

## **Chapter 8**

### **COPING WITH RISKS**

8.1. THE INCREMENTAL SAFETY APPROACH

The Mississauga evacuation brought to public attention the fact that every day many communities are exposed to the risk of a disaster due to the transportation of hazardous materials. Questions therefore arise about how society handles the problem of such risk and what degree of protection is provided for innocent victims of the accidents which may happen. The transportation of hazardous materials is but one part of a growing public concern with a wide range of risks to which people are involuntarily being exposed as a result of the advance of technology, the growth of industry and the concentration of population in areas where accidents are likely to occur (Whyte and Burton, 1980).

Western industrial societies, Canada included, are in a transition process with regard to dealing with risk. The now traditional approach can be labelled the "incremental safety" method. The new approach can be labelled "risk assessment or risk analysis". The "incremental safety" approach simply requires that levels of safety are monitored by experience and are improved usually in small steps when found wanting. This approach has dominated the thinking in the rail transport industry, at least until very recently.

The rationale for the "incremental safety" approach is that safety is in everyone's interest and that the companies responsible for the transport of dangerous materials will therefore act in their own interest by operating in a safe manner. This involves applying the best practicable technology in the design of tank cars and railway tracks and exercising reasonable care in the testing of operational procedures and safety inspections. It also involves following government specifications and regulations where these apply.

This approach also relies on the self-correcting method of experience. From time to time accidents occur, and where these are judged to indicate a serious doubt as to the level of safety which exists, an official enquiry is indicated. In the Mississauga case an inquiry was conducted by Mr. Justice Grange whose report (Grange,1980) recommended a number of changes in railway inspection of equipment designed to increase safety. These recommendations are now the subject of further examination before the Railway Safety Committee of the Canadian Transport Commission. The evaluation of the Grange recommendations depends on an assessment of the risks and benefits of transporting chlorine by rail.

What is being challenged in the CTC hearings (underway at the time of writing) is the traditional "incremental safety" method or approach. The argument, stated implicitly and not in these terms, is that the level of risk may have increased through the creation of a new class of risk not readily susceptible to learning by experience. These are the low probability - high consequence risks (LOPHIC) - the sort of event that is extremely unlikely to happen, but which can happen, and if and when it does, is likely to have extremely serious consequences indeed.

The "classical" risk of this kind which has been much discussed and analysed is the possibility of an accident at a nuclear power station resulting in a massive release of radioactivity into the surrounding environment (U.S. NRC,1974). It now seems possible that similar LOPHIC accidents could also occur in the transportation field. The main accident of this kind that has been identified is the BLEVE (boiling liquid expanding vapor explosion) that could conceivably result from damage to an ocean-going tanker carrying liquified natural gas(LNG). The Mississauga accident is a reminder that LOPHIC events can also occur in various modes of inland transportation.

## 8.2. RISK ANALYSIS

As an aid to rational decision making about safety the method that is being developed to study and assess such possibilities is called risk analysis. Risk analysis was first developed as a formal quantitative method in the aerospace industry, specifically in the NASA programme. It was subsequently applied to the nuclear industry, most notably in the Rasmussen report on accidents at nuclear generating stations. The method is now being extended to a wide range of technological systems in many different countries. The procedure of risk analysis is essentially to model a sequence of events (contingent probabilities) that can lead to an accident, and then to assess the consequences of an accident. The average annual expectation of loss or damage can then be calculated by multiplying the consequences by the probability.

In order to carry out an assessment of the risks of transporting chlorine by rail, a model of the relevant parts of the transportation system is required as well as information on the properties of chlorine and the behaviour and distribution of people involved. This is the "risk system" and defining its components and interactions is a major research task.

From data such as the total volume of chlorine shipped by rail; the size of shipments; distance travelled and accident rates, it is possible to estimate the probability that tank cars carrying chlorine will be involved in an accident. Further information on design specifications of tank cars and the type of damage incurred in accidents is needed to estimate the likelihood that a chlorine release will occur.

