Home Fire Sprinkler Cost Assessment

Final Report

Prepared by:

Newport Partners

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THE
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RESEARCH FOUNDATION

FIRE RESEARCH

THE FIRE PROTECTION RESEARCH FOUNDATION
ONE BATTERYMARCH PARK
QUINCY, MASSACHUSETTS, U.S.A. 02169
E-MAIL: Foundation@NFPA.org
WEB: www.nfpa.org/Foundation

FOREWORD

Residential fire sprinkler ordinances have been adopted by several hundred U.S. communities for use in single-family dwellings. Such systems have been shown to provide significant life safety benefits, however the installed cost of these systems remains as a point of uncertainty and a potential barrier to broader adoption. Informal estimates of typical installation costs can vary widely, and influence decision makers' views on the viability of sprinkler systems in new homes.

In order to provide information on this topic, and to understand the factors that may influence the costs and hence impede the widespread use of residential fire sprinklers, the Foundation undertook this study to provide a national perspective on the cost of home fire sprinklers by developing data on installation costs and cost savings for ten communities distributed throughout the United States. The study also explores the range of insurance premium discounts which are available to home owners with sprinkler systems in their houses.

The Research Foundation expresses gratitude to the National Fire Protection Association for its sponsorship of the project, and to the project technical panelists listed on the following page.

The content, opinions and conclusions contained in this report are solely those of the authors.

Home Fire Sprinkler Cost Assessment Research Project

Technical Panel

David Butry, National Institute of Standards & Technology

Mike Chapman, Chapman Homes

Keith Covington, Third Coast Design Studio, LLC

Paul Emrath, National Association of Home Builders

Jeff Feid, State Farm Insurance

Tony Fleming, Metropolitan Fire Protection

J. Dennis Gentzel, Office of the State Fire Marshal (MD)

Michael Kebles, Las Vegas Valley Water District

Ron Murray, UA Local 290, Portland, OR

Peg Paul, Home Fire Sprinkler Coalition

James Tidwell, International Code Council

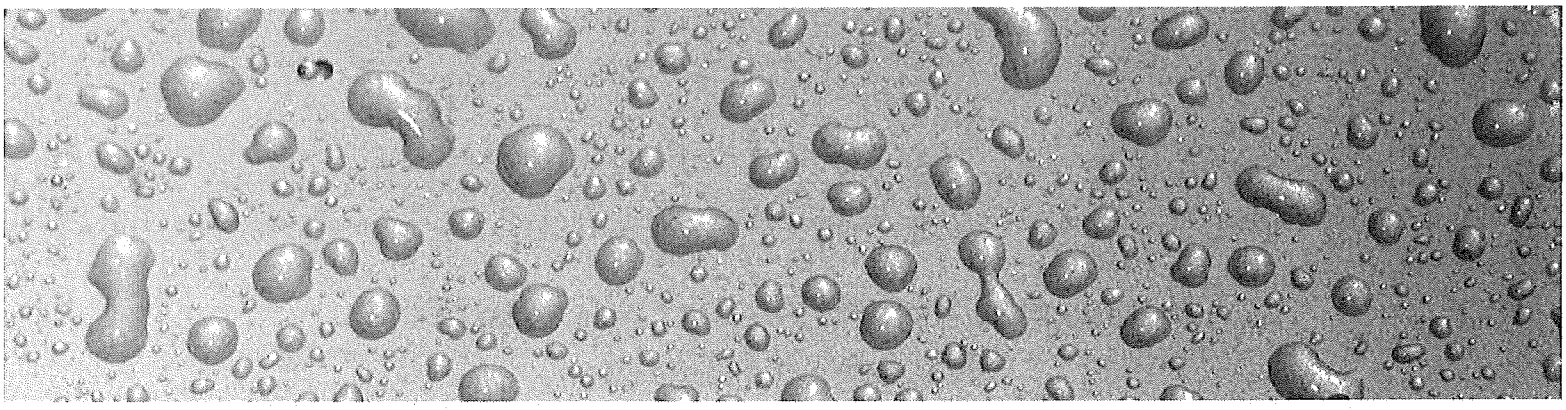
Paul Valentine, Mt. Prospect (IL) Fire Department

Keith Zaccard, Hanover Park (IL) Fire Department

Gary Keith, NFPA liaison

Principal Sponsor

National Fire Protection Association



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FIRE PROTECTION
RESEARCH FOUNDATION
Research in support of the NFPA mission

Home Fire Sprinkler Cost Assessment

Prepared by:
Newport Partners
Davidsonville, MD

Fire Protection Research Foundation

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Final Report

September 10, 2008

Acknowledgements

This research project was performed for the Fire Protection Research Foundation (FPRF) under the direction of Kathleen Almand, by Newport Partners LLC of Davidsonville, MD. While these two groups oversaw and conducted the research, respectively, many of the project's findings were made possible only through the cooperation of homebuilders, sprinkler contractors, local fire bureaus, and city officials. The design of this work called for a great deal of information gathering on the state of fire sprinklers in residential construction, and these groups helped to provide that information in the form of extensive documentation and responding to many requests for additional data. The authors of this report wish to gratefully acknowledge the contributions of dozens of individuals for their assistance.

This project was also guided by the FPRF's technical review panel, which provided valuable direction and feedback throughout the course of the project. The project authors wish to recognize this group and thank them for their participation and input:

David Butry, National Institute of Standards and Technology
Mike Chapman, Chapman Homes
Keith Covington, Third Coast Design Studio
Paul Emrath, National Association of Home Builders
Jeff Feid, State Farm Insurance
Tony Fleming, Metropolitan Fire Protection
Dennis Gentzel, Maryland State Fire Marshal's Office
Michael Kebles, Las Vegas Valley Water District
Ron Murray, UA Local 290
James Tidwell, International Code Council
Paul Valentine, Mt. Prospect Fire Department
Kenneth Zaccard, Hanover Park Fire Dept, Representing IAFC

Liaison
Peg Paul, Home Fire Sprinkler Coalition
Gary Keith, National Fire Protection Association

Executive Summary

Residential fire sprinkler ordinances have been adopted by several hundred United States communities for use in single-family dwellings. Such systems have been shown to provide significant life safety benefits, however the installed cost of these systems remains as a point of uncertainty and a potential barrier to broader adoption. Informal estimates of typical installation costs can vary widely and influence decision makers' views on the viability of sprinkler systems in new homes. Accordingly, the purpose of this study is to provide a national perspective on the cost of home fire sprinklers by developing data on installation costs and cost savings for ten communities distributed throughout the United States. The study also explores the range of insurance premium discounts which are available to homeowners with sprinkler systems in their houses.

To obtain information on the cost of installing residential sprinkler systems, ten case study communities were selected: nine in the United States, and one in Canada. The ten communities offer diversity in terms of sprinkler ordinance status, geographic location, housing style, and sprinkler system variables such as the type of piping material and the water supply source (municipal or on-site). For each of these communities, three building plans were collected from builders and sprinkler installers, along with sprinkler system cost data and other related cost and system information.

The term "sprinklered square feet" (sprinklered SF) reflects the total area of sprinklered spaces, including basements, garages, and attics when applicable. This term is used to better characterize the cost of sprinklers per unit of space which is covered by the system, especially since many of the homes have sprinklers in spaces beyond the normal living space, such as a garage. In terms of absolute costs, the total sprinkler system costs to the homebuilder ranged from $2,386 to $16,061 for the 30 houses.

The cost of sprinkler systems to the homebuilder, in dollars per sprinklered SF, ranged from $0.38 to $3.66. This range represents the 30 different house plans, with the average cost being $1.61 per sprinklered SF. The low end of this range

($0.38/sprinklered SF) represents a California house in a community with a long-standing ordinance, sprinklers in the attic and the garage (in addition to the living space), and some potential pricing benefits from a volume relationship with the sprinkler contractor. The high end of this cost range ($3.66/sprinklered SF) represents a Colorado house on well water and a system constructed with copper piping which utilized anti-freeze for freeze protection during the winter. These costs include all costs to the builder associated with the sprinkler system including design, installation, and other costs such as permits, additional equipment, and increased tap and water meter fees – to the extent that they apply. When accounting for any available credits given for the use of residential sprinklers (as was the case in Wilsonville, OR), the total sprinkler system costs to the builder averaged $1.49 per sprinklered SF.

Variables associated with higher cost systems included extensive use of copper piping (instead of CPVC or PEX), an on-site water supply (instead of municipal water), local requirements to sprinkler additional areas like garages or attics, and higher local sprinkler permit fees. The cost data also support the concept that communities with sprinkler ordinances in effect for more than five years tend to experience market acceptance and increased competition leading to lower system costs.

Credits or "trade-offs," which could include incentives like greater fire hydrant spacing in a community with sprinklers, were also investigated in each of the ten communities. While trade-offs may be used in communities as part of the zoning approval process for specific developments, just one of the ten communities had a credit or trade-off that applied to the houses which were analyzed. Wilsonville, OR, offers a credit of $1.21 per square foot of living space in an effort to partially offset the costs of sprinklers.

