Running head: HAZARD AND VULNERABILITY ASSESSMENT FOR THE CITY OF

Hazard and Vulnerability Assessment for the City of Margate

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Certification Statement

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

Signed: _____

Abstract

In order for a community to respond effectively to an emergency incident, it must have an all hazard emergency plan. All hazards that have the possibility to affect the local area must be considered and components added to the emergency plan. The problem is that Margate Fire Rescue has not completed an assessment of the target hazards within its jurisdiction, to include in an emergency response plan providing a coordinated fire department response during a large scale emergency incident.

The purpose of this Applied Research Project (ARP) is to identify the infrastructure, transportation, life safety and major target hazards that would have the greatest impact during a large scale emergency incident within the city of Margate, Florida. This information will be added to the Margate Fire Rescue Emergency Response Plan.

The action research method will be used to answer the following questions: (a) What are the federal, state and county criteria for and what hazard and vulnerability information is contained within the national, state and county emergency response plans? (b) What are the potential infrastructure, transportation, life safety and major target hazards that would have the greatest impact on the city of Margate during a large scale emergency incident? (c) Based on collected data identifying potential

hazards, what additional hazards should be included in the City of Margate Emergency Response Plan?

At the completion of this research, a hazard and vulnerability assessment form was developed. Additionally hazards and target occupancies were identified within the response area of Margate Fire Rescue. Recommendations included using the created form on an annual basis to update the existing emergency plan.

Table of Contents

Table of Tables

Appendices

Hazard and Vulnerability Assessment for the City of Margate

Introduction

Community emergency response by public safety responders is generally guided by some predetermined response standards. The preplanned response standards cover routine emergencies. However, problems can arise when a large emergency incident threatens or occurs, requiring a large-scale commitment of local, state and possible federal resources. If local agencies are not prepared to commit the appropriate resources, a lack of coordinated response could result in a less than desirable outcome. To properly plan for an appropriate response, the local community must understand what hazards threaten the area.

The problem is that Margate Fire Rescue has not completed an assessment of the target hazards within its jurisdiction, to include in an emergency response plan providing a coordinated fire department response during a large scale emergency incident.

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To answer these questions, various documents and existing emergency plans were analyzed. The analysis provided guidance as to what hazard and vulnerability analysis programs already existed in the plans and what should be included in the Margate Fire Rescue (MFR) emergency plan. Then the existing MFR emergency plan was compared with the results to define what improvements could be made.

Following this, various documents, literature, and hazard tracking agencies were consulted to provide possible hazard data that could be incorporated in a hazard and vulnerability analysis.

Background and Significance

The city of Margate is located in the southeast tip of Florida and lies within Broward County. In the 2000 census, the total population was 59,909 with 55.4% of that population being between 20 and 64 years of age (U.S. Census Bureau, 2000). Margate Fire Rescue (MFR) provides fire, emergency medical services (EMS), fire prevention and education, and disaster response for the city of Margate. Additionally, MFR provides fire, EMS, and disaster response for the city of Coconut Creek. According to the 2000 census, the city of Coconut Creek had a total population of 43,566 with 54.3% of that population being between 20 and 64 years of age (U.S. Census Bureau).

Located within the response area of MFR are several major transportation corridors including the Florida Turnpike, State Road 869, and State Road 7. Several healthcare facilities are also located in the response area such as one large hospital and numerous smaller assisted living facilities. In addition to the natural gas distribution line located along the Florida Turnpike, there is a propane distribution facility within the city of Margate. Additionally, other facilities exist which could be affected by potential hazards.

To respond to incidents, MFR staffs three engine companies, one ladder/quint company, five EMS units and one battalion chief each day. Supplementing this staff is a fire prevention division

which conducts annual inspections and other hazard identification activities.

Margate Fire Rescue has been providing fire, EMS and disaster response to the city of Margate since the early 1970's and contracting services to the city of Coconut Creek since 2000. According to the mission statement, MFR is dedicated to "providing the best fire, EMS and fire prevention service to the residents…" (Margate Fire Rescue, n.d.).

In recent times, several natural and man-made emergency incidents have occurred in the MFR response area which should have shown the need for a hazard analysis. The most expensive was in October 25, 2005, when Hurricane Wilma crossed the area at Category 2 level. It caused $12.8 million in damage to the city of Margate alone (G. Gargano, personal communication, March 15, 2010). Following the response to this incident, several deficiencies were noted in the MFR emergency response plan (ERP) and changes were made and included in the new Hurricane Operations Plan.

Another incident occurred on October 5, 2005, when three teenagers and two MFR personnel were struck by lightning, resulting in the death of one of the teenagers and injuries to the remaining teenagers and the MFR personnel. The strike occurred while the MFR personnel were out of their vehicle and standing coverage for a high school football game. Although this

incident was localized, it affected the community because of the injuries and deaths involved. Following the incident, no changes were made to any existing policies, procedures or guidelines.

By creating and completing a hazard assessment of the city of Margate, MFR will come into agreement with two of the three operational objectives of the United States Fire Administration. These are to "improve local planning and preparedness," and to "improve the fire and emergency services' capability for response to and recovery from all hazards" (U.S. Fire Administration, n.d.). In order to prepare a proper response, Margate Fire Rescue must know what hazards potentially threaten the city, and to what degree these hazards will affect the city. The preparation that ensues will allow the current Margate Emergency Response Plan (ERP) to be updated to include potential hazards, some of which have already affected the area.

According to the student manual for the Executive Analysis of Fire Service Operations in Emergency Management (EAFSOEM), communities such as the city of Margate are "unaware of the risks they face and are unprepared to respond to them" (U.S. Fire Administration, 2009, p. SM 4-3). Margate Fire Rescue has shown awareness of potential disaster occurrence and the need to plan for it by updating its hurricane operations plan, but has not conducted a risk assessment to identify all potential risks even when two employees were directly affected by one such

hazard. The risk assessment, when conducted, can be considered "a critical first step in any proactive hazard management plan" (U.S. Fire Administration, p. SM 4-3).

Literature Review

The purpose of this literature review is to gather and review current materials regarding the questions posed for this applied research project. The literature review section was completed by conducting research and reviewing journal articles, periodicals, books, codes and standards, and web sources.

