LONG RANGE PLANNING: THE ACQUISITION, REPLACEMENT, AND UPGRADE OF APPARATUS AND EQUIPMENT FOR THE WACO COMMUNITY VOLUNTEER FIRE DEPARTMENT

EXECUTIVE ANALYSIS OF FIRE SERVICE OPERATIONS IN EMERGENCY MANAGEMENT

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Abstract

The Waco Community Volunteer Fire Department (WCVFD) had no long-range plan for the acquisition, replacement, or upgrade of apparatus and equipment. This study identified the capabilities necessary for the WCFD to meet the community's needs. The descriptive research project addressed the following questions:

1. What are the critical hazards and vulnerabilities faced by the Waco Fire District (WFD)?
2. What are the Department's current capabilities to protect the community from these risks?
3. What improvements are necessary to fully meet the community's needs as identified in the risk assessment?

The procedures involved gathering pertinent data for all built-on tax parcels in the WFD. The information was entered into a spreadsheet formatted for later importation into the RHAVE program. Skills learned in the Executive Analysis of Fire Service Operations in Emergency Management (EAFSOEM) course were used to identify hazards, assess vulnerabilities, and rate risk unrelated to fire. A literature review was conducted, including books, manuals, and other publications from area libraries.

The results indicated that the WFD faces a low risk of mass casualty incidents, a moderate risk of fire and hazardous materials incidents, and a high risk to technological and natural disaster incidents. The research identified several short-term equipment deficiencies. To

ensure that the WCVFD meets the critical needs identified in the risk assessment, the organization should analyze the past, evaluate the present, and develop a long-range future plan.

Recommendations were: to develop and implement a long-range plan regarding apparatus and equipment, including replacing Reserve Engine 305 and purchasing small equipment; to identify an adequate level of fire protection in the district; and to solidify working relationships with neighboring departments that would provide automatic and/or mutual aid during unanticipated contingencies. The WCVFD should also request an inspection and rating survey from the North Carolina Response Rating of Fire Departments Program.

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Introduction

The Waco Community Volunteer Fire Department (WCVFD) does not have a long-range plan for the acquisition, replacement, or upgrade of apparatus and equipment. The purpose of this study is to identify adequate capabilities, including apparatus and equipment, to meet the community's needs for the services delivered by the WCVFD. This is a descriptive research project. The research questions are:

1. What are the critical hazards and vulnerabilities faced by the Waco Fire District (WFD)?
2. What are the Department's current capabilities to protect the community from these risks?
3. What improvements are necessary to fully meet the community's needs as identified in the risk assessment?

Background and Significance

At the present time a long-range plan for the acquisition, replacement, or upgrade of apparatus and equipment does not exist. The WCVFD has traditionally purchased equipment based on the personal beliefs of a majority of the fire department membership**.** Volunteer emergency services organizations are no longer sacred cows for which citizens are willing to provide revenue without understanding needs. A citizen might wonder how excess chrome or gold leaf on a new apparatus increases its efficiency or effectiveness. In these days of limited funds and taxpayer revolt, we have to be better fire service managers.

The WCVFD was organized in December 1962 and temporary officers were elected. Mr. George Murray was elected as the department's fire chief. The department had forty original members who completed the Fireman's Training Program sponsored by the North Carolina Department of Insurance. In March 1963, the department purchased its first piece of apparatus, a 1962 International engine. The WCVFD purchased the 1962 engine from Sandy Plains Fire Department (Union County, NC) after it had been damaged in a motor vehicle accident. The apparatus was purchased for $3,000 and had less than 1,300 miles on it. Three months and $2,500 in repairs later, the WCVFD had a "new" engine at an "old" engine price. The apparatus was a Howe built engine equipped with a 750-gallon booster tank and a 500-gallon per minute midship pump. A few months later, the members built a tanker on 1958 International chassis. The tanker was equipped with a 1,000-gallon booster tank and had an auxiliary pump for loading and unloading water. In June 1964, the members built a brush truck on a 1955 Dodge chassis, a surplus U.S. Army weapons carrier. The vehicle body was retrofitted to suit the needs of a brush truck. It was equipped with 280-gallon booster tank, an auxiliary pump, and a booster reel with hose and nozzle.

As time passed and the fire district grew, the members added another engine to the fleet. In 1974, the WCVFD purchased a new Howe engine built on a C-65 Chevrolet chassis. This engine was equipped with a 750-gallon booster tank and a 750-gallon per minute midship pump. The 1958 International tanker was replaced in 1980 with a new commercial tanker built by E-One. This 1980 E-One tanker, built on a C-70 Chevrolet chassis, is equipped with a 1,250-gallon booster tank and has a 250 gallon per minute power take off pump. The 1962 International engine was replaced in 1992 with a commercial engine built by E-One. This 1992 E-One

pumper/tanker, built on a Chevrolet Topkick chassis, is equipped with a 1,250-gallon booster tank and a 1,250-gallon per minute midship pump. The 1974 Howe engine was replaced in 1998 with a commercial engine built by E-One. This 1998 E-One rescue style engine, built on a Freightliner chassis, is equipped with a 1,000-gallon booster tank and a 1,250-gallon per minute midship pump. The 1955 brush truck was replaced in 1997 with a new brush truck assembled by the WCVFD members. This brush truck is a 1997 four-wheel drive Chevrolet pick-up equipped with a pre-manufactured skid unit. The skid unit has a 200-gallon booster tank and 100 gallon per minute auxiliary pump.

Monies collected through fire taxes primarily fund the WCVFD. The WCVFD became part of the Cleveland County Fire Protection District (CCFPD) in fiscal year 1978-1979. The CCFPD became effective by authority granted to county commissioners under North Carolina General Statute (NCGS) 153A and levied the first fire tax for fiscal year 1978-1979. The amount of money budgeted for each fire department within the CCFPD was based on its average number of calls responded to during the most recent three-year period. Approximately three years after the establishment of the Fire Protection District, there was another count of calls responded to for that three-year period, and the annual allotments were adjusted accordingly. As of approximately 1984, allocations were given as a percentage increase, generally 5% per year, to each of the nine fire departments. Beginning with fiscal year 2003-2004 each department will be funded with an annual budget of $100,000.

This study is important to the WCVFD for several reasons. First, a critical hazards and vulnerabilities analysis will give quantifiable data for deciding future equipment needs. Second,

a resource analysis will identify any shortcomings in current capabilities. Third, this data can serve as a source for a long-range plan in the acquisition, replacement, or upgrade of apparatus and equipment.

This Applied Research Project (ARP) relates to the Community Risk Assessment and Capability Assessment sections taught in the Executive Analysis of Fire Service Operations in Emergency Management (EAFSOEM) course. An appropriate general topic area from Community Risk Assessment was "…conduct a community risk assessment that identifies and assess the critical hazards a typical community faces." (National Fire Academy [NFA], 2001, p. 4-1). Appropriate general topic areas from Capability Assessment were "…evaluate current capabilities to meet critical risks identified in the risk assessment;" and "…identify capability shortfalls in a typical community," and "…based on identified shortfalls, develop methods to obtain critically needed resources." (NFA, 2001, p. 6-1). The problem addressed by this research project relates directly to the following USFA operational objectives: "reduce the loss from fire of firefighters" and "to promote within communities a comprehensive, multi-hazard risk-reduction plan led by the fire service organization." (NFA, 2002, p. II-2). This ARP directly contributes to these objectives by analyzing the community for existing vulnerabilities, evaluating the current capabilities of the WCVFD and identifying the critical needs identified in the risk assessment.

Literature Review

The purpose of this literature review is to set the logical and rational foundation for the study. Three basic questions need to be addressed. First, what are the risks and hazards of a

typical rural fire district? Second, are there recommended capabilities for fire departments protecting rural fire districts? Third, would long-range planning aid in the acquisition, replacement, and upgrade of apparatus and equipment for fire departments protecting rural fire districts?

