Economic Cost Benefit Analysis of Residential Fire Sprinkler Systems Broward County, Florida

Prepared for:
Broward County

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Executive Summary

The cost of residential fire sprinkler systems varies across the country for a variety of reasons. Housing design, construction, and plumbing materials, and the availability of sprinkler contractors are a few variables that can factor into pricing. The purpose of this report is to present an estimate of the economic cost benefit pertaining to the installation of residential fire sprinkler systems in new, single-family homes in Broward County using the data from previously completed cost benefit studies from Coral Springs (2021) and Tamarac, Florida (2019), two jurisdictions located within Broward County.

To best estimate the costs associated with installing residential fire sprinkler systems Newport obtained estimates from sprinkler contractors in Broward County. Three estimates were provided by contractors in Coral Springs and three from Tamarac for a total of six estimates. The estimates were based on house plans identified by each jurisdiction that best represent the characteristics of new home construction in the area. Contractors were asked to only provide estimates for the design and installation of the system, and not include any outside fees or costs.

In addition to the design and installation costs, other costs that are typically associated with installing a residential fire sprinkler system include permit fees and water meter fees or upsizing charges. Often, these fees and costs are determined by the individual jurisdictions. For this report, Newport determined that both Coral Springs and Tamarac had permit fees as well as a hard cost for upsizing water meters. These costs were determined through conversations with city and fire officials and sprinkler contractors in both jurisdictions and are included in the final cost estimates.

The total cost for installing residential fire sprinklers in Broward County was estimated by using the six contractor estimates for design and installation and adding the estimated permit fees and meter upsizing costs to each to obtain a total cost estimate for each home. From these estimates, the average cost across Broward County is $2.78 per square foot of sprinklered space.[1] When compared to the most recent cost study from the National Fire Protection Association (NFPA) in 2013, this represents a higher-than-average cost. However, there are

[1] Sprinklered space refers to the area of the home required to covered by an automatic fire sprinkler system according to NFPA 13D.

many variables that factor into the price of installing a residential fire sprinkler system that will be discussed later in the report.

Benefit calculations took into consideration a variety of inputs including determining probability of a home fire, the average ratio of property loss to value for homes without sprinklers, expected deaths or injury that occur from fires, and the value of life. In addition, the home and property value in Tamarac and Coral Springs were considered. These measures were compared for homes with and without fire sprinkler systems. The differences resulted in significant benefits associated with fire sprinklers in homes, including monetary benefits of lives saved, injuries averted, and the uninsured direct and indirect costs from property loss. Additionally, reduced cost of homeowner's insurance provides a direct economic benefit for homeowners.

In addition to the benefits associated with an individual homeowner or property, the jurisdiction may also benefit from the reduction of impact fees, as well as a reduction of infrastructure requirements. Examples of infrastructure requirement reductions include: reduced requirements for hydrant spacing, minimum road widths, fire flows, cul-de-sac widths, and dead-end street width. Applicable incentives associated with Florida's adoption of NFPA 1, were considered in the net positive benefit calculations.

The costs and benefits associated with residential fire sprinkler systems are outlined in Table 1. This report discusses the methodology used in this study, the variables considered for both costs and benefits, and other factors that impact the costs of installing residential fire sprinklers. Overall, the study concludes residential fire sprinklers are estimated to provide a net positive benefit in Broward County.

Table 1. Net Benefit

	Broward County (Average)
Average Cost of Installation	$5,290.61
Infrastructure Reduction	$1,271
Benefit	$10,815.75
Net Positive Benefit	$6,796.14

Overview

Homeowners today are at significant risk for injury, property loss, and even death from home fires. A recent National Fire Protection Association (NFPA) study, reported annual fires in residential buildings to be over 270,500.[2] One-and-two family homes only represent about twenty percent of all structure fires reported yet these fires represent 66 percent of civilian deaths and 51 percent of civilian injuries according to the same report.[3]

Fire sprinkler installation in one- and two-family dwellings can be used as a tool to greatly reduce death and injury for home inhabitants. Across a 4-year period, there was an 81 percent reduction in civilian deaths in homes with fire sprinklers than those without.[4] Firefighters are also impacted by fire sprinklers when responding to home fires. Homes with fire sprinkler systems reported fire fighter injury rate being 79% lower than when responding to homes without sprinkler systems.[5]

Automatic residential fire sprinkler systems for one- and two-family dwellings have been required as part of the International Residential Code (IRC) since the 2009 version. This requirement has carried forward in each subsequent update (2012, 2015, 2018, and most recently in 2021). The 2020 Florida Building Code is based on the 2018 IRC with amendments that exclude provisions for residential fire sprinkler systems in one – and two-family dwellings.[6] The Florida Fire Prevention Code, based on NFPA 1 and NFPA 101, also removes the requirements for automatic fire sprinkler systems in one- and two-family dwellings at the state level.[7]

While not a statewide requirement, Florida allows local jurisdictions the ability to implement residential fire sprinkler requirement for one- and two-family dwellings. To do so, the jurisdiction must perform and submit an analysis of the economic impacts to inform local constituents prior to adopting the requirement. This analysis should not only include the cost to design and install the system, but also any additional fees as previously discussed, as well as the benefits that

[2] *Trends and Patterns of Fire Losses in 2017*, National Fire Protection Association, January 2017
[3] Ibid
[4] Marty Ahrens*, U.S. Experience with Sprinklers*, National Fire Protection Association, July 2017
[5] Ibid
[6] Florida Building Code, 7th Edition, 2020, Section 903.2.11.3
[7] Florida Fire Prevention Code, 2020, Section 8(a)

may accrue to residents. Additionally, before imposing any requirement, the local government must provide the homeowner with a letter documenting any infrastructure, tax, or fee allowances and waivers as well as a cost analysis that determines these cost savings are approximate to the cost of installing a residential sprinkler system.[8] The purpose of this study is to show expected costs and benefits relevant to the proposed adoption of requirements for residential fire sprinkler systems in Broward County, Florida.

The main point of resistance to requiring automatic fire sprinklers in one- and two- family dwellings is cost. Because this is such a prevalent issue, there have been several economic studies conducted to analyze the cost impact associated with these sprinkler systems. In 2013, NFPA completed a comprehensive national study which found the national average to design and install a residential fire sprinkler system to be $1.35 per square foot. That report also compared the national data to data from states (California and Maryland) which have statewide requirements for all new construction, which dropped the average cost to $1.16 per square foot. The cost of sprinkler systems can vary widely depending on several variables (house size, house design, climate, type of pipe, water supply, labor costs, etc.). What was apparent however, was that widespread adoption helps to lower costs.[9]

In addition to the cost studies, NFPA conducted a 2016 market research study, "Home Fire Sprinklers- - Stakeholder Perceptions in Mandatory Requirement States." Various stakeholder groups (water purveyors, local government officials, and homeowners) in both California and Maryland were surveyed and interviewed to gauge how the statewide requirements were affecting stakeholders. The report highlights an overwhelmingly positive experience and perceived value from these groups. To summarize the key findings, homeowners noted that the sprinklers provided them with a sense of safety, added value to their home, and lowered their homeowners insurance rates. Local government officials believed that home fire sprinklers help reduce death and injury to both residents and firefighters and help in reducing the costs due to fire damage. Lastly, water purveyors indicated the impact on the water supply is a non-issue stating, "Our system can handle 2,000 gallons/min. Residential fire sprinklers are a drop in the bucket." That report can be read in its entirety here.[10]

[8] Florida Fire Prevention Code, 2020, Section 8(a), Section 8(b) 2
[9] *Home Fire Sprinkler Cost Assessment*, Newport Partners, 2013
[10] *Stakeholder Perceptions of Home Fire Sprinklers*, Newport Partners, 2016

Based on the estimates used in his report, the average cost per square foot of sprinklered space is estimated to be $2.78 per square foot, as shown in Table 2. While at first this may seem significantly higher compared to the national average of $1.35 per square foot, there are several variables that factor into the higher estimated cost. The lack of a residential sprinkler requirement results in a low number of residential projects, which impacts the cost in several ways. First, it drives up the design costs as each home in this report needed an individual design. With more expertise and repetition of designs, the design cost decreases. Second, the labor costs for any different or innovative type of work are almost always higher. This is true even if the contractor has commercial experience as residential systems are designed and installed differently. Newport contacted over 40 fire sprinkler installers that included "residential installations" in their promotional material to secure bids used in this report, however the vast majority indicated they had little to no experience installing residential systems. If volume were to increase by instituting a sprinkler requirement, more contractors would gain experience designing and installing them, and competition for the jobs would drive prices down. Materials may then be purchased in bulk, and builders and developers would likely work directly with sprinkler contractors to reduce costs.

For Coral Springs, an additional factor and arguably the biggest factor in the high price estimates is due to the COVID-19 pandemic ongoing during the time of the study. During the pandemic, it has been widely documented that building material prices across the board have risen and labor has been in short supply. Businesses in the construction industry have now been forced to charge higher prices. As these prices normalize again, and with the adoption of a sprinkler requirement, the cost of designing and installing a residential fire sprinkler system will likely move closer to the national average of $1.35 per square foot.

Table 2. Cost per Square Foot

Location	Cost per square foot of sprinklered space
Tamarac	$2.40
Coral Springs	$3.16
Broward County (Average)	$2.78

Methodology

This report uses data collected from two previous economic studies, Coral Springs and Tamarac, to estimate the costs and benefits of residential sprinkler systems for Broward County. The benefit of using these two jurisdictions is the difference in demographics and housing characteristics. Coral Springs population has larger households, higher income, and higher property values than Tamarac. Single family units (both detached and attached) also represent a larger share of the housing stock. Taken together the costs and benefits are a better estimate for the costs and benefits in Broward County than either individual study.

Table 3. Household Size Trends shown in Median Persons per Housing Unit

Location	1990	2000	2010	2015
National	2.29	2.59	2.59	2.64
Florida	2.15	2.46	2.53	2.63
Broward	2.05	2.45	2.57	2.73
Coral Springs	2.85	2.96	2.95	3.12
Tamarac	1.85	2.00	2.13	2.31

Source: U.S. Census Bureau, 2011-2015 American Community Survey 5-Year Estimates

Table 4. Percent of Single-Family Housing both Detached and Attached

Location	1-Unit detached %	1-unit attached %
Broward	41.3	8.3
Coral Springs	49.4	6.9
Tamarac	38.5	15.3

Source: U.S. Census Bureau, 2011-2015 American Community Survey 5-Year Estimates

Table 5. Location Characteristics from US Census Bureau

	Tamarac	Coral Springs	Broward County
Property Value (Structure+Contents)	$340,000	$449,909	$265,000
Population	66,721	133,759	1,952,778
Median Income	$48,930	$77,360	$59,547

Several items contribute to the total cost of a residential fire sprinkler system. Much of the system's cost comes from the design and installation for the system, but other costs must also be included. Table 6 outlines different costs that are applicable to Broward County and describes sources of information for these costs. It is important to note that while Broward County does not impose any permit or meter upsizing fees, these may vary among jurisdictions.

Table 6. Residential Fire Sprinkler System Cost Categories

Cost Category	**Information Source**
System design, installation, and materials	Cost estimates for design, installation, and materials from fire sprinkler contractor.
Sprinkler system permit fees	Discussions with city officials and sprinkler contractors
Added hard cost for increased water meter size from 5/8 in. to 1 in. in diameter.	Discussions with city officials and published residential meter cost schedule.

The size of homes in terms of square footage, the number of stories, the foundation types, as well as the system type and material choices can all contribute to the overall cost of fire sprinklers. Actual building plans that had been submitted to Tamarac and Coral Springs that represent a typical single-family residence in that area were obtained to generate cost estimates. Four of the six homes were two-story structures, while two homes were single-story structures. The homes ranged from 1,612 square feet to 2,675 square feet in size.

Newport contacted sprinkler contractors in both areas to verify they had experience with installing residential fire sprinkler system and discuss the details of the study. Because residential fire sprinklers are not a requirement, it was important to ensure the contractors providing estimates had experience with residential systems to best estimate the cost of design and installation. Once the contractors were identified, Newport provided all three sets of building plans as well as project specifications and instructions for providing cost estimates. Each contractor was to provide an estimate for the design and installation of a NFPA 13D compliant fire sprinkler system, that was a standalone system using CPVC piping material, the most common system type and piping material found in residential systems. Contractors were

asked to exclude any fees or additional costs, but were asked to identify what they were if they did exist.

Building Plans

Table 7 outlines the relevant characteristics for the homes with fire sprinkler specifications used in this report. All systems were to be designed to NFPA 13D standards, be a standalone sprinkler system type (as opposed to multi-purpose), use CPVC piping, and built on concrete slab on grade foundations.

Table 7. Sample Home Characteristics for Broward County

	Coral Springs			Tamarac		
Square Footage	1,721	1,915	2,076	1631 SF	1612 SF	2675 SF
Number of Stories	Two	One	Two	Two	One	Two

Estimated Costs

All estimates received from the fire sprinkler contractors were reviewed to ensure they included the correct system specifications and did not include any additional fees. In the case where detailed information was lacking, follow up contact was made with the fire sprinkler contractors to confirm the estimates were based on the correct details and specifications of the project. In some cases, minor adjustments were made to the original estimates. Contractors were asked to not include permit fees or any other additional fees beyond the design and installation of the fire sprinkler system as those were obtained from conversations with city officials in both Coral Springs and Tamarac and added to the estimates later.