Emergency preparedness is one of the primary responsibilities of the fire service because of its response to the incidents. "Some of the greatest value delivered by the US fire service comes in activities that prevent fires and other emergencies from occurring, or ones that moderate their severity when they do occur" (U.S. Fire Administration, 2006, p. 51). While fire prevention activities were the main focus of the material reviewed, emergency management and preparedness, including hazard analysis, is included in this statement. The more hazards the local authorities identify and plan for before an incident occurs the better prepared they are to handle the results of a disaster. (U.S. Fire Administration)

Disaster preparedness involves all the activities necessary to plan a response during a disaster incident. Disaster "preparedness is important to the overall emergency management

cycle because it provides for the readiness and testing of all actions and plans before the actual application occurs in response to a real event or disaster" (Bullock et al., 2006, p. 279). The act of preparedness encompasses all activities, programs and systems that are in place prior to the incident occurring that enable a more effective and coordinated response following an incident.

Community risk assessment is just one area of the preparedness activities that can be done prior to a disaster event. The risk assessment is oriented to identifying all those hazards that may affect a community, in order to create an all-hazards response plan. To achieve this, community risk assessment should be "holistic, multidisciplinary, and community oriented" (U.S. Fire Administration, 2009, p. SM4-4). Hazards come in three forms: natural, human or technological caused, and terrorism related. The response to these incidents may start at the local level and expand to involve state or national elements. These possible responses have to be recognized prior to the incident to ensure the proper response. The State of Florida, for instance, recognizes four levels of ascending disaster response services from the local, county, state and federal levels (Florida Fire Chiefs' Association, p. 7)

The National Fire Protection Association (NFPA) is a consensus bureau that develops standards that can be used to

prevent, prepare for, respond to and mitigate emergency incidents. The purpose of the NFPA 1600 code is to establish a guideline for emergency managers to "assess current [response] programs, or to develop, implement and maintain a program" (National Fire Protection Association, 2000, p. 4) to enable them to respond to disaster incidents. General recommendations on the emergency management programs include compliance with "all applicable legislation, regulations, and industry codes of practice" (National Fire Protection Association, p. 5).

Other NFPA recommendations on hazard assessments include identifying local hazards and their potential effects on the local population to lessen the effects when they do occur. The hazard assessment should include an impact analysis to determine "the potential for detrimental impacts of the hazards" (National Fire Protection Association, 2000, p. 5) on the surrounding areas.

In addition to the NFPA, the International Association of Fire Chiefs (IAFC) has recognized the need to plan for hazards prior to their occurrence.

The International Association of Fire Chiefs developed model procedures or guidelines to enable fire departments to minimize the risk to personnel, and to protect the community and critical infrastructures before, during, and after a storm. Major emphasis is placed on protecting the responder and

citizens' lives in the local area. In the pre-season preparation section of the guidelines is the recommendation to update the target occupancies list for the local community. These targets are further identified as occupancies "with a high probability of trapped victims or a structure that stores a large amount of hazardous materials, or is susceptible to structural failure" (International Association of Fire Chiefs, 2008, p. 4).

Other relevant NFPA recommendations task several types of occupancies with completing annual emergency action plans that could be used to conduct hazard assessment on their property. NFPA 1 specifically tasks facilities such as "high-rise buildings, health care, ambulatory health care, residential board and care, assembly, day-care centers, special amusement buildings, detention and correctional occupancies, underground and windowless structures, facilities storing or handling [hazardous] materials" (National Fire Protection Association, 2008, 10.9.1) with developing and using emergency plans.

Once completed, these plans would be required to be submitted to the local fire authority for review and copies available on site to enable the occupants and workers to understand their role during an emergency (National Fire Protection Association, 2008, 10.9.2.1). In addition to the annual update, these emergency plans are required to be updated whenever major changes occur "in the occupancy or physical

arrangement of the building or fire protection systems or features" (National Fire Protection Association, 10.9.9.2.2).

NFPA 101 is more specific in the recommendations for emergency plans. For example, the section pertaining to residential board and care facilities requires all supervisory personnel to be provided with written copies of the emergency plans, including identifying areas of refuge as well as evacuation plans for getting the residents to that area (National Fire Protection Association, 2008, 32.7.1.1).

In addition to the NFPA recommendations criteria for an Emergency Action Plan (EAP), recommendations are also set forth in the Occupational Safety and Health Administration (OSHA) Regulations Standard 29 CFR-1910.38. Within this standard is the requirement that the emergency plan must be communicated to all employees when they are initially hired, when the tasks with which they are assigned change, and when the EAP itself changes. The information contained in the plan includes any procedures for evacuation and exit paths or assignments in the event of an emergency. There must also be a system in place to ensure that all employees are accounted for, once they are evacuated.

Additionally, the complex EAP must contain "procedures to be followed by employees who remain to operate critical plant operations" (U.S. Department of Labor/Occupational Safety and Health Administration, n.d.). This would also include an

accounting system for all employees who are required to perform any rescue duties.

The Federal Emergency Management Association (FEMA) developed the National Response Framework (NRF) to coordinate responses to natural and man-made disasters. It assists local agencies with a best practices approach to a coordinated incident management. Under the planning component of the framework, incident planning is a critical element of the emergency management and response. According to this section, all "State, tribal, and local governments have responsibility to develop detailed, robust all-hazards plans and hazard- or incident specific annexes with supporting procedures and protocols to address their locally identified hazards and risks" (Department of Homeland Security, 2008, p. 74).

To accomplish this, a Hazard Identification and Risk Assessment (HIRA) program is incorporated to identify local risks. Identifying the hazards and assessing their involved risks will serve as a "foundation for planning, resource management, capability development, public education, and training and exercises" (Department of Homeland Security, 2008, p.74).

The HIRA ensures that the local authority has an appropriate response planned which enables coordinated state and federal response assistance should an incident occur.

Local hazards that jurisdictions face need to be identified before a disaster of some sort occurs. Researching, identifying and analyzing the general hazards and risks that an area may face can add specificity to the area's emergency plan. Specifically "if hazards and threats are viewed as problems and operational plans are the solution, then hazard and threat identification and analysis are key steps in the planning process" (FEMA/DHS, 2009, p.55).