If it is postulated that chlorine is released either in a steady stream or sudden burst, the risk analysis will have to consider models of atmospheric dispersion and dose/response models for estimating health effects.

The risk analysis is thus developed using a fault tree analysis in which a number of sequential events are postulated and contingent probabilities are attached to each one.

Batelle (1980) have undertaken a risk analysis for chlorine transportation by rail in the U.S.A. They estimated that:

- a) the probability that a chlorine release will occur is  $1.9 \times 10^{-4}$  per shipment;
- b) the number of chlorine tank car trains involved in accidents in 1985 will be 150;
- c) 1.8 of these accidents will result in a serious release of chlorine
- d) the expected number of fatalities from chlorine releases in 1985 is 9.4.

Thus, for the average American, the chance of being killed in a tornado is ten times greater than being killed by a chlorine gas leak from a rail car accident (1 in 2,300 compared to 1 in 22.3 million persons).

A comparison of the Batelle study with other risk analyses for chlorine transportation shows a considerable range in the estimates for risk of death per ton/mile of liquid chlorine transported (Table 8-1). The final figures yielded by such analyses are orders of magnitudes only, despite the fact that the input data requirements are very high, and are not even generally available for Canada.

A comparison of the estimates in Table 8-1 with accident experience shows that the risk analyses predict a greater incidence of chlorine release and public fatalities than have actually occurred. Indeed the historical frequency of

minor releases is about 80% less than predicted; for significant releases, it is about 20% less than predicted; and fatalities predicted are about 10 times the historical levels for the period 1976-78 (86 predicted deaths versus 9 actual; of which 8 were in 1978).

The Batelle study identifies a total of 103 possible release sequences, but these do not appear to include the one that occurred in Mississauga.

The Batelle study is concerned with the frequency distribution of all accidents and does not address itself to the maximum credible accident. As noted elsewhere in this report, the Mississauga accident is notable for its lucky circumstances. The risk analysis carried out by Batelle nowhere suggests the possibility of consequences of the magnitude which we know could have occurred had the circumstances (location, timing, manner of chlorine release) of the Mississauga accident been different.

Furthermore the Batelle and other risk analyses of transportation of chlorine are concerned with accident probabilities and probable deaths. In the case of Mississauga the major consequences were in the economic and social costs of disruption. None of these significant economic and social costs that actually occurred are included in the formal assessments of the risks. The Batelle study does not estimate the costs of risk reduction methods to see whether they are justifiable in terms of expected reduction in fatalities nor does it indicate how deaths might be reduced by means other than technical changes - means such as higher inspection and maintenance standards or more effective emergency planning.

It is clear from these comparisons of the predictions of risk analysis and an actual event, that there are major shortcomings to what risk analysis can do and has done so far.

Table 8.1 Comparison of estimates for risk of death from transportation of chlorine

Report	Country	Deaths per ton/mile of liquid chlorine transported
Lautkasi and Mankamo, 1976	Finland	$5.9 \times 10^{-8}$
Simmons, Erdmann and Naft, 1974	U.S.A.	$1.5 \times 10^{-8}$
Batelle, Memorial Institute, 1980	U.S.A.	$6.8 \times 10^{-9}$
Westbrook, 1974	U.K.	$2.5 \times 10^{-10}$
		1 ton/mile = 1464 kg/km

Part of these shortcomings are a result of the heroic simplifying assumptions that have to be made, particularly relating to human behaviour and demographic data. At the same time, such risk analyses are expensive to undertake and even more expensive in the data collection they require.

Indeed, one reason why such a risk analysis has not yet been done for Canada is that the prime emphasis at present is to set up a reliable data base system. It may take some years (and considerable expense) before a full analysis is possible. The Risk Analysis Section, Dangerous Goods Branch Transport Canada is now working on the design of an accident reporting data system.