To arrive at the average cost to design and install a residential fire sprinkler system in Broward County, permit fees and meter upsizing costs were added to the contractor estimates for each home. For Coral Springs these additional costs added $255 ($200 permit fees and $55 meter upsizing) to the contractor estimates, and $174 ($110 permit fees and $64 meter upsizing) was added to the contractor estimates in Tamarac. The average cost of each home in both studies was then added together and divided by the six estimates received. Based on this, the average system design and installation cost was calculated to be $5,290.61 in Broward County. Table 8

below shows the total cost estimates (design and install plus additional fees) used to derive the average cost for Broward County.

Table 8. Individual Sprinkler Contractor Estimates by Home

Coral Springs Estimates				
	Home A	Home B	Home C	Average
Home Size (ft^2)	1,721	1,915	2,076	1,904
Estimate ($)	$4,205.00	$4,505.00	$4,905.00	
Estimate ($)	$5,055.00	$5,055.00	$5,455.00	
Estimate ($)	$7,755.00	$8,805.00	$8,255.00	
Average ($)	$5,671.67	$6,121.67	$6,205.00	$5,999.45
Average $/ft2	$3.30	$3.20	$2.99	$3.16
Tamarac Estimates				
Home Size (ft^2)	1,631	1,612	2,675	1,973
Estimate ($)	$6,674.00	$5,374.00	$6,574.00	
Estimate ($)	$3,274.00	$3,374.00	$5,074.00	
Estimate ($)	$3,344.00	$3,499.00	$4,049.00	
Average ($)	$4,430.67	$4,082.33	$5,232.33	$4,581.78
Average $/ft2	$2.72	$2.53	$1.96	$2.40
Broward County Estimates				
Average Cost ($)	$5,290.61			
Average $/ft^2	$2.78			

Estimated Benefits

Benefit calculations of a sprinkler system for homeowners in Broward County, Florida generally follow the methodology used in the 2007 report *Benefit-Cost Analysis of Residential Fire Sprinkler Systems* prepared by the National Institute of Standards and Technology[11] as well as the 2012 *Economic Cost Benefit Analysis of Residential Fire Sprinkler Systems in Cape Coral.*[12] More recent data were used from updated sources in order to more accurately assess the benefits of a fire sprinkler system.

The estimates assume that the value of the structure and contents of a new home will be $449,090 in Coral Springs and $340,000 in Tamarac. That assumption influences the calculations for property damage and insurance, but not the values for lives saved and injuries averted. All monetary values in the calculations are in terms of 2021 prices. A real interest rate of 4.8 percent is used to discount future benefits (and costs) over 30 years to present values.

Table 10 shows the key assumptions and estimated future benefits of sprinklers in new homes in Coral Springs and Tamarac. The estimated benefit from Coral Springs and Tamarac were averaged together for an estimated benefit in Broward County of $10,815.75.

Table 9: Summary of Estimated Benefits

Jurisdiction	Estimated Benefits
Coral Springs	$13,527.15
Tamarac	$8,104.36
Broward County	$10,815.75

[11] David T. Butry, M. Hayden Brown, and Sieglinde K. Fuller, *Benefit-Cost Analysis of Residential Fire Sprinkler Systems* (U.S. Department of Commerce, National Institute of Standards and Technology, NISTIR7451, September 2007)
[12] Newport Partners LLC, *Economic Cost Benefit Analysis of Residential Fire Sprinkler Systems Cape Coral, FL,* July 2012

Table 10. Estimated Present Value of Benefits as Calculated for Tamarac and Coral Springs

	Tamarac	Coral Springs
	Estimate 2019	Estimate 2021
Inputs:		
Annual Fire Probability	0.0031	0.003067485
Pr: Death/Fire (No Sprinklers)	0.0075	0.0075
Pr: Injury/Fire (No Sprinklers)	0.0340	0.034
Property Value (Structure+Contents)	$ 340,000.00	$449,909
Fire Loss-to value (No Sprinklers)	0.155	0.155
Uninsured Share of Direct Loss	0.20	0.2000
Indirect/Direct Loss	0.10	0.1000
Uninsured Share of Indirect Loss	0.40	0.4000
Reduction in Death (Sprinklers)	0.81	0.87
Reduction in Injury (Sprinklers)	0.31	0.27
Reduction in Fire Loss-to-value	0.63	0.63
Value of life (2019)	$ 9,852,576.00	$11,600,000
Rate in real increase in life, injury value	0.0088	0.880%
Value of Injury (2019)	$ 463,071.07	$ 545,200.00
Annual Insurance Prem (No Sprinklers)	$ 3,004.00	$6,143.00
Insur Discount for Sprinklers	9.00%	9.00%
Time horizon (years)	30	30
Real Discount Rate	4.80%	4.80%
Intermediate Calculations:		
Uniform PV of Constant T year benefit	15.7292203	$ 15.73
Uniform PV with real growth g	17.46124368	$ 17.46
Direct Prop Damage per Fire (No Sprinklers)	$ 52,700.00	$ 69,735.90
Uninsured direct loss/Fire (No Sprinklers)	$ 10,540.00	$ 13,947.18
Unins Indirect Costs/Fire (No Sprinklers)	$ 2,108.00	$ 2,789.44
Death/fire (Sprinklers)	0.001425	$ 0.00
Injury/Fire (Sprinklers)	0.02346	$ 0.02
Uninsured direct loss/Fire (Sprinklers)	$ 3,899.80	$ 5,160.46
Uninsured Indirect Costs/Fire (Sprinklers)	$ 779.96	$ 1,032.09
Value from Lower Deaths in 2019	$ 183.60	$ 232.18
Value from Lower Injury in 2019	$ 14.97	$ 15.35
Annual Value Lower Uninsured Direct	$ 20.37	$ 26.95
Annual Value Lower Uninsured Indirect	$ 4.07	$ 5.39
Annual Savings on Insurance	$ 270.36	$ 552.87
Present Value of Benefits:		
PV from Lower Deaths	$ 3,205.93	$ 4,054.12
PV from Lower Injury	$ 261.42	$ 268.07
PV from Lower Uninsured Direct Prop Loss	$ 320.38	$ 423.95
PV from Lower Uninsured Indirect	$ 64.08	$ 84.79
PV from Insurance Discount	$ 4,252.55	$ 8,696.21
	$ 8,104.36	$ 13,527.15

A large part of the estimated benefits of sprinklers consists of the value of lives saved. Although it is difficult to place a monetary value on a human life, people in fact implicitly do so regularly as they make choices about risks they face in choosing where to work or live, what products to buy, etc. Based on "revealed preferences" derived from those choices, particularly the wage premia demanded for riskier jobs, various studies have calculated the "value of a statistical life" (VSL), and such values have been widely employed in the evaluation of the costs and benefits of regulations and investments. VSL assumptions specified by the U.S. Department of Transportation in 2016 and used by a variety of government agencies are used as part of this analysis. Those VSL amounts were set at $9.6 million for 2016, with annual real increases of 0.877 percent for succeeding years.[13]

Another significant component of the estimated benefits of sprinklers looks at the annual savings on insurance. Homes in Coral Springs are significantly more expensive than the average home in Tamarac. Annual insurance premiums within Coral Springs are estimated to be nearly double that in Tamarac leading to greater annual savings on insurance for a home with a fire sprinkler system.

Findings

This study finds that, for Broward County, the average total cost to design and install a residential fire sprinkler to NFPA 13D standards is $5,290.61 or $2.78 per square foot of sprinklered space, based on six contractor bids and estimated fees.

Benefit calculations for this report follow the general methodology of the 2007 NIST report and use the 9 percent reduction in insurance rates referenced. Values were updated to reflect most recent local data. The Present Value of benefits for installing a fire sprinkler system in Broward County comes to $10,815.75 with most of the benefits attributable to savings on insurance and the value of fewer fatalities.

The net benefit expected is $6,796.14 as shown in Table 10.

[13] Memorandum from Molly J. Morgan, Carlos Monje to Secretarial Officers Model Administrators, "Guidance on Treatment of the Economic Value of Statistical Life" August 8, 2016

Table 10. Net Positive Benefit

	Tamarac	Coral Springs	Broward County (Average)
Average Cost	$4,581.78	$5,999.44	$5,290.61
Infrastructure Reduction	$1,271.00	$1,271.00	$1,271
Benefit	$8,104.36	$13,527.15	$10,815.75
Net Positive Benefit	$4,793.58	$8,798.71	$6,796.14

Loudoun County Fire and Rescue

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October 11, 2019

For Immediate Release:
Cause Determined in Fatal Sterling House Fire

Sterling, VA. – The Loudoun County Fire Marshal's Office has determined that unattended cooking was the cause of a fatal house fire in Sterling and have estimated damages to the home at $144,000. The investigation also revealed that there were no working smoke alarms in the residence.

A 9-1-1 call came into the Loudoun County Emergency Communications Center just before 3:00 a.m., Sunday, October 6, 2019 reporting a house fire in the 200 block of Giles Place in Sterling. Firefighters arrived to find smoke coming from a two-story townhouse and one adult outside suffering from burn injuries. The patient was transported to the Burn Center at MedStar Washington Hospital with non-life threatening injuries.

Once inside, firefighters located an adult male who was brought outside to waiting EMS crews. Paramedics immediately began advanced life support care and transported the victim to a local hospital where he was pronounced dead. One additional resident refused medical treatment on the scene.

Loudoun County Fire Officials remind residents of easy steps you can take to prevent these fires and protect your family if a fire does occur:

- **Stay in the kitchen** while cooking, especially on the stovetop. If you leave the kitchen, even briefly, turn off the stove. If baking, roasting, or broiling, set timers to remind you food is cooking.
- **Have working smoke alarms!** Smoke Alarms provide an early warning giving you more time to safely escape. Install smoke alarms on every level, outside the door of any sleeping area, and inside each bedroom. Test alarms monthly, change the battery, and replace after 10 years. Loudoun County Fire and Rescue has a free smoke alarm program, to learn more visit www.loudoun.gov/smokealarms for more information.
- **Close Before You Doze!** Closing your bedroom door before going to sleep can help slow the spread of smoke, heat, and fire. Homes have more open layouts, and lightweight construction materials which allow fires to spread much quicker affecting the time a family has to escape.
- **Have a home escape plan!** A family has as little as 2-3 minutes to escape should a fire occur. Discuss with your family a home escape plan that includes two ways out of each room and an outside meeting place.

For more fire prevention information for you and your family, please visit www.loudoun.gov/firemarshal or call Lisa Braun, Public Education Manager at 571-258-3222.

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Residential Fire Sprinkler Cost Benefit Analysis

For

City of Las Vegas (NV) Fire and Rescue

July 2017

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Residential Fire Sprinkler Study - 2017

Executive Summary:

This is a study commissioned by the Las Vegas Fire and Rescue Department, which provides a dispassionate and objective cost benefit analysis of residential fire suppression (sprinkler) systems, which could be mandated in all new home construction up to 5,000 square feet of livable space*. This study is in direct response of Nevada Revised Statue (NRS) 278.586, which specifies that any governing body considering such a mandate must perform a cost benefit analysis and hold a public hearing on the results of that analysis prior to enacting legislation requiring residential fire suppression systems in all new home construction.

UNLV performed a detailed study over the course of 3 months and determined that there is a definite cost benefit to both homeowners and home builders by installing fire suppression systems in all new residential homes up to 5,000 square feet of livable space.

The following pages detail the UNLV study, which also compares and contrasts the study results with those provided by Applied Analysis (a local Las Vegas analytical company), which was contracted to perform a similar study by the Southern Nevada Homebuilders Association in March 2015.

The UNLV study clearly shows that survival is the primary reason for mandating installation of residential fire sprinkler systems, as well as detailing the source of all cost savings back to homeowners and homebuilders, if such a mandate were enacted.

***The scope of this report addresses new homes which are less than 5,000 square feet in total livable area to match the scope of the requirements of Section 278.586, added to Nevada Revised Statue as a result of the passage by of SB477. This statute requires that a cost cost-benefit analysis be performed whenever a residential sprinkler ordinance will be considered for residential dwelling structures which are less than 5000 sq. feet in livable area. Please see Attachment 1 of this report for the complete NRS 278.586.**

Residential Fire Sprinkler Study - 2017

Purpose:

The purpose of this study is to present an independent, objective analysis regarding the possible installation of residential fire suppression systems (sprinkler systems) in all new single-family home construction within the city limits of Las Vegas, Nevada. As a starting point, the University of Nevada Las Vegas (UNLV) was asked to study, analyze, and document the different perspectives presented in two studies prepared by reputable organizations:

- The National Institute of Standards and Technology (NIST): Benefit-Cost Analysis of Residential Fire Sprinkler Systems (NISTIR-7451), September 2007.
- Applied Analysis: Benefit-Cost Analysis of Residential Fire Suppression Systems – A Review and Analysis in Unincorporated Clark County, March 2015.

