

**THE MISSISSAUGA TRAIN DERAILMENT AND
EVACUATION, 10-16 NOVEMBER 1979**

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THE MISSISSAUGA TRAIN DERAILMENT AND EVACUATION, 10-16 NOVEMBER 1979

The evacuation of a quarter of a million residents of the city of Mississauga, Ontario, in the aftermath of the derailment of a freight train carrying hazardous materials on 10 November 1979, was, at that time, the largest peacetime evacuation ever conducted in North America. It took place with little panic or injury, no deaths, and no apparent resistance to evacuation advice. Not surprisingly, then, the success of the Mississauga evacuation has attracted the interest, and raised the hopes, of emergency planners, governments, and industry officials in North America and many other countries. These groups want to understand the reasons for the success of the evacuation, and, if possible, to transfer the effective elements of the Mississauga emergency plans and response procedures to their own jurisdictions. Their concerns reflect the wider search for a model of public decision-making under threat which would identify and link critical factors, decisions, and behaviour, and which would provide a framework for emergency planning and research.

THE ACCIDENT

Freight trains frequently carry hazardous materials through Mississauga. On the evening of Saturday, 10 November 1979, Canadian Pacific freight train 54 was carrying 106 cars from Sarnia to Toronto on a weekly run. Thirty-eight cars were carrying cargo designated as hazardous, including chlorine, liquid petroleum products, and caustic soda. At approximately 11:53 pm, as the train crossed Burnhamthorpe Road, it appears that an axle bearing burnt through and a car lost a pair of wheels (Figure 1). Three minutes later, at the Mavis Road crossing, a number of cars derailed and collided, starting a series of explosions. The derailed section of the train contained chlorine, styrene, toluene, butane, and propane cars, the latter two chemicals probably causing the initial 'BLEVE' (Boiling Liquid Expanding Vapour Explosion).

Local officials, seeing and hearing the explosions, initiated the Peel Regional Police Disaster Plan which co-ordinates the immediate institutional response to emergencies within the region.¹ On learning that a chlorine tanker was probably in the derailed and burning section of the train, local officials decided to evacuate the immediate residential area (Zone 1 in Figure 1). The chlorine tanker contained 90 tons of liquid chlorine, a chemical which vaporizes on contact with air, forming a toxic gas capable of inflicting severe chemical burns and fatal lung damage at concentrations above three parts per million in air. Re-evaluation of the risks of exposure to chlorine gas and changes in weather conditions resulted in a series of further, staged, expanding evacuations to encompass, by Sunday evening, the whole of the city of Mississauga (Figure 1). As the fires were quelled, and as the threat of chlorine leaks diminished, residents were permitted to return home to the two outer areas on Tuesday, and inner areas on Friday, 16 November, almost six days after the first departures.²

SURVEY METHODS

The size, success, and implications of the Mississauga evacuation prompted this study, which seeks to describe the institutional responses to the accident and residents' responses to leaving their homes. The aims are, first, to identify some of the reasons for the success of the evacuation, particularly those elements of success which relate to social rather than institutional factors, and, second, to provide empirical data on the evacuation which can be compared with information gathered in parallel evacuation studies.³

Data were collected by means of a questionnaire survey mailed to a stratified random

