A Public Guide to Residential Fire Sprinklers For New Construction of Single Family Homes in New Hanover County (NC)

Michael Pinson

New Hanover County Fire Rescue, Wilmington, NC

Certification Statement

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

Signed: _____

Abstract

The problem for New Hanover County Fire Rescue was that public guides to residential sprinklers in single family dwellings for new construction was not available. The purpose of this research was to develop a public guide to residential sprinklers for new construction of single family dwellings. The study used an action research method to answer the following questions: (1) how to work with the builder and associated trades in order to have a fire sprinkler installed into new construction; (2) identify what information should be included in a public guide; and (3) identify what the home buyer should know about residential fire sprinkler systems. Interviews and literature were used to answer the research questions in developing a public guide. A situational analysis was conducted to determine factors causing or contributing to the problem. Objectives were set and strategy developed for creating the public guide. The residential fire sprinkler public guide was created and presented. Six recommendations were identified: adoption of the guide for use within the department, initiate a marketing campaign for residential sprinklers to maximize its effectiveness, identify benchmarks for the guide's success, review the guide in two years for usefulness, initiate future research for developing a residential fire sprinkler guide for areas in the area that may not be supported by the municipal water authority, and commence future research into monitoring for multipurpose fire sprinkler systems in single family residences.

Table of Contents

Certification Page…….. 2

Abstract……. 3

Introduction……... 5

Background and Significance…… 7

Literature Review…….. 12

Procedures……. 23

Results…….. 26

Discussion……. 34

Recommendations……. 38

Reference List…… 41

Appendices

Appendix A (Residential fire sprinkler guide)……..…… 45

Appendix B (Interview form for local inspectors)……..……. 56

Appendix C (Interview form for builders)……..……. 57

Appendix D (Interview form for sprinkler contractors)……..……. 58

Introduction

New Hanover County Fire Rescue is a medium sized combination department that serves 202,667 persons year-round throughout the unincorporated and municipal areas. The county has 198.4 square miles of land area. Just over half of the residents live within the boundary of the county seat of Wilmington and three beach municipalities. Those citizens are served primarily by their respective fire departments with assistance provided by New Hanover County Fire Rescue through emergency response, inspection services, prevention, and risk reduction. During the summer seasons, the area sees an influx of visitors; more specifically in the beach communities. While New Hanover County surrounds the incorporated limits of the beaches and the city, it provides fire protection services directly and indirectly to all citizens that reside within its borders. Additionally, New Hanover County has further contract responsibilities for primary fire response services to the north for several miles into into Pender County. This contract arrangement is in response to provide fire protection and improve insurance rates to the citizens that reside in that area. Wilmington, a college town, is home to the University of North Carolina at Wilmington and Cape Fear Community College. There are also several private colleges in town and the surrounding region performing academic purposes. New Hanover County sits between the mouth of the Cape Fear River and the Atlantic Ocean. This region of southeastern North Carolina is known as the Cape Fear area.

For the purposes of this research, single family residences are stand-alone buildings that are normally occupied by one to two families. Buildings that are designed for multiple families such as condominiums, apartments, and dormitories are not included in this research project as there are differences in building regulations that apply to those occupancies. North Carolina has its own adopted code regulations that are amended from the nationally recognized code editions.

According to the US Census American Fact Finder, New Hanover County has over 101,000 housing units; 67% of which are stand-alone single family structures (United States Census Bureau, 2012, p. 1).

The problem is that public guides to residential sprinklers in single family dwellings for new construction is not available. While there is an abundance of information provided nationally, there is not a specific local informational guide readily available to the citizens who choose to build their homes within New Hanover County and the surrounding region.

The purpose of this research is to develop a public guide to residential sprinklers for new construction of single family dwellings. Distribution of a guide into the local community will provide necessary information to citizens and other stakeholders in order to help them make informed decisions about placing residential fire sprinklers into the homes they are building. The end product should also give the public insight into how to streamline the process of including residential sprinklers into their new homes; potentially reducing some of the challenges they may see from the time of their decision to include residential sprinklers to the closing of their home. This project uses an action research method; implementing literature and interviews to answer the following questions:

1. How does a home buyer work with the builder, sprinkler contractor, and local inspections departments on including a residential sprinkler system in new construction?
2. What information should be included in a public guide for residential sprinklers in new construction single family dwellings?
3. What should the home buyer know about sprinkler designs in a single family residential building?

Background and significance

New Hanover County Fire Rescue is young when compared to other departments of similar size. Beginning in 1997, New Hanover County Fire Rescue was created in response to the changing needs and expectations the public had for fire protection services. Up until the department was created, contract volunteer corporations provided fire protection services; most starting in the 1950's. As the needs of the community increased, so did the department's staffing, resources, and responsibilities. Fire prevention and education activities were a shared responsibility among the contract departments and New Hanover County Fire Rescue. Since 1997, fire code enforcement activities in the unincorporated areas of the county were completed by the department. Prior to that time, code enforcement for fire protection remained in the county's inspection department. Residential fire sprinkler installations for single family homes still are inspected by the plumbing inspection team today.

In 2010, at the recommendation of a recent master planning process, the New Hanover County commissioners consolidated the volunteer corporations under the umbrella of New Hanover County Fire Rescue. Over the next two years, more changes would occur in an effort to provide improved fire service protection to the public. The Wilmington Fire Department and New Hanover County Fire Rescue enjoy a somewhat unique relationship, choosing to operate as a modified single response entity. In other words, the Wilmington Fire Department may respond to incidents outside of its recognized boundaries and New Hanover County may respond directly into the city limits of Wilmington. This goes beyond a normal mutual aid agreement often found elsewhere. Response focuses on the closest available unit with the intention that service for fire protection improves. Both departments operate on the same: radio frequencies including dispatch, incident response tactics, medical protocols, and training guidelines. Ultimately, the

customer gets faster service during their emergency without sacrificing consistency. Each department's fire prevention bureau of inspectors was relocated in 2011 to share the same office space; streamlining fire code enforcement initiatives and creating a one-stop-shop opportunity to the public for related services regardless of whether they live within the city limits or not. Also, both departments share some budgeted staffing responsibilities for fire and life safety educators. This is important in that prevention efforts are sounded simultaneously through each department. Simply put, each department echoes similar messages due to the shared endeavors of code enforcement and prevention education efforts. It ties in to this research for data collection and future residential sprinkler guide promotional campaigns. Each department can use the guide created here to concurrently deliver a message to the majority of residents who choose to live within and around New Hanover County.

In 2009, the International Residential Code (IRC) was adopted that included a section requiring new construction for single family dwellings to have fire sprinkler protection; effective in 2011 (Internation Code Council, 2009). With inclusion of the fire sprinkler requirement, states and local jurisdictions were faced with the decision to adopt or amend the IRC as it sits. North Carolina has chosen to adopt the code with amendments deleting the sprinkler condition from new construction (North Carolina international residential code, 2012). This deletion means that while North Carolina has chosen to adopt the code, the state has made selections as to what components it would choose to follow. The deviation, while not an uncommon practice, does reduce the effectiveness of legislation in support of residential fire sprinklers in single family homes. As a result, a guide supporting residential sprinklers as an option for the home buyer is basic in preventing fire related injury and death for the future.

The lack of a local guide for the public addressing fire sprinkler systems in new construction single family residences is a problem in that the public fails to recognize all available options for protecting their lives and property. Often, this failure isn't realize until after the home is completed; when costs for installation would increase. This missed opportunity during the construction phase of their homes could plague each occupant for the duration of their residency and the life of the structure. The impact the decision has on installing sprinklers when the home is first built is monumental. Residential fire sprinkler installation is not like the inclusion of smoke detectors from years past. Smoke detectors are much smaller and less expensive in comparison. They can be installed fairly easily long after construction is completed. In fact, New Hanover County Fire Rescue, in partnership with Wilmington Fire Department and the local senior center, participates in smoke detector installation programs throughout the year. The construction phase is the best opportunity from an economic perspective for the future homeowner and those that own the property afterward have for installing residential sprinklers. A guide with pertinent information, coupled with an effective marketing strategy, has the ability to influence life safety in the region for generations. This statement is made with the assumption that most homes built today, are expected to have a life of at least fifty or more years before replacement.

Fire death and injury is a national problem. This is evident in America Burning, a report commissioned by former President Richard Nixon, "Fire is a major national problem." (The National Commision on Fire Prevention and Control, 1973, p. 1). Although the report is over forty years old, it still holds true. Despite the many advances and improvements that have come forth since the report, the United States still has an annual fire death rate of more than two times that of multiple European nations (U.S. Fire Administration / National Fire Data Center, 2009, p.

2). As a leading country in technology and global influences, this statistic demonstrates that the U.S. is trailing in the realm of residential fire protection. According to the U.S. Fire Administration, there were 364,500 residential fires that occurred in 2011; resulting in 2450 civilian deaths and over $6.6 billion in property loss (U.S. Fire Administration, 2013). While this number is significantly less than that of the time when America Burning (1973) was first published, it still reflects a need to improve. For example, the total number of American military killed during the combined campaigns in Iraq and Afghanistan from March 19th, 2003 until February 5th, 2014 are 6,795 (U.S. Department of Defense, 2014), (Icasualties, 2014). In comparison, the total number of civilians killed in their homes from fire during the same time period, including the first three months of 2003, was 24,335 (U.S. Fire Administration, 2013). The significance here is that there are more than three times the fire related fatalities in residences than overseas for U.S. military conflict. One could argue that these deaths could are preventable. This was discussed in the referenced text of America Burning (1973). The document recognized that residential automatic sprinkler system at the time were not cost effective and promoted the support of developing the technology needed to improve the ability to install these systems (The National Commision on Fire Prevention and Control, 1973, p. 120). While residential sprinkler systems were not cost effective at the time, there was recognition in its value as a lifesaving tool. This also appeared in the sequel publication to America Burning with another recommendation that residential fire sprinkler technology continue with development (United States Fire Administration, 1987, p. 97). Research projects were run in the 1970's that helped develop the quick response residential sprinkler, catapulting the technology to a much more economical product in the 2000's (FM Global, 2010, pp. 33, 62, 164). The technology to provide installation of residential sprinkler systems today is much more cost

effective and readily available to the new home buyer than it was in the 1970's and 1980's. Even with the modern advancements in technology, there are not many single family homes in the Cape Fear region that have fire sprinklers installed when being built.