Background:

The City of Las Vegas, through the Las Vegas Fire and Rescue, commissioned a cost-benefit analysis to determine the affordability of residential fire sprinklers in single family dwellings with usable living space equaling 5,000 square feet or less. This analysis is to determine the costs associated with a local mandate, as well as the benefits the homeowner and the community gain from residential fire sprinklers. This cost-benefit analysis is also required to satisfy Nevada Revised Statute 278 enacted during the 2015 Nevada legislative session through Senate Bill 477 (attachment 1). Embedded in the Senate language is a mandate requiring that a cost-benefit analysis be performed to demonstrate that the installation of a residential fire suppression system in a new home would be:

> to the benefit of the owners of the residential dwelling units to which the requirement would be applicable and that such benefit exceeds the costs related to the installation of automatic fire sprinkler systems in such residential dwelling units. (Reference: Nevada Senate Bill 477)

Further, the City may elect to issue a mandate requiring fire suppression systems in new residential homes with livable area of 5,000 square feet or less, if:

> the unique characteristics or the location of the residential dwelling unit, when compared to residential dwelling units of comparable size or location within the jurisdiction of the governing body, would cause an unreasonable delay in firefighter response time. (Reference: Nevada Senate Bill 477)

The Senate bill also specifies that the City may mandate residential fire suppression systems in new homes with livable area greater than 5,000 square feet without requiring either of the two criteria mentioned above.

Following the City of Las Vegas' decision to consider adopting this fire suppression system mandate, the Southern Nevada Home Builders Association commissioned a local analytical company, Applied Analysis, to perform a cost-benefit analysis in order to determine the financial feasibility of such a mandate.

Applied Analysis used the 2007 NIST Study (referenced above) as a baseline document. Then, using only local Clark County (Nevada) data in the NIST-developed algorithms, Applied Analysis performed a study to determine if there was, indeed, a cost benefit to the homeowner derived from having a residential fire suppression system installed. Applied Analysis concluded:

> The National Study found that sprinkler systems are economical (i.e., the benefits outweigh the costs) based on national data; however, the utilization of local datasets leads to a different conclusion. Based on the cost-benefit analysis conducted and described herein, results indicate that in unincorporated Clark County, home fire sprinkler systems are not economical (i.e., the costs outweigh the benefits of installation) based on local fire probabilities and system installation costs. (Reference: Applied Analysis Study, page 3)

Observations:

It is important to note that the Applied Analysis study did not dispute the factual content of the NIST Study. Further, Applied Analysis did not suggest that the data used by NIST was flawed; the cost-benefit algorithms developed by NIST were incomplete; nor the conclusions reached by NIST were faulty. Rather, Applied Analysis simply stated that when local Clark County (Nevada) data is plugged into the NIST-developed algorithms, then the installation costs of a residential fire suppression system appear more expensive than any potential financial benefit for a homeowner.

Additionally, the Applied Analysis Study did not consider the potential economic benefits to the homebuilders nor the community, if residential fire suppression systems were mandated in all new residential home construction of 5,000 square feet or less. Without this information, any attempt to provide the City of Las Vegas with a comprehensive cost-benefit analysis is short-sighted and incomplete.

Following the action of the 2015 Legislative Session, the City of Las Vegas asked the University of Nevada Las Vegas (UNLV) to conduct an independent study in an attempt to, if possible, reconcile the differences between the two studies (NIST and Applied Analysis) and to determine if there was additional information, which could shed more light on the wisdom of adopting the legislation mandating the installation of fire suppression systems in all new residential home construction.

Armed with both studies, the UNLV researchers commenced their independent study.

Approach:

UNLV met with the Las Vegas Fire Rescue (LVFR) Fire Marshals with whom they conducted extensive interviews, took detailed notes, and obtained a wealth of background studies on residential fire suppression systems performed over the past 15 years. Further, UNLV met with several fire suppression installation contractors to determine the types of fire sprinkler systems available to home builders and the costs of installation based on current and projected residential home building trends with the Las Vegas city limits.

The researchers also contacted fire marshals, insurance companies, and analytical companies from across the nation. Specifically, they contacted Verisk Analytics:

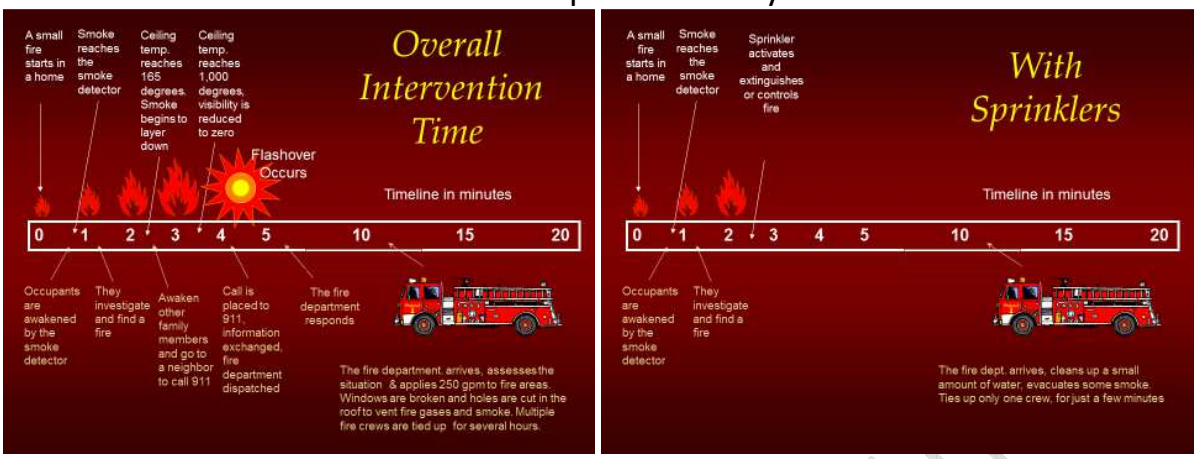
> Verisk Analytics, Inc. is an American data analytics and risk assessment firm based in Jersey City, New Jersey, United States, serving customers worldwide in insurance, natural resources, financial services, government, and risk management.

Each of the organizations and individuals provided the UNLV researchers with supplementary information. The information indicated that additional data (beyond simply just the cost of installation) needed to be factored into any thorough study on fire suppression systems. This new data coupled with realistic fire suppression system installation costs would provide Las Vegas City Council with comprehensive information upon which to make a final decision as to how to proceed with residential fire suppression system legislation.

Findings:

- **Cost:** UNLV performed an in-depth cost analysis, which refutes the cost figures generated by Applied Analysis and its subsequent conclusions (Attachment 2). As shown Attachment 3, UNLV discovered that a residential fire suppression system actually pays for itself in a matter of months after the new residential home is complete (For more detailed information, see Attachment 4). Further, the positive cost benefits to the homebuilder and community-in-general were studied and detailed in the following pages.

- **Smoke Alarms – A Case of Too Little, Too Late:** Smoke alarms without residential fire suppression systems do not appear to be enough to save lives and/or avert major home damage.
    - Smoke alarms do not provide sufficient warning to save all lives. In a typical residential house fire, they activate at about the 45 second point after a fire has started. Smoke becomes a visibility problem at 2 ½ minute point. Temperatures reach in excess of 1,000 degrees in about 4 minutes. Delays in notification (occupants waking up; assessing & identifying the problem; insuring humans and pets are alerted; then calling 911) means the Fire Department commences response at approximately the 5-minute point. It takes (on average) 10 minutes (total elapsed time) for the fire department to arrive. (Source: Power Point Presentation "Why Sprinklers?") By that time, the residence is fully involved in the fire.



Fire Suppression in Homes with and without Sprinkler Systems
(Source: "Residential 1-2 WHY SPRINKLERS" Presentation by Roy Marshall)

- **<u>Damage to Home:</u>** Beyond fire and smoke damage, there is a significant amount of water and structural damage to a house that has experienced a fire.

    - Residential sprinkler systems are set to activate at 150 degrees F.
        - The average residential sprinkler system outputs water at an average of 13 gallons per minute (GPM).
        - Given average fire department response times, a residential sprinkler head may output less than 200 gallons of water before being shut off by a fire fighter.
    - Unprotected residential dwellings will require between 1,500 and 100,000 gallons of water to extinguish the blaze. (This figure does not include damage to doors, windows, and the roof as the fire department works to gain entry into the home.)

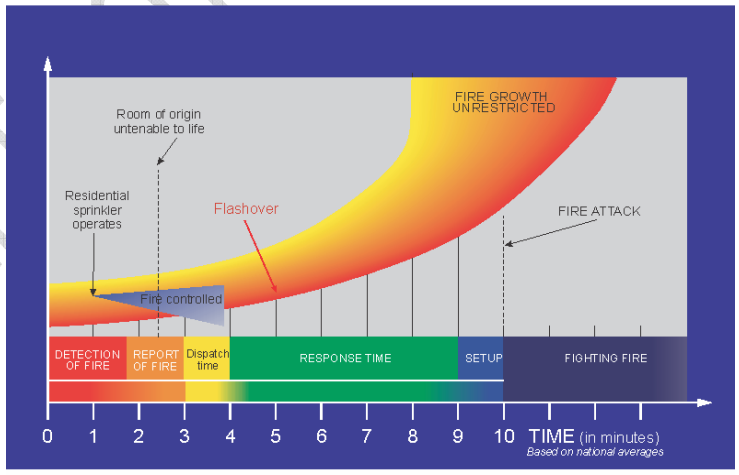


Figure 3: Positive Effects of Residential Sprinklers
(Source: "Why Sprinklers" Power Point Presentation by Pat Coughlin)

- **The Danger in Synthetics:**
  When a house is on fire, many times It is not the structural fire that causes fire deaths, it is the synthetic composition of the residential contents. (Synthetics burn twice as hot and twice as fast.) **(Source: Power Point Presentation "Why Sprinklers?")** Additionally, synthetic materials will typically outgas extremely hazardous and toxic smoke clouds.

  - During a fire, temperatures in a house (without fire suppression systems) can reach 1200 degrees F in less than 5 minutes.
  - "Thermal burns and smoke inhalation were the primary symptoms leading to death, accounting for 90 percent of all fatalities in residential fires." **[Source: Topical Fire Report Series, Volume 16, Issue 2 / July 2015, *"Civilian Fire Fatalities in Residential Buildings (2011-2013)*]**

- **Fatalities:**
  Residential Fire Suppression Systems save lives. According to an extensive study performed by the Medford (Oregon) Fire Department:

  - Home fire sprinklers are designed to ensure a tenable atmosphere for escape.
  - Fire sprinklers with smoke detectors increases chance of surviving a fire by over 97%.
  - Smoke detectors aren't enough.
    (Source: Power Point Presentation "The Case for Residential Sprinklers in Medford, Oregon.)

- **Modern Home Building Trends:**
  New trends in home building and modern furnishing are compressing the timelines between a fire starting, toxic smoke release, and flashover occurring. The Federal Emergency Management Agency (FEMA) and the US Fire Administration hosted a two-day workshop at the Maryland Fire & Rescue Institute (College Park, MD) on 11-12 Dec 2012. This workshop was attended by leading experts from the fire service and home fire research specialists, who gave compelling presentations on how the latest trends in homebuilding and residential furnishing are cause for concern. What they revealed is that there is not only increased concern for the residents, but substantially increased risks for the firefighters as they combat fires in newer residential homes. Their observations are summarized as follows:

  - Changes in the Design of New Homes
    - Larger home footprints.
    - Open concept floor plans.
    - More unventilated attics.
    - Increasingly airtight construction.
    - Increased concealed space.
    - Variety in plans and construction types.
    - Increased housing density.
    - Building at the wildland interface.

- **Modern Home Building Trends (continued):**

  - Changes in Home Construction Materials and Techniques
    - Engineered wood assemblies.
    - Combustible exterior finishes.
    - Green building features.

  - Changes in Home Furnishings
    - New information on effectiveness and hazards of fire retardant chemicals in upholstered furnishings.
    - Overall increased plastic contents.
    - Energy-saving technologies.
    - Photovoltaics.
    - Electric vehicles.
    - Energy storage and distributed power solutions.

  - Changing Fire Service-related Risks
    - Shorter time available for size up due to reduced times to flashover.
    - Fire flow/Wind-driven fires phenomena.
    - Current fire ground procedures and firefighter training inadequate to address those new risks.
    - Less experience in fighting fires due to fewer fires.
    - Staffing reductions in selected jurisdictions independent of increased risks.
    - New firefighter gear/tools with varying performance levels.
    - Firefighter gear improvements increasing other personnel risks.
    - Exposure to carcinogens from contents and construction materials.

    (Source: "Changing Severity of Home Fires Workshop Report," US Fire Administration/National Fire Data Center, December 2012)

- **IRC 2012:** Las Vegas adheres to 2012 International Residential Code (IRC), which mandates fire sprinkler systems. However, during the adoption process, the City placed a qualifier on when residential fire sprinklers will be required. Las Vegas City Ordinance 6351 stipulates:

  The commencement date for residential sprinkler installation shall be the July 1st that follows the first calendar year, if any, during which the combined number of building permits issued by the Southern Nevada jurisdictions for single family dwellings reaches or exceeds 10,000.
  (Note: Southern Nevada jurisdictions include all of Clark County to include the cities of Las Vegas, North Las Vegas, and Henderson.)

  Although, special provisions are provided when fire sprinkler systems are installed (0-hour versus 1-hour fire resistance walls and decreased separation distances between homes), the lack of a mandate means that many new homes are built with the inherent issues identified in the bullet statement above.