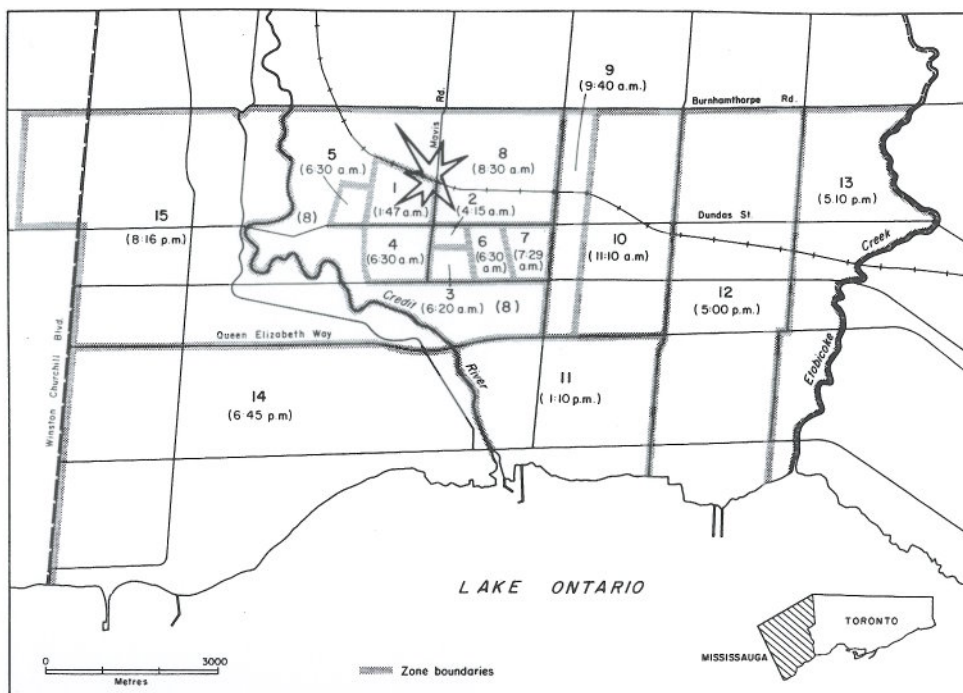


FIGURE 1. Evacuation zones (with times orders issued in brackets).

sample of Mississauga households in the week following the accident. The sample was systematically selected from a street directory and checked with local tax assessment lists. The sample was originally stratified according to the five erroneous evacuation zones printed in the *Toronto Star* on Monday, 12 November 1979.⁴ However, the data were restratified for this paper to coincide with the 15 sequentially declared zones shown in Figure 1, since Peel Regional Police records, examined after the survey was completed, indicated that 15, and not 5, temporally and spatially distinct evacuation zones were declared on Sunday, 11 November.⁵

The survey included questions about the nature, timing, and site of the accident as perceived by residents; their sources and timing of information about the accident, its risks, and the evacuation; the basis and timing of individual decisions to evacuate; the patterns of the evacuation; the impact of the evacuation; and the characteristics of respondents.

Questionnaires were mailed to 991 households of which 953 were deliverable. Three hundred and fifty-four completed questionnaires were returned by mail, the majority in the six weeks following the accident, yielding a response of 37 per cent. After six weeks a telephone follow-up was initiated. Some questions were eliminated in the telephone interview to limit its length but the same basic information was requested. Two hundred and twenty-seven telephone surveys were completed, so that, overall, replies were obtained for 581 households, giving a total response rate of 61 per cent.

Information on five household characteristics – length of residence in Mississauga, occupation of household head, household size, gross family income, and automobile ownership – for the mail and telephone questionnaires was compared before the results from these sources were combined.⁶ Significant differences were found between the two sets of replies only for household size and gross family income, at the 5 and 1 per cent levels of significance respectively. Therefore, the respondents in the two samples were similar,

except that the telephone respondents tended to come from smaller households, that, not surprisingly, reported lower gross family incomes. In addition, there were no significant locational differences between the three groups (mail respondents, telephone respondents, non-respondents) using chi-square at the 1 per cent level of significance. The mail and telephone responses were therefore combined for analysis.

RESULTS

Who Were the Respondents?

The households that responded to the survey possessed a number of characteristics which may have influenced their evacuation decisions and behaviour. The respondents had resided in Mississauga for an average of 11.1 years, with 7.8 per cent of the sample moving to the city within the last 2 years. Household size averaged 3.2 persons, with approximately one child under 18 years old in each household. Over four-fifths of the households had less than five members. Gross family income was widely distributed but suggested a relatively prosperous community with only 6.9 per cent of households reporting less than \$10,000 annual income, and 29.1 per cent reporting incomes in excess of \$30,000. The relatively high socio-economic status of Mississauga residents is supported by the fact that 42.4 per cent of the sample were occupied in professional, administrative, and managerial categories, and 94.0 per cent of the sample owned automobiles.

Survey data on four socio-economic characteristics – household size, length of residence in Mississauga, automobile ownership, and gross family income – were compared with similar information for the whole of the city of Mississauga in the 1971 and 1976 censuses to determine whether the sample represented a typical breakdown of city households.⁷ No significant differences were identified between the two sets of data at the 5 per cent level of significance.⁸ Therefore, it was cautiously concluded that the sample was representative.

What Did People Do?

The claim of a total evacuation of almost 225,000 people created both hope and disbelief in the minds of officials and planners in many North American communities.⁹ The co-operation of so many people in vacating their homes contradicts many previous experiences, but promotes an optimistic climate for planning large-scale evacuations. The survey confirms that most residents (91.7 per cent) evacuated their homes. Only 13 out of 581 households surveyed said that they did not evacuate (2.2 per cent of the sample). In addition, the survey identified 35 households (6.0 per cent) who were already away when the accident occurred, or who left home after the accident without realizing they might be evacuated or unable to return home.