Risks and Hazards

"The fire service uses the word risk to define or measure both the possibility that an emergency will occur and the potential outcome of this event. If a type of incident occurs frequently and with significant severity, the risk is severe. At the other end of the spectrum, if an emergency incident occurs infrequently and with little or no severity, the risk of the incident is low" (Compton & Granito, 2002, p. 42). Every community in the world faces the risk of fire; however, this risk may be greater in some areas due to population, building construction, lack of fire protection systems, and related factors. Other risks faced by communities are: mass-casualty incidents, terrorism, hazardous materials, and natural disasters (Carter, 1999). Risk can be assigned to one of three categories: high, moderate, and low. High-risk designations are of substantial size and contain a concentration of properties with a high risk to loss of life, loss of property, and loss of economic wealth to the community (NFA, 2001). Moderate-risk designations are properties with a moderate risk of loss of life or financial impact on the community, and an extraordinary likelihood of damage to property (NFA, 2001). Low-risk designations are of minimal risk of loss of life or property damage in the event of fire in a single building (NFA, 2001). The Commission on Fire Accreditation International developed a universal tool called RHAVE, which allows the community to be evaluated for the risk of fire. The Risk, Hazard, and Value Evaluation (RHAVE) model classifies individual properties in

relevance to protecting life and property. Community leaders, when developing objective, quantifiable risk reduction policies such as the deployment of emergency service resources, may then use information collected through the use of RHAVE model (United States Fire Administration [USFA], 2003). The concept is a simple-to-use methodology combining forms, formulas, databases, and data analysis. The programs summary page assigns each property an Occupancy Vulnerability Assessment Profile (OVAP) that can be used as a management tool to aid in the decision process of the jurisdiction. Properties that receive an OVAP score of 60 or greater are classified as maximum risk; an OVAP score of 40-59, significant risk; an OVAP score of 15-39, moderate risk; and an OVAP score of less than 15, low risk (Raddigan, 2003).

Recommended capabilities

In 1981, the North Carolina Insurance Commissioner authorized the standard known as, North Carolina Response Rating of Fire Departments Program. The result of this action was the development of requirements by which all rural fire departments will be certified with a 9S rating for insurance grading purposes. This provides for the eligibility of the department's personnel to participate in the Firemen's Pension Fund, the Firemen's Death Benefit Act, and the Firemen's Relief Fund. The "S" attached to the 9 classification designates that fire department as having met the current minimum standards for a rated class 9 or split 9 fire department in North Carolina. In order to meet and/or retain the 9S classification, each fire department must meet minimum requirements in each of the following areas: fire department organization, personnel, meetings and drills, alarms and communications, records and documents, apparatus, and buildings (Lohr, 1994).

On July 22, 2000, the North Carolina General Assembly passed House Bill 1696, granting the Office of the State Fire Marshal (OSFM) the responsibility for inspecting and rating all fire departments and fire districts in the state serving a population of 100,000 citizens or less. The OSFM uses the Fire Suppression Rating Schedule (FSRS) developed by the Insurance Services Office (ISO). Once an inspection is completed, a rating is assigned and submitted to ISO. ISO then records the classification data and provides it to the insurance industry (Gladdin, 2001).

To meet this minimum requirement, the fire department shall be incorporated under Chapter 55A of the General Statutes of North Carolina. If the fire department is incorporated, it shall operate under a contract with a city or county. The board of county commissioners shall establish and define the area of responsibility outside of a given municipality (Lohr, 1994).

Each fire department shall have a minimum of twenty personnel, with eighteen designated as firefighters and two as traffic personnel. Alternatively, the department may document that an average of twelve firefighters have responded to each of the previous twenty structure fires. Initial certification of a new fire district shall require the twenty personnel roster. Eight additional personnel shall be added to the roster for each substation (Lohr, 1994).

All members shall comply with the training requirements set forth in Chapter 58 of the North Carolina General Statutes, which states that fire departments shall provide four hours monthly of drills and meetings, for a total of 48 hours per year. Each firefighter shall attend at least 36 hours of drills and meetings in each calendar year. While it is left up to the chief of the

department to determine what constitutes these 36 hours of meetings and drills, personnel are encouraged to attend as many hours as possible of actual fire training (Lohr, 1994).

Communications must be reliable for reporting of emergencies, notifying firefighters, and dispatching apparatus. The system must have a telephone listing for fire emergencies that reaches a location that can receive calls and dispatch apparatus and personnel 24 hours per day. The fire station shall be equipped with a siren, or each listed firefighter shall be equipped with a pager capable of being toned by the central communications center (Lohr, 1994)

The following documents should be on file in the fire and rescue services division office: articles of incorporation, contract with county or city, map and district description, designation of insurance district, roster of active firefighters, results of pump service tests on engine companies, and certified weight tickets for apparatus. The following documents will be reviewed by the inspector on the inspection site at the time of the 9S inspection: alarm log, business meeting minutes, meeting and drill rosters, inventory of equipment, and apparatus check off sheets (Lohr, 1994).

Engine companies and tankers shall be certified by either Underwriters Laboratories, Inc., or the National Bureau of Fire Underwriters, and shall be constructed in accordance with NFPA 1901, Standard for Automotive Fire Apparatus. All apparatus shall have a manufacturer's gross vehicle weight plate attached to the vehicle. Engines and tankers shall not be loaded beyond their specified limits. Engine companies shall be rated at not less than 500 gpm at 150-psi net pump pressure and equipped with a minimum 500-gallon tank. A complete and accurate service

test shall be performed annually. Each engine company shall carry an assortment of various hand tools to facilitate fireground operations (Lohr, 1994).

Tankers shall be equipped with a minimum of 1000 gallons capacity, or enough to equal 1500 gallons total for an engine and tanker first-due combination. This standard recommends booster tank size not to exceed 1500 gallons and proper tank baffling to limit the movement of water. All tankers shall be equipped with the necessary hose for filling the onboard booster tank and transferring water to the engine (Lohr, 1994).

The response-rating program standard requires each fire department to provide a building with suitable heating for all weather protection of required engine and tanker (Lohr, 1994).

Long-range planning for apparatus and equipment

"Each aspect of today's fire service requires the development of basic strategies. Most departments do some kind of planning. Whether it is called budgeting, pre-fire planning, long-range planning, comprehensive planning, five-year planning, or strategic planning, the fire service has a long history of trying to look into the future to predict what will be" (Wallace, 1998, p. 5). Establishing and growing the planning process is the responsibility of the fire chief. In smaller agencies, the chief is often the person responsible for manging the planning process, whereas in larger agencies, facilitating the process is more than likely assigned to a subordinate.

"The strategic plan is the organization's road map for the future" (Compton & Granito, 2002, p. 63). Fire departments must consider careful planning an important key to success. Fire

administrators must always think of tomorrow and beyond. Although the bulk of the work is dealing with current matters, there is much important work to be accomplished at some later date. The fire chief's most important work concerns long-range plans that will enable the department to fulfill its needs for many years to come (Carter, 1999). Long-range planning involves decisions that will have a major effect on reaching goals far in the future. In business, long-range planning includes the products the business will produce, the geographic areas it will serve, and the markets it will penetrate. Long-range planning in the fire service involves matters such as the number and location of fire stations, the planning of water supplies, and the purchase of major apparatus (Wallace, 1998). When preparing budgets for the financial management of a department's capital resources, consideration must be given to the long-range use of such resources (Carter, 1994). "Capital resources are the equipment, vehicles, and facilities that enable firefighters to deliver service to their customers" (Compton & Granito, 2002, p. 203). Proven assumptions regarding capital resources are difficult to defend because fire departments differ widely in the services they provide. Focusing on the process used to acquire, replace, and upgrade apparatus and equipment should help most fire departments manage their capital resources (Coleman & Granito, 1998).

Procedures

A review of available literature was conducted, summarizing the critical findings of others concerning long-range planning and how these findings would be applicable to this research project. This review included books, manuals, and other publications from the libraries at Cleveland Community College, Waco Community Volunteer Fire Department, Charlotte Fire Department Training Academy, and from the Learning Resource Center at the National Fire

Academy. Internet search engines such as Web Crawler, Yahoo, and MSN were also used to access articles and other printed material pertaining to long-range planning. The following web pages were consulted for research: United States Fire Administration (www.usfa.fema.gov), North Carolina Department of Insurance (www.ncdoi.com), RADware Solutions (www.rhave.com), and the Commission on Fire Accreditation International (www.cfainet.org). The Planning and Information Management page on the USFA site was consulted to gather information regarding the Risk, Hazard, and Value Evaluation (RHAVE) computer program. The Fire and Rescue Personnel page on North Carolina Department of Insurance (NCDOI) web page was visited to identify fire department rating requirements. RHAVE.com was launched to download the RHAVE software and support manuals. The Peer Assessor News downloads pages on the Commission on Fire Accreditation International (CFAI) web page were viewed to seek information on assessing fire department capabilities. North Carolina State Law was also reviewed to identify any General Statues that would be applicable to minimum requirements for fire departments.