It is important to note that Residential occupancies are required by the IRC and International Energy Conservation Code (IECC) to limit air leakage to prevent conditioned air escaping the dwelling. This approach to energy savings has created a condition to limit the escape of smoke and fire gases in the case of a fire condition within the dwelling. The combination of fire gases from synthetic materials with limited ability to vent causes fires to reach flashover potential within three minutes of ignition.

- **<u>Incentives or Trade-ups for Homebuilders and Developers.</u>**

  - **Garages:**
    The base IRC, 2012 Edition, Section 302.6 and Table 302.6 requires fire rated separation from habitable rooms and garages when the habitable rooms are located above the garage. The City of Las Vegas may consider the installation of fire sprinklers in the garage space as an equivalent alternative to 5/8" Type X gypsum board. This may be proposed as a local code amendment.
    - As a result, homes and garages with sprinklers can use less expensive and fewer gypsum panels in the construction of garage walls and ceilings. Assuming a 22' by 22' garage with 8' ceilings, two walls adjacent to living space, and living space above, the estimated cost savings per house from this incentive was estimated to be $226.
    - Without sprinklers in the house and garage, the design is assumed to include two layers of 5/8'' Type X gypsum board on the ceiling and have two garage walls with 5/8" Type X panels on both the inside and outside of the wall. These specifications are based on 1-hour rated assemblies found in the Gypsum Association's "Fire Resistance Design Manual." With sprinklers used in the garage and the home, there would be only one layer of ½'' drywall on the ceiling and ½" gypsum panels on the walls dividing the garage from the home.
    - Approximate prices for the 5/8'' Type X and ½'' standard gypsum panels were based on a review of the cost of a 4' by 12' panel from several national retailers who supply the products. The cost for 5/8'' Type X panel was roughly $15.23 per panel while the standard ½'' panel was about $11.98. (These prices are only estimates.)

  - **Exterior Wall Elements:**
    - The IRC requires separation between homes to reduce the likelihood of fire spreading from one home to the next. If they are placed closer than outlined in Section R302.1 (Table R302.1(1)) then a 1-hour minimum fire resistance rating, as tested by approved standards, is required.

- **Exterior Wall Elements (continued):**
  - Table R302.1(2) allows dwellings to be spaced two feet closer when fire sprinklers are installed versus Table R302.1(1) which is used for dwellings without fire sprinklers.
  - This provision allows a home builder to install fire sprinklers to decrease separation distance between houses without exterior walls being rated. The house can grow one foot wider on each side.

- **Increased Fire Hydrant Spacing:**

  The City of Las Vegas allows fire hydrants serving homes built under the IRC to be spaced every 500 feet, and if all homes served by the hydrant have fire sprinklers, then the spacing can be every 600 feet (CLV Fire Code - Section 507). The City of Las Vegas may consider larger spacing of fire hydrants, up to 900 foot intervals with master planned communities where all homes have fire sprinklers. This can be done as a code amendment, or as part of development agreement with a master developer. In considering the information gathered from jurisdictions for this incentive, it was determined that a 400 foot increase in hydrant spacing feet was representative, resulting in an "incentivized spacing" of roughly 900 feet. The more distance there is between hydrants, the lower the hydrant cost per building lot because one hydrant covers more lots. The value of the incentive is therefore presented as a reduced cost per building lot.
  - The value of this incentive was estimated to be $49 per building lot. In calculating this figure, the cost of a fire hydrant is estimated to be $4,000. This figure was obtained from a price sheet of a residential fire hydrant manufacturer (Kennedy). Also, it was necessary to assume that a standard sized lot would have 50 feet of frontage for tract home developments. This figure was sourced from a Tualatin Valley Fire and Rescue report on fire sprinkler incentives, and is a representative lot width in many residential developments nationwide. In considering both sides of the street, 20 building lots can be covered by a hydrant under standard spacing requirements. This results in a per-building lot hydrant cost of $110.
  - There can be 36 lots covered by a single hydrant under the incentivized spacing, reducing the per-building lot hydrant cost to about $122. This translates into an incentive value of $98 per building lot.
  - It is worth noting that the incentive's per-lot value may not hold under certain development scenarios. For example, a sub-division's layout might not allow for each hydrant to cover the maximum amount of building lots. Most hydrants may cover the full 36 lots, but others may cover fewer based on the layout of roads and buildable lots. (This would serve to increase the sub-division's hydrant cost per lot, and reduce the overall value of the incentive.)

- **Increased Fire Hydrant Spacing (continued):**

  - One additional benefit is reducing the need for water district easements for each hydrant location and, if applicable, additional space for on street parking.
    ("Study of Cost Implications Associated with a Voluntary Residential Sprinkler System for New Construction," hydrants. This report provides a comparison between the cost of a sprinkler system and the total value of a number on and off-site tradeoffs, or incentives.)

- **Reduction of Road Width:**
  The City of Las Vegas currently does not allow a reduction of road through a code amendment, but can as a condition of a development agreement. The City of Las Vegas has a fire apparatus access road minimum width requirement of 24 feet. Of the jurisdictions that offer this type of incentive, several different road width reductions are noted.

  - In light of this, a 4' reduction provides a reasonable estimate. In order to present this incentive on a per-lot basis, the reduction in width is divided by two to account for lots being present on each side of the street. The frontage length of a building lot (50') is multiplied by ½ of the road width reduction (2') to determine the area of road, per building lot, which no longer needs to be paved. This area, 100 square feet (SF), is then multiplied by an estimated road development cost ($3.50/SF) to determine the savings from avoided excavation and paving costs ($350/lot). The estimated road development cost per SF of $3.50 was calculated by obtaining the paving cost per single-family lot from Public Works Sources. This cost was divided by one-half the total area of road in front of a building lot, assuming road frontage of 50' and road width of 24', to obtain the cost per SF.

  - The value of the raw land that is able to remain unpaved as a result of this incentive also serves as a component of the value determination, because this land becomes available to the developer for some other use. It is assumed that the developer is able to make some sort of productive use of the non-paved land, such as additional building lots, open spaces, etc. In calculating an estimate for the value of raw land, a raw lot cost of $48,769 was obtained from the NAHB's 2004 Construction Cost Survey while a median lot size of 9,114 for new single-family detached homes was obtained from the U.S. Census Bureau's Characteristics of New Housing for 2009. Relevant data was combined to arrive at a raw land cost of $5.35 per SF, which was in turn multiplied by 100 SF (per lot) to arrive at value of $535/lot for the value of the additional available land.

  - Combining these two components of the reduced road width incentive, the estimated value of the 4' width reduction is roughly $1,172 per building lot.

- **Reduced Fire Flows:**

  Code required fire flow for one- and two-family dwelling currently is a minimum requirement of 1500 gallons per minute (GPM). The fire code as adopted will allow for a 50 percent reduction in fire flow as long as the 1500 gallons per minute is maintained. A reduced minimum fire flow requirement of 750 gallons per minute (GPM), down from a standard flow rate of 1,500 GPM could be implemented for dwellings less than 3000 square feet. The Las Vegas Valley Water District will maintain a minimum flow rate and pressure for residential tract areas, but a reduction in fire flow could reasonably result in the water main size being reduced from 8" to 6" in diameter.

  - The value of this incentive was found to be $50 per lot. For this calculation, it was assumed that the 2" reduction in water main diameter would result in a cost savings of $2 per linear foot of pipe.
  - To obtain the per-lot metric, a lot frontage of 50 feet was used. The water main was assumed to serve both sides of a street; therefore, lots across the street from each other "shared" the value of this incentive, essentially dividing the value by 2. Both the 50' lot frontage and the $2 cost savings/lineal foot pipe figures were obtained from the Tualatin Valley Fire and Rescue report referenced above.

- **Reduced Cul-De-Sac Width:**

  Based on information gathered from jurisdictions offering this incentive, the most common reduction of a cul-de-sac radius was found to be 2 feet. For instance, to allow developers to decrease the radius of a cul-de-sac 2 feet in exchange for including sprinkler systems in the project's homes.

  - Unlike some of the previous incentives which have been valued on a per-lot basis, this incentive is valued for a single cul-de-sac. With the three-foot reduction noted above, the estimated value was found to be $5,433 per cul-de-sac. This figure is based on the area of cul-de-sac which would not have to be paved in moving from a 52' radius to 50' radius, allowing for the fact that part of this area would still be paved where the road enters the cul-de-sac. Road paving cost per square foot was obtained using the same method as was applied in estimating the value of a reduced road width. (This will also require a code amendment if the City of Las Vegas and the homebuilding industry find value in using this approach.)
  - In addition to reduced excavation and paving costs, this figure is also based on the estimated value of raw land of $5.35 per SF that no longer needs to be paved and becomes available to the developer for some other use. Again, this component of the valuation assumes the developer can make some sort of productive use of the preserved land. The value for raw land was determined using the NAHB and U.S. Census Bureau sources noted above in the discussion on reduced road widths.

- **Increased Dead-End Street Length:**
  The typical amount of extended dead-end street length found in the study was 125 feet.
  - Similar to the incentive for reduced radii of cul-de-sacs, this incentive is not valued on per-lot basis. Instead, the benefit of the incentive is stated in terms of how many lots can be added as a result of the increased street length. Under a scenario where 125 feet of street length can be added to a dead-end, an additional four lots can be included.
  - **T**his determination assumes that a standard size lot includes 50 feet of street frontage, and that lots are situated on both sides of the extended dead-end. It should be noted that the value of these additional lots would be partially offset by added land development costs, and that the application of this incentive could be limited by some development layouts.

- **Secondary Access Point:**
  The International Fire Code as adopted and amended though Section 503.1.2 requires a secondary access point for emergency services when a planned community has more than 100 dwelling units. The code allows this secondary access point to be eliminated until a planned community reaches 200 dwelling units with equipped throughout with residential fire sprinklers. This secondary access point may represent a buildable lot for an additional dwelling unit. The return on investment for the homebuilder and master developer will vary based on the street and lot configuration of the community.

Conclusions:

- **Cost is the wrong metric:**
  The cost of installation is not a core issue. In our opinion, the issue of cost appears to be a "red herring" issue. Certainly, while important, cost cannot be used as the sole criterion for accepting or rejecting the provisions contained in Senate Bill 477, NRS 278.576.
  - First, it does not matter whether fire suppression systems increase value of a Las Vegas home by $3,500 - $5,049 (NIST Study) or provide negative value by as much as $2,230 (Applied Analysis Study). (See Attachments 2 & 3) The real issues are: "Do fire suppression systems work and do they save lives and property?" The answer to both questions is: "Yes."
  - Second, the UNLV Cost Analysis (Attachment 4) demonstrates that having a fire suppression system installed in a new home (during construction, not retrofitting) amortizes to zero within the first 12-18 months of home ownership. What is important about this analysis, is that it used current Las Vegas area costing data.

  - Third, on page 4 of the Applied Analysis study, the following statement is made:
    "It is also noteworthy that to retrofit older, existing houses in unincorporated Clark County with a fire sprinkler system, assuming similar pricing, it would cost nearly $ 1 billion."

Nowhere in Senate Bill 477, NRS 278.576, or any Las Vegas Fire Department proposal put in front of the City Council mention anything about retrofitting older homes. We view this statement as completely unnecessary and a distraction, which may be interpreted as an attempt to strengthen a very weak case against residential sprinkler systems.

- Finally, community developers and homebuilders can realize significant overall cost savings and increased profit margins by allowing residential fire suppression systems to be an integral part of new residential homes built in Las Vegas. These cost savings come in the form of reduced street widths; reduced cul-de-sac widths; less costly building materials in certain areas of the home; and more.

In the opinion of the UNLV researchers, cost is an ancillary issue. This study has essentially put the perception of increased cost of new home construction due to installation of fire suppression systems to rest. Fire suppression systems pay for themselves. So, if cost is not the main issue, what is? The core issue is Safety.

- **Survival is the Paramount Issue:** Abraham Maslow, noted American psychologist, developed a concept called the Hierarchy of Needs. The most fundamental human need is: Survival. While fire alarms provide some level of warning, they do not provide sufficient notification to the occupants of a burning home to allow the occupants to get to safety in a reliable manner. Residential sprinkler systems are designed to put water on the ignition source of a home fire, while allowing the resident to escape safely. Thus, residential fire sprinkler systems in new homes speaks to the most fundamental human need – Survival.

- **Mandated Residential Sprinklers do not "disincentize" home buyers:** The UNLV researchers took the extra step of reviewing new home permits for the Las Vegas area. What was discovered that the City of Henderson, NV (which mandates residential fire suppression systems in all new residential home construction) has surpassed the City of Las Vegas in new home permits. It would appear that mandating residential fire sprinkler systems will not adversely affect new home building in Las Vegas. (Attachment 5)

Recommendation:

In the opinion of the researchers from the University of Nevada Las Vegas, the Las Vegas City Council should immediately pass the ordinance mandating fire suppression systems for all new single family residential home construction.

Attachment 1

Adopted language as a result of Senate Bill 477

NRS 278.586 Adoption of building code or other action by local government requiring installation of automatic fire sprinkler system in new residential dwelling units and other structures.

1. A governing body may adopt a building code or take any other action that requires the installation of an automatic fire sprinkler system in a new residential dwelling unit that has an area of livable space of 5,000 square feet or more.