The department realizes this problem due to the very low numbers of fire sprinkler installations in single family residences over the past few years. There have been a total of 24 permitted residential sprinklers installed into single family homes during 2012 and 2013; all but three were installed as part of a local habitat for humanity program (K. Hall, personal communication, February 7, 2014). According to this information, there were three homes built that sought to have residential sprinklers installed that were not required to be built as part of a community development program. In comparison, there were 1,515 permits issued for new residential construction of single family dwellings within New Hanover County during the same time period (K. Hall, personal communication, February 7, 2014). This information supports the challenge in that less than two percent of all new homes built in 2012 and 2013 had fire sprinklers installed for life safety and property protection. Echoing the national position on residential fire sprinklers, the department acknowledges the lack of a guide as a problem and encourages installation during the construction phase of new homes. As an individual who has seen limited awareness of how fire sprinklers can positively impact life safety and property conservation, the author recognizes that value in addressing the problem. The significance of this research is to achieve the purpose of developing a public guide to residential sprinklers for new construction of single family dwellings.

This research ties into the Nation Fire Academy (NFA) Executive Fire Officer (EFO) Executive Analysis of Community Risk Reduction (EACRR) course as it develops a guide on sprinklers for the local community home buyers of new construction in single family residences;

thus reducing risk. This study impacts three elements of the United States Fire Administration's Operational Objectives of: reducing risk at the local level, improving local planning and preparedness, and improving the capability of an all hazards response (United States Fire Adminstration, 2010, p. 13).

Literature Review

For this applied research project, a literature review was conducted to understand: (1) the impact residential sprinklers have on life safety and property conservation, (2) national perspective of residential fire sprinklers among the building community, inspectors, and public, and (3) informational guides others have completed concerning residential sprinkler systems in new construction.

Impact residential sprinklers have on life safety and property conservation

Understanding the effect residential sprinklers have on single family residences is a vital part of developing a public guide. The impact helps the reader understand the purpose behind installing such systems for their safety. Part of the guide is to help reinforce this. During this literature review, most of the statistical information found was conducted by nationally recognized government and safety organizations. The focus of those organizations is life safety related. Examples of these organizations include, but are not limited to: The U.S. Fire Administration, the National Fire Protection Association (NFPA), the National Institute for Safety and Technology (NIST), and the Centers for Disease Control and Prevention (CDC). In performing a thorough literature review, it was found that private research entities predominantly used the statistics provided by the aforementioned national organizations in reaching their conclusions. Although these secondary sources provided valuable insight into the review, they

were excluded in this portion of the manuscript since the primary sources were readily available. Their results and conclusions, however, were included when appropriate.

According to Underwriters Laboratories (UL) research, trends since the 1970's in modern homes have increased in square footage by almost double; including more homes being built as two stories (Kerber, 2012, p. 3). This information is significant due to the changing dynamics the fire service may see as homes of the past are replaced by homes of the present and future. Wider room spans, changes in fuel loadings, and changing construction materials all impact how fires react in single family homes (Kerber, 2012, p. 3). In other words, fires are getting hotter, developing more before discovery, and are becoming more dangerous despite efforts for enhanced fire code development. The study goes on to report that flashover testing occurred where fires in newer homes were reaching total room ignition conditions in less than four minutes; compared to legacy homes of about thirty minutes (Kerber, 2012, p. 16). The caveat to this means that firefighters are just arriving to see structures reach their most dangerous time of the fire occur; creating a life safety hazard not only for the occupants, but now for the firefighters. In older homes, firefighters had time and opportunity to get into the structures to extinguish fires. This isn't the case with newer, larger homes with a different fire load. As a result, a means of controlling and extinguishing fires prior to fire department arrival is crucial to maintaining life safety. The information contained in this evidence helps provide groundwork for the value in residential fire sprinklers in single family homes.

Further looking into safety standards and research surrounding residential fire sprinklers found that the National Institute of Standards and Technology (NIST) created a report supporting their installation in homes. In their report, Madrzykowski and Fleming concluded that fire sprinklers in residences are instrumental in allowing occupants to escape with little to no injury

in the event of a fire (2011, p. 16). Their study reviews the current standards from National Fire Protection Association (NFPA) 13 and UL 1626; demonstrating the effectiveness they have in real world situations (Madrzykowski & Fleming, 2011). The review helps to validate the standards. It also reinforces statements about the changing dynamics of home construction and fire loading made in recent years (Madrzykowski & Fleming, 2011, p. 16). The report mirrors earlier statements made by UL in regards to the changing of fire dynamics from years past. It is also worthwhile to add that the paper mentions another type of sprinkler system outside of a standalone sprinkler; multi-purpose systems. It describes multi-purpose fire sprinklers as a viable option for connecting home sprinklers to already planned plumbing through the new home being built (Madrzykowski & Fleming, 2011, p. 13). In essence, using this type of system gives advantages the end user may find valuable in selecting their type of sprinklers.

According to the US Fire Administration's topical fire report series, installed automatic extinguishing systems make up less than one percent of all residential structure involved in fires reported from 2009 until 2011 (U.S. Fire Administration, 2013, p. 10). This means that most single family detached homes are not protected by residential sprinklers. This poses a problem with protecting occupants from fire. The same report goes on to expand on that a third of the fires that did occur, occupants were notified of a fire by a smoke detector (U.S. Fire Administration, 2013, p. 10). The data presented lays out the evidence that smoke detectors do not resist fire in order to protect lives and property in residential occupancies. While smoke alarms are valuable and have proven effective at combating the nation's fire problem, the report suggests that it isn't enough.

As concluded in Hall's work, fire sprinklers are "…highly effective and reliable…" at protecting structures from the threat of fire when not hampered with by human intervention

(Hall, Jr., 2013, p. 57). In other words, the fire sprinklers were proven successful in keeping the fire controlled or extinguished a majority of the time. According to the work, four percent of the time, sprinklers did not work in fires that were large enough to actuate the protective system; sixty percent of which were the result of the system being turned off (Hall, Jr., 2013, p. 57). Expanding on this, when left on and in working order, sprinklers were effective in preventing injury or fatality. The study showed an eighty two percent reduction in death rates in structures that contained fire sprinklers compared to structures without a wet pipe sprinkler system commonly found in residential fire sprinkler systems (Hall, Jr., 2013, p. 41). This helps to solidify the argument that residential fire sprinklers are effective in preventing injury and death when used and maintained appropriately. While this information draws statistical data from the U.S. Fire Administration, it corroborates with the conclusions from UL and NIST (Kerber, 2012), (Madrzykowski & Fleming, 2011).

In an analysis of structure fires, the fire death rate per 1,000 was six times higher in residences with no wet pipe suppression system compared to those with residential fire sprinklers (Ahrens, 2013, p. 44). This adds to the argument that fire sprinklers create a significant difference in survivability in the event of a fire. The report provides additional clarification that fire sprinklers can control and limit a fire's spread prior to arrival of the fire department (Ahrens, 2013, p. 45). This statement is essential in the argument for the effectiveness of fire sprinklers in that a fire can be kept from spreading, preventing death to occupants even before the fire department can arrive to assess the situation. The information contained in Ahrens' report shows statistical data gathered from a variety of sources to reinforce these conclusions (2013).

National perspective of residential sprinklers among the building community, inspectors, and public

In reviewing the literature, this author found a multitude of articles, research, and analysis. While many articles were editorial in nature, they were found to be informative in understanding the national mindset of sprinklers among the various stakeholders such as fire service professionals, sprinkler advocates, builders, and the public. Some of those articles were carefully included as evidence to support the perception stakeholders have on this particular issue.

Since home buyers tend to work with building groups or general contractors, it was prudent to include their perspective in developing a guide. By doing so, some pitfalls or challenges may be avoided if included in the guide. While performing a review of the national perspective of builders, it was found that the National Association of Home Builders (NAHB) appeared to represent most builders collectively in the home fire sprinkler position. Very little other evidence was found contrary to this view. The focus of each article was on discouraging residential fire sprinklers with no information on how the home buyer would work with the builder on accomplish having fire sprinklers installed into their homes. Nevertheless, the information was included to encompass the perspective from the building community. The NAHB created a special study in 2007 to review fire sprinklers and how they affect homeowner insurance. The study looked into the cost effectiveness of adding fire sprinklers into homes in relation to the expected financial benefit through insurance or other discounts. According to the report, homebuyers would expect to pay significantly more for adding sprinklers into their new homes and see half to a fifth of a return on the investment through insurance discounts (Xu, 2007, p. 3). This report provides some insight on the cost effectiveness of adding sprinklers into

new residential construction; namely identifying that there is not a significant enough amount of discount to warrant a net gain for the home buyer. The report goes on to include data from each state on how much of a discount insurance companies provide for homes that have residential sprinkler systems installed; from zero to 15 percent (Xu, 2007, pp. 6-7). The report gives the audience a different perspective from the builder on what to expect with up-front costs, hidden costs, and the financial benefits.

Another document from by the NAHB focuses on the value of smoke detectors. The organization encourages the usage of smoke detectors and that sprinkler systems do not have enough evidence to warrant their use (National Association of Home Builders, n.d.). The document goes on to approach the cost ineffectiveness and challenges of installing sprinkler systems into the home to include: excessive water damage from sprinkler discharge, ineffectiveness of sprinkler components through recalls, current building codes already make homes safer, tradeoffs being false incentives, and that insurance savings are negligible (National Association of Home Builders, n.d.). The document and the affiliated website makes general statements about how ineffective sprinklers are and centers on the opinion that sprinkler initiatives are pushing a product in order to promote an industry that cannot make money other than through legislative measures. This perspective is that the home building community, while agreeing that the home buyer should have an option for a sprinkler system to be installed, does not support mandatory requirements for building codes. In other words, the viewpoint is that sprinkler systems in single family residences should remain voluntary and that if it does, not many people would choose the safety feature. This is evident in the end of the document, where the authors identify data stating that the homeowners have decided that fire sprinklers are not worth the investment when given the choice (National Association of Home Builders, n.d.). In

looking at the document as a whole, there are many generalities and references to studies that indicate fire sprinklers are not effective without including citations for reference. This may show evidence that, while this is the viewpoint of the home building community, does not have much factual relevance. If further studies support this document, then it would have more value as evidence against fire sprinklers in single family homes. This is not an opinion about the document, merely observation of how this part of the literature review was submitted as evidence for perception.

