Emergency Notification in a Time of Crisis: Can North Las Vegas Count on Their Reverse 911 System?

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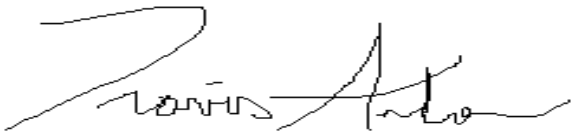

Signed:_____

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Abstract

On a late evening in 2006, the City of North Las Vegas was rocked with a series of explosions from a propane facility on fire. At the heart was a 30,000-gallon tank that could explode at any moment. This drove the fire department to initiate a mass evacuation. The reverse 911 system was used and over 1,000 people self-evacuated leaving emergency vehicles available to mitigate the incident. If this incident was to occur in 2016, the evacuation results could look dramatically different. The problem was many people use cellular phones exclusively bringing into question the effectiveness of the reverse 911 system, which is based on landline phone numbers. The purpose of this research project was to identify the effectiveness of the North Las Vegas reverse 911 system to notify affected residents to take appropriate action. The descriptive method of research was utilized to assemble and analyze information to answer the following questions: 1) What role did the reverse 911 system play in North Las Vegas's Emergency Operations Plans? 2) What percent of North Las Vegas residences had a landline phone? 3) What percent of North Las Vegas residences had registered their cellular phone to the reverse 911 system? 4) What were the barriers for residents to register their cellular phones? A literature review was completed, interviews were conducted with emergency management personnel, and 732 residents were surveyed. The research results demonstrated that the reverse 911 system was essential to the emergency operation plan. It was discovered that 60 percent of North Las Vegas residences did not have a landline phone and only 379 had a cellular phone registered. Final recommendations were to continue to support reverse 911, focus on marketing registration especially in Southeast area, and become a Collaborating Operating Group with the Integrated Public Alert and Warning System.

Emergency Notification in a Time of Crisis: Can North Las Vegas Count on Their Reverse 911 System?

In the late evening of July 28, 2006, the City of North Las Vegas became the backdrop to a series of explosions that sent fireballs and metal debris shooting hundred of feet in the air. The culprit was a large propane distribution facility on fire. The potential for a massive boiling liquid expanding vapor explosion (BLEVE) from a 30,000-gallon tank, prompted the North Las Vegas Fire Department (NLVFD) to initiate a mass evacuation of the surrounding area. Emergency management initiated the reverse 911 system resulting in over 1,000 people self-evacuating to the designated shelter. The author of this research paper, a firefighter for North Las Vegas, was on the initial response to this fire and witnessed first hand the challenges that a large complex incident could place on resources. It would have been extremely difficult to obtain enough resources to evacuate the area by canvasing neighborhoods: making a mass notification system, such as reverse 911, an essential tool.

Fast-forwarding ten years, the author, now a battalion chief for the NLVFD, came across an article that stated landlines had dropped nearly 50 percent across the country putting into question the effectiveness of reverse 911 systems. As a result, the author of this research paper raised questions to the North Las Vegas Office of Emergency Management concerning the status of the system. The response was that the city was aware of the trend and created a system where residence could register cellular phones. The Office of Emergency Management believed very few residents had taken advantage of the registration system. The problem is many people use cellular phones exclusively bringing into question the effectiveness of the reverse 911 system, which is primarily based on landline phone numbers. The purpose of this research project is to identify the effectiveness of the North Las Vegas reverse 911 system to notify affected residents

to take appropriate action. The descriptive method of research will be utilized to assemble and analyze information to answer the following questions: 1) What role does the reverse 911 system play in North Las Vegas's Emergency Operations plans? 2) What percent of North Las Vegas residences have a landline phone? 3) What percent of North Las Vegas residences have registered their cellular phone to the reverse 911 system? 4) What are the barriers for North Las Vegas residents to register their cellular phones to the reverse 911 system?

