CONDITIONS EFFECTING RURAL FIRE DEPARTMENT PREPAREDNESS FOR CHEMICAL DISASTERS IN NORTHEAST OKLAHOMA: A CASE STUDY

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Abstract

Throughout history, humankind has struggled with vulnerability and the effects of disasters on the ill prepared. The community and field of disaster research acknowledges fire departments as key stakeholders in preparedness. These agencies commonly conduct pre-fire planning, purchase specialized equipment, and train for a variety of responses. Fire departments operate with certain types of capital, including funding, available personnel, community values and beliefs, political atmospheres, and natural and built environments; which limit or allow preparedness planning. Research has shown that, compared to their urban counterparts, rural communities have fewer trained and prepared personnel, less equipment, and a lack of financial capital with which to prepare for disaster events involving chemicals. Chemical use continues to increase in industry, and recent U.S. legislation has caused shipments through rural communities to escalate, resulting in an increased risk of chemical releases. Fire chiefs understand how the community creates and changes capital used by the fire department. This study examined the impact of community capitals on chemical disaster preparedness in rural Northeast Oklahoma fire departments from the fire chief perspective.

The 27 survey participants, and 21 interviewees, revealed that the social capital within the study region was robust. Strong community linkages created support for their local fire department. Although this support did not necessarily result in volunteers, it did result in reduced resistance to preparedness activities. Emergent themes revealed vulnerability in the meager number of capable and available personnel, lack of response equipment and materials, low perceived chemical risk, inadequate time, and inconsistent funding to prepare for chemical hazards. While community capitals in rural communities appear lacking, fire departments have found means of coping, allowing them to conduct some preparedness activities; but not for chemical disasters events.

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> The book of Genesis provides a vivid description of Noah and his ark. Mythical or real, the description of Noah's activities in anticipation of the great flood is perhaps the first recorded account in the Western World of disaster preparedness planning.
>
> -Enrico Quarantelli (1985b, 2)

Chapter I

Fire departments have been a primary responder to hazard and disaster events, along with police agencies (or the military), since early in the history of the United States. Fire departments should be prepared for incidents regardless of their nature (floods, motor vehicle accidents, medical, hazardous materials, etc.). The community expects their fire department to respond to incidents, regardless of their cause, because they have specific resources with which to resolve the problem, making them one of the primary agencies in most disasters (Wenger, Quarantelli, and Dynes 1989). For a fire department to be prepared for a hazardous material incident, they must have available adequately trained and capable personnel, specialized equipment, and must conduct planning activities such as drills and exercises, public education, and guideline development.

Fire departments in rural communities, however, experience problems due to a lack of adequate capital. Staffing problems, including fewer volunteer recruits (especially of the younger generation), lack of training, and commitments competing for reduced leisure time have created a lack of available qualified personnel available to prepare or respond. Shrinking financial capital causes fire departments to find coping strategies further straining local funding sources,

creating a lack of equipment. Cultural beliefs within these communities create a public expectation that fire departments provide services such as those offered in urban centers. Urban fire departments often conduct pre-incident planning, code enforcement inspections, and are on available within their community for immediate response. Community hazard and disaster planning does not take place due to competing priorities, lack of funding, or insufficient support; this is evident in rural communities. Quarantelli (1985b) writes that proper response during chemical disasters is far more important than the speed. While appropriate response actions are more important than speed, the community anticipates that their fire department responds fast and with a high standard of care. Unfortunately, rural departments tend do so with fewer capable personnel, less equipment, and to a variety and large quantity of emergencies. Firefighters respond to calls where the identity of chemical hazards is unknown. Early and appropriate response actions at an incident can prevent an emergency from becoming a disaster. Responding to these types of releases requires greater caution than with other responses; and slower. These types of standard response protocols, when response actions are delayed, can "…turn minor chemical incidents into major chemical disasters" (Quarantelli 1985b, n.p.). Vulnerability within community capitals cause planners to lose their ability to prepare effectively, and they place a greater reliance on slower outside resources. These outside resources do not have a stake in the community and complicate response frameworks, potentially allowing a disaster to develop, and delaying a return to pre-disaster conditions. Political support for small departments is dynamic, locally elected officials have competing interests, may not understand or support fire department needs, and exert control over some community capitals.

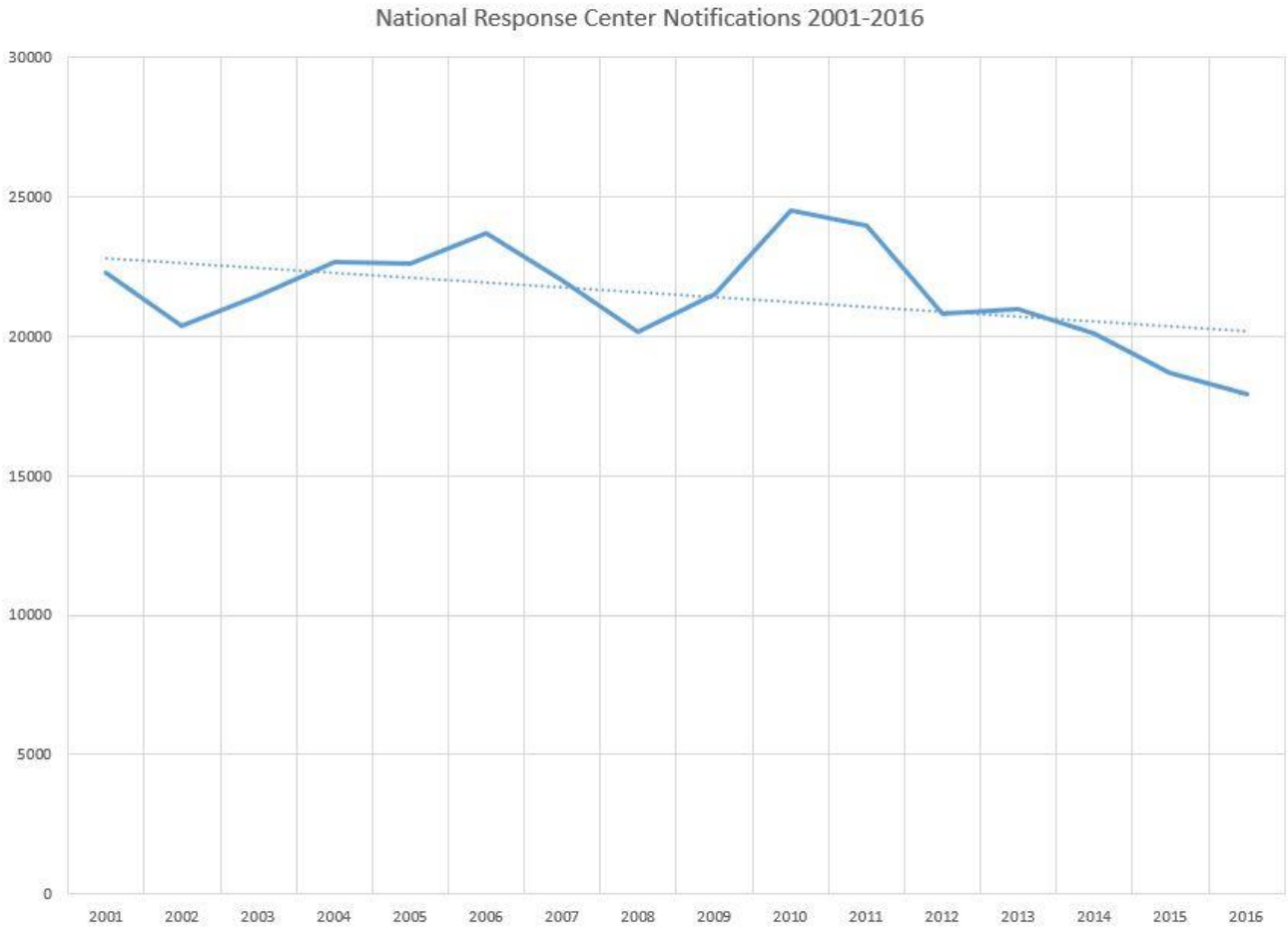
This study examines how resources affect fire department preparedness for hazardous materials incidents through a community capitals framework. The community capitals

framework chosen for this study includes natural, built, human, financial, social, cultural, and political capitals. Fire chiefs are the unit of measure chosen for this study, because they are the lead decision makers for these rural agencies and have in-depth knowledge of how capitals affect preparedness for responding to, and recovering from, chemical incidents.

Chemical Hazard and Disaster Preparedness: An Introduction

Chemical production and use in the United States is massive, and due to the ease of siting waste sites and complying with regulatory standards, chemical production in rural communities is widespread. According to the *Economic Census,* there were 563,815,000 tons of chemicals shipped in the U.S. in 2012 (U.S. Department of Commerce 2014b). According to U.S. Census data, there were 313,998,379 citizens in the United States in 2012; meaning that there was more than 1.7 tons of chemicals shipped in the U.S. for every man, woman, and child (U.S. Department of Commerce, under Bureau of the Census 2014a). While most shipments arrive at their destination safely, there are close to 250,000 incidents annually (Johnson 2009). According to the National Fire Protection Association (2016a), hazardous materials incidents have increased 388 percent since recording of that category began in 1986. Notwithstanding the NFPA statistics, reports to the National Response Center indicate a general downward trend since 2001. The National Response Center (NRC) is the "…designated federal point of contact for reporting all oil, chemical, radiological, biological and etiological discharges into the environment, anywhere in the United States and its territories. . ." (U.S. EPA 2014f). This trend could indicate that fewer responders are reporting chemical releases, which may be smaller and do not meet reportable quantity thresholds or responders underemphasize or misunderstand reporting requirements. Figure 1 reveals notifications of hazardous materials releases from 2001 through 2012 according to the NRC.

Figure 1. *Data Adapted from* U.S. Environmental Protection Agency Region 6 Accidental Release Information 2001-2012: Thirty Years Release/Spill Information, NRC Notifications Nationally 2001-2012. Found on http://southplains.asse.org/wp-content/uploads/sites/139/2016/11/ANNUAL-ACCIDENTAL-RELEASE-REPORT-Region-6-FY2012-2016.pdf (accessed August 31, 2013).



Northeast Oklahoma

Throughout Oklahoma, people refer to the Northeast corner of the State as *Green Country* for its picturesque natural landscapes and Ozark-style recreational destinations. Within this region, there are also abundant commercial opportunities stemming from numerous interstate corridors and one of America's largest rural industrial parks. Infrastructure in the industrial park is developing, including a $50 million expansion that began in the spring of 2015 (Davis 2015), as well as a $2 billion investment expected from Google by 2018 that should add jobs, increasing local staffing to at least 400 in the Pryor facility (The Paper September 26, 2016). According to

an article titled “The Measure of MAIP? $1.3 Billion” in The Times (Baron 2017c) the total economic impact of the MidAmerica Industrial Park is $1.3 billion. Industries using chemicals in Northeast Oklahoma receive their feedstock via three interstate highways, multiple railways, pipelines, and a major inland waterway through which a massive quantity of hazardous materials flow daily. According to the 2013, Department of Environmental Quality Emergency Planning and Community Right-to-Know chemical inventory there are 197 fixed sites storing large quantities of hazardous chemicals in the four most Northeast counties in Oklahoma (Mayes County LEPC 2013).

Chemical shipments in Northeast Oklahoma have increased since 2005, due to expansion of oil extraction and regulatory changes influencing railroad routing decisions; adding to the existing chemical risk from the industrial capacity there. Recent advances in technology have created an oil boom from shale and oil sand extractions. Since 2005 railroad hazardous chemical shipments, including ethanol and crude oil; trainloads have increased by over 440 percent (Hersman 2014). Shipments of crude oil have increased faster than the industry’s ability to adapt tank cars with adequate safety designs. Chemical hazard and disaster events involving trains carrying Bakken crude oil have occurred at numerous places (Mosier, Oregon 2016; Watertown, Wisconsin 2015; Culbertson, Montana 2051; Galena, Illinois, 2015; Lynchburg, VA 2014; Cassleton, ND; Aliceville, AL 2013; and Lac-Mégantic, Canada 2013) leading to increased public concern. Oklahoma is not immune to crude oil incidents, in 2008 a crude oil train derailed outside of Luther, Oklahoma resulting in a chemical spill and fire that caused the evacuation of residents (Tulsa News on 6 Investigation 2014, under “Recent Derailments, Deadly Explosions Have Crude Oil Rail Transport”). According to the U.S. Department of Transportation, Pipeline Hazardous Materials Safety Administration data, Craig, Mayes, and Ottawa Counties (three of

the four counties included in this study) are first, tied for second, and tied for sixth highest in anticipated weekly Bakken crude oil train shipments, respectively. The predicted frequency for the area of study is 12-16 weekly train shipments of greater than 1 million gallons; an average of 1.7-2.3 trains per day (Oklahoma DEQ, 2014a).

In 2008, the Department of Transportation, Pipeline Hazardous Materials Safety Administration, promulgated a rule requiring railroads to consider population density into routing decisions to reduce the impact of a hazardous material release to populous areas (U.S. DOT 2014b, under “Railroad Safety Enforcement Procedures”). This change has resulted in increased hazardous chemical routing through sparsely populated and less prepared rural communities. Notwithstanding new regulations improving flammable liquid characterization, new railcar design requirements and a retrofit deadline for the current fleet of railcars, derailments and releases continue to occur (U.S. DOT 2017, under Briefing Room).

A derailment on May 6, 2015 in Heimdal, North Dakota highlighted the existence of chemical hazards regardless of the measures taken by the railroad industry. The shippers had treated the crude oil to have most of the volatile chemicals removed. Additionally, the train operators slowed the shipment to approximately half the speed limit for that section of rail. Even with safety measures implemented, the train derailed and the resulting release of 60,000 gallons of crude oil, and a fire consuming 34,000 gallons, caused the Town of Heimdal, ND evacuated (Nicholson and Brown 2015). According to a Safety Alert issued by the U.S. DOT Pipeline Hazardous Material Safety Administration (2014g), Bakken crude oil presents a greater risk than other crudes due to its volatility. In an April news briefing, the former National Transportation Safety Board (NTSB) Chairperson Deborah Hersman said "…we aren't prepared. Our communities aren't prepared to respond to this. This is, or this can be, a worst case scenario event

and we don't have provisions in place of how to deal with it, either on the industry side or first responders" (Hersman 2014).

Responsibility to Prepare

The responsibility for conducting disaster preparedness has fallen to multiple agencies, departments, and organizations throughout the history of the United States. Prior to the turn of the twentieth century, family members and neighbors conducted disaster planning (Dynes 2000). Community members assessed the needs of other families and lent assistance through civic groups, churches, and individual efforts. As the role of government in disaster preparedness changed, the responsibility fell to the states; the federal government mainly served in a support capacity until World War II. During and after this period, there was an increasing expectation of government intervention in disaster. Chemical releases occurring in industrial or commercial chemical complexes were, and continue to be, handled by specialized units of that plant. When a release extends outside the plant boundaries, however, it is the responsibility of the local public emergency response system (Faupel and Bailey 1988).

Local emergency response agencies have a duty to prepare for all hazards. A fundamental principle in disaster preparedness, and reinforced in the National Response Framework is that all disasters begin and end locally (U.S. DHS 2014, under "National Response Framework 2nd ed"). The moral of this axiom is that local responders are the first on the scene, and remain until incident resolution. Local fire departments have a stake in community recovery, and often provide public service assistance throughout the process. Fleming (2010, 133) notes that the ". . . initial response will always be local in nature . . ." even though incident commanders may call mutual aid, the success of incident mitigation relies on the readiness of the local fire department and the capabilities and wisdom of the chief officers. Conversely, some planners believe it is not

the responsibility of local fire departments to prepare for chemical disasters, since they will be calling mutual aid specializing in this field.

Tierney (1981, 339) writes,

> . . . despite the existence of outside resources, there is a tendency for organizational personnel to hope rather than plan. That is, community emergency personnel assume outside help will be forthcoming from somewhere in that once chance in a thousand it will be needed, rather than expend the effort needed on a day-to-day basis to determine what forms of emergency assistance are available and where and how they can be obtained.

Quarantelli (1981) writes, that while some outside organizations may be better suited for some tasks, local emergency planners are not relieved of their preparedness responsibilities. While the job of preparing for chemical disasters does not solely lie in the hands of fire departments, these agencies should be aware and sensitive to hazardous chemical disasters due to the implications for their own response activities (Quarantelli 1984; Gray and Quarantelli 1984).

Preparedness planners often base their efforts on recent history, or the likelihood of an incident occurring in their district (Quarantelli 1985b). However, planners cannot solely base their anticipation of disasters and their effects on previous experience (Aguirre 2006). This is extremely problematic when a low frequency, high impact, event occurs. According to Tierney, Lindell, and Perry (2001), communities plan for frequent, and familiar events and neglect less frequent, but catastrophic events in their planning.

In Oklahoma, the Emergency Management Act of 2003 directs all incorporated jurisdictions in the state to designate an emergency manager (State of Oklahoma 2007, under "Update/revision of Title 63"). The duties of this emergency manager include writing and revising operating plans, hazard identification, risk assessment, disseminating information, and planning for evacuations. While a significant responsibility toward chemical hazard and disaster event preparedness is given to emergency managers through this Act, local fire departments

continue to be primary stakeholders in chemical disaster planning. Several studies (Quarantelli 1984, 1987a; Gray and Quarantelli 1984; Wenger, Quarantelli, and Dynes 1989; Basolo, Steinberg, Burby, Levine, Cruz, and Huang 2009; Paton and Johnston 2001; Fleming 2010) indicate that, whether part of a team or individually, fire departments should conduct preparedness.

Rural community fire departments are less prepared to handle chemical releases than their urban counterparts. A Disaster Research Center study (Gray and Quarantelli 1983) of chemical accident preparedness indicates small community fire departments are unprepared to respond to sudden chemical accidents. Urban communities, who appear more capable of handling hazardous chemical releases, often have dedicated fire department units, greater funding, and a larger pool from which highly educated and trained individuals (required for many technological disasters) are available. Large cities have greater risk due to their dense populations, but also have greater resources with which to deal with them (Cross 2001). Urban areas with greater resources have the opportunity to utilize innovative preparedness methods like technologically advanced warning and communication systems (Rogers and Sorensen 1991). The adequacy of a fire department's response to a chemical disaster appears to vary inversely with the geographical setting (Quarantelli 1985a).

Theoretical Framework

A theoretical framework establishes what is important to know about how we view the world around us, how knowledge is produced, and what questions should be asked to resolve these issues (Patton 2002). The framework provides perspective to researchers over general philosophical ideas, how information is created, viewed, and ways in which data should be

collected and analyzed. Viewing data through a sociological lens, provides an opportunity to reveal the inside perspectives surrounding these issues.

Community Capitals Framework

All communities contain capitals that can be committed to create or develop new capabilities. The framework chosen for this study contains seven categories of community capitals, including natural, built, financial, human, social, political, and cultural (Flora and Flora 2008; Fey, Bregendahl, and Flora 2006). Natural capital describes the totality of the living ecosystem (water, air, land, biosphere, wildlife, etc.) from within and around a community. Built capital includes community infrastructure (water treatment and transport systems, energy resources and delivery systems, roads and other human transport systems) and buildings (commercial, industrial, community and cultural, and residential) that help support life. Financial capital includes liquid assets, savings, tax base(s), invested funds, and income from grants and other non-tax sources. Human capital includes knowledge, skills, education, talents, and other intrinsic abilities inseparable from their human host. Social capital is a benefit that arises from the sympathy toward another person or group's situation, in which no reciprocity of goods or services is expected. People form political capital when elected officials or appointed representatives use their powers to support causes or identified needs through policies, laws, and dedication of other forms of capital (financial, natural, etc.). Cultural capital is developed when people, or groups of people, have shared beliefs, and may be couched in the environment (race, gender, ethnicity, and group and peer pressures) to which they have been exposed throughout their lives.

Throughout the preparedness process, communities and fire chiefs make value judgements on how best to utilize capitals. As the agency head, the fire chief is the lead decision

maker on use of resources available for preparedness activities; providing an invaluable perspective on the use of capitals within their community. Many of these assets and abilities are fluid, coming and going in the community with the movement of citizens, businesses, and the ebb and flow of local government; as well as being convertible to other forms of capital. To assess how these resources impact chemical hazard and disaster event preparedness, I chose to utilize a community capitals framework.

Previous Research

A void in research has resulted in little recent data available on local fire departments conducting preparedness planning for hazardous chemicals. An annotated bibliography of fire and police department studies prior to 1987, indicates that the majority of those sources discussed topics including riots, natural disasters, traditional fire department operations (fire responses), and organizational dynamics (Linn, Ketter, Kingsley, and Wright 1987). Discussing the scarcity of studies in the past twenty-five years, Tierney, Lindell, and Perry (2001, 51) write, "…consequently, almost nothing new has been learned about police and fire department disaster preparedness." Thanks to the U.S. Fire Administration and the National Fire Protection Association, recent research of the fire service has resulted in guidance to improve capabilities of the fire service. The National Volunteer Fire Council's mission is to develop a strong advocacy towards improving the volunteer fire service. Since the World Trade Center disaster of 2001, fire departments have been extensively studied for various components, including administration, hiring practices, and response. However, the research into fire department preparedness for chemical hazards and disaster events is meager. Several searches of online databases found few studies of fire department disaster preparedness or fire chief decision making. There is also a recent scarcity of research examining fire and police department roles in disaster (Barnshaw,

Letukas, and Quarantelli 2008). One technical report (U.S. DHS 2017, under U.S.F.A. Technical Report Series "U.S.F.A.-TR-162") from the U.S. Fire Administration discussed disaster preparedness for natural and extreme weather events, but searches of online databases only found one recent study (Connery, Krawczyk, Borton and Moskovitz 2004) discussing chemical disaster preparedness. Studies of this topic have mainly focused on community and family preparedness, response teams, business continuity plans, medical treatment and victim care, and components of planning (vulnerable populations, shelter establishment, warning systems, etc.).

Research Questions

The public expects their fire department to respond to an emergency regardless of its nature, in a fast and professional manner. In order for the fire department to be prepared, they must have proper training, equipment, available personnel, and strategies with which to resolve the problem. If a community has inadequate or inefficiently utilized capitals, preparedness and planning activities are inhibited. Chemical shipments through rural Northeast Oklahoma communities are increasing. New regulations require that companies consider community population when transporting hazardous chemicals; encouraging shipments to be routed through less densely populated rural communities. Sparsely populated areas have fewer resources and a greater vulnerability to chemical releases than urban areas. Without rural fire departments conducting preparedness planning and increasing their available resources, it is only a matter of time until a derailment, chemical release, or disaster causes the next perfect storm.

The purpose of this study is to examine the impact of community capitals on chemical hazard and disaster event preparedness in rural Northeast Oklahoma from the perspective of fire chiefs. In order to study how community capitals impact preparedness for chemical disaster events, five research questions were posed:

1. What capitals exist in Northeast Oklahoma rural communities?
2. What risk do fire chiefs assign to chemical hazards as being the causal agent for a disaster in these rural communities?
3. Explain the roles fire departments play in chemical disaster preparedness and response.
4. Explain the community expectations for fire department chemical disaster preparedness in these communities and its evolution.
5. How have fire departments met these preparedness expectations?

Problem Significance

This research contributes to a limited body of knowledge by providing an emic, or insider, perspective of how rural community capitals affect varying fire department chemical hazard and disaster event preparedness. Findings provide a deeper understanding of culture and conditions of fire departments in rural communities following release of the *National Preparedness Goal (U.S. DHS 2011b),* the Comprehensive Preparedness Guide (*U.S. DHS 2010,* under *"*Developing and Maintaining Emergency Response Plans"), and Executive Order Number 13650 *Improving Chemical Facility Safety and Security* (U.S. Whitehouse Executive Orders 2015). By understanding how community capitals affect chemical hazard and disaster event preparedness, planners can evaluate their local conditions; and can work to build capacity, improving preparedness for response.

Limitations

The primary limitation of this study was establishing and maintaining contact with the fire chiefs. I used several communication vehicles, including face-to-face contact, cell phone calls (and voice messages on fire station answering machines and cell phones), emails to

personal and fire department accounts, and sending/leaving messages through firefighters. Melvin Washburn, the Grand Gateway Regional Rural Fire Defense Coordinator, assisted with initial fire chief contact for the study area. Throughout the data collection phase, it was apparent that fire chiefs changed (often prior to their term expiration), frequently changed cell phone numbers and email addresses, and did not ensure the information is widely disseminated. Fire chiefs did not frequently check FD email addresses, and it appeared to occur during training or meeting nights; and some chiefs had challenges with electronic device use.

Another potential limitation was that in Mayes County, the Emergency Management Agency and the community local emergency planning committee (LEPC) frequently have handled portions of preparedness and planning activities. It is unclear whether the fire departments primarily relied on these agencies to conduct all chemical preparedness planning, or whether they viewed it as less important, or a lower priority competing for limited time.

Salient literature and emergent themes from this study indicated that time for duties was limited and prioritized. When time was available to participate in the study, difficulties arose in scheduling (including around emergencies or emergent situations). Due to the dynamic nature of the fire chief's schedules, several interviews took place late in the evening or on a day and time other than the initial appointment. The most successful time to contact fire chiefs was after 5 PM in the evening, and during the week.

Only two of the counties had regularly scheduled firefighter association meetings. In both of the counties with irregular meetings, I did not have the opportunity to introduce or discuss the details and merits of this study. In these counties, there were issues with trust and unwillingness to participate, due to ignorance of the study; often contact attempts met with resistance.

Delimitations

This study examined rural community capitals through the perspective of local fire chiefs. If the local emergency managers' role included preparedness planning, and fire chiefs deferred to these individuals for completion of that task, the population would be exclusive, and the study would risk missing potentially valuable data. Although none of the responses indicated the fire chiefs having deferred to emergency managers, future research should consider the potential for the existence of this condition; including emergency management personnel as study participants.

Firefighters in the participating departments could have had a different perspective, institutional memory, and understanding from fire chiefs that might have broadened the emergent themes. I chose fire chiefs as the units of measure, because they set departmental priorities and agency focus, and they understood the extent of department assets and general capabilities.

Organization of this Study

The organization of this paper includes five chapters. The first chapter provides the background, relevance, and significance of the research question. The second chapter reviews salient literature on disasters, preparedness, and community capitals. The third chapter discusses the methodology used to accomplish research goals. The fourth chapter discusses results and the impact of these data on the current knowledge base regarding fire departments and preparedness for chemical disasters. The fifth and final chapter provides relevant discussion and conclusions as well as recommendations for future research.

Summary of Chapter I

In Chapter one, I provided an overview of chemical hazards in Northeast Oklahoma. Increased chemical production has caused an upsurge in shipments through rural communities. Multiple transportation corridors through the four most Northeast counties in Oklahoma, along with chemical use in various plants, have created a multitude of chemical hazards.

Throughout modern history, disaster preparedness for chemicals has been the responsibility of various agencies. However, public perception has resulted in the expectation that local government and fire departments be key stakeholders in chemical hazard and disaster event preparedness. There is a paucity of recent research into fire department preparedness planning; this study works to fill gaps in understanding, and to create new knowledge using findings from collected data. To wit, data are viewed through a community capital lens, revealing their impact on fire department chemical disaster preparedness in rural Northeast Oklahoma.

Chapter II

Literature Review

A review of literature on community capitals, fire department response and pre-planning, underscores the need for theoretical advancement of community capital impact on chemical hazard and disaster event preparedness. This chapter reviews salient literature, by discussing the definition of disasters and preparedness, and conducts an inventory of characteristics of resources in rural communities through the lens of the community capitals framework.

Disasters

Disasters are a product of social ebbs and flows, and the meaning has evolved over time. Multiple sources (Fritz, 1961; Quarantelli, 1985b, 1989; Quarantelli & Dynes 1977; Kreps 1984, 1989, 1995, 1998; Dynes, Quarantelli, and Kreps 1981; Drabek, 1989; Neal, 1997; Bailey, 1989; Comerio, 1998; Tierney, Lindell, and Perry, 2001; Drabek, 2005; Mileti, 1989), including a special 1989 edition of the International Journal of Mass Emergencies and Disasters, discuss the definition of disaster with little consensus. Disasters originally attempted to explain the negative events befalling an individual caused by the stars, sun, and moon (Quarantelli 1987b). The term evolved to include major physical disturbances like earthquakes, floods, and other natural events. Recent adaptations to the definition have introduced situations caused by "Acts of Men and Women" (Quarantelli 1987b, 9). Several authors (Dynes 1970 and 1983; Dynes, Quarantelli, and Kreps 1981; Kreps, 1989; Fritz, 1961; Lewis, O'Keefe, and Westgate 1977; Quarantelli 1998b) define disasters as an event occurring in a time and location, imparting danger, and resulting in social disruption. From the natural hazards viewpoint, people define

disasters as a physical situation affecting a vulnerable population (Lewis, O'Keefe, and Westgate 1977). According to Wenger and Weller (1973), disasters represent an event that poses a threat to a community uncontrolled by *institutional means* normally used for emergencies. There may never be expert consensus about the definition of disasters, because as with any socially defined term, it is dynamic. B.E. Aguirre (2006, 2) lends a definition that closely resembles the manner in which it is employed for this study, "..[d]isasters are the result of the combined effects of a hazard on a social organization that has a specific set of vulnerabilities and resiliences." For the purposes of this study, chemical disasters include releases that overwhelm the response capabilities of local and regional responders, governments, and interrupt the social continuum within communities.

Chemical disasters have different challenges than natural or other disasters. Several studies (Gill and Picou 1998; Faupel and Bailey 1988; and Ritchie 2004) note differences between natural and technological disasters, including etiology, property and material damage due to chemical properties, phases of disaster, effects to the community, impact to people, and how the event is viewed. Meteorological conditions further complicate the prediction of chemical release characteristics (Quarantelli 1987a). These variable meteorological conditions (wind patterns, precipitation and relative humidity) can alter the way in which a chemical release evolves. Multiple chemicals involved in an incident can further complicate planning due to the unpredictable nature of some chemical interactions; especially the initial response phase in which fire departments are most likely to participate (Faupel, Bailey, and Williams 1987). Proper remedial actions for one situation may not be proper for another, and chemical interactions may result in synergistic toxicological effects that are difficult to anticipate. There are differences between disaster types from the social science perspective as well. According to Picou, Gill,

Dyer and Curry (1990, 2), victims of technological disasters tend to show more "..anger, hostility, and rage than …victims of natural disasters."

Disaster Preparedness

There are multiple definitions of preparedness from within the field of disaster research. Neal (1997) noted that preparedness is the first of the early explanation of disaster phases, including preparation, response, recovery, and mitigation, so its definition should include measures taken to prevent or reduce potential impact. Although slightly altered in their order, the National Governor's Association document *Comprehensive Emergency Management: A Governor's Guide* (1979) included the same four phases, listing mitigation first, then preparation, response, and recovery. Several authors (Barton 1969, Dynes 1970, Neal 1997) have noted other phases (pre-emergency, emergency, post-emergency, pre-disaster, discovery, warning communication, warning, threat, etc.) included in disasters. Disaster phases overlap, are difficult to pinpoint in time, or the chronology of an event, and ultimately help us categorize or organize information. Multiple studies (Gillespie and Banerjee 1993; Banerjee and Gillespie 1994; Gillespie and Streeter 1987; Sims and Baumann, 1972; Rogers and Nehnevajsa, 1984; and Faupel, Bailey, and Williams 1987) identify preparedness as ensuring life safety, conservation of property; and decreased time, human capital, and cost of recovery. Two studies (Gillespie and Streeter 1987, Lindell and Perry, 1992) note that preparedness includes actions taken prior to an event to improve disaster response. Not only should preparedness reduce the impact of an event on the physical structures in a community, but planning should also aim to reduce "social hardships" experienced by people (Gillespie and Banerjee 1993). Preparedness planning should add to the capacity of response agencies to provide services in support of relief efforts during the response.

An indicator of community preparedness is the availability of resources with which to prepare. Several sources (Saenz and Peacock 2006; Cutter and Solecki 1989; Solecki 1992; Wenger 1978; Gray and Quarantelli 1983; and U.S.F.A. 2016) indicate that rural communities have fewer resources to prepare, and are more vulnerable to disasters. This vulnerability appears related to lack of experience, equipment, and personnel trained to respond to such incidents (Solecki 1992).

There are characteristics of preparedness that would reduce loss of life and injuries, and improve the effectiveness of organizational response. Several studies (Sutton and Tierney 2006; Tierney, Lindell, and Perry 2001; Perry and Lindell, 2003; Quarantelli 1982, 1987a, 1992, 1998b; Gillespie and Streeter 1987; Lindell and Perry 1992; U.S. DHS 2010, under "Developing and Maintaining Emergency Response Plans; Bowonder, X. Kasperson, and R. Kasperson 1985; Dynes 1970, and 1983; and Mileti 1989) reveal salient characteristics of preparedness. Table 1 lists these characteristics and their respective references.

A study by Faupel, Bailey, and Williams (1987) found that conditions experienced during a chemical disaster differ from natural disasters. The equipment, knowledge, and skills used to stop chemical releases are specialized within the fire service. However, according to the U.S. Fire Department Census, only 17.5 percent of fire departments have the capability to respond to hazardous materials incidents at the "technician" level of training (U.S. Department of Commerce 2015, under the "National Fire Department Census"). The function of some equipment used for hazardous material releases limits its usefulness in other capacities (Dynes 1970). This equipment includes chemically protective apparel, sampling tools and meters, software, longer duration breathing apparatus, and decontamination products used against chemical, etiological, and radionuclide contaminants. Lindell and Perry (1992) add to the list of

equipment including heavy equipment (bulldozers, excavators, etc.), monitoring, and data processing. Other specialized assets for chemical disasters include foam trucks, acid suits, clean-up materials, and neutralizing substances (Caplow 1984). New technologies including real-time sensing meters, software that blends chemical plume data with meteorological readings, and use of unmanned drones to map plumes; equip responders with new tools with which to make educated decisions.

Table 1. Preparedness Characteristics & Salient References

Characteristic	Source
Identify Hazards	Bowonder, X. Kasperson, and R. Kasperson 1985; Sutton and Tierney 2006; Lindell and Perry 1992
Assess Vulnerability	Bowonder, X. Kasperson, and R. Kasperson 1985; Lindell and Perry 2003; Sutton and Tierney 2006; Lindell and Perry 1992; Tierney, Lindell, and Perry 2001; Gabor and Pelanda 1981;
Mitigate Hazards	Bowonder, X. Kasperson, and R. Kasperson 1985; Lewis, O'Keefe, and Westgate 1977; Lindell and Perry 2003; Sutton and Tierney 2006;
Review and Acquire Assets	Gillespie and Streeter 1987; Lindell and Perry 1992, 2003; Quarantelli 1985b, 1987a; Sutton and Tierney 2006; Dynes 1970; Caplow 1984;
Develop Linkages & Aid Pacts	Quarantelli 1987a; Sutton and Tierney 2006; Gillespie and Streeter 1987; Lindell and Perry 2003; Quarantelli 1985b, 1987a;
Preparedness Planning	Bowonder, X. Kasperson, and R. Kasperson 1985; Dynes 1983; Gillespie and Streeter 1987; Lewis, O'Keefe, and Westgate 1977; Lindell and Perry 1992, 1997, 2003; Quarantelli 1982, 1985b, 1992; Gillespie and Perry, 1984; Sutton and Tierney 2006; Faupel, Bailey, and Williams 1987; Dynes, Quarantelli, and Kreps 1981; Caplow 1984;
Warning Systems	Bowonder, X. Kasperson, and R. Kasperson 1985; Gillespie and Streeter 1987; Lewis, O'Keefe, and Westgate 1977; Sorensen and Rogers 1988; Sutton and Tierney 2006; Lindell and Perry 1992; Tierney, Lindell, and Perry 2001; Betts 2003; Rogers and Nehnevajsa 1987;
Information	Bowonder, X. Kasperson, and R. Kasperson 1985; Ronan and Johnston 2005; Dynes 1983; Quarantelli 1987a; and Sutton and Tierney 2006
Records Systems	Lindell and Perry 1992

Chemical disaster preparedness includes adequately training responders within the community. A study (Connery, Krawczyk, Borton, and Moskovitz 2004) conducted in Western

New York identified a direct relationship between firefighter perception of preparedness for an incident related to a weapon of mass destruction and the amount of training activities performed. This study concluded that volunteers needed additional hazardous materials training opportunities.

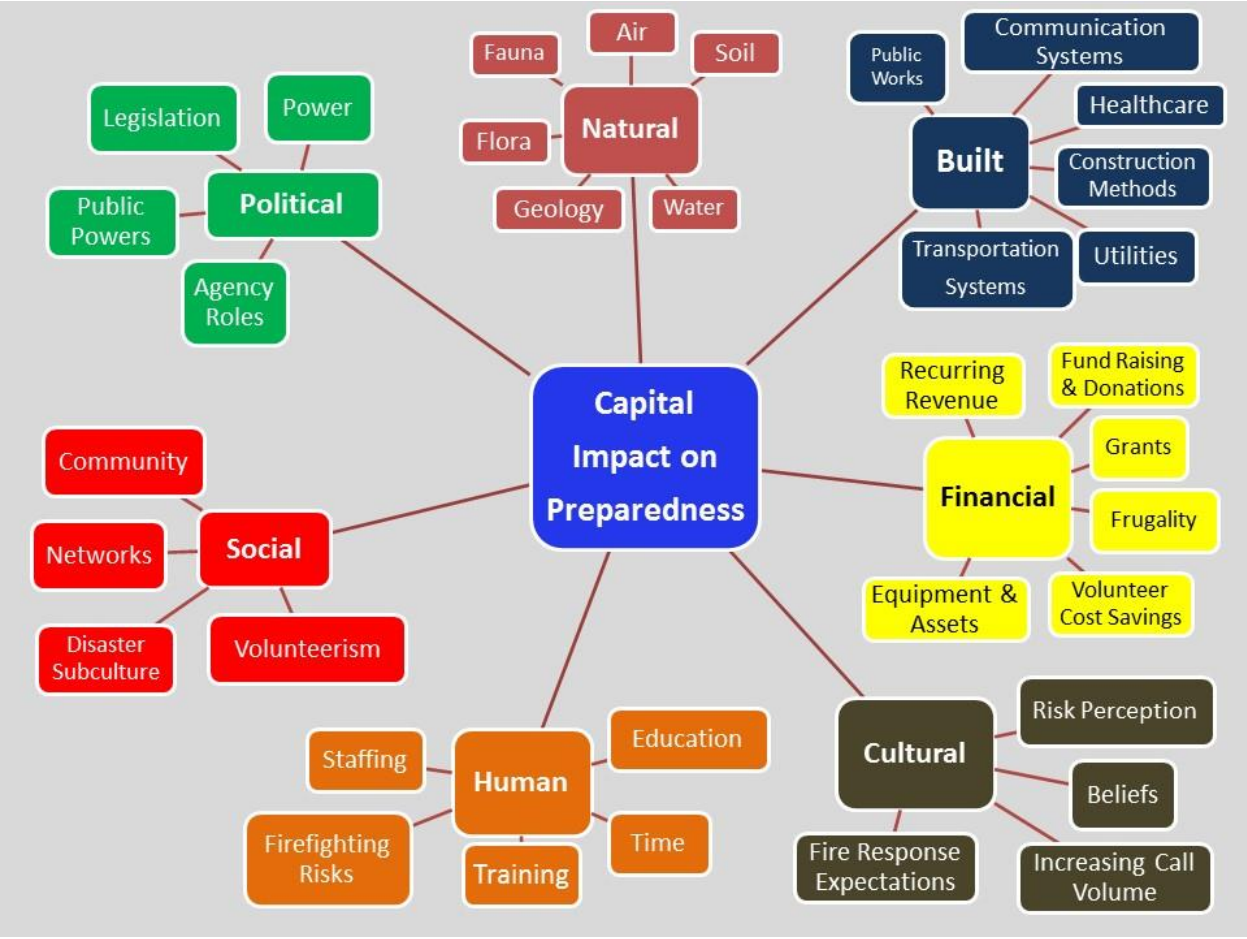
Findings from a chemical preparedness study (Gray and Quarantelli 1984) indicate that even though there are differences between chemical and natural disaster preparedness and responses, planners should consider a generic, rather than an agent-specific approach. Several sources (Tierney 1981; U.S. DHS 2011b, "National Preparedness Goal"; Rogers and Nehnevajsa, 1984; and Dynes, Quarantelli, and Kreps 1981) advocate the use of an all-hazards approach rather than agent-specific. By using an all-hazards approach for preparedness, planners can judiciously use resources that may be in short supply during a disaster (Rogers and Nehnevajsa 1984).

Community Capitals Framework

A community capitals framework views the material and intangible assets and capabilities contained within a community as a means to improve capacity. In a sense, communities try to better themselves through improving, or increasing their capital(s). As mentioned in chapter one, this study examines seven categories of community capitals, including natural, built, financial, human, social, political, and cultural. Within these main capitals exists sub-capitals specific to the community under study. Figure 2 contains a graphic representation of the sub-categories in this study. Communities build capacity through individual and organizational skills and technical knowledge, attracting industries with required technical proficiencies, strengthening abilities, improving collaboration with other organizations,

increasing and improving assets, and developing attitudes and a commitment to supporting community efforts (Simmons, Reynolds, and Swinburn 2011).

Figure 2. *Capital Impact on Preparedness*



Community resilience and vulnerability

The valuation of community capitals is implicit to the discussion of capacity building and improving chemical hazard and disaster event preparedness. Within the community capitals framework chosen for this study, examples exist of how resources bolster community resilience or create vulnerability to a chemical hazard or disaster event.

Researchers have extensively studied resilience in the disaster context. While the definitions vary, they include the capacity of a system to withstand the effects of a disaster agent and provide continued service with little or no interruption. The more resilient the system is, the

less capital it requires returning to full service following a disaster event. According to the *United Nations International Strategy for Disaster Reduction* (2009), the definition of resilience includes, "[t]he ability of a system, community, or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions." Other authors (Kendra and Wachtendorf 2001) indicate that resilience includes the ability to "bounce back" from a disruption. The manner in which this study uses resilience is closer to the definition provided by Aguirre (2006), who examines a "..physical, biological, personality, social, and cultural systems' capability to effectively absorb, respond, and recover from an internally or externally induced set of demands."

The term vulnerability means a system that is susceptible to a hazard agent under certain circumstances. Vulnerabilities are also dynamic and they evolve with policies, social or cultural beliefs, economic conditions, and built components within the community. When planners identify vulnerabilities, they concentrate on reducing or eliminating the causal factors that created the vulnerability; also known as mitigation. When the process of system reconstitution occurs, it can result in increased safety for communities (Aguirre 2006). As discussed in the preparedness section, earlier in this paper, mitigation is a component in the phases of disaster (or the disaster cycle), and includes activities that reduce vulnerability. If a transportation system is vulnerable to flooding, due to its road height, mitigation planning may include things like raising the height of a road to a level above flood stage, so that the transportation system is unaffected by rising water.

The following section examines resilience and vulnerability within the seven forms of community capitals and their impact to chemical hazard and disaster event preparedness. During

the data reduction, it became apparent that some forms of capital created both resilience and vulnerability. For instance, a ranch with grazing lands would be susceptible to a chemical leak that killed the grass or cattle; a vulnerability. However, knowledge of this vulnerability and heightened risk perception toward a chemical release, could bolster preparedness planning, and the support for planning could be considered a resilience.

In the same manner as resilience and vulnerability, capitals sometimes appeared to have duality of interpretation, and many forms of capital did not solely exist within a single category; many overlapped into other forms of capital. For instance, the use of firefighters to exact repairs on apparatus increases available financial capital in the form of savings from not paying a mechanic; and would fall into the financial capital category. However, the use of human capital in this manner instead of having them conduct training, preparedness planning, or other activities falls within the human capital category; both would appear the correct location for this topic, and often was dependent on context.

Natural Capital

Natural capital is the capacity of a community's living environment to sustain biological activity, provide resources with which a community can support cultural and social interaction, and be converted to other forms of capital. Within the environment, there exists many forms of natural capital, including air, soil and geological formations, water, flora and fauna, and their relationships. Each of these categories has resilience and vulnerabilities in relation to preparedness. A technological disaster could easily damage natural capital, or its intrinsic or perceived value, impacting individuals and the communities in which they live. If the community values their natural capitals, pressures to protect them should exist.

Resilience

Human contact with the environment, both flora and fauna, has been shown to improve health conditions, lower stress, and improve the quality of life. Several sources (Frumkin 2001; Staats, Kieviet, and Hartig 2003; Kaplan 1995) indicate that human interaction with animals, plants, and natural landscapes like those found in parks and golf courses bring about feelings of tranquility and peacefulness. People can achieve a feeling of *cognitive calm* and *clarity* when they focus on a serene natural setting or when removed from the *cognitive clutter* found in urban communities. People can achieve this feeling of peace through either allegorical or geographical distance (Staats, Kieviet, and Hartig 2003). According to the Oklahoma Water Resources Board Comprehensive Water Plan (2011, 10) forests and rangelands are increasingly being utilized for "non-production benefits." The report also adds that as population migration continues from major metropolitan areas, people are increasingly seeking sparsely populated neighborhoods, large open landscapes, and "recreational experiences." When people view or market natural capital as attractive, it can be converted into human capital with the migration of people into a community.