As complementary data to the cost analysis, a survey of available insurance premium discounts for homeowners with sprinkler systems was conducted. For each of the ten communities where sprinkler cost data was analyzed, the average insurance premium discount (as a percentage) was obtained from five insurers with significant market share

in the state. Discount savings percentages ranged from 0 to 10% among all companies and agencies surveyed, with an average premium discount of 7%. Related issues such as limits on the overall discount allowed for protective devices, sprinkler system requirements, and any potential insurance penalties for sprinklers were also explored. There were no instances discovered of insurance penalties or extra fees associated with the use of residential sprinkler systems due to concerns such as system leakage.

Insurance quotes for a theoretical prototype house were also obtained for the nine United States communities and one Canadian community. Quotes were obtained with and without a sprinkler system in an effort to estimate the discount that may result from having a sprinkler system. Annual discount savings averaged $22, or 3.42% of the annual premium. The difference in this discount compared to the average percentage discount found in the survey is likely due to the disconnect between generally quoted ranges and the real discounts allowed on real policies. As sprinkler systems become more common in given areas and this discount becomes a more common topic in the consumer-insurance agent dialogue, it is anticipated that actual discounts would more closely track with general ranges.

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I. Introduction

In 1975 the National Fire Protection Association (NFPA) introduced Standard 13D: Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Mobile Homes.[1] Since that time there have been approximately ten updates to the standard to reflect practical experience and to accommodate such things as nonmetallic piping and multipurpose systems. NFPA Standard 13D and related standard NFPA 13R[2] have evolved and been balanced to optimize system costs and fire safety for specific types of residential occupancy buildings.

Although residential sprinklers have been adopted by many communities, only 2% of all existing one- and two-family homes included a sprinkler system as of 2003.[3] Although the life safety benefit of home fire sprinklers is well validated, installed cost remains a major barrier to their acceptance by homebuilders and local regulators. In 1986, the City of Scottsdale commissioned an independent study of the cost to install an NFPA 13D compliant system in an average single-family residence in that city. The study reviewed installation and related costs associated with sprinklers, as well as where sprinklers would result in cost savings.

In September 2007, the National Institute of Standards and Technology (NIST) released a cost benefit analysis that concluded the multipurpose residential sprinkler systems are economical across three housing types: townhouse, colonial style two-story, and a ranch design. Multipurpose systems (a system integrated with the home plumbing system) are allowed in some locations but were not used as the basis of the Scottsdale study, as it was completed prior to the updates in the 13D standard which permitted multipurpose systems.

Since 1986, the number of communities in the United States with sprinkler ordinances has increased, resulting in increased efficiencies in design, manufacturing and installation, as well as greater regulatory, insurance and builder acceptance. Further, the more widespread installation of these

[1] "Mobile Homes" was replaced with "Manufactured Homes" in the 1994 edition.
[2] Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height, NFPA 13R.
[3] www.usfa.fema.gov/downloads/pdf/nrfsi-03report.pdf

systems provides the opportunity to take a broader look at the costs and cost savings associated with home fire sprinklers in today's housing industry. A broader range of cost data will be of value to local communities considering sprinkler ordinances, homebuilders and homeowners considering the installation of sprinklers, and other industry stakeholders.

The purpose of this study is to provide a national perspective on the cost of home fire sprinklers by developing data on installation costs and cost savings for ten communities, distributed throughout the United States.

II. Cost Analysis of Residential Sprinkler Systems

A. Criteria for Community Selection

To obtain information on the cost of installing residential sprinkler systems, ten case study communities were selected. The selection of the communities was based on the status of a local sprinkler ordinance, geography, availability of data, and other factors. In an effort to obtain a cross-section of jurisdictions with varied experiences, the communities selected include five that have had an ordinance in effect for more than five years, two that have had an ordinance in effect for five years or less, two that have never had an ordinance, and one that had an ordinance which has subsequently been repealed. The basis for these criteria was to capture potential cost differences that exist between regions with high rates of sprinkler regulation and those with lower rates of regulation (and presumably lower frequency of installations).

The broad geographic spread of the case study communities, as seen in the following section, provides variation which reflects different local circumstances. Such differences may include the type of installer, materials used, and specific system requirements – which all contribute to the cost of the system. The geographic spread also allowed for a variety of housing types to be analyzed. For example, while basement foundations are typical in the Northeast, slab foundations are more typical in places like California.

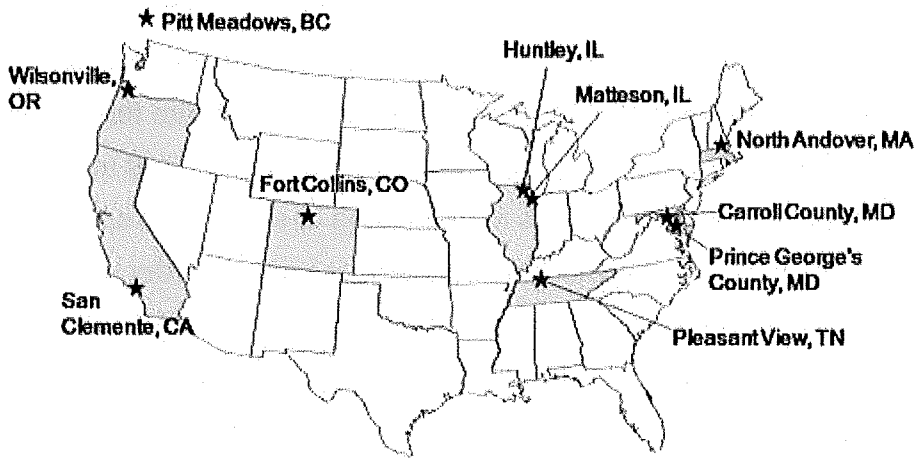
While the status of the local sprinkler ordinance and the geographic location of communities were the primary selection criteria, several other factors were evaluated with the intent of gaining a diverse set of data. For instance, communities which allow the use of multipurpose systems were sought to be included in the sample. And in fact, two communities that commonly install multipurpose systems were included in the cost analysis. Likewise, the selected communities cover a range of sprinkler piping materials, with CPVC (most common), copper, and PEX.

An effort was also made to select communities which would provide a mix of housing types in terms of the number of stories and foundation system. These housing features can significantly impact the extent and cost of a sprinkler system. The selection process also took into consideration the typical sprinkler installer in a community (sprinkler contractor or plumber), in an effort to include communities with both models.

As a result of the varied technical requirements between sprinkler systems installed in areas with and without a municipal water supply, building plans connected to non-municipal (on-site) water supplies were also captured in the selection. The study includes two communities where the building plans analyzed were on well water systems, allowing the characterization of the associated costs.

B. Community Overview

The ten communities selected for the cost analysis are shown below:



The selection of communities satisfies the various criteria and overall provides a diverse mix of sprinkler systems in terms of type of system, house, piping material, installer, water supply, etc. A Canadian community with a well established ordinance was also included to add more diversity to the community mix.

C. Selection of House Plans and Obtaining Cost Data

Within each case study community, the selection of house plans for obtaining cost data was typically based on builder or sprinkler contractor recommendations from local fire departments or local homebuilder associations. Nearly all builder and contractor participants were generally quite willing to share house plans and cost data documentation on sprinkler systems, as well as responding to a wide range of related questions.

All of the house plans and associated cost data obtained for this study were for homes that have been built since 2005, allowing for the analysis of recent cost figures. Three house plans were requested from each builder in an effort to obtain a broader sample. Actual house plans were obtained from the builder or sprinkler contractor with sprinkler system information, installation costs to the builder, and any additional costs to the builder not included in the installation cost. In cases where the builder could not provide additional cost information, local government offices were consulted on items such as permit fees or increased tap fee charges.

Overall, the thirty house plans reflect a cross-section of housing types nationwide, including one- and two-story homes; basement, slab, and crawl space foundations; and custom, semi-custom, and production homes. House sizes, measured in terms of "sprinklered square feet", averaged 4,118 sprinklered SF, ranging from 1,913 to 6,542 sprinklered SF. Throughout this report, the term "sprinklered SF" is frequently used, and reflects the <u>total area</u> of sprinklered spaces, including basements, garages, and attics when applicable. This term is used to better characterize the cost of sprinklers per unit of space, especially since many of the homes have sprinklers in spaces beyond the normal living space, such as a garage. For the sake of comparison, the thirty houses averaged 3,660 square feet <u>living space</u>, ranging from 1,723 to 6,360 sf. For the houses with basement

foundations, the area of the basement (unfinished or finished) was included in calculating the house's living space square footage.