Information that is gathered in the hazard assessment process must be placed in a usable format so that planners can adequately develop possible response scenarios. While the types of risks will vary, the hazard analysis parameters should be similar in nature. The analysis contains several elements necessary to enable the potential risks to be addressed. These include probability of occurrence, frequency of occurrence, magnitude, intensity, time available to act, location of event, potential area affected, speed of onset and duration of impact (FEMA/DHS, 2009, p. 57).

Risk assessment involves determining the risks of an area and categorizing the associated threats and hazards. An important facet of the risk assessment is the identification of the risks and determination of vulnerability to ensure resilience of the local, state and federal emergency responses as well as the affected population. "Resilience is the key since

it refers to our coping capacity to absorb events, adapt, and respond to and recover from its effects" (U.S. Department of Homeland Security, 2007, p. 23).

Emergency plans incorporate a threat analysis and risk assessment that is current and accurate to assist with adequate planning. They also help ensure that the proper resources are deployed to where they are needed in the correct quantities to precipitate recovery from any natural or man-made disaster (U.S. Department of Homeland Security, 2007, p. 31).

Broward Emergency Management Association in Broward County, Florida is in the process of developing municipal emergency planning criteria which will provide all the municipalities in the county with guidance and assistance in compliance with the National Incident Management System (NIMS). This will ensure effective coordination following a local disaster within the county. Additional guidance is included to ensure that all local governmental emergency plans and programs are consistent throughout the county. According to the criteria, all municipal preparedness programs should contain certain components to allow the various agencies to respond appropriately during a disaster. The initial component addresses the planning and programming standards which identify, among other things, the criteria that each municipality should use or adopt to "ensure that the jurisdiction's characteristics and capabilities are adequately

evaluated periodically and their influence on the planning and programming fully considered" (Emergency Response Planning & Management, 2005, 2.6). According to the component the key facilities that need to be analyzed for their level of risk include hazardous materials facilities, transportation corridors, and prominent potential targets. Also included with these are facilities with a high percentage of vulnerable populations (Emergency Response Planning & Management, 2005, 2.6.5-6).

Additionally, the planning criteria require the municipalities to take an all-hazards approach when conducting a risk analysis of its jurisdiction. They should include all natural, man-made and technological hazards which could affect the area. (Emergency Response Planning & Management, 2005, 3.2)

Several types of hazards were examined to ascertain what types the South Florida, and particularly the city of Margate, areas are vulnerable to.

Sinkholes occur frequently in the area encompassing the southeastern portion of the United States. South Florida is no different in that the sinkholes are formed or developed when changing water table levels, during sustained droughts, cause a wearing away of limestone. These drought conditions, which deplete the aquifer, occur on an annual basis and are compounded by the population explosion in the area causing increased water

demands. “Areas with the greatest potential for sinkholes are those where surface water tends to percolate into the ground recharging the aquifers below” (Hyndman & Hyndman, 2009, p. 229). The South Florida water table is within a foot of the surface in some areas (Florida Department of Environmental Protection, n.d.) and the low levels are further exacerbated by the large population centers located in and around the Fort Lauderdale area which cause frequent overuse of the available water in the aquifer. The end result is that the Southern Florida area contains huge limestone deposits which, combined with the shallow aquifer, cause an increased risk of sinkholes.

Additional hazards are associated with the shallow aquifer and include any accidental or purposeful release of hazardous materials. These spills will almost immediately enter the ground water table resulting in long-lasting pollution issues. Hazardous materials release events are a high probability type of occurrence because of several major transportation corridors which directly affect the Margate area. According to US Department of Transportation data there were 556 hazardous materials incidents in Florida causing $ 7,857,256 in damage during calendar year 2009 (U.S. Department of Transportation, 2010). With this number, Florida was ranked seventh in the country with these types of incidents. The number one cause of transportation accidents was human error including inadequate

preparation for transportation and rollover accidents. (U.S. Department of Transportation, 2010)

In addition to the threat of hazardous materials incidents, a host of bacteria and viruses thrive naturally within the area and are carried by a number of animals and humans. Some are potentially lethal and threaten to cause widespread loss of life. Response planning must consider large-scale infections and contaminations of various biological agents. The World Health Organization (WHO) made recommendations that "Central governments should provide the information and framework for the planning which must take place across all sectors of society" (World Health Organization, July, 2009, p. 11). While all sectors of society are involved in pandemic preparedness and response, central governments are responsible for leadership, communication, and coordination. Disaster preparedness plans should build "on existing national disaster management approaches and institutions and be regularly revised as circumstances change and new information becomes available" (World Health Organization, p. 11).

Recent flu outbreak reports have caused the WHO to raise the pandemic alert level to six. This level indicates that a global pandemic is underway (World Health Organization, 2009). Under a global influenza pandemic occurrence the virus would spread rapidly due to the interconnected nature of the modern

world. The highly global nature of travel and relocation of people would continue to cause the spread of the viral outbreak. Additionally, once the pandemic evolved, it could become widespread and cause the vaccines, antiviral agents and antibiotics to become increasingly harder to obtain and the demand would outpace production. Medical facilities could become overwhelmed with the care demands of patients in addition to the potential shortages of healthcare professionals. And finally, current epidemiological models project that a flu pandemic such as the H1N1 flu strain could result in 2 to 7.4 million deaths globally (World Health Organization).

According to Center for Disease Control estimates between April 2009 and January 16, 2010, there were just over 57 million cases of the H1N1 version of the flu in the United States. Of those, around 257,000 people were hospitalized and almost 12,000 died from the effects of influenza. The burden of the affected population was in the 18-64 year old category. That category alone accounts for 33 million cases with 150,000 hospitalizations and 8980 deaths associated with the H1N1 outbreak (Centers for Disease Control and Prevention, 2010).

