CANADA MORTGAGE AND HOUSING CORPORATION

COSTS AND BENEFITS TO MUNICIPALITIES OF MANDATORY RESIDENTIAL FIRE SPRINKLERS

HOUSING AFFORDABILITY AND FINANCE SERIES

Research Report

CMHC SCHL
Canada

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Costs and Benefits to Municipalities of Mandatory Residential Fire Sprinklers

Summary Report

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Cette publication est aussi disponible en français sous le titre : *L'installation obligatoire d'extincteurs automatiques à eau dans les habitations : coûts et avantages pour les municipalités,* PF0314.

This project was funded by Canada Mortgage and Housing Corporation (CMHC); the Ontario Ministry of Municipal Affairs and Housing, Housing Development and Buildings Branch; and the Ontario Ministry of the Solicitor General and Correctional Services, Office of the Fire Marshal. The National Research Council and Federation of Canadian Municipalities are also involved in the project. The views expressed are the personal views of the authors and CMHC accepts no responsibility for them.

Canadian Cataloguing in Publication Data

Main Entry under title:

Costs and benefits to municipalities of mandatory residential fire sprinklers

Issued also in French under title: L'utilisation obligatoire d'extincteurs automatiques à eau dans les habitations, coûts et avantages pour les municipalités.
Includes bibliographical references.
ISBN 0-660-17676-9
Cat. No. NH15-289/1998E

1. Fire sprinklers – Canada – Costs.
2. Dwellings – Fires and fire prevention – Canada.
I. Arencon Inc.
II. Canada Mortgage and Housing Corporation.

TH9336.C67 1998 363.37'7 C99-980011-6

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Printed in Canada
Produced by CMHC

PURPOSE

The primary objective of this study is to assess, on impartial, technically justified economic grounds, the costs and benefits to municipalities of the mandatory installation of fire sprinklers in all new residential construction. Secondarily, the study will identify the benefits and risks of automatic sprinklers, the effect on construction costs of housing and the effect on service and maintenance costs.

A case study approach has been employed, to analyze the costs and benefits of mandatory residential fire sprinklers, using six representative case study sites. The base case was established by collection of data (fire department policies and practices, population and growth projections, and capital and operating cost projections) from each site.

Factors such as potential changes in municipal infrastructure (fire hydrant spacing, water main sizes, road widths and site services), municipal insurance premiums and fire department operations have been considered.

The sprinklered scenario has been developed to assess the costs and benefits that would accrue to the various parties (municipality, developer, builder and homeowner), due to changes that would be made because of the introduction of mandatory residential sprinklers. The cost-benefit analysis compares the base case costs with the sprinklered scenario costs and projects the net present value of the costs and benefits to the various parties over a 30-year period. This period was specified in the Terms of Reference as being considered long enough for the effects of long-term changes, due to the introduction of mandatory residential sprinklers, to become apparent. It is also consistent with the periods considered in a study prepared for CMHC entitled "Impact of Mandatory Sprinklering of Multi-Unit Residential Buildings," which considered periods of 35 to 50 years for the useful life of sprinkler systems.[1]

ACKNOWLEDGEMENTS

The study team is grateful for the assistance of the staff of each of the case study municipalities who provided extensive background material and participated in interviews. Their cooperation and assistance was essential to the project.

The Advisory Committee provided valuable constructive criticism, counsel and direction.

Comments provided by independent reviewers and from stakeholders on the draft report for Phase 1 helped to focus the subsequent work.

Stakeholders interested in residential sprinkler issues, participated in a forum held in Ottawa on December 12, 1997. Comments received at this forum and subsequently, provided valuable feedback on the issues raised by this study. These comments, where appropriate, have been addressed in this report.

The advice and encouragement of CMHC's project managers and staff throughout the project, are gratefully acknowledged.

EXECUTIVE SUMMARY

This report presents the results of a study to assess, from an economic perspective, the costs and benefits to municipalities of the mandatory installation of fire sprinklers in all new residential construction. The study was commissioned by Canada Mortgage and Housing Corporation (CMHC), with the participation of the Ontario Ministry of Municipal Affairs and Housing, and the Office of the Ontario Fire Marshal. The National Research Council and Federation of Canadian Municipalities are also involved in the project. In Phase 1, the economic model was developed and tested using data collected from two Ontario case study municipalities, Barrie and Burlington. Subsequently, in Phase 2, revisions to the method and economic model were made and four additional case studies were carried out. The Phase 2 case study municipalities are Edmonton, Alberta; Pitt Meadows, British Columbia; Gatineau, Quebec; and Kawacatoose First Nation, Saskatchewan.

Scope

The study examines the benefits and costs of automatic sprinklers and estimates the effect of mandatory sprinklers on the cost of providing municipal fire protection services. The study also identifies the impact of sprinklers on the cost of housing development, construction and maintenance. Municipal costs, such as potential changes in municipal infrastructure, municipal insurance premiums and fire department facilities and operations, have been considered. Development costs, such as for the direct provision of infrastructure or the payment of development charges, are examined. Direct construction costs, such as the installation of the sprinkler system, and ongoing operating and maintenance costs for the homeowner, are also identified.

Assumptions

While some municipalities have introduced sprinkler by-laws or undertaken a major reorganization of municipal fire services, these cases are not widespread. For the purposes of this study, a number of assumptions were made regarding municipal fire protection services. It was assumed that municipalities would not undertake major fundamental changes to the current methods in which they provide and operate fire department services. As an example, it was assumed that the fire department's role in the provision of non-fire-related emergency services would remain constant. However, the impact of changes in firefighting techniques and equipment as a result of mandatory sprinklers was included in the analysis. It was assumed that the existing building stock, which consists of sprinklered and unsprinklered buildings, would remain essentially unchanged. Mandatory retrofit of the existing building stock with automatic sprinkler systems was not considered as part of the study, except for the Aboriginal reserve case study.

Potential implications of sprinklers for life risk to individuals or property damage to buildings were not assessed in this study as these issues are beyond the scope of the Terms of Reference. A parallel study has been conducted by CMHC and the National Research Council's National Fire Laboratory (NFL) which assesses the impact on risk of potential changes in the level and types of municipal fire protection services which might result from the introduction of mandatory residential sprinklers. The NFL study utilizes the FiRECAM™ model, developed by the National Fire Laboratory, to analyze the data from the six case study municipalities.

Method

A case study method has been employed to analyze the costs and benefits of mandatory residential fire sprinklers. The base case was established by collecting current data from each municipality. The data included present policies and practices, population growth and development projections, and capital and operating cost projections. The fire departments were reviewed with respect to current operating practices, equipment, staffing, use of volunteer firefighters and fire prevention activities. The range of services provided by a fire department has significant impact on staffing, equipment, facilities and costs. The proportion of time currently spent on non-fire-related activities (medical assist, vehicle extraction, rescue, hazardous materials, etc.) was identified; however, the study did not attempt to determine the most effective allocation of the fire department resources.

An economic model was developed to establish the base case costs for the case study municipalities. The model was then used to estimate the changes in costs that would result from potential changes in municipal fire protection service due to the introduction of mandatory sprinklers (the sprinklered scenario). The model was simplified for Phase 2 by excluding those cost and benefit items which were found not to be relevant or significant for Canadian municipalities such as housing density, road width, fire hydrant spacing and water main sizing. Using a net present value analysis, the change in costs to the municipalities was calculated over a 30-year time period. Cost changes for development, construction and home operation were also calculated; however, the emphasis in the study was on the direct costs to the municipality.

The potential changes to the municipality's capital and operating plans, and their associated costs, due to the introduction of mandatory residential fire sprinklers were estimated based on questionnaires and follow-up discussions with planning, development, finance and fire department staff in each of the case study municipalities. The projected changes in the level of municipal fire protection for the case study municipalities are based on information provided by officials in those municipalities. Changes in level of risk for persons or property as a result of reduced fire services or by the installation of sprinklers, are addressed in the NFL parallel study.

Results

The results of the analysis of the case study sites show that direct municipal cost savings for fire protection services may be achieved through the introduction of mandatory residential fire sprinklers for new development, although these savings are considerably less than the related additional costs which would be incurred for the installation of sprinklers in the new housing.

Municipal cost reductions will depend on a variety of factors including the municipal development pattern and nature of the fire service. Reductions are more likely where new development will occur in greenfield (unserviced) areas, beyond the area served by existing fire stations, and where the fire department role is primarily fire suppression and not emergency medical response.

Changes in the level of risk for persons or property as a result of the introduction of sprinklers or changes in the level of municipal fire protection service are addressed in the parallel NFL study. In all case study municipalities, the NFL analysis indicates that the risk to life is relatively lower for persons living in sprinklered homes in areas that have longer response times than the fire department provides for existing areas of the municipality.

Analysis of the case study municipalities, indicates that each municipality demonstrates a different set of variables and results. The results of the present value analysis are summarized in tables 1 and 2. Each case study is discussed in turn.

Burlington, Ontario

Future fire department staffing and equipment requirements are not projected to change due to the introduction of residential sprinklers. The proposed additional station would be required even if mandatory sprinklering was introduced for new development.

The level of non-fire-related emergency services provided by the Burlington fire department is the major determinant in planning for future staffing, equipment and levels of service. As a result, there would be no change in the municipality's costs for fire protection service with the introduction of mandatory sprinklers. The estimated net present value of the increased construction costs for installation of sprinklers is $42.3 million over the 30-year study period.

Barrie, Ontario

In the sprinklered scenario, it is assumed that Barrie could reduce the number of fire stations required to satisfy future growth over the next 30 years from six to four by the introduction of mandatory residential

sprinklers and longer fire department response times to the new sprinklered areas. One existing fire station would be relocated west of Highway 400 and a new station would be built west of Highway 400.

In the unsprinklered scenario, three new fire stations would be built west of Highway 400 over the 30-year study period and the existing three fire stations would be maintained. The proposed new fire stations are planned primarily to provide fire protection services to new growth areas.

The reduction in municipal costs for fire protection services is estimated to have a net present value of $7.4 million over the 30-year horizon. The provision of sprinklers in the new houses would result in increased construction costs having a net present value of $38 million over the same period.

Edmonton, Alberta

The introduction of mandatory residential sprinklers for new residential development will permit the fire department to limit the number of fire stations to the present complement. The new sprinklered development around the perimeter of the existing built-up area, would be served by existing fire stations using longer response times than current response times.

Without mandatory residential sprinklers for new development, six new fire stations, related staff, vehicles and equipment are projected to be required over the 30-year study period.

The net present value of municipal fire protection cost savings over the study period is estimated to be $38.5 million. Increased home construction costs for installation of sprinklers are estimated to have a net present value of $130.1 million over the same period.

District of Pitt Meadows, British Columbia

Pitt Meadows, British Columbia already has a mandatory sprinkler by-law in effect; therefore, the model was used to estimate the changes from the base case sprinklered scenario to a non sprinklered scenario. Under the existing mandatory sprinkler policy, the District plans to service the proposed new development in the north and northeast areas by the volunteer fire department from the existing fire station in the south. Without mandatory sprinklers, an additional fire station would be required to serve the northern development area.

Under the sprinklered scenario, the net present value of municipal cost reductions would be $2.8 million and the net present value of additional construction costs of installing sprinklers in the new housing would total $11.7 million over the 30-year period.

The continuation of all volunteer fire services is an issue of ongoing concern to rapidly growing municipalities such as Pitt Meadows. Uncertainty exists regarding volunteer availability given future demographics, the increasing importance of the emergency medical response role of the fire department and ratepayer service expectations. Therefore, at the request of Pitt Meadows, an alternative scenario was assessed to examine the impact of the mandatory sprinkler requirement if the current volunteer fire department would be replaced with a composite force (paid professional and volunteer firefighters). Under this alternative, some of the volunteer firefighters in the existing station would be replaced by full-time, paid staff and the additional fire station required in the non-sprinklered scenario would also be staffed by full-time paid firefighters and volunteers. All other assumptions in the model remained unchanged.

In the sprinklered scenario of the composite alternative, the net present value of municipal cost reductions would increase to $5.1 million over the 30-year period. Additional construction costs for installation of the sprinklers would again total $11.7 million over the study period.

Gatineau, Quebec

A major residential development, anticipated to accommodate in excess of 20,000 people, is planned for the northwest area, north of Highway 50. A new fire station with 12 firefighters and vehicles, located north of Highway 50, is planned to serve this new residential area, and is established as the base case.

In the sprinklered scenario, all new residential construction in this new northwest residential area, north of Highway 50, as well as in the remainder of the city, is assumed to be sprinklered. This will enable the fire department to serve the new northwest area from the existing fire stations, with longer fire department response times. Sprinkler protection of new residential development in the existing urban area will enable the fire department to protect an increased population in the existing urban area with the current resources.

Over the 30-year period, the net present value of municipal cost reductions is estimated to be $8.9 million. Increased home construction costs for installation of sprinklers having a net present value of $29.2 million would result over the same period.

Kawacatoose First Nation Reserve, Saskatchewan

On this reserve, and typical of other Native reserves, the band owns the land, housing, municipal infrastructure and fire service. Therefore, the scope of the potential costs and benefits to the band is wider than the scope of potential costs and benefits to non-reserve municipalities. The wider scope is reflected in a modified approach for this case study site.

The base case has been considered as the continuation of the present practices. The sprinklered scenario is based on a proactive measure to address the high fire loss record on Saskatchewan Native reserves. This includes installation of sprinklers in all new housing constructed to accommodate anticipated increases in the band population as well as installation of sprinklers in all existing housing on the reserve over a 10-year period.

As the band is the municipal government, the land developer, the homebuilder and the homeowner, the cost allocation to different parties does not apply to Kawacatoose. The net present value of the direct financial costs and benefits for the band of the sprinklered scenario are shown in Table 2.

Under the sprinklered scenario, the existing fire service would remain unchanged; therefore, no change in fire department costs would result. Sprinkler installation costs would total $548,191 over the study period and an estimated $34,724 would be required for ongoing sprinkler system maintenance. The band would realize an estimated reduction in fire-related home replacement and repair costs of $333,153 over the same period.

Table 1
Changes in Costs Due to Mandatory Residential Fire Sprinklers
Results of Net Present Value Analysis

	Net Present Value Increase (Decrease)				
Sector/Municipality	Burlington $	Barrie $	Edmonton $	Pitt Meadows $	Gatineau $
Municipal costs	0	(7,400,000)	(38,490,383)	(2,762,164)	(8,892,648)
Development costs	0	(800,000)	0	0	0
Construction costs	42,300,000	38,000,000	130,112,965	11,719,655	29,246,975
Home maintenance costs	1,700,000	1,600,000	5,207,604	492,895	1,223,293
Home insurance costs	(5,900,000)	(5,200,000)	(16,324,418)	(1,526,494)	(3,750,912)

Table 2
Kawacatoose First Nation - Changes in Costs Due to Mandatory Residential Fire Sprinklers Results of Net Present Value Analysis

Sector	Net Present Value Increase (Decrease)
Fire department costs	0
Sprinkler installation costs	548,191
Sprinkler maintenance costs	34,724
Fire-related home replacement and repair costs	(333,153)

The fire death rate on Saskatchewan reserves is more than four times the fire death rate for non reserve communities. Reduced property damage fire losses of homes on the reserve are likely to have a related and significant impact on personal injuries and deaths from fire, directly related to the relatively high number of occupants in reserve houses.

Conclusion

The results of the analysis of the case study sites show that, in certain circumstances, direct municipal cost savings for fire protection services may be achieved through the introduction of mandatory residential fire sprinklers for new development, although these savings are considerably less than the related additional costs which would be incurred for the installation of sprinklers in the new housing.

Changes in the level of risk for persons or property as a result of the introduction of sprinklers or changes in the level of municipal fire protection service are addressed in the parallel NFL study. In all case study municipalities, the NFL analysis indicates that the risk to life is relatively lower for persons living in sprinklered homes in areas that have longer response times than the fire department provides for existing areas of the municipality.

This analysis demonstrates that the potential for municipal savings occurs where:

- There are significant opportunities for new greenfield residential development.
- The pattern of future growth in residential development extends the existing built-up area beyond the areas presently served by the fire department from existing fire stations.
- New buildings (residential and non-residential) in the future growth areas are sprinklered.
- Response times for the fire department to arrive at the fire scene can be lengthened for fire stations serving sprinklered areas.
- The fire department's role is fire suppression, and only secondary support is provided for non-fire emergency services when requested.

When all of the criteria are met, the municipality has the potential to obtain the maximum savings. When all the criteria are not met, potential savings would be reduced or negated, depending on the specific characteristics of the municipality. In each of the cases, potential savings to the municipality would be less than the additional construction costs for the installation of sprinklers.

Planning and building department staff in the case study municipalities were questioned regarding the potential impact of mandatory residential sprinklers on standards for land development, infrastructure and the construction of homes. In some American jurisdictions, municipalities have permitted various concessions to developers and homebuilders in exchange for residential sprinklers, such as higher development densities, reduced infrastructure costs (e.g., road width, placement of fire hydrants, water supply standards). In some of the case study municipalities, infrastructure requirements are being adjusted due to planning initiatives and changes in fire department operating procedures, without requiring residential sprinklers. However, none of the case study municipalities indicated that it would be able to grant additional infrastructure concessions in exchange for mandatory residential sprinklers.

For other costs and benefits included in the model:

- There was no change in the costs for land development, except in Barrie where development costs are reduced due to a reduction in development charges related to fewer fire stations.

- There were increased construction costs for the installation of sprinklers in the new housing.

- There were increased home maintenance costs for the sprinkler system which are offset by savings on home insurance costs.

The six case study municipalities provide a basis that other Canadian municipalities can use for comparison. They represent a range of planned development potential and fire service models, faster or slower growth projections, and the use of volunteer firefighters.

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The study examines the benefits and costs of automatic sprinklers, and estimates the effect of mandatory sprinklers on the cost of providing municipal fire protection services. The study also identifies the impact of sprinklers on the cost of housing development, construction and maintenance.

Municipal costs, such as potential changes in municipal infrastructure, municipal insurance premiums and fire department facilities and operations, have been considered. Development costs, such as for the direct provision of infrastructure or the payment of development charges, are examined.

Direct construction costs, such as the installation of the sprinkler system, and ongoing operating and maintenance costs for the homeowner, are also identified.

The potential changes to the municipality's capital and operating plans, and their associated costs, due to the introduction of mandatory residential fire sprinklers, were estimated based on data submitted by the municipalities in response to questionnaires and follow-up discussions with planning, development, finance and fire department staff in each of the case study municipalities. The projected changes in the level of municipal fire protection for the case study municipalities are based on information provided by officials in those municipalities. Changes in level of risk for persons or property as a result of reduced fire services or by the installation of sprinklers are addressed in the National Fire Laboratory (NFL) parallel study.

CHAPTER 2 – ASSUMPTIONS

While some municipalities have introduced sprinkler by-laws or undertaken major reorganization of municipal fire services, these cases are not widespread. For the purposes of this study, a number of assumptions were made regarding municipal fire protection services. It was assumed that municipalities would not undertake major fundamental changes to the current methods in which they provide and operate fire department services. As an example, it was assumed that the fire department's role in the provision of non-fire-related emergency services would remain constant. However, the impact of changes in firefighting techniques and equipment was included in the analysis. It was assumed that the existing building stock, which consists of sprinklered and unsprinklered buildings, would remain essentially unchanged. Mandatory retrofit of the existing building stock with automatic sprinkler systems was not considered as part of the study, except in the Aboriginal reserve case study.

Potential implications of sprinklers for life risk to individuals or property damage to buildings were not assessed in this study as these issues are beyond the scope of the Terms of Reference. A parallel study has been conducted by CMHC and the National Research Council's National Fire Laboratory (NFL) which assesses the impact on risk of potential changes in the level and types of municipal fire protection services which might result from the introduction of mandatory residential sprinklers. The NFL study utilized the FiRECAM™ model, developed by the National Fire Laboratory, to analyze the data from the case study municipalities.

CHAPTER 3 – METHOD

A case study method has been employed to analyze the costs and benefits of mandatory residential fire sprinklers. The six case study communities that participated in this project are Barrie and Burlington, Ontario; Edmonton, Alberta; Pitt Meadows, British Columbia; Gatineau, Quebec and Kawacatoose First Nation, Saskatchewan.

The base case[2] was established by collecting current data from each municipality. The data included present policies and practices, population growth and development projections, and capital and operating cost projections. The fire departments were reviewed with respect to current operating practices, equipment, staffing, use of volunteer firefighters and fire prevention activities. The proportion of time currently spent on non fire-related activities (medical assist, vehicle extraction, rescue, hazardous materials, etc.) was identified; however, the study did not attempt to determine the most effective allocation of the fire department resources. This review did not assess the fire departments' existing facilities (fire stations and equipment), staffing and operating policies, for compliance with the municipalities' policies on the provision of fire protection services.

An economic model was developed to establish the base case costs for the case study municipalities. The model was then used to estimate the changes in costs that would result from potential changes in municipal fire protection service due to the introduction of mandatory sprinklers (the sprinklered scenario). Two Ontario municipalities, Barrie and Burlington, were the Phase 1 case study sites. Following completion of Phase 1, the economic model was simplified for Phase 2 by excluding those cost and benefit items which were found not to be relevant or significant for Canadian municipalities. These included housing density, road width, fire hydrant spacing and water main sizing. Using a net present value analysis, the change in costs to the municipalities was calculated over a 30-year time period. Cost changes for development, construction and home operation were also calculated; however, the emphasis in the study was on the direct costs to the municipality.

CHAPTER 4 – ECONOMIC MODELLING

This study assesses, from an economic perspective, the costs and benefits to municipalities of the mandatory installation of fire sprinklers in all new residential construction. A case study approach has been employed to analyze the costs and benefits of mandatory residential fire sprinklers using six communities of widely different character across Canada.

Fire departments were reviewed with respect to current operating practices, equipment, staffing, use of volunteer firefighters and fire prevention activities. The range of services provided by a fire department has a significant impact on staffing, equipment, facilities and costs. Changes to the municipal fire department's capital and operating plans, and their associated costs, due to the introduction of mandatory residential fire sprinklers were estimated. These estimates were based on a questionnaire and follow-up discussions with the case study municipalities' staffs.

An economic model was developed to establish the base case costs for the case study municipalities, and to assess the changes to municipal costs projected to occur due to mandatory sprinklers (the sprinklered scenario). Using a net present value analysis, the costs and benefits to the case study municipalities were calculated over the next 30 years. The analysis produces different results for each of the case study sites.

Cost data for the case study sites, including new fire stations, timing of expenditures, operating and maintenance costs are all based on historical cost data and the long-term projections by the case study municipalities. Data were taken from the municipalities' 1994 financial information returns and their 1995 municipal budgets and multi-year capital budget forecasts for the Phase 1 municipalities (Barrie and Burlington), and from data gathered in 1997 for the Phase 2 case study sites (Edmonton, Pitt Meadows, Gatineau and Kawacatoose). These cost projections also take into account the municipalities' forecasts of the changes in materials, equipment, firefighting and emergency services technology, and staffing levels.

The model covers a 30-year period, considered long enough for the effects of long-term changes due to the introduction of mandatory residential sprinklers to become apparent. While the model is designed to provide insight into the costs and benefits incurred by various parties, the bottom line focusses on the ultimate impact for the municipalities, in accord with the Terms of Reference for this study. The cost-benefit analysis is based on the premise that no changes are made to the fire department's services outside the area of fire suppression and that other factors, such as the fire department's role in the provision of non-fire emergency services and union rules regarding staffing, remain constant.

This study is not intended to encompass the full range of costs and benefits associated with mandatory residential sprinklers. Rather, it is intended to focus particularly on the costs and benefits for municipalities. The study also examines costs and benefits for developers and homebuilders and the direct financial costs and benefits for homeowners. These costs and benefits are examined to assess the change of balance, if any, of the allocation of costs among the municipalities, developers and homeowners. By including these sectors in the analysis, potential shifts in municipal costs and benefits to other sectors, such as developers, builders and homeowners, can be identified.

Cost-benefit economic analysis model

- The framework of the cost-benefit economic analysis model uses background data and fire department statistics, and the costs and benefits by sector.

- The annual net benefits (or costs) associated with mandatory sprinklers are summed for

each sector for each year. The net present value of the stream of net benefits over the 30-year period is then calculated.

Model inputs and calculations

- Population – Population and housing unit projections were provided by municipal planning staff and supplemented with census data.

- Fire Department Statistics – The timing of new stations, hiring of additional staff and purchase of new vehicles were based on information collected from current municipal capital budget forecasts and interviews with municipal fire department staff.

- Capital Expenditures – Additional land, buildings, vehicles and equipment were based on budget data provided by each case study municipality related to plans to build new stations and hire additional staff. Replacement costs were based on long-term capital forecasts provided by municipal finance staff, where available, with the annual pattern of expenditures assumed to repeat every 10 years. Where additional vehicles are to be purchased for the fire department, allowance has been made for their eventual replacement in accord with current municipal policies. Costs shown for new fire stations are those included in the municipalities' capital budgets. The capital forecasts predict the capital needs of the fire department over the forecast period (generally 10 years).

- Wages and Benefits – Costs reflect operating budgets. Costs are assumed to increase based on the hiring of additional fire staff and volunteers where applicable.

- Materials and Services – Costs reflect operating budgets. Costs are assumed to increase based on additional operating and maintenance costs for new stations.

- Inspection Fees – Costs and revenue related to inspection fees for installation of sprinklers are assessed in accord with each municipalities' practices and expectations.

- Average Operating Costs per Capita – Include wages, benefits, materials, services and replacement capital costs.

- Non-Sprinkler versus Sprinkler Scenario – Total annual fire department costs with sprinklers were subtracted from the total annual costs without sprinklers. Projections of costs for the non-sprinklered and sprinklered scenarios are provided.

- Municipal Capital Expenditures – Discussions with fire, public works and planning staff in the case study municipalities suggested that sprinklers were unlikely to result in significant changes in capital costs for water supply and distribution, hydrants, sanitary sewers or roads.

- Development Charges – Practices vary regarding the use of development charges to fund new fire stations and similar facilities. Cost changes are included in accord with each case study site's practice.

- Water Hook-Up Charges – No impact is expected.[3]

- Building Permit Fees – For case study sites where building permit fees are based on construction costs, increased costs associated with the installation of sprinklers will result in more fee revenues for the municipality. In other case study sites, building permit fees are a flat fee and are not affected by increased construction costs that may be related to sprinkler installation.

- Municipal Operating Costs – Sprinklers are not expected to affect operating or maintenance costs related to water, hydrants, sewers or roads. Municipal insurance premiums are not expected to be affected by sprinklers.

- Tax Revenues – Staff responsible for municipal property assessment in each

municipality indicated that sprinklers do not affect the taxable assessment for homes, although a consistent pattern of higher resale prices for sprinklered houses could result in a change in this practice. Based on the existing assessment practices, the analysis incorporates no change in property taxes related to the assessment of sprinklered homes. The current models for tax assessment do not consider sprinklers in most parts of Canada, however, in the Province of Quebec, this is not the case, as sprinklers are included in tax assessments. No provision is included for tax incentives to encourage the installation of residential sprinklers in existing buildings.

- Land Developers' Costs/Benefits – No change is expected in the direct cost of providing services for new subdivisions or in the density of new subdivisions. In Barrie, reduced capital costs for fire stations will be reflected in lower development charges paid by land developers.

- Dwelling Sizes – Typical new home sizes (186 m^2 or 2,000 sq. ft. for singles and semis; 139 m^2 or 1,500 sq. ft. for townhouses; and 93 m^2 or 1,000 sq. ft. for apartments)[4] were used in the assessment of installation costs for residential sprinkler systems. The areas given represent the area of finished interior space above ground level. They do not include garages (attached or detached) or unfinished basement space.

- Homebuilders' Costs/Benefits – Sprinkler installation costs[5] were estimated based on typical installation costs of $1.70/sq. ft. for singles, semis and townhouses; and $1.45/sq. ft. for apartments. These costs, which would be incurred by homebuilders and would be passed on to homebuyers (subject to market conditions), include all costs related to installation of residential sprinkler systems, including installation, permit fees and inspections. No other significant changes in construction costs are expected, based on discussions with municipal building and planning department staff.

- Monitoring Costs – Moderate and large buildings are required by the 1995 National Building Code of Canada (NBC) to have Underwriters' Laboratories of Canada (ULC)-listed central station monitoring service to transmit directly to the fire department, alarms from the building's fire alarm system, including water flow detection on the building's sprinkler system. The costs for this monitoring service are not affected by a municipality requiring mandatory residential sprinklers. Therefore, the costs associated with installation and monitoring charges are not included in the cost-benefit analysis.

  For buildings not required to have a ULC-listed central station monitoring service, intrusion alarm systems monitored by intrusion alarm monitoring services may also be used to monitor sprinkler water flow alarms. Such systems, however, are voluntary and therefore, are not included in the cost-benefit analysis. Additional installation costs to add the sprinkler water flow detector to the intrusion alarm are minimal, and there is no additional monthly monitoring cost.

  In Pitt Meadows, certain buildings are required to be equipped with ULC-listed central monitoring service that would not be required to be so equipped by the NBC. These monitoring costs are included in the cost-benefit analysis.

- Maintenance and Inspection Costs – Maintenance and inspection costs are projected to amount to $200 per home every 10 years, beginning 10 years after the initial sprinkler system installation, based on current information from the Vancouver area. This figure includes the cost of replacing parts as required.

  Larger buildings, within the scope of NFPA 13R and NFPA 13, are required by the Fire Code to have regular inspections and testing of their fire safety systems, including sprinkler systems.

- Insurance Premiums – Some home insurance providers offer a discount for residential sprinklers. The range of savings offered is generally up to 10 per cent with an average of five per cent discount on the basic homeowner's insurance premium, or approximately $32.50 per home per year. These figures are based on the cost for a typical replacement value homeowner's policy for the average southern Ontario area home.[6] The discount for residential sprinklers is offered in accord with the insurer's standard underwriting practice.[7] It was assumed that all sprinklered homes would benefit from this reduction if residential sprinklers were mandatory.

  Residential property insurance rates are generally established based on the level of municipal fire protection available. "Protected" rates are offered to homes located within 8 km (5 miles) of a fire station and within 305 m (1,000 ft) of a fire hydrant. Some insurers offer "protected" rates to homes up to 13 km (8 miles) from a fire station.[8] "Semi-protected" rates are offered to homes located within 8 km of a fire station, but more than 305 m from a fire hydrant. "Unprotected" rates are offered for homes that are more than 8 km (or 13 km for some insurers) from a fire station.

  For the municipalities that are included in this study, most new residential development is located within the distance limits from fire stations that qualify for "protected" property insurance rates.[9]

  Conventional homeowner's insurance policies provide for replacement of the building to the same standard of construction as exists immediately prior to a loss. Where changes in building regulations have taken place since the building was constructed that are more costly than the replication of the insured building the costs of compliance with such changes are not covered by the standard homeowner's policy. A by-law endorsement (termed a "Demolition and Construction Endorsement (for Dwelling Risks)" by one insurer) is available from most property insurance companies.[10]

Sectors covered by the model

The model includes costs and benefits for the following sectors:

- the municipality, with particular emphasis on the fire department, but including potential impacts on other services such as water supply and building inspection services, and on municipal revenues such as property taxes, development charges and user fees;

- land developers who may be affected through changes in subdivision service costs, potential for higher development densities or changes in development charge rates related to changes in municipal capital requirements;

- homebuilders who would initially incur the costs related to installation and whose sales and earnings might be affected by higher construction costs flowing into higher house prices; and

- the residents of new homes who would incur higher house prices (subject to market conditions), ongoing maintenance and inspection costs, higher property tax assessments (if sprinklers are included in the assessed value) and lower tax rates (if municipal cost savings are realized). In those municipalities where mandatory sprinklers in new homes could reduce the fire department costs, the savings would be reflected in a reduction in taxes for all ratepayers across the municipality, including the residents of older homes where sprinklers are not required.

In some cases, items identified in the model as benefits for one sector may be passed on to other sectors. For example:

- Where sprinklers eliminate the need for the construction of new fire stations in the future, reduced capital costs may be reflected in lower development charges on new homes – a

cost saving for land developers. This cost saving will, at least partially, be passed on to the homebuilder and, ultimately, to the new homebuyer.

- Any reductions in municipal operating costs will reduce municipal property tax rates for all taxpayers. Developers with major land holdings and new homebuyers will benefit through reduced tax rates (as will other taxpayers in the municipality). Developer tax savings may be reflected in reduced lot costs for homebuilders and, ultimately, in lower prices for new homebuyers.

- Increases in construction costs related to the installation and inspection of sprinklers will initially have an impact on homebuilders, but are likely to be passed on to new homebuyers through price increases.

- The potential net impact of sprinklers on housing prices will depend on housing market supply and demand conditions (which vary over time and among communities). In communities where the supply of housing is restricted and housing demand is very strong, the cost increase for installation of sprinklers will be passed forward into higher home prices. Where there is a large potential supply of new housing and housing demand is weak and price sensitive, homebuilders and developers may absorb a share of increased costs. In municipalities where fire protection costs are reduced due to mandatory sprinkler policies, the direct cost of sprinkler installation may be tempered by developer and homebuilder savings in development charges and property taxes.

- Higher housing prices, in turn, may reduce the number of new homes sold in future years. Reduced home sales will have negative fiscal impacts on developers and homebuilders. Reduced home sales will also slow the rate of growth in the municipality, reduce growth of the municipality's taxable assessment base and affect the timing of fire department expansion.

- A reduction in property value losses due to mandatory sprinklers will reduce losses in municipal taxation revenues due to residential fires. This would apply in provinces where the municipal tax assessment of a building damaged or destroyed by fire is reduced to reflect the reduction in property value due to the fire. Only after the building is repaired or rebuilt, is the tax assessment returned to normal levels, based on the increased property value resulting from the reconstruction or repair.

Due to the complexity of the linkages among the various sectors included in the model, the secondary and subsequent rounds of impacts are not directly reflected in the cost-benefit analysis.