Another article from the NAHB shows cost ineffectiveness of fire sprinklers in homes. In the study, the NAHB uses an online tool recently developed by the National Institute of Standards and Technology (NIST) to demonstrate that residential fire sprinklers are not worth the money when compared to a statistical life (Emrath, 2011, pp. 1-2), (National Institute of Standards and Technology, 2010). In essence, the group is able to prove why fire sprinklers are not cost effective in single family dwellings for new construction. The article inputs data such as the number of years the homeowner would expect to live in the home, insurance discounts, costs for maintenance in reaching its conclusions (Emrath, 2011, pp. 3, 7, 13-15). It points out many aspects of cost affiliated with fire sprinklers and utilizes a third party developed program to reach its conclusions. It shows that when looking at costs, including the statistical value of human life, value plays a significant role in determining cost effectiveness. This is the case with the home building community. Upon reviewing the NIST website, the user can add study parameters such as: discounts applied, construction costs, and the value of a human life among others to evaluate the effectiveness of a residential fire sprinkler system (National Institute of Standards and Technology, 2010). The program derives its output from research completed and contained in a NIST report indicating the cost effectiveness of residential fire sprinklers (National Institute of

Standards and Technology, 2010). It is apparent that values can be adjusted to meet the needs of the user, dependent on what is considered acceptable. The NAHB article uses inputs from accepted best practices in regards to the value of a human life to make its case (Emrath, 2011, pp. 9-11). This helps in the justification asserted from this source that the conclusions are more impartial.

Inspectors are often the essential component in regards to development and final certificate of occupancy for construction. Without their involvement, a guide may prove to stall out in helping the public include fire sprinklers into their home. Although inspectors tend to represent members of the fire service, they were included to provide another viewpoint for the end product. A handbook produced by the National Association of Fire Marshals Fire Research Foundation reviews the effectiveness of fire sprinklers in the homes. The research looks at modern construction features, to include a historical look at previous designs, modern furnishings, and protection systems (Tidewell, Kraus, & Love, 2013, pp. 12-25). More specifically, the authors identify multi-purpose extinguishing systems in their documentation as effective means of extinguishing fires in residential occupancies; utilizing the existing plumbing features to keep cost down and ensure the system remains charged (Tidewell, Kraus, & Love, 2013, pp. 24-25). This is important as there have been other works seen throughout the literature review that indicate the value of the multi-purpose sprinkler system. The work also goes on to include information on how to: approach getting the buy in from the stakeholders, overcome policy challenges, incentive methods, and implementation strategies in order to become successful in getting fire sprinklers into new homes (Tidewell, Kraus, & Love, 2013, pp. 32-34, 85-100). The evidence produced here, indicates a strong view from the inspectors group; supporting residential fire sprinklers as a legislative measure. The guide also provides a resource

for policy makers and fire service professionals to make progress towards improving life safety in single family homes through the installation of fire sprinklers. There is value in incentivizing the installation of sprinklers (Tidewell, Kraus, & Love, 2013, p. 87). For example, tax reduction for fire sprinkler installation would be a good incentive for the citizen who may have excessive taxation on his or her mind. The argument is that less money could be spent on taxes and rolled over to a safety device that the taxpayer could see and own. It may be a little easier to persuade using this information.

An alternative perspective reviewed is that of the home buyer. After all, they are the ones who will be living with the decision to place fire sprinklers into their homes. An editorial written discusses the experience one home buyer had with deciding all of the options to be included in the newly constructed home. According to Carli, the builder helped the family with all of the tough components and options of the home to include lawn sprinklers; only to forget about home fire sprinklers (Carli, 2009, p. 38). The angle of the home buyer here gives insight into the idea that residential fire sprinklers are often unnoticed or disregarded before any real discussion about them goes on. The article continues on to emphasize the value of fire sprinklers in the home; including that the next home will have more than just the lawn sprinkler (Carli, 2009, p. 38). The lessons learned by this individual, according to the article, is that fire sprinklers are a necessity for future homes. The other point is that the author is now living without the protection of a home fire sprinkler system despite the awareness of its impact. This component of the article drives that, underneath the surface of this research, installation of residential fire sprinklers during the construction phase is more vital to the success of the program.

Informational guides others have completed in regards to residential sprinkler systems in new construction

In looking at previous works for residential sprinkler guides, it appears that several start with a point of reference from national models. One national model is that of the Home Fire Sprinkler Coalition (HFSC). This not-for-profit organization has completed much of the foundational work that is seen in many other guides. This is evident in the guides provided by the organization located on their website; which includes how-to data for the consumers, fire service professionals, home builders, elected officials, other contractors, and insurance providers (Home Fire Sprinkler Coalition, 2014). The result is a consistent message being delivered nationwide. Much of the material is available for free for download or can be ordered online. There are many advantages to this resource as it provides the leg work necessary to develop a focused program for residential fire sprinklers. The disadvantage to this resource is that it concentrates on national issues in regards to residential sprinklers. Local issues or state challenges are not addressed as readily. The HFSC does have some guidance for overcoming some of the common challenges seen in local jurisdictions.

According to the National Fire Sprinkler Association, there are several concerns about residential sprinklers that the homeowner may have about installation into their home. In response, they developed a guide that addresses the concerns about: water damage, sprinkler effectiveness, reliability, dos and don'ts, and costs (National Fire Sprinkler Association, 2014) This guide adds some depth from the perspective of the sprinkler contractor groups. It answers questions the homeowner may have about sprinkler systems, including that one in sixteen million sprinkler heads accidentally activate per year (National Fire Sprinkler Association, 2014, p. 2). This is noteworthy as a consumer may be hesitant to install fire sprinklers into their homes if

they have to worry about sprinkler heads going off without a fire. This information suggests that sprinkler heads are reliable at not activating when there is no fire. It does not indicate whether the accidental activation is a result of human intervention such as bumping the head; or just product failure on its own.

In an effort to be thorough, guides developed by local jurisdictions were sought to get an idea of what has been delivered so far. This is valuable in this research as it takes a look at what may be viewed as successful or not. Unsuccessful components in residential sprinkler guides can be drawbacks that can be avoided in this final product of this research. The Central Savanna River Area Chapter of the Society of Fire Engineers developed a guide that would be used to help a home buyer with answering some common questions and myths about home fire sprinklers (Central Savannah River Area Chapter of the Society of Fire Engineers, 2014). The guide, while not too specific to the geographical area, does provide good information to the consumer on what fire sprinkler systems do and how to maintain them. At nine pages, the document provides a briefing and stays to the point; giving pertinent information without losing the reader in excessive factoids. The structure of the guide is mostly written with no images for the reader to illustrate the points.

Another local guide was found in the Village of Wheeling, Illinois. In the Wheeling guide, a similar approach was made in an effort to educate persons on their residential sprinkler; including how to maintain their standalone systems (Village of Wheeling Fire, 2014, pp. 3-4). The guide provides pertinent information on sprinkler systems to the average consumer. At five pages, the guide is short and to the point. Visual depictions are noted with the village fire department logo on the top of each page may create some interest to the reader, but does not

contain fire sprinkler related data. Much of the information contained can be referenced back to standards and national data provided by sprinkler advocacy groups.

In the City of Petaluma, the local fire department created a flyer for the homeowner to utilize in helping them understand fire sprinkler systems they may have (City of Petaluma Fire Department, 2014). At two pages, the flyer is filled with information and diagrams to benefit the reader in understanding how their sprinkler system works. It does not go into detail on how to work with builders and contractors in constructing a new home with fire sprinklers. However, it does provide valuable insight into keeping the final product short and to the point without going beyond the information overload threshold.

The literature review also considered information sent out by the fire sprinkler industry. The National Fire Sprinkler Association has sent out a guide that is designed to answer commonly asked questions; to include some quick references for maintaining a residential sprinkler system (National Fire Sprinkler Association, 2014). The brief guide provides some pertinent information about standards and uses information found in other guides reviewed. There is not any information on how a home buyer would be able to work with a builder or contractor to streamline the installation process.

Procedures

At the beginning of this action research, the problem was rechecked for clarity and comprehensiveness. The problem is that public guides to residential sprinklers in single family dwellings for new construction is not available. After reconfirming the problem, a broad goal was established to create the final product for the action research. The goal of this research is to develop a public guide to residential sprinklers for new construction of single family dwellings.

Next, a situational analysis was conducted to determine some of the factors that may be contributing to the problem. The literature review found an abundance of information from national sources that is likely to assist in providing content to the public guide. Other guides completed in some jurisdictions also provide some foundational data and techniques that can be used in the final product. The analysis also examined forces that may hinder the goals of the project. In the investigation, it was discovered that the building community may interfere with the success of the goal. This is evident in speaking with some building representatives in that there is significant resistance to residential fire sprinklers. Upon further review, the resistance is in legislative measures to include codes and ordinances. While the goal is to create a guide for the public, this group could prove to be a deterrent in implementation. Structure of the guide along with a well prepared marketing plan can eliminate some of the factors that cause the problem as well as overcome resistance of from the local building community.

In this project, objectives were set to address the goal. They are designed to aid in answering the research questions. The objectives are: (1) Describe what a home buyer would need to know about working with a builder, contractor, and local inspector on planning and implementing a residential fire sprinkler into a new home being constructed, (2) Identify what information should be included in a public guide; including facts and myths of residential fire sprinklers in new construction single family dwellings, and (3) Identify the design type of residential fire sprinklers suitable for single family dwellings in new construction.

