain kind of operator, depending on where in the transportation system accidents most frequently occur and the nature of a company's operations.⁸¹

Probabilistic Models

The definition for risk referred to earlier, essentially forms a probabilistic model.⁸² These sorts of models use the conditional probability of an accident and the magnitude of its consequences as the two parameters. These models differ in how they combine the two parameters to arrive at risk estimates, the level of detail for data, and the methods for obtaining the data and the model parameters.

To calculate the risk, some models start with the shipment of a certain material by a specific mode over a set route or distance. In each case the expected risk value is found by developing estimates of the likelihood of an accident and the magnitude of consequences. Each individual expected risk is then aggregated over all paths, modes, vehicle types, cargos etc. in

⁸⁰ M. Matthews, op. cit., 7.

⁸¹ Marjorie Mathews, "A Discussion of Risk Assessment As Applied to Dangerous Goods Transportation", (Ottawa: Transport Canada, 1984) 7.

⁸² W.D. Rowe, op. cit., 11-12.

order to obtain an estimate of absolute expected risk.⁸³ This is an example of a bottom-up approach whereby one goes from the smallest risk component, and then aggregates it upward, to an overall risk. Some models start with higher levels of detail in aggregated data in order to obtain their expected risk values.

Some models use fault-tree analysis to develop probabilities. Others use average accident rates by mode and vehicle. Dispersion models for population exposure and simulations to determine spill behaviours are approaches that have been tried to estimate the magnitude of consequences.

The reason for using a bottom-up approach is to develop an absolute risk estimate for a particular route or series of routes. However, this kind of an approach often leads to a multiplicative buildup of errors and also is unable to contend with the uncertainties of rare events.

Regression Models

Regression models attempt to use measurable parameters to develop a value for the probability of an accident per million kilometers (or some other similar probabilistic form) for a specific type of vehicle. Such parameters might include average daily traffic, number of heavy volume areas, number of signals, type of route, or road or rail maintenance condition. The probability is then combined with an evaluation of the

⁸³ *ibid*, 8. Absolute expected risk is a determination of the probability of occurrence of specified consequences based on measured data or models.

consequence by determining the population density at risk.

These kinds of methods are route specific because the data come from specific routes that are usually independent of the type of cargo. Though regression equations use actual data, constants for equations are either set arbitrarily or are correlated with actual conditions and the accident history for the specific route. Although this second approach seems to be the most appropriate to determine the average number of accidents expected over a given route, it does not properly account for the impact of the consequences of an accident.

Regression models seem more applicable to determine the risk of specific shipments over alternative routes rather than for use by communities to estimate overall risk or specific risk problems. This approach may provide guidance on alternative route selection.

Network/Distribution Models

These types of models are based on the development of a network of routes and transportation links with particular characteristics. Using historic data from across the country, accident rates for different links and travel modes are determined. Since this data is taken from national data bases, these models essentially assess either national or regional risks for a given mode and, in some cases, by class of commodity.

The shortest path matrix is an example of a distribution model which is based on a risk/cost weight, where the weighting

is based on the product of conditional probability and consequence.⁸⁴ These models are similar to probabilistic models and are a form of sensitivity analysis. They are best suited for assessing dangerous goods routes rather than identifying risk.

Enumerative Indices

In order to develop a risk rating score, these models count the number of conditions that exist in a certain situation. Weights are then assigned to the different conditions and the weighted count forms a risk index. The problem with these types of models is that they lack precision and the aggregation process can further distort results which might result in a hidden high-risk situation. On the other hand, these models are easy to use in terms of collecting the data and compiling the results. For a small community they can provide a good overview of the community's vulnerability.

Further studies are needed to determine how best to apply the four types of models which have been briefly described here, prior to their use because of the inadequacies that have been noted with them.⁸⁵

⁸⁴ B.G. Hutchinson, Principles of Urban Transport Systems Planning, (Washington: Scripta Book Co., 1974).

⁸⁵ W.D. Rowe, op. cit., 12-13. Rowe further discusses the difficulties in carrying out absolute risk assessments using bottom-up and top-down risk estimates.

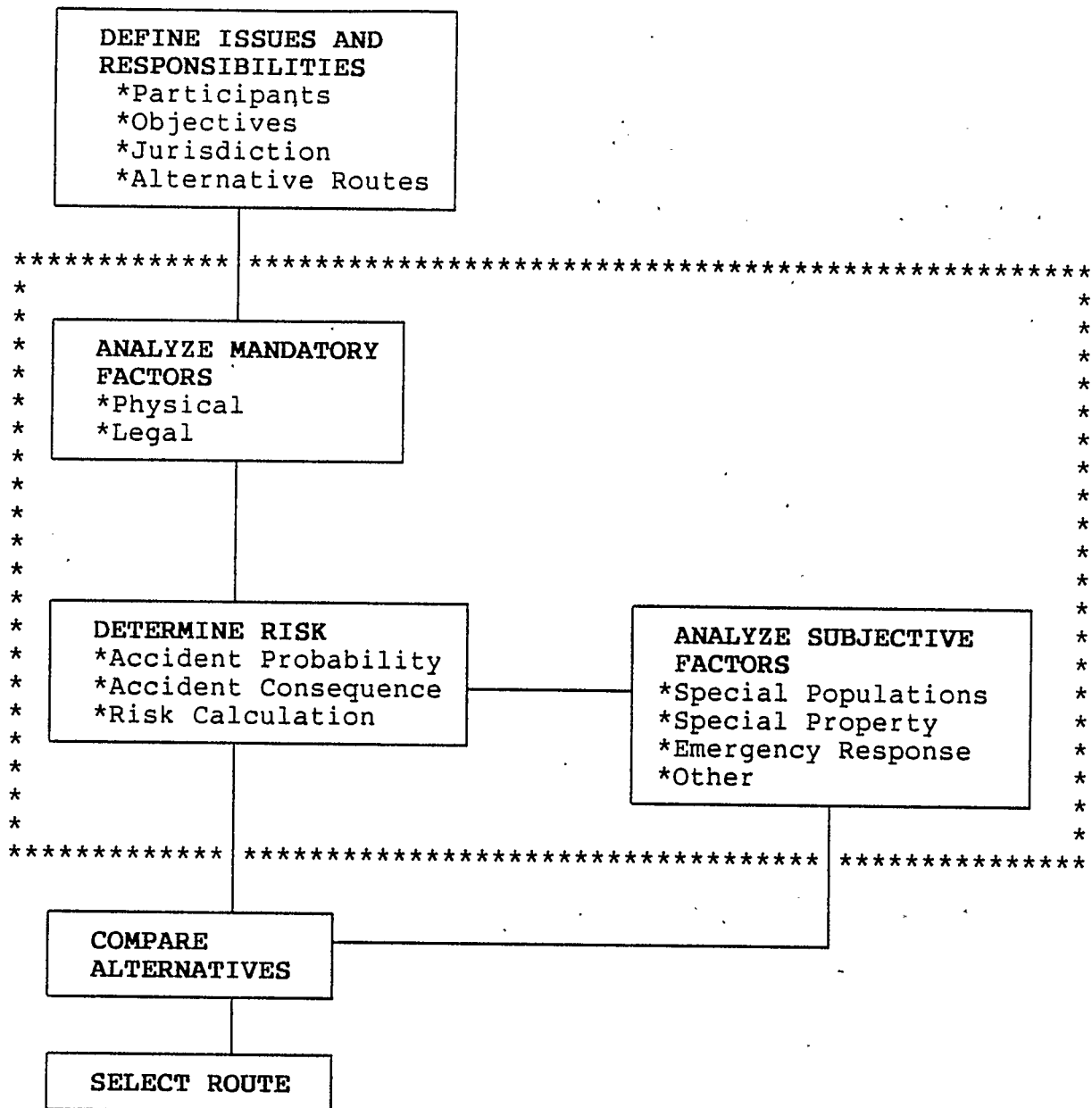
How to Designate Routes for the Transportation of Dangerous Goods

The "Hazardous Materials Routing Method" was developed by a consulting team in 1980 for the U.S. Department of Transportation. The procedure is relatively long and a risk analysis is a component of it. Figure 2 illustrates the components of the method and the order in which they are performed. Each box represents an activity (or related activities) in the process. A Routing Analysis Worksheet, Figure 3, records the information as it is gathered for each component of the process and presents it in an ordered fashion so as to simplify the final comparison between selected alternative routes. Though the method was designed for use in determining routes through developed areas, it would be equally valuable in the determination of routes through areas yet to be developed.

To summarize, the method starts by identifying the roles of the performing actors, who the affected parties are and what the community's goals and objectives are for managing the shipment of dangerous goods. Once these elements have been identified, a preliminary selection is made between possible alternative routes consistent with the community objectives. Then, the established criteria, which are shown in Figure 2, are applied to determine which of the selected routes are the most, to least, preferred. Based on a comparison among them, a route is selected.

The first step in the procedure is the establishment of who is to be involved in the endeavour, such as public interest groups, government officials, the general public, industry, and

FIGURE 2: HAZARDOUS MATERIALS ROUTING METHOD



Source: U.S. Department of Transportation, Federal Highway Administration, Guidelines for Applying Criteria to Designate Routes for Transporting Hazardous Materials, (Washington, D.C.: U.S. Government Printing Office, 1983).

FIGURE 3 : THE HAZARDOUS MATERIALS ROUTING METHOD WORKSHEET

1. ROUTE CHARACTERISTICS					
Alternative No. _____	Length _____ Miles	Travel Time _____ Minutes	Circuity _____		
Origin _____	Destination _____	Via _____			
Description _____					
Is the route currently used by hazardous materials carriers?				<input type="checkbox"/> Yes	<input type="checkbox"/> No
Explain _____					
Select hazardous materials class for study:				<input type="checkbox"/> CL	<input type="checkbox"/> FL
				<input type="checkbox"/> FB	<input type="checkbox"/> OXI
				<input type="checkbox"/> NFG	<input type="checkbox"/> FQ
				<input type="checkbox"/> POI	<input type="checkbox"/> COR
				<input type="checkbox"/> EXP	<input type="checkbox"/> RAM
Impact Radius: _____					
2. MANDATORY FACTORS					
Are there any physical constraints?				<input type="checkbox"/> Yes	<input type="checkbox"/> No
Explain _____					
Are there any legal constraints?				<input type="checkbox"/> Yes	<input type="checkbox"/> No
Explain _____					
3. RISK DETERMINATION					
Segment No.	Probability of a Hazardous Materials Accident	Potential Population Exposed to Hazardous Materials	Population Risk		
_____	_____	X _____	= _____		
_____	_____	X _____	= _____		
_____	_____	X _____	= _____		
_____	_____	X _____	= _____		
_____	_____	X _____	= _____		
_____	_____	X _____	= _____		
			Total	<input type="text"/>	
Segment No.	Probability of a Hazardous Materials Accident	Potential Property Exposed to Hazardous Materials	Property Risk		
_____	_____	X _____	= _____		
_____	_____	X _____	= _____		
_____	_____	X _____	= _____		
_____	_____	X _____	= _____		
_____	_____	X _____	= _____		
_____	_____	X _____	= _____		
			Total	<input type="text"/>	
4. SUBJECTIVE FACTORS (OPTIONAL)					
Which of the following are subjective factors in the routing decision?			Explain the choice of all subjective factors and how they are to be applied in the routing decision.		
Special Populations	<input type="checkbox"/> Yes	<input type="checkbox"/> No	_____		
Special Properties	<input type="checkbox"/> Yes	<input type="checkbox"/> No	_____		
Emergency Response Capability	<input type="checkbox"/> Yes	<input type="checkbox"/> No	_____		
Other	<input type="checkbox"/> Yes	<input type="checkbox"/> No	_____		

Source: U.S. Department of Transportation, Federal Highway Administration, Guidelines for Applying Criteria to Designate Routes for Transporting Hazardous Materials, (Washington D.C.: U.S. Government Printing Office, 1983).

so forth. This group is best comprised of parties who may potentially be affected by the selection of any, or all of the dangerous goods routes under scrutiny. The group should then set up a structure of authority to keep activities organized and to help resolve disputes.

A series of objectives must then be established that reflect community concerns in areas which could be affected by the selection of a dangerous goods route. Different communities may have entirely different goals requiring different objectives to achieve them. A goal might be to segregate dangerous goods entirely from the public, to the greatest feasible extent. This would result in an objective which would restrict movements of dangerous goods to avoid populated areas, regardless of the additional travel time or distance that might be needed. Issues that would have to be resolved early in the process would include such things as the determination of whether road restrictions will apply to all dangerous goods shipments or only to unusually dangerous materials or whether the community wants to limit the size of individual shipments. The documented discussion and formulation of objectives, provides a reference for future decisions and determination of policy statements.

The regulation of dangerous goods being transported can be quite complicated and there are several levels of jurisdiction involved. It would be a great advantage to have a member of the group representing each of these levels. However, in the event that such persons are not available, certain members of the group

should be chosen to become familiar with the different areas of responsibility and to impart their knowledge to the group.

Lastly, the group must identify possible routes that appear to satisfy the objectives they have listed, are reasonably compatible with existing dangerous goods transportation practices, and are void of obvious barriers to use.

As Figure 2 implies, the bulk of the calculations required to do the Hazardous Materials Routing Method is contained in the second phase of the process. Within this phase, "Criteria Application", there are three levels of decision-making. Each one seeks to identify factors that would preclude the use of a certain route. Successive decisions will reduce the number of potential alternatives, and result in the selection of a preferred route.

The first level covers mandatory factors such as physical or legal constraints that might prevent or prohibit the travel of dangerous goods. Examples of such constraints might be narrow tunnels, inadequate turning spaces for tanker trucks, poor roadway conditions or specific legal roadway restrictions.

The second level focusses on the determination of risk, based on the probability of a dangerous goods accident and the consequences of an accident (as explained earlier). Routes that have the smallest adjacent population, the lowest accident rates, and the least valuable properties will result in the lowest risk values. Such a combination is extremely hard to find, however. A lengthy description of how the data must be manipulated is

contained within a working example which is provided in the document, Guidelines for Applying Criteria to Designate Routes for Transporting Hazardous Materials. Appendix 4 contains the series of Worksheets necessary for the collection of data to perform the estimation part of a risk analysis. For the purposes of this paper, this level will only be explained briefly.

To determine the probability of an accident, accident rate data is required. The average daily traffic rates that are collected are adjusted to reflect the likelihood that a single vehicle might experience an accident and then further factored to represent the much smaller incidence of dangerous goods vehicles accidents.

To measure the impact of an accident on people, property and the environment is difficult because it depends on what type of material is under consideration and other factors. Local knowledge of what dangerous goods are most prevalent helps to decide what choice of class to use in the calculations. Population data helps to determine the potential impact zone should an accident occur along a particular route. The possible losses to property can be determined by adding up assessed property values.

Unfortunately, risk values are rarely useful in their absolute terms. If sufficient differences do exist between various routes, it may be possible to designate preferred routes strictly on the basis of the mandatory factors determined in the first phase and the risk calculation in the second phase.

However, most often there will be a series of tradeoffs involved in the selection.

The third level of criteria application brings into account these tradeoffs or subjective factors, the immeasurable considerations that might positively or negatively affect the selection of a particular route. The introduction of subjective factors allows the routing decision to be tempered by thoughts or ideas that might not otherwise be represented by doing a straight expected value analysis, based on probability and the monetary cost of damages.⁸⁶

Community priorities and values must be reflected in the subjective factors. Typical subjective factors might be the locations of emergency response units and their abilities, the locations of semi-ambulatory or pre-school populations that may not be able to evacuate themselves, or sensitive environmental areas of critical importance such as watersheds or reservoirs.

Though Part 4 on the Routing Analysis Worksheet, "Subjective Factors", suggests that it is optional, some decision-makers may choose to weigh subjective factors very highly when they make the final evaluation, especially when reduced to lives versus the value of property. Depending on the outcome of the earlier risk calculation, these subjective factors can be very useful for resolving situations that are essentially equal in other

⁸⁶ In his book, Planning for Multiple Objectives, pp. 23-46, M. Hill makes some suggestions on the evolution of how objectives expressed in qualitative terms may be compared to objectives expressed in quantitative terms, in general transportation planning.

important respects. The weighting of these factors is judgemental and their importance in the overall analysis of the routes must reflect their relative value or expected influence.

It is possible that in planning for new developments, certain design features may be incorporated that actually perform a dual role. For instance, from the standpoint of urban design and esthetic value, parkland, boulevards and open space are regarded as highly desirable features. In terms of dangerous goods safety, these same features result in lower population densities and fewer personal properties at risk. Perhaps these conditions would serve as positive marketing devices for developers in new development design. This enhancement to their public image would certainly appeal to developers.

The final comparison and selection of the appropriate routes would follow a decision sequence that: first, eliminates routes that have physical barriers; second, considers routes that present legal or political implications (positive or negative); third, selects the route(s) with the lowest risk; and finally, applies the subjective factors if one is unable to differentiate based on the numerical risk calculations alone.

Throughout the process of applying the Hazardous Routing Method, the public should be able to participate in any decisions they feel will possibly affect their safety situation. The route which is ultimately selected should be supported with thorough documentation for the public record. All details, and any assumptions, must be explained in such a way as to keep the

public informed and knowledgeable, in terms of their own safety.

In the following two chapters of this document, the reader must keep in mind the notion of public participation and awareness. All citizens possess the right to be well informed about the progress or lack of progress in the field of safety. This includes the transportation of dangerous goods through their communities.

CHAPTER FOUR

THE CITY OF CALGARY : A DESCRIPTION AND AN ASSESSMENT OF THE SITUATION

Over the past two decades, Calgary has grown dramatically. During the seventies, the city experienced a boom economy and all its attendant characteristics; low unemployment, steady population growth, business successes, increased rates of crime, overcrowding, among other things. Calgary soon became well known as Canada's leader in the oil industry and a land of opportunity for anyone who ventured there. Approximately 60% of the nation's oil and gas companies make Calgary their Canadian headquarters.⁸⁷ Indeed, many people did flock to Calgary, and the population grew from 385,435 in 1970 to 560,618 in 1980, an average annual growth rate of 4.5%.⁸⁸ According to the 1988 census, there are now 657,118 persons in Calgary and, given current and anticipated economic and demographic developments, there will be more than 700,000 persons by 1992.⁸⁹ These growth trends add to the difficulty of determining how much of Calgary and how many of its citizens might be exposed in the event of a dangerous goods accident. Any calculations would be dependent on the area where an accident occurs, the nature and volume of the material being transported, the proximity of other similar containers, weather

⁸⁷ Calgary Economic Development Authority, op. cit., 11.

⁸⁸ ibid, 37.

⁸⁹ ibid, 36.

conditions and so forth. The City must be prepared to deal with accidents that may be subject to extremes of any one or more of these conditions, to keep any damages to a minimum. Since there are so many possible factors that may influence the result of a dangerous goods accident, the City must also make efforts to reduce the probability of an accident ever occurring, before these factors come into play. In other words, efforts must be made to reduce both the probability of an occurrence and the extent of damages, should an accident occur. These two factors combine to determine what risk is present in any given situation.

The City of Calgary has clearly recognized that safety is a matter of both prevention and mitigation and it has taken steps in both directions to better protect its citizens. Calgary is to be commended on the work it has done and the achievements it has made, regarding the transportation of dangerous goods. Overall public safety has been positively affected by the changes that have been made and this is very noticeable when compared to the situation only ten to fifteen years ago.⁹⁰ But, are there still avenues left for exploration that could result in a safer situation for Calgary?

This chapter begins with a description of the major elements of the transportation network in Calgary. It then describes how

⁹⁰ Prior to 1978, there were no designated routes where carriers of dangerous goods could travel nor were there any standards for the training of emergency response personnel who would have to react in the event of a dangerous goods accident. This was not unique to Calgary. Study of the area of dangerous goods transportation is still in its youth and information is changing almost daily.

the various actors involved in the transportation of dangerous goods, i.e., the Fire Department, the Police Department, the Transportation Department and others, in Calgary, work to ensure public safety. Throughout the chapter, this description will undergo a critical analysis and evaluation in order to provide an assessment of how safe the city actually is.