Costs and benefits not included in the model

The framework is designed to assess the impact of sprinklers on direct monetary costs and benefits for the sectors noted above. Costs and benefits that are not directly measured in dollars are not included in the framework.

The cost-benefit framework does not incorporate costs and benefits directly related to fire suppression by sprinklers, including:

- reduced health care costs because fewer residents and firefighters may be injured in residential fires and injuries may be less severe;

- other injury-related costs such as lost earnings, and the cost of backup fire department staff, and injury-related early retirement;

- reduction in the cost of claims to insurers of damage and losses of home and contents (except in the Kawacatoose case study);

- water damage attributable to leakage from, or accidental damage to, the residential sprinkler system; and

- reduction in number of deaths of residents and firefighters.

Where sprinklers are expected to have an impact on the location and staffing of fire stations, these changes in fire department facilities and staffing could result in indirect costs or benefits that are not covered by the framework including:

- increased response times[11] and, therefore, increased risk associated with fires for properties that do not have sprinklers (e.g., existing homes, older commercial buildings, new homes with malfunctioning sprinklers, etc.) which may result in increases in property damage, injuries and deaths; and

- increased response times for medical emergencies that may result in increases in medical costs and deaths, or increases in costs for ambulance and paramedical services.

CHAPTER 5 – THE CASE STUDY MUNICIPALITIES

Analysis of the case study municipalities indicates that each municipality demonstrates a different set of variables and results. Each is discussed in turn. Detailed assumptions for each case study municipality, as well as a map showing current and future development areas, are provided in Appendix A.

Burlington, Ontario

Urban development in Burlington is concentrated along the north shore of Lake Ontario. Long-range planning will limit the urbanized area of the city to the area south of Highway 403. The area north of this highway is rural and agricultural land, with a small settlement (Kilbride) in the northwest corner of the city. New residential development in the urban area will consist mainly of infill of large pockets of undeveloped land within the limit of urban growth.

The fire department is a composite department with a mix of professional and volunteer firefighters. Volunteers staff Station No. 5, which serves the Kilbride area, and provide backup crews when the professional staff have responded to an emergency call.

The city presently (1996) has six fire stations with plans for a seventh fire station to be constructed in 1998. This proposed fire station is required to serve an existing developed area not adequately served by the existing fire stations, as well as to serve anticipated growth, and is expected to meet the city's needs for the next 30 years.

Barrie, Ontario

Barrie is located around the west end of Kempenfelt Bay on Lake Simcoe and is bisected by Highway 400 which runs north-south through the city. The existing urban area is concentrated around the older areas of the city east of Highway 400 and adjacent to the Bay, with most new growth anticipated to occur around the perimeter of the built-up area, particularly in the southwest sector of the city.

The Barrie fire department is a composite department; however, volunteers are not called out as frequently as they are in Burlington. The Barrie fire department allocates the majority of its resources to fire-related activities.

The city currently has three fire stations all of which are located east of Highway 400. The fire department's long range plans include three additional fire stations, all to be located west of Highway 400, primarily to provide fire protection services to new growth areas.

Edmonton, Alberta

Edmonton has a large urban area, bisected by the North Saskatchewan River valley from southwest to northeast, and a major rail line running south from the city centre parallel to the Calgary Trail. New residential development is expected to occur primarily around the perimeter of the existing built-up area. This will result in expansion of the urban area to be served by the fire department.

The fire department has a full professional staff and does not use volunteers.

The fire department presently operates 23 fire stations. Over the next 30 years, six additional fire stations are projected to be required, based on population and growth projections for the city.

District of Pitt Meadows, British Columbia

Pitt Meadows is a suburban Vancouver-area municipality which has an existing urban area in the south area of the District. The centre and north area is largely rural agricultural land, with small isolated residential subdivisions. Limited residential development is expected to occur in the existing urban core area. This development will be adequately served by the existing fire station. However, the majority of future residential development is expected to be concentrated in the north and northeast areas

of the District, on uplands areas that are unsuitable for agriculture. This future residential development, will increase the population of Pitt Meadows from 13,436 persons in 1996 to approximately 44,000 by 2026.

In 1990, Pitt Meadows adopted mandatory sprinkler requirements for all new buildings except one- and two-family dwellings. In 1996, mandatory sprinkler requirements were extended to include one- and two-family dwellings. These measures were taken to enable the District to continue to provide fire protection for the foreseeable future using the present volunteer fire department. Therefore, the base case for Pitt Meadows assumes that all new construction is sprinklered.

Gatineau, Quebec

Gatineau's urban area is bounded generally by the Ottawa River on the south and Highway 50 on the north. Presently, the rural area north of Highway 50 contains very limited rural residential development with an industrial area and the municipal airport located just north of the highway. The city is currently served by a professional fire department with three fire stations located south of Highway 50. The existing fire department organization, station locations and staffing are the result of a rationalization and reorganization conducted a few years ago.

A major residential development, anticipated to accommodate in excess of 20,000 people, is planned for the northwest area, north of Highway 50. A new fire station with 12 firefighters and appropriate equipment and vehicles, located north of Highway 50, is planned to serve this new residential area, and is established as the base case.

Kawacatoose First Nation, Saskatchewan

On the Kawacatoose reserve, and typical we understand of other Native reserves, the band owns the land, housing, municipal infrastructure and fire service. Therefore, the scope of the potential costs and benefits to the band is wider than the scope of potential costs and benefits to non-reserve municipalities. The wider scope is reflected in a modified approach for this case study site.

Kawacatoose had a population of 1,061 people in 1997. Approximately one-half of the population lives in subdivisions near the school, arena, store, band office and fire hall. This area is served by a municipal water system with fire hydrants supplied with water from a well and pumping station. The band is served by a volunteer fire chief and six volunteer firefighters with one fire truck located in a small fire hall.

The remainder of the reserve population lives in rural housing distributed along the roads in the reserve. Water is supplied to the rural housing by a water truck to refill cisterns located in each house. A water pump in each house supplies domestic water to the plumbing system in the house from the cistern.

The base case has been considered as the continuation of the present practices.

CHAPTER 6 – RESULTS OF ECONOMIC MODELLING

The results of the analysis of the case study sites show that direct municipal cost savings for fire protection services may be achieved through the introduction of mandatory residential fire sprinklers for new development, although these savings are considerably less than the related additional costs which would be incurred for the installation of sprinklers in the new housing.

Municipal cost reductions will depend on a variety of factors including the municipal development pattern and nature of the fire service. Reductions are more likely where new development will occur in greenfield (unserviced) areas, beyond the area served by existing fire stations and where the fire department role is primarily fire suppression and not emergency medical response.

Changes in the level of risk for persons or property as a result of the introduction of sprinklers or changes in the level of municipal fire protection service are addressed in the parallel NFL study. In all case study municipalities, the NFL analysis indicates that the risk to life is relatively lower for persons living in sprinklered homes in areas that have longer response times than the fire department provides for existing areas of the municipality.

Analysis of the case study municipalities indicates that each municipality demonstrates a different set of variables and results. The specific assumptions for the base case and the sprinklered scenario (unsprinklered scenario for Pitt Meadows) for each case study are included in Appendix A. The results of the economic modelling for each case study are discussed in turn and shown in tables 1 and 2. Table 1 summarizes the results of the cost-benefit analysis for Burlington, Barrie, Edmonton, Pitt Meadows and Gatineau. Table 2 summarizes the results for Kawacatoose First Nation.

Burlington, Ontario

Future fire department staffing and equipment requirements are not projected to change due to the introduction of residential sprinklers. The proposed additional fire station would be required even if mandatory sprinklering was introduced for new development.

The level of non-fire-related emergency services provided by the Burlington fire department is the major determinant in planning for future staffing, equipment and levels of service. As a result, there would be no change in the municipality's costs for fire protection service with the introduction of mandatory sprinklers. The estimated net present value of the increased construction costs for installation of sprinklers is $42.3 million over the 30-year study period.

Barrie, Ontario

Barrie could reduce the number of fire stations required to satisfy future growth over the next 30 years from six to four by the introduction of mandatory residential sprinklers. In the sprinklered scenario, one existing fire station would be relocated west of Highway 400 and a new station would be built west of Highway 400.

In the unsprinklered scenario, three new fire stations would be built west of Highway 400 over the 30-year study period, and the three existing fire stations located east of Highway 400 would be maintained, for an ultimate total of six fire stations. The proposed new fire stations west of Highway 400 are planned primarily to provide fire protection services to new growth areas.

The reduction in municipal costs for fire protection services is estimated to have a net present value of $7.4 million over the 30-year horizon. The provision of sprinklers in the new houses would result in increased construction costs having a net present value of $38 million over the same period.

Edmonton, Alberta

The introduction of mandatory residential sprinklers for new residential development will permit the fire department to limit the number of

fire stations to the present complement. The new sprinklered development around the perimeter of the existing built-up area, would be served by existing fire stations using longer response times than current response times. Without mandatory residential sprinklers for new development, six new fire stations, related staff, vehicles and equipment are projected to be required over the 30-year study period.

The net present value of municipal fire protection cost savings over the study period is estimated to be $38.5 million. Increased home construction costs for installation of sprinklers is estimated to have a net present value of $130.1 million over the same period.

District of Pitt Meadows, British Columbia

Pitt Meadows, British Columbia already has a mandatory sprinkler by-law in effect; therefore, the model was used to estimate the changes from the base case sprinklered scenario to a non-sprinklered scenario. Under the existing mandatory sprinkler policy, the District plans to service the proposed new development in the north and northeast areas by the volunteer fire department from the existing fire station in the south. Without mandatory sprinklers, an additional fire station would be required to serve the northern development area.

Under the sprinklered scenario, the net present value of municipal cost reductions would be $2.8 million and the net present value of additional construction costs of installing sprinklers in the new housing would total $11.7 million over the 30-year period.

The continuation of all volunteer fire services is an issue of ongoing concern to rapidly growing municipalities such as Pitt Meadows. Uncertainty exists regarding volunteer availability given future demographics, the increasing importance of the emergency medical response role of the fire department and ratepayer service expectations. Therefore, at the request of Pitt Meadows, an alternative scenario was assessed to examine the impact of the mandatory sprinkler requirement if the current volunteer fire department would be replaced with a composite force (paid professional and volunteer firefighters). Under this alternative, some of the volunteer firefighters in the existing station would be replaced by full-time, paid staff and the additional fire station required in the non-sprinklered scenario would also be staffed by full-time paid firefighters and volunteers. All other assumptions in the model remained unchanged.

In the sprinklered scenario of the composite alternative, the net present value of municipal cost reductions would increase to $5.1 million over the 30-year period. Additional construction costs for installation of the sprinklers would again total $11.7 million over the study period.

Gatineau, Quebec

In the sprinklered scenario, all new residential construction in the new northwest residential area, north of Highway 50, as well as in the remainder of the city, is assumed to be sprinklered. This will enable the fire department to serve the new northwest area from the existing fire stations, with longer fire department response times.

Sprinkler protection of new residential development in the existing urban area will enable the fire department to protect increased population in the existing urban area with the current resources.

Over the 30-year period, the net present value of municipal cost reductions is estimated to be $8.9 million. Increased home construction costs for installation of sprinklers having a net present value of $29.2 million would result over the same period.

Kawacatoose First Nation, Saskatchewan

The base case has been established as the continuation of the present practices. The sprinklered scenario is based on a proactive measure to address the high fire loss record on Saskatchewan Native reserves. This includes installation of sprinklers in all new housing

constructed to accommodate anticipated increases in the band population as well as installation of sprinklers in all existing housing on the reserve over a 10-year period.

As the band is the municipal government, the land developer, the homebuilder and the homeowner, the cost allocation to different parties does not apply to Kawacatoose. The net present value of the direct financial costs and benefits for the band of the sprinklered scenario are shown in Table 2.

Under the sprinklered scenario, the existing fire service would remain unchanged. Therefore, no change in fire department costs would result. Sprinkler installation costs would total $548,191 over the study period and an estimated $34,724 would be required for ongoing sprinkler system maintenance. The band would realize an estimated reduction in fire-related home replacement and repair costs of $333,153 over the same period.

The fire death rate on Saskatchewan reserves is more than four times the fire death rate for non-reserve communities. Reduced property damage fire losses of homes on the reserve are likely to have a related and significant impact on personal injuries and deaths from fire, directly related to the relatively high number of occupants in reserve houses.

Table 1
Changes in Costs Due to Mandatory Residential Fire Sprinklers
Results of Net Present Value Analysis

	Net Present Value Increase (Decrease)				
Sector/Municipality	Burlington $	Barrie $	Edmonton $	Pitt Meadows $	Gatineau $
Municipal costs	0	(7,400,000)	(38,490,383)	(2,762,164)	(8,892,648)
Development costs	0	(800,000)	0	0	0
Construction costs	42,300,000	38,000,000	130,112,965	11,719,655	29,246,975
Home maintenance costs	1,700,000	1,600,000	5,207,604	492,895	1,223,293
Home insurance costs	(5,900,000)	(5,200,000)	(16,324,418)	(1,526,494)	(3,750,912)

Table 2
Kawacatoose First Nation - Changes in Costs Due to Mandatory Residential Fire Sprinklers Results of Net Present Value Analysis

Sector	Net Present Value Increase (Decrease)
Fire department costs	0
Sprinkler installation costs	548,191
Sprinkler maintenance costs	34,724
Fire-related home replacement and repair costs	(333,153)

CHAPTER 7 – RELATED ECONOMIC ISSUES

Impact on housing affordability

Residential sprinklers will increase the cost of constructing new housing. The potential net impact of sprinklers on housing prices will depend on housing market supply and demand conditions (which vary over time and among communities). In communities where the supply of housing is restricted and housing demand is very strong, the cost increase will be passed forward into higher home prices. Where there is a large potential supply of new housing and housing demand is weak and price sensitive, homebuilders, developers and land owners may absorb a share of increased costs. In municipalities where fire protection costs are reduced due to mandatory sprinkler policies, the direct cost of sprinkler installation may be tempered by savings in development charges and property taxes.

An increase in the price of new housing will have an impact on the price of resale housing, because the markets are directly linked. If the price of new houses goes up, some potential purchasers will choose to purchase resale homes rather than new homes. Increased demand for resale homes will tend to increase the price of resale homes. In communities where a significant share of homes for sale are newly constructed homes, an increase in the price of newly constructed homes will result in an increase in the price of resale homes.

Increased housing prices will have an impact on the ability of many families to afford to purchase a home. An accepted manner of assessing the impact of housing prices (and other variables such as interest rates) on housing affordability is based on the rule of thumb that the regular mortgage payments, insurance and taxes paid by a family for housing should not exceed 30 per cent of the family income. This relationship can be used to estimate the net impact an increase in housing prices would have on the minimum household income required to afford to purchase a home.

The addition of $3,000 to the price of a home (a typical cost for the installation of a sprinkler system in a 160 m^2 or 1,800 sq. ft. home) would result in a $1,200 increase in the minimum annual household income required for a family to afford to purchase a home. A $1,200 increase in the minimum household income required to purchase a home could exclude approximately 175,000 to 225,000 Canadian households from the group of households that could afford to purchase a home.

Impact on mortgage payments

In the present value model developed for this study, capital costs are shown during the year in which construction or purchase costs will be incurred. The full installation cost of sprinklers is shown during the year in which the sprinklers will be installed. Likewise, the full cost of building a new fire station is shown during the year in which the station is planned to be constructed.

An alternative approach to model design would exclude the direct capital costs for sprinkler installation and other capital expenditures and, instead, build in the annual payments on the home mortgages or municipal debentures incurred to finance these capital costs. A further refinement might be to build in differential interest rates for the various sectors covered by the model. Such an approach would add a great deal of complexity to the model designed for this study and would not have a significant impact on the net present value of estimated costs and benefits.

Property tax issues

Cost Saving Impacts

Lower fire department costs will generally be reflected in lower property tax rates. Typically, fire department costs are funded from taxes raised across the municipality as a whole – both new and old areas and residential, industrial, commercial and rural districts. Therefore, the municipal savings associated with the installation of sprinklers in new homes would be shared by all taxpayers.

The annual tax savings per residence (for both new and existing homes) related to fire department operating cost savings due to mandatory sprinklers were estimated for two of the case study municipalities. The tax savings will vary over time depending on the projected timing of the savings and the projected growth in the municipal tax base. For the City of Barrie, annual tax savings are projected to range from approximately $20 per home per year in 2011 to $30 per home per year in 2023 as the impact of reduced growth in the number of fire stations takes effect. In Gatineau, annual tax savings are projected to range from approximately $16 per home per year in 2002 to $11 per home per year by 2026. In Gatineau, the initial savings per house apply to relatively few homes. Over time, these savings continue but are spread over a greater number of homes toward the end of the study period.

In most provinces, municipalities may choose to levy different tax rates for different geographic areas based on services provided. Therefore, if new residential districts which are subject to mandatory residential sprinklers are not provided with the same level of local fire service as older unsprinklered areas, a municipality may choose to levy lower fire department taxes for those homeowners in new residential districts who are protected by sprinklers.

Assessment of Sprinklered Homes

Generally, the municipal property assessment officials contacted regarding the case study sites indicated that residential sprinklers are unlikely to have a significant impact on the taxable assessment of homes. However, as sprinklers become more common, a consistent pattern of higher prices for sprinklered homes may result in higher taxable assessment.

In Ontario for example, typical annual property taxes amount to 1.25 per cent of the assessed market value of a house. If the value of new houses was to increase by $3,000 per house due to the installation of sprinklers, the annual property taxes on sprinklered homes would be approximately $37.50 higher than the taxes on similar, unsprinklered homes. However, some municipalities that have mandatory residential sprinkler requirements do not include sprinklers as an added value to the assessment of homes (e.g., Parkland County, Alberta).

Implications for the Municipal Tax Base

Residential sprinklers may affect the tax base of a municipality from a number of perspectives. An increase in housing prices as a result of mandatory sprinklers would tend to decrease residential growth and, therefore, decrease the rate of growth in the taxable assessment base. If sprinkler costs are reflected in higher assessments for new houses, this will tend to increase the municipal tax base.

Residential sprinklers will reduce the loss of taxable assessment due to fires. A reduction in property value losses due to mandatory sprinklers will reduce losses in municipal taxation revenues due to residential fires. In the provinces of Quebec and Ontario, for example, the taxable assessment of a building damaged or destroyed by fire is reduced to reflect the reduction in property value due to the fire. This practice is also common in other provinces. Only after the building is repaired or rebuilt, is the tax assessment returned to normal levels, based on the increased property value resulting from the reconstruction or repair.

Inflation and the real interest rate

Constant dollars are used in the cost-benefit model to avoid problems associated with trying to predict inflation over a 30-year period. This approach implicitly assumes that the various costs and benefits included in the analysis will be subject to the same rate of inflation over the study horizon.

A "real" interest rate, net of the inflation premium included in actual interest rates, is used for the discounting of future costs and benefits. A real interest rate of five per cent is used in this present value analysis. This rate reflects the average real interest rate, net of inflation on Ontario government debentures over the last 25 years.

Real government borrowing rates are an appropriate discount rate to use in assessing the costs and benefits of government policies. As Table C-1 in Appendix C shows, all but one of the earlier cost-benefit studies used real interest rates of five or six per cent to discount future costs and benefits.[12]

Discount rate sensitivity analysis

The cost-benefit analysis model uses an interest (discount) rate of five per cent. The results of present value analyses can be sensitive to changes in the interest rate used to discount future costs and benefits. In order to demonstrate the sensitivity of the economic modelling used for the sprinkler analysis to changes in the interest rate, tests were run on two municipalities.

The present value calculations for Pitt Meadows and Gatineau were tested using alternative discount rate assumptions – three per cent and seven per cent. Under the lower interest rate, future costs and savings were not as highly discounted – the present value of total costs increased as did the total value of savings.

Under the higher interest rate, the total present value of both future costs and future savings are reduced. The use of alternative discount rates does not change the relative relationships of future costs and savings for any of the case study municipalities.

Installation cost sensitivity

Sprinkler installation costs may vary across the country depending on local circumstances. If installation costs were only half the estimates used in the cost-benefit modelling, the gap between sprinkler-related costs and sprinkler-related savings would be narrowed for all the case study present value analyses with the exception of the Pitt Meadows composite fire staff scenario, but in no case would the results be switched such that the savings would outweigh the costs.

If sprinkler installation costs in Pitt Meadows were double the estimate used in the present value analysis for the composite fire staff scenario, the results would be reversed and the present value of sprinkler-related costs would be greater than the present value of sprinkler-related savings. The economic break-even point for this scenario can be determined by summing the municipal savings, homeowner maintenance costs and insurance savings and equating this figure to the homeowners' costs for installation of sprinklers. In this case, the installation costs for sprinklers would have to increase by 27.6 per cent from those used in the net present value analysis.

Table 3
Net Present Value Under Alternative Discount Rates

	3 Per cent		7 Per cent	
	Pitt Meadows $	Gatineau $	Pitt Meadows $	Gatineau $
Municipal costs	(3,610,058)	(12,363,413)	(2,176,388)	(6,583,991)
Development costs	0	0	0	0
Construction costs	16,332,777	38,163,934	6,732,931	23,185,434
Home maintenance costs	780,325	1,895,533	318,784	808,995
Home insurance costs	(2,267,439)	(5,458,769)	(1,060,914)	(2,659,844)

CHAPTER 8 – IMPACT ON LIFE RISK OF MANDATORY SPRINKLERS IN RESIDENTIAL BUILDINGS

The economic analysis conducted on the case study municipalities, indicates that, in most cases, cost savings are available to the municipalities as a result of being able to serve a larger area with the existing fire department resources. This means that fire department response times to the new development areas will be longer than present standards of service to existing developed areas. Concerns were raised as to the effect such changes would have on the level of risk to the building occupants.

The National Fire Laboratory (NFL) was engaged by CMHC to conduct a parallel study on whether mandatory sprinklering of all residential buildings in new development areas in the case study municipalities, coupled with a reduced level of fire protection by the fire department, would adversely affect life safety.[13]

The fire risk assessment model, FiRECAM™ (Fire Risk Evaluation and Cost Assessment Model), developed by the National Research Council of Canada (NRC), was used to assess whether an apartment building with sprinkler protection, but with increased fire department response time, provides a level of fire safety for the occupants equivalent to that in a building without sprinkler protection but with the current fire department response time. The model assesses the expected risk to life and the fire costs in a building based on the dynamic interaction of fire and smoke spread, occupant evacuation and fire department response.

In the NFL study, a three-storey apartment building is used as a representative building in a new development area of a municipality, where buildings may range from a single-family house to a medium-rise apartment building. The expected risk to life to the occupants is assessed with and without sprinkler protection and with two levels of fire department response: with and without new fire stations.

The new development areas in Barrie and Burlington, Ontario; Edmonton, Alberta; Pitt Meadows, British Columbia; and Gatineau, Quebec are used in the study. For each municipality, the response times of the fire department are calculated using existing fire stations and added new fire stations. Future stations were previously determined by the municipal fire departments to meet protection needs for the projected populations. In addition, the impact of mandatory sprinklers in Kawacatoose First Nation, Saskatchewan is also assessed.

The results of this study, using a three-storey apartment building as a model building, show that the provision of sprinkler protection and longer than normal fire department response time (i.e. no new fire stations) provides a level of fire safety better than the case without sprinkler protection but with a normal fire department response time (i.e., with new fire stations).

Based on similar considerations in fire and smoke spread and occupant evacuation between single family houses and apartment buildings, the impacts of mandatory sprinklers on the expected risk to life, obtained for three-storey apartment buildings, are argued to be applicable to single-family houses. For single, detached houses, the risk to life is significantly reduced by the use of sprinklers and is not increased by longer fire department response times.

CHAPTER 9 – CONCLUSION

The results of the analysis of the case study sites show that, in certain circumstances, direct municipal cost savings for fire protection services may be achieved through the introduction of mandatory residential fire sprinklers for new development, although these savings are considerably less than the related additional costs which would be incurred for the installation of sprinklers in the new housing.

Changes in the level of risk for persons or property as a result of the introduction of sprinklers or changes in the level of municipal fire protection service are addressed in the parallel NFL study. In all case study municipalities, the NFL analysis indicates that the risk to life is relatively lower for persons living in sprinklered homes in areas that have longer response times than the fire department provides for existing areas of the municipality.

This analysis demonstrates that the potential for municipal savings occurs where:

- There are significant opportunities for new greenfield residential development.
- The pattern of future growth in residential development extends the existing built-up area beyond the areas presently served by the fire department from existing fire stations.
- New buildings (residential and non-residential) in the future growth areas are sprinklered.
- Response times for the fire department to arrive at the fire scene can be lengthened for fire stations serving sprinklered areas.
- The fire department's role is fire suppression, and only secondary support is provided for non-fire emergency services when requested.

When all of the criteria are met, the municipality has the potential to obtain the maximum savings.

When all the criteria are not met, potential savings would be reduced or negated, depending on the specific characteristics of the municipality. In each of the cases studied, potential savings to the municipality would be less than the additional construction costs for the installation of sprinklers.

Planning and building department staff in the case study municipalities were questioned regarding the potential impact of mandatory residential sprinklers on standards for land development, infrastructure and the construction of homes. In some American jurisdictions, municipalities have permitted various concessions to developers and home buildings in exchange for residential sprinklers, such as higher development densities, reduced infrastructure costs (e.g., road width, placement of fire hydrants, water supply standards) and reduced construction costs (due to the additional safety provided by sprinklers). In some of the case study municipalities, infrastructure requirements are being adjusted due to planning initiatives and changes in fire department operating procedures, without requiring residential sprinklers. However, none of the case study municipalities indicated that they would be able to grant similar concessions in exchange for mandatory residential sprinklers. Such changes are being permitted by the case study municipalities without mandatory residential sprinklers as a result of changing municipal planning policies.

For other costs and benefits included in the model:

- There was no change in the costs for land development, except in Barrie where development costs are reduced due to a reduction in development charges related to fewer fire stations.
- There were increased construction costs for the installation of sprinklers.

- There were increased home maintenance costs for the sprinkler system which are offset by savings on homeowners' insurance costs.

The six case study municipalities provide a basis that other Canadian municipalities can use for comparison. They represent a range of planned development potential and fire service models, faster or slower growth projections and the use of volunteer firefighters.

Appendix A

ASSUMPTIONS AND COST-BENEFIT SPREADSHEETS FOR EACH CASE STUDY MUNICIPALITY

Appendix A – ASSUMPTIONS AND COST BENEFIT SPREADSHEETS FOR EACH CASE STUDY MUNICIPALITY

The base case for each case study municipality was established from projections for growth and current practices provided by planning and development, public works and fire department staff of each municipality. For the Barrie, Burlington, Edmonton and Gatineau case study municipalities, the base case is the non-sprinklered scenario. The sprinklered scenario represents an analysis of the effect of changing the present policy to require mandatory installation of sprinklers for new construction.

The Pitt Meadows case study differs in that the base case is the sprinklered scenario, as Pitt Meadows has legislation in force which requires installation of sprinklers in all new buildings. The non-sprinklered scenario assumes that the existing mandatory sprinkler legislation is repealed and that subsequent new construction is not sprinklered, except where required by the B.C. Building Code.

The legal local government structure for Aboriginal reserve communities is distinct from non-reserve communities as the Aboriginal band on each reserve is the local government responsible for providing municipal services, including fire protection. Therefore, the Aboriginal band is considered to be the municipality for the purpose of this study. The band also owns all of the buildings including housing. The Kawacatoose case study differs from the other case study municipalities with respect to the range of costs and benefits that accrue to the band as the municipality.

The assumptions used for the cost-benefit analysis for each case study municipality and the cost-benefit spreadsheet analysis, follow.

Barrie, Ontario

The inputs to the cost-benefit analysis for Barrie, Ontario are based on the following assumptions.

- 1995 to 2004 capital budget and forecast includes:
  - the construction of a third fire station for South Barrie ($730,000);
  - the purchase of equipment and a vehicle for the third station ($347,600);
  - land purchase for two additional stations (northwest and Holly area, both locations are west of Highway 400) ($200,000);
  - construction of northwest station ($800,000); and
  - the purchase of equipment and a vehicle for the northwest station ($369,200).
- The capital forecast also includes:
  - a total of $156,500 for the purchase of new or replacement equipment; and
  - a total of $1,415,000 for vehicle replacement.
- Costs of wages and benefits for the fire department amounted to $3,426,776 in 1994 and are budgeted to amount to $3,832,085 for 1995.
- Total expenditures for the department (net of recoveries and revenues) amounted to $3,679,856 in 1994 and are budgeted to total $4,016,242 in 1995.
- The budget estimates are broken into categories: administration, firefighting force, fire alarm system, maintenance of stations, and maintenance of apparatus and vehicles.
- The fire department provides dispatch services for some surrounding municipalities. These services generate revenue for the fire department.
- The fire department is a composite department, with volunteers being called as the second response to incidents that the full-time staff cannot handle, to any large working fire and to staff fire stations when full-time firefighters are on a call expected to take more than one hour. On average, volunteer firefighters are called out about three times per month.

- Approximately 93 per cent of fire department calls are fire-related calls (actual fires, suspected fires and false fire alarms), in accord with City Council's policy direction.

- Population estimates were provided for the planned ultimate population and number of housing units for future growth areas of the city.

- Most of the future growth is expected to occur all across the south of the existing urban area, with smaller, but still significant, future development areas found to the north and west of the existing urban area.

- The total population of the city is projected to increase from 71,704 in 1994 to a planned ultimate population of 159,000.

- Over the 30-year time span, three additional fire stations would be required to serve the anticipated population and urban area growth. Two of these new fire stations are anticipated to be required between 1995 and 2000.

- The sprinklered scenario is based on construction of one new fire station, in the southwest area of the city, west of Highway 400, and relocation of the existing central fire station to the northwest area of the city, also west of Highway 400. This results in four fire stations serving the city.