To address the objectives, a literature review was conducted to locate and identify material that could be utilized in providing information into the final product. Each objective required studying how others have accomplished similar task previously. This provides a foundation for the guide. After completing the literature review, a series of interview questions are developed

for local: builders, sprinkler contractors, and fire sprinkler related inspectors. Interviews are conducted with representatives from the three groups. It is assumed that the experience and perspective from each group can give insight into accomplishing the goal of creating a useful guide. This assumption is made that it would be the same group of people that would interact with members of the public in building homes with fire sprinklers.

After collecting the information from the previous steps; the next task is to compile it into a readable document that is easy to understand is and concise. Caution is taken here so that the end product does not become a user manual that is difficult to follow. Visual aids as well as pertinent information could be used based on reviews. Checklists of the steps with due dates are used to try and keep the project on an acceptable timeline. Once the final product is completed, an analysis of its entirety is made to ensure that it meets the goals, objectives as well as answers the problem statement and research questions.

Limitations and assumptions

One limitation of this applied research project is that it focuses on local water supply services. There is little mention on how a resident would supply their sprinkler system in a rural area not currently supplied by the local water authority. This is due to the time constraints of the project and the assumption that much of the new construction will have water supplied by the local utility authority. While there is some discussion about this here, further examination is warranted in order to fully get sprinkler information to all residents of the New Hanover community.

Another limitation of this research project is that there is no input from the general public on creating a guide designed to help them in their decision making process. This leaves room for additional research opportunities to include the stakeholder as a method for benchmarking the

level of success of the guide produced here. Nevertheless, while this component would provide valuable insight, it was not included in this project.

Additionally, there is a limitation created during the interview period. It was found that often sprinkler contractors and building representatives were not enthusiastic to meet someone performing the research on this project. Despite multiple efforts to contact many of these representatives, only a few responded with information usable to this study. The general observation in attempts to contact building representatives was: ignoring requests or stating that they do not support fire sprinklers in single family construction. As a result, more of the data had to be utilized from the literature review.

A final limitation is in that there is not enough information related specifically to the number of burn injuries or fire related deaths in residential occupancies within the local jurisdiction. In other words, data quantifying the number of lives that could be impacted by the installation of residential fire sprinklers is not included. One could argue that without this information, the entire project loses value. Nevertheless, this is limited due to the abundant information available from the national level.

There is an assumption with this project that the general public is not completely aware of the value of fire sprinkler in their homes; including facts and myths. This is derived from direct observation and personal experiences throughout the community as well as literature review. Some of the information included in the final product applies this assumption.

Results

After reviewing literature and interviewing subject matter professionals; a guide was developed to meet the purpose of this research. The completed guide is located in Appendix A.

The guide has a cover page and a section at the beginning describing the New Hanover County area. In the guide, it was decided to include information on frequently asked questions and answers. Two pages are dedicated in the guide in an attempt to educate the public on commonly misunderstood components of fire sprinklers. Next, the guide provides a very brief overview of how a fire sprinkler works with visual depictions offered by the fire sprinkler coalition. There is a step-by-step component that overviews the process from beginning to end of a sprinkler project. There are also details on the type of sprinkler system and various sprinkler heads that could be chosen. Choice is the rule in this component of the guide and includes graphics for better understanding. At the end of the guide, there is a resources page that allows the reader to go beyond what is offered in this guide. All outside source material has been credited appropriately where applicable.

Interviews

Below is data in narrative form of the interviews that occurred. The formatting used to structure each type of interview is referenced in the Appendix and is referenced where appropriate

During this process, several interviews took place in an effort to better understand the perspective from the various trades; to include builders, inspectors, and sprinkler contractors. One interview was conducted with the Deputy Chief Matthew Davis from New Hanover County Fire Rescue on January 24th, 2014. He has served as the department's fire marshal for the department for the past ten years. He has insight on residential sprinklers from a code enforcement and inspector perspective. The interview questions form utilized is found in Appendix B for reference.

In the interview, Mr. Davis wasn't exactly sure of how many residential fire sprinklers were permitted with the past two years. He did know where to find the information and advised to

follow up through personal communications with the inspections department personnel. When asked about the type of sprinkler system he recommended for the public; he stated that multi-purpose had clear advantages. This is due to: the use of existing plumbing, water is constantly moved through the use of the normal plumbing fixtures, and that it is a looped system. He acknowledged a disadvantage is that the system cannot be currently monitored (by an alarm company or water gong). He posed the question of why it can't be done with today's technology. There is possibly an opportunity for future research here.

Mr. Davis identified some challenges seen for the homeowner as there being a limited number of contractors available in the area that can perform residential fire sprinkler installations. He also stated that customers in the area have a limited knowledge of sprinkler systems; partially because they can't get a straight answer from the builder or plumber. Often limited resources and cost factors are another challenge that may prevent the homeowner from implementing fire sprinklers into their homes. Mr. Davis added that residential fire sprinkler installations need to be a competitive market. There is a fear factor that the marketing of a guide will become a battle. A way to combat that fear, according to Davis, is by reaching out to the public for an unbiased opinion.

In his statement, Mr. Davis went on to describe a need for a step by step process in the guide. He expresses the following are items to be included in a proposed guide: dealing with the plumbing inspector for code enforcement, identify licensed contractors for the sprinkler and plumber, meet with the builder about fire sprinklers early, information about how the local water authority has adopted a residential rate for residences with fire sprinklers, basic maintenance, insurance incentives, and how to reach out to a subject matter expert if there are questions.

Since, in North Carolina, single family residential fire sprinkler inspections are performed by the plumbing code official, an interview occurred with one of the plumbing inspectors, Mr. William Eubanks. He has been an inspector for many years and typically performs the inspections for fire sprinklers in single family residences. This interview, which occurred on January 24, 2014, followed the same format from Appendix B. In his interview, Mr. Eubanks acknowledged that he has only performed inspections on homes that were part of the habitat for humanity program homes plus one home in a very upper class neighborhood. In speaking with him, he was not familiar with all of the types of sprinkler systems; but admitted that in order for a system to be approved by plans, they must be designed by a professional to meet the needs of the home and be installed exactly as planned. He did not see any challenges with having residential fire sprinklers installed. In fact Mr. Eubanks recognized that in a multi-purpose system; the costs are reduced since it is using existing plumbing with additional heads, pipes, and design fees.

When asked about information for a guide for the public, Mr. Eubanks said that marketing was important to get the message out there. He also advised that there was not enough information out there, as evidence from past inspections and interactions with the public. He didn't foresee any problems in working with inspectors other than some glitches he has seen in some flow tests. He did want to remark that single family residential inspections do count as a plumbing inspection; costing $25 per trip according to the fee schedule currently in place.

When the research turned to interviews with the building community, it was found that there were few people enthusiastic enough about the topic to enter into a discussion for research. Of multiple contacts requested, only two builder representatives offered to speak about a guide for residential fire sprinklers. Their names and company information was removed from this

manuscript out of a request that identifying information not be used. For the purposes of this document, they have been identified as Interviewee 1 and 2, respectively. If requested during peer review, this information can be made available.

An interview was conducted with Interviewee 1 on January 23, 2014. He is a representative of a major area building company. He started out by initially stating that he was adamantly opposed to residential fire sprinklers legislation. After informing him of the purpose of the research, the interview continued. The format of the interviews with builders can be found in Appendix C. When asked about the advantages and disadvantages of home fire sprinklers, Interviewee 1 responded, "You can't prepare for everything". He expanded that fire sprinklers are designed to save property primarily and may save lives as well. He explained further that occupants should be able to get out of the house with smoke detectors, adding that current buildings are built so that fire hazards have been decreased. No other information was shared related to this question.

When asked about how to help a potential home buyer install fire sprinklers into a new construction home, Interviewee 1 answered with that they would install them if requested; however no one ever has. He explained that is what the code is there for. Interviewee 1 would not recommend fire sprinklers since they have never really offered as an option and he had some past experiences with fire sprinkler installations that was negative.

When asked about what to include into a guide for the public, interviewee 1 offered a list of pros and cons for the buyer to weigh out the benefit versus the cost. He included that the advantage is that the property would be saved while the disadvantage is that it costs too much. He added that he would like to see up to date statistics where fire hazards apply to the current 2012 building code. He sees that most homes today are built under obsolete building codes.

According to Interviewee 1, “If we find houses built to current fire code are killing people (through data) we need to make changes.” He clarified by stating that if through current NC specific statistics and present-day code, there is a life safety issue; then changes need to be made to include fire sprinklers in single family occupancies. At the end of the interview, Interviewee 1 concluded that he wants to ensure people are living safely and they build safe homes to the latest standards; but that building code needs to be balanced so it is safe and affordable at the same time.

The next interview occurred with Interviewee 2 on January 25, 2014. This individual has been in the construction industry for many years, focusing on custom homes. The format used is listed in Appendix C. He lists advantages of a residential fire sprinkler system as an option on a list he could offer clients; however there is not enough demand. He included that it is not a value added benefit in construction; that people don’t want to see the legislation. He did add that there is potential for some trade off with adding sprinklers in exchange for removing certain other requirements such as narrower roads or fire hydrant spacing. When asked about how he would handle sprinkler questions from a homeowner, he replied that they don’t offer it. He supplemented his response with the afterthought that it might be a good idea to at least offer it as an option; however, he didn’t know currently enough about the product to be confident in doing this. He has never encountered anyone asking about installing fire sprinklers into their home being built.

Interviewee 2 stated, when asked about what to include into a public guide, he would include information about: the cost, cause and effect, risk versus benefit model, inspection procedures, and how it works. He concluded that he was skeptical that people would spend the money for installing residential fire sprinklers into their homes.