The Transportation System

The transportation system in Calgary includes two trans-continental railways, the Canadian Pacific Railroad and the Canadian National Railroad, with an east-west line that bisects the downtown business district and another that runs north-south, just east of the Deerfoot Trail. An artery that was used by oil refineries to haul products west from their refineries located just east of the CBD, still exists, but the volumes of petroleum have decreased since the oil boom collapsed and the refineries relocated. There are numerous small rail lines that service industrial areas throughout the city, primarily in the southeast where there are chemical, fertilizer and manufacturing plants. The TransCanada Highway (16 Avenue North) bisects the city, running east-west approximately one mile north of the downtown core. A major north-south provincial highway (Deerfoot Trail) cuts through Calgary just east of the central core. In addition, Calgary has ten trans-continental and numerous interprovincial truck routes that divide the city into many areas. The transportation system is based on these primary corridors. The

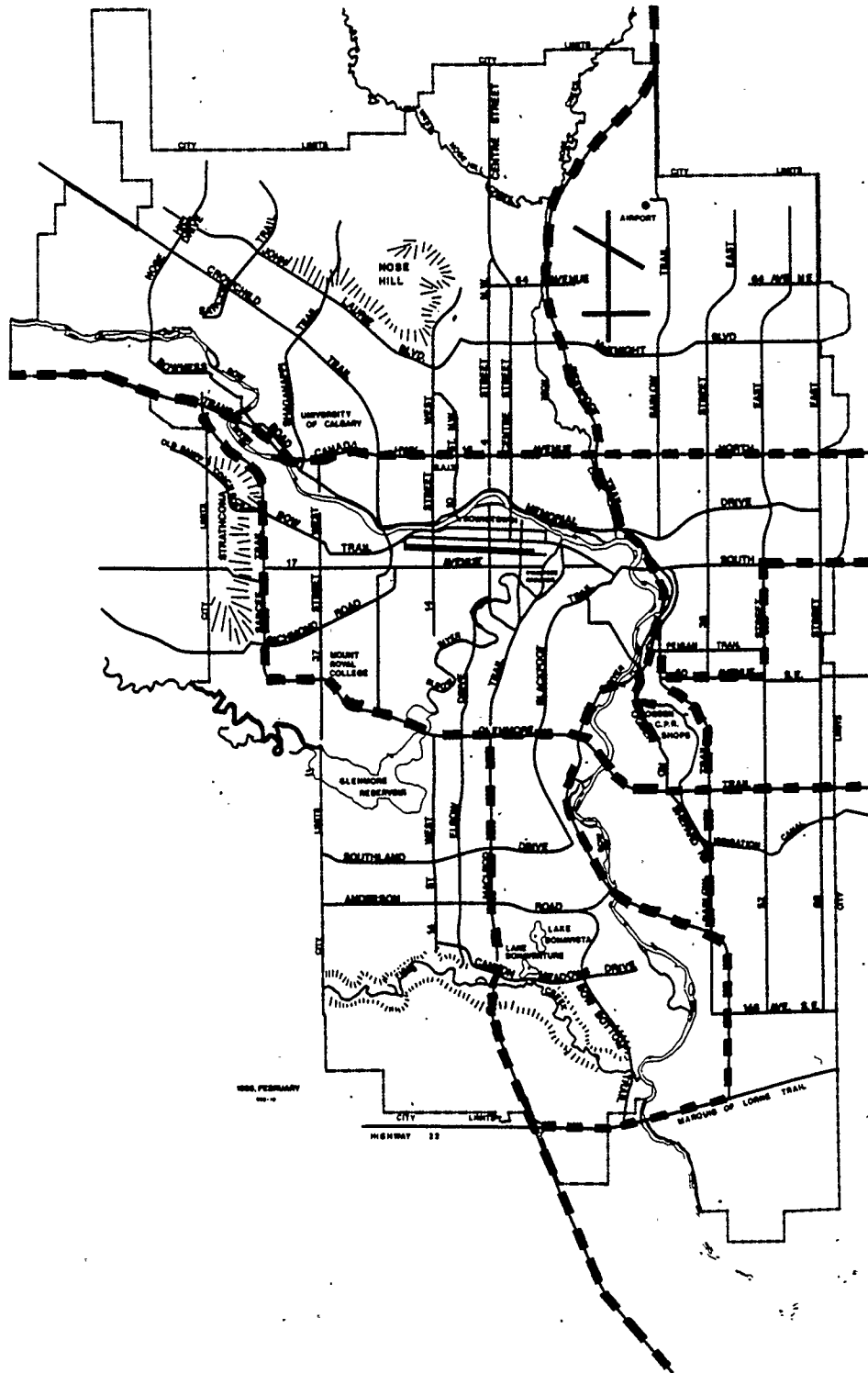
City Map, Figure 4, shows major roadway routes, in addition to dangerous goods routes that are marked by broken lines. Dangerous goods route signs are located at the four major entrances to the City, at Deerfoot Trail north and south, and the TransCanada Highway east and west. These signs give immediate directions and provide the telephone number necessary to obtain further information about dangerous goods routes and regulations. Within the city, gas stations require gasoline shipments in tankers, retail stores sell dangerous household products, and industries use dangerous commodities that depend on the rail and trucking systems for safe delivery. Therefore, a system of truck routes was established which crosses and connects the major roadway network described above.

Development of the Transportation of Dangerous Goods By-law

It was not until 1978, when Alderman Brian Lee first introduced the issue of dangerous goods safety in City Council, that formal measures to reduce the risk of dangerous goods accidents to the public were initiated. Yet, the potential problems had been recognized earlier. In fact, Captain Murdo MacKenzie, formerly of the Fire Department, was unsuccessful in his attempts in the 1970s to have legislation brought forward through the normal channels of administrative policy change.⁹¹ A working relationship developed between Capt. MacKenzie and

⁹¹ L. Ciurysek, Hazardous Goods By-laws in the City of Calgary, (unpublished Masters Degree Thesis, The University of Calgary, Department of Political Science, 1986) 30.

FIGURE 4 : DANGEROUS GOODS ROUTES IN CALGARY



Adapted from the Truck Routes and Dangerous Goods Routes Map, January 1987.

Alderman Lee. This form of direct communication was discouraged by the administration because, technically, under the Municipal Government Act at the time, members of Council could only gather information through the Commissioners at Council meetings. Alderman Lee observed that one of the reasons why Capt. MacKenzie's initiatives had failed was that his seniors did not want to alarm the public or Council and therefore held back his initiatives. In some respects he had been viewed as an alarmist.⁹² This feeling still exists among some officials today.⁹³

Both Capt. MacKenzie and Alderman Lee persisted in their efforts to protect the public against a growing problem. Capt. MacKenzie created an informal emergency force committee in 1978, which included representatives from the City Fire and Police Departments, the Provincial Government, the transportation industry, and Canadian Western Natural Gas. This team became a model for other Canadian cities.⁹⁴ To pursue legislation, Alderman Lee set out to collect further information about dangerous goods from many national and international sources.

⁹² *ibid*, 30.

⁹³ During the course of interviews, a significant caution or wariness on the part of several of the interviewees was detectable. Findings indicate that they seem to feel that the public, being generally uneducated, would blow things out of proportion if they were made aware of the finer points in the transportation of dangerous goods.

⁹⁴ Captain Murdo MacKenzie, "Dangerous Goods Incident Handling: Planning and Response", in J. Shortreed (ed.) Dangerous Goods Movements, (Waterloo: University of Waterloo Press, 1985) 177.

After much research into the field of transportation of dangerous goods, Alderman Lee produced a series of suggestions to present to Council. He titled these "Proposals for the Safe Transportation of Hazardous Cargo Through Calgary". On January 31, 1979 he brought them forward as a Notice of Motion in Council.⁹⁵ This first legislative initiative was promptly adopted by Council, though there remained some skeptics.⁹⁶ Alderman Lee was instrumental in the evolution of dangerous goods legislation and safety in Calgary until he left local politics in 1982.⁹⁷

The first achievement made, after Alderman Lee's Motion was passed, was the designation of routes where dangerous goods could be transported, the times of day when they could travel and the posting of dangerous goods routes signs at the city's major entrances. These were introduced in June 1979 as amendments to the existing Truck Routes By-law (See Appendix 1).

The "Transportation of Dangerous Goods By-law" was approved by City Council on January 11, 1988 and by the Minister of Alberta Public Safety Services on February 8, 1988, at which time it came into force (See Appendix 2). This is the first such by-

⁹⁵ Alderman Brian Lee, Notice of Motion: "Proposals for the Safe Transportation of Hazardous Cargo Through Calgary", dated January 1978.

⁹⁶ L. Ciurysek, op.cit., 40. Officials (Tyler of Alberta Disaster Services) felt that decisions should be held off until such time as the federal government legislation was passed.

⁹⁷ Personal communication with Bill Bruce, Traffic Services Co-ordinator, Transportation Department, March, 1988.

law that stands on its own, apart from a basic truck routes by-law, which makes it unique in the province of Alberta. This most recent by-law was developed by a six member review committee, comprised of representatives from the Transportation, Police and Fire Departments of the City as well as a representative from the Alberta Trucking Association. Though all the restrictions of the Truck Routes By-law do apply, additional specific restrictions have been written into this new document. It contains definitions pertaining to dangerous goods transport, specific regulations regarding their movements through Calgary, application information for the acquisition of a Special Permit to travel within the Central Business District (CBD), and a penalty provision regarding the violation of any part of the by-law. Presumably, any difficulties or questions regarding the transport of dangerous goods through Calgary can be addressed through this by-law.

Dangerous Goods Routes

The "Truck Routes and Dangerous Goods Routes" map, which accompanies the Transportation of Dangerous Goods By-law as Schedule C (See adaptation provided on Figure 4), graphically represents the road restrictions in the city in terms of load, vehicle size, time of travel and routes that may be used to access a point within the city or to pass through the city en route to another destination.

Calgary's major transportation routes have remained the same

since the seventies. In keeping with this, the dangerous goods routes have not changed since 1979 when they were first established. The routes into or around the city are well known by most truckers. In the event that a trucker does not know where to travel, the large signs posted at the entrances to the city provide directions and also a contact telephone number for further information. This map is distributed across western Canada through the provincial trucking associations and through provincial weigh scales (vehicle inspection stations) and industry contacts. It may also be acquired through other trucking associations across the country. These measures serve to inform any dangerous goods carrier about local restrictions, before they have the opportunity to breach any of them.

The dangerous goods route map was last printed in 1987 despite the fact that its content has not changed since 1984. The most recent by-law added a few stretches of roadway in the southeast. No structured risk analyses have ever been performed to arrive at, or to evaluate, the dangerous goods routes.⁹⁸

In 1984, the Institute for Risk Research at the University of Waterloo held its first workshop that dealt with risk and dangerous goods movements. Capt. MacKenzie presented a paper at this workshop, which described how Calgary had approached dangerous goods planning and emergency response. He divided the planning activities into four components:

⁹⁸ Personal communications with Bill Bruce and Al Borgardt, June 1987.

1. Identify what is a dangerous good and which ones are most prominent in the local area.
2. Conduct a risk analysis to measure the magnitude and nature of a dangerous goods exposure in storage and transportation in the local area.
3. Develop an incident response plan for the local conditions, both for emergency response and for the follow up response.
4. In consultation with the local community, industry, etc., develop local regulations on truck routes, permissible land uses etc.⁹⁹

He also included statements about public perception.

The public perception of what is a dangerous good must also be taken into account. The public perception of what is dangerous and knowledge of risk factors have to be presented to people who live or have businesses along a truck route. They must be aware of those substances which are identified as not being dangerous, or, could at anytime become dangerous. The public should be made aware that a dangerous goods route has to be in someone's backyard.¹⁰⁰

In this paper, he noted that Calgary had a very good data base, and therefore, that a risk analysis could be very accurate. From this paper, it is clear that the Fire Department is (or at least was) well aware of how the planning process should flow, how the public should play a role and what factors must be addressed in order to perform a risk analysis. Yet, the review of dangerous goods routes today is an ongoing process, initiated only on a complaint basis. Interviews have revealed simply that traffic counts are done and, based on their results, no changes to the routes have been deemed necessary to date.¹⁰¹ Perhaps

⁹⁹ Capt. Murdo MacKenzie, op.cit., 179.

¹⁰⁰ ibid, 180.

¹⁰¹ Personal communication with Al Borgardt, June /88.

this is because a citywide review is thought to be too costly a measure, with little perceived benefit. Or, maybe it is because of the deep-rooted fear of negative findings.¹⁰² The author definitely sensed the latter during several conversations with officials.

The most controversial dangerous goods route through the city is the TransCanada Highway which travels in an east/west direction through populated areas for its entire length. For the majority of this distance, it is a four lane roadway with frequent traffic signals and some roadside parking. The average speed is relatively slow, primarily due to traffic congestion. City officials claim that if an accident occurred, it would not be major because of the reduced impact at a low speed.¹⁰³ Despite this assurance, it is clear that the TransCanada Highway is of major concern because the City approached the Province in January, 1988 regarding a northwest bypass of the city. This is not the first time that Alberta Transportation has been approached regarding this matter. The Stoney Trail Proposal for a bypass has been in place since the early 1970s. The northern bypass will affect much fewer people and their properties. Hopefully, the proposal will be successful because it will mean a significant reduction in risk to those people who use, or live or

¹⁰² This was actually indicated by several officials.

¹⁰³ Al Borgardt made this comment, though he made it clear that he was skeptical of its validity as volumes of dangerous goods and traffic congestion alter the levels of risk.

work near to, the current route along 16 Avenue North.¹⁰⁴

City Planning

During the seventies in particular, Calgary was growing at a very rapid rate and the process of development was rushed. Growth of all sorts flourished and development permits were quickly passed through the municipal approval process. There was an almost desperate need for housing as well as industrial, commercial and office space to accommodate Calgary's new residents and businesses.¹⁰⁵ Looking back, aldermen and planners cannot agree about whether the city gave away too much to developers. But they do agree on one thing. Everyone was in a hurry. At a time when the planning department could not keep up with demand and was frequently at odds with council, developers were wooing the policy-makers.¹⁰⁶ All this activity may be viewed in hindsight as a "mixed blessing". The result was a city designed economically (in theory), without the maximization of safety for its citizens in mind, at least not with respect to the transportation of dangerous goods.

¹⁰⁴ Personal communications with Bill Bruce and Cliff Storvold, Transportation Department, May 1988.

¹⁰⁵ Statistics provided by the City of Calgary Planning Department Library indicate that building permit applications grew from 7,751 in 1970 to 21,396 in 1981. Over the course of those eleven years, there was an average increase in number of application was 11%. The rush on approvals during the boom years, was confirmed by an official in the Planning Department.

¹⁰⁶ Roman Cooney, "Public Amenities Had Low Priority in Boom Years", Calgary Herald, Saturday, June 11, 1988, A5.

It has been well established that speed does not equate with effectiveness in any endeavour, though many people may have thought that at one time. Therefore, it is not unreasonable to assume that the speedy process of approving applications during the boom period may have jeopardized the integrity of some standards set by the Planning Department, or those yet to come. During this period, no legislation existed to deal with problems of dangerous goods transport. The whole issue was not of great significance in the minds of officials. The concerns were indeed recognized and relevant at that time, but they simply were given low priority as other municipal demands increased.

Two particular areas in the city may be used to illustrate errors in planning that resulted in high risk situations. It is of note that these are not the only areas in Calgary where communities are at risk due to dangerous goods incidents, but have been chosen as examples of existing problems that could have been avoided during the planning stages of their development. There was an increase in the vulnerability of, or potential risk to, the people and property in these two areas, particularly in the event of a large scale accident. The first case is an example primarily of design error and the second case is one that illustrates the stresses of development during the boom years in Calgary.

The first area, the Glenmore Reservoir, is one of major contention because it is a recognized dangerous goods route, and has been since the system of dangerous goods routes was first

developed. The Glenmore reservoir was built in the 1930s and, at the time, it was far from the centre of activity in Calgary and any risk to the water supply was very low. The error here was one of long term planning. Though the construction of the causeway over the reservoir made access to either side of it less difficult, it simultaneously put the water supply at risk in the event of fuel spills from vehicles travelling over it. At that time, dangerous goods movements simply were not an issue in much of the world, let alone Calgary. Political decisions were made to address the concerns immediately at hand.

The causeway, which passes over the Glenmore Reservoir in the southwest quadrant of the city, is only about four hundred metres long. This is the only stretch of the route whereby a direct spill into the reservoir could occur. But, the extent of the area which drains into it, and the Elbow River watershed in general, is notably larger. Direct drainage and groundwater seepage may increase this affected area significantly and this could contaminate the reservoir supply.

The Glenmore reservoir contains 21 billion litres of water and serves as a major supply of drinking water for Calgary. The only other supply of drinking water is the Bearspaw Reservoir in the northwest. It draws from the Bow River watershed which is endangered by dangerous goods movements along the TransCanada Highway and the railway that enters from the west, the highway being one of the most contentious routes for dangerous goods in

the city.¹⁰⁷ (Since the problems of the TransCanada route are quite political, were long in the making and are not the result of a planning decision, it cannot be tackled as a good example of poor planning by planners. However, it does provide an even stronger case for the elimination of the Glenmore causeway as a dangerous goods route.) This leaves no doubt that the city's drinking water is always at risk due to the transportation of dangerous goods. This situation is just cause for a change to either or both of these routes, as Marshall Macklin Monaghan states in its report, which is part of an Elbow River watershed study: "From a water quality perspective, any future crossing of the Elbow River by a hazardous goods route should ideally be downstream of the City's water supply intakes." ¹⁰⁸ The study concludes that "the greatest risk to water quality is the

¹⁰⁷ L. Ciurysek, op.cit., 41. After Alderman Lee made the motion for a number of changes in the City regarding dangerous goods transportation, he received a letter from Edgar H. Davis, the President of Systems Investments and a professional engineer. In this letter, Davis commented on how the engineers' recommendations to skirt the city, when the original TransCanada Highway was proposed, were ignored by City Council for political reasons. "Most of the problems now experienced by the City of Calgary have been anticipated and carefully outlined by Canadian professionals some fifteen or twenty years ago, or more. I am not, of course, against your proposal. I am simply saying that when we incur problems by taking on areas of responsibility where we have no background or experience, we generally are forced to face these problems by prohibitions, regulatory controls, and the bureaucracy are asked to carry out very annoying policing duties." This of course, is a comment on policy-making and the conflict between politicians and the bureaucracy.

¹⁰⁸ Marshall Macklin Monaghan, Commissioners' Report to Operations and Development Committee, (Calgary: February 2, 1987) 6.

possibility of a spill resulting from a traffic accident on the Hazardous Goods Route over Glenmore Causeway."¹⁰⁹

Various consulting groups have tried to determine the effect of a major dangerous goods spill into the reservoir; but, results vary, with the mention that the reservoir could remain contaminated and unusable for several years even after it is flushed completely.¹¹⁰ Even though the consultants have employed expertise from outside of Calgary to draw some of their conclusions relating to the reservoir, the City's response team remains confident that it could manage a spill with the equipment and personnel that are currently in place. It is reasonable to be skeptical because they have never had to do it. There is no guarantee that any of the safeguards proposed by the City Engineering Department will be completely effective.¹¹¹ Mock exercises have dealt with minor spills using canola oil. There have been instances where small oil slicks have been spotted on the surface, but they have been taken care of by the catchment system in place that extends the distance of the causeway.¹¹² However, if the substance were a soluble contaminant or a disease-carrying agent of some kind, what would happen?

The Marshall Macklin Monaghan report notes that there are

¹⁰⁹ *ibid*, 3.

¹¹⁰ Personal communication with Doug Jamieson, Production Superintendent, Engineering Department, Waterworks Division, June 1987.

¹¹¹ Marshall Macklin Monaghan, *op. cit.*, 4.

¹¹² Personal communication with Doug Jamieson, June 1987.