Map A1
City of Barrie

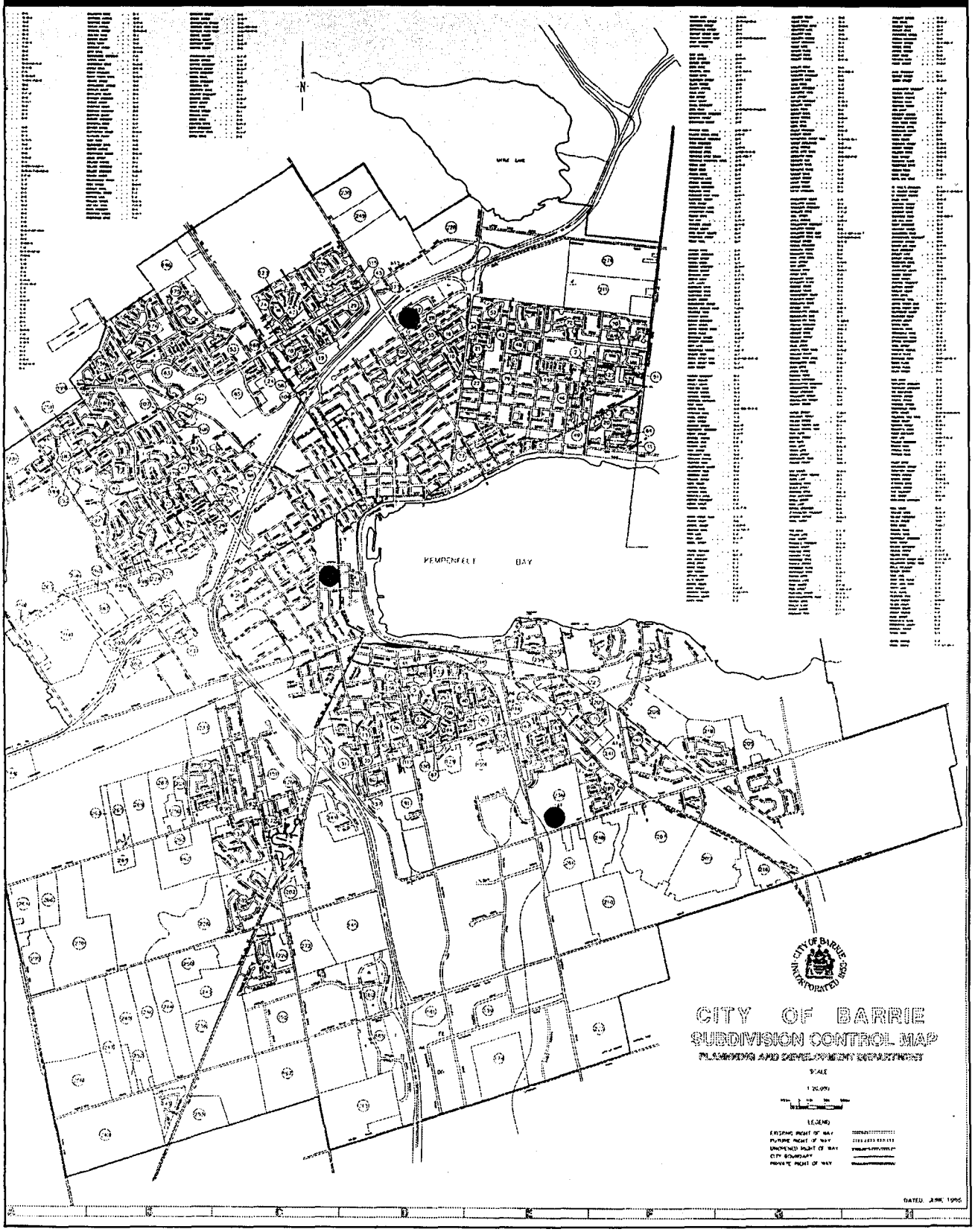

Table A1
Barrie Cost-Benefit Analysis – Residential Fire Sprinklers

Barrie Cost-Benefit Analysis
Residential Fire Sprinklers

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
INPUTS FOR COST-BENEFIT CALCULATIONS											
BACKGROUND DATA											
Population	74,000	76,000	78,600	81,200	83,800	86,400	89,000	91,600	94,200	96,800	99,400
Housing Units	25,574	26,310	27,222	28,134	29,046	29,958	30,870	31,790	32,710	33,630	34,550
New Housing Units	736	912	912	912	912	912	920	920	920	920	920
-Singles and semis	552	456	456	456	456	456	460	460	460	460	460
-Townhouses	110	182	182	182	182	182	184	184	184	184	184
-Apartments	74	274	274	274	274	274	276	276	276	276	276
NON-SPRINKLER SCENARIO											
FIRE DEPARTMENT STATISTICS											
Number of Stations	3	3	3	3	3	3	4	4	4	4	4
Number of Full-Time Staff	71	71	71	71	71	71	91	91	91	91	91
Number of Vehicles	15	15	15	15	15	15	17	17	17	17	17
FIRE DEPARTMENT EXPENDITURES											
Capital Expenditures											
-Additional land, buildings, vehicles and equipment	1,077,600	61,500	69,400	20,000	0	0	1,169,200	14,400	0	0	0
-Replacement buildings, vehicles and equipment	20,000	565,000	15,000	0	30,000	21,000	550,000	35,000	0	200,000	30,000
Operating and Maintenance Expenditures											
-Wages and benefits	3,832,085	3,832,085	3,832,085	3,832,085	3,832,085	3,832,085	5,032,085	5,032,085	5,032,085	5,032,085	5,032,085
-Materials and services	184,157	188,357	188,357	188,357	188,357	188,357	199,957	199,957	199,957	199,957	199,957
Fire Department Revenues											
-Installation inspection fees	0	0	0	0	0	0	0	0	0	0	0
-On-going inspection fees	0	0	0	0	0	0	0	0	0	0	0
Average Operating Costs Per Capita	54.54	60.33	51.34	49.51	48.33	46.78	64.97	57.50	55.54	56.12	52.94
Total Capital and Operating Costs	5,113,842	4,646,942	4,104,842	4,040,442	4,050,442	4,041,442	6,951,242	5,281,442	5,232,042	5,432,042	5,262,042

Table A1 (*continued*)
Barrie Cost-Benefit Analysis – Residential Fire Sprinklers

Barrie Cost-Benefit Analysis
Residential Fire Sprinklers

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
SPRINKLER SCENARIO											
FIRE DEPARTMENT STATISTICS											
Number of Stations	3	3	3	3	3	3	4	4	4	4	4
Number of Full-Time Staff	71	71	71	71	71	71	91	91	91	91	91
Number of Vehicles	15	15	15	15	15	15	17	17	17	17	17
FIRE DEPARTMENT EXPENDITURES											
Capital Expenditures											
-Additional land, buildings, vehicles and equipment	1,077,600	61,500	69,400	20,000	0	0	1,169,200	14,400	0	0	0
-Replacement buildings, vehicles and equipment	20,000	565,000	15,000	0	30,000	21,000	550,000	35,000	0	200,000	30,000
Operating and Maintenance Expenditures											
-Wages and benefits	3,832,085	3,832,085	3,832,085	3,832,085	3,832,085	3,832,085	5,032,085	5,032,085	5,032,085	5,032,085	5,032,085
-Materials and services	184,157	188,357	188,357	188,357	188,357	188,357	199,957	199,957	199,957	199,957	199,957
Fire Department Revenues											
-Installation Inspection Fees	0	0	0	0	0	0	0	0	0	0	0
-Ongoing inspection fees	0	0	0	0	0	0	0	0	0	0	0
Average Operating Costs Per Capita	54.54	60.33	51.34	49.51	48.33	46.78	64.97	57.50	55.54	56.12	52.94
Total Capital and Operating Costs	5,113,842	4,646,942	4,104,842	4,040,442	4,050,442	4,041,442	6,951,242	5,281,442	5,232,042	5,432,042	5,262,042
Non-sprinkler less sprinkler total costs	0	0	0	0	0	0	0	0	0	0	0
OTHER MUNICIPAL COSTS/BENEFITS											
Municipal Capital Expenditures											
-Water supply system	0	0	0	0	0	0	0	0	0	0	0
-Water distribution system	0	0	0	0	0	0	0	0	0	0	0
-Hydrants	0	0	0	0	0	0	0	0	0	0	0
-Sanitary sewage system	0	0	0	0	0	0	0	0	0	0	0
-Roads	0	0	0	0	0	0	0	0	0	0	0
-Total	0	0	0	0	0	0	0	0	0	0	0
Development Charges and Other Developer Contributions	0	0	0	0	0	0	0	0	0	0	0
-Water hook-up charges	0	0	0	0	0	0	0	0	0	0	0
-Building permit fees	(22,087)	(23,192)	(23,192)	(23,192)	(23,192)	(23,192)	(23,396)	(23,396)	(23,396)	(23,396)	(23,396)
-Total change in revenues	(22,087)	(23,192)	(23,192)	(23,192)	(23,192)	(23,192)	(23,396)	(23,396)	(23,396)	(23,396)	(23,396)
Municipal Operating and Maintenance Costs											
-Water supply and distribution	0	0	0	0	0	0	0	0	0	0	0
-Hydrants	0	0	0	0	0	0	0	0	0	0	0
-Sanitary sewage system	0	0	0	0	0	0	0	0	0	0	0
-Roads	0	0	0	0	0	0	0	0	0	0	0
-Municipal insurance premiums	0	0	0	0	0	0	0	0	0	0	0
-Building inspections	22,087	23,192	23,192	23,192	23,192	23,192	23,396	23,396	23,396	23,396	23,396
-Total	22,087	23,192	23,192	23,192	23,192	23,192	23,396	23,396	23,396	23,396	23,396
Tax Revenues Related to Assessment of Sprinklers	0	0	0	0	0	0	0	0	0	0	0
Sub-Total Net Impact on Municipal Costs	0	0	0	0	0	0	0	0	0	0	0

Table A1 (*continued*)
Barrie Cost-Benefit Analysis – Residential Fire Sprinklers

Barrie Cost-Benefit Analysis
Residential Fire Sprinklers

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Costs and Benefits for Other Parties											
LAND DEVELOPERS' COSTS/BENEFITS											
Direct Cost of Providing Services for Subdivisions											
-Water mains and hydrants	0	0	0	0	0	0	0	0	0	0	0
-Roads	0	0	0	0	0	0	0	0	0	0	0
Development Charges Paid to Municipality											
-For water supply and distribution infrastructure	0	0	0	0	0	0	0	0	0	0	0
-For roads	0	0	0	0	0	0	0	0	0	0	0
-For fire stations, vehicles and equipment	0	0	0	0	0	0	0	0	0	0	0
Profits Related to Higher Densities	0	0	0	0	0	0	0	0	0	0	0
Sub-Total Net Costs for Developers	0	0	0	0	0	0	0	0	0	0	0
HOMEBUILDERS' COSTS/BENEFITS											
Sprinkler Installation Costs											
-Singles and semis	1,676,600	1,550,400	1,550,400	1,550,400	1,550,400	1,550,400	1,564,000	1,564,000	1,564,000	1,564,000	1,564,000
-Townhouses	225,216	372,096	372,096	372,096	372,096	372,096	375,360	375,360	375,360	375,360	375,360
-Apartments	106,720	396,720	396,720	396,720	396,720	396,720	400,200	400,200	400,200	400,200	400,200
-Total	2,208,736	2,319,216	2,319,216	2,319,216	2,319,216	2,319,216	2,339,560	2,339,560	2,339,560	2,339,560	2,339,560
Other Changes in Construction and On-site Servicing Costs	0	0	0	0	0	0	0	0	0	0	0
Fees Related to Sprinkler Installation											
-Sprinkler inspection/building permit fees	22,087	23,192	23,192	23,192	23,192	23,192	23,396	23,396	23,396	23,396	23,396
-Water hook-up fees	0	0	0	0	0	0	0	0	0	0	0
Sub-Total Net Costs for Homebuilders	2,230,823	2,342,408	2,342,408	2,342,408	2,342,408	2,342,408	2,362,956	2,362,956	2,362,956	2,362,956	2,362,956
ONGOING COSTS/BENEFITS FOR RESIDENTS OF NEW HOMES											
Maintenance Costs	0	0	0	0	0	0	0	0	0	132,480	127,680
Replacement of Parts	0	0	0	0	0	0	0	0	0	0	0
Ongoing Sprinkler Inspection Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Insurance Premiums	0	(23,920)	(53,560)	(83,200)	(112,840)	(142,480)	(172,120)	(202,020)	(231,920)	(261,820)	(291,720)
Property Taxes Due to Increased Assessment	0	0	0	0	0	0	0	0	0	0	0
Sub-Total Net Costs for Residents	0	(23,920)	(53,560)	(83,200)	(112,840)	(142,480)	(172,120)	(202,020)	(231,920)	(129,340)	(164,040)
Sub-Total Net Costs Borne by Other Parties	2,230,823	2,318,488	2,288,848	2,259,208	2,229,568	2,199,928	2,190,836	2,160,936	2,131,036	2,233,616	2,198,916
Total Annual Costs (Savings)	2,230,823	2,318,488	2,288,848	2,259,208	2,229,568	2,199,928	2,190,836	2,160,936	2,131,036	2,233,616	2,198,916
PRESENT VALUE OF NET COSTS (SAVINGS)	26,548,345										
DISCOUNTED NUMBER OF HOUSING UNITS	15,156										
npv of municipal savings	(7,998,075)										
npv of developer savings	(811,358)										
npv of homebuilder costs	39,250,709										
npv of maintenance costs	1,658,985										
npv of insurance savings	(5,551,916)										

Table A1 (*continued*)
Barrie Cost-Benefit Analysis – Residential Fire Sprinklers

Barrie Cost-Benefit Analysis
Residential Fire Sprinklers

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
INPUTS FOR COST-BENEFIT CALCULATIONS											
BACKGROUND DATA											
Population	102,000	104,600	107,200	109,800	112,400	115,000	117,600	120,200	122,800	125,400	128,000
Housing Units	35,470	36,460	37,450	38,440	39,430	40,420	41,496	42,572	43,648	44,724	45,800
New Housing Units	990	990	990	990	990	1,076	1,076	1,076	1,076	1,076	1,034
-Singles and semis	495	495	495	495	495	538	538	538	538	538	517
-Townhouses	198	198	198	198	198	215	215	215	215	215	207
-Apartments	297	297	297	297	297	323	323	323	323	323	310
NON-SPRINKLER SCENARIO											
FIRE DEPARTMENT STATISTICS											
Number of Stations	4	4	4	4	5	5	5	5	5	5	5
Number of Full-Time Staff	91	91	91	91	111	111	111	111	111	111	111
Number of Vehicles	17	17	17	17	19	19	19	19	19	19	19
FIRE DEPARTMENT EXPENDITURES											
Capital Expenditures											
-Additional land, buildings, vehicles and equipment	0	0	0	0	1,169,200	0	0	0	0	0	0
-Replacement buildings, vehicles and equipment	847,500	22,500	0	45,000	31,500	825,000	52,500	0	300,000	30,000	847,500
Operating and Maintenance Expenditures											
-Wages and benefits	5,032,085	5,032,085	5,032,085	5,032,085	6,232,085	6,232,085	6,232,085	6,232,085	6,232,085	6,232,085	6,232,085
-Materials and services	199,957	199,957	199,957	199,957	211,557	211,557	211,557	211,557	211,557	211,557	211,557
Fire Department Revenues											
-Installation inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Ongoing inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Average Operating Costs Per Capita	59.60	50.23	48.81	48.06	57.61	63.21	55.24	53.61	54.92	51.62	56.96
Total Capital and Operating Costs	6,079,542	5,254,542	5,232,042	5,277,042	7,644,342	7,268,642	6,496,142	6,443,642	6,743,642	6,473,642	7,291,142

Table A1 (*continued*)
Barrie Cost-Benefit Analysis – Residential Fire Sprinklers

Barrie Cost-Benefit Analysis
Residential Fire Sprinklers

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
SPRINKLER SCENARIO											
FIRE DEPARTMENT STATISTICS											
Number of Stations	4	4	4	4	4	4	4	4	4	4	4
Number of Full-Time Staff	91	91	91	91	91	91	91	91	91	91	91
Number of Vehicles	17	17	17	17	17	17	17	17	17	17	17
FIRE DEPARTMENT EXPENDITURES											
Capital Expenditures											
-Additional land, buildings, vehicles and equipment	0	0	0	0	0	0	0	0	0	0	0
-Replacement buildings, vehicles and equipment	847,500	22,500	0	45,000	31,500	825,000	52,500	0	300,000	30,000	847,500
Operating and Maintenance Expenditures											
-Wages and benefits	5,032,085	5,032,085	5,032,085	5,032,085	5,032,085	5,032,085	5,032,085	5,032,085	5,032,085	5,032,085	5,032,085
-Materials and services	199,957	199,957	199,957	199,957	199,957	199,957	199,957	199,957	199,957	199,957	199,957
Fire Department Revenues											
-Installation inspection fees	0	0	0	0	0	0	0	0	0	0	0
-Ongoing inspection fees	0	0	0	0	0	0	0	0	0	0	0
Average Operating Costs Per Capita	59.60	50.23	48.81	48.06	46.83	52.67	44.94	43.53	45.05	41.96	47.50
Total Capital and Operating Costs	6,079,542	5,254,542	5,232,042	5,277,042	5,263,542	6,057,042	5,284,542	5,232,042	5,532,042	5,262,042	6,079,542
Non-Sprinkler Less Sprinkler Total Costs	0	0	0	0	2,380,800	1,211,600	1,211,600	1,211,600	1,211,600	1,211,600	1,211,600
OTHER MUNICIPAL COSTS/BENEFITS											
Municipal Capital Expenditures											
-Water supply system	0	0	0	0	0	0	0	0	0	0	0
-Water distribution system	0	0	0	0	0	0	0	0	0	0	0
-Hydrants	0	0	0	0	0	0	0	0	0	0	0
-Sanitary sewage system	0	0	0	0	0	0	0	0	0	0	0
-Roads	0	0	0	0	0	0	0	0	0	0	0
-Total	0	0	0	0	0	0	0	0	0	0	0
Development Charges and Other Developer Contributions	0	116,920	116,920	116,920	116,920	116,920	116,920	116,920	116,920	116,920	116,920
-Water hookup charges	0	0	0	0	0	0	0	0	0	0	0
-Building permit fees	(25,176)	(25,176)	(25,176)	(25,176)	(25,176)	(27,363)	(27,363)	(27,363)	(27,363)	(27,363)	(26,302)
-Total change in revenues	(25,176)	91,744	91,744	91,744	91,744	89,557	89,557	89,557	89,557	89,557	90,618
Municipal Operating and Maintenance Costs											
-Water supply and distribution	0	0	0	0	0	0	0	0	0	0	0
-Hydrants	0	0	0	0	0	0	0	0	0	0	0
-Sanitary sewage system	0	0	0	0	0	0	0	0	0	0	0
-Roads	0	0	0	0	0	0	0	0	0	0	0
-Municipal insurance premiums	0	0	0	0	0	0	0	0	0	0	0
-Building inspections	25,176	25,176	25,176	25,176	25,176	27,363	27,363	27,363	27,363	27,363	26,302
-Total	25,176	25,176	25,176	25,176	25,176	27,363	27,363	27,363	27,363	27,363	26,302
Tax Revenues Related to Assessment of Sprinklers	0	0	0	0	0	0	0	0	0	0	0
Sub-Total Net Impact on Municipal Costs	0	116,920	116,920	116,920	(2,263,880)	(1,094,680)	(1,094,680)	(1,094,680)	(1,094,680)	(1,094,680)	(1,094,680)

Table A1 (*continued*)
Barrie Cost-Benefit Analysis – Residential Fire Sprinklers

Barrie Cost-Benefit Analysis
Residential Fire Sprinklers

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Costs and Benefits for Other Parties											
LAND DEVELOPERS' COSTS/BENEFITS											
Direct Cost of Providing Services for Subdivisions											
-Water mains and hydrants	0	0	0	0	0	0	0	0	0	0	0
-Roads	0	0	0	0	0	0	0	0	0	0	0
Development Charges Paid to Municipality											
-For water supply and distribution infrastructure	0	0	0	0	0	0	0	0	0	0	0
-For roads	0	0	0	0	0	0	0	0	0	0	0
-For fire stations, vehicles and equipment	0	(116,920)	(116,920)	(116,920)	(116,920)	(116,920)	(116,920)	(116,920)	(116,920)	(116,920)	(116,920)
Profits Related to Higher Densities	0	0	0	0	0	0	0	0	0	0	0
Sub-Total Net Costs for Developers	0	(116,920)	(116,920)	(116,920)	(116,920)	(116,920)	(116,920)	(116,920)	(116,920)	(116,920)	(116,920)
HOMEBUILDERS' COSTS/BENEFITS											
Sprinkler Installation Costs											
-Singles and semis	1,683,000	1,683,000	1,683,000	1,683,000	1,683,000	1,829,200	1,829,200	1,829,200	1,829,200	1,829,200	1,758,295
-Townhouses	403,920	403,920	403,920	403,920	403,920	439,008	439,008	439,008	439,008	439,008	421,991
-Apartments	430,650	430,650	430,650	430,650	430,650	468,060	468,060	468,060	468,060	468,060	449,917
-Total	2,517,570	2,517,570	2,517,570	2,517,570	2,517,570	2,736,268	2,736,268	2,736,268	2,736,268	2,736,268	2,630,202
Other Changes in Construction and Servicng Costs	0	0	0	0	0	0	0	0	0	0	0
Fees Related to Sprinkler Installation											
-Sprinkler inspection/building permit fees	25,176	25,176	25,176	25,176	25,176	27,363	27,363	27,363	27,363	27,363	26,302
-Water hook-up fees	0	0	0	0	0	0	0	0	0	0	0
Sub-Total Net Costs for Homebuilders	2,542,746	2,542,746	2,542,746	2,542,746	2,542,746	2,763,631	2,763,631	2,763,631	2,763,631	2,763,631	2,656,504
ONGOING COSTS/BENEFITS FOR RESIDENTS OF NEW HOMES											
Maintenance Costs	127,680	127,680	127,680	128,800	128,800	128,800	128,800	128,800	271,080	266,280	266,280
Replacement of Parts	0	0	0	0	0	0	0	0	0	0	0
Ongoing Sprinkler Inspection Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Insurance Premiums	(321,620)	(353,795)	(385,970)	(418,145)	(450,320)	(482,495)	(517,465)	(552,435)	(587,405)	(622,375)	(657,345)
Property Taxes Due to Increased Assessment	0	0	0	0	0	0	0	0	0	0	0
Sub-Total Net Costs for Residents	(193,940)	(226,115)	(258,290)	(289,345)	(321,520)	(353,695)	(388,665)	(423,635)	(316,325)	(356,095)	(391,065)
Sub-Total Net Costs Borne by Other Parties	2,348,806	2,199,711	2,167,536	2,136,481	2,104,306	2,293,016	2,258,046	2,223,076	2,330,386	2,290,616	2,148,519
Total Annual Costs (Savings)	2,348,806	2,316,631	2,284,456	2,253,401	(159,574)	1,198,336	1,163,366	1,128,396	1,235,706	1,195,936	1,053,839

Table A1 (*continued*)
Barrie Cost-Benefit Analysis – Residential Fire Sprinklers

Barrie Cost-Benefit Analysis
Residential Fire Sprinklers

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
INPUTS FOR COST-BENEFIT CALCULATIONS										
BACKGROUND DATA										
Population	130,600	133,200	135,800	138,400	141,000	143,600	146,200	148,800	151,400	154000
Housing Units	46,834	47,869	48,903	49,937	51,400	52,351	53,299	54,247	55,195	56,143
New Housing Units	1,034	1,034	1,034	1,463	951	948	948	948	948	948
-Singles and Semis	517	517	517	731	476	474	474	474	474	474
-Townhouses	207	207	207	293	190	190	190	190	190	190
-Apartments	310	310	310	439	285	284	284	284	284	284
NON-SPRINKLER SCENARIO										
FIRE DEPARTMENT STATISTICS										
Number of Stations	5	5	5	5	5	6	6	6	6	6
Number of Full-Time Staff	111	111	111	111	111	131	131	131	131	131
Number of Vehicles	19	19	19	19	19	21	21	21	21	21
FIRE DEPARTMENT EXPENDITURES										
Capital Expenditures										
-Additional land, buildings, vehicles and equipment	0	0	0	0	0	1,169,200	0	0	0	0
-Replacement buildings, vehicles and equipment	22,500	0	45,000	31,500	825,000	52,500	0	300,000	30,000	847,500
Operating and Maintenance Expenditures										
-Wages and benefits	6,232,085	6,232,085	6,232,085	6,232,085	6,232,085	7,432,085	7,432,085	7,432,085	7,432,085	7,432,085
-Materials and services	211,557	211,557	211,557	211,557	211,557	223,157	223,157	223,157	223,157	223,157
Fire Department Revenues										
-Installation inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Ongoing inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Average Operating Costs Per Capita	49.51	48.38	47.78	46.79	51.55	53.68	52.36	53.46	50.76	55.21
Total Capital and Operating Costs	6,466,142	6,443,642	6,488,642	6,475,142	7,268,642	8,876,942	7,655,242	7,955,242	7,685,242	8,502,742

Table A1 (*continued*)
Barrie Cost-Benefit Analysis – Residential Fire Sprinklers

Barrie Cost-Benefit Analysis
Residential Fire Sprinklers

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
SPRINKLER SCENARIO										
FIRE DEPARTMENT STATISTICS										
Number of Stations	4	4	4	4	4	4	4	4	4	4
Number of Full-Time Staff	91	91	91	91	91	91	91	91	91	91
Number of Vehicles	17	17	17	17	17	17	17	17	17	17
FIRE DEPARTMENT EXPENDITURES										
Capital Expenditures										
-Additional land, buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Replacement buildings, vehicles and equipment	$22,500	$0	$45,000	$31,500	$825,000	$52,500	$0	$300,000	$30,000	$847,500
Operating and Maintenance Expenditures										
-Wages and benefits	5,032,085	5,032,085	5,032,085	5,032,085	5,032,085	5,032,085	5,032,085	5,032,085	5,032,085	5,032,085
-Materials and services	199,957	199,957	199,957	199,957	199,957	199,957	199,957	199,957	199,957	199,957
Fire Department Revenues										
-Installation inspection fees	0	0	0	0	0	0	0	0	0	0
-Ongoing inspection fees	0	0	0	0	0	0	0	0	0	0
Average Operating Costs Per Capita	40.23	39.28	38.86	38.03	42.96	36.80	35.79	37.18	34.76	39.48
Total Capital and Operating Costs	5,254,542	5,232,042	5,277,042	5,263,542	6,057,042	5,284,542	5,232,042	5,532,042	5,262,042	6,079,542
Non-Sprinkler Less Sprinkler Total Costs	1,211,600	1,211,600	1,211,600	1,211,600	1,211,600	3,592,400	2,423,200	2,423,200	2,423,200	2,423,200
OTHER MUNICIPAL COSTS/BENEFITS										
Municipal Capital Expenditures										
-Water supply system	0	0	0	0	0	0	0	0	0	0
-Water distribution system	0	0	0	0	0	0	0	0	0	0
-Hydrants	0	0	0	0	0	0	0	0	0	0
-Sanitary sewage system	0	0	0	0	0	0	0	0	0	0
-Roads	0	0	0	0	0	0	0	0	0	0
-Total	0	0	0	0	0	0	0	0	0	0
Development Charges and Other Developer Contributions	116,920	116,920	116,920	116,920	116,920	116,920	116,920	116,920	116,920	116,920
-Water hookup charges	0	0	0	0	0	0	0	0	0	0
-Building permit fees	(26,302)	(26,302)	(26,302)	(37,200)	(24,195)	(24,104)	(24,104)	(24,104)	(24,104)	(24,108)
-Total change in revenues	90,618	90,618	90,618	79,720	92,725	92,816	92,816	92,816	92,816	92,812
Municipal Operating and Maintenance Costs										
-Water supply and distribution	0	0	0	0	0	0	0	0	0	0
-Hydrants	0	0	0	0	0	0	0	0	0	0
-Sanitary sewage system	0	0	0	0	0	0	0	0	0	0
-Roads	0	0	0	0	0	0	0	0	0	0
-Municipal insurance premiums	0	0	0	0	0	0	0	0	0	0
-Building inspections	26,302	26,302	26,302	37,200	24,195	24,104	24,104	24,104	24,104	24,108
-Total	26,302	26,302	26,302	37,200	24,195	24,104	24,104	24,104	24,104	24,108
Tax Revenues Related to Assessment of Sprinklers	0	0	0	0	0	0	0	0	0	0
Sub-Total Net Impact on Municipal Costs	(1,094,680)	(1,094,680)	(1,094,680)	(1,094,680)	(1,094,680)	(3,475,480)	(2,306,280)	(2,306,280)	(2,306,280)	(2,306,280)

Table A1 (*continued*)
Barrie Cost-Benefit Analysis – Residential Fire Sprinklers

Barrie Cost-Benefit Analysis Residential Fire Sprinklers	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Costs and Benefits for Other Parties										
LAND DEVELOPERS' COSTS/BENEFITS										
Direct Cost of Providing Services for Subdivisions										
-Water mains and hydrants	0	0	0	0	0	0	0	0	0	0
-Roads	0	0	0	0	0	0	0	0	0	0
Development Charges Paid to Municipality										
-For water supply and distribution infrastructure	0	0	0	0	0	0	0	0	0	0
-For roads	0	0	0	0	0	0	0	0	0	0
-For fire stations, vehicles and equipment	(116,920)	(116,920)	(116,920)	(116,920)	(116,920)	(116,920)	(116,920)	(116,920)	(116,920)	(116,920)
Profits Related to Higher Densities	0	0	0	0	0	0	0	0	0	0
Sub-Total Net Costs for Developers	(116,920)	(116,920)	(116,920)	(116,920)	(116,920)	(116,920)	(116,920)	(116,920)	(116,920)	(116,920)
HOME BUILDERS' COSTS/BENEFITS										
Sprinkler Installation Costs										
-Singles and semis	1,758,295	1,758,295	1,758,295	2,486,822	1,617,448	1,611,374	1,611,374	1,611,374	1,611,374	1,611,600
-Townhouses	421,991	421,991	421,991	596,837	388,188	386,730	386,730	386,730	386,730	386,784
-Apartments	449,917	449,917	449,917	636,334	413,876	412,322	412,322	412,322	412,322	412,380
-Total	2,630,202	2,630,202	2,630,202	3,719,993	2,419,512	2,410,427	2,410,427	2,410,427	2,410,427	2,410,764
Other Changes in Construction and Servicng Costs	0	0	0	0	0	0	0	0	0	0
Fees Related to Sprinkler Installation										
-Sprinkler inspection/building permit fees	26,302	26,302	26,302	37,200	24,195	24,104	24,104	24,104	24,104	24,108
-Water hook-up fees	0	0	0	0	0	0	0	0	0	0
Sub-Total Net Costs for Home Builders	2,656,504	2,656,504	2,656,504	3,757,193	2,443,707	2,434,531	2,434,531	2,434,531	2,434,531	2,434,872
ONGOING COSTS/BENEFITS FOR RESIDENTS OF NEW HOMES										
Maintenance Costs	266,280	266,280	278,320	279,440	279,440	279,440	279,440	273,601	283,401	283,401
Replacement of Parts	0	0	0	0	0	0	0	0	0	0
Ongoing Sprinkler Inspection Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Insurance Premiums	(690,959)	(724,574)	(758,188)	(791,803)	(839,345)	(870,267)	(901,072)	(931,878)	(962,684)	(993,490)
Property Taxes Due to Increased Assessment	0	0	0	0	0	0	0	0	0	0
Sub-Total Net Costs for Residents	(424,679)	(458,294)	(479,868)	(512,363)	(559,905)	(590,827)	(621,632)	(658,277)	(679,283)	(710,089)
Sub-Total Net Costs Borne by Other Parties	2,114,904	2,081,290	2,059,715	3,127,910	1,766,882	1,726,784	1,695,978	1,659,333	1,638,328	1,607,863
Total Annual Costs (Savings)	1,020,224	986,610	965,035	2,033,230	672,202	(1,748,696)	(610,302)	(646,947)	(667,952)	(698,417)

Burlington, Ontario

The inputs to the cost-benefit analysis for Burlington are based on the following assumptions.

- City planning staff provided long-term projections of the population and housing units by planning district by five-year intervals for the 1996 to 2016 period and for the ultimate build-out.
- The population of the city is projected to increase from 137,500 in 1996 to 188,600 in 2016 and ultimately to 214,700.
- The number of housing units is projected to increase from 49,770 in 1996 to 72,270 in 2016 and ultimately to 82,370.
- Burlington and the Region of Halton have clearly defined the northern limit of future urban growth for the city as Highway 403 (refer to map). Only very limited development will be permitted in the rural area north of the planned Highway 403. The fire department has based its long-term plans for fire services on this policy.
- One centrally located station (Station No. 7) is expected to be sufficient to service the new growth area. With this new station, the fire department expects to meet the established response standards, provided development is confined to the area south of Highway 403.
- The capital cost of building and equipping the new station is expected to amount to approximately $1 million. The cost of the two vehicles to be purchased for the new station is projected to amount to approximately $920,000.
- Budget forecasts also include replacement vehicles for the entire municipality for the 10-year period, in amounts ranging from $0 to $450,000 per year.
- Costs of wages and benefits for the fire department amounted to $8,362,839 in 1994 and are budgeted to amount to $8,387,516 for 1995.
- Expenditures for materials and services purchased for the department amounted to $991,086 in 1994 and are projected to amount to $1,035,079 in 1995.
- The 1995 budget also includes $385,618 contribution to a reserve fund to be used for the replacement of fire vehicles.
- Total expenditures, net of recoveries and revenues, amounted to $9,633,860 in 1994 and are estimated to be $9,711,128 for 1995.
- Budget data provided by the municipality are also broken down by fire department activity. Fire suppression functions accounted for 81 per cent of the total expenditures of the department for 1995.
- The additional annual cost associated with staffing, operating and maintaining the new station is expected to total $1,146,000, when the station is in full operation.
- The majority of fire department calls are non-fire calls (± 65.4 per cent in 1994). Calls that turned out to be false alarms are included as fire calls. The non-fire calls have become the driving force in the determination of fire department equipping and staffing requirements as the fire department's role, mandated by City Council, has expanded to include a broad range of emergency services.
- Volunteer firefighters are called in to staff a fire station almost every time a primary dispatch is made. The volunteers are then in place to respond to subsequent alarms within the coverage area of the station, or to respond to second and subsequent alarms from the original call.

- The city has sufficient volunteers to re-staff all fire stations if all the primary paid firefighters on duty are out of the fire stations on calls.

- There is no change in the number or locations of the existing or proposed fire stations for the sprinklered scenario, as the fire department requires the proposed station No. 7 to serve existing and proposed non-residential uses that are already located in its service area.