2. Except as otherwise provided in subsection 3, a governing body may, on or after July 1, 2015, adopt a building code or take any other action that requires the installation of an automatic fire sprinkler system in a new residential dwelling unit that has an area of livable space of less than 5,000 square feet only if, before adopting the building code or taking the action, the governing body:

(a) Conducts an independent cost-benefit analysis of the adoption of a building code or the taking of any other action by the governing body that requires the installation of an automatic fire sprinkler system in a new residential dwelling unit that has an area of livable space of less than 5,000 square feet; and

(b) Makes a finding at a public hearing that, based on the independent cost-benefit analysis conducted pursuant to paragraph (a), adoption of the building code or the taking of any other action by the governing body that requires the installation of an automatic fire sprinkler system in a new residential dwelling unit that has an area of livable space of less than 5,000 square feet is to the benefit of the owners of the residential dwelling units to which the requirement would be applicable and that such benefit exceeds the costs related to the installation of automatic fire sprinkler systems in such residential dwelling units.

3. A governing body may require the installation of an automatic fire sprinkler system in a new residential dwelling unit that has an area of livable space of less than 5,000 square feet without conducting the analysis or making the findings required by subsection 2 if the governing body makes a determination at a public hearing that the unique characteristics or the location of the residential dwelling unit, when compared to residential dwelling units of comparable size or location within the jurisdiction of the governing body, would cause an unreasonable delay in firefighter response time. In making such a determination, the governing body may consider:

(a) The availability of water for use by firefighters in the area in which the residential dwelling unit is located;

(b) The availability to firefighters of access to the residential dwelling unit;

(c) The topography of the area in which the residential dwelling unit is located; and

(d) The availability of firefighting resources in the area in which the residential dwelling unit is located.

4. A governing body shall not adopt a building code or take any other action that requires the installation of an automatic fire sprinkler system in a structure other than a residential dwelling unit or any portion of such a structure, whether located on public or private property:

(a) That is covered but not completely enclosed;

(b) That is used primarily for agricultural, livestock or equestrian activities;

(c) That has spectator seating situated around the perimeter of the structure or portion thereof; and

(d) Which is otherwise in compliance with all relevant building codes concerning exits and fire alarm systems.

5. The provisions of this section do not prohibit:

(a) A local government from enforcing an agreement for the development of land which requires the installation of an automatic fire sprinkler system in any residential dwelling unit; or

(b) A person from installing an automatic fire sprinkler system in a structure described in subsection 4 or any residential dwelling unit.

6. As used in this section:

(a) "Automatic fire sprinkler system" has the meaning ascribed to it in NRS 202.580.

(b) "Residential dwelling unit" does not include a condominium unit, an apartment unit or a townhouse unit that shares a common wall with more than one other such unit.

(Added to NRS by 2015, 1989)

Residential Fire Sprinkler Study - 2017

Attachment 2

Summary of Benefit-Cost Analysis per Housing Unit: National Study vs. Unincorporated Clark County

(Source: Applied Analysis Study: March 2015)

	National Study (2005 dollars)	National Study (2014 dollars)	Unincorporated Clark County (2014 dollars)
Benefits			
Fatalities Averted	$3,725.57	$4,516.01	$1,019.61
Injuries Averted	$224.74	$272.74	$145.18
Direct Uninsured Property Losses Averted	$79.64	$96.54	$36.95
Indirect Costs Averted	$15.93	$19.31	$7.39
Insurance Credit	$948.41	$1,149.63	$1,341.15
Benefits Subtotal	$4,994.29	$6,054.23	$2,550.29
Cost	$829-$2,075	$1,005-$2,515	$4,780.00

Residential Fire Sprinkler Study - 2017

Attachment 3

Cost Benefit Comparison Analysis

	Cost of Sprinkler Installation		
Newly Constructed Tract Home	AA Study (2014 Dollars)	National Study (2014 Dollars)	UNLV Study (2016 Dollars)
Per Square Foot	$2.00	$1.02	$0.95
2,000 Square foot Home	($4,000)	($2,040)	($1,900)

	Benefit		
Newly Constructed Tract Home	AA Study (2014 Dollars)	National Study (2014 Dollars)	UNLV Study (2016 Dollars)
Insurance Premium Credit	12%	8%	15%
Annual Insurance savings	$71	$48	$89
Appreciation in First Year	2.80%	6.80%	2.80%
2,000 Square foot Home	$6,384	$15,504	$6,384
Total Benefit in first year	$6,455	$15,552	$6,473

Attachment 4

The provided Cost Benefit Analysis (CBA) will compare the cost of the installation with a residential fire suppression system versus the monetary benefits. For the ease of a mathematical baseline, the square footage of 2,000 was used to represent a single family new construction tract home in Las Vegas, NV. Please note that number for any square footage of a home does not affect the formula used in the Cost Benefit Analysis.

The following dataset inputs were used in the CBA:

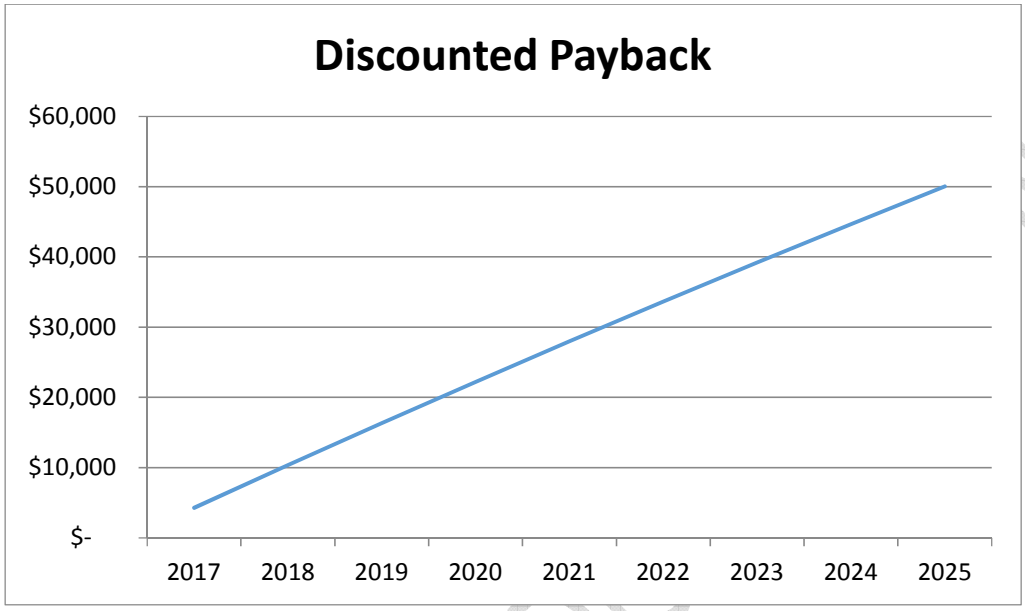
1. The estimate proposal of $.95 per ft² for the cost of installation in a new tract home.[1]
2. The average cost of $114 per ft² to build was used for the square footage of a new constructed tract home. [2]
3. The average home appreciation of 2.8% was applied for a ten-year projection. [3]
4. The discount rate used was the same 4.6% discount rate found in the Applied Analysis study.
5. The average insurance premium discount of 15% for a credit of $89 annually. [4]

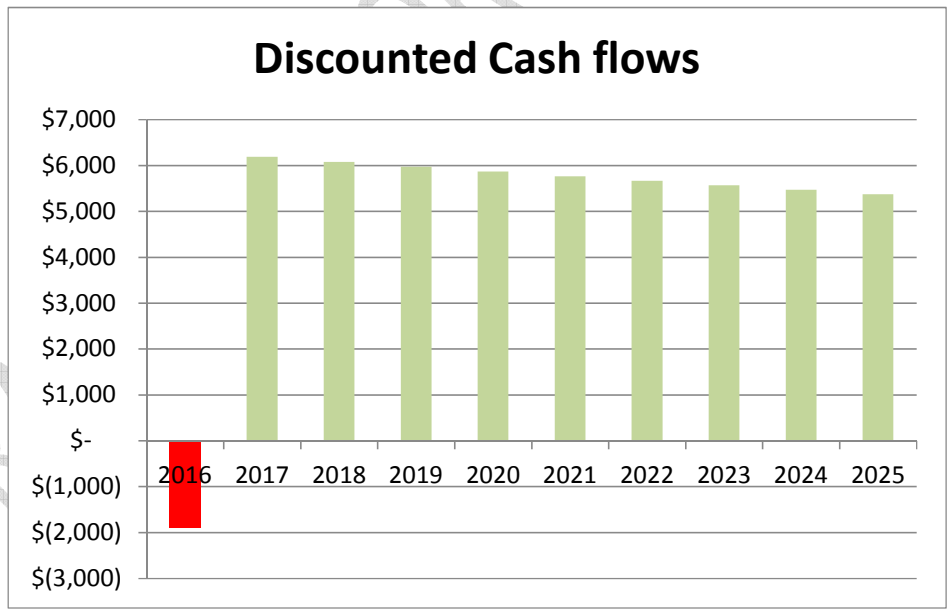
The cost of a new 2,000 ft² tract home is $228,000 in today's dollars net a projected 10-year benefit of $64,032 bringing the potential value of the home to $292,032 in 2025. The investment cost of a $1,900 residential fire suppression system has a payback period in the first year of home ownership. See table 1 below.

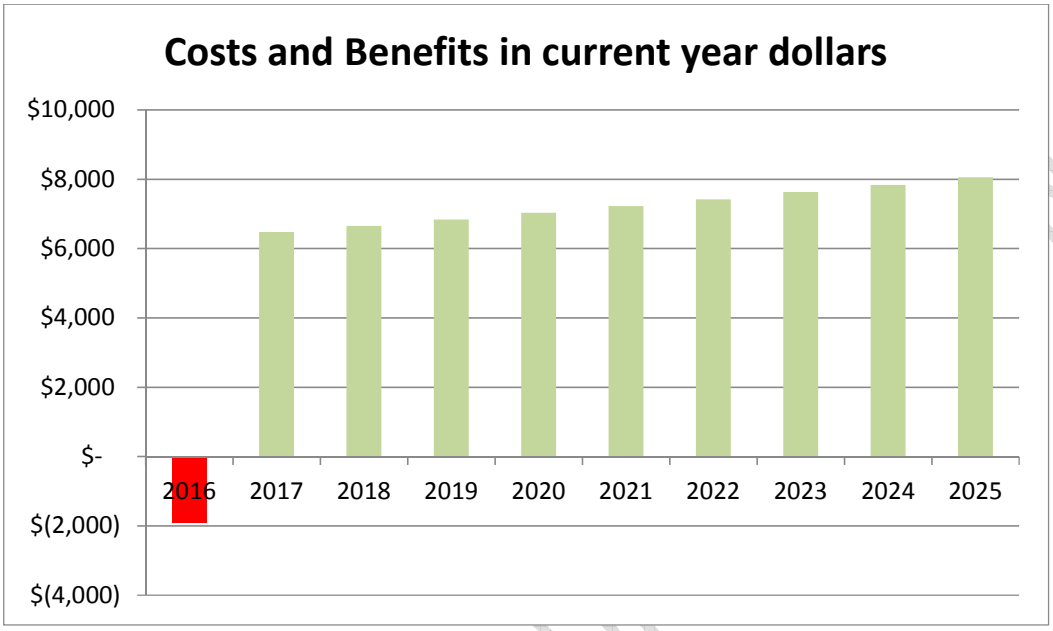
Table 1

2000 SF Single Family Home	**$228,000**									
Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Fire Sprinkler Cost	$(1,900)									
Home Appreciation		$6,384	$6,563	$6,747	$6,935	$7,130	$7,329	$7,534	$7,745	$7,962
Insurance Premium Credit		$89	$89	$89	$89	$89	$89	$89	$89	$89
Total Benefits Per Year/FCF	$(1,900)	$6,473	$6,652	$6,836	$7,024	$7,219	$7,418	$7,623	$7,834	$8,051
Cumulative Benefits	$64,032									
Discount Factors										
Discount Rate	4.6%									
Base Year	2016									
Year Index	0	1	2	3	4	5	6	7	8	9
Discount Factor	1.0000	0.9560	0.9140	0.8738	0.8354	0.7986	0.7635	0.7299	0.6978	0.6671
Discounted FCF	$(1,900)	$6,188	$6,080	$5,973	$5,868	$5,765	$5,664	$5,565	$5,467	$5,371
Cumulative FCF	$(1,900)	$4,288	$10,368	$16,341	$22,209	$27,974	$33,637	$39,202	$44,669	$50,040
NPV	$50,048									
IRR	343%									

[1] The cost of the residential fire sprinkler system was based on an estimate from a local reputable installer.
[2] According to the Las Vegas Review-Journal, the average sale price of home in 2015 is $114 per square foot.
[3] Since 1990 the average appreciation rate for homes in Las Vegas is 2.8% (neighborhoodscout.com).
[4] The average insurance rate premium credit for an automatic sprinkler system to a home in Las Vegas is 15% annually (USAA underwriting, property and casualty).