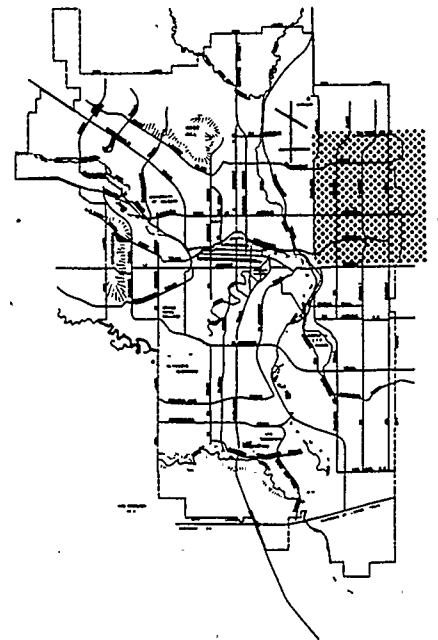
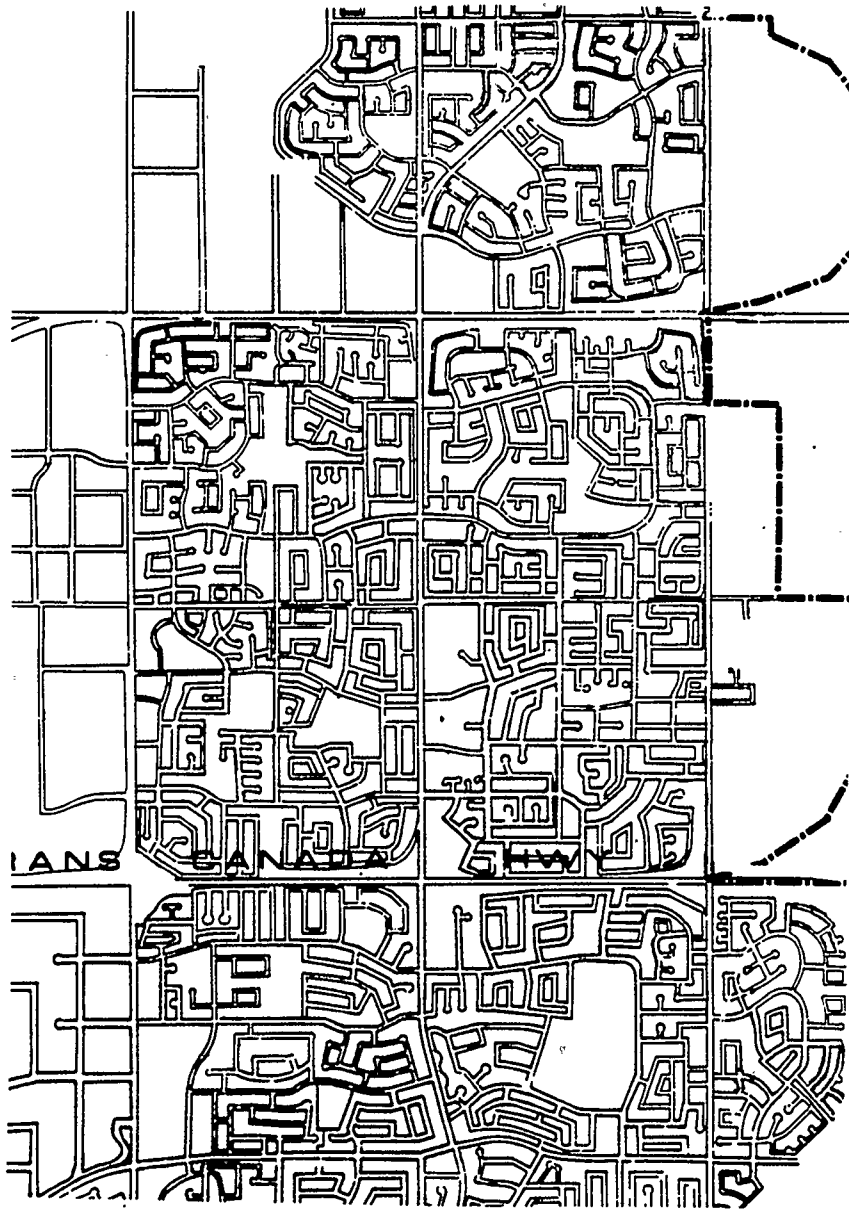
potentially lethal substances that are not covered by the TDGA, such as biological substances, which may travel over the causeway.¹¹³ The trout fish biomonitoring system¹¹⁴ at the pumping station may detect their existence very quickly, but how would they be cleaned up safely and how long would the people of Calgary be unable to drink Glenmore water? This is a case of a low probability event that could result in major consequences, thereby making it an area of significant risk, one that merits just as much, if not more, attention as a high probability event that rarely results in major losses. The federal government is attempting to address this issue in pending amendment schedules but there is no projected date for its inclusion in the TDGR. At this stage, it is stipulated that any substances suspected of carrying disease be packaged accordingly and transported using dangerous goods routes, if necessary. Perhaps local legislation should try to regulate dangerous goods movements of this nature, specifically, rather than vaguely, in the area of the causeway.

The other area chosen to illustrate a planning oversight, is in the northeast quadrant of the city bounded by 36 St. to the west, Memorial Drive to the south, 68 St. to the east and up to the Martindale community in the north. Figure 5 provides a map

¹¹³ Marshall Macklin Monaghan, op. cit., 7.

¹¹⁴ Trout fish are extremely sensitive to changes in their environment. An elaborate system of aquariums is in place at the station by the reservoir containing moving water drawn in from the reservoir. They are electronically monitored and any increase or reduction in the movements of the fish is recorded. Such a change is usually an indication that the water has changed somehow.

FIGURE 5 : THE NORTHEAST QUADRANT

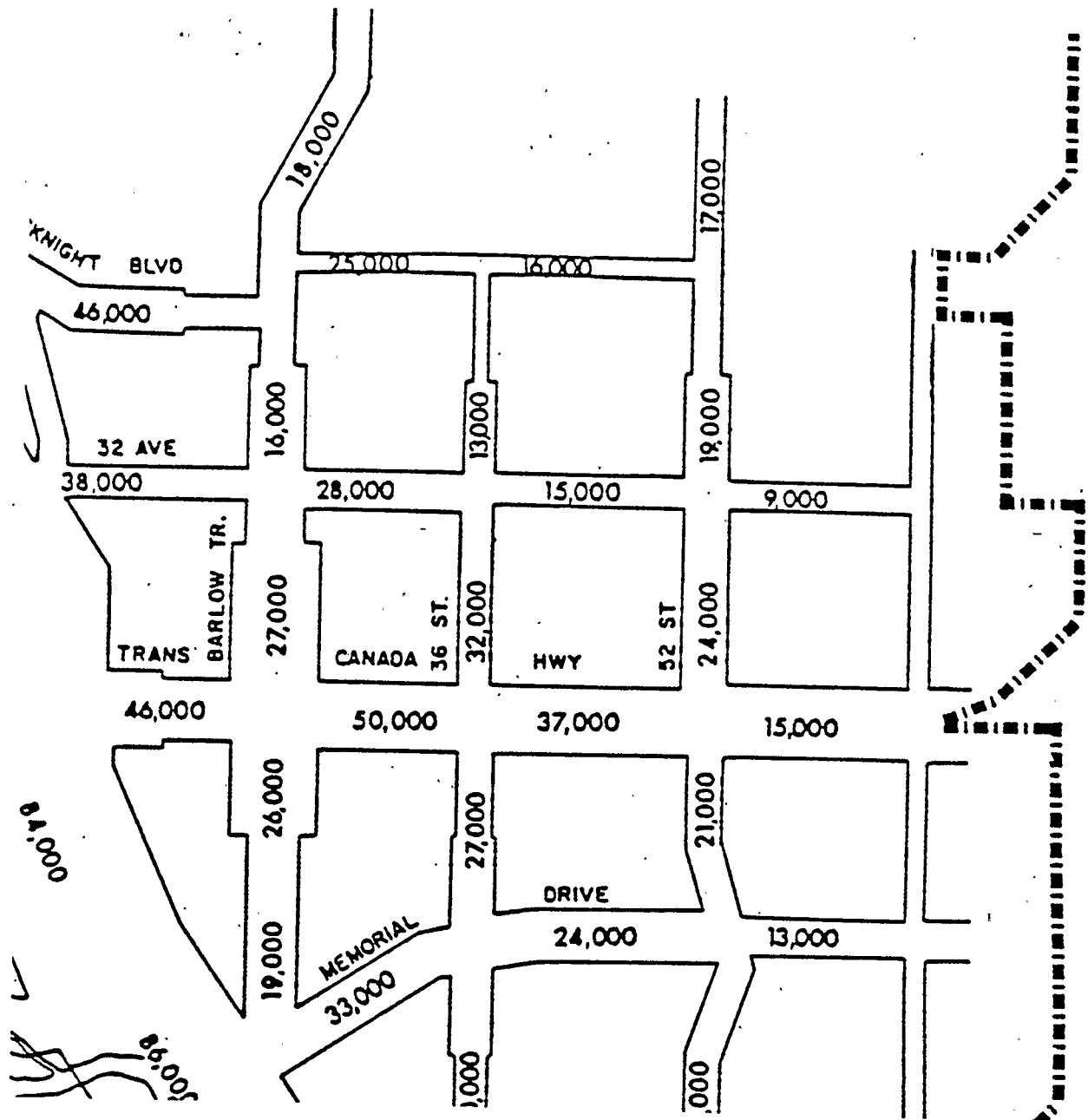


of the area as well as a view of it in context with the rest of the city. It is an area of high density residential development that borders a major commercial and light industrial development on the west side of 36 St. E. The TransCanada Highway, a major dangerous goods route, runs through it and to the north are several sour gas developments. The residents are placed in a precarious situation, not so much because of the high probabilities of dangerous goods accidents, but because of the potential impacts, should an accident occur.

Due to the high cost of servicing new areas, high density development is often considered most appropriate to reduce the costs to taxpayers. This was the case when this area was developed in the 1970s. The design for development was successful in its objective to attain high densities and relatively low development costs; however, it also resulted in poor access and egress routes that consequently put a greater number of people at risk in the event of evacuation due to an emergency of any nature. Approximately 80,000 people now live within these boundaries and many others who work in the areas of commercial and industrial activity. This has helped to contribute to the high volumes of traffic through the area.¹¹⁵ The most recent complete traffic data are illustrated on Figure 6, a map which shows Average Weekday Traffic Volumes on the major roads in the area for 1985.

¹¹⁵ Unpublished figures provided by the City of Calgary Planning Department Library.

FIGURE 6 : TRAFFIC VOLUMES IN THE NORTHEAST QUADRANT, 1985



Source : The City of Calgary, Transportation Department

In the residential areas, there are numerous cul-de-sacs, narrow winding streets with parking, and few through routes that are east-west or north-south. This situation could be a great hinderance in the event of any emergency, including a dangerous goods accident, which would require an evacuation. It is hard to understand why a development of this magnitude and design was approved, but it appears that the achievement of high density was the motivating factor. Why else would concerns about access and egress routes, and the location of sour gas wells be overlooked?

Neither of the two problem areas that have been described should exist. However, because they do indeed exist, they must be dealt with and the public must be made as safe as possible with them in place. The only moves the City has made to reduce the risk in these areas is to designate dangerous goods routes. Further action is needed to achieve a better level of safety, one that could be considered "as safe as possible". It is too late to redesign the homes, the road pattern and the population density in the northeast quadrant but, this area can serve as an example of what planners must avoid in future development planning if they are concerned about dangerous goods and public safety. This kind of residential design has been denounced for other planning reasons also, and prior to the development of this area.¹¹⁶ In the case of the reservoir, only the elimination of

¹¹⁶ Though this form of subdivision design remains popular for some reasons, such as the reduction of drag strip car racing in a neighborhood, it presents a greater number of problems dealing with such things as garbage pickup, snow removal, emergency vehicle access (mostly because of parking conditions)

the causeway as a dangerous goods route will remove the great, uncertain risk associated with water quality. The existence of a dangerous goods route passing over a reservoir is unique to Calgary. Therefore, no solutions have been developed elsewhere and no precedent has been set.

Emergency Response and Enforcement

Capt. Murdo MacKenzie initiated the first emergency response system in the City of Calgary when he drew upon the expertise from various sources to create an informal emergency response committee in 1978. From this committee, a more structured and formalized planning and response system developed, which involves the efforts of the Calgary Fire Department, the Calgary Police Department and Calgary's Emergency Medical Services. The roles, responsibilities, and training of each of these actors will be explained below.

The Hazardous Materials section of the **Calgary Fire Department** was set up in 1980. It has four members, extensively trained in emergency response measures associated with accidents that involve dangerous goods. These people are referred to as Dangerous Goods Officers (DGO). There is a Prevention Officer, a Planning Officer, a Training Officer and a Co-ordinator. They have received their training through experience and through the completion of courses offered by many agencies. They also participate in an in-house training program and keep themselves

and wasted property space.

state-of-the-art by attending seminars and courses related to the transportation and handling of dangerous goods. These officers carry the prime responsibility at the site of an accident and they orchestrate the actions of firefighting personnel.

To keep the Fire Department's skills honed, the DGOs devise and carry out practice response plans, addressing specific conditions in mock scenarios. The actual response to an incident can be very complicated and no two incidents are exactly the same. The Fire Department's Disaster Services Section helps to devise these scenarios and to assist in the development of contingency plans. Since information is always changing in the field of transportation and dangerous goods, the DGOs must remain in touch with the mainstream of information flowing from national, international and provincial research. In addition to courses, they attend seminars and conferences in order to keep up with advances in the area of dangerous goods transportation, storage and packaging technologies.¹¹⁷ In Calgary, there is an emphasis on teamwork and communication to ensure that effective actions are made on extremely short notice.

The Calgary Fire Department has state-of-the-art fire fighting equipment located at various fire stations throughout the city. To date, the Hazardous Materials Division has been able to deal with all the situations that have required a cleanup and little assistance has been enlisted from private companies.

All City of Calgary Police Officers have the authority to

¹¹⁷ Personal Communication with Al Borgardt, June 1987.

inspect dangerous goods shipments travelling through the city. If a carrier is found to violate any of the provisions of the by-law, the officer may issue a warning or a tag which may be accompanied by a fine or criminal charge. It is the job of the Police Force to make sure that the legislation is obeyed.

The role of the Calgary Police force at the scene of a dangerous goods accident is to secure the area and establish traffic control for a minimum of 100 metres around the site. If the public is in immediate danger, they may also commence an evacuation. The Fire Department may also request their assistance during the identification and cleanup procedures. The entire police force receives general dangerous goods training through courses offered in Calgary or Edmonton by APSS trained individuals.

The City of Calgary **Emergency Medical Services** (EMS) has a force of one hundred and seventy people in its Operations and Support Services Branch. This team is comprised of paramedics, ambulance drivers and administrative personnel. The Branch operates fifteen ambulances daily from 7:30AM to 7:30PM and fourteen from 7:30PM to 7:30AM and all day on statutory holidays. It has twenty seven trained paramedics stationed in fifteen different firehalls across the city.¹¹⁸

Patient care is of prime importance, but these people are also aware of the dangers that may affect more complicated safety

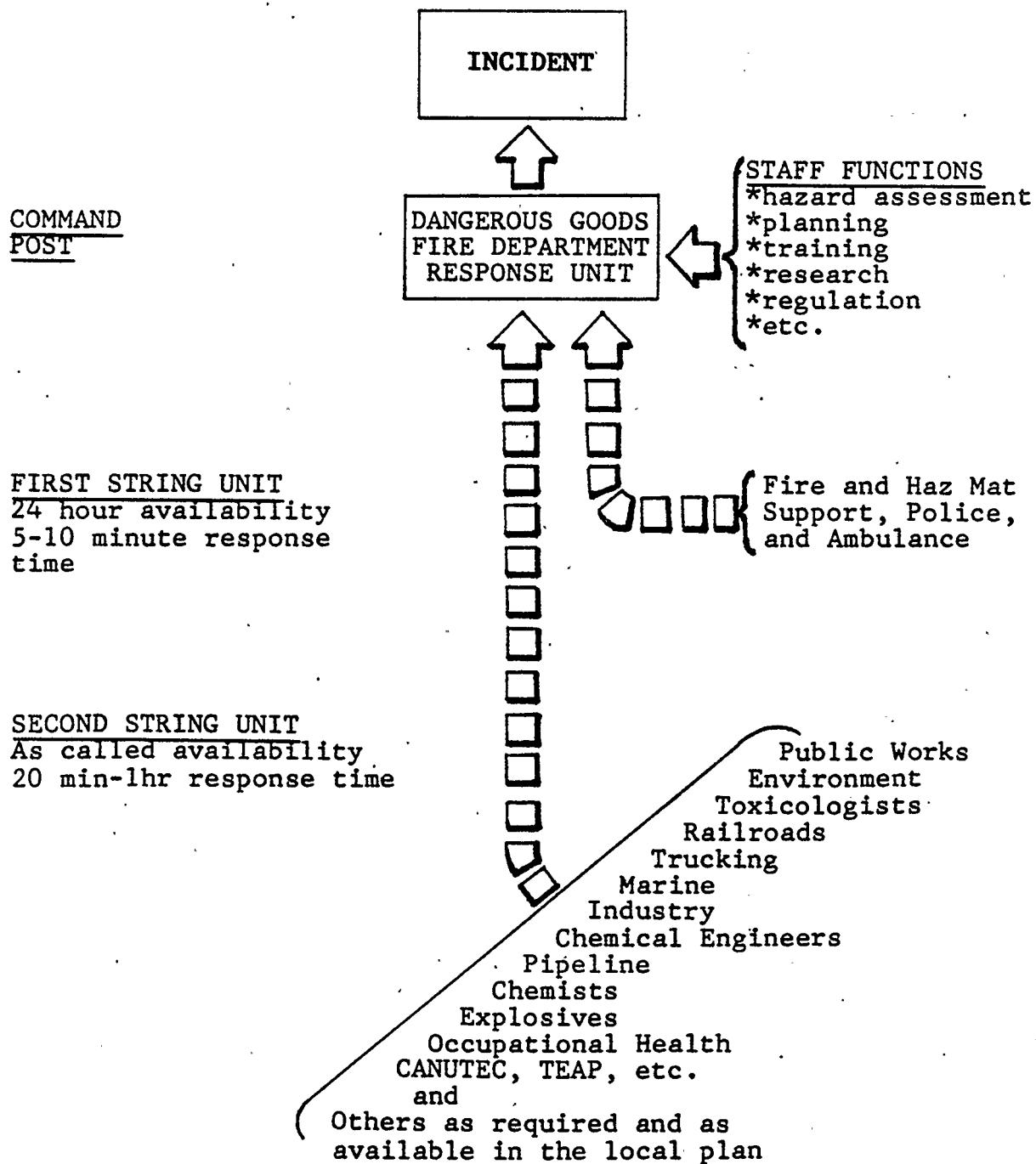
¹¹⁸ Personal communication with Tom Sampson, Manager, Operations and Support Services, Emergency Medical Services, June 1987.

procedures at the scene of a dangerous goods accident. The vast majority of calls that EMS responds to are associated with traffic accidents; thus, a strong relationship with the police force at the scene of an accident has developed. It is crucial that they communicate well with each other. To address problems that arise in these situations they have jointly developed the CODE 1000 course. This is a course that introduces new innovations and information in the field of emergency medical services and provides an opportunity to discuss current relevant issues or problems with the system. This course has solidified the working relationship between the Calgary Police Department and EMS.

In the event of a dangerous goods accident, where evacuation would be required, EMS would be the prime movers of non-ambulatory people such as the elderly in nursing homes, hospital patients, or children from elementary schools. No such major accident has ever occurred but scenarios have been developed, such as the ones most recently carried out for the Calgary 88 Olympic venues, to test the effectiveness of their emergency response plans in place.

The emergency response system brings these three main actors together and also draws upon the expertise of persons from the outside of the municipal government, to provide a very extensive and up-to-date response capability which would otherwise be unavailable. Figure 7 illustrates the three-tiered structure of

FIGURE 7 : CALGARY'S GAME PLAN FOR INCIDENT RESPONSE



Source: MacKenzie, Capt. M., "Dangerous Goods Incident Handling: Planning and Response", in J. Shortreed (ed.) Dangerous Goods Movements: Proceedings of the 1984 Waterloo Workshop, (Waterloo: University of Waterloo Press, 1985) 188.