Map A2
City of Burlington

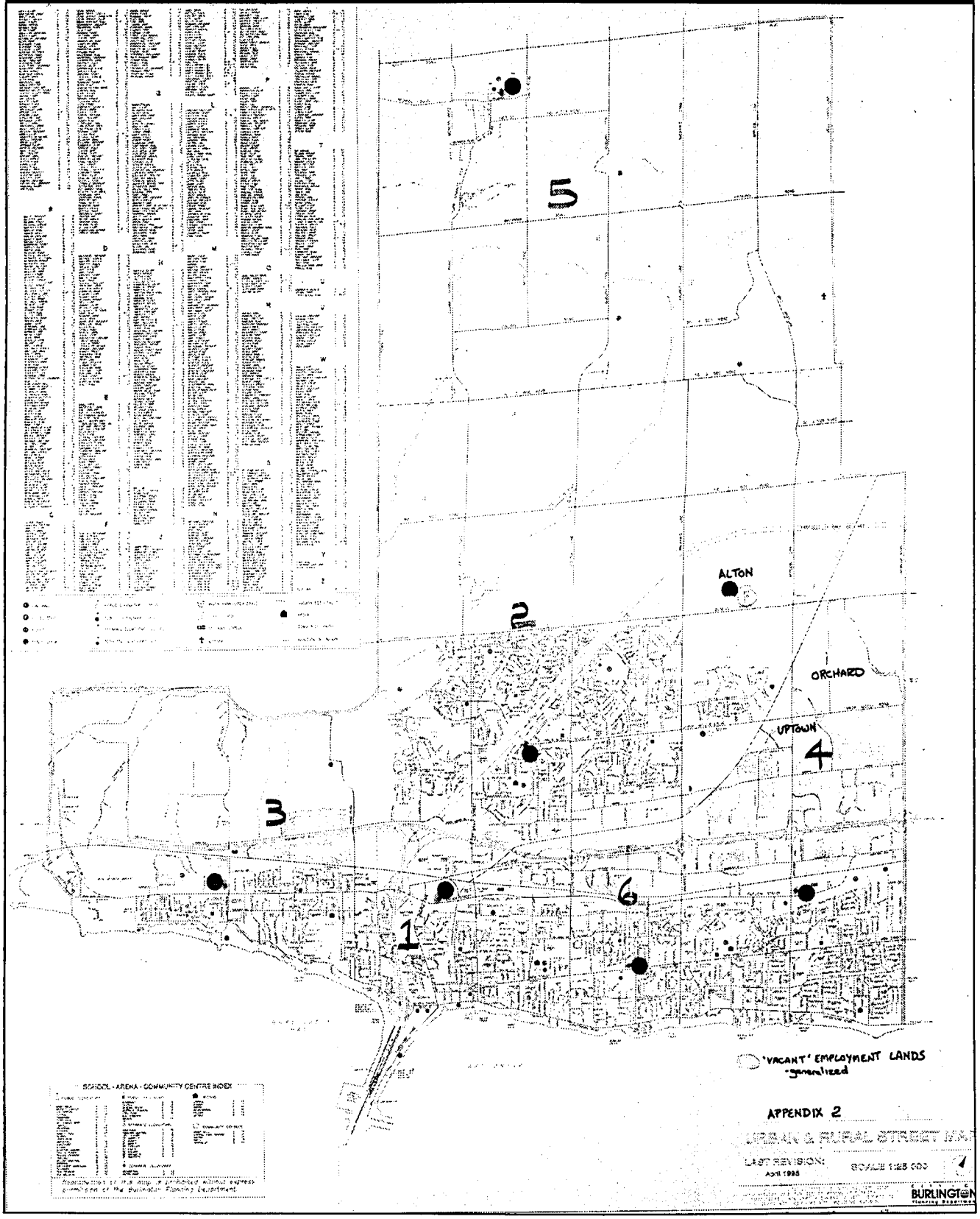

Table A2
Burlington Cost-Benefit Analysis – Residential Fire Sprinklers

Burlington Cost-Benefit Analysis
Residential Fire Sprinklers

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
INPUTS FOR COST-BENEFIT CALCULATIONS											
BACKGROUND DATA											
Population	135,000	137,500	139,530	141,560	143,590	145,620	147,650	150,570	153,490	156,410	159,330
Housing Units	48,865	49,770	50,670	51,570	52,470	53,370	54,270	55,470	56,670	57,870	59,070
New Housing Units	905	900	900	900	900	900	1200	1200	1200	1200	1200
-Singles and semis	453	450	450	450	450	450	600	600	600	600	600
-Townhouses	181	180	180	180	180	180	240	240	240	240	240
-Apartments	272	270	270	270	270	270	360	360	360	360	360
NON-SPRINKLER SCENARIO											
FIRE DEPARTMENT STATISTICS											
Number of Stations	6	6	6	7	7	7	7	7	7	7	7
Number of Full-Time Staff	120	120	120	128	136	136	136	136	136	136	140
Number of Vehicles	29	29	29	30	31	31	31	31	31	31	31
FIRE DEPARTMENT EXPENDITURES											
Capital Expenditures											
-Additional land, buildings, vehicles and equipment		300,000	1,000,000	850,000							
-Replacement buildings, vehicles and equipment	335,000	79,191	350,000	350,000	450,080	105,751	30,000	0	430,000	0	335,000
Operating and Maintenance Expenditures											
-Wages and benefits	*8,387,516*	*8,387,516*	*8,387,516*	*8,888,780*	*9,412,240*	*9,412,240*	*9,412,240*	*9,412,240*	*9,412,240*	*9,412,240*	*9,662,872*
-Materials and services	1,035,079	1,035,079	1,035,079	1,056,007	1,056,007	1,056,007	1,056,007	1,056,007	1,056,007	1,056,007	1,056,007
Fire Department Revenues											
-Installation inspection fees	0	0	0	0	0	0	0	0	0	0	0
-Ongoing inspection fees	0	0	0	0	0	0	0	0	0	0	0
Average Operating Costs Per Capita	72.28	69.10	70.04	72.72	76.04	72.61	71.10	69.52	71.00	68.93	69.38
Total Capital and Operating Costs	9,757,595	9,801,786	10,772,595	11,144,787	10,918,327	10,573,998	10,498,247	10,468,247	10,898,247	10,468,247	11,053,879

Table A2 (*continued*)
Burlington Cost-Benefit Analysis – Residential Fire Sprinklers

Burlington Cost-Benefit Analysis
Residential Fire Sprinklers

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
SPRINKLER SCENARIO											
Total Operating and Capital Costs	9,757,595	9,801,786	10,772,595	11,144,787	10,918,327	10,573,998	10,498,247	10,468,247	10,898,247	10,468,247	11,053,879
Non-Sprinkler Less Sprinkler Scenario	0	0	0	0	0	0	0	0	0	0	0
OTHER MUNICIPAL COSTS/BENEFITS											
Municipal Capital Expenditures											
-Water supply system	0	0	0	0	0	0	0	0	0	0	0
-Water distribution system	0	0	0	0	0	0	0	0	0	0	0
-Hydrants	0	0	0	0	0	0	0	0	0	0	0
-Sanitary sewage system	0	0	0	0	0	0	0	0	0	0	0
-Roads	0	0	0	0	0	0	0	0	0	0	0
-Total	0	0	0	0	0	0	0	0	0	0	0
Development Charges and Other Developer Contributions	0	0	0	0	0	0	0	0	0	0	0
-Water hook-up charges	0	0	0	0	0	0	0	0	0	0	0
-Building permit fees	(23,150)	(23,022)	(23,022)	(23,022)	(23,022)	(23,022)	(30,696)	(30,696)	(30,696)	(30,696)	(30,696)
-Total change in revenues	(23,150)	(23,022)	(23,022)	(23,022)	(23,022)	(23,022)	(30,696)	(30,696)	(30,696)	(30,696)	(30,696)
Municipal Operating and Maintenance Costs											
-Water supply and distribution	0	0	0	0	0	0	0	0	0	0	0
-Hydrants	0	0	0	0	0	0	0	0	0	0	0
-Sanitary sewage system	0	0	0	0	0	0	0	0	0	0	0
-Roads	0	0	0	0	0	0	0	0	0	0	0
-Municipal insurance premiums	0	0	0	0	0	0	0	0	0	0	0
-Building inspections	23,150	23,022	23,022	23,022	23,022	23,022	30,696	30,696	30,696	30,696	30,696
-Total	23,150	23,022	23,022	23,022	23,022	23,022	30,696	30,696	30,696	30,696	30,696
Tax Revenues Related to Assessment of Sprinklers	0	0	0	0	0	0	0	0	0	0	0
Sub-Total Net Impact on Municipal Costs	0	0	0	0	0	0	0	0	0	0	0

Table A2 (*continued*)
Burlington Cost-Benefit Analysis – Residential Fire Sprinklers

Burlington Cost-Benefit Analysis Residential Fire Sprinklers	1995	1996	1997	1998	1999	2000	2001	2002	2003	Page three of t 2004
Costs and Benefits for Other Parties										
LAND DEVELOPERS' COSTS/BENEFITS										
Direct Cost of Providing Services for Subdivisions										
-Water mains and hydrants	0	0	0	0	0	0	0	0	0	0
-Roads	0	0	0	0	0	0	0	0	0	0
Development Charges Paid to Municipality										
-For water supply and distribution infrastructure	0	0	0	0	0	0	0	0	0	0
-For roads	0	0	0	0	0	0	0	0	0	0
-For fire stations, vehicles and equipment	0	0	0	0	0	0	0	0	0	0
Profits related to higher densities	0	0	0	0	0	0	0	0	0	0
Sub-Total Net Costs for Developers	0	0	0	0	0	0	0	0	0	0
HOMEBUILDERS' COSTS/BENEFITS										
Sprinkler installation costs										
-Singles and semis	1,538,500	1,530,000	1,530,000	1,530,000	1,530,000	1,530,000	2,040,000	2,040,000	2,040,000	2,040,000
-Townhouses	369,240	367,200	367,200	367,200	367,200	367,200	489,600	489,600	489,600	489,600
-Apartments	407,250	405,000	405,000	405,000	405,000	405,000	540,000	540,000	540,000	540,000
-Total	2,314,990	2,302,200	2,302,200	2,302,200	2,302,200	2,302,200	3,069,600	3,069,600	3,069,600	3,069,600
Other Changes in Construction and On-Site Servicing Costs	0	0	0	0	0	0	0	0	0	0
Fees Related to Sprinkler Installation										
-Sprinkler inspection/building permit fees	23,150	23,022	23,022	23,022	23,022	23,022	30,696	30,696	30,696	30,696
-Water hook-up fees	0	0	0	0	0	0	0	0	0	0
Sub-Total Net Costs for Homebuilders	2,338,140	2,325,222	2,325,222	2,325,222	2,325,222	2,325,222	3,100,296	3,100,296	3,100,296	3,100,296
ONGOING COSTS/BENEFITS FOR RESIDENTS OF NEW HOMES										
Maintenance Costs	0	0	0	0	0	0	0	0	0	126,700
Replacement of Parts	0	0	0	0	0	0	0	0	0	0
Ongoing Sprinkler Inspection Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Insurance Premiums	0	(29,413)	(58,663)	(87,913)	(117,163)	(146,413)	(175,663)	(214,663)	(253,663)	(292,663)
Property Taxes Due to Increased Assessment	0	0	0	0	0	0	0	0	0	0
Sub-Total Net Costs for Residents	0	(29,413)	(58,663)	(87,913)	(117,163)	(146,413)	(175,663)	(214,663)	(253,663)	(165,963)
Sub-Total Net Costs Borne by Other Parties	2,338,140	2,295,810	2,266,560	2,237,310	2,208,060	2,178,810	2,924,634	2,885,634	2,846,634	2,934,334
Total Annual Costs (Savings)	2,338,140	2,295,810	2,266,560	2,237,310	2,208,060	2,178,810	2,924,634	2,885,634	2,846,634	2,934,334
PRESENT VALUE OF NET COSTS (SAVINGS)	39,211,530									
DISCOUNTED NUMBER OF HOUSING UNITS	16,879									
Pv of municipal costs (savings)	0									
PV of developers costs(savings)	0									
PV of homebuilder costs	43,607,670									
PV of maintenance costs	1,866,770									
PV of Insurance Savings	(6,262,910)									
	39,211,530									

Table A2 (*continued*)
Burlington Cost-Benefit Analysis – Residential Fire Sprinklers

Burlington Cost-Benefit Analysis
Residential Fire Sprinklers

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
INPUTS FOR COST-BENEFIT CALCULATIONS											
BACKGROUND DATA											
Population	162,250	164,980	167,710	170,440	173,170	175,900	178,440	180,980	183,520	186,060	188,600
Housing Units	60,270	61,470	62,670	63,870	65,070	66,270	67,470	68,670	69,870	71,070	72,270
New Housing Units	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,010
-Singles and semis	600	600	600	600	600	600	600	600	600	600	505
-Townhouses	240	240	240	240	240	240	240	240	240	240	202
-Apartments	360	360	360	360	360	360	360	360	360	360	303
NON-SPRINKLER SCENARIO											
FIRE DEPARTMENT STATISTICS											
Number of Stations	7	7	7	7	7	7	7	7	7	7	7
Number of Full-Time Staff	140	140	140	140	140	140	140	140	140	140	140
Number of Vehicles	31	31	31	31	31	31	31	31	31	31	31
FIRE DEPARTMENT EXPENDITURES											
Capital Expenditures											
-Additional land, buildings, vehicles and equipment											
-Replacement buildings, vehicles and equipment	79,191	350,000	350,000	450,080	105,751	30,000	0	430,000	0	335,000	979,191
Operating and Maintenance Expenditures											
-Wages and benefits	9,662,872	9,662,872	9,662,872	9,662,872	9,662,872	9,662,872	9,662,872	9,662,872	9,662,872	9,662,872	9,662,872
-Materials and services	1,056,007	1,056,007	1,056,007	1,056,007	1,056,007	1,056,007	1,056,007	1,056,007	1,056,007	1,056,007	1,056,007
Fire Department Revenues											
-Installation inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Ongoing inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Average Operating Costs Per Capita	66.55	67.09	66.00	65.53	62.51	61.11	60.07	61.60	58.41	59.41	62.03
Total Capital and Operating Costs	10,798,070	11,068,879	11,068,879	11,168,959	10,824,630	10,748,879	10,718,879	11,148,879	10,718,879	11,053,879	11,698,070

Table A2 (*continued*)
Burlington Cost-Benefit Analysis – Residential Fire Sprinklers

Burlington Cost-Benefit Analysis
Residential Fire Sprinklers

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
SPRINKLER SCENARIO											
Total Operating and Capital Costs	10,798,070	11,068,879	11,068,879	11,168,959	10,824,630	10,748,879	10,718,879	11,148,879	10,718,879	11,053,879	11,698,070
Non-Sprinkler Less Sprinkler Scenario	0	0	0	0	0	0	0	0	0	0	0
OTHER MUNICIPAL COSTS/BENEFITS											
Municipal Capital Expenditures											
-Water supply system	0	0	0	0	0	0	0	0	0	0	0
-Water distribution system	0	0	0	0	0	0	0	0	0	0	0
-Hydrants	0	0	0	0	0	0	0	0	0	0	0
-Sanitary sewage system	0	0	0	0	0	0	0	0	0	0	0
-Roads	0	0	0	0	0	0	0	0	0	0	0
-Total	0	0	0	0	0	0	0	0	0	0	0
Development Charges and Other Developer Contribut	0	0	0	0	0	0	0	0	0	0	0
-Water hook-up charges	0	0	0	0	0	0	0	0	0	0	0
-Building permit fees	(30,696)	(30,696)	(30,696)	(30,696)	(30,696)	(30,696)	(30,696)	(30,696)	(30,696)	(30,696)	(25,836)
-Total change in revenues	(30,696)	(30,696)	(30,696)	(30,696)	(30,696)	(30,696)	(30,696)	(30,696)	(30,696)	(30,696)	(25,836)
Municipal Operating and Maintenance Costs											
-Water supply and distribution	0	0	0	0	0	0	0	0	0	0	0
-Hydrants	0	0	0	0	0	0	0	0	0	0	0
-Sanitary sewage system	0	0	0	0	0	0	0	0	0	0	0
-Roads	0	0	0	0	0	0	0	0	0	0	0
-Municipal insurance premiums	0	0	0	0	0	0	0	0	0	0	0
-Building inspections	30,696	30,696	30,696	30,696	30,696	30,696	30,696	30,696	30,696	30,696	25,836
-Total	30,696	30,696	30,696	30,696	30,696	30,696	30,696	30,696	30,696	30,696	25,836
Tax Revenues Related to Assessment of Sprinklers	0	0	0	0	0	0	0	0	0	0	0
Sub-Total Net Impact on Municipal Costs	0	0	0	0	0	0	0	0	0	0	0

Table A2 (*continued*)
Burlington Cost-Benefit Analysis – Residential Fire Sprinklers

Burlington Cost-Benefit Analysis
Residential Fire Sprinklers

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Costs and Benefits for Other Parties											
LAND DEVELOPERS' COSTS/BENEFITS											
Direct Cost of Providing Services for Subdivisions											
-Water mains and hydrants	0	0	0	0	0	0	0	0	0	0	0
-Roads	0	0	0	0	0	0	0	0	0	0	0
Development Charges Paid to Municipality											
-For water supply and distribution infrastructure	0	0	0	0	0	0	0	0	0	0	0
-For roads	0	0	0	0	0	0	0	0	0	0	0
-For fire stations, vehicles and equipment	0	0	0	0	0	0	0	0	0	0	0
Profits related to higher densities	0	0	0	0	0	0	0	0	0	0	0
Sub-Total Net Costs for Developers	0	0	0	0	0	0	0	0	0	0	0
HOME BUILDERS' COSTS/BENEFITS											
Sprinkler installation costs											
-Singles and semis	2,040,000	2,040,000	2,040,000	2,040,000	2,040,000	2,040,000	2,040,000	2,040,000	2,040,000	2,040,000	1,717,000
-Townhouses	489,600	489,600	489,600	489,600	489,600	489,600	489,600	489,600	489,600	489,600	412,080
-Apartments	540,000	540,000	540,000	540,000	540,000	540,000	540,000	540,000	540,000	540,000	454,500
-Total	3,069,600	3,069,600	3,069,600	3,069,600	3,069,600	3,069,600	3,069,600	3,069,600	3,069,600	3,069,600	2,583,580
Other Changes in Construction and On-Site Servicing Costs	0	0	0	0	0	0	0	0	0	0	0
Fees Related to Sprinkler Installation											
-Sprinkler inspection/building permit fees	30,696	30,696	30,696	30,696	30,696	30,696	30,696	30,696	30,696	30,696	25,836
-Water hook-up fees	0	0	0	0	0	0	0	0	0	0	0
Sub-Total Net Costs for Home Builders	3,100,296	3,100,296	3,100,296	3,100,296	3,100,296	3,100,296	3,100,296	3,100,296	3,100,296	3,100,296	2,609,416
ONGOING COSTS/BENEFITS FOR RESIDENTS OF NEW HOMES											
Maintenance Costs	126,000	126,000	126,000	168,000	168,000	168,000	168,000	168,000	294,700	294,000	294,000
Replacement of Parts	0	0	0	0	0	0	0	0	0	0	0
Ongoing Sprinkler Inspection Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Insurance Premiums	(370,663)	(409,663)	(448,663)	(487,663)	(526,663)	(565,663)	(604,663)	(643,663)	(682,663)	(721,663)	(760,663)
Property Taxes Due to Increased Assessment	0	0	0	0	0	0	0	0	0	0	0
Sub-Total Net Costs for Residents	(244,663)	(283,663)	(322,663)	(319,663)	(358,663)	(397,663)	(436,663)	(475,663)	(387,963)	(427,663)	(466,663)
Sub-Total Net Costs Borne by Other Parties	2,855,634	2,816,634	2,777,634	2,780,634	2,741,634	2,702,634	2,663,634	2,624,634	2,712,334	2,672,634	2,142,753
Total Annual Costs (Savings)	2,855,634	2,816,634	2,777,634	2,780,634	2,741,634	2,702,634	2,663,634	2,624,634	2,712,334	2,672,634	2,142,753

Table A2 (*continued*)
Burlington Cost-Benefit Analysis – Residential Fire Sprinklers

Burlington Cost-Benefit Analysis
Residential Fire Sprinklers

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
INPUTS FOR COST-BENEFIT CALCULATIONS										
BACKGROUND DATA										
Population	191,210	193,820	196,430	199,040	201,650	204,260	206,870	209,480	212,090	214700
Housing Units	73,280	74,290	75,300	76,310	77,320	78,330	79,340	80,350	81,360	82370
New Housing Units	1,010	1,010	1,010	1,010	1,010	1,010	1,010	1,010	1,010	1,010
-Singles and semis	505	505	505	505	505	505	505	505	505	505
-Townhouses	202	202	202	202	202	202	202	202	202	202
-Apartments	303	303	303	303	303	303	303	303	303	303
NON-SPRINKLER SCENARIO										
FIRE DEPARTMENT STATISTICS										
Number of Stations	7	7	7	7	7	7	7	7	7	7
Number of Full-Time Staff	140	140	140	140	140	140	140	140	140	140
Number of Vehicles	31	31	31	31	31	31	31	31	31	31
FIRE DEPARTMENT EXPENDITURES										
Capital Expenditures										
-Additional land, buildings, vehicles and equipment										
-Replacement buildings, vehicles and equipment	350,000	350,000	450,080	105,751	30,000	0	430,000	0	0	0
Operating and Maintenance Expenditures										
-Wages and benefits	9,662,872	9,662,872	9,662,872	9,662,872	9,662,872	9,662,872	9,662,872	9,662,872	9,662,872	9,662,872
-Materials and services	1,056,007	1,056,007	1,056,007	1,056,007	1,056,007	1,056,007	1,056,007	1,056,007	1,056,007	1,056,007
Fire Department Revenues										
-Installation inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Ongoing inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Average Operating Costs Per Capita	57.89	57.11	56.86	54.38	53.30	52.48	53.89	51.17	50.54	49.92
Total Capital and Operating Costs	11,068,879	11,068,879	11,168,959	10,824,630	10,748,879	10,718,879	11,148,879	10,718,879	10,718,879	10,718,879

Table A2 (*continued*)
Burlington Cost-Benefit Analysis – Residential Fire Sprinklers

Burlington Cost-Benefit Analysis
Residential Fire Sprinklers

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
SPRINKLER SCENARIO										
Total Operating and Capital Costs	11,068,879	11,068,879	11,168,959	10,824,630	10,748,879	10,718,879	11,148,879	10,718,879	10,718,879	10,718,879
Non-Sprinkler Less Sprinkler Scenario	0	0	0	0	0	0	0	0	0	0
OTHER MUNICIPAL COSTS/BENEFITS										
Municipal Capital Expenditures										
-Water supply system	0	0	0	0	0	0	0	0	0	0
-Water distribution system	0	0	0	0	0	0	0	0	0	0
-Hydrants	0	0	0	0	0	0	0	0	0	0
-Sanitary sewage system	0	0	0	0	0	0	0	0	0	0
-Roads	0	0	0	0	0	0	0	0	0	0
-Total	0	0	0	0	0	0	0	0	0	0
Development Charges and Other Developer Contribution	0	0	0	0	0	0	0	0	0	0
-Water hook-up charges	0	0	0	0	0	0	0	0	0	0
-Building permit fees	(25,836)	(25,836)	(25,836)	(25,836)	(25,836)	(25,836)	(25,836)	(25,836)	(25,836)	(25,836)
-Total change in revenues	(25,836)	(25,836)	(25,836)	(25,836)	(25,836)	(25,836)	(25,836)	(25,836)	(25,836)	(25,836)
Municipal Operating and Maintenance Costs										
-Water supply and distribution	0	0	0	0	0	0	0	0	0	0
-Hydrants	0	0	0	0	0	0	0	0	0	0
-Sanitary sewage system	0	0	0	0	0	0	0	0	0	0
-Roads	0	0	0	0	0	0	0	0	0	0
-Municipal insurance premiums	0	0	0	0	0	0	0	0	0	0
-Building inspections	25,836	25,836	25,836	25,836	25,836	25,836	25,836	25,836	25,836	25,836
-Total	25,836	25,836	25,836	25,836	25,836	25,836	25,836	25,836	25,836	25,836
Tax Revenues Related to Assessment of Sprinklers	0	0	0	0	0	0	0	0	0	0
Sub-Total Net Impact on Municipal Costs	0	0	0	0	0	0	0	0	0	0

Table A2 (*continued*)
Burlington Cost-Benefit Analysis – Residential Fire Sprinklers

Burlington Cost-Benefit Analysis
Residential Fire Sprinklers

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Costs and Benefits for Other Parties										
LAND DEVELOPERS' COSTS/BENEFITS										
Direct Cost of Providing Services for Subdivisions										
-Water mains and hydrants	0	0	0	0	0	0	0	0	0	0
-Roads	0	0	0	0	0	0	0	0	0	0
Development Charges Paid to Municipality										
-For water supply and distribution infrastructure	0	0	0	0	0	0	0	0	0	0
-For roads	0	0	0	0	0	0	0	0	0	0
-For fire stations, vehicles and equipment	0	0	0	0	0	0	0	0	0	0
Profits related to higher densities	0	0	0	0	0	0	0	0	0	0
Sub-Total Net Costs for Developers	0	0	0	0	0	0	0	0	0	0
HOME BUILDERS' COSTS/BENEFITS										
Sprinkler installation costs										
-Singles and semis	1,717,000	1,717,000	1,717,000	1,717,000	1,717,000	1,717,000	1,717,000	1,717,000	1,717,000	1,717,000
-Townhouses	412,080	412,080	412,080	412,080	412,080	412,080	412,080	412,080	412,080	412,080
-Apartments	454,500	454,500	454,500	454,500	454,500	454,500	454,500	454,500	454,500	454,500
-Total	2,583,580	2,583,580	2,583,580	2,583,580	2,583,580	2,583,580	2,583,580	2,583,580	2,583,580	2,583,580
Other Changes in Construction and On-Site Servicing Costs	0	0	0	0	0	0	0	0	0	0
Fees Related to Sprinkler Installation										
-Sprinkler inspection/building permit fees	25,836	25,836	25,836	25,836	25,836	25,836	25,836	25,836	25,836	25,836
-Water hook-up fees	0	0	0	0	0	0	0	0	0	0
Sub-Total Net Costs for Home Builders	2,609,416	2,609,416	2,609,416	2,609,416	2,609,416	2,609,416	2,609,416	2,609,416	2,609,416	2,609,416
ONGOING COSTS/BENEFITS FOR RESIDENTS OF NEW HOMES										
Maintenance Costs	294,000	294,000	294,000	336,000	336,000	336,000	336,000	309,400	309,400	309,400
Replacement of Parts	0	0	0	0	0	0	0	0	0	0
Ongoing Sprinkler Inspection Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Insurance Premiums	(793,488)	(826,313)	(859,138)	(891,963)	(924,788)	(957,613)	(990,438)	(1,023,263)	(1,056,088)	(1,088,913)
Property Taxes Due to Increased Assessment	0	0	0	0	0	0	0	0	0	0
Sub-Total Net Costs for Residents	(499,488)	(532,313)	(565,138)	(555,963)	(588,788)	(621,613)	(654,438)	(713,863)	(746,688)	(779,513)
Sub-Total Net Costs Borne by Other Parties	2,109,928	2,077,103	2,044,278	2,053,453	2,020,628	1,987,803	1,954,978	1,895,553	1,862,728	1,829,903
Total Annual Costs (Savings)	2,109,928	2,077,103	2,044,278	2,053,453	2,020,628	1,987,803	1,954,978	1,895,553	1,862,728	1,829,903

Edmonton, Alberta

The inputs to the cost-benefit analysis for Edmonton are based on the following assumptions.

- 1996 population and housing units data from the census were used.
- Population projection for 2002 from the Planning Department assumes a steady increase from 1996 to meet the 2002 projection. For the longer term beyond 2002, an annual increase of 1.1 per cent is assumed – roughly equal to the average annual increase in long-term projections prepared by Edmonton Metropolitan Regional Planning Commission for the city.
- The number of housing units is calculated from the population increase assuming constant average household size.
- Emergency medical services are assumed to account for 10 per cent of total emergency response net budget (costs net of revenues). This is applied to the total 1997 approved budget to arrive at total budget for fire.
- Costs and timing for the first two additional stations are calculated from budget information provided. Includes capital and operating costs for new stations.
- Four additional stations would be added over the study period – one new fire station for roughly every 30,000 population increase.
- The approximately 30,000 population increase, which would generate the need for a new fire station, would occur mostly on the perimeter of the existing urban area, in new housing that would expand the urban area of the city.
- A $100 per unit inspection cost for residential sprinkler installation is assumed to be sufficient to cover the city's costs.
- No revenue from development charges is assumed to pay for the cost of establishing new fire stations.
- There is no significant saving in land developer costs, due to such factors as narrower roads permitting increased housing density. Increases in housing density are occurring without being tied to requirements for mandatory residential sprinklers.

Map A3
City of Edmonton

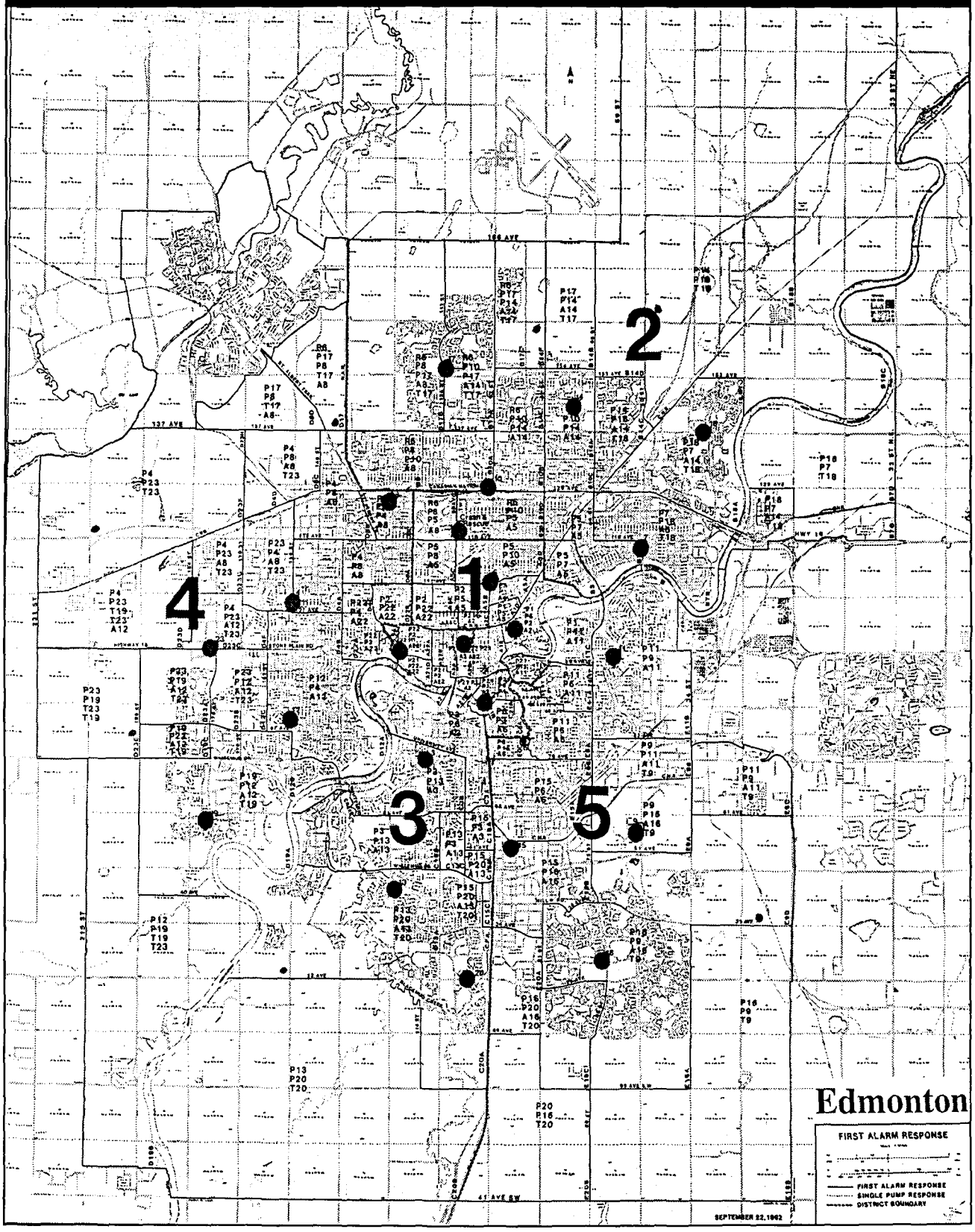

Table A3
Edmonton Cost-Benefit Analysis – Residential Fire Sprinklers

Edmonton Cost-Benefit Analysis
Residential Fire Sprinklers

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
BACKGROUND DATA										
Population	616,306	623,188	630,069	636,951	643,832	650,714	657,595	664,829	672,142	679,535
Housing Units	241,129	243,821	246,514	249,206	251,899	254,591	257,283	260,113	262,975	265,867
New Housing Units		2,692	2,692	2,692	2,692	2,692	2,692	2,830	2,861	2,893
-Singles and semis	0	2,019	2,019	2,019	2,019	2,019	2,019	2,123	2,146	2,170
-Townhouses	0	337	337	337	337	337	337	354	358	362
-Apartments	0	337	337	337	337	337	337	354	358	362
NON-SPRINKLER SCENARIO										
FIRE DEPARTMENT STATISTICS										
Number of Stations	23	23	23	23	23	23	23	23	24	24
Number of Full-Time Staff	766	766	766	766	766	766	766	766	786	786
Number of Vehicles	115	115	115	115	115	115	115	115	117	117
FIRE DEPARTMENT EXPENDITURES										
Capital Expenditures										
-Additional land, buildings, vehicles and equipment	$0	$595,000	$0	$0	$0	$0	$0	$0	$1,891,000	$200,000
-Replacement buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Operating and Maintenance Expenditures										
-Wages and benefits		$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$56,780,000	$56,780,000
-Materials and services		$0	$0	$0	$0	$0	$0	$0	$30,000	$30,000
Fire Department Revenues										
-Installation inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Ongoing inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Average Operating Costs Per Capita	$0	$88.95	$87.97	$87.02	$86.09	$85.18	$84.29	$83.37	$84.52	$83.60
Total Capital and Operating Costs	$0	$56,025,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$58,701,000	$57,010,000

Table A3 (*continued*)
Edmonton Cost-Benefit Analysis – Residential Fire Sprinklers

Edmonton Cost-Benefit Analysis — Page two of nine

Residential Fire Sprinklers

SPRINKLER SCENARIO	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
FIRE DEPARTMENT STATISTICS										
Number of Stations	23	23	23	23	23	23	23	23	23	23
Number of Full-Time Staff	766	766	766	766	766	766	766	766	766	766
Number of Vehicles	115	115	115	115	115	115	115	115	115	115
FIRE DEPARTMENT EXPENDITURES										
Capital Expenditures										
-Additional land, buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Replacement buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Operating and Maintenance Expenditures										
-Wages and benefits	$0	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000
-Materials and services	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Fire Department Revenues										
-Installation inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Ongoing inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Average Operating Costs Per Capita	$0.00	$88.95	$87.97	$87.02	$86.09	$85.18	$84.29	$83.37	$82.47	$81.57
Total Capital and Operating Costs	$0	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000
Non-Sprinkler Less Sprinkler Total Costs	$0	$595,000	$0	$0	$0	$0	$0	$0	$3,271,000	$1,580,000
OTHER MUNICIPAL COSTS/BENEFITS										
Municipal Capital Expenditures	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Municipal Revenues										
-Development charges and other developer contributions	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Water hook-up charges	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Building permit fees		$269,238	$269,238	$269,238	$269,238	$269,238	$269,238	$283,012	$286,125	$289,272
-Total change in revenues	$0	$269,238	$269,238	$269,238	$269,238	$269,238	$269,238	$283,012	$286,125	$289,272
Municipal Operating and Maintenance Costs										
-Building inspections	$0	$269,238	$269,238	$269,238	$269,238	$269,238	$269,238	$283,012	$286,125	$289,272
-Other costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Total	$0	$269,238	$269,238	$269,238	$269,238	$269,238	$269,238	$283,012	$286,125	$289,272
Tax Revenues Related to Assessment of Sprinklers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Impact on Municipal Costs	$0	($595,000)	$0	$0	$0	$0	$0	$0	($3,271,000)	($1,580,000)

Table A3 (*continued*)
Edmonton Cost-Benefit Analysis – Residential Fire Sprinklers