While the natural environment provides many resources to these four counties, it is fragile and is susceptible to harm from potential and actual pollution sources (agricultural chemicals from runoff and irresponsible farming practices, residential sources, recreational or transient sources, increased industrial or commercial loads, rural road construction, and ambient wind-blown debris), weather patterns, and seismic events. In communities where technological disasters have struck, there is often a feeling that the environment is a damaged good; resulting in several likely outcomes, including a perceived loss of property value, insecurity about employment continuity, and unknown health risks cause people to relocate for the good of their

household (Gill and Picou, 1991). The ability to utilize the natural capital, or to convert it to financial capital, resides in its quality. To put it plainly, there will be few buyers of polluted drinking water, or a swimming beach contaminated with toxins or algal blooms. When toxic exposure from technological sources is unknown, there is a potential for decreased property and neighborhood values when people assign them the stigma of being damaged goods (Gill and Picou 1991). During the Livingston Train Derailment there was actual environmental pollution, but not in the built environment, and the public perception persisted that they were highly at risk (Picou, Marshall, and Gill 2004). This perceived risk could result in support for chemical disaster preparedness planning.

Built Capital

Built capital includes those physical infrastructure components that support life, allow restoration of services, and affect resilience against the impact of a disaster. Community infrastructure provides the vital "lifelines" that allow businesses and residents to exist (U.S. DHS 1997, 6, under "Report on Costs and Benefits of Natural Hazard Mitigation"). In their document on community resilience, the Federal Emergency Management Agency considers decision makers within infrastructure organizations (public works, etc.) crucial to the preparedness process. This form of capital provides the backbone to support human activity (Flora and Flora 2008). Built capital includes components such as transportation systems, communication infrastructure, residences, and public buildings that house critical and supportive services that allow citizens to conduct day-to-day activities. These resources can vary with respect to availability and exclusivity, especially to those in outlying areas.

However, as Flora and Flora (2008) point out, communities are more than their built capital. Infrastructure projects designed to improve the quality of life for community members

can actually harm them or displace the target population if poorly designed. One case study showed that an increase in ethanol plants resulted in a local economic boom for several Iowa communities, but resulted in increases in the cost of land and corn, ultimately inhibiting agriculture in these rural locales (Flora and Flora 2008).

Resilience

Capital conversion can occur, turning built public capital into semi-private (or fee-based) services to generate income (or financial capital). Flora and Flora (2008) show an example of how the Bethel, MD fire department provides fire protection to neighboring towns, and charges a flat fee for response availability of apparatus, and then a per-response fee that ultimately covers staffing costs, and other overhead related to the response. This case resulted in increased fire department revenue, and "presumably…a higher level of fire protection available to the smaller communities" (Flora and Flora 2008, 216).

Healthcare and Medical Facilities

One of the factors in the attractiveness of a geographic location includes services available to community residents. When families consider moving to an area, one of the services important to potential residents is healthcare facilities. Well-developed medical services can result in attractiveness to potential community members, bolstering human capital when migration occurs.

Public Service Buildings and Parks

Emergency managers and responders can often utilize public buildings and facilities during a disaster for multiple functions. Public buildings can provide an opportunity to act as shelters, a central location for data collection, and can serve as an information clearinghouse during disasters. Public officials often use fire, police, and emergency service buildings for kid

safe zones, temporary shelter during emergencies, and as a central distribution point during water rationing or for mass immunizations. These public buildings can provide opportunities for planning without additional costs associated with hiring, renting, or otherwise paying fees for short-term disaster facilities.

Tornado Shelters

Northeast Oklahoma lies in an area affectionately known as *tornado alley*. Tornado shelters in Oklahoma are commonplace, and although many sources indicate increased risk from community shelters, some rural locales have built them as a service to their residents. The presence of these shelters indicates a community's willingness to conduct preparedness activities and to the dedicate resources to increase community safety.

Transportation Systems

Transportation systems have been strongly entrenched in American society. Self-ownership of automobiles and establishment of a robust freeway system in the United States has built a culture of reliance on transportation systems. These systems are vital to first response organizations, for commerce before and after a disaster, debris removal, and recovery operations. Damage to this built form of infrastructure can leave a community isolated, and can place commerce at risk (U.S. DHS 1997, under "Report on Costs and Benefits of Natural Hazard Mitigation").

Vulnerabilities

Human Healthcare Facilities

There are several obstacles to establishing reliable healthcare for residents. According to Flora and Flora (2008), rural healthcare is lacking, due to fiscal challenges. These challenges are further complicated due to federal healthcare regulations and medical insurance. A large

component of rural populations includes the elderly who receive Medicaid, and rural healthcare facilities experience financial problems related to a lower rate of reimbursement than urban facilities (Flora and Flora, 2008). Rural clinics and medical service providers experience financial pressures and are often forced to close or reduce services. When these medical providers close, the community may view this as a liability to potential residents.

Financial Capital

Financial capital includes savings, liquid assets, cash-on-hand, material resources, and other budgetary allowances that can be spent during times of a disaster, or those spent during mitigation, planning, or recovery. The need for expending financial resources differs for each disaster, and each phase within a disaster. Communities are sometimes better suited to keep financial capital as liquid assets rather than spending it on a physical resource; that may not be suited to a singular situation. In addition to liquid financial resources, available credit is also critical, allowing communities to fund gaps in budgetary allowances.

Resilience

Fire Department Funding

According to the FEMA Document *Funding Alternatives for Emergency Medical and Fire Services* (U.S. DHS 2012a), the main funding sources for these agencies include, taxation, user fees, enterprise funds or utility rates, sales of assets, benefit assessments, borrowing, foundation grants, corporate giving, and program-related investments. This same DHS document lists typical fire department fund raising opportunities, including raffles, bingo, athletic tournaments, fun runs, and other methods (U.S. DHS 2012a). Annual fund raising efforts can create legacy giving and can build social capital, additional interest providing human capital for fire departments, and opportunities to build support for preparedness planning.

Assets and Material Resources

Fire departments already own some of the commonly used equipment found valuable during a hazardous materials disaster (turnout gear with a vapor barrier and self-contained breathing apparatus), but they are rarely adequate to protect firefighters from exposure. However, as a report (U.S. DHS 1987) on an evacuation at a chemical plant in Naticoke, Pennsylvania reveals, when dealing with a fire involving large quantities of hazardous materials, additional equipment (specifically large numbers of breathing apparatus already owned by fire departments) may be required. Gaining and pre-positioning resources ahead of a disaster is important to preparedness (Quarantelli 1998a). In their Bakken crude oil report, the Congressional Research Service indicated that a history of Bakken crude releases, as well as the severity of these disasters, could lead to communities asking for resources to increase response capability. Included in the response resources were "…personnel, training, equipment, and community notification…" (U.S. Congressional Research Service 2014, 22, under "U.S. Rail Transportation of Crude Oil: Background and Issues for Congress). This led to an agreement between the U.S. DOT and the American Association of Railroads resulting in the requirement that railroads inventory hazardous materials assets and resources on routes over which key Bakken crude oil shipments operate (U.S. DOT 2014b, under "Letter to the Association of American Railroads"). This inventory includes rail routes within all four counties in the area of study, and is available to local emergency responders upon request.

Funds and Reimbursement

Some fire departments seek financial restitution following emergency responses. This reimbursement occurs when fire departments invoice the responsible party to recover funds spent in the purchase of personal protective equipment, training, specialized tooling, and labor that was

dedicated to the response effort. Early EPA regulation called the Comprehensive Environmental Response Compensation and Liability Act provides for public agencies to recover these funds at waste sites. The U.S. EPA has also developed a reimbursement grant program that repays some funds to qualifying local governmental agencies for response costs of hazardous materials incidents (U.S. EPA 2017a). While the time spent by volunteers is "free," the fire department can bill for their time and use the funds to purchase new or improved resources.

Vulnerability

Community Financial Resources

In a study conducted by Faupel, Bailey, and Williams (1987) an official said that local decision makers were not willing to fund disaster preparedness until after a disaster hits. Disaster-related preparedness must compete with other organizational priorities; and planners utilize limited resources for the most perceived benefit (Tierney, Lindell, and Perry 2001). Communities adopt a belief that money could be better spent on activities other than preparedness efforts. Thus preparedness activities are inhibited because they are viewed as a luxury during times of economic downturn (Tierney 1981). Both a decrease in disposable income and time with which to conduct preparedness activities inhibits preparedness planning (Fritz 1961). Hildebrand (1980) indicates that funding was the primary limiting factor to completing plans, and conducting development, and training.

According to a study on the impact of Hurricane Katrina, rural communities tend to be more impoverished ($10,000 dollars less per-capita than disaster affected urban areas), with lower education levels, that affect loans and other financial assistance (Saenz and Peacock 2006). These rural communities also have smaller governing bodies, fire departments have fewer resources available, and less support from local business partners (Wenger 1978; Gray and

Quarantelli 1983; Solecki 1992). Rural community fire departments must find alternative sources of funding with which to meet their agency mission.

Assets and Material Resources

Fire department funding is dynamic, and resources such as sales tax revenues, fund raisers, and memberships can easily change year-to-year; basing budgetary forecasts on a dynamic sales tax is fraught with potential error. According to the National Volunteer Fire Council *Volunteer Fire Service Fact Sheet* (2016), the cost to provide a firefighter with training and equipment is approximately $27,095. This amount pays for basic firefighting protective ensemble, and does not address chemical specific protective clothing or equipment.

Chemical protective equipment and clothing is extremely expensive, requires a maintenance and inspection program, and is not useful for other types of response. Smaller rural communities are economically depressed and do not have the infrastructure required to adequately respond to hazardous chemical disasters (Faupel and Bailey 1988; Solecki 1992). These communities are less likely to possess chemical emergency response equipment and materials than larger communities (Quarantelli 1988). Chemical emergencies require two things that traditional emergency response organizations may not possess; specialized equipment and trained personnel (Faupel and Bailey 1988).

Many resources needed for chemical disaster response may not be locally available during the initial phase. Chemical disaster resources are mostly in the possession of state and federal response agencies instead of local disaster relevant organizations (Quarantelli 1987a). Local fire departments and community members assume that outside resources will arrive to aid them in resolving a release. Faupel, Bailey, & Williams (1987) write that planners may be well suited to rely on mutual aid, but is not a substitute for integrated planning efforts. This

assumption could explain why fire departments limit their planning for disasters, and why little effort is put into assessing aid resources and obtaining them (Tierney 1981).

Human Capital

Human capital is the intrinsic value contained within community members, including knowledge, skills, disposable time, and other characteristics. According to Flora and Flora (2008, 84), "..[h]uman capital includes those attributes of individuals that contribute to their ability to earn a living, strengthen community, and otherwise contribute to community organizations, to their families, and to self-improvement."

Resilience

Staffing

The volunteer fire service has a strong history in the United States, refuted by the number of current volunteer fire departments. According to the National Fire Protection Association, *U.S. Fire Department Profile Through 2014,* there were approximately 748,000 volunteer and mostly volunteer fire departments in the United States (NFPA 2016c). Literature supports the extensive amount of time, increasing expectations, and activities volunteer firefighters are dedicating to their department. However, one study (Thompson III and Bono 1993), indicates that even though the time devoted to volunteering is extensive, 69 percent of respondents indicated that they "..never considered resigning." In a study of the Ulster County volunteer fire company, Thompson III (1993) found that 57 percent of the volunteers were born in the community they served, and 92 percent had no intention to move away. The commitment of volunteer firefighters is "enduring."

Education and Training

There are differences between the terms education and training of individuals, education implies provision of information to recipients about a subject. Educating the community or responders over chemical hazards could include sharing the results of commodity flow studies, chemical properties, and appropriate responses to a release. Training is the practice of physically applying techniques or equipment to a given scenario. An example of these differences would be a firefighter educated in fire science versus practicing deployment of hose lines and attacking fires in a burn building under controlled conditions.

Rural communities, in which chemical and other technologically based industries are becoming increasingly prevalent, are also growing by way of human capital. Due to lower median incomes and education levels, manufacturers utilizing complicated technologies are more likely to relocate to rural areas (Flora and Flora 2008). These manufacturers provide technical education and training to their employees and support advanced college degrees. The low cost of living, advantages to life in a rural community, and ease of commuting, can attract highly educated and specialized employees to these areas. This relocation can provide employment and educational opportunities for community residents, along with financial investment in the local economy. Increased human capital with technical knowledge and abilities can result in a rich pool of firefighter candidates and support for chemical disaster preparedness activities.

One component of planning and preparedness includes knowledge of chemical hazards. While risk perception varies, and there will be no agreement about the level of risk posed from a chemical hazard, general acceptance of risk and the need to prepare exists. Public officials, response agencies, and the community need to be educated in the planning process to ensure the information is accurate and transparent. Public awareness and knowledge of plans is useful in

maintaining solidarity among community members and responders. Emergency planners can reinforce the importance of conducting preparedness activities, as well as bolstering personal and familial-level preparedness, through public education. In a study regarding the Bhopal disaster, Bowonder, Kasperson, and Kasperson (1985) write that neither local preparedness officials nor hospitals had information regarding chemicals stored at the Union Carbide plant. Knowledge of these chemicals could have helped residents protect themselves and establish guidelines for medical treatment. Tierney, Lindell, and Perry (2001) reveal that the primary goal of disaster preparedness is to provide information and planning not just to responding agencies, but to empower families, businesses, and organizations to plan for, and respond appropriately, during a disaster. If the public understands the specific hazard's etiology, they will take measures commensurate with the risk to protect themselves (Rogers and Nehnevajsa 1984). By increasing personal and family-level capacity to cope with a disaster involving a specific hazard, emergent disaster response from individuals will increase and the capital needed to support public self-rescue efforts will be less. Conversely, if a hazard is misunderstood, community members are not able to mitigate it through behavioral changes or preparedness (Dynes 1970). People miscalculate the risk of a hazardous chemical release because they are “ill-informed” (May 1989, 299). This reinforces the notion that the education process for policy makers and stakeholders is critical in understanding the hazards and subsequently, gaining support from community members and elected officials for the planning process.

Fire department personnel have a dual role, in the expectation that they be knowledgeable about the chemical hazards in their jurisdiction, as well as having a need to pass that information on to community members. Education programs are important for response agencies to understand their organizational roles and expectations, as well as for other agencies to facilitate

effective incident resolution (Faupel, Bailey, and Williams 1987). Responders should be educated over information contained within plans, known chemical hazards, behavioral responses, and understanding warning systems. Education allows a transfer of hazard assessment and vulnerability information, as well as roles and expectations of responders, which reduces misunderstandings during a disaster; this idea is the fifth of Quarantelli's (1982) ten principles of disaster planning. Knowledge of community hazards is key to assessing resources appropriate for response.

Training allows for understanding and practice of decision making under controlled conditions. Fire departments can identify vulnerabilities in their actions, equipment, and response plans, when they physically apply techniques using local resources. Responders become familiar with locally available tools and methods of effective application. Training among different fire stations and departments helps responders familiarize themselves with tools and capabilities of others with whom they may interact during a mutual aid request.

Vulnerabilities

Staffing

Historically, staffing for volunteer fire departments has been a challenge. The National Fire Protection Association *U.S. Fire Department Profile Through 2014* (2016) indicates that the number of volunteer firefighters in the U.S. has decreased 12.2 percent since 1986. Rural fire departments have fewer personnel available to respond and train over mitigation (Gamache, Hall, Ahrens, Penney, and Kirtley 2008). The U.S. Fire Administration (U.S. DHS 2007) lists general reasons for firefighter staffing losses, this list is included in Figure 3

Figure 3. *Next Page. Retention and Recruitment for the Volunteer Emergency Services*, FEMA, under U.S. DHS, Publication number FA-310 (U.S. DHS 2007).

Figure 3.

Retention and Recruitment Root Causes

SOURCES OF PROBLEMS	CONTRIBUTING FACTORS
Time Demands	• the two-income family and working multiple jobs • increased training time demands • higher emergency call volume • additional demands within department (fundraising, administrative)
Training Requirements	• higher training standards and new Federal requirements • more time demands • greater public expectation of fire department's response capabilities (broader range of services such as EMS, Hazmat, technical rescue, etc.) • additional training demands to provide broader range of services • recertification demands
Increasing Call Volume	• fire department assuming wider response roles (EMS, Hazmat, technical rescue. • increasing emergency medical call volume • increase in number of automatic fire alarms
Changes In The "Nature Of The Business"	• abuse of emergency services by the public • less of an emphasis on social aspects of volunteering
Changes In Sociological Conditions (In Urban And Suburban Areas)	• transience • loss of community feeling • less community pride • less of an interest or time for volunteering • two-income family and time demands • "me" generation
Changes In Sociological Conditions (In Rural Areas)	• employers less willing to let employees off to run calls • time demand • "me" generation
Leadership Problems	• poor leadership and lack of coordination • authoritative management style • failure to manage change
Federal Legislation And Regulations	• Fair Labor Standards Act interpretation • "2 in, 2 out" ruling requiring four firefighters on scene befor entering hazardous environment • Environmental Protection Agency (EPA) live-fire burn limitations
Increasing Use Of Combination Departments	• disagreements among chiefs or other department leaders • friction between volunteer and career members
Higher Cost Of Housing (In Affluent Communities)	• volunteers cannot afford to live in the community they serve
Aging Communities	• greater number of older people today • lack of economic growth and jobs in some towns
Internal Conflict	• disagreements among departmental leaders • friction between volunteer and career members

Although these are many of the reasons for firefighters leaving the fire service, the U.S. Fire Administration (U.S. DHS 2007) poses general themes for firefighter staffing losses, as increasing demands on limited time in a "hectic modern society," more stringent training requirements, rural population shifts to urban communities, declining sense of civic duty, and

changing economic conditions. According to a weblog entry titled, *Challenges of Rural Emergency Management,* rural areas have experienced a decline of population due to young residents moving to urban areas (Dianna Bryant, Homeland News Blog entry May 16, 2015). According to Thompson III (1993), one of the strengths of belonging to a fire department (friendships, family connections, etc.) may actual inhibit new volunteers joining the department due to their recruitment practices. Thompson III also points out that recruitment needs to extend beyond tradition methods to include a more diverse population reflective of community demographics (females, minorities, etc.).

The availability highly trained and motivated personnel is an indication of a fire department's ability to effectively achieve their mission and to serve the public good (Fleming 2010). A case study of a rural Alabama county's chemical disaster preparedness found that a lack of experienced response personnel was the most serious limiting factor (Faupel, Bailey, & Williams 1987).

Lack of leadership is one cause for staffing loss identified by the U.S.F.A. document *Retention and Recruitment for the Volunteer Fire Service* (U.S. DHS 2007). Like in business, people leave an organization for a number of reasons, one of which is lack of inspiration or leadership from their manager. As indicated in the U.S.F.A. recruitment document (U.S. DHS 2007), tactics used to combat a structure fire may not be suitable when dealing with administrative functions at the fire station. Being a good manager of volunteers is a skill, and providing direction, being flexible, and fostering firefighter worth is crucial to retention.

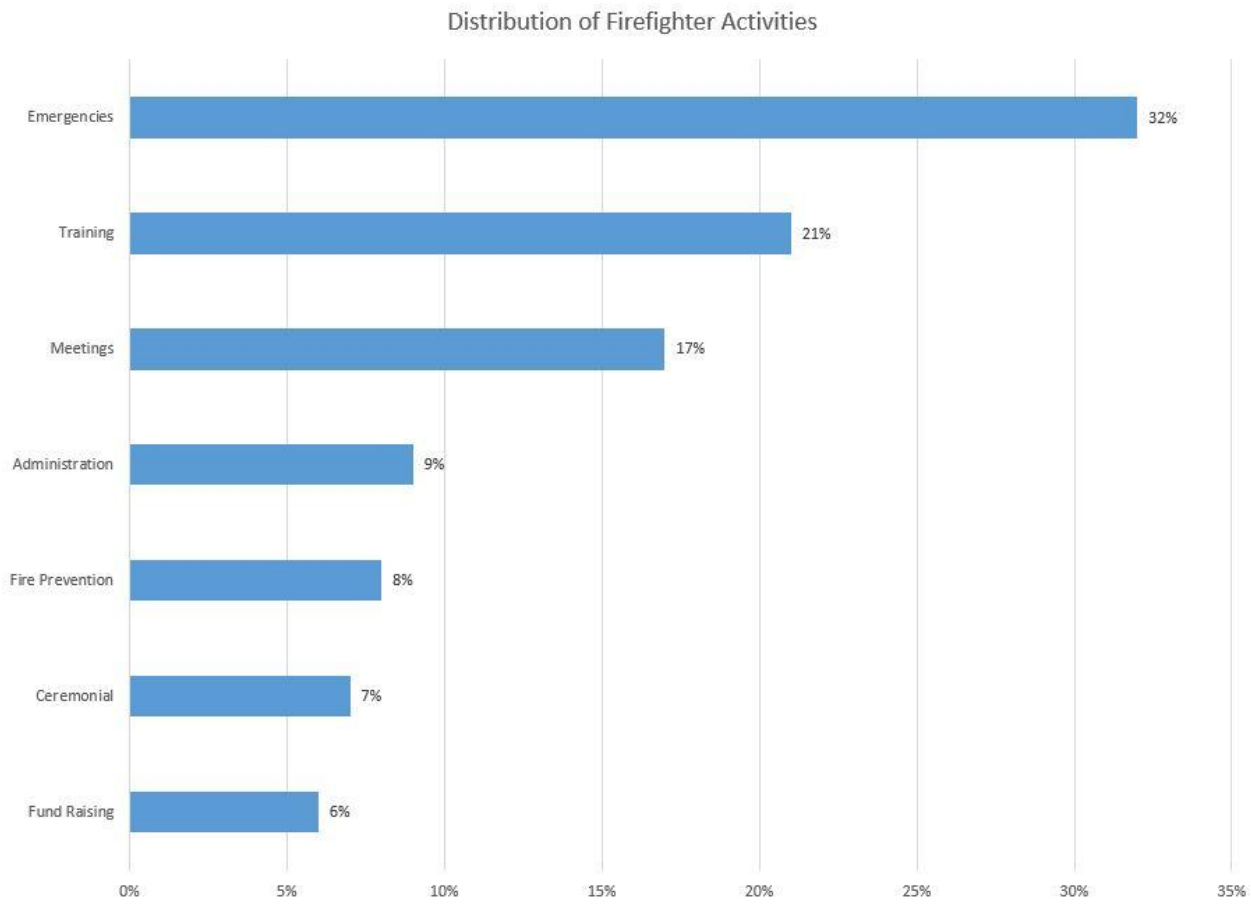
While the number of available volunteer firefighters is decreasing, the frequency and variety of responses is increasing. According to the National Fire Protection Association ("Fire Department Calls" 2016), the number of fire department responses in the United States has

increased 311 percent since 1986. Many of these responses include false alarms, increases in the community expectations to respond to minor medical emergencies (simple fractures, illnesses, etc.), and calling the fire department instead of a general laborer to help with electrical questions, or other situations to which the public expects the fire department to respond (U.S. DHS 2007).

Time

Becoming a firefighter "…is one of the most time-demanding volunteer activities today…members in the departments typically contribute 20 to 100 hours per month or more" (U.S. DHS 2007). Jacobs (1976) found that an average volunteer firefighter donates 15-20 hours working on equipment, training, attending meetings, and responding to actual emergencies. A study by Thompson III and Bono (1993) indicated that on average, volunteer firefighters included in their study devoted 4.54 hours per week; which equated to 25 percent of their "free time." A joint-funded study conducted by the Public Safety Institute of Saint Joseph's University revealed that 92.3 percent of respondents identified lack of time as the primary reason for leaving their volunteer organization (U.S. DHS 2007). According to the National Volunteer Fire Council *Volunteer Fire Service Fact Sheet* (2016) duties of volunteer firefighters often include emergency response with little notice, training, fundraising, equipment maintenance, and administration. Time constraints, along with the additional costs of regulatory changes have resulted in a large drop in volunteer firefighters (Stocker 2004-2005). Thompson III and Bono (1993) broke down the activities of volunteer firefighters; Figure 4 contains a list of these activities.

Figure 4. *Next Page. Data Adapted from* Thompson III and Bono (1993) "Work Without Wages" *The American Journal of Economics and* Sociology 52, no. 3 July (1993): 323-343.



According to Trainor and Barsky (2011) the roles of emergency responders are in direct competition with family expectations and need fulfillment. Thompson III and Bono (1993) lend that training time by emergency responders is increasing, due to the "…need for expertise in emergency medicine, hazardous materials, and occupational safety and health." An article (Atkinson and Wildermuth 2013) published in *Fire Engineering* discussed the struggle between familial and fire department commitments; factors included scheduling, planning, childcare, being flexible, the importance of communication in joint decision making. According to a study of a volunteer fire company in Ulster County, NY, Thompson III (1993) found that 82 percent of participants acknowledged frequent or occasional family interference; only 4 percent replied that their family supported their firefighting commitment. Volunteer firefighters have decreasing flexibility at work, and increasing calls from other organizations for volunteers, competing for

limited leisure time available with which to conduct fire department activities (Smith 1978). According to Fritz (1961) a decrease in disposable personal time inhibits preparedness activities that volunteers can conduct.

There are several obstacles associated with planning. Hildebrand (1980) writes that personnel turnover in preparedness planning is a problem, and maintaining continuity during transitions is difficult, if not impossible to achieve. Many situations inhibit people from participating in preparedness activities, including time constraints (Sutton and Tierney 2006). Unless planning teams meet on a regular basis, and with support from local elected officials, they have difficulty legitimizing time spent on meetings and planning efforts (Dynes, Quarantelli, and Kreps 1981). One study (Hildebrand 1980) adds that limited resources and time have resulted in reduced disaster drills.

Under the Emergency Planning Community Right to Know Act fire department participation in chemical disaster planning is required, as well as other governmental organizations, including elected officials, police departments, and environmental and public health agencies. Non-governmental organizations such as community and grass roots environmental groups, hospitals, transportation personnel, media, and local companies who use chemicals are also required to participate as part of the countywide local emergency planning committee membership (U.S. EPA 2014a, under "Emergency Planning Community Right-to-Know Act"). Surprisingly, Lindell and Perry (1992) find that emergency services (fire and police departments) are involved mainly in implementing plans and policy, and only secondarily in the plan development process.

Fire departments are supposed to be included in these countywide local emergency planning committee meetings for understanding their roles, getting to know other stakeholders,

and for communication in the event of a chemical release. The U.S. EPA document *2008 Nationwide Survey of Local Emergency Planning Committees* study found that rural committees have problems retaining members due to employment and familial commitments (2014a). The same document on planning committees noted a lack of membership interest as the most frequently referenced reason for planning committees not having met in the past 12 months (U.S. EPA 2014a).

Education and Training

Current-day firefighter training requirements are greater than in the past. According to a U.S. Fire Administration document (U.S. DHS 2007), consensus standards developed by the National Fire Protection Association have increased ". . . both classroom and practical requirements." This same document reveals that increases in training required of firefighters, include basic firefighting skills, medical training, and federally mandated hazardous materials training, and can take as long as a year (U.S. DHS 2007).

According to their study on the impact of Hurricane Katrina, Saenz and Peacock (2006) reveal that rural communities tend to have less education per capita. In order to effectively plan for, and manage, chemical disasters some technical knowledge of chemistry, weather patterns, toxicology, and of the social sciences is needed. The education and training levels in rural communities generally lags their urban counterparts (Flora and Flora 2008). In these communities, where the average level of education is less than urban areas, technical knowledge may not be readily available. There are several factors reducing the attainment of advanced degrees including, but not limited to, socioeconomic conditions and family resistance to educating their children, and cultural beliefs that formal degrees are unnecessary. According to

Flora and Flora (2008), rural poor may actually resist sending their children to formal post-secondary schooling because they see little value in it affecting earning potential.

There are definite benefits (ability to self-rescue, taking proper actions for the hazard, etc.) to the fire department providing chemical hazard information to the community. The use of local school systems to disseminate information is very effective. When families receive information through the school system they pay attention to the communication and take protective actions to prepare for hazards (Ronan and Johnston 2005). Knowing about disaster plans can help families anticipate response activities of agencies and to develop strategies for their own family response. In the article reviewing the Bhopal disaster, Bowonder, Kasperson, and Kasperson (1985) lend that if the public has resources and an understanding of proper response measures, they will be able to conduct self-rescue and reduce the number of the casualties. Planning should include the school system, helping to provide a public forum for preparedness activities (Faupel, Bailey, and Williams 1987). However, planners rarely educate and engage the public when creating and framing warning messages (Betts 2003). And, while the provision of information to the community is critical for their own risk perception, it does not always mean that those members and their families will adopt preparedness measures (Basolo et al. 2009).

Planners need to be prepared to provide accurate information and resources to impacted populations. Knowledge of specific community hazards allows planners to anticipate likely events and to provide a solid base for preparedness activities (Sutton and Tierney 2006). In revisiting the Bhopal disaster, Bowonder, J. Kasperson, and R. Kasperson (1985) the authors indicated that provision of information to the community (emergency manuals; evacuation plans; toxic chemicals stored at the plant, their properties, toxicity, and treatment options) would have

better prepared the public to protect themselves. The provision of information to community members, even off-the-shelf, simple, readily identifiable, and proper measures is incredibly important for effective preparedness. In the lack of information sources, people will utilize their own sources, which may lead to inaccurate information and improper response actions. Conversely, there is not a direct correlation between provision of information and preparedness planning at the community level (Ronan and Johnston 2005). Even with the availability of information for preparedness planners, conditions change throughout the evolution of a chemical release, causing questions as to the identity of the chemicals and appropriate protective actions.

Risks of Firefighting

The U.S. Fire Administration document *Critical Health and Safety Issues in the Volunteer Fire Service* (U.S. DHS 2016), indicates that "[w]hile the number of volunteer firefighters is declining; the age of volunteer firefighters is increasing." Recent publications have highlighted the need to provide for the health and wellness needs of firefighters. National statistics from the U.S.F.A. document *Firefighter Fatality Summary Incident Report* indicated that there had been 513 volunteer firefighter deaths in the United States from January 11, 2006 through December 22, 2015 (U.S.F.A. 2016). Of those deaths, 60.2 percent involved emergency duty, 59.5 percent of the deaths involved stress or overexertion, 55.4 percent were due to heart attacks, and 72.1 percent involved firefighters over the age of 40. These statistics suggest that there is a problem in the volunteer fire service of cardiac-related emergencies, occurring during or immediately following an emergency response and the problem is going to get worse as the median age of volunteer firefighters increases. In the same U.S.F.A. (2016) document, changing fire department priorities are discussed, specifically indicating programs like behavioral and physical fitness take place after other critical needs such as equipment and gear are resolved.

Social Capital

Social capital has many definitions, several authors (Ritchie and Gill 2007; Flora and Flora 2008) define social capital as group-level phenomena that includes trust between linkages, networks, and shared norms. Social capital includes bonds or ties that attract and hold a person to a community, like emotional safety, a sense of belonging, personal stake, and common symbol systems (McMillan and Chavis 1986). In a sense, social capital is an immeasurable series of bonds between members of groups without the expectation of reciprocal actions based on a mutually shared set of values. One study defines social capital as "…a person's or group's sympathy towards another person or group that may produce a potential benefit, advantage, and preferential treatment for another person or group of persons beyond that expected in an exchange relationship" (Robison, Schmid, and Siles 2002, 19). Several sources show a positive correlation between strong social support systems, "overall well-being," and the ability to cope with health issues (Ritchie and Gill 2007, 111). This form of capital can manifest itself in many ways, including volunteering in civic groups, donating to charities, and putting oneself in harm's way to protect another (Robison and Flora 2003). Social networks, and members of a group or community, contain social capital (Dynes 2006). Within social capital, there are several subtypes of performance and expectations. Ritchie and Gill (2007) discuss formal (public organizations, community groups, etc.) and informal (interpersonal, familial, friendships, etc.) subtypes. Within these subtypes, there are varying levels of familiarity, trust, and expectations for reciprocity.

Volunteerism

Several motivational factors drive volunteerism, including incentives (material, services, discounts, etc.), relationship building, and varying psychological feelings of contribution. According to a study by Thompson III and Bono (1993), the motivation behind volunteering as a

firefighter include (in order of intensity), helping the community, making a "real" contribution, firefighter friendships, being in control, excitement, raising self-esteem, prestige, lower taxes, and job opportunities. A study by Carpenter and Myers (2010) reveals that altruism is the primary motivating factor behind deciding to volunteer. Regardless of the sense of altruism related to volunteering, there will always be some component of "psychic reward" or satisfaction from personal performance or anticipated actions (Smith 1981).

Communities with good social capital tend to have strong bonds, increased security, and well developed social support networks. When social capital is lacking, there is little engagement or *sense of community*, an inability to change, and individuals resist acting independently (Flora and Flora 2008). These areas also experience greater crime rates and the citizens have health problems related to stress and hypertension. Developing a sense of community, where people watch out for each other, and everyone is supported by the community networks and philanthropic efforts fosters a welcoming environment. In communities with these characteristics, support for civic organizations like volunteer fire departments increases, making improvements easier. To that end, this section examines the ways in which these organizational networks and opportunities exist in Northeast Oklahoma communities, and their resilience and vulnerabilities during technological disasters.

Resilience

Volunteerism

The psychological and intrinsic rational behind the decision to volunteer has been well studied. According to Smith (1981), there are individual, group, and societal levels volunteerism. An individual volunteer is one who receives some psychic benefit(s) of greater value than the remuneration for the service they provide; and he points out that there is no purely altruistic form

or volunteerism. Smith goes on to say that, volunteer fire departments and firefighter motivations are multifaceted, and can result in many forms of reward, including saving the community funds that they would have had to expend on a paid fire service or otherwise higher taxation rates to pay for fire protection. According to the National Fire Protection Association (2016b), the donated time and services by volunteers in the United States equates to approximately $139.8 billion annually.

Social capital is required for community action to meet oncoming chemical threats, to assess and meet the needs of citizens, to utilize networks and linkages in place, and for effective recovery from a disaster. Group members, who work together during periods of stress, do so from *esprit de corps* (K. Lang and G. Lang 1964). Decision-making is impacted by shared values and views of this group, but trust among the network sources is critical in assigning the weight of these views on the decision making (Granovetter 1973). As the strength of ties between individuals increases, so does the trust, and ultimately the reciprocity (Paxton 1999). Common linkages and attraction between people within a group improves performance towards resolution of common goals when these members exhibit "…appropriate norms for behavior" (K. Lang and G. Lang 1964). Even weak linkages among small groups of those we trust affect decision-making (Granovetter 1973). The bonds between firefighters are strong, and support between fire departments can result in shared resources with which to conduct preparedness.

Rural fire departments have a history of relying on one another through mutual aid compacts and linkages resulting in strong bonds among the group. In addition to emergency response, fire departments often support each other during fund raising and social events such as pancake breakfasts, fish fries; and develop comraderies during firefighter field days and competitions like the firefighter combat challenge and pushball competitions.

Due to the traditional remote and isolated nature of small rural communities, residents tend to develop strong linkages, and utilize them more often than in larger urban areas, which have greater resources with which to handle a problem. According to Lindell and Perry (1992), smaller communities may utilize personal linkages for risk identification, assessing hazards, and risk reduction rather than multiple written plans. There is a direct relationship between the strength and sympathy of social networks and the validity people assign to information they provide, as well as their provision of assistance to victims (Barton 1969). Rural communities possess strong social capital, and projects viewed as meaningful can gain widespread community support.

Millennial Generation Volunteerism

Literature supports a problem with youth volunteerism in today's society. However, a recent study (Patuska 2010) of the millennial generation (born between 1981 and 1995) found that volunteerism was increasing. Encouraged by regulation such as the Serve America Act (Corporation for National and Community Service 2017, under "Disaster Services"), with specialized groups such as disaster services, young volunteers are helping in communities affected by extreme events. The Act created several programs like AmeriCorps and the Summer of Service to train and incentivize community volunteerism. According to the *2009 America's Civic Health Index* (National Conference on Citizenship 2009), the generational rate of volunteerism revealed that the Millennials (43 percent) surpassed the Baby Boomers (35 percent).

Several studies (Suleman and Nelson 2011; Gursoy, Maier, and Chi 2008; Kultalahti, Viitala 2014; Thompson and Gregory 2012) reflect motivational factors for Millennial Generation volunteerism. These factors include the desire for task guidance and direction,

personal development opportunities, social interaction and team building, regular and frequent feedback, and meaningful rewards and praise (especially utilizing online sources for praise and recognition).

Vulnerabilities

Social Networks

Technological disasters create social pressures, confusion, and stress; even among family members. These social pressures can result in social disruption, limit interactions, and damage to social linkages, which tend to tie people to their geographic community (Kroll-Smith 1995). Wildavsky and Dake (1990) reveal that we perceive the risk of technological hazards based upon trust and distrust of societal institutions. During technological disasters cultural beliefs (ties to the environment, etc.) and varying priorities (providing for family financially, livelihood continuity, minimizing health risks, etc.), can create an ". . . abrasive community atmosphere" (Gill 1994, 222). This situation not only reduces the strength of current and future social capital, it can create factions within the community with separate and often competing goals. Perceived risk and uncertainty from an unknown or unseen hazard can easily drive people to action, even in the absence of sound scientific data or actual exposure pathways, causing stress and social disruption (Freudenburg and Jones 1991). A technological disaster damages the strength of social bonds when we question emotional safety due to fear of the unknown health risks associated with ecological pollution. In the presence of psychological stress and pressure to migrate to a less "damaged" community, weak social bonds can result in easier decisions to move. In rapidly evolving technological disasters, responders make decisions based on knowledge and information already possessed, or gained through informal networks or other social relationships (Dynes 2006). Damaged social support systems or networks can hinder

information flow, accuracy, and ultimately the effective use of the information to resist the hazards or recover (Ritchie and Gill 2007). A breakdown of social capital can result in mistrust, unwarranted criticism, and resistance toward preparedness planning that responders might otherwise view as worthwhile. And, while technical knowledge and understanding of chemical risks may be possessed by community members working in local plants, literature indicates that their perception of risk is lower than that of the community.

Volunteerism

There are several issues surrounding the ways in which Millennials volunteer. The Serving America Act creates local opportunities at schools and colleges and provided volunteerism by providing scholarships for time served. This expectation of reciprocal benefit is counter to the traditional definition of volunteering (doing an activity without the expectation of an exchanged or reciprocal benefit). Service projects appeared to require short-term commitments, such as volunteering for a summer, helping in a community impacted by a disaster for a week, or planting a community garden. While these projects have value, the number of Millennials who are joining fire departments is decreasing. This could be due to the extensive time to complete initial training required of firefighters, as mentioned in the U.S.F.A. (U.S. DHS 2007) document; taking up to a year. While this topic begs further study, some aspect of firefighting (time commitments, convenience, lack of leadership, etc.) does not satisfy or provide for the motivational factors that make volunteering in such agencies appealing.

Cultural Capital

Cultural capital involves shared values, morals, and group beliefs. Several sources (Flora and Flora 2008; Simmons, Reynolds, and Swinburn 2011) note that cultures or communities are considered people who identify with group norms and values, a common interest, or a "…shared

sense of identity." The environment in which people have developed throughout their lifetime, learned values, morals, and beliefs forms cultural capital.

The term *rural* often elicits visions of family-owned farms and communities with a strong and proud lineage. Characteristics of rural communities, including small size and isolation, combined in the past to create uniform cultures based on connections to natural resources and a strong local identity (Flora and Flora 2008).

Cultural beliefs guide our daily life, and are visible in the decisions we make. The impact of cultural norms is seen in how we perceive risk, how we act outwardly, and in political decisions and policies. People decide what they should fear, and the extent to which they should fear it (Sigve, Bjorg-Elin, Hroar, and Torbjorn 2004). It is clear that there are differences in cultural values between groups, with varying importance placed on their worldview; one group may view a chemical hazard as acceptable, and another as intolerable.

Resilience

Risk Perception and Decision Making

Many factors drive the decision to prepare. Douglas and Wildavsky (1982) write that social values are a way to legitimize social programs. According to May (1989), shared values and social institutions guide and legitimize choices to prepare. There are multiple *grass roots* communities that resist the chemical industry, including the Sierra Club, Greenpeace, Natural Resources Defense Council, and the Friends of Earth; all having different missions, but with the common goal of restricting or reducing use of chemicals. These groups who are dedicated to reducing chemical use and environmental risk can elevate community and cultural perception of hazards resulting in support for preparedness actions. The more a community perceives the risk,

the higher the quality and quantity of disaster planning (Quarantelli, Lawrence, Tierney, and Johnson 1979).

First responders generally have a perception that there is a risk of chemical disasters in their community. Hildebrand (1980) conducted a study to learn about the beliefs of fire chiefs over the likelihood of experiencing a disaster caused by a range of natural and technological agents. In his report 93.1 percent of fire chiefs indicate the potential for hazardous materials incidents to occur within their district. Respondents believed that hazardous materials posed the greatest threat for causing a disaster; greater even, than automobile or transportation incidents. A study (Helms 1981) of emergency response agencies indicates that fire departments view chemical risk highest, followed by police departments, and chemical companies. Elevated risk perception can result in increased worth placed on chemical disaster preparedness planning.

Disaster Subculture

Communities that experience frequent disasters can develop a disaster subculture, retaining the knowledge learned from experiences, helping to shape response to future events (Wenger and Weller 1973). Disaster response is more effective when disaster relevant organizations have prior networks established and interact often (Tierney, Lindell, and Perry 2001). Fire department personnel often possess institutional knowledge of previous emergencies (floods, wildland firefighting, search and rescue, etc.) that could be beneficial during hazardous materials disasters. Several sources (Quarantelli & Dynes 1972; Fritz 1961; Caplow 1984; and Wenger 1978) verify that recent history was the reason for a community's advanced level of preparedness. The emergencies, to which fire and police departments respond on a regular basis, often help to form the topics planners use when conducting disaster preparedness activities and developing written plans. Experience may be effective in helping to break down the resistance to

planning (Ponting 1974). Using frequent response scenarios reduces public outcry that these activities are a waste of public resources.

Vulnerabilities

Risk Perception and Decision Making

Since fire departments respond to chemical disasters, there is a presumption that they be capable of managing an event and fire department decision makers be selectively sensitive to them (Gray and Quarantelli 1984). Unfortunately, the results of studies examining the correlation between perceived risk and protective actions are inconsistent (Basolo et al. 2009). One of the reasons for varying risk perception and preparedness is due to the skills, resources, and motivation required; all of which vary among populations (Lindell and Perry 1992).

When evaluating the traditional model of risk, we compare the likelihood of occurrence to its potential consequences (Ronan and Johnston 2005). From a societal standpoint, however, when examining technological choices, the probability versus magnitude calculation is mostly irrelevant (Rayner and Cantor 1987). Different populations and groups view toxic chemical exposure through vastly different lenses (Douglas and Wildavsky 1982). Issues such as trust and equity must be resolved, and use of calculations cannot reconcile these issues (Rayner and Cantor 1987). Chauncey Starr (1969) writes that there are two portions to assessing risk, the first is a quantitative account of protective measures versus financial investment, second is a qualitative inquiry of social attitude, beliefs, and trust in technical experts. The level of acceptable risk is a contentious matter, a part of a constant struggle between the rights, stewardship, and benefits of technology versus the empirical data and scientific evaluation of the peril (Dake 1992). From the systems perspective, this situation occurs because it is part of an

"invariably flawed" production and transportation system because we value the products more than the risk they pose (May 1989).

There has been a long understood struggle between capitalists and advocates for community interest. There are 13,500 chemical facilities currently operating in the United States, contributing approximately $555 Billion to the U.S. economy annually (U.S. EPA 2013, under Office of Policy). Preparedness planners are often reluctant to publicize their efforts because of a fear that elected officials view it as shining a negative light on the critical businesses that add to the local economy. Organizations having a financial stake in the community affect the accuracy of portrayed risk and technical information (Meltsner, 1979). While there are definite economic benefits from the presence of chemical companies for some sectors within the community, the perceived benefits may not universally valued. When financial benefits are present, they may be unequally distributed among stakeholders (Faupel and Bailey 1988). The technical nature of chemical manufacture and use may limit positions within these companies for local community residents (Faupel and Bailey 1988).

Some industries represent a significant economic boom, but chemical concerns can cause opposing views and pressures. In rural communities where industrial jobs have increased, but the per capita income is less, community members are disproportionally impacted by risk (Beck 1992). Quarantelli et al. (1979) indicate that small communities play down the risk posed by chemical companies. Societal pressures affect risk assessment and decision-making. Fritz (1961) indicates that some communities (based on their circumstances) accept risk that otherwise would not be acceptable. In his study on coal mining Fritz found that West Frankfort residents understood deaths and disasters were part of mining. Several authors (Douglas and Wildavsky 1982; Rogers and Nehnevajsa 1984; and Gray and Quarantelli 1981) point out that there are

definite benefits to certain technological risks or even disasters (Mileti 1980) that may outweigh the risks. Some of these technological benefits improve "the quality of life" (Starr 1969, 1234).

