Feasibility Study of the Installation of Fire Flow Hydrants and Water Mains Throughout Ross Township

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A research project submitted to the Ohio Fire Executive Program

July 30, 2010

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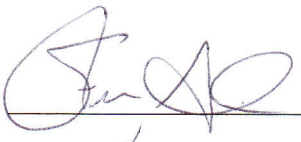
Signed: 

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ABSTRACT

This research analyzed the feasibility study of installing fire flow hydrants and water mains throughout Ross Township. Ross Township, like many rural townships in Butler County Ohio has an urgent need to increase or improve the water supply all while reducing the time it takes to apply water for fire suppression. This research project employed the evaluative research. The following questions were asked; (1) What areas in Ross Township are in need of upgraded water mains and the installation of fire flow hydrants? (2) What will be the cost benefits to the homeowner? (3) What resources are available to help in the installation costs? The principal procedures employed were a literature review of relevant material related to improving our water supply system, improvement of the ISO rating schedule, the cost comparison to an improved rating from ISO, and fire department manning issues at fires.

It was determined though the research with an almost $15,000,000 price tag, completely upgrading the installation of new water mains and fire flow hydrants throughout Ross Township is unfeasible at this time. Ross Township or the Southwest Regional Water District does not have that kind of capital funds available, without outside assistance. Although during the data collection on the cost analysis of the township, the data proved that there are some areas that would actually see a cost benefit to upgrading the water system. This benefit would be in the monetary form of what they would save in homeowners insurance premiums over a period of twenty years verses of what the cost would be for them pay in taxes to cover the installation cost of new mains over twenty years.

The recommendations resulting from this research included (a) Presenting the findings to the Board of Trustees of Ross Township explaining the importance of an established water supply for suppressing fires. Recommend to the board to present the findings to the Butler County Trustees Association with special attention directed to the townships that are in Southwest Regional Water District. Together as a group of government authorities, present the findings to the Board of Directors of Southwest Regional Water District. (b) Develop a better working relationship with the Board of Directors of Southwest Regional and come up with a strategic plan for the future and be more involved in future planning of public water service in Ross Township. (c) Educate the community of the importance of having a usable water system for fire protection. (d) Improve the mutual aid agreements with our neighboring fire departments to include an automatic dispatch on certain incidents. (e) Improve our water delivery system for fighting fires in non-hydrant areas.

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INTRODUCTION

Ross Township Fire Department (RTFD) provides fire protection within Ross Township Ohio and the Village of Millville Ohio with a population of 9,000 residents. It is also under contract with the Department of Energy to provide fire protection for the Fernald Preserve, a former Uranium Process facility. RTFD has two stations and responds to approximately 1,200 calls per year, including emergency medical calls providing advanced life service. The department is a combination fire department providing services with a full time chief, supplemented with part time and volunteer personnel.

Statement of the Problem

The Ross Township Fire Department has an urgent need to increase or improve its water supply ability while reducing the time it takes to get water to the fire. This study will address the feasibility of the installation and/or upgrade of new water mains and hydrants that will provide sufficient water for fire suppression. There are several areas in our township that do not have sufficient water for fire suppression. Without available water, the fire department is forced to bring water to the fire for suppression. This water is delivered to the fire scene by way of fire tanker apparatus that carry large volumes of water. These fire tankers are designed to haul water to the fire scenes in areas where no fire hydrants are available.

The department has three fire tankers in its fleet of apparatus. The fire tankers tank capacities are 1500, 1800, and 2600 gallons, respectively. Once on the scene these fire tankers can either pump the water from their tanks to the fire engines on the scene or they can dump the water from their tanks into portable drop tanks that are carried on the fire tankers. From the drop tanks the fire engine operator can draft the water into the fire engine.

Our department's fleet of four fire engines are equipped with fire pumps designed to move water from the fire pump to the hose. These apparatus carry 500, 750, and two engines equipped with 1000 gallon booster tanks. In a perfect situation we could possibly have 9,150 gallons of water available for fire suppression use. As we all know we don't live in a perfect world. These apparatus do not always respond to every call depending on available manpower. When this is the case, the department often has to rely on tankers from surrounding fire departments. Due to staffing issues, our department and our mutual aid departments have a rough time getting personnel to respond at times. This causes a serious delay in getting much needed water to the fire scene. In several areas in the township that do have sufficient water by way of proper size water mains, there are no fire hydrants installed along these water mains. In areas where there are fire hydrants they are in place for maintenance purposes. An adequate and reliable water supply for firefighting is an essential part of the fire protection for any fire department in the country.

Purpose of the Study

The purpose of this study will be to identify areas in Ross Township that do not have adequate size water mains to support the amount of water necessary for adequate fire control. In these areas that are identified, the author would like to research the installation cost of new water mains, that are of sufficient size in accordance with American Water Works Association (AWWA) M31 Distribution System Requirements for Fire Protection. These new water mains will also be figured with dry barrel hydrants, placed at distances to the recommended spacing requirements according to the Insurance Services Offices (ISO) Fire Suppression Rating

Schedule. In areas that have sufficient size mains, the author will investigate the installation cost to install new fire hydrants spaced to ISO recommendations. The research will focus on developing an estimated cost for the upgrade of a new/improved water distribution system in Ross Township. This will include the cost benefit to a homeowner through savings on their insurance premiums over a period of time. Recommendations from the output of this research will be presented to the boards of the Southwest Regional Water District and the Ross Township Board of Trustees. The research project will be based on the safety and effectiveness of our firefighters and to the citizens we protect. To be safe and effective is a challenge that involves tradeoffs based on both risk and benefits. This balance will be analyzed in this research project.

Research Questions

The following questions will be answered by this evaluative research:

1. What areas in Ross Township are in need of upgraded water mains and the installation of fire flow hydrants?
2. What will be the cost benefits to the homeowner?
3. What resources are available to help in the installation cost?

BACKGROUND AND SIGNIFICANCE

Ross Township Fire Department (RTFD) is a combination department that covers 36 square miles and protects 9,000 citizens. The department employs one full time chief, 27 part time firefighters/EMT's, 26 volunteer firefighter/EMT's and provides services from two stations located at the northern and southern borders of Ross Township. The department provides fire suppression, emergency medical services, fire inspections, and fire prevention. The department holds an Insurance Service Office (ISO) combination rating of 4/8B in Ross Township and a rating of 3 in the Village of Millville. The rating of 4 in the township only applies to structures that are within 1000 feet of a hydrant. A rating of 8B applies to structures beyond 1000 feet.

Two firefighters are assigned to each station seven days a week from 06:00 to 18:00. On Friday and Saturday nights, part time personnel are assigned to work from 18:00 to 06:00. Sunday night through Thursday night from the hours of 18:00 to 06:00 our stations are left empty and volunteers respond from their homes to respond to emergency fire and EMS calls. There is a dedicated squad schedule of volunteer personnel who are assigned a specific night to run squad. Some nights the stations are staffed with volunteers who spend their volunteer squad shift on station. A paramedic is also scheduled to run from Sunday through Thursday night and they respond to EMS calls in a Medic first responder vehicle. When an EMS call comes in they respond in the medic vehicle and meet the squad on the scene. If a fire call comes in during Sunday through Thursdays volunteers who are available respond from their homes to their respective fire stations.

The township receives its water from the Southwest Regional Water District (SWRWD). SWRWD is a political subdivision in the State of Ohio. The district serves drinking water to approximately 15,000 people within its service area, which is primarily western Butler County Ohio, but also includes areas of Preble and Warren Counties. The original distribution system was constructed in the early 1960's. The system was financed by Farmers Home Administration (FHA), which would only finance the installation of water mains large enough to provide domestic flows for household use only. During the installation of these mains, if a road only had ten houses on it, then the water main would be sized to supply those ten houses. Today that same road could have one hundred houses and the size of the main hasn't changed. Many of these water mains then and today are inadequate for providing fire flows.