Other studies report much lower proportions of evacuees. It has been consistently observed that up to one-third of the households threatened by hurricanes will not evacuate.¹⁰ Similarly, the studies of the evacuation from the Three Mile Island incident, for instance, estimate that as few as 31.0 per cent of the households within 24 km of the nuclear plant evacuated after the April 1979 accident.¹¹ The lower proportion of evacuees in response to Three Mile Island may be related to the lack of official evacuation advisories, other than Governor Thornburgh's advice regarding the departure of pregnant women and children under five years old.

Mississauga households acknowledged receiving evacuation advisories. Ninety-five per cent of the sample said they received evacuation advice or warnings on Sunday, 11 November, before vacating the area. Over 80 per cent of households received evacuation advice directly from the police, or via the news media (Figure 2). Respondents indicated these messages were the major reason for leaving, although sizeable proportions of evacuees also responded to family pressure or concern, the departure of neighbours, or the smell of chlorine gas (Figure 3). However, there was no legal mechanism by which residents could be forced to leave their homes, and thus the evacuation was voluntary – although a number of respondents seemed to believe that the police had powers of eviction.

The survey results suggest that approximately 1,470 households (4,850 people) in

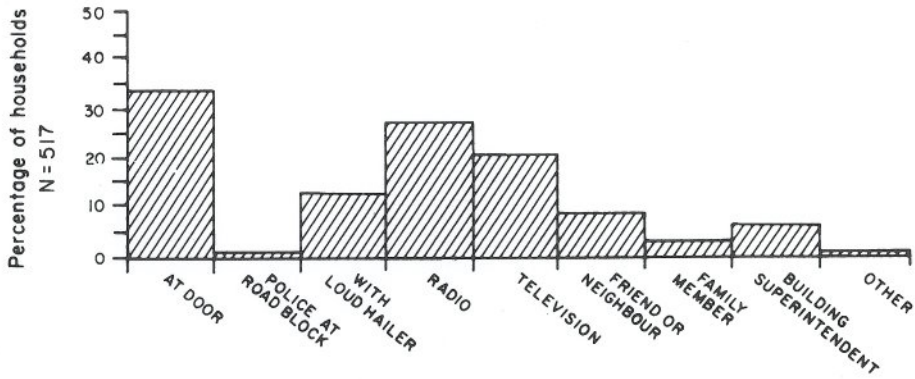


FIGURE 2. Sources of evacuation messages.

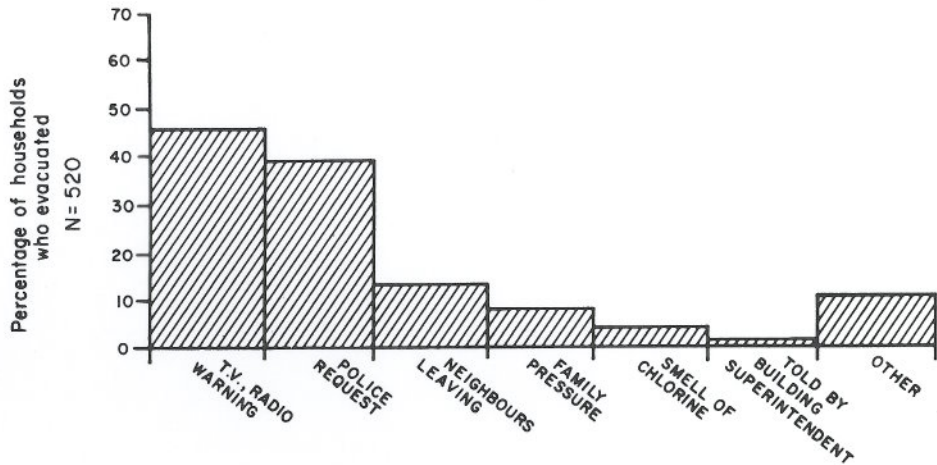


FIGURE 3. Evacuation stimuli.

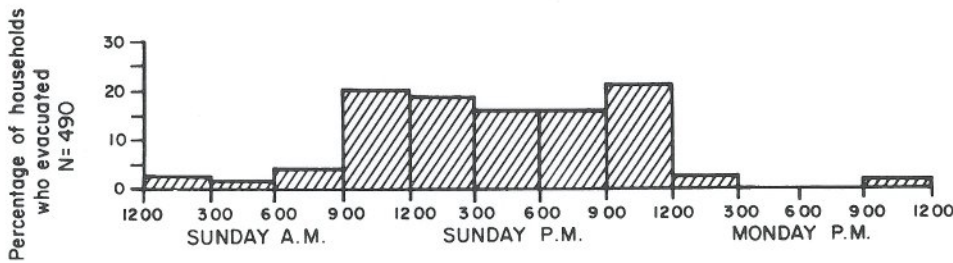


FIGURE 4. Time of evacuation.