Some community groups view plants who use advanced chemical technologies as contentious and object to their presence in the community. There are many examples of how plant management has shifted the focus of community concerns by calling into question the integrity and trustworthiness of public denouncers (Davidson and Freudenburg 1996). There have also been several attempts to reduce public opposition to technology, including blackouts of local incidents, reducing the opportunity for public opinion in siting hazardous waste landfills, and excluding nuclear power from public information requests (Dake 1992).

Chemical disaster preparedness is not given a high priority in the community, nor is it systemically addressed (Gray and Quarantelli 1984). Disaster planners need to understand that rarely do people worry about conducting preparedness activities outside the realm of what immediately affects their daily lives (Fritz 1961). The same conditions (low priority, financial limitations, etc.) that constrain preparedness decision-making in the home also do so at organizational levels (Tierney, Lindell, and Perry 2001). Competing priorities such as making a living, family protection, health, and community responsiveness inhibit preparedness (Fritz 1961). When examining the Bhopal disaster Bowonder, Kasperson and Kasperson (1985) write that researchers need to examine these social value differences to prevent shifting of technological hazards to unprepared populations.

It has been well-documented (Sutton and Tierney 2006; Perry and Lindell 2003; Quarantelli 1992; Dynes 1983; and Drabek 1993) that communities do not conduct disaster preparedness planning. Several authors (Hildebrand, 1980; Tierney, Lindell, and Perry 2001; Caplow 1984; Lindell and Perry 1997; and Quarantelli et al. 1979) identify a lack of community

interest or priority in conducting chemical or all-hazards disaster preparedness. Although the public consensus philosophically supports preparedness activities, the priority placed on actually conducting them is low (Caplow 1984). According to a study of the Disaster Research Center (Tierney 1981), perceptions of chemical risk varied directly with the size of the community sampled; smaller communities viewed chemical risk as less than larger communities.

Acknowledgement of the risk of a chemical disaster does not always result in preparedness action. Quarantelli, et al. (1979) writes that, while there may a generally accepted agreement of chemical risk, it does not always result in local recognition of the problem. In general, research has revealed that communities do not assign chemical disaster preparedness a high priority, nor is it systemically addressed (Quarantelli 1981). Through public outreach and engagement efforts, preparedness planning can gain supporters rather than detractors. Once initial support is gained, the ongoing process can be fostered so that changes in the plans and processes are not difficult; nor surprising. In order for preparedness planning to be successful it must be thought of as normal, "rewarding," and "socially approved" during non-disaster times rather than a sacrificial duty competing with other social goals (Fritz 1961, 663).

Political Capital

Political capital is the ability to influence the expenditure and apportionment of resources within a governmental system. Public policy creation involves gathering information and weighing options, engaging stakeholders, gaining legitimacy from elected officials, and enrolling policy into law (Lindell and Perry 1992). Political power varies between people, and among politicians, and people who gain power are often those who affect votes or donate financial resources to campaigns. Political power is an intangible asset that ebbs and flows with pressures from stakeholders including political peers, financial backers and their lobbyists, organized

labor, the media, and civil society (French 2011). People gain political influence through power brokers, organizing and networking, and obtaining a voice (Flora and Flora 2008). In order to affect political will, there is a need to understand the power structure, and to convince brokers that the new idea is complimentary to their agenda. Elected officials consult powerful supporters and work to maintain the status quo; but their constituents evaluate them by their ability to serve the common good (Flora and Flora 2008). To assess and prepare for responding to a disaster, it is essential to engage these elected and appointed officials to ensure they understand and endorse written emergency response plans, which could ultimately require dedication of resources entrusted to them of their office.

The struggle between capitalists and environmentalists, discussed in the section on cultural capital, provides some background on these strong lobbies vying for power. The groups often have juxtaposed goals and attempt to influence elected officials to introduce policy to forward their agenda. The following section reveals examples of the political process and regulatory means by which political power brokers have influenced policy making in the United States.

Responsibility to Prepare

When examining the history of preparedness in the U.S., the level of political responsibility for preparedness planning has varied. There are data supporting the public expectation that government should be responsible for preparedness, response, and recovery, because they also provide information about hazards as part of preparedness planning (Paton and Johnston 2001). Several studies (Alexander 2005; Drabek 1993; Gray and Quarantelli 1984; Quarantelli 1984, 1987a, and 1981; Lindell and Perry 1992; and Faupel and Bailey 1988) support the idea that disaster preparedness is not only a legitimate function of the government, but also

its obligation. According to Abbott and Hetzel (2010), the protection of the lives, health, and the welfare of people over who they govern, is the primary responsibility of governments. There is also a correlation between confidence in the government's ability to adequately manage a disaster, provide preparedness information, and having a higher perception of being prepared (Basolo et al. 2009). However, confidence in the government's ability to take care of its citizenry does not remove the need at the familial level to plan for these types of events. The most well prepared community is one in which there is shared responsibility for preparedness by both households and governmental agencies (Basolo et al. 2009).

Resilience

National Focus on Preparedness

Recent events including the terrorist attacks on the World Trade Center, Pentagon, and the White House, along with Hurricane Katrina have drastically changed the organization and focus of preparedness in the United States. Congress passed the Homeland Security Act in November 2002, placing several emergency response and preparedness agencies under the governance of one department (Borja 2008). The mission statement of the U.S. Department of Homeland Security, states that it "provides the coordinated, comprehensive federal response in the event of a terrorist attack, natural disaster . . ." (U.S. DHS 2013a, under "About DHS"). As a means to accomplish this mission, they share information, provide funding and training, and Gulf Coast recovery support. Since the creation of the Department of Homeland Security, the United States devoted extensive resources to develop programs including the National Response Framework, building stockpiles of assets, and preparing public agencies receiving federal funding to respond to a multi-hazard incident (International Association of Emergency Managers 2010). The National Response Framework created an organizational structure under which all incidents can be managed (U.S. DHS 2014).

The traditional roles of fire departments have included preparedness and mitigation activities such as pre-incident planning, code enforcement inspections, and community outreach programs. Local fire departments are a "cornerstone" in emergency preparedness across the country, having responsibilities beyond their traditional ones (fire suppression, vehicle accident, etc.), including need-based risk reduction activities (Fleming 2010, 133). Fire departments often have pre-incident planning roles in their local jurisdiction. These roles result in fire personnel becoming sources of local information who have institutional knowledge of the impact of disasters on vulnerable populations in their district and specific knowledge of chemicals used in nearby plants. The tasks related to pre-incident planning have expanded to include hazardous chemical response and risk reduction. Many times, chemical plant personnel are also members of local volunteer fire departments, bringing specific chemical knowledge to their agencies. Fire departments and chemical companies conduct formal planning more than other organizations because they have more personnel possessing the knowledge of how to handle chemical emergencies (Tierney 1981).

Fire departments are an extension of local government, traditionally funded by public sources, and the elected or appointed fire chief usually takes an oath of office overseen by local officials. As an agency of local government, the goals and mission of local fire departments are somewhat effected by local political agenda. Regardless of the missions and goals, local emergency responders (police, fire, and emergency management) are responsible for incident command at all events that threaten public health and safety within their district (Abbott and Hetzel 2010). The community expects fire departments to respond to disasters regardless of nature because they have specific resources with which to resolve the problem, making them one of the primary responding agencies in most disasters (Wenger, Quarantelli, and Dynes 1989).

Organizations tasked with life safety and property conservation in these communities have a duty to respond to these situations (Quarantelli 1981). According to the U.S.F.A. document *Retention and Recruitment for the Volunteer Fire Service* (U.S. DHS 2007), a consensus of fire chiefs nationwide indicate that there is an increasing public expectation that fire departments provide a wide range of services, including fires, EMS, technical rescue, hazardous materials spills or terrorist incidents; ". . . when the public calls for assistance in any of these situations, the fire department must be ready to respond . . ."

Policy Making: Environmental Policy in the U.S.

Chemical regulation in the United States experienced a renaissance in the 1970's following publication of a fictional novel titled "Silent Spring" and several environmental disasters. Public sentiment and pressure caused elected officials to revisit current regulation, and promulgate new rules designed to protect people and the environment from chemical creation, use, and transport. Congress approved several regulations including the Clean Water Act because of the Torrey Canyon oil spill to protect waters of the United States from this type of spill. Within this Act, Congress ratified the National Contingency Plan, which created the National Response Center to receive reports of oil spills (later expanded to include other hazardous materials), as well as the formation of response teams (U.S. EPA 2014, under National Response Team). Congress also sanctioned the Comprehensive Environmental Response Compensation and Recovery Act following the Times Beach disaster and Love Canal, which allows recourse for remuneration following an environmental remediation from the responsible party. Because of public pressure following the Love Canal disaster, Congress approved the Resource Conservation and Recovery Act in 1976 to protect people from the hazards of waste, prevent

environmental pollution, reduce waste generation, and regulate the manner in which wastes are managed (U.S. EPA 2014b, under "History of RCRA Wastes, Laws, and Regulations").

Following a decade of legislation designed to rein-in environmental contamination and the potential for unplanned chemical releases, several serious chemical disasters created increased public fervor to improve chemical preparedness. A chemical release in Bhopal, India killed at least 2,500 people and caused the evacuation of 100,000, resulting in the most deadly industrial release to date (Bowonder, Kasperson, and Kasperson 1985). In reaction to this disaster, Congress reallocated the "Superfund" portion of the Comprehensive Environmental Response Compensation and Liability Act, adding the Emergency Planning Community Right to Know Act, which provides a vehicle for chemical information conveyance and preparedness planning. As part of this Act, governors of each state were required to name a State Emergency Response Commission. This Commission is responsible for appointing Local Emergency Planning Committees in emergency planning districts. The U.S. Environmental Protection Agency created the Toxic Release Inventory under the Comprehensive Environmental Response Compensation and Liability Act allowing public access to chemical release reports for more than 650 extremely toxic chemicals used at fixed facilities. The releasing plant generates these reports shortly following a release; they submit them to local emergency responders and emergency management agencies for transparency and future planning.

Numerous chemical incidents throughout the eighties led the U.S. Congress to revise the Clean Air Act in 1990 to include a provision, that industries using extremely hazardous materials to develop Risk Management Plans to provide for contingency planning and to give local responders information on anticipated actions during a release (U.S. EPA 2013, under "Clean Air Act Section 112(r): Accidental Release Prevention/Risk Management Rule").

Policy Making: Chemical Transportation Legislation

In 2004, the U.S. Congress directed the Department of Transportation to create the Pipeline and Hazardous Materials Safety Administration. The goals of this department are to reduce risk posed from hazardous material transport to people and the environment, to improve reliability of chemical delivery systems, to standardize hazardous materials transport with global efforts, and to reduce the extent of damage when a failure occurs (U.S. DOT 2014a, under *About the PHMSA*). The Pipeline and Hazardous Materials Safety Administration released regulation in 2008 encouraging the routing of railroad hazardous chemical shipments through rural (and sparsely populated) areas to reduce the impact of a release to populous areas (U.S. DOT 2014b, under "Hazardous Materials: Enhancing Rail Transportation Safety and Security for Hazardous Materials Shipments; Interim Final Rule"). While the goal of this effort is to reduce the likelihood of a chemical release adversely affecting a large population, it places hazardous chemical shipments in less prepared rural communities.

President Obama released the Presidential Policy Directive 8 in April, 2011, directing the U.S. Department of Homeland Security to develop the *National Preparedness Goal (U.S. DHS 2011b)* to bolster all-hazards preparedness with unified goals and objectives. Within the NPG document, DHS ". . .describes the Nation's approach to preparing for the threats and hazards. . ." (U.S. DHS 2011, 1). The Department strives to achieve their goal through building *Core Capabilities* (phases of disaster) including prevention, protection, mitigation, response, and recovery. The annual review of the national preparedness level in 2012 (based on self-reported preparedness levels) shows marked improvement. The report identified areas for improvement

including cyber security, integration of the needs of people with physical, psychological, or emotional challenges, and enhancing the relationship between public and private response organizations (U.S. DHS 2012, under "National Preparedness Report").

Many organizations have transitioned from response procedures to guidelines. While the differences between these terms may seem a matter of semantics, guidelines allow responders flexibility during a response to make critical decisions. Several sources (Quarantelli 1982; Perry and Lindell, 2003; Sutton and Tierney, 2006) acknowledge that unplanned situations can arise during disasters that require flexibility and potentially work outside existing procedures. Building flexibility into the planning process provides a vehicle to "adapt, improvise, and innovate." Tierney (2003) writes that responders required flexibility during the September 11, 2001 disaster, because previous preparedness activities were inadequate to meet the needs of the response. It is important to provide flexible guidance to help the public make informed decisions to respond to the situation (Caplow 1984).

Written plans allow pre-designation of organizational roles so responders can make critical decisions based on predefined conditions. One study (Sorensen and Rogers 1988) finds that planners need to empower responders to make decisions during incidents. Planning to incorporate redundant organizational structures that empower field personnel to make decisions is critical. This helps resolve problems when communication methods experience problems and ad hoc means of decision making have to be utilized (Manoj and Baker 2007). Formal and informal linkages established between organizations during times of "normalcy" can improve response and clarify issues like jurisdictional boundaries, responsibilities, and roles during a disaster. Preparedness activities require collaboration between response organizations and clear guidance rather than a "top-down" organizational structure (Sutton and Tierney 2006).

A strength of modern day preparedness planning is that decision makers can base their policy assumptions on well-established behavioral patterns. Basing plans on incorrect behavioral responses, along with other conceptual misunderstandings about disasters, creates the potential for ineffective resource allocation and conveyance of inaccurate information (Lindell and Perry 1992). There is a large pool of research studying human behavior in disasters that can assist planners in understanding how we react. According to Dynes, Quarantelli, and Kreps (1981), behavioral responses to different types of disasters (technological, natural hazards, etc.) are similar. However, community disasters versus "conflict situations" like riots or terrorist incidents will be behaviorally dissimilar (McNeil and Quarantelli 2008, 3). Understanding human behavior during disaster allows planners to predict, plan for, and develop appropriate activities to support victim needs, reducing the potential for problems resulting from misinformation, distrust, and anger during these difficult times. If not properly conducted, preparedness efforts can result in resistance and rejection by the public due to distrust of top-down governmental efforts to tell the public what to do (Dynes, Quarantelli, and Kreps 1981).

Many emergency response plans emphasize response principles instead of detailed strategies with instructions for users. By developing emergency operation plans in this manner, the likelihood of the plans becoming outdated, inaccurate to the changing hazard, and confusing is reduced (Lindell and Perry 1992). This idea also reflects Quarantelli's (1982) sixth principle of disaster planning, plans should concentrate on general principles and not get too specific.

Preparedness planning for evacuations differs depending on the community, but tends to be easier in rural communities. In smaller rural communities, evacuation plans may be unwritten, while larger communities have more formalized plans (Gillespie and Perry 1984). Many communities have already conducted evacuation planning. In order to qualify for FEMA disaster

mitigation funding, communities must conduct projects including evacuation planning, in which, routes are identified (U.S. DHS 2011a, under "Local Mitigation Plan Review Guide"). When developing evacuation plans, like other portions of disaster planning, it is critical to engage the public. Planning for evacuations needs to take into account anticipated behaviors, and reactions to public information releases. Planners should utilize routes that are a part of citizen's daily routines, and that are familiar to people when a disaster necessitates evacuation (Dynes 1983). The routines offered as examples include school bus routes and traffic patterns. Community members will utilize familiar routes from their daily routines, and without proper planning for use of these routes, could put people in harms' way. Planners need to communicate their assumptions and the response actions to community members, so the public can comment and understand appropriate actions plans expect them to take to protect themselves in the event of this situation (Gillespie and Perry 1984). In the Bhopal India disaster, responders did not share news of the chemical plume location, expected drift pattern, or proper evacuation responses with the community (Bowonder, Kasperson, and Kasperson 1985). If proper plans and expectations of chemical release characteristics had been known in Bhopal, pre-planned evacuation routes could have been utilized and instructions given so that community members could have lessened the possibility of exposure.

A critical component of disaster planning is conveyance of warning messages. The purpose of a warning message is to elicit proper responses and provide alternatives (Dynes, Quarantelli, and Kreps 1981). Community reactions to warning messages are a result of previous experience, how the conditions marry with the message, and social context (Rogers and Nehnevajsa 1987). Community education campaigns in the use of warning message information can positively affect the development of the incident, limit the ramifications of acting outside of

these expected actions, convey the limitations of responders, and emphasize personal responsibility for individual family planning. During the Bhopal disaster, responders poorly executed conveyance of the warning message. The warning siren did not activate for 30-45 minutes following the chemical release in Bhopal, India (Bowonder, Kasperson, and Kasperson 1985). Had responders issued the warning earlier, and had the community understood the message, the exposure to surrounding residents could have been reduced.

An important part of the planning process should be exercising written plans. Written plans cannot possibly account for all contingencies, so as planners exercise them, participants can help identify weaknesses, and update the plans to resolve issues (Faupel, Bailey, and Williams 1987). Community participation in exercises can bolster their strength and accuracy, as well as reconciling assumptions of organizational needs and individual agency roles. During exercises, participants test written plans and evaluate skills for their adequacy (Lindell and Perry 1992). In order for the plan to be realistic, valid, and accurate, planners need to ensure responders practice their capabilities. Exercises can also provide an invaluable benefit of educating the public about organizational capacities and needs. Involving the public in disaster drills and exercises can help them to understand the importance of planning, to identify weaknesses, and reveal areas in which they need increased community support (Faupel, Bailey, and Williams 1987). Fire departments also play a pivotal role during policy exercises, helping to identify their weaknesses and then, in helping to implement changes (Lindell and Perry 1992).

Tracking the evolution of disasters is important for financial, legal, and planning reasons. When mutual aid agencies return to their jurisdiction, they will expect some remuneration for equipment and consumables, wages (if paid personnel are utilized), and the cost of other mutual aid agencies covering their districts while they are away assisting others. Planning for

recordkeeping facilitates discussion about the cost of chemical disasters, and begins capital inventory within the community. In order to receive funding following a disaster, FEMA requires accurate paperwork documenting equipment utilized, time spent in incident stabilization, and other key factors. FEMA has developed forms for use by the planners to catalog disaster evolution. Emergency service agencies commonly use record-keeping systems, including the National Fire Incident Reporting System to track fire department responses; so implementing a record-keeping system should not be foreign to their normal operations.

Reducing population vulnerability is a critical component of preparedness planning. A vulnerability assessment should not only include conditions which are likely to cause exposure (non-ambulatory populations, children, etc.) but also populations who may not understand warning messages (English as a second language, deaf, blind, etc.). This assessment helps planners incorporate vulnerability into risk-based planning and opens the discussion of pre-incident conditions leading to evacuation versus shelter-in-place decisions. By engaging these vulnerable groups, fire department planners can conduct outreach education conveying information and assumptions used in plan development.

There are many free resources to help fire departments conduct preparedness planning. The U.S. Department of Homeland Security document *Developing and Maintaining Emergency Response Plans, Comprehensive Preparedness Guide* CPG (101) was last released (version 2.0) in November 2010. The purpose of this guide was to provide a resource for communities to ". . . conduct community-based planning . . . ensure plans are developed through an analysis of risk . . . identify operational assumptions and resource demands . . . prioritize planning efforts . . . [and] to integrate and synchronize efforts across all levels of government" (U.S. DHS 2010, 5). This

guide can help local planners to develop strong written guidelines based on widespread knowledge and wisdom gleaned from experts in disaster preparedness.

The EPA offers software (CAMEO, ALOHA, and MARPLOT) to provide a means for fire department pre-incident planning and as a source of information helping with incident response and stabilization. This software can help fire departments understand the nature of chemicals stored on plant sites, the means by which they are stored, quantities, and data sheets informing firefighters and planners of critical chemical properties, first aid measures, and proper protective gear. This data, along with map overlays from emergency communication (9-1-1) addressing database maps, can help provide data for making decisions on risk and response. The newly revised Emergency Planning and Community Right To Know Act requires fixed installations to report changes to extremely hazardous chemicals to the Oklahoma DEQ, local emergency planning committees, and the local fire department within 30 days. This assists fire departments and local planning committees plan for chemical releases of substances stored within their communities. The Oklahoma DEQ provides education classes, funded by the collection of chemical storage fees, and training over the use of ALOHA, CAMEO, and MARPLOT at no cost to responders. The U.S. EPA document *2008 Nationwide Survey of Local Emergency Planning Committees* (U.S. EPA 2014a) revealed that these committees used it to locate chemical information (74.8 percent), for planning (72.5 percent), and incident mitigation (71.6 percent).

The U.S. Department of Transportation first published the Emergency Response Guidebook in 1973, providing a resource for identifying and responding to transportation-related hazardous materials incidents. This guidebook gives first responders information on how to appropriately respond to chemical releases during the first 30 minutes of an incident. Training

for use of this resource is free, and there are mobile applications for use on portable electronic devices. The Guidebook is updated and revised every four years to include relevant information and updates to current protocols that would impact these types of responses (U.S. DOT 2013, under "How to use the 2012 Emergency Response Guidebook"). Recent U.S. Government initiatives to improve preparedness, including President Obama's Executive Order titled "Improving Chemical Facility Safety and Security," have stimulated provision of chemical identification tools for first responders. Information sources such as the DOT Guidebook, the Wireless Information System for Emergency Responders (WISER) developed by the National Institutes of Health, and numerous other electronic sources of chemical information and response guidance are offered through smartphone applications or online. This is a good source of information for use by planners to help when chemical hazards are known, and environmental conditions can be approximated. Several authors (Dynes 1983; Quarantelli 1987a; and Sutton and Tierney 2006) indicate that disaster preparedness efforts should aim at reducing the unknown, including all the information available about the hazard.

Vulnerabilities

Policy Making: Disaster Preparedness and Policy in the U.S.

On the national level, strong social forces and powerful political structures outside of local stakeholders cause policy creation that often ignores the interests of local businesses and communities. The history of disaster planning in the U.S. is as example of reactionary policy creation. Policies are usually a compromise between profit and securing the common good. These policies expand, based on public pressures, and contract when public opinion is amicable to it (Nave 1984). Most technological disasters (Bhopal, Love Canal, etc.) result in some program evaluation and resolution to prevent recurrence. However, not all disasters result in

significant change. According to Kahn (2007) the Chernobyl nuclear disaster did not result in significant change to Nuclear Regulatory Commission (NRC) regulations. Whereas many regulations aim to preventing recurrence of disasters, if authors do not fully explore the impact of these policies, there can be extreme unintended consequences. Public pressure to develop policies and procedures addressing disaster may actually result in poorly written plans or those that are not in the best interest of the communities they are designed to protect (Nave 1984). Officials are elected often and create policies to achieve short-range success and sell them as long-range solutions (Lewis, O'Keefe, and Westgate 1977).

The recent history of disaster preparedness, response, and recovery has evolved since World War 2. Political agenda and public sentiment changed preparedness planning from national defense against attacks to include natural and technological agents. These varying policies and agenda created confusion and disjointed efforts to provide a cohesive means by which to prepare.

A paper (Quarantelli and Tierney 1979, 3) on disaster preparedness provides a synopsis of national disaster preparedness efforts to date:

> Federal involvement in disaster planning and response has been marked by confusing, changing and inconsistent policies; failure to link preparedness and response activities; the absence of a single agency point-of-contact for disaster-relevant activities; duplicative and means-rather-than-ends-oriented bureaucracies; and the absence of a comprehensive overview of resource allocation and use.

Policy Making: Department of Labor

In 1985, the Department of Labor interpreted the Fair Labor Standards Act to prohibit paid firefighters from volunteer as a firefighter in the same jurisdiction in which they worked; overtime rules applied (U.S. DHS 2007). In order to respond in this manner, these paid

firefighters must be paid and subject to "call-backs." According to the same U.S.F.A. document, some volunteer fire departments have lost hundreds of firefighters due to this provision.

In another regulatory interpretation, the Department of Labor, Occupational Safety and Health Administration ruled that in order to fight a structure fire, departments had to utilize a 2-in, 2-out strategy in case a rescue was necessary (Stocker 2004-2005, U.S. DHS 2007). According to the U.S.F.A. (U.S. DHS 2007) this causes additional burdens to fire departments ". . . that are already struggling with the size of their memberships . . ."

Policy Making: Local Ordinances

There are many difficulties in negotiating local policy creation. Lindell and Perry (1992) write that there are three obstacles that need to be overcome in writing a local policy, including a lack of knowledge by local officials, the chemical hazard is not viewed as manageable, and solutions are not economically feasible. There is a need to educate local elected officials about the extent of chemical hazards, and they must be convinced that it is as important as other priorities within their political agenda. Secondly, the hazard must be viewed as manageable. As Lang and Lang (1964) point out, the public will not support preparedness efforts aimed at a hazard viewed as unmanageable. As shown in the history of preparedness policy, communities do not view large-scale technological disasters such as nuclear attacks as manageable; and this can affect support for policy creation. However, the mere existence of chemical disaster planning means that disaster relevant organizations identify the hazard as manageable (Caplow 1984). Thirdly, solutions must be economically feasible and implementable. Unfortunately, political will and competing priorities can impede preparedness planning efforts. At least one author (J.P. Rockett 1994) writes that for preparedness efforts to be successful, planners needed to remove the activities from the political process. Since competing interests can create inefficiency in the

planning process, goal setting should be clear and concise from the start, to reduce problems wherever possible.

Within a planning team, there are often representatives from organizations with differing missions and goals. Planners need to ensure they establish ground-rules early in the planning process, with each organization having an equal stake, to prevent power struggles and inequity. One of the difficulties found with planning, is that each organization wants to gain funding commensurate with their recognized role and perceived status (Lindell and Perry 1992). When examining status of organizations during a disaster, their assigned roles, and other components of disaster response, this same issue can emerge.

Directly approaching elected officials is not necessarily an efficient way in which to precipitate change; understanding the power structure and networks within a community is critical to successful political navigation. As mentioned in the section on financial capital, there is a struggle between the financial interests of having chemical companies in a community, and those involved in lowering the risk. Executives within these companies wield power and influence among elected officials.

Chemical planning decisions have historically marginalized rural communities. Two studies (Cutter and Solecki 1989; Solecki 1992) reveal that rural communities are disproportionally susceptible to acute chemical disasters. The process of siting hazardous waste landfills and preparedness planning within the nuclear power industry has perpetuated this fact. According to Epstein (1982), because of the ease of siting hazardous waste landfills, lack of public outcry due to sparsely populated areas, and the inexpensive price of land, hazardous waste policy makers have marginalized rural America for many years.

Working to diminish risk perception for political ends, or advocating for the best interests of rural communities is not new. Politicians, lobbyists, and the media have reinforced this idea within agricultural policy-making, using the illusion that policy represents the interests of rural peoples (Flora and Flora 2008). Many hazardous waste treatment facilities are located in rural communities who are economically depressed, and least prepared to handle disasters involving these chemicals (Faupel and Bailey 1988).

The priorities of local government may not include preparedness (Lindell and Perry 1992). Communities consider disaster preparedness a luxury, and they subsequently place it near the low end for political policy agenda during times of non-disaster (Drabek 1993). Tierney (1981) discussed two issues affecting support of preparedness, the first being that successful programs result in "non-events;" and proving their effectiveness and the cause-effect relationship can be contentious. The second issue involves the inflation of public risk perception by the masses. In addition to community resistance to conducting planning activities, planners do not always want to publicize their efforts due to the process acting as a reminder of the ever-present threat (Faupel, Bailey, & Williams 1987). One solution is to use local ordinances to reduce risk or improve resilience against chemical hazards. This type of advocacy has drawbacks, however, commerce is impacted through transportation route changes, the price of housing and construction increases, and these can further exacerbate financial stratification within the community. Even in the case of emotionally charged atmospheres following chemical releases, public support for preparedness planning is mixed. Faupel, Bailey, & Williams (1987) found that in politically charged hazardous chemical situations (hazardous waste landfill), feelings surrounding preparedness are mixed, but not absent.

Planners must devote significant resources to engage the community, as well as to ensure the community understands the hazard significance. The planning process should be community-based (The term community is inclusive of both the local area, and among common interest groups outside of the local jurisdiction). Properly engaging the public as part of the planning process may gain support, and volunteers, and may reduce resistance from public officials when planners require future funding for preparedness efforts (Quarantelli 1982).

There is a great temptation to utilize written plans for dealing with the panacea of disasters that may occur (Faupel, Bailey, and Williams 1987). A concern of preparedness planners, however, is that responders will place written plans on a shelf to gather dust, rather than to read, understand, and practice them. While planners perceive disaster plans as critical to emergency preparedness, they are not enough by themselves (Lindell and Perry 1992). Written documents are static, and planners need to update them regularly, or they are vulnerable to dynamic conditions such as changes in roles, contact information, personnel, and other life situations. At the National Defense Executive Reserve Conference, President Eisenhower stated that, "Plans are worthless, but planning is everything…keep yourselves steeped in the character of the problem you may one day be called upon to solve. . ." (Eisenhower 1957). According to Abbot and Hetzel (2010), ". . . governments will act more effectively in response, and can act to minimize their own liabilities and to maximize reimbursement costs available to them, only if they understand and develop plans in accordance with the laws applicable to the event . . ."

Fire Department Roles in Disaster and Preparedness

The mission statements of fire departments vary, but the traditional role of these agencies includes fires, motor vehicle accidents, medical emergencies, and some disaster response. As Wenger, Quarantelli, and Dynes (1978) indicate, police and fire departments are possibly the

most visible and engaged local organizations during a disaster. When a chemical release occurs, fire and police departments, as well as public works organizations are mainly called because of specialized training, tools and equipment, and available personnel. Without preparedness being made a priority to political power brokers, the fire chiefs as appointed or elected representatives of local government may not ensure it is a part of their agency's mission. The majority of organizations do not view preparedness as a priority unless stated as such in their mission (Tierney, Lindell, and Perry 2001). Some authors argue that government preparedness initiatives are ineffective and but resisted (Lindell, Alesch, Bolton, Greene, Larson, Lopes, May, Mulilis, Nathe, Nigg, Palm, Pate, Pine, Tubbesing, Whitney 1997).

Summary of Chapter II

In Chapter II the definitions of disaster and preparedness were discussed, showing great variation and little agreement between experts in the field. The definition of disaster is socially defined and dynamic; subject to perceived reality and changing social expectations. For the purposes of this study, disasters are releases that overwhelm the response capabilities of local and regional responders, governments, and interrupt the social continuum within communities. Several characteristics of chemical disasters are different from natural and other disasters, due to the chemical etiology, impact from weather conditions, ways in which they effect people, and in remedial actions to stabilize conditions.

Preparedness activities are actions aimed to reduce the unknown; conserve life and property; improve response capabilities; and limit social hardships, time, and resources required to recover. An indicator of preparedness is the availability of adequate resources with which to respond. Community capitals are the assets and abilities with which to conduct chemical disaster preparedness and to respond. Sparsely populated rural communities experience human capital

limitations, lack of financial resources and equipment, low average education levels, and community and political pressures causing preparedness planning to compete with other perceived priorities such as firefighting, motor vehicle accidents, and medical emergencies leave them unprepared for a chemical disaster. These rural communities have difficulty attracting businesses that would support higher wages, and ultimately increase the ability to gain a higher average level of education. Lack of healthcare, advanced technological infrastructure and extensive public service support creates disparate resource availability when compared to urban counterparts.

Chemical specific equipment, and the specialized training required to use it, is lacking in volunteer organizations without a of recent history chemical disasters affecting the community. Chemical response equipment is specialized within the fire service, and found in the hands of regional and national response agencies. Rural communities have few responders trained in hazardous materials or with advanced education in chemistry, and with the advanced technical understanding chemical sampling equipment.

Rural departments are comprised mostly of volunteers, whose fire department activities (disposable leisure time) are in direct competition with other commitments like family activities, church, and other civic organizational participation. With shrinking spare time and lack of flexibility related to primary employment, fire departments have limited human capital with which to conduct outreach and preparedness planning.

Natural Capital is valuable when viewed as undamaged and a *refuge* from society. People value contact with the natural environment, and migrate to communities where this capital exists. However, the natural environment is fragile and susceptible to a chemical disaster.

Many forms of financial capital are available to fund fire departments. However, these resources are often dynamic and are difficult to anticipate when planning and forecasting budget needs year-to-year. Equipping and training a fire department for hazardous materials response is extremely expensive, and causes additional stress to the human and social capitals when firefighters have to be away from home for training, and social acceptance of volunteerism is negatively impacted from the extensive dedication required.

Human capital is in direct competition with familial responsibilities and leisure time. Extensive training over various topics causes stress to human capital and an inability to meet industry standards. Attracting and retaining young volunteer firefighters is growing more difficult, and older firefighters conduct more firefighting activities. This may be resulting in increased risk of medical problems to the older generation of firefighters. The number and variety of fire department responses is growing, and causing stress to a limited fire department staff. Societal and community changes have resulted in less flexibility at work, fewer community linkages, and increasing competition from other volunteer organizations for increasingly limited free time. Changes in training and standard-of-care requirements have resulted in longer classes and additional practical applications.

Social capital is what drives volunteerism, provides the linkages and strength of bonds with the community. Rural fire departments are socially accepted and supported within communities. Reliance on other rural and municipal departments helps build *esprit de corps* and social bonds within the fire service. Since rural communities are often geographically isolated, there is often a presence of strong networks and linkages.

Cultural capital is comprised of structures, learned behavior, values, and morals contained within communities. The term *communities* is inclusive of both geographic areas and

groups with shared beliefs. Risk perception is a critical component of cultural capital. The disagreement between risks and perceived benefits of chemical plants is well studied. People with differing beliefs and agenda view chemicals through vastly different lenses. Chemical plants and waste facilities search out rural locations for a number of reasons, including a lack of organized and populous resistance, financial advantages, and reduced environmental regulations. Chemical companies bring with them increased chemical storage and the potential for releases. While there will be no consensus on risk perception, there is some agreement that a risk of chemical disasters is possible in rural communities, and general preparedness activities are supported. Literature supports the idea that chemical disaster preparedness is not a priority, is not done, and not supported until after a disaster occurs.

Communities with a chronic history of disasters can develop a subculture that increases response capabilities for future events. Rural communities are unprepared for chemical disasters, and recent increases in chemical production and transport rules have adversely put these areas at risk. In addition, while a community may not be prepared in the traditional sense, a disaster subculture may provide some level of preparedness and capability to respond ad-hoc to disasters of any nature.

Political capital is the ability to influence the expenditure of public resources through interacting with power brokers. Elected officials are often shortsighted, have vastly different agenda, and write policy that expands under public pressures and contracts when conditions allow. The U.S. has a long and extensive history of disaster preparedness planning and chemical regulations. The evolution of these policies has complicated the roles rural fire departments play in preparedness and response, and has made it almost impossible to comply. Fire departments have traditionally implemented plans, but not been a part of their development. Planning is a

process, not a written document, and while guidelines may clarify roles and expectations, responders must practice these plans and disseminate information in order to be prepared.

Fire departments respond to situations due to specialized equipment and training they possess; almost regardless of their nature. During a response, fire departments conduct activities outside of their normally accepted duties. Understanding their capabilities and expected roles in disaster response helps them to train, plan, and budget to public expectations.

Chapter III

Methodology

This study questions the impact of community capitals on chemical hazard and disaster event preparedness in rural Northeast Oklahoma from the perspective of fire chiefs. Chapter 1 introduced the problem of chemical hazards in Northeast Oklahoma. In Chapters 1 and 2, studies revealed that rural communities have fewer resources and response equipment, lower average levels of education and degree attainment, fewer available responders, and a lack of adequate preparedness when compared to their urban counterparts. However, social and cultural capital provide support and a feeling of solidarity towards fire department activities, and communities expect that fire departments be capable of providing services rivalling urban areas, should emphasize preparedness planning.

The concept of preparedness is subjective, but chapter 2 identified common activities and characteristics seen as having value in preparedness planning from the field of disaster research. This study examines many of these characteristics through the lens of a community capitals framework. This study inquires about the impact of capitals on preparedness in two ways, conducting an inventory of rural community capitals, and exploring how those capitals affect fire department preparedness. Capitals vary due to differences in population, funding, size of government, proximity to industrial areas, and other characteristics. I examined differences between communities using a quasi-inventory of capitals via a survey; a quantitative method.

The second area of inquiry involves the impact these capitals have on preparedness and fire department activities. Because the impact of capitals on preparedness is subjective, and based upon individual experiences, it requires an emic perspective, and one in which fire chiefs provide in-depth information about their perceptions of reality; a qualitative method. In order to gain an emic perspective or perceived realities and to gain an understanding of capital impact on preparedness (subjective), I chose to use participant interviews. Since these two areas of inquiry appeared to answer the research questions from both a quantitative and qualitative approach, I chose a mixed method design. Document analysis is the third instrument chosen for this study to provide context of the general state of fire departments in the study area through examining public perception, as well as providing a means by which I explored alternative explanations of emergent themes. This study uses three primary instruments to triangulate the findings. When data are obtained, using at least two methods, and they appear congruent, cross validation occurs (Jick 1979). Using data sources such as observations, photographs, and documents provide triangulation and ultimately establish "stronger qualitative research" (Stallings 2002, 205).

Mixed Method Design

The goal of a mixed method approach is to strengthen the overall validity of a study by using both quantitative and qualitative methods to gather data. Quantitative methods utilize strong scientific theory to design and test hypotheses of the researcher. Qualitative methods examine personal stories, symbols, perceived realities, and approach the study of humans trying to assign significance to the participant experience; many times limiting a priori assumptions. Each of these methodologies has strengths and weaknesses, and a mixed method design utilizes the strengths of qualitative and quantitative approaches to *shore-up* the weaknesses of each individual approach.

This chapter outlines the methods used to address the research questions posed in chapter 1, specifically:

1. What capitals exist in Northeast Oklahoma rural communities?
2. What risk do fire chiefs assign to chemical hazards as being the causal agent for a disaster in these rural communities?
3. Explain the roles fire departments play in chemical disaster preparedness and response.
4. Explain the community expectations for fire department chemical disaster preparedness in these communities and its evolution.
5. How have fire departments met these preparedness expectations?

The section begins with a detailed description of the population characteristics in the area of study viewed through a community capitals framework. This investigation uses a case study approach; the explanation of why this is appropriate to this field of inquiry follows the site description portion of this chapter. The final portion of this chapter includes an in-depth discussion of the methodological procedures followed, and instruments used to obtain, secure, protect, and analyze data; and any limitations or bias in the sampling process.

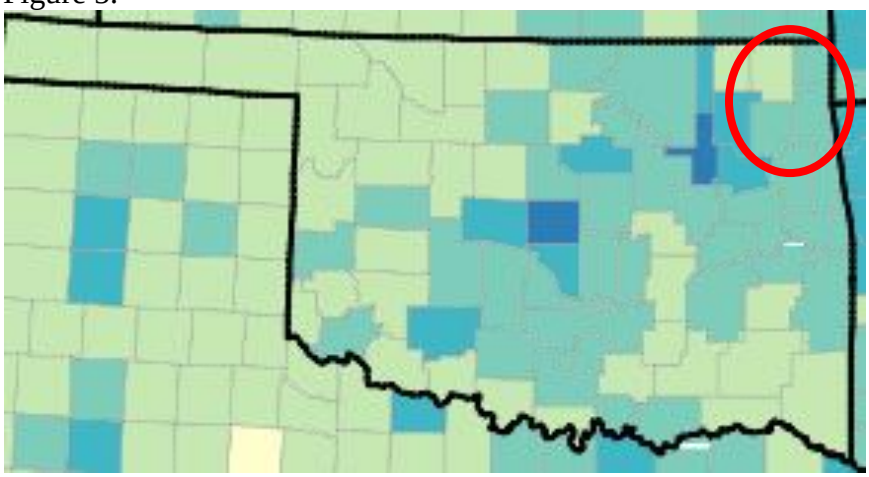
Site Description

One of the characteristics examined in this study includes a dimension of being a fire department in a rural setting. The site chosen for this study includes a 4-county region in the farthest Northeast corner of Oklahoma. The four counties (Mayes, Craig, Ottawa, and Delaware) in the study region have between 1 and 88.3 people per square mile. According to the 2010 U.S. Census, these four counties are in the top 3 of the 6 least populous categories for counties in Oklahoma (U.S. Department of Commerce 2014a, under “2010 Census”). Figure 5 indicates the

2010 U.S. Census results from the four most Northeast counties in Oklahoma containing the desired study case populations.

Figure 5. *Data Adapted from* U.S. Department of Commerce, U.S. Census Bureau. "2010 Census Results – United States and Puerto Rico: Population Density by County or County Equivalent." U.S. Census Bureau. http://www.census.gov/geo/maps-data/maps/pdfs/thematic/ us_popdensity_ 2010map.pdf (accessed 2012).

Figure 5.



Governmental structure and community demographics have a significant impact on preparedness. Municipal governments in Oklahoma, include incorporated areas, with more than 1,000 inhabitants (cities) and less than 1,000 inhabitants (towns). A search of the U.S. Department of Commerce Census Fast Facts revealed that within Craig County there are 5 municipal governments, 13 in Mayes County, 7 in Delaware County, and 8 in Ottawa County (2015, under Local Governments in Individual County-Type Areas: 2012 - State -- County / County Equivalent).

Natural Capital

Resilience

Air

Air quality in Northeast Oklahoma appears to be good. The U.S. Environmental Protection Agency's Clean Air Act identifies areas of the country with airborne pollutant

problems, called non-attainment areas. These non-attainment areas are those locations with higher than acceptable levels of contaminants, including lead, carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide, and particulates of a certain size (U.S. EPA 2017b). The four counties included in this study are free of non-attainment areas identified through the EPA Clean Air Act (no counties in Oklahoma fall into this category).

Water

Community members call Northeast Oklahoma *Green Country*, due to its picturesque views, wildlife conservation areas, and opportunities to take part in outdoor sports and activities such as boating, hiking, fishing, and hunting. The Grand River Dam Authority, created through the Senate Bill 395 of 1935 is responsible for water conservation, flood control, and power generation (Grand River Dam Authority 2013, under "Power of Power"). The GRDA is responsible for dams controlling the waters of Grand Lake and Lake Hudson (within the four counties examined in this study). The public acknowledges the benefits of these water bodies for recreational and environmental purposes. Tourism contributes to local economies by creating jobs, service industries, and attracting influential and technologically knowledgeable residents or visitors to local communities.

The lakes are a source of pride in Northeast Oklahoma, hosting fishing enthusiasts and widely publicized fishing tournaments, including the 2013 Bassmaster Classic. The Oklahoma Tourism and Recreation Department considers Lake Hudson the third best bass fishing lake in the state (Oklahoma Tourism and Recreation Department 2015, under "Pryor"). There are many sources of outdoor sports in the study area, including 10 golf courses (7 public, 2 private, and 1 resort); 50 public access and recreation areas including 9 state parks, multiple municipal parks, hiking trails, wildlife conservation, and boat launch areas. According to an Oklahoma Water Resources Board Report (2011) there were less people fishing and hunting in 2011, than in 2001,

but there were more than in 2006 (U.S. Department of the Census 2014, under "National Survey of Fishing, Hunting, & Wildlife-Associated Recreation"). The fishing and wildlife watching expenditures shown in this report have increased in 2011 since 2001, and fishing since 2006 as well; but wildlife expenditures went down between 2006 and 2011. Hunting expenditures have decreased since both 2001 and 2006; but since the overall trend in outdoor activities has increased for these recreational areas, financial impact for natural tourism should be positive.

Surface waters conserved in these bodies of water provide benefits to surrounding communities. Communities surrounding these lakes and rivers use these bodies for potable water supplies and irrigation. Hydroelectric dams create these lakes, and help to regulate water storage and flow during periods of adequate precipitation and runoff. Efforts aimed to prevent flooding result in increased lands for agriculture, a reduction in the need for flood insurance, and an improved quality of life for residents who had previously experienced chronic flooding and property damage. According to a report by the Oklahoma Water Resources Board (OWRB), even though the water use demand on Grand Lake has increased, the water quality from 1995 – 2009 had no significant changes to chlorophyll, nitrogen, or phosphorus (Oklahoma Water Resources Board 2012, under "Grand Watershed Planning Region Report"). These water quality measurements are a measure of human activity, and can predict potential algal blooms, which could affect lake use and pose risk to sensitive human receptors. This same study revealed that 59 percent of the water consumed in the Grand Watershed was for municipal and industrial uses. The provision of a reliable water source for both potable and general-purpose uses constitutes a significant benefit, attracting businesses, and subsequent financial and human capital, to Northeast Oklahoma.