Edmonton Cost-Benefit Analysis
Residential Fire Sprinklers

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Costs and Benefits for Other Parties										
LAND DEVELOPERS' COSTS/BENEFITS										
Direct Cost of Providing Services for Subdivisions	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Development Charges Paid to Municipality	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Profits Related to Higher Densities	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Developers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
HOMEBUILDERS' COSTS/BENEFITS										
Sprinkler Installation Costs										
-Singles and semis	$0	$6,865,566	$6,865,566	$6,865,566	$6,865,566	$6,865,566	$6,865,566	$7,216,796	$7,296,181	$7,376,439
-Townhouses	$0	$686,557	$686,557	$686,557	$686,557	$686,557	$686,557	$721,680	$729,618	$737,644
-Apartments	$0	$487,994	$487,994	$487,994	$487,994	$487,994	$487,994	$512,959	$518,601	$524,306
-Total	$0	$8,040,116	$8,040,116	$8,040,116	$8,040,116	$8,040,116	$8,040,116	$8,451,434	$8,544,400	$8,638,388
Other Changes in Construction and On-Site Servicing Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Fees Related to Sprinkler Installation										
-Sprinkler inspection/building permit fees	$0	$269,238	$269,238	$269,238	$269,238	$269,238	$269,238	$283,012	$286,125	$289,272
-Water hook-up fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Homebuilders	$0	$8,309,354	$8,309,354	$8,309,354	$8,309,354	$8,309,354	$8,309,354	$8,734,446	$8,830,524	$8,927,660
ONGOING COSTS/BENEFITS FOR RESIDENTS OF NEW HOMES										
Maintenance Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Ongoing Sprinkler Inspection Costs	0	0	0	0	0	0	0	0	0	0
Insurance Premiums		($87,502)	($175,005)	($262,507)	($350,009)	($437,512)	($525,014)	($616,993)	($709,983)	($803,997)
Property Taxes Due to Increased Assessment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Residents	$0	($87,502)	($175,005)	($262,507)	($350,009)	($437,512)	($525,014)	($616,993)	($709,983)	($803,997)

PRESENT VALUE OF NET COSTS (SAVINGS)	5	3	7
npv of municipal savings	($38,940,383)	($59,701,251)	($26,105,251)
npv of developer savings	$0	$0	$0
npv of homebuilder costs	$130,112,965	$173,684,534	$100,931,357
npv of maintenance costs	$5,207,604	$8,145,415	$3,408,962
npv of insurance savings	($16,324,418)	($23,789,947)	($11,568,444)

Table A3 (*continued*)
Edmonton Cost-Benefit Analysis – Residential Fire Sprinklers

Edmonton Cost-Benefit Analysis
Residential Fire Sprinklers

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
BACKGROUND DATA											
Population	687,010	694,567	702,207	709,932	717,741	725,636	733,618	741,688	749,847	758,095	766,434
Housing Units	268,792	271,749	274,738	277,760	280,815	283,904	287,027	290,185	293,377	296,604	299,866
New Housing Units	2,925	2,957	2,989	3,022	3,055	3,089	3,123	3,157	3,192	3,227	3,263
-Singles and semis	2,193	2,218	2,242	2,267	2,292	2,317	2,342	2,368	2,394	2,420	2,447
-Townhouses	366	370	374	378	382	386	390	395	399	403	408
-Apartments	366	370	374	378	382	386	390	395	399	403	408
NON-SPRINKLER SCENARIO											
FIRE DEPARTMENT STATISTICS											
Number of Stations	24	24	25	25	25	25	26	26	26	26	27
Number of Full-Time Staff	786	786	806	806	806	806	826	826	826	826	846
Number of Vehicles	117	117	119	119	119	119	121	121	121	121	123
FIRE DEPARTMENT EXPENDITURES											
Capital Expenditures											
-Additional land, buildings, vehicles and equipment	$0	$0	$2,128,000	$0	$300,000	$0	$2,128,000	$0	$300,000	$0	$2,128,000
-Replacement buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Operating and Maintenance Expenditures											
-Wages and benefits	$56,780,000	$56,780,000	$58,080,000	$58,080,000	$58,080,000	$58,080,000	$59,380,000	$59,380,000	$59,380,000	$59,380,000	$60,680,000
-Materials and services	$30,000	$30,000	$60,000	$60,000	$60,000	$60,000	$90,000	$90,000	$90,000	$90,000	$120,000
Fire Department Revenues											
-Installation inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Ongoing inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Average Operating Costs Per Capita	$82.69	$81.79	$82.80	$81.90	$81.00	$80.12	$81.06	$80.18	$79.31	$78.45	$79.33
Total Capital and Operating Costs	$56,810,000	$56,810,000	$60,268,000	$58,140,000	$58,440,000	$58,140,000	$61,598,000	$59,470,000	$59,770,000	$59,470,000	$62,928,000

Table A3 (*continued*)
Edmonton Cost-Benefit Analysis – Residential Fire Sprinklers

Edmonton Cost-Benefit Analysis Page five of nine

Residential Fire Sprinklers

SPRINKLER SCENARIO	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
FIRE DEPARTMENT STATISTICS											
Number of Stations	23	23	23	23	23	23	23	23	23	23	23
Number of Full-Time Staff	766	766	766	766	766	766	766	766	766	766	766
Number of Vehicles	115	115	115	115	115	115	115	115	115	115	115
FIRE DEPARTMENT EXPENDITURES											
Capital Expenditures											
-Additional land, buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Replacement buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Operating and Maintenance Expenditures											
-Wages and benefits	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000
-Materials and services	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Fire Department Revenues											
-Installation inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Ongoing inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Average Operating Costs Per Capita	$80.68	$79.81	$78.94	$78.08	$77.23	$76.39	$75.56	$74.73	$73.92	$73.12	$72.32
Total Capital and Operating Costs	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000
Non-Sprinkler Less Sprinkler Total Costs	$1,380,000	$1,380,000	$4,838,000	$2,710,000	$3,010,000	$2,710,000	$6,168,000	$4,040,000	$4,340,000	$4,040,000	$7,498,000
OTHER MUNICIPAL COSTS/BENEFITS											
Municipal Capital Expenditures	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Municipal Revenues											
-Development charges and other developer contributions	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Water hook-up charges	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Building permit fees	$292,454	$295,671	$298,923	$302,212	$305,536	$308,897	$312,295	$315,730	$319,203	$322,714	$326,264
-Total change in revenues	$292,454	$295,671	$298,923	$302,212	$305,536	$308,897	$312,295	$315,730	$319,203	$322,714	$326,264
Municipal Operating and Maintenance Costs											
-Building inspections	$292,454	$295,671	$298,923	$302,212	$305,536	$308,897	$312,295	$315,730	$319,203	$322,714	$326,264
-Other costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Total	$292,454	$295,671	$298,923	$302,212	$305,536	$308,897	$312,295	$315,730	$319,203	$322,714	$326,264
Tax Revenues Related to Assessment of Sprinklers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Impact on Municipal Costs	($1,380,000)	($1,380,000)	($4,838,000)	($2,710,000)	($3,010,000)	($2,710,000)	($6,168,000)	($4,040,000)	($4,340,000)	($4,040,000)	($7,498,000)

Table A3 (*continued*)
Edmonton Cost-Benefit Analysis – Residential Fire Sprinklers

Edmonton Cost-Benefit Analysis Residential Fire Sprinklers	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
									Page six of nine		
Costs and Benefits for Other Parties											
LAND DEVELOPERS' COSTS/BENEFITS											
Direct Cost of Providing Services for Subdivisions	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Development Charges Paid to Municipality	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Profits Related to Higher Densities	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Developers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
HOME BUILDERS' COSTS/BENEFITS											
Sprinkler Installation Costs											
-Singles and semis	$7,457,579	$7,539,613	$7,622,548	$7,706,397	$7,791,167	$7,876,870	$7,963,515	$8,051,114	$8,139,676	$8,229,213	$8,319,734
-Townhouses	$745,758	$753,961	$762,255	$770,640	$779,117	$787,687	$796,352	$805,111	$813,968	$822,921	$831,973
-Apartments	$530,073	$535,904	$541,799	$547,759	$553,784	$559,876	$566,034	$572,261	$578,555	$584,920	$591,354
-Total	$8,733,410	$8,829,478	$8,926,602	$9,024,795	$9,124,067	$9,224,432	$9,325,901	$9,428,486	$9,532,199	$9,637,053	$9,743,061
Other Changes in Construction and On-Site Servicing Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Fees Related to Sprinkler Installation											
-Sprinkler inspection/building permit fees	$292,454	$295,671	$298,923	$302,212	$305,536	$308,897	$312,295	$315,730	$319,203	$322,714	$326,264
-Water hook-up fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Home Builders	$9,025,864	$9,125,149	$9,225,526	$9,327,006	$9,429,603	$9,533,329	$9,638,196	$9,744,216	$9,851,402	$9,959,768	$10,069,325
ONGOING COSTS/BENEFITS FOR RESIDENTS OF NEW HOMES											
Maintenance Costs	$471,166	$471,166	$471,166	$471,166	$471,166	$471,166	$495,270	$500,718	$506,226	$511,795	$988,591
Ongoing Sprinkler Inspection Costs	0	0	0	0	0	0	0	0	0	0	0
Insurance Premiums	($899,044)	($995,137)	($1,092,287)	($1,190,506)	($1,289,805)	($1,390,197)	($1,491,693)	($1,594,305)	($1,698,046)	($1,802,928)	($1,908,964)
Property Taxes Due to Increased Assessment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Residents	($427,878)	($523,971)	($621,121)	($719,340)	($818,639)	($919,031)	($996,422)	($1,093,587)	($1,191,820)	($1,291,133)	($920,373)

Table A3 (*continued*)
Edmonton Cost-Benefit Analysis – Residential Fire Sprinklers

Edmonton Cost-Benefit Analysis
Residential Fire Sprinklers

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
BACKGROUND DATA										
Population	774,865	783,388	792,005	800,717	809,525	818,430	827,433	836,535	845,737	855,040
Housing Units	303,165	306,500	309,871	313,280	316,726	320,210	323,732	327,293	330,893	334,533
New Housing Units	3,299	3,335	3,371	3,409	3,446	3,484	3,522	3,561	3,600	3,640
-Singles and semis	2,474	2,501	2,529	2,556	2,585	2,613	2,642	2,671	2,700	2,730
-Townhouses	412	417	421	426	431	435	440	445	450	455
-Apartments	412	417	421	426	431	435	440	445	450	455
NON-SPRINKLER SCENARIO										
FIRE DEPARTMENT STATISTICS										
Number of Stations	27	27	27	28	28	28	28	29	29	29
Number of Full-Time Staff	846	846	846	866	866	866	866	886	886	886
Number of Vehicles	123	123	123	125	125	125	125	127	127	127
FIRE DEPARTMENT EXPENDITURES										
Capital Expenditures										
-Additional land, buildings, vehicles and equipment	$0	$300,000	$0	$2,128,000	$0	$300,000	$0	$2,128,000	$0	$0
-Replacement buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Operating and Maintenance Expenditures										
-Wages and benefits	$60,680,000	$60,680,000	$60,680,000	$61,980,000	$61,980,000	$61,980,000	$61,980,000	$63,280,000	$63,280,000	$63,280,000
-Materials and services	$120,000	$120,000	$120,000	$150,000	$150,000	$150,000	$150,000	$180,000	$180,000	$180,000
Fire Department Revenues										
-Installation inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Ongoing inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Average Operating Costs Per Capita	$78.47	$77.61	$76.77	$77.59	$76.75	$75.91	$75.09	$75.86	$75.04	$74.22
Total Capital and Operating Costs	$60,800,000	$61,100,000	$60,800,000	$64,258,000	$62,130,000	$62,430,000	$62,130,000	$65,588,000	$63,460,000	$63,460,000

Table A3 (*continued*)
Edmonton Cost-Benefit Analysis – Residential Fire Sprinklers

Edmonton Cost-Benefit Analysis

Residential Fire Sprinklers

SPRINKLER SCENARIO	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
FIRE DEPARTMENT STATISTICS										
Number of Stations	23	23	23	23	23	23	23	23	23	23
Number of Full-Time Staff	766	766	766	766	766	766	766	766	766	766
Number of Vehicles	115	115	115	115	115	115	115	115	115	115
FIRE DEPARTMENT EXPENDITURES										
Capital Expenditures										
-Additional land, buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Replacement buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Operating and Maintenance Expenditures										
-Wages and benefits	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000
-Materials and services	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Fire Department Revenues										
-Installation inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Ongoing inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Average Operating Costs Per Capita	$71.54	$70.76	$69.99	$69.23	$68.47	$67.73	$66.99	$66.26	$65.54	$64.83
Total Capital and Operating Costs	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000	$55,430,000
Non-Sprinkler Less Sprinkler Total Costs	$5,370,000	$5,670,000	$5,370,000	$8,828,000	$6,700,000	$7,000,000	$6,700,000	$10,158,000	$8,030,000	$8,030,000
OTHER MUNICIPAL COSTS/BENEFITS										
Municipal Capital Expenditures	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Municipal Revenues										
-Development charges and other developer contributions	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Water hook-up charges	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Building permit fees	$329,853	$333,481	$337,150	$340,858	$344,608	$348,398	$352,231	$356,105	$360,023	$363,983
-Total change in revenues	$329,853	$333,481	$337,150	$340,858	$344,608	$348,398	$352,231	$356,105	$360,023	$363,983
Municipal Operating and Maintenance Costs										
-Building inspections	$329,853	$333,481	$337,150	$340,858	$344,608	$348,398	$352,231	$356,105	$360,023	$363,983
-Other costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Total	$329,853	$333,481	$337,150	$340,858	$344,608	$348,398	$352,231	$356,105	$360,023	$363,983
Tax Revenues Related to Assessment of Sprinklers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Impact on Municipal Costs	($5,370,000)	($5,670,000)	($5,370,000)	($8,828,000)	($6,700,000)	($7,000,000)	($6,700,000)	($10,158,000)	($8,030,000)	($8,030,000)

Table A3 (*continued*)
Edmonton Cost-Benefit Analysis – Residential Fire Sprinklers

Edmonton Cost-Benefit Analysis
Residential Fire Sprinklers

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Costs and Benefits for Other Parties										
LAND DEVELOPERS' COSTS/BENEFITS										
Direct Cost of Providing Services for Subdivisions	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Development Charges Paid to Municipality	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Profits Related to Higher Densities	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Developers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
HOME BUILDERS' COSTS/BENEFITS										
Sprinkler Installation Costs										
-Singles and semis	$8,411,251	$8,503,775	$8,597,316	$8,691,887	$8,787,498	$8,884,160	$8,981,886	$9,080,687	$9,180,574	$9,281,560
-Townhouses	$841,125	$850,377	$859,732	$869,189	$878,750	$888,416	$898,189	$908,069	$918,057	$928,156
-Apartments	$597,859	$604,435	$611,084	$617,806	$624,602	$631,472	$638,418	$645,441	$652,541	$659,719
-Total	$9,850,235	$9,958,587	$10,068,132	$10,178,881	$10,290,849	$10,404,048	$10,518,493	$10,634,196	$10,751,172	$10,869,435
Other Changes in Construction and On-Site Servicing Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Fees Related to Sprinkler Installation										
-Sprinkler inspection/building permit fees	$329,853	$333,481	$337,150	$340,858	$344,608	$348,398	$352,231	$356,105	$360,023	$363,983
-Water hook-up fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Home Builders	$10,180,088	$10,292,069	$10,405,281	$10,519,739	$10,635,457	$10,752,447	$10,870,724	$10,990,302	$11,111,195	$11,233,418
ONGOING COSTS/BENEFITS FOR RESIDENTS OF NEW HOMES										
Maintenance Costs	$994,282	$1,000,037	$1,005,854	$1,011,736	$1,017,682	$1,047,798	$1,059,324	$1,070,976	$1,082,757	$1,565,833
Ongoing Sprinkler Inspection Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Insurance Premiums	($2,016,166)	($2,124,547)	($2,234,121)	($2,344,900)	($2,456,898)	($2,570,127)	($2,684,602)	($2,800,336)	($2,917,344)	($3,035,638)
Property Taxes Due to Increased Assessment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Residents	($1,021,884)	($1,124,511)	($1,228,267)	($1,333,164)	($1,439,216)	($1,522,329)	($1,625,279)	($1,729,360)	($1,834,587)	($1,469,805)

District of Pitt Meadows, British Columbia

For Pitt Meadows, the base case has been established as the sprinklered scenario, as legislation is now in force that requires all new construction in the District to be sprinklered. The sprinklered scenario is based on the continuation of the existing mandatory sprinkler legislation and of fire protection for the entire District being provided by the existing volunteer firefighters and one paid fire chief.

The non-sprinklered scenario represents an analysis of the effect of changing the present policy to eliminate mandatory residential sprinkler requirements for new construction, and provide fire department resources in the form of a small new fire station to serve the northeast area, staffed by volunteers and led by one full-time firefighter (the volunteer scenario).

The inputs to the cost-benefit analysis for Pitt Meadows are based on the following assumptions.

- Population data for 1996 from the census, assumed four per cent annual increase over the planning horizon (Pitt Meadows Northeast Area Study, page 37).
- New residential development areas located in the northeast area of the District are within 13 km (8 miles) of the existing fire station.[14] Housing in this area is assumed to be eligible for "protected" rates from insurance companies.
- Housing units projection (1996 from census) was calculated from population projection assuming constant average household size.
- The housing mix is based on the mix proposed for the current urban area and the mix proposed for the northeast area.
- The vehicle count from the budget and the long-range capital plan (to the year 2034) were used.
- For the unsprinklered scenario, we have assumed a new station for the northeast area to be ready for 2001, with one full-time employee and two vehicles (a pumper and a van).
- The 1997 costs are based on the proposed budget.
- Expenses include contracting out of dispatch services at $15,000 plus $38.11 per call. We have assumed that the variable portion of this cost would increase proportionately with population increases.
- The land cost for the new station is assumed to be $300,000; construction costs at $525,000; vehicles at $300,000.
- The increase in costs related to the new station includes one full-time employee at $60,000 per year; telephone, costs for volunteers, fire hall expenses and vehicle expenses, $60,000; annual contribution to reserve for vehicle replacement, assumed to increase by $20,000 with two new vehicles for the new station.
- Development cost charges are not permitted to provide for fire protection capital costs.
- There are no inspection fees or costs for fire department for installation or periodic inspections of residential sprinklers.
- Building permits are based on a fixed fee, so no increase in building permit fees is assumed due to sprinklers.

Central station sprinkler water flow alarm monitoring is required by Pitt Meadows Sprinkler By-law No. 1585 for all sprinklered buildings including:[15]

- Buildings that are constructed in accord with Part 3 of the B.C. Building Code. This includes some smaller buildings that would not be required to have central station alarm monitoring under the 1995 National Building Code. For garden apartment developments, a single-stage fire alarm system is used, with each apartment's flow switch being a separate

zone. An annunciator panel is located at the driveway entrance from the street, which identifies the specific apartment unit in which the flow switch has activated. The fire alarm system is monitored by a ULC-listed central station service at an average cost of $25 per month which is distributed over the number of dwelling units in the development. There is no additional cost for the telephone line as the alarm signal is transmitted to the central station using the superintendent's personal telephone line and a line-capturing device. For a representative development of 65 dwelling units, the monthly monitoring cost works out to $0.40 per unit.

- Single family, semi-detached, row housing and small apartment buildings built under Part 9 of the B.C. Building Code that would not be required to have central station monitoring under the 1995 National Building Code. Under NFPA 13D and 13R, the standards for residential sprinkler system design, the sprinkler flow switch would be wired into an interior alarm device or the smoke alarms. Currently, the Pitt Meadows by-law central station monitoring requirement for these dwellings is not actively enforced. Many homeowners include the sprinkler flow switch as an additional zone in their monitored security system. The monthly monitoring cost for a residential security system would be an average of $25; however, there would be no incremental monitoring cost to add the sprinkler flow switch to an existing security system.

The ongoing monthly monitoring costs were calculated and included in the Pitt Meadows' model based on the following assumptions.[16]

- For townhouse and garden apartment developments, an estimate of $0.50 per unit per month was used. The monitoring fee of $6 per year was applied to all new townhouses and apartments in the Pitt Meadows model. The present value of ongoing monitoring for these units totalled $127,000 over the 30-year period.
- For single family and semi-detached units, a monitoring fee estimate of $25 per unit per month was used. This fee was applied to half of the new units as it was assumed that half of the units would already have a monitored security system and could add the sprinkler flow switch with no incremental monthly monitoring cost. The present value of ongoing monitoring costs for single and semi-detached units totalled $3.9 million over the 30-year period.

Alternative Composite Scenarios for Pitt Meadows

The northeast area to be developed is expected to be marketed to an affluent population, not expected to provide a suitable pool of potential volunteer firefighters (a white collar, bedroom community with little or no industry or shift work employment). The demographics of this area may make the establishment of an effective volunteer firefighter department to serve this area unviable.[17]

The continuation of all volunteer fire services is an issue of ongoing concern to rapidly growing municipalities such as Pitt Meadows. Uncertainty exists regarding volunteer availability given future demographics, the increasing importance of the emergency medical response role of the fire department and ratepayer service expectations. Therefore, alternative sprinkler and non-sprinkler scenarios were assessed to examine the impact of mandatory sprinklers in Pitt Meadows with a composite (volunteer and paid professional) firefighting force.

In the alternative scenarios, the continuation of the all volunteer firefighting force is considered impractical and a shift to a composite force takes place. In the composite non-sprinklered scenario, a new two-bay fire station equipped with a pumper and a van (for transportation) would still be required in 2001 to serve the northeast area (as in the volunteer non-sprinklered scenario). Under the composite scenarios, paid professional firefighters would replace volunteers over time beginning in 2001.[18]

Map A4
District of Pitt Meadows

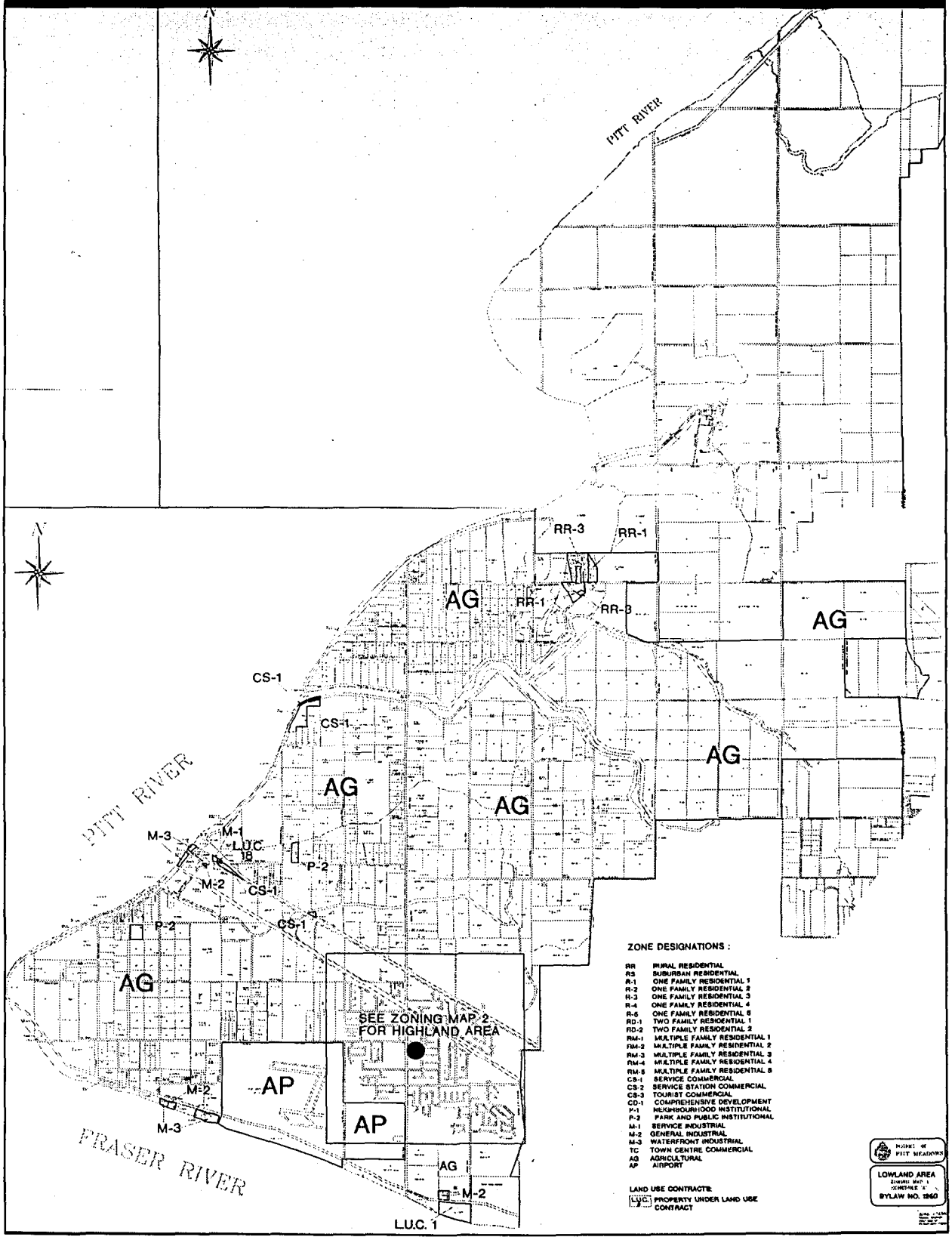

Table A4
District of Pitt Meadows Cost-Benefit Analysis – Residential Fire Sprinklers
Volunteer Scenario

Pitt Meadows Cost-Benefit Analysis
Residential Fire Sprinklers
Volunteer/With Monitoring Costs

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
INPUTS FOR COST-BENEFIT CALCULATIONS										
BACKGROUND DATA										
Population	13,436	13,973	14,532	15,114	15,718	16,347	17,001	17,681	18,388	19,124
Housing Units	4,733	4,922	5,119	5,324	5,537	5,758	5,989	6,228	6,477	6,737
New Housing Units		189	197	205	213	221	230	240	249	259
-Singles and semis	0	104	108	113	117	122	127	132	137	143
-Townhouses	0	66	69	72	75	78	81	84	87	91
-Apartments	0	19	20	20	21	22	23	24	25	26
NON-SPRINKLER SCENARIO										
FIRE DEPARTMENT STATISTICS										
Number of Stations	1	1	1	1	1	2	2	2	2	2
Number of Full-Time Staff (paid)	1	1	1	1	1	2	2	2	2	2
Number of Volunteers	20	20	20	20	20	40	40	40	40	40
Number of Vehicles	5	5	5	5	5	7	7	7	7	7
FIRE DEPARTMENT EXPENDITURES										
Capital Expenditures										
-Additional land, buildings, vehicles and equipment	$0	$0	$0	$0	$300,000	$825,000	$0	$0	$0	$0
-Replacement buildings, vehicles and equipment	$0	$60,000	$60,000	$60,000	$60,000	$60,000	$80,000	$80,000	$80,000	$80,000
Operating and Maintenance Expenditures										
-Wages and benefits		$87,413	$87,413	$87,413	$87,413	$147,413	$147,413	$147,413	$147,413	$147,413
-Materials and services		$153,002	$153,367	$153,748	$154,143	$253,541	$253,968	$254,413	$254,875	$255,356
Fire Department Revenues										
-Installation inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Ongoing inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Average Operating Costs Per Capita	$0	$21.50	$20.70	$19.93	$19.19	$28.20	$28.32	$27.25	$26.23	$25.24
Total Capital and Operating Costs	$0	$300,415	$300,780	$301,161	$601,556	$1,285,954	$481,381	$481,826	$482,288	$482,769

Table A4 (*Continued*)
District of Pitt Meadows Cost-Benefit Analysis – Residential Fire Sprinklers
Volunteer Scenario

Pitt Meadows Cost-Benefit Analysis
Residential Fire Sprinklers/Volunteer/Monitoring Costs

SPRINKLER SCENARIO	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
FIRE DEPARTMENT STATISTICS										
Number of Stations	1	1	1	1	1	1	1	1	1	1
Number of Full-Time Staff (paid)	1	1	1	1	1	1	1	1	1	1
Number of Volunteers	20	20	20	20	20	20	20	20	20	20
Number of Vehicles	5	5	5	5	5	5	5	5	5	5
FIRE DEPARTMENT EXPENDITURES										
Capital Expenditures										
-Additional land, buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Replacement buildings, vehicles and equipment		$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000
Operating and Maintenance Expenditures										
-Wages and benefits		$87,413	$87,413	$87,413	$87,413	$87,413	$87,413	$87,413	$87,413	$87,413
-Materials and services		$153,002	$153,367	$153,748	$154,143	$154,554	$154,981	$155,426	$155,889	$156,369
Fire Department Revenues										
-Installation inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Ongoing inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Average Operating Costs Per Capita	$0	$21.50	$20.70	$19.93	$19.19	$18.47	$17.79	$17.13	$16.49	$15.89
Total Capital and Operating Costs	$0	$300,415	$300,780	$301,161	$301,556	$301,967	$302,394	$302,839	$303,302	$303,782
Non-Sprinkler Less Sprinkler Total Costs	$0	$0	$0	$0	$300,000	$983,987	$178,987	$178,987	$178,987	$178,987
OTHER MUNICIPAL COSTS/BENEFITS										
Municipal Capital Expenditures	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Municipal Revenues										
-Development charges and other developer contributions	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Water hook-up charges	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Building permit fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Total change in revenues	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Municipal Operating and Maintenance Costs										
-Building inspections	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Other operating and maintenance costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Total	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Tax Revenues Related to Assessment of Sprinklers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Impact on Municipal Costs	$0	$0	$0	$0	($300,000)	($983,987)	($178,987)	($178,987)	($178,987)	($178,987)

Table A4 (*Continued*)
District of Pitt Meadows Cost-Benefit Analysis – Residential Fire Sprinklers
Volunteer Scenario

Pitt Meadows Cost-Benefit Analysis
Residential Fire Sprinklers/Volunteer/Monitoring Costs

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Costs and Benefits for Other Parties										
LAND DEVELOPERS' COSTS/BENEFITS										
Direct Cost of Providing Services for Subdivisions	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Development Cost Charges	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Profits Related to Higher Densities	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs (Savings) for Developers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
HOMEBUILDERS' COSTS/BENEFITS										
Sprinkler Installation Costs										
-Singles and semis	$0	$354,028	$368,190	$382,917	$398,234	$414,163	$430,730	$447,959	$465,877	$484,512
-Townhouses	$0	$135,174	$140,581	$146,205	$152,053	$158,135	$164,460	$171,039	$177,880	$184,996
-Apartments	$0	$27,451	$28,549	$29,691	$30,879	$32,114	$33,399	$34,735	$36,124	$37,569
-Total	$0	$516,654	$537,320	$558,813	$581,166	$604,412	$628,589	$653,732	$679,882	$707,077
Other Changes in Construction and On-Site Servicing Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Fees Related to Sprinkler Installation										
-Sprinkler inspection/building permit fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Water hook-up fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Homebuilders	$0	$516,654	$537,320	$558,813	$581,166	$604,412	$628,589	$653,732	$679,882	$707,077
ONGOING COSTS/BENEFITS FOR RESIDENTS OF NEW HOMES										
Maintenance Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Ongoing Sprinkler Inspection Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Insurance Premiums		($6,153)	($12,552)	($19,207)	($26,128)	($33,326)	($40,812)	($48,597)	($56,694)	($65,115)
Property Taxes Due to Increased Assessment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Monitoring Costs		$16,130	$32,905	$50,352	$68,496	$87,366	$106,990	$127,400	$148,626	$170,701
Sub-Total Net Costs for Residents	$0	($6,153)	($12,552)	($19,207)	($26,128)	($33,326)	($40,812)	($48,597)	($56,694)	($65,115)

npv of municipal savings	($2,762,164)
npv of developer savings	$0
npv of homebuilder costs	$11,719,655
npv of maintenance costs	$492,895
npv of insurance savings	($1,526,494)
npv of monitoring	$4,001,763

Table A4 (*Continued*)
District of Pitt Meadows Cost-Benefit Analysis – Residential Fire Sprinklers
Volunteer Scenario

Pitt Meadows Cost-Benefit Analysis
Volunteer

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
INPUTS FOR COST-BENEFIT CALCULATIONS											
BACKGROUND DATA											
Population	19,889	20,684	21,511	22,372	23,267	24,197	25,165	26,172	27,219	28,308	29,440
Housing Units	7,006	7,286	7,578	7,881	8,196	8,524	8,865	9,219	9,588	9,972	10,371
New Housing Units	269	280	291	303	315	328	341	355	369	384	399
-Singles and semis	148	154	160	167	173	180	188	195	203	211	219
-Townhouses	94	98	102	106	110	115	119	124	129	134	140
-Apartments	27	28	29	30	32	33	34	35	37	38	40
NON-SPRINKLER SCENARIO											
FIRE DEPARTMENT STATISTICS											
Number of Stations	2	2	2	2	2	2	2	2	2	2	2
Number of Full-Time Staff (paid)	2	2	2	2	2	2	2	2	2	2	2
Number of Volunteers	40	40	40	40	40	40	40	40	40	40	40
Number of Vehicles	7	7	7	7	7	7	7	7	7	7	7
FIRE DEPARTMENT EXPENDITURES											
Capital Expenditures											
-Additional land, buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Replacement buildings, vehicles and equipment	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000
Operating and Maintenance Expenditures											
-Wages and benefits	$147,413	$147,413	$147,413	$147,413	$147,413	$147,413	$147,413	$147,413	$147,413	$147,413	$147,413
-Materials and services	$255,856	$256,377	$256,918	$257,480	$258,065	$258,674	$259,307	$259,965	$260,649	$261,361	$262,102
Fire Department Revenues											
-Installation inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Ongoing inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Average Operating Costs Per Capita	$24.30	$23.39	$22.51	$21.67	$20.87	$20.09	$19.34	$18.62	$17.93	$17.27	$16.63
Total capital and operating costs	$483,269	$483,790	$484,331	$484,893	$485,478	$486,087	$486,720	$487,378	$488,062	$488,774	$489,515

Table A4 (*Continued*)
District of Pitt Meadows Cost-Benefit Analysis – Residential Fire Sprinklers
Volunteer Scenario