Listings of all tax parcels for the Waco Fire District (WFD) were requested from the Cleveland County Tax Assessor's Office. The Tax Assessor provided tax property record cards, maps, and property valuation data for each tax parcel within the WFD. The data were then entered into a spreadsheet and filtered into a more applicable form for this research project. The filtered spreadsheet contained the following fields: parcel number, street address, mailing address, property owner, land value, building value, and total value. All tax parcels without buildings were removed from the spreadsheet at this point. The parcels with buildings were filtered again to divide them by property description, property use, and occupancy type. When

completed, this spreadsheet contained all built-on tax parcels within the WFD and was in a format for later importation into the RHAVE program.

The RHAVE program was downloaded from RADware solutions onto a desktop computer and registered through the Internet according to the software instructions. Once the program was loaded and configured correctly, the fire department information was entered into the database using the set-up pad on the main menu of the program. The following data elements were required for the set-up: jurisdictional information, agency identifier, and applicable building code information. OVAP data, consisting of specific property identification information and the OVAP scoring, were entered into the program. OVAP scoring includes subclass scores assessed from data pertaining to premises, buildings, life safety, risk, water demand, and value.

Skills learned in the EAFSOEM course were used to identify hazards, assess vulnerabilities, and rate risk unrelated to fire. The author used forms from the EAFSOEM student manual to classify potential risk to the WFD. The forms used were the hazard identification, vulnerability assessment, and risk rating matrixes (Appendix A). Applicable risks to the WFD, unrelated to fire, were selected from the Comprehensive FEMA Hazard List (Appendix B).

The procedures employed in this research project were based on two assumptions. First, it was assumed that all of the authors referenced in the literature review performed objective and unbiased research. Second, it was assumed the Tax Assessor gave accurate information

concerning the tax parcels for the WFD. There are two limitations that affected this research, both pertaining to RHAVE. The OVAP data had to be entered one property at a time, which made for a time consuming process to enter the 2803 tax parcels. Also, the computer program provides no mechanism to import data into the RHAVE program without entering it into the OVAP menu screens.

Definition of Terms

Capital Resources: equipment costing more than $100.00 and having a service life longer than one year.

Cleveland County Fire Protection Service District: a service tax district established April 17, 1978, pursuant to North Carolina General Statute 153A-300.

Fireman's Death Benefit Act: a benefit for a line-of-duty death of $25,000, paid in installments of $10,000 at the time of a line of duty death.

Fireman's Pension Fund: any member who has served twenty years as an eligible firefighter or rescue squad worker in the State of North Carolina and who has reached age of 55 years is entitled to be paid a monthly amount of $135 from the Pension Fund. The member must have paid a total contribution of $2,400, or $10 per month over the twenty-year period, to qualify for benefits.

Fireman's Relief Fund: a tax levy of one half of one percent of the fire and lightning insurance premiums collected in a rated fire district is returned annually to the local fire department to safeguard firefighters from financial loss for various approved proposes.

North Carolina Response Rating of Fire Departments Program: the Commissioner shall establish and modify from time to time insurance public protection districts for all rural areas of

the State and for cities with populations of 100,000 or fewer, according to the most recent annual population estimates certified by the State Planning Officer. In establishing and modifying these districts, the Commissioner shall use standards at least equivalent to those used by the Insurance Services Office, Inc., or any successor organization.

Occupancy Vulnerability Assessment Profile: a collection of data elements designed to provide objective and quantitative recommendations by using commonly accepted measurement definitions.

Risk, Hazard, and Value Evaluation: a set of tools and methods to help the fire service and community leaders make objective, quantifiable decisions about their fire and emergency services needs.

Spreadsheet: software designed to organize data in rows and columns to perform calculations on the data. These rows and columns collectively are called a worksheet.

Tax Parcel: a plot or portion of land used by the Tax Assessor to assess property taxes.

Results

Critical hazards and vulnerabilities

The WFD, like any other community in the world, faces the risk of fire. The risk of fire is fluid from community to community due to population, building construction, lack of fire protection systems, and other related factors. The WFD contains 2,803 tax parcels, 1,679 of which have buildings valued from $300 to $2,994,903. The primary property use was residential; 1,665 of the buildings were classified as such. Building values for the residential properties ranged from $300 to $665,188. The remaining 14 buildings were classified as commercial, assembly, educational, and the fire station. These building values ranged from

$67,282 to $2,994,903. Each tax parcel containing at least one building was assigned an OVAP by the RHAVE modeling program. All 1,665 of the residential properties received an OVAP assessment of 16.22, which is considered a moderate risk by RHAVE. The sole educational property received an OVAP assessment of 36.87. The remaining properties - eight assemblies, four commercial, and the fire station – all received an OVAP assessment of 34.07. Properties with an OVAP score of 36.87 and 34.07 are also considered a moderate risk by RHAVE (Table 1). Table 2 contains the risk classification assignments after the properties receive their OVAP score.

Table 1

Waco Fire District OVAP Scores

Properties Use	Building Name	OVAP Scores	Risk Designation
Assembly	New Prospect Baptist Church	34.07	Moderate
Assembly	Buffalo Baptist Church	34.07	Moderate
Assembly	Washington Baptist Church	34.07	Moderate
Assembly	Mary's Grove Baptist Church	34.07	Moderate
Assembly	Macedonia Baptist Church	34.07	Moderate
Assembly	Waco Baptist Church	34.07	Moderate
Assembly	St. Paul United Methodist Church	34.07	Moderate
Assembly	Beulah United Methodist Church	34.07	Moderate
Commercial	Corral Western Store	34.07	Moderate
Commercial	Stony Point Restaurant	34.07	Moderate
Commercial	Sperling Farm Supply	34.07	Moderate
Commercial	Waco Feed Mill	34.07	Moderate
Educational	Washington Elem. School	36.87	Moderate
Fire Station	Waco Fire Department	34.07	Moderate
Residential	All Residential Properties (1665)	16.22	Moderate

Table 2

Risk Designation: Based On OVAP Scores

Risk Designation	OVAP Score
Maximum	60 or greater
Significant	40-59
Moderate	15-39
Low	15 or less

Other risks faced by the WFD are: mass-casualty, technological, hazardous materials, and natural disaster incidents. When these risks were applied to the hazard identification matrix, mass-casualty incidents constituted a possible risk affecting an estimated 50 people; technological incidents, a likely risk affecting an estimated 4,000 people; hazardous materials incidents, a possible risk affecting an estimated 2,000 people; and natural disaster incidents, a likely risk affecting an estimated 4,000 people (Table 3).

Table 3

Hazard Identification Matrix

Possible Hazards	Probability of Hazard	Affected Population
Mass Casualty	Possible	50
Technological	Likely	4000
Hazardous Materials	Possible	2000
Natural Disaster	Likely	4000

Vulnerability categorizes what may be exposed or at risk through evaluation of five factors which will affect the community: danger/destruction, economic, environmental, social, and political. The WFD has a moderate vulnerability to a mass-casualty incident, a high vulnerability to a technological incident, a moderate vulnerability to a hazardous materials incident, and a high vulnerability to an incident involving a natural disaster (Table 4).

Table 4

Vulnerability Assessment Matrix

		Hazards			
Rank:		Mass Casualty	Technological	Haz-Mat	Natural Disaster
5 to 8 = Low					
9 to 11 = Moderate					
12 to 15 = High					
Impact Rating	Danger/Destruction	2	3	2	3
	Economic	2	2	2	2
	Environmental	1	2	2	2
	Social	2	3	2	3
	Political Planning	2	2	2	2
	Total Vulnerability Rating	9	12	10	12

The risk rating matrix calculates the risk through multiplying the probability of occurrence by the vulnerability or probability by the danger. The WFD has a low risk rating for a mass-casualty incident, a high risk rating for a technological incident, a moderate risk rating for a hazardous materials incident, and a high risk rating for an incident involving a natural disaster (Table 5).