Despite the present shortcomings of risk analysis the case seems clear that knowledge of the probability of accidents and the possible consequences has now become recognized as an essential basis for decision-making about railway safety as well as for other technological systems. Canada is proceeding relatively slowly in this area and probably should move more rapidly. This leaves open the question of

who should be responsible for carrying out risk assessments and at whose expense. The mood in industry and in government is not characterized by great enthusiasm for risk assessment. It generally seems to be regarded with caution as a new analytical tool. Caution in the use of risk analysis would seem to be justified.

### 8.3. A STRATEGY FOR RISK MANAGEMENT

Given that risk analysis does not in any case by itself reduce risks, how is society proceeding with respect to the protection of the public especially from LOPHIC risks?

Three objectives can be distinguished: to reduce the risks; to optimize risks against benefits; and to mitigate the consequences of accidents (Table 8.2). The first objective assumes that risks can be progressively reduced by learning from experience. Incremental improvements in safety are achieved through mechanisms like the Grange Enquiry and Railway Safety Committee hearings, leading to new regulations. Public concern and public pressure play a role in this process as exemplified by the Metro Toronto Residents' Action Committee (M-TRAC 1981) brief to the Committee. This approach works well with many types of risk but is open to question for LOPHIC risks, where experience is not a satisfactory guide.

The second objective assumes that the problem is not necessarily to reduce risks (they may be low enough already) but to achieve an optimal solution by balancing risks against benefits. According to this view, it makes no sense to spend large amounts of money reducing risks if such costs will, in effect, reduce the benefits by a greater amount than



Table 8.2. Strategies for risk management

Objective	Method of Approach
1. Risk Reduction	incremental safety and response pressure
2. Risk Optimizing	introduction of risk analysis, risk-benefit calculations
3. Consequence Mitigation	improve emergency planning, compensation and insurance

the expected increase in safety. The introduction of risk analysis and risk-benefit calculations is a response to this objective.

The third objective is simply to find ways of mitigating the consequences of accidents should they occur. The first approach is through the improvement of emergency planning and various steps are now in progress in Ontario to achieve this. A second approach is through the payment of compensation for damage to injured parties and the purchase of insurance to make sure that funds are available for this purpose without bankrupting or severely affecting those who might be judged to be liable.

#### 8.4. INSURANCE

Companies involved in business that can result in substantial liability often resort to insurance to protect themselves against major claims. However, this is not a universal practice. Some companies prefer to be entirely "self-insured", that is, they pay no insurance premiums and

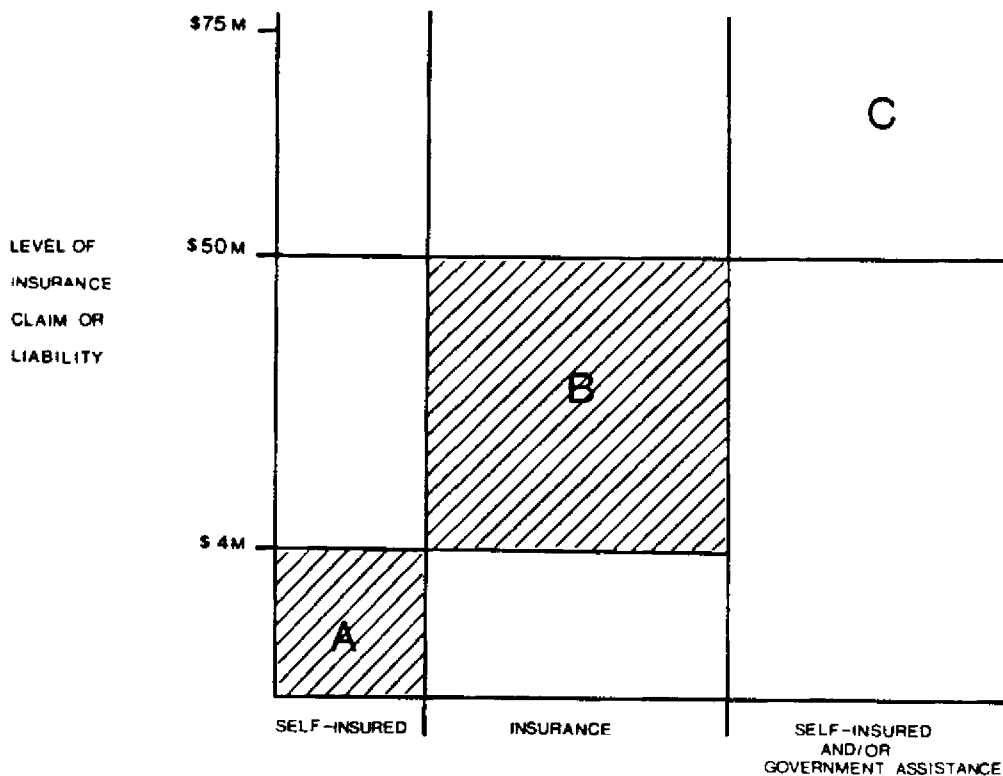
expect, if the worst comes to the worst, to pay out of their own funds.