Pitt Meadows Cost-Benefit Analysis
Volunteer

SPRINKLER SCENARIO	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
FIRE DEPARTMENT STATISTICS											
Number of Stations	1	1	1	1	1	1	1	1	1	1	1
Number of Full-Time Staff (paid)	1	1	1	1	1	1	1	1	1	1	1
Number of Volunteers	20	20	20	20	20	20	20	20	20	20	20
Number of Vehicles	5	5	5	5	5	5	5	5	5	5	5
FIRE DEPARTMENT EXPENDITURES											
Capital Expenditures											
-Additional land, buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Replacement buildings, vehicles and equipment	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000
Operating and Maintenance Expenditures											
-Wages and benefits	$87,413	$87,413	$87,413	$87,413	$87,413	$87,413	$87,413	$87,413	$87,413	$87,413	$87,413
-Materials and services	$156,870	$157,390	$157,931	$158,493	$159,078	$159,687	$160,320	$160,978	$161,662	$162,374	$163,115
Fire Department Revenues											
-Installation inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Ongoing inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Average Operating Costs Per Capita	$15.30	$14.74	$14.19	$13.67	$13.17	$12.69	$12.23	$11.78	$11.36	$10.94	$10.55
Total Capital and Operating Costs	$304,283	$304,803	$305,344	$305,906	$306,491	$307,100	$307,733	$308,391	$309,075	$309,787	$310,528
Non-Sprinkler Less Sprinkler Total Costs	$178,987	$178,987	$178,987	$178,987	$178,987	$178,987	$178,987	$178,987	$178,987	$178,987	$178,987
OTHER MUNICIPAL COSTS/BENEFITS											
Municipal Capital Expenditures	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Municipal Revenues											
-Development charges and other developer contributions	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Water hook-up charges	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Building permit fees											
-Total change in revenues	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Municipal Operating and Maintenance Costs											
-Water supply and distribution	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Hydrants	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Total	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Tax Revenues Related to Assessment of Sprinklers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Impact on Municipal Costs	($178,987)	($178,987)	($178,987)	($178,987)	($178,987)	($178,987)	($178,987)	($178,987)	($178,987)	($178,987)	($178,987)

Table A4 (*Continued*)
District of Pitt Meadows Cost-Benefit Analysis – Residential Fire Sprinklers
Volunteer Scenario

Pitt Meadows Cost-Benefit Analysis — Page six of nine

Volunteer	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Costs and Benefits for Other Parties											
LAND DEVELOPERS' COSTS/BENEFITS											
Direct Cost of Providing Services for Subdivisions	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Development Cost Charges	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Profits Related to Higher Densities	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Developers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
HOME BUILDERS' COSTS/BENEFITS											
Sprinkler Installation Costs											
-Singles and semis	$503,893	$524,049	$545,010	$566,811	$589,483	$613,063	$637,585	$663,089	$689,612	$717,197	$745,884
-Townhouses	$192,395	$200,091	$208,095	$216,419	$225,075	$234,078	$243,442	$253,179	$263,306	$273,839	$284,792
-Apartments	$39,072	$40,635	$42,260	$43,951	$45,709	$47,537	$49,438	$51,416	$53,473	$55,611	$57,836
-Total	$735,360	$764,775	$795,366	$827,180	$860,267	$894,678	$930,465	$967,684	$1,006,391	$1,046,647	$1,088,513
Other Changes in Construction and Servicing Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Fees Related to Sprinkler Installation											
-Sprinkler inspection/building permit fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Water hook-up fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Homebuilders	$735,360	$764,775	$795,366	$827,180	$860,267	$894,678	$930,465	$967,684	$1,006,391	$1,046,647	$1,088,513
ONGOING COSTS/BENEFITS FOR RESIDENTS OF NEW HOMES											
Maintenance Costs	$35,441	$36,858	$38,333	$39,866	$41,461	$43,119	$44,844	$46,638	$48,503	$50,443	$86,538
Ongoing Sprinkler Inspection Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Insurance Premiums	($73,872)	($82,980)	($92,452)	($102,303)	($112,548)	($123,203)	($134,284)	($145,808)	($157,794)	($170,258)	($183,222)
Property Taxes Due to Increased Assessment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Monitoring Costs	$193,659	$217,536	$242,367	$268,192	$295,050	$322,982	$352,031	$382,242	$413,662	$446,339	$480,322
Sub-Total Net Costs for Residents	($38,432)	($46,122)	($54,120)	($62,437)	($71,088)	($80,084)	($89,440)	($99,171)	($109,291)	($119,815)	($96,683)

Table A4 (*Continued*)
District of Pitt Meadows Cost-Benefit Analysis – Residential Fire Sprinklers
Volunteer Scenario

Pitt Meadows Cost-Benefit Analysis
Volunteer

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
INPUTS FOR COST-BENEFIT CALCULATIONS										
BACKGROUND DATA										
Population	30,618	31,842	33,116	34,441	35,818	37,251	38,741	40,291	41,902	43,578
Housing Units	10,785	11,217	11,665	12,132	12,617	13,122	13,647	14,193	14,761	15,351
New Housing Units	415	431	449	467	485	505	525	546	568	590
-Singles and semis	228	237	247	257	267	278	289	300	312	325
-Townhouses	145	151	157	163	170	177	184	191	199	207
-Apartments	41	43	45	47	49	50	52	55	57	59
NON-SPRINKLER SCENARIO										
FIRE DEPARTMENT STATISTICS										
Number of Stations	2	2	2	2	2	2	2	2	2	2
Number of Full-Time Staff (paid)	2	2	2	2	2	2	2	2	2	2
Number of Volunteers	40	40	40	40	40	40	40	40	40	40
Number of Vehicles	7	7	7	7	7	7	7	7	7	7
FIRE DEPARTMENT EXPENDITURES										
Capital Expenditures										
-Additional land, buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Replacement buildings, vehicles and equipment	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000
Operating and Maintenance Expenditures										
-Wages and benefits	$147,413	$147,413	$147,413	$147,413	$147,413	$147,413	$147,413	$147,413	$147,413	$147,413
-Materials and services	$262,871	$263,672	$264,505	$265,371	$266,272	$267,209	$268,183	$269,196	$270,250	$271,346
Fire Department Revenues										
-Installation inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Ongoing inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Average Operating Costs Per Capita	$16.01	$15.42	$14.85	$14.31	$13.78	$13.28	$12.79	$12.33	$11.88	$11.45
Total Capital and Operating Costs	$490,284	$491,085	$491,918	$492,784	$493,685	$494,622	$495,596	$496,609	$497,663	$498,759

Table A4 (*Continued*)
District of Pitt Meadows Cost-Benefit Analysis – Residential Fire Sprinklers
Volunteer Scenario

Pitt Meadows Cost-Benefit Analysis
Volunteer

SPRINKLER SCENARIO	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
FIRE DEPARTMENT STATISTICS										
Number of Stations	1	1	1	1	1	1	1	1	1	1
Number of Full-Time Staff	1	1	1	1	1	1	1	1	1	1
Number of Volunteers	20	20	20	20	20	20	20	20	20	20
Number of Vehicles	5	5	5	5	5	5	5	5	5	5
FIRE DEPARTMENT EXPENDITURES										
Capital Expenditures										
-Additional land, buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Replacement buildings, vehicles and equipment	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000
Operating and Maintenance Expenditures										
-Wages and benefits	$87,413	$87,413	$87,413	$87,413	$87,413	$87,413	$87,413	$87,413	$87,413	$87,413
-Materials and services	$163,885	$164,685	$165,518	$166,384	$167,285	$168,222	$169,196	$170,209	$171,263	$172,359
Fire Department Revenues										
-Installation inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Ongoing inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Average Operating Costs Per Capita	$10.17	$9.80	$9.45	$9.11	$8.79	$8.47	$8.17	$7.88	$7.61	$7.34
Total Capital and Operating Costs	$311,298	$312,098	$312,931	$313,797	$314,698	$315,635	$316,609	$317,622	$318,676	$319,772
Non-Sprinkler Less Sprinkler Total Costs	$178,987	$178,987	$178,987	$178,987	$178,987	$178,987	$178,987	$178,987	$178,987	$178,987
OTHER MUNICIPAL COSTS/BENEFITS										
Municipal Capital Expenditures	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Municipal Revenues										
-Development charges and other developer contributions	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Water hook-up charges	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Building permit fees										
-Total change in revenues	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Municipal Operating and Maintenance Costs										
-Building inspections	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Other operating and maintenance costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Total	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Tax Revenues Related to Assessment of Sprinklers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Impact on Municipal Costs	($178,987)	($178,987)	($178,987)	($178,987)	($178,987)	($178,987)	($178,987)	($178,987)	($178,987)	($178,987)

Table A4 (*Continued*)
District of Pitt Meadows Cost-Benefit Analysis – Residential Fire Sprinklers
Volunteer Scenario

Pitt Meadows Cost-Benefit Analysis Volunteer	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
									Page nine of nine	
Costs and Benefits for Other Parties										
LAND DEVELOPERS' COSTS/BENEFITS										
Direct Cost of Providing Services for Subdivisions	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Development Cost Charges	$0	$0	$0	$0						
Profits Related to Higher Densities	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Developers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
HOMEBUILDERS' COSTS/BENEFITS										
Sprinkler Installation Costs										
-Singles and semis	$775,720	$806,749	$839,019	$872,579	$907,482	$943,782	$981,533	$1,020,794	$1,061,626	$1,104,091
-Townhouses	$296,184	$308,031	$320,353	$333,167	$346,493	$360,353	$374,767	$389,758	$405,348	$421,562
-Apartments	$60,149	$62,555	$65,058	$67,660	$70,366	$73,181	$76,108	$79,153	$82,319	$85,611
-Total	$1,132,053	$1,177,335	$1,224,429	$1,273,406	$1,324,342	$1,377,316	$1,432,408	$1,489,705	$1,549,293	$1,611,265
Other Changes in Construction and Servicing Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Fees Related to Sprinkler Installation										
-Sprinkler inspection/building permit fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Water hook-up fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Homebuilders	$1,132,053	$1,177,335	$1,224,429	$1,273,406	$1,324,342	$1,377,316	$1,432,408	$1,489,705	$1,549,293	$1,611,265
ONGOING COSTS/BENEFITS FOR RESIDENTS OF NEW HOMES										
Maintenance Costs	$90,000	$93,600	$97,344	$101,238	$105,287	$109,499	$113,879	$118,434	$123,171	$162,176
Ongoing Sprinkler Inspection Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Insurance Premiums	($196,703)	($210,724)	($225,306)	($240,471)	($256,243)	($272,646)	($289,704)	($307,446)	($325,896)	($345,085)
Property Taxes Due to Increased Assessment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Monitoring Costs	$515,665	$552,422	$590,649	$630,405	$671,751	$714,751	$759,471	$805,980	$854,350	$904,654
Sub-Total Net Costs for Residents	($106,703)	($117,124)	($127,962)	($139,234)	($150,956)	($163,147)	($175,826)	($189,012)	($202,725)	($182,909)

Table A4A
District of Pitt Meadows Cost-Benefit Analysis – Residential Fire Sprinklers
Composite Scenario

Pitt Meadows Cost-Benefit Analysis
Residential Fire Sprinklers
Composite Scenario
Monitoring Costs

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
INPUTS FOR COST-BENEFIT CALCULATIONS										
BACKGROUND DATA										
Population	13,436	13,973	14,532	15,114	15,718	16,347	17,001	17,681	18,388	19,124
Housing Units	4,733	4,922	5,119	5,324	5,537	5,758	5,989	6,228	6,477	6,737
New Housing Units		189	197	205	213	221	230	240	249	259
-Singles and semis	0	104	108	113	117	122	127	132	137	143
-Townhouses	0	66	69	72	75	78	81	84	87	91
-Apartments	0	19	20	20	21	22	23	24	25	26
NON-SPRINKLER SCENARIO										
FIRE DEPARTMENT STATISTICS										
Number of Stations	1	1	1	1	1	2	2	2	2	2
Number of Full-Time Staff	1	1	1	1	1	14	14	14	14	14
Number of Volunteers	20	20	20	20	20	28	28	28	28	28
Number of Vehicles	5	5	5	5	5	7	7	7	7	7
FIRE DEPARTMENT EXPENDITURES										
Capital Expenditures										
-Additional land, buildings, vehicles and equipment	$0	$0	$0	$0	$300,000	$825,000	$0	$0	$0	$0
-Replacement buildings, vehicles and equipment	$0	$60,000	$60,000	$60,000	$60,000	$60,000	$80,000	$80,000	$80,000	$80,000
Operating and Maintenance Expenditures										
-Wages and benefits		$87,413	$87,413	$87,413	$87,413	$1,148,413	$1,148,413	$1,148,413	$1,148,413	$1,148,413
-Materials and services		$153,002	$153,367	$153,748	$154,143	$203,681	$204,108	$204,553	$205,015	$205,496
Fire Department Revenues										
-Installation inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Ongoing inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Average Operating Costs Per Capita	$0.00	$21.50	$20.70	$19.93	$19.19	$86.38	$84.26	$81.05	$77.95	$74.98
Total Capital and Operating Costs	$0	$300,415	$300,780	$301,161	$601,556	$2,237,094	$1,432,521	$1,432,966	$1,433,428	$1,433,909

Table A4A (*Continued*)
District of Pitt Meadows Cost-Benefit Analysis – Residential Fire Sprinklers
Composite Scenario

Pitt Meadows Cost-Benefit Analysis
Composite Scenario

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
SPRINKLER SCENARIO										
FIRE DEPARTMENT STATISTICS										
Number of Stations	1	1	1	1	1	1	1	1	1	1
Number of Full-Time Staff	1	1	1	1	1	13	13	13	13	13
Number of Volunteers	20	20	20	20	20	8	8	8	8	8
Number of Vehicles	5	5	5	5	5	5	5	5	5	5
FIRE DEPARTMENT EXPENDITURES										
Capital Expenditures										
-Additional land, buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Replacement buildings, vehicles and equipment		$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000
Operating and Maintenance Expenditures										
-Wages and benefits		$87,413	$87,413	$87,413	$87,413	$1,076,913	$1,076,913	$1,076,913	$1,076,913	$1,076,913
-Materials and services		$153,002	$153,367	$153,748	$154,143	$154,554	$154,981	$155,426	$155,889	$156,369
Fire Department Revenues										
-Installation inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Ongoing inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Average Operating Costs Per Capita	$0	$21.50	$20.70	$19.93	$19.19	$79.00	$75.99	$73.09	$70.31	$67.63
Total Capital and Operating Costs	$0	$300,415	$300,780	$301,161	$301,556	$1,291,467	$1,291,894	$1,292,339	$1,292,802	$1,293,282
Non-Sprinkler Less Sprinkler Total Costs	$0	$0	$0	$0	$300,000	$945,627	$140,627	$140,627	$140,627	$140,627
OTHER MUNICIPAL COSTS/BENEFITS										
Municipal Capital Expenditures	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Municipal Revenues										
-Development charges and other developer contributions	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Water hook-up charges	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Building permit fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Total change in revenues	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Municipal Operating and Maintenance Costs										
-Building inspections	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Other operating and maintenance costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Total	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Tax Revenues Related to Assessment of Sprinklers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Impact on Municipal Costs	$0	$0	$0	$0	($300,000)	($945,627)	($140,627)	($140,627)	($140,627)	($140,627)

Table A4A (*Continued*)
District of Pitt Meadows Cost-Benefit Analysis – Residential Fire Sprinklers
Composite Scenario

Pitt Meadows Cost-Benefit Analysis Composite Scenario	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
									Page three of nine	
Costs and Benefits for Other Parties										
LAND DEVELOPERS' COSTS/BENEFITS										
Direct Cost of Providing Services for Subdivisions	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Development Cost Charges	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Profits Related to Higher Densities	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs (Savings) for Developers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
HOMEBUILDERS' COSTS/BENEFITS										
Sprinkler installation costs										
-Singles and semis	$0	$354,028	$368,190	$382,917	$398,234	$414,163	$430,730	$447,959	$465,877	$484,512
-Townhouses	$0	$135,174	$140,581	$146,205	$152,053	$158,135	$164,460	$171,039	$177,880	$184,996
-Apartments	$0	$27,451	$28,549	$29,691	$30,879	$32,114	$33,399	$34,735	$36,124	$37,569
-Total	$0	$516,654	$537,320	$558,813	$581,166	$604,412	$628,589	$653,732	$679,882	$707,077
Other Changes in Construction and On-Site Servicing Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Fees Related to Sprinkler Installation										
-Sprinkler inspection/building permit fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Water hook-up fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Homebuilders	$0	$516,654	$537,320	$558,813	$581,166	$604,412	$628,589	$653,732	$679,882	$707,077
ONGOING COSTS/BENEFITS FOR RESIDENTS OF NEW HOMES										
Maintenance Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Ongoing Sprinkler Inspection Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Insurance Premiums		($6,153)	($12,552)	($19,207)	($26,128)	($33,326)	($40,812)	($48,597)	($56,694)	($65,115)
Monitoring Costs	$0	$16,130	$32,905	$50,352	$68,496	$87,366	$106,990	$127,400	$148,626	$170,701
Property Taxes Due to Increased Assessment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Residents	$0	$9,977	$20,353	$31,145	$42,368	$54,040	$66,178	$78,803	$91,932	$105,586

npv of municipal savings	($5,117,330)
npv of developer savings	$0
npv of homebuilder costs	$11,719,655
npv of maintenance costs	$492,895
npv of insurance savings	($1,526,494)
npv of monitoring costs	$4,001,763

Table A4A (*Continued*)
District of Pitt Meadows Cost-Benefit Analysis – Residential Fire Sprinklers
Composite Scenario

Pitt Meadows Cost-Benefit Analysis
Composite Scenario

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
INPUTS FOR COST-BENEFIT CALCULATIONS											
BACKGROUND DATA											
Population	19,889	20,684	21,511	22,372	23,267	24,197	25,165	26,172	27,219	28,308	29,440
Housing Units	7,006	7,286	7,578	7,881	8,196	8,524	8,865	9,219	9,588	9,972	10,371
New Housing Units	269	280	291	303	315	328	341	355	369	384	399
-Singles and semis	148	154	160	167	173	180	188	195	203	211	219
-Townhouses	94	98	102	106	110	115	119	124	129	134	140
-Apartments	27	28	29	30	32	33	34	35	37	38	40
NON-SPRINKLER SCENARIO											
FIRE DEPARTMENT STATISTICS											
Number of Stations	2	2	2	2	2	2	2	2	2	2	2
Number of Full-Time Staff	14	14	14	14	14	22	22	22	22	22	22
Number of Volunteers	28	28	28	28	28	20	20	20	20	20	20
Number of Vehicles	7	7	7	7	7	7	7	7	7	7	7
FIRE DEPARTMENT EXPENDITURES											
Capital Expenditures											
-Additional land, buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Replacement buildings, vehicles and equipment	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000
Operating and Maintenance Expenditures											
-Wages and benefits	$1,148,413	$1,148,413	$1,148,413	$1,148,413	$1,148,413	$1,720,413	$1,720,413	$1,720,413	$1,720,413	$1,720,413	$1,720,413
-Materials and services	$205,996	$206,517	$207,058	$207,620	$208,205	$208,814	$209,447	$210,105	$210,789	$211,501	$212,242
Fire Department Revenues											
-Installation inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Ongoing inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Average Operating Costs Per Capita	$72.12	$69.37	$66.73	$64.19	$61.75	$83.03	$79.87	$76.82	$73.89	$71.07	$68.36
Total capital and operating costs	$1,434,409	$1,434,930	$1,435,471	$1,436,033	$1,436,618	$2,009,227	$2,009,860	$2,010,518	$2,011,202	$2,011,914	$2,012,655

Table A4A (*Continued*)
District of Pitt Meadows Cost-Benefit Analysis – Residential Fire Sprinklers
Composite Scenario

Pitt Meadows Cost-Benefit Analysis
Composite Scenario

SPRINKLER SCENARIO	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
FIRE DEPARTMENT STATISTICS											
Number of Stations	1	1	1	1	1	1	1	1	1	1	1
Number of Full-Time Staff	13	13	13	13	13	13	13	13	13	13	13
Number of Volunteers	8	8	8	8	8	8	8	8	8	8	8
Number of Vehicles	5	5	5	5	5	5	5	5	5	5	5
FIRE DEPARTMENT EXPENDITURES											
Capital Expenditures											
-Additional land, buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Replacement buildings, vehicles and equipment	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000
Operating and Maintenance Expenditures											
-Wages and benefits	$1,076,913	$1,076,913	$1,076,913	$1,076,913	$1,076,913	$1,076,913	$1,076,913	$1,076,913	$1,076,913	$1,076,913	$1,076,913
-Materials and services	$156,870	$157,390	$157,931	$158,493	$159,078	$159,687	$160,320	$160,978	$161,662	$162,374	$163,115
Fire Department Revenues											
-Installation inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Ongoing inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Average Operating Costs Per Capita	$65.05	$62.57	$60.19	$57.90	$55.70	$53.58	$51.55	$49.59	$47.71	$45.90	$44.16
Total Capital and Operating Costs	$1,293,783	$1,294,303	$1,294,844	$1,295,406	$1,295,991	$1,296,600	$1,297,233	$1,297,891	$1,298,575	$1,299,287	$1,300,028
Non-Sprinkler Less Sprinkler Total Costs	$140,627	$140,627	$140,627	$140,627	$140,627	$712,627	$712,627	$712,627	$712,627	$712,627	$712,627
OTHER MUNICIPAL COSTS-BENEFITS											
Municipal Capital Expenditures	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Municipal Revenues											
-Development charges and other developer contributions	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Water hook-up charges	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Building permit fees											
-Total change in revenues	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Municipal Operating and Maintenance Costs											
-Building inspections	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Other operating and maintenance costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Total	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Tax Revenues Related to Assessment of Sprinklers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Impact on Municipal Costs	($140,627)	($140,627)	($140,627)	($140,627)	($140,627)	($712,627)	($712,627)	($712,627)	($712,627)	($712,627)	($712,627)

Table A4A (*Continued*)
District of Pitt Meadows Cost-Benefit Analysis – Residential Fire Sprinklers
Composite Scenario

Pitt Meadows Cost-Benefit Analysis Composite Scenario	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
									Page six of nine		
Costs and Benefits for Other Parties											
LAND DEVELOPERS' COSTS/BENEFITS											
Direct Cost of Providing Services for Subdivisions	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Development Cost Charges	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Profits Related to Higher Densities	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Developers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
HOME BUILDERS' COSTS/BENEFITS											
Sprinkler installation costs											
-Singles and semis	$503,893	$524,049	$545,010	$566,811	$589,483	$613,063	$637,585	$663,089	$689,612	$717,197	$745,884
-Townhouses	$192,395	$200,091	$208,095	$216,419	$225,075	$234,078	$243,442	$253,179	$263,306	$273,839	$284,792
-Apartments	$39,072	$40,635	$42,260	$43,951	$45,709	$47,537	$49,438	$51,416	$53,473	$55,611	$57,836
-Total	$735,360	$764,775	$795,366	$827,180	$860,267	$894,678	$930,465	$967,684	$1,006,391	$1,046,647	$1,088,513
Other Changes in Construction and On-Site Servicing Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Fees Related to Sprinkler Installation											
-Sprinkler inspection/building permit fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Water hook-up fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Home Builders	$735,360	$764,775	$795,366	$827,180	$860,267	$894,678	$930,465	$967,684	$1,006,391	$1,046,647	$1,088,513
ONGOING COSTS/BENEFITS FOR RESIDENTS OF NEW HOMES											
Maintenance Costs	$35,441	$36,858	$38,333	$39,866	$41,461	$43,119	$44,844	$46,638	$48,503	$50,443	$86,538
Ongoing Sprinkler Inspection Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Insurance Premiums	($73,872)	($82,980)	($92,452)	($102,303)	($112,548)	($123,203)	($134,284)	($145,808)	($157,794)	($170,258)	($183,222)
Monitoring Costs	$193,659	$217,536	$242,367	$268,192	$295,050	$322,982	$352,031	$382,242	$413,662	$446,339	$480,322
Property Taxes Due to Increased Assessment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Residents	$155,228	$171,414	$188,248	$205,755	$223,962	$242,898	$262,591	$283,072	$304,372	$326,524	$383,639

Table A4A (*Continued*)
District of Pitt Meadows Cost-Benefit Analysis – Residential Fire Sprinklers
Composite Scenario

Pitt Meadows Cost-Benefit Analysis
Composite Scenario

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
INPUTS FOR COST-BENEFIT CALCULATIONS										
BACKGROUND DATA										
Population	30,618	31,842	33,116	34,441	35,818	37,251	38,741	40,291	41,902	43,578
Housing Units	10,785	11,217	11,665	12,132	12,617	13,122	13,647	14,193	14,761	15,351
New Housing Units	415	431	449	467	485	505	525	546	568	590
-Singles and semis	228	237	247	257	267	278	289	300	312	325
-Townhouses	145	151	157	163	170	177	184	191	199	207
-Apartments	41	43	45	47	49	50	52	55	57	59
NON-SPRINKLER SCENARIO										
FIRE DEPARTMENT STATISTICS										
Number of Stations	2	2	2	2	2	2	2	2	2	2
Number of Full-Time Staff (paid)	22	22	22	22	22	22	22	22	22	22
Number of Volunteers	20	20	20	20	20	20	20	20	20	20
Number of Vehicles	7	7	7	7	7	7	7	7	7	7
FIRE DEPARTMENT EXPENDITURES										
Capital Expenditures										
-Additional land, buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Replacement buildings, vehicles and equipment	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000
Operating and Maintenance Expenditures										
-Wages and benefits	$1,720,413	$1,720,413	$1,720,413	$1,720,413	$1,720,413	$1,720,413	$1,720,413	$1,720,413	$1,720,413	$1,720,413
-Materials and services	$213,011	$213,812	$214,645	$215,511	$216,412	$217,349	$218,323	$219,336	$220,390	$221,486
Fire Department Revenues										
-Installation inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Ongoing inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Average Operating Costs Per Capita	$65.76	$63.26	$60.85	$58.53	$56.31	$54.17	$52.11	$50.13	$48.23	$46.40
Total Capital and Operating Costs	$2,013,424	$2,014,225	$2,015,058	$2,015,924	$2,016,825	$2,017,762	$2,018,736	$2,019,749	$2,020,803	$2,021,899

Table A4A (*Continued*)
District of Pitt Meadows Cost-Benefit Analysis – Residential Fire Sprinklers
Composite Scenario

Pitt Meadows Cost-Benefit Analysis
Composite Scenario

SPRINKLER SCENARIO	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
FIRE DEPARTMENT STATISTICS										
Number of Stations	1	1	1	1	1	1	1	1	1	1
Number of Full-Time Staff	13	13	13	13	13	13	13	13	13	13
Number of Volunteers	8	8	8	8	8	8	8	8	8	8
Number of Vehicles	5	5	5	5	5	5	5	5	5	5
FIRE DEPARTMENT EXPENDITURES										
Capital Expenditures										
-Additional land, buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Replacement buildings, vehicles and equipment	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000
Operating and Maintenance Expenditures										
-Wages and benefits	$1,076,913	$1,076,913	$1,076,913	$1,076,913	$1,076,913	$1,076,913	$1,076,913	$1,076,913	$1,076,913	$1,076,913
-Materials and services	$163,885	$164,685	$165,518	$166,384	$167,285	$168,222	$169,196	$170,209	$171,263	$172,359
Fire Department Revenues										
-Installation inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Ongoing inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Average Operating Costs Per Capita	$42.49	$40.88	$39.33	$37.84	$36.41	$35.04	$33.71	$32.44	$31.22	$30.04
Total Capital and Operating Costs	$1,300,798	$1,301,598	$1,302,431	$1,303,297	$1,304,198	$1,305,135	$1,306,109	$1,307,122	$1,308,176	$1,309,272
Non-Sprinkler Less Sprinkler Total Costs	$712,627	$712,627	$712,627	$712,627	$712,627	$712,627	$712,627	$712,627	$712,627	$712,627
OTHER MUNICIPAL COSTS/BENEFITS										
Municipal Capital Expenditures	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Municipal Revenues										
-Development charges and other developer contributions	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Water hook-up charges	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Building permit fees										
-Total change in revenues	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Municipal Operating and Maintenance Costs										
-Building inspections	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Other operating and maintenance costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Total	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Tax Revenues Related to Assessment of Sprinklers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Impact on Municipal Costs	($712,627)	($712,627)	($712,627)	($712,627)	($712,627)	($712,627)	($712,627)	($712,627)	($712,627)	($712,627)

Table A4A (*Continued*)
District of Pitt Meadows Cost-Benefit Analysis – Residential Fire Sprinklers
Composite Scenario

Pitt Meadows Cost-Benefit Analysis Composite Scenario	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
									Page nine of nine	
Costs and Benefits for Other Parties										
LAND DEVELOPERS' COSTS/BENEFITS										
Direct Cost of Providing Services for Subdivisions	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Development Cost Charges	$0	$0	$0	$0						
Profits Related to Higher Densities	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs (Savings) for Developers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
HOME BUILDERS' COSTS/BENEFITS										
Sprinkler installation costs										
-Singles and semis	$775,720	$806,749	$839,019	$872,579	$907,482	$943,782	$981,533	$1,020,794	$1,061,626	$1,104,091
-Townhouses	$296,184	$308,031	$320,353	$333,167	$346,493	$360,353	$374,767	$389,758	$405,348	$421,562
-Apartments	$60,149	$62,555	$65,058	$67,660	$70,366	$73,181	$76,108	$79,153	$82,319	$85,611
-Total	$1,132,053	$1,177,335	$1,224,429	$1,273,406	$1,324,342	$1,377,316	$1,432,408	$1,489,705	$1,549,293	$1,611,265
Other Changes in Construction and On-Site Servicing Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Fees Related to Sprinkler Installation										
-Sprinkler inspection/building permit fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Water hook-up fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Home Builders	$1,132,053	$1,177,335	$1,224,429	$1,273,406	$1,324,342	$1,377,316	$1,432,408	$1,489,705	$1,549,293	$1,611,265
ONGOING COSTS/BENEFITS FOR RESIDENTS OF NEW HOMES										
Maintenance Costs	$90,000	$93,600	$97,344	$101,238	$105,287	$109,499	$113,879	$118,434	$123,171	$162,176
Ongoing Sprinkler Inspection Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Insurance Premiums	($196,703)	($210,724)	($225,306)	($240,471)	($256,243)	($272,646)	($289,704)	($307,446)	($325,896)	($345,085)
Monitoring Costs	$515,665	$552,422	$590,649	$630,405	$671,751	$714,751	$759,471	$805,980	$854,350	$904,654
Property Taxes Due to Increased Assessment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Residents	$408,962	$435,298	$462,687	$491,171	$520,795	$551,604	$583,646	$616,969	$651,625	$721,744

Gatineau, Quebec

The inputs to the cost-benefit analysis for Gatineau are based on the following assumptions.

- The 1996 population and number of housing units are taken from the census.
- Seven hundred new units per year are asssumed (based on the high end of the 650 to 700 units per year provided).
- Population is calculated from the number of housing units assuming constant average household size.
- Seventy per cent of housing units are assumed to be single-family or semi-detached units aimed at second-time buyers.
- Capital costs for replacement of vehicles, etc., are based on the 1997 debt charges (excluding charges associated with building new stations).
- Wages and other expenses are taken from the 1997 budget original. The budgets for controle par le service d'incendie, entretien des casernes and d'entretien de la flotte des incendies have been added together.
- One new fire station is assumed to be required without mandatory sprinklers – to be open for the year 2003.
- Twelve additional employees are assumed to staff the new fire station at $60,000 each.
- Annual capital replacement is assumed to increase proportionately with the increase in the number of vehicles.
- Other expenses are assumed to increase by 25 per cent due to the new fire station.
- There are no development charges for financing of the new fire station, no increase in building permit fees related to sprinklers; also assume no inspection on installation of sprinklers (so no municipal costs or revenues for these items).