The Tri County Mining District has created chemical benefits and risks for Northeast Oklahoma. According to a report from the United States Geological Survey, the Grand Lake

sediment sampling indicated lead and cadmium below probable-effect concentrations (PEC), and although the zinc was above the general PEC, it was below the specific level for the Tri State Mining District (Juracek and Becker 2010). The PEC is the concentration above which there would be an expected adverse biological impact. The report also indicated that the chemicals of concern have not historically exceeded the Tri State Mining District PEC.

Abundant rainfall in *Green Country* allows flora to flourish, and for water-based recreation to continue when much of Oklahoma experiences drought conditions. The four counties in this study receive approximately 45 inches of rainfall annually (Oklahoma Climatological Survey 2012, under "Oklahoma Normal Annual Precipitation Map"); while Oklahoma as a whole only receives an average of 33.6 inches (Oklahoma Climatological Survey 2014, under "Graph of Annual Precipitation History with 5-Year Tendencies" http://climate.ok.gov/index.php/climate/map/normal_annual_precipitation/ oklahoma_climate).

The Grand River Dam Authority operates the Salina Pumped Storage Project. This elevated water storage conservation pool is created by pumping water from the Saline Creek arm of Lake Hudson up into an elevated and dammed (Chimney Rock Dam) area creating the W.R. Holway Reservoir (Grand River Dam Authority 2012, under "Once Upon A Time at GRDA: the "pump back" Experiment"). The reservoir provides a system of storing potential energy. The Salina Pumped Storage Project creates additional storage of water, abundant clean energy, and 50,372 acre-feet of wildlife habitat (Oklahoma Water Resources Board 2012, under "Hydrographic Survey of W.R. Holway Reservoir").

Fauna

Agribusinesses are abundant in the study region, animal domestication including cattle, deer, chickens, sheep, alpacas, and other breeds are plentiful. According to a report from the Oklahoma Water Resources Board, people use approximately 80 percent of land in Oklahoma

for agricultural purposes (Oklahoma Water Resources Board 2011, under "Oklahoma Comprehensive Water Plan Supplemental Report: Agricultural Issues and Recommendations"). These businesses are important, providing a source of local income, and increasing cultural capital through pride in continuing family enterprises; many of these businesses are family-owned. This same report indicated that the Oklahoma agriculture sector had a financial impact to the State economy of $28 billion dollars. The agribusinesses rely on water from the lakes, rivers and their tributaries, to grow crops and to water animals, as well as greening fields used for grazing and growing alfalfa, and other grains for feed and sale. The OWRB report (2011) indicated that irrigated cropland was 27 percent more valuable than non-irrigated.

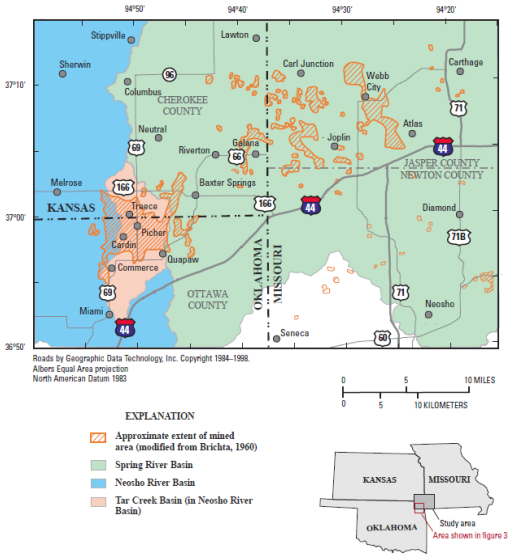
Farming and ranching science has evolved in recent years, and more people are embracing sustainable practices for water conservation, soil remediation, and to improve ecological value of their lands. Stewardship efforts have resulted in a historically significant number of agribusinesses responsibly conducting business; ensuring a lasting legacy for future generations (Oklahoma Water Resources Board 2011, under "Oklahoma Comprehensive Water Plan, Supplemental Report: Agricultural Issues and Recommendations"). In 1937, Oklahoma formed the Conservation Commission, allowing counties to create individual subdivisions. Subsequent to this Act, all four counties in this study have conservation districts, whose mission is to "…assist citizens in practicing wise use and management of the state's renewable natural resources, especially its soil and water (Oklahoma Conservation Commission 2015, under "History").

Soil & Geologic Formations

Northeast Oklahoma contains a portion of the Tri County Mining District (labelled the Tar Creek Superfund Site), a 40 square mile (see figure 6) lead and zinc ore (also containing cadmium) mine partially contained within the towns of Picher, Cardin, Hockerville, and

Quapaw, Oklahoma in Ottawa County. This mine operated from the early 1900s until the mid-1960s, helping to provide lead for ammunition during two World Wars (Oklahoma DEQ 2015b). The Mining District produced mountains of chat used for concrete, road bedding, and to harvest metals for various industries. During its operation, the mine was the main producer of lead and zinc in the U.S. (U.S.G.S. 2009). This mine ceased operation in the early 1970s and the EPA placed it on the National Priorities List in 1983; remediation efforts resulted in the demolition of the last building in 2014.

Figure 6. *Location of mining areas in the Tri-State mining district of Oklahoma, Kansas, & Missouri,* U.S.G.S. Selected Metals in Sediments & Streams in the Oklahoma Tri-State Mining District, 2000–2006, http://pubs.usgs.gov /sir/2009/5032/pdf/SIR2009-5032-web.pdf (accessed April 26, 2015).



Several licensed mines still operate in Northeast Oklahoma producing a variety of minerals. According to the most recent production records from the Oklahoma Department of Mines, companies in Ottawa County mined a mineral called Tripoli in 2013, along with clay, sand and gravel, limestone, and select fill. Manufacturers use Tripoli as an additive to paint and concrete, and it as an abrasive. In 2013, Ottawa County was the only producer of chat in Oklahoma, probably due to the residual materials from the Tri-County Mining District (also known as the Tar Creek Superfund Site). Delaware and Mayes Counties mined significant

quantities of sand and gravel, limestone, and clay in 2013. Craig County mined significant amounts of limestone during this same period (Oklahoma Department of Mines 2013, under "Mineral Production by Company"). Craig County is the only county in the study area mentioned who had a producing coal mine in Oklahoma in 2013 (Oklahoma Department of Mines 2013, under "Coal Bed Production"). Mines in Northeast Oklahoma provide a non-renewable source of natural minerals, which they convert to financial capital (Oklahoma Department of Mines 2013, under "Mineral Production by Company"). According to the Oklahoma Department of Transportation, there are hydraulic cement concrete plants operating in all four counties in the study area. Mayes County has four concrete plants, Delaware and Ottawa both have 3 plants each, and Craig County has 1 operating plant (Oklahoma DOT 2015, under "Materials Division, Hydraulic Cement Concrete Plant List"). These industries create jobs and increase revenues to many of the communities contained within this study.

Vulnerabilities

Air

Clean air is a problem that brought significant attention during the twentieth century. The last industrial revolution resulted in acid rain and other problems from pollutants emitted through chemical processes. The U.S. EPA and Congress have implemented several regulations and laws (Clean Air Act, Clean Air Interstate Rule, National Emissions Standards for Hazardous Air Pollutants, etc.) to reduce pollutants from air emissions; an example of natural capital converting to political capital.

An EPA greenhouse gas program requires reporting of gases emitted by plants annually. According to this program, in 2011, there were 7 reporting entities in Mayes County. The reports included methane, carbon dioxide and biogenic carbon dioxide, and nitrous oxide. A search for

other greenhouse gases revealed no other emission sources in the four-county region (U.S. EPA 2015b).

There is an EPA program, which uses computerized emission sampling equipment to track contaminants from stationary sources. According to the tracking system, there are 38 facilities required to report emissions in Mayes County, 7 in Craig County, 19 in Ottawa County, and 5 in Delaware County (U.S. EPA 2015a).

While the air quality has mixed results depending on the contaminant sampled in the four county region, the trend of commercial businesses moving to rural locations will negatively affect the ambient air quality. This is due to the reduction of plant and wildlife habitat from building facilities and parking lots, air emissions from operations, suspended dusts from construction, and increased vehicle emissions from people reporting to work in this region. While this may not have a visibly negative impact, it will add to the ambient air concentrations.

Water

There are several sources of contamination in Northeast Oklahoma that cause stress on surface waters as well as the local aquifer. The runoff and surface water infiltration into mine structures of the Tri County Mining District have caused many problems immediately around the mining areas. During its operation, millions of gallons of acidic wastewater was discharged into local streams, feeding both the NEOSHO and Spring Rivers; and ultimately Grand Lake and Lake Hudson (U.S.G.S. 2009). Ongoing water sampling conducted by the Oklahoma DEQ has indicated presence of heavy metal contamination in the Roubidoux aquifer from Tar Creek sources (Oklahoma DEQ 2015, under “Report Number 10 2008, Roubidoux Monitoring”). According to an OWRB report, that documented water quality between 1995 and 2009, the electrical conductivity of Grand Lake during this period rose; a possible indication of elevated dissolved metals (Oklahoma Water Resources Board 2012, under “Grand Watershed Planning

Region Report"). Residents in communities surrounding the mining district, and those around Grand Lake should have an elevated level of concern for potential pollution from this site.

Stream and lake sediment in, and downstream of, the Tri County Mining District have shown indications of heavy metal contamination. During periods of river flooding, these contaminants could have affected farmlands and domesticated animals. According to the U.S.G.S. Report on Tar Creek (U.S.G.S. 2009), surface water levels of aluminum and iron were highest in the NEOSHO River, and could have resulted from shale formations and concurrent natural runoff. In addition to the issues surrounding the runoff and contamination from the Tri County Mining District, irresponsible agricultural practices can cause pollution from fertilizers, pesticides, and other chemicals into riparian zones and ultimately water bodies with sensitive plant and animal receptors.

There are several potential sources for technological pollution, including commercial and private sources alike. According to the *Grand Lake Watershed Plan 2008* (Grand Lake O' The Cherokees Watershed Alliance Foundation 2008), residential septic system failure is a significant problem leading to infiltration of bacteria into the watershed. According to the report, the Neosho River Watershed, Elk River, and Grand Lake "high priority impairments" included septic systems. In addition to septic failure, the watershed plan indicated that pesticides and fertilizers on residential as well as agricultural lands could run into water bodies when attached to soil particles. The seasonal human loading of the lakes is great, visiting for weekend or day trips and leaving for weekdays. Fuels and lubricants from boats and vehicles easily leak into waters and soils surrounding the lakes. Pollutants including pesticides, sunscreens, human waste, and other chemicals also create heavy loading that impact wildlife and delicate ecosystems.

A problem in recent history affecting the Grand Watershed has been increased nutrient loads and blue-green algal blooms. These blooms have resulted in parks and other natural

attraction closure to reduce risk posed to swimmers and anglers. Nutrient levels in water can reducing dissolved oxygen levels, increase algal growth, and harm aquatic life (Oklahoma Conservation Commission, under the Illinois River Watershed Based Plan, 2010). Blue-green algae blooms can also create a human interface problem due to toxins released from the algae in areas used for swimming, fishing, and other recreational activities. One source of nutrients in the watershed is agricultural runoff. Animal waste (primarily chicken litter) spread onto fields as a fertilizer and allegedly causing high nutrient loading in the Illinois River Basin (flowing through a portion of Delaware County) created concern, resulting in a lawsuit filed by Oklahoma's Attorney General in 2005 (Green 2015).

Water levels in the lakes and storage system are limited and at the mercy of rainfall. While Northeast Oklahoma appears immune to this problem in recent years, changes to climatological patterns could create stress on the hydraulic sources, resulting in degraded use and reduced potential for conversion of this natural capital into other forms of capital.

Flora and Fauna

There are many sources of potential harm to plant and animal life in this delicate ecosystem. The Tar Creek site discharges affect the Grand Lake area. The Oklahoma DEQ published a *Fish Consumption Guide for Tar Creek Areas including Grand Lake* warns consumers to be aware of potential exposure to toxic metal levels (Oklahoma DEQ 2015a). According to a U.S. Geologic Survey Report (U.S.G.S. 2009), "[m]etals in water and sediments in streams, draining the mining district, can potentially impair the habitat and health of many forms of aquatic and terrestrial life." The water infiltrating mineshafts at Tar Creek has also decreased the pH levels in local groundwater water due to acid. This pH change can affect fish and plant life, as they have a pH range in which they can live, and since these acids have a high

specific gravity, they accumulate in sediments and are difficult to remediate from lake and river bottoms.

Soil & Geologic Formations

Environmental contamination to soils and the water bodies in the four-county area would cause serious damage to many Northeast Oklahoma communities. Technological disasters create a multitude of community difficulties. Rural road construction has been an item of concern for the U.S. EPA since 1972. In their document *Compilation of Air Pollutant Emissions Factors (AP-42),* dust from soils and their impact have the potential for contaminating water bodies, and to reduce the ability of drainage systems to effectively carry away and control runoff (U.S. EPA 2015d). In Oklahoma, the methods used to construct roads have created their own problem; for many years, construction companies used chat containing elevated levels of heavy metals as roadbed in rural community roads.

If environmental pollution or damage to natural capital reduces available financial capital provided through ecotourism, political capital may increase causing greater emphasis placed on chemical disaster preparedness. In the same manner, pollution can build cultural capital when environmental groups become concerned.

Built Capital

Resilience

Human Healthcare Facilities

The Oklahoma Department of Health website search of licensed long-term care facilities in the four counties in this study found 15 nursing homes, 13 facilities (all were Home of Hope facilities) for people with intellectual disabilities, 14 residential care homes, and 3 assisted living facilities (Oklahoma Department of Health 2015, under “Directory of Oklahoma Licensed Long Term Care Facilities”).

Young families, who tend to have more educated young professionals, want services that support their family needs while allowing them to work locally. Searching the study area using Oklahoma Department of Human Services data, I found childcare services best for Delaware, followed by Craig, Ottawa, and Mayes Counties (Oklahoma Department of Human Services 2015, under "Childcare"). A search of the licensed daycare facilities in the four county area resulted in 25 facilities in Delaware County, 19 in Craig, 28 in Ottawa, and 30 in Mayes.

During technological disasters, it is critical to have the support of community services to help victims and to foster recovery. In the study area, there are 3 rural health clinics according to the (Centers for Medicare and Medicaid Services 2015, under "Rural Health Clinic List"). The Oklahoma Board of Medical Licensure shows that Mayes County has 15 medical doctors (MDs) and 2,750 residents per doctor as of May 2, 2015 (Oklahoma State Board of Medical Licensure and Supervision 2015, under "Number of MDs by County"). The same report found there are 12 medical doctors (MDs) inside the Craig County, or 1,252 residents per doctor (Oklahoma State Board of Medical Licensure, 2015). Delaware County has 32 medical doctors and 1,296 residents per doctor, and Ottawa County has 30 medical doctors and 1,061 residents per doctor. The average number of residents per doctor in Oklahoma is 2,677, meaning that 3 of the 4 counties being studied in this research have fewer residents per doctor than the state average. While these statistics do not account for Doctors of Osteopathic Medicine, they are a reflection of general medical professionals per capita in rural communities.

Tornado Shelters

The existence of public tornado shelters indicates the willingness of community leaders to take some measures of preparedness to protect its residents. The Mayes County Board of Commissioners donated several 20,000-pound steel vessels (previously donated to them by Google) for use as community storm shelters (Day 2014). Unfortunately, towns like Spavinaw,

Oklahoma have experienced problems financially, and have been unable to finish those projects completely. Chouteau, OK has completed a community shelter, and others are in progress. The Town of Locust Grove decided to improve their schools, making them into rated storm shelters; and allowing the community access during times of hazardous weather (Tulsa ABC Channel 8, 2015, under "Is This School Tornado Proof?").

Residential Construction

Residential dwellings in Northeast Oklahoma vary in age, construction techniques, building materials, and other ways that could affect their ability to provide protection against exposure during a chemical release. According to a video by the Federal Emergency Management Agency and the U.S. Army, all buildings have some air infiltration. Sampling has revealed that older and less sealed buildings can experience a higher air exchange rate (1-2 air exchanges per hour) than newer and tighter buildings (U.S. DHS 2002, under "Residential Shelter in Place"). Changes to energy policy since 1975 have resulted in increased attention to reducing air leakage in buildings. This change was primarily driven from an American Society of Heating, Refrigeration, and Air Conditioning Engineers Document (Standard 90.1, Energy Conservation in New Building Design), in 1975 to improve building insulation, energy efficiency, and to reduce unintended leakage (Alliance Commission on National Energy Efficiency Policy 2013, under "The History of Energy Efficiency"). Many changes since that time, including a concentration on sustainable building practices, have resulted in greater building tightness. Other variables aside, building construction during a chemical release may be crucial to making a decision to evacuate or shelter-in-place.

According to the American Factfinder database within the U.S. Department of Commerce, Census Division, (2016, under "Year Structure Built, by county") 20 percent of residences currently exist in Delaware County were built from the early census records until the

decade of 1970-1979; during which housing "tightness" changed. In the same report, Mayes County indicated 31 percent; Craig County had 48 percent, and Ottawa County 46 percent of houses built between during the same period. This indicates that sheltering in place in the study area during a chemical release will be moderately successful at best (unless improvements have been made to reduce air infiltration into the building envelope); and significant thought should be given to the neighborhood characteristics and general age of homes prior to making this type of decision.

Water Treatment Systems

The water sources for Northeast Oklahoma include the Grand River watershed, and multiple wells throughout the rural communities and private properties. Increases in transparency and water quality standards have resulted in upgrades to systems and cleaner potable water with fewer undesirable contaminants. A U.S. EPA search for potable water supplies, however, indicates 70 municipal, tribal, and private potable water providers in the four-county area (U.S. EPA 2015f). There are also a great number of private drinking water wells in rural locations. These wells may contain contaminants, and unless owners test the quality, the water may pose a risk to residents. The Safe Drinking Water Act passed by Congress in 1974, covers drinking water wells greater than those serving 25 people (U.S. EPA 2015e).

In order to ensure wastewater is safe to discharge into rivers and other water bodies, the EPA issues permits and requires testing of effluent. A search of the EPA permitting database revealed 15 permitted discharge facilities in Mayes County. A similar search resulted in 12 permitted facilities in Craig County, 16 in Ottawa County, and 14 in Delaware County (U.S. EPA 2015c).

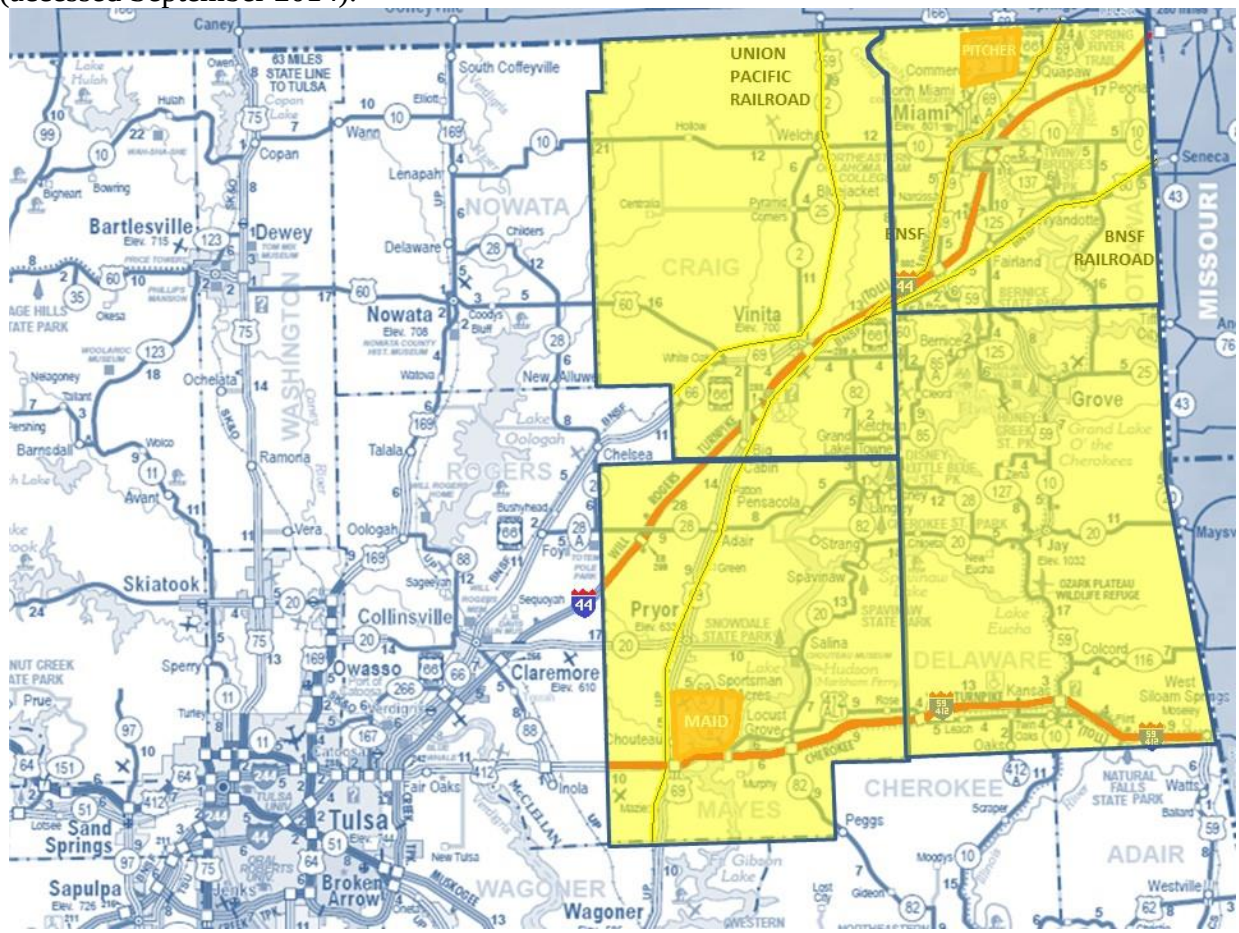
Transportation

The study are includes several transportation systems, including 2 interstate highways, 3 rail routes, and multiple smaller roads designed to deliver chemicals for storage and use. According to a report from the Oklahoma Department of Transportation (Oklahoma DOT 2016, under "Update on Oklahoma Bridges and Highways"), in 2005, the State of Oklahoma decided to rectify many years of flat spending on infrastructure and deferred maintenance on critical roads and bridges throughout the state. This has led to the State of Oklahoma issuing an 8-year plan to repair and replace roads and bridges in danger of failure. Oklahoma re-approved this program extending it through 2024. In the four counties of this study, there were 13 bridges that were structurally deficient and 3 that were obsolete. Of the originally identified deficient bridges, the State of Oklahoma has already replaced and repaired many. The original report identified several state roads in the study area with steep grades or sharp curves. This report identifies need for increasing safety devices and making improvements to reduce risk. While this report may appear to reveal vulnerabilities rather than resilience, the State of Oklahoma has completed many of the projects or they are contained in the 8-year strategic plan, improving transportation routes critical during a disaster. These routes are important for emergency responders, evacuation of residents, ensuring goods and material flow for business continuity and for restoration of normalcy following a disaster.

Northeast Oklahoma has numerous alternate transportation routes for commerce and area access during disaster situations. This region of Northeast Oklahoma is close to the City of Tulsa, and chemical shipments that support industry often travel through this transport corridor. Although the Port of Catoosa is not in the study area, it bears mention for its impact on commerce and cargo shipments. The Port of Catoosa is located between the study area and the City of Tulsa. According to the Port of Catoosa website, customers send and receive 2.2 million

tons of cargo (some including hazardous chemicals) through the port annually (Port of Catoosa 2017). The MidAmerica Industrial park, located within the study area, has three main access routes, a railroad spur, and closed seasonal roads that emergency responders could use during times of crisis. Highway maintenance inspects and maintains normally traversed roads and bridges to ensure continuance of commerce on a regular basis. Figure 7 depicts the study area and shows proximity to an industrial park and metropolitan areas.

Figure 7. Map adapted from the ODOT Maps, Oklahoma State Highway Map. http://www.okladot.state.ok.us/hqdiv/p-r-div/maps/statemap/pdfs/09-StateMapHiRes.pdf (accessed September 2014).



Electrical Supply

The electric supply system in Northeast Oklahoma is robust, having several power generation plants and improving transmission and distribution systems throughout the region.

According to a 2014 map created using the Department of Energy annual data, there have been no major power grid disruptions since 2000 (Jordan Wirfs-Brock, 2014). Mayes County Emergency Management has two large capacity generators and one smaller generator and light tower used to supplement backup systems for critical infrastructure. Craig County has a portable generator used to provide temporary power during outages. According to the Department of Energy, Office of Electricity Delivery and Energy Reliability, in 2014 no service interruptions occurred in Oklahoma (U.S. DOE 2014, under "Electric Disturbance Events (OE-417) Annual Summaries"). From January through April of 2015, the annual summary indicates no grid disturbances in the study area. Utilities and municipalities have improved the resilience of the electrical grid following the release of the Presidential Policy Directive 8, *National Preparedness*. Oklahoma's Emergency Operations Plan also delineates responsibilities and command structures as the energy infrastructure failures dictate during an emergency (Oklahoma Office of Emergency Management 2009, under "Oklahoma Emergency Operations Plan, ESF 12, Energy Annex").

Natural Gas and Propane

Numerous industries use propane as a source of fuel and feedstock. From 2009 until 2014, Oklahoma has averaged as the fourth largest U.S. producer of natural gas (U.S. Energy Information Administration 2015, under "Natural Gas Data"). According to the National Pipeline Mapping System, there are two liquid natural gas (LNG) pipelines in Craig County, 1 each in Delaware and Ottawa Counties, and 3 in Mayes County (National Pipeline Mapping System 2015, under "NPMS Public Map Viewer" https://www.npms.phmsa.dot.gov/PublicViewer/).

Gasoline and Diesel Supply

During a disaster, many of the tools and pieces of equipment require diesel or gasoline to function. There are numerous retail and government sources for fuel in Northeast Oklahoma.

Temporary fuel supplies are stored in above ground tanks and on travelling skids for use during these periods.

Communication Process and Systems

Being able to send and receive messages is crucial to the effectiveness of disaster response and for situational awareness. Recent large-scale disasters have highlighted the issue of communication problems, specifically Hurricane Katrina and the September 11th disaster (Manoj and Baker 2007). While situational awareness is key to mitigating a chemical release, knowing the status of responders, and monitoring information as it is conveyed, is key to making informed decisions during a disaster. Acting on improper or misunderstood information can be disastrous in its own right.

Television

According to the Nielsen's National Television Household Universe Estimates, 96 percent of U.S. households have television sets receiving a signal via cable, antennae, telephone companies, and internet sources (Nielsen's National Television Household Universe website search, 2015). The relative cost of televisions has decreased, as technological advances have made equipment smaller and easier to manufacture.

Telephone

The technology used in land-based telephones has improved since its inception. Emergency services dispatch systems can easily trace the location for a call, and reverse 9-1-1 systems can dial a group of residences having land-based telephones in a short time period to deliver critical messages to community members.

Cellular Telephones

Mobile telephones have become smaller, better, with more technological computing power, batteries last longer, and applications allow for subscription to warning services for

weather and other emergencies. The Broadcastify application provides a live streaming radio signal akin to a police and fire scanner, where subscribers can hear dispatch and radio traffic between responders. This application can provide an invaluable source of information to transient populations during a disaster.

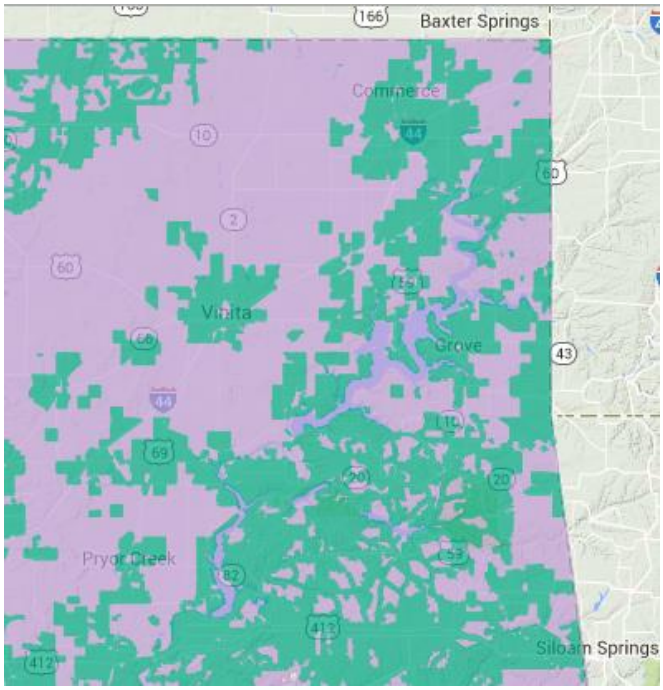
Internet

Historically, rural communities have not been a priority for communications companies, as the majority of their customers reside in metropolitan areas. In one study of Oklahoma emergency managers, the most prevalent form of internet access was still dialup modems (Marks 2006). According to the Federal Communication Commission National Broadband Plan Executive Summary, ". . . our first responders still lack a nationwide public safety mobile broadband communications network, even though such a network could improve emergency response and homeland security" (U.S. FCC 2010, under "National Broadband Plan, Executive Summary"). According to the FCC technical paper *Healthcare Broadband in America* (2010, under "OBI Technical Paper #5"), medical providers need improved broadband access to provide advanced care. However, recent federal programs have aimed to improve rural access to these services, especially concentrating on communications. These programs have added internet connectivity, satellite television, changed income distributions, and increased local knowledge, altering the character of rural communities (Flora and Flora 2008).

Oklahoma's participation in the Broadband Initiative aims to improve rural access to broadband internet. The current broadband service map for the study area is represented by Figure 8; green areas have high-speed broadband and the purple areas have slower systems.

Figure 8. *Next Page*. Data Adapted from Oklahoma Broadband Initiative Mapping Site. http://broadbandmapping.ok.gov/OKindex.html (accessed August 31, 2013).

Figure 8.



Emergency Response Communications

First responding agencies utilize various modes of communication, and multiple frequencies within those modes, for levels of organizational responsibility (communication with dispatchers versus fire ground communication). Communication technologies (UHF, VHF, Shortwave, Satellite phones, etc.) have become valuable tools available to fire departments today that were not available many years ago. Mayes County Emergency Management has procured a communications vehicle designed to allow redundancy and inter-agency communication. The vehicle has ultra-high, very high frequency radios, shortwave and long wave band radios, 800 megahertz radios (which have until recently been too costly for most fire departments), a satellite telephone (which is still too costly for most agencies), and other equipment. Technological advances have led to improving internet and satellite coverages in rural communities, and improved television signals in historically problematic areas. With streaming devices like Roku or internet cable sticks, Amazon Prime, Hulu, Netflix, and using smart DVD and blue-ray players and video game consoles, using television to communicate warnings and live information

has become problematic, reducing opportunities for using live television for communicating with the public. The use of mobile devices and internet to stream live-time warnings and updates allow community residents (and transients) to choose mobile warnings and applications that use the location of the mobile device user for notifications in their current area.

Warning Systems

Northeast Oklahoma experiences chronic hazardous weather and warning systems are a component of daily life. Although some disasters allow little opportunity for a warning prior to the event, receipt of the message can be critical in reducing its impact (Dynes, Quarantelli, and Kreps 1981). The process of creating a warning system should utilize grass roots networks by which the community tells planners of their needs and the best manner by which to receive a message. Community outreach helps educate the public over the meaning behind warnings, when responders will use them, and what they should think about when planning their responses. Emergency managers test tornado sirens in Mayes County on a regular basis, weather-alert radios are commonplace in households and businesses, and weather spotters stumble over one-another watching and broadcasting during inclement wind events. However, there are few chemical release alarms notifying people in the area of an event. One company in the Mid America Industrial Park has a chemical siren to notify those within earshot of an emergency. The Industrial Park also has an emergency radio system where 911 dispatchers can send out an alarm of an incident in the park to subscribers. The Mayes County Emergency Management organization also utilizes reverse-dialing software to notify telephone participants of a situation and proper actions to take.

Vulnerabilities

Healthcare Facilities

Rural healthcare is a large component of community attractiveness that causes businesses and employees to move into an area. Mentioned in chapter 2, reliable rural healthcare is difficult to establish. In an article by The Times (Baron 2017a) Alliance Health-Pryor asked Mayes County for $500,000 towards facility upgrades to entice a new owner for the hospital. Alliance Health has opted to let the contract lapse and let another owner/operator take over. Mayes County voted to provide $250,000 to the hospital after they provided an itemized list of repairs and improvements. The hospital has been providing this service to Mayes County for 60 years, and a lapse in service would negatively affect areas residents.

The University of Wisconsin Population Health Institute studies health systems and ranks counties in each state. According to the rankings of Oklahoma counties, Mayes County ranked 33, Craig 50, Delaware 53, and Ottawa County 57 out of 77 total counties (University of Wisconsin 2016). According to a report from the Oklahoma State Department of Health, Ottawa, Craig, and Mayes Counties rank in the highest deaths per capita category of all counties in Oklahoma; Delaware was in the 2nd of the 4 categories (Oklahoma State Department of Health 2012, under "Age-Adjusted Death Rates by County"). This report attributed the most frequent cause of death for 15-65 years of age and older to accidental deaths for the 15-44 year old, cancer for the 44-64 year old, and heart disease for 65 and older populations; this was a common trend among the four counties. A search of the licensed Medical Doctors in the four counties in this study indicated 1 specialist in emergency medicine (for injuries related to accidents), but no specialist oncologists (cancer) or cardiologists (heart disease); listed above, as being the leading causes of death in the counties.

Adult daycare facilities allow families to move into a community and to keep relatives requiring advanced care nearby. According to the Oklahoma Department of Human Services website search, there is only 1 adult daycare facility located in Ottawa County of the 4 counties in this study (Oklahoma DHHS 2015 “Protective Health Services - Provider Survey/Inspection Search”).

Public Service Buildings and Parks

During disasters, responders can open public buildings for temporary shelters or other similar services. However, planners should not utilize these structures to house people for long periods, and normal government services need to continue during emergencies. Although designers are more frequently specifying public buildings be built with backup generators and to withstand inclement weather, limitations of rural financial conditions may dictate the age of structures, and their relative maintenance activities.

Building Construction

Changes to energy policy have resulted in tighter buildings, which may be beneficial in providing shelter-in-place options during a chemical release. Tighter buildings should reflect positively on the ability to shelter residents in place; but these tighter building policies only affect new construction, and are usually limited to areas with residential building codes and rigorous enforcement. While newer construction can better withstand the impact of a chemical plume, those vulnerable residents who do not have the resources to evacuate may not homes able to effectively protect them from exposure should they choose to shelter-in-place.

Water Treatment Systems

Water treatment systems can be robust, but experience the same limitations as other forms of built systems. Water treatment uses various technologies, but a common method found in many rural districts is to use hypochlorite solution (bleach) or chlorine gas. Interruptions in

supply chains, transportation routes, or other problems with commercial availability prevent adequate provision of potable water. Some districts experience this problem and issue boil orders to reduce the likelihood of bacteria and viruses affecting health of customers.

Electrical interruption or fluctuations can inhibit effective potable water treatment. Some districts have implemented backup power supplies, but this is an expensive measure. Pipelines experience separations and failures, affecting potable water systems. Like other systems, evacuations of communities can affect services due to a lack of available personnel.

Transportation Systems

During a chemical disaster, evacuations and delivery of emergency equipment, tools, and medical supplies, as well as available personnel are reliant on an open and reliable transportation system. While the roads and bridges in Northeast Oklahoma are currently being repaired as part of new initiatives, chemical releases can cause complications, further degrading an already-compromised system. An example of this would be an acid spill on a concrete road; the acid reacts with the caustic constituents of concrete, resulting in structure degradation.

Electrical Supply

Many initiatives in the past 20 years have resulted in a more resilient electrical generation, transmission, and distribution system. However, many weaknesses exist within the system, including solar events causing damage to relay and control equipment; terrorism, theft, and vandalism causing damage or missing components that could result in failures and grid disruption. According to Wirfs-Brock (2014) power outages are on the rise. From 2000 until 2014, the number of outages doubled during every five-year span. The reason for this increase includes the rising needs of a growing population, an aging power grid, and increasingly violent weather patterns. Without a resilient electrical supply, community recovery from a chemical

disaster is increasingly difficult. According to Bryant (2009, 2), rural communities often experience slower restoration of electrical service due to “remoteness and separation.”

Natural Gas and Propane

The delivery of natural gas and propane is important for resident heating, as well as for feedstock at local commercial plants. These fuels are critical during certain times of the year when weather could cause outages. These fuel stock interruptions can negatively affect the economic viability recovery of rural communities. Delivery of this resource is crucial to maintaining some form of normalcy during a disaster.

Gasoline and Diesel Suppliers

While Oklahoma has a vast array of commercial diesel and gasoline delivery locations, during a disaster these suppliers may have limited fuel deliveries due to power outages, evacuations due to chemical plumes, and other causes. Gasoline and fuel oil have storage lives, and will degrade during long periods of dormancy. While service companies can arrange deliveries from regional suppliers, limitations on fueling stations will be a significant problem during a chemical release or disaster event.

Television

Information received from television and related signal technologies in rural areas is improving, but options for on-demand programming and watching less live television, means there could be problems with receipt of warning messages transmitted through traditional means.

Telephone

Telephone service can be critical during power outages, and for ensuring accurate address locations during an emergency. A growing trend in the U.S. is to forgo a land-based telephone in favor of cellular phones. According to a program managed by the Centers for Disease Control (U.S. CDC 2012, under “Wireless Substitution: State-level Estimates from the National Health

Interview Survey"), 38.2 percent of households in the United States rely solely on a cell phone. This survey tracks the number of telephones owned by residents since 2003. According to the report, land-based telephone ownership in homes has decreased every year since 2003 (U.S. CDC 2012, under "National Health Interview Survey Early Release Program"). This becomes problematic for effective use of warning messages that use standard telephone lines.

Cellular Telephones

Cellular telephones are wonderful tools, especially applications used for emergency warning notifications. However, cell phone signal, battery life, limited bandwidth, and other problems can emerge during a disaster. New technologies for cell phones allow responders to triangulate a signal, but triangulating their location has limitations. Broadcastify, Active 911, and other applications on cellular phones offer many advantages. However, these applications, and other similar internet-based applications, have drawbacks including the need for adequate cellular and internet signal, and the ability to afford a cellular phone plan that allows for streaming data.

This paper has addressed problems related to transient populations in the natural capital section. These seasonal populations, eager to experience natural recreational opportunities, create a unique problem in notification during an emergency. While many applications have locator options that allow the user to receive messages and information specific to the area in which they are located. However, unless the transient population uses these options or bring NOAA weather radios, have portable communication equipment (radios, televisions for emergency broadcast system notifications), or other means, they may not be able to receive these warning messages.

Emergency Response Communications

Multiple communication systems are available to responders, but complicated use of multiple frequencies, and equipment not commonly found in the local responders' hands can

create problems. Manoj and Baker (2007) note that responders complain that lack of radio interoperability is a problem during a response.

Internet

Internet access can be an issue during a disaster, satellite signals can be interrupted, cabling used to carry internet signal can be severed, power outages and server interruptions can create signal disruption that all result in a loss of connectivity. While federal programs aim to reduce inequities of rural community access to information on the internet, these programs take time to implement, and may not fit every rural community's needs.

Northeast Oklahoma has many forms of warning message conveyance, including social media, television (emergency broadcast system), reverse 911, text message warnings, applications for cellphones, a chemical siren, radio messages, and others.

Financial Capital

Resilience

Rural Community Financial Resources

There are many sources of community financial capital available, from block grants and loans, to equipment purchase agreements that allow rural fire departments to afford equipment and improvements. The Oklahoma Department of Commerce provides Community Development Block Grants for the purpose of providing opportunities for low income rural Oklahomans. These block grants can be used for projects such as potable and waste water treatment, solid waste, streets and community centers, fire protection, storm-water drainage systems, gas and electric system improvements, and to improve access for residents with limited mobility (Oklahoma Department of Commerce 2015, under "Rural Economic Action Plan"). A goal of this program is to improve community infrastructure to attract and keep businesses that provide higher paying employment opportunities in these rural areas.

The four counties in this study qualify for the Department of Commerce *5 percent program*. This program provides economic incentives in the form of a quarterly cash repayment of up to 5 percent of the new taxable payroll if the new payroll amounts exceed $2.5 million dollars (Oklahoma Department of Commerce 2015, under "Quality Jobs Program 5 Percent Incentive"); better incentives exist for employment of veterans or certain industries. In addition, the program provides a significant tax credit for investment made to depreciable property or by hiring new employees for manufacturing, processing, or aircraft maintenance. (Oklahoma Department of Commerce 2015, under "Investment/New Job Tax Credit Package"). Incentives exist under this program for small businesses who pay 110 percent of the community average wage and do at least 75 percent of their business out-of-state. Another facet of the program incentivizes doing business on tribal lands if you hire a person of Native American heritage. Additional funds are available for hiring engineers who graduated from Oklahoma in the aerospace industry, and those whose average wage is $94,000.00 or more in a technology field. Finally, the program provides motivation for hiring immigrants to the United States and a pathway to citizenship (Oklahoma Department of Commerce 2015, under "Incentives").

The United State Department of Agriculture provides low interest loans and grants (depending on the economic characteristics of the community) to towns, townships, community non-profit organizations, cities, and federally recognized Tribes in areas under 20,000 people. These funds can be used to purchase equipment or build community service facilities, such as health care facilities, government and public service (fire stations) buildings, aircraft hangars, childcare and adult daycare facilities, community centers, vehicles and equipment (fire response vehicles), and for infrastructure improvements (U.S.D.A. 2015, under "Community Facilities Direct Loan and Grant Program"). The U.S.D.A also provides backing for loan lenders to encourage business improvements and development in rural areas (U.S.D.A. 2015, under

"Business and Industry Loan Program"). Rural Business Development Grants exist under the United States Department of Agriculture (U.S.D.A.) to foster improvement and development, creating a business friendly community environment (U.S.D.A. 2015, under "Rural Business Development Grant").

Following a disaster or chemical release, communities can apply for an Emergency Water Assistance Grant from the U.S.D.A. for repairs to water systems (U.S.D.A. 2015, under "Emergency Community Water Assistance Grant"). Communities can also make potable and wastewater infrastructure improvements using funds from the aforementioned Oklahoma Department of Commerce Community Block Grants. The Water & Waste Disposal Grants Program provides funding for improvements to communities with water systems located on tribal lands (U.S.D.A. 2015, under "Water & Waste Disposal Grants").

To improve communication infrastructure, communities can apply to the U.S.D.A. for a Community Connect Grant. This grant provides financial assistance for broadband internet projects in rural communities (U.S.D.A. 2015, under "Community Connect Grant"). Along with internet services, the U.S.D.A. offers guaranteed low interest loans for expanding 911 and emergency services communication systems, transportation communications, and homeland security systems (U.S.D.A. 2015, under "Expansion of Rural 911 Service Access Loans and Loan Guarantees").

Disaster preparedness funding is available to reduce or mitigate risks. According to the Federal Emergency Management Agency, there are several funding opportunities with which to reduce risk or improve preparedness. These opportunities include the Pre-Disaster Mitigation program, Emergency Management Performance Grant, and Regional Catastrophic Preparedness Grant Programs (U.S. DHS 2012a, under "Funding Alternatives for Emergency Medical and Fire Services").

Fire Department Funding

Fire departments in Oklahoma can benefit from participation in their local emergency planning committee. Preparedness training, outreach, and equipment are legitimate uses of LEPC funds. Eligible LEPCs in Oklahoma can receive $1,000.00 annually from the Oklahoma DEQ, with which to conduct planning activities. To receive these funds, LEPCs must document their dissemination of the EPCRA Tier II chemical information to local fire departments for use in preparedness planning. In addition to the State DEQ funds, the Mayes County LEPC invoices its commercial and industrial partners annually; providing several thousand dollars with which to further provide services to local emergency responders. The Department of Transportation *Hazardous Materials Emergency Preparedness* (HMEP) grants provide additional funding sources to response agencies. The Pipeline Hazardous Materials Safety Administration within the DOT provides grants to help prepare public employees for hazardous materials response related to transportation. The Oklahoma Department of Emergency Management administers the PHMSA block grants in Oklahoma.