When SWRWD converted to a "regional water district" in 1992, the sizing restrictions for any new water mains were eliminated and many of the water mains installed since that time are now designed for fire flow. Today where we do have adequate water mains for fire flow, the SWRWD will only install hydrants at locations that meet their needs for maintenance purposes. The SWRWD permits fire departments to use these hydrants to fill tankers or to use for fire suppression. The only areas in the township that have fire flow hydrants every five hundred feet are in new housing and commercial developments. Butler County Building and Zoning enacted rules several years ago that regulates building developers in new sub-divisions to install fire flow hydrants at every five hundred feet. The cost of installing these hydrants and water mains are passed through the developer to the people purchasing these building lots.

The minimum response to a fire emergency involving a structure fire in a non-hydrant is a single Engine, Tanker, and Life Squad. A non-hydrant area is determined by the firefighter, looking the address up in our department map book which shows the location of fire hydrants. If the fire is in a non-hydrant area then Command will order "drop tank operations." A drop tank is a portable collapsible tank that is carried on each fire tanker. The capacity of these tanks is generally the same size of the amount carried on the fire tanker. This method is used when Command determines that fireground conditions dictate that drop tank operations are to be used to supply the fire attack apparatus.

In most cases, tanker operation will consist of dump and run operations. The decision to go to a dump and run operation initially rests with Command. Once a dump and run order has been given, the following procedure will occur.

The fire attack apparatus positions itself on the fire ground and initial fire attack is started using the water from the apparatus booster tank. Operators of the fire tanker apparatus will then remove the portable drop tank from their apparatus and set it up at the pump panel of the fire attack apparatus. The fire tanker will unload its water from their tank by way of a water chute located at the rear and sides of the fire tanker. The operators of the fire tanker will then leave and respond to the nearest fire hydrant to re-fill the fire tanker. The operator of the fire attack apparatus will remove a hard suction line from the apparatus, place all the necessary appliance on the hard suction, connect it to the intake side of the fire pump and then places it in the drop tank filled with water. Once the flow of water is established, the attack engine operator will advise that a water supply is established. The operator of the fire attack engine is responsible to watch the water level

in the tank and advise Command as to the approximate number of minutes of water remaining in the tank.

In most cases, where tanker operations are required for a well involved structure fire, a multiple drop tank operation is required. The decision to establish multiple drop tank operations rests with Command. If a multiple drop tank operation is not initially ordered from Command once the fire attack is started, the decision to implement a multiple drop tank operation rests with the attack engine operator. The drop tank from the next arriving fire tanker will be dropped and set up towards the rear of the engine adjacent to the fire tank. The attack engine operator then can move water from the second drop tank and transferred to the main drop tank the fire attack apparatus is drafting from. If more fire tankers arrive and if the conditions warrant, their drops tanks can be positioned towards the front of the fire attack apparatus and the same procedure can be applied. If manpower is available they can be assigned to be siphon operator to assist the fire attack engine operator in assuring the main drafting tank is always full.

To assist in the filling the fire tankers at a remote site hydrant, Command will order another fire engine either from the RTFD or a mutual aid fire engine to respond to the fill location. This fire engine will be used as a fill source at the hydrant. A supply line will be connected to the hydrant and connected to the fire engine. Three discharge lines will be connected to the fire engine. These fill lines will be stretched out in order to fill up to three fire tankers simultaneously.

The above paragraphs clearly indicate that a fire in a non-hydrant area is very labor intensive. Each system in the water shuttle process is a vital part of the overall fire suppression and each is quite complex. Listed in **Table 1** is the manpower needed if all RTFD fire tankers are used and a fill site is established;

Table 1: ***Manpower Needed for Water Shuttle Operations***

Tanker 101	1 Firefighter
Tanker 102	1 Firefighter
Tanker 103	1 Firefighter
Jet Siphon Operator	1 Firefighter
Water Supply Officer	1 Firefighter
Fill Site Engine Operator	1 Firefighter
Fill Site Assistant	1 Firefighter
Total	7 Firefighters

Ross Township Fire Department prides itself in the art of shuttling water to the fire ground. We continue to train on and improve our standard operations procedure for water movement. We have also identified our non-hydrant areas, conducted long lay pre-plans. Even with efficiency in moving water, there is still a concerning issue of manpower. As stated in **Table 1** it takes 7 personnel to run the water shuttle operation, but this takes personnel away from the fire ground activities. Activities that could be performed such as fire suppression, backing up our attack crews, conducting ventilation, or Rapid Intervention Teams (RIT).

Volunteerism in Ross Township is as strong as any other community in our area. However, it has shown a downward slope over the past 10 years. This can easily be attributed to the changes made in society both from the side of what it takes a family to function these days, to the demands and expectations that society has laid upon public service. The growth in population has meant in increase in the number of calls answered, putting added pressure on the volunteer system. Most families have to have a two person income to survive the economical conditions today and more have competition for personal and family time. Training demands both from the State of Ohio and the department have increased over the last ten years which makes it harder on the volunteer to keep up on the required training hours. Our older members can no longer stay current with their training hours. Our younger members are getting married, having children and moving out of our township. One reason they are moving out of Ross Township is because they can't afford the housing. No longer is the fire department called out for serious types of emergencies, but we have become a routine service giver on a daily basis. As indicated in the **Table 1** it would take seven firefighters to develop a water supply in a non-hydrant area. If the same above scenario was in a hydrant area it would only take one firefighter to make the water supply connection to the hydrant. Once that water supply was connected that firefighter could be utilized on the fireground.

LITERATURE REVIEW

The purpose of this literature review was to examine published documents related to improving our water supply system, improvement of the ISO rating schedule, the cost comparison to an improved rating from ISO, and fire department manning issues at fires. Multiple literary sources were reviewed to gain a better understanding.

Water Supply System

For decades, rural populations have accepted the fact that not enough water exists to control every fire. But society has changed. This is the age of accountability and "people who pay for fire protection whether through donations or by tax dollars, expect the best protection, even though that they really may not know what that is" (Davis, 1986). Many of our residents that live in Ross Township are transients from suburban areas and take for granted that there is an established water supply readily available for the departments use. Many are surprise to find out there is no available water for fire suppression, and that what water is used is brought in by tankers.

The current status of any community's ability to protect itself from fire is usually a top concern of elected officials and fire chiefs. Even when a serious fire has not occurred, this is often a pressing issue. It is always an urgent matter following a serious fire or other disaster that is considered the fire department's responsibility. To learn "where we stand" officials must evaluate the community's ability to protect itself against fires. Fire protection evaluation and planning may be precipitated by a change in size or configuration of the territory being protected. A loss in fire department resources may result in a reduction of territory or scope of service, or a

change in the organization structure of the department in order to compensate (Granito & Dionne, 1988).

For many years water has been used to extinguish fire. The inexpensiveness and the availability of water are the reasons for its use. Water must not only be available for fire protection, but it must be available in adequate supply. The decision to provide water for fire protection means that the utility must consider fire flow requirements in sizing the water main, pumps and storage tanks. In smaller systems such as Southwest Regional Water District (SWRWD) these requirements can correspond to a significant increase in the size of many components in areas where there is insufficient sized water mains. The most significant impacts are installing hydrants, maintaining the hydrants, providing the adequate storage capacity, and meeting the minimum pipe sizes in neighborhood distribution mains when much smaller pipes would suffice for the delivery of potable water only.