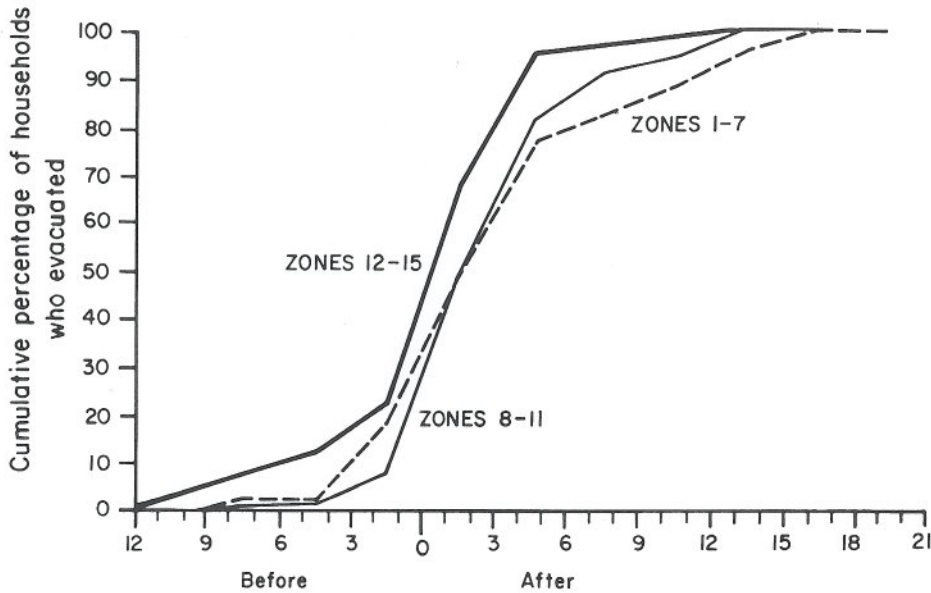


FIGURE 5. Relationship between timing of evacuation orders and departures (in hours).

Mississauga stayed at home during the evacuation. The 13 households in the sample who did not evacuate gave a variety of explanations for their behaviour. Four households said that they saw no reason to leave, for example: 'There was never any specific report of a definite risk ... just potential or possible' and 'We listened to the radio ... it was not serious enough and we did not feel like evacuating.' Another 4 households reported that they did not receive any messages to evacuate, 2 had family members who were too old or infirm to be moved, and 1 household did not leave for fear of looting. The survey provides no single reason why some households in Mississauga did not evacuate, since the lack of messages, and other characteristics, were shared by some of the households who did evacuate. The small number of non-evacuees in this study precluded the use of statistical tests to identify socio-economic and other determinants of evacuation behaviour.

When and Where Did Households Go?

The majority of residents left their homes after 9 am on Sunday 11 November (Figure 4). Although the timing of individual departures generally followed the sequence in which evacuation zones were declared (Figure 1) cross-correlation of the departure times relative to the timing of declarations with three sets of evacuation zones, and testing with the chi-square statistic, highlighted significant differences at the 1 per cent level of significance. The 15 evacuation zones were allocated to one of the three groups according to when the orders to evacuate areas were given: early morning (zones 1-7); late morning to early afternoon (zones 8-11); and late afternoon to early evening (zones 12-15). Different explanations can be presented to describe the cumulative frequency curves for these three sets of evacuation zones shown in Figure 5.

The orders to evacuate zones 1 through 7 were given between 1:47 am and 7:29 am on Sunday. Figure 5 indicates that 17.7 per cent of the households surveyed in these zones left before orders to evacuate were given, and that a slightly higher proportion (21.5 per cent) delayed their departures for at least six hours after the orders were given. The early response