Table 5

Risk Rating Matrix

	Probability of Occurrence				Vulnerability				Risk
	Likely (3)	Possible (2)	Unlikely (1)		High (3)	Moderate (2)	Low (1)		Rating
Mass Casualty		2		**x**		2		=	4
Technological	3			**x**	3			=	9
Hazardous Materials		2		**x**	3			=	6
Natural Disaster	3			**x**	3			=	9
	Risk Ratings: 9 = High, 6 = Moderate, 4 = Low, and 1 = Very Low								

Current capabilities

Traditionally, the fire service uses the fire service model, which matches the required fire flow to the ability to apply water to the fire. In this model, various rules of thumb are used. The application rates of 500 gpm/engine, 50 gpm/firefighter on handlines, and 750 gpm/master stream appliances are generally accepted. The resources or capabilities used in the fire service model are engines, aerial apparatus, deluge sets, water supply systems, hose and nozzles, small hand tools, and firefighters. Resources should be properly trained and equipped to meet the critical risk identified in a risk assessment.

Resources should be trained to accepted standards nationally, regionally, and statewide. The North Carolina Firefighter Certification program was enacted in an effort to continually reduce the fire loss in the State of North Carolina. The North Carolina General Assembly requires the State Fire and Rescue Commission to establish voluntary minimum qualifications for all levels of fire and rescue service personnel. The standard for certifications is considered to be a minimum standard by the Fire and Rescue Commission. It is the intent of this voluntary program for fire departments to meet or exceed this standard. All of the voluntary certification

programs are based on National Fire Protection Association Professional Qualifications. WCVFD personnel must meet various certification requirements based on their responsibilities (Table 6).

Table 6

Certification Requirements

Areas of Certification	Required	Minimum Level	NFPA Standard
Fire Fighter	All Personnel	Level 1	1001
Haz-Mat Responder	All Personnel	Operations	472
Emergency Rescue Technician	All Personnel	Technician	1006
Fire Officer	All Officers	Level 1	1021
Driver Operator	All Drivers	Pumps	1002
Instructor	Training Staff	Level 2	1041

Apparatus should be equipped to meet standards such as ISO, NFPA, a regional authority and Occupational Safety and Health Administration (OSHA) or State OSHA. By classifying a community's ability to suppress fires, any of these standards will assist a community in evaluating their public fire protection services. The North Carolina Response Rating of Fire Departments Program provides an objective, statewide program that helps fire departments in planning and budgeting for facilities, equipment, and training. The North Carolina Response Rating of Fire Departments Program uses ISO's Fire Suppression Rating Schedule (FSRS) for evaluating fire department capabilities. Tables 7, 8, 9 and 10 include the resource capabilities for the WCVFD using Table 512.A-Pumper Equipment and Hose (Appendix C) and Table 544.A-Equipment for a Service Company (Appendix D) from the FSRS.

Table 7

Engine 303 and Equipment

Equipment and Hose	**Needed**	**Inventory**	**Inventory**
Booster Tank	300 gal.	1250 gal.	
Booster Hose(*)	200 feet	Extra 1 3/4 Pre-connect	
1-1/2" Hose	400 feet	900 feet	
2-1/2" or Larger Hose	1200 feet	1200 feet-5"	400 feet- 21/2"
Heavy Stream Appliance	1000 gpm	1000 gpm	
Distributing Nozzle	1	**None**	
Foam Nozzle	1	1	
Foam Supply	25 gal.	30 gal.	
Combination Nozzle 2-1/2"	2 @ 250 gpm	2	
Combination Nozzle 1-1/2"	2	5	
SCBA	4 @ 30 minute	12	
Spare SCBA Cylinders	4 @ 30 minute	6	
Salvage Covers	2 @ 12' x 18'	2 - 12' x 18'	2 - 12' x 14'
Hand-lights	2 @ 6v dry	6	
Hose Clamp	1	1	
Hydrant Hose Gate 2-1/2"	1	2	
Burst Hose Jacket 2-1/2"	1	**None**	
Gated Wye	1	1	
12' or 14' Roof Ladder	1	1-14'	
24' Ext. Ladder	1	1-24'	
* Extra pre-connect of 1 1/2 hose may be substituted for booster hose.			

Engine 303 receives an annual pumper service test in accordance with NFPA 1911. The duration for the service test is 20 minutes at 150 psi, 10 minutes at 200 psi, and 10 minutes at 250 psi, with an overload test for five minutes. All hose carried on Engine 303 undergoes an annual hose service test in accordance with NFPA 1962. All hose is tested at 250 psi for five minutes. Engine 303 needs a distributing nozzle and burst hose jacket to be a fully equipped engine company.

Table 8

Engine 302 and Equipment

Equipment and Hose	**Needed**	**Inventory**	**Inventory**
Booster Tank	300 gal.	1000 gal.	
Booster Hose (*)	200 feet	Extra 1 3/4 Pre-connect	
1-1/2" Hose	400 feet	900 feet	
2-1/2" or Larger Hose	1200 feet	1200 feet-5"	400 feet- 21/2"
Heavy Stream Appliance	1000 gpm	1000 gpm	
Distributing Nozzle	1	**None**	
Foam Nozzle	1	1	
Foam Supply	25 gal.	30 gal.	
Combination Nozzle 2-1/2"	2 @ 250 gpm	2	
Combination Nozzle 1-1/2"	2	5	
SCBA	4 @ 30 minute	12	
Spare SCBA Cylinders	4 @ 30 minute	6	
Salvage Covers	2 @ 12' x 18'	2 - 12' x 18'	2 - 12' x 14'
Hand-lights	2 @ 6v dry	6	
Hose Clamp	1	1	
Hydrant Hose Gate 2-1/2"	1	2	
Burst Hose Jacket 2-1/2"	1	**None**	
Gated Wye	1	1	
12' or 14' Roof Ladder	1	1-14'	
24' Ext. Ladder	1	1-24'	
* Extra pre-connect of 1 1/2 hose may be substituted for booster hose.			

Engine 302 also receives an annual pumper service test in accordance with NFPA 1911. The duration for this service test is 20 minutes at 150 psi, 10 minutes at 200 psi and 10 minutes at 250 psi, and an overload test for five minutes. All hose carried on Engine 302 undergoes an annual hose service test in accordance with NFPA 1962. All hose is tested at 250 psi for five minutes. Engine 302 needs a distributing nozzle and burst hose jacket to be a fully equipped engine company. This engine company also doubles as a service company and carries an

additional compliment of equipment (Table 9). Engine 302 needs eight (12’ x 18’) salvage covers to be a fully equipped service company.

Table 9

Engine 302 and Service Company Equipment

Equipment and Hose	**Needed**	**Inventory**	**Inventory**
Large Spray Nozzle	500 gpm	1	
Breathing Equipment	6 @ 30 min.	12	
Extra Cylinders	6 @ 30 min.	6	
Salvage Covers	10 @ 12' x 18'	2 - 12' x 18'	2 - 12' x 14'
Electric Generator	1 @ 2.5 kw	15 kw	
Portable Floodlights	3 @ 500 w	4	
Smoke Ejector	1	2	
Oxyacetylene Cutting Unit (*)	1	1	
Power Saw	1	2	
Hand-lights	4 @ 6v dry	6	
Pike Poles	2 @ 6'	2	
Pike Poles	2 @ 8'	2	
Pike Poles	2 @ 12'	2	
Ladders	1 @ 10' collapsible	1	
Ladders	1 @ 14' ext.	1	
* Hydraulic cutting tool may be substituted for oxyacetylene cutting unit.			

ISO provided classification details and improvement statements for a survey of the WCVFD, which was completed in December 11, 1989. The improvement notes specify that the WCVFD needs one fully equipped reserve pumper to receive maximum credit from the FSRS. During this last survey, the WCVFD received 0.02 points for having a reserve engine. The maximum credit for reserve engines is 1.00. The WCVFD currently has a reserve engine that carries minimum equipment (Table 10).

Table 10

Engine 305 (Reserve) and Equipment

Equipment and Hose	**Needed**	**Inventory**	**Inventory**
Booster Tank	300 gal.	1250 gal.	
Booster Hose(*)	200 feet	200 feet	
1-1/2" Hose	400 feet	500 feet	
2-1/2" or Larger Hose	1200 feet	**None**	
Heavy Stream Appliance	1000 gpm	**None**	
Distributing Nozzle	1	**None**	
Foam Nozzle	1	1	
Foam Supply	25 gal.	30 gal.	
Combination Nozzle 2-1/2"	2 @ 250 gpm	**None**	
Combination Nozzle 1-1/2"	2	2	
SCBA	4 @ 30 minute	**None**	
Spare SCBA Cylinders	4 @ 30 minute	**None**	
Salvage Covers	2 @ 12' x 18'	**None**	
Hand-lights	2 @ 6v dry	**None**	
Hose Clamp	1	**None**	
Hydrant Hose Gate 2-1/2"	1	**None**	
Burst Hose Jacket 2-1/2"	1	**None**	
Gated Wye	1	**None**	
12' or 14' Roof Ladder	1	1-14'	
24' Ext. Ladder	1	1-24'	
* Extra pre-connect of 1 1/2 hose may be substituted for booster hose.			