Discounted Payback
$60,000
$50,000
$40,000
$30,000
$20,000
$10,000
$-
2017
2018
2019
2020
2021
2022
2023
2024
2025


Discounted Cash flows
$7,000
$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$-
$(1,000)
$(2,000)
$(3,000)
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025

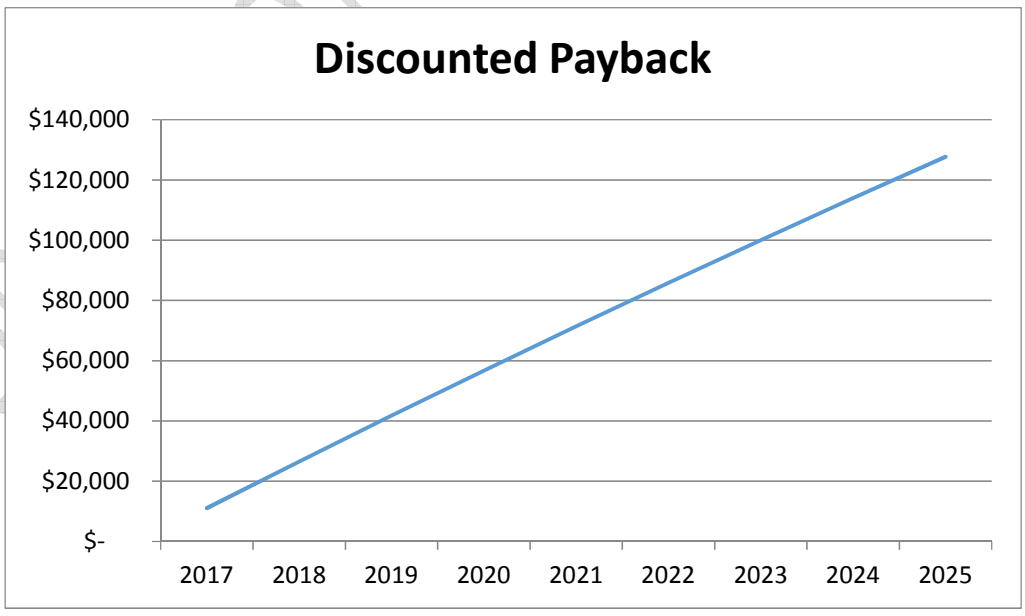


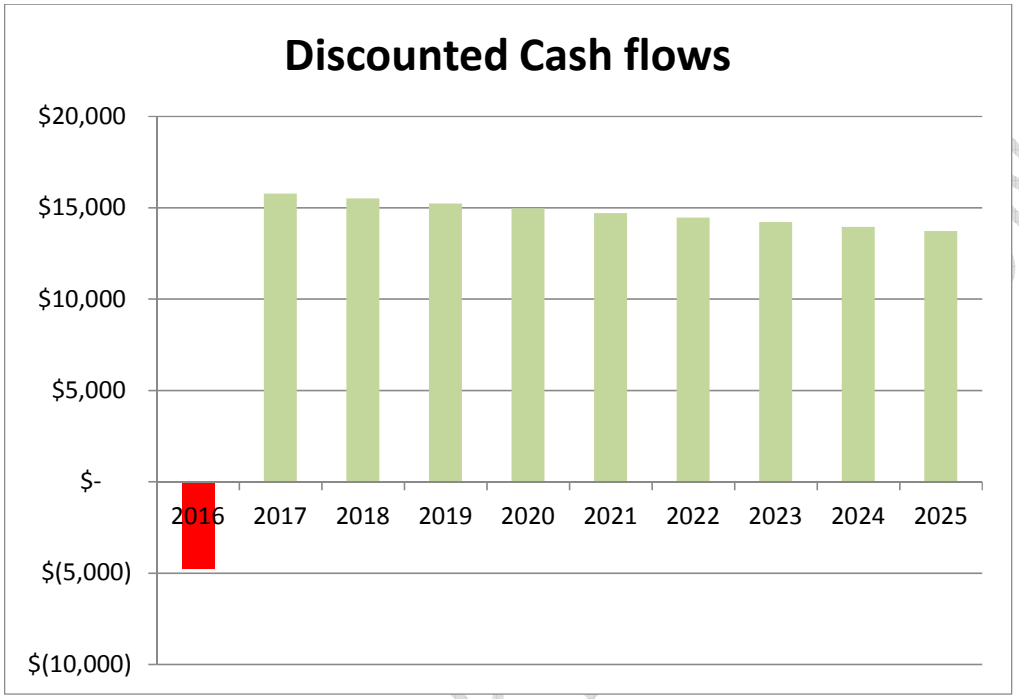
5,000 Square Foot Example:

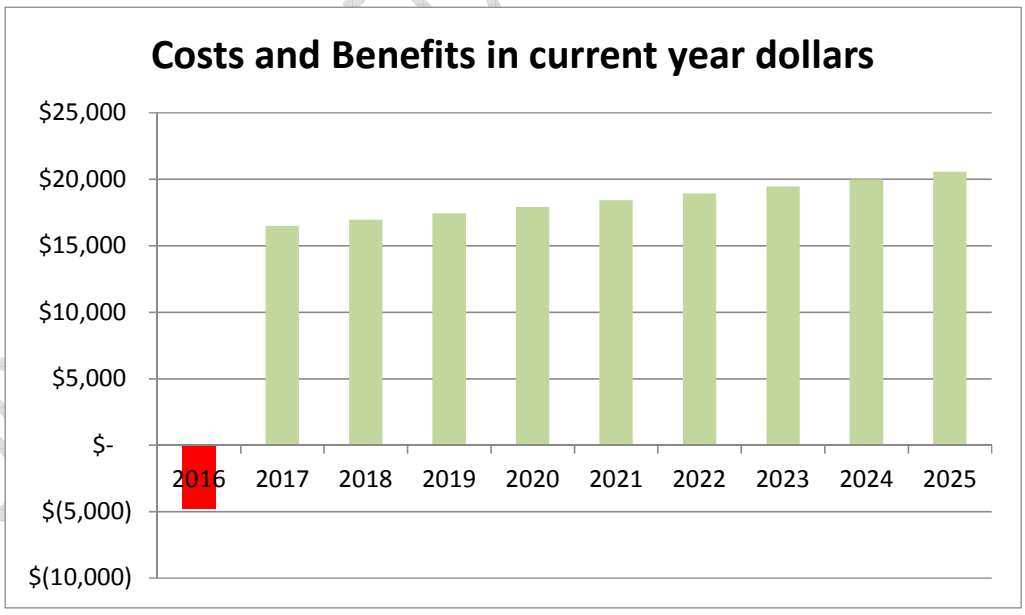
The cost of a new 5,000 ft² tract home is $570,000 in today's dollars net a projected 10 year benefit of $162,180 bringing the potential value of the home to $732,180 in 2025. The investment cost of a $4,750 residential fire suppression system has a payback period in the first year of home ownership. See table 2 below.

Table 2

5000 SF Single Family Home	$570,000									
Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Fire Sprinkler Cost	$(4,750)									
Home Appreciation		$16,407	$16,866	$17,339	$17,824	$18,323	$18,836	$19,364	$19,906	$20,263
Insurance Premium Credit		$89	$89	$89	$89	$89	$89	$89	$89	$89
Total Benefits Per Year/FCF	$(4,750)	$16,496	$16,955	$17,238	$17,913	$18,412	$18,925	$19,453	$19,955	$20,552
Cumulative Benefits	$162,180									
Discount Factors										
Discount Rate	4.6%									
Base Year	2016									
Year Index	0	1	2	3	4	5	6	7	8	9
Discount Factor	1.0000	0.9560	0.9140	0.8738	0.8354	0.7986	0.7635	0.7299	0.6978	0.6671
Discounted FCF	$(4,750)	$15,771	$15,497	$15,228	$14,964	$14,704	$14,449	$14,199	$13,953	$13,711
Cumulative FCF	$(4,750)	$11,021	$26,517	$41,745	$56,709	$71,413	$85,863	$100,062	$114,015	$127,726
NPV	$127,734									
IRR	350%									




Discounted Cash flows
$20,000
$15,000
$10,000
$5,000
$-
$(5,000)
$(10,000)
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025


Costs and Benefits in current year dollars
$25,000
$20,000
$15,000
$10,000
$5,000
$-
$(5,000)
$(10,000)
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025

Attachment 5

New Home Permits
Las Vegas Area
2001-2016

New Home Permits	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001
Boulder City	3	22	15	10	9	3	11	7	9	19	13	26	45	52	46	69
Clark County	4085	3593	3410	3567	2966	1604	2137	1931	2470	5859	9765	13535	14367	11132	10644	10329
Henderson	2223	1689	1222	1274	1117	799	707	505	1097	2387	4249	4923	4595	4267	3980	4109
Las Vegas	1454	1662	1438	1517	1233	808	926	744	1085	2356	2998	4268	6200	6861	4451	4281
Mesquite	246	202	196	202	169	134	201	106	379	487	303	599	429	387	289	404
North Las Vegas	794	630	471	497	618	510	648	498	834	2365	4262	7007	6105	4599	2735	2665
Totals	8805	7798	6752	7067	6112	3858	4630	3791	5874	13473	21590	30358	31741	27298	22145	21857

http://socds.huduser.gov/permits/

We, the undersigned, have read the Residential Fire Sprinkler Study – Final Copy (July 2017). We monitored the research throughout the study. We have reviewed and agree with the finding, and find that analysis to be sound and thoughtful in its approach. Therefore, we endorse the conclusions reached. Please let us know if you have any questions or need any additional clarifications.

Date: 7/27/17

Christopher Stream, Ph.D.
Director
School of Public Policy and Leadership
Greenspun College of Urban Affairs
University of Nevada, Las Vegas (UNLV)

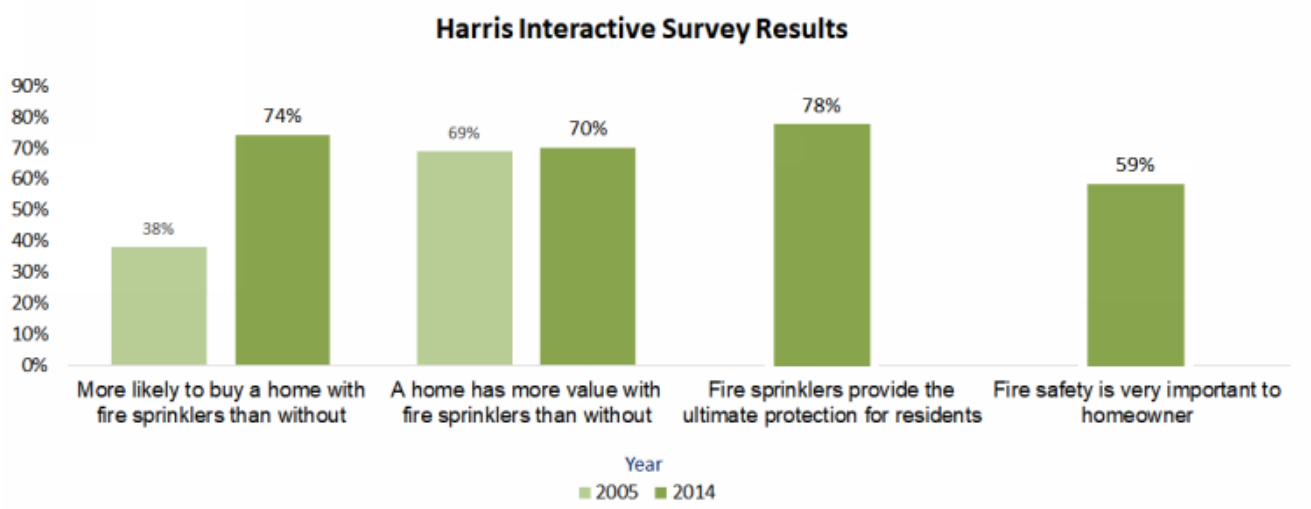
INTERNATIONAL RESIDENTIAL CODE
FIRE SPRINKLER COALITION

FACT SHEET

Homebuyer Interest in Residential Sprinkler Systems

Beginning with the 2009 edition, the International Residential Code (IRC) has required fire sprinkler systems as a standard feature in all newly constructed homes and townhouses. This document provides information to dispel myths regarding home buyer interest in residential fire sprinkler systems.

It is often stated by representatives of the home building industry that home buyers have little or no interest in purchasing a home with a residential sprinkler system, but surveys conducted in 2005 and 2014 by Harris Interactive say otherwise. The surveys, conducted for the Home Fire Sprinkler Coalition, show significant and increasing interest by homeowners in purchasing a home with sprinklers. The figure below summarizes key survey findings (some questions were new to 2014).



Nearly 3/4 of respondents to the 2014 survey stated that they would be more likely to buy a home with fire sprinklers than one without, and similar percentages agreed that a home with fire sprinklers has more value and provides “ultimate protection” for residents. The 2005 survey included 1,019 U.S. adults, of which 620 were homeowners. The 2014 survey focused exclusively on current homeowners and included 1,026 participants.

The home building industry justifies its claims of low interest based on data from localities where builders are required to offer sprinklers as an option, but these results are misleading because builders will inflate costs and scare buyers with claims of leaks, false activations and water damage in an effort to talk buyers out of installing fire sprinklers. Although builders will claim that they will install a sprinkler system if a buyer wants one, we have many documented examples of cases where that is simply untrue.

About IRC Fire Sprinkler Coalition

Founded in 2007, the IRC Fire Sprinkler Coalition has grown to include more than 100 international, national and regional public safety organizations, including associations representing 45 states, all of whom support the mission of promoting residential fire sprinkler systems in new home construction. More information can be found at www.IRCFireSprinkler.org.