Besides naturally occurring biological agents, the tropical South Florida climate causes numerous thunderstorms. Between 1950 and November 30, 2009, there were 262 reported major thunderstorms and high wind events. These events caused almost

$2.2 million in property damage in addition to injuring 12 and causing the death of four people (U.S. Department of Commerce, National Climatic Data Center, 2010). In and around these storms, frequent lightning strikes cause brush and structure fires as well as power outages from direct strikes. One author noted that lightning caused "twice as many deaths in Florida than any other state" (Hyndman & Hyndman, 2009, p. 432). Between September 14, 1993, and November 30, 2009, there were 96 lightning strike events reported. There were 13 deaths and 73 injuries, including two MFR personnel, as a result of these strikes during the 16- year period (U.S. Department of Commerce, National Climatic Data Center, 2010).

In addition to the formation of thunderstorms, the warm moist climate lends itself to the production of tornadoes. Tornadoes are ranked on the Fujita intensity scale from zero to five with five being the most destructive. Between 1950 and November 30, 2009, there were 112 tornadoes reported in Broward County, Florida. Of these, 70 were categorized as F0, 32 were F1, seven were F2 and three were F3 type tornadoes. There were a total of 92 injuries and one death as a result of these tornadoes (U.S. Department of Commerce, National Climatic Data Center, 2010).

Other meteorological events that frequently affect the Florida region are tropical storms and hurricanes. These

frequently develop and build up in the warm moist waters in the vicinity of the Caribbean Islands directly southeast of the United States. Annually, depending on the steering currents in the Gulf Stream, Florida is in the forecast track area for tropical events. This occurs several times during the annual hurricane season which, in the Atlantic basin, is the period between June 1st and November 30th of each year (City of Margate Fire Rescue, n.d.). This is when the ocean temperatures are high enough to promote the formation of tropical cyclone events. Because of the uniqueness of tropical storm and hurricane development, the National Weather Service (NWS) is able to provide some advance warning for emergency services to prepare for an event. The NWS issues two types of advisories related to all storms, but tropical storms and hurricanes are unique in the amount of lead time that can be provided to emergency responders. The first advisory is a watch, which means that tropical storm or hurricane conditions, including winds, may be experienced in the area within 36 hours. A warning means that tropical storm or hurricane force conditions and winds are expected in the area within 24 hours or less (National Weather Service, n.d.).

Southeast Florida is not unique in the number of direct landfalls, but the frequent nature of these weather-related events makes it a high-risk area. Between September 1903 and

December 2005 there have been 30 total landfalls from hurricanes in the South Florida area in addition to the numerous near misses. Twelve of these have been category three or higher (Eastern U.S. WxForumns, 2009). Hurricanes are ranked on a scale of 1–5, which gives an indication of the intensity of the storm. The Saffir–Simpson Hurricane Wind Scale is the official rating and "only addresses the wind speed and does not take into account the potential for other hurricane–related impacts, such as storm surge, rainfall–induced floods, and tornadoes" (National Weather Service, n.d.). Category three or greater corresponds to wind speeds of 111 mph or higher and will cause devastating or catastrophic damage in the affected area.

To summarize the literature review, the U.S. fire service has the responsibility of not only responding to emergencies but planning and coordinating disaster responses to a wide variety of events within their varied jurisdictions (U.S. Fire Administration, 2006). These disasters come in many forms but are categorized as either natural or human caused (Florida Fire Chiefs' Association, 2004). Disaster preparedness includes all the components of hazard mitigation, including hazard assessment (Bullock et al., 2006). The community risk/hazard assessment should encompass all disciplines and involve all facets of the community (U.S. Fire Administration, 2009). Industry standards have been developed to assist with the hazard analysis involving

select occupancies (National Fire Protection Association, 2000, National Fire Protection Association, 2008, National Fire Protection Association, 2008, International Association of Fire Chiefs, 2008, U.S. Department of Labor/Occupational Safety and Health Administration, n.d.). In addition to these standards, there are county, state and federal level drafts available to assist with hazard analysis (Emergency Response Planning & Management, 2005, Florida Fire Chiefs' Association, Department of Homeland Security, 2008, FEMA/DHS, 2009, U.S. Department of Homeland Security, 2007, Emergency Response Planning & Management).

The South Florida area, which includes the city of Margate, is vulnerable to several hazards. Because of the shallow water table and large limestone deposits, the area is prone to sinkholes (Hyndman & Hyndman, 2009, Florida Department of Environmental Protection, n.d.). As a result of the shallow water table, any hazardous material release will quickly contaminate the available water supply (U.S. Department of Transportation, 2010, U.S. Department of Transportation, 2010).

In addition to these hazards, there is the potential for a bacterial or viral disease outbreak in the area (World Health Organization, 2009, World Health Organization, July, 2009, Centers for Disease Control and Prevention, 2010). Another hazard is associated with the tropical environment of the South

Florida area. Thunderstorms and the associated lightning frequently occur in the area and cause damage (Hyndman & Hyndman, U.S. Department of Commerce, National Climatic Data Center, 2010). Tornadoes are among the other weather phenomena which are prevalent in the area (U.S. Department of Commerce, National Climatic Data Center). And finally, and again because of the tropical location of the area, tropical weather systems such as tropical storms and hurricanes routinely threaten the area (City of Margate Fire Rescue, n.d., National Weather Service, n.d., National Weather Service, n.d., Eastern U.S. WxForumns, 2009).

Procedures

The action research method was used to gather information pertaining to what federal, state and county criteria exist to enable Margate Fire Rescue to perform a hazard and vulnerability assessment within the city of Margate. Once this was completed, potential hazards were identified as well as occupancies and infrastructure facilities could be potentially impacted by these hazards.

The first part of the research involved review of available literature on the need for a hazard assessment. This was initially conducted in Emmitsburg, Maryland, at the National Fire Academy. The student manual for Executive Analysis of Fire Service Operations in Emergency Management was consulted to

begin the project. The Learning Resource Center electronic resource catalog was also accessed. The topics searched included "hazard assessment," "hazards," "emergency planning," and "emergency response plan."

Further research was conducted in Boca Raton, Florida, at the Florida Atlantic University (FAU) library. Again literature was consulted in an attempt to identify reasons why hazard assessments should be completed as well as what constitutes a hazard assessment. Various combinations of "emergency planning" and "weather hazards" were entered into the card catalog search engine to discover references including journal articles and books on the subject.