The decision of whether or not to size distribution system components, including the water lines, appliances, and storage facilities for fire protection lies with the governing body of the community. The decision is made in conjunction with the water utility if the utility is privately owned. However there is no legal requirement that a governing body must size its water distribution system to provide fire protection. In some instances, this undertaking may be prohibitively expensive. For privately owned utilities, the distribution system would not be sized for fire protection unless such an undertaking could be shown to be commercially profitable (AWWA M31 4th Edition, 2008).

This has been the case in Ross Township and the western part of Butler County since the 1960's. As stated previously, SWRWD first installed the water distribution system in the 1960's and was financed through Farmer's Home Administration (FHA). The stipulation of installing the water system was for domestic use only. This has left the community with several areas with under sized water mains and a lack of hydrants. In the areas where there is a 6" or larger water mains there are no hydrants in place. SWRWD will only install hydrants at locations on these properly sized mains for maintenance purposes only. They will allow fire departments to utilize these hydrants for fire suppression or to fill tankers. This past year SWRWD installed 10,000 feet of a new 10" water main on Kirchling Rd in Ross Township. This new water main replaced the original 4" main that was installed in the 1960's. On this project SWRWD would only place 4 hydrants along the new installation. Placing a hydrant at every 500' would be an added cost to the district which SWRWD would not agree to do. The Ross Township Board of Trustees agreed to pay for the additional cost of providing 6 additional hydrant at a cost of $21,000. This will place hydrants at every 500 feet.

As to date, any new development that occurs in Ross Township, requires plans that are forwarded Fire Chief for approval. No commercial development is approved unless the water mains are of proper size to meet the needed fire flow (NFF) and there are sufficient fire hydrants to conduct fire suppression. Any new housing development plans have to go through Butler County Building and Zoning for approval. The county requires developers to install an 8" minimum water main except for short cul-de-sacs and some secondary loop connections which may be 6" if approved by the County Engineer. In commerical/industrial areas, the minimum size water main is 10" unless specifically authorized by the County Engineer. Fire hydrants are

American Water Works Association (AWWA) approved, “break-off” or “traffic type” with 5” main valve openings; two (2) 2 ½’ discharge nozzles and one (1) 4 ½” steamer nozzle with National Standard Threads (NST). The locations of these hydrants are at the street corners, near radius tangent points, between intersections at property lines, and generally with a 250’ radius coverage (Commissioners, 1997).

Pipe less than 6” in diameter are not recommended for fire service and 6” pipe are only used when looped in a grid where no leg is greater than 600 feet in length. The cost of a line of pipe includes such factors as delivery, trenching, laying the pipe, backfilling, and testing. All of these factors are present regardless of the size of pipe being used. It is usually good practice, therefore, to install pipe for fire protection that is one or more sizes larger than the bare minimum might require. Increasing the pipe diameter only one size will often nearly double the possible flow (Schultz, 1997). The relative capacity of pipe obtained by increasing the sizes above 6” can be seen in **Table 2**.

Table 2

Comparison of Pipe Capacity

Inches	Relative Capacity
6”	1.0
8”	2.1
10”	3.8
12”	6.2
14”	9.3
16”	13.2

Note: Data developed from (1997). Fire Protection Handbook 18th Edition. In G. R. Schultz, *Water Distribution Systems* (18th ed., pp.6-34). Quincy: National Fire Protection Association.

ISO Rating Schedule

Any fire department attempting to improve its Insurance Services Office (ISO) rating begins with the identification of the fire departments problems. To achieve an understanding of the problem, the ISO system must be examined. ISO has been in operation since 1916 (Stevens, 2004). In 1971, ISO became a standalone agency and has remained in operation since that time. The purpose of the ISO Rating Schedule, a product of the Insurance Service Office, is to review public fire suppression capabilities and to develop a classification for fire insurance rating purposes (Insurance Service Office, 2003). The rating schedule is used to evaluate fire departments. Once a department has been evaluated, insurance agents then used the rating to

determine insurance premiums for properties within the fire department's district. Commercial and residential property rates are established after the fire departments rating has been determined. Depending on the population, fire departments are rated every ten or fifteen years (Office, 2003).

The rating schedule states that a fire department is rated on a one-to-ten scale with a one being the best rating while a ten suggest less than the minimum recognized protection. It further stated that the rating schedule is only an evaluation tool, not a sole source of determining the overall effectiveness of a fire department and the fire protection provided within a fire district.

In the rating schedule, there are three components that yield numerical scores. The components, associated maximum points of each section, and the overall total follow in **Table 3**: ISO Components and Associated Maximum Point-Value (Insurance Service Office, 2003).

Table 3: ***ISO Components and Associated Maximum Point Value***

Component	*Maximum Point-Value*
Receiving and Handling Fire Alarms	10
Fire Department	50
Water Supply	40
Maximum Points Available	100

An ISO examiner visits the fire department and thoroughly launches an examination of the three previously listed components. After collecting the necessary data, the summation is

calculated. However, there exists the possibility of a penalty being imposed, if the fire department score and the score of the water supply do not match.

Such an event is labeled as a divergence, and the calculated divergence is subtracted from the total score, thus creating the final fire departments cumulative score. The purpose of the divergence is to create an incentive for the fire departments capabilities to match the capability of the water supply. Illustratively, the formula used to calculate the final number of points appears as follows:

Receiving and Handling Fire Alarms

\+ Fire Department

\+ Water Supply

\- Divergence

= Total Numerical Score

The final numerical score is then placed on a scale in ten point increments. For each increment, a separate numerical score is yielded, with the number being the final designated assigned to the fire department. The cumulative score and the ISO rating have an inverse relationship. In other words as the cumulative score climbs to a higher number, the fire departments rating number decreases. However, the optimal score for a fire department is an ISO class 1 while a whole number such as an eight would be less preferred than a class one status. Below, in **Table 4:** Fire Department Ratings, such ratings are explained.

Table 4: Fire Department Ratings

The Fire Department's Rating Is:	If the Cumulative Score Is:
1	90.00 or more
2	80.00 to 89.99
3	70.00 to 79.99
4	60.00 to 69.99
5	50.00 to 59.99
6	40.00 to 49.99
7	30.00 to 39.99
8	20.00 to 29.99
9	10 to 19.99
10	0 to 9.99

(Source: Fire Suppression Rating Schedule, 2003)

The Fire Suppression Rating Schedule offered very good information in this part of the research project. It was felt that a thorough and accurate understanding of the Rating Schedule is a primary step. The Rating Schedule offered a clearer picture of the scoring process, components of the rating, and an overview of the Rating Schedule's purpose.

Effects of the ISO Rating Schedule on the Fire Department

(Stevens, 2004) says the ISO classification impacts the fire insurance rates on all properties within a fire district. The amount of insurance paid is determined primarily by the ISO rating, as determined by the rating Schedule. Quantitatively, (Stevens, 2004) gave a scenario illustrating the amount of money saved on insurance premiums, due to the ISO rating,

In the article, for a town of 7,000 homeowners, by dropping five ISO grades, each house saved $61-$174 annually. The community, as a whole, saved over $4 million, during the ISO rating period.

While it is true that a reduction in the classification of a fire district can reduce the amount of premiums paid by it's residents and businesses, it is equally true that cost of making the improvements necessary to obtain that reduction can exceed the insurance savings realized (Freeman, 2003).