Background and Significance

The NLVFD is located in the southern tip of Nevada serving the incorporated City of North Las Vegas in Clark County. The City of North Las Vegas covers 100.48 square miles and is one of Nevada's fastest growing cities with a population of 230,788 in 2014 (North Las Vegas, 2015). The city is considered 100% urban with dense residential and a large corridor of industrial and warehouse storage. Additionally, the City of North Las Vegas just approved the Apex Industrial Park, which entails 18,000 acres for new business enterprises. According to the developers, the Apex Industrial Park, fitted with high-pressure gas lines, five power generation stations, and high voltage power lines, has the potential to be one of the predominate industrial development plants in the Western United States. Several large companies have already signed agreements to build in the Apex Industrial Park, including the electric car manufacture Faraday Motors who recently broke ground on their $1 billion state-of-the-art North American production facility (Apex Industrial Park, 2016).

The NLVFD was established in the 1930's and became a career department in 1959. The department is an all hazard organization that responds to fires, emergency medical service calls, technical rescues, and hazardous material incidents. The organization operates out of eight strategically located fire stations with personnel divided into two battalions and three platoons.

Firefighters work a 48/96-hour schedule and are supervised by one of two battalion chiefs that are on-duty each day. The NLVFD is a member of the Southern Nevada Fire Operations and has automatic aid agreements with the City of Las Vegas and Clark County utilizing automatic vehicle locator technology to ensure the closest available unit responds regardless of jurisdiction. In 2015, the NLVFD responded to 27,448 emergency incidents utilizing six engine companies, two truck companies, one air resource/rehab unit, two rescues, and two battalion chiefs (North Las Vegas Fire Department, n.d).

Responding to and mitigating emergencies is only part of the mission of the NLVFD. The most efficient way to protect life and property is to prevent an emergency from ever occurring. This was a key goal identified in the student manual for the National Fire Academy Course Executive Analysis of Community Risk Reduction, which this applied research project is tied to. The manual states the ultimate goal is to implement a plan to reduce preventable occurrences and/or mitigate loss from risks that cannot be stopped (United States Fire Administration, 2016). The NLVFD has both a public education division and a fire prevention division to help achieve this goal. In 2015, these divisions conducted 210 fire investigations and reached over 112,834 citizens via 233 public education events (North Las Vegas Fire Department, n.d.).

While prevention is the ultimate goal, it would be foolish to believe every emergency could be prevented. North Las Vegas houses a diverse economy that may pose many hazards to its citizens. On any given day, tons of hazardous materials are transported through their city via interstate, railway, and pipelines. According to a report from the Clark County Local Emergency Planning Committee (2015), nearly 125,000 trucks haul over 2.7 million tons of hazardous materials through North Las Vegas each year. Additionally, Union Pacific has a rail transfer

station located in North Las Vegas designed for transfer of bulk chemical packages from railway lines to ground transportation. The city also sits astride several major pipelines including the UNEV, a 12-inch pipe capable of bringing in more than 2.5 million gallons of refined petroleum product each day, with a terminal in North Las Vegas that stores almost 9.5 million gallons (Clark County, 2015). And in the heart of North Las Vegas sits the fixed facility US Foodservice with its 24,000 gallon anhydrous ammonia tanks, ranked #13 in facilities in Nevada storing the largest amount of extremely hazardous substances (Cryptome, n.d.).

Dangers posed by hazardous materials coursing through the valley become increasingly apparent as one examines the risks combined with a dense, urban city. In 2011, a tanker truck carrying over 9,000 gallons of gasoline crashed and exploded on Interstate-15 near the busiest North Las Vegas exit. In 2007, a rail tanker holding highly toxic chlorine gas escaped the train yard and rolled at speeds upwards of 50 miles per hour through the Las Vegas Valley until it was stopped in North Las Vegas. Casualty estimates were placed as high as 90,000 civilians if the tanker would have rolled or collided with a vehicle in certain areas of the city (Chappell, 2014). In 2006, as previously mentioned, a fire at one of the largest propane distribution yards in the state resulted in hundreds of explosions with the potential for a 30,000-gallon propane tank to BLEVE (North Las Vegas Fire Department, 2006).