A more typical case is shown in Figure 8-1. Here a company accepts responsibility for claims or liability up to a certain level - say \$4 million. This is, in effect, a deductible clause that protects the insurance company from frequent small claims. A large area of liability (from \$4 million to \$50 million in Figure 8-1) is then covered by insurance for which the insured party pays a premium. Usually one insurance company does not accept the whole "package" of insurance itself, but makes reinsurance arrangements with other companies to spread the risk.

The insurance company imposes an upper limit on the amount of coverage. Usually this is not based on any analysis of the probability of claims being made at that level. The insurance industry recognizes the unreliability of estimates of the probability of low frequency events and these are not used in decision-making. The upper limit to insurance is usually based on a number of quite extraneous factors such as the amount of money available for investment in insurance; the anticipated rate of return in the investment market; the reputation and loss-history of the corporation in question as well as the loss-history of other corporations engaged in similar activities. The insurance industry approach, therefore, is not dissimilar to the approach of "incremental safety". It relies on experience.

Experience is less useful for low probability situations, especially where there can be high consequence risks. The upper limit on coverage excludes such risks from consideration. When a LOPHIC event occurs one of three things can happen: the company pays up and suffers a major loss, the company cannot pay up and those who suffer damages receive no

FIGURE 8.1  
EXAMPLE TO SHOW HOW A COMPANY  
HANDLES ITS LIABILITY INSURANCE



compensation, or less than the full amount of damages; government intervenes to provide compensation (either because it does not wish to see a company collapse or because of political demands that help be given to those who have suffered loss.)

This means that in some industries new risks may be in the process of being created by the enlarged scale of operations, which private companies have no hope of being able to cover from insurance or from assets. Implicitly, the risks are being thrown on government or the whole society to accept. This is another reason for risk analysis - to provide some information on the level of risk that private corporations (and Crown Corporations) are implicitly asking the society at large to take, and to bear the consequences.

#### 8.5. THE PAYMENT OF COMPENSATION BY CP RAIL

In the normal course of events people who suffer damage to their property, their health or through the disruption of their business or enjoyment of their homes, can sue whomsoever they consider to be liable for such damages in a court of law. The tort system can be used to recover damages provided that the court agrees on the question of liability. The tort system can be extremely slow, however, as well as costly in contested cases. For these reasons, damaged parties are discouraged from filing suit when the damage is relatively small and when the matter of liability is difficult to establish.

The slowness of the tort system can impose particular hardship on individuals or families who are evacuated as a result of accidents of the kind that occurred in Mississauga.

It has become the practice of many private companies to establish compensation programmes to reimburse evacuees for the out-of-pocket expense incurred during an evacuation. Government agencies often make similar arrangements during evacuations due to natural disasters.