House Size for 30-Home Sample

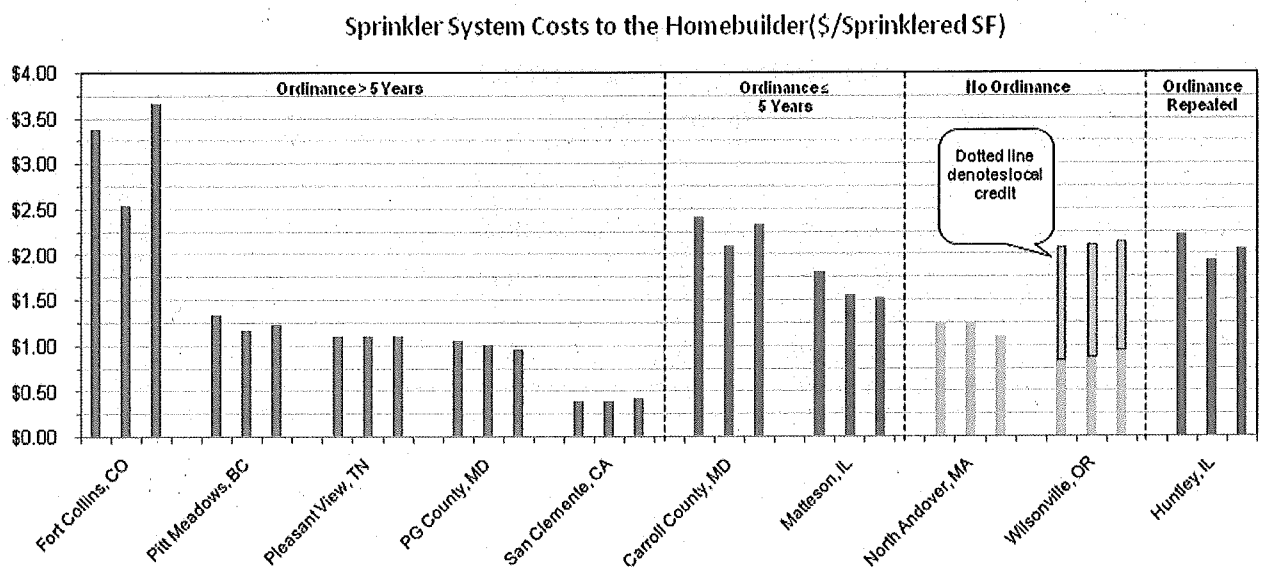
(Square feet)

	Sprinklered Area*	Living Area**
Mean	4,118	3,660
Median	4,124	3,441
Minimum	1,913	1,723
Maximum	6,542	6,360

* Sprinklered SF includes all spaces with sprinkler coverage
**Living area SF includes all livings spaces including basements (unfinished or finished)

D. Sprinkler System Costs

The cost of sprinkler systems to the homebuilder, in dollars per sprinklered SF, ranged from $0.38 to $3.66. This range represents the thirty different house plans, with the average cost being $1.61 per sprinklered SF. This figure includes all costs associated with the sprinkler system including design, installation, and other costs such as permits, additional equipment, increased tap and water meter fees – to the extent they apply. When accounting for any additional costs and any available credits (Wilsonville, OR), the total sprinkler system costs to the builder averaged $1.49 per sprinklered SF. Sprinkler system costs to the homebuilder are shown in the graph and table below, with more detailed cost data included in Appendix A.



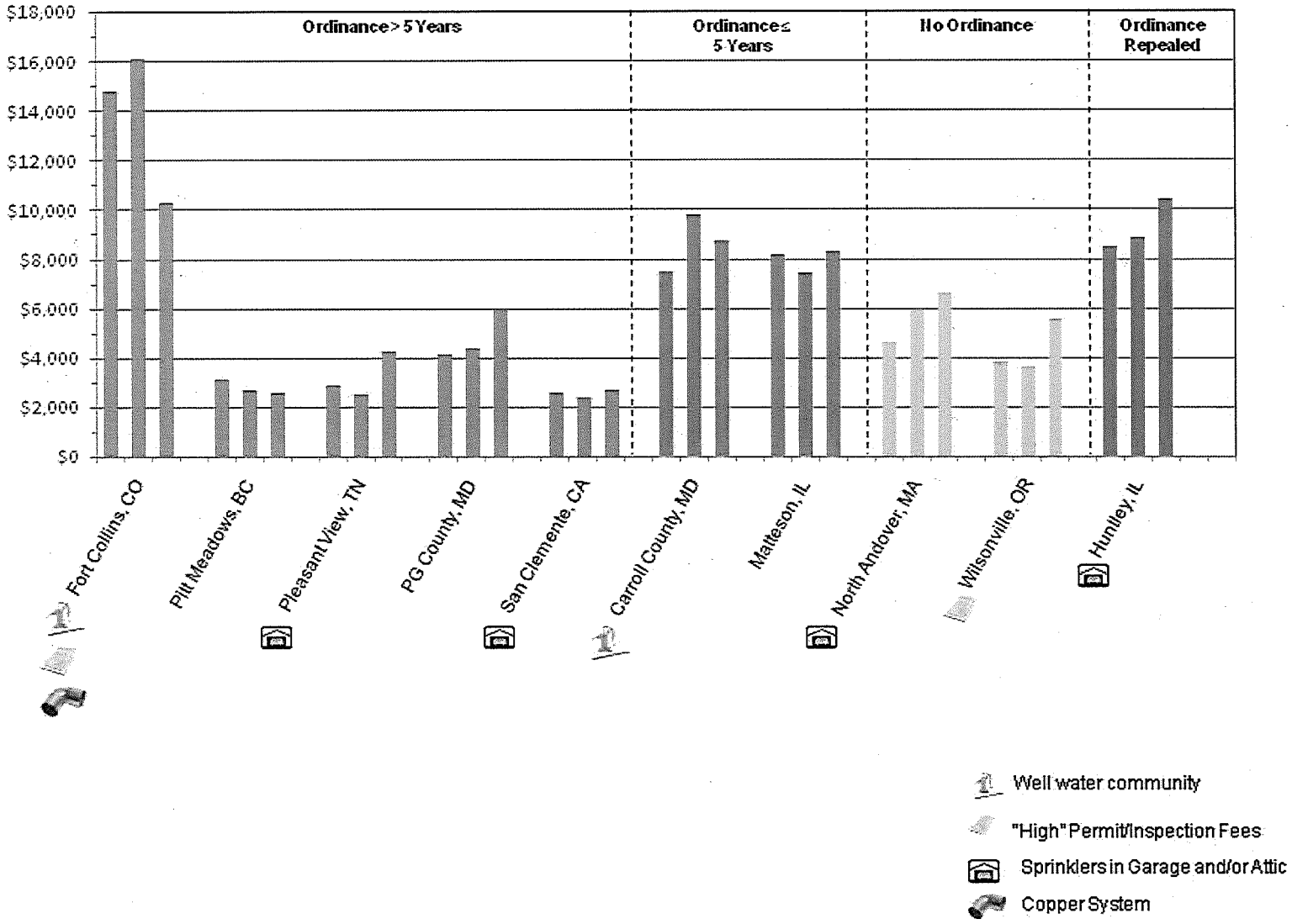
Sprinkler System Costs to the Homebuilder

	Cost ($/sprinklered SF)	Cost ($/living space SF)	Cost With Available Credits ($/sprinklered SF)	Cost with Available Credits ($/living space SF)
Mean	$1.61	$1.72	$1.49	$1.60
Median	$1.42	$1.49	$1.23	$1.38
Minimum	$0.38	$0.74	$0.38	$0.74
Maximum	$3.66	$3.66	$3.66	$3.66

The data above reflects the sprinkler system bid price plus all associated costs for the system which were not included in the bid (e.g. permit fee, increase in water service line, increase in tap fee). In several of the case study communities, these additional costs were already included in the contractor's bid price (like a permit fee) or these cost impacts did not apply (like an increased tap fee). One case study community, Wilsonville, OR, offers a $1.21 per square foot credit in an effort to partially offset the costs of sprinklers. When accounting for this credit across the entire 30-home sample, the total sprinkler system costs to the builder averaged $1.49 per sprinklered SF.

In addition to the cost of sprinklers per unit of space, the total cost per house is also an important metric. The following graph relates the total cost of the sprinkler system to the builder for all thirty house plans, with price-influencing variables noted for each community.

Total Installation Cost



It should be noted that the variables identified in the graph above, such as the use of copper piping, were identified as significant factors in the overall price of the sprinkler system through discussions with the builder or contractor, and more detailed cost data in some cases. However, given the small size of the data set and other limitations, this research did not attempt to specifically quantify the pricing influence of variables like copper piping or well water systems for use on a broader basis. Several system variables, including those identified on the graph, are discussed and summarized below. Many of these factors are discussed further in the Individual Community Analysis section of this report.

E. Sprinkler System Variables

Sprinkler System Requirements and Extent of Coverage

Sprinkler systems provisions which go beyond NFPA 13D minimum requirements are sometimes found in local ordinances. Such modifications may require additional types of spaces to be sprinklered, such as garages. In the ten communities analyzed, local modifications include requiring all bathrooms (regardless of size) to have fire sprinklers (Matteson, IL); requiring fire sprinklers in garages (Huntley, IL, North Andover, MA, Pleasant View, TN, and San Clemente, CA); and requiring fire sprinklers in attics (San Clemente, CA).

Since adding sprinkler coverage to spaces like garages necessitates additional piping, sprinkler heads, and in some cases systems which can be used in areas reaching freezing temperatures, this factor is significant to note when assessing system costs.