Online sources were then consulted, including the US Census Bureau website, to determine the population profile of Margate and Coconut Creek, FL, and Broward County, FL.

The second part of the research involved identifying federal, state, county and local agency hazard and vulnerability assessment procedures and recommendations. Online sources such as OSHA, FEMA, and DHS were consulted for this information. Other sources such as NFPA, IAFC, State of Florida, Broward County, and City of Margate were then consulted for recommendations.

The third part of the research involved identifying possible hazards that could affect the South Florida area,

particularly the city of Margate. This research was accomplished by again consulting the FAU card catalog search engine for hazards. Topics searched include “Florida weather,” “tornado,” “hurricane,” and other weather related phenomena. Following this, various online sources such as National Weather Service, National Oceanic and Atmospheric Administration, CDC, U.S. Department of Commerce, U.S. Department of Transportation and WHO were consulted to assist in identifying possible hazards affecting the South Florida area.

Limitations to this part of the research involved the inability to identify literature that predicts every possible hazard that could affect an area. The list was as inclusive as possible in an attempt to provide a thorough account of potential hazards.

The fourth and final part of the research involved determining what types of occupancies or other areas within the city of Margate need to be included in the hazard assessment. Again, various literature and online sources were consulted to provide guidance.

Once occupancy types that should be included in the hazard assessment were identified through research, several local agencies were consulted to provide guidance. Jack Morel, the Chief Building Official for the city of Margate, was interviewed in person to locate possible life hazard occupancies within the

city (J. Morel, personal communication, March 2010). He advised of the number of gas stations and other hazmat facilities within the city. Morel then related that Ben Ziskel, City Planner, was responsible for identifying all assisted living facilities (ALF), adult congregate facilities (ACF) and group homes (GH) within the city. Ziskel provided data on all those types of facilities within Margate cities (B. Ziskel, personal communication, March 2010).

A limitation to this part of the research was that not all hazard occupancies and other areas could be identified this way. Individual occupancies will need to be added at a later date, as they are discovered, in order to keep this list as current as possible.

Results

Research question 1. What are the federal, state and county criteria for and what hazard and vulnerability information is contained within the national, state and county emergency response plans? The literature review revealed several agencies with recommendations for a hazard assessment.

The EAFSOEM student manual provided a template to assist with the identification of hazards and the area they could potentially affect. The template contains three forms. (Appendix B, C, and D)

The first form is used to approximate the probability of an event occurring at the hazard site and the population that could be affected. (Appendix B) To use this template, the name of the identified hazard, which is contained in Table 1 and appendix A, is entered into the left column under a number. Proceeding to the right, a number is checked referring to the approximated probability that an event will happen at this hazard site. The value unlikely corresponds with a low possibility that an event will occur and is assigned a value of one. Possible is the next probability value and corresponds with a somewhat probability of an event occurring. The last probability value is the Likely probability of occurring. In the final column is the approximate numerical estimate of the population affected if an event were to occur at the hazard site. The results are then saved to use later in the process.

The second form is for identifying how vulnerable the local area is to an event occurring at the hazard site. (Appendix C) The name of the hazard from Table 1 or Appendix A is entered at the top of the template. The same number should be used for the site as in the previous section. For example if the Margate Treatment Plant was used under number one in the first section, it should also be entered under number one of the second section. Continuing down this column, the next row corresponds to the first factor that could affect the surrounding area. The

danger/destruction factor is ranked from one to three, with three being the potentially greatest impact. A value of one would mean that few fatalities could be expected from an incident which could be handled with local emergency responders. A value of two would mean that some fatalities could occur and slightly more damage. A value of three would mean that numerous fatalities could occur with substantial impact on the local infrastructure and long term recovery likely to be needed.

Economic impact is considered in the next row. Again, a 1 to 3 numerical value is assigned with a three having the highest impact. A value of one would mean that the effect would be short-lived and able to be handled by local finances. A value of two would mean that either the effects would be long lasting or exceed the local finances. The value of three would mean that the local finances are overwhelmed and the effects are long lasting.

Continuing down to the next row, the potential environmental impacts to the local area are considered. A value of one would mean that the potential impact is short-lived and would have no lasting impact on the public health. A value of two would mean that the impact is long-lived or has an effect on the public health. The highest value is three which means that the potential exists for irreversible harm to public health or at the least would affect it for a long time.

The next row is where the potential social aspects are considered. The value of one to three is again used. A value of one would mean that the social effects are felt by a limited few individuals. A value of two would mean that shelters would need to be established with some social values affected. The value of three would mean mass evacuations and numerous additional resources would be needed.

The following row is where the level of needed planning would be considered. A value of one would mean that local planning and resources could handle the incident. The value of two would mean that regional or state planning and resources would be needed to control an incident at the hazard site. The value of three would mean that planning and resources at the federal level would be required.

The final row is where the total vulnerability is added up and ranked. The numerical values of the above rows are added together and the resulting value is placed in a group. A value from 5 to 8 is considered low, 8 to 11 is moderate and 12 to 15 is high. This number is saved to enter into the third section.

In the final form which is Appendix D and combines the previous two sections, the hazard name from Table 1 or Appendix A is entered into the first column. Proceeding to the right, the probability of occurrence, which was determined in the Appendix B template, is entered. In the next column to the right, the

vulnerability, which was determined in the template in Appendix D, is entered. Finally, the last column is where the two previously entered values are multiplied and the resulting value is entered. For example, if the probability of occurrence for a hazard was three and the vulnerability was also a three then the risk disaster rating would be nine, which is the highest rating that can be achieved.

The National Response Framework (NRF) does not provide a specific hazard or vulnerability assessment form. However the NRF does provide the direction that local agencies should plan for response operations by conducting assessments.

Broward County, Florida, has included in the Municipal Emergency Plan template requirements for municipal plans. The key element is the need for municipalities to include in their local emergency plan contingencies for all natural, man-made and technological hazards by which they may be affected. Additionally, a template was included to assist municipalities with recognizing all possible hazards. The template entitled Mini Assessment of the Hazards Threatening the Municipality is contained in Appendix F. For each category, a best guess estimate is entered as to what level- high moderate, or low- the risk is to the area.