On Monday, November 12, 1979 while the evacuation of Mississauga was still in progress, CP Rail announced that it would, as a gesture of goodwill and without admitting liability, pay the out-of-pocket expenses of Peel region residents who were advised to evacuate. In a fuller statement on Tuesday, November 13, CP Rail spokesman Stephen Morris said that claimants would be asked to sign a receipt for their expenses, and that this would not prevent them from seeking compensation for building damage or lost wages if the Company was later found liable for the emergency. This initial position was rapidly changed the following day (November 14) when a fuller statement was made that CP Rail would require people to sign releases from further claims before receiving payment.

On Monday, November 19, one week after the accident, CP Rail opened its claims office at Square One in Mississauga where it had 26 claims agents on hand to look after those seeking compensation for their out-of-pocket expenses. A copy of the claim form is shown in Figure 8.2. There were long lineups during the first couple of weeks so that on December 1 CP Rail announced that it would start an appointment plan for claims. On the first day when some 1500 claims were processed, CP Rail agents are reported to have been generous in what they allowed evacuees to list in the category of "other" expenses and what exclusions they could write into the waiver clause. Many wrote in exclusions like wage losses and future health and property expenses. By Tuesday, November 20, the agents were taking a more restrictive view and claimants were allowed to exclude only



**CLAIM REPORT FOR OUT OF POCKET EXPENSES**

Please Print or Type

**NAME:**  MR  MRS  MISS  MS

Initials: 1  2  Last name: \_\_\_\_\_

**ADDRESS:** Street: \_\_\_\_\_

City: \_\_\_\_\_

Postal Code: \_\_\_\_\_

**SOCIAL INSURANCE NO.:** \_\_\_\_\_

**BIRTH DATE:** Day:  Month:  Year:  **DRIVER'S LICENCE NO.:** \_\_\_\_\_

**OTHER MEMBERS OF FAMILY INCLUDED IN THIS CLAIM:**

Initials 1 2	Last name	Relationship
<input type="checkbox"/> <input type="checkbox"/>	_____	_____
<input type="checkbox"/> <input type="checkbox"/>	_____	_____
<input type="checkbox"/> <input type="checkbox"/>	_____	_____
<input type="checkbox"/> <input type="checkbox"/>	_____	_____

attach separate list where necessary

**OUT OF POCKET EXPENSES INCURRED (ATTACH RECEIPTS WHERE AVAILABLE)**

DESCRIPTION	AMOUNT CLAIMED	FOR OFFICE USE ONLY
Hotel Accommodation: Hotel _____ No. Nights _____	\$ _____	
Meals Purchased: Sun 11/11/79 No. Meals _____	\$ _____	
Mon 12/11/79 No. Meals _____	\$ _____	
Tues 13/11/79 No. Meals _____	\$ _____	
Wed 14/11/79 No. Meals _____	\$ _____	
Thur 15/11/79 No. Meals _____	\$ _____	
Fri 16/11/79 No. Meals _____	\$ _____	
OTHER (provide description): _____ attach separate list where necessary	\$ _____	
<b>TOTAL AMOUNT CLAIMED:</b>		\$ _____

**PAYMENT OF THIS CLAIM IS NOT AN ADMISSION OF LIABILITY**

**HAVE YOU INCLUDED:**

- Name, Address, Telephone Number
- Social Insurance Number
- Birth Date
- Other Family Members Included In Claim
- Details Of The Claim
- All Available Receipts

**UPON COMPLETION, PLEASE MAIL TO:**

CP Rail Emergency Claims Office  
Suite 930  
40 University Avenue  
Toronto, Ontario  
M5J 1T1

I release all claims against Canadian Pacific Limited in any way connected with the derailment of CP Train #54, at Mississauga at approximately midnight between November 10th and November 11th, 1979.