An interview occurred with Eric Williams from Odyssey Fire Protection on January 23, 2014. Questions for this interview are located in Appendix D. According to Mr. Williams, he has received requests from many people asking about fire sprinklers, yet cost factors discourage most. He states that he only does a few residential fire sprinklers on custom built homes. He recommends that the type of fire sprinklers for homes to install is the standalone type for their simplicity. He states that annual costs are zero, other that water and repairs that may be needed. When asked about challenges he saw, Mr. Williams replied that he saw money as a challenge; adding that keeping cost in line with potential competition (plumbers) would be difficult. He also included that rural areas may have additional costs since they do not have immediate access to municipal water sources; requiring them to have a fire pump to support their fire sprinkler system.

When asked about what the home buyer should know about residential fire sprinklers, Mr. Williams responded with three components: the decision making process to include the statistical elements of fire safety, know what they are getting prior to planning and installation, and that not all sprinkler heads are created equal (no clarification given on this last comment). He remarked on what type of information should be included in a guide for the public. He started with including information on what he calls homeowner concerns such as appearance, how it works, information on control valves, and debunk some myths, etc. He also included information on turnaround time; clarifying that it takes that same amount of time that other trades typically take to install. Mr. Williams also inserted information about cost. He stated that a square footage price is difficult to entertain since there are a multitude of factors in calculating costs. He did want convey that the more residential fire sprinkler systems that get installed, the

lower the price is due to volume. He concluded the interview by stating that marketing needs to occur in order for the message to get out to the public.

Answers the Research Questions

1. How does a home buyer work with the builder, sprinkler contractor, and local inspections departments on including a residential sprinkler system in new construction?

Typically, the home buyer in this region would work directly with a builder or general contractor in order to complete residential fire sprinkler work; unless they were the general contractor. They would need to identify that they want a residential fire sprinkler system installed into the new home under construction during the design and planning phase of the project. Once the details of the fire sprinkler system have been decided, the home buyer would need to convey that information to the builder with the specific information so that it can be written into the contract for building. The home buyer should not have to work directly with the contactors or with the inspection department; but should have an understanding of the process since there is potential for some confusion; mainly due to the limited amount of experience with single family residential fire sprinkler installations seen in the area. A checklist indicating the steps necessary would be helpful in aiding the home buyer through the process of including fire sprinklers into the design.

2. What information should be included in a public guide for residential sprinklers in new construction single family dwellings?

A public guide should include information about common myths, questions, and answers typically seen by the public. It should also contain a checklist for helping the home buyer

through the process of including fire sprinklers into the home under construction. A brief over view of the county may help those relocating to this area. Information on the types of sprinkler system options and sprinkler heads available should also be included to give the reader some definition and understand about the topic in the guide. Data on how to work with the local water utility is warranted in this guide. Also a quick list of benefits should be included for the guide. A resource list is also helpful so that further questions can have references to look up beyond what is in the guide.

3. What should the home buyer know about sprinkler designs in a single family residential building?

The homeowner should know what type of system they want before they have one installed so that they may understand most of the major advantages or disadvantages of each type of system. The home buyer should be able to identify the type of system based on their needs and future plans for investment and maintenance. They should also understand the various types of sprinkler heads and the options those can carry.

Discussion

In comparing the results with the literature, it is evident that fire sprinklers are valuable at reducing the risk to lives and property in residential occupancies. It is clear that multiple sources in the literature review share the same conclusions in their reports. Fire sprinklers control and limit fire spread when evaluated against occupancies without fire sprinklers (Ahrens, 2013, p. 44). This message is consistent with that from the Home Fire Sprinkler Association's literature encouraging the installation of home fire sprinklers (Home Fire Sprinkler Coalition, 2014). This

links to the results to the finished guide in giving the public information needed to make an informed decision. A guide is not useful when there is not enough information to do this.

With the changes in the construction design within the past few decades, a proactive approach is needed to encourage residential fire sprinklers for today and the future. Homes are being built differently when compared to legacy homes from the 1970's; resulting in larger room areas, lighter weight construction materials, and fuel loading changes all impacting how fire reacts inside of a structure (Kerber, 2012, p. 3). Homes being built today should have fire sprinklers based on this change. In essence, fires are burning hotter and faster than ever before; reducing the time available for occupants to be able to exit the structure safely. This clearly demonstrates the need that fire sprinklers, as an active means of controlling the fire. This information becomes a useful tool in creating and implementing a guide. If home buyers really new how fast a fire could develop in their homes, they may take a different outlook in making fire sprinkler decisions. Some of this information was included in an effort to inform the layperson. The information also echoes the message from the interviews with code enforcement officials on life safety.

It is clear that representatives of the building community do not support single family residential building codes or ordinances that require fire sprinklers. This is evident from the article sponsored by the National Association of Home Builder (NAHB) in their website depicting that smoke alarms do work more efficiently than fire sprinklers (National Association of Home Builders, n.d.). Despite evidence produced by some of the referenced literature, the material presented by the NAHB appears to be more political and cost management minded in discussion about fire sprinklers in single family residences. This is distinct in the NAHB study where they utilize the National Institute of Standards and Technology (NIST) website to focus on

the premise that residential fire sprinklers are too costly for the benefits provided (Emrath, 2011), (National Institute of Standards and Technology, 2010). Granted there is a threshold that the home buyer would need to identify and implement in their cost benefit analysis for the decision to have fire sprinklers. In reality, fire sprinklers have the same impact to cost for the home as does granite counter tops, hard wood flooring, or upgraded cabinets. They are options. The home buyer must make the choice. The guide is not designed to do this; as an extensive marketing program would be necessary. That issue resides outside of the current problem and purpose.

The building community also published research on fire sprinklers impact on homeowner's insurance by state. The focus of this report is in that insurance rates, while there is some discount seen to the home buyer, it is not enough to warrant purchasing a fire sprinkler system (Xu, 2007). This concurs with interviews with one of the building community representatives. According to the data from Interviewee 1, fire sprinklers are designed primarily to save property and at the same time may save lives. This view would suggest that the insurance company's interest relies in property conservation instead of life safety. However, there is strong data and opinion from the public that would be contrary to this observation (Carli, 2009), (Madrzykowski & Fleming, 2011). The guide, as a result, did not attempt to address this as a valid component of the final product.

The results do show that a guide will see some challenges. In several of the interviews, perceptions of the home buying public were made expressing that few would be interested in moving forward with residential fire sprinklers in their new construction homes. The literature would suggest agreement here as indicated in less than 1% of single family homes with sprinklers were involved in a structure fires during 2009 through 2011 (U.S. Fire Administration,

2013). While there is hope that this information is misleading by a lack of public information, it is a distinct possibility that people are disinterested in residential fire sprinklers. In combating lack of information, the public guide has information that should be helpful to the end user.

Another factor used in developing the guide was deciding on what types of fire sprinkler systems to include. The guide needed to be short and concise, yet informative enough to be valuable. It was decided that a normal, standalone, fire sprinkler be included. This is from the recommendation during the interviews with the plumbing inspector, Mr. Eubanks; and the fire sprinkler contractor, Mr. Williams. The literature indicates that option as viable and reliable with some varying levels of maintenance that occurs on an annual basis. A second type of system that was seen was that of the multi-purpose system. Mr. Davis, with New Hanover County Fire Rescue, indicated the recommendation that multi-purpose fire sprinkler systems be used in residential single family homes, specifically for their ease of maintenance and use. The advantages of using the existing plumbing in this type of system are clear for the home buyer who may not be aware of this option. This is supported in the literature through a guide written to help implement residential fire sprinklers with the same recommendation (Tidewell, Kraus, & Love, 2013, p. 25). With this information, it appeared logical to include multi-purpose fire sprinkler systems into this guide.

In looking at the guides available, none clearly detailed a how to accomplish getting fire sprinklers installed into new construction single family homes. Most identified raw data and worked to address some of the myths that appear widespread among the public. The City of Petaluma has a flyer about how fire sprinklers work, addressing some myths, and placed a diagram in it to show the components of a system (City of Petaluma Fire Department, 2014). However, there is not anything to walk the home buyer through the building process as it relates

to fire sprinklers in the home. The benefit is that it shows illustrations to help the home buyer understand. Hence the guide in the results section of this manuscript included visual aids. It is believed that the message is better received with this combination. The Central Savannah River Area Chapter of the Society of Fire Engineers developed a guide that listed similar information as seen with other guides reviewed. Nine pages appeared to be a length tolerable for the reader and still give beneficial information. This information took into consideration this factor in developing the public guide. After reviewing the National Fire Sprinkler Association's guide for the public, it was also decided that including additional information for facts and questions about would be constructive (National Fire Sprinkler Association, 2014). This coincided with the feedback received in the interviews and in other literary resources.

Most of the components placed into the public guide were the result of information obtained through literature and interviews. Outside influence or personal beliefs were recused in the guide's development. The result is that the guide attempts to give options and choice for the home buyer without overwhelming them. Sources for visual graphics were given credit in the final product (Home Fire Sprinkler Coalition, 2014).

Recommendations

This process was designed to develop a product to be used by the department in an attempt to reduce risk of home fire related life safety hazards. It may also potentially be utilized by other departments in the region that may benefit from the product. It is the result of literature review and interviews in order to get the best understanding and perception about home fire sprinklers in the community and nationwide. The next step, and first recommendation, in this process is to implement the guide into the department's campaign for risk reduction. Not executing this guide

for the public has the potential to impact the community for generations. Each home that is built without the benefit of at least reviewing the material in the guide is a possible loss in the event there is a fire at that home in the future.

Recommendation 2 is that the department, using the guide as a platform, begins a marketing campaign designed to educate the public and building community of the impact fire sprinklers have. This campaign is crucial to get out the information contained in the guide. Without marketing, the guide sits on a shelf not being used. Advocating for getting stakeholders involved into the program is central to the success the guide may have through marketing. Examples of marketing contain, but are not limited to: public service announcements, television ads, media relations, social media, and forums. Also, copies of the guide should be made available on each fire apparatus, in each realtor's office, at each neighborhood model home, and in insurance offices. This can be a significant route to get the message the guide contains out.