Hazardous Materials incidents are not the only hazards the City of North Las Vegas faces. According to the United States Geological Survey (2016), Nevada is the fourth most seismic state in the country with seven faults running under the Las Vegas Valley. The City of North Las Vegas also experiences significant flash floods during the summer months. Additionally, the recent attacks in San Bernardino and Orlando have proven that no city is immune from terrorism and man-made disasters.

The City of North Las Vegas and its neighboring partner cities recognized the need to provide timely information and protective measures during an emergency incident to reduce loss of life and property. In 2002 the reverse 911 system was installed giving emergency management the ability to simultaneously call all residents in a specific neighborhood to warn them of a natural disaster, man-made disaster, or police incident where protective measures needed to take place (Reverse 911, 2002). This exact system was utilized during the North Las Vegas propane distribution fire, where a mandatory one square mile evacuation was implemented. The system was extremely successful with over 1,000 residents reporting to the emergency evacuation center (North Las Vegas Fire Department, 2006).

However, if this incident occurred today it is likely that the results of the reverse 911 system would not be as effective. The reverse 911 system was built from a database of registered and non-registered landline numbers and is annually updated by the carriers. According to the Centers for Disease Control and Prevention (as cited in Stobbe, 2015), households having landlines have decreased by five percent each year. If North Las Vegas follows national trends, then less than 50 percent of households have landline phones. Unfortunately, there is no central repository for cellular phone numbers to add to the reverse 911 system. Cellular phones users may opt into the countywide system, but preliminary reports show that few have registered.

This applied research project will help identify how effective the reverse 911 system will be in notifying affected residents to take protective measures, and is directly linked to goal one and two of the United States Fire Administration (2015) whose mission "is to provide national leadership to foster a solid foundation for our fire and emergency services stakeholders in prevention, preparedness and response." Goal one, "Reduce Fire and Life Safety Through

Preparedness, Prevention and Mitigation." Goal two, "Promote Response, Local Planning and Preparedness for All Hazards" (p.1). This project also relates to the Executive Analysis of Community Risk Reduction course, which is part of the National Fire Academy's Executive Fire Officer program. Unit one encourages the fire service to promote the concept of all-hazard community risk reduction. Furthermore, it states, the fire service will act proactively as a risk-reduction entity for their community (United States Fire Administration, 2016). This project will proactively reduce risk by identifying ways to improve the reverse 911 system to effectively notify citizens to take protective measures.

Literature Review

The purpose of the literature review was twofold: First, determine the value of mass notification systems. Second, determine whether the reverse 911 system is still relevant in the cellular phone age and the advances made in mass notification systems such as the Integrated Public Alert and Warning System, Wireless Emergency Alerts (WEA), and Social Media. Electronic mass notification systems gained prominence back in 1963 when the federal government implemented the Emergency Broadcast System, which utilized television and radio to warn the entire population of an emergency. In 1994, the President of the United States requested a new mass notification system that could be used to address the entire nation within minutes; this resulted in the creation of the Emergency Alert System (EAS), which still relied on radio and television. While the EAS was very effective at notifying large geographical areas, it was not flexible enough to address localized emergencies at the city and county level. As a result reverse 911, utilizing a database of landline phone numbers, was created in early 2000 to answer the challenge of localized catastrophes (Mahdavi, 2010).