Very often a property owner can realize just as much in savings to his own particular property by making fire safety improvements such as improvements to the fire alarm or extinguishing systems. This will result in as much of a reduction in his own premium as could have been realized by a reduction in the overall fire district classification. This is particularly true for homeowners insurance. In many states, once a community reaches a certain classification, Class 3-4 in many cases, the homeowner's premium may not change, even if there is further improvement in the fire department's rating. This is precisely the reason that the ISO stresses the fact that the Fire Suppression Rating Schedule is an insurance rating tool and not intended to be used as a means of evaluating the quality of fire protection provided by a community (Freeman, 2003).

State Farm Insurance

State Farm Property/Casualty Insurance Group, the largest property/casualty group in the world, decided to no longer use ISO's Public Protection Classification (PPC) grading schedule. State Farm has developed their own rating system that they feel will more accurately assess a

community's loss rate. State Farm has estimated that approximately 70 percent of all claims paid by their company were not fire related losses (Kang, 2001). For this reason, their new system looks not only at the fire losses but at all other losses such as natural occurrences, criminal, and liability losses. State Farm will be able to reduce operating cost, improve their ability to respond to actual claim loss trends within a particular area and ultimately save money for their customers.

Insurance companies that use the ISO rating service have to pay a fee for this service. This service is ultimately paid by the consumers through higher insurance rates. State Farm is able to offer it's insurance at a lower price because it doesn't have to pay for the ISO service fee. If all fire insurance were priced using actual loss experience, then there would be no need for ISO rating system. The quality and the effectiveness of local fire departments will clearly have an impact on claim history in a particular area. However many fire officials have relied on the ISO ratings and use their recommendations to help justify improvements in their own departments.

One problem with using the ISO rating system for budget trends, especially in any cost benefit analysis becomes apparent when the financial positives and negatives are considered. Any improvements for the fire department will be funded by tax dollars. Any benefit to the citizens and property owners comes from lower insurance premiums. To the average person, the two might not be noticeable. An example would be a business owner may pay less fire insurance but has to pay for higher property taxes to fund improvements in public fire protection. It is extremely important for us in the fire service to educate the business community and our elected officials about the advantages of a more effective fire and emergency services. Many jurisdictions have used lower insurance premiums to attract new commercial developments and

can be seen from the fire loss data from ISO. Complying with its recommendations does make fire departments more effective.

State Farm's new system looks at the past history of a community and its total insurance losses to determine a rate code that is tied to the community's zip code. This new system is called the Subzone Rating Factor system. With this new system, changes in a community's status will change the local rates. State Farm will use its loss experience to assign subzones to zip codes and then establish subzone rates. In a interview with Tom Brum, a local State Farm Insurance agent, he stated that Ross Township has two subzone ratings score of 12. A subzone rate of 10 is a baseline number similar to the ISO rating of 1 being the best possible score. Mr. Brum also estimated that State Farm Insurance has over 30 percent market share of homeowners that insures their properties with State Farm Insurance in Southwestern Ohio (Brum, 2009).

Ross Township has two different zip codes that are used by the United States Post Office. The zip code 45013 is a Hamilton Ohio zip code is used for the majority of the township. Hamilton Ohio is the largest city in Butler County, employs a paid, full time fire department and has an established water supply system for fire protection. The zip code of 45014 is a Fairfield Ohio zip code. Fairfield, like Hamilton employs a paid full time staff and also has an established water supply system as well. Hamilton and Fairfield Fire Departments both have ISO rating of 2. According to Mr. Brum in theory, Ross Township and other departments in the subzone ratings area have benefited from these ISO ratings the two departments share when State Farm established their subzone ratings. The State Farm system is based on past experience and does not take in assessed capabilities such as fire hydrants 1000 feet or closer to a structure, needed fire flow, equipment carried on the apparatus, staffing, and other factors that ISO uses to evaluate for Public Protection Classifications. Therefore, improvements in fire service

capabilities theoretically have a beneficial effect on local rates under the subzone rating schedule. Similarly, improvements in police protection have an indirect effect on local rates when considering theft loss.

For years fire departments have complained that ISO does not accurately show their capabilities. The complaints vary from schedules that are not accurate to rating outdated equipment and not crediting departments for having new technology equipment. Most of these complaints surround the fact that ISO looks at specific items rather than the performance of the individual department. From these initial descriptions it seems that the State Farm system will more accurately assess the fire service and therefore create a more accurate insurance rate.

Fire Department Staffing

As stated in the background and significance section the number of volunteer personnel on the department roster has diminished over the last five years. In **Table 5** listed is the average number of personnel who responded to building fires in Ross Township from January 1, 2004 to December 31, 2008.

Table 5

Average Turnout per Incident – Alarm Date between 01/01/2004 – 12/31/2008 for Building Fires

	Building Fires	Average Number
2004	12	8
2005	15	15
2006	14	9
2007	12	14
2008	20	9
TOTAL	73	11 Average Turnout

Note. This does not include mutual aid department personnel.

Fire suppression operations have three basic functions: (1) rescue; (2) work involving the ladder, forcible entry, and ventilation; and (3) the application of water through hose lines (Granito & Dionne, 1988). For paid departments, rescue and ladder companies handle the first two, and engine companies the third. For volunteer and combination departments these three basic functions are handled by the first arriving engine. To raise ladders, ventilate, search, and rescue simultaneously takes quick action by at least four and often eight or more firefighters, each team under the supervision of an officer. The number of of firefighters required to search and rescue should never be fewer than two and typically is at least four. The number of firefighters needed to advance and operate one hose lines varies from two on smaller lines to four on larger hand lines.

As firefighting tactics were conducted for comparative purposes, five person fire suppression companies were judged to be 100 percent effective in their task performance, four person companies 65 percent effective, and three person companies 38 percent effective; six person companies are judged 20 percent faster than four person companies (Granito & Dionne, 1988).

Minimum protection for a rural area would include an engine with a large water tank and a fire tanker vehicle responding on an initial alarm. Properly designed fire tankers should be able to transport water from a source one mile from the scene so a minimum of 250 gallons per minute can be pumped at the fire scene by the engine. Since a larger flow is often required to provide adequate fire protection services, additional tankers must be used. To be even minimally effective in controlling a fire, the initial responding apparatus should reach the emergency scene before rapid fire spread. As in the case of rural firefighting, this is termed "initial attack" and is aimed at stopping the fire as close to the point of origin as possible. So-called "sustained attack" attempts to reduce the loss to the exposed adjoining or nearby property. Because of longer response times, rural departments may find themselves in the sustained attack or "defensive" mode upon arrival. Unless sufficient water can be made can be made available within a short time frame, the British thermal units (BTU's) generated by the burning material cannot be absorbed so the temperature is not reduced sufficiently to extinguish the fire. The keys to successful rural protection planning usually reduce response times and water availability (NFPA, Fire Protection Handbook , 1997).

In any locale, to be minimally effective in controlling a fire, the initial responding apparatus should reach the emergnecy scene in time to prevent "flashover. The time from ignition to flashover is controlled by many variables. Recorded times to flashover vary widely,

but fire departments should operate on the assumption that prevention of flashover requires quick action especially in newer homes that are built with light weight construction.