Engine 305 does not receive an annual pumper service test because it is equipped with a power take off pump with a rated capacity of 250 gpm and is not currently compliant with NFPA 1901. All hose carried on Engine 305 undergoes an annual hose service test in accordance with NFPA 1962. All hose is tested at 250 psi for five minutes. Engine 305 needs the following equipment to be a fully equipped engine company: 1200 feet of 2 ½ hose or larger, a heavy stream appliance, a distributing nozzle, two 2 ½ combination nozzles, four self contained

breathing apparatus (SCBA), four spare SCBA bottles, two 12’ x 18’ salvage covers, two hand-lights, a hose clamp, a 2 ½ hydrant hose gate, a burst hose jacket, and a gated wye.

Necessary Improvements

The shortage of a particular resource or capability critical to the outcome becomes a limiting factor in the suppression of fire and mitigation of incidents involving mass causalities, natural disasters, technological emergencies, or hazardous materials. To be effective during fire suppression, the limiting factor must be supplemented or replaced in sufficient time to match the energy output, or the burning material will be totally destroyed. The effectiveness of the fire service is extremely difficult to measure when responding to incidents involving mass causalities, natural disasters, technological emergencies, or hazardous materials. Fire service leaders must quickly complete a risk benefit analysis at these incidents and assign resources to tasks that will affect the largest number of victims in the shortest period of time. Limiting factors for any incident can be addressed in one of four basic avenues: mitigation, preparedness, response, and recovery.

Mitigation is defined as to make or become less intense, severe, or painful (Webster’s II, 1996). One form of mitigation would be to reduce the risk of fire, and thus in return reduce the required fire flow. Reducing the risk of fire might be accomplished through building and fire code provisions. Preparedness is defined as a state of sufficient preparation (Webster’s II, 1996). Acquiring and maintaining mutual aid agreements with neighboring departments would allow rapid access to additional resources. Response is defined as an act of responding (Webster’s II, 1996). Fire departments need to respond rapidly with enormous force to halt the incident while

the fire is in the smallest phase possible. Recovery is defined as to get back or regain; regain normal health, control, or balance (Webster's II, 1996). It is imperative that fire departments place companies back into service to prevent shortage of resources, especially during large-scale events. Limiting factors and the avenues to address them can easily be addressed through long-range planning.

Planning for the future needs of a fire department is the most important job of fire department managers. Without adequate planning, an administrator will find that he or she is handling one crisis after another and can never seem to get ahead. Fire department managers have often neglected long-range planning, but with budget constraints today, it is absolutely essential that this be done. The WCVFD is no exception to this rule and today has no long-range plan.

The U.S. Fire Administration has developed a master planning process, available to local communities, that outlines the steps a community may take to determine long-range goals for its fire department and explains how these goals can be achieved. The NFPA Technical Support Program will assist local government in developing a master planning process.

All departments, small or large, need to develop long-range plans. These plans need to be flexible and continually updated to reflect changes in the local community, as well as developments within the fire service. Excellent fire protection is technically available and undoubtedly can be provided with the resources of most communities. However, this level of

service may take years to obtain even with considerable public support. Every fire district must identify its fire protection benchmarks and formulate plans in order to meet them.

Discussion

The results indicate that the WCVFD has certain equipment deficiencies when the department's capabilities are compared against nationally recognized standards. The potential consequences of these shortcomings can be eliminated by developing and implementing a long-range plan for the acquisition, replacement, and upgrade of apparatus and equipment. First, what are the critical hazards and vulnerabilities faced by the Waco Fire District? "Fire risk and protection can be analyzed in several ways. One is to make a statistical summary of the structures and other risk in the planning area, including, for example, the distribution of building construction, occupancy classification, and fire flow required. Such a summary will give a picture of what there is to burn and how it will change with time in the future" (Burns, 1988, p. 91). The RHAVE modeling program was used to assign an OVAP assessment to every tax parcel with a building within the WFD. There were 1,665 residential properties, each of which received an OVAP assessment of 16.22, considered a moderate risk by RHAVE. The sole educational property received an OVAP assessment of 36.87, also considered a moderate risk by RHAVE. The 13 additional properties, including eight assemblies, four commercial properties, and one fire station, each received an OVAP assessment of 34.07, again a moderate risk. Burns cited examples of building construction, occupancy classification, and fire flow requirements as gauges for evaluating the potential risk for fire and needed fire protection (Burns, 1998).

RHAVE assessed a building factor of 10 for the residential properties in the WFD. The value of 10 was based on the following building factors: exposure separation, 1 (greater than 101'); type of construction, 5 (NFPA Type 5); height, 1 (1-2 stories); access, 2 (three sides), and square footage, 1 (0-7500 square feet). RHAVE assessed a life safety factor of 3 for the residential properties in the WFD, based on the following life safety factors: occupant load, 1 (0-10 occupants); occupant mobility, 0 (not a factor); and warning alarm, 2 (automatic local alarm). The value of 3 was RHAVE assessed a risk factor of 2.22 for the residential properties in the WFD (Raddigan, 2003). The value of 2.22 was based on the following risk factors: regulatory oversight, 0 (not a factor); human activity, 0 (not a factor); experience, 1.6666 (rare occurrence); capacity to control, .3333 (control within building of origin); hazard index, .6666 (common hazards for residential occupancies); and fire load, .3333 (light). RHAVE assessed a water demand factor of 1 for the residential properties in the WFD (Raddigan, 2003), based on the water demand factor of 1 (fire flow available). RHAVE assessed a property value of 1 for the residential properties in the WFD (Raddigan, 2003). The value of 1 was based on a property value factor of 1 (personal or family loss).

RHAVE assessed a building factor of 11 for the sole educational property in the WFD (Raddigan, 2003). The value of 11 was based on the following building factors: exposure separation, 1 (greater than 101'); type of construction, 4 (NFPA Type 2); height, 1 (1-2 stories); access, 2 (three sides); and square footage, 1 (0-7500 square feet). RHAVE assessed a life safety factor of 8 for the sole educational property in the WFD (Raddigan, 2003). The value of 8 was based on the following life safety factors: occupant load, 5 (over 300 occupants); occupant mobility, 1 (awake and ambulatory); and warning alarm, 2 (automatic local alarm). RHAVE

assessed a risk factor of 5.33 for the residential properties in the WFD (Raddigan, 2003). The value of 5.33 was based on the following risk factors: regulatory oversight, .3333 (mandatory compliance); human activity, .6666 (controlled access to authorized persons); experience, 1.6666 (rare occurrence); capacity to control, .3333 (control within building of origin); hazard index, 1 (mixed hazards); and fire load, .6666 (ordinary hazard). RHAVE assessed a water demand factor of 2 for the residential properties in the WFD (Raddigan, 2003). The value of 2 was based on the following water demand factor: water demand factor, 2 (fire flow not available). RHAVE assessed a property value of 1.4 for the residential properties in the WFD (Raddigan, 2003). The value of 1.4 was based on the following property value factor: property value factor, 1.4(major infrastructure loss to community).

RHAVE assessed a building factor of 9 for 13 additional properties, which include eight assemblies, four commercial, and one fire station (Raddigan, 2003). The value of 9 was based on the following building factors: exposure separation, 1 (greater than 101'); type of construction, 4 (NFPA Type 2); height, 1 (1-2 stories); access, 2 (three sides); and square footage, 1 (0-7500 square feet). RHAVE assessed a life safety factor of 8 for these 13 additional properties (Raddigan, 2003). The value of 8 was based on the following life safety factors: occupant load, 5 (over 300 occupants); occupant mobility, 1 (awake and ambulatory); and warning alarm, 2 (automatic local alarm). RHAVE assessed a risk factor of 5.33 for these 13 additional properties (Raddigan, 2003). The value of 5.33 was based on the following risk factors: regulatory oversight, .3333 (mandatory compliance); human activity, .6666 (controlled access to authorized persons); experience, 1.6666 (rare occurrence); capacity to control, .3333 (control within building of origin); hazard index, 1 (mixed hazards); fire load, .6666 (ordinary

hazard). RHAVE assessed a water demand factor of 2 for these 13 additional properties. The value of 2 was based on the following water demand factor: water demand factor, 2 (fire flow not available). RHAVE assessed a property value of 1.4 for these 13 additional properties (Raddigan, 2003). The value of 1.4 was based on the following property value factor: property value factor, 1.4 (major infrastructure loss to community).