There exists a great deal of literature regarding the benefits and limitations of mass notification systems. One of the best examples of value was demonstrated last decade during the Southern California wildfires. In 2003, wildfires fueled by Santa Ana winds sparked the need for mass evacuations in Southern California. At that time, Southern California had no system in place to quickly notify residents to evacuate; consequently, 22 residents lost their lives to the fires identifying the need for an effective mass notification system. Following the 2003 fires, San Diego County and the City of San Diego purchased a reverse 911 system to rapidly notify residents of emergencies and protective measures to take. In late October 2007, San Diego experienced what would become the county's largest firestorm in history surpassing the 2003 fires that killed 22 residents. This time, only one resident succumbed to the fires. The difference: a mass notification system that quickly advised residents to evacuate their homes. A CBS report stated, "Reverse 911 is the reason so many thousands of Southern Californians were able to quickly evacuate their homes" (Meleard, 2008, p. 55).

Similar to San Diego, the City of North Las Vegas emphasizes the importance in early notification of its residents. The City's *All-Hazard Emergency Operation Plan* establishes the process and structure to address the consequences of any emergency or disaster within the city. According to this guiding document,

> Warning the public of existing or pending emergencies and the protective actions they should take is one of the first steps that must be taken to minimize the impact on people and property in the City of North Las Vegas (City of North Las Vegas, 2016, p. 2).

The plan identifies that one or more of the following methods may be utilized to warn the public depending on the hazard and area threatened: EAS, social media, mobile sirens, door-to-door sweeps, and the reverse 911 system (City of North Las Vegas, 2016).

Emergencies are not planned and rarely go as one would like. The ability to quickly and effectively communicate with residents and business during an emergency, as identified in the aforementioned wildfires, can be the difference between an effective response and a prolonged disaster (Ladin, 2009). The 2007 Virginia Tech shooting was a prime example of a notification system and process that took too long to initiate. The shooting began at 7:15 A.M. but the process to initiate the mass notification system was not completed until 9:26 A.M., two hours and eleven minutes after the shooting started. According to Guth (2013), the most important lesson learned from the Virginia Tech Shooting is the need to rapidly disseminate emergency information. Going door-to-door or utilizing sirens from emergency vehicles, as outlined in the *North Las Vegas All-Hazard Emergency Operation Plan*, would be both inefficient and a waste of valuable resources needed to help mitigate the emergency.

In addition to being timely, Strawderman, Salehi, Babski-Reeves, Thornoton-Neaves, and Cosby (2012) found in their mass notification study "The design of effective evacuation warnings is critical in ensuring that the right people are notified, that the information given is complete and accurate…" (p. 65). As previously identified, the EAS was designed for the president to speak to the entire population. It does not have the capabilities to target specific areas to reach the right people as Strawderman et al. identified as a critical element. As a result, the EAS could not have been used for emergencies like the San Diego fires or the North Las Vegas propane incident without creating confusion and panic to millions of people who were not in danger.

Social media, a powerful communication tool, also has several disadvantages in its use as an emergency mass notification tool. First, residents may not be logged on to social media to receive emergency information broadcasts. Second, research completed by the Pew Research

Center has shown that only two-thirds of American adults use social media. The percentage of use by those over the age of 65, who the Center for Disease Control (2012) considers the most vulnerable group at risk during and emergency, is even lower at one-third (Perrin, 2015). Census data from 2015 identified 3,076 residences in North Las Vegas that were owned or rented by someone 65 years of age or older (Suburban, 2015).

Many authors agree the reverse 911 system has the potential to address most of the weaknesses identified above. Reverse 911 is a public safety communication system with geo-targeting capability designed to simultaneously notify residents within a crisis area utilizing a database of telephone numbers and associated addresses (Schmitz, 2011). According to the National Research Council (2013) and Strawderman et al. (2012), the reverse 911 systems provides both a high degree of precision as well as detailed information and protective measure to take for those within the affected area. A study from the National Research Council (2013) found the aforementioned attributes critical:

> Past research has shown that specific and clear information, including which locations are and are not at risk, increases the likelihood that people take protective actions. The less precise the geotargeting, the more likely the recipient will ignore the alert… because they are not sure whether the message applies to them (p. 2).