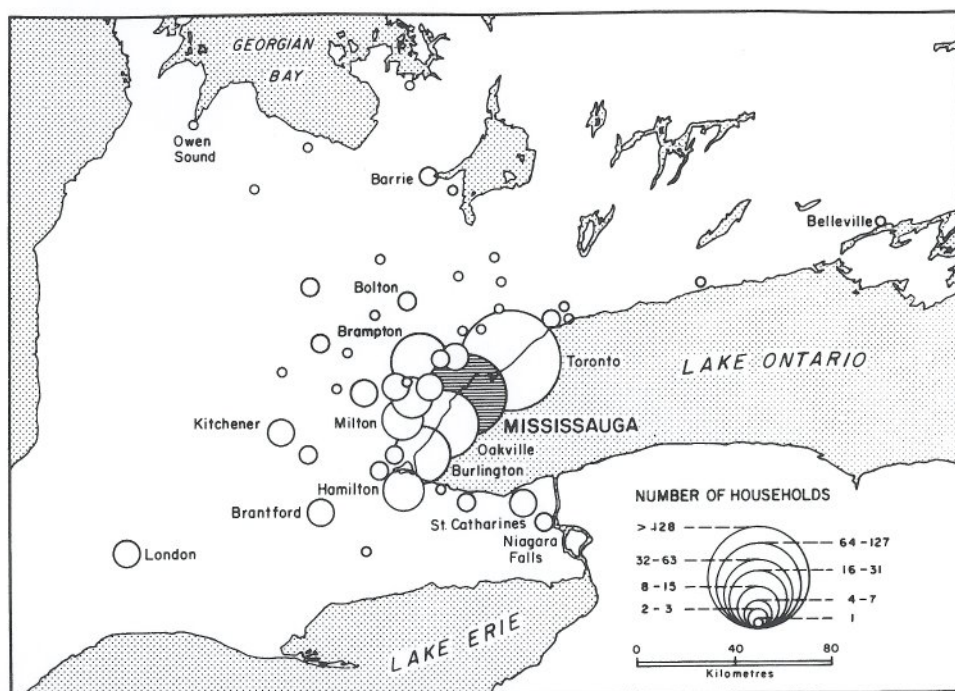


FIGURE 6. Initial evacuation destinations.

of some households can be attributed to the proximity of these zones to the accident site (Figure 1), and the visible and audible cues provided by the accident. The delayed responses, on the other hand, highlight the problems associated with night-time evacuations and correlate significantly with the source of evacuation warnings.¹² Households that received warnings in these zones tended to receive them from the police or a neighbour, whereas the warnings to households in the other two sets of zones came predominantly from the news media.

In zones 8 through 11, only a small proportion of households (8.0 per cent) left before the evacuation orders were given, although 83.9 per cent left in the six hours following these orders. The explanations invoked in the case of zones 1 through 7 seem relevant again, since the orders to evacuate these zones were given between 8:30 am and 1:10 pm on Sunday. The lack of households anticipating evacuation orders in this group probably highlights an unwillingness to leave before daybreak, whereas the high proportion leaving in the first six hours after evacuation orders left during the daytime. In the outer zones (12 through 15), evacuation orders were given between 5 pm and 8:16 pm on Sunday evening. Figure 5 shows that a relatively high proportion of the households (22.0 per cent) in these zones left before evacuation orders were given, and that almost all the remaining households (70.1 per cent) left in the six hours following the orders. The anticipation of evacuation orders in these zones probably stems from households observing the staged expansion of the evacuated zone, and from extensive radio and television coverage of the accident. The prompt departure of the majority of households still at home when orders to evacuate the outer zones were given enabled these households to avoid a night-time evacuation on Sunday evening.

One of the important revelations of this study was that the departure from their home was only the first in a series of evacuations for many households. Some moved several times during the first day of the evacuation, propelled by the sequential expansion of the evacuated

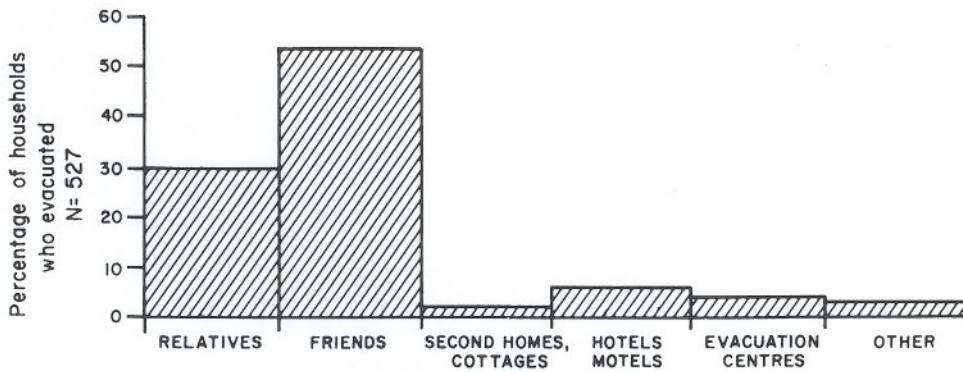


FIGURE 7. Initial destinations by type.

area. Twelve per cent of evacuees made their first move within Mississauga and were later re-evacuated. Overall, 24.3 per cent of households made two moves, 7.7 per cent made three, and 2.5 per cent four or more moves during the evacuation period.

Figure 6 shows the first destinations of evacuees and illustrates the important role that Metropolitan Toronto, Oakville, Brampton, Burlington, and Hamilton played in absorbing them. The survey indicates that the Queen Elizabeth Way, the main transport route linking these communities around Lake Ontario to Mississauga, carried approximately three-fifths of the evacuees to their initial destinations. This proportion, representing 40,000 households, reflects a pressure on transportation arteries which was fortunately staggered over at least 15 hours by the sequential nature of the evacuation (Figure 4). Almost all households left in their own cars despite the publicized availability of emergency public transportation. Eleven per cent of the households encountered gasoline supply or traffic congestion problems in evacuating.