Calgary's emergency response system and shows where each of the Fire and Police Departments, and EMS perform.¹¹⁹

The first string unit consists of representatives from the Fire Department, the Police Department and Ambulance Services (EMS). The team co-ordinator is one or more of the DGOs from the Fire Department's Hazardous Materials Section. The second string unit is a group of volunteer resource personnel provided to assist the first unit. These people are drawn from many areas: military, occupational health, local health departments, provincial department of environment, universities, utility companies, energy resources companies, industry, transportation and others. Depending on the nature of the incident, different representatives make up the second string unit.

This structure may be activated in the event of a dangerous goods accident and also when concerns are raised regarding dangerous goods handling, at any stage. Together, all the players try to resolve the problem while each would bring their own logistics and opinions related to the issue.

Interdepartmental Co-ordination

In the past, two major problems have been recognized by many cities which have experienced dangerous goods accidents.¹²⁰ These two problems are clearly linked. The first is the

¹¹⁹ Murdo Mackenzie, op. cit., 188.

¹²⁰ From "Workshop Discussions" in J. Shortreed (ed.), op. cit., 196.

confusion of authority and roles at the scene of the accident, i.e., who's in charge? The second is the need for interagency co-ordination. Calgary has addressed these problems formally in a document titled Managing Dangerous Spills.¹²¹ It was formulated primarily by the Fire Department and the Waterworks Division of the Engineering Department.¹²² It is a well-written, step-by-step guide setting out responsibilities and communication links between the various departments of the City government who presently deal in emergency response activities or dangerous goods route designation: Fire Department, Police Department, Engineering Department, Transportation Department, Health Services, and the City Engineer's Office. In addition, it provides emergency contacts within the Provincial Government departments. It clarifies what precautionary measures must be taken at the site immediately and by whom. This is the first guidebook of this nature to be published in Canada and is a major organizational accomplishment that in itself may mean the difference between a manageable event and a catastrophe.¹²³

Although the Hazardous Materials section personnel are well trained and the public can feel sure of their competence, this may not necessarily be the case when it comes to enforcement personnel or, particularly, the actual carriers of dangerous

¹²¹ City of Calgary Fire Department, Managing Dangerous Spills, (Calgary: City of Calgary, 1986).

¹²² From answers to questions sent by mail to Al Borgardt, April 1988.

¹²³ Personal communication with Al Borgardt, June 1987.

goods that pass through the city. This is not just a Calgary problem, but one shared across the country; the non-standardization of dangerous goods handling training. This can lead to discrepancies or inconsistencies in actions at any stage of dangerous goods transport or emergency response, despite established organizational responsibilities.

Instead of making attempts collectively to effect greater safety on the whole, many actions have been taken individually to affect specific problems encountered by a specific group. The course that was designed for the police and the paramedics is a good example. Perhaps it should include fire personnel.

Since the Fire Department, the Police Department and EMS are the primary actors at the site of a dangerous goods accident, they should be taught the same course, at the same facility in mixed classes comprised of all the departments, to ensure that they are taught precisely the same things. It might be advisable to have representatives from transportation, engineering, and planning also.

Even though the input was limited, The Managing Hazardous Spills document is a major positive step towards better service and co-ordination in the response to a dangerous goods accident. However, the measures and assurances it provides are only associated with the technical response to a dangerous goods accident and the number of departments involved is limited. There have been no provisions or related guidebooks developed to describe roles in the prevention or reduction of the probability

of safety risks associated with the transportation of dangerous goods. In particular, it is of note that the City Planning Department and the public at large are not included - both of whom should be made more knowledgeable regarding the transportation of dangerous goods and the associated levels of risk to public safety.

The Planning Department plays virtually no role in the practice of transportation of dangerous goods safety. Its only associated action is to forward development plans to other City departments for feedback. The amount of time provided for the officials from the other departments to undertake a review, is limited and often insufficient for a thorough review, given how busy many departments are. Department officials are expected to respond only in the event of a query, a suggestion or a problem. The lack of a response is interpreted as approval of the plan's components.

Due to the low profile of dangerous goods issues in the past, it is understandable why community planners have not shown, or have not been encouraged to show, an interest in dangerous goods routes as a very real community concern, something that would affect community structure, design, function and safety. But, now that the importance of the issues has been raised, community planners should be concerned with the question of vulnerability and a community's overall sensitivity, given the existing level of threat and its ability to cope in an emergency situation. But, in planning for the future, planners should also

be concerned with the risk factor and the prevention of such threats in addition to community-coping measures.

Too much remains unknown and untapped in Calgary in both scientific and human terms. As noted earlier, no structured risk analyses (such as those outlined in the chapter on risk) have ever been conducted to assess the dangerous goods routes that were officially established about a decade ago.¹²⁴ The assumption remains that the general characteristics of these routes have not changed and therefore their suitability as dangerous goods routes still stands. Maybe this is so, but what evidence actually supports it? The public has never been approached to find out how they feel about the present system or to estimate how knowledgeable or fearful they are of dangerous goods in general. The public's perception of risk and tolerance of it are extremely important when decision-makers make choices or decisions that affect the transport of dangerous goods and hence the safety of the public at large. Studies have shown that people are willing to pay for the assurance that maximum safety is a major priority in the transportation of dangerous goods. The public generally supports changes to improve safety rather than major new construction.¹²⁵ This may or may not be the case in Calgary. Perhaps Calgarians would support the notion in

¹²⁴ Personal communication with Bill Bruce, March 1988.

¹²⁵ Ekos Research Associates Inc. "Consultant Summary Report: Public Perception Survey" in Toronto Area Rail Transportation of Dangerous Goods Task Force: Information Package, (Toronto: December 1987) iii.

principle and in terms of financial costs, of a complete roadway and rail bypass.

The City has acted responsibly with the public interest at heart, but much like a parent, protective but not informative. This does not encourage public awareness or participation in what should be a very public matter.¹²⁶

Assessment

Prior to investigating the situation in the City of Calgary, in terms of all the factors associated with the transportation of dangerous goods, the author's impression was that the municipal government was secretive about its policies, probably because it was skeptical about them itself. The author found that the City is very concerned about its public and their safety and it has taken many progressive steps to enhance safety. The situation is not nearly as unsatisfactory as originally thought. However, there is room for improvement. The impression regarding the secretiveness of policy is well-founded; numerous loops and frequent backtracking and vagueness were encountered in the quest for information about who was doing what, in the present and in the past. Information was more readily available at the provincial and federal levels. It is not clear why this is so. It can only be speculated that the author was viewed (and perhaps feared) by some people as an interloper because of the original

¹²⁶ Captain Murdo MacKenzie, op. cit., 180 and D. Friend, op. cit., 192.

hypothesis that, in terms of safety, Calgary is unsatisfactory in its efforts to increase public safety. It would have been more rational to be overly co-operative to help prove that hypothesis wrong, if it were indeed so.

Also, the planning and emergency response system described by Capt. MacKenzie in his article, does not appear to be fully adhered to in several areas. Conversations, in particular, made it clear that the public is not involved in transportation of dangerous goods planning or decision-making. The review of dangerous goods routes is not a constant process, but one based on complaints. Last, but not least, no structured risk analyses have been performed on the dangerous goods routes, despite the fact that Capt. MacKenzie lists the factors requiring special attention, when doing an overall risk analysis for routes.¹²⁷

To make an assessment of the Calgary situation and to determine whether the transportation of dangerous goods is carried out as safely as possible, it would be appropriate to rate it somehow in terms of the areas of concern related to the transportation of dangerous goods through any urban area. These areas of concern would be: legislation, dangerous goods routes, emergency response, training, enforcement of the legislation, interdepartmental co-ordination and community awareness.

The City scores most highly in the legislation and emergency response categories of issues. All of the other categories have recognizable areas where improvement is needed, as I have

¹²⁷ Captain Murdo MacKenzie, op. cit., 184-185.

indicated, especially in the area of community awareness and public involvement. Possible improvements, in the form of management options, will be developed in the final chapter of this paper.

The Future

It is obvious that research into the field of transportation of dangerous goods is still in its youth and the data, opinions and concerns about dangerous goods are changing and growing constantly and very rapidly. Because this is so, the City needs to be continually reviewing its policies that relate to the transportation of dangerous goods, in case the possibility exists for improvement. Even though Calgary officials may be confident right now about the transportation of dangerous goods through the City, that is no reason for relaxing concern.

To keep up with advances in dangerous goods technology and concerns, and to ensure that its efforts to manage risk result in a condition which is as safe as possible, Calgary must be willing to accept and account for uncertainties in its development of a strategy to manage risk. This must be done in addition to calculating risk estimates based on empirical evidence regarding dangerous goods and how they must be handled. The City must be as prepared for these uncertainties as it is for the certainties.¹²⁸

¹²⁸ v. Nishi, op. cit. Too often in the past, information that could not be confirmed, has not been included when making assessments or evaluations about project parameters or actions.

The Glenmore causeway is a prime example of where uncertainty should affect decision-making. Calgary is unique in its placement of a dangerous goods route over a reservoir so there is no empirical data related to accidents and the potential impacts, under such circumstances. The fact that this is so, should be cause enough for reflection, if not skepticism. The absence of empirical data to relate to a situation, is not a justifiable reason for the exclusion of uncertain factors when making decisions that may affect property, the environment or public safety.¹²⁹ This is a very difficult endeavour, but it could mean the difference between the success or failure of an emergency response plan, in the event of a dangerous goods accident. Most plans only go so far in their estimates of danger and many do not focus on the worst case scenario, but rather, what is deemed to be the most likely one. This could be perilous.

In the Glenmore instance, based on the potential consequences such as human death due to contamination of the drinking water supply or the spread of an infectious disease, or

The exclusion of this uncertain information has led to grave oversights which have resulted in many negative impacts on people, property and the environment i.e., costs. ¹⁴⁸.

¹²⁹ In V. Nishi's MDP, Chapter Six describes in detail the domino effect of negative impacts associated with the Churchill River water diversion that can be linked directly to the insufficient collection and extrapolation of data related to the area which resulted in a large degree of uncertainty. Some data was never even sought before approvals were made and construction underway. The resulting problems have proven to be very costly in both monetary and social impact terms.

the destruction of fish populations downstream, there should not be any dangerous goods routes that could directly result in the spill of dangerous goods into the reservoir. The low probability of a major accident at this location, gives a false sense of security to many. Overprotectiveness, on the part of any city, given this sort of situation, would be well justified. There is a genuine fear that the experts are minimizing the real dangers or that they really do not fully understand them.¹³⁰ Experts are often proven wrong: the sinking of The Titanic and the accident at Three Mile Island, for example.

In summary, Calgary could be safer. Though the City has made great strides in the area of safety, it can do more. Most of the problems that exist in the city today are the result of past actions or non-actions. They may not be entirely solvable but they can be further minimized. As new technology finds ways to improve the technical aspects of dangerous goods transportation, the other actors, such as legislators, enforcement and emergency personnel, and planners, must continue to research ways to improve strategies to reduce risk and to improve public safety. In hindsight, the variables that are the most difficult to improve in any existing situation are precisely those that can be avoided, prevented or ameliorated in the planning stage, such as, the proximity of dangerous goods routes and storage facilities to concentrations of population, sensitive

¹³⁰ M. Skolnick from discussion paper responding to paper by D. Friend, op. cit., 193.

facilities and industrial sites. Some of the current problems in Calgary will never arise again, if the suggested management options in the final chapter are implemented.

CHAPTER FIVE

SUGGESTED MANAGEMENT OPTIONS

This chapter addresses the problems that were identified in Chapter Four and provides management options for improving transportation of dangerous goods in Calgary. This MDP began with two main objectives: to develop a set of management options to make the transportation of dangerous goods safer and to suggest ways to minimize or avoid public safety problems in the future. It would be very simple to present grandiose schemes for rerouting dangerous goods entirely, but this would be inappropriate, mainly due to the costs that would be involved. Instead, presented here are management-oriented options which should achieve, to some extent, the goal of greater safety for present and future Calgarians.

Seven problems will be addressed. Each problem will be discussed individually, together with the suggested management options and methods for implementing them. The order of presentation does not reflect their importance.

Problem #1 - Dangerous Goods Routes

Calgary's dangerous goods routes were established just over ten years ago, apparently based on educated guesses made by City officials at the time. Since then, no structured risk analyses have ever been applied to the routes and they have remained virtually unchanged. They should now be rigorously examined. In

the past, rather than practicing a regular series of route reviews, investigations were initiated strictly on a complaint basis. This is insufficient because it can allow problems to develop that might otherwise be detected and remedied in their early stages. The approach has been reactive rather than proactive.

The "Hazardous Materials Routing Method", as described in Chapter Three, should be applied to determine whether the current dangerous goods routes are, in fact, those which are the safest. Viable alternative routes must be tested also. This particular method of scrutinizing the routes is suggested because the procedure is relatively simple and the required data should be available for the City of Calgary.

A few other matters regarding the routes also should be addressed. The current by-law reads somewhat ambiguously that "...the City is desirous of restricting vehicles transporting dangerous goods to Dangerous Goods Truck Routes and designated truck routes as much as possible." This wording appears to provide the carrier with some legal leeway, should he find him/herself caught in a precarious situation. There are numerous truck routes and it is plausible that carriers transporting dangerous goods may be travelling along them, in some cases, unjustifiably. The by-law does permit travel along these routes as long as they comprise the shortest path to make deliveries or pickups. This should be worded differently in the by-law and should also be explained on the Dangerous Goods Routes map. By

doing so, the intent of the by-law, which is safety, will be clearer to truckers when they choose to take certain routes. By being knowledgeable about the routes they will take and their restrictions, there is less probability that they will encounter situations such as heavy traffic, that will heighten both the probability of and the losses due to an accident. All vehicles (except rail) carrying dangerous goods are restricted from the CBD between 6AM and 6PM, due to the volumes of traffic and the population at risk during those hours. During the review of the current dangerous goods routes, further time restrictions or dangerous goods vehicles speed limits should be considered in certain areas of dense population or high traffic flows or congestion (for example, the northeast area). This would apply to the truck routes as well since vehicles carrying dangerous goods do travel along them. This would reduce the probability of dangerous goods vehicles coming in contact with other vehicles during those hours when patience is thin and accidents occur more frequently.¹³¹ A posted reduced speed limit for dangerous goods vehicles along certain routes or during certain hours of the day would result in lower speeds of impact should an accident occur and this could limit damages. The implementation of the Dangerous Goods Route Sign which is Schedule B of the by-law should also be undertaken despite the cost of doing so because it will serve to direct carriers and will also serve to educate the public about where the routes are.

¹³¹ Personal communication with Bill Bruce, June 1987.

Once the safest routes have been determined, the present casual review procedure of dangerous goods routes should be replaced with constant monitoring of them. This should include the collection of a wide variety of traffic data, such as vehicle size or volumes, types of vehicles, accident sites, accident characteristics, and types of product being transported, by commodity classification (as illustrated in Table 3 in Chapter Three). Information regarding population, land use, land values and projected traffic should be recorded. Monitoring and data collection will help to determine the most prevalent factors which may be related to accidents or to measures of safety. The data will be useful when dangerous goods planning decisions are required in the future. This would have a positive impact on safety by reducing the probability of an accident and limiting the population and property exposure should an accident occur.

Examination of the current dangerous goods routes may result in changes that pose greater restrictions on dangerous goods carriers. There is no doubt this will result in objections by industry, based on increased economic burden. It is very possible that responsible members of industry could suffer on account of the less responsible ones whose records encourage greater government intervention in regulation. However, the establishment of dangerous goods routes and regulations serves to increase safety in terms of the probability of an accident and in terms of the cost associated with an accident. The merits of the restrictions must be explained to industry in social and economic

terms. Over the long term, the movement of goods and therefore commerce, should benefit. The restriction of the entire CBD during the hours of 6AM through 6PM and the designation of routes through less populated or environmentally sensitive areas results in lower costs should an accident occur.

The causeway that travels over the Glenmore reservoir should be eliminated as a dangerous goods route. The average weekday traffic volume over the causeway in 1985 was 75,000 vehicles. This compares with a peak of 84,000 vehicles on the heaviest stretch of the Deerfoot Trail.¹³² There are other routes that may be used to direct dangerous goods traffic arriving from the west to areas south of Calgary, and vice versa. For example, as Figure 8 shows, Highway 22 west of Calgary, runs south from the TransCanada Highway curving slightly westward to join with Highway 66 at Bragg Creek. Highway 66 travels eastward to Priddis where it turns into Highway 22X. Highway 22X continues to travel eastward and meets up with Highway 2, south of Calgary.

It would be necessary to eliminate the stretch of Glenmore Trail from approximately Crowchild Trail to Elbow Drive. Since it is evident that most of the dangerous goods movements in this area is in a west to south and vice versa direction, movements of goods in the active area of the southeast industrial sector, would be minimally affected. The area would continue to be well served by the bypass route with access to the area via Deerfoot, Glenmore and Barlow Trails. It is important to note though, that

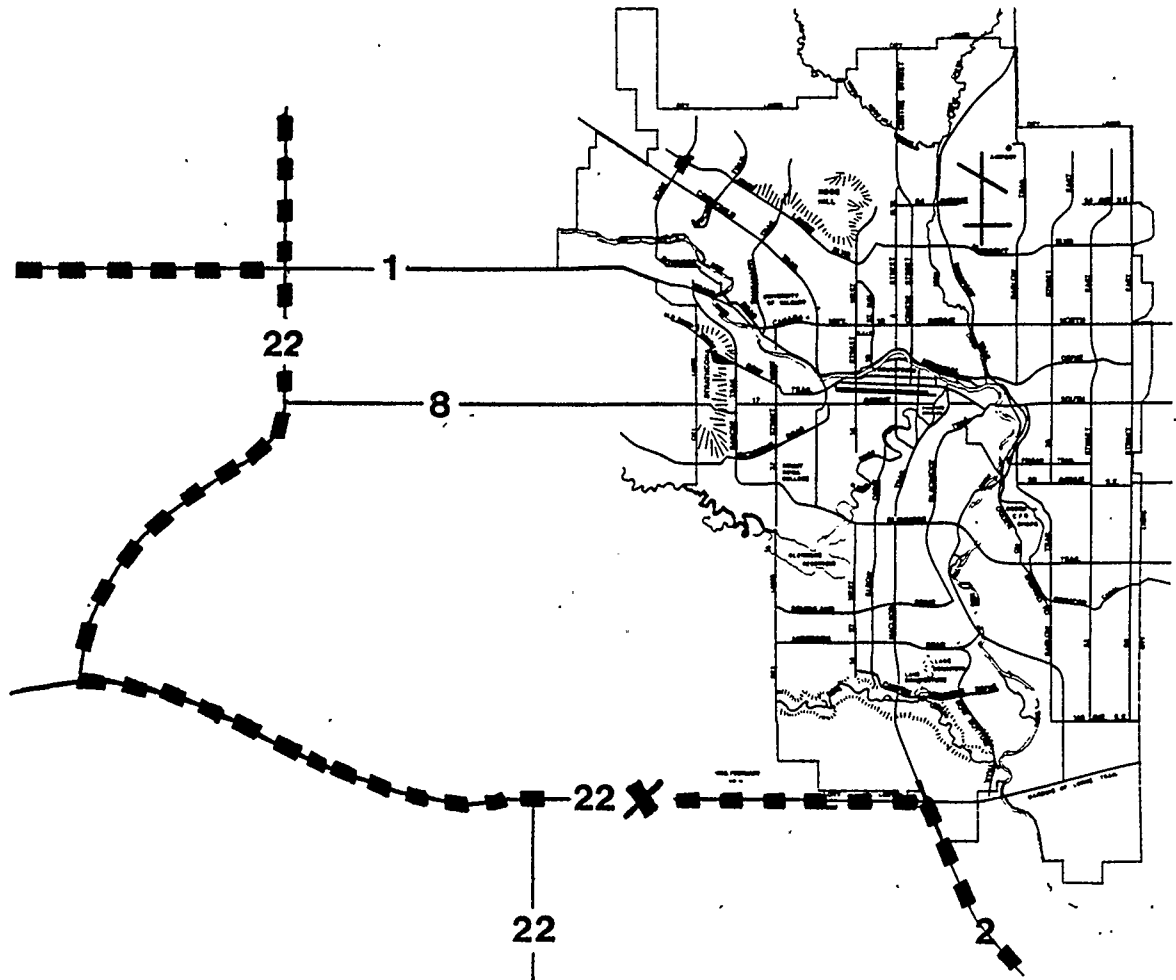
¹³² Calgary Economic Development Authority, op. cit., 30.

the business community in general will always object to further government intervention such as this. Even if finances are not threatened, it is a symbolic response and one that gets much attention if industry feels intimidated by government controls.