Several studies have also concluded that reverse 911 is the most effective measure in motivating someone to take protective action. Strawderman et al. (2012) found,

> The effectiveness of the Reverse 911 system for evacuation warnings has been demonstrated. When compared with other evacuation warning sources, reverse 911 was the most effective at motivating affected people to evacuate the area, likely because of the specific and personal information given through this warning source (p. 72).

Sorenson, Sorenson, Smith and Williams (2009) found in their study of the 2007 San Diego Wildfires that the reverse 911 system was the dominant form of initial warnings to evacuate reaching 42 percent of the households. The wildfires destroyed 1,500 homes and over 500,000 people were evacuated. San Diego County's Emergency Services Director went on record stating "There's no doubt in anyone's mind that the reverse 911 saved lives. There's no way we would have been able to notify everyone, especially during the first night of the fires" (McKay, 2008, p. 21). According to Sorenson et al. (2009), the next closest warning source came from television accounting for a mere eight percent. Like Strawderman et al., they also concluded that those who received a reverse 911 call were much more likely to evacuate than those residents who did not receive a call.

While the reverse 911 system contains a lot of the critical features needed in a mass notification system, it does have one significant hurdle that must be addressed, which is the decline of landline usage. "Although this type of emergency notification system can help to evacuate communities… it is often limited in reach by its inability to extend beyond landline phones" (Schmitz, 2011, p. 42). According to Wimberly (2012), "Where land lines are used, obtaining telephone numbers isn't difficult. Databases can be purchased that include most land lines telephone numbers…Because there's no central repository of cellphone numbers, local public safety officials don't have these numbers to call" (p.30).

In the United States, cellular phone only households increased from three percent in 2003 to over 47 percent in 2015. Annually, the percentage of cellular phone only households increases by about five percent (Stobbe, 2015). Like the rest of the nation, Nevada has also seen a large drop in the number of households with landlines. In 2008 there were 591,000 households with landlines. Four years later the number of households with landlines had decreased to

360,000 (Wargo, 2014). To address the exodus from landlines, Southern Nevada emergency managers procured a system in September 2011 that would allow residents to register their cellular phones and e-mail addresses to the reverse 911 system (Guillermo, 2011). This solved the problem with landlines but created an entirely different challenge of getting the message out for residents to "opt-in" as well as keep their information updated. According to Schmitz (2011), this is not unique to North Las Vegas.

> Reverse 911 data can become stale quickly as larger municipalities do not update contact points in keeping with their changing demographics. Relying on a database of reverse 911 numbers alone is not a sufficient emergency management plan, and while these data points are certainly helpful, they should be just one piece of information in a redundant multi-modal communication plan (p. 42).

With the challenges of maintaining an accurate reverse 911 database, many consider the Integrated Public Alert and Warning System (IPAWS) the future of emergency mass notification systems. IPAWS was launched on June 26, 2006, with Executive Order 13407 which authorized the Secretary of Homeland Security to:

> Establish or adopt, as appropriate, common alerting and warning protocols, standards, terminology, and operating procedures for the public alert and warning system to enable interoperability and the secure delivery of coordinated messages to the American people through as many communication pathways as practicable, taking account of Federal Communications Commission rules as provided by law (Executive Order, 2006).

IPAWS was designed to get information out quickly by integrating the various notification systems such as EAS, WEA, Internet Services/Social Media, and state/local unique alerting

systems like the aforementioned reverse 911 system. IPAWS was signed into law on April 11, 2015, as the Integrated Public Alert and Warning System Modernization Act of 2015.

The most important technological advancement with IPAWS was the Commercial Mobile Alert System (CMAS), which allows local agencies to issue text-based WEA, similar to the Amber Alerts, to cellular phones within a targeted region without requiring the user to "opt-in" (Bristow, 2011). While there is great excitement about CMAS and its future, there are several shortcomings that preclude it from being the answer to the reverse 911 notification system. First, text-based alerts are broadcasted over airwaves utilizing cellular towers and picked up by cellular devices. According to Wimberly (2010), the airwaves are not always predictable; they are influenced by weather and topography. Also, it is highly unlikely that the labyrinth of cellular towers and their signal sector will correspond with the impact area resulting in either overshooting or undershooting the targeted recipients (see figure 1).