Type of Pipe Used

Systems in the study used a mix of metallic (copper) and nonmetallic (CPVC or PEX) pipe. In communities using solely nonmetallic pipe, installation costs averaged $1.18 per sprinklered square foot. Several communities used CPVC piping in unexposed areas and copper in exposed areas like unfinished basements. In such cases, installation costs averaged $1.56 per sprinklered square foot. The houses analyzed in Fort Collins, CO, used exclusively copper piping, with an average installation cost of $3.19 per sprinklered square foot. This suggests that the type of piping used in systems can substantially impact the overall job cost.

Sprinkler System Costs by Type of Pipe

	CPVC	CPVC/ Copper	Copper	CPVC	CPVC/ Copper	Copper
	$/Sprinklered SF			$/Living Space SF		
Mean	$1.18	$1.56	$3.19	$1.30	$1.65	$3.19
Median	$1.10	$1.56	$3.37	$1.24	$1.56	$3.37
Minimum	$0.38	$0.95	$2.53	$0.74	$0.95	$2.53
Maximum	$2.40	$2.21	$3.66	$2.40	$2.49	$3.66

Water Source

While most of the houses assessed rely on municipal water sources, two of the communities (Carroll County, MD, and Fort Collins, CO) included homes reliant on well water. Sprinkler systems of this type require a booster pump, which according to estimates from sprinkler contractors, can add roughly $2,000 to $3,600 to the overall system cost. Installation costs in dollars per sprinklered square foot for these two communities ranged from $2.09 to $3.66. This results in an average of $2.73 per sprinklered square foot, compared to the $1.18 average for houses in those communities with a municipal water supply. Consequently, it is evident that a home's water supply source can be a significant factor in increasing price.

Sprinkler System Costs by Water Source

	Municipal	Non-Municipal	Municipal	Non-Municipal
	$/Sprinklered SF		$/Living Space SF	
Mean	$1.18	$2.73	$1.31	$2.73
Median	$1.10	$2.47	$1.24	$2.47
Minimum	$0.38	$2.09	$0.74	$2.09
Maximum	$2.21	$3.66	$2.49	$3.66

Permit and Inspection Fees

Communities often have a combined permit and inspection fee for the installation of sprinkler systems. While two of the case study communities do not have any fee for sprinkler permit and

inspection (Pleasant View, TN, and San Clemente, CA), the other eight communities do have such fees. In these communities, those permit and inspection fees which were identified ranged from $50 to just under $800, although in some of the case studies the permit fees were layered into the overall system bid and were not identifiable as single line item costs. While some of the ten communities have a flat fee, others calculate permit and inspection fees based on the size of the house or valuation of the construction. In determining which communities should be classified as having "high" permit and inspection fees, a threshold amount of $350 was set as a "high" based on the limited data available on the range of fees.

System Design Type

Multipurpose systems combine plumbing and sprinklers into one system and piping network, resulting in continuous flow of water circulating in the system. Conversely, a standalone sprinkler system uses dedicated sprinkler piping supply, with water flowing only when a sprinkler is activated. In analyzing the system type used, data was obtained for multipurpose systems (six homes) and standalone sprinkler systems (twenty-four homes). In communities where multipurpose systems are used, installation costs in dollars per sprinklered square foot averaged $1.04. In communities where standalone systems were used, installation costs averaged $1.61 per sprinklered SF.

Sprinkler System Costs by Design Type

	Multipurpose (6 Homes)	Standalone (24 Homes)	Multipurpose (6 Homes)	Standalone (24 Homes)
	$/Sprinklered SF		$/Living Space SF	
Mean	$1.04	$1.61	$1.04	$1.73
Median	$1.02	$1.39	$1.02	$1.49
Minimum	$0.81	$0.38	$0.81	$0.74
Maximum	$1.32	$3.66	$1.32	$3.66

Type of Foundation

House foundation types in the study varied depending on geographic location. While basement foundations were the prevalent foundation type in the eastern communities, slab or crawl space

foundations were more common in the western communities of the study. The following table depicts house foundation types by region, based on U.S. Census Bureau data:

2007 Foundation Type Market Shares

	Nationwide (U.S.)	Northeast	Midwest	South	West
Full/Partial Basement	27.7%	73.6%	73.7%	10.6%	18.6%
Crawl Space	18.4%	10.5%	6.2%	19.2%	27.3%
Slab	52.7%	14.0%	19.7%	68.7%	53.5%
Other	0.6%	0.7%	0.1%	0.9%	0.4%
Not Reported	0.5%	1.2%	0.3%	0.6%	0.2%

For houses in the study with basement foundations, sprinkler system costs averaged $1.81 per sprinklered square foot. System costs for houses with slab foundations averaged $0.81 per sprinklered square foot, while houses with crawl spaces had an average cost of $0.92 per sprinklered square foot.

Sprinkler System Costs by Foundation Type

	Basement (20 homes)	Slab (6 homes)	Crawl Space (4 homes)	Basement (20 homes)	Slab (6 homes)	Crawl Space (4 homes)
	$/Sprinklered SF			$/Living Space SF		
Mean	$1.81	$0.81	$0.92	$1.90	$0.99	$1.00
Median	$1.68	$0.78	$0.88	$1.68	$0.97	$0.88
Minimum	$0.95	$0.38	$0.81	$0.95	$0.74	$0.81
Maximum	$3.66	$1.12	$1.10	$3.66	$1.32	$1.44

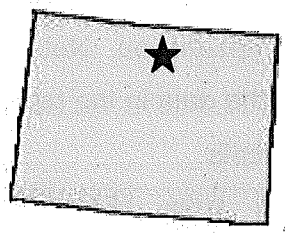
It should be noted that these costs, when presented in terms of dollars per sprinklered square foot, reflect the cost impacts of the foundation system but simultaneously incorporate the impacts of installing sprinklers in garages and attics in some cases. In other words, the limited data set and number of variables involved with each particular data point do not allow a more thorough analysis of this issue within this research.

F. Individual Community Analysis

The following table summarizes the communities, research houses, and sprinkler systems analyzed within each of the ten communities, followed by more detailed summaries of each jurisdiction. Note that for information such as pipe type, system type, and several other categories, the data in the table refers specifically to the 30 homes analyzed in the study, not community requirements.

Community	Sprinkler Ordinance Information	Year of Ordinance Adopted	Local Modifications to 13D	System Type	Pipe Type	Sprinkler Head Type	Water Supply	Foundation Type
Fort Collins, CO	13D > 5 years	1986	None	standalone	Copper	concealed; semi-recessed in exposed areas	Well water	Basement
Pitt Meadows, BC	13D > 5 years	1998	None	multipurpose	CPVC	semi-recessed	Municipal	Slab
Pleasant View, TN	13D > 5 years	2002	Sprinklers or a 1-hour rated assembly required in garage	standalone	CPVC	concealed	Municipal	2 Basement 1 Crawl Space
Prince George's County, MD	13D > 5 years	1992	None	standalone	CPVC; copper in basements	concealed; semi-recessed in exposed areas	Municipal	Basement
San Clemente, CA	13D > 5 years	1980	Sprinklers required in garages and attics	standalone	CPVC	concealed	Municipal	Slab
Carroll County, MD	13D < 5 years	2006	None	standalone	CPVC	concealed; semi-recessed in exposed areas	Well water	Basement
Matteson, IL	13D < 5 years	2004	All bathrooms must have sprinklers, regardless of size	standalone	CPVC; copper in basements	concealed; semi-recessed in exposed areas	Municipal	Basement
North Andover, MA	no ordinance	N/A	Sprinklers in garages	standalone	CPVC	concealed	Municipal	Basement
Wilsonville, OR	no ordinance	N/A	None	multipurpose	PEX	semi-recessed	Municipal	Crawl Space
Huntley, IL	13D repealed	2005	2 Sprinkler heads required in garages	standalone	CPVC; copper in basements	concealed; semi-recessed in exposed areas	Municipal	Basement

Fort Collins, Colorado



Fort Collins, Colorado has mandated NFPA 13D since 1986. The community is served by the Poudre Fire Authority. Residential sprinkler systems are typically installed by sprinkler contractors, but the installation may also be done by a plumber. Both standalone and multipurpose systems have been installed in homes in Fort Collins, and pipe type is typically plastic (CPVC or PEX), but may also be metallic (copper). The housing styles in Fort Collins range from manufactured housing to custom homes larger than 5,000 square feet, typically with basement foundations.

In the case study of Fort Collins, three house floor plans were obtained from a local sprinkler contractor. All three homes were built on a basement foundation, thus requiring sprinkler heads in the basement in addition to the main living areas per NFPA 13D. Including the basement area, the three homes had living space ranging from 2,797 to 6,360 square feet. In sprinklered square footage, the three homes ranged from 2,797 to 6,360 square feet (sprinklered area = living space area). The cost of the systems to the builder ranged from $10,250 to $16,061. The cost of the systems ranged from $2.53 to $3.66 per sprinklered SF.