Some federal agencies as well as nationally-accepted standards require certain occupancy types to conduct some kind

of hazard and vulnerability analysis and to assemble an emergency plan. NFPA standards require high-rises, health care facilities, residential board and care facilities and hazardous materials facilities to construct emergency plans. These plans are required to be submitted to the local authority having jurisdiction for approval.

In the OSHA standard, the employees are required to be provided access to the facility emergency plan. They also must be provided any training necessary to fulfill their roles that are contained within those plans.

Research question 2. What are the potential infrastructure, transportation, life safety and major target hazards that would have the greatest impact on the city of Margate during a large scale emergency incident?

The literature review identified several key hazards that need to be included in the hazard assessment.

The IAFC identified target structures that need to be identified and included in the Margate Fire Rescue Hazard assessment. These are those structures which contain a large amount of hazardous materials and those that have a high chance of containing trapped victims (International Association of Fire Chiefs, 2008).

The target hazard list is contained in Appendix A and begins with the transportation corridors. These are roadways

wider than four lanes and open to all traffic. There were six identified within the response area of MFR. On the northern boundary is West Sample Road which runs east to west with direct access to Interstate 95, the Florida Turnpike and State Road 869. Copans Road also runs east to west and is located in the approximate center of the city. Next is Coconut Creek Parkway which also runs east and west through the city. West Atlantic Boulevard is the next east to west roadway and also provides direct access to Interstate 95, the Florida Turnpike and State Road 869. Running north to south through the center of the city is North State Road 7, which runs throughout Broward County. Also located within the response area of MFR but not within the city of Margate are the Florida Turnpike and State Road 869. Both of these roadways are toll roads and the Florida Turnpike runs in a north to south direction along the east border of the MFR response area. State Road 869 runs east and west along the northern border of the MFR response area.

The next category of hazards identified was infrastructure of the city. This included the Florida Power and Light (FPL) substation located in the northwest section of the city. This substation provides power to the northern section of the city and some of the surrounding areas. Located in the center of the city are a water plant and a water treatment facility from which

Margate provides drinking water and sewage treatment for the city residents.

There were also nine gas stations found to be located within the response are of MFR. These were categorized as hazardous materials locations. They are scattered throughout the city and located primarily along the major transportation corridors. Additionally, one large liquid propane storage and distribution center is located in the Northeast section of the city. Another hazardous materials location identified was the natural gas pipeline which parallels the Florida Turnpike within the response area of MFR.

Life safety occupancies were identified by NFPA Standard 101. Included in this section are the only hospital facility and 38 ALF, ACF, and group homes within the city. The hospital, along with three medical office buildings greater than two stories were identified in the northeast section of the city.

Once the target hazards are identified, the information has to be placed into some usable format to facilitate its usage. A city of Margate map was consulted and 11 zones were identified (Appendix E). Target hazards can be placed onto the map within their appropriate zone. The map can then be viewed in whole or by zone during an emergency situation.

Research question 3. Based on collected data identifying potential hazards, what additional hazards should be included in the City of Margate Emergency Response Plan?

The potential hazards were divided into natural and man-made categories and included in Table 1. Man-made hazards that have the potential to directly affect the city of Margate are listed on the left side. First were sinkholes, which can occur as a result of depletion of available water supplies as well as drought conditions. These can disrupt transportation corridors and threaten structures and infrastructure. The second type was transportation incidents. These include traffic accidents of such magnitude as to overwhelm the available resources. Third was hazardous materials release. Some of these occur along transportation corridors as well as at fixed sites and structures. Fourth were infectious biological agents, which can be natural or man-made. Besides the various flu strains, there are many agents which can affect the local community. Some of these could be involved in the fifth type, which were terrorist attacks. The terrorist attacks could also be directed at all target hazards. The sixth type was wildfires. These also could be man-made as the result of arson or accidental causes, as well as natural from lightning storms. The seventh and final man-made hazard was structure fires which obviously could occur in target hazard occupancies.

Natural hazards are listed on the right side and include thunderstorms, which occur daily during certain seasons and sometimes produce deadly lightning and hail. These could potentially affect transportation corridors as well as other target hazards. Drought conditions are another natural hazard that could affect the city of Margate. Hurricanes or tropical storms are natural hazards that could potentially affect the city of Margate as well as the surrounding area. Naturally occurring tornadoes are another potential hazard which affects the area. Finally, extreme heat events are a natural event that could occur in Margate. The tropical environment is hot and humid on a daily basis during the summer and without air conditioning while inside or in crowded outdoor events the effects of the heat can cause numerous problems.

Table 1
Man-made and Natural Hazards

Man-made	**Natural**
Sinkholes	Thunderstorms
Transportation Incidents	Lightning
Hazardous Materials Release	Hail
Infectious Biological Agent	Drought
Terrorist Attack	Hurricanes
Wildfire	Tropical Storms
Structure Fire	Tornadoes
	Extreme Heat Event

Discussion

An emergency plan is in place to enable the City of Margate to handle emergency incidents. However, the existing plan is singular in its focus and primarily addresses the occurrence of a tropical type storm. The ability for the City to plan, respond to and recover from an incident has been compromised because of the lack of consideration given to any other hazards. Recognizing the other hazards that threaten the area can increase the effectiveness of the Margate Emergency Plan.

The National Fire Academy, in partnership with FEMA, recognizes the importance of disaster planning before an incident and the resulting successful mitigation and recovery phase of operations. To enforce the importance of hazard and vulnerability assessment, a form was created and included in the EAFSEOM student manual. This form forces the emergency planner to consider numerous hazards and their possible impact on the local community (U.S. Fire Administration, 2009).

Broward County, Florida, also included a hazard and vulnerability assessment form in the templates for the local municipalities (Emergency Response Planning & Management, 2005). This form is similar to the one included in the EAFSEOM manual but is limited in its scope. It only contains a form to enter what the municipalities consider to be hazards.