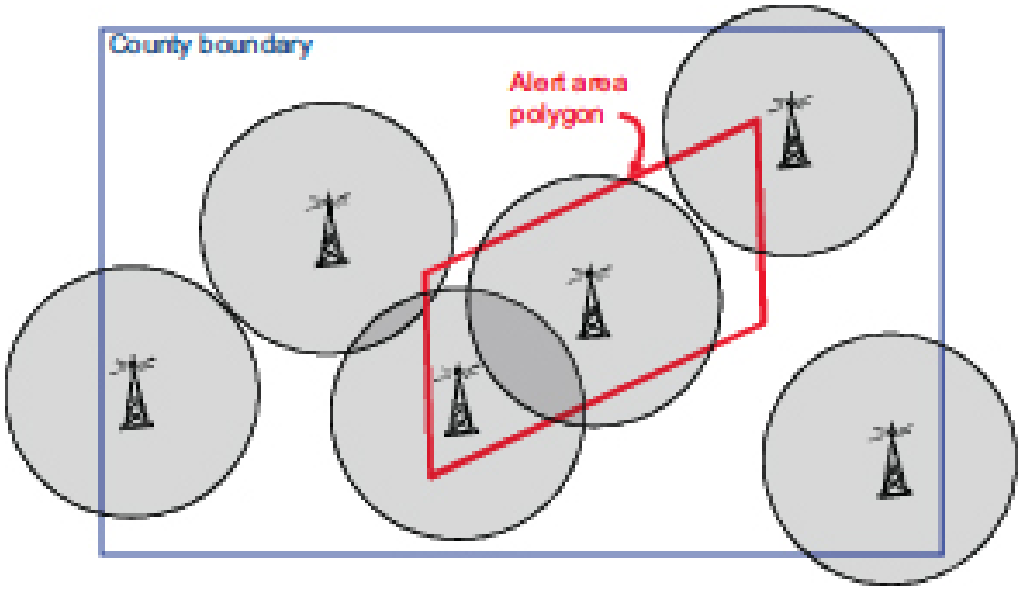

Figure 1: Mapping Alert Area Polygon

Source: National Research Council, 2013

Second, technology limits WEA to 90 characters and will not allow uniform resource locators (URL) where recipients can obtain further information. The University of Maryland conducted a study and found that the 90-character limit is inadequate in convincing people to take protective action. According to the study, it will get their attention but people will look for other sources to confirm information before taking action (Wimberly, 2012). Last, carriers are not required to participate in CMAS and the cellular phone user always has the option to disable WEA. With the identified shortcomings, the director of IPAWS, Antwane Johnson, went on record (as cited in Wimberly, 2012) stating, "Even as IPAWS grows it will not replace existing state and local alerting initiatives but rather enhance them (p.35).

To take advantage of IPAWS, an agency must be designated as a Collaborative Operating Group by the IPAWS Program Management Office. According to the Federal Emergency Management Agency (2016) document *Organizations with Public Alerting Authority Completed*, the City of North Las Vegas is not authorized to use IPAWS. If North Las Vegas wants to become an authorized user it must complete the five steps required by the Federal Emergency Management Agency (FEMA): select IPAWS compatible software, apply for a memorandum of agreement with FEMA, apply for public alerting permission, complete IPAWS web-based training, and complete application.

The literature review identified the importance of emergency mass notification systems. Specifically, it identified that an effective system must be timely and provide detailed information to the targeted audience. Low loss of life during the California wildfires identified the effectiveness of reverse 911. However, the rapid reduction in landlines will continue to diminish the effectiveness of the reverse 911 system for years to come unless municipalities find ways to update their databases. Additionally, the author discovered IPAWS, what many consider

the future of emergency mass notifications. These findings drove many of the questions asked in both the interviews and surveys.