The entire bypass route is in good condition. Parts of it were upgraded in the last few years and further upgrading is scheduled for the next two years. The majority of the route is two lanes but twinning is scheduled for Highway 66 between Bragg Creek and Priddis. This route affects a minimum of population, mostly as it passes near Bragg Creek. Since it is outside of Calgary's jurisdiction, a provincial agreement would have to be sought through Alberta Transportation and APSS to designate it as an official bypass route for Calgary. Such an agreement should not be difficult to negotiate, primarily because the roadway already exists and no special construction or maintenance costs will be incurred. This route still passes over the Elbow River but in the instance of a spill, cleanup measures would be activated long before any problems could pose a threat to the water quality in Calgary. The length of the bridge over the river on Highway 22 is shorter than the causeway passing over the reservoir. Therefore, the likelihood of a direct spill is less also.

The elimination of the causeway over the Glenmore reservoir would reduce the probability of an accident that could result in the spill of dangerous substances directly into the water supply. Since other vehicles will continue to travel along this route,

FIGURE 8 : POSSIBLE SOUTHWEST BYPASS OF THE CITY OF CALGARY

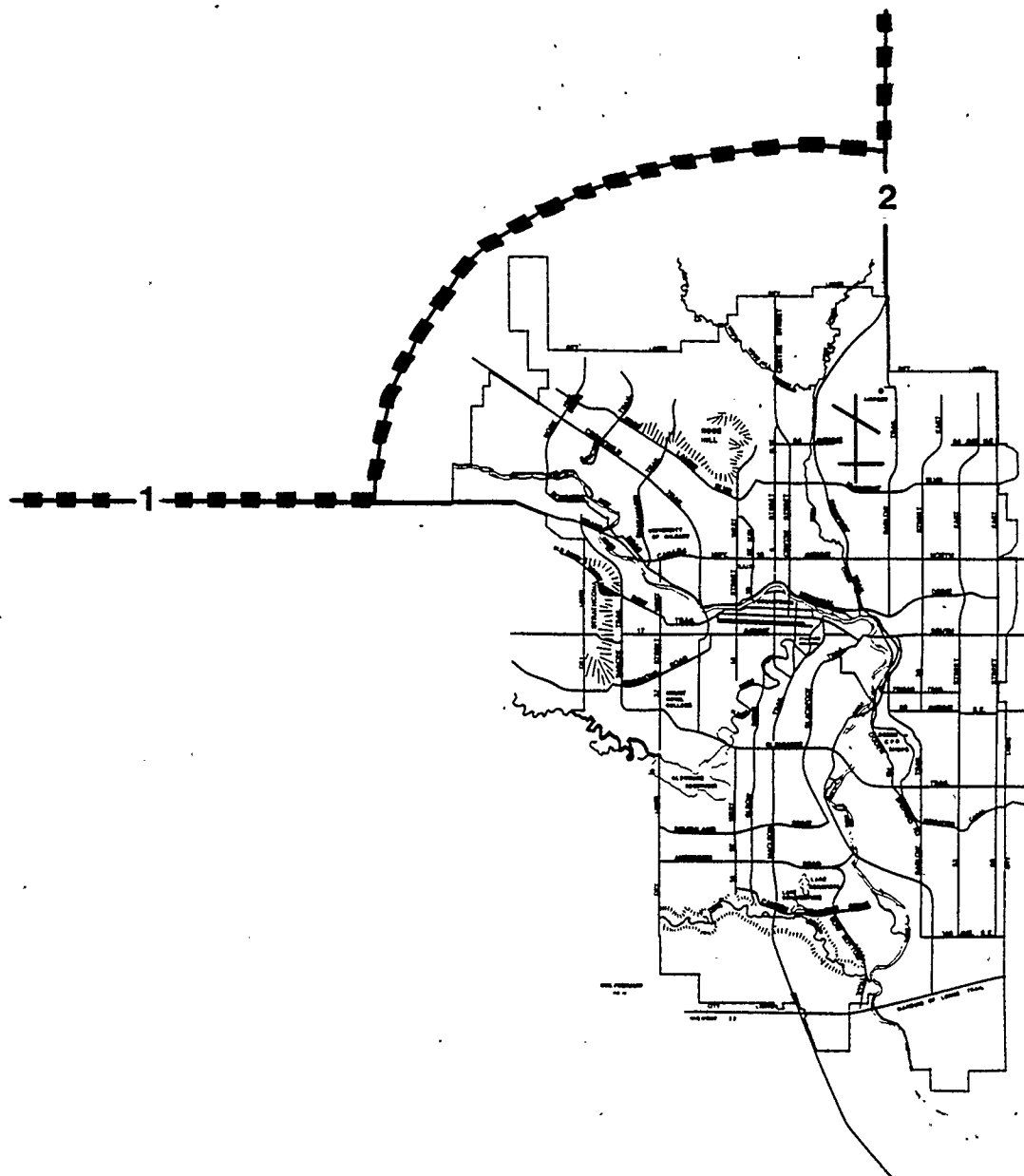


the possibility still exists for spills of fuel into the water. The use of the prescribed southwest bypass would reduce the probability of an accident involving a dangerous goods vehicle because the routes are less travelled. It would also result in fewer people at risk should an accident occur. If an accident were to occur, the emergency response team may take longer to respond because of distance, but the reduced risk makes this alternative a feasible one.

The difficulty in dealing with the TransCanada Highway as a dangerous goods route is primarily the cost of the only proposed alternative, a bypass around the northwest part of the city.¹³³ This proposal, as illustrated by the broken lines on Figure 9, is for a route that goes north from the TransCanada, just west of the city limits, then curves gently eastward at a point which lines up roughly with the existing Country Hills Blvd., and eventually joins Deerfoot Trail. The proposal does not include a route to join Deerfoot Trail in the north with the TransCanada east of Calgary, because all accesses onto the TransCanada east of Deerfoot are controlled with traffic signals and the highway is wider and in much better condition. This proposal has been submitted to the provincial government on several occasions. The Provincial Government has assured Calgary that the route will be constructed "some day". The City must continue to remind Alberta Transportation of the importance of

¹³³ City of Calgary, Transportation Department, "Stoney Trail Proposal", proposed in early 1970s.

FIGURE 9 : PROPOSED NORTHWEST BYPASS OF THE CITY OF CALGARY



Source : The City of Calgary, Transportation Department

this project. The Province has been purchasing properties when available, in order to build the route in the future. However, once approved, it will be close to ten years before it will be constructed, due to the reduced provincial transportation budget and the backlog of commitments.¹³⁴ The project will be a provincial endeavour and the costs will not be shared by Calgary.

As the city continues to grow, the use of risk analyses will be helpful in determining where residential, commercial and industrial development should or should not occur. The analyses would consider projected flows of dangerous goods, and the need for dangerous goods routes and storage facilities within the city. Inherent in the planning process would be development design sympathetic to the requirement for dangerous goods routes and the need for increased safety standards. Similarly, risk analyses could be applied to determine what types of land use are most/least compatible with the transportation of dangerous goods. Perhaps certain routes should have protective green belt buffer zones around them if a particularly volatile substance is commonly transported along them. Or, maybe they should be built below grade with walls on either side for better containment of a spill or for protection from wind in the event of a release of gas. Open undeveloped or recreational land could be a compatible use if it results in a low surrounding population for most of the day. Routes through these areas would experience limited damages in the event of a dangerous goods incident.

¹³⁴ Personal communication with Cliff Storvold, June 1988.

This paper provides only a cursory explanation of the details of risk analysis and focusses on the routing method to determine where dangerous goods routes should be located. There are many forms of risk analysis and any one of them might be more appropriate than the others to handle a certain situation in the future.¹³⁵ The City should be aware of the changes to risk analysis procedures and how other cities may be using them to determine public, property and environmental risks.

The most likely candidate for collecting the data required to apply the routing method, would be the Transportation Department. However, the actual process of the risk analysis would draw information and expertise from several departments and from the public. Details such as demographic statistics and characteristics, property values and approved future developments, would be available through the Planning Department. The Engineering Department would provide information about infrastructure; the Fire Department would provide information about fire station locations and equipment; and Parks and Recreation could indicate where environmentally sensitive areas exist. The public influence would be incorporated via the representatives who sit on the interdepartmental co-ordinating committee which will be discussed later. The person, section or department working on the risk analysis will have to consult with these other departments in order to get that needed information.

¹³⁵ Some of these differences are described in M. Matthews, op. cit., 4-5 and W.D Rowe, op. cit., 11-14.

A more likely scenario would be the hiring of consultants to actually conduct the risk analysis with the co-operation and assistance of any departments necessary.

Future research in this area might include the possibility of an existing computer model that can be manipulated to perform what has been called a sensitivity analysis in general transportation planning.¹³⁶ This type of analysis tests the response to changes in the magnitude of certain model parameters, in differing combinations. The objective is to discover what combination of factors achieves the optimal impact, (which could range from nothing to any level greater than that). Perhaps, once Calgary's data base has been expanded, such a model will be viable for use in Calgary. I am not aware of one in existence. However, geographic information systems have become quite advanced and also very popular, so the possibility that one does exist or is in the developmental stages, is quite good. If such a model exists or can be developed, the process of determining risks and where development should and should not occur will be much easier, at least in terms of the calculations.

Problem #2 - Public Awareness and Participation

At present, the public makes no solid contributions to decisions that affect the transportation of dangerous goods in Calgary. There is no mechanism whereby an individual can inquire

¹³⁶ E. Stokey and R. Zeckhauser, A Primer for Policy Analysis, (New York: W.W. Norton and Company, 1978).

about policy or planning for the transportation of dangerous goods. For information, one is directed to Fire Department personnel who appreciate public concern in the form of reporting suspicious activities, but does not encourage any influence on decision-making regarding dangerous goods policy. The information they provide tends to be vague and reassuring. It appears that they would prefer to keep the public at a distance from the issues. The public may even be unaware that dangerous goods pass through Calgary each day, and possibly right next door. Some argue that the public really does not want to get involved in such things because the issues are so complex and it expects the government to take care of us all anyway.¹³⁷ However, whether concerned or not, the public has the right to be informed about any issues that affect public safety, and this includes the transportation of dangerous goods.

The City, in turn, should know about the perceptions and fears of its citizens. It needs to know how acceptable the current transportation of dangerous goods is to the public, how willing it is to improve safety, and to pay the relevant costs to do so. A public perception survey is required to determine these things. One such survey was conducted in the Toronto area by Ekos Research Associates Inc., and it may be used as an example of what sort of information should be gathered (See Appendix 5 to view the survey conducted in the Toronto area). This particular survey resulted in some interesting findings that are likely to

¹³⁷ This was discussed at the Risk Course held in Banff.

hold true in most other communities:

1. In general, people have little knowledge about dangerous goods transportation.
2. As knowledge increases, so does tolerance and therefore, the acceptability of some risks.
3. People prefer to proceed with changes to improve safety rather than undergo major new construction. They view new construction as more disruptive to daily activities and also as more costly to the taxpayer.
4. People are less willing to proceed with plans as their personal share of the costs increases. Yet, even at a personal cost of \$250 per year, 50% of the Toronto area residents agree with proceeding with activities to reduce risk; and at \$50, nearly 80%!
5. People do not support the principle of shifting risks from more densely populated to less densely populated areas.

These are all important findings that will certainly affect the development of a risk management strategy for the Toronto area.

Once a public perception survey has been conducted, City officials will have the information upon which they can build a public awareness campaign. "Awareness" is a level of knowledge regarding an issue, which in this case, is safety and the transportation of dangerous goods. Studies have pointed out that the public wants to be made aware of dangerous goods and they want to be assured that everything possible that can be done, in terms of safety, is in fact being done.¹³⁸ The public cannot make this assessment unless they are provided with some information. But, why inform the public beyond it being their right? In a democratic society this should be sufficient reason,

¹³⁸ Ekos Research Associates Inc., op. cit., ii.

but there are costs associated with public knowledge and participation and sometimes it is difficult to determine whether public involvement is cost effective and in the best economic interest.

In transportation planning, public participation is

...the attempt by potential clienteles [the Public and other groups] to make transportation planning responsive to their interests and values. The result will be that considerations other than the classic engineering ones of cost, safety and speed will be taken into account in the decision-making process. Including the public in transportation planning has been justified from several standpoints; responsiveness, equity and expediency. Responsiveness, in that the participation of other clienteles [the Public and other groups] will result in decisions which will better serve their interests and be more consistent with their values. Equity, in that all those clienteles who will be significantly affected by a transportation decision are deemed to have a right to have a voice in that decision. Expediency, in that it may be necessary to involve new clienteles if politicians want to retain power and planners want to implement their plans.¹³⁹

The transportation planning process in Canada has included public participation of varied sorts since the mid 1960s, spurred on by public opposition to the proposed Spadina Expressway in Toronto, Ontario. Although the involvement of more actors with more interests and values could have made the process of planning more difficult and contentious, public participation was soon incorporated in the planning process because the public protests that developed in the 1960s had revealed the tenuous responsiveness of transportation officials. Due to the protests,

¹³⁹ B. Wellman, "Strategy and Tactics for Public Participation in Transportation Planning in North America", Public Participation in Transportation Planning: Alternative Strategies", Research Report No. 23, (Toronto: University of Toronto and York University, 1974) 1.

construction schedules were subject to delays and often to costly overruns or design modifications.¹⁴⁰ It became both technically and politically necessary to make public participation an integral part of the planning process because the pressure of responding to outside protest hindered the agencies' capacity to plan systematically and to implement decisions routinely. The incorporation of public demands and desires necessarily became part of the routine planning situation because it was impractical to treat them as crises factors.¹⁴¹

Granted, in the past, most of the issues that have arisen in terms of transportation planning have been social impacts such as noise reduction, esthetics of roadway design, or transit convenience. These types of considerations do not affect life and limb; rather they are like and dislike factors. In the case of the transportation of dangerous goods, the issues are more sensitive because they deal with safety, and consequently they do affect life and limb. They are a matter of fear and confidence and an appropriate level of information is required so as not to instill fear or to encourage apathy in the public.

The consideration of the transportation of dangerous goods is just an added dimension to the transportation planning process and should be included in the future. Experience has proven the public quite capable of understanding technical material as long as it does not contain awkward language or jargon and is

¹⁴⁰ *ibid*, 6.

¹⁴¹ *ibid*, 5.

presented clearly.¹⁴² The primary goal of informing the public is to establish public recognition of dangerous goods transportation as being a world-wide issue and in turn, to inform the public that industry and government are always working on solutions to the issues that arise and that they invite inquiries and suggestions on how to make improvements.

However, of what value is the effort of developing knowledge, if it does not evoke some constructive response?¹⁴³ There are two major misconceptions about public participation and its impact on decision-making for any kind of endeavour. The first is that the inclusion of the public is a "bizarre imposition from the outside by fuzzy-minded, misguided forces, and that it can only lead to bad planning".¹⁴⁴ The second is that "participation is essentially a ritual of democracy".¹⁴⁵ The fact is, that although there is an element of truth to both these claims, the public has real interests and concerns that should be included in the planning process that are not always obvious. It is unlikely that public participation will result in consensus on many issues but, it will assist in narrowing alternatives, bringing about new options and clarifying what the

¹⁴² *ibid*, 14.

¹⁴³ For more information on the reasons for public education see W.J. McGuire, "Theoretical Foundations of Campaigns", in Rice, R.J. and Paisley, W.J., Public Communication Campaigns, (Beverly Hills, Cal.: Sage Publications, 1981) 41-70.

¹⁴⁴ *ibid*, 18.

¹⁴⁵ *ibid*.

costs and benefits are by making a particular decision.

In the case of transportation of dangerous goods, there are two identifiable positive responses that increased knowledge could produce: more rational action in the case of an emergency related to a dangerous goods accident; and, greater scrutiny of the system and the actors who are involved in the transportation of dangerous goods. An awareness campaign may result first in community concern because the transportation of dangerous goods involves matters of hazard that are unknown to the public and admittedly uncertain to the experts. (It is important to note here that the use of the term "community" does not necessarily suggest small scale areas, but may mean larger areas and possibly an entire city). Concern, or fear, is often what promotes a greater interest in a topic or an issue and results in a desire for more information and the ability to affect the situation. This could lead to better participation in such things as learning evacuation procedures, deciding what community areas are least suitable for a particular type of development, or how to report odd occurrences or findings that possibly relate to dangerous goods. The public may also scrutinize the decision-makers in government and emergency response personnel. This interaction could be positive or negative but it will keep the public aware and contributing, as well as providing some stimulus for the actors in government and industry to remain responsive to community concerns.

The information provided by the awareness campaign would

also encourage the public to play an active role in the determination of objectives for its communities. In turn, the public would share the responsibility for the improvement of safety programs related to the transportation of dangerous goods as well as others that already exist. To achieve that greater measure of safety, the public would learn how they must respond in the event of an emergency. Familiarity with the procedures of evacuation should help to ensure that the community as a whole will act more rationally in the event of an emergency of any kind.¹⁴⁶ This greater organization and composure would be of major assistance to the emergency response personnel handling the situation and could result in the saving of lives.

The public as watchdog has been successful in other circumstances that are associated with crime and/or safety. For example, the "Neighbourhood Block Watch" program serves to keep communities on their guard and alert to unusual incidents.¹⁴⁷ "Crimestoppers" is another very successful program that has resulted in the apprehension of many violators and criminals.¹⁴⁸

¹⁴⁶ Practice fire drills in buildings are carried out with this aim in mind also i.e., that practice or familiarity will make the individual more competent and sensible.

¹⁴⁷ In June 1988 a rather odd sort of thief was apprehended in Calgary for stealing garden equipment over a period of several years. The man was found and charged as a result of the Block Watch program.

¹⁴⁸ "Crimestoppers" was established in 1982. It is funded solely through corporate and private donations. As of June 1988, the value of stolen property and illegal drugs that have been recovered, amounts to approximately \$31 million at a cost of only \$215 thousand paid out in rewards for information helping to solve crimes. 1,190 persons have been apprehended and charged

The reporting of placarded vehicles travelling on roads not designated as dangerous goods routes, or the noticing of a strange odour in an area, would help to alert the authorities about possible spills or by-law offenders.

There is no question that the public can be an extremely effective participant in efforts to maximize safety in dangerous goods transportation. This has been illustrated before.¹⁴⁹ However, to contribute constructively, the public requires information and knowledge about dangerous goods and how they affect our lives. This could be achieved through a public awareness campaign, one that provides a sound basis upon which informed opinions about the transportation of dangerous goods can be made. At present, only the media provide information of this nature and it does not provide a sound basis for forming opinions.¹⁵⁰ The concept of public awareness and participation as a management option affects, once again, both the probability of a dangerous goods incident and also the extent of potential damages in the event of one. The association may seem convoluted but, by having an influence on decision-making regarding dangerous goods routes and future development, the public helps

for various offenses. The program has proven to be very cost effective over its six year operation. For more information, Month End Reports are available through Calgary and Area Crimestoppers.

¹⁴⁹ D. Friend, op. cit., 192.

¹⁵⁰ This is not due solely to the nature of journalism. Government and industry are often selective in what information is provided to the media. L.L. Lackey, op. cit., 61-62.

to keep the probability of accidents to a minimum. Learning about evacuation procedures and how to make your own home less susceptible to fire or explosion, helps to minimize losses should an accident occur.

The public does not require an intimate knowledge of dangerous goods transportation. There is no need to present them with detailed projections of dangerous goods movements in Canada or a set of amendment schedules to the TDGR. Such things will only serve to create confusion about the more local issues. What is needed, is a well-rounded education about how important dangerous goods are to society, what risks are involved in transporting them, how the City approaches dangerous goods safety and where the problem areas exist. To complement this information, the campaign should provide means for the public to contribute to the discussion of issues and therefore influence decisions, if they choose to.