Fort Collins – Sprinkler System Costs

	System Cost	*Sprinklered Space*		*Living Space*	
		Size	*$/SF*	*Size*	*$/SF*
House 1	$14,745	4,373	$3.37	4,373	$3.37
House 2	$16,061	6,360	$2.53	6,360	$2.53
House 3	$10,250	2,797	$3.66	2,797	$3.66

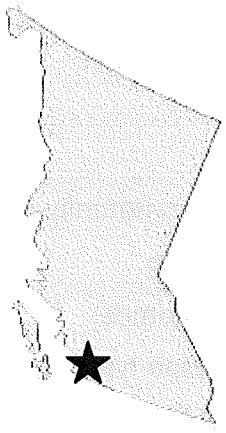
In each home, the sprinkler contractor installed a standalone system using copper piping.[4] Concealed sprinkler heads were used in the main living area, while semi-recessed sprinkler heads

[4] The sprinkler contractor has traditionally used only copper for sprinkler systems, believing it to be superior to plastic both in performance and longevity. The contractor is considering switching to plastic on their larger projects to remain competitive in the local market.

were used in areas where piping is exposed. Design fee, inspection fee, and permit fee were included in the sprinkler contractor's installation price. It is important to note, however, that the permit fee varies depending on the valuation of the individual home. Thus, permit fees for the three case study homes ranged from $510.46 to $799.83. The contractor's installation price also included an anti-freeze system, a system flow switch and alarm, and a backflow preventer. Because all three homes rely on well water, a booster pump and tank was required for the sprinkler system, which was also included in the contractor's installation price.

A supplemental bid for the sprinkler system installations in Fort Collins may help to characterize the relatively high system costs which were obtained for the homes. A second residential sprinkler contractor in the Fort Collins area quoted the system installations on the same three homes with a range of $8,000 to $12,500. This difference from the actual contractor bid range ($10,250 to $16,061) may be heavily influenced by the type of pipe used for the systems. PEX was used in the supplemental system bid design, while copper was used in the actual plans. PEX pipe is flexible tubing that is significantly less expensive than copper.

Pitt Meadows, British Columbia



Pitt Meadows, British Columbia has mandated NFPA 13D since 1998. The community is served by the Pitt Meadows Fire Department. There are no specific requirements for residential sprinkler systems beyond those of NFPA 13D. Residential sprinkler systems are typically installed by sprinkler contractors. Both standalone and multipurpose systems have been installed in homes in Pitt Meadows, and pipe is typically CPVC. Typical housing type in Pitt Meadows is two-story, 2,500 square feet in living space, with a crawl space or slab foundation.

In the case study of Pitt Meadows, three house floor plans were obtained from a semi-custom builder. All three homes were built on a slab foundation. The three homes had living space (and sprinkler square footage space) ranging from 2,109 to 2,342 square feet. The cost of the systems to the

builder ranged from $2,560 to $3,090.[5] When considered in terms of dollars per unit of space, the cost of the systems ranged from $1.15 to $1.32 per sprinklered SF (U.S. dollars).

Pitt Meadows – System Costs

	System Cost	*Sprinklered Space*		*Living Space*	
		Size	*$/SF*	*Size*	*$/SF*
House 1	$3,090	2,342	$1.32	2,342	$1.32
House 2	$2,690	2,336	$1.15	2,336	$1.15
House 3	$2,560	2,109	$1.21	2,109	$1.21

The sprinkler contractor installed a standalone system using CPVC piping and standard white semi-recessed sprinkler heads were used. Design fee, inspection fee, and permit fee were included in the sprinkler contractor's installation price. It is important to note, however, that the permit fee is calculated as 0.95% of the sprinkler system construction value. Thus, permit fees for the three case study homes ranged from $24.32 to $29.35. The contractor's installation price also included a system flow switch and alarm, and a backflow preventer.

Pleasant View, Tennessee

Pleasant View, Tennessee has mandated NFPA 13D since 2002. The community is served by the Pleasant View Volunteer Fire Department. In addition to the requirements of NFPA 13D, Pleasant View requires sprinkler coverage in the garage of homes. Standalone systems are the more common system used in Pleasant View, with CPVC pipe typically used. Typical housing type in Pleasant View ranges from 1,200 to 4,000 square feet of living space, both one- and two-story homes, with differing foundation types.

[5] The original prices were in Canadian dollars (CAN). Amounts were converted to USD (U.S. dollars) based on currency exchange rates of $1.00 CAN to $1.0099 USD as of March 2008 (when the costs were incurred).

In the case study of Pleasant View, three house floor plans were obtained from a semi-custom builder. Two of the homes were built with a basement foundation; the other home had a crawl space. The three homes had living space ranging from 1,723 to 3,326 square feet. In addition to sprinkler coverage in the living space, sprinklers were also installed in the garages. Thus, total sprinklered space in the three homes ranged from 2,612 to 3,826 sprinklered SF. The total cost of the sprinkler systems to the builder ranged from $2,489 to $4,208. When considered in terms of dollars per unit space, the cost of the system for each of the three homes was $1.10 per sprinklered SF.

Pleasant View – System Costs

	System Cost	*Sprinklered Space*		*Living Space*	
		Size	*$/SF*	*Size*	*$/SF*
House 1	$2,872	2,612	$1.10	2,112	$1.36
House 2	$2,489	2,273	$1.10	1,723	$1.44
House 3	$4,208	3,826	$1.10	3,326	$1.27

The sprinkler contractor installed a standalone system using CPVC piping and concealed sprinkler heads. The design fee for the sprinkler system was included in the sprinkler contractor's installation price. Pleasant View does not charge an inspection fee or permit fee for residential sprinkler systems. The contractor's installation price also included a system flow switch and alarm, and a backflow preventer.

All three homes use a municipal water source. An increased water service line size is needed in Pleasant View to allow for the potential increase in water flow associated with the sprinkler system. This increase from ¾" to 1" does not result in an increase in price for the sprinkler system installation, as all building lots now come with this increased line size. Increases in water meter size or water tap fee were not required or incurred.

Prince George's County, Maryland

Prince George's County, Maryland phased in the requirement of NFPA 13D beginning in 1987, when county council approved the mandate of residential sprinklers. On January 1, 1992, the final stage of the law went into effect stating that from that point on all residential structures, including single-family homes, must be fully protected by a NFPA Approved 13-D residential sprinkler.[6] The county is served by the Prince George's County Fire Department. There are no specific requirements for residential sprinkler systems beyond those of NFPA 13D. Residential sprinkler systems are typically installed by sprinkler contractors. Standalone systems are the common system used in Prince George's County, and pipe type is typically CPVC. Typical housing type in Prince George's County is two-story, roughly 3,000 square feet in living space, with a basement foundation.

In the case study of Prince George's County, three house floor plans were obtained from a regional production builder. All three homes were built on basement foundations. Including the basement area, the three homes had living space ranging from 3,903 to 6,170 square feet. The amount of sprinklered square footage ranged from 3,903 to 6,170 square feet. The cost of the systems to the builder ranged from $4,100 to $5,886. When considered as dollars per square foot of sprinkler coverage, the cost of the system ranged from $0.95 to $1.05 per square foot.

[6] Ronald Jon Siarnicki, "*Residential Sprinklers: One Community's Experience Twelve Years after Mandatory Implementation*," January 2001.

Prince George's County – System Costs

	System Cost	*Sprinklered Space*		*Living Space*	
		Size	*$/SF*	*Size*	*$/SF*
House 1	$4,100	3,903	$1.05	3,903	$1.05
House 2	$4,332	4,345	$1.00	4,345	$1.00
House 3	$5,886	6,170	$0.95	6,170	$0.95

The sprinkler contractor installed a standalone system using CPVC piping, using both concealed and standard white semi-recessed sprinkler heads. Design fee, inspection fee, and permit fee were included in the sprinkler contractor's installation price. The contractor's installation price also included a system flow switch and alarm, and a backflow preventer.

San Clemente, California

San Clemente, California has mandated NFPA 13D since 1980. The community is served by the Orange County Fire Authority. In addition to the requirements for residential sprinkler systems stated by NFPA 13D, the community also requires sprinkler coverage in the garage and attic space of homes. Standalone systems are the common system used in San Clemente, with CPVC pipe typically used. Typical housing type in San Clemente ranges from 2,500 to 5,000 square feet with slab foundations.

In the case study of San Clemente, three house floor plans were obtained from a production builder. All of the homes were built on slab foundations with living space ranging from 3,214 to 3,482 square feet. With garage and attic space considered, sprinklered space ranged from 6,329 to 6,542 square feet. The cost of the systems to the builder ranged from $2,386 to $2,655. When considered in terms of dollars per square foot of sprinkler coverage, the cost of the systems ranged from $0.38 to $0.41 per square foot. These low costs for the sprinkler system are likely the result of volume pricing

(the builder indicated that the contractor does a large volume of work with them) and the competitive market as a result of the length of the ordinance's existence.

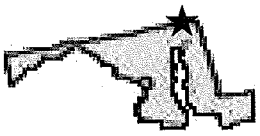
San Clemente – System Costs

	System Cost	*Sprinklered Space*		*Living Space*	
		Size	*$/SF*	*Size*	*$/SF*
House 1	$2,565	6,542	$0.39	3,482	$0.74
House 2	$2,386	6,329	$0.38	3,214	$0.74
House 3	$2,655	6,448	$0.41	3,358	$0.79

The sprinkler contractor installed a standalone system using CPVC piping and concealed sprinkler heads. The design fee and inspection fee for the sprinkler system was included in the sprinkler contractor's installation price. San Clemente does not charge a permit fee for residential sprinkler systems—the city promotes the use of residential sprinkler systems by eliminating such a fee. The contractor's installation price also included a system flow switch and alarm, and a backflow preventer.