Commercial areas generally require additional apparatus or more to respond to the initial alarm. If properties with considerable life hazard are involved (schools, nursing homes, etc.) additional resources should be considered. Especially large number of personnel are needed for search and rescue operations in these properties. **(Table 6)**

Table 6: Typical Initial Attack Response Capability Assuming Interior Attack and Operations Response Capability

Occupancy	Apparatus	Manpower
High Hazard Occupancies (Schools, Nursing Homes etc)	4 – Engines 2- Ladders	24 - Firefighters 2 – Chief Officers
Medium Hazard Occupancies (apartments,offices etc)	3 – Engines 1 - Ladder	16 – Firefighters 1 – Chief Officer
Low Hazard Occupancies (one,two,three family dwellings, small business)	2 – Engines 1-Ladder	12 – Firefighters 1 – Chief Officer
Rural Operations (scattered dwellings, small dwelling and farm buildings)	1 – Engine (large water tank) 1- Fire Tanker (1000 gallon)	12 – Firefighters 1 – Chief Officer
Additional Alarms At least the equivalent of that required for rural operations for second alarms; equipment as may be needed according to the type of emergency and capabilities of the fire department. This may involve the immediate use of mutual aid departments		

Source: NFPA Fire Protection Handbook 18th Edition Chapter 10 Organizing for Fire Protection

The limitation of an emergency scene operation to those that can be safely conducted by the number of personnel on the scene is intended to reduce the risk of firefighter death or injury

due to understaffing. While members can be assigned and arrive at the scene of an incident in many different ways, it is strongly recommended that any interior fire attack should not be conducted without an adequate number of qualified firefighters.

It is recommended that a minimum acceptable fire staffing level should be four members responding on or arriving with each fire engine. On higher risk areas these numbers should be five members arriving on each engine and six members on a ladder truck. These recommendations are based on experience derived from actual fires and in-depth fire simulations, and are the result of the Fire Company's effectiveness. These studies indicate significant reductions in performance and safety where crews have fewer members than the above recommendations. Overall, five member crews were found to provide a more coordinated approach for search and rescue and fire suppression task (NFPA, 1996)

During actual emergencies the effectiveness of personnel working on the fire ground can become critical to the safety and health of firefighters and the citizens that we protect on a day to day basis. Potentially fatal work environment can be created rapidly in many fire situations. The training and skills of firefighters will do no good if there are not enough personnel to complete the task necessary to complete the job.

Determining the unprotected risk

Unprotected risk is the degree of imbalance that exists between the risk and suppression capability. If suppression forces available to respond to any location are inadequate to deal with fire suppression, that particular situation must be part of the community's unprotected risk. Unprotected risk can be reduced or eliminated by decreasing the risk or increasing the suppression capability. Suppression capability can be increased by upgrading the water supply system.

"Acceptable Risk" is the level of unprotected risk which the community is willing to live. Unfortunately, few citizens have any understanding that they have, by default, established a level of acceptable risk. When a fire occurs, they fully expect the fire department to arrive with red lights, sirens and the equipment and personnel to suppress the situation. Sometimes we win; sometimes we lose (Bennet & Forsman, 2003).

PROCEDURES

The research utilized the evaluative research methodology to identify the following criteria: a) an in depth analysis of each water main along roads in Ross Township, b) determined the required size main through water flow calculations based on the opinion of engineers of the Southwest Regional Water District, c) determined project length of each section of water mains that would need to be upgraded, d) hydrants currently in place along sections of water mains, and e) hydrants that would need to be placed at 500 feet increments. The procedures used to gather the above noted information are by utilizing software called Pictometry™.

The Ross Township Fire Department has been using this remarkable program through the Butler County Auditor's Office GIS Division. The software is offered to any department in Butler County, including local police, emergency management, and fire departments free of charge. Ross Township has taken advantage of this program and has been using it since 2007. Currently the department is using the program in our department command vehicle, desk top computers, and in our first out engines.

Imagine being able to view all four sides of a building as if you were circling them in a low flying helicopter. This new system uses aerial photographs to capture, process and examine orthro (straight down) and oblique (taken from angles) to create a 3-D map of a given area of location. By using this type of system to gather images, we can view and examine any structure, intersections, physical features, fire hydrants, and water mains in a selected area in respective coverage areas. This is an incredible improvement over the standard computer or hand written maps that our department has used in the past. With this new technology, it enhances our preplanning capabilities in the areas of disasters, emergency planning and response, hazardous materials, and structure assessments. Hand written or satellite image photographs allow us to

view only the tops of buildings. This type of map can be useful if operations are restricted to the rooftops. However, with Pictometry™ we will are able to capture every feature in its entirety, allowing the department to see the four sides of these buildings right down to the street level. This type of imagery allows our department to view the building just as the arriving fire apparatus will see it.

This software has a number of tools that can be used to enhance the view of a structure. A distance tool allows the user to measure anything in the image. For example a firefighter can measure the distance from a fire hydrant to a burning structure to determine which hydrant is closers or if a hydrant is too far from the structure which would exceed the amount of hose carried on a fire apparatus. A radius tool enables a hazardous material team to set up an evacuation area and know which buildings are located within the evacuation areas. The height of any object in the picture can be measured by a click of a button. This is an extremely important part of a preplan to determine the height of a ladder needed or if an aerial device is needed. A location tool allows the firefighter to click on any location on an image and get the GPS coordinates. This is very helpful for determining helicopter landing zones. An annotation tool is one of the most important tools. It allows the user to attach any information they wish to a certain location. Building information can be loaded into the specific file for that building when new or updated information is provided. This information can be retrieved later during an emergency or to conduct preplanning simply be entering the address or by clicking on the building itself.

Additionally, this system is used in conjunction with other agencies' GPS mapping systems. For example, we are able to download and overlay existing water main and hydrant

information from Southwest Regional Water District. This feature allows us to view water main sizes and locate hydrant locations.

The author contacted seven local Insurance companies and asked each agent if they could provide insurance quotes for structures in Ross Township that were within 1000 feet of a fire flow hydrant and quotes for structures that have fire flow hydrant beyond 1000 feet. When the author contacted the agents, it was explained to them about the research being conducted and all were very helpful to assist the author in obtaining the quotes

Each agent was asked to provide the following Homeowners Insurance quotes;

- $150,000 Structure with fire flow hydrants within 1000 feet
- $150,000 Structure with/ or without fire flow hydrants beyond 1000 feet
- $250,000 Structure with fire flow hydrants within 1000 feet
- $250,000 Structure with/ or without fire flow hydrants beyond 1000 feet

Each agent was asked to include the following coverage's to keep the continuity of each quote as close to one another as possible. Each quote has a $1000 deductible

- Dwelling
- Other Structures
- Personal Property
- Loss of use
- Personal Liability
- Medical Payments to others

Limitations of the Study

One limitation to this evaluative research project was based on the estimated cost of the installation of the fire flow mains and fire hydrants. During an interview with the Operations Manager and two Engineers of the Southwest Water District (Norma Pennock, 2009), the research project and the main topic of the interview were discussed. It was agreed to base the estimated cost of the research on recent bid tabulations for projects that Southwest Regional Water District has currently under construction, their current inventory cost, current pricing rates from their regular pipe supplier, and some rule of thumb estimating.