The Planning Department would be the best preparatory organizer of a campaign of this nature. However, other departments would be needed to contribute and approve of the content (such as those to be represented on an interdepartmental co-ordinating committee). It might be logical for consultants to design and administer the campaign, especially if a consultant is hired to perform the public perception survey which is the preliminary step in the process of a public awareness campaign. The campaign should be delivered on a community basis across the entire city. The interdepartmental Dangerous Goods Co-ordinating

Committee, would review the process and the content thoroughly for its appropriateness and accuracy.

It is extremely important to recognize the difficulties inherent in efforts to educate the public that in turn, can be exacerbated by local problems. It is very common for public participation attempts to be plagued with problems at all levels of the process which are affected by inaccurate information, attitudes of city officials and the traditionally low turnout for meetings to discuss the issues. In Calgary, this is evident and the low performance to date by the City, to educate its public, indicates that it is not clear about what is wanted or needed.

A measure of insufficiency must be expected in any public awareness campaign, despite efforts to reach the majority. There are always people who just do not respond or seem to care about even the most crucial issues.¹⁵¹ Perhaps the use of various media to promote public awareness will result in a greater number of persons gaining knowledge. Part of the campaign could take the form of a graphic mall display which reaches many people of all classes and ages. Another part of the campaign could be in the form of reading materials distributed to each household. Local newspapers could include some interesting highlights and offer contact numbers for more information or list times, dates and places where public information workshops or seminars will be held. Any combination of these types of means to introduce the public to dangerous goods and the issues surrounding them, in

¹⁵¹ B. Wellman, op.cit., 4.

terms of production, transportation and storage, would be a positive step towards the development of the public as a worthwhile contributor to the development and review of a risk management strategy for Calgary.

Some research into program design and delivery, that focuses on the general public as the target group, will have to be conducted. This might include research into graphic design and other such areas that affect the sociological impact of presenting information and the review of other public information campaigns, especially those dealing with health or safety issues. The ultimate cost of a campaign is not easily comparable to the possible benefits it will encourage in the long term.

Another, more formal, avenue to promote public awareness, is through the public education system, beginning at the elementary level. Children could be taught the symbols and/or colours used in the classification of dangerous goods which are displayed on transport vehicles carrying dangerous loads. They are already taught a number of symbols to promote their own safety such as "Cross Bone Jones" which means poison and do not touch. This could be incorporated into the curriculum quite simply and gradually with more complicated issues being dealt with at higher education levels. By starting out with simple identification, children will become interested in the topic and, as they grow older, they will be better equipped to contribute to their communities when issues regarding dangerous goods arise.

To teach this information, officials from the fire

department would be most appropriate, at least in the earlier stages, until a teacher is qualified to do so. A teacher or teachers, could be trained in much the same fashion as the firefighting force is, through a brief but comprehensive course at the training centre in southeast Calgary.

Post Secondary Education, possibly through the Northern and Southern Alberta Institutes of Technology, may be another avenue to take. The Transportation of Dangerous Goods is a large and rapidly growing field. There may be warrant for the "Transportation and Handling of Dangerous Goods" to find a place as an established curriculum or as part of a larger one, for which a diploma could be earned. There are already a great number of programs and courses that are required for different levels of expertise in emergency response. The need for individuals trained to deal with dangerous goods at all levels, i.e., planning through emergency response is rapidly growing.¹⁵² The preparation of younger individuals could result in a more youthful, experienced force and one that will have members who made the issues of the transportation of dangerous goods, a actual career choice.

¹⁵² There are not enough trained enforcement personnel available to ensure that the Transportation of Dangerous Goods By-law is being obeyed in the Calgary area. This lack provides opportunities for violation of the by-law and thus increases the likelihood of a dangerous goods incident. Personal communication with Constable J. Litkowski, Calgary Police Force, June 1988.

Problem #3 - The Role of the Planning Department

The Planning Department presently plays no role in transportation of dangerous goods decisions and is minimally informed about the present framework to reduce or mitigate public risks. This is odd because part of a community planner's role is to form a link between the citizens of the community and the government that serves them. This is a role unlike that played by most other government departments. The Planning Department develops the structural framework or design of the functioning city. The other departments almost independently fill in that framework with details such as buildings, parks, industrial sites and other features. Therefore, the Planning Department is a sort of umbrella under which other departments act and contribute; essentially, an organizing body. Based on these notions, the community planner would be the most appropriate liaison person to activate public awareness and participation.

The planner is already accountable for a great number of responsibilities and must often play the role of troubleshooter in development situations. There is a countless number of factors involved in planning for people and the natural and man-made environments. Naturally, they are often at odds with each other. Therefore, the addition of another responsibility to the current ones a planner must address, will pose additional stresses. It would be unreasonable to assume that this new effort, to include transportation of dangerous goods considerations in community planning, should immediately be given

high priority. The planner will have to continue to weigh the costs and benefits as always, but, the transportation of dangerous goods must be included to some degree immediately in community planning.

The planner would not need to learn all there is to know about the transportation of dangerous goods. Rather, the planner would gather and disseminate information acquired through the various other contributing departments such as the Fire Department, the Transportation Department and the Police Department. This role, as an interactive link between the public, industry and the rest of the municipal government, is a very important one.

The other way in which the Planning Department can participate in decisions that impact on the transportation of dangerous goods is through representation on an interdepartmental Dangerous Goods Co-ordinating Committee. This committee would be set up to discuss issues about the transportation of dangerous goods and how they affect Calgary's future growth. Since planners are concerned with land use, people and the environment, they would be worthwhile contributors to decisions that could affect any of these three areas. The structure and role of this committee will be discussed later in this chapter.

Approaching this issue from the opposite direction, some planning decisions need greater input from other departments to ensure that they are made in the best interest of the public. Though development plans are forwarded to fourteen government

sections and the affected Community Associations for review before approval, the process is rather casual. Some officials stated that, in some instances, the time allowed for the review was inadequate or their office was just too busy to give them thorough consideration. The design and density of development in the northeast area, discussed earlier, are examples of planning decisions that were more likely short-term political decisions rather than thoroughly thought through ones.

In fact, at no stage in the planning approval process is it evident that the issue of dangerous goods transportation is addressed explicitly. It is not identified as a development factor with certain criteria that must be met for the approval of a plan. The Fire Department reviews it primarily from a response capability perspective. Plans are not designed with dangerous goods in mind as an important safety-limiting factor. Perhaps an individual should be specifically responsible for dangerous goods route planning and development approval. This role would most likely fit into the Transportation Department and could incorporate a number of other related responsibilities such as federal, provincial and local legislation review, chairmanship of the interdepartmental Dangerous Goods Co-ordinating Committee, and the process of dangerous goods route data investigation. This person would represent a solid link between the departments.

The problem of insufficient interdepartmental co-ordination will be addressed next.

Problem #4 - Interdepartmental Co-ordination

It is rare that input is provided by many municipal departments on a dangerous goods issue because there are always what are deemed to be more pressing departmental concerns. This kind of problem is common in many bureaucracies. An organized inter-departmental Dangerous Goods Co-ordinating Committee is needed, ideally comprised of representatives, as listed in Table 4, from all of the community associations and a number of the departments and businesses currently on the Planning Department's circulation letter. (Clearly, the inclusion of public representatives on council committees, discussing any issue, would be beneficial.) The inclusion of all the representatives listed may be overwhelming. Instead, representatives to cover larger communities or regions may be most appropriate. These groups of representatives may be augmented for area-specific issues on an ad hoc basis through a series of sub-representatives perhaps.

A similar group to discuss dangerous goods issues was formed in the past, comprised of representatives from the Fire and Police departments, the Provincial Government, the Transportation Industry and Canadian Western Natural Gas. But it only existed for a short term; City Council did not support it, since dangerous goods transportation and handling were not perceived as an important issue. With the growing importance of dangerous goods, the handling of them is now recognized as an important issue; for example, in June, 1988 Alberta Fire Chiefs met in

Leduc for three days to review and discuss the latest dangerous goods issues that have arisen in the province.¹⁵³

The formation of a specific group is the only way to ensure that there is equal opportunity for contributions and inquiries regarding an issue from municipal departments, concerned businesses and the public via its community representatives. Each of the members should be formally educated to some extent about dangerous goods legislation, transportation problems, emergency response and community awareness. The City would provide this education using instructors with a set curriculum. The Community Awareness and Emergency Response Handbook devised by the CCPA, may be a good reference for this group and a subscription to the Transport Canada Dangerous Goods Newsletter would help them keep abreast of activities around the country and internationally.

The purpose of this formal group would be to provide a forum to raise issues and concerns as well as to gather and distribute information. Any proposed activities or issues that arise which may affect Calgarians with regard to dangerous goods transportation, would be presented by members of the committee to the rest of the committee. The opportunity for members to ask questions or make suggestions would be provided. Recommendations resulting from the meetings would be formally tabled and the appropriate representatives would perform the necessary followup actions. The community representatives would solicit feedback

¹⁵³ Access CKUA radio report, June 20, 1988.

**TABLE 4 : LIST OF INTERDEPARTMENTAL CO-ORDINATING COMMITTEE
REPRESENTATIVES**

City Departments

Planning
Engineering
Fire
Transportation
Calgary Police Service
Emergency Medical Services
Electric System
Business Development
Land
Parks Site Planning Sub Committee
Social Services

External Parties

Alberta Government Telephones
Canadian Western Natural Gas
Calgary Cable TV
Rogers Cable TV
Calgary Board of Education
Separate School Board
Ward Aldermen
Community Association Representatives
Calgary Regional Planning Commission

**Source : The City of Calgary Planning Department, Circulation
List**

from the affected public. (It is clearly necessary that the public be aware of dangerous goods issues to be able to respond and contribute knowledgeably in this situation.) The end result should be better planned developments in the future, the recognition of public concerns as indicators of what decisions are most suitable, and a better informed bureaucracy in general. The left hand need not be unaware of what the right hand is doing but this has been the case on occasions in the past.¹⁵⁴ In the future, with the establishment of this committee, the process of communicating should be easier and more effective. In turn, both the numbers of incidents and their effects should be minimized.

Problem #5 - Training and Emergency Response

The City of Calgary Fire Department has an excellent training facility located in southeast Calgary. The courses and on-site emergency exercises provide invaluable experience for Fire Department personnel. The trainers are members of the Hazardous Materials Section and they regularly teach and take part in training exercises. Fire personnel are well trained and prepared for most types of accidents that could occur. However, the Fire Department is not the only responder to dangerous goods accidents.

The Police Department and Emergency Medical Services (EMS) are also part of the force which arrives at the site to provide

¹⁵⁴ Several officials did not know about various issues or concerns such as the status of the northwest bypass proposal or the current locations of dangerous goods routes.

assistance. Though a document has been prepared to delineate a structure of authority, one which places the Fire Department in charge, it would be beneficial if the three departments were to co-ordinate training as well, primarily to provide consistency in learning which can result in a more efficient emergency response. No doubt there are details that it is not necessary for EMS or the Police to know, just as there is information that the Fire Department will not need to know in terms of enforcement at the scene of an accident. Nevertheless, it would be advantageous for the three members of the response force to work together in theory as well as in practice. There is the possibility that differing factual or theoretical information exists between the departments and errors or discrepancies at the site of an accident could jeopardize the response and result in undue losses.

Links do exist between the departments but they are not solid. Apparently communications have not been sound between the Fire Department and EMS in the past, due largely to internal political reasons.¹⁵⁵ The Fire Department trains its own personnel. The Police receive their training via APSS with regard to enforcement and inspection and they participate in a course with EMS that is essentially an issues course, where concerns are brought forward, discussed and hopefully resolved. These efforts, though they have improved safety overall, are

¹⁵⁵ There were problems associated with operations in the fire stations regarding responsibility and authority. Personal communication with Tom Sampson, June 1987.

disjointed and seem to have developed on an ad hoc basis.

An approach toward obtaining some standardized training, is to establish a working group with members from each of EMS, the Fire Department, Engineering and the Police Department, and devise a structured teaching program that addresses emergency response from all perspectives. The Engineering Department should be included because in many instances engineering personnel will discover an incident and in some cases will participate in the cleanup procedures. The key factor will be consistency of information and knowledge of state-of-the-art practices. Transport Canada's emergency response training video may be a valuable addition to the repertoire of Fire Department training resources. It is likely that the participants will end up with a greater understanding and appreciation of the roles played by the other actors in the emergency response. In addition, technical information, that might have been updated or have been subject to interpretations in the past and passed on incorrectly, can be verified.

A cohesive response force will strengthen the effectiveness of emergency procedures and will thus reduce the extent of losses due to an incident involving dangerous goods.

Problem #6 - Data Base

Though Capt. MacKenzie claimed that Calgary has an extensive data base, this was not evident in terms of the more specific items of importance regarding dangerous goods. Greater detail is

required in order to make better judgements and predictions about the flow of dangerous goods in Calgary. Accurate information such as numbers of vehicles carrying dangerous goods, what they are carrying and how much, where to and how frequently, are important pieces of information, especially when performing risk analyses. Such data will assist in the designation of future dangerous goods routes, the monitoring of current routes and the study of what areas of the city are at greatest risk. By knowing these things, actions to reduce the probability of an incident, such as load restrictions or time of day restrictions, can be implemented. In addition, by understanding the situation, the response team and the community can be better equipped to deal with an incident.

It is difficult to recommend a means of accurately collecting these statistics. One possibility would be to make use of vehicle inspection stations (VIS) located near the city limits. It is probably difficult to pull over all vehicles, especially small ones that do not often get called into a VIS or travel within the city but do not pass a VIS. It might be feasible to arrange a system of signs indicating that all vehicles carrying dangerous goods must report to a certain checkpoint between specific hours or if they are carrying a particular type of commodity. These parameters could change or include other details as well.

Perhaps a mechanical system of some kind could be developed to monitor the vehicles travelling along dangerous goods routes

using cameras or some other technology. This would address the problem of getting all vehicles included in the effort to receive accurate data, however, it could be costly.

Part IV of the TDGR stipulates that shipments of dangerous goods must be accompanied by a declaration providing information about the shipment including what the product is, how much there is of it, where it is coming from and where it is going to. These declarations could be registered with a specific authority within each province, data could be collected and then provided to areas requiring the information for conducting various analyses. Similarly, the Calgary Transportation of Dangerous Goods By-law could include requirements for all shippers within the city to submit regularly the same types of information to the Transportation Department. By collecting data in these ways, Calgary would know what percentage of traffic is through movements, what goods are most prevalent, what routes are most travelled etc. Further research is needed to establish a simple and economical means of obtaining this data.

A transportation of dangerous goods study was conducted by a consultant for Alberta Economic Development in 1984. In this document are figures for volumes of dangerous goods and numbers of vehicles travelling through the province during 1983-84. Some of these figures were referred to in an issue of H.O.T.line magazine and they were cited in Chapter Two of this document. The consultant must have devised some way to collect this data (though it may not be accurate). However, this report contains

"sensitive" data and, therefore, despite efforts, was not made available for viewing. Thus, the consultant's data collection method could not be reviewed.¹⁵⁶

Problem #7 - Enforcement of the Transportation of Dangerous Goods By-law

As a form of encouragement to comply with the regulations set down by the Transportation of Dangerous Goods By-law, an increased number of impromptu inspections by trained Police personnel should be carried out within the city limits along major travel routes, (dangerous goods routes and others), and at facilities where dangerous goods may originate or be delivered. This is already done, but there is a need for a more intense program of inspection, given the provincial and federal non-compliance figures (31% and 85% respectively). The shortage of trained inspection and enforcement officers may make this a difficult task. Conceivably, fewer warnings and larger fines are in order. The TDGR were adopted by Alberta and have been in effect for over two years now; adequate time for transporters to have learned how to comply with the by-law. Naturally, if carriers decide not to take chances violating the by-law, then the by-law works to reduce both the probability of an accident occurring and the degree of damages should an incident take

¹⁵⁶ Personal communication with N. McCullough, Dangerous Goods Control Division, APSS, May 1988. Stanley Associates Engineering, "Transportation of Dangerous Goods in Alberta", (Edmonton: Alberta Economic Development, Transportation Services Branch, 1984).

place.

An example of a program that deters violation is the RIDE program (Reduce Impaired Drivers Everywhere). The program is administered by the City Police. It used to be strictly a seasonal program focusing on the festive Christmas months when greater numbers of people were found drinking and driving afterwards. In some cities it is now a year round program whereby police set up check stops in various locations where violations tend to be more frequent. The number of persons driving under the influence of alcohol, has dropped significantly over the past several years. This has been achieved primarily by threatening fines and/or charges if an individual is caught.¹⁵⁷

¹⁵⁷ Calgary Police Department.

RECOMMENDATIONS

The management options that have been suggested in this chapter will effect a reduction in risk by acting directly or indirectly on the probability of an accident's occurrence or the extent of damages in the event of an accident, as described in Chapter Three.

In summary, the following actions are recommended to improve the safety situation in the City of Calgary.

- * Apply the Hazardous Materials Routing Method to the dangerous goods routes that are currently being used and test some alternatives.
- * Include more details on the Dangerous Goods Routes map regarding allowable routes during peak traffic hours, speed limits and what procedure to follow when making deliveries or pickups in areas not serviced by a dangerous goods route.
- * Implement the use of the Dangerous Goods Route Sign that is Schedule B of the Transportation of Dangerous Goods By-law.
- * Eliminate the Glenmore causeway as a dangerous goods route.
- * Continue to approach the Provincial government about a northern bypass route so that traffic along the TransCanada highway can be minimized.
- * Expand and regularly build upon the existing dangerous goods data base.
- * Investigate whether a feasible computerized risk or routing model exists, and whether it is obtainable.
- * Develop a public awareness and risk perception survey to be

applied across the city.

- * Based on the findings of a public awareness and risk perception survey, develop and implement a public awareness campaign spearheaded by community planners.

- * Introduce the transportation of dangerous goods into the education system.

- * Establish an official Dangerous Goods Planner position within the Transportation Department, one that allows autonomy from the Transportation Department so that it will function as an effective link between the departments.

- * Establish an interdepartmental Dangerous Goods Co-ordinating Committee comprised of representatives listed in Table 4.

- * Provide training for emergency response personnel that is comprehensive and consistent for all the participating departments.

- * Determine whether or not the Police force has the authority to increase the number of fines and instructions to "proceed to the courts" that are issued to violators of the TDGR and if so, they should become more strict by issuing more of each.

CONCLUSION

The word "safe" as defined by the Oxford Dictionary, means free from risk or danger. But, since no activity truly can be free from risk, no activity can be said to be absolutely safe. There are degrees of risk and, consequently, there are degrees of safety. Therefore, a measurement of the risk and a determination

of how acceptable that level is, is necessary. Safety is a highly relative attribute that can change from time to time and be judged differently in different contexts. This is due, primarily, to the fact that our knowledge of risks evolves and so do our personal and social standards of acceptability. There is no better example than smoking to illustrate this point. With these factors in play, there will always remain differing opinions about how safe is "safe enough" or "as safe as possible".¹⁵⁸ The "grey area" where risk is not defined as either acceptable or unacceptable, as described in Chapter Three, will always exist. It is within this area that the management options will be applied. The sometimes immeasurable gain in safety that will be achieved by them will no doubt be considered less beneficial by those persons who, by nature, tend to take risks, than by those persons who are generally more cautious.

The options in this chapter have been presented as creative, but untested, suggestions and, therefore, may not be easily supported with proof of their end results or success for Calgary. The cost implications of the options are not easily determinable because they will involve further research and refinement prior to their implementation. This paper has suggested the basic means to effect change in the various areas of concern that have been noted.

It is important to reiterate that the City of Calgary has a good safety record, relative to other places in Canada. It has

¹⁵⁸ Concord Scientific Corporation, op. cit., 4.

made solid efforts to organize the process of emergency response and to ensure the state-of-the-art abilities of its fire fighting force. However, it needs to expand its horizons into some other areas of importance which have been addressed in this paper. The original hypothesis stated in Chapter One, "despite the great progress that has been made by the City of Calgary in this area of safety, there are further steps that should be taken which will result in greater safety for the city's citizens", is correct and there is room for improvement to public safety in Calgary. This greater safety will be achieved through the reduction of the probability of an event and/or by the enhancement of the mitigation measures that are employed and/or through greater community preparedness which will result in reducing the potential losses, as described in Chapter Three.