The EAFSEOM form contains additional processes that will enable the Margate emergency planners to rank the hazards and establish a vulnerability rating for the various hazards. The hazards identified in the literature review and results sections of this research can be entered into the assessment form. Once this is completed the current emergency plan can be updated and improved.

Due to the time constraints of this research, only the hazard and vulnerability forms and a list of hazards were created. Hazards need only to be entered into the forms and the resulting hazards ranked. The resulting ranking can then be used to identify which hazards the Margate Emergency Plan can be updated to address. Margate is similar to other municipalities in that limited resources and finances are available for emergency planning. These must be used optimally to prevent an unnecessary burden or additional time and expenses while preventing, responding to or recovering from an emergency incident.

Recommendations

Based on the research, the City of Margate should include the form identified from the EAFSEOM manual in the emergency planning procedures. Hazard identification was completed with this research and the vulnerability analysis can be accomplished by completing these forms.

Once the hazards are ranked the Margate emergency planners from each department can then focus their efforts on developing current emergency plans to be included in the Margate Emergency Plan.

Additionally, occupancies were identified through the literature review that is required by NFPA standards to have emergency plans that are updated on an annual basis. These plans are submitted to the local Authority Having Jurisdiction, which is Margate Fire Rescue. Currently these plans are submitted in written format for approval. Recommendations have been made to Fire Prevention Division Chief Dan Booker to require the plans be submitted in electronic form. Once these are approved, they can be easily stored and made available for quick access during an emergency operation.

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Appendix A

Margate Target Hazards

Name	Type	Zone
West Sample Rd	Transportation	4,8,11
West Copans Road	Transportation	3,7,10
Coconut Creek Parkway	Transportation	2,3
West Atlantic Boulevard	Transportation	9,6,2
State Road 7	Transportation	1,2,3,4
Florida Turnpike	Transportation	OZ
State Road 869	Transportation	OZ
Margate Treatment Plant **6630 NW 9th St**	Infrastructure	6
Margate Water Plant **980 NW 66th Ave**	Infrastructure	6
FPL Substation **Winfield Blvd**	Infrastructure	8
Propane USA **1900 Banks Rd**	Hazardous Materials	3
Natural Gas Pipeline	Hazardous Materials	OZ
Chevron **5789 Margate Blvd**	Hazardous Materials	6
BP **6600 W Atlantic Blvd**	Hazardous Materials	6
Mobil **7844 W Sample Rd**	Hazardous Materials	11
Hess **150 N State Rd 7**	Hazardous Materials	2
Marathon **804 N State Rd 7**	Hazardous Materials	2
Shell **2485 N State Rd 7**	Hazardous Materials	8
BP **5298 Copans Rd**	Hazardous Materials	3
Chevron **5200 W Sample Rd**	Hazardous Materials	4
Valero **2001 N State Rd 7**	Hazardous Materials	7
Northwest Hospital **2801 N State Rd 7**	Life Safety 101	8
Northwest Medical Building **5961 Colonial Dr**	Life Safety 101	8

Medical Office Building **2960 N State Rd 7**	Life Safety 101	4
Medical Office Building **2964 N State Rd 7**	Life Safety 101	4
A&J ALF of Florida **2187 NW 63rd Ave**	ALF/ Life Safety 101	8
All Abilities #2 **6799 NW 3rd St**	Group Home/Life Safety 101	9
All Abilities #3 **1795 NW 66th Ave**	Group Home/Life Safety 101	7
Golden Care **4980 SW 4th St**	ALF/Life Safety 101	1
A Touch of Class **715 SW 51st Ave**	ALF/Life Safety 101	1
BCJ Retirement Home **4976 SW 7th St**	ALF/Life Safety 101	1
Casa Vive **6950 NW 18th Ct**	Group Home/Life Safety 101	7
Claudette Clark **6150 Southgate Blvd**	ALF/Life Safety 101	5
Coral Plaza **5850 Margate Blvd**	ALF/Life Safety 101	6
Cypress Manor **7459 Royal Palm Blvd**	ALF/Life Safety 101	11
Cypress Manor I **1910 NW 77th Ave**	ALF/Life Safety 101	10
Devereux/Margate Group Home **6212 NW 15th Ct**	Group Home/Life Safety 101	7
Nancy Duroseau **104 E Palm Dr**	Group Home/Life Safety 101	2
Anne-Marie Duverseau **965 SW 12th St**	Group Home/Life Safety 101	1
Makillia Dwelle **6950 NW 21st Ct**	ALF/Life Safety 101	8
Embassy Retirement Home **6093 NW 9th Ct**	ALF/Life Safety 101	6
Emerald Manor I **421 Kathy Lane**	Group Home/Life Safety 101	5
Fellowship **451 Banks Rd**	Group Home/Life Safety 101	2
Fellowship **461 Banks Rd**	Group home/Life Safety 101	2
Gardens at Margate **6700 NW 21st St**	ALF/Life Safety 101	8

Henderson Mental Health **2181 NW 69th Terrace**	Group Home/Life Safety 101	8
House of Tranquility **421 SW 64th Terrace**	ALF/Life Safety 101	1
Carol Leigh **6741 SW 3rd St**	Group Home/Life Safety 101	5
Lorna's Home for the Elderly **551 SW 10th Ct**	ALF/Life Safety 101	1
LV Walters #2 **2205 NW 62nd Terrace**	Group Home/Life Safety 101	8
LV Walters #3 **1317 NW 58th Terrace**	Group Home/Life Safety 101	7
LV Walters #4 **7925 NW 6th Court**	Group Home/Life Safety 101	10
Margate Manor **1189 W River Drive**	ALF/Life Safety 101	6
Mona's Group Home I **225 NW 79th Ave**	Group Home/Life Safety 101	9
Mona's Group Home #2 **6108 NW 20th Court**	Group Home/Life Safety 101	7
Professional Care Facility **5515 SW 8th St**	ALF/Life Safety 101	1
Rebekah Children of God **1535 NW 80th Ave**	Group Home/Life Safety 101	10
RHD of Margate **6602 NW 4th St**	Group Home/Life Safety 101	6
Merna Stewart-Nuby **840 SW 50th Ave**	ALF/Life Safety 101	1
Summerville at Regency **5600 Lakeside Dr N**	ALF/Life Safety 101	2
UCP/Margate **4950 SW 8th St**	Group Home/Life Safety 101	1
Unicare Home **6945 NW 9th Court**	Group Home/Life Safety 101	6
VIP Care Pavilion **6810 SW 7th St**	ALF/Life Safety 101	5