They assumed the hydrants would be at 500 foot intervals and line valves at 1,000 foot intervals. They also included engineering fees (5% of the base project cost), inspection fees ($400 per day and assuming 2,000 feet per month), and a 10% contingency on the base construction cost. They also included the costs for the purchase of easements at $2.50 per foot. With these figures in hand, the following estimate cost were used for calculating cost for the new installation of fire flow water mains and fire flow hydrants;

- 6-inch water main $46.00 per foot
- 8-inch water main $51.00 per foot
- 10-inch water main $56.00 per foot
- 12-inch water main $63.00 per foot

In areas of the township where there were sufficient sized water mains and no hydrants in place, a separate calculation was needed to install hydrants on an existing water main. Southwest Regional Water District used their current inventory prices to estimate time and

material cost for cutting in hydrants on an existing water main. The following prices were included in the data collection of the research project;

- M&H Hydrant $1,426
- 6x6 anchor tee $143
- 2 – 6" solid sleeve $167
- 2 – 6x13 anchor pipe $188
- 6" gate valve $478
- 3 – piece valve box & lid $79
- 3 – man crew & equipment for 8 hours $800

  Total Estimate per hydrant $3,281

Another limitation to the research project was determining the insurance rates to base the research on. Four different quotes were requested to the Insurance Agents. Ross Township has a very diverse amount of property values. New homes being constructed in Ross Township, especially in the outlying areas could range in the value of up to $800,000, to homes in the older sections of Ross Township that could have a value of $65,000. Therefore to find a median value, the author received quotes of homes with $150,000 and $250,000. The author came to the understanding when shopping for insurance, it is important for the customer to understand what they are getting when they purchase a homeowner insurance policy. Talking with each Insurance Agent, all of the insurance companies vary on determining a premium for the policy. Knowing and understanding a home owner insurance policy coverage is important. A home owner's insurance policy is designed to protect homeowners against certain hazards. There is also usually a deductable when filing a home insurance claim. For this research a $1,000

deductible was requested for every quote. A home insurance deductible is the amount paid for the covered damage before the insurance company pays the remainder. Customers can generally choose a higher deductible in order to lower their insurance premium if they don't mind taking the added risk. Individual home insurance policies are determined by named hazards and exclusions in a policy.

When buying a home owner's insurance policy, it is typically divided into two parts;

- Home Insurance Property Protection
- Home Insurance Liability Protection

Looking at the home insurance declarations page, which is usually the first page in a home owner's insurance policy, you would see Part 1: Property Protection. This protection is usually broken down into four additional sections

- A. Dwelling
- B. Other Structures
- C. Personal Property
- D. Loss of Use

There is also "Additional Property Coverage" home owners insurance may provide such as the removal of debris along with damaged trees and shrubs, fire department charges, property removal, theft or illegal use of credit cards. Endorsements can also be added to your home owner insurance policy at an additional cost to provide extra protection. In addition to the Property Coverage section you would also see another section listed as "Liability Coverage." The Liability Coverage section is broken down into two sections;

- Home Insurance Personal Liability
- Home Insurance Medical Payments

Your credit score also helps determines insurance premiums as well. For years, creditors have been using credit scoring systems to determine if you would be a good risk for credit cards, auto loans, and mortgages. Currently, many types of businesses, including insurance companies are using credit scores to decide whether to approve you for a loan or service and on what terms. Auto and homeowners insurance companies are among the businesses that are using credit scores to help decided if you would be a good risk for insurance. A higher credit score means you are likely less of a risk, and in turn, means you will be more likely to get insurance and to pay less for it.

RESULTS

Research Questions

Research Question 1: What areas in Ross Township are in need of upgrading their water mains and the installation of fire flow hydrants?

The first step in determining the areas in Ross Township that are in need of upgrading the water system was to evaluate each road in the township where a water main was in place. The research determined that there over 431,494 feet of roadway in Ross Township. There are 131 roads in the township that were evaluated. Along the side of these roads underground, lay utilities such as water mains to supply domestic water to home, natural gas lines, and underground electric and telephone lines. The following results were found;

Water Mains

One Hundred and thirty one (131) water mains were identified and evaluated if they were the proper size to supply sufficient amount of water for fire suppression. Fifty five (55) water mains were identified as being undersized to establish a sufficient amount of water. The research found many mains to be 3" or smaller in residential areas. Along these small mains, flush hydrants were located in strategic locations along the main. The flush hydrants are those that only have two small nozzles to discharge water. To the average person they may think that this is a water hydrant only to find out to may discharge less than 100 gallons per minute. Seventeen (17) water mains were found to be of the correct size but were lacking fire hydrants located every 500 feet. One water main in particular, which was installed less than 5 years ago, is a 12" main over fifteen thousand feet in length only has 3 fire hydrants in place. This main is very

capable of supply water for fire suppression. There are 92 homes on this water main and only 7% are protected by hydrants. The remaining 59 water mains that were identified are of sufficient size and have the required hydrants in place. These locations are mainly in the newer subdivisions and locations where the developer was required by regulations of Butler County Building and Zoning and meets the approval of the Ross Township Fire Chief.

Fire Hydrants

Three Hundred (300) fire hydrants were identified in place during the evaluation. These hydrants are located on mains that provide the amount of water for fire suppression. During the evaluation process it was determined that an additional 643 hydrants are needed to be installed to have 100% coverage Ross Township. These hydrants estimated, would be placed at 500 foot intervals.

Structures

During the evaluation of the water mains, each structure along that road was counted. The author also took in consideration of locating a hydrant along the road and calculated each structure within 500' distance from the hydrant. 3,327 structures were identified, including residential and commercial buildings. Of these structures 1,580 structures were identified to be within 500 feet of a fire hydrant.

Cost

Based on the figures obtained from the Southwest Regional Water District on the cost of the installation of different size mains, and the cost of cutting in (installation) hydrants on

existing mains the total cost of upgrading the water delivery system in Ross Township would be estimated at: $14,847,236.00

Table 7
Total Calculation of the Installation of Water Mains

Current Hydrants	Hydrants Needed	Project Cost	Total Structures	Structures Protected	Percentage of Structures Protected
300	643	$14,847,236	3,327	1,580	48.1%

Summary

It was determined that 48.1% of Ross Township is protected by fire hydrants and the other 51.9% of are in need of upgrading the water mains and the installation of fire flow hydrants.

Research Question 2: What will be the cost benefits to the homeowner?

Four different quotes for homeowners insurance were requested from six separate insurance agents. These agents were all from the Ross Township area each and had a vested interest in the research and were all very happy to assist in the researchers needs. As stated in the procedure section of the research paper, each agent was requested to provide a quote for homeowners insurance for a $150,000 home and a $250,000 both within a 1000 feet of a hydrant and beyond 1000 feet of a hydrant. The figures listed below in **Table 8** are the results;

Table 8
Insurance Quotes

Insurance Company	$150,000 Structure		Difference	% Cheaper	$250,000 structure		Difference	% Cheaper
	< 1000 ft	>1000 ft			<1000ft	>1000 ft		
American Family	$365	$406	$41	10%	$498	$561	$63	11%
All State	$445	$672	$227	34%	$537	$593	$56	9%
Nationwide	$669	$771	$102	13%	$923	$1,065	$142	13%
Ohio Mutual	$566	$999	$433	43%	$957	$1,701	$744	44%
State Farm	$450	$450	$0	0%	$546	$546	$0	0%
Grange Ins	$487	$534	$47	9%	$583	$635	$52	8%
Average Cost	$497	$639	$142		$674	$850	$176	
Average Savings				18%				14%

As stated in the above table the average savings to a homeowner of a $150,000 home with a fire hydrant located within 1000 feet of a hydrant is $142. This is a savings with an average of over 18%. The homeowner with a $250,000 home with a fire hydrant within 1000 feet of a fire hydrant is $176. This is a savings with an average of 14%. This result of having a fire hydrant within 1000 is certainly a cost benefit to the homeowner.

Research Question 3: What resources are available to help in the installation cost?

The author does not claim to be an expert in obtaining resources for water supplies, but has had some success in obtaining grants for the fire department. Ross Township recently entered into a contract with eCivis® Grants Network. eCivis®, which has hundreds of clients in cities and counties nationwide, is a web based research system that includes grants at the federal, state and foundation levels. Two potential grants were researched as potential resources to help in the installation cost;

Type: Federal

Agency: US Environmental Protection Agency

Office: Office of Ground Water and Drinking Water

Application Date: Rolling

Match Required: None

Actual Funds: $2,000,000,000

Summary: The purpose of this program is to support water infrastructure improvement projects that are needed to achieve or maintain compliance with Safe Drinking Water Act requirements. Funds may also be used to support programs aimed at preventing contamination problems via source water protection and enhanced water system management activities. This program has received funding through the economic stimulus bill formally known as the American Recovery and Reinvestment Act (ARRA).