Dated at Mississauga this \_\_\_\_\_ day of \_\_\_\_\_ AD \_\_\_\_\_

\_\_\_\_\_  
Witness

\_\_\_\_\_  
Claimant

future wage losses from the waiver. By Wednesday, November 21, no exclusions at all were allowed.<sup>1</sup>

During this time, a dispute arose between the Ontario Attorney-General, the Honourable Roy McMurtry, and CP officials over the legitimacy of the waiver clause which read:

*I release all claims against Canadian Pacific Ltd. in any way connected with the derailment of CP Train No. 54, at Mississauga at approximately midnight between November 10 and November 11, 1979.*

Mr. McMurtry announced at Queen's Park that he was attempting to get CP Rail to either remove the waiver or to reword it. He said that CP Rail was being irresponsible in using the form. On November 20, Mr. McMurtry said that on the preceding Monday, he told Mr. W. Stinson, an executive vice-president of CP Rail, that the release form was unacceptable, and that if CP Rail insisted on using the form it should at least stamp the warning "full and final release" in red, inch-high letters. CP Rail refused, and Mr. La Fontaine, Regional Manager of Public Relations announced:

*I am advised that we are not going to change the wording.*

The only thing the company agreed to do was to reprint the form with the release in bold type.

Mr. McMurtry sent a lawyer from the Ministry of the Attorney-General to the claims office in Mississauga to make sure that the claimants knew what they were signing, and he publicly urged evacuees to consult their lawyers before signing the form. It was reported in The Globe and Mail

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<sup>1</sup>According to CP Rail, this did not reflect a change in CP policy but simply a tightening up of procedures.

that the Ministry lawyer feared that:

*although many claimants appear happy to settle for out-of-pocket expenses most of them don't realize that they may be forfeiting claims for such things as health problems.*

Mr. McMurtry felt that a simple receipt for payment should satisfy the rail company but he claimed that as Attorney - General he had no authority to require CP Rail to use any particular form. Nonetheless, he promised to protect the rights of those who signed.

CP Rail adopted a "take it or leave it" approach. Gerald La Fontaine, speaking for CP Rail said:

*We told the Ontario Government that if it was dissatisfied with the way in which CP Rail was running its emergency claims office, we would close it down and let the Government of Ontario take over reimbursing residents for out-of-pocket expenses.*

Having examined the possibility of setting up its own compensation program, and having decided that it could not likely do as good a job as CP Rail on such short notice, the Ontario Government took no further action. Premier Davis praised CP Rail for swiftly organizing the program. He told the House at Queen's Park that Ian Sinclair, Chairman of CP Rail had informed him that CP Rail does not accept responsibility for the accident. It was therefore acting on the advice of its lawyers in continuing to use the waiver form because, if it were removed, CP Rail might not be able to deny liability in future claims by the same people.

CP Rail kept its claims office open for over six months. 50,254 claims were processed either at the office or by mail, and according to CP, Rail \$9,568,000.00 was paid out to evacuees.



8.6. PUBLIC RESPONSE TO COMPENSATION IN MISSISSAUGA8.6.1. Claimants and non-claimants

Our surveys indicate that 57% of all evacuated households made a claim to CP Rail for compensation. More of the evacuees using the evacuation centres made claims (70%). About 35% of families living north of Burhamthorpe Road (and therefore beyond the official evacuated area) who evacuated tried to file claims; 17% actually managed to do so, and a few received compensation.

The reasons why people say they did not claim compensation are given in Table 8.3. The commonest reason is that the amounts of money involved were insignificant.

This is largely because many evacuees went to private homes and their costs were absorbed by many individual citizens. As has been noted elsewhere, more people can be expected to go to hotels in another evacuation because they now realize their expenses are likely to be compensated.

Twenty percent of those who decided against making a claim from CP Rail were put off by the process involved, particularly the long queues and the need to find receipts. It is likely that these people also had relatively small expenses. Ten percent felt that it was morally wrong to take money from CP Rail. They tended to see the derailment as an "accident", or an Act of God, and felt that no one should profit from it. In follow-up interviews, older people, in particular, voiced this view and expresses dismay at the greed of others. Only a few people (3%) did not make a claim because of the waiver to further claims that they were required to sign.