Figure 7 shows the types of destinations used by Mississauga residents. Most found shelter with friends and relatives (84.6 per cent), and more went to hotels and motels than to evacuation centres. Nineteen official evacuation centres were established and the data indicate that these sheltered about 2,600 Mississauga households (8,320 people) during the evacuation. The results parallel evacuation patterns from Three Mile Island where it was found that approximately three-quarters of the evacuees went to stay with friends or relatives.¹³

The proportion of households moving to hotels, motels, and second homes increased with the number of moves made. Whereas only 5.9 per cent of evacuees went to motels or hotels on their first move, 11.1 per cent of second movers and 20.5 per cent of third movers went to hotels or motels. Evacuees who went to the early evacuation centres in their cars had to leave them behind when these centres were re-evacuated.

One-quarter of the respondents admitted that they had attempted to return home before they were allowed to. However, the police used their legal authority to set up roadblocks to prevent people returning to the evacuated areas. The re-entry was staggered, with outer zone residents returning on Tuesday, 13 November, and inner zone residents on Friday, 16 November. The duration of evacuations therefore ranged from two to six days.

What Were the Individual Impacts?

'The effects were worry ... when the blast came, scared ... then depressed that we could not come back, and as more days passed, frustration that it was taking so long.' Such a comment reflects the immediate negative impact felt by households who responded to the survey. Almost all the households identified one or more negative impacts which they attributed to the evacuation. Approximately one-third (34.2 per cent) noted general disruption and

inconvenience, 22.2 per cent felt that the emergency had generated worry, stress, and tension, and 19.5 per cent reported that they were worried about having missed work or lost income. Sizeable proportions also reported concern about children missing school (10.5 per cent) and feelings of fatigue and boredom (9.1 per cent), while smaller numbers mentioned accommodation problems or worries about other people (neighbours, friends), their homes, pets, and plants. When specifically asked what they were worried about while they were away from home, many evacuees noted looting or damage to property (66.6 per cent), although in fact very little occurred. Other people were concerned about their pets and plants (38.7 per cent), about contacting others (14.5 per cent), or medication (13.9 per cent). Finally, 8.2 per cent of the households did not worry about anything while away from their homes.

In contrast, only 37.2 per cent of respondents identified beneficial effects from the evacuation. For some it was a learning experience (9.2 per cent), for others a vacation (7.2 per cent), or an opportunity to visit friends and relatives (7.0 per cent). For example, one household reported that the evacuation was '... an interesting break in routine ... It brought people closer together ... It made my elderly father feel needed because he was able to look after us.'

Impact of the evacuation is also reflected in respondents' comments about what they would do in the event of a future evacuation. Many comments refer to the need to make more elaborate preparations next time, since most respondents (66.1 per cent) indicated that they had taken too few clothes or insufficient money, or had attended poorly to household security, food storage, pets, and plants. Twelve per cent of respondents wished to change the pattern, timing, or destination of evacuation in any future event. Sixteen households (3.2 per cent) who evacuated, in addition to the 13 households who did not evacuate this time, said they would stay at home next time. Notwithstanding, 9 of the households who did not evacuate said that the evacuation was justified. Ninety-four per cent of those who did evacuate approved of the process, although 3.0 per cent thought the evacuation zones were too large or the duration too long.

Results also indicated that the derailment and subsequent evacuation changed and modified certain attitudes of some Mississauga residents, at least in the short term.¹⁴ Prior to the accident, only 42.6 per cent of the households knew that hazardous chemicals were being transported through Mississauga, and only 11.2 per cent said that this worried them. In the aftermath of the accident, 75.2 per cent of respondents said that their feelings had changed in the direction of wanting stricter regulations and controls on the transport of dangerous goods, with another 6.0 per cent demanding alternative routes for the transportation of hazardous chemicals.

WHY DID THE EVACUATION SUCCEED?

The survey results support the notion that the evacuation of Mississauga was a success by virtue of the high proportion of people who evacuated. Alternatively, the success might be measured by the high proportion of both evacuees and non-evacuees who approved of the evacuation. But why was it so apparently successful? Are there plans and processes which can be transferred to similar situations in other communities to ensure similar success? This study, and the circumstances of the accident, suggest that there are specific and, in some cases, unique aspects of the Mississauga derailment and public response that must limit or guide further application of the Mississauga experience.