There are multiple grants available to fire departments, including for the purchase of equipment, protective garments, response vehicles, training and education, and other resources (U.S.F.A. 2015, under “Assistance to Firefighters Grants”). In addition to providing funding for equipment and training, the Staffing for Adequate Fire & Emergency Response Grants (SAFER) help hire new, and rehire certified firefighters to maintain safe staffing levels (U.S.F.A. 2015, under “Staffing for Adequate Fire & Emergency Response Grants”). The United States Fish and Wildlife Service (U.S.F.W.S.) provides Rural Fire Assistance Grants to help fire departments who respond on federal lands, including opportunities to purchase equipment and train volunteer firefighters (U.S.F.W.S. 2015, under “Rural Fire Assistance”). The United States Forest Service (U.S.F.S.) provides matching funds for organizing, equipping, and training rural fire departments

who serve communities of less than 10,000 people (U.S.F.S. 2015, under "Volunteer Fire Assistance"). The Oklahoma Division of Forestry provides a Rural Fire 80/20 Grant Program allowing fire departments to receive partial reimbursement for costs related to fire station construction and equipment purchase (Oklahoma Forestry Services 2015, under "Grants Available to Fire Departments and Communities"). Governor Fallen approved Operational Grants for fire departments serving less than 10,000 people for a range of projects; 49 departments each received $4,484 dollars (Oklahoma Forestry Service 2015, under "Rural Fire Operational Assistance Grants"). According to the Alternative Funding Sources report (U.S. DHS 2012, under "Funding Alternatives for Emergency Medical and Fire Services"), there are also multiple private grant sources for fire department improvement.

The Communities Foundation of Oklahoma provides a wide range of community and non-profit organization funds and matching donations. The aim of this funding is to increase education and organizational growth opportunities at the community level. By expanding these opportunities, increasing community attractiveness, human capital can develop and ultimately increase the potential for new volunteers.

Vulnerabilities

Fire Department Funding

Changes to the federal grant award process gave fire departments, with more established training and organization systems, higher priority than those without. Requirements placed on fire departments to win these awards has driven greater competition for reduced federal funding to spend on more costly equipment (Patterson 2009).

Protective Equipment

The National Fire Protection *Third Needs Assessment of the U.S. Fire Service: Oklahoma* (NFPA 2010) identified that the 68 participating fire departments (out of 498 surveyed) did not

possess enough self-contained breathing apparatus to equip all firefighters on shift. This was a decrease from 2001, but a slight increase from 2005. The study also indicated that 9 percent of the respondents could not provide responders with their own personal protective clothing.

Communications Equipment

In the same needs assessment survey (NFPA 2010), 41 percent of respondents did not have enough portable radios to equip all firefighters on shift. This is a tremendous problem, as one of the most frequent problems in emergency management includes lack of communication on the ground.

Human Capital

Resilience

Population migration into and out of communities is based upon several variables, including services offered, amenities (parks, museums, etc.), degree attainment, need to escape the stresses of urban life, and other reasons. In the period between 2008 and 2012, the four county region in this study experienced a net increase of 10 residents (-74 Ottawa, -190 Mayes, +234 Delaware, and +40 in Craig). However, Mayes County, in which the Mid America Industrial Park is located, saw a net decrease of 190 residents (U.S. Department of Commerce 2012, under "county-to-county migration flows").

Education

Education levels have a significant impact on various components of preparedness, including risk perception, evacuation decision making, technical knowledge, and other facets. The percentage of residents with a high school education or greater in the four most Northeast counties in Oklahoma (Ottawa, Craig, Delaware, and Mayes) was 83.73 percent versus the Oklahoma average of 86.2 percent (U.S. Department of Commerce 2014d, under "State and County QuickFacts *2008-2012*"). When looking at K-12 education, and using the contentious

Oklahoma A-F Report Card Grading System results for 2014, Mayes, Ottawa, and Craig Counties averaged a C letter grade, with Delaware achieving a C- grade (Oklahoma Department of Education 2014, under "Oklahoma A-F Statewide Grades"). The same report indicated that the State of Oklahoma achieved an overall grade of D+. The same information revealed that residents possessing a bachelor's degree or higher was 14.2 percent versus the Oklahoma average of 23.2 percent.

Degree attainment could be a reason for out-migration from rural communities. While Mayes, Craig, and Ottawa Counties follow a pattern of degree attainment and out-migration of residents, according to the U.S. Census Data (2008-2012), Delaware is exactly the opposite (U.S. Department of Commerce 2012, under "under county-to-county migration flows"). A dichotomy emerges when discussing the need for education and training to respond to hazardous materials incidents. A higher technical education involving chemistry and mathematics is required for responders to understand hazardous chemical releases, but studies show outmigration of technically literate residents when they attain higher levels of education; in essence, the cure to the illness is a poison.

In the four counties of interest, there are two college branch campuses and a regional university. Rogers State University, Pryor campus offers courses in support of both undergraduate and graduate degrees. Oklahoma State University Institute of Technology, Pryor campus offers courses in support of a two-year technical degree. Northeastern State University, Miami campus, offers courses in support of a two-year degree. The Oklahoma Career Technology system supports three campuses in the four county region including, Kansas, Afton, and Pryor. Technical courses helping to qualify local residents for employment increase the value in these communities.

Social Capital

Resilience

Northeast Oklahoma has numerous opportunities for social and civic engagement. The mission statements of these organizations include community service, helping those in need, providing resources to build capacity, and providing opportunities to take part in relationship building and civic growth. The study area has numerous civic organizations, including 15 Masonic Lodges, 8 Lions Clubs, 3 Rotary Clubs, 2 Elks Clubs, 7 Veterans of Foreign War Posts, 1 Odd Fellow Temple, 1 Kiwanis Club, 9 American Legion Posts, and other organizations existing to provide social cohesiveness opportunities to local residents.

Oklahoma is within a portion of the United States considered as the "Bible Belt." According to a Gallup Report on religion and social trends, titled *Mississippi maintains hold as most religious U.S. State; Vermont is the least religious* (Gallup 2012), Oklahoma is the tenth most religious State in the U.S., having 48 percent of its residents identifying themselves as religious. The Mennonite and Southern Baptist communities have subsets of their faith (Southern Baptist Disaster Relief and the Mennonite Disaster Service) specifically geared toward disaster response. Theological organizations serve the needs of the community, add to social capital through servitude, and conducting community events (like trunk-or-treat for safe candy giving during Halloween, food banks, toys for the needy during Christmas, and clothing drives). According to the Association of Religion Data Archives (as listed by the U.S. Census), there are 62 churches in Mayes County, 28 in Craig County, 49 in Delaware County, and 53 Churches in Ottawa County; for a total of 192 religious institutions on the four-county area (Association of Religion Data Archives 2015, under "Interactive GIS Maps"). Within these organizations community and individual outreach helps to support community needs.

Cultural Capital

Risk perception varies, based on many factors, including social pressures, beliefs, and values. In a Tulsa News on 6 Investigation (2014, under "Recent Derailments, Deadly Explosions Have Crude Oil Rail Transport"), Jennifer Loren interviewed the unidentified owner of the Jones Lumber Store (in Jones, Oklahoma). The owner said he could not even remember a train derailment occurring 9 years earlier resulting in a hazardous chemical release, and that "trains are just a part of life here."

The struggle of risk perception versus the benefits of technology is ever-present in Oklahoma. It is well-established that a large portion of Oklahoma's economy is based on the petrochemical industry; mainly oil and gas. The Editorial Board of the Daily Oklahoman, a newspaper based out of Oklahoma City, published an article titled *Rail car crackdown could slow or alter North American energy boom,* which questions whether railcars are "unsafe," and new regulations making the railcars safer will slow or alter the North American energy boom (Daily Oklahoman 2014). In the article, the author indicated that Bakken crude "…is a major source of wealth for the rapidly growing Continental Resources Co. of Oklahoma City." The article further indicates that the petrochemical industry is "under siege" and "inflated claims" have created "irrational fears." Conversely, a KOTV Tulsa News Channel 6 report (KOTV story 24698333, 2014, under "Potentially explosive train cargo puts Tulsans at risk") emphasized the risk of Bakken crude oil shipments through the City. While interviewing a local Tulsa resident (Jim Tenon) living near railroad lines, the reporter said, "according to new warnings from federal government agencies, perhaps Tenon and the rest of us should be worried…the warnings come in the wake of those deadly train explosions and conclude that the millions of barrels of crude oil being shipped out of North Dakota's Bakken oil fields each day are more flammable than traditional oil." When being asked about the current fleet of the DOT 111 railcars used to carry

Bakken and other crude oils predominantly in the industry, the outgoing NTSB Chairperson Deborah Hersman said, ". . . they are not safe enough to be carrying hazardous liquids . . . carrying corn oil is fine, carrying crude oil is not…at this point the industry and others agree" (Hersman 2014).

Political

It is critical to understand the power structure behind political action within a community. Knowledge of this structure is important to gain an understanding of the boundaries within which politicians operate. Each County in the State of Oklahoma has a government, based on a board of elected commissioners. County commissioners oversee many districts, including rural road improvement districts; and rural water, sewer, gas, and solid waste districts. According to the U.S. Department of Commerce, other governing bodies within the county include water supply; flood and soil erosion control conservancy districts; enterprise zones; and emergency medical service and fire protection districts (2012, under "Local Governments in Individual County-Type Areas: 2012 - State -- County / County Equivalent").

Policy

In the study region, chemical hazards are ever-present, from railroad and highway traffic, chemical production, and storage onsite at local plants. The U.S. EPA Risk Management Plan regulation requires plants with extremely hazardous chemicals to conduct preparedness planning for the potential of a chemical release. There are several locations in the four-county region required to file a risk management plan, but amendments to the regulation have made public transparency difficult, so I was unable to gain access to primary data from the Environmental Protection Agency website.

The Toxic Release Inventory program is a process by which companies report chemical releases of reportable quantities to local planners, and made transparent to community members.

In 2013, there were 12 plants reporting toxic releases in Mayes County; emitting a total of 4,363,259 pounds of hazardous chemicals. Craig County had one facility in 2013, emitting a total of 20 pounds of chemicals. During the same year, Delaware County had one facility releasing a total of 3207 pounds of chemicals. Ottawa County had six facilities reporting releases totaling 89,041 pounds of chemical in 2013 (Right to Know Network 2015, under "Toxic Release Inventory Database").

Oklahoma created the Hazardous Materials Emergency Response Commission (OHMERC) in 1986 (U.S. Regional Response Team 2014, under "Local Emergency Planning Committee Membership"). Under this regulation, the Commission directed formation of 77 emergency planning districts in Oklahoma (each county as well as 3 military installations); each district containing a LEPC (Oklahoma Office of Emergency Management 2009, under "Oklahoma Emergency Operations Plan 2009"). Companies with stored chemicals above the threshold submit an EPCRA report to the Department of Environmental Quality (ODEQ) in Oklahoma. Once the ODEQ receives this information, they issue invoices to private companies based upon their chemical holdings. These fees provide a small amount of funding in support of EPCRA program implementation and for LEPC planning efforts. The ODEQ sends responders the chemical information for their districts via the local emergency planning committees. The EPCRA law mandates that LEPCs have fire department participation, but there are no methods to enforce this mandate.

Participants

This study examines community capitals from the perspective of fire chiefs; and they are the unit of measure. The chief officer within the fire department is the person most familiar with the budget processes, apparatus and equipment needs, infrastructure within the community, social and cultural beliefs, firefighter capabilities and availability, and the political environment.

Rural fire departments often choose their fire chiefs from the veteran ranks, and is a firefighter considered knowledgeable on fire department operations. The fire chiefs participating in this study were all male, generally middle-aged, and appeared Caucasian or of Native American heritage.

Fire Department Characteristics

A large number of fire departments consisting of volunteer firefighters find themselves the primary first responding agency in dealing with transportation chemical incidents Quarantelli 1987a). In the study area, rural fire departments consist of 84.3 percent volunteers, as compared to 81.5 percent in the rest of Oklahoma (U.S. DHS 2015, under "National Fire Department Census") and 70 percent nationwide (NVFC 2016, under "Volunteer Firefighter Fact Sheet"). In the four counties of this case study there are a total of 51 fire departments, 4 are career, 4 are combination, and the remaining are all volunteer (U.S. DHS 2015, under "U.S. Fire Department Census"). This study utilizes a single case study of the four-county region. In order to ensure data were representative of the experiences and perceptions of varying fire department and community environments, the study provided an opportunity for fire chiefs from all of the 51 departments in the study area to participate.

Site Entre

I am actively involved in the Mayes County Office of Emergency Management and the Mayes County Local Emergency Planning Committee. This involvement has placed me in direct contact with local fire department personnel. These contacts provided site entrance, helped develop a rapport, and provided insight into fire departments in rural locales throughout Northeast Oklahoma. I also work for an Oklahoma State Agency that has existing relationships with local firefighters in the study area. Patton (1987) describes this method of gaining entrance to cases as a sponsor approach. The researcher uses the existing relationship between the

potential participant and a "trusted" sponsor for the introduction. This also helps establish a temporary affirmation of the study's legitimacy. It was my belief that fire departments will actively participate in this study because it will provide a voice to their plight, and may help them to gain support for conducting preparedness activities that will better ready them for responding to a chemical disaster.

Data Collection Process

I attempted to make contact with all fifty-one fire departments in the study area. Only two of the four county fire chief's associations had regularly occurring meetings, but I attended three regularly scheduled meetings to discuss the merits and drawbacks of this study with fire chiefs to determine interested participants. Once I had been introduced through these meetings, I attempted to call (leaving multiple voice mail messages), and sent emails to potential participants. Of the 51 potential participants, 27 fire chiefs participated in the surveys and 21 took part in interviews; participation rates of 53 percent and 41 percent respectively. Three potential participants chose not to participate due to time or other reasons; the remainder either did not respond, or were unable to maintain contact. Several rural fire chiefs in the counties without regularly scheduled firefighter's association meetings said they were unaware of the study. Fire chiefs received copies of the informed consent document and expanded on the rationale for the study, explained limitations, and verbally reinforced the voluntary nature of research participation. Potential participants received informed consent document (requiring signature) and a self-addressed envelope with which to mail back the requisite permission. Following an initial stage of non-reply by potential participants, I modified the methodology (with IRB approval) to allow an introduction page of the electronic survey to serve as the informed consent. By design, the survey was the first step of a multiple step process, followed by

interviews, in order to gain consent. If fire chiefs did not submit a survey, I excluded them from the remainder of the study (interviews) as a non-participant.

Instruments

Survey

I delivered the closed and semi-closed question survey using the SurveyMonkey online web application. The first 10 questions in the 17-question survey prompted participants to check any items available to their fire department, a form of inventory, and way in which to assess these capitals. Each question provided an option for participants to add "other" case-specific forms of capital to ensure the study questions were not exclusive and based solely on a priori assumptions. The last 7 questions of the survey utilize a Likert Scale to gauge fire chief perceptions about risk, community support, understanding of plans, and perception of their fire department preparedness; the survey is included in Appendix A.

I pilot tested questions during survey design, wherein my family (two current firefighters, one being a fire chief), and two fire chiefs from counties outside the study area, helped to verify the validity and reliability of survey and interview questions. If data revealed themes that need further explanation, I had the freedom to expand upon them during interviews. The survey produced data for cursory statistics, an inventory of capitals, and general participant impressions; but not for in-depth statistical analysis.

Interviews

To gain an inside perspective of the impact of capitals on fire department preparedness, and their reality, fire chiefs who completed the surveys were asked to take part in interviews. Data gathered as part of interviews is inductive, and grounded in the perceived reality of the participants. By providing this insight, researchers limit assumptions and reduce the potential for injecting their own bias into the data. According to Rubin and Rubin (2005), interviews are

appropriate if research involves topics that have limited previous data, a need to gather new ideas or solutions, or that require penetrating several layers of data. This study utilizes a semi-structured interview format that allows for follow-up when needed. The interview guide contains the questions, but I had the freedom to reword or ask follow-up questions, for clarification or to discuss new themes as opportunities arise. The interview guide provides a "checklist" for researchers to choose wording that fits situations (Patton 1987, 111). The interview guide allows a focus on the issues, but enough flexibility to explore emergent themes (Patton 1987). Berg (2004) writes, a semi-structured format allows the interviewer the freedom to digress from the predetermined line of questioning gain a better understanding of the way in which a participant views the world. This approach to interviewing is critical, as case study researchers cannot predict all information that becomes relevant to the research (Yin 2003).

Interview Questions

This study examines conditions affecting chemical disaster preparedness decision making. I worded interview questions to gain insight into the perception of the impact community capitals have on disaster preparedness. Patton (1987) discusses the types of interview questions that the researcher should ask. The types of questions include experience or behavior, opinion or beliefs, feelings, knowledge, sensory, and background or demographics. It is also important for questions to consider the context and time (e.g. past, present, and future); the interview guide is included in Appendix B, and contains the questions used in this study.

Document Review

The purpose of document review is to gain an independent perspective of the topic in a written form. When documents include newspaper, radio and video transcripts, and other forms of media, they include perspectives of reporters and news outlets; but often have an appearance of objectivity. Documents can reflect social opinion, emotional or political ties, historical

background, and other significant information that can prove or refute the research question. Lofland, Snow, Anderson, and Lofland (2006, 89) wrote that documentary evidence, "archival records" as they title them, can lead to rich findings. The function of document review is to look at data collected in its normal environment to gain "contextual information," and to gain an understanding of culture (Bloomberg and Volpe 2008, 195). According to Hamel, Dufour, and Fortin (1993) researchers should give weight to the perspective of those under study. One method of doing this includes use of "field materials," possibly including the remarks of participants or other documents. Use of these articles places feelings and characteristics in a social context. This study examines several document sources, including fire association minutes, newspaper articles about the fire departments, county commissioner board minutes, and other online sources that became relevant as data were gathered, and themes emerged.

Researchers must be careful not to introduce a change into the document archival or recording process. As Webb, Campbell, Schwartz, and Seachrest (1966) point out, by requesting documents, normally archived by an understaffed department, or when their system could come under scrutiny, people are capable of altering them. These reactions could affect the internal and external credibility of the study. While alteration of electronic archival records is possible, mass media materials are mostly nonreactive. A problem with mass media documents, however, is that they are a reflection of not only social bias, but can be subject to the biases of the editor with respect to the drive to achieve ratings or subscription sales. Mass media documents, however, can provide vital cursory data on general environmental conditions, such as economic news, political opinions, wars, and other pressing matters of the day (Webb, Campbell, Schwartz, and Seachrest 1966).

Case Study

Qualitative case studies allow in-depth exploration of the characteristics under study. In case studies, theories and themes develop inductively, rising from the data, helping the researcher to ensure the findings reflect reality (Merriam 1998). This approach reveals behavioral patterns, interactions, and structures of social life (Hamel, Dufour, and Fortin 1993). Case studies are historically significant, as they were the original platform for the qualitative method in sociology (Hamel, Dufour, and Fortin 1993). This approach is the chief mechanism to convey the emic perspective (Lincoln and Guba 1985). An emic perspective is an insider's view, and is critical to reveal reality constructions of participants. It is crucial to understand these constructions, as they are the conditions on which the participants base their decision-making. This approach reveals the pluralistic meanings actors assign to symbols, manners of speech, and unwritten understandings common to members of the same group. The case study approach allows examination of the nuances and interactions among the phenomena identified as characteristic of the populations under study (Berg 2004). A "unique strength" in the case study approach rests in the ability to utilize multiple varieties of evidence, such as interviews, observations, and documents (Yin 2003, 8).

Case studies examine "systems of action" instead of individuals or groups as the unit of analysis. This allows a focus on a few issues that are basic to gaining an understanding of these systems (Tellis 1997). Case studies are particularly convenient and allow accurate portrayal of the environment, conditions, and characteristics by grounding the data in the setting under study (Lincoln and Guba 1985). The information used for the study must be examined in its meaning, context, and the conditions under which it was used to fully grasp its importance. Case studies provide thick rich data allowing a full characterization and understanding (Berg 2004).

In case studies, flexibility must be available to change the design to reflect new ideas or questions that require clarification in previous or future cases as part of the study (Yin 2003). Without this flexibility, the research risks overlooking important discoveries just to ensure the "original design" of the study is followed. If we miss these emergent themes, we are at risk of detractors accusing us of publishing particular data and ignoring others for the convenience of our "theoretical propositions" (Yin 2003, 51).

Case Selection

The definition of rural communities vary, but Bealer, Willits, and Kuvlesky (1965) indicate that the term rural includes four factors: a degree of rurality, a cultural portion (lifestyle), spatial parameters (demographic & geographic), and structural form (metropolitan governance). Policy makers and researchers cite two main sources qualifying a community's degree of rurality, the United States Census and the U.S. Office of Management and Budget (Flora and Flora 2008). An additional source of demographic information cited by this study is the U.S. Department of Agriculture (U.S.D.A.). According to the 2010 Census, 19 percent of the U.S. population lives in rural areas, which equates to 59,492,267 people (U.S. Department of Commerce 2010, under "2010 Urban and Rural Classification"). The U.S. Government defines rurality for the purposes of administering programs (Flora and Flora 2008). The U.S.D.A. and the U.S. Census indicate that rural communities contain less than 50,000 people and have open countryside (U.S.D.A. 2014, under "Urban and Rural Classification"). Communities have a centralized government, and an ability to impose taxes. According to Flora and Flora (2008, 12), communities are "…the smallest geographical unit for which data are readily available and comparable." For the purposes of this paper, a community is a recognized local area for which a government exists, taxes levied, and in which a fire department exists.

Limitations

Survey Limitations

Although the use of an online survey is convenient for the researcher, and easily reduced for analysis, it could have been an inconvenience for participants. According to Creswell (2005), actual participation may be limited due to lack of computer access, or comfort in using electronic devices and the internet. I encountered this issue in two of the participant situations, one fire chief utilized his administrative assistant to fill in the electronic survey using his answers, and the second printed out a survey and completed it manually.

Interview Limitations

Researchers should be aware that what a participant says, and what they truly believe, might be two entirely different perspectives. Boholm (1996) writes that researchers cannot wholly accept the verbal accounts of a person's social life as a reflection of their actions; there is a difference between what people say and do. This study uses multiple instruments to observe unobtrusive measures. In a book of the same title (Webb, Campbell, Schwartz, and Seachrest 1966) write that there is a correlation between being tested and replying with a *socially desirable response*. Conducting interviews reveals what the fire chief outwardly says is their perception and those things affecting decision-making.

Document Analysis Limitations

Document analysis allows discovery of public (and regulatory) pressures and perceptions of conditions affecting the fire departments as well as highly visible fire department actions documented in the media. Not only will the use of these instruments provide triangulation of findings, but also they will support or refute the link between verbal accounts and actions.

Data Maintenance

Participant Identity Protection

The interviewer must play the role of guardian, for the purposes of data security and ensuring the protection of participant identity. I had the responsibility to minimize the impact of the study to the population; even to the point of stopping the process. There is an obligation to provide a "protective umbrella" both before and after interviews (Rubin and Rubin 2005, 83). Data gathered as part of this is confidential; I assigned all participants a pseudonym (random surname) to protect their identity.

Security of Data

Disaster research originally developed from a need to reduce damage and disruption to the country, while inflicting the maximum extent of damage to an enemy during an event (Fritz 1961). While the purpose of this study is the former, steps need to be taken to prevent use of findings (including community vulnerability to chemical risks) to identify and target weaknesses in specific cases for the latter. I kept the codebook and raw data in a locked safe to protect the information. Data retention (for three years) follows the methods prescribed by the HHS protection of human subject regulations (U.S. DHHS 2014, under "Office for Human Research Protections"). Documentation of the subject's informed consent will be stored as required by the Oklahoma State University Graduate College. This study presents the data in a narrative format with excerpts from data used as representative of emergent themes.

Credibility, Transferability, Dependability, and Confirmability.

This research utilizes qualitative methods, specifically a case study, to provide an emic perspective of conditions affecting preparedness planning. Lincoln and Guba (1985) establish four criteria for ensuring the rigor of qualitative inquiry, credibility (internal validity), transferability (external validity), dependability (reliability), and confirmability (objectivity).

Credibility

It is critical to ensure the data collected as part of the study are accurate and correct. In traditional quantitative terms, scholars called this internal validity. Internal validity compares and contrasts patterns to develop links and to look for rival explanations of phenomena. This study establishes credibility through member checking, triangulating instruments, and open coding. Credibility addresses the accuracy of data in the "eyes of the information sources…" (Lincoln and Guba 1985, 213). These data portray realities that the participants see as true and certain (Schwandt 2007). Presenting the participant realities is crucial to ensure a degree of trustworthiness in emergent themes and critical to portraying the emic perspective. Miles and Huberman (1994, 267) write, "[if] you self-consciously set out to collect and double-check findings, using multiple sources and modes of evidence, the verification process will largely be built into data collection as you go."

I inductively searched for rival explanations of emergent themes throughout the collection and reduction portions of this study. Since analysis occurs from the first data gathering session, these considerations will improve the quality of the data and the analysis. Patton (1987) writes that it is more important to consider the weight we assign on data reliance and categories they are in, than whether or not analysis fits.

Triangulation

A primary method of ensuring internal validity is to compare data among different instruments so see if findings were consistent among them. Berg (2004, 5) likens triangulation to having three "lines of sight" that allow the researcher to verify the accuracy of the data being collected. Jick (1979) wrote about triangulation, "the term comes from military navigation at sea where sailors triangulated among different distant points to determine their ship's bearing." As with the location of sailors on pitching seas, the instruments used in this study provide an emic

view of what the fire chiefs perceive is affecting preparedness planning. As Webb, Campbell, Schwartz, and Seachrest (1966, 3) write, "…once a proposition has been confirmed by two or more independent measurement processes, the uncertainty of its interpretation is greatly reduced." The instruments used in this study include a survey, interviews with member checking of transcripts, and document analysis. One of the strengths of case studies is the ability to use multiple sources of evidence (Yin 2003). It is important that triangulation consider not only data between instruments, but also the differences between formal and informal times, public and private times, and how people respond over time (Patton 1987). Miles and Huberman (1994, 267) write "[t]he aim is to pick triangulation sources that have different biases, different strengths, so they can complement each other."

The use of different instruments strengthens a study by reducing the common weaknesses. Triangulation helps shore-up the argued weakness of qualitative studies by quantitative advocates (Tellis 1997). One of the arguments of using single instruments, like interviews or surveys, is that they are intrusive, and can create atypical roles and responses (Webb et al. 1966). By using several different instruments, the researcher reduces the likelihood of common weaknesses, and the ultimate strength of the inquiry increases (Webb et al. 1966).

Member Checks

This study utilizes member checking as a qualitative tool to ensure the dependability and trustworthiness of the data. The reason for conducting member checks is to ensure the data are accurate and credible (Lincoln and Guba 1985). Researchers utilizing a qualitative methodology need to involve participants to ensure data correctly represents their perceptions (Creswell and Miller 2000). Once data was gathered, I emailed participants a copy of the individual interview transcript allowing them to verify the accuracy of the information. Member checking allows the participant an opportunity to review the data gathered for accuracy. Creswell (2000) wrote that

researchers choosing to utilize a qualitative methodology "actively involve participants in assessing whether the interpretations accurately represent them." Lincoln and Guba (1985, 314) write that member checks are, "…the most crucial technique for establishing credibility."

Transferability

The second method of ensuring the academic rigor of this study is transferability. The term transferability includes the application of study results or findings to similar conditions or characteristics found in other populations or cases. Lincoln and Guba (1985, 359) write that the case study approach results in the "thick description" that is necessary to see if a case is transferable to another similar population. Case studies utilize analytical generalization to apply certain findings to a broader theory (Yin 2003). As Lincoln and Guba (1985) indicate, transferability is ultimately dependent not upon the populations under study, but the sending and receiving contexts. Case study findings are not transferable to populations, they can only be applied to what Yin (2003, 10) calls, "theoretical propositions." That even though the credibility is sound, samples may not be generalizable to each other, as population (and the notion of population boundaries) variability becomes problematic. The audience charges the researcher with providing enough information to the readers so that they may determine similarity between cases to which they could apply the findings (Schwandt 2007).

Researchers cannot generalize findings from this study to other populations, but general themes may be transferable to other cases possessing similar conditions or characteristics. General studies about fire service volunteerism (Patterson 2009), of Oklahoma fire departments (NFPA 2010, under "Third Needs Assessment of the U.S. Fire Service: Oklahoma"), and regarding recruitment and retention (U.S. DHS 2007), had similar findings as those in this study. This would indicate that some issues facing the fire service may be generalizable (especially the volunteer fire service), but further study would be necessary to determine the significance of the

relationship. I found few studies about rural community capitals and their relationship to fire departments.

Dependability

In qualitative studies, the researcher must ensure that the data is "logical, traceable, and documented" (Schwandt 2007, 299). There can be no credibility without dependability, and vice-versa, these two criteria are interdependent (Lincoln and Guba 1985). This study utilizes open coding, and synthesis to bolster dependability in the findings.

Data Coding and Analysis

Coding is the process of reducing raw data into themes, ideas, or categories, and revealing their relationship to one another, or as Patton (1987, 144) describes, ". . . bringing order to the data . . ." Qualitative methods utilize inductive analysis, meaning the themes arise from within the data instead of reinforcing preconceived ideas. Doctors Benjamin Glaser and Anselm Strauss (1967) introduced open coding; it is a process used by this study. The researcher gathers data through the chosen instruments and examination of the information begins immediately. There is not an exact moment where data collection concludes and analysis starts (Patton 1987). The nine-step process starts with the development of categories using initially identified themes. The researcher further develops categories to set boundary criterion and to create definition to make future decisions for data inclusion. Analyzing data as it and other data are collected provides better quality data and analysis, as long as researchers ensure they do not inject emergent themes into newly gathered information (Patton 1987). Analysis of the data emerging from the field can help prevent missed opportunities to reform understandings and to collect new data (Miles and Huberman 1994).

I began using the constant comparison method as soon as the first data gathering session was complete. This method compares data between interviews and within each interview.

Constant comparison requires researchers to scrutinize data "line-by-line," recording observations of emergent themes, and then comparing them to other data to confirm or refute their reliability or to discover a divergence (Goulding 2005, 297). The researcher should pose the following two questions during this process: first, what are the main issues important to the participant (or variation within the problem); and second, what this finding indicates (or in which categories could this description belong) (Glaser 1992). This method of comparison allows for emergence of themes and categories from the start of the process to ensure the researchers do not miss critical findings. Patton (1987) indicates that as with data collection and analysis, there is not a specific point at which analysis (data reduction into categories and themes) ends and interpretation (attaching meaning, examining linkages, and looking for relationships) begins.

I examined data sources for underlying meanings, relationships, and emerging themes, which identify potential areas for further inquiry; or to broaden the understanding of the condition under study. The author presents grouped and coded themes, with representative examples from specific responses, to illustrate pertinent findings. Open coding allows data analysis to reveal emergent categories and their "properties" (Glaser 1992, 39). Categories containing similar information emerge from the themes within data. Glaser (1992) cautions that researchers should not separate one sentence or piece of an observation to give each portion a category, but instead should be comparing and contrasting pieces to one another to identify linkages and concepts.

Data reduction occurs throughout the entire research process, not limited to a single specific time or "leg" of the project. As the researcher writes memos, identifies linkages, and as themes emerge the reduction process continues (Miles and Huberman 1994). Themes emerge from the data and ultimately develop into pertinent findings that guide additional data collection.

In addition to data reduction, and as themes emerge; I took time to consider alternative explanations that could challenge initial insights of this study.

Confirmability

Confirmability are those steps taken by the researcher to ensure that findings emerge from the data, rather than from their bias or predispositions (Shenton 2004). The extent to which a researcher is concerned with objectivity is through their comparable concern with confirmability (Shenton 2004). In order to establish objectivity and ensure emergent themes arise from within the data rather than from researcher beliefs and bias, documentation was maintained in a manner to withstand the scrutiny of an audit, bias and the background of the researcher is made transparent in this dissertation, triangulation of instruments, and open coding. The researcher should document their data in the same manner as keeping financial records, so that an auditor could reach the same conclusions by following the same steps (Yin 2003). This study does not claim to utilize a grounded theory approach, however, it does use open coding and establishes subcategories of broader community capital categories (natural, built, etc.) helping to ensure that themes emerge from data (a grounded theory tenet) rather than testing a priori beliefs and assumptions. When data are compared in this manner, the themes and categories confirm themselves independent of the researcher.

Bias

I have volunteered and served as a partial-paid firefighter and emergency medical technician for several years in different states. I had preconceived notions of what the data could reveal, including limiting factors such as time, financial resources, and perceived risk. However, I was unsure if these ideas were correct or existed within the population. I was curious how resources affected fire department chemical disaster preparedness planning, rather than testing my notions; which would have only tested my reality based upon my experiences. In order to

ensure that these a priori assumptions did not influence instruments used to gather data, I asked questions in an open format, and encouraged participants to speak about their experiences in reference to the seven community capitals. This study uses questions carefully designed to prevent injection of personal beliefs into the study. I diligently worked to avoid leading the participants or affecting their answers. However, as the interviews progressed, it was evident that participants needed some clarification certain questions. Use of print media such as newspapers and firefighter association minutes provide an objective source of data, which would not include my biases or a priori assumptions. I based inclusion of this data on community or fire department capital relevance and not upon theme relevance; this ensured that this type of print media would be representative of rival explanations.

Data Presentation

The researcher presents emergent themes and data in a narrative format, helping to paint the picture of the participant's reality. Although themes emerge among the participants, variations exist and themes are not generalizable; each community should stand-alone. As Patton (1987) describes each case study should stand on its own merits.

Summary of Methodology Section

This study examines the impact of community capitals on chemical disaster preparedness from the perspective of fire chiefs. Quantitative methods utilize strong scientific theory to design and test hypotheses of the researcher. Qualitative methods are appropriate for examining shared beliefs, priorities and decision-making, knowledge, defining symbols and reality. I utilized a mixed method design to provide an inventory and data on perception that resulted in breadth, along with qualitative data resulting in depth. This study utilizes a case study design, case study allows the flexibility to explore new emergent categories and for clarification of discovered conditions.

Residents of Oklahoma refer to the Northeast part of the state as *Green Country*, celebrated for its abundant natural resources, picturesque landscapes, robust agrarian business sector, and tourist economy.

The built environment supports living, and includes transportation routes and components, utilities, public agencies, and other service-based entities. In Northeast Oklahoma, there is a chronic risk of inclement weather, and several examples of shelters to resist winds. Actions to resist or withstand natural disasters indicates the public willingness to plan or prepare for disasters to which they assign risk.

There are various financial opportunities available to fire departments in the study area, including block grants, low-or-no interest loans, reimbursement programs, and many opportunities to conduct fundraisers. However, there appears to be little funding available strictly for hazardous materials preparedness. Studies indicate a lack of chemical disaster equipment possessed at the local level.

Human capital is dynamic, residents often move into or out of a community based on multiple factors. When movement occurs, fire departments experience a loss of the availability of trained and capable personnel. There are also many local educational institutions in the study area.

Social capital involves bonds or linkages that tie people to a community. Civic and theological opportunities provide a means to build bonds within a community. In the study area, there are abundant civic groups. According to one source, there are 192 religious groups, helping to reinforce Oklahoma being known as part of the *Bible Belt*. These groups provide support during times of disaster, and build networks and linkages to increase personal feelings of security.

Cultural capital includes values, morals, and beliefs, and is strong in Northeast Oklahoma. Chemical risk perception is highly contentious, and viewed through two vastly different lenses. The chemical industry has great support for growth, and tends to be dismissive of chemical hazard concerns. Chemical transport experts, and those concerned about residents living nearby transport routes, advocate for chemical safety.

Fire departments in Northeast Oklahoma all have a degree of rurality, but vary in demographics, community capitals, and characteristics. Since fire chiefs possess an objective knowledge of their agency, understanding of financial capital, and are the primary decision makers who set agency priorities, I chose them as the unit of measure. In order to capture the varying conditions within which these agencies operate, I provided the opportunity for all fire chiefs within the four most Northeast counties in Oklahoma to participate.

This study utilized a quantitative survey and two qualitative instruments, interviews, and document analysis. Using three different instruments allows for triangulation of data and for unexpected themes to emerge without a priori assumptions. I employed member checking and other means to bolster the study credibility, dependability, and transferability. The data were grounded in the information and understanding of the participants. The researcher coded the data using an open coding process and reduced them using the constant comparison method. This helps ensure inclusion of emerging themes, and that I can perform follow-up inquiries while information and participant relationships are still fresh.

Chapter IV

Findings

The purpose of this study was to examine how community capitals affect rural Northeast Oklahoma fire department chemical hazard and disaster event preparedness from the perspective of the fire chief. While the communities all varied in the extent to which they possessed or utilized community capitals, emergent themes revealed some common strengths and vulnerabilities that affect preparedness for hazardous materials disasters. In the following chapter, data are presented from the multiple instruments using the community capitals framework to organize them into themes. The resilience and vulnerabilities within each capital reflects the presence and use of that capital by fire departments in relation to chemical hazard and disaster event preparedness and operations.

Natural Capital

Resilience

Impact to Agribusiness

Fire chiefs were asked to describe how the natural environment impacts their community, and how it might be effected by a chemical disaster. Several themes emerged from the data, including the impact to personal businesses (mainly cattle and ranches with stock ponds), regional business (as tourism related to the large lakes and rivers in the area), and potable water supplies. While chemical risk varied among the population, fire chiefs consistently perceived the presence of chemical hazards in their community or neighboring communities, and a risk to

residents. The reliance on agribusiness for local income was critical in many of the rural communities in the study area. When asked about the impact of a chemical disaster, Chief Jefferson said that, depending on what [the] agent . . . was . . . it could be catastrophic out here because there's a lot of cattle . . . the grasslands we fertilize, we bale hay, we graze cattle . . . it would effect it tremendously . . ." Chief Pratt described his community, saying, ". . . we have a lot of farms . . . and recreational areas there . . . that would be a big hit; that'd be huge . . ."

Recreational Impact

In Northeast Oklahoma, several water bodies provide income from tourism to communities and local business owners. Chief Eaton described the impact of these revenue sources on preparedness, ". . . we're heavily wooded, but we also have a, a recreational lake . . . that would be the biggest impact from a natural standpoint . . . that would . . . result in . . . pretty good economic . . . damage to the area."

Chief Beltran said:

> Where we're located at, on the lake, it would be devastating to have a chemical spill where we're at. Our area . . . basically is based upon tourism during the summertime. You know, that's the big shot in the arm in support for this area, is summertime tourists, coming down to Grand Lake, and . . . bringing their family down, spend the weekend, that's where a lot of our businesses that we have in this area…[make] their profits.

Impact to Potable Water

One of the greatest threats to the study area is the impact of a chemical disaster to the potable water supply. Chief Hobbs described the risk chemicals pose to his community, saying that the ". . . industrial park can literally have a spill that can impact the water intake for . . . about two-thirds of this county, and the county next to us could literally be without water for long periods of time. Chief Koch explained the chemical risk in his community, ". . . we have a lot of water . . . [i]f we had a chemical disaster . . . we would be effected the most . . . if it . . .

reached a creek or a river . . . because we have a rural water district that provides our drinking water." Within his district, Chief Spears said, ". . . we definitely have . . . streams around us that . . . that the chemicals in the industrial park area could . . . cause issues with . . . all hours of the day things are going up and down, that could dump in a creek . . . on the side of the road, get in the storm sewers, it could be a huge . . . catastrophe to the community."

Built Capital

Built capital includes support services for community residents, such as infrastructure like potable water, waste treatment, and access to services through roads and bridges.

Resilience

Several fire chiefs discussed their volunteers and the community pulling together to make improvements to their fire stations and equipment. Chief Bruce described the improvements made to his fire station, ". . . we've put in a new fire hydrant . . . put the grass in . . . laid the brick . . ." Chief Bruce expounded to illustrated how his equipment has been put together, ". . . we built them all right here, in-house . . . a guy . . . works for a company in [location withheld], so they rolled all the stainless, and then we brought 'em all up here, and welded everything . . . some of us have been inside them tanks . . . 'weldin around on it . . . we put baffles in them . . ."

Vulnerability

The built capital within communities varied, from potable water systems to rural drinking water wells, and struggles surrounding fire stations to equipment. Built capital could present a benefit in infrastructure that could support long-term resilience against a chemical release, and could provide reduced recovery time during a release. Potable water piping allows residents to drink treated water, rather than through private drinking water wells that are susceptible to ground-water contamination. Chief Hobbs related the impact of a chemical spill within his

community, a spill in the industrial park ". . . could actually . . . shut down major industry and . . . power plants in the area."

Financial Capital

Data revealed a variety of financial capital present in the study area. Chief Koch explained how his department has evolved, ". . . used to, it just was . . . by donations and fundraisers and membership dues . . . costs have increased of equipment and everything, now we're participating into . . . local grants, or state grants, or federal grants . . . and then . . . a sales tax to be collected to help fund the fire department for our operations."

General Financial Health

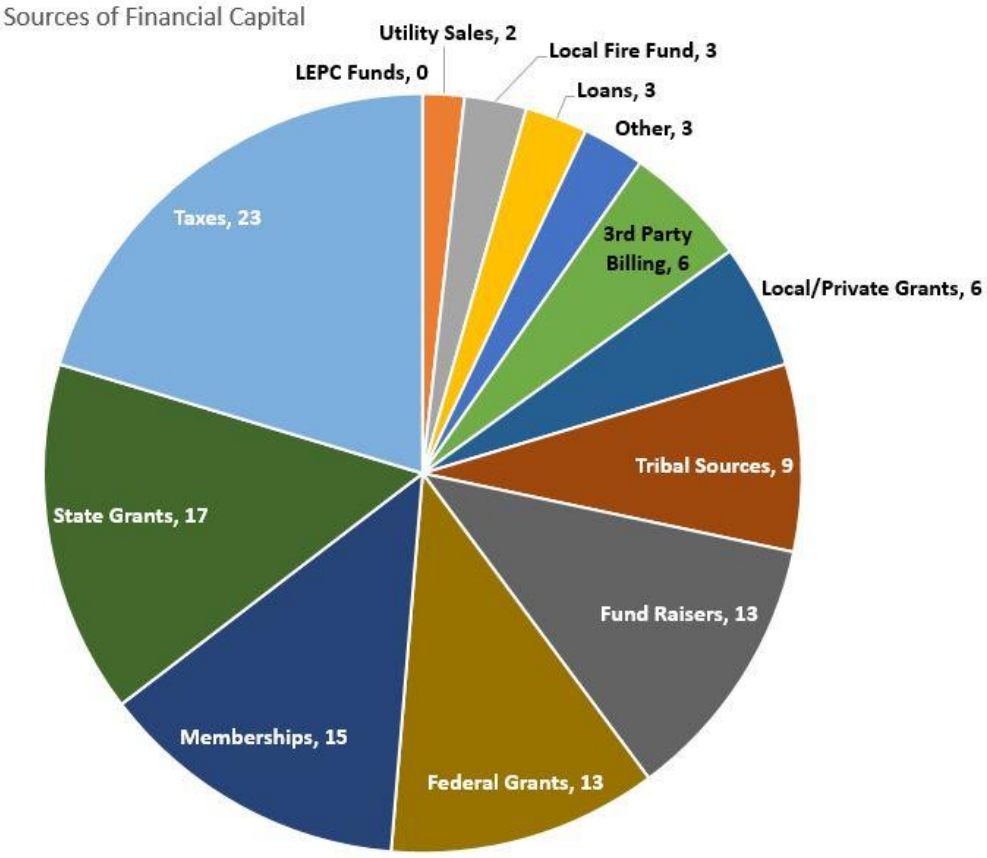
Fire department funding varied by income sources, expenditure types, and general financial health. The ways in which rural volunteer departments gained funding was also different from the paid departments, but almost all of the departments shared a common theme of having financial difficulties. Financial constraints have impacted fire department purchasing, Chief Jefferson said, "[w]e've . . . got [to] . . . not really scrounge, but we've got to pinch pennies to buy what we get to basically get our best bang for our buck and push our money as far as we can push it out to get everything we need in."

Since their beginnings, Chief McLaughlin said:

> . . . we've got some pretty nice equipment now . . . our first out engine . . . is a surplus engine that [name withheld] Fire . . . had replaced . . . I got with that company in Mississippi, but that company never came and got the truck, I got with that company and said hey y'all traded for this truck, let's try and sell that to us and you'll never have to come to get it, I'll just go straight to [name withheld] to get it . . . so we arranged that, and bought it for the same price that they traded it in for . . .

Fire chiefs identified the types of financial capital that their department receives in the survey, Figure 9 reveals the findings of this inquiry.

Figure 9, *Sources of Financial Capital* (n=27)



Resilience

Multiple fire chiefs mentioned that their departments were not flush with money, but that they found ways with which to cope. Discussing how his department originally was funded, Chief Bruce said, ". . . they had no money . . . now that we've got the . . . city tax plus the . . . county tax . . . we're not 'hurtin by no means . . . we try to conserve and save where we can . . . " Chief Maddoux expressed the financial health of his volunteer department, ". . . we're very fortunate . . . [we] always seem to need more funds, but we're not struggling like some . . . we've got the resources, it's not like we need gas money . . . " Chief Bruce explained his department's recent purchase of a pumper:

> We're pretty fortunate, we . . . just paid that engine off . . . two months ago . . . we had borrowed about 90 some thousand, and it already had probably $30,000 dollars' worth of equipment already on it, you know, they just left it on there . . . we just put the hose back

> on it, and got it here, put our logo on it, and it was pretty much up and . . . running . . . it's a $225,000 dollar truck basically . . .