All three homes use a municipal water source. There is no need for an increased water service line size, water meter size, or tap fee as a result of the sprinkler system installation.

Carroll County, Maryland



Carroll County, Maryland has mandated NFPA 13D since 2006. The county is served by local paid and volunteer fire departments. There are no specific requirements for residential sprinkler systems above and beyond those of NFPA 13D. Standalone systems are the common system used in Carroll County, although multipurpose systems may also be used. CPVC pipe is typically used in finished areas of homes, with copper used in unfinished areas. Typical housing in Carroll County is about 1,800 square feet for one-story ranches, and 3,500 square feet for two-story homes, with basement foundations.

In the case study of Carroll County, three house floor plans were obtained from a semi-custom builder. All three homes were built with a basement foundation, with living space (including basement) ranging from 3,131 to 4,686 square feet. The cost of the systems to the builder ranged from $7,499 to $9,800. When considered in terms of dollars per square foot of sprinkler coverage, the cost of the systems ranged from $2.09 to $2.40 per sprinklered square foot.

Carroll County – System Costs

	System Cost	*Sprinklered Space*		*Living Space*	
		Size	*$/SF*	*Size*	*$/SF*
House 1	$7,499	3,131	$2.40	3,131	$2.40
House 2	$9,800	4,686	$2.09	4,686	$2.09
House 3	$8,750	3,772	$2.32	3,772	$2.32

Because all three homes rely on well water, a booster pump and tank was required for the sprinkler system, which was included in the contractor's installation price. The sprinkler contractor installed a standalone system using CPVC piping. Concealed sprinkler heads were used in unexposed areas and semi-recessed sprinkler heads were used in exposed areas. The design fee, inspection fee, and permit fee for the systems were included in the sprinkler contractor's installation price. The contractor's installation price also included a system flow switch and alarm, and a backflow preventer.

Matteson, Illinois

Matteson, Illinois has mandated NFPA 13D since 2004. The community is served by the Matteson Fire Department. There are no specific requirements for residential sprinkler systems beyond those of NFPA 13D. Standalone systems are the more common system used in Matteson, with CPVC pipe typically used. Typical housing type in Matteson is about 3,000 square feet, both one- and two-story homes, usually with basement foundations.

In the case study of Matteson, three house floor plans were obtained from a semi-custom builder. All three homes were built with a basement foundation, with living space (including the basement area) and sprinklered space ranging from 4,562 to 5,478 square feet. The cost of the systems to the builder ranged from $7,407 to $8,329, or $1.52 to $1.80 per sprinklered square foot.

Matteson – System Costs

	System Cost	*Sprinklered Space*		*Living Space*	
		Size	*$/SF*	*Size*	*$/SF*
House 1	$8,198	4,562	$1.80	4,562	$1.80
House 2	$7,407	4,740	$1.56	4,740	$1.56
House 3	$8,329	5,478	$1.52	5,478	$1.52

The sprinkler contractor installed a standalone system using CPVC piping. Concealed sprinkler heads were used in unexposed areas and semi-recessed sprinkler heads were used in exposed areas. The design fee for the sprinkler system was $50, and the inspection fee and permit fee were a combined $150. The contractor's installation price also included a system flow switch and alarm, and a backflow preventer.

All three homes use a municipal water source. An increase in water service line size is needed in Matteson to accommodate the potential increase in water flow associated with the sprinkler system. This increased service line cost the builder an additional $700. Increase costs for a larger water meter or water tap fee were not incurred.

North Andover, Massachusetts

North Andover, Massachusetts does not require residential sprinklers by law, but instead has implemented NFPA 13D through local zoning. Sprinklers are a part of the zoning approval process, as discussed in a later section of the report. The community is served by the North Andover Fire Department. In addition to the requirements for residential

sprinkler systems stated by NFPA 13D, the North Andover Fire Department requires sprinkler coverage in the garage. Standalone systems are the common system used in North Andover, with CPVC pipe typically used. Typical housing type in North Andover is about 2,000 to 3,500 square feet, both one- and two-story homes, usually with basement foundations.

In the case study of North Andover, three house floor plans were obtained from a local developer in the community. All three homes were built with a basement foundation, with living space (including the basement area) ranging from 3,084 to 5,422 square feet. With garage square footage considered, the three homes ranged from 3,568 to 5,906 sprinklered square feet. The cost of the sprinkler systems to the builder ranged from $4,500 to $6,500, or $1.10 to $1.26 per sprinklered square foot.

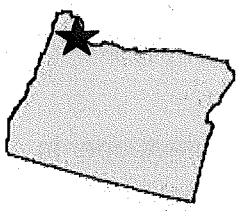
North Andover – System Costs

	System Cost	*Sprinklered Space*		*Living Space*	
		Size	*$/SF*	*Size*	*$/SF*
House 1	$4,500	3,568	$1.26	3,084	$1.46
House 2	$5,800	4,632	$1.25	4,148	$1.40
House 3	$6,500	5,906	$1.10	5,422	$1.20

The sprinkler contractor installed a standalone system using CPVC piping. Concealed sprinkler heads were used in unexposed areas and semi-recessed sprinkler heads were used in exposed areas of the home. The design fee and inspection fee were included in the cost to the builder, while the permit fee was a separate cost at $50 per home. The contractor's installation price also included a system flow switch and alarm, and a backflow preventer.

All three homes use a municipal water source. An increase in water service line size was needed to accommodate the potential increased water flow associated with the sprinkler system. This increase cost the builder an additional $450. An increase in tap fee at a cost of $500 was also incurred. There was no additional cost incurred related to the water meter size.

Wilsonville, Oregon



Wilsonville, Oregon does not require residential sprinklers by law, but has required NFPA 13D in the planned community of Villebois. The community is served by Tualatin Valley Fire and Rescue. There are no specific requirements for residential sprinkler systems beyond those of NFPA 13D. System installations are typically done by a plumber; thus a multipurpose system is the most common system used in the area. Typical housing type in Wilsonville is between 2,000 to 3,000 square feet, often with a crawl space foundation.

In the case study of Wilsonville, three house floor plans were obtained from a developer in the region. All three homes were on a crawl space, with living space (and sprinklered square footage) ranging from 1,913 to 2,917 square feet. The total cost of the systems to the builder (before any credit is applied) ranged from $4,014 to $5,892, or $2.02 to $2.10 per sprinklered square foot

The City of Wilsonville offers a $1.21 per square foot of living space credit to the builder to offset the costs associated with sprinklers. This is a one-time credit, offered at the time of system installation. The credit cannot be any greater than the water meter system development charge for a 3/4" meter, which is currently $4,436 – regardless of the size of the home. In rare situations, a large home requiring a 1" water meter may receive a greater credit, but only if proof is shown that this increased water meter size is directly a result of water flow requirements for the sprinkler system.

When accounting for the impact of this credit, the sprinkler system costs for the three Wilsonville homes range from $0.81 to $0.89 per sprinklered square foot, as shown in the table below.

Wilsonville – System Costs

	System Cost	*Sprinklered Space*			*Living Space*		
		Size	*Credit ($/SF)*	*$/SF*	*Size*	*Credit ($/SF)*	*$/SF*
House 1	$4,178	2,005	$1.21	$0.87	2,005	$1.21	$0.87
House 2	$4,014	1,913	$1.21	$0.89	1,913	$1.21	$0.89
House 3	$5,892	2,917	$1.21	$0.81	2,917	$1.21	$0.81

The plumber installed a multipurpose system using PEX piping and standard white semi-recessed sprinkler heads. The design fee was included in the cost to the builder, while the inspection and permit fee was a separate cost to the builder, at $360 per home. The system did not feature a flow switch and alarm, but a required backflow preventer was included in the installation cost. All three homes use a municipal water source. An increase in water service meter size from 5/8" to 3/4" was needed to accommodate the increased water flow associated with the sprinkler system.

Huntley, Illinois

Huntley, Illinois mandated NFPA 13D in 2005, and the mandate was repealed by the Village of Huntley in 2007. Residential sprinkler systems are currently a "mandatory option" in the Village of Huntley—builders must offer homeowners the option to install a residential sprinkler system. While 13D is not required in the village itself, sprinkler systems are still required in the county portion of the fire district. When NFPA 13D was required, sprinkler coverage was also required in the garages of homes. System installations are typically done by a sprinkler contractor, using CPVC pipe. Typical housing in Huntley ranges from 2,000 to 4,500 square feet, usually with basement foundations.

In the case study of Huntley, three house floor plans were obtained from a local sprinkler contractor. All three homes were built with a basement foundation, with living space (including the basement area) ranging from 3,400 to 4,560 square feet. With garage areas considered, the three homes ranged from 3,835 to 5,045 sprinklered square feet. The cost of the sprinkler systems to the builder ranged from $8,476 to $10,406, or $1.93 to $2.21 per sprinklered square foot.