Contact: George Ames (202) 564-0661
U.S. Environmental Protection Agency
1200 Pennsylvania Ave
Washington DC 20460

Type: Ohio

Agency: Ohio Department of Development

Office: Office of Housing and Community Partnerships

Application: Rolling

Match Required: Yes

Actual Funds: $9,500,000 (Award request must not exceed $600,000)

Summary: The purpose of this program is to assist small, needy, and rural Ohio communities in achieving compliance with Environmental Protection Agency mandates regarding safe and reliable drinking water and sanitary waste. Proposed projects should be designed to primarily benefit distressed communities or areas with a majority of low and

moderate income families. Projects must take place where residential users make up at least 60 percent of the water service users. Projects must alleviate the identified health hazards or replace a functionally obsolete facility. Examples of recently funded projects include the installation and replacement of thousands of linear feet of water and sewer lines and the installation of water tanks and booster stations. This program has received funding through the economic stimulus bill formally known as the American Recovery and Reinvestment Act (ARRA).

Contact: Program Staff (614) 466-2285
Ohio Department of Development
Community Development Division
Office of Housing and Community Partnerships
77 South High Street, 24th Floor
PO Box 1001
Columbus, Ohio 43216-1001

DISCUSSION

With almost a $15,000,000 price tag, completely upgrading the installation of new water mains and fire flow hydrants throughout Ross Township is unfeasible. Ross Township or the Southwest Regional Water District does not have that kind of capital funds available, without outside assistance.

As stated in the literature review, for decades rural populations have accepted the fact that not enough water exist to control every fire. This would be acceptable where there wasn't any water available. However where there is water available and the fire departments have no way of utilizing it is unacceptable. For many years, an official would say "We have always done it this way" and in the Author's opinion, this is unacceptable. Our elected officials and fire officials need to be more proactive in getting the word out to the public, the importance of having an established water supply system that is usable for fire suppression. People who pay for fire protection whether through donations or by tax dollars, expect the best protection, even though that they really may not know what that is (Davis, 1986).

Although during the data collection on the cost analysis of the township, it is apparent the cost is too high to completely upgrade the system, but the data proves that there are some areas that would benefit from the upgrading. The data was analyzed for specific areas such as subdivisions and private communities. Listed below in **Table 9** is a breakdown cost to upgrade the water system in Dry Run Subdivision. Dry Run Subdivision is an established community in Ross Township that was developed in the 1970's. The water mains in the subdivision are all undersized. The smallest main is 2" in diameter and the largest size is 6". When the area was developed in 70's there were no regulations pertaining to water for fire suppression. The

subdivision has 336 homes. There are nine fire hydrants located throughout the area and most are on undersized mains. To completely redo the water system, it would take over 24,377 feet of water main. With the addition to the water main an additional 49 fire hydrants would need to be placed. The total cost of upgrading the system in Dry Run would be an estimated cost of $1,235,998. If this estimated cost was divided by the amount of homes in the subdivision the cost per residence would be $3,678. This cost, spread out over 20 years would be $184 per year. If you base the estimated cost to the comparison of the insurance rates savings of having a structure within a 1000 feet of a hydrant it would cost a homeowner of a $150,000 home an additional $42 a year. A homeowner with a $250,000 home would cost an additional $8 a year.

Table 9: Dry Run Subdivision

Road Name	Current Size Main (in inches)	Required Size Main	Main Cost ($ per foot)	Project Length	Current Hydrants	Hydrants Needed (@ $2482)	Total Project Cost ($)	Total Structures	Structures Protected	% Structures Protected	Sub-Division
Acer Ct	2	6	46	215	0	1	12372	7	0	0	Dry Run
Beth Lane	4	6	46	300	0	1	16282	3	0	0	Dry Run
Brater Ct	2	6	46	578	0	1	29070	9	0	0	Dry Run
Brown Farm Dr	4	8	51	4702	3	6	254694	51	30	58.82	Dry Run
Bruce Ct	6	6	0	657	0	2	4964	10	0	0	Dry Run
Celtis Ct	2	6	46	296	0	1	16098	7	0	0	Dry Run
Chad Lane	2	6	46	298	0	1	16190	6	0	0	Dry Run
Clyde Ct	2	6	46	467	0	1	23964	7	0	0	Dry Run
Donbar Dr	6	8	51	966	0	2	54230	13	0	0	Dry Run
Dry Run Dr	4	8	51	1729	0	4	98107	24	0	0	Dry Run
Gloria Lane	4	6	46	357	0	1	18904	2	0	0	Dry Run
Jennifer Dr	4	8	51	2755	0	6	155397	44	0	0	Dry Run
Laurie Ct	4	6	46	323	0	1	17340	7	0	0	Dry Run
Leona Ct	2	6	46	832	0	2	43236	11	0	0	Dry Run
Mike Hill Dr	6	8	51	1004	1	3	58650	15	8	53.33	Dry Run
Moeller Dr	6	8	51	2622	0	6	148614	21	0	0	Dry Run
Platinus Dr	6	6	0	633	1	1	2482	8	4	50	Dry Run
Quercus Ct	6	6	0	877	0	2	4964	16	0	0	Dry Run
Scottwood Dr	6	8	51	1097	0	2	60911	15	0	0	Dry Run
Silax Dr	6	8	51	1462	1	3	82008	19	3	15.79	Dry Run
Sorbus Dr	6	8	51	2207	3	2	117521	41	14	34.15	Dry Run
				24377	9	49	$1235998	336	59	10.1	

Cost per Structure	$3678
Cost over 20 year period	$184

. Listed below in **Table 10** is a breakdown cost to upgrade the water system in Ross Manor Subdivision. Ross Manor Subdivision is an established community in Ross Township that was developed in the 1960's. There are no water mains in this subdivision with the exception of School Road which is close to a 12" main near Hamilton-Cleves Rd. Lark Street, which connects to Venice Gardens has an 8" main. All of the remaining homes are on well water. The subdivision has 173 homes. There are six fire hydrants located throughout the area and most are remote to the majority of the subdivision, To completely redo the water system, it would take over 14,237 feet of water main. With the addition to the water main an additional twenty seven fire hydrants would need to be placed. The total cost of upgrading the system in Ross Manor would be an estimated cost of $480,276. If this estimated cost was divided by the amount of homes in the subdivision the cost per residence would be $2,776. This cost, spread out over twenty years would be $138 per year. If you based the estimated cost to comparison of the insurance rates savings of having a structure within a 1000 feet of a hydrant, it would save a homeowner of a $150,000 home $4 a year. A homeowner with a $250,000 home would save $38 a year.

Table 10: Ross Manor Subdivision

Road Name	Current Size Main (in inches)	Required Size Main	Main Cost ($ per foot)	Project Length	Current Hydrants	Hydrants Needed (@ $2482)	Total Project Cost ($)	Total Structures	Structures Protected	% Structures Protected	Sub-Division
Banyon Ct	0	6	46	1007	0	2	51286	23	0	0	Ross Manor
Banyon Dr	0	6	46	386	0	2	22720	1	0	0	Ross Manor
Beechwood Dr	0	8	51	2160	0	6	125052	27	0	0	Ross Manor
Bella Vista Dr	0	8	51	2031	0	5	115991	35	0	0	Ross Manor
Birch Dr	0	8	51	1593	0	3	88689	19	0	0	Ross Manor
Cypress Lane	0	8	51	720	0	2	41684	9	0	0	Ross Manor
Elda Dr	0	6	46	380	0	1	19962	3	0	0	Ross Manor
Lark St	8	8	0	3744	5	3	7446	34	26	76.5	Ross Manor
School Rd	12	12	0	2216	1	3	7446	22	3	13.6	
Totals				14237	6	27	$480276	173	29		
Cost per Structure				$2776							
Cost Over 20 year period				$138							

There are other established subdivisions listed in the appendix that will show cost analysis for each area.