Many departments have benefitted through donations of time, land, and building materials that have allowed them to build their departments. Chief McLaughlin revealed how his department formed, saying that they got the land donated, a FEMA grant to build the station, and then they tried to qualify for the county sales tax funds. Chief McLaughlin said, ". . . we finally got all the ducks in a row . . . and . . . started getting some [U.S. (sic)] Forestry units . . . and we were glad to get 'em, some old wore out stuff that we had, and other departments would sell us stuff cheap, or donate us stuff, or give us their surplus [U.S. (sic)] Army trucks and such . . ." Chief Rhodes recounted how his department began, ". . . it actually got started with the donation of some property and donation of some materials, built the building and then it went on to the subscription base . . ." Fire departments have found ways in which to adapt to their financial limitations. In the rural volunteer departments, a common theme was volunteers doing maintenance and improvements, rather than hiring the work done. Chief Bruce described the work completed by his volunteers, ". . . we've done all of this work here . . . that's all been donated man-hours . . . there are just a lot of people that has helped this community." Chief Bruce described use of his department's financial capital ". . . when you're trying to make things go as far as you possibly can . . . when you're dealing with taxpayer money . . . you need to be pretty thrifty in my opinion."

Impact of Tax Revenue

In several of the communities studied, financial resources included sales tax revenue, memberships, fundraisers, third-party billing, and grants. The survey showed that 79.31 percent of participants received tax funds. In Mayes and Delaware Counties, fire departments receive a distribution from a countywide sales tax, with which to fund their needs. In addition to this fund,

Fire Departments often utilize memberships, which include an individual assessment for having fire department coverage. Chief Rhodes illustrated the importance of tax funding to his department, ". . . the four-tenths of one percent, split twenty ways in Delaware County through the fire departments has been a Godsend . . ." Chief Bruce described the impact of tax resources to his department, ". . . we're very blessed to have what we've got . . . there's other [counties] . . . North of us . . . they struggle all the time with money . . . especially as rural departments." Following the cuts to the county funds, Chief Bruce said, "We've had some issues as you know . . . some dark times, but you know, I think we're working through a lot of those . . . and we're very blessed to have what we've got . . ."

Chief Eaton related the evolution of financial capital within his department:

> Originally . . . it was . . . totally supported by . . . membership and donation and bean supper stuff . . . [n]ow all the fire departments in the county receive their share of a quarter-penny sales tax . . . the main difference there being . . . that we have a little more . . . financial support, so we've managed to upgrade . . . equipment . . . based on the county money. We don't have to spend so much time fund-raising.

Sometimes we can frame financial capital in terms of reduced expenditures, rather than revenue. The Salina Fire Department in Mayes County estimates that they save their community $2,550,000 in direct and indirect savings; excluding insurance savings from improvements to their ISO rating (The Paper 84, no. 005 January 10, 2017).

Paid Versus Volunteer Departments

Several volunteer fire chiefs mentioned that paid municipal fire departments had more funding than rural volunteer departments. Chief Jefferson contrasted his rural fire department to an urban or city department, "Belonging to a rural fire department . . . you don't have the city councils . . . and that type of atmosphere. You still have a board, being a title 18 fire department . . . and it's harder . . . because you don't have the funding that the city has. The city has the,

basically a tax base where they pull money out for that fire department that basically stays with that department."

The paid fire departments shared a theme of having limited funding, Chief Nixon described the struggles associated with a paid fire department, ". . . like everything else, [it] comes down to . . . money and budget problems . . . we're limited on . . . funds to . . . keep our equipment in good repair and up-to-date . . . [and] to pay for the manpower that we have." Another chief representing a paid department, Chief Schwartz said, " . . . it always comes down to financing. It's [a] very expensive business, you know, to operate a fire and EMS . . . with full time employees . . . there's not a lot of grants available for fire departments . . . outside of the Assistance to Firefighters grant from FEMA; there's just not much there." Chief Schwartz further expanded on his opinion of funding shortfalls, ". . . I think that's a huge downfall . . . for our country . . . we fund, uh, other branches of emergency services very well and, I'm not taking away from them, but I . . . don't think we, as a whole, do very well with fire departments and emergency services and ambulance services at all." Chief Bender described financial capital constraints related to his paid department, ". . . they expect that we have all of the money that we would ever need to . . . fund . . . for equipment and things like that . . . and we hurt just like everybody else."

Grants

The survey showed that 58.62 percent received state grants, and 44.83 percent federal grants. Within the Mid America Industrial Park, a fire fund was set up into which local companies contribute funds for the Pryor Fire Department to utilize when equipment requires repair or upgrades. Similar to the industrial park local grant, 20.69 percent of participants received private grants. One of the most visible risks in the study area is the MidAmerica

Industrial Park. Several fire departments respond to the industrial park, and according to Chief Spears, ". . . in reference to the industrial park, there's some different difficulties and probably financial stakes, we . . . are lucky to have that in our area . . . but we don't . . . really get that much funding from that area that I think we should, I mean . . . that's probably the most vulnerable area that we have in our response area that we really receive pretty much zero from . . . it kind of puts us in a bind . . . "

Memberships

The Oklahoma Insurance Department also passed a regulation in 2016 requiring insurance companies to ensure their Oklahoma customers in unincorporated parts of the state to prove that they have paid any membership dues required of their local responding fire departments (Oklahoma Insurance Department 2016, under "Documents"). Study participants indicated that 51.72 percent take advantage of membership funding.

Fund Raisers

Several fire departments also have benefits like fish fries, barbeques, and other fundraisers to help supplement their tax distribution. Chief Roy described his department's fund raising events, "We do fundraisers . . . and try to involve the community and . . . do things to get out there in the public's eye . . . we put on a kids day deal every year . . . have a water day and fun day for the little kids to try to help promote volunteers . . . or future firefighters . . ." Chief McClain described the community financial capital and support his department receives, ". . . [our] [c]ommunity is very proud of their fire department. We have a fundraiser once a year, and that's where all our money comes from. Um, very little comes from state, uh, so, uh, the fact that we're still running proves that our community is behind us 100 percent. We sell a lot of 250 dollar pies."

Third Party Billing

Some fire departments use third-party billing for medical calls and fires, invoicing the insurance companies for their services. According to an article in The Times (Ashford 2016) the Locust Grove fire department was instructed by the City to seek $13,000 for damage to turnout gear related to a trucking accident.

Utility Funding

The Grand River Dam Authority has provided community improvement grants to fire departments in the past. The Grand River Dam Authority provides wholesale electricity to municipal customers, who then increase cost to customers, and resell the power to offset the financial burden of municipal (fire, police, public works, etc.) services (Grand River Dam Authority 2012, under "Once Upon A Time at GRDA: the "pump back" Experiment").

Vulnerabilities

Chief Jefferson described his department's financial situation:

> . . . whenever our county money was . . . basically taken and redistributed to the departments that run more calls, we got a lower amount of money and whenever that happened, we [were] . . . going through an ISO re-grading . . . this fire department has never had to finance anything and we had to finance a pumper truck . . .We had to basically borrow the money to buy that truck, because we would have had it, had our money not been, been messed with . . .

Chief Bruce illustrated some of the financial burdens the tax issue has created for his department, ". . . unfortunately . . . our funds have been cut in half . . . out of all the cities in Mayes County, we're getting less funding than [others] . . . comparable to our size."

While raising funds may have certain benefits, such as increasing social and financial capital, there are definite drawbacks. Time spent fund raising reduces the time firefighters could use to increase their professionalism through training and education (Patterson 2009).

Funding for Hazardous Materials Preparedness

As discussed in Chapter 2, following an expansion of policy due to public pressures, contraction occurs once public opinion is amicable to it (Nave 1984). Chief McClain described the financial capital changes since the World Trade Center disaster of 2001, ". . . dwindling funding. Oh, it's gotten horrible (laughing). You know . . . it wasn't too long after 9/11, and at that time, 400 grand I put in for, I got, and now I can put in for 15 and not get any of them."

Chief Hobbs expanded on the evolution of hazardous material funding:

> . . . there used to be a lot of money out there for hazardous materials. That money is dried up. And even some of the equipment that's been funded 10 years ago is not what it should be today. So, there's not the . . . money that you need for the . . . hazardous materials . . . equipment. There's not the money for all the training that you need . . . so in this area, people did not get on board when they had the initial funding to get the right equipment in here 10 years ago. Nobody, you know, they wanted to stick their head in the sand, not deal with this problem, and now it has grown, and there's no money to get it. So we basically . . . run a lot of these calls without . . . the NFPA recommended equipment for it . . .

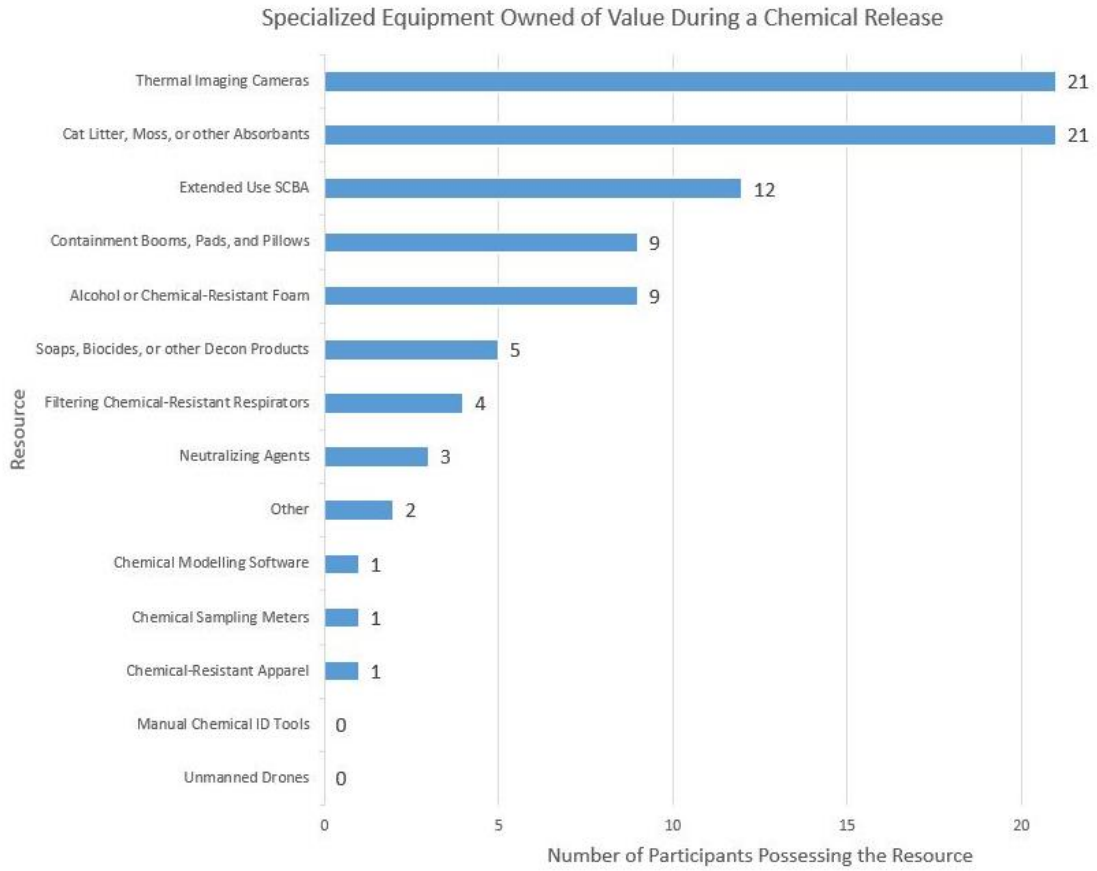
Chief Hayden discussed the financial capital challenges related to specialized chemical response equipment, that even though his firefighters have Hazmat training, ". . . we're just going to be first responders, because we don't have any of the suits . . ."

Some of the resources are primarily for firefighting, but would have value in some chemical situations. Examples of these resources would include extended use SCBA's, thermal imaging cameras, and alcohol resistant foam. The *Third Needs Assessment of the U.S. Fire Service: Oklahoma* (2010) revealed that 82 percent of participants could not handle a hazardous materials incident with at least 10 injuries using local trained personnel without assistance. Additionally, 83 percent of these respondents indicated they could not handle this type of incident using only local resources. Conversely, while fire departments do not have all of the requisite funding or resources

for hazardous materials equipment with which to combat a disaster, the survey revealed that they possess some of the resources necessary to begin defensive operations.

In the survey, fire chiefs identified what resources they possessed which would have value during a hazardous materials release. Figure 10 indicates the resources possessed by fire departments for Hazmat responses.

Figure 10, *Specialized Equipment Owned of Value During a Chemical Release* (n=27).



Human Capital

The data revealed a common theme that none of the fire departments felt they had adequate available and trained staff for response. Staff problems revolved around dwindling volunteerism, activities competing for volunteer leisure time, family and occupational

complications, large amount of required time for training and fire department activities, and volunteer management and dedication.

Resilience

Staffing

Although the time required of volunteer firefighters is significant, many firefighters have found ways in which to cope. Chief Jefferson portrayed the way in which he achieved his own training, “I took the time out of my life early-on when my kids was little and took all this to get it out of the way so whenever they got older, I could do stuff with my kids . . .”

Having enough time for activities

The local fire department, as an extension of local government, has become a de facto expert when there is no other obvious governmental agency to call. In addition to their normal role in emergency response, Chief Maddoux indicated that the community, “call[s] about their insurance, what do I do about this? I don’t know who else to ask, but what do I do about this?” Chief Maddoux mentioned the challenges related to his fire department’s ability to conduct outreach activities, “. . . we try . . . now obviously we’re all volunteer, so you know, 90 percent of us that are on the department have full-time jobs outside of another full-time job of being . . . a fireman.” The chief expanded on outreach activities they provide, “. . . we help put up smoke alarms . . . fire prevention week . . . in October for the kids.” In addition to these activities, “. . . like every other volunteer department, we fill swimming pools for some people.” Chief Maddoux said, “Everything we do revolves around . . . my men and women . . . personnel limits . . . what we can actually do.” If an outreach activity is important to his volunteers, Chief Maddoux said, “. . . if it becomes a big thing, then we may make it . . . a training project . . . but . . . we’re limited on our personnel . . . it’s not necessarily prioritizing as [much as] it is scheduling.” Chief Phillips

illustrated activities in his community, ". . . I've got one private school in my area, and . . . we do try to do something for them every year during fire prevention week . . . a lot of my guys are farmers and they're working and busy, but every chance we get we try to do that or some training or something." Chief Jefferson discussed his department's activities, saying, ". . . certain times of the year . . . we cover certain things . . . when we're coming into winter time, we stress . . . smoke detectors . . . October's fire prevention month . . . the elderly people . . . [s]ee if they've got anything that needs [to be] looked at or the chimney might need cleaning . . . you know, anything like that." According to an article in The Times (Baron 2017b) the Salina Fire Department conducted a Muscular Dystrophy Association (MDA) "Fill the Boot" fund raising drive, took part in fire prevention at local schools, and they hosted the annual "Oklahoma Firefighter Burn Camp" day of boating and fishing.

Chief Swanson characterized preparedness activities in his community:

> . . . we do fire safety week and . . . take in our trailer. We have a fire safety trailer, training trailer that we take to the school . . . we actually do that all year round at different places, um, teaching the kids about fire and smoke . . . putting smoke detectors up is a big thing for . . . a lot of older people . . . we go over and get groceries for 'em, help 'em unload . . . sometimes we've gone up and helped . . . like the ones that are on the scooters, their battery dies, so we help them out . . . either go back to their house, get another battery, or push their . . . scooter all the way to the senior housing before . . . we're involved in the [berry] festival, the car show . . . cruise night, the Halloween trunk-or-treat . . . the Christmas . . . lighting ceremony . . . a lot of ball games . . . all the different sports events . . .

Chief Bender depicted activities in his community, ". . . smoke detectors would be a higher priority over, burning somebody's piles of leaves . . . we always try to put . . . the children's education stuff as a top priority . . . because that's . . . things that could . . . possibly save a life in the future." According to an article about fire prevention week in The Times, ". . . In Pryor, firefighters think awareness and education are crucial. ""If we can educate the kids in the school system and the adults in the community about being fire safe it will help us prevent

fires, fire injuries, and fire deaths. We have then, with the help of the citizens and children, made Pryor a safer place to live and work," said Pryor Fire Department's Brandon Merritt" (The Times, October 15, 2016). As mentioned earlier, volunteer firefighters have varying knowledge, skills and abilities, and different interests.

Although volunteer time is inadequate, Chief Hobbs said his department finds a way to participate:

> . . . we usually have people that have different interests . . . [a community] may request us to bring a truck out to a special . . . event . . . [we approach the firefighter with a special interest in that community, and] say hey, do you want to take a truck out here on Saturday to this event . . . there's guys on here that like to go to all the football games . . . we try to prioritize . . . by seeing who, first, if we got people interested in taking stuff, and then next if we have to kind of order it out, seeing what is the . . . benefit of it . . . we like to . . . benefit our local community, in our district, and . . . our benefactors . . . that help us out . . . if they have a special activity, we'll figure out a way to be there.

Extrinsic Skillsets Benefitting Staffing Capabilities

One of the strengths of firefighters' knowledge, skills, and abilities was diverse experience. Regardless of whether a department was paid, combination, or volunteer, firefighters usually have skills or expertise outside of the fire department that are valuable within the department. Chief Roy related his firefighter's abilities, "I have . . . several real knowledgeable firefighters . . . I have two, uh, firefighters that work for a paid department . . . that . . . truly do this as a career." Paid firefighters work shifts, and often have part-time jobs outside of the fire department, and volunteers have paying jobs that provide diverse skills and abilities. Chief Maddoux related, ". . . we have a variety of people that . . . [bring] strengths to the department . . . I'm a mechanic by trade . . . we've got a carpenter . . . " Chief Schultz expressed the staffing strengths within his department, said, "some of the guys have their own talents, I try to utilize that . . . " Chief Hayden described the talents and education of his firefighters, ". . . we've got . . .

knowledge in different areas, you know . . . [y]ou've got guys that do heat and air on their days off, and guys that do construction, so you get a broad knowledge on those things."

HAZMAT Knowledge, Skills, and Abilities

The Oklahoma State University Fire Service Training (OSUFST) division is the preeminent training group in fire protection. The International Fire Service Accreditation Congress (IFSAC) is a body that oversees content and certifies training in fire service fields, and is located within Oklahoma State University. The training course content (prior to 2000) for *Firefighter I* requires certification in Hazmat Awareness, an 8-hour course that exposes firefighters to methods of hazardous substance identification, initial actions, establishing "zones" for protection, and to provide initial guidance on notification for additional resources to assist them with situation mitigation (Oklahoma State University Fire Service Training 2016). In the year 2000, the *Firefighter I* curriculum changed to incorporate Hazmat Operations, an intermediate 40-hour certification (Hazmat Awareness is a prerequisite). This course is designed to provide attendees with the knowledge and skills to safely analyze the risk posed from hazardous substances, plan and implement initial actions utilizing the capabilities of personnel, use and documentation of protective equipment, and to evaluate response actions versus established goals (Oklahoma State University Fire Service Training 2016) These operations are defensive in nature, intended to prevent a chemical release from getting worse; several participants use the terms dam, dike, divert, and contain in relation to liquid chemical spill. Chief Spears conveyed his firefighter's training, ". . . all of the paid personnel are Hazmat Ops . . ." Chief Pratt said that their department's response was limited, "being able to . . . mediate that, would be well beyond our capacity . . . we would basically have to do . . . evacuations if that was

needed, information, make contacts, trying to get . . . the resources in, that could actually handle that type of release."

Volunteer Vs. Municipal Staffing

Chief Spears commented on his department's outreach activities:

> . . . we're the person that the communities go to when they need help . . . granny needs up, or granny's got a dryer that she needs moved out here to the outhouse . . . it's kind of the old in a smaller community, the fire department's the one that a lot of them will call not necessarily is it on your shift time but they may say, hey, when is there a couple boys off, that'll come help us do that . . . I guess in a way, a public servant, I think that's the way it ought to be.

Chief Hayden characterized his paid fire department's activities, ". . . we do smoke detector programs, [w]e'll install them, [w]e'll change batteries for elderly people, [w]e have a . . . program that we put on [each] year for school kids . . . I think they had over 2,000 this year . . . we'll go talk in civic groups . . ."

Education, Skills, and Abilities

Chief Koch explained about his department staffing, ". . . guys [that] have been here for a long time [have] a lot of knowledge and skills, and as . . . far as being able to move up . . . if I'm not here, the assistant chief can step right in behind me . . . the same function . . . will . . . get accomplished . . ."

Vulnerabilities

Inadequate Staffing

Fire chiefs commented on some of the challenges facing their department in achieving its mission. During a City of Chouteau Board of Trustees meeting, Chief Key said:

> . . . volunteers are getting harder and harder to come by. He said that 90 percent of fire departments nationwide are having trouble recruiting firefighters. Floyd suggested placing newspaper ads as recruitment tools, but Key was skeptical that would have any effect. Lane asked about incentive programs or other forms of motivation. Key discussed a previous

> incentive that would have offered more compensation which was denied by the board (The Paper May 19, 2013).

Chief Bender discussed how his department had changed over time:

> . . . we started out with minimal equipment . . . larger amount of manpower . . . and now we've kind of come to a medium, in the middle, where we've got a decent amount of equipment and we've lost some of the manpower. I . . . write that off to the, uh, failing volunteers in . . . the United States at this point . . . volunteerism is, is starting to die . . . we do struggle . . . getting enough people . . . to volunteer time to make all the calls. I mean, we cover it, but it's, it's usually with the same 4-to-5, maybe 6 guys.

Chief Spears reflected on his staffing challenges, ". . . it's kind of a harder thing to find today that it has been in a few years back, so that's kind of why we're, uh, low on a volunteer basis at this time." Reflecting on lack of volunteerism, Chief Spears expanded, "I think the biggest thing is . . . the challenge of . . . finding volunteer folks in the generation we live in today, that is willing to volunteer for not much money or no money." Lack of personnel affected all of the participants, Chief Eaton descried the impact to his agency, "recruiting capable personnel . . . is a big issue . . ." Having adequate personnel is complicated, Chief McLaughlin depicted the challenges his department faces, ". . . you know a total volunteer fire department everybody's got to have a job . . . unless they're retired, and then they're elderly, and they can't be going into a structure fire . . . that's our biggest issue . . . is people not being available, because we got to work, you know, we've got to have a life." Chief Phillips described the largest obstacle facing his department, saying "Our main challenge . . . is getting volunteers . . ." Chief Roy expounded on a lack of personnel:

> [t]he biggest challenge we have is manpower . . . being a volunteer fire department 'aint like a career fire department, like a job where people have a responsibility . . . you get into their pocketbook, you know, what are you going to do? Take their paycheck away? . . it's hard to discipline a volunteer. I mean, you can . . . discipline them, but, you know, all you're going to do is drive that volunteer away . . .

Chief Bruce illustrated how his department recognizes the commitment of his firefighters, "We try to have . . . a dinner for 'em once-a-year, and we had the best turn-out . . . right after Christmas . . . we wound-up having probably sixty-five people here . . . didn't everybody just come and eat, they come and visited . . . some of 'em got up and told stories where we'd . . . come to 'em on medical calls, and helped save some of 'em . . . it was pretty inspirational . . . so that's what it's all about . . ."

Inadequate Time to Volunteer or Respond

Chief Bruce described the response challenges his department faces during the day, ". . . You may not have any agencies. I mean, it's that bad sometimes . . . you just start 'hopin and 'prayin the minute the call goes out, that . . . you got people 'gonna show up. 'Cause you know, everybody works . . . " Chief Eaton described the challenges facing his volunteers, ". . . most of your young, healthy . . . adults are . . . employed and have full-time jobs, so during the day is pretty hard to . . . get people to respond." Chief Eaton explained about the expectations of being a volunteer firefighter, ". . . if you're anywhere at home, you're basically on call 24/7 . . . if you're home, you're on call . . . any time of the day or night." Chief Beltran commented on his department's challenges, ". . . lack of volunteers . . . it's part of the problem . . . with life's fast-pace right now, there are a lot of ind-, individuals that want to get in, want to volunteer, but because of the lifestyles that we live now, there are just shortcomings in time." Chief McClain indicated that while funding is big, ". . . quality of help is another one . . . these young people nowadays, they're at work two, three jobs to survive . . . they're making what I used to make 25 years ago . . . it's just hard for them to volunteer and survive." According to an article in The Times (Baron 2017b), the Salina Fire Department firefighters volunteered a total of 5,342 hours in 2016 responding to 642 emergencies, working, and training.

Chief Pratt portrayed his department's limitations related to human capital:

> The biggest thing is . . . enough trained firefighters . . . sometimes depending on the time of the day . . . it's tough . . . the majority of firefighters . . . in my area, work . . . across the state line in Arkansas, so . . . the biggest challenge is being able . . . to comfortably supply . . . enough manpower, during, say Monday through Friday, you know, eight-to-five, it, is the hard part; very difficult to do.

Chief Roy described his department's obstacles, ". . . it's pretty hard finding volunteers . . . people to donate their time . . . volunteer for it. Everybody's got a busy . . . lifestyle and a busy job . . . " Chief Koch mentioned that besides funding, training, and equipment, "volunteer-ship . . . that's coming from the community now with the, uh, different generation that we had . . . [t]hey just don't volunteer their time like they used to."

Chief Hobbs illustrated some of the issues related to time:

> To get over the . . . top of the hill and to do what we need to do, it takes more time, it takes . . . more training . . . people have to have an incredible level of dedication. Used to, people would come to one training a month, uh, in an evening time, a evening meeting for a couple of hours, um, run 7 calls in a month, uh, top deal of 10 calls in-a-month, and you [were] a member of a local fire department, and you were in good standing, and everything was great. Nowadays, when they're running 70 calls-a-month, and they're requiring people to go to extensive training, it's a totally different deal. Right now we have people in a basic fire fighter training program, that Wagoner County's putting on, that started in August and will end in December, and that is just basic classes . . . I think they're going about . . . 16 hours-a-week, and . . . they're having to spend . . . 10 hours out of class to do the studying . . . the dedication has just got to be astronomical . . ."

The time required to volunteer places stress on the personal lives of firefighters. Chief McClain said, ". . . I've had firefighters that's lost their jobs 'cause they missed too much time, A. because of firefighting, B. because they have attendance issues." Chief Roy characterized the problem of trying to manage volunteers, ". . . they're volunteers . . . it's hard to put a lot of restrictions on some of these people due to their work schedule, because . . . if I don't have no volunteers, I can't have a volunteer fire department." Expanding on his firefighters, Chief Roy said, ". . . people have . . . other things to do in their life. They can't just sit there at the station

waiting for the call to come over." Chief Roy illustrated the challenges with staffing variation during the day, ". . . [y]ou never know, every time that pager goes off, what group of guys [you] are going to get. Are you going to get your first string? Are you going to get your second string? You don't know . . . who's going to respond . . . it's hard to plan . . . it 'aint like playing a game of football or basketball where you can strategize beforehand."

Chief Roy further expanded on the variation among his staff, saying:

> . . . there's just so many variables, from the time of day . . . that affects . . . who I've got, 'cause we're volunteers, we work a full-time job . . . if it's from 8-to-5 . . . I've got guys at work . . . that makes it tough . . . [e]specially with small communities, now, in Oklahoma, versus years ago. Years ago, we had a lot of business owners that belonged to your volunteer fire department that owned businesses in town and they would close the door [to] their business and . . . jump on the fire truck and go . . . But, as businesses are leaving our rural communities, and as the dollars got more important to sustain life, and . . . keep the light[s] . . . on, we don't have [those] luxuries anymore. Everybody gets up and leaves town every morning to go to the big cities, where the big jobs are, and where the money's [at], so . . . that's a big challenge.

Chief Bruce discussed how his department made accommodations for time constraints of volunteers, ". . . [we] bought an engine, which is just like the one we got . . . set up the same way . . . so we trained on the first one, we basically have everybody trained on the second one . . . everything's set up the same way, so . . . you don't have to do a whole lot of thinking . . . when you're on the fire scene." Later, when showing me the equipment set-up, Chief Bruce expanded, ". . . everything's just set up the same . . . it just takes some of thought process, out of, out of having to fight fire. 'Cause, you know, you got, we've got volunteers!"

The U.S. Department of Homeland Security awarded the Oklahoma State Firefighter's Association $2.1 million for implementation of a statewide volunteer recruitment and retention program (Oklahoma State Firefighter's Association 2016, under "Oklahoma State Firefighters Association Receives Grant for Volunteer Firefighter Training Recruitment Retention"). The U.S. Fire Administration, as well as The National Volunteer Firefighter Council (Make Me a

Firefighter – Department Video 2015) developed Resources to help volunteer fire departments recruit and retain firefighters and focus on the Millennial Generation.

Mutual Aid

Chief Bruce recalled past department responses, ". . . we've had times when we had to immediately call, we had a fire just across the street over here, and windy day, house fully-engulfed, we called [our mutual aid] immediately, before we ever pulled out of the station . . ." Chief Eaton described how his county response is set up, ". . . anytime there's a . . . structure fire, three departments are called, so hopefully we get enough people to show up to handle the situation."

Chief Bender detailed the staffing issues related to being in a rural community:

> . . . you're limited on how many people are local . . . versus . . . a larger . . . one of the larger volunteer cities . . . you just don't run across a whole lot of people that will want to volunteer their time for no compensation . . . you never know if you're going to have enough people . . . to fill a call and…then you rely . . . [on] your auto aid or your mutual aid agreements with your local fire departments to . . . come in and help.

Having enough time to train

Fire chiefs commented on the knowledge, skills, and abilities of their fire department. Several fire chiefs said that training presented one of the biggest challenges they face. Chief Jefferson illustrated his personal experience and preparation, saying that his Grandfather (a previous fire chief) and his Father (who was also a firefighter) groomed him from an early age. He said, "I've got probably 550 hours' worth of training through Oklahoma State University in the fire service."

Chief Hobbs described meeting NFPA standards for professional competence:

> . . . NFPA . . . basically . . . sets the . . . standard and the recommendations. It is basically impossible for a fire department . . . of our size . . . to be able to meet all the . . . standards set forth by NFPA . . . what you've got to weigh as a fire chief is, where do you break the firemen . . . [where] they stop responding or they quit . . .

> [i]f we put the bar at the level NFPA has it at, for every fireman that gets on this fire department, we would not have enough people to respond. So we have to give people time. NFPA wants these people fully trained, they want them at a high level the day they start responding on calls, it is just not feasible . . . we have to have some leeway in certain areas.

Training often occurs at regular intervals, as revealed by Chief Eaton, ". . . we have training twice-a-month . . . one day during the week and evening, and then one Saturday-a-month." Chief McLaughlin reflected on his fire department staffing issues, "we're volunteer, we've still got some rookies . . . they're young and they have to learn as they go . . . due to . . . children in basketball, or children in football, or 4H . . . they can't dedicate the time needed to take a firefighter one class, or to take the, uh, EMR class . . . that's the worst thing . . . the availability of a volunteer." Chief Phillips described his firefighter's training, "I'd like to see a lot more training in my guys, and coming up with time and everything and getting everybody together is hard to do, in a volunteer department." When asked to expand on his answer, Chief Phillips said, "Well, I mean, they've all got lives of their own . . . they're all busy with their families and their jobs, and with their farms and all that . . . we do the best we can . . . but it's just really hard to get that done; takes a lot of effort."

Discussing the challenges facing his department, Chief Bruce said:

> . . . you know, everybody's got kids that they're 'raisin, and . . . things to do, and so, it's Mainly . . . training, trying to get time for training . . . a lot of times the training may be far-off, and . . . the guys just can't dedicate enough time to go . . . and get the training . . . so we're trying to do some of it in-house, trying to catch some stuff at the Vo Tech, so that's, that's helped a bunch . . . OSU's good about . . . having their classes where they can, but . . . a lot of times, they may be in McAlister, or . . . somewhere out West, and . . . that's a hardship.

Chief McLaughlin described the importance of training in his department, ". . . training is . . . one of the most important things . . . but . . . with a volunteer fire department, [firefighters] have to want to, and me being bossy can't make them do anything . . . and of course, the younger

guys . . . they're going to have children, and they're going to miss out on, on some activities, there are sacrifices, a lot of sacrifices . . . " Chief Rhodes expounded on challenges related to ongoing training, ". . . just keeping the training up is going to be one of our greatest challenges because of . . . being [a] full volunteer base, everybody having time to devote . . . giving such hours . . . that is required throughout the year, that's probably one of our major challenges." Chief Jefferson expounded on his firefighters' training, ". . . I would love to see everybody have the same amount [of training] that I've got. Everybody's got families. Everybody's got stuff going on: baseball, football, basketball, with their kids, whatever . . ."

Chief Rhodes relates the challenges his department faces related to training:

> It is really, really tough, I mean if you work a . . . job 40 hours [a] week, and have any type of a, a home life then . . . if somebody asks you to go through . . . basic firefighting or firefighter A, B, or 1 or 2 . . . that's another 40-to-72 hours and your live burn training . . . sometimes you 'gotta leave . . . sometimes you have to travel, go out of district . . . to have some of . . . these classes when they're available . . . these people really, really try, but there's just a lot of times that it just doesn't fit their schedule, this time of year's really bad, holidays coming up so . . . we try not to schedule anything during these times as far as training to let . . . people have time . . . "

Number of Responses

The number of emergency responses is increasing. Chief Bruce reflected on a recent situation, ". . . we had a lady that had four calls in six hours the other day. You know, you got people being pulled away from their job . . . it was nothing more than over-medicated.

Volunteer Vs. Municipal Staffing

Chief Nixon characterized the personnel challenges facing a paid fire department, "we feel fortunate to have . . . paid firefighters for a department as small as we are . . . our staffing does fall short sometimes due to . . . vacation scheduling and . . . sick time." The challenges of staffing are not limited to volunteer departments, Chief Schwartz related the issues his community faces, ". . . our vulnerabilities [are] in numbers . . . we have a limited number of full

time employees, and so if you have a big event . . . you have to do a callback, and so, you never know how many you're 'gonna get to come back in." Chief Hayden expanded on personnel challenges, ". . . monies would be key . . . [m]anpower is always a struggle . . . having enough to do the job at hand."

In the July 16, 2016 edition of The Times (Baron 2016), Mayor Jimmy Tramel discussed the City of Pryor budget problems. According to the article, Pryor retains 12 paid firefighters, and ". . . Facing a budget deficit, Mayor Jimmy Tramel said emergency responders may have to hold things down with fewer heads." Similar budgetary constraints occurred in the Town of Chouteau, discussed in an April 30, 2013 edition of The Paper. The Town discussed budget constraints, "The Chouteau Board of Trustees called a special meeting Friday to discuss two firefighters . . . The board entered an executive session for the purpose of discussion and consideration regarding taking full-time firefighters Assistant Chief Keith Brandon and Captain Billy Wishard back to volunteer status. In a show of support, many Chouteau firefighters attended. Brandon joined the Chouteau Fire Department in 2003 and became full-time in 2005. Wishard joined the department in 2009 and became full-time in 2012. Fire Chief Ted Key said Chouteau is currently a combination department and switching to all volunteer would not change its operation."

Education

General education of staffing varied, as many municipal departments require a minimum amount of college accredited coursework and volunteer firefighters do not. Chief Hayden discussed the talents and education of his firefighters, ". . . we've got a range from high school education to a 4-year degree . . ." Chief Spears characterized his education in preparing for being chief, ". . . I have, uh, taken quite a bit of training, um don't have any college-level courses . . . in

reference to the fire service, [but,] I uh did a go a year in college before I went to work in the fire department . . . [and] in-service training through OSU fire service training or trying to get Texas A&M, at the National Fire Academy . . . ”

Young firefighters learning from experienced ones

Chief Beltran said, “. . . for volunteers . . . it’s an up and down motion, you’ll have a young crew come in, you educate that crew, unfortunately, we’re volunteers, they’re looking to make the next step, and a lot of them goes straight paid departments . . . so you got a fluctuation.” Chief Koch described staffing issues in his community, “. . . weaknesses would be when we have people . . . that move out of the community. Basically, you have to start over with training . . . [a]nd . . . training takes time to get . . . we try to do a lot of our in-house training . . . but there’s a lot of time that some of the classes . . . that’s . . . not available all the time to us . . .” Chief Bruce illustrated how his staffing experiences peer learning, “. . . we’ve got two or three young ones, that’s on now, and . . . they draw from the older guys . . . and . . . so you just have to bring them along . . . and hope that they’ll have the time!”

Chief Swanson portrayed the issues his department faces related to firefighter knowledge and abilities:

> . . . half of our roster ha[s] been on here longer than 10 years . . . that’s where a lot of the . . . education and the knowledge comes from. We have a group of guys that’s been on here for 5-to-10 years and . . . they learn a lot real fast and then . . . we got the younger people that are just now coming around and learning . . . and the older people . . . all of us veterans, we give them all the knowledge that they can handle, or that we think they, they need in that point in time . . .

HAZMAT Knowledge, Skills, and Abilities

Although the amount of hazardous materials training varied amongst the participant’s departments, the general theme was that they did not possess adequate training in this area. Chief Spears said that of his firefighters, “. . . we do not have any Hazmat Techs, just for the [reason]

that keeping staffing while the training is taking place to take care of day-to-day, daily operations, as well as to keep 'em all trained, and have enough to say we have a Hazmat team, so we do not; everybody is at the Hazmat Ops level." Chief Phillips discussed his firefighter's knowledge, skills, and abilities, Chief Phillips said, ". . . some of my guys have had just some training here and there. There's none of them one and two certified, um, oh, and Hazmat or anything like that, other than myself."

Several fire chiefs acknowledged that an area in which they are vulnerable includes training. Chief Maddoux indicated that some of the resistance to non-fire training was disinterest, ". . . [t]he guys that, that are wanting to be volunteer firemen 'wanna be volunteer firemen, they don't really have any self-satisfaction from being a medical personnel, strictly medical." Expanding on his firefighter's training, Chief Maddoux said, ". . . the areas that we are . . . not trained in, are those areas [in which] . . . the likelihood of a call is very slim . . . "

In the survey, fire chiefs were asked to rank their department's training priorities by order of importance, the data is presented in Figure 11.

In Figure 11, only one participant listed hazardous materials and chemical sampling as the highest priority, this same participant categorized firefighting activity training as the lowest priority. Although I did not attempt to clarify the answer, this participant could have errantly inverted the prioritization ranking. I took general training topics for this survey question from the Oklahoma State University Fire Service Training website.

Figure 11. *Next Page. Fire Department Training Priorities (By Order of Importance)* (n=27)

Social Capital

Resilience

Community Support for the Fire Department

Chief McLaughlin characterized the community support, ". . . everybody's pretty tight around, we watch out for each other, and, uh, most of us still know each other, and know everybody's different needs. Chief Koch described the support his department receives from the community, ". . . we're close . . . [we] are also comfortable with the . . . community members . . . helping each other out, along with the department . . . neighbors helping neighbors . . . like having a structure fire . . . we have people in the community bring us water . . . we've even had people in our community to bring us sandwiches and stuff while we're at [a] structure fire or grass fires for a long period of time." Chief Hayden discussed his personnel being involved in the community, "We have people in clubs . . . we're a close-knit community." Chief Rhodes described the community sentiment towards his agency, ". . . it's really, really wonderful . . . I

don't believe . . . we have received any negative input at all . . . if we do need help with something . . . just call and somebody's got a tractor we need something . . . I mean they're just, they're super supportive in our area." According to an article in The Times (January 26, 2016), "On January 22, Pryor Creek Masonic Lodge #100 presented a check for $250 to Pryor Fire Department to help buy fire safety materials that are used to teach school children about fire safety and burn prevention. The Masonic Lodge has been supporting this program for over 18 years."

Chief Swanson expressed his community's feelings toward their department:

> . . . we get a lot of feedback from people telling us that they're glad we're here . . .it seems like all the community just rallies behind us . . . we can ask any of 'em to do any little thing and they . . . want to help out more than what we've ever expected them to . . . you know . . . a while back, we were . . . raising some money for some new boots and the outpouring from the community was just fantastic, and getting out and being a part of 'em . . . mingling with the people and education . . . that's a big deal for the community. It makes them feel a lot safer, makes them feel prouder . . . of . . . seeing us around.

Chief Schwartz described the support from his rural and agrarian community:

> . . . the thing about the rural community is . . . farmers and . . . ranchers, and people like that in our area out here, they're . . . always supportive of us, that's . . . probably the main thing that you see out in rural areas that you don't see in some of the cities . . . if I have an issue, or if I have to get out and get into a piece of property, or I have to cut a fence . . . [t]hose guys, they're . . . always there to support us . . . there's never anyone critical of us . . . and I think that's . . . part of . . . rural America, rural Oklahoma . . . I think people are just more receptive and more appreciative of public service than they are in . . . the cities.

Attributes of firefighters

Chief Maddoux related the dedication and character of his firefighters, ". . . the only thing [that] probably is the same is the heart of the volunteers that doesn't mind to get up in the middle of the night, everything else has changed." Chief Bruce described the volunteerism within his department, ". . . it's about everybody that donates their time, and . . . it's a great 'feelin when you know that you're . . . helping the community. We've got good guys . . . and, uh, it 'aint just

the guys, ‘cause if the women won’t let ‘em come and do their time . . . a lot of it has to do with just having a whole group of good families.” Chief Roy illustrated what it is like being a firefighter, “. . . you have the people that you know that you, you saved the day or made the day and they think you’re, you know, a hero . . . it makes a difference. It makes a difference with the people. Chief Hobbs described what it means to be a part of a fire department, “It’s a . . . sense of pride being part of the fire department . . . being able to help their community . . . I think as time goes on . . . members stay on here for long-term it’s more of a duty to help your fellow citizen . . . help your community.”

Vulnerabilities

Community Changes

Chief Maddoux characterized his community’s social environment, “I feel that [my community] has become a bedroom community to Tulsa . . . I think all of our small communities . . . are slipping away . . .” According to the USFA document *Retention and Recruitment for the Volunteer Emergency Services* (U.S. DHS 2007), sociological changes in communities including the elimination of family-owned stores with regional shopping facilities, which have resulted in loose community ties, are less likely to let employees off to volunteer. Community demographics have also created a complication, in that it is difficult to find younger volunteers to replace the aging population.

Stress on Volunteers

A factor that affects many small communities is that everyone relies on, and knows their neighbors; this can become stressful to a department’s personnel. Chief Maddoux described the complications of volunteering, “. . . more than likely, if we run on a bad call, if we run on a house fire, if we run on a death, we’re probably ‘gonna . . . either know them or know somebody

who knows them." Chief Beltran said, "[the fire department's] a very family-built atmosphere . . . most of us have been here for a very long time so we know a lot of people in our community . . . it's a very close tight-knit group." Chief McClain discussed what it is like being a firefighter in a rural community, ". . . it's personal . . . everybody you run on you know . . . I've done CPR on people that baby-sitted, you know, in the past . . ." Chief Bruce characterized his closely connection to his community, "[a community member's] son got killed over there on . . . [a local] road, which is a cousin of mine . . . and then, just like a day or two after that was the girl . . . got killed . . . she was 'fixin to go into the army." Chief Bruce expanded on the graphic details of the incident, saying "[it] almost turned me."

According to Chief Roy, being a volunteer firefighter is:

> . . . very rewarding . . . and is also very frustrating at the same time. Uh, like anything in life, you're only going to get out of it what you put into it . . . it's a lot of work for no pay . . . if we get our 20 years in, we get a small pension from the state . . . sometimes I wonder if it's worth it, if you look at firemen and the elements that we go into . . . the risks that we take . . . for the little reward that we do get . . . sometimes I wonder if . . . I don't need my head examined.

Chief Bruce related how the community views his department and his expectations of his firefighters, ". . . we hold our-self[s] above, kind of the way teachers used to do their-self, they were considered pillars of the community, that's the way I want them to . . . hold their-self up . . . we just try to . . . do what we can, for the community, and hold our-self a little higher than . . . what most of 'em . . . are around here." Chief Maddoux related the community presumptions of the professionalism of his department, ". . . everybody has a . . . sense of . . . respect if you're wearing that fire department shirt." He expanded, saying, ". . . for the most part, when you're wearing [our] fire shirt your held to a higher standard."

Cultural Capital

As mentioned in chapter 2, Cultural capital involves shared values, morals, and group beliefs. Cultural beliefs affect our decision making, how we perceive risk, how we act outwardly, and in political decisions and policies.

Fire Department History

The participants include fire chiefs from departments formed in the past 15 years spanning back to one created before statehood. Some have been in the fire service their entire adult life, and others are in their first year. Their stories contain a passion for helping their fellow citizens, a pride in their community and department, and in their firefighters. Regardless of their differences, there is an overwhelming desire to be the best at what they do.