Huntley – System Costs

	System Cost	*Sprinklered Space*		*Living Space*	
		Size	*$/SF*	*Size*	*$/SF*
House 1	$8,476	3,835	$2.21	3,400	$2.49
House 2	$8,851	4,575	$1.93	4,030	$2.20
House 3	$10,406	5,045	$2.06	4,560	$2.28

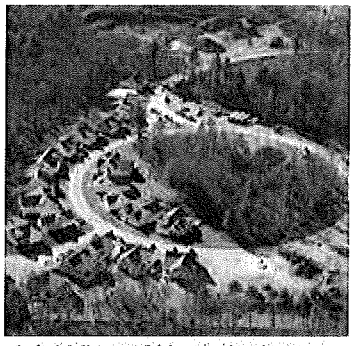
The sprinkler contractor installed a standalone system using CPVC pipe in all areas except the basement, where copper was used. Concealed sprinkler heads were used in unexposed areas and semi-recessed sprinkler heads were used in exposed areas. The design fee for the system was included in the sprinkler contractor's installation price, while the inspection fee and permit fee were a combined $300, an additional cost outside of the sprinkler contractor's installation price. The contractor's installation price also included a system flow switch and alarm, and a backflow preventer.

All three homes use a municipal water source. An increase in water service line size from 1" to 1 ½" was required to accommodate the increased water flow associated with the sprinkler system. This increase in water line size cost the builder an additional $821.

G. Credits and Trade-Offs

Trade-offs is a general term for allowances that can be made in the building construction or the development planning when sprinkler systems will be used in the houses. At the house level, a trade-

off could be a waiver of using fire-rated drywall in attached garages when the garage will be sprinklered. At the development level, trade-offs can include greater spacing of fire hydrants, narrower road widths, reduced water main sizes, relaxed requirements for the number of neighborhood exits, and others.


Arial View of North Andover Subdivision Illustrating Cluster Zoning

Potential trade-offs at the development level and the house level were investigated for all ten communities. Possible trade-offs were particularly scrutinized in North Andover, Massachusetts and Wilsonville, Oregon. Neither community has a mandated residential sprinkler ordinance, so incentives of some type could be reasonable tools to encourage the use of sprinklers.

North Andover has experienced tremendous growth in the past thirty-five years and has implemented cluster zoning as a way to preserve open space in the community. In subdivisions such as Hickory Hills, several additional building lots have been made available through cluster zoning, while still allowing for a large amount of open space in the development. Cluster zoning involves smaller lots and tighter setbacks, with larger parcels of dedicated open space nearby. The former North Andover Fire Chief viewed cluster zoning as a potentially greater fire risk (as homes are built closer together), resulting in a requirement for residential sprinklers for such developments as an additional safety measure. Additionally, because North Andover lacks the manpower for a new fire station, residential sprinkler systems can buy the fire department time in the event of an emergency. As a result, the town planning board created cluster-zoned subdivisions in North Andover as specially permitted lots, where developers and builders are required to install residential sprinkler systems in homes. Although the planning board does sometimes offer a decrease in the width of streets, increased spacing between fire hydrants, and the elimination of a turnaround for cluster developments, none of these trade-offs were offered in Hickory Hills.

Wilsonville, OR provides a per-house credit intended to help cover the cost to install a residential sprinkler system. The credit is limited to the current water meter system development charge. Thus, the one-time credit changes as the system development charge changes. Beyond this credit offered

by the City of Wilsonville, there were no documented development-level or house-level trade-offs in the ten communities.

For communities where garages are sprinklered, there were no trade-offs identified related to drywall specifications. For each of the four communities in the study with sprinklered garages, the additional coverage is treated as an added safety measure, to be implemented in addition to the traditional fire-rated drywall required by building codes. In many cases, local jurisdictions will require sprinkler coverage in the garage when there are bedrooms and/or other living areas above the garage.

Although evidence of trade-offs was not found in the case study communities, there is a general knowledge in the industry that trade-offs may be implemented on more of a case-by-case basis integrated with the zoning approval process for developments, rather than as a standard community policy. Negotiations are often made between a developer and the Authority Having Jurisdiction (AHJ). Such agreements may be made in order for a developer to avoid penalty for not installing sprinklers.

III. Insurance Discounts for Residential Sprinkler Systems

A. Methodology for Estimating Insurance Premium Reductions

A 2007 study conducted by the National Association of Home Builders (NAHB) economics department showed that insurers do offer meaningful discounts for residential sprinkler systems, but that the discounts varied from state to state. For this study, an insurance survey was created to examine insurance companies and local agencies in the nine states where case study communities were located. This survey was both quantitative and qualitative, gathering not only average insurance premium discounts, but also information on insurance company categorization and/or requirements for discounts, and the familiarity of consumers with such discounts. This information is intended to help round out the case studies and provide meaningful data on actual insurance incentives and policies.

For each community, the average insurance premium discount (as a percentage) was obtained from five insurance companies. The National Association of Insurance Commissioners (NAIC) 2007 Market Share Reports for Property/Casualty Insurance Groups and Companies were used to identify the top five insurance companies in each state. In cases where insurance discounts could not be obtained from a top-five company, discounts were obtained from subsequent companies from the NAIC report list. In cases where information could not be obtained directly from an insurance company, local insurance agencies were contacted.

B. Insurance Premium Discounts for Residential Sprinkler Systems

Discount savings percentages are derived from the whole annual homeowner's insurance premium (rather than just a portion of the premium). Discount savings percentages ranged from 0 to 10% among all companies and agencies surveyed, with an average discount savings percentage premium of 7%.

In California, annual homeowner's insurance premium discount percentages were obtained from Allstate, State Farm, Farmers, Auto Club Enterprises, and Nationwide. Discounts ranged from 0 to 10%.

In Colorado, annual homeowner's insurance premium discount percentages were obtained from State Farm, Farmers, American Family, Allstate, and Travelers. Discounts ranged from 3 to 10%.

In Illinois, annual homeowner's insurance premium discount percentages were obtained from Allstate, State Farm, Country Financial, Farmers, and American Family. Discounts ranged from 5 to 10%.

In Maryland, annual homeowner's insurance premium discount percentages were obtained from Allstate, State Farm, Travelers, Nationwide, and Erie. Discounts ranged from 4 to 10%.

In Massachusetts, annual homeowner's insurance premium discount percentages were obtained from Commerce, Andover, Chubb & Son, Travelers, and Liberty Mutual. Discounts ranged from 5 to 10%.

In Oregon, annual homeowner's insurance premium discount percentages were obtained from State Farm, Farmers, Allstate, Country Financial, and American Family. Discounts ranged from 5 to 10%.

In Tennessee, annual homeowner's insurance premium discount percentages were obtained from State Farm, Tennessee Farmers, Allstate, Travelers, and Nationwide. Discounts ranged from 0 to 10%.

In British Columbia, annual homeowner's insurance premium discount percentages were obtained from Aviva, Canadian Northern Shield, Economical Insurance, Dominion of Canada, and Gore Mutual. Discounts ranged from 0 to 12%.

These findings are summarized in the table below.

State	Insurance Company	Market Share in State/Province	Percentage Discount for Residential Sprinklers
Maryland	Allstate	21.06%	4%
	State Farm	16.61%	10%
	Travelers	13.01%	10%
	Nationwide	11.12%	5%
	Erie	8.38%	5%
Tennessee	State Farm	26.54%	10%
	Tennessee Farmers	18.30%	5%
	Allstate	11.43%	10%
	Travelers	5.58%	10%
	Nationwide	5.24%	0%
Illinois	State Farm	32.66%	10%
	Allstate	16.29%	10%
	Country Insurance	8.09%	5%
	Farmers	6.60%	6%
	American Family	5.28%	10%
Massachusetts	Commerce	10.02%	5%
	Andover Companies	8.45%	5%
	Chubb & Son Inc.	7.98%	10%
	Travelers	7.65%	7%
	Liberty Mutual	7.08%	6%
Colorado	State Farm	23.62%	10%
	Farmers	15.45%	5%
	American Family	12.42%	10%
	Allstate	10.28%	5%
	Travelers	3.96%	3%
California	State Farm	20.23%	10%
	Farmers	17.03%	10%
	Allstate	13.33%	10%
	Auto Club Enterprises	4.33%	0%
	Nationwide	3.58%	6%
Oregon	State Farm	25.26%	10%
	Farmers	19.09%	5%
	Allstate	10.66%	10%
	American Family	4.17%	10%
	Country Insurance	4.07%	5%
British Columbia	Aviva	8.05%	5%
	Canadian Northern Shield	6.23%	13%
	Economical Insurance	6.10%	0%
	Dominion of Canada	3.11%	0%
	Gore Mutual	1.98%	0%

Categorization of Sprinkler Systems

Many insurance companies classify the discount offered for residential sprinkler systems by the extent of sprinkler coverage in the home. While these exact categories and their specific requirements differ between companies, most insurers typically classify system types into "partial" or "full" systems. A partial system generally means sprinkler coverage in the main living area only. In a few instances, partial may be defined as sprinkler coverage in the utility room only. A full system often means sprinkler coverage in all areas of the home, including the basement or crawl space, all bathrooms, closets, and hallways. In some instances, a full system classification may also require sprinkler coverage in garages. Furthermore, several companies required the sprinkler system to be monitored with an alarm. For the purposes of this insurance survey, the discount percentage offered by an insurer that most closely aligned with the fire sprinkler ordinance requirements for the particular case study community being assessed was used.