Recommendation 3 is to identify benchmarks for the success of the guide. This is essential to its continued use. One benchmark is to see if there is an increase during the next two years in the number of construction permits for single family dwellings for residential fire sprinklers. This should be done in comparison to the past two years of permits. This is a clear method for determining whether the guide is making any impact. A second benchmark is to begin documentation within the department's offices each time a customer calls to ask about residential fire sprinklers. This helps to point out the interest level of the public relative to the information in the guide.

Recommendation 4 is that this guide be reviewed within the next two years to see its effectiveness; or if it is obsolete. Dependent on the results of the review, the guide should be

updated for pertinent information, content, changes in technology, and changes in policies for the area.

Recommendation 5 suggests that future research be conducted to develop a guide for the public that addresses residents that may live outside of the local water authority. In order for this type of work to impact all residents; sprinkler systems that rely on: well water, tanks, and pumps needs to be researched to see how much change would be required of the currently produced guide.

Recommendation 6 is for additional research for developing a program that would allow multipurpose residential fire sprinkler systems to be monitored by an alarm system or company. Currently, since the multipurpose system utilizes part of the existing plumbing, it becomes more difficult for monitoring to occur. Research overcoming this challenge would be beneficial to individuals who take advantage of this type of fire sprinkler system.

References

Ahrens, M. (2013). *Home structure fires.* Fire and analysis division. Quincy: National Fire Protection Association.

Carli, L. (2009, March/April). Not just for the lawn. (S. Southerland, Ed.) *NFPA Journal*, 38.

Central Savannah River Area Chapter of the Society of Fire Engineers. (2014, January 26). *Homeowners guide to your residential sprinkler system.* Retrieved January 26, 2014, from Society of fire protection engineers central savannah river area chapter: http://www.csra-sfpe.org/Resources/Documents/Homeowners%20Guide%20toYour%20Residential%20Sprinkler%20System.pdf

City of Petaluma Fire Department. (2014, March 30). *Your Residential Fire Sprinkler System Owners Manual.* Retrieved March 30, 2014, from City of Petaluma fire department fire prevention: http://cityofpetaluma.net/firedept/pdf/residential-fire-sprinkler-system-flyer.pdf

Emrath, P. (2011, September 19). *NAHB study examines fire sprinkler analysis tool.* Retrieved January 23, 2014, from NAHM eye of housing: http://www.nahb.org/fileUpload_details.aspx?contentTypeID=3&contentID=166135&subContentID=382017&channelID=311

FM Global. (2010). *Advances in sprinkler technology.* Retrieved February 10, 2014, from Advances in sprinkler technology: http://www.fireprotection.org.nz/publications/fmglobal_presentation.pdf

Hall, Jr., J. R. (2013). *U.S. experience with sprinklers.* Fire and analysis research division. Quincy: National Fire Protection Association.

Home Fire Sprinkler Coalition. (2014, March 30). *Home fire sprinkler coalition*. Retrieved March 30, 2014, from http://www.homefiresprinkler.org/

Icasualties. (2014, January 25). *Iraq coalition casualty count.* Retrieved January 25, 2014, from Icasualties: http://icasualties.org

Internation Code Council. (2009). International residential code for one and two families. Washington, DC: International code council. Retrieved March 31, 2014, from http://publicecodes.cyberregs.com/icod/irc/2009/

Kerber, S. (2012). *Analysis of changing residential fire dynamics and its implications on firefighter operational timeframes.* Northbrook: Underwriters Laboratories.

Madrzykowski, D., & Fleming, R. P. (2011). *Residential sprinkler systems.* National Institute of Standards and Technology. Gaithersburg: National Institute of Standards and Technology. Retrieved January 23, 2014, from http://fire.nist.gov/bfrlpubs/fire08/PDF/f08007.pdf

National Association of Home Builders. (2011, September 19). *NAHB study examines fire sprinkler analysis tool.* Retrieved January 23, 2014, from NAHB eye on housing: http://www.nahb.org/fileUpload_details.aspx?contentTypeID=3&contentID=166135&subContentID=382017&channelID=311

National Association of Home Builders. (n.d.). *Facts about fire sprinklers.* Retrieved March 30, 2014, from Smoke alarms work: http://www.smokealarmswork.org/firesprinklers/firesprinklers_print.html#top

National Fire Sprinkler Association. (2014, March 31). *F.Y.I. homeowners guide to fire sprinkler systems.* Retrieved March 31, 20014, from Sprinkler info: http://www.nfsa.tv/info_items/FAQ_Homeowner.pdf

National Fire Sprinkler Association. (2014, March 30). *Homeowners guide to fire sprinkler systems.* Retrieved March 30, 2014, from National fire sprinkler association: http://www.nfsa.tv/info_items/FAQ_Homeowner.pdf

National Institute of Standards and Technology. (2010, October 5). *Sprinkler use decisioning*. Retrieved January 28, 2014, from NIST engineering laboratory: http://ws680.nist.gov/FireSprinkler/Default.aspx

North Carolina international residential code. (2012, July 1). Retrieved March 31, 2014, from 2012 North Carolina codes: http://ecodes.biz/ecodes_support/free_resources/2012NorthCarolina/Residential/Part_I_Residential/12NC_residential.html

The National Commision on Fire Prevention and Control. (1973). *America burning.* Washington, DC: US Government Printing Office.

Tidewell, J., Kraus, K., & Love, M. (2013). *Bridging the gap: a guide to implementing residential sprinkler requirements* (2nd ed.). Washington, DC: National Association of State Fire Marshals.

U.S. Department of Defense. (2014, February 5). *U.S. department of defense casualty status.* Retrieved February 5, 2014, from U.S. department of defense: http://www.defense.gov/news/casualty.pdf

U.S. Fire Administration / National Fire Data Center. (2009, October). *Fire in the United States 2003-2007*. Retrieved February 5, 2014, from http://www.usfa.fema.gov/downloads/pdf/statistics/fa_325.pdf

U.S. Fire Administration. (2013, September). *One- and two-family residential Building fires 2009-2011.* Retrieved January 1, 2014, from www.usfa.fema.gov/statistics/

U.S. Fire Administration. (2013, August 13). *Residential Building Fires (2007-2011).* Retrieved January 25, 2014, from United States Fire Administration: http://www.usfa.fema.gov/statistics/estimates/index.shtm

United States Census Bureau. (2012). *Selected housing characteristics 2008-2012 american community survey 5-years estimates.* Retrieved January 23, 2014, from American Fact Finder: http://factfinder2.census.gov/rest/dnldcontroller/deliver?_ts=408731402239

United States Fire Administration. (1987). *America burning revisited.* Tyson's Corner: Federal Emergency Manaegement Agency.

United States Fire Adminstration. (2010). *America's fire and emergency services leader strategic plan fiscal years 2010-2014.* Emmitsburg: United States Fire Administration. Retrieved January 2014

Village of Wheeling Fire. (2014, January 26). *Residential fire sprinkler system guide to fire sprinkler systems and maintenance.* Retrieved January 26, 2014, from Villiage of Wheeling fire prevention bureau: http://www.vi.wheeling.il.us/Services/Fire/PDF/2-Homeowners_Guide_To_Residential_Sprinklers_And_Maintenance.pdf

Xu, L. (2007). *Fire sprinklers and homeowner insurance.* Washington, DC: National Association of Home Builders.

Appendix A

A Guide to Residential

Fire Sprinklers

For New Homeowners

An Informational Guide from

New Hanover County Fire Rescue

New Hanover County Fire Rescue is committed to provide a professional service to the community by protecting life and property through all hazards response and risk reduction

Honor ◆ Dedication ◆ Compassion ◆ Service ◆ Excellence

Appendix A

About New Hanover County

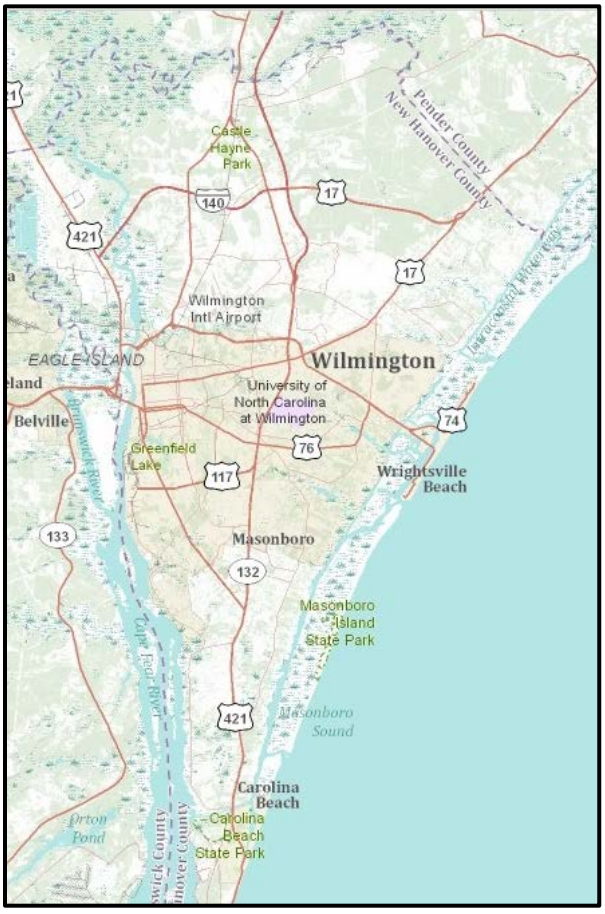
According to the US Census Bureau [1], there are over 202,000 people living within New Hanover County. Of those, about half live within the city limits of Wilmington and surrounding beach towns of Wrightsville Beach, Carolina Beach, and Kure Beach.

New Hanover County is known for its beach communities, its rich historical significance, the Battleship USS North Carolina, and the University of North Carolina Wilmington (UNCW).

There are over 101,000 housing units within New Hanover County; about 67% of which are standalone single family homes [1].

Currently, there is no local ordinance or NC code requiring the installation of residential sprinklers into single family residences [2]. There are, however, code requirements for fire sprinklers in the International Residential Code adopted in 2009 [3].