A community's culture impacts fire department activities, expectations and roles, organizational values and beliefs, and risk perception. The fire department's role in the community has changed over the years. Several of the participants indicated their run volume is increasing, they are providing an expanding range of services, and the community expects their agency to be prepared for almost any emergency. Chief Maddoux related the evolution of his department and experiences, "If you needed . . . a fire truck, you just come, jumped in it and took off, kinda like Mayberry, just off you went . . . our department has changed as far as what we'd run on . . . the emphasis on customer satisfaction, [and] the emphasis on public perception." Further expanding on the nature of how calls have changed, Chief Maddoux said ". . . 13 years ago, if the pager went off someone needed us. 13 years later if the pager goes off, now we assist the ambulance in loading grandma that has been sick for 3 days and she's wanting a ride to the hospital." This sentiment was reflected in *Retention and Recruitment for the Volunteer Emergency Services* (U.S. DHS 2007), mentioning the public has a greater reliance on the fire

department, giving an example of someone with a broken arm in year's past would get driven to the hospital by a neighbor, now they often call for an ambulance.

Chief Pratt characterized how his department has evolved:

> . . . years ago, if you were voted on the fire department, well, we'd scrounge-up some gear, a radio, a pager, and we'd give it to you that night; here you go. We do not do that, uh, we require certain, uh, basic training areas, and when you get to a certain level, then you would, you'll get a pager, be able to respond, and basically, uh stay in the cold zone, and uh, watch and ask questions, and learn that-a-way; so we just try to ease 'em in, without, um, getting anybody hurt.

Resilience

Risk Perception

Risk perception varies depending on several factors, including values and beliefs, history of responses, and known hazards in the community.

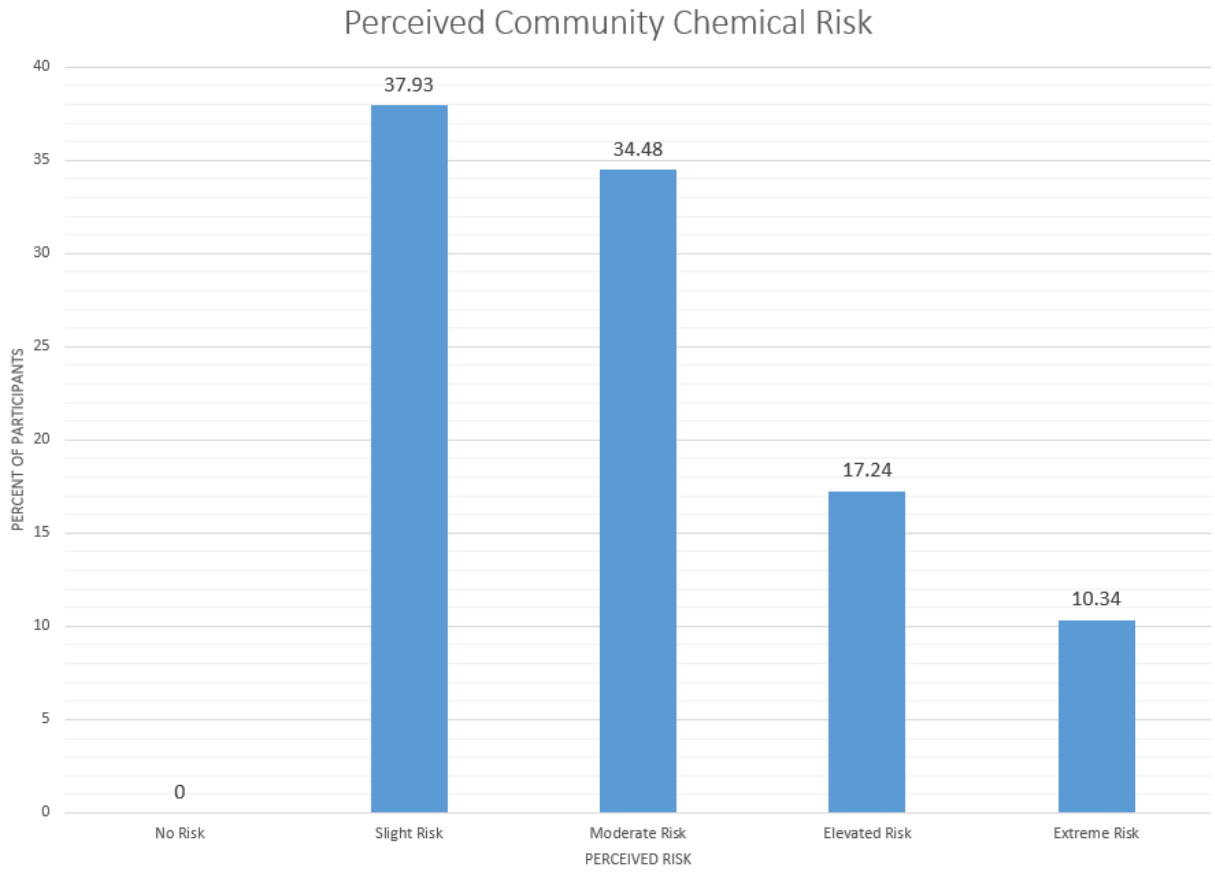
Chief Maddoux said they had a, "High risk . . . in our watch area, we have a [state] highway . . . which is a main thoroughfare . . . and the . . . railroad that goes through our town . . . [that] if things are working right . . . in a 24-hour period they could be running 24 to 26 trains, and we all know what's carried on trains. So the worst chemicals out there are carried by rail . . . The likelihood is very slim, but the impact could be major." Chief Nixon described the risk posed form chemicals to his district, ". . . we have a high risk . . . mainly because of the . . . railroad . . . transportation providers . . . several state highways that . . . definitely [pose] a high risk for chemical disaster[s]." Chief Pratt described the chemical risk within his community, "we have a tremendous amount of truck traffic . . . if I remember the statistics correctly, it is the third busiest port of entry into the State of Arkansas . . . so we have a lot of truck traffic . . . and . . . who knows what they're carrying." Chief McClain illustrated the amount of chemical hazards in his community, "there's a lot of farmers that store chemicals and stuff in their barns . . . you know . . . SCBAs are important to us."

Chief Schwartz described chemical hazards in his community:

> I think that's something that we all . . . overlook. I think it's a huge issue down here where we're at . . . we have a pretty good size . . . chemical facility . . . they keep a lot of bad material up there. Our railways are ridiculous. We actually . . . get copies of the manifest for the railroad that comes through here right behind our fire station actually, it comes through a dozen times a day. But the, the materials that they're carrying on those, I mean . . . we're one derailment away from having a huge incident up here, and I think it's not only us, but, I, I don't think the whole . . . region up here is prepared to handle a mass casualty incident . . . Hazmat response was regionalized here in Oklahoma, so our, our Hazmat response unit is in Claremore . . . best case scenario, Claremore is an hour-and-a-half to two-hours . . . before we get a response team here.
> In the survey, fire chiefs ranked the risk chemicals posed to their community, Figure 12

indicates the findings from this question.

Figure 12. *Fire Chief Perceived Community Chemical Risk* (n=27)



Chief Hobbs illustrated the risk chemicals posed to his community:

> . . . it's probably astronomically higher than most small towns because of [transportation routes and nearby] rural industrial park . . . and we have a large number of hazardous

> material type calls . . . there's departments . . . our size . . . that hasn't had a hazardous materials call in 20 years . . . we're liable to have those type of calls multiple times-a-year . . . in the industrial park, [it's] almost a daily occurrence that somebody's having a spill.

Community Expectations

Chief Phillips characterized his community's expectations, ". . . when they have an emergency, I think they expect us to be there, in one way or another . . . they expect us to show up and . . . take care of business." Chief Pratt spoke about his community's confidence in their fire department's response, ". . . they expect us to show up when called . . . we have enjoyed a pretty good reputation of the fact that . . . when we get called, we show up, we do the job . . . and we try to make sure that . . . our response is adequate, and that we do it according to . . . the latest training."

A common theme emerging from multiple sources is that their department has changed from years past, and the variety of calls to which they respond has vastly changed. Chief Hobbs described how calls have changed, they have "expand[ed] into . . . accidents, vehicle extrication . . . medical calls . . . EMS response . . . it's an ever-changing entity . . . its expanded into hazardous materials stuff that uh, uh, people 20 years ago would have never thought about . . ." The public expects the fire department to respond when called, and to be able to do the job, no matter the nature of the call. Chief Maddoux said that, "[i]f we have a train crash, if we have a tornado . . . they expect when they call 911 . . . our community expects someone to show up." Chief Beltran described how his department's responses have changed, "We've done all kinds of things . . . from . . . we've had individuals out here that's on life support . . . on oxygen, that's . . . called us up . . . needing something." In discussing what activities his department has done during a disaster, Chief Pratt said, ". . . we have . . . worked with . . . other agencies . . . whenever . . . the creek and river gets up, they get flooded in, we get a boat . . . whatever, get 'em out . . .

we cleared roads . . . we have . . . hauled in 100 pound propane cylinders." Chief McLaughlin illustrated the outreach activities conducted by his department, ". . . when the snow got . . . real deep, and I knew . . . in a housing edition . . . they weren't going to be out there shoveling snow and such . . . we would go out and take care of people's things like that, even went to the pharmacy for a couple of different people . . . helped 'em get their porch swept off . . ." Chief Rhodes described his departments' past role during a disaster, ". . . we have to go around . . . and help . . . the community with . . . meds, getting to and from . . . hospitalizations and . . . that type of thing." Chief Hayden discussed his community's presumption of service, ". . . they expect us to . . . be able to be an all-service department, whether it's extrication, a house fire . . . a heart attack . . . a lift assist . . . we respond to any type of need in the community." Chief McClain characterized his community's expectations of his department, ". . . we try to offer the same services you could get in Tulsa, or Claremore . . . we can extricate . . . we're EMS . . . we're very rural . . . a lot of help is slow to get there, so we try to fill the gap . . ." The *Third Needs Assessment of the U.S. Fire Service: Oklahoma* (NFPA 2010) indicates that for communities in Oklahoma, whose population is under 10,000, 76.1 percent provide hazardous materials response.

Community Expectations of the Fire Department during a HAZMAT Disaster

Chief Maddoux described his fire department's role in a hazardous chemical disaster, saying that as a community member, he would want to ". . . know immediately if I need to shut my windows, if I need to head for higher ground . . . should I pack my clothes, [or] should I just forget everything and grab my kids and leave . . ." According to Chief Jefferson, in his district, his community expects the fire department to provide information on response actions, "you need to know to . . . get up wind of it . . . uphill . . . or upstream . . . to get away from it . . . and

just let it do its thing." Chief Beltran discussed his fire department's role in disasters, ". . . education . . . most of these people out here . . . has not been educated on what to do if there is . . . a chemical spill. You know, 'shuttin down HVAC units . . . wet towels on doors, closed windows . . . there's no education going on in this area for that." According to Chief Spears, ". . . we need to train them with the . . . knowledge . . . to listen to their local TV channels, or radio stations . . . or weather alert radio[s], if there is an instance that we need to shelter in-place or if they need to evacuate, they need to be prepared to do so." Chief Nixon depicted his department's role in preparedness, ". . . education . . . proper equipment . . . and proper training . . . we also ask . . . any resident that's . . . interested to become part of the . . . LEPC, and . . . we . . . try to prepare for responses through that . . . committee also." Chief Eaton described his department's role in preparing the community, ". . . all we are equipped to do is notify 'em . . . we don't have any kind of equipment to aid the public . . . about all we could do, at this point . . . is . . . try to notify them as soon as possible that there is a situation. As far as, uh, beyond that would be down to the emergency management personnel, I would assume." Chief McLaughlin reflected on the role his department should play in community preparedness, "oof, that's a tough one, because we are not prepared for that at all, uh, I guess we should be trained for that, in a sense, because it could happen anywhere, but that's very, not likely . . . "

Chief Roy described is department's role during a disaster:

> . . . the main thing is . . . evacuation. That's 'gonna be our . . . main goal . . . work on our Evacuation . . . contain the spill if there's any way possible . . . there again, we don't know what we're dealing with, there's so many variables. There's some things we can, you know, dam, dike, divert . . . to a certain area . . . you['ve] got to take wind speed . . . and . . . terrain and all that into consideration, where the release was . . . was it uphill, downhill, upwind, downwind.

Further discussing his department's role, Chief Roy said, ". . . I think they just expect us to help them . . . kind of inform them of what's . . . going on . . . [inform] them of the situation . .

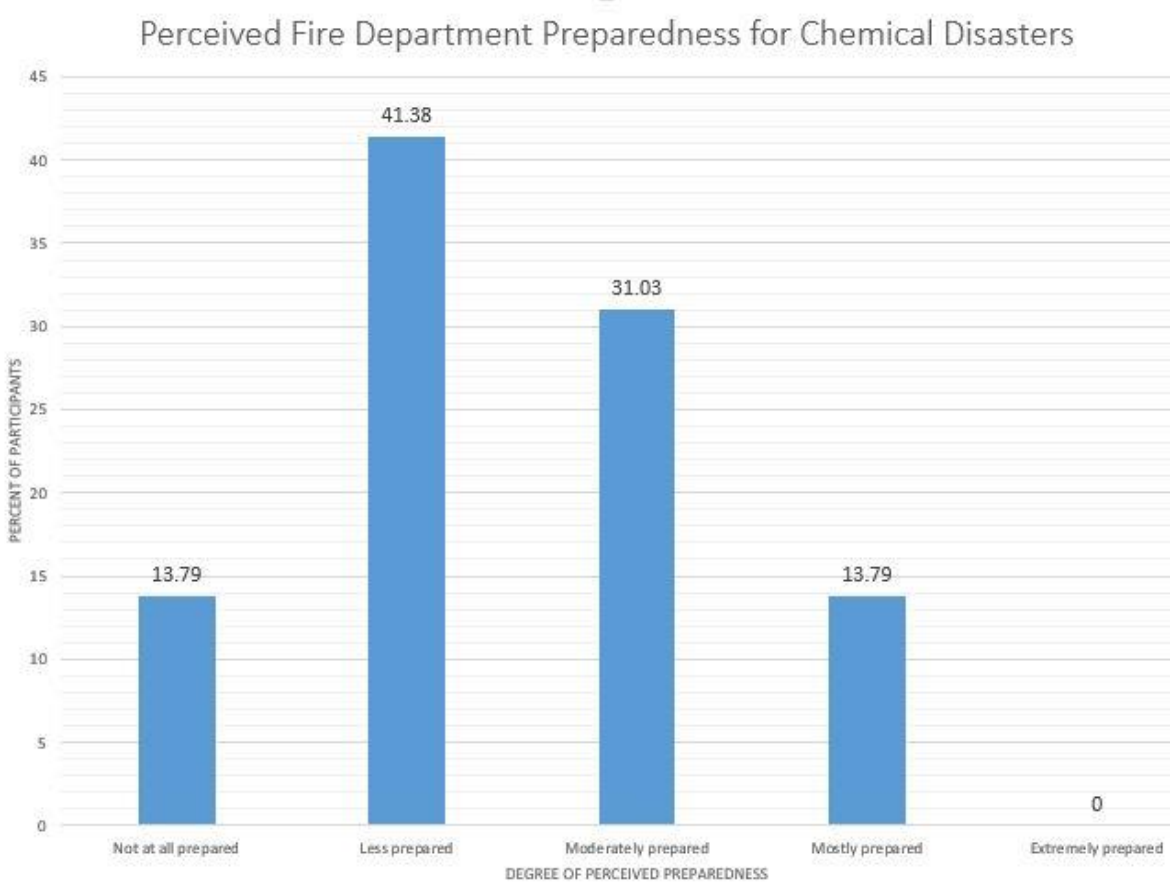
. and the dangers . . .” During a hazardous materials release, Chief Schwartz said his department does “. . . mutual aid up [highway name withheld] . . . but other than that . . . we’re ‘kinda hung out waiting on . . . Claremore, so, the potential’s very high here and the response is . . . just not ‘gonna be immediate . . . I think we’re ‘gonna struggle with any type of that . . . chemical situation. But I think as far as potential, it’s huge.” Chief Hayden discussed his department’s role in a chemical disaster, “. . . I would say, inform, evacuate, and educate.” Chief Swanson described what his department would do during a chemical disaster, “. . . probably more (pause) letting the public know . . . where the resources are ‘gonna be at . . . where they can go . . . where I can go to get help . . . what I need to do to prepare my family . . . how they’re ‘gonna respond . . . a lot of community people don’t know how we’re ‘gonna respond.” Chief McClain characterized his department’s response, “. . . we would . . . [shut] off access to the area . . . we have our books where we can look up the chemicals and stuff, and know how far back we ‘gotta be to be safe . . . we don’t have the gear to go into a live scene, or an active scene to pull somebody out, but we do have the knowledge to stop people from going in . . . we kind of operate under the do no, do no harm.” Chief Rhodes illustrated his department’s limitations, “. . . our major trouble is confinement . . . as far as that goes . . . we have Ops level, but as far as the equipment goes, we don’t have a lot . . . I foresee in the future that we will have a team, a county-wide team . . .” According to the *Third Needs Assessment of the U.S. Fire Service: Oklahoma* (NFPA 2010), “. . . [t]here has been little change in the ability of departments, using on local resources, to handle certain types of unusually challenging incidents, including two types of homeland security scenarios (structural collapse and chem/bio agent attack) . . .” Chief Hobbs, whose department regularly responds to chemical leaks, said:

> . . . we basically respond at the Operations level . . . we believe it’s our job to be able to respond to it . . . dam, dike, or divert…[b]e able to look at the . . . MSDS sheets, and . . .

> basically . . . give them some ideas on what they need to do to clean it up . . . [w]e don't actually clean up hazardous material. We will help people keep it from getting worse, keep it from getting on your neighbor's property . . . give you phone numbers you can call that come out and remediate it.

In the survey, the study asked whether their fire department was prepared to respond to a chemical disaster. Figure 13 presents the findings of the fire chief's perceived preparedness.

Figure 13. *Perceived Fire Department Preparedness for Chemical Disasters.* (n=27)



Fire Department Role in HAZMAT Disaster Preparedness

Chief Pratt described his department's biggest challenge in conducting hazardous materials preparedness, "getting the customers, our patrons out there, to come and ask questions is probably the hardest part . . . if I was a citizen in the area . . . my first thing would be to . . . contact the fire department . . . and say "hey . . . what about" and . . . we would go from there.

But the biggest thing is . . . getting people . . . aware . . . and interested enough to ask questions." Chief Bender characterized his department's role in a chemical disaster, ". . . as the community member, I think I would expect . . . [information] . . . get the information out on what chemicals are available in the area . . . what are some of the effects . . . that they would cause . . . maybe flyers . . . and once it . . . happens . . . get the information out quickly in a timely manner to all those that could be affected." Chief Rhodes related his department's role in preparedness, ". . . publicity and awareness, that if we have a problem, here's what you do . . . [b]ut as far as the community, letting them know, notification and . . . publications of different pamphlets and such, that's probably the only way we could do that."

Chief Koch illustrated his department's role in community chemical preparedness:

> [e]ducate me on . . . the plan . . . educate me if we should have a situation, a release . . . to do this and that . . . also, would . . . be utilizing . . . emergency management as far as helping out . . . doing reverse 911 . . . or get the education out to the . . . an evacuation in the area . . . to stay away from . . . looking at the fire department to help me . . . [t]he department . . . should help to educate me."

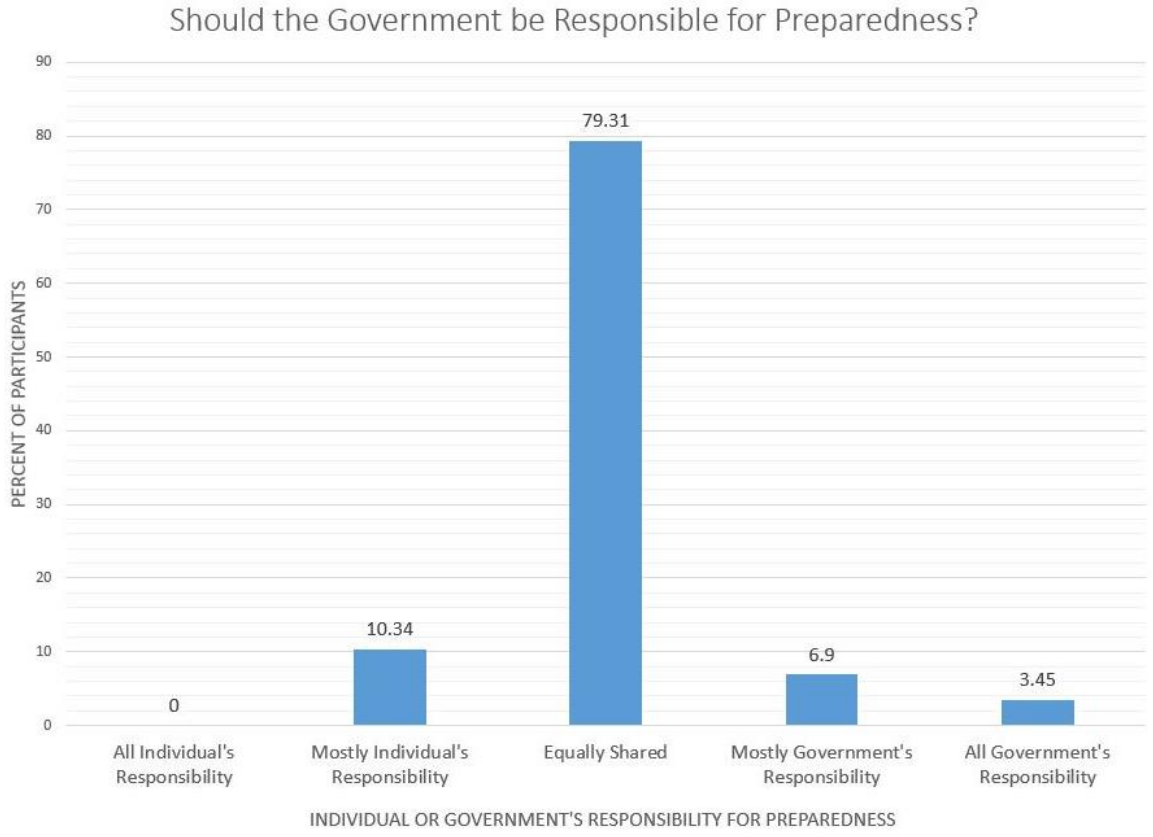
Community Member Individual Preparedness

There are many challenges related to personal and familial preparedness levels. However, there are signs of personal preparedness improving. Chief Maddoux said, ". . . I know that simple things, the Moore tornadoes, now more and more people's . . . got cellars . . . after the wildfires people keep their yards mowed a little-bit cleaner . . . after we had the ice storm here 4 or 5 years ago I noticed a lot of people got generators now." Chief Schwartz reflected on recent disasters, ". . . I'd love to have been a storm cellar salesman in the last . . . 5 or 6 years . . . If someone has a bad tornado . . . guess what . . . there's 'gonna be a big sale on tornado shelters . . . " Chief Roy examined the impact of disasters in his community, ". . . we go out for storm watch or, you know, there's a little potential thunderstorm comes through . . . I've noticed a big incline of

people running to our shelters . . . we have a shelter down in the community center and . . . people run to it a lot more than they used to. They used to just kind of stay in their homes and . . . wait, but they're a little more cautious . . . now, because of previous disasters."

In the survey, fire chiefs ranked their belief about who should be responsible for preparedness. The majority (79.31 percent) of respondents said it is an equally shared responsibility. Figure 14 contains findings on preparedness.

Figure 14. *Should the Government be Responsible for Preparedness?* (n=27)



Number of Responses

Chief Bruce commented on the changes his department has seen, ". . . over the last . . . several years, it has become more medical than it is fire . . . we're 'runnin on 500 medical calls-a-year, uh, maybe 40, 50 structure fires at the most . . . so it's mainly medical . . . they expect us to be here . . . if they're 'payin tax money they expect to have service, but yet . . . you still have

those calls that are repeat calls, we had a [community member] that had four calls in six hours the other day. You know, you got people being pulled away from their job . . . it was nothing more than over-medicated." Chief Bender discussed how his department has evolved, ". . . we just increased calls year-to-year." Chief Maddoux reflected on how his department has changed, ". . . used to . . . if you had a fire, smoke showing, you can rent the fire truck. But now with cell phones . . . GPS . . . if somebody's driving by on the road and they see the sun reflecting in a house, in a window, they call 911 . . . that kinda sometimes puts some burdens on us."

Chief Spears discussed the community presumptions related to fire department response, ". . . the community expects when you're called, they want you there right then . . . whether you're short on manpower, or whatever, that's really not a thought in their mind . . . when they make that call for help, they expect you to be there." Chief Nixon related the community expectations of his department, " . . . they expect fast response . . . well trained personnel . . . they expect the . . . very best . . . treatment . . . of their lives and property." Chief Eaton described the community expectations of his department, ". . . to respond in a timely manner . . . to operate in a professional manner . . ." Chief Schwartz explained his community's beliefs, ". . . they expect us to be there . . . to provide quality service . . . to be able to save their family member's life if they're in . . . a critical situation, and have the training and expertise to do that." Chief Hobbs relayed his community's anticipation of fire department response:

> [they have] an expectation that we are there for whatever type of hazard they have . . . in a very . . . quick time-frame . . . to have trained personnel there . . . the right equipment there, [and] they want us to mitigate their situation in a professional manner . . . no more is there this deal, well hey, these are volunteers, or this is a small town fire department, uh, they expect the same service that, uh, somebody would get in Tulsa or Oklahoma City, and they expect you to be able to do the same job.

In contrast to the increase in calls, and nuisance responses, Chief Jefferson said, "Usually, whenever we have an emergency out here, people aren't calling because . . . they're . .

. being proactive . . . whenever . . . people in our community call, they have got a actual emergency."

Disaster Subculture

In communities where disasters chronically occur, a disaster subculture can develop. Chief Schwartz described his department's recent history of disasters, ". . . I don't know . . . if you know it or not, but we've had . . . 7 nationally declared disasters in the last 10 years in our area . . . [w]e've had tornadoes, we've had blizzards, we've had floods, you name it, we've had it." Chief Spears explained the risk posed to his community, ". . . in the early '70s . . . they had a disaster out at . . . the industrial park at the chemical plant . . . [they] had an explosion [that blew] all the windows out of the downtown businesses, so I think that was quite a trying time for the community . . ." Chief Schwartz detailed the formation of a disaster subculture in his community, ". . . I think the big disasters that we've had, they've made us…a lot better in a lot of ways as far as the department goes, and we've had to use things that you don't use every day . . . you don't do mass casualty triage every day, but you know what, [w]e've gotten pretty good at it." Chief Hayden portrayed their department's abilities, ". . . our strengths are probably in what we do the most . . . our highest frequency, lowest risk runs . . . the things that . . . come around the least are your lowest frequency highest risk things."

Vulnerabilities

Chemical Disaster Risk Perception

Fire chiefs were asked how much of a risk do chemicals pose as the cause of a disaster in their community? Chief Bruce indicated that there was a low risk in his first-due response area; mostly the hazards existed in neighboring mutual aid districts. Further expanding on chemical risk in his district, Chief Bruce said that in the eighteen years he had been on the fire department,

he did not know of chemical hazards in his district other than gasoline, when a filling station had an incident involving a drive-off. However, I noticed while driving through the fire district, that a truck carrying various chemicals including a 1-ton cylinder of chlorine gas (used as a nerve agent during World War I) was making a delivery to a wastewater treatment facility. Chief Schwartz described chemical vulnerability within his department, ". . . I don't think hazardous materials is one of those things that if you're going to commit to do hazardous materials response . . . you have to commit 100 percent, it's very expensive, [a]nd you may use it once every 5 years, so it's hard to justify it."

Increasing Variety of Calls

Mayes County Firefighter's Association discussed the increasing number and variety of calls to which they respond:

> . . . discussed possible ways to reduce the numbers of non-emergency calls they are dispatched for. Sick calls, headaches, back aches, and stomach aches are currently responded to by Mayes Emergency Services Trust Authority and the nearest fire department. Many firefighters said they wanted to return to the days of emergency calls being prioritized, to save them from running an exorbitant number of non-emergency calls." "Locust Grove Fire Chief Ray Vaughn said, "Our intention is absolutely not to short-change the communities we serve and we understand sometimes it's not the person that needs help, it's the crew." Dispatchers should be able to make some determinations. For example, do we need to call seven firefighters to get on a truck and risk their lives to check on somebody's gout," said Salina Assistant Chief Garrett Ball. "Firefighter's Association Chairman Jason Miller, Chief of Cabin Creek Fire Department said his department has run 637 calls in the past two years and that is costs the department between $50 and $100 every time they go on a call. There are budget cuts coming," Miller said. "Just like with every other state agency we could be facing some budget cuts. But fire departments can't make cuts, we can't cut structure fires or grass fires or car wrecks. Non-emergency calls are the only way we can cut back" (The Times, February 18, 2016).

Political Capital

As mentioned earlier in this paper, knowledge of written plans, and the planning process are crucial to being prepared. When asked about their knowledge of local emergency response plans, a majority (68.97 percent) of the fire chiefs responded that they understood some, most, or

all of the local plan(s). The more telling percentage is the 31.03 percent that knew very little about the plan. Knowledge of this plan allows fire chiefs to realize their roles in disaster response, to know the response capabilities of a joint agency command, and to understand the expectations of their fire departments' response. Local planners often base these emergency response plans upon templates suggested in *Developing and maintaining emergency response plans, Comprehensive Preparedness Guide* (U.S. DHS 2010), to include general information on response plans, organization, roles, expectations, identifies people and resources and their locations, contact information, and other information specific to planning and preparedness. While this information is included in the main body of the document, annexes are included at the end of the plan for specific response scenarios and resources. These specific scenarios include transportation, communications, hazardous materials, public works and engineering, emergency management, firefighting, and other topics (U.S. DHS 2010).

The suggested location for hazardous materials response plans is within the annex of the emergency operations plan. Since chemical disasters have differences separating their response characteristics from that of natural or other technological disasters, the ideal location would be within the annex. General preparedness information should remain within the main body of the plan, so that information used for most disasters is earlier and more prominent that incident/response specific information or directions. If fire chiefs do not comprehend emergency operations plans, they risk marginalization when plans do not meet their needs due to a lack of engagement.

Resilience

Fire Departments throughout the study region have benefitted financially from their county sales taxes. Small sales tax stipends can provide a steady source of revenue on which fire

departments can base budgeting forecasts. Larger countywide sales taxes can offset local community member expenditures. When large community events such a concerts, festivals, and celebrations attract extra-community visitors, local and county-wide sales revenues benefit from transient populations. In this manner, support of these large events can add to planned financial capital, and support local improvements.

Vulnerabilities

Sales tax and local policy changes can create strife. Chief McLaughlin described political issues affecting his department, ". . . we . . . sometimes have issue with . . . county commissioners . . . kind of favoritism toward another part of our county, and not being in the area for us, we've had that issue in the past, we've got that going on right now . . ."

Mayes County Tax Funding Cuts. The Mayes County Commissioners voted 2-to-1 on December 17, 2012 to change the sales tax funding divided equally among the fire departments in Mayes County. "Currently, each department receives an equal 1/13 share from the one-quarter of 1 percent county fire sales tax, which approximates to $5,300 per month or $63,600 per year per department" (The Paper, December 19, 2012). However, "[b]eginning in February, each department will receive $3,000 per month—with the remainder based upon each department's percentage of total fire runs in the county" (The Paper January 28, 2013)." This issue began with problems stemming from use of public funds and capabilities among departments. The Osage Fire Department opened an investigation into possible embezzlement of funds. According to The Paper (January 14, 2013):

> Mayes County Commissioners upon learning of this investigation and learning of other questionable activity, recently called for a state audit of Osage, Diamond Head, and Strang Fire departments, recently changed the way county fire sales taxes are disbursed, recently approved "minimum standards" that fire departments will be required to meet to share in the county fire sales tax funding, recently required fire departments to keep a mileage log

showing business use of fire vehicles when requesting reimbursement of vehicle-related expenses.

According to the Mayes County Board of Commissioners, “All fire departments are required to meet the minimum standards adopted by the Mayes County Fire Association and approved by the Board of County Commissioners. These standards must be met to receive any funding, read Yoder. The fire departments that meet the required standards will receive $36,000 per year base funding” (The Times, January 8, 2013.). The funding change was due to unequal number of responses throughout the county departments as well as unequal attempts to improve response capabilities, “Yoder then pointed out that the definition says departments that make no effort in lowering their ISO rating to an acceptable number will be removed from funding.” “I don’t think there will be a problem with them paying their bills, but if someone does, they can come before the Board and we’ll help take care of it,” said district 1 Commissioner Alva Martin” (The Times, January 8, 2013.). After discussing the new disbursement of funds, the Mayes County Firefighter’s Association issued a letter to the Board of County Commissioners, asking them to “reconsider their decision to redistribute county fire sales tax money” (The Paper March 18, 2013).

In the letter, the Association discussed several points, including:

> 1. Action taken by the commissioners is not in the best interest of the fire departments or safety of the citizens and firefighters of Mayes County. Since the tax was approved (2002), substantial improvements have been made to the fire protection of Mayes County. 2. The citizens of Mayes County approved a tax to improve fire protection and to be equally distributed between each department. 3. The commissioners' action has destroyed bonds built between the firefighters of Mayes County that have been formed since the sales tax was approved. Animosity between departments is greater now than it was prior to the adoption of the fire tax. The number one key to exceptional fire protection throughout the county is cooperation and trust between departments. During large scale incidents, cooperation of all departments (no matter their size) is absolutely critical to accomplish positive outcomes. 4. The Mayes County Firefighters Association and the majority of firefighters in Mayes County do not support the action to redistribute the fire tax funds by the board of county commissioners. A vote of those in support vs. those against at the

> meeting was 2 to 9. 5. Some remarks made by the commissioners that have been published in the local media are hurtful to the public trust of firefighters and discouraging to volunteer firefighters throughout the county. Firefighters of Mayes County sacrifice each day to protect the lives and property of their families, friends, and neighbors. Recruitment of new volunteers is at an all-time low in this county, state and country. Elected officials should be doing everything in their power to encourage volunteerism instead of demonizing current volunteers. 6. The actions by the county commissioners have not and will not fix any problems. Rumors that circulated before this decision involved mishandling of county funds (all purchases with county funds are approved by the county commissioners) and misuse of fire department equipment. The recent action to redistribute tax funds taken by the commissioners does absolutely nothing to remedy either of these allegations or any other problems. 7. The actions by commissioners will prevent many county fire departments from making any improvements. The $3,000 allotted by month will barely pay department's payments, excluding utilities. 8. ISO ratings are often discussed by commissioners, but minimal facts about the matter are ever discussed. First, there is no mandate requiring any department to improve their ISO rating. It is true that some people will realize lower insurance premiums when a department lowers their rating, but some insurance providers do not even recognize the ISO rating system. Secondly, improving an ISO rating can take many years and may not be possible or feasible. ISO ratings depend greatly on available water supply and are not possible for many departments without millions of dollars of infrastructure improvements in rural areas of the county. Finally, ISO ratings are not necessarily an accurate evaluation of a department's preparedness. What is required in some communities that may be effective to provide fire suppression may not be recognized by ISO. Also note that ISO does not evaluate a department's capabilities to provide to provide rescue or medical first response services, which are as much a part of the fire service's mission today as fire suppression (The Paper, March 18, 2013).

During a meeting Commissioner Alva Martin commented in making improvements to a fire department’s ISO rating, “. . . Mayes County fire departments can do little things to improve their ISO rating. “You can improve your ISO rating just by keeping better paperwork, showing up at a fire with at least four people, and having mutual aid agreements with other departments . . . Fire departments have ISO ratings from 1 to 9, with 1 being the best. Only one fire department in Oklahoma has a "1" rating. Pryor Fire has the county's best ISO rating at 4. "You need to score 70 to be a "3" and our score was 69.19," said Fire Chief Tim Thompson, who said Pryor Fire is currently in the process of gathering data to make a run at the "3." Three county departments have a "5" rating, including Chouteau, Locust Grove, and Salina. Diamond Head, Cabin Creek, Chimney Rock, Osage and Strang have a "9" rating. (Strang has a 10 rating outside its corporate

limits, meaning those properties further than five miles from those limits have fire protection that does not meet the ISO's minimum criteria). Martin noted that Tiajuana, immediately east of Disney, has a "5" rating, as does Tri-County, which is located west of Osage" (The Paper March 18, 2013).

Further discussion on the Mayes County funding reallocation led to explanations of fire department incorporation and categorization. According to Commissioner Martin, "several of Mayes County's rural fire departments are Title XVIII. If they would [change] to Title XIX, their volunteers would be able to draw $125 per month retirement if they put in 20 years, and they would have a $5,000 death benefit…some of the county fire departments do not want to become Title XIX because the county commissioners would choose their board of directors and there would be more oversight and accountability. While a letter from Mayes County Firefighter's Association states it is harder to find volunteers, Martin said one fire department no longer has three excellent volunteers because they questioned the way money was being spent and they were removed" (The Paper, March 18, 2013). Commissioner Alva Martin discussed the funding cuts, and subsequent lawsuits brought against the county commissioners for changing the disbursements, "How long do you overlook wrongs before you step-up and 'pick on them' in their words," asked Commissioner Alva Martin, "All we are doing is protecting the people's money, which is what we were elected for, and what I intend to do," said Commissioner Darrell Yoder. "A few bad apples put us into a position of having to do what we did." According to Commissioner Yoder, "I'd like to see all of those fire departments have an audit going back seven years to prove they're clean," said Yoder, who said he would be willing to return to equal distribution if fire departments would have audits done and convert to Title 19 departments subject to annual audits of funds. Prove to me that the tax dollars are being properly spent."

Yoder said the redistribution of funds is not killing smaller fire departments. “We’re not squeezing them down where they can’t operate,” said Yoder. “The $3,000 monthly that everybody gets is enough to make payments on equipment and pay for gasoline to run their equipment” (The Paper April 29, 2013).

Mayes County is not the only entity discussing changes to county sales-tax funding, “…A proposal by the Delaware County Commission to harness fire department funds for county-wide use was met with mixed results after a meeting last week between the commission and representatives from area fire departments . . . " "At the end of the year, the calendar year, which is the middle of our fiscal year, there are funds that will come up short and need to be paid. We make intra-fund transfers to cover those particular accounts . . ." "All elected (county) officials have agreed that we will participate in that. What we were asking the fire departments to consider was a being a part of that pool . . . Sanders said if funds were used by the commission, county officials be required to reimburse the fire departments by the end of the fiscal year . . . The state says before the end of the fiscal year, so it would have to paid back by the end of June . . . We've never taken that long to pay it back. Once the tax money starts coming in December, we start paying those funds back . . . Several chiefs, including Grove Fire Chief Mike Reed, expressed reservations about using a sales tax, which voters approved for county fire departments, for something other than its intended purpose . . . The fund in question, are provided to the various county fire departments through a four-tenths of a percent sales tax, approved by voters in 2001 . . . The proceeds of the tax, which are collected by county officials, are divided equally among county fire departments in allotments . . . Hickory Grove Fire Chief Billy Moore said his department uses the funds, primarily, to keep equipment up to date . . . In many cases, according to Reed, much of the money is already accounted for, in the various

budgets . . . The majority, 80 to 85 percent, of the money we receive annually actually goes for equipment payments," Reed said. "I have very little left over after our annual equipment payments of the (appropriated) tax money . . . In other cases. some chiefs said, the funds are being saved by department officials, in order to purchase additional equipment, or new equipment . . . We are saving up money to be able to buy more than just three sets of gear," Jay Fire Chief Brandon Alexander said. "We need approximately $10,000 to buy more than three sets of gear. We are keeping our money pretty well spent just to maintain and keep our stuff updated." (Collums, Zach. 2017).

The fire chiefs were asked to explain the political environment in their community, how decisions are made, and any pressures that are exerted. Chief Spears mentioned an industrial park in his district, ". . . because of the . . . bargaining they've done, or that they've done at the state level, in reference to permitting that nobody's really looking at anything that's being built out there . . . I don't think they're intentionally trying to build anything that does not meet code, but there's nobody looking at anything, and that's kind of a no-man's land out there of any enforcement when it comes to issues like that; which can really hinder us in reference to the safety of what we're trying to do."

Chapter V

Summary/Recommendations

This study examines the impact of community capitals on rural fire department chemical disaster preparedness in Northeast Oklahoma from the perspective of fire chiefs. Nationally, chemical use and regulatory changes have resulted in increased chemical production and shipments through the four most Northeast counties in Oklahoma. According to the National Fire Protection Association *Fire Department Calls* (NFPA 2016a) incidents involving hazardous chemicals have increased by 388 percent since recordkeeping began in 1986. Rural communities with sparse populations experience problems with inadequate human capital, limited financial resources and equipment, average education levels lower than their urban counterparts, and cultural and political disagreement about chemical risk and policy. As shown in chapter 4, 72.41 percent of participating fire chiefs perceived that their departments were less-or-moderately prepared to respond to a chemical disaster. However, several fire chiefs indicated that their mutual aid neighbors had increasingly prevalent chemical and industrial plants in their districts that posed a risk if they responded for aid.

Natural Capital

With an abundance of annual rainfall, majestic waterways and lush flora, people refer to Northeast Oklahoma as *Green Country*. The natural environment provides significant financial and cultural capital through tourism, agribusiness, mineral mining, water sales, and community identity. There is intrinsic value associated with spending time in outdoor pursuits, including

reduced stress and increased feelings of calm and serenity. People value natural Capital when they perceive it as undamaged, and tend to migrate toward it.

The natural environment is fragile, however, and susceptible to a chemical disaster. Literature supports that chemical disasters result in decreased social capital, due to mistrust and in-fighting, decreased human capital when residents move out, reduced financial capital when property is viewed as a damaged good, and cultural capital damage when families are forced to move off ancestral homesteads.

Even though the perceived risk from chemical hazards varied, all of the participants agreed that the impact of a chemical disaster to natural capital would be "catastrophic" or a "big hit" to the economy and potable, industrial, and agricultural water supplies of Northeast Oklahoma. This perceived vulnerability of natural capital to a chemical disaster resulted in increased chemical risk perception by fire chiefs; and ultimately could increase support for preparedness planning in fire departments.

Built Capital

Built capital includes the physical structures and assets that support life and community growth, and consists of roads and bridges, public buildings and equipment, utilities, and other public projects that affect the community. As mentioned earlier, Flora and Flora (2008) discuss the Bethel, Maryland fire department providing fire protection service to surrounding communities. The increase in services from an extra-community source provided cost savings from reduced capital outlay, and allowed communities to concentrate on other needs deemed a priority. Data supports that the fire departments in this study did not possess abundant financial resources, but they found ways in which to build fire stations, to acquire equipment, and to utilize those assets to increase services provided to the community.

The utility infrastructure in Northeast Oklahoma is sound. Local power generation and updated transmission and distribution lines have led to few outages during inclement weather and adverse conditions. Water supplies are abundant and maintained by rural water districts and the Mid America Industrial Park, among other sources. Natural gas, gasoline, and diesel fuel stocks are in good supply and regional production ensures a rapid return-to-service during a disaster. Communications infrastructure is important, and increasingly so for younger generations, who may choose to live in urban areas that have better broadband internet services and communication line redundancy. Reliable utilities help attract business and human capital to communities. If a community has consistent power outages, few gas stations, internet limitations, and other difficulties, residents will be less satisfied, and could potentially move out. In Northeast Oklahoma, data supports that initiatives and service provision has improved in the field of communication. Preparedness planning for natural disasters has led to increased resilience, redundancy including generators, and other resources that provide support of daily life activities.

The Oklahoma Department of Transportation report on roads and bridges identified several areas needing improvement. While this would not appear on face value to affect preparedness-planning, road and bridge condition improvements increase the quality of life, allow companies to transport goods to market, and attract potential community members. This could ultimately increase human and financial capitals with which to conduct planning or conduct preparedness activities.

Financial Capital

There are many forms of financial capital that fire departments use to support their activities, including taxation, grants, fund raising, utility sales, donations, and other revenue

streams. Rural communities have fewer resources than their urban counterparts. Many fire chiefs said that their departments originally received donations of land and equipment, had fundraisers, and sometimes memberships. One of the emergent themes indicated that fire departments have more funding opportunities than they have historically had. One chief said that because of the sales tax revenue, his firefighters had to spend less time fund raising. Literature lends that within Northeast Oklahoma there are numerous grants and financial incentives to improve infrastructure and attract new economic opportunities. Recent funding opportunities have provided sales tax revenues, memberships incentivized through the insurance industry providing funds, and publicized donations from private sources encourage giving. None of the participants said they had excess funding, but few said they were unable to meet their normal obligations.

Several fire departments indicated they conduct fundraisers to add revenue. These events have intrinsic value outside of financial capital development. Fire chiefs revealed that during their fundraisers, they have activities to involve community members, young children who might one-day volunteer, to build social capital, and to show residents how their money is spent.