During the interview with the operations manager of Southwest Regional Water District (Norma Pennock, 2009) the topic of discussion was when SWRWD installs or upgrades a water main why doesn't SWRWD install fire hydrants every 500 feet? Her reply was the SWRWD is a provider of domestic water to its customers. They are not in the business of providing fire protection water unless the customer requires it, such as commercial development or residential

development. In this case the developer pays for the cost and it is passed on to the consumer. She did state that any new installation or upgrade to the system they would consider installing the hydrants, only if the majority of the customers on that affected main agrees to the cost of the installation. If 50% of the affected parties agreed, then that cost would be added on to their property tax to be paid out for several years. This situation may take several years to become a reality, but a fair proposal to eventually have the township fully covered. It is not fair for a homeowner to pay additional money for the installation of a hydrant if they already live in an area that has them. Additionally they have already paid for those upgrades by purchasing a new home or lot which included the cost of those hydrants and the proper size mains.

As examined in background section of the research and determined by manning issues, it was discussed that at the most, if all Ross Township tankers were involved in a water shuttle it would take seven additional firefighters to complete this task. Having these seven firefighters establishing a water supply, takes them away from doing task on the fireground. It is in our operating procedures, in most cases tanker operations, consist of "dump and run" operations. This decision rest with Command but generally the decision is made with the apparatus operator.

There has never been a need in determining how much water is needed on the fireground in non-hydrant areas. When we have a structure fire in these areas, it is automatically assume that we need as much water as necessary. Relay pumping is taken into consideration if there is a water source within 2500 feet from the fire scene. Large diameter hose relays are a more efficient way to move up to 2500 feet, while tanker shuttles are more efficient for distances more than 5000 feet.

Road conditions also have been shown to play a critical factor in the decision to relay pump or use a water shuttle. Narrow and winding roads make securing and maintaining an

adequate water supply challenging for our fire department and that water shuttles operations can create a nightmare on roads not intended to sustain the degree of traffic of large and heavy vehicles. Safety regarding water shuttle operations is another consideration. Water shuttles can be dangerous, personnel can be injured, and apparatus and equipment can be damaged. If the operations are allowed to take place haphazardly, the probability of injury to personnel and damage to equipment can be high.

The current Ross Township Fire Department Standard Operating Guidelines do not specifically direct the department when to use a water shuttle, relay pump or direct pump in regards to distance to a water source or the amount of water needed. Our current experience indicates that relay pumping or direct pumping from another water source such as another engine or tanker can be established in a timely manner and can establish significant flow rates using fewer firefighters. It could prove to be more efficient to direct pump or to pump in series for flows of less than 750 GPM and the total water usage of less than 10,000 gallons, or use a relay or water shuttle operation for fire requiring more than 10,000 total gallons of water. For fire requiring more than 10,000 gallons of water would be considered a defensive fire and would require less firefighter's on the fireground.

RECOMMENDATIONS

Five recommendations have been developed based on the research for this project.

First, present this research and its findings to the Ross Board of Trustees. Explain the importance of a usable water supply in regards to proper fire protection, but most importantly for the safety of our fire crews. Explain to the Board that in actual emergencies the effectiveness of our personnel working on the fire ground can become critical to the safety and health of our firefighters and the citizens that we protect on a day to day basis. Potentially fatal work environments can be created rapidly in many fire situations. The training and skills of firefighters will do no good if there are not enough personnel to complete the task necessary to complete the job. Recommend to the Board of Trustees, to present this research and its findings to the Butler County Trustees Association at a quarterly meeting. Special attention should be directed at the townships that are in the Southwest Regional Water District and inform that this research applies to them as much as it does to Ross Township. Together, as a group of government authorities, they should present this to the Board of Directors of Southwest Regional Water District, and demand that the Townships should have more say in the water system in the respective areas.

Secondly, develop a better working relationship with the Board of Directors of the Southwest Regional Water District. In developing this relationship, present the data found during the research and come up with a strategic plan for the future and be more involved in the future planning of the public water service in Ross Township.

Thirdly, educate the community on the importance of having a usable water system for fire protection. As examined in the introduction section, many of the residents that live in Ross Township are transients from suburban areas and they take for granted that there is an established water supply readily available for the departments use. When a fire does occur in their area they are surprise to find out there is no available water for fire suppression, and that what water is used is brought in by tankers. They take for granted that the water we carry on our apparatus have enough water to suppress the fire. We can expand their education either through the quarterly community newsletters or by having displays at our annual open houses explaining the water supply system in Ross Township. Explain the benefits to the homeowner by having a hydrant within 1000 feet of their homes. These benefits such as cost savings to their homeowners insurance and the safety and the well being our firefighters to the homeowner by having a hydrant within 1000 feet of their home.

Additionally, improve the mutual aid agreements with our neighboring departments to include an automatic response on certain incident calls. These improvements could either come from the CAD system at our dispatch center or by improving our map books, which indicate non-hydrant areas. Both of these areas could describe which automatic mutual aid units would be dispatched and a detailed description of how they will be used in the water supply system.

The Ross Township Fire Department will also look into updating Standard Operating Guideline section 6.16 “Single Drop Tank Operations.” On working structure fires our usual mode of operation is to automatically go to a “dump and run.” We are going to expand on this

research for possibilities of improving our water delivery systems. We need to establish a more consistent and more effective method of providing a water supply for any situation that may be encountered. We are going to explore three basic operational methods of water delivery. These three basic modes could be used for water supply operations.

- Series pump operation
- Relay pump operations
- Water Tanker shuttle operations

Series pump operations could be used for water supply needs of less than 750 GPM and fire which are small fires requiring less than the amount of water carried to the scene, such as room and contents fires. Fires requiring more than 10,000 gallons total should not use a series pump operations. But going to this type of operation will free up several firefighters that it would have taken to set up water shuttle operations. The fire attack will begin with the 1st due engines tank water and each arriving apparatus will pump its tank water through Large Diameter Hose (LDH) to the steamer intake of the truck in front of it. The engine receiving water will continue the fire attack or pump to the truck in front of it and top off its water tank. The series pump concept may have 3 or more trucks hooked "in series" with only the last unit in line having a tank is less than full.

Relay pump operations could be used for water supply needs exceeding that of a series pump operations capability within a close proximity of a primary water supply. The first due engine will typically forward lay to the fire with each successive arriving unit reverse laying back to the primary water supply. A relay pump operation is a very reliable water supply method and should be considered when we are operating in areas where tanker access is limited due to narrow roads or inclement weather conditions.

Tanker shuttle operations will still be used for water supply exceeding that of a series pump operations capability (10,000) and not within a close proximity of a primary water source. The first due engine will typically begin the fire attack with tank water and set up portable drop tanks. Typically this type of scenario would be a defensive fire and the manning issues are not as important as an offensive fire. This is primarily what the department has been doing on all fires.

This new guideline will be trained on extensively before it will go into effect. When done efficiently and effectively, rural water supply more accurately resembles a highly choreographed dance with all the elements working together for optimum results. Training is the life blood of any organization and the more we train with our equipment and neighbors, the more capable we will be to meet the challenges that the fire service will face tomorrow.

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