Residents do have the option of having fire sprinklers installed into their newly constructed homes. Fire sprinklers save lives and property by controlling and often extinguishing the fire before the fire department arrives. The majority of fire related deaths in the US occur in the home at night. Fire sprinklers are required in businesses, industry, and multiple family dwellings such as: condominiums, apartments, and dormitories. If they are required elsewhere, why do you not have them in your own home?

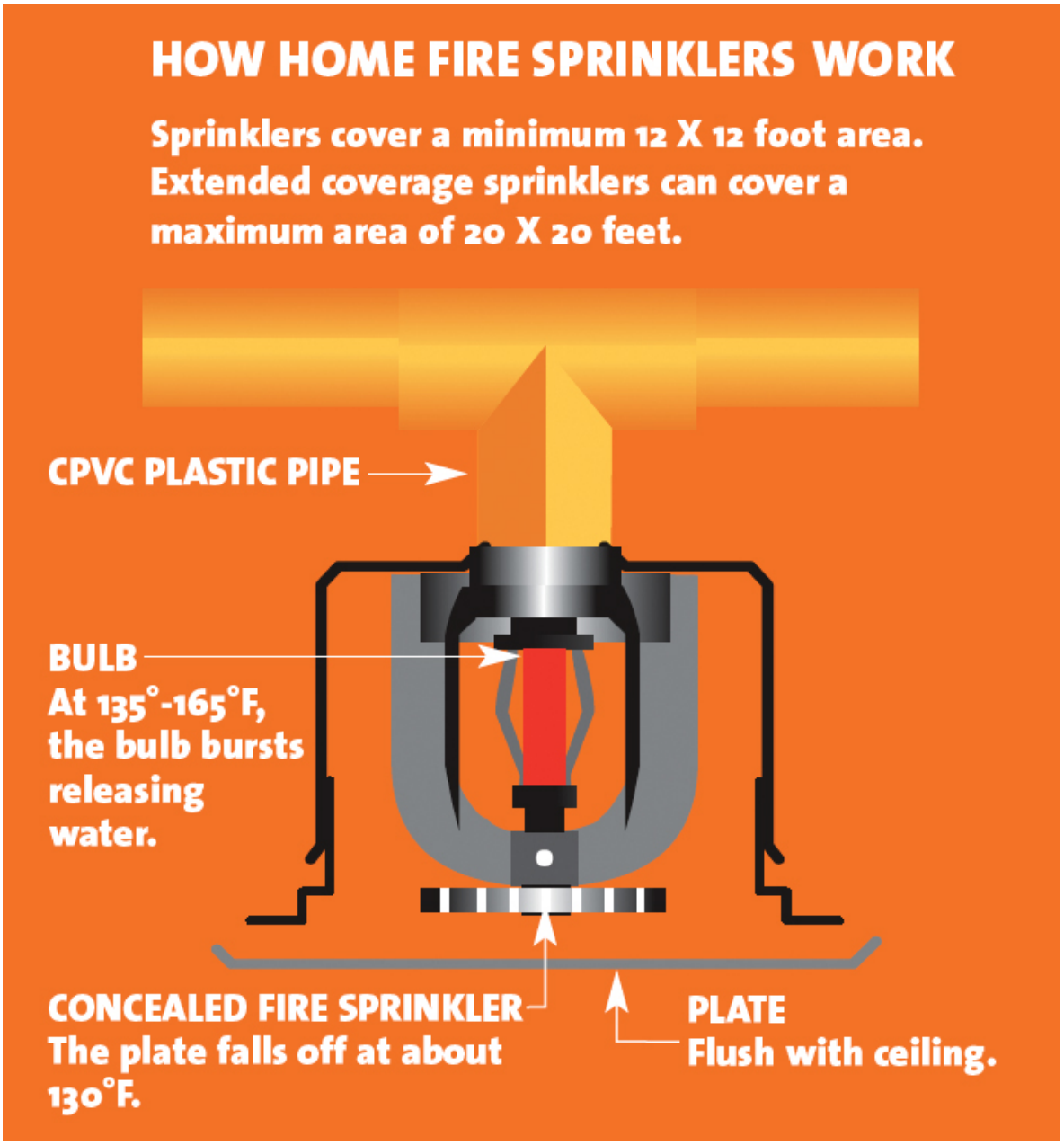


Source: http://nhcgov.com

Sources:

1. *US Census Bureau Quick Facts, 2013*
2. *http://library.municode.com*
3. *International Residential Code (IRC) 2009*

Appendix A



Source: http://homefiresprinkler.org/

Home fire sprinklers work by piping water above each room[1] in your home. In the event of a fire, a bulb bursts allowing the water to spray onto the fire and extinguishing it. In the picture above, the plate is flush with the ceiling and allows the sprinkler to remain concealed until it is needed. Consider it a safety device just like you would an airbag or seatbelt for your vehicle. Hopefully, it will never be needed; but it is there just in case.

[1] Rooms less than a certain dimension such as closets or small bathrooms may be omitted.

Appendix A

Frequently Asked Questions and Myths about Residential Sprinkler Systems

1) Why do I need fire sprinklers in my home?

a) Having fire sprinklers installed into your new home provides you some peace of mind and safety for you, your family, and your property. A properly designed and installed sprinkler system can protect your live and property every day; even when you are not home. In 2011 (the most recent available information), there were 364,500 residential fires that occurred in the U.S.; killing 2,450 civilians and caused over $6 billion in property loss. In the same year, 472 soldiers were killed serving the United States in military conflicts in Afghanistan and Iraq. There is a higher number of people dying from fires in their own homes each year than are fighting in armed forces overseas.

2) Isn't a smoke detector enough to protect my family?

a) Smoke detectors are a valuable component of your family's safety. They alert you of a fire so you and your family may escape. However, they do not put the fire out. Many fires claim the lives of elderly and children; often because they are not able to escape before being overcome by smoke and flames. Having a fire sprinkler system installed in your home is like having a personal firefighter on duty, in every room of your home, 24 hours a day; every day.

3) Doesn't fire sprinklers cause more water damage to my home than it would protect?

a) No. The piping used to supply your fire sprinklers is virtually the same piping for your normal plumbing systems with a few additional components. Many people are concerned that children or an accidental bump against a sprinkler head will activate the system. While possible, it is not likely (1 in 16 Million). Very rarely do sprinklers activate accidentally. 90% of the time a fire is controlled and extinguished by a single sprinkler head.

4) If I burn food while cooking or accidentally activate the smoke detector, won't all of my sprinkler heads go off, flooding my house?

a) Contrary to what you may see in the movies, residential sprinklers are individually activated with a heat sensitive component that only works when there are extreme levels of heat produced by a fire. Smoke does not activate sprinklers. Your smoke and carbon monoxide detectors are separate from the sprinkler system, still alerting you of a potential problem.

5) I don't want to see "ugly" sprinkler heads popping out from my ceiling. Is there a way to hide them?

a) Actually, you may choose to have concealed sprinkler heads installed into your home. They protect your family and property the same way that normal one does; except they are "tucked" into the ceiling. All you do see is a round disk plate covering the sprinkler. These plates can match almost any paint scheme you may have. Most people don't even notice when sprinklers are installed using concealed heads. They may also add a little extra protection from inadvertent bumps from a child or other person.

Appendix A

Frequently Asked Questions and Myths about Residential Sprinkler Systems

6) Isn't it too expensive for fire sprinklers to be installed into my new home?

a) Each person makes their own decisions on cost. It is completely up to the home buyer. For example, people often choose to add upgrades such as granite countertops and hardwood floors to their new home being built. These upgrades are as expensive if not more expensive than having a fire sprinkler system installed. It provides years of protection. According to the Home Fire Sprinkler Coalition, the national average of a home fire sprinkler system is about $1.61 per square foot. Recent information brings the cost closer to $1.31 per square foot. Prices may vary based on locations and contractors serving the area.

7) What is the cost of maintaining the sprinkler system once it is installed?

a) There is little maintenance for your sprinkler system; depending on what type of system you choose. For example, a multi-purpose system uses the already existing cold water lines in your home to attach your sprinkler heads together. This eliminates the need for additional equipment such as a backflow preventer; and results in no annual need for a test on the sprinkler system. Since the system is part of the cold water plumbing, each time you flush your toilet, wash your hands, or take a shower, you are testing a component of your fire sprinkler system.

b) According to the current standard, there is a life span for the fire sprinkler heads. Outside of activated sprinkler heads, they typically need to be evaluated / replaced every fifty years depending on the manufacturer and regulations. The cost to replace heads currently is a few dollars each.

c) In North Carolina, there is currently an insurance discount for people who have residential fire sprinklers installed into their homes. Check with your insurance agent for savings currently up to 12%.

8) Why aren't more people taking advantage of installing fire sprinkler systems into their homes?

a) The best answer is that many people do not know about the advantages a residential sprinkler system has. A properly designed and working fire sprinkler system reduces the chance of death by fire to virtually zero. It provides protection from fire every day whether you are home or not.

b) Another reason why more homeowners are not taking advantage of fire sprinklers is that there is a cost to it. People often overlook fire sprinklers as an option because of the expense. The cost is dependent on the type of system you choose to have installed. Work with your builder and fire sprinkler contractor on what you decide is best for your family.

c) If you have questions about how to best protect your family with home fire sprinklers and injury prevention, please call New Hanover County Fire Rescue / Wilmington Fire Department at 910-798-7420. A knowledgeable professional will be happy to assist you.