Fire departments appear to have found ways to meet their financial obligations. Data reveals that fire departments have improved fire station plumbing, built additions to the structure, and have assembled and maintained new fire apparatus using fire department personnel to limit expenditures. These departments also have purchased used and have repurposed apparatus to fill a need, rather than spend additional funds for new or specialized equipment. However, there was very little evidence of funding dedicated to hazardous materials response equipment or preparedness. Data lent that local fire departments possessed thermal imaging cameras, firefighting foam, cat litter for spills, extended use breathing apparatus, booms and pads, and some soaps or decontamination agents. All of these resources have multiple uses within a fire

department's variety of responses (firefighting, motor vehicle accidents, etc.). However, few fire departments possess extensive chemical response assets. According to the literature, state and federal agencies usually possess these assets, and they are unavailable to local departments during the initial response phase of a chemical release or disaster event. Literature also supports, that when local departments possess these assets, responders often do not have the necessary training to use them. The *Third Needs Assessment of the U.S. Fire Service: Oklahoma* by the NFPA (2010) revealed that fire department equipment was lacking, and local fire departments could not adequately respond to a hazardous material release with 10 or more injuries. Literature revealed that residents expect trained and equipped local responders that can assist them during a disaster or emergency. Several fire chiefs said that they did not have suits or other equipment to respond to a chemical release, and that they would wait for the Oklahoma Regional Response System; specifically mentioning the unit out of Claremore, Oklahoma.

Financial capital supporting hazardous materials preparedness and response equipment was prevalent following the destruction of the World Trade Center on September 11, 2001. However, since that time, grants and controlling agencies have reduced funding to better prepare for chemical disasters.

Fire chiefs perceived their role in disaster response and preparedness as being a provider of information. The financial capital required for provision of education and chemical information is minimal compared to purchasing a fire prevention trailer or training trailer; which many participants have acquired. While multiple departments have purchased training trailers in the study area, no participants mentioned utilizing financial capital in support of chemical disaster preparedness outreach.

Fire department funding was problematic, but data revealed that fire chiefs had adequate funds to meet the needs of their departments. The amount and means by which fire departments gained revenue differed, especially with the type of department (paid, combination, volunteer, Title 18, Title 19).

Sharing of common resources

Data revealed that few departments purchased or procured equipment specifically for use in hazardous materials preparedness and response. Fire chiefs viewed this equipment as being very expensive and infrequently needed, based on local history. However, funding exists for other response types (medical, water rescue, high-angle rope rescue, wildland search, etc.) by local departments. A U.S.F.A. publication *Critical Health and Safety Issues in the Volunteer Fire Service* (U.S.F.A. 2016) discusses funding and equipment limitations, and recommends fire districts consider consolidation between departments. Consolidation offers opportunities to share specialized equipment, improve ISO ratings, and improving training and response planning. One fire chief mentioned that he expected formation of a countywide hazardous materials team in the future. By consolidating funds and personnel, fire departments can efficiently staff and train a hazardous materials team with limited financial, human, and political capital. However, consolidation of equipment and personnel could be negatively impact fire department volunteerism if stations or departments close, experience a loss of identity, or a decrease in the motivation behind branding (Patterson 2009).

Policy changes in Mayes County caused financial capital to increase for some departments, and decrease for some, but the funds have returned to previous levels, and the departments appear to have coped with the changes. In *Retention and Recruitment for the Volunteer Emergency Services* (U.S. DHS 2007), the idea of provision of extra fee-based

services is discussed. Most fire departments bill either the homeowner or their insurance company for costs related to a response. If a fire department were to provide "board-up" services, restoration services, and other means of taking care of a community resident, there may be a means by which the department could legitimately increase their revenue.

Data revealed that county elected officials distrusted some fire departments due to a lack of transparency, and recent financial problems including embezzlement, and questionable spending practices. According to an article in Firehouse Magazine (Jenaway 2015), "It is important to you and the organization to take the necessary steps to eliminate the opportunity, means and motive for members to even want to commit a financial wrong against the organization." The author recommends a series of checks and balances to include audits for transparency, use of dual signature checks or other means by which expenditures require two reviews, emphasizes maintaining financial insurance (that protects the organization against loss due to embezzlement and theft, fraud, etc.), development of policies guiding conflict of interest, educating members about whistleblower protections, and proper maintenance and disposition of records.

Changes to fire department organizational structures to include a designated treasurer, and administrative officers who are responsible for the day-to-day organizational operations (not related to emergency response) can provide resources to meet the needs of the agency and associated boards of directors. While staffing is limited, establishment of these administrative positions is easy, and can provide opportunities to firefighters to learn about positions within the department, bolster morale and engagement through serving in a post, and to reduce the workload of a few officers who complete all tasks. Examples of fire department organization includes establishing engine, truck, rescue companies with operational positions (chiefs,

captains, lieutenants, etc.) as well as administrative positions (president, vice president, treasurers) who are not serving in both roles. While these groups work together to purchase equipment, maintain a budget, conduct activities, a parallel chain-of-command for operations and administration helps to accomplish organizational goals and while reducing the workload, and adding financial and organizational transparency. Positions of authority and financial responsibility should not be held by members of the same family, in other words, two brothers holding the position of president and treasurer at the same time (Jenaway 2015).

Human Capital

Staffing

Human capital is dynamic, residents often move within or out of a community based on multiple factors. Attracting and retaining young volunteer firefighters is growing more difficult, and as older firefighters do more firefighting activities, the potential for medical issues related to response increases. The number and variety of fire department responses is growing, causing stress to a limited fire department staff. Societal and community changes have resulted in less flexibility at work, fewer community linkages, and increasing competition from other volunteer organizations for increasingly limited free time.

Staffing is a serious concern for Oklahoma volunteer fire departments, but some help may be on the way. According to a press release from the Oklahoma State Firefighter's Association, FEMA awarded a grant to the OSFA $2.1 million for implementation of a statewide volunteer recruitment and retention program (OSFA 2016). The U.S. Fire Administration has developed resources to help volunteer fire departments recruit and retain firefighters, as well as The National Volunteer Firefighter Council (*Make Me a Firefighter – Department Video* 2015) to focus on the Millennial Generation.

Staffing problems are not limited to volunteer fire departments. Paid and combination departments have human capital limitations such as paid and sick time, unknown volunteer response during a call-back, and the need to utilize mutual aid systems to ensure adequate resources during an emergency.

The number of fire department responses is growing, and is increasingly sapping the motivation of volunteers, as well as decreasing funds, and causing equipment age faster. Fire departments can use several different solutions to improve staffing utilizing current membership. While overall staffing and numbers of apparatus may prohibit creating divisions within a fire department, establishment of companies (engine, truck, rescue, etc.) allows delegation of responsibilities related to the equipment like maintenance and inspections, and it increases pride and healthy competition among these groups. Creation of divisions within a fire department appeals to millennials' need for social interaction and team building and provides *micro-branding*, a way in which to appeal to the general need for individualism; they can have the honor of belonging to "Engine Company 2." Fire departments can expand identity branding by using tee shirts, helmet shields, and subpages within the fire department website.

Duty Shifts

One issue identified in the data was the increasing number of fire department responses, specifically due to medical calls. By specifically requiring firefighters to sign-up for a duty shift or being on-call, a two-person response to medical emergencies can reduce the number of other firefighters required, and ensure personnel are available in-district. This also allows a department to coordinate on-call personnel to ensure the availability of medical personnel during the shift. In addition to signing up for duty shifts, departments can utilize different paging tones so that firefighters who are not on-call or who do not want to respond to medical calls are not paged-out.

By utilizing separate paging tones, fewer firefighters are required for a general response, keeping others motivated and fresh for additional calls.

Alternate Service Billing

Data revealed that fire chiefs are in support of selectively screening calls to reduce non-emergency responses (sick calls, assists, etc.), but literature and data revealed community expectations of fire departments responding to calls of various nature. Fire departments should consider billing for certain responses (problematic alarm activations, non-emergency medical responses, etc.) that may result in reduced community expectations or additional funding to support these responses.

Bunk-in Programs

To increase the number of available firefighters and better prepare responders, fire departments should consider bunk-in programs. Several articles provide alternative methods to increase staffing, including allowing firefighters to "bunk-in" at fire stations while they volunteer (Steed 2013). With this type of program, fire departments can decrease response times, provide additional on-the-job training opportunities, and decrease the amount of time volunteers dedicate to equipment checks, maintenance, and other projects (Steed 2013). However, allowing firefighters living in a station can create complicated issues such as gender inclusion, use of fire department facilities, interpersonal complications, and other issues that fire departments have to resolve. Chief Key of the Chouteau Fire Department implemented a program similar to a bunk-in program, which developed problems. According to Chief Key, quoted by The Times (5/19/2013), when the volunteers began to stay at the fire station during the night, the City Board said that they should volunteer during the day as well, and this caused the interest in staying at the station overnight to cease.

Paying firefighters

The U.S.F.A. document *Critical Health and Safety Issues in the Volunteer Fire Service* offers some possible solutions to funding, to include transitioning to a combination department with partial-paid firefighters to decrease response times, provide consistent staffing resources, improve ISO scores, and decrease pressure on volunteers who have limited leisure time (U.S.F.A. 2016).

Some training opportunities exist that provide a large amount of training over a moderate time (like attending an academy). While this often takes firefighters away from their family or job, they can achieve certification in a short time. Fire departments should consider holding academies and paying firefighters while they attend. This allows firefighters to be better trained in a shorter time, is less expensive than hiring paid firefighters, and can quickly bolster the availability of trained personnel; as opposed to a multi-year break-in period and extended time spent certifying new firefighters (Pillsworth 2007).

Medical Health of Firefighters

The U.S.F.A. document *Retention and Recruitment for the Volunteer Emergency Services* (U.S. DHS 2007) and one of the participants agrees that there are inherent risks with fire department response. These risks include health and wellness related to emergencies, specifically with cardiac-related conditions. Fire departments should consider providing medical evaluations and services to their members to help the attractiveness of joining. These services include annual physicals to determine fitness for duty and to identify potential health concerns before they become catastrophic, offering coverage for medical treatment, as well as death and dismemberment benefits (U.S. DHS 2007).

Time

Rural fire departments in the study area reflected a diversity of types, although the majority (83.4 percent) of departments were volunteer. A salient finding from the data was that the time required of volunteers is increasing. The perception is that the lifestyles people live today (versus in the past) inhibits time to be able to volunteer. Volunteer activities (disposable leisure time) are in direct competition with familial commitments and competition from other volunteer organizations (civic groups and religious organizations). Volunteer firefighters spend their decreasing leisure time on longer training courses, for improving built capital, and maintaining equipment, leading to reduced human capital available to conduct outreach and preparedness planning.

While firefighter time is limited and focused on training and preparing for response, departments still find time to conduct outreach and preparedness activities. Data revealed that departments conduct various outreach and preparedness activities (smoke detector installations, chimney cleaning, helping with dead batteries on scooters, filling swimming pools, helping move furniture, sweeping off walkways, moving propane tanks for homeowners during power outages, fetching groceries and medications during inclement weather, stand-by for sporting events, school education programs for learning not to burn and crawling low in smoke, Halloween trunk-or-treat activities to provide safe alternatives for kids, and other activities as time allows). Fire chiefs perceive that the community expects them to educate about local chemical hazards and proper response actions to take during a chemical release. If responding to a chemical disaster, fire departments perceive that their role includes diking, damming, and diverting contaminants if possible, evacuating, and then waiting for the regional response unit. However, not one participant mentioned that they conduct any chemical disaster preparedness activities. The

process of educating the community on chemical preparedness and familial actions in response to a chemical disaster takes time, education, training, and little financial capital. Fire chiefs acknowledged that the potential is present within their communities, and that the impact would be severe; however, they are the decision makers who have to change preparedness activities and training priorities for their agency.

Dynamic Knowledge, Skills, and Abilities

A firefighter's knowledge, skills, and abilities are dynamic with staffing turnover. Older or more tenured firefighters share information with younger or less experienced personnel. However, as one participant pointed out, sometimes the younger firefighters move out of the community to become paid firefighters, and the process begins again.

Extrinsic Skillsets

Volunteer firefighters usually have a job outside of the department, or they are retired from one, in which they have skills outside of the field of firefighting. However, as some articles point out, volunteer firefighters sometimes receive compensation from fighting fires as part of another department in which they serve. Even so, paid firefighters often have skills and abilities learned or practiced on a job on their days off. These extrinsic skillsets often provide additional capabilities within the fire department, or resources. An example given in the interviews was of a diesel mechanic or carpenter; both have extrinsic skillsets that are beneficial in response and maintenance activities of a fire department.

Education & Training

Changes in training standards have resulted in longer classes and additional practical testing. These increased standards have caused stress to human capital and an inability to meet expectations. Training for hazardous materials responses was identified as a vulnerability in

many of the fire departments. The time required to become a hazardous materials technician (80 hours) was difficult to schedule, and even the paid fire departments were unable to cope with losing a firefighter for two weeks. Another problem identified in the data was that hazmat technicians could not stay in practice due to a lack of a dedicated response unit or organized team. Several fire chiefs noted that their training priority was based on likelihood of an incident occurring or community history; which was low for the majority of participants.

Volunteer firefighters have limited time with which to train, respond, and conduct fire department activities. Training takes a lot of time for new firefighters. According to one source, in order to achieve basic firefighting proficiency, it may take a new volunteer up to one year. Not all firefighters achieve Firefighter 1 certification, and contained within this certification is hazardous materials training. For those without this certification, hazardous materials knowledge and proficiency varies greatly. Participants in this study ranked their department's training priorities, and in last place out of 13 categories was hazardous materials and chemical sampling. Several chiefs (and supported by literature) indicated that they prioritized training based on events they experienced on a regular basis. According to *Critical Health and Safety Issues in the Volunteer Fire Service* (U.S.F.A. 2016), there are several ways in which to combat time constraints, including online or blended learning, offering flexible training via modules or other methods to fit into restrictive schedules.

According to *Retention and Recruitment for the Volunteer Emergency Services* (U.S. DHS 2007), training should be offered during times and at locations convenient to the firefighters, and in modules where multiple needs are met with single sessions. In addition to these ideas, the U.S.F.A. recommends utilizing innovative training opportunities to engage and build comradery among firefighters and departments. As mentioned in this conclusion section,

participation in competitions like field days and combat challenges helps to create training opportunities for participants. Although this would add to the time spent by volunteers, there is great intrinsic value in practicing skills and peer learning from seasoned veterans. Fire departments should also consider paying for "get-away" weekends for firefighters' families to travel and go out while the firefighter trains, or full reimbursement of costs related to training in order lessen the burden to personnel and their families (U.S. DHS 2007).

As part of a new firefighter orientation, fire departments should identify training goals and progression within the fire department. A formal training plan or "roadmap" for members to is critical to meet goals and improve retention (U.S. DHS 2007). As mentioned in chapter 3, data reveals the dynamic nature of firefighter training and evolution, and it is crucial to provide opportunities for veterans to share lessons learned with younger or less experienced firefighters. A formal mentorship program where veteran firefighters follow a plan and help train younger and less experienced members can provide these opportunities. This type of program motivates members of the millennial generation through providing coaching and trust building opportunities.

Rewards and Recognition

Fire departments should consider rewarding firefighters to increase retention (U.S. DHS 2007). Forms of recognition vary, but can include awards banquets, publications and media recognition, thank you cards for their family. A key factor in reward and recognition programs is to involve the volunteer's family. There is a struggle between volunteer organizations and firefighter's families when competing for limited leisure time of firefighters. Data reveals that several fire departments had means to reward firefighters, including recognition dinners,

department shirts, adding per diem funds to training, and supporting their interests during outreach activities.

Literature and emergent themes support community pride in their local fire department. County and regional firefighter's field days, the firefighter combat challenge, and other events are not a new idea, and have built comradery, improved skills, and increased community support in other parts of the country. Local venues can hold these events, providing opportunities for combined fund raising efforts, allows for recognition of performance, and increases teamwork. These competitions often include games such as pushball, wood chops, hose-stream target practice, race-to-the-ladder-top, Pompier ladder climbs, hydrant operations, and bucket brigade competitions that tip water over on opponents blend fun with teamwork to accomplish goals. Other attractions such as live bands, rides, chili and barbecue cook-offs, and parades offer opportunities to firefighters and their families. These competitions cause teams to practice and further develop skills, build trust, and foster social linkages. Publishing results on social media outlets, and awarding trophies and publicly acknowledging performance bolsters attractiveness of volunteering opportunities; especially for the millennial generation.

Social Capital

Social capital is what drives volunteerism, provides the linkages and strength of bonds with the community. Within rural communities, data supports that social capital is strong, and networks and linkages are well established. Rural fire departments are socially accepted and supported within communities. Reliance on other rural and municipal departments helps build *esprit de corps* and social bonds within the fire service. Since rural communities are often geographically isolated, there is a need for strong networks and linkages.

There are multiple motivations driving volunteerism. In the participating communities there appeared to be a strong sense of volunteerism, duty, and community respect of the department. Data lent that the "heart" of a volunteer firefighter was intrinsic and caused them to get up in the middle of the night; and that has not changed. Fire chiefs also consistently mentioned appreciation for the families of volunteers who support their loved ones' pursuit to train and improve, to be a part of something bigger; so they can make a difference. However, literature indicates that volunteerism in rural fire departments is decreasing. There is a belief that the millennial generation is different, lagging other generations in volunteerism, but data reveals that this may not be true for the fire service. According to Thompson III (1993), a study of a volunteer fire company in Ulster County, NY revealed that their primary recruitment age group of 18-24 year olds had been decreasing for several decades.

All of the fire chiefs said their community stood behind them, and supported their efforts. Some of the departments mentioned examples of community members bringing water or food out to a scene, or the unique support when trying to raise funds; "we sell a lot of 250 dollar pies." When human capital is running low, as in a response during the daytime, local social capital has compensated through mutual aid compacts with extra-community resources.

Literature indicates that millennial volunteerism is increasing in the United States, incentivized by the U.S. Government, and socially desirable for that generation. However, surveys by the National Fire Protection Association, and substantiated by emergent data from this study, indicate that volunteerism in the fire service is decreasing. Researchers should examine the rationale behind the lack of volunteerism by millennials in the fire service. One author (Shkuro 2011) studied millennial generation volunteerism, and lent that volunteer opportunities had to satisfy at least the first two levels of Maslow's Hierarchy of Needs. The

Hierarchy includes meeting physiological (food, clothing, shelter, etc.), safety and security, social, and personal needs before trying to fulfill a need for personal growth (self-actualization). Fire chiefs acknowledged that some of their members struggled financially, experienced stress on their family life from fire department activities, and had other competing priorities for limited leisure time. In order to improve volunteerism in the fire service, it is critical that fire departments provide means by which to support their staff needs.

Fire departments should consider increasing the visibility of their organization, utilizing linkages and networks to bolster community support. This can be accomplished through creating a marketing strategy, utilizing multiple social media outlets, keeping a well-developed website, and using traditional means to publicizing events and engage the community. Use of social media and ensuring agency branding will increase the attractiveness of the organization to millennials. To increase the attractiveness of volunteering to millennials fire departments should also consider providing individual praise and recognition using the social media outlets.

Cultural Capital

Risk Perception

Belief structures, learned behavior, values, and morals create cultural capital. Literature supports the strength of cultural capital in rural communities. Varying beliefs, priorities, and value systems cause disagreement between risks and perceived benefits of chemicals. Communities who support chemical plants, and environmental activists who oppose this industry, view risk through two vastly different lenses. Literature reveals that chemical plants seek rural locations due to a lack of public resistance, financial incentives, and ease of complying with environmental rules. The chemical industry supports economic growth, and tends to be dismissive of chemical hazard concerns. Community advocates against chemical use realize, that

while many communities benefit from chemical companies, they also bring with them increased chemical use and the potential for releases. While there will be no consensus on chemical risk and benefits, data reveals that communities general support preparedness activities. However, literature reveals that chemical disaster preparedness is not a priority, and planners usually base it on previous history, and the likelihood of occurrence.

In Northeast Oklahoma, there is a chronic risk of inclement weather, and several examples of shelters to resist winds. As well, data supported a variety of outreach and preparedness activities highly publicized in the fire service such as learn-not-to-burn, crawl low in smoke, and smoke detector installation programs. Actions taken by the public to resist, or withstand natural disasters or to provide outreach to educate younger residents, indicates the public willingness to plan or prepare for disasters to which they assign risk.

Data revealed that, even though perceived risk from hazards varies, fire chiefs acknowledge the potential risk chemicals posed to their community. The perceived risk of fire chiefs is slight risk (37.93 percent), moderate risk (34.48 percent), elevated risk (17.24 percent), and extreme risk (10.34 percent). Several chiefs indicated that impact of a chemical disaster to the environment and their community would be catastrophic, but the frequency of occurrence would be low; all of the fire chiefs said there was some likelihood of a chemical disaster occurring in their community.

Literature lends that risk perception varies commensurate with cultural beliefs and agenda. In order to overcome resistance to planning from the political and financial sectors due to support for chemical plants, revenues, jobs, and planning shining a negative light on industry, advocacy and careful planning must be done.

Chemical companies often publicize corporate environmental stewardship efforts. Careful efforts to work with elected officials and chemical companies can foster a positive atmosphere and a transparent planning process. Literature shows that when preparedness is required, as in the nuclear power industry, that it can result in a planning process that is socially normal and anticipated. Fire departments should consider publicizing chemical preparedness planning, and the need for volunteers, to attract millennials and satisfy their need to be a part of something bigger, as well as to foster their interest in environmental protection. Literature supports the effectiveness of local school systems in providing information to parents and the community. The local school system should be utilized to disseminate preparedness information and for discussion of familial planning.

Nature and Number of Calls

Data indicates that the number and the variety of fire department responses is increasing. Fire chiefs agreed that they respond to more calls now, than they have historically. Literature lends that the roles and public expectations of fire departments are expanding from traditional firefighting duties. At a meeting of the Mayes County Firefighter's Association, The Times (02/18/2016) recorded firefighters who were disgruntled at the way in which the control center dispatches them. Firefighters discussed how dispatchers could prioritize calls to prevent them from running on so many. Firefighters aimed their displeasure at dispatchers for sending them to the calls, rather than the community expectations that caused them to call 9-1-1 to begin with. Studies reveal that medical responses, as an example, that would not have required an ambulance trip in years past now receive an ambulance and fire personnel. The natural of the medical responses has changed as well, to include public assistance calls, sick calls, and post-surgical bleeding, and other responses that may not require emergency transport.

Fire chiefs perceive that the community expects them to be proficient in all areas and for services in rural departments to mimic those of urban departments. Communities expect fire departments to respond to situations due to specialized equipment and training they possess; almost regardless of their nature. During a response, fire departments conduct tasks outside of their normally accepted duties. This increases the burden and risk posed to human capital and increases the stress on limited financial capital. If these types of calls create discontent and firefighters lose their motivation to respond, there will also be a negative impact to volunteerism within social capital.

Fire chiefs perceive that during a hazardous materials release, the community expects them to provide information on proper response actions. The fire department's role is to provide chemical information, evacuation or shelter instructions, to act in a defensive manner to prevent chemical spills from getting worse, to assist evacuees, and provide contact telephone numbers for you to call to help get a spill cleaned up. Universally, fire departments mentioned that they were underprepared for a hazardous materials disaster, and there was a significant reliance on utilizing mutual aid.

Disaster Subculture

Communities with a chronic history of disasters can develop a subculture that increases response capabilities for future events. Rural communities are unprepared for chemical disasters, and recent increases in chemical production and transport rules have increased shipments, storage of chemicals, and risk posed to these rural areas. In addition, while a community may not be prepared in the traditional sense, a disaster subculture may provide some level of preparedness and capability to respond ad-hoc to disasters of any nature. Rural Northeast Oklahoma has developed a disaster subculture due to the number of disasters they have

experienced in the past 10 years. Recent disasters have bolstered fire departments skills useful in disaster response such as mass casualty, swift-water rescue, and search teams, which all require a regional response; and resulting in improves linkages and inter-departmental relationships.

Political Capital

Political capital is the ability to influence the expenditure of public resources through interacting with power brokers. Elected officials are often shortsighted, have vastly different agenda, and write policy that expands under public pressures and contracts when conditions allow. The U.S. has a long and extensive history of disaster preparedness planning and chemical regulations. Fire departments have traditionally implemented plans, and not taken part in plan development. Planning is a process, not a written document, and while written guidelines clarify roles and expectations, use and practice of plans and dissemination of information is critical to its success.

The history of environmental policy aimed to reduce the potential for chemical disasters, has resulted in numerous complicated and sometimes redundant policies. National policies affect local response, but due to their complication, many fire departments fail to understand their impact, and do not have the resources with which to meet their intent.

Local political capital should focus on supporting fire departments; providing consistent guidance, and services, that ultimately reflect improved services to the communities they serve. Effective means of communication and engaging departments prior to implementing new local policy can preempt difficulties that can inhibit a department's ability to provide emergency response services.

It is clear that local fire departments need to clarify their missions, needs, and abilities to local politicians. It is the duty of these departments (as public agencies) to be transparent in their

budgeting and purchasing, and their future direction, in providing services to the communities they protect. Fire departments need to engage elected officials to provide training, include them in public unveiling events, and to help build rapport and linkages to incentivize volunteerism in their communities (U.S. DHS 2007). Fire department officers have a responsibility to educate politicians on the services they provide and the benefits a volunteer organization provides their constituency.

Political changes and inconsistent guidance and priorities cause pressure on fire departments for strategic planning, standard guidelines, staffing, and other programs. It is critical for fire department leadership to foster a positive relationship with public officials to ensure they effectively serve the needs of their constituents (U.S. DHS 2007). One of the issues identified in this study includes the distrust between Mayes County Commissioners and fire chiefs. Fire departments need to ensure accountability of their agencies due to scrutiny from elected officials and the public (U.S. DHS 2007).

Horizontal versus Vertical Integration

A way in which to understand political interactions between governmental and non-governmental organizations is with the concept of horizontal and vertical integration (Smith 2015). This concept examines the relative strength of local communities and their ability to utilize local community support networks (horizontal) as well as extra-community (county, state, and federal; e.g. vertical) resources. A well-balanced and prepared community (Type 1) is one in which horizontal and vertical connections are strong, and recovery from the impact of a disaster is robust. Type 2 communities have strong horizontal connections, but weak vertical linkages. These types of communities have strong local ties and linkages, understand local needs and resources, but do not have strong vertical ties to state or federal resources, and may not

understand their capabilities in supporting their local recovery. In type 3 communities, strong reliance and established ties exist with state and federal support agencies, but local ties and knowledge of needs are lacking. In these types of communities, there is often a lack of recovery planning grounded in local needs. Type 4 communities have weak vertical and horizontal linkages, and have difficulty recovering from a disaster easily. Most of the communities in this study resembled a type 2 community; they had well-established local connections, and relied on the state resources for hazardous chemical response, but had little understanding of the capabilities or implications of a disaster on the use of vertical resources within their jurisdiction.

Chemical preparedness planning should incorporate ideals from the National Response Framework, utilizing the National Incident Management System (NIMS) for agency response organization, and incorporate components such as unified command in order to ensure smooth expansion of resources to include state and federal agencies. The National Response Framework provides assistance when expanding or contracting resources during a dynamic incident. By following the model of the National Response Framework, preparedness planning can effectively utilize vertical resources for response and local resources for preparedness education and planning. Local planning is necessary due to the knowledge and understanding of local needs, but may be limited in actual response capabilities. However, reliance on vertical linkages for response does not relieve local planners from conducting preparedness activities and becoming familiar with vertical resource capabilities in case local fire departments need them.

Community capital limitations in the rural fire service in Northeast Oklahoma have created obstacles to conducting preparedness planning for chemical disasters. Chapter 5 introduces several opportunities to overcome capital limitations, based on innovative ideas, previous research, and from evidence within the fire service. Fire chiefs have acknowledged that

the risk of a chemical disaster occurring in their communities is present. By increasing and fostering development of community capitals, concentrating on best practices, and through active community engagement chemical disaster preparedness planning can occur.

Future Research

Future research should focus on the impact of millennials on social capital and volunteerism in the fire service. Action research could provide solutions for researchers to engage millennials and to bolster their volunteerism; and utilize their extrinsic technological skillsets to benefit fire department capabilities. Scholars should examine the use of social media for chemical information, and response actions. Additionally, research should examine community chemical information searches, how information is gleaned, communicated, and the validity of sources of chemical information.

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APPENDIX A

Survey Questions

1. How is your agency funded? (check all that apply)

_____ Federal Grants

_____ State Grants

_____ Local/Private Grants

_____ Loans

_____ Resident or Corporate Memberships

_____ Fund Raisers

_____ Taxes

_____ Tribal sources

_____ Local Fire Fund

_____ Utility sales (price adjustment to support public services)

_____ Third-party billing (of insurance companies or home owners for costs related to response)

_____ Local Emergency Planning Committee (LEPC) funds

_____ Other (Please List) _____

2. What specialized equipment does your department have that would be of value during a hazardous chemical release? (check all that apply)

_____ Extended-use Self-Contained Breathing Apparatus (1 hour bottles)

_____ Chemical sampling meters or tubes

_____ Manual chemical identification tools (pH paper, identifying strips, etc.)

_____ Chemical modelling software

_____ Containment booms, pads, adsorbent pillows

_____ Cat litter (clays), moss, or other spill absorbent

_____ Chemical-resistant apparel

_____ Alcohol or chemical-resistant foam

_____ Soaps, biocides, or other decontamination products

_____ Unmanned drones

_____ Neutralizing agents

_____ Filtering respirator cartridges or chemical-resistant respirators

_____ Thermal imaging cameras

_____ Other (Please List) _____

3. What infrastructure/utilities are available in your community?

_____ Provider-supplied electricity

_____ Locally-generated power (community owned/provided)

_____ Natural gas

_____ Propane

_____ Gasoline/Diesel filling station

_____ Potable water

_____ Waste-water treatment

_____ High-speed Internet/DSL

_____ Internet less than 768 Kilobits per second

_____ Cellular service (adequate coverage and reception)

_____ Standard/traditional telephone line

_____ Cable television

_____ Over-the-air television antennae

_____ VHF two-way radio system

_____ UHF two-way radio system

_____ 800 Megahertz two-way radio system

_____ Community warning systems (tornado sirens, chemical alerts, reverse 911, etc.)

_____ Other (please specify) _____

4. What healthcare services are provide in your community.

_____ Hospital

_____ Urgent care

_____ Surgical center

_____ Ambulance located in your community

_____ Physician(s)

_____ Assisted living facility

_____ Nursing home

_____ Mental health clinic

_____ Childcare center

_____ Veteran's Administration healthcare center

_____ Tribal healthcare center

_____ Adult daycare

_____ Other (please specify) _____

5. What civic/religious organizations exist in your community?

_____ Church

_____ Lions Club

_____ Moose Club

_____ Elks Club

_____ Veteran's of Foreign Wars

_____ Masonic Lodge

_____ Rotary Club

_____ Odd Fellows

_____ Toast Masters

_____ American Legion

_____ Kiwanis

_____ Other (specify) _____

6. What disaster preparedness or chemical resources do you use for planning and response?

_____ Department of Transportation Emergency Response Guidebook

_____ National Institute of Occupational Safety and Health (NIOSH) Pocket Guide

_____ CAMEO Software

_____ Marplot Software

_____ Aloha Software

_____ Printed Tier II lists

_____ Chemical safety data sheets

_____ Comprehensive Preparedness Guide (CPG-101)

_____ Wireless Information System for Emergency Responders (WISER)

_____ Local or County-wide Emergency Response Plan

_____ Other (please specify) _____

7. Rank your department's training priorities (by order of importance)?

_____ Firefighting activities

_____ Motor vehicle accident activities (extrication, shoring, traffic control, etc.)

_____ Rescue (swift-water, confined space, trench, rope/high angle, structural collapse, etc.)

_____ Wildland search

_____ Medical response/patient treatment

_____ Emergency response safety (emergency vehicle operations)

_____ Fire department administration

_____ Executive & front-line fire officer development

_____ Fire prevention/investigation

_____ Hazardous materials/chemical sampling

_____ Fire service instructor

_____ Industrial emergency response

_____ National Incident Management System (NIMS)/Incident Command System (ICS)

_____ Other (Specify) _____

8. Other than emergency response, what role(s) does your agency have **before** a disaster?

_____ Emergency Planning

_____ Fire Prevention/outreach

_____ Code Enforcement

_____ Fire System Preventative Maintenance (hydrant flowing, testing, painting, pump tests, hose tests, etc.)

_____ Civic development/fund raisers (MDA fill-the-boot, etc.)

_____ Public service (pool filling, cellar pumping, etc.)

_____ Other (please specify) _____

9. Other than emergency response, what role(s) does your agency have **during** a disaster?

_____ Traffic control

_____ Sand bagging

_____ Street cleaning

_____ Evacuations

_____ Conveying warning messages

_____ Sheltering evacuees

_____ Providing Temporary power

_____ Other (please specify) _____

10. Identify any preparedness exercises or activities in which your agency has taken part over the past year.

_____ Tabletop exercises of our local Emergency Response Plans

_____ Exercises or drills using actual resources

_____ Mass decontamination exercises

_____ Dangers of drinking and driving activity with schools

_____ Local Emergency Planning Committee (LEPC) meetings

_____ Passing out disaster-related literature to schools or businesses

_____ Learn-not-to-burn/smoke detector battery checks or installations

_____ Carbon monoxide check campaigns

_____ Evacuation drills using schools, daycares, or invalid care facilities

_____ Addressing church congregations or civic groups regarding emergency preparedness

_____ Mutual aid drills or exercises with other agencies

_____ Other (please specify) _____

11. Do chemicals pose a risk to your community?

No Risk	Slight Risk	Moderate Risk	Elevated Risk	Extreme Risk
1	2	3	4	5

12. Does your community support preparedness activities?

Not at all	Slightly Supportive	Moderately Supportive	Supportive	Very Supportive
1	2	3	4	5

13. Should the government be responsible for preparedness?

No, each person and business should be responsible for their own preparedness	Preparedness is mostly the responsibility of Individuals with some government support	It is an equally shared responsibility	The government should be mostly responsible, with individuals doing some preparedness	Government should be responsible for all of our preparedness
1	2	3	4	5

14. How well does your department know and understand state and federal regulations guiding emergency management and hazardous chemical releases?

Not at all	We reference a few regulations, but do not understand them well	We understand some of the rules	We have read and understand most of the rules	We are very knowledgeable about all of the applicable rules
1	2	3	4	5

15. Rank your community's social cohesiveness (neighbors trusting and relying on neighbors for assistance)?

No social Cohesion, I do not trust my neighbors, I do not belong here	Little social cohesion or trust exists	I trust some of my neighbors and community members	Most of our community is close, and I feel comfortable, with few pockets of concern	Our community is very close and secure, I feel welcomed and comfortable here; **I belong here**
1	2	3	4	5

16. Is your agency prepared to respond to a chemical disaster?

Not at all	We are less prepared	We are moderately prepared	We are mostly prepared	We are extremely prepared
1	2	3	4	5

17. How well does your department know and understand your local emergency response plan?

Not at all	We understand very little about The plan	We have read the plan and understand some	We have read the plan and understand most of it	We have read and understand all of the plan
1	2	3	4	5

APPENDIX B

Interview Guide

1. How was your department formed, and how it has changed throughout its life?
2. What is it like belonging to a fire department in a rural community?
3. What are some of the challenges your department faces in achieving its mission?
4. What are some expectations your community has of your fire department?
5. How much of a risk do chemicals pose as the cause of a disaster in your community?
6. In what ways were you prepared for being a fire chief (training, expectations, mentoring, education, etc.)?
7. Explain how you prioritize using resources within your agency.
8. Put yourself in the position of a community member. What should the fire department do to help a community resident prepare or respond to a chemical release?
9. Describe the social networking within your community (bonds, feeling of security, support structures, volunteerism, civic activities, sense of community, etc.)
10. Define the staffing strengths and vulnerabilities that exist in your fire department.
    a. Knowledge, skills, and abilities of your firefighters
11. Characterize how disasters have impacted your community.
12. Explain the political environment in your community, how decisions are made, and any pressures exerted.
13. Describe how your natural environment impacts your community, and how it might be effected by a chemical disaster.

APPENDIX C

Project Title: **Conditions effecting rural fire department preparedness for chemical disasters in Northeast Oklahoma: A Case Study**

Investigators: Robert C. Scudder, M.Ed.

We are conducting a study to examine conditions affecting fire department chemical disaster preparedness in rural Northeast Oklahoma. Fire Chiefs can provide valuable insight into the environment in which fire departments operate. Understanding conditions that effect preparedness will help to evaluate support structures put in place to foster better planning for chemical disasters.

We expect the length of your participation to be 90 minutes. There will be no monetary compensation for participating in this study.

If you choose to participate, you will be asked to complete an online survey; participate in an interview that will be audio recorded for accuracy and transcription; review a typed interview transcript and edit for accuracy; answer follow-up questions; and voluntarily provide supporting documents.

Data gathered as part of this study will be kept by Robert Scudder in a secure location; it will only be used for research, instructional use, and possible peer-reviewed publication. All names and identities will be kept confidential; a code book linking identities to study participants will be kept by the researcher to prevent the information from being connected to participants. The participation consent and research process will be observed by staff responsible for safeguarding the rights and wellbeing of participants and to ensure the information follows rigorous research standards.

Data will be kept for at least three years following completion of the research; as prescribed by the HHS protection of human subjects regulations (45 CFR 46.115(b)). The participant information document and surveys indicating consent will be stored as required by the Oklahoma State University Graduate College. Data will be reported in narrative format with excerpts from data used as representative of findings.

We do not expect there to be any risks associated with participating in this study greater than those ordinarily encountered in daily life. Participation in this study is completely voluntary; you can cease participating at any time or refuse to answer questions without reprisal or penalty. You also have the right to ask for your data to be excluded from this study, and it will not be included with study findings. If risks are identified that could lead to participants dropping out, these risks will be communicated to the subjects immediately to ensure they are still willing to participate.

Contacts:

Researcher	*Oklahoma State IRB Chairperson*	*Research Chairperson*
Robert C. Scudder 111 Sundance Pryor, OK 74361 (918) 803-6499 robert.scudder@okstate.edu	Dr. Hugh Crethar IRB Chair 223 Scott Hall Stillwater, OK 74078 (405) 744-6756 irb@okstate.edu	Dr. Duane Gill Oklahoma State University 413B Murray Hall Stillwater, OK 74078-4062 (405) 744-6104 duane.gill@okstate.edu

APPENDIX D

INSTITUTIONAL REVIEW BOARD DOCUMENTATION

Oklahoma State University Institutional Review Board

Date:	Friday, October 09, 2015
IRB Application No	GC1514
Proposal Title:	Conditions effecting rural department preparedness for chemical disasters in northeast Oklahoma: A case study
Reviewed and Processed as:	Exempt

Status Recommended by Reviewer(s): Approved Protocol Expires: 10/8/2018

Principal Investigator(s):

Robert Scudder
Stillwater, OK 74078

Duane A. Gill
431 Murray
Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1.Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval. Protocol modifications requiring approval may include changes to the title, PI advisor, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms
2.Submit a request for continuation if the study extends beyond the approval period. This continuation must receive IRB review and approval before the research can continue.
3.Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of the research; and
4.Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Dawnett Watkins 219 Scott Hall (phone: 405-744-5700, dawnett.watkins@okstate.edu).

Sincerely,

Hugh Crethar, Chair
Institutional Review Board

APPENDIX C

Project Title: **Conditions effecting rural fire department preparedness for chemical disasters in Northeast Oklahoma: A Case Study**

Investigators: Robert C. Scudder, M.Ed.

We are conducting a study to examine conditions affecting fire department chemical disaster preparedness in rural Northeast Oklahoma. Fire Chiefs can provide valuable insight into the environment in which fire departments operate. Understanding conditions that effect preparedness will help to evaluate support structures put in place to foster better planning for chemical disasters.

We expect the length of your participation to be 90 minutes. There will be no monetary compensation for participating in this study.

If you choose to participate, you will be asked to complete an online survey; participate in an interview that will be audio recorded for accuracy and transcription; review a typed interview transcript and edit for accuracy; answer follow-up questions; and voluntarily provide supporting documents.

Data gathered as part of this study will be kept by Robert Scudder in a secure location; it will only be used for research, instructional use, and possible peer-reviewed publication. All names and identities will be kept confidential; a code book linking identities to study participants will be kept by the researcher to prevent the information from being connected to participants. The participation consent and research process will be observed by staff responsible for safeguarding the rights and wellbeing of participants and to ensure the information follows rigorous research standards.

Data will be kept for at least three years following completion of the research; as prescribed by the HHS protection of human subjects regulations (45 CFR 46.115(b)). The participant informed consent documents will be stored as

Removed anonymous Language

required by the Oklahoma State University Graduate College. Data will be reported in narrative format with excerpts from data used as representative of findings.

We do not expect there to be any risks associated with participating in this study greater than those ordinarily encountered in daily life. Participation in this study is completely voluntary; you can cease participating at any time or refuse to answer questions without reprisal or penalty. You also have the right to ask for your data to be excluded from this study, and it will not be included with study findings. If risks are identified that could lead to participants dropping out, these risks will be communicated to the subjects immediately to ensure they are still willing to participate.

Contacts:

Researcher	*Oklahoma State IRB Chairperson*	*Research Chairperson*
Robert C. Scudder 111 Sundance Pryor, OK 74361 (918) 803-6499 robert.scudder@okstate.edu	Dr. Hugh Crethar IRB Chair 223 Scott Hall Stillwater, OK 74078 (405) 744-6756 irb@okstate.edu	Dr. Duane Gill Oklahoma State University 413B Murray Hall Stillwater, OK 74078-4062 (405) 744-6104 duane.gill@okstate.edu

I have read and fully understand the consent form. I sign it freely and voluntarily. A copy of this form has been given to me.

_____ _____

Signature of Participant Date

_____ _____

Signature of Researcher Date

September 2, 2015

(Insert Name of Fire Department Here)
(Address 1)
(Address 2)
(City, OK, Zip Code)

Dear Chief (Specific Name Here):

My name is Bob Scudder, and I am a student at Oklahoma State University. I am reaching out to all fire departments in the four most northeast counties (Mayes, Delaware, Craig, and Ottawa) in Oklahoma to solicit their assistance. I am researching conditions experienced by rural fire departments and their communities from the perspective of fire chiefs. Ultimately, I believe this study will provide accurate insight into rural fire departments and their communities, and will help planners to understand current issues facing your agencies.

Participation in this research is completely voluntary, will include no financial incentives, but the findings from this study should provide opportunities for increasing your preparedness and departmental capabilities and resources.

Participation includes taking an online survey, participating in an interview (at a time and place of your choosing) where we can discuss topics in more detail, reviewing the interview transcript for accuracy, and potentially providing relevant documents.

I have included two copies of the informed consent document with this letter. If you agree to participate, please sign and return one copy in the prepaid envelop (the other copy is for your records). Once I receive your consent form, I will enter your information and you will receive an email from the Survey Monkey website shortly thereafter with instructions and a link to take the survey. The survey requires you to enter your name and agency, this is for accountability purposes only, and your responses will be kept confidential once I have received them.

When you are done with the survey, I will contact you and arrange a convenient time and place to conduct the interview.

Whether you choose to participate or not, I want you to know I appreciate your dedication and service, and hope this research will benefit your community as well as those in the study area.

Respectfully,

Robert C. Scudder
Cell (918) 803-6499
robert.scudder@okstate.edu

Robert C. Scudder, 111 Sundance, Pryor, OK 74361

VITA

Robert Scudder, M.Ed., CIH, CSP, CET

Candidate for the degree of

Doctor of Philosophy

Title: Conditions affecting rural fire department preparedness for chemical disasters in Northeast Oklahoma: Case Studies.

Major Field: Environmental Science

Education:

Completed the requirements for the Doctor of Philosophy in Environmental Science at Oklahoma State University, Stillwater, Oklahoma in May, 2017.

Completed the requirements for the Master of Science in General Education at the University of Central Oklahoma, Edmond, Oklahoma in December, 2008.

Completed post-baccalaureate coursework in Industrial Safety, at the University of Central Oklahoma, Edmond, Oklahoma, 2006.

Completed the requirements for an Associate of Applied Science in Fire Protection Technology, at SUNY Onondaga Community College, Syracuse, NY, in May, 1996.

Completed coursework in general studies at the State University of New York at Potsdam College, no degree received (42.0 hours), 1992-1994.

Norwich High School Graduated May 1992 Technology Major.

Work Experience

Grand River Dam Authority-GRDA Safety Coordinator, 8/26/2009-Present

Grand River Dam Authority -Superintendent of CFC Safety Management, 06/2006-8/25/2009

CACI, Inc.- Located at Tinker Air Force Base, Industrial Safety Engineer, 05/2005-06/2006

Unified Investigations & Sciences, Inc., EH&S Consultant, 03/2001-5/2005

Unified Investigations & Sciences, Inc., Forensic Technician, 4/1999-2/2001

Professional Certifications

American Board of Industrial Hygiene, Certified Industrial Hygienist #10373 CP

Board of Certified Safety Professionals, Certified Safety Professional #20747

Board of Certified Safety Professionals, Certified Environmental Safety & Health Trainer, #13157