Map A5
Gatineau, Quebec

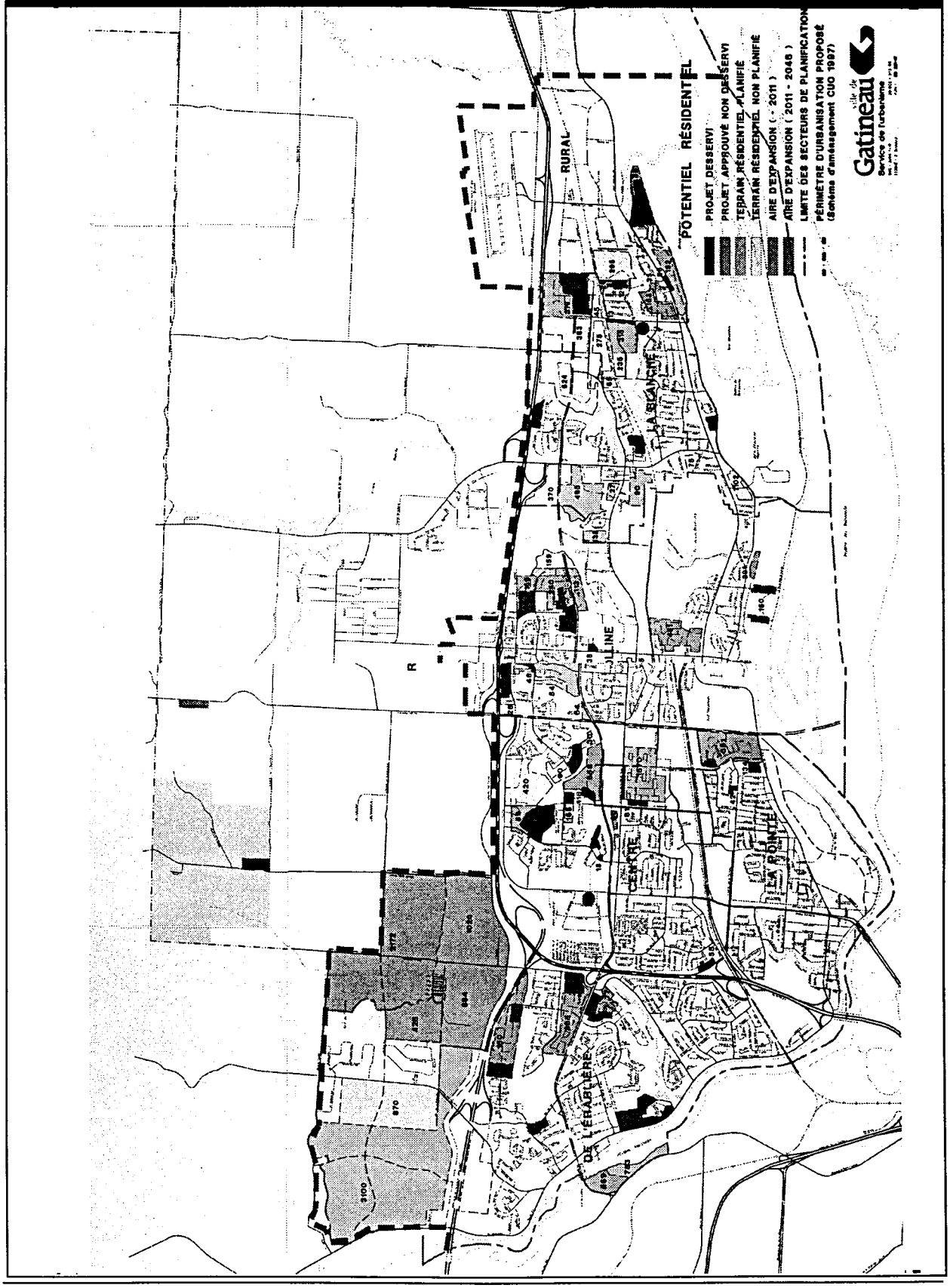

Table A5
Gatineau Cost-Benefit Analysis – Residential Fire Sprinklers

Gatineau Cost-Benefit Analysis
Residential Fire Sprinklers

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
INPUTS FOR COST-BENEFIT CALCULATIONS										
BACKGROUND DATA										
Population	100,702	101,638	103,428	105,355	107,283	109,210	111,137	113,065	114,992	116,919
Housing Units	36,574	36,914	37,564	38,264	38,964	39,664	40,364	41,064	41,764	42,464
New Housing Units	340	650	700	700	700	700	700	700	700	700
-Singles and semis	238	455	490	490	490	490	490	490	490	490
-Townhouses	34	65	70	70	70	70	70	70	70	70
-Apartments	68	130	140	140	140	140	140	140	140	140
NON-SPRINKLER SCENARIO										
FIRE DEPARTMENT STATISTICS										
Number of Stations	3	3	3	3	3	3	3	4	4	4
Number of Full-Time Staff	65	65	65	65	65	65	65	77	77	77
Number of Vehicles	18	18	18	18	18	18	18	21	21	21
FIRE DEPARTMENT EXPENDITURES										
Capital Expenditures										
-Additional land, buildings, vehicles and equipment	$0	$0	$401,000	$0	$0	$0	$852,000	$284,000	$0	$0
-Replacement buildings, vehicles and equipment		$197,963	$197,963	$197,963	$197,963	$197,963	$197,963	$230,957	$230,957	$230,957
Operating and Maintenance Expenditures										
-Wages and benefits		$4,635,235	$4,635,235	$4,635,235	$4,635,235	$4,635,235	$4,635,235	$5,355,235	$5,355,235	$5,355,235
-Materials and services		$318,602	$318,602	$318,602	$318,602	$318,602	$318,602	$398,253	$398,253	$398,253
Fire Department Fees										
-Installation inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Ongoing inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Average Operating Costs Per Capita	$0	$50.69	$49.81	$48.90	$48.02	$47.17	$46.36	$52.93	$52.04	$51.18
Total Capital and Operating Costs	$0	$5,151,800	$5,552,800	$5,151,800	$5,151,800	$5,151,800	$6,003,800	$6,268,444	$5,984,444	$5,984,444

Table A5 (*Continued*)
Gatineau Cost-Benefit Analysis – Residential Fire Sprinklers

Gatineau Cost-Benefit Analysis
Residential Fire Sprinklers

SPRINKLER SCENARIO	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
FIRE DEPARTMENT STATISTICS										
Number of Stations	3	3	3	3	3	3	3	3	3	3
Number of Full-Time Staff	65	65	65	65	65	65	65	65	65	65
Number of Vehicles	18	18	18	18	18	18	18	18	18	18
FIRE DEPARTMENT EXPENDITURES										
Capital Expenditures										
-Additional land, buildings, vehicles and equipment		$0	$0	$0	$0	$0	$0	$0	$0	$0
-Replacement buildings, vehicles and equipment		$197,963	$197,963	$197,963	$197,963	$197,963	$197,963	$197,963	$197,963	$197,963
Operating and Maintenance Expenditures										
-Wages and benefits		$4,635,235	$4,635,235	$4,635,235	$4,635,235	$4,635,235	$4,635,235	$4,635,235	$4,635,235	$4,635,235
-Materials and services		$318,602	$318,602	$318,602	$318,602	$318,602	$318,602	$318,602	$318,602	$318,602
Fire Department Revenues										
-Installation inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Ongoing inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Average Operating Costs Per Capita	$0	$50.69	$49.81	$48.90	$48.02	$47.17	$46.36	$45.57	$44.80	$44.06
Total Capital and Operating Costs	$0	$5,151,800	$5,151,800	$5,151,800	$5,151,800	$5,151,800	$5,151,800	$5,151,800	$5,151,800	$5,151,800
Non-Sprinkler Less Sprinkler Total Costs	$0	$0	$401,000	$0	$0	$0	$852,000	$1,116,644	$832,644	$832,644
OTHER MUNICIPAL COSTS/BENEFITS										
Municipal Capital Expenditures	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Municipal Revenues										
-Development charges and other developer contributions	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Water hook-up charges	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Building permit fees										
-Total change in revenues	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Municipal Operating and Maintenance Costs										
-Building inspections	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Other operating and maintenance costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Tax Revenues Related to Assessment of Sprinklers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Impact on Municipal Costs	$0	$0	($401,000)	$0	$0	$0	($852,000)	($1,116,644)	($832,644)	($832,644)

Table A5 (*Continued*)
Gatineau Cost-Benefit Analysis – Residential Fire Sprinklers

Gatineau Cost-Benefit Analysis — Page three of nine

Residential Fire Sprinklers	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Costs and Benefits for Other Parties										
LAND DEVELOPERS' COSTS/BENEFITS										
Direct Cost of Providing Services for Subdivisions	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Development Charges Paid to Municipality	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Profits Related to Higher Densities	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Developers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
HOMEBUILDERS' COSTS/BENEFITS										
Sprinkler installation costs										
-Singles and semis	$809,200	$1,547,000	$1,666,000	$1,666,000	$1,666,000	$1,666,000	$1,666,000	$1,666,000	$1,666,000	$1,666,000
-Townhouses	$69,360	$132,600	$142,800	$142,800	$142,800	$142,800	$142,800	$142,800	$142,800	$142,800
-Apartments	$98,600	$188,500	$203,000	$203,000	$203,000	$203,000	$203,000	$203,000	$203,000	$203,000
-Total	$977,160	$1,868,100	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800
Other Changes in Construction and On-Site Servicing Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Fees Related to Sprinkler Installation										
-Sprinkler inspection/building permit fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Water hook-up fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Homebuilders	$977,160	$1,868,100	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800
ONGOING COSTS/BENEFITS FOR RESIDENTS OF NEW HOMES										
Maintenance Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$54,400
Ongoing Sprinkler Inspection Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Insurance Premiums		($11,050)	($32,175)	($54,925)	($77,675)	($100,425)	($123,175)	($145,925)	($168,675)	($191,425)
Property Taxes Due to Increased Assessment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Residents	$0	($11,050)	($32,175)	($54,925)	($77,675)	($100,425)	($123,175)	($145,925)	($168,675)	($137,025)

Net Present Value of Costs (Savings)

npv of municipal savings	($8,892,648)
npv of developer savings	$0
npv of homebuilder costs	$29,246,975
npv of maintenance costs	$1,223,293
npv of insurance savings	($3,750,912)

Table A5 (*Continued*)
Gatineau Cost-Benefit Analysis – Residential Fire Sprinklers

Gatineau Cost-Benefit Analysis
Residential Fire Sprinklers

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
INPUTS FOR COST-BENEFIT CALCULATIONS											
BACKGROUND DATA											
Population	118,847	120,774	122,701	124,629	126,556	128,484	130,411	132,338	134,266	136,193	138,120
Housing Units	43,164	43,864	44,564	45,264	45,964	46,664	47,364	48,064	48,764	49,464	50,164
New Housing Units	700	700	700	700	700	700	700	700	700	700	700
-Singles and semis	490	490	490	490	490	490	490	490	490	490	490
-Townhouses	70	70	70	70	70	70	70	70	70	70	70
-Apartments	140	140	140	140	140	140	140	140	140	140	140
NON-SPRINKLER SCENARIO											
FIRE DEPARTMENT STATISTICS											
Number of Stations	4	4	4	4	4	4	4	4	4	4	4
Number of Full-Time Staff	77	77	77	77	77	77	77	77	77	77	77
Number of Vehicles	21	21	21	21	21	21	21	21	21	21	21
FIRE DEPARTMENT EXPENDITURES											
Capital Expenditures											
-Additional land, buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Replacement buildings, vehicles and equipment	$230,957	$230,957	$230,957	$230,957	$230,957	$230,957	$230,957	$230,957	$230,957	$230,957	$230,957
Operating and Maintenance Expenditures											
-Wages and benefits	$5,355,235	$5,355,235	$5,355,235	$5,355,235	$5,355,235	$5,355,235	$5,355,235	$5,355,235	$5,355,235	$5,355,235	$5,355,235
-Materials and services	$398,253	$398,253	$398,253	$398,253	$398,253	$398,253	$398,253	$398,253	$398,253	$398,253	$398,253
Fire Department Fees											
-Installation inspection fees	0	0	0	0	0	0	0	0	0	0	0
-Ongoing inspection fees	0	0	0	0	0	0	0	0	0	0	0
Average Operating Costs Per Capita	$50.35	$49.55	$48.77	$48.02	$47.29	$46.58	$45.89	$45.22	$44.57	$43.94	$43.33
Total Capital and Operating Costs	$5,984,444	$5,984,444	$5,984,444	$5,984,444	$5,984,444	$5,984,444	$5,984,444	$5,984,444	$5,984,444	$5,984,444	$5,984,444

Table A5 (*Continued*)
Gatineau Cost-Benefit Analysis – Residential Fire Sprinklers

Gatineau Cost-Benefit Analysis
Residential Fire Sprinklers

SPRINKLER SCENARIO	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
FIRE DEPARTMENT STATISTICS											
Number of Stations	3	3	3	3	3	3	3	3	3	3	3
Number of Full-Time Staff	65	65	65	65	65	65	65	65	65	65	65
Number of Vehicles	18	18	18	18	18	18	18	18	18	18	18
FIRE DEPARTMENT EXPENDITURES											
Capital Expenditures											
-Additional land, buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Replacement buildings, vehicles and equipment	$197,963	$197,963	$197,963	$197,963	$197,963	$197,963	$197,963	$197,963	$197,963	$197,963	$197,963
Operating and Maintenance Expenditures											
-Wages and benefits	$4,635,235	$4,635,235	$4,635,235	$4,635,235	$4,635,235	$4,635,235	$4,635,235	$4,635,235	$4,635,235	$4,635,235	$4,635,235
-Materials and services	$318,602	$318,602	$318,602	$318,602	$318,602	$318,602	$318,602	$318,602	$318,602	$318,602	$318,602
Fire Department Revenues											
-Installation inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Ongoing inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Average Operating Costs Per Capita	$43.35	$42.66	$41.99	$41.34	$40.71	$40.10	$39.50	$38.93	$38.37	$37.83	$37.30
Total Capital and Operating Costs	$5,151,800	$5,151,800	$5,151,800	$5,151,800	$5,151,800	$5,151,800	$5,151,800	$5,151,800	$5,151,800	$5,151,800	$5,151,800
Non-Sprinkler Less Sprinkler Total Costs	$832,644	$832,644	$832,644	$832,644	$832,644	$832,644	$832,644	$832,644	$832,644	$832,644	$832,644
OTHER MUNICIPAL COSTS/BENEFITS											
Municipal Capital Expenditures	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Municipal Revenues											
-Development charges and other developer contributions	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Water hook-up charges	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Building permit fees											
-Total change in revenues	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Municipal Operating and Maintenance Costs											
-Building inspections	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Other operating and maintenance costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Tax Revenues Related to Assessment of Sprinklers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Impact on Municipal Costs	($832,644)	($832,644)	($832,644)	($832,644)	($832,644)	($832,644)	($832,644)	($832,644)	($832,644)	($832,644)	($832,644)

Table A5 (*Continued*)
Gatineau Cost-Benefit Analysis – Residential Fire Sprinklers

Gatineau Cost-Benefit Analysis
Residential Fire Sprinklers

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
INPUTS FOR COST-BENEFIT CALCULATIONS										
BACKGROUND DATA										
Population	140,048	141,975	143,902	145,830	147,757	149,685	151,612	153,539	155,467	157,394
Housing Units	50,864	51,564	52,264	52,964	53,664	54,364	55,064	55,764	56,464	57,164
New Housing Units	700	700	700	700	700	700	700	700	700	700
-Singles and semis	490	490	490	490	490	490	490	490	490	490
-Townhouses	70	70	70	70	70	70	70	70	70	70
-Apartments	140	140	140	140	140	140	140	140	140	140
NON-SPRINKLER SCENARIO										
FIRE DEPARTMENT STATISTICS										
Number of Stations	4	4	4	4	4	4	4	4	4	4
Number of Full-Time Staff	77	77	77	77	77	77	77	77	77	77
Number of Vehicles	21	21	21	21	21	21	21	21	21	21
FIRE DEPARTMENT EXPENDITURES										
Capital Expenditures										
-Additional land, buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Replacement buildings, vehicles and equipment	$230,957	$230,957	$230,957	$230,957	$230,957	$230,957	$230,957	$230,957	$230,957	$230,957
Operating and Maintenance Expenditures										
-Wages and benefits	$5,355,235	$5,355,235	$5,355,235	$5,355,235	$5,355,235	$5,355,235	$5,355,235	$5,355,235	$5,355,235	$5,355,235
-Materials and services	$398,253	$398,253	$398,253	$398,253	$398,253	$398,253	$398,253	$398,253	$398,253	$398,253
Fire Department Fees										
-Installation inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Ongoing inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Average Operating Costs Per Capita	$42.73	$42.15	$41.59	$41.04	$40.50	$39.98	$39.47	$38.98	$38.49	$38.02
Total capital and operating costs	$5,984,444	$5,984,444	$5,984,444	$5,984,444	$5,984,444	$5,984,444	$5,984,444	$5,984,444	$5,984,444	$5,984,444

Table A5 (*Continued*)
Gatineau Cost-Benefit Analysis – Residential Fire Sprinklers

Gatineau Cost-Benefit Analysis Residential Fire Sprinklers	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
									Page six of nine		
Costs and Benefits for Other Parties											
LAND DEVELOPERS' COSTS/BENEFITS											
Direct Cost of Providing Services for Subdivisions	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Development Charges Paid to Municipality	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Profits Related to Higher Densities	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Developers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
HOME BUILDERS' COSTS/BENEFITS											
Sprinkler installation costs											
-Singles and semis	$1,666,000	$1,666,000	$1,666,000	$1,666,000	$1,666,000	$1,666,000	$1,666,000	$1,666,000	$1,666,000	$1,666,000	$1,666,000
-Townhouses	$142,800	$142,800	$142,800	$142,800	$142,800	$142,800	$142,800	$142,800	$142,800	$142,800	$142,800
-Apartments	$203,000	$203,000	$203,000	$203,000	$203,000	$203,000	$203,000	$203,000	$203,000	$203,000	$203,000
-Total	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800
Other Changes in Construction and On-Site Servicing Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Fees Related to Sprinkler Installation											
-Sprinkler inspection/building permit fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Water hook-up fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Homebuilders	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800
ONGOING COSTS/BENEFITS FOR RESIDENTS OF NEW HOMES											
Maintenance Costs	$104,000	$112,000	$112,000	$112,000	$112,000	$112,000	$112,000	$112,000	$112,000	$166,400	$216,000
Ongoing Sprinkler Inspection Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Insurance Premiums	($214,175)	($236,925)	($259,675)	($282,425)	($305,175)	($327,925)	($350,675)	($373,425)	($396,175)	($418,925)	($441,675)
Property Taxes Due to Increased Assessment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Residents	($110,175)	($124,925)	($147,675)	($170,425)	($193,175)	($215,925)	($238,675)	($261,425)	($284,175)	($252,525)	($225,675)

Table A5 (*Continued*)
Gatineau Cost-Benefit Analysis – Residential Fire Sprinklers

Gatineau Cost-Benefit Analysis
Residential Fire Sprinklers

SPRINKLER SCENARIO	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
FIRE DEPARTMENT STATISTICS										
Number of Stations	3	3	3	3	3	3	3	3	3	3
Number of Full-Time Staff	65	65	65	65	65	65	65	65	65	65
Number of Vehicles	18	18	18	18	18	18	18	18	18	18
FIRE DEPARTMENT EXPENDITURES										
Capital Expenditures										
-Additional land, buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Replacement buildings, vehicles and equipment	$197,963	$197,963	$197,963	$197,963	$197,963	$197,963	$197,963	$197,963	$197,963	$197,963
Operating and Maintenance Expenditures										
-Wages and benefits	$4,635,235	$4,635,235	$4,635,235	$4,635,235	$4,635,235	$4,635,235	$4,635,235	$4,635,235	$4,635,235	$4,635,235
-Materials and services	$318,602	$318,602	$318,602	$318,602	$318,602	$318,602	$318,602	$318,602	$318,602	$318,602
Fire Department Revenues										
-Installation inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Ongoing inspection fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Average Operating Costs Per Capita	$36.79	$36.29	$35.80	$35.33	$34.87	$34.42	$33.98	$33.55	$33.14	$32.73
Total Capital and Operating Costs	$5,151,800	$5,151,800	$5,151,800	$5,151,800	$5,151,800	$5,151,800	$5,151,800	$5,151,800	$5,151,800	$5,151,800
Non-Sprinkler Less Sprinkler Total Costs	$832,644	$832,644	$832,644	$832,644	$832,644	$832,644	$832,644	$832,644	$832,644	$832,644
OTHER MUNICIPAL COSTS/BENEFITS										
Municipal Capital Expenditures	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Municipal Revenues										
-Development charges and other developer contributions	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Water hook-up charges	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Building permit fees										
-Total change in revenues	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Municipal Operating and Maintenance Costs										
-Building inspections	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Other operating and maintenance costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Tax Revenues Related to Assessment of Sprinklers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Impact on Municipal Costs	($832,644)	($832,644)	($832,644)	($832,644)	($832,644)	($832,644)	($832,644)	($832,644)	($832,644)	($832,644)

Table A5 (*Continued*)
Gatineau Cost-Benefit Analysis – Residential Fire Sprinklers

Gatineau Cost-Benefit Analysis Residential Fire Sprinklers	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
									Page nine of nine	
Costs and Benefits for Other Parties										
LAND DEVELOPERS' COSTS/BENEFITS										
Direct Cost of Providing Services for Subdivisions	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Development Charges Paid to Municipality	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Profits Related to Higher Densities	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Developers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
HOME BUILDERS' COSTS/BENEFITS										
Sprinkler installation costs										
-Singles and semis	$1,666,000	$1,666,000	$1,666,000	$1,666,000	$1,666,000	$1,666,000	$1,666,000	$1,666,000	$1,666,000	$1,666,000
-Townhouses	$142,800	$142,800	$142,800	$142,800	$142,800	$142,800	$142,800	$142,800	$142,800	$142,800
-Apartments	$203,000	$203,000	$203,000	$203,000	$203,000	$203,000	$203,000	$203,000	$203,000	$203,000
-Total	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800
Other Changes in Construction and On-Site Servicing Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Fees Related to Sprinkler Installation										
-Sprinkler inspection/building permit fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Water hook-up fees	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Home Builders	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800	$2,011,800
ONGOING COSTS/BENEFITS FOR RESIDENTS OF NEW HOMES										
Maintenance Costs	$224,000	$224,000	$224,000	$224,000	$224,000	$224,000	$224,000	$224,000	$278,400	$328,000
Ongoing Sprinkler Inspection Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Insurance Premiums	($464,425)	($487,175)	($509,925)	($532,675)	($555,425)	($578,175)	($600,925)	($623,675)	($646,425)	($669,175)
Property Taxes Due to Increased Assessment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub-Total Net Costs for Residents	($240,425)	($263,175)	($285,925)	($308,675)	($331,425)	($354,175)	($376,925)	($399,675)	($368,025)	($341,175)

Kawacatoose First Nation, Saskatchewan

The sprinklered scenario for Kawacatoose represents an analysis of the effect of requiring mandatory installation of sprinklers for all new construction and the installation of sprinklers in all existing homes on the reserve, over a 10-year period.

The inputs to the cost-benefit analysis for Kawacatoose are based on the following assumptions.

- The 1996 population and unit count are from the band's housing and infrastructure report.
- The population projection is based on the planning report.
- The housing unit projections are derived from population assuming constant average household size.
- There is no change in the fire department statistics or budget with mandatory sprinklers, from its current budget.
- The current capital budget includes fire protection (fire truck, fire hall, etc.) community buildings, housing and roads.
- Existing homes on the reserve would be sprinklered over a 10-year period.
- The sprinkler systems proposed to be installed in houses not connected to the existing municipal water service will be served by the domestic water system pump in each house.
- Added savings related to a decrease in average fire losses – $32,383 (average fire loss on reserves from insurance report) less $2,100 (average fire loss with sprinklers derived from Scottsdale statistics) times 0.45 per 100 houses (residential fire frequency on Saskatchewan reserves) or $136 per sprinklered house per year.
- The average cost per housing unit for sprinkler installation would be $3,000.
- All the fire losses would be paid for by the band; therefore, insurance savings are not built in to the model.
- We understand that, on average, one house per year is lost to fire in Kawacatoose.

Map A6
Kawacatoose First Nation

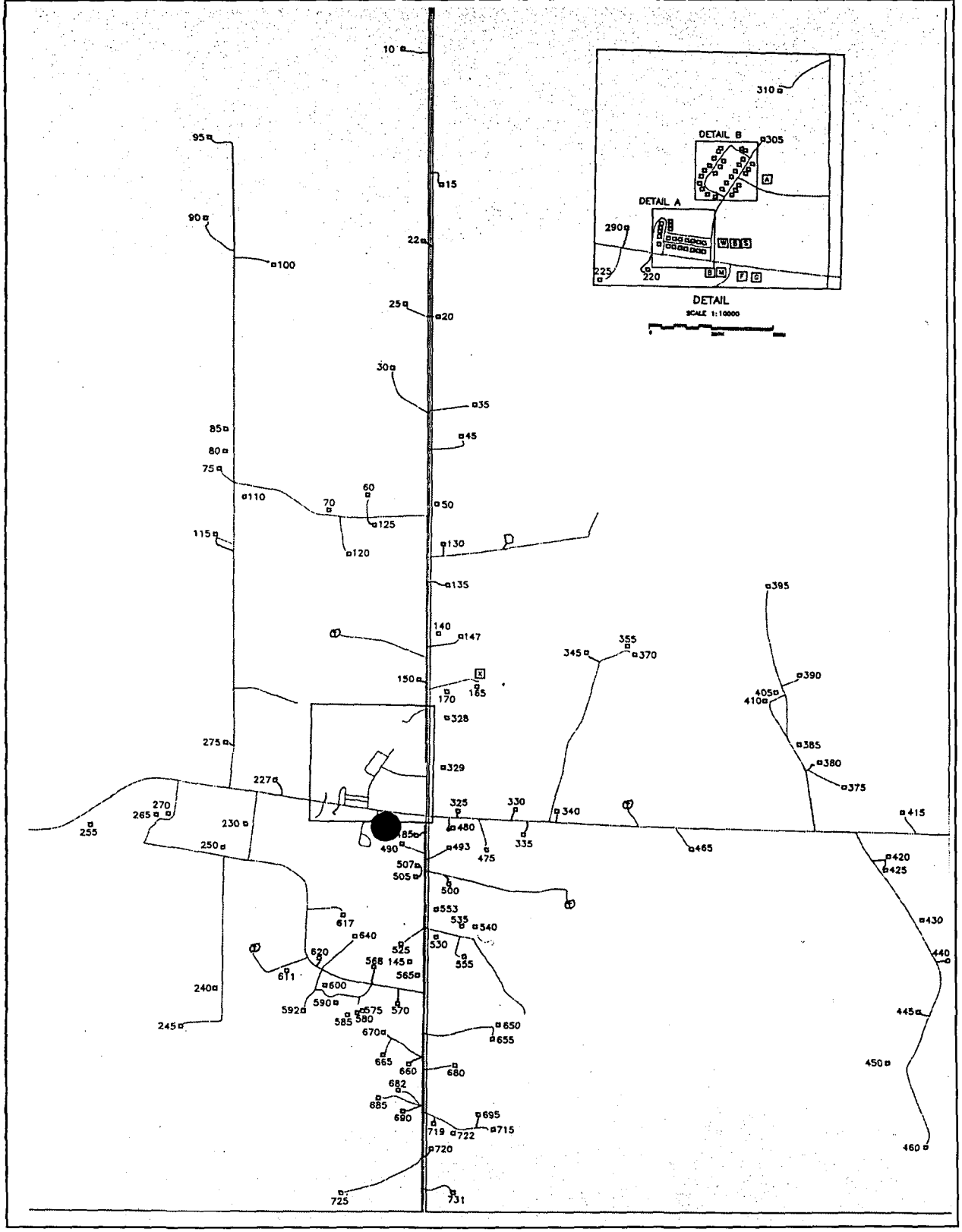

Table A6
Kawacatoose Cost-Benefit Analysis – Residential Fire Sprinklers

Kawacatoose Cost-Benefit Analysis
Residential Fire Sprinklers

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
INPUTS FOR COST-BENEFIT CALCULATIONS										
BACKGROUND DATA										
Population	1,044	1,081	1,095	1,122	1,148	1,173	1,198	1,223	1,249	1,276
Housing Units	174	174	183	187	191	196	200	204	208	213
New Housing Units		0	9	4	4	5	4	4	4	5
NON-SPRINKLER SCENARIO										
FIRE DEPARTMENT STATISTICS										
Number of Stations	1	1	1	1	1	1	1	1	1	1
Number of Full-Time Staff	1	1	1	1	1	1	1	1	1	1
Number of Vehicles	1	1	1	1	1	1	1	1	1	1
FIRE DEPARTMENT EXPENDITURES										
Capital Expenditures										
-Additional land, buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Replacement buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Operating and Maintenance Expenditures										
-Wages and benefits	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600
-Materials and services	$6,208	$6,208	$6,208	$6,208	$6,208	$6,208	$6,208	$6,208	$6,208	$6,208
Average Operating Costs Per Capita	$9.39	$9.07	$8.96	$8.74	$8.54	$8.36	$8.19	$8.02	$7.85	$7.69
Total Capital and Operating Costs	$9,808	$9,808	$9,808	$9,808	$9,808	$9,808	$9,808	$9,808	$9,808	$9,808

Table A6 (*Continued*)
Kawacatoose Cost-Benefit Analysis – Residential Fire Sprinklers

Kawacatoose Cost-Benefit Analysis
Residential Fire Sprinklers

SPRINKLER SCENARIO	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Total Number of Sprinklered Homes	0	0	26	48	69	92	113	134	156	178
Total Number of Unsprinklered Homes	174	174	157	139	122	104	87	70	52	35
FIRE DEPARTMENT STATISTICS										
Number of Stations	1	1	1	1	1	1	1	1	1	1
Number of Full-Time Staff	1	1	1	1	1	1	1	1	1	1
Number of Vehicles	1	1	1	1	1	1	1	1	1	1
FIRE DEPARTMENT EXPENDITURES										
Capital Expenditures										
-Additional land, buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Replacement buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Operating and Maintenance Expenditures										
-Wages and benefits	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600
-Materials and services	$6,208	$6,208	$6,208	$6,208	$6,208	$6,208	$6,208	$6,208	$6,208	$6,208
Average Operating Costs Per Capita	$9.39	$9.07	$8.96	$8.74	$8.54	$8.36	$8.19	$8.02	$7.85	$7.69
Total Capital and Operating Costs	$9,808	$9,808	$9,808	$9,808	$9,808	$9,808	$9,808	$9,808	$9,808	$9,808
Non-Sprinkler Less Sprinkler Total Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
OTHER BAND COSTS/BENEFITS										
Infrastructure Capital Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Net Reduction in Fire Losses	$0	$0	($3,590)	($6,501)	($9,411)	($12,458)	($15,368)	($18,278)	($21,189)	($24,235)
Band Operating and Maintenance Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

Table A6 (*Continued*)
Kawacatoose Cost-Benefit Analysis – Residential Fire Sprinklers

Kawacatoose Cost-Benefit Analysis
Residential Fire Sprinklers

		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Sprinkler Installation Costs											
-In existing homes		$0	$52,200	$52,200	$52,200	$52,200	$52,200	$52,200	$52,200	$52,200	$52,200
-In new homes		$0	$0	$27,000	$12,000	$12,000	$15,000	$12,000	$12,000	$12,000	$15,000
-Total		$0	$52,200	$79,200	$64,200	$64,200	$67,200	$64,200	$64,200	$64,200	$67,200
Costs for Sprinkler System Maintenance		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Annual Costs (Savings) for Band		$0	$52,200	$75,610	$57,699	$54,789	$54,742	$48,832	$45,922	$43,011	$42,965
Net Present Value of Costs (Savings)	$249,763										
	5	3	7								
npv of fire department savings	$0	$0	$0								
npv of sprinkler installation costs	$548,191	$653,537	$469,444								
npv of sprinkler maintenance costs	$34,724	$52,451	$23,508								
npv of savings on fire-related home replacement	($333,153)	($477,068)	($239,848)								
	$249,763	$228,920	$253,105								

Table A6 (*Continued*)
Kawacatoose Cost-Benefit Analysis – Residential Fire Sprinklers

Kawacatoose Cost-Benefit Analysis
Residential Fire Sprinklers

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
BACKGROUND DATA											
Population	1,303	1,330	1,359	1,388	1,417	1,447	1,477	1,507	1,537	1,567	1,597
Housing Units	217	222	227	231	236	241	246	251	256	261	266
New Housing Units	4	5	5	4	5	5	5	5	5	5	5
NON-SPRINKLER SCENARIO											
FIRE DEPARTMENT STATISTICS											
Number of Stations	1	1	1	1	1	1	1	1	1	1	1
Number of Full-Time Staff	1	1	1	1	1	1	1	1	1	1	1
Number of Vehicles	1	1	1	1	1	1	1	1	1	1	1
FIRE DEPARTMENT EXPENDITURES											
Capital Expenditures											
-Additional land, buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Replacement buildings, vehicles and equipment	$0	$0	$0	$0	$200,000	$0	$0	$0	$0	$0	$0
Operating and Maintenance Expenditures											
-Wages and benefits	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600
-Materials and services	$6,208	$6,208	$6,208	$6,208	$6,208	$6,208	$6,208	$6,208	$6,208	$6,208	$6,208
Average Operating Costs Per Capita	$7.53	$7.37	$7.22	$7.07	$148.06	$6.78	$6.64	$6.51	$6.38	$6.26	$6.14
Total Capital and Operating Costs	$9,808	$9,808	$9,808	$9,808	$209,808	$9,808	$9,808	$9,808	$9,808	$9,808	$9,808

Table A6 (*Continued*)
Kawacatoose Cost-Benefit Analysis – Residential Fire Sprinklers

Kawacatoose Cost-Benefit Analysis
Residential Fire Sprinklers

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
SPRINKLER SCENARIO											
Total Number of Sprinklered Homes	200	222	227	232	236	241	246	251	256	261	266
Total Number of Unsprinklered Homes	17	0	0	0	0	0	0	0	0	0	0
FIRE DEPARTMENT STATISTICS											
Number of Stations	1	1	1	1	1	1	1	1	1	1	1
Number of Full-Time Staff	1	1	1	1	1	1	1	1	1	1	1
Number of Vehicles	1	1	1	1	1	1	1	1	1	1	1
FIRE DEPARTMENT EXPENDITURES											
Capital Expenditures											
-Additional land, buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Replacement buildings, vehicles and equipment	$0	$0	$0	$0	$200,000	$0	$0	$0	$0	$0	$0
Operating and Maintenance Expenditures											
-Wages and benefits	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600
-Materials and services	$6,208	$6,208	$6,208	$6,208	$6,208	$6,208	$6,208	$6,208	$6,208	$6,208	$6,208
Average Operating Costs Per Capita	$7.53	$7.37	$7.22	$7.07	$148.06	$6.78	$6.64	$6.51	$6.38	$6.26	$6.14
Total Capital and Operating Costs	$9,808	$9,808	$9,808	$9,808	$209,808	$9,808	$9,808	$9,808	$9,808	$9,808	$9,808
Non-Sprinkler Less Sprinkler Total Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
OTHER BAND COSTS/BENEFITS											
Infrastructure Capital Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Net Reduction in Fire Losses	($27,146)	($30,192)	($30,872)	($31,552)	($32,096)	($32,776)	($33,456)	($34,136)	($34,816)	($35,496)	($36,176)
Band Operating and Maintenance Costs	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

Table A6 (*Continued*)
Kawacatoose Cost-Benefit Analysis – Residential Fire Sprinklers

Kawacatoose Cost-Benefit Analysis									Page six of nine		
Residential Fire Sprinklers	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Sprinkler Installation Costs											
-In existing homes	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-In new homes	$12,000	$15,000	$15,000	$12,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
-Total	$12,000	$15,000	$15,000	$12,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
Maintenance costs	$3,480	$5,280	$4,280	$4,280	$4,480	$4,280	$4,280	$4,280	$4,480	$4,280	$4,480
Total Annual Costs (Savings)	($11,666)	($9,912)	($11,592)	($15,272)	($12,616)	($13,496)	($14,176)	($14,856)	($15,336)	($16,216)	($16,696)

Table A6 (*Continued*)
Kawacatoose Cost-Benefit Analysis – Residential Fire Sprinklers

Kawacatoose Cost-Benefit Analysis
Residential Fire Sprinklers

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
BACKGROUND DATA										
Population	1,627	1,657	1,687	1,717	1,747	1,777	1,807	1,837	1,867	1,897
Housing Units	271	276	281	286	291	296	301	306	311	316
New Housing Units	5	5	5	5	5	5	5	5	5	5
NON-SPRINKLER SCENARIO										
FIRE DEPARTMENT STATISTICS										
Number of Stations	1	1	1	1	1	1	1	1	1	1
Number of Full-Time Staff	1	1	1	1	1	1	1	1	1	1
Number of Vehicles	1	1	1	1	1	1	1	1	1	1
FIRE DEPARTMENT EXPENDITURES										
Capital Expenditures										
-Additional land, buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
-Replacement buildings, vehicles and equipment	$0	$0	$0	$0	$0	$0	$0	$0	$200,000	$0
Operating and Maintenance Expenditures										
-Wages and benefits	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600	$3,600
-Materials and services	$6,208	$6,208	$6,208	$6,208	$6,208	$6,208	$6,208	$6,208	$6,208	$6,208
Average Operating Costs Per Capita	$6.03	$5.92	$5.81	$5.71	$5.61	$5.52	$5.43	$5.34	$112.38	$5.17
Total Capital and Operating Costs	$9,808	$9,808	$9,808	$9,808	$9,808	$9,808	$9,808	$9,808	$209,808	$9,808

Appendix B

FIREFIGHTING PRACTICES

Appendix B – FIREFIGHTING PRACTICES

There are no mandatory standards for municipal fire departments in Canada. The criteria used to develop fire department planning policies on fire station location, roles, equipment and staffing are determined at the direction of the council of each municipality. There is no uniformity, except for some use of the Fire Underwriters Survey (FUS) guidelines.