INTERNATIONAL RESIDENTIAL CODE
FIRE SPRINKLER COALITION

FACT SHEET
Fire Sprinkler Systems for Townhouses

Beginning with the 2009 edition, the International Residential Code (IRC) requires fire sprinkler systems to be provided as a standard feature in all newly constructed townhouses. This document provides information to dispel myths about the background and costs associated with townhouse fire sprinkler systems.

MYTH: Fire sprinkler systems are an expensive add-on in new townhouses that will negatively impact affordability.

FACTS: The IRC provides numerous financial offsets that reduce the cost of fire sprinklers. For example, townhouse separation walls are permitted to be 1-hour fire rated, rather than 2-hour, when sprinklers are provided. This single incentive can dramatically reduce the overall construction costs, when comparing the total cost of building a sprinklered townhouse with 1-hour separation walls vs an unsprinklered townhouse with 2-hour walls.

According to a 2010 estimate provided by a national "Top 10" multifamily builder, the cost savings associated with reducing a townhouse separation wall from a 2-hour rated assembly to a 1-hour rated assembly is approximately $2.20 per square foot of separation wall. Assuming a 2-story, 1,200 square foot townhouse measuring 20-feet by 30-feet with a pitched roof and attic, the incremental cost of providing a 2-hour wall versus a 1-hour wall would be $1,567. In comparison, the sprinkler system for this building, using the most recent national average cost of $1.35 per square foot cited by the National Fire Protection Research Foundation would be $1,620. Therefore, the firewall incentive alone could reduce the net cost of sprinklers to $53 in this example.

When other factors are considered, such as reduced fire access roadway widths, reduced fire hydrant and water main requirements, and the fact that sprinkler installation costs are often less for townhouses vs. single-family homes due to economies of scale, the overall cost of constructing a sprinklered townhouse community may be less than a non-sprinklered community.

MYTH: Residential sprinkler systems in townhouses are a new and unproven technology that is not yet ready for widespread use.

FACTS: The first residential sprinkler standard was written more than 45 years ago, in 1975, and according to U.S. government statistics, millions of families now live in sprinkler-properties. With respect to townhouses, the **Maryland Building Officials Association**, one of the original proponents of the IRC sprinkler requirement for townhouses in 2008, summed up their extensive experience with fire sprinklers in townhouses in their justification statement, as follows:

> "*Since 1990, townhouses in Maryland have been sprinklered and being so has not been detrimental to the home building industry, but has been a major success to saving lives over the past 18 years. To address reasonable fire protection and affordable housing, many Maryland jurisdictions over the years have permitted townhouse separation of one hour with sprinklers installed in accordance with NFPA 13D. Therefore, based on our past success with sprinklered townhouses with one-hour separations between the townhouses, MBOA is in support of mandatory sprinklers in townhouses with one-hour dwelling unit separations.*

MYTH: The IRC requirement to install fire sprinklers in townhouses was initiated by the fire service and the fire sprinkler industry and it was forced on builders.

FACTS: The code change proposal that added the IRC fire sprinkler requirement (Proposal RB66-07/08) was actually submitted by a major multifamily builder, AvalonBay Communities, and public comments supporting this change were submitted by the Maryland Building Officials Association and the New York State Building Officials Conference. As a major builder of multifamily residential properties, AvalonBay Communities developed extensive experience in installing fire sprinkler systems in townhouses and concluded that sprinkler systems were desirable, cost-effective and should be required as a standard feature in new townhouses.

MYTH: It's best to give home buyers the right to choose whether or not to have sprinklers, as opposed to having codes mandate these systems in all townhouses.

FACTS: It is a fundamental function of building codes to ensure safe housing. Home buyers don't get to choose whether their homes are built to withstand seismic forces, wind loads or snow loads. Likewise, home buyers aren't given the choice of having or not having safe electrical, plumbing, or mechanical systems or smoke alarms. Codes provide minimum requirements for all of these aspects of safe housing in the interest of public safety.

Fire sprinkler systems are no different. Just as car safety regulations have evolved over time from only requiring seat belts to now requiring air bags and backup cameras, building codes have evolved from requiring only smoke alarms to now requiring sprinkler systems for fire safety.

In the case of townhouses, it particularly makes sense for codes to require sprinkler systems because each family's safety is reliant on their neighbors. An accident or careless behavior in one unit often impacts multiple units in non-sprinklered townhouses. Fire sprinklers are the most effective way to ensure that a fire in one townhouse will not threaten families in adjacent units.

Furthermore, townhouses are typically constructed as "spec homes," without buyer involvement during the design or construction process. Adding sprinklers after-the-fact to a finished townhouse unit would greatly increase the cost and complexity of the installation, if it were feasible at all. Likewise, it makes no sense to allow an initial buyer, or the builder in the case of a speculative home, to opt out of fire sprinklers, knowing that such a choice will deny all future owners the option of having sprinklers, given that retrofit installations are typically not feasible.

About IRC Fire Sprinkler Coalition. Founded in 2007, the IRC Fire Sprinkler Coalition has grown to include more than 100 international, national and regional public safety organizations, including associations representing 45 states, all of whom support the mission of promoting residential fire sprinkler systems in new home construction. More information can be found at www.IRCFireSprinkler.org.

INTERNATIONAL RESIDENTIAL CODE
FIRE SPRINKLER COALITION

FACT SHEET

Water Supplies for Home Fire Sprinkler Systems

This document has been developed to dispel myths by providing factual information about water supply requirements for home fire sprinkler systems.

MYTH: ***Home fire sprinkler systems require expensive upgrades to a new home's water supply system.***

FACTS: Home fire sprinkler systems have become so efficient that they can often be designed to use the same or even less water than a new home's plumbing system.

- Fire sprinklers typically require only 7 pounds-per-square-inch (psi) to operate, which is less than the minimum required pressure for residential plumbing fixtures.

  Plumbing systems require:
  - 8 psi minimum pressure for any plumbing fixture.[1]
  - 20 psi minimum pressure for temperature controlled shower valves (these are mandatory in new homes).[2]
  - 40 psi minimum pressure for the main supply connection (applies to all homes with indoor plumbing, even those supplied by wells).[3]

- A single fire sprinkler can use as little as 8 gallons-per-minute (gpm). With home fire sprinkler systems typically designed to accommodate two simultaneously flowing sprinklers, 16 gpm may be all that's needed to supply fire sprinklers. This is actually less than the 18 gpm minimum that would be required by the Plumbing Code to supply plumbing fixtures in a typical entry-level home with 3 bedrooms, 2 bathrooms and 2 outdoor hose connections.[4]

- Fire sprinklers will typically require more water in larger, more expensive homes, but such homes tend to have more plumbing fixtures, which require an increased water supply for plumbing as well. One or two sprinklers must flow for a minimum of 7-10 minutes, which can be provided by a well and/or a small tank when sprinklers are not supplied by a water distribution system.

MYTH: ***Home fire sprinkler systems require big, expensive water meters.***

FACTS: When a fire sprinkler system is supplied by a water distribution system, water meter size is based on the required pressure and flow, which as stated above, may actually be greater for plumbing than for fire sprinklers. Fire sprinklers won't lead to increased meter or tap fees when the sprinkler system is able to be supplied by the same size meter that serves household plumbing.

A typical 5/8-inch meter will flow up to 20 gpm, which is adequate to operate a fire sprinkler system in many homes.[5] A 3/4-inch meter, which will flow well over 30 gpm, is capable of handling just about any home fire sprinkler system. Most often, the size of underground pipe leading to a house is much more limiting than the meter itself. Upsizing the underground piping

[1] International Residential Code (IRC) Table P2903.1
[2] IRC Section P2708
[3] IRC Section P2903.3
[4] IRC Table P2903.6 [17.5 fixture units: 2 bathroom groups, 1 kitchen group, 1 laundry group and 2 hose bibs], and IRC Table P2903.6(1)
[5] IRC Table P2904.6.2(2) [This is the prescriptive allowance for any meter. When a meter of known flow characteristics flows more, the higher flow may be used.]

between the meter and the house is an easy and inexpensive way to improve pressure and flow for all plumbing, including fire sprinklers, without a larger meter.

It's important to note some meter manufacturers' literature specify lesser flow limits, focusing on the range over which a meter will accurately measure continuous flow. With respect to supplying home fire sprinklers, meter flow limits should be evaluated based on the maximum flow rate rather than continuous flow accuracy limits. Water authorities should recognize that sprinklers will always use less water than fire hoses connected to unmetered fire hydrants that would otherwise be needed to put out a fire, so there is no legitimate value in requiring accurate measurement of sprinkler flow in the event of a fire

MYTH: Fire sprinkler systems require expensive backflow preventers.

FACTS: National plumbing codes never require backflow protection for home fire sprinkler systems fabricated with materials approved for household plumbing, such as CPVC, PEX or copper.[6] Occasionally, a local plumbing authority may nevertheless request a backflow preventer, not recognizing that fire sprinkler systems can be safety connected directly to a potable water supply.

Where backflow prevention is an issue because of a local requirement, there are several options whereby additional backflow controls for fire sprinklers can be avoided.

- Fire sprinklers can be incorporated as part of a multipurpose plumbing system that feeds both sprinklers and plumbing fixtures from a home's cold water plumbing pipes.
- Fire sprinklers can be supplied by a separate water connection, with a toilet connected to the end of sprinkler piping to ensure that the piping is occasionally purged by flushing the toilet to prevent stagnant water. This arrangement is referred to as "passive purge."
- Where a yard irrigation system is installed, backflow prevention will be required because such systems are subject to backflow of non-potable water. Fire sprinklers can share the irrigation backflow preventer; thereby, eliminating the need for an additional device.

MYTH: Rural water distribution systems and wells don't have enough water to supply home fire sprinklers.

FACTS: As indicated above, if the water distribution system or well provides enough water to supply household plumbing needs, the supply may be adequate for fire sprinklers. In some cases a larger pump or tank may be needed for sprinklers, but standard, off-the-shelf pumps and tanks suitable for plumbing systems are permitted. When such upgrades are provided, they actually benefit the owner on a daily basis beyond fire protection, because the home's plumbing system will be more robust. Additional water storage can also be invaluable for emergency use in the event of a natural disaster that interrupts utilities.

It should also be noted that, were a rural water distribution system found to be inadequate to supplying 16 gpm for fire sprinklers, it would probably fall short of the minimum code-required plumbing demand, and it would surely fall far short of the 1,000+ gpm needed from fire hydrants to support a fire department extinguishing a fire in an unsprinklered home.

About IRC Fire Sprinkler Coalition

Founded in 2007, the IRC Fire Sprinkler Coalition has grown to include more than 100 international, national and regional public safety organizations, including associations representing 45 states, all of whom support the mission of promoting residential fire sprinkler systems in new home construction. More information can be found at www.IRCFireSprinkler.org.

[6] IRC Section P2904.1

The Home Fire Sprinkler Coalition outlines “Community Risk Reduction” strategies that include how trade ups (modifications) to existing building and fire codes offset the costs associated with installing sprinkler systems. These benefits to builders, developers, and communities are outlined here:

https://homefiresprinkler.org/community-risk-reduction/

The Home Fire Sprinkler Coalition has a number of community case studies where the developer incentive programs were utilized and has published case studies on those communities outlining the costs and benefits associated. Those case studies can be downloaded here:

https://homefiresprinkler.org/fire-sprinkler-incentives-case-studies/

The Home Fire Sprinkler Coalition has developed a number of educational resources for delivering the information about home fire sprinklers, targeting developers, builders, and home buyers. These include PowerPoint presentations, pdf documents, and videos. The can be accessed here:

https://homefiresprinkler.org/free-resources-stakeholders/

BENEFITS of RESIDENTIAL FIRE SPRINKLERS:

Prince George's County 15-Year History with its Single-Family Residential Dwelling Fire Sprinkler Ordinance

Prepared by Steve Weatherby
August 2009

Produced in cooperation with the Home Fire Sprinkler Coalition, University of Maryland University College, Prince George's County Fire Department and the Maryland State Fire Marshal's Office.

Home Fire Sprinkler® COALITION
Protect What You Value Most™

HomeFireSprinkler.org

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Maryland Fire and Rescue Institute

Table of Contents

Executive Summary

In 1992, Prince George's County in Maryland enacted an ordinance mandating the installation of automatic fire sprinkler systems in new one- and two-family structures. Through a partnership with the Home Fire Sprinkler Coalition (HFSC), the Maryland State Fire Marshal's Office, the Prince George's County Fire Department, and the University of Maryland University College, a study was conducted to review Prince George's County's experience with this ordinance over the 15-year period of 1992-2007.

The most obvious benefit of the ordinance is the direct impact that home fire sprinkler systems have made in saving lives and reducing fire-related injuries.

From 1992-2007, there were 101 fire deaths and 328 civilian injuries in single-family or townhouse fires that were not protected with fire sprinkler systems. No fire deaths occurred in sprinklered-structure fires during the period studied, and there were only six civilian injuries.

Property protection is another important benefit. Looking at the average loss per event in a structure that did not have a residential sprinkler system installed, the damages averaged $9,983 per incident, and $49,503 per incident when there was a fatality. The average loss for a single-family/ townhouse structure protected by fire sprinklers was $4,883 per event. Having sprinklers cut the property loss by almost one-half.