It is clear that the existence and implementation of the Peel Regional Police disaster plan made a significant contribution to the evacuation's success.¹⁵ This plan, which has two long-term aims – the control and, if necessary, the dispersement of crowds within the emergency area through the setting up of 'no-go' cordons and traffic control, and the establishment of a command post to direct activities at or near the emergency area – was implemented at 12:15 am on Sunday, 11 November, less than 30 minutes after the accident.¹⁶ The presence of Toronto International Airport at Malton within the Peel Region has provided an important stimulus for the preparation and practice of this elaborate emergency-disaster plan. The availability of the plan was a major factor contributing to the rapid,

co-ordinated response which unfolded during the night-time period immediately following the Mississauga derailment.

The environmental factors which influenced the evacuation are numerous and evident. The accident occurred as the train was passing through one of the few non-residential areas on the railway route. The Mavis Road crossing is surrounded by industrial facilities and farmland and was almost totally unpopulated on the Saturday night of the accident. The potential exists for a similar accident in some of the most densely populated areas of Metropolitan Toronto where the immediate risks would be much greater, whatever the institutional or public response.

The survey results support the expectation that because it was a Saturday night many households were together, at home, at the time of the accident (64.2 per cent of the sample). The weekend timing appears to have facilitated a calm evacuation, because Sunday was available for preparations and communication of information, and most families were united – in contrast to a weekday event where spouses and children could be widely separated.

The nature of the accident – an explosion and fire – was such that many households were immediately alerted to the occurrence of an emergency. Fifty-one per cent of respondents said that they knew about the accident by midnight on Saturday – within 10 minutes of the derailment – because they had either heard the explosion or seen the fire. Eighty-two per cent of the households perceived an immediate danger upon hearing about or seeing the accident, identifying the risk of an explosion, gas leak, or fire. Seventeen per cent of respondents said that they knew the risk was from chlorine, but this probably reflects knowledge gained during or after the accident rather than in the first few minutes after the derailment. Nevertheless, the smell and irritant effects of chlorine were experienced by a number of people. Thus the nature of the accident provided clear cues that an emergency was occurring. Mack and Baker believe that such environmental cues predispose households to evacuate.¹⁷ In this case it would appear that these cues, in combination with official verbal advisories, promoted an effective evacuation.

The socio-economic characteristics of Mississauga residents probably expedited evacuation in that the vast majority of households owned cars, many could afford hotels, and some owned second homes. Mississauga is also a community where looting is unlikely, and not immediately a concern. Social relationships of Mississauga residents were such that most people had friends and relatives with whom they could stay. The thought of a familiar and friendly destination for many residents must have made evacuation much easier. The survey also indicates that people did not have to go very far to find shelter. The proximity of major urban centres such as Toronto and Hamilton, with combined populations in excess of three million, provided accessible shelter with friends and relatives for the majority of evacuees. The geographical location of Mississauga with respect to these other cities that were able to absorb approximately a quarter of a million people was one of the more important elements contributing to the success of the evacuation.

In addition, the survey revealed that the majority of evacuees (91.3 per cent) thought that they were being asked to evacuate for less than one day. Most Mississauga households were not expecting, or prepared for, a major evacuation of several days' duration. They made few preparations and left their houses willingly, leaving food out, the heating on, and their pets behind. Twenty-nine per cent of the evacuees took nothing with them when they left their homes, and the remainder took only a small suitcase or other short-term requirements. This suggests that the co-operative and speedy response of many households rested on their perception that the evacuation would be for less than a day. Warnings of a longer absence from home might delay response to any future evacuation as people make more complete preparations. There would also be a danger of people deciding not to evacuate in order to stay at home to look after their pets, plants, and property.

The successful evacuation of Mississauga, therefore, can be attributed to three sets of factors – institutional, environmental, and social – which are notable for their uniqueness and complexity. These attributes, plus the problems inherent in cross-cultural hazards research identified by Torry,¹⁸ highlight the difficulties and challenges of designing universal hazard response and evacuation models.