Table 8.3. Reasons given by those evacuees who did not claim for compensation from CP Rail

Reasons	All evacuees (N=218)	Those using centres (N=53)
No significant money loss	55	46
Compensation process bothersome	21	14
Morally wrong to take money	10	14
Claim was refused	12	16
Wanted to leave option open	3	9
	101%	100%

Table 8.4. Reasons why people felt that their claims for compensation cannot cover all the costs to them of the emergency

REASONS: it would not cover	All Evacuees (N=212 or 55% of total)	Those using Centres (N=107 or 72% of total)
all out-of-pocket expenses	29	27
lost income	26	17
exposure to danger	22	28
disruption and anxiety	20	23
property damage	1	1
other reasons	3	3
TOTAL	101%	99%

### 8.6.2. Claims versus costs

The average claim for all evacuees was \$157 with people in evacuation centres claiming more: \$250 on average. The average amount received was \$114 (\$170 for those who went to an Evacuation Centre). Almost half (45%) of those people who made claims, felt that the amount that they had asked for represented full compensation. However, people who had used an Evacuation centre were significantly more likely to be dissatisfied: 72% of them did not feel fully compensated (differences between the two samples significant at .001 confidence level).

The reasons why evacuees felt that their claims for compensation did not cover all the costs they incurred in the emergency are fairly evenly divided into four groups (Table 8.4.):

- a) it did not cover all their out-of-pocket expenses
- b) it did not cover lost income
- c) they were not compensated for the risks they endured,
- d) they were not compensated for the disruption to their lives and the anxiety they felt.

These reasons were equally likely to be given by people in different age groups, except that concerns about the danger and anxiety were less often mentioned by people under 40 years old. Their reasons were not related to differences in annual family income between evacuees and can be considered as representative of the many evacuees' feelings about the unfairness of the compensation awarded.

The amounts of money that evacuees felt would fully compensate them are shown in Table 7.10. The responses fell into three groups:

- a) those saying no compensation is necessary,
- b) those quoting dollar figures (mainly less than \$1000),
- c) those saying that no amount of money can compensate them.

Among those who used evacuation centres there are fewer people who want no money and more who feel that no amount can compensate them.

As a group, therefore, the people who used the evacuation centres, felt that they had more expenses, and that their lives were more disrupted and affected by the emergency. For them, the gap between their perceived need to be compensated and what they received, is larger than for other evacuees.

#### 8.6.3. Attitudes towards the compensation process and the role of government

The way in which CP Rail compensated evacuees also gave rise to some dissatisfaction. In response to an open-ended question "Do you have any comments about the way CP Rail compensated evacuees?" 45% of those evacuees replying thought that the procedure was generally fair. A further 9% thought the process "courteous" making a total of 54% of generally favourable responses. The 42% of unfavourable responses were scattered over six different complaints; generally not fair, (13%), some over compensation (8%), some under compensation (7%), process was not courteous (9%), and objections to the waiver claim (3%). This last finding is surprising. In spite of the public debate about the waiver clause that took place at the time only ten individuals out of 315 who replied to the question thought to complain about it.

There was no significant difference in these responses between those who went to Evacuation Centres and those who did not.

There was a significant difference between the users of evacuation centres and other evacuees in expressing feelings about the role the Ontario government played in relation to

compensation. The evacuees as a whole were relatively unaware of the Ontario Government role; 44% reported that they did not know about it. Those using the Evacuation Centres were more likely to be aware; only 28% said that they did not know anything about it.

The major difference in the reaction to the Ontario Government's role in compensation was that a larger percentage of those using Evacuation Centres thought that the Ontario government could have done more (17% as opposed to only 7% of all evacuees). What more these evacuees thought that the provincial government might have done is not clear.

#### 8.6.4. Conclusions on compensation

Overall, the public response to the question of compensation is roughly balanced between people who are generally happy with the amounts they received and the way the process was handled; and those who are not. However, 8% of households report having lost income for which they have received (unfairly, they feel) no compensation so far, so that these people may try to claim more in the future. One other group feels that it has been unfairly treated - those living north of Burnhamthorpe Road who were prevented by road blocks from reaching their homes. They have been refused compensation because they were outside the official evacuation zone.