The firefighting practices of the case study municipalities, and their relationship with other non-fire emergency response assignments have been reviewed. It is recognized that fire departments are now placing more emphasis on fire prevention and other non-firefighting roles; however, this study assumes that the non-firefighting roles remain constant.

The present practices of the case study fire departments have a direct impact on a municipality's overall approaches to firefighting and to factors that may affect the economic benefits and costs to the case study municipalities related to mandatory residential fire sprinklers. Considerations include:

- Fire department emergency response standards are usually established in the municipality's fire protection plan or through municipal policy direction. Many municipalities use *A Guide to Public Fire Protection* issued by the FUS[19] as the basis for setting response time standards.

- The response time standards are based on economics and on time-critical emergencies, including fire and medical-assist calls. For fire calls, the primary objective is for the fire department to arrive on the fire scene and begin fire suppression before flashover occurs, and to get people out. The response time objectives recognize that fires grow at an exponential rate. Reduction of the time between fire start and commencement of fire suppression efforts enables the fire department to intervene earlier on a smaller fire.

- In cases where the fire department has a major role in emergency medical response, medical response standards are based on ministry of health standards for medical (ambulance) response (e.g., eight minutes to 90 per cent of the urban area). This level of service arises from recommendations of the American Heart Association.

- Where the fire department's role, as mandated by the municipal council, includes a broad range of emergency services, the majority of fire department calls were found to be non-fire calls (such as in Burlington[20]). The non-fire calls have become the driving force in the determination of fire department equipping and staffing requirements.

- In other cases, such as Barrie, the large majority of fire department calls are fire-related calls (actual fires, suspected fires, and false fire alarms).[21] In Barrie, the fire department only responds to non-fire emergency calls when specifically requested, and then on a cost-recovery basis. Council's direction to the fire department is to bill medical-assist calls to the Ministry of Health. If the medical-assist call bills are not paid, Council has directed the fire department to abandon these non-fire-related services.

- Minimum staffing on a firefighting vehicle (quint or pumper/rescue) varies in accord with municipal practices from three to five firefighters (paid or volunteer). One captain or higher-ranking officer is assigned to each fire vehicle.

- Standard first response dispatches are widely variable. In Burlington, for example,[22] the first response to an alarm in occupancies such as a house, townhouse, small building, high rise, hospital, nursing home or senior citizens' home is:
  - three vehicles staffed with paid firefighters (quint and two pumper/rescue units);

- one platoon chief; and
- one pumper staffed with volunteer firefighters.

This contrasts to Barrie's first alarm response to a building structure fire call which is one pumper from the nearest station and one aerial from the central station (No. 1). The first two responding vehicles are staffed by seven to 10 firefighters. This is deemed by the fire department to be the minimum effective and safe response to a fire call.

In both examples, the initial level of response could be substantially reduced, if the alarm is known to originate in an area consisting of sprinklered residential buildings.

- Quints and pumpers in the case study municipalities, except Kawacatoose, each carry 244 to 305 m (800 to 1,000 ft.) of pre-connected 10 to 13 cm (4 or 5 in.) high-volume hose. On arrival at the fire scene, a firefighter is dropped off with the end of the high-volume hose at the nearest fire hydrant. He connects the hose to the hydrant. The vehicle continues to set up as close as is reasonable to the fire scene. Firefighters use 4.5 cm (1 3/4 in.) pre-connected hose on the vehicle to assess the fire scene and commence fire attack, drawing water from the vehicle's own tank. During this time, the pump operator has completed connection of the high-volume hose to the pumper and operates the pump. This procedure is designed to bring the vehicle and equipment close to the fire scene and reduces the importance of proximity of the fire hydrant to the fire scene and the location of the pumper.

- Fire prevention and education activities are becoming more prominent in fire department operations. In some municipalities, fire suppression crews are assigned residential and commercial fire safety inspection duties during certain times of the year.

Appendix C

SELECTED BIBLIOGRAPHY – FIRE DEPARTMENT IMPACT IN OTHER STUDIES

Appendix C – SELECTED BIBLIOGRAPHY – FIRE DEPARTMENT IMPACT IN OTHER STUDIES

A wide variety of literature regarding sprinklers and fire protection services was reviewed by the project team for this study. This selected bibliography includes only those studies which were formal cost-benefit analyses.

Most of the formal cost-benefit studies for residential sprinklers have included assumptions or estimates of the potential savings for municipal fire departments. The approaches to municipal cost savings used in the reports reviewed as background for this study are outlined below.

- R.T. Ruegg and S.K. Fuller, *A Benefit-Cost Model of Residential Fire Sprinkler Systems*, U.S. Department of Commerce and National Bureau of Standards, 1984.

  This study assumed that if all new residential development was sprinklered, no new fire stations would be required. The cost of building, equipping and staffing (for 30 years) a new fire station was estimated. Typical service areas and populations for fire stations where residential sprinklers are not mandatory were also developed by the authors based on theoretical analysis rather than a review of actual fire department practice.

  The present value of the cost of a station to serve 642 houses was estimated to amount to $1,256,300 in 1982 dollars. The present value of the cost of firefighting services with mandatory sprinklers was assumed to be nil. The after-tax, present value of the related local tax benefits was estimated to amount to $1,179.49 per household in 1982 dollars.

- T.Z. Harmathy, "On the Economics of Mandatory Sprinklering of Dwellings," *Fire Technology*, 1988.

  In this model, it was assumed that mandatory sprinklers would affect fire department costs in proportion with the impact on the "fire fighting load" which was defined as the product of the number of fires and direct property losses. The calculation of fire department cost savings incorporated the reduction in average property loss in sprinklered dwellings, the share of fire services related to residential fires, and the capital and operating costs of new fire stations.

  The present value of fire department savings was estimated to amount to approximately $149 per unit in 1985 dollars.

- National Association of Home Builders (NAHB) National Research Centre, *Cost-Benefit Analysis of Residential Fire Sprinklers*, 1988.

  The reduction of fire department costs resulting from residential sprinklers was estimated based on the following assumptions: 40 per cent of fire service costs were related to residential fire protection, sprinklers will reduce long-run capital and operating costs for residential firefighting by 25 per cent, and typical firefighting costs for larger urban municipalities were $64 per capita (1984 dollars). The average savings per household were estimated to amount to $16.38 per year in 1984 dollars.

- A. T. Hansen and R.E. Platts, Scanada Consultants Ltd., *Analysis of Costs/Benefits of Installing Fire Sprinklers in Houses*, Phase 2, "The Cost of Saving Property and Lives by Fire Sprinklering in New Houses," 1989.

  This study (which includes a critical assessment of the approaches used in the studies listed above) used the NAHB assumptions regarding the share of fire costs related to residential calls and the impact of sprinklers on residential fire costs. The assumptions were applied to the average American firefighting costs of $37 per capita and translated into Canadian dollars. Fire

department savings were estimated to amount to $18 per house per year.

- IBI Group and Larden Muniak Consulting, *Impact of Mandatory Sprinklering of Multi-Unit Residential Buildings*, 1993.

  The study found that a very small amount of fire department response effort was related to fires in multi-unit residential buildings. The study concluded that mandated sprinklers in new apartment units would not result in any downsizing of fire departments, even decades after sprinklering requirements are mandated. Therefore, savings in fire department costs were assumed to be nil.

Table C-1 compares various other features of the studies listed above. The comparison includes: perspective (homeowner versus society), housing types included, key inputs in the cost-benefit calculations, the form of the results, and the costs and benefits included in each study.

Table C-1
Comparison of Sprinkler Cost-Benefit Studies

Authors	NBS	Harmathy	NAHB/NRC	Scanada	IBI	Arencon
General						
American/Canadian	A	A	A	C	C	C
Perspective:						
• Homeowner	X		X			X
• Society		X		X	X	
	X					
Present value/llife cycle analysis	X	X	X	X	X	
Study period (years)	30	30	30	40/50	30	
Housing types:						
• Single family	X	X	X	X		X
• Semi-detached			X			X
• Townhouses						X
• Apartments			X		X	X
• Mobile Homes			X			X
Year published	1984	1988	1988	1989	1993	1998
Real discount rate (%)	6	6	35920	10	6	5
Form of Results						
Cost per year of life saved					X	
Cost per life saved				X		
Ratio of benefits to costs			X			
Net benefits	X		X			
Comparison of present value of net costs for sprinklered and unsprinklered options		X				X

Table C-1 (*continued*)
Comparison of Sprinkler Cost-Benefit Studies

Authors	NBS	Harmathy	NAHB/NRC	Scanada	IBI	Arencon
Costs and Benefits Included in Analysis						
Purchase and installation	X	X	X	X	X	X
Plan review and/or building inspection					X	X
Ongoing inspections					X	X
System maintenance	X	X	X	X	X	X
Parts replacement	X	X			X	X
Home mortgage payments	X		X			
Income tax effect	X		X			X
Water charges	X		X			X
Cost of fires:						
• Dollar value of life loss	X	X	X			
• Dollar costs of injuries	X	X	X	X	X	X
• Direct property loss	X	X	X	X	X	
• Indirect losses	X	X	X	X	X	
Owners' insurance premiums	X		X			X
Insurance underwriting costs		X				
Life insurance					X	
Indirect impacts on construction costs					X	X
Assessment increase	X		X		X	X
Cost of municipal fire protection services	X	X	X	X	X	X
Firefighter safety			X			
System activation costs			X			

Appendix D

PLANNING, LAND USE AND INFRASTRUCTURE CONSIDERATIONS

Appendix D – PLANNING, LAND USE AND INFRASTRUCTURE CONSIDERATIONS

Some commentators[23] have suggested that with mandatory sprinklers, significant cost savings can be achieved through measures such as increased density of housing, narrower roads, reduced setbacks from lot lines and reductions in municipal infrastructure (increased distances between fire hydrants and smaller water mains). Cost savings to a developer from such planning, land use and infrastructure changes could then be applied to reduce the cost of land for new housing units. The reduction in land cost per housing unit could then be applied to offset the cost of installation of sprinklers in new residential buildings included in the purchase price paid by the homeowner.

Cost savings related to potential implementation of planning, land use changes and infrastructure reductions have not been factored into the cost-benefit analysis for the case study sites for the following reasons:

- Municipalities are currently studying or implementing planning measures that would permit increased density, narrower roads, reduced distances between buildings and innovative site layouts for both new greenfield development and for infill development, without consideration of mandatory residential sprinkler requirements. Implementation of these measures would create reduced costs per unit or lot for developers, even without mandatory residential sprinklers. No additional cost reductions would accrue with mandatory residential sprinklers.
- In the case of Barrie, the official plan states that Barrie is a single-family low-density community. Required setbacks for front, side and rear yards, have been reduced in recent years and minimum lot frontage for new, single-family residential lots has been reduced to 10 m (33 ft.). However, increased densities over those now permitted, would be expected to generate community and political resistance to such intensification of land use.
- Road design (minimum width, turning radius) is governed by larger vehicles than those used by the fire department (snowploughs, moving vans, delivery vehicles). While reductions in road requirements may be possible for the fire vehicles, accommodation of the other larger vehicles prevents such changes.
- The spacing between fire hydrants on streets can be significantly increased (perhaps up to 305 m or 1,000 ft.) based on the current standard operating procedures of both fire departments. Homes located within 305 m of a fire hydrant are considered "protected risks" by the insurance companies. Therefore, spacing of fire hydrants at 305-m intervals would not be expected to affect residential insurance rates in areas served by municipal water supply systems with fire hydrants.

Appendix E

PART 3 AND PART 9 RESIDENTIAL BUILDINGS

Appendix E – PART 3 AND PART 9 RESIDENTIAL BUILDINGS

At the outset of this study, there was interest in determining whether there would be benefits to municipalities if only new residential buildings, required to be built in accord with Part 3 of the National Building Code of Canada – buildings greater than three storeys in building height or 600 m^2 (6459 sq.ft.) in building area – were required to be sprinklered.

Discussions with the municipalities studied in Phase 1, and informal discussions with others in the fire service during the course of this study, have indicated that providing automatic sprinkler protection only in Part 3 residential buildings, does not create conditions under which cost savings to the municipality may be developed.

The inability to generate municipal cost savings if only Part 3 residential buildings were sprinklered, arises from the mixed use nature of most areas served by a typical fire station. In some municipalities, there is the potential and willingness to change methods of fire department operations, provided the entire area served by the fire station is sprinklered. If unsprinklered buildings exist within a fire station's primary response area, the fire departments must provide services based on the most severe hazard they are to protect – the unsprinklered buildings. Therefore, to generate the greatest opportunity for municipal cost savings from mandatory sprinklers, the entire area to be protected by a fire station must consist of sprinklered buildings.

Appendix F

CONSTRUCTION TRADE-OFFS FOR MANDATORY RESIDENTIAL SPRINKLERS

Appendix F – CONSTRUCTION TRADE-OFFS FOR MANDATORY RESIDENTIAL SPRINKLERS

Proponents of mandatory residential sprinkler requirements promote construction trade-offs (reduced construction standards) for buildings in which automatic sprinklers are installed. As an example, the Vancouver building by-law contains numerous relaxations of building construction standards for buildings which are sprinklered.

Discussion with the case study municipalities' staff has produced suggestions for potential changes in building construction requirements based on the introduction of mandatory residential sprinklers. These suggestions include:

- Spatial separation and exposing building face construction requirements could be reduced and increased areas of unprotected openings could be permitted (in addition to the doubling permitted now for sprinklered buildings).
- Construction requirements for sprinklered buildings larger than single-family houses could be reduced, resulting in some cost savings, a process already started with the 1995 NBC.
- Precautions during construction to limit the prospect for a conflagration before the residential sprinkler systems are commissioned should be reviewed.
- Fire resistance ratings for required fire separations for apartments and multi-family houses could be reduced.
- Escape window requirements for large houses could be reduced.
- Use of combustible materials in construction of both low- and high-rise residential buildings could be expanded.
- Travel distances to exits (as now permitted for other sprinklered buildings) could be increased.

Prior to implementation of these suggestions, a detailed study would be required, which is outside the scope of this study.

Appendix G

RELATIONSHIP TO OTHER STUDIES

Appendix G – RELATIONSHIP TO OTHER STUDIES

Name of Study	Year	Author
The effect of the City of Winnipeg's "upgrading" bylaw on Law on fire safety in apartment buildings	1986	Fraser Dunfor Jodie L. Roy
Analysis of costs/benefits of installing fire sprinklers in houses: Phase 1, "Selecting an appropriate assessment procedure"	1988	A.T. Hansen
Analysis of costs/benefits of installing fire sprinklers in houses: Phase 2, "The cost of saving property and lives by fire sprinklering new houses"	1989	A.T. Hansen and R.E. Platts Scanada Consultants Ltd.
The costs and benefits of smoke alarms in Canadian houses	1990	A.T. Hansen and R.E. Platts Scanada Consultants Ltd.
Smoke alarms and residential sprinklers: costs and benefits: summary report	1992	Rowena E. Moyes
Strategic plan for improving fire safety in Canadian homes: final report	1992	Elyau (Eli) Avidor Professional Loss Control Ltd.
Impact of mandatory sprinklering of multi-unit residential buildings: final report	1993	IBI Group and Larden Muniak Consulting

CMHC has been involved in evaluating the impact of mandatory sprinklering for a number of years and has commissioned several studies on the safety and cost-effectiveness of current and proposed fire safety technologies, especially smoke alarms and residential fire sprinklers. These previous CMHC studies, listed above, have shown:

- The fire fatality rate for newer houses is 3.5 times less than for the entire Canadian housing stock.
- Smoke alarms, especially in older houses, are seen to be cost-effective at saving lives.
- Sprinklers, with an estimate of $38 million per life saved, were not seen to be cost effective (cost per life saved for car seat belts is estimated at less than $500,000, for residential smoke detectors, at less than $2 million).
- Although the installation of fire sprinklers would drive up the cost of housing, there may be savings for other groups, e.g., municipal fire services.
- Previous studies did not include a detailed analysis of the impact on municipal fire services and finance.
- There was a need to verify and quantify the costs and benefits to municipalities of mandatory residential sprinklers.

CMHC commissioned this study to study the impact of the requirement for sprinklering of residential buildings, on municipal services and finance.

The National Research Council's National Fire Laboratory was retained to study the impact on the level of fire safety to the occupants as a result of changes in fire department response time due to the introduction of mandatory residential sprinklers.

Appendix H

PURPOSE OF RESIDENTIAL FIRE SPRINKLER SYSTEMS

Appendix H – PURPOSE OF RESIDENTIAL FIRE SPRINKLER SYSTEMS

The National Building Code of Canada (1990 and 1995 editions) and provincial building codes require fire sprinkler systems to be designed and installed in accord with standards published by the National Fire Protection Association (NFPA). NFPA 13, Installation of Sprinkler Systems may be applied to the design of sprinkler systems for all buildings. Its purpose is "to provide a reasonable degree of protection for life and property from fire...." [24]

Alternative standards (included as referenced standards in NFPA 13) are published by NFPA for apartment buildings up to four storeys in building height (NFPA 13R) and for one- and two-family dwellings and mobile homes (NFPA 13D). The alternative standards (NFPA 13R and 13D) have a different purpose, that is "to provide a sprinkler system that will aid in the detection and control of residential fires and thus provide improved protection against injury, life loss, and property damage. A sprinkler system designed and installed in accordance with this standard is expected to prevent flashover (total involvement) in the room of fire origin, where sprinklered, and to improve the chance for occupants to escape or be evacuated."[25]

However, a sprinkler system designed and installed in accord with NFPA 13D cannot be "expected to control completely a fire involving fuel loads that are significantly higher than average for dwelling units (10 lbs./ft.^{2} [49 kg/m^2]) and where the interior finish has an unusually high flame spread rating (greater than 225)."[26]

NFPA 13D and 13R permit sprinklers to be omitted from areas of buildings where the incidence of loss of life from fires is low such as bathrooms with areas less than 5 m^2 (55 sq. ft.), certain small closets, garages, carports, attached porches, and attics and crawl spaces not intended for living or storage.

This study does not assume that sprinklers are 100 per cent reliable. However, statistics and practice have shown that fire sprinkler systems are highly reliable systems. The major cause of sprinkler system failures is impaired or shut off water supplies. Risks associated with residential sprinkler systems are minor, consisting of accidental sprinkler system discharge due to failure of a sprinkler.

Estimated failures of this nature are in the order of one per 16 million sprinklers, and one in 2,500,000 installed sprinkler systems will fault and permit water discharge.[27] Risk of building damage due to mechanical damage to sprinkler piping and freezing of sprinkler piping is considered similar to that of domestic water systems. These risks are not considered significant for the purposes of this study.

Appendix J

Stakeholders Forum Participants List

Appendix J – STAKEHOLDERS FORUM PARTICIPANTS LIST

A forum for interested stakeholders was held at CMHC headquarters in Ottawa on December 12, 1997. The following organizations and their representatives attended.

Organization	Representative
Canadian Home Builders' Association	Don Johnston
Insurance Bureau of Canada	Janice Oliver
Insurers' Advisory Organization	Rob Wolfesbergen
National Research Council, Canadian Codes Centre	Alastair Aikman
Ontario Building Officials Association/City of Nepean	Terry Dalkowski
Hull Fire Department	Raymond Dubuc
Edmonton Emergency Response Department	Don Pilling
Canadian Automatic Sprinkler Association	John Galt
Mississauga Fire and Emergency Services	Roy Chalk
Canadian Association of Fire Chiefs	John Le Gros
Ottawa Fire Department	Fred Ross
Nepean Fire and Emergency Services	Steve Armstrong
Alberta Labour, Fire Commissioner	Tom Makey
Federation of Saskatchewan Indian Nations	Don Ross
Royal Architectural Institute of Canada	John Hobbs
Urban Development Institute of Ontario	Michael Steele
District of Pitt Meadows Fire Department	Don Pamplin
Ontario Ministry of Municipal Affairs and Housing	Ali Arlani
Ontario Ministry of the Solicitor General and Correctional Services	Krystyna Paterson
National Fire Laboratories, NRC	Ken Richardson
Gouvernemement du Québec, Ministère de la Sécurité publique, Direction des affairs policières et de la sécurité incendie	Robert Laroche
Province of British Columbia, Ministry of Municipal Affairs, Fire Commissioner	Richard Dumala
Technical Advisor	Asbjörn Hansen
Kawacatoose First Nation, Saskatchewan	Fred Poorman
	Jack Peterson
Aboriginal Fire Fighter Association of Canada	Terry Diabo
Assembly of First Nations	Paulette Tremblay
Ontario New Home Warranty Program	Dan Moreau
Canadian Portland Cement Association	Alicje Cornellisen
INAC (Indian and Northern Affairs Canada)	Allan Turner

Presenters/Facilitators

Arencon Inc.	Peter Colquhoun
Clayton Research Associates Limited	Jeannette Gillezeau
National Research Council/National Fire Laboratory	David Yung
	George Hadjisophocleous
	Nouredine Benichou
Canada Mortgage and Housing Corporation	Terry Robinson
	Tom Kerwin
	Mark Holzman
	Nicole Parent
	Line Gullison

Appendix K

ADVISORY COMMITTEE MEMBERS

Appendix K – ADVISORY COMMITTEE MEMBERS

Ali Arlani
Manager, Code Development and Technical Training Section
Ontario Ministry of Housing
Housing Development and Buildings Branch
Toronto, Ontario

Richard Dumala
Fire Commissioner
Province of British Columbia, Ministry of Municipal Affairs
Victoria, British Columbia

Oz Hansen
A.T. Hansen, Consulting Services
Ottawa, Ontario

Robert Laroche
Service de la sécurité incendie, Gouvernement du Québec,
Ministère de la Sécurité publique
Direction des affaires policières et de la sécurité incendie
Sainte-Foy, Québec

Krystyna Paterson
Unit Manager, Research and Standards, Office of the Fire Marshal
Ministry of the Solicitor General and Correctional Services
North York, Ontario

Ken Richardson
Head, National Fire Laboratory
Institute for Research in Construction
National Research Council, Canada
Ottawa, Ontario

Dan McGregor (May 1995 to December 1995)
Kathy Thompson (January 1996 to May 1996)
Stephan Blais (June 1996 to summer 1997) and
Robin Tourangeau (Fall 1997 to present)
Federation of Canadian Municipalities
Ottawa, Ontario

END NOTES

PURPOSE

1. Final Report, IBI Group in association with Larden Muniak Consulting Inc., December 1993, pp 8-9.

CHAPTER 3

2. The base case is defined as "the capital and operating costs associated with providing fire protection" that the municipalities would incur, based on present levels of service for fire protection. "This estimate will include the costs of buildings and land, vehicles and equipment, maintenance and operation costs and wages required to serve present needs and projected growth." The "timing of the expenditures and the parties who will pay for the expenditures" is also identified for the time period covered in the study (30 years). (Text in quotation marks is excerpted from the Terms of Reference for this study).

CHAPTER 4

3. Standard water services for single-family and townhouse developments for domestic use are generally 20 mm (3/4 in.) diameter to each home. For sprinklered homes, the water service size would be increased to 25 mm (1 in.) diameter. The only potential cost differential is the variation in material costs for increased size of the water service. Such costs may be offset by the use of new, more economical materials.

4. Dwelling unit sizes used in this study were selected based on representative unit sizes found in housing market studies conducted by Clayton Research Associates Ltd.

5. Costs for residential sprinkler systems, installed in accord with NFPA 13D (one- and two family dwellings), NFPA 13R (residential occupancies up to four stories in height) and NFPA 13 (all other buildings), were based on questionnaires and interviews with Vancouver area sprinkler contractors who have had extensive residential sprinkler experience. The "per square foot" installations costs and unit areas used in the economic model are for finished spaces and include an allowance for unfinished spaces, such as basements, that are normal components of new houses. These costs were reconfirmed in March 1998 with sprinkler contractors active in the Vancouver area who are familiar with and work in Pitt Meadows. The cost of installation of sprinklers does not directly affect, and is external to, the municipality. Quotations received for installation of residential sprinklers in new single-family dwellings located in the Greater Toronto area, have indicated costs of $1.50/sq. ft. of finished space, including 10 per cent builder's markup on the sprinkler contractor's costs and goods and services tax (GST).

   Sprinkler system installation in new homes should not result in additional framing or insulation costs. Rooms and spaces in conventional house designs below roofs and attics, are sprinklered using side wall sprinklers, located on interior walls, so that no sprinkler piping is located in the ceiling or attic.

   While many commentators have suggested that residential sprinkler installation costs will decrease over time as sprinkler installation becomes more commonplace, such future reductions in installation costs have not been included in the cost-benefit analysis.

6. Typical replacement value homeowner's policy with a limit of $200,000 and a premium of $650 per year.

7. Fax from Capri Insurance, Kelowna, British Columbia to Canadian Home Builders' Association, dated May 5, 1994. "Further to your inquiry regarding premium credits for the installation of sprinkler systems, please be advised that an overview of the insurance

markets would represent from 0% to 10% but common published discounts are 5%." This information has been confirmed with insurance industry sources in Southern Ontario in 1995 and 1996 and in the lower mainland area of British Columbia in March 1998. Where this report refers to a discount on insurance costs for residential sprinklers, the discount is calculated based on the overall policy premium, not just the fire insurance component of the insurance premium.

8. Insurance brokers contacted in Pitt Meadows, British Columbia (March 1998) and Toronto, Ontario (June 1998) have confirmed that some of the insurance companies they represent offer "protected" rates for homes within 13 km (8 miles) of a fire station.

9. Market conditions and the practices of individual insurance companies determine the application of "protected," "semi-protected" and "unprotected" rates for residential property insurance. Examples were encountered during this study of residential properties being insured at "protected" rates, even through they were more than 13 km (8 miles) from a fire station.

   In the case of Parkland County, west of Edmonton, houses in a subdivision located approximately 14.5 km (9 miles) from the fire station (about 14 minute response time) are required to be sprinklered in accord with the County's Policy Number US 006. This policy, established "for budgetary and/or other reasons," states that the County, "within certain designated subdivision and/or areas...is not able to provide a sufficient source of water at a pressure and flow which would enable fire hydrants within the subdivision to operate at normally accepted fire flows and to be used directly for fire control and prevention purposes." An insurance broker serving Parkland County advised that the area would be considered as "unprotected." However, one of the insurance companies the broker represents offers a 20 per cent discount for sprinklers. The rates quoted for an example policy, brought the cost of insurance, after the sprinkler discount, to very close to "protected" rates offered by the same company for a comparable home within five miles of the fire station.

10. The insurance premium costs related to a by-law endorsement are the owner's risk management decision and, therefore, are not included in the cost-benefit analysis. This type of endorsement covers all manner of upgrading that may be required to make the reconstruction of a home comply with current codes and standards. The policy limit and premium paid must be based on an amount sufficient to cover the reconstruction and upgrading costs required to comply with current codes and standards. In addition, the reconstructed home must be built substantially on the same site as the original building.

11. "Response time" as used in this report, means the time from the moment the fire department receives notification of a fire to the time the first crew arrives at the scene of the fire.

CHAPTER 7

12. Higher discount rates are typically used in financial pro formas for private-sector investments. Private companies typically face significantly higher borrowing rates than governments. In addition, discount rates for private-sector investments include substantial risk premiums.

13. Yung, D., G.V. Hadjisophocleous, N. Benichou and Q. Liu, "Impact on Life Risk of Mandatory Sprinklers in Residential Buildings," Report published by the National Research Council of Canada, 1998.

APPENDIX A

14. Map and fax dated March 16, 1998, from Len Garis, Pitt Meadows Fire Chief.

15. Fax dated March 16, 1998, from Daryl Birtch, Pitt Meadows Building Inspector, excerpt from By-Law No. 1585. The by-law also requires sprinklers in certain non-residential buildings, not required under the 1995 National Building Code, which have not been included in the analysis.

16. Monitoring cost obtained from two monitoring services in the Vancouver area and confirmed by telephone by Mr. N. Cheeseman, Executive Director, Canadian Alarm and Security Association, March 10, 1998.

17. Letter dated January 23, 1998, from Tom Makey, Fire Commissioner, Alberta Labour.

18. Full-time professional firefighters are included in the non-sprinklered scenarios, in accord with the B.C. Workers Compensation Board regulations. These regulations require a minimum of four firefighters at the fire scene before firefighters are allowed to enter a building on fire. Section 4 of the B.C. *Fire Department Act* specifies a "2 platoon" system for staffing of fire departments. In order to provide four professional firefighters on duty 24 hours per day, 20 firefighters are required at a base salary of $55,000 plus 30 per cent for benefits = $71,500 per firefighter per year.

    Letter dated March 19, 1998, R. Dumala, Fire Commissioner of British Columbia.

APPENDIX B

19. Fire Underwriters Survey, *A Guide to Public Fire Protection*, 1995, A1.

    This Guide suggests effective fire department response in terms of personnel, equipment, response travel times to the fire scene for fire department companies and required fire flow for a wide variety of building types. The guidelines are "based on successful practices in evaluating the fire suppression force needs in a great variety of municipalities and are reinforced by strong indications that municipalities tend to perceive the need for and to provide similar levels of fire suppression response. In fact, the strength and quality of protection that a community provides are presumably a function of its citizens' choice and the perception of need."

20. In this study, the term "non-fire calls" is used to describe fire department calls including medical assist, ambulance, vehicle extraction, water and ice rescue, hazardous materials incidents, disaster relief and emergency measures. "Fire calls" include actual fires, fires that are extinguished before fire department arrival, fire alarm calls for which the occupant suspected there was a fire but no fire was found and false alarms. In Burlington, non-fire calls amounted to approximately 65.4 per cent of all fire department calls in 1994.

21. *City of Barrie Fire Department - Summary of Fires and Alarms* (1993 and 1994). Approximately 93 per cent of fire department calls are fire-related calls.

22. Burlington Fire Department dispatch sheets derived from: Dillon, *City of Burlington Master Fire Protection Plan* (1987), 7-1 to 7-4.

APPENDIX D

23. The following reports reference planning, land use and infrastructure considerations related to mandatory sprinklers:

    Rosalie T. Reugg and Siegleinde K. Fuller, *Benefit-Cost Model of Residential Fire Sprinkler Systems*. NBS Technical Note 1203, (1984), 99, 100. (Note that

study does not include estimation of benefits to the homeowner due to relaxations in code requirements for home construction).

R.T. Reugg and S.K. Fuller, "The Economics of Fire Protection: Fast Response Residential Sprinklers," *Construction Management and Economics.* Vol. 3, (1985), 45.

League of California Cities Fire Chiefs Department Subcommittee, California Institute for Local Self Government, *Fire Sprinklers: How You Can Save Lives and Property.* (1989), 14-16.

John L. Bryan and Raymond C. Picard, *Managing Fire Services.* 2nd edition, (1988), Ch. 17, 439-444.

Buddy Dewar, *Saving Construction Money with Automatic Fire Sprinklers: An Economic Viewpoint.* 6-9.

Pam Powell, *Leadership for Life Safety: A Tale of Two Cities.* (1991), 25, 26.

APPENDIX H

24. National Fire Protection Association, NFPA 13, *Standard for the Installation of Sprinkler Systems.* (Quincy, Mass.: NFPA, 1996), p. 13-5.

25. National Fire Protection Association, NFPA 13D, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Mobile Homes.* (Quincy, Mass.: NFPA, 1996), p. 13D-5.

26. National Fire Protection Association, *NFPA 13D, Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Mobile Homes.* (Quincy, Mass.: NFPA, 1996), pp. 13D-14-13D-15.

27. Arthur E. Cote, P.E., and Jim L. Linville, *Fire Protection Handbook*, Seventeenth Edition, National Fire Protection Handbook (1991), 5-129.

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