The OVAP scores are assessed by the RHAVE modeling program. The OVAP score equals the building, life safety, and risk factor scores multiplied by the property value score (Raddigan, 2003). The building score includes following factors: exposure separation, type of construction, height, access, and square footage (Raddigan, 2003). The life safety score includes the following factors: occupant load, occupant mobility, and warning alarm (Raddigan, 2003). The risk score is the frequency/likelihood score multiplied by the consequence score (Raddigan, 2003). The frequency/likelihood score includes the following factors: regulatory oversight, human activity, and experience. The consequence score includes the following factors: capacity to control, hazard index, and fire load (Raddigan, 2003).

Properties within the WFD face a moderate risk of fire. As explained earlier, this risk is fluid from community to community due to population, building construction, lack of fire protection systems, and many other related factors (Carter, 1999). In addition to the risk of fire, the WFD also faces risk due to mass-casualty, technological, hazardous materials, and natural disaster incidents (NFA, 2001, p.4-7). The WFD has a moderate vulnerability to a mass-casualty incident, a high vulnerability to a technological incident, a moderate vulnerability to a hazardous materials incident, and a high vulnerability to an incident involving a natural disaster (NFA,

2003). An accepted way of rating the risk is calculated by multiplying probability of occurrence by the vulnerability or probability by the danger (NFA, 2003). The WFD has a low risk rating for a mass-casualty incident, a high risk rating for a technological incident, a moderate risk rating for a hazardous materials incident, and a high risk rating for an incident involving a natural disaster (NFA, 2003).

What are the current capabilities of the WCVFD to meet critical risks identified in the risk assessment? It does seem reasonable to say that not less than two fire suppression vehicles and a command officer should respond to any residential structure fire and that the number of personnel responding should be sufficient to carry out the tasks necessary to maintain the standard of care expected by the community (Loflin & Sanders, 2002). Commercial, industrial, and mercantile areas generally require an additional apparatus or more in response to the initial alarm. If properties with considerable life hazard are involved, additional resources should be considered for initial alarms (Wallace, 1998). The required fire fighting units should arrive on scene close enough in time after the initial alarm to operate as an effective fire-fighting unit following planned tactical procedures (Loflin & Sanders, 2002). The resources or capabilities used for fire suppression are engines, aerial apparatus, deluge sets, water supply systems, hose and nozzles, small hand tools, and firefighters (Wallace, 1998).

The North Carolina Insurance Commissioner authorized the standard known as the North Carolina Response Rating of Fire Departments Program. The result of this action was the development of requirements by which all rural fire departments will be certified with a 9S rating for insurance grading purposes. The "S" attached to the 9 classification designates that fire

department as having met the current, minimum standards for a rated class 9 or split 9 fire department in North Carolina. In order to meet and/or retain the 9S classification, each fire department must meet minimum requirements in each of the following areas: fire department organization, personnel, meetings and drills, alarms and communications, records and documents, apparatus, and buildings (Lohr, 1994). The WCVFD has exceeded these requirements since its inception in 1981 and is re-inspected biannually.

ISO recently provided classification details and improvement statements for their last inspection of the WFD and WCVFD. The WFD and WCVFD were last inspected on December 11, 1989. These classification details and improvement statements cover items that are reviewed in ISO's FSRS. The following areas need improvement to receive maximum credit:

- Receiving and Handling Fire Alarms -
  - Individual telephone numbers of each fire station should not be listed in the telephone directory (K. Gimeno, personal communication, August 01, 2003).
  - Five 911 operators are needed on duty at all times; we have 1.90 911 operator.
  - The radio alarm dispatch circuit should be monitored for integrity in accordance with NFPA standard 1211 (K. Gimeno, personal communication, August 01, 2003).
- Fire Department -
  - Engine 303 needs a distributing nozzle and a burst hose jacket to receive maximum credit (K. Gimeno, personal communication, August 01, 2003).
  - Engine 302 needs a distributing nozzle and a burst hose jacket to receive maximum credit (K. Gimeno, personal communication, August 01, 2003).

    - Verify whether Engine 302 can also double as a service company. It is currently equipped at a sufficient level to receive maximum credit for a service company (K. Gimeno, personal communication, August 01, 2003).
    - Engine 305 needs the following equipment to receive maximum credit: 1200 feet of 2 ½ hose or larger, a heavy stream appliance, a distributing nozzle, two 2 ½ combination nozzles, four self contained breathing apparatus (SCBA), four spare SCBA bottles, two 12' x 18' salvage covers, two hand-lights, a hose clamp, a 2 ½ hydrant hose gate, a burst hose jacket, and a gated wye (K. Gimeno, personal communication, August 01, 2003).
- Water Supply
    - The necessary fire flows should be available at each location in the district (K. Gimeno, personal communication, August 01, 2003).
    - All hydrants should be inspected twice a year. The inspection should include operation and a test at domestic pressure. Records should be kept of the inspections. Hydrants should be conspicuous, well located for the use by a pumper, and in good condition (K. Gimeno, personal communication, August 01, 2003).

The last question related to identification of the critical needs addressed in the risk assessment and solutions assuring that the current capabilities are expanded to meet discrepancies. A community - whether it is rural, suburban, or urban - considering its fire defense, must scrutinize the past and present while looking into the future to make predications and forecasts. A review of the past is called data analysis and depends upon sound record

keeping (Coleman & Grantino, 1998). Looking at the present is called evaluation, and requires the ability to examine a situation objectively. It is imperative that a planning process be followed to forecast and prepare the organization for future conditions. If done correctly, the planning process will yield an implemented plan to meet the future challenges of the community and the organization (Coleman & Grantino, 1998). A feedback process should be included in the planning process to ensure continued assessment of how well the plans are contributing to the successful achievement of goals and objectives of the community and organization. These plans should be quite specific, directed at one clearly defined goal, and operational over a relatively brief time period (Coleman & Grantino, 1998).

To summarize, the WFD faces a low risk to mass casualty incidents, moderate risk to fire and hazardous materials incidents, and high risk to technological and natural disaster incidents. The research has shown a qualitative measurement of the risk but has done little to assess a quantitative meaning to the low, moderate or high classifications. The research has implicated several short-term equipment deficiencies, which must be satisfied promptly to meet the minimum equipment requirements outlined by the FSRS. Long-range planning involves decisions that will have a major effect on reaching goals far in the future. To ensure that the WCVFD meets the critical needs identified in the risk assessment, the organization should analyze the past, evaluate the present, and develop a strategic plan which will serve as a road map to the future (Compton & Granito, 2002).

Recommendations

Based upon this research, the following recommendations are made:

1. The WCVFD should develop and implement a long-range plan for the acquisition, replacement, and upgrade of apparatus and equipment. Planning is carried out in three phases: preparation, planning, and implementation. The primary planning steps are as follows: decide whether to undertake planning, become organized, collect and analyze data to identify problems, define goals and objectives, define alternative options, compare the alternatives and select most appropriate choice, prepare the documented plan, implement the plan, evaluate the plan periodically, and update and/or modify as needed.

2. The WFD should identify an adequate level of fire protection in the district. Identifying an acceptable level of fire protection will allow the WCVFD to develop a long-range plan for the acquisition, replacement, and upgrade of apparatus and equipment. Adequate fire protection will satisfy the everyday needs of the district and most major contingencies that can be expected in the future. Optimal fire protection is the minimal protection needed just to satisfy the everyday requirements. Maximum fire protection would definitely satisfy the day-to-day requirements and exceed anticipated future contingencies. However, maximal fire protection is usually more expensive than most communities can afford.

3. The WCVFD should begin making plans to replace Reserve Engine 305 and purchase the small equipment deficiencies identified by this research. The purchase and replacement of the engine company should work in concert with the future long-range plan. The need for this equipment and apparatus, which has been proven within this research, should become apparent in the long-range plan.

4. The WCVFD should solidify working relationships with neighboring departments and communities to ensure that additional equipment and manpower needs are available through automatic and/or mutual aid for unanticipated contingencies. This would include atypical incidents involving mass casualties, technological, hazardous materials, and natural disasters.