Prince George's County experienced 13,494 single-family or townhouse fires during the period, with an average of 900 fires per year. The County's total fire loss for single-family/townhouse structures topped $134 million, averaging almost $9 million per year. Prince George's County's data indicates that more than 45,000 permits were issued for single-family/townhouse structures from 1992 through 2007, with an average issuance of 3,019 permits per year.

During the period studied, Prince George's County Fire Department (PGFD) recorded 245 sprinkler activations in single-family and townhouse structure fires. In the 245 activation incidents, PGFD recorded no lives lost and only six civilian injuries. PGFD reports 446 residents were present in the structures during the time of sprinkler activation. More than 80 of those residents were present when sprinklers activated during the hours of 10:00 p.m. to 5:59 a.m., which is the most common time for fire deaths to occur, according to NFPA fire data. In the 245 activation incidents, the PGFD estimated the fire loss at $1,352,820, compared to a total potential loss of $42,578,420.

The cost impact to developers/builders was determined by interviewing several Prince George's County sprinkler contractors, who indicated that the per-square-foot cost to install a fire protection system in a single-family home in the County has decreased over the years to under $2.00 per square foot. This is consistent with a recent NFPA study that found the average cost of installation nationally to be $1.61 per sprinklered square foot. ❖

Demographics

Prince George's County, Maryland, is roughly 500 square miles and is situated in close proximity to Washington, DC. Prince George's County has a mixture of light industrial, retail, residential and institutional structures that are protected by the county's fire department. Prince George's County is known for providing affordable living for many people who commute to work in the Washington, DC area(1).

Most of Prince George's County's population is concentrated in the northern two-thirds of the County(1). The southern part of the County is predominantly rural(1) but urban sprawl has pushed development into these areas, which are affected by Prince George's County's residential sprinkler code. According to Census figures(6), the average population in the County from 1992-2006 was 846,000 residents. In 2007, it was 828,770. The overall population of Price George's County has grown 11 percent on average since the enactment of the residential sprinkler ordinance(6).

The average median income in Prince George's County in 2004 was $55,129.00(6). The percentage of home ownership in Prince George's County is 61.8 percent, which is almost 6 percent less than the average for the State of Maryland and in 2008 the median value of a single-family dwelling in Prince George's County is $145,600(6).

YEAR	POPULATION	% CHANGE	No. of Permits
1992	740,390	N/A	3680
1993	743,156	1.00%	3858
1994	751,282	1.01%	2418
1995	757,795	1.00%	4344
1996	764,644	1.00%	3635
1997	769,840	1.00%	2920
1998	776,907	1.00%	2664
1999	781,781	1.00%	2927
2000	803,291	1.02%	2506
2001	815,203	1.01%	2467
2002	824,365	1.01%	3068
2003	830,513	1.00%	2088
2004	835,021	1.00%	2233
2005	838,156	1.00%	2782
2006	834,660	-1.00%	2233
2007	828,770	-1.00%	1462
		11.05%	**45,285**

Source: US Census Bureau Estimates

Source: Prince George's County Planning Department Estimates

Since 1992, Prince George's County has issued more than 45,285 building permits for one- and two-family dwellings. The average yearly issuance of one- and two-family dwelling building permits is 3,019.

The Prince George's County Fire Department has 44 stations with a career staff of more than 800 individuals and a volunteer force of 2,000 members. There are 1,200 active emergency responders. In 2007, Prince George's County Fire Department responded to nearly 127,000 calls for service(7). ❖

Prince George's County Residential Sprinkler Ordinance

In 1987, Prince George's County signed a mandatory fire sprinkler law for all residential structures. This law covered every type of residential dwelling from multi-family structures to townhomes to one- and two-family structures. This law was to be phased in over the next five years with the final phase requiring all newly constructed single-family structures to be protected by an NFPA 13D fire sprinkler system(1).

The ordinance was phased as follows: one- and two-family model homes were to feature residential fire sprinklers by February 1, 1988. All newly constructed multi-family structures were to have residential fire sprinklers installed by January 1, 1989. In the final phase, January 1, 1992, all newly constructed single-family homes were to be fully protected by an NFPA 13D residential sprinkler system (1). ❖

Statistical Comparisons

This report consolidates the data collected from Prince George's County Fire Department. The fire department tracked each sprinkler activation by dispatching an on-duty Fire Marshal to the scene. The Fire Marshal was required to complete a Sprinkler Activation Report, which included the type of structure, documentation of the number of sprinklers activated, the potential cause, the type of sprinkler system, the room(s) involved, total dollar value of the property, the estimated dollar loss, and the number of residents present in the structure during activation.

From the years 1992 to 2007, Prince George's County recorded a total of 13,494 single family/ townhouse fires and 245 of those were protected by fire sprinkler systems. In those 245 incidents, no deaths were recorded and only six injuries were reported. In the 13,249 fires that occurred in homes that were not protected by sprinklers, 101 residents were killed and 328 were injured. Fire deaths in residential dwellings made up 89% of the fire deaths in Prince George's County during the years.

Four hundred forty-six persons were present in the structures at the time of sprinkler activation. According to the NFPA, the most vulnerable time of day for home fire deaths is between the hours of 10:00 p.m. and 6:00 a.m. Eighty-one occupants were present in their homes during this time period. Another 294 residents were home at the time of sprinkler activation between the hours 6:00 a.m. and 9:59 p.m. Seventy-one residents were home during activation at unrecorded times.

During the study period, there were 45 recorded residential fire deaths between the hours of 6:00 a.m. and 9:59 p.m., 38 recorded residential fire deaths between 10:00 p.m. and 5:59 a.m. and 18 recorded residential fire deaths where the timeframe was not known in residences without sprinklers.

Fire Deaths and Fire-Related Injuries

These findings clearly show the benefits of an automatic sprinkler system. The most compelling data is that no deaths occurred in any fire where a fire sprinkler system was present. In a tragic contrast, 101 people lost their lives to fires in nonsprinklered home fires during the same period. When one looks at the large number of residents present during fires in sprinklered homes, the protective value of home fire sprinklers is underestimated even more. These residents would have been at a much higher risk of death due to flame and smoke spread had their residences not been sprinklered.

In some of the cases analyzed, residents were impaired or asleep at the time of the fires and were awakened by fire crews. In these instances, the sprinkler system's ability to keep the fire controlled with just one or two sprinklers allowed responding fire crews to rescue the residents in a

Statistical Comparisons *(continued)*

less hazardous environment. In 96 percent of the 245 reported fire-related sprinkler activations only one or two sprinklers operated.

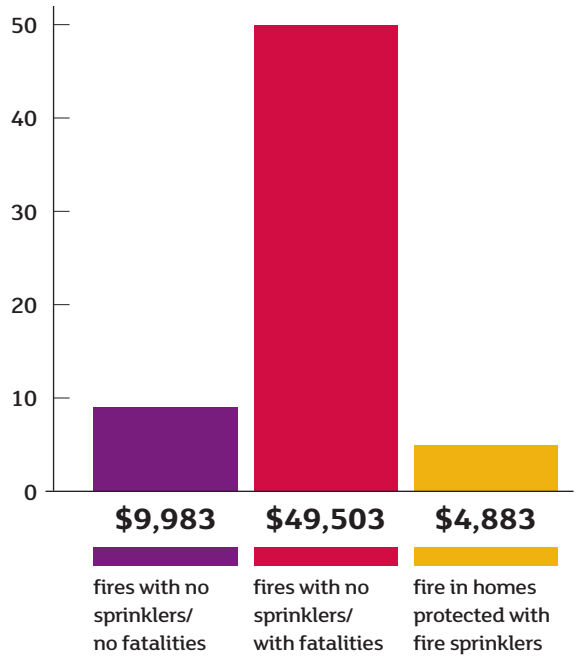
Another important advantage of home fire sprinklers is property protection. From the years 1992 to 2007, Prince George's County Fire Department recorded fire loss for single-family homes and townhouses at $134,711,199. Property loss from the 245 activated sprinkler events was $1,352,820. The average loss per event in a structure that did not have a sprinkler system installed averaged $9,983 per incident. The average fire loss in a structure that was not protected by a sprinkler system and resulted in a fatality came to $49,503. The average loss for a sprinklered single-family/townhouse structure was $4,883 per event. (See chart.) This cut the property loss by almost one-half in single-family and townhouse residences and is at least 10 times less than a fatal non-sprinklered residential fire.

The average water output of a residential fire sprinkler is between 13-15 gallons per minute. The average flow from a fire hose is 95 to 200 gallons per minute, under high pressure. Obviously, the activation of a fire sprinkler will create far less water damage.

Another benefit to the residents of Prince George's County is lower insurance costs for homeowners. Having a home fire sprinkler system helps protect the structure and its contents, lowering the replacement risk of the dwelling. When the sprinklered housing stock increases, the overall fire loss will decrease. which potentially decreases the insurance premiums for everyone.

The cost of installing a residential fire sprinkler system has long been debated. A 2008 study by the Fire Protection Research Foundation showed

Average Property Loss Per Incident



that the national average cost for fire sprinkler installation is $1.61 per sprinklered square foot. In the report, the average median sprinkler-protected area of a new construction single-family home is 4,124 square foot, which makes the cost of a full NFPA 13D system $6,640 for an average sprinklered structure(4). The Research Foundation study used Prince George's County as one of Its models and showed that within five years of the ordinance being enacted, the average installation cost dipped below $1.00 per square foot. At this price point, sprinkler installation should be less than a 5 percent increase over the entire cost of construction for the single-family structure. ❖

Conclusion

This study shows numerous benefits that residential fire sprinklers provide to the public. Prince George's County's residential sprinkler ordinance has had a significant impact on life safety and reduction of property damage. Prince George's County's experience of suffering no loss of life in a sprinklered home should provide ample justification for other jurisdictions throughout the country to pass similar ordinances. ❖

References

1 **Residential Sprinklers: One Community's Experience Twelve Years after Mandatory Implementation**
Fire Chief Ron Siarnicki, Prince George's County Fire Department, January 2001.

2 Source: **National Fire Protection Association: Fire Loss in the U.S. 2007** and **USFA's Firefighter Fatalities in the United States in 2007**

3 **Automatic Sprinklers: A 10-Year Study**
City of Scottsdale, AZ, Rural/Metro Fire Department and the Home Fire Sprinkler Coalition, 1997.

4 **Home Fire Sprinkler Cost Assessment**
The Fire Protection Research Foundation, Newport Partners, 2008.

5 **http://www.realestatemapsmdva.com/princegeorges.shtml**

6 **http://www.quickfacts.census.gov/qfd/states/24/24033.html**

7 **http://www.co.pg.md.us/Government/PublicSafety/Fire-EMS/index.asp**

Virginia Townhouse Sprinkler Price Survey

Compiled by Jeffrey Shapiro, P.E., FSFPE, IRC Fire Sprinkler Coalition 12/7/2020

The information below has been provided by two sprinkler contractors who were asked to provide Virginia-specific price histories for townhouse projects built in Virginia in the past few years. These are the prices charged to builders, exclude any builder markup that might increase the actual cost to consumers, and exclude permit fees that may be charged in addition to the base building permit cost.

Response from Contractor 1

- The following data reflects costs for 10 projects constructed between 2016 and 2019. Prices do not include added costs associated with local amendments exceeding what is required by the nationally recognized standard.

Job Location	Year	Cost per Unit	Average Cost Per Square Foot
Reston, VA	2019	$2,050.00	$1.33
Reston, VA	2017	$2,045.00	$1.27
Reston, VA	2017	$1,800.00	$1.17
Haymarket, VA	2016	$2,762.00	$1.25
Haymarket, VA	2016	$2,490.00	$1.13
Haymarket, VA	2016	$2,350.00	$1.16
Leesburg, VA	2020	$3,525.00	$1.21
Leesburg, VA	2020	$3,250.00	$1.25
Alexandria, VA	2019	$4,900.00	$1.48
Alexandria, VA	2019	$5,000.00	$1.41

- **Fairfax County average price is $1.26 per square foot (NFPA 13D).**
- **Prince William County average price is $1.18 per square foot (NFPA 13D).**
- **Loudon County average price is $1.23 per square foot (NFPA 13D).**
- **Arlington County average price is $1.31 per square foot (NFPA 13D).**

Response from Contractor 2

- **Loudoun County average price is $1.71 per square foot (NFPA 13R).**
  - $1.71 figure represents the average price for over 500 units constructed by four different builders in the past five years.
  - Loudoun permits a modified NFPA 13R design, that does not require a fire department connection and permits a design based on 2 sprinklers operating, rather than 4, which is ordinarily required under NFPA 13R.
- **Fairfax County average price is $1.86 per square foot (NFPA 13R)**
  - The $1.86 figure represents the average price for 220 units constructed by three different builders in the past four years

Costs provided by this contractor exceed what would be expected to comply with the proposed Virginia Residential Code because the costs reflect systems that were designed to the NFPA 13R standard, not the NFPA 13D standard, which the residential code will permit. NFPA 13R systems are typically used to protect large residential complexes and are more expensive than NFPA 13D systems, which are for protection of townhouses and one- and two-family dwellings.

The table and figure on the following page summarize all results

Fairfax County	**NFPA 13D**	**$1.26**
Fairfax County	**NFPA 13R**	**$1.86**
Prince William County	**NFPA 13D**	**$1.18**
Loudon County	**NFPA 13D**	**$1.23**
Loudon County	**NFPA 13R**	**$1.71**
Arlington County	**NFPA 13D**	**$1.31**