ACKNOWLEDGMENTS

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NOTES AND REFERENCES

- 1 P. Timmerman, *The Mississauga Train Derailment and Evacuation, November 10-17, 1979: Event Reconstruction and Organizational Response* (Toronto: University of Toronto, Institute for Environmental Studies Emergency and Risk Research Working Paper EER-6, 1980).
- 2 M.C. Havey, A. Dickie, and D. Allen, *Derailment: The Mississauga Miracle* (Toronto: Queen's Printer for Ontario, 1980), p. 17.
- 3 S.D. Brunn, J.H. Johnson, Jr., and D.J. Zeigler, *Final Report on a Social Survey of Three Mile Island Area Residents* (East Lansing, Mich.: Michigan State University, Department of Geography, 1979); K. Barnes, J. Brosius, S.L. Cutter, and J.K. Mitchell, *Responses of Impacted Populations to the Three Mile Island Nuclear Reactor Accident: An Initial Assessment* (New Brunswick, NJ: Rutgers University, Department of Geography Discussion Paper No. 13, 1979); C.B. Flynn, *Three Mile Island Telephone Survey: Preliminary Report on Procedures and Findings* (Tempe, Ariz.: Mountain West Research Inc., 1979).
- 4 A.V.T. Whyte, D.M. Liverman, and J.P. Wilson, *Preliminary Report on Survey of Households Evacuated during the Mississauga Chlorine Gas Emergency* (Toronto: University of Toronto, Institute for Environmental Studies Emergency and Risk Research Working Paper EER-7, 1980).
- 5 Restratification altered the sample weightings in the following manner:

Original sample

	1	2	3	4	5
(a) Evacuation zones					
(b) Number of questionnaires delivered	164	166	168	310	145
(c) Number in sample/1,000 population	27.8	5.9	4.0	3.5	3.1

Restratisfied sample

	1	2	3	4	5	6/7	8	9	10	11	12/13	14	15
(a)	1	2	3	4	5	6/7	8	9	10	11	12/13	14	15
(b)	13	0	5	7	20	48	159	93	77	92	205	145	89
(c)	3.7	-	8.7	7.8	4.5	7.7	8.2	12.2	2.7	5.3	3.5	3.8	3.4

Aggregated zones

	1-7	8-11	12-15
(a)	1-7	8-11	12-15
(b)	93	421	439
(c)	5.8	5.8	3.6

These data illustrate the two ways in which restratification altered sample weights. First, the emphasis given to households in the two inner zones, which the *Toronto Star* claimed were told to evacuate before 8 am on Sunday, 11 November, was lost. This was caused by the *Star's* inclusion of the majority of households from official evacuation zones 8, 9, and 10 in their two inner zones. The households in these areas were not asked to leave until 8:30 am, 9:40 am, and 11:10 am respectively. Second, restratification meant that highly variable weights were assigned to the 15 zones. However, the results of this survey do reflect the responses of the total population because few significant differences were uncovered between the attitudes and behaviour of households in different zones, and because the major differences that were found relied on aggregation of the official zones into three groups (e.g. Figure 5). Aggregating the official zones in this way not only distinguished between three meaningful temporal periods, but also introduced a consistent weighting scheme in which slightly more emphasis was given to the earlier evacuation zones.

- 6 The Kolmogorov-Smirnov test was employed in the first four instances and the difference of proportions test in the case of automobile ownership.
- 7 The information about household size and length of residence in Mississauga was taken from the 1976 census. Details about automobile ownership and gross family income were obtained from the 1971 census. The 1970 mean gross family income for the city of Mississauga taken from the 1971 census

- was adjusted after comparison with gross family income data for the province of Ontario to provide a 1979 estimate of mean gross family income for the city.
- 8 Two tests were used: the *t*-test for difference of means (household size and gross family income) and the *z*-test for difference of proportions (length of residence in Mississauga and automobile ownership).
 - 9 This interest and concern culminated in an emergency planning conference hosted by the Ontario government in November 1980. This conference attracted emergency planners and other interested parties from several countries, including Australia, Belgium, the Federal Republic of Germany, Great Britain, Israel, Italy, the Netherlands, and the United States.
 - 10 E.J. Baker, *Hurricanes and Coastal Storms* (Gainesville, Fla.: University of Florida, Sea Grant College Report, 1980).
 - 11 Brunn et al., op cit.; Barnes et al., op cit.; Flynn, op cit.
 - 12 Correlation at the 1 per cent level of significance using chi-square test.
 - 13 Brunn et al., op cit.
 - 14 The permanence of these attitudes and longer term impacts are being examined by a working group at the Institute for Environmental Studies; see for example I. Burton, P.A. Victor, and A.V.T. Whyte, *An Evaluation of the Mississauga Emergency: Preliminary Findings* (Toronto: University of Toronto, Institute for Environmental Studies Emergency and Risk Research Working Paper EER-8, 1981).
 - 15 Burton, et al., op cit.
 - 16 Timmerman, op cit.
 - 17 R.W. Mack and G.W. Baker, *The Occasion Instant: The Structure of Social Responses to Unanticipated Air Raid Warnings* (Washington, DC: National Academy of Sciences and National Research Council, Publication 945, Disaster Study No. 15, 1961).
 - 18 W.I. Torry, 'Hazards, hazes and holes: a critique of "The Environment as Hazard" and general reflections on hazard research,' *The Canadian Geographer*, 23 (1979), pp. 368-83.

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