Appendix B

Hazard Identification		
Hazards	What is the probability an event will occur at this hazard	What is your best estimate of the total population that could be affected seriously by this hazard? Consider peak population, if appropriate.
1.	• Unlikely • Possible • Likely	_____ Enter a number
2.	• Unlikely • Possible • Likely	_____ Enter a number
3.	• Unlikely • Possible • Likely	_____ Enter a number
4.	• Unlikely • Possible • Likely	_____ Enter a number
5.	• Unlikely • Possible • Likely	_____ Enter a number
6.	• Unlikely • Possible • Likely	_____ Enter a number
7.	• Unlikely • Possible • Likely	_____ Enter a number
8.	• Unlikely • Possible • Likely	_____ Enter a number

Appendix C

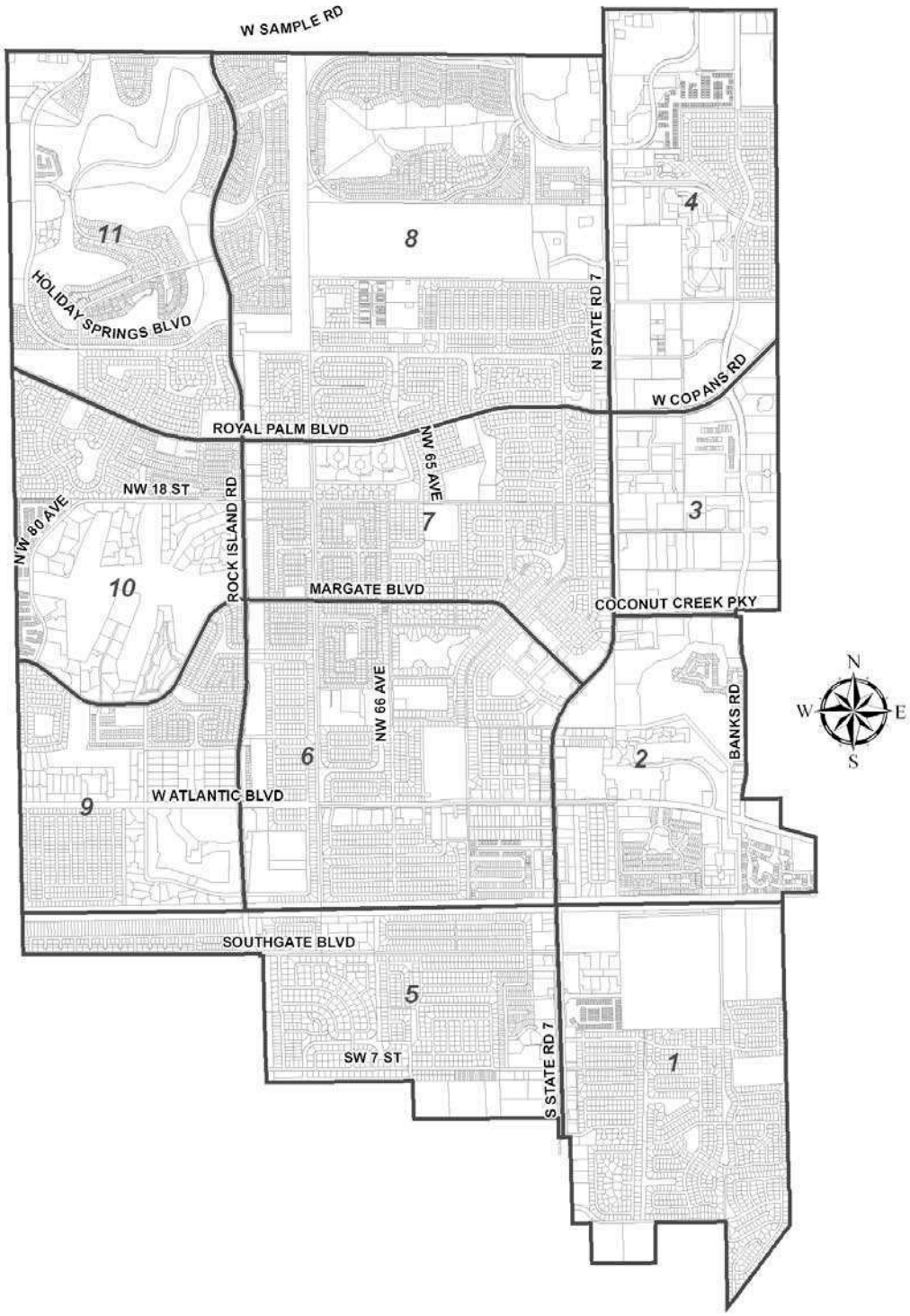
Vulnerability Assessment					
Hazards	1.	2.	3.	4.	5.
Danger/Destruction **(High=3, Moderate=2, Low=1)**					
Economic **(Permanent=3, Temporary=2 Short term=1)**					
Environmental **(High=3, Moderate=2, Low=1)**					
Social **(High=3, Moderate=2, Low=1)**					
Political Planning level **(Local=1, Regional=2, Federal=3)**					
Total Vulnerability Rating **(Sum of all factors)**					
Rank **5-8 (Low)** **9-11 (Moderate)** **12-15 (High)**					

Appendix D

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

Appendix E

City of Margate Zone Map



Appendix F

Broward County Emergency Management Agency

Mini-Assessment of The Hazards Threatening the Municipality

Municipality: _____

Quickly list the hazards, e.g., hurricane, flood, wildfire, etc., that threaten your municipality. Then indicate the estimated level of risk of each.

Hazard Category	High Risk ☑	Moderate Risk ☑	Low Risk ☑
Natural Hazards			

Hazard Category	High Risk ☑	Moderate Risk ☑	Low Risk ☑
Technological Hazards			
Man-made/Criminal Hazards			