5. The department should prepare for and request an inspection and rating survey from the North Carolina Response Rating of Fire Departments Program. This program takes the place of the ISO Response Rating and was given authority through NC House Bill 1696 on July 22, 2000. Preparation for the inspection will facilitate the data gathering for the planning process, and the inspection process will provide an outside viewpoint into how resources are distributed within the fire district.

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Appendix A -- Hazard Identification, Vulnerability Assessment, & Risk Rating Matrixes

Hazard Identification

Hazard identification is the step-by-step process developed to identify hazards (Table 4-3)

Step 1: Identify the hazards.

The main categories of hazards to consider are

- Natural hazards such as earthquake, flood, wildfire, or epidemic.
- Technological hazards such as civil disorder, power failure, or urban fire/conflagration.
- National security hazards such as nuclear attack, sabotage, or terrorism.
- Target hazards such as arsenal, prisons, pipelines, or hospitals.

Step 2: What is the probability this hazard will occur?

- Low hazard is unlikely to occur or to affect the community.
- Moderate hazard is somewhat likely to occur or to affect the community.
- High hazard is likely to occur or recur and to affect the community.

Step 3: What is your best estimate of the population that would be affected?

Vulnerability

Vulnerability identifies what may be exposed or at risk through evaluation of five factors that affect the community:

- Danger / destruction
- Economic
- Environmental
- Social; and
- Political

Note. Information from *Executive analysis of fire service operations in emergency management student manual.* (NFA, 2001). Emmitsburg, MD. (pp. 4-18 -- 4-29)

Vulnerability Assessment

Step 1: For each hazard identified in the hazard identification process, consider each of the five factors (Table 4-4).

Factor 1: Danger/Destruction.

- Life risk, e.g., fatalities and serious injuries, can range from very high to very low. They must be known.

- Ratings

    - Few if any fatalities; injuries handled by normal emergency medical facilities. Structural damage limited to one city block or less--l point.

    - Some fatalities, injuries triaged but handled by community facilities. Damage more extensive but infrastructure (lifelines) intact--2 points.

    - Numerous fatalities, mass casualties overwhelm system, infrastructure compromised for more than 24 hours--3 points.

- Destruction of physical elements of the community, community segments, individual properties (e.g., in a fire, the whole community, such as in Baltimore, San Francisco, Chicago; or a segment of the community: Topanga Canyon in Los Angeles; Chelsea, MA, rag district; or Oakland).Utilities (lifeline integrity) such as power, transportation, and communications are top priority considerations to maintain/restore a community.

Factor 2: Economic.

- In analyzing the economics, look at incident control costs; loss costs; and sum of costs plus loss. This is the economic measure of the consequence of an event.

- Ratings.

    - Will not exceed community fiscal limitations and effect is temporary--l point.

    - Will either exceed community fiscal limitations, or effect is permanent--2 points.

    - Will both exceed community fiscal limits and effect is permanent--3 points.

Note. Information from *Executive analysis of fire service operations in emergency management student manual.* (NFA, 2001). Emmitsburg, MD. (pp. 4-18 -- 4-29)

- The cost of responding to the emergency causes the fiscal limitation of the community to be exceeded and the community can be bankrupted.

- The economic impact is both short term and long term.

    - Immediate duration of incident, effect is temporary.

    - Duration of rebuilding phase, effect is permanent.

Factor 3: Environmental impacts.

Water/Food supplies can be compromised.

- Wilderness values may be affected.

- Limitations on the use of equipment due to environmental values.

- Rare and endangered plants and wildlife, scenic values, and historical values must be respected. It is the law.

- Permanent destruction, long-term recovery is greater than one year, short-term recovery less than one year.

- Ratings.

    - Impact is short term/reversible with no impact on public health-I point.

    - Impact is long term, or affects public health--2 points.

    - Impact is long term and affects public health or is irreversible--3 points.

Factor 4: Social aspects.

- Emergency personnel safety and the safety and well-being of their families.

- Public safety in all its aspects.

- Historical values deserve special consideration.

Note. Information from *Executive analysis of fire service operations in emergency management student manual.* (NFA, 2001). Emmitsburg, MD. (pp. 4-18 -- 4-29)

- Evacuation/Shelter for victims.
- Recreation values, while possibly frivolous, add to the social fabric of a community.
.
- Ratings.
    - Minor social upheaval limited to a few families--I point.
    - Shelters established, some historical/cultural values affected--2 points.
    - Emergency personnel must consider their own families; mass evacuations; shelter requirement exceeds community capability--3 points.

Factor 5: Political considerations-planning level.

- Can all of the planning take place at the local level (e.g., major single-structure fire)?
- Is some regional/statewide planning involved (e.g., interface fire not too great in size)?
- Is national planning involved? Will FEMA be involved when it's over (e.g._ tunnel or Topanga fires)?
- Ratings.
    - The planning, response, and recovery are all at the local level--I point.
    - Planning, response, and recovery are at the regional or State level--2 points.
    - Planning, response, and recovery are at the Federal level--3 points.

Step 2: Score the vulnerability from this hazard.

- Total the points.
- If score is 5 to 8 the vulnerability is low; 8 to 11 the vulnerability is moderate; 12 to 15 the vulnerability is high.
- Consider that if the danger/destruction score is 3 the vulnerability ought to be moderate or high, regardless of the computed score.

Note. Information from *Executive analysis of fire service operations in emergency management student manual.* (NFA, 2001). Emmitsburg, MD. (pp. 4-18 -- 4-29)

Step 3: Reconsider priority of each hazard based on vulnerability.

- Consider that the decisions that affect a community's vulnerability to hazards are made daily by individuals, businesses, community leaders, and emergency managers.
- These decisions have a profound effect on vulnerability of the community.

Rating the Risks

Risk assessment in any modem community is holistic, multidisciplinary; community oriented, and is mission oriented. Risk assessment is a useful tool for determining priorities.These priorities can help the fire department, as well as the community; focus its energy where it will be most effective. Determining the priorities is a step-by-step process.

- Step 1: List the hazards from the hazard identification process on the Risk Rating Matrix (Table 4-5).
- Step 2: In the appropriate box, mark the probability of occurrence, also from the hazard identification process.
- Step 3: Mark the vulnerability for each hazard in the appropriate box.
- Step 4: Determine the risk rating by multiplying probability of occurrence by the vulnerability (probability x danger).
- Step 5: Classify the hazards facing your community into four groups:

Score	Rating
9	High
6	Moderate
4	Low
1	Very Low

Note. Information from *Executive analysis of fire service operations in emergency management student manual.* (NFA, 2001). Emmitsburg, MD. (pp. 4-18 -- 4-29)

Determining the final category is done in a similar fashion. After hazard identification, and again after the vulnerability assessment, each hazard was given a Category 1 or 2 classification. Multiply those two classifications; this product is the risk category score. Any risk that scores a 1 is definitely a Category 1. Any risk that scores a 4 is definitely a Category 4. Any risk that scores a 2 could fall in either Category 1 or 2. You will have to judge, based on total knowledge of the situation, into which category to put this risk. Based on these scores and on the situation in your community, you now can focus your planning where the need is greatest.

Note. Information from *Executive analysis of fire service operations in emergency management student manual*. (NFA, 2001). Emmitsburg, MD. (pp. 4-18 -- 4-29)

Table 4-3 Hazard Identification Matrix

List 5 possible hazards.	What is the probability this hazard will occur?	What is your best estimate of the total population that could be affected seriously by this hazard? Consider peak population if appropriate.
1.	1. ❒ unlikely 2. ❒ possible 3. ❒ likely	_____ Enter a number
2.	1. ❒ unlikely 2. ❒ possible 3. ❒ likely	_____ Enter a number
3.	1. ❒ unlikely 2. ❒ possible 3. ❒ likely	_____ Enter a number
4.	1. ❒ unlikely 2. ❒ possible 3. ❒ likely	_____ Enter a number
5.	1. ❒ unlikely 2. ❒ possible 3. ❒ likely	_____ Enter a number

Note. Information from *Executive analysis of fire service operations in emergency management student manual.* (NFA, 2001). Emmitsburg, MD. (pp. 4-18 -- 4-29)

Table 4-4 Vulnerability Assessment Matrix

HAZARDS					
Impact Rating					
Danger/Destruction (High=3; Moderate=2; Low=1)					
Economic (Permanent=3; Temporary=2; Immediate short term=1)					
Environmental (High=3; Moderate=2; Low=1)					
Social (High=3; Moderate=2; Low=1)					
Political Planning Level (Local=1; Regional=2; Federal=3)					
Total Vulnerability Rating (Sum of all factors)					
RANK					
5 to 8 LOW					
9 to 11 MODERATE					
12 to 15 HIGH					