Appendix A

If you've decided you want to have fire sprinklers installed into your new home:

Congratulations if you have made the decision to place fire sprinklers in your new home. This guide is designed to help the home buyer work through the process of installing a fire sprinkler into their new home as it is being built. It does not imply that you must work with a certain builder or sprinkler contractor. The choices made are that of the home buyer(s). The guide omits less common options and features that are less often seen in residential fire sprinkler systems. If you have any questions, you may call New Hanover County Fire Rescue at 910-798-7420. You may also find additional information available at the Home Fire Sprinkler Coalition online at http://www.homefiresprinkler.org/index.php/Consumer/quick-guide.html

Steps for Installing a Fire Sprinkler in your New Home

- ✓ Review this guide and research questions you may have. Contact New Hanover County Fire Rescue at 910-798-7420 if you have questions. We are more than happy to help you!
- ✓ Make the decision to have sprinklers installed in your home
- ✓ Choose the type of sprinkler system you would prefer; stand alone or multi-purpose
- ✓ Choose the type of sprinkler heads you would prefer.
- ✓ Contact your builder or general contractor with your decision. Make sure you are specific in what you want. Have it written into the contract. This is usually done in the design phase.
- ✓ If you are using a building company, they typically will handle working with the plumbing and sprinkler contractor. However, it is important to make sure everyone involved is aware of what you want.
- ✓ By North Carolina rules for single family residences, the plumbing inspector will evaluate the fire sprinkler system by actually flowing water once the system is completed. Don't worry, your property shouldn't get wet! But the test is quite interesting to see.
- ✓ Once you have closed on the house and are turning the water on from Cape Fear Public Utility Authority, you will need to inform them that you have a residential fire sprinkler. You have a larger meter to meet the needs of the fire sprinkler system. They have approved a special condition to allow you a larger meter and charge you the same rate as a regular home.

Appendix A

1) ***Types of Residential Sprinkler Systems available***:

a) Multi-Purpose

i) This system is designed to be included as a part of the cold water plumbing that is already being run throughout your new home.
ii) Water is supplied and ready at the sprinkler pipe.
iii) All piping is insulated from cold temperatures the same way that the water lines for plumbing is protected.
iv) The system does not require a back flow preventer device from the water department.
v) This system has the least requirements for maintenance.
vi) The system does require that a larger meter from the water department be used to meet the water flow needs of the sprinkler system, however, Cape Fear Public Utility Authority (CFPUA) allows an exemption for residences to maintain the same rates as homes without a sprinkler system. Please see the additional information section at the end of this guide.

b) Wet-Pipe System

i) This is a standalone piped system that is separate from your plumbing water supply. All lines connected to the fire sprinkler system is used only for fire sprinklers.
ii) Water is supplied directly to the sprinkler.
iii) This system requires a separate back flow preventer that will carry an annual cost for testing and maintenance.
iv) The system requires regular inspections and maintenance.
v) The system does require that a larger meter from the water department be used to meet the water flow needs of the sprinkler system, however, Cape Fear Public Utility Authority (CFPUA) allows an exemption for residences to maintain the same rates as homes without a sprinkler system.

Appendix A

2) ***Types of sprinkler heads*** (Note: All sprinkler heads activate by heat from a fire). You may also choose standard sprinkler heads as well. Note: Pictures courtesy of http://homefiresprinkler.org/

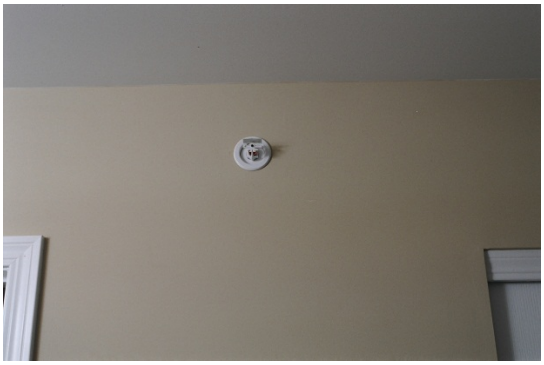
a) *Concealed head:* The head is out of general view and deploys only in a fire.



b) *Recessed Head:* The head is slightly tucked away but can still be seen improving clearance



c) *Sidewall head:* The head is attached to the wall and sprays at an angle. It can be seen.



Appendix A

3) Working with the Builder, contractor, and inspector:

a) Most often, the builder will be the point of contact for you. Fire sprinklers in single family homes are required in the 2009 Edition of the International Residential Code. Currently, the North Carolina Residential Code does not require fire sprinklers to be installed in single family homes. Fire sprinklers are the choice of the home buyer. Be prepared to inform the builder of your intention to have fire sprinklers installed into the project. The design phase of the job is when you would identify your choice to have sprinklers. This is when you are selecting items such as counter tops, carpet color, additional upgrades, etc. Be sure to inform the builder early if you want to have sprinkler systems installed.

b) Be ready to answer questions from the builder and elaborate on what you want. Be specific when identifying the type of system you want to have (If you want a standalone or a multi-purpose system). Do you want concealed head or recessed head sprinklers?

c) Often the normal home builder will not yet have the experience with working with sprinkler contractors for residential systems. This is due to the few requests people have had to install sprinklers. You may need to answer questions or explain details. You may even hear common misconceptions about sprinkler systems such as; “smoke detectors are sufficient” or “sprinklers cause water damage and activate when they aren’t needed”. Some people may try to talk you out of it. You get to make the decision on whether this investment in your family’s safety is needed.

d) Be patient. This is for your family’s safety.

e) On a multi-purpose system (cold water), the sprinkler contractor and the plumbing contractor will need to meet to attach the correct components of plumbing and the sprinkler system together. Make sure the builder and the plumber know this. Typically, the sprinkler contractor will be familiar with this process.

f) Standalone sprinkler systems will have a required backflow preventer and the pipes will be separate from the regular plumbing. Keep in mind that there will be some annual maintenance with this type of system. Typically, an annual backflow preventer test costs about $50 per year along with other maintenance procedures for maintaining the system.

Appendix A

g) The local inspections department will look at the system after a “rough in” and before the certificate of occupancy is issued. In North Carolina, residential fire sprinkler systems are inspected by the plumbing inspector. A water flow meeting the design requirements is part of the test; ensuring that you will have the needed water capabilities in the even you have a fire in your home. A properly conducted flow test does not cause water damage.

4) Getting water turned on from Cape Fear Public Utility Authority (CFPUA)

a) When your home was built with a sprinkler system, you will have a larger than normal water meter (usually a 1 inch meter instead of a 5/8 inch meter). This is due to the needed flow of water in the event you have a fire and the sprinkler system is activated. This does not mean you will use more water than a home without fire sprinklers. It does mean that you will need to inform the CFPUA that you do have a fire sprinkler system and that they should be charging you the residential rates. They will already know what size meter that you have installed; however, they may not realize that you have fire sprinklers. Be sure to check your first billing cycle to ensure you are being charged correctly. Please see the resources section at the end of the guide for more information.

Appendix A

5) Resources Available:

a) New Hanover County Fire Rescue
230 Government Center Drive, Suite 130
Wilmington, NC 28403
910.798.7420 or http://www.nhcgov.com/Fire/Pages/default.aspx

b) Home Fire Sprinkler Coalition (HFSC)
The website gives information about the benefits and facts about residential fire sprinklers.
www.firesprinkler.org

c) United States Fire Administration Fire Sprinkler Citizens Guide
http://www.usfa.fema.gov/citizens/home_fire_prev/sprinklers/

d) National Fire Protection Association (NFPA) Fire Sprinkler Initiative
Home fire sprinkler fact sheet and information available about cost
http://www.firesprinklerinitiative.org/resources/fact-sheets.aspx

e) National Association of State Fire Marshals Fire Research Foundation
Information for the home owner who wants more information on fire sprinklers
http://nasfm-training.org/virtual-help-desk/#

f) National Association of Home Builders (NAHB)
Information from the building community on fire sprinklers and smoke detectors
www.smokealarmswork.org
http://eyeonhousing.org/2011/09/19/nahb-study-examines-fire-sprinkler-analysis-tool/

g) American Burn Association
Information on burn related injuries
http://www.ameriburn.org/resources_factsheet.php

h) Cape Fear Public Utility Authority (CFPUA)
Fact and information sheet on billing for water services for residential fire sprinkler system.
235 Government Center Dr, Wilmington, NC 28403
305 Chestnut St., Wilmington, NC 28401
910) 332-6550
http://www.cfpua.org/
http://nc-cfwu2.civicplus.com/ArchiveCenter/ViewFile/Item/414

Appendix B

Interview Questions about Residential Fire Sprinklers for Local Fire and Plumbing Inspectors

1. How often do residential fire sprinklers get installed into new construction single family homes?

2. What type of sprinkler system would you recommend having installed into a new home being designed and built that would be most beneficial to the end consumer? Please explain why.

3. What challenges do you see with having residential sprinkler systems installed into new single family dwellings?

4. If a guide was available for helping the home buyer make informed decisions regarding residential fire sprinklers into their newly constructed home; what information would you put into it to help them?

5. What should the home buyer know about residential sprinkler systems for single family dwellings? How can this be marketed?

Appendix C

Interview Questions about Residential Fire Sprinklers for Single Family Residential Builders

1. What advantages/disadvantages do you see with residential sprinkler systems? Please explain why.

2. If a potential homebuyer was interested in having residential sprinklers installed into their new home design, how would you respond?

3. Would you or do you recommend prospective home buyers the option to have residential fire sprinklers installed into their new home? Please clarify your answer.

4. How often have you had potential home buyers inquire, within the past 2 years, about having residential sprinkler systems installed into a newly constructed home to be built by you?

5. If a guide was available for helping the home buyer make informed decisions regarding residential fire sprinklers into their newly constructed home; what information would you put into it to help them in working with you, the builder?

6. Do you have any additional information you would like to add concerning residential fire sprinklers in new construction?

Appendix D

Interview Questions about Residential Fire Sprinklers for Local Sprinkler Contractors

1. How many requests have you received within the past 2 years from builders and home buyers about installing residential sprinkler systems into their homes under construction?

2. How often do you design/install residential sprinklers into single family dwellings that are considered new construction?

3. What type of sprinkler system would you recommend having installed into a new home being designed and built that would be most beneficial to the end consumer? Please explain why.

4. What challenges do you see with having residential sprinkler systems installed into new single family dwellings?

5. What should the home buyer know about residential sprinkler systems for single family dwellings?

6. If a guide was available for helping the home buyer make informed decisions regarding residential fire sprinklers into their newly constructed home; what information would you put into it to help them in working with you, the sprinkler contractor?