Most insurance companies consider a residential sprinkler system to be a protective device. Other protective devices warranting homeowner's insurance discounts include a monitored fire alarm connected to the sprinkler system (which may range from a 3 to 5% discount based on limited feedback from insurance agents), smoke detector, fire extinguisher, security system, deadbolt locks, and home location in a gated community. The majority of insurance companies place a cap on the maximum discount percentage offered for all protective devices. This cap ranged from 10 to 20% in the survey, with an average protective device discount cap of 14%.

Penalties/Fees as a result of System Leakage

The presence of a residential sprinkler system can raise concern about the risk of accidental water leakage from the system. According to the Insurance Services Office, Inc. (ISO) standard "Homeowners 3—Special Form" policy provides for coverage due to damages from residential fire sprinkler system leakage provided that reasonable care has been taken to maintain heat in the building to prevent freezing of the residential fire sprinkler system. Essentially residential fire sprinkler piping is treated the same as regular household plumbing as far as coverage and pricing for ISO's

standard Homeowners program. Thus, there is no extra charge for the coverage of the peril of fire sprinkler leakage.[7]

This issue was probed in the insurance survey to see if the homeowner's insurance policy typically covers sprinkler system leakage. Insurers interviewed in the study echoed the preceding ISO recommendations. Insurance companies routinely treat sprinkler system piping the same as a plumbing system. Sprinkler system leakage is reported as a loss. Accidental sprinkler system leakage is most likely covered under the homeowner's insurance policy, whereas sprinkler system leakage as a result of a maintenance issue may not be covered by the policy. Claims adjusters determine whether or not sprinkler system leakage is covered under the homeowner's policy, often on a case by case basis.

Document Requirements for Discounts

For those insurance companies offering premium discounts for residential sprinkler systems, many require proof of the system's installation or existence. Methods of providing proof to insurance company underwriters vary among companies. However, the most common include an interior inspection of the home, a copy of the installation certificate and/or receipt, submitting pictures of the actual system, and providing the name of the sprinkler contractor. In some instances, one or more of these may be required by an insurer. In other cases, an insurer may not require any proof at all—the homeowner would simply be required to notify the insurer of the system installation upon application. It is important to note that misrepresentation in the application could put the homeowner in breach and possibly void parts or all of the policy.

Homeowner Awareness of Discounts

Homeowners are often informed of possible insurance savings for sprinklers by their insurance agent. An insurance agent typically gathers fact-finding information about the homeowner and the property in an initial or renewal appointment with the homeowner purchasing insurance. It is common for an insurance agent to ask the homeowner at this time if the property being insured has certain protective devices, including a residential sprinkler system.

[7] Fire Sprinkler System Leakage in ISO Homeowners Policy, Insurance Services Office, 2008.

C. Related Issues Affecting the Magnitude and Availability of Discounts

The level of insurance discount knowledge varied greatly, which was particularly evident in comparing a region where residential sprinkler systems are very common to a region where residential sprinkler systems are not common. This often resulted in varying levels of an agent's familiarity with residential sprinkler systems and the insurance premium discount offered by their insurance company. Insurance agents with modest familiarity with residential sprinkler systems typically referred to the insurance company manual to obtain insurance premium discount information.

In obtaining information on possible penalties as a result of sprinkler system leakage, many agents were unsure of or unfamiliar with such penalties. Agents explained that insurance company underwriters deal with the claims process that would result if a sprinkler system were to accidentally leak.

D. Home Insurance Quotes for a Sample Home

As a separate part of the insurance study to complement the information obtained from the insurance survey, insurance policy quotes were obtained for the nine United States communities and one Canadian community using a theoretical prototype house. For the United States communities, the prototype house was a two-story 2,500 square foot colonial with an unfinished basement and one-car attached garage. Quotes were obtained with and without a sprinkler system in an effort to estimate the discount that may result from having a sprinkler system. Discount savings in dollars ranged from $5 in Huntley, IL to $53 in North Andover, MA, with an average savings of $22. As a percentage from the quoted price without a sprinkler system, savings ranged from 1.14% to 6.68%, with an average of 3.42%.

For the Canadian community, the prototype house was a two-story 2,300 square foot home with crawl space, located in Pitt Meadows, British Columbia. Similar to the United States communities, quotes were obtained with and without a sprinkler system. Discount savings in dollars was $55, and the percentage discount from the quoted price without a sprinkler system was 4.83%.

Community	Actual Residence Value	Quoted Residence Value	Premium without Sprinklers	Premium with Sprinklers (all areas)	Discount Savings($)	Discount Savings (%)
PG County (Bowie), MD	$244,836	$245,000	$970	$919	$51	5.26%
Pleasant View, TN	$223,612	$224,000	$600	$588	$12	2.00%
Matteson, IL	$294,414	$294,000	$455	$443	$12	2.64%
Huntley, IL	$282,051	$282,000	$438	$433	$5	1.14%
San Clemente, CA	$316,172	$316,000	$674	$661	$13	1.93%
Fort Collins, CO	$228,639	$229,000	$411	$404	$7	1.70%
Carroll County (Finksburg), MD	$243,361	$243,000	$519	$485	$34	6.55%
Wilsonville, OR	$274,138	$274,000	$342	$332	$10	2.92%
North Andover, MA	$285,162	$285,000	$794	$741	$53	6.68%
Pitt Meadows, BC	--	$305,000	$1,139	$1,084	$55	4.83%

As noted in the above table, the average discount in all the communities when using a prototype home to get actual bids was less than the percentage range found in the insurance survey. This shows that there is variance in the discount percentage offered which can be best attributed to competitive market pricing.

Appendix A – Sprinkler System Costs by Community

Community and House Plan	Area of Sprinklered Spaces (SF)	Living Space (SF)	TOTAL COST	Local Sprinkler Credit	Net Cost (contractor + additional + credits) in $/SF of Sprinklered SF	Net Cost (contractor + additional + credit) in $/SF of Living Space
Fort Collins, CO - House 1	4,373	4,373	$14,745	0	$3.37	$3.37
Fort Collins, CO - House 2	6,360	6,360	$16,060	0	$2.53	$2.53
Fort Collins, CO - House 3	2,797	2,797	$10,250	0	$3.66	$3.66
Pitt Meadows, BC - House 1	2,342	2,342	$3,090	0	$1.32	$1.32
Pitt Meadows, BC - House 2	2,336	2,336	$2,690	0	$1.15	$1.15
Pitt Meadows, BC - House 3	2,109	2,109	$2,5600	0	$1.21	$1.21
Pleasant View, TN - House 1	2,612	2,112	$2,872	0	$1.10	$1.36
Pleasant View, TN - House 2	2,273	1,723	$2,489	0	$1.10	$1.44
Pleasant View, TN - House 3	3,826	3,326	$4,208	0	$1.10	$1.27
Prince George's County, MD - House 1	3,903	3,903	$4,100	0	$1.05	$1.05
Prince George's County, MD - House 2	4,345	4,345	$4,332	0	$1.00	$1.00
Prince George's County, MD - House 3	6,170	6,170	$5,886	0	$0.95	$0.95
San Clemente, CA - House 1	6,542	3,482	$2,565	0	$0.39	$0.74
San Clemente, CA - House 2	6,329	3,214	$2,386	0	$0.38	$0.74
San Clemente, CA - House 3	6448	3,358	$2,655	0	$0.41	$0.79
Carroll County, MD - House 1	3,131	3,131	$7,499	0	$2.40	$2.40
Carroll County, MD - House 2	4,686	4,686	$9,800	0	$2.09	$2.09
Carroll County, MD - House 3	3,772	3,772	$8,750	0	$2.32	$2.32
Matteson, IL - House 1	4,562	4,562	$8,198	0	$1.80	$1.80
Matteson, IL - House 2	4,740	4,740	$7,407	0	$1.56	$1.56
Matteson, IL - House 3	5,478	5,478	$8,329	0	$1.52	$1.52
North Andover, MA - House 1	3,568	3,084	$4,500	0	$1.26	$1.46
North Andover, MA - House 2	4,632	4,148	$5,800	0	$1.25	$1.40
North Andover, MA - House 3	5,906	5,422	$6,500	0	$1.10	$1.20
Wilsonville, OR - House 1	2,005	2,005	$4,178	($1.21)	$0.87	$0.87
Wilsonville, OR - House 2	1,913	1,913	$4,014	($1.21)	$0.89	$0.89
Wilsonville, OR - House 3	2,917	2,917	$5,892	($1.21)	$0.81	$0.81
Huntley, IL - House 1	3,835	3,400	$8,476	0	$2.21	$2.49
Huntley, IL - House 2	4,575	4,030	$8,851	0	$1.93	$2.20
Huntley, IL - House 3	5,045	4,560	$10,406	0	$2.06	$2.28