The transportation of dangerous goods is a sensitive issue. In the process of researching this paper, it became clear that something of a mist shrouds the numerous issues. No one seems entirely certain of what they know to be true or what is hearsay. I even found discrepancies in print. This made it difficult to find out details and to be sure that what I did find out was, in fact, the latest information. Therefore, I cannot attest to the complete accuracy of all the details contained herein. The whole field of transportation of dangerous goods is still in its infancy. The newness of legislation and the accompanying confusion regarding regulation confirms this, while amendments, revisions and issues are brought forward almost daily. During

the period in which this paper was written, many new items and issues arose; for example reclassifications of products, updates on emergency response training, and the controversy over whether empty tanker trucks are indeed ever empty and should they be placarded in any special manner. Many of the issues have been dealt with while others have yet to be addressed. There are many upcoming meetings and conferences scheduled world-wide to search for solutions to the issues.¹⁵⁹ Meanwhile, we continue to hear about the truck tanker that flipped and the subsequent roadway closure, the railway car that leaked or the blatant violation of placarding regulations by some unknown carrier.

¹⁵⁹ The Dangerous Goods Newsletter issued by Transport Canada and the H.O.T.line magazine issued by Alberta Public Services, both provide information on upcoming events that are relevant to the handling of dangerous goods.

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APPENDICES

**APPENDIX 1 : THE TRANSPORTATION OF DANGEROUS GOODS SECTION
OF THE OLD TRUCK ROUTES BY-LAW**

SOURCE: THE CITY OF CALGARY, TRANSPORTATION DEPARTMENT.

Hazardous Products

5A In Sections 5B, 5C, 5D, 5E, 5F and 5G of this By-law:

- (a) "allowable quantities of goods" means hazardous goods being transported:
 - (i) in bulk in quantities of less than One Thousand Kilograms (1,000 kg.);
 - (ii) in consumer packaging; or
 - (iii) pursuant to Special Permit issued pursuant to this By-law;and it includes a reasonable supply of fuel for use in the vehicle conveying the same;
- (b) "carrier" means any person conveying hazardous goods in, into, through or out of the City by either truck, trailer or semi-trailer;
- (c) "Central Business District" means that portion of the City contained within the boundaries described in Schedule "D" to this By-law;
- (d) "hazardous goods" means any solid, liquid or gaseous product, substance or organism that is an actual or potential hazard to the health or safety of any persons, animals, property or the environment or any product, substance or organism prescribed in any manner whatsoever as hazardous or potentially hazardous as aforesaid by the Federal Government or by the Province of Alberta or by any International Agency, but it shall not include allowable quantities of goods;
- (e) "Hazardous Goods Truck Route" means a highway so designated in Schedule "E" to this By-law;
- (f) "Permitted Storage Location" means any premises in the City located at least One Hundred and Fifty Metres (150 m) away from the nearest residence and at which there are adequate security devices to prevent theft or damage to any motor vehicle stored on such premises.

(B/L 28M79, 1979 June 18)

(B/L 34M79, 1979 July 23)

- 5B
- (1) No carrier shall convey hazardous goods in or into the Central Business District between the hours of 6:00 A.M. and 6:00 P.M., Monday to Saturday, both inclusive.
 - (2) No carrier shall convey hazardous goods through the Central Business District from a location outside the Central Business District to a location outside the Central Business District at any time unless such hazardous goods are part of a shipment the remainder of which are being delivered in the Central Business District in accordance with all other provisions of this By-law.
 - (3) Notwithstanding any other provision of this By-law no tank vehicle capable of carrying flammable or hazardous liquids in excess of One Thousand Kilograms (1,000 kg.), shall be allowed to enter or to through or to remain in the Central Business District after six o'clock in the morning and before six o'clock in the evening of any day from Monday to Saturday, both days inclusive, and no carrier shall cause, permit or suffer such a vehicle to enter, drive through or remain in the Central Business District during such times.

(B/L 28M79, 1979 June 18)

(B/L 4M80, 1980 February 19)

- 5C
- (1) No carrier shall enter the City on other than a Hazardous Goods Truck Route.
 - (2) No carrier shall leave the City on other than a Hazardous Goods Truck Route.

- (3) If a carrier is conveying hazardous goods through the City from a location outside the City to a location outside the City such carrier shall:
 - (a) Proceed on the shortest combination of Hazardous Goods Truck Routes between the location where the carrier enters the City and the location where the carrier proposes to leave the City;
 - (b) Remain at all times on a Hazardous Goods Truck Route; and
 - (c) Not stop within the City except in accordance with the directions of traffic control devices and Enforcement Officers or at a permitted storage location.
- (4) Subject to Section 2 of this By-law a carrier may, for the purpose of obtaining or delivering hazardous goods from a location off a Hazardous Goods Truck Route drive his vehicle on streets forming the most accessible connection between the delivery or collection point, as the case may be, and the Hazardous Goods Truck Route.
- (5) Without restricting the generality of Subsection 5C (3) no carrier conveying hazardous goods through the City from a location outside the City to a location outside the City shall obtain or deliver any goods other than hazardous goods from a location off a Hazardous Goods Truck Route.

(B/L 28M79, 1979 June 18)
(B/L 34M79, 1979 July 23)

- 5D In the Central Business District no person conveying hazardous goods shall convey the same by truck, semi-trailer or trailer if there is attached to the truck or semi-trailer a trailer and no person conveying hazardous goods shall convey the same in a trailer if there is attached to the trailer a second trailer.

(B/L 28M79, 1979 June 18)

- 5E No person shall:
- (a) Drive any motor vehicle transporting hazardous goods in excess of the allowable quantities as defined in Section 5A unless such person is in the act of transporting such hazardous goods directly to a point of delivery or to a permitted storage location; or
 - (b) Park or leave unattended any motor vehicle containing hazardous goods in excess of the allowable quantities as defined in Section 5A unless in a permitted storage location.

(B/L 34M79, 1979 July 23)

- 5F
- (a) A carrier shall, when requested by a Police Officer, produce for such Officer's inspection the Bills of Lading showing the origin and destination of the trip and the description of the load.
 - (b) Particulars obtained by a Police Officer from a Bill of Lading produced to him under Subsection (1) of this Section and submitted by him in evidence in Court shall be prima facie proof of the particulars thereon submitted in evidence without proof of signature or official capacity of the person signing the Bills of Lading.

(B/L 34M79, 1979 July 23)

- 5G
- (a) A carrier may apply for a Special Permit with respect to hazardous goods being transported to or delivered to a location within the Central Business District. If the carrier furnishes evidence in support of his application, which establishes that he would be unable to deliver or transport the hazardous goods in accordance with the other provisions of this By-law, the Fire Marshall shall issue a Special Permit.
 - (b) A Special Permit may be granted subject to terms and conditions respecting the transporting and unloading of the hazardous goods which the Fire Marshall determines in the circumstances are necessary to safeguard the citizens of Calgary and their property.

5H Notwithstanding any other provision of this By-law, a carrier whose vehicle requires emergency repairs or service may leave a Hazardous Goods Truck Route for the purpose of proceeding to the nearest service station, garage or other type of repair depot where such emergency repairs or service may be obtained.

(B/L 39M80, 1980 November 17)

APPENDIX 2 : THE TRANSPORTATION OF DANGEROUS GOODS BY-LAW, 1988

SOURCE: THE CITY OF CALGARY, TRANSPORTATION DEPARTMENT.

BY-LAW NUMBER 67M87

Being a By-law of The City of Calgary
respecting the transportation of
dangerous goods.

WHEREAS the City is empowered by the Transportation of Dangerous Goods Control Act, Chapter T-6.5, to regulate the transportation of dangerous goods within the corporate limits:

AND WHEREAS in the interests of public safety the City is desirous of restricting vehicles transporting dangerous goods to Dangerous Goods Truck Routes and designated truck routes as much as possible.

NOW, THEREFORE, THE COUNCIL OF THE CITY OF CALGARY ENACTS AS FOLLOWS:

1. This By-law may be cited as the "Transportation of Dangerous Goods By-law".
2. Definitions contained in the Transportation of Dangerous Goods Control Act and Regulations, as applicable, are adopted for the purposes of the interpretation and the application of this By-law.
3. In this By-law:
 - (a) "carrier" means any person transporting dangerous goods in, into, through or out of the City by any vehicle;
 - (b) "Central Business District" means that portion of the City contained within the boundaries described in Schedule "A" attached to and forming part of this By-law;
 - (c) "dangerous goods" means dangerous goods for which placards are required by the Transportation of Dangerous Goods Control Act and Regulations;
 - (d) "Dangerous Goods Route Signs" means those signs identified in Schedule "B" attached to and forming part of this By-law;
 - (e) "Dangerous Goods Truck Route" means any highway so designated in Schedule "C" attached to and forming part of this By-law which may be posted with Dangerous Goods Route Signs;
 - (f) "service station or repair depot" means any premises licensed for the purposes of dispensing fuel or carrying out mechanical repairs;
 - (g) "truck route" means a truck route as defined in the Truck Routes By-law (By-law 77/75); and
 - (h) "vehicle storage location" means any area which is at least one hundred and fifty (150) metres away from the nearest residential, institutional or assembly occupancy and has been accepted by the Fire Marshal, or other location accepted by the Fire Marshal.

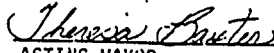
4. Subject to this By-law, all trucks transporting dangerous goods are also subject to the Truck Routes By-law as amended from time to time.
5. Subject to Section 7, no carrier shall transport dangerous goods other than on a Dangerous Goods Truck Route except:
 - (a) to obtain or deliver dangerous goods from or to a location off a Dangerous Goods Truck Route or to gain access to a vehicle storage location, in which event he shall:
 - (i) proceed on a Dangerous Goods Truck Route to the truck route which forms the most direct route to the collection or delivery point or the vehicle storage location;
 - (ii) proceed on the truck route specified in (i) directly to the collection or delivery point, the vehicle storage location or to the street which forms the most direct route thereto;
 - (iii) if applicable, proceed on the street specified in (ii) directly to the collection or delivery point or the vehicle storage location; and
 - (iv) return to the Dangerous Goods Truck Route on the same street and truck route; or
 - (b) to obtain emergency repairs or service at the nearest service station or, repair depot located on a truck route.
6. No carrier shall stop within the City except:
 - (a) in compliance with a peace officer, an inspector or a traffic control device;
 - (b) to load or unload;
 - (c) to repair or refuel the vehicle; or
 - (d) at a vehicle storage location.
7.
 - (1) Notwithstanding Section 5(a) and (b), no carrier shall transport dangerous goods in the Central Business District except to obtain or deliver dangerous goods from or to a location in the Central Business District.
 - (2) No carrier shall transport dangerous goods in the Central Business District between the hours of 0600 and 1800, Monday to Saturday, both inclusively.
 - (3) No carrier shall transport dangerous goods in the Central Business District in any combination of vehicles that includes a trailer except a single trailer attached to a truck tractor.
8.
 - (1) A carrier may apply for a Special Permit to transport dangerous goods in the Central Business District other than in the manner set out in Section 7.
 - (2) Application for a Special Permit shall be made to the Fire Marshal and shall contain evidence to support that compliance with Section 7 is impracticable.
 - (3) The Fire Marshal may issue a Special Permit granting total or partial exemption from the requirements of Section 7 and may impose any terms and conditions considered necessary in the circumstances to safeguard the citizens of the City and their property.

- (4) Any contravention of the terms and conditions contained in a Special Permit issued in pursuance of Subsection (3) shall render such Special Permit invalid.
9. (1) A carrier shall, when requested to do so by a peace officer, produce for such officer's inspection the shipping document showing the description, origin and destination of all consignments of dangerous goods being transported.
- (2) Particulars obtained by a peace officer from a shipping document produced under Subsection (1) and submitted by him in evidence in Court shall be prima facie proof of the particulars thereon without proof of signature or official capacity of the person signing the shipping document.
10. Any carrier violating any of the provisions of Section 5, 6 or 7, or any other person responsible for such violation is guilty of an offence and liable to a penalty not exceeding One Thousand Dollars (\$1,000.00) exclusive of costs, or, in the case of non payment of fine and costs imposed, to imprisonment for a period not exceeding Thirty (30) days unless such fine and costs are sooner paid.
11. (1) Where a peace officer or a By-law Enforcement Officer of the City of Calgary believes that a person has contravened a provision of this By-law, he may serve upon or mail such person a Tag.
- (2) The Tag shall be in such form as the Calgary Police Service determines and shall indicate thereon the date of the offence, the time of the offence, the place where the offence occurred and the Section of the By-law which was contravened.
- (3) Upon the issuance of a Tag for a breach of Section 5, 6 or 7 of this By-law, the penalty of Two Hundred Dollars (\$200.00) shall apply.
- (4) Notwithstanding the other provisions of this Section, a person to whom a Tag is served or mailed pursuant to Subsection (1), may exercise the right to defend any charge of a contravention of any of the provisions of this By-law indicated on the Tag.
- (5) A person authorized to issue a Tag as provided in Subsection (1) is not required to issue a Tag in respect of a contravention if, in his sole discretion, it seems expedient to him to issue a Summons prosecuting the offence instead of issuing a Tag.
12. Sections 5A, 5B, 5C, 5D, 5E, 5F, 5G and 5H and Schedules "D" and "E" of the Truck Route By-law are hereby repealed.
13. This By-law does not come into force until it is approved by the designated Minister pursuant to Section 17 of the Transportation of Dangerous Goods Control Act.

READ A FIRST TIME THIS 11 DAY OF JANUARY , 1988.

READ A SECOND TIME, AS AMENDED, THIS 11 DAY OF JANUARY , 1988.

READ A THIRD TIME
AND PASSED, AS AMENDED, THIS 11 DAY OF JANUARY , 1988.


ACTING MAYOR


CITY CLERK

APPROVED PURSUANT TO SECTION 17 OF THE TRANSPORTATION OF DANGEROUS
GOODS CONTROL ACT THIS 8 DAY OF February , 1988.


MINISTER OF ALBERTA PUBLIC SAFETY SERVICES

SCHEDULE "A" BY-LAW NUMBER 67MB7

CENTRAL BUSINESS DISTRICT

COMMENCING at the north east corner of the intersection of 17th Avenue South and 14th Street West;

THENCE easterly along the northerly boundary of 17th Avenue South and an easterly extension thereof to the banks of the Elbow River;

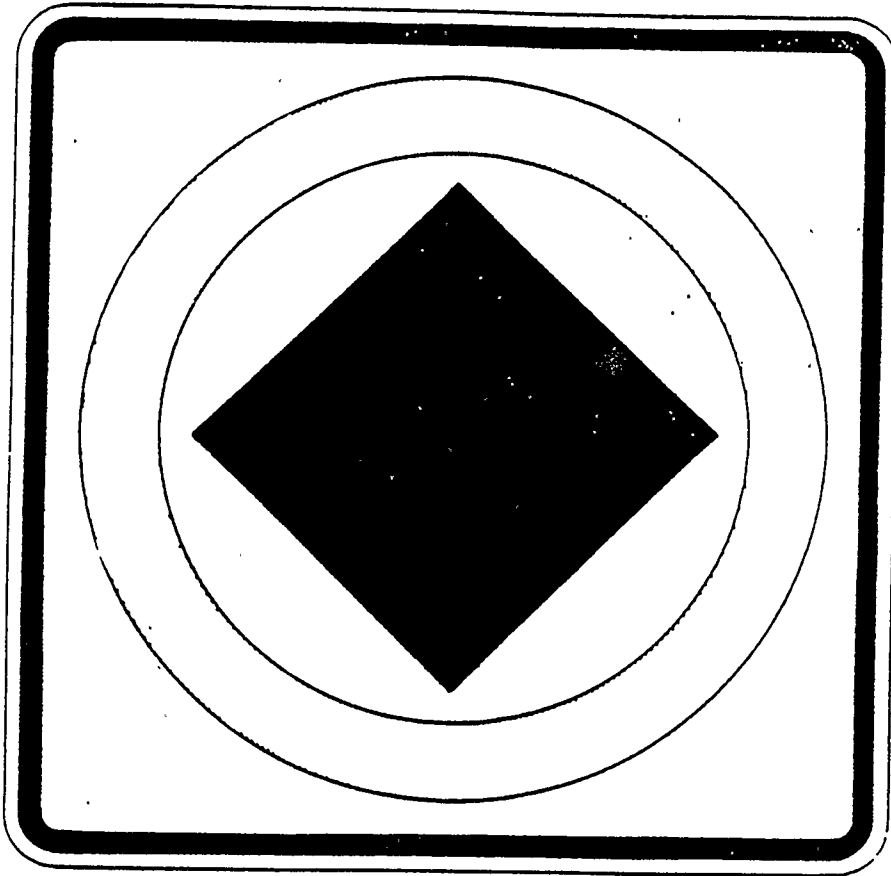
THENCE northerly along the westerly bank of the Elbow River to the Bow River;

THENCE westerly along the southerly bank of the Bow River to the extension northerly of the easterly boundary of 14th Street West;

THENCE southerly along the easterly boundary of 14th Street West, to the point of COMMENCEMENT.

DANGEROUS GOODS ROUTE SIGN

RB-69



DIMENSIONS (cm)	60X60	COLOUR		
		BACKGROUND	BORDER	MESSAGE / SYMBOL
SECTION REFERENCE	A2.82.01	WHITE	BLACK	BLACK/ GREEN
ENLARGEMENT FACTOR	4			

SCHEDULE "C" - BY-LAW NUMBER 67M87

DANGEROUS GOODS TRUCK ROUTE

	<u>THOROUGHFARE</u>	<u>FROM</u>	<u>TO</u>
1.	Trans Canada Highway (Being 16th Avenue North)	Eastern City Limits	Western City Limits
2.	Deerfoot Trail	Northern City Limits	Southern City Limits
3.	Glenmore Trail	Eastern City Limits	Sarcee Trail
4.	Macleod Trail	Glenmore Trail	Southern City Limits
5.	Sarcee Trail	Trans Canada Highway	Glenmore Trail
6.	Barlow Trail	Peigan Trail	Deerfoot Trail
7.	50th Avenue S.E.	Barlow rail	52nd Street S.E.
8.	52nd Street S.E.	Glenmore Trail S.E.	17th Avenue S.E.
9.	17th Avenue S.E.	52nd Street S.E.	Eastern City Limits
10.	Peigan Trail S.E.	Deerfoot Trail S.E.	Barlow Trail S.E.
11.	Blackfoot Trail S.E.	17 Avenue S.E.	Glenmore Trail S.E.
12.	17 Avenue S.E.	Blackfoot Trail S.E.	Deerfoot Trail S.E.
13.	Ogdendale Road S.E.	61 Avenue S.E.	69 Avenue S.E.
14.	61 Avenue S.E.	Ogdendale Road S.E.	Barlow Trail S.E.

APPENDIX 3 : THE COMMUNITY SAFETY ASSESSMENT MODEL

ADAPTED FROM: R.D. SCANLON AND E.J. CANTILLI, "ASSESSING THE RISK AND SAFETY IN THE TRANSPORTATION OF HAZARDOUS MATERIALS" IN TRANSPORTATION RESEARCH BOARD, NATIONAL RESEARCH COUNCIL, IMPROVING TRANSPORTATION OF HAZARDOUS MATERIALS THROUGH RISK ASSESSMENT AND ROUTING, TRANSPORTATION RESEARCH RECORD 1020, (WASHINGTON D.C.:THE TRANSPORTATION RESEARCH BOARD, 1985) 8-11.

A Proposed Community Safety Assessment Model

The two elements of an overall Community Safety Assessment model are community risk (CR) and community preparedness (CP).

CR is developed from a formulation of the risk level of a motor vehicle incident [RL (mvi)], the risk level of a hazardous materials incident [RL (hmi)], traffic volume level (Ltv), and community risk factors. Traffic volume levels are given in the following table.