Note. Information from *Executive analysis of fire service operations in emergency management student manual.* (NFA, 2001). Emmitsburg, MD. (pp. 4-18 -- 4-29)

Table 4-5 Risk Rating Matrix

	Probability of Occurrence			Vulnerability			Risk
5 Hazards	Likely (3)	Possible (2)	Unlikely (1)	High (3)	Moderate (2)	Low (1)	Rating (probability x vulnerability)

Note. Information from *Executive analysis of fire service operations in emergency management student manual.* (NFA, 2001). Emmitsburg, MD. (pp. 4-18 -- 4-29)

Appendix B -- Comprehensive FEMA Hazard List

	Could this hazard affect your jurisdiction?	Is this hazard a significant threat to your jurisdiction?	About how often does this hazard occur in your jurisdiction?	What is your best estimate of the population that could be affected seriously by this hazard?
NATURAL HAZARDS				
Avalanche				
Drought				
Earthquake				
Flood				
Hurricane/Tropical storm				
Landshift / Erosion / Earthslide				
Tornado				
Tsunami				
Volcano				
Wildfire				
Winter storm (severe)				
Epidemic				
High wind				
TECHNOLOGICAL				
Civil Disorder				
Dam Failure				
Haz Mat (stationary)				
Haz Mat (transportation)				
Nuclear Facility				
Power Failure				

Note. Information from *Executive analysis of fire service operations in emergency management student manual.* (NFA, 2001). Emmitsburg, MD. (pp. 4-16 -- 4-17).

Subsidence				
Transportation Accident				
Urban Fire/Conflagration				
Air Disaster				
Rail Disaster				
Other				
NATIONAL SECURITY HAZARD				
Attack				
Conventional				
Nuclear				
Chemical/Biological				
Sabotage				
Terrorism				
Nuclear				
Chemical/Biological				
Public Utility Disruption/Contamination-				
TARGET HAZARDS				
Agricultural hazard areas				
Blight				
Infestation				
Severe weather				
Arsenals				
Armories, storage centers				
Military manufacturing centers				
Civil disorder-prone areas				
Campuses				

Note. Information from *Executive analysis of fire service operations in emergency management student manual.* (NFA, 2001). Emmitsburg, MD. (pp. 4-16 -- 4-17).

Prisons				
Special population concentrations				
Terrorist targets				
Communication systems and networks				
Dam				
Drought-prone areas				
Earthquake fault and risk zones				
Floodplains				
Hazardous waste sites				
Chemical / Biological				
Nuclear/Radiological				
Institutions				
Hospitals and nursing homes				
Mental health facilities				
Group homes for handicapped				
Prisons and jails				
Halfway houses				
Schools and dormitories				
Manufacturing and agricultural plants and storage facilities				
Chemical/Allied				
Coal, uranium, and other mines				
Gas/Oil				
Hydroelectric/Electric				
Nuclear				
Other				
Military bases				

Note. Information from *Executive analysis of fire service operations in emergency management student manual.* (NFA, 2001). Emmitsburg, MD. (pp. 4-16 -- 4-17).

Missile sites				
Pipelines				
Reservoirs and dams				
Transportation systems				
Airports				
Commercial				
Military				
Private				
Highways				
County/Local high-density or hazardous route areas				
Federal				
Interstate				
State				
Transportation depots and garages				
Waterways				
Coastal				
Inland rivers, lakes, canals				
Railroads				
Passenger service				
Freight service				

Note. Information from *Executive analysis of fire service operations in emergency management student manual.* (NFA, 2001). Emmitsburg, MD. (pp. 4-16 -- 4-17).

Appendix C -- Table 512.A Pumper Equipment and Hose

Pumper Equipment (Table 512.A) from FSRS		
FSRS Item	Needed	Equivalency
Booster Tank	300 gal.	300 gal. or larger
Booster Hose	200 feet	1-1/2" or 1-3/4" Preconnected Hose
1-1/2" Hose	400 feet	1-3/4" or 2" Hose
2-1/2" or Larger Hose	1200 feet	First 400 feet — 2", 2-1/2", or 3" Remaining 800 feet — 2-1/2" or larger hose
Heavy Stream Appliance	1000 gpm	Not needed when Basic Fire Flow is less than 1500 gpm. Mounted, elevated, or portable is acceptable.
Distributing Nozzle	1	1-1/2" or 2-1/2" piercing nozzle, 1-1/2" distributing nozzle
Foam Nozzle	1	1-1/2" or 2-1/2" eductor is acceptable. Built-in proportioning or CAFS system is acceptable.
Foam Supply	25 gal.	Any foam listed in *UL Fire Protection Equipment Directory* as foam liquid concentrate (GFGV). Class A foam is also acceptable. Wetting agents, emulsifiers, and surfactants are *not* acceptable for credit as foam.
Combination Nozzle 2-1/2"	2 @ 250 gpm	2 @ 200 gpm or 1-3/4" combination vari-nozzle tip with 2-1/2" adapter
Combination Nozzle 1-1/2"	2	1-3/4" combination nozzle with 1-1/2" coupling
SCBA	4 @ 30 minute	4 @ 30 minute or longer duration
Spare SCBA Cylinders	4 @ 30 minute	4 @ 30 minute or longer duration. Portable air cascade or air filling station is *not* equivalent.
Salvage Covers	2 @ 12' x 18'	2 @ 12' x 14' canvas or rip-stop plastic is acceptable.
Handlights	2 @ 4v wet or 6v dry	Rechargeable handlight 6v
Hose Clamp	1	2-1/2", 3", or LDH hose clamp is acceptable.
Hydrant Hose Gate 2-1/2"	1	4-way valve is acceptable; LDH manifold; trimese
Burst Hose	1	2-1/2", 3", or LDH hose clamp

Note. Information from *Fire suppression rating schedule*. (ISO, 2003). Jersey City, NJ. (p. 19)

Jacket 2-1/2"		
Gated Wye 2-1/2" x 1-1/2" x 1-1/2"	1	Water Thief or 2-1/2" gated wye w/1-1/2" reducers
12' or 14' Roof Ladder	1	16' Roof Ladder
24' Ext. Ladder	1	28', 30', or 35' Ext. Ladder

Note. Information from *Fire suppression rating schedule*. (ISO, 2003). Jersey City, NJ. (p. 19)

Appendix D -- Table 544.A Equipment for a Service Company

Ladder Equipment (Table 544.A) from FSRS		
FSRS Item	Needed	Equivalency
Elevated Stream Device	1000 gpm	1250, 1500 gpm
Large Spray Nozzle	500 gpm	500 gpm (may be carried on pumper)
Breathing Equipment	6 @ 30 min.	6 @ 30 min. or longer duration
Extra Cylinders	6 @ 30 min.	6 @ 30 min. or longer duration
Salvage Covers	10 @ 12' x 18'	10 @ 12' x 18' canvas or rip-stop plastic
Electric Generator	1 @ 2.5 kw	PTO driven inverter — capacity prorated Mini-generator floodlight — each 500w prorated Mini-generator ventilation fan — 1,000w prorated
Portable Floodlights	3 @ 500 w	Tripod floodlight or mini-generator floodlight
Smoke Ejector	1	Positive pressure ventilation (ppv) fan Mini-generator ventilation (ppv) fan Thermal imaging device
Oxyacetylene Cutting Unit	1	Hydraulic or pneumatic cutting tool or plasma cutting tool Circular saw with composite blade Thermal imaging device
Power Saw	1	Chain saw with carbide tip cutting blades Thermal imaging device
Handlights	4 @ 4v wet or 4 @ 6v dry	Rechargeable handlight 6v
Pike Poles	2 @ 6' 2 @ 8' 2 @ 12'	6 @ various lengths (pike poles, plaster hooks, or similar hooks)
Ladders	1 @ 10' collapsible 1 @ 14' ext. 1 @ 20' roof 1 @ 28' ext. 1 @ 40' ext.	1 @ 10' folding 1 @ 14' combination 1 @ 16' roof (additional) 1 @ 24' ext. 1 @ 35' ext. (additional)

Note. Information from *Fire suppression rating schedule*. (ISO, 2003). Jersey City, NJ. (p. 25)