Table 1 Traffic Volume Levels

Level	Annual Average Daily Traffic
1	0-5,000
2	5-10,000
3	10-15,000
4	15-20,000
5	20-30,000
6	30-40,000
7	40-50,000
8	50-60,000
9	60-70,000
10	70,000 +

$$RL(mvi) = Ltv * (Ni \text{ or } Nr + Nhc + Nvc + Cp + Cm + Nr_h + Ctc)$$

where

Ni = Number of intersections per mile

Nr = number of on and off ramps per mile

Nhc = number of horizontal curves per mile

Nvc = number of vertical curves per mile

Cp = condition of pavement (e.g., a Pavement Serviceability Index, to be based on AASHTO's Present Serviceability Index),

Cm = condition of median (e.g., a scale of 1 to 10, with 1 = positive barrier, correctly chosen, correctly installed and maintained and 10 = no barrier, median width of 20 ft or less),

Nr_h = number of roadside hazards per mile (e.g., a scale of 1 to 10, with 1 = no roadside hazards, 30 ft clear zone or smooth walls per barriers, and 10 = 20 primary hazards or 30 secondary hazards or a combination of the two), and

Ctc = condition of traffic control devices (signs, signals, markings) (e.g., a scale of 1 to 10, with 1 = excellent, and 10 = great number of devices in poor condition).

Then, the PL(hmi) can be expressed as follows:

$$RL(hmi) = RL(mvi) * (P(ex) * 5.5 + P(fl) * 2.5 + P(cg) * 4.0 + P(c) * 1.0 + P(p) * 1.0) * Lv * Ld$$

where

P(ex) = proportion of explosives vehicles in AADT (e.g., use percentage derived from random surveys; random surveys should cover 24 hour, each day of week, four seasons of year),

P(fl) = proportion of flammable liquids vehicles in AADT,

P(cg) = proportion of compressed gas vehicles in AADT,

P(c) = proportion of corrosive vehicles in AADT,

P(p) = proportion of poisons vehicles in AADT [the multipliers (5.5, 2.5, 4.0, 1.0, 1.0) were based on the approximate comparative impact of an incident],

Lv = vehicle level, including physical condition, how material is loaded, braking system, age of vehicle, condition of tires and type of container-- evaluation of the container is to be based on criteria of Bureau of Motor Carrier Safety, Federal Highway Administration, U.S. Department of Transportation. This evaluation is related also to available gauges and instruments within or on specific vehicles, and

Ld = driver level (including driver experience, accidents, violations history, training, awareness of regulations, awareness of emergency response actions, and knowledge of potential of material carried).

Then,

$$CR = RL(hmi) * Pd * Na + V\$ + Ns$$

where

Cp = population density of impacted areas (e.g., from census Bureau classification in specific tracts, available to community representatives, on a scale from rural to heavily urbanized),

Na = number of hazardous materials actors (generators, receivers, storers): this requires a land-use survey--available records should not be relied upon,

V\$ = dollar value of property affected, and

Ns = number of sensitive facilities (e.g., schools, hospitals, churches, nursing/old age homes, libraries, manufacturing facilities, and area of public concentration).

The CP element is formulated in the following manner:

$$CP = Ler + Lec$$

where Ler is the level of emergency response capability (e.g.,

training, equipment, communication, transportation, manpower, evacuation capability, response time, planning, and exercises). Public awareness and preparedness emergency services include fire services, police, health and hospitals, public works, and contract personnel. Lec is the enforcement and compliance level, including training level of personnel (police and fire); number of inspections, both fixed-facility and on-highway; history of violation; history of related incidents; and penalty structure.

CP when combined with CR, provide an overall community safety assessment (CSA) as can be seen in the following equation:

$$CSA = CP / CR$$

The eventual value of CSA, as a product of CP and CR, will reflect the overall community safety situation relative to hazardous materials transportation. For instance, values between 1 and 5 for CP, with 5 as "best" condition, or highest CP level, and between 0.1 and 1.0 for CR, with 1.0 as "worst" condition, or highest CR level, offer the following CSA values: in the worst-case scenario, CP = 1, CR = 1.0: CSA = 1; and in the best-case scenario, CP = 5, *cr = 0.1: CSA = 5.0.

If the variables introduced in the three elements of the CSA are given values that result in a CSA index of this configuration, the significance of CSA can be shown Graphically, as in the following figure. A "criticality level" would be chosen to represent unacceptable levels (to the community) of death, injury, and/or destruction in the event of an incident. If, for example, we set the criticality value of the CSA as 25, it is clear that a reduction of risk has a much greater effect on overall safety that does an increase in preparedness.

**APPENDIX 4 : THE HAZARDOUS MATERIALS ROUTING METHOD,
WORKSHEET SERIES**

ADAPTED FROM: U.S. DEPARTMENT OF TRANSPORTATION, FEDERAL HIGHWAY
ADMINISTRATION, GUIDELINES FOR APPLYING CRITERIA TO DESIGNATE
ROUTES FOR TRANSPORTING HAZARDOUS MATERIALS, (WASHINGTON D.C.:
U.S. GOVERNMENT PRINTING OFFICE, 1983).

WORKSHEET 1: ROADWAY INVENTORY

Alternative: _____

Date: _____

Page _____ of _____

1		2	3	4	5	6	7	8		9	
Segment		Road Type	Number of Lanes	Urban Suburban Rural	Length	Speed Limit	ADT (000)	Traffic Signage		Heavy Volume Intersections	
#	%							#	/mi.	#	/mi.

cont'd

10	11	12	13	14
Terrain	Accident Rate	Probability of any Vehicle Accident	HM Accident Factor	Probability of HM Accident

WORKSHEET 2: POPULATION

Alternative: _____
 Date: _____
 Page ____ of ____

HM Class: _____
 Impact Radius: _____

1	2	3	4	5
SEGMENT	CENSUS TRACTS			
	Number	Population	× Percent of Tract in Impact Area	= Population in Impact Area

Alternative: _____

Date: _____

Page _____ of _____

H.M. Class _____

Impact Radius _____

WORKSHEET 3: PROPERTY VALUE

SEGMENT	LAND USE VALUE (\$)				VALUE OF ROADWAY STRUCTURES (\$)		SEGMENT TOTAL (\$)
	LAND USE	VALUE/FT	X LENGTH (FT)	= VALUE	BRIDGE	OVERPASS	
	HI-DENSITY RESID.						
	MED-DENSITY RESID.						
	LOW-DENSITY RESID.						
	COMMERCIAL						
	INDUSTRIAL						
	TOTAL						
	HI-DENSITY RESID.						
	MED-DENSITY RESID.						
	LOW-DENSITY RESID.						
	COMMERCIAL						
	INDUSTRIAL						
	TOTAL						

ALTERNATIVES COMPARISON

1	2	3	4	5	6
ALTERNATIVE				MANDATORY FACTORS	
Number	Length	Travel Time	Rank	Physical	Legal

cont'd

7	8	9	10	11	12	13
RISK DETERMINATION				SUBJECTIVE FACTORS		
Population		Property		Population	Property	Emergency Response
Risk	Lowest Alternative	Risk	Lowest Alternative			

APPENDIX 5 : SAMPLE PUBLIC PERCEPTION SURVEY AND FINDINGS

SOURCE: EKOS RESEARCH ASSOCIATES INC. "CONSULTANT SUMMARY REPORT:
PUBLIC PERCEPTION SURVEY" IN TORONTO AREA RAIL TRANSPORTATION OF
DANGEROUS GOODS TASK FORCE: INFORMATION PACKAGE, (TORONTO:
DECEMBER 1987)

I. KNOWLEDGE AND PRIORITIES

There are a number of situations in which health and safety can be put at risk. I would like you to rate how you feel about the safety of the following items on a scale from 1 to 7 where 1 means extremely safe, 7 means extremely dangerous, and the midpoint 4 means neither safe nor dangerous.

	EXTREMELY SAFE				NEITHER		EXTREMELY DANGEROUS		\bar{x}	n
1. Living near a nuclear power plant?	1	2	3	4	5	6	7			
	4.9	7.5	8.1	9.4	13.8	11.5	44.9	5.336	992	
2. Smoking cigarettes?	1	2	3	4	5	6	7			
	1.8	2.0	5.7	11.9	17.3	14.3	47.1	5.719	1001	
3. Travelling by automobile? ...	1	2	3	4	5	6	7			
	9.0	20.6	26.1	23.3	11.8	5.1	4.0	3.397	998	
4. Living near a rail line on which dangerous goods are transported?	1	2	3	4	5	6	7			
	3.5	11.4	13.6	17.0	19.2	14.6	20.6	4.634	999	
5. Living near a road on which dangerous goods are transported?	1	2	3	4	5	6	7			
	3.1	9.9	12.6	18.2	20.1	16.8	19.2	4.697	999	
6. Do you live or work directly adjacent to, within two or three blocks of, or within one mile of a train line? (Accept only one answer.)										
Directly Adjacent	1									4.5%
Within 2-3 Blocks		2								10.1%
Within One Mile			3							38.9%
More Than One Mile				4						46.5%

n = 990

ASK ONLY IF THEY LIVE WITHIN 1 MILE OR 1.5 KM OF A RAIL LINE

There may be many different things that bother people living near a rail line. Could you please rate your personal level of concern with the following factors on a scale from 1 to 7 where 1 is not at all concerned, 7 is extremely concerned and 4 is somewhat concerned.

	NOT AT ALL CONCERNED		SOMEWHAT CONCERNED			EXTREMELY CONCERNED		\bar{x}	n
	1	2	3	4	5	6	7		
7. Noise	1	2	3	4	5	6	7		
	39.4	14.8	11.8	9.3	12.0	5.1	7.5	2.850	507
8. Risk of a dangerous goods accident	1	2	3	4	5	6	7		
	17.5	15.1	15.1	9.3	15.3	9.9	17.9	3.911	504
9. Vibration/shaking	1	2	3	4	5	6	7		
	48.7	15.4	7.7	7.5	9.7	4.8	6.1	2.529	505
10. Speed of the trains	1	2	3	4	5	6	7		
	42.5	13.9	9.7	10.3	10.1	6.2	7.2	2.787	503
11. Impact on property values	1	2	3	4	5	6	7		
	33.2	11.7	11.9	12.7	11.7	9.7	8.9	3.231	503
12. Aesthetics (or unsight- liness of track area) ...	1	2	3	4	5	6	7		
	32.7	16.0	12.6	12.2	10.6	8.6	7.2	3.068	499

We are interested in your opinions about the likelihood of accidents involving the transport of dangerous goods for different modes of transport. Please rate the likelihood using a 1 to 7 scale where 1 is extremely unlikely, 7 is extremely likely and 4 is somewhat likely.

	EXTREMELY UNLIKELY		SOMEWHAT LIKELY			EXTREMELY LIKELY		\bar{x}	n
	1	2	3	4	5	6	7		
13. Truck?.....	5.1	8.2	15.2	22.1	22.8	16.2	10.5	4.400	988
14. Train?.....	10.6	20.6	21.5	18.3	16.5	7.6	4.9	3.516	989

In your opinion, when and if an accident involving dangerous goods occurs with each type of transport, what is the likely severity of the consequences of that accident? Consider injury or death, pollution, property damage. Please rate on a 7 point scale where 1 is no impact and 7 is an extremely serious impact and the midpoint 4 is moderate impact.

	NO IMPACT		MODERATE IMPACT			EXTREMELY SERIOUS IMPACT		\bar{x}	n
	1	2	3	4	5	6	7		
15. Truck?	1.4	4.3	9.5	17.7	23.7	18.5	24.8	5.129	986
16. Train?	2.4	2.5	4.9	11.0	20.0	23.4	35.8	5.570	985

All things considered, how would you rate your level of concern about accidents involving dangerous goods for these modes of transport? Please rate on a 7 point scale where 1 is not at all concerned and 7 is extremely concerned and the midpoint 4 is moderately concerned.

	NOT AT ALL CONCERNED		MODERATELY CONCERNED			EXTREMELY CONCERNED		\bar{x}	n
	1	2	3	4	5	6	7		
17. Truck?	4.4	7.8	10.6	18.9	17.1	18.4	22.8	4.828	990
18. Train?	4.4	8.5	10.3	16.4	17.9	15.9	26.7	4.890	990

Hundreds of products have been classified as dangerous. How often do you think each of the following types of dangerous products are involved in transport accidents? Please rate on a 7 point scale where 1 is never, 7 is all the time and 4 is fairly often.

	NEVER		FAIRLY OFTEN			ALL THE TIME		\bar{x}	n
	1	2	3	4	5	6	7		
19. Explosives, toxic toxic chemicals and flammable materials?	4.0	16.0	21.8	22.8	18.1	8.3	8.9	3.955	779
20. Radioactive material?	12.7	30.8	20.1	13.4	9.8	6.6	6.7	3.231	961

21. In your opinion, about what percentage of all rail cars carry dangerous goods?

PERCENTAGE %

\bar{x} = 29.34%
s = 21.77%
n = 896

22. Approximately how many people do you think have been killed or injured in rail accidents involving the transport of dangerous goods since 1981 in Canada? (Prompt with range if necessary, e.g., zero, 1 to 10, 11 to 20, 21 to 50, more than 50.)

Zero people 0 8.7%
1 to 10 people 1 24.4%
11 to 20 people 2 15.9% n = 803
21 to 50 people 3 23.5%
More than 50 people 4 27.4%

23. In 1979, there was a derailment of 24 cars in Mississauga. One quarter of a million people were evacuated as a result. How concerned are you about this incident? Please rate on a 1 to 7 scale where 1 is not at all concerned, 7 is extremely concerned and 4 is moderately concerned. (Circle 8(N/A) if respondent did not know of the derailment.)

NOT AT ALL CONCERNED MODERATELY CONCERNED EXTREMELY CONCERNED

1 2 3 4 5 6 7
4.7 5.4 6.0 16.0 15.8 17.2 34.9

\bar{x} = 5.242
n = 923

II. PUBLIC ACCEPTANCE

I am going to read a series of statements and I would like you to tell me whether you agree or disagree with each one. Please rate on a 1 to 7 scale where 1 means strongly agree, 7 means strongly disagree and 4 means neither agree nor disagree.

STRONGLY AGREE NEITHER STRONGLY DISAGREE

- | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | \bar{x} | n |
|--|------|------|------|------|------|------|------|-----------|------|
| 24. Accidents are inevitable and the public will just have to accept some accidents involving dangerous goods | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 4.254 | 1001 |
| | 15.3 | 12.6 | 12.4 | 11.0 | 12.8 | 11.9 | 24.1 | | |
| 25. Dangerous goods should never be transported through populated areas | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 3.063 | 999 |
| | 38.3 | 13.1 | 10.4 | 10.1 | 9.5 | 7.1 | 11.4 | | |
| 26. Generally speaking, the rail industry has done a good job in developing safe methods to transport dangerous goods ... | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 3.193 | 963 |
| | 19.8 | 19.1 | 19.1 | 20.7 | 10.7 | 6.3 | 4.3 | | |
| 27. There have been so many accidents and problems with transportation of dangerous products, I have difficulty believing anyone who tries to tell me about safety anymore | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 4.195 | 985 |
| | 11.0 | 9.9 | 11.3 | 25.3 | 15.7 | 12.6 | 14.2 | | |

Continued

	STRONGLY AGREE							STRONGLY DISAGREE	\bar{x}	n
	1	2	3	4	5	6	7			
28. There have been a number of important changes in rail technology for safely transporting dangerous goods in the past decade	1	2	3	4	5	6	7			
	15.3	17.4	18.8	31.0	8.2	4.9	4.4	3.317	901	
29. My main concern is that people responsible for rail transportation safety are not properly trained	1	2	3	4	5	6	7			
	21.2	14.3	14.4	18.5	12.8	10.1	8.7	3.527	961	
30. What I know about the transport of dangerous goods is mainly based on newspaper or television reports	1	2	3	4	5	6	7			
	62.6	14.7	5.4	4.4	5.0	2.7	5.2	2.035	999	
31. From what I know, the current methods of transporting dangerous goods through my community are reasonably safe	1	2	3	4	5	6	7			
	38.4	21.6	13.4	12.1	6.1	4.3	4.1	2.554	970	
32. The economic well-being of the Toronto area is significantly dependent upon the use of dangerous products	1	2	3	4	5	6	7			
	22.5	14.2	14.6	19.8	11.9	7.4	9.6	3.450	938	
33. Railroads have traditionally been irresponsible in their attention to public safety ..	1	2	3	4	5	6	7			
	6.2	8.2	10.0	17.7	19.0	18.4	20.6	4.725	968	
I believe it is important to proceed with alternatives which reduce the level of public risk, even if it personally costs me:										
34. \$50 per year	1	2	3	4	5	6	7			
	51.5	17.4	8.0	6.0	5.5	2.3	9.3	2.408	999	
35. \$250 per year	1	2	3	4	5	6	7			
	29.6	11.3	10.6	12.7	8.6	6.3	20.8	3.615	997	
36. If I truly believed that the measures to reduce the risks from the transport of dangerous goods by rail are of top quality, I could live with the existing system	1	2	3	4	5	6	7			
	42.1	20.1	13.8	8.9	6.4	4.5	4.2	2.476	984	

37. As a matter of principle, it is fair to shift risks (of a rail accident involving dangerous goods) to a new group of people, if significantly fewer people are exposed?

STRONGLY AGREE			NEITHER		STRONGLY DISAGREE	
1	2	3	4	5	6	7
15.4	8.8	9.3	10.2	9.0	11.9	35.3

$\bar{x} = 4.656$
n = 974

38. IF AGREE, (1-4 to Q. 37) I would feel the same even if they shifted the rail traffic to my area.

STRONGLY AGREE			NEITHER		STRONGLY DISAGREE	
1	2	3	4	5	6	7
24.2	12.0	16.3	20.8	7.7	8.9	10.3

$\bar{x} = 3.435$
n = 418.

39. As a matter of principle, the risks of a rail accident (involving dangerous goods) should be reduced to a minimum regardless of costs.

STRONGLY AGREE			NEITHER		STRONGLY DISAGREE	
1	2	3	4	5	6	7
56.3	13.6	8.1	6.5	5.8	3.2	6.4

$\bar{x} = 2.274$
n = 995

40. IF AGREE (1-4 to Q. 39) I would feel the same even if I personally had to bear some of that cost.

STRONGLY AGREE			NEITHER		STRONGLY DISAGREE	
1	2	3	4	5	6	7
50.7	16.2	10.4	11.5	4.2	2.3	4.7

$\bar{x} = 2.282$
n = 827

III. BACKGROUND CHARACTERISTICS

Finally, I'd like to ask you a few general questions about yourself and your background. This information will be used only for statistical analysis.

42. Do you or does any member of your household work at a job that directly involves the manufacture, handling or transportation of hazardous goods in any way?

YES 1 15.3%
NO 2 84.7% n = 998

43. Do you or a member of your household use the GO trains to commute to work?

YES 1 14.2%
 NO 2 85.8% n = 1003

44. How many members of your household are financially dependent on you?

NUMBER
 $\bar{x} = 1.11$
 $s = 1.32$
 $n = 997$

45. Do you own or rent your home?

OWN 1 74.1%
 RENT 2 25.9% n = 979

46. In what year were you born?

YEAR
 \bar{x} Age = 40.87
 $s = 14.60$ yrs.
 $n = 982$

47. What is the highest level of formal education which you have achieved? (Enter the grade or circle the appropriate code.)

Primary School (enter grade) 2.9%
 High School (enter grade) 47.2%
 $n = 990$
 Some Community College 14 8.2%
 Some University 15 6.5%
 Community College Graduate 16 10.7%
 University Graduate 17 17.5%
 Post Graduate 18 7.0%

48. What municipality or township do you live in? (Probe for town or borough if respondent does not know the municipality or township.)

Metro-Toronto 1 20.4%
 York 2 18.4% n = 1008
 Halton & Peel 3 40.2%
 Durham 4 21.0%

49. What is your postal code? n = 894

50. Finally, in 1986, in what range was the total income for your household? (Read list.)

LESS THAN \$10,000	1	3.8%	
\$10,000 to \$20,000	2	10.3%	
\$20,000 to \$30,000	3	16.7%	
\$30,000 to \$40,000	4	21.1%	n = 809
\$40,000 to \$50,000	5	18.8%	
\$50,000 to \$75,000	6	18.9%	
\$75,000 to \$100,000	7	6.4%	
OVER 100,000	8	4.0%	

THESE ARE ALL THE QUESTIONS WE HAVE.
THANK YOU VERY MUCH FOR YOUR COOPERATION.

DO NOT ASK: Code sex:

Male	1	48.1%	
Female	2	51.9%	n = 1003