Procedures

The purpose of this descriptive applied research project was to identify the effectiveness of the North Las Vegas reverse 911 system to notify affected residents to take appropriate action. More precisely, to answer the following four research questions:

1. What role does the reverse 911 system play in North Las Vegas's Emergency Operations plans?
2. What percent of North Las Vegas residences have a landline phone?
3. What percent of North Las Vegas residences have registered their cellular phone to the reverse 911 system?
4. What are the barriers for North Las Vegas residents to register their cellular phones to the reverse 911 system?

The strategy for obtaining efficient, yet credible, data to answer the aforementioned questions resulted in research being conducted through three different methods: literature review, interviews, and in-person surveys.

The literature review commenced on June 20, 2016, at the Learning Resource Center on the National Fire Academy campus with a search of their online catalog system for material on the subjects of mass notification systems, reverse 911, and IPAWS. In addition, the author searched the same subjects on the World Wide Web utilizing the search engine Google and Google Scholar. The World Wide Web, with its abundance of published articles, provided the author an avenue to obtain some of the most current information. The literature review was

utilized to help answer question one of this applied research project as well as identify the value of mass notification systems and the current relevance of reverse 911.

An interview with the City of North Las Vegas Emergency Management as well as City of Las Vegas Emergency Management was executed to address research questions one and three. The North Las Vegas emergency manager was interviewed because he is responsible for administering an all-hazard preparedness, prevention, response and recovery program for the City of North Las Vegas. The City of Las Vegas Emergency Management Specialist Rick Diebold was also interviewed because he was tasked with managing the reverse 911 system for Southern Nevada. The author interviewed North Las Vegas Emergency Manager Carlito Rayos on June 25, 2016, and Las Vegas Emergency Management Specialist Rick Diebold June 30, 2016. Both emergency management officers were provided questions via department email on June 20, 2016, to review and prepare for the interview. Each interview lasted approximately 20 minutes and can be found in Appendices A and B.

To answer questions two and four, the author needed to interview residents of North Las Vegas to determine what percentage of households had landlines and what the barriers were to signing up for the reverse 911 system. The author set out to have a sample size great enough to ensure a 95 percent confidence level. With 66,499 households in North Las Vegas, the author needed to survey 595 residents according to Creative Research Systems (2012). A total of 732 North Las Vegas residents were interviewed surpassing the 95 percent confidence level.

Great care was taken in ensuring the data was credible and a true reflection of the population of North Las Vegas. As a result, the author divided the city into four regions and selected a grocery store in each region to conduct the research. A survey (Appendix D) was created with four questions for respondents to answer. The author utilized 13 NLVFD explorers

to ask the questions and record the respondent's answers. Each explorer was provided education on how they were to ask the questions and record the respondent's answers. The research took place on August 30, 2016, from 1000 – 1500 hours at the following four locations:

1. Walmart- 5545 Simmons St, North Las Vegas, NV 89031 (Northwest location).
2. Walmart- 5940 Losee Rd, North Las Vegas, NV 89081 (Northeast location).
3. Mariana's Super Market 2325 E Cheyenne Ave, North Las Vegas, NV 89030 (Southeast location).
4. Walmart- 1807 W Craig Rd, North Las Vegas, NV 89032 (Southwest location).

While great care was taken to acquire and present credible data, there are several assumptions and limitations that should be noted. First, the author primarily used two emergency management specialists to answer question one and three. Utilizing a small group increases the opportunity for data to be skewed. Second, NLVFD explorers were relied on to ask the questions and record the respondent's answer, but with only beforehand training, any misunderstanding could significantly sway the data. Last, the author assumed each respondent represented a different household in North Las Vegas, but it is possible that different members of the household could have been surveyed at different locations or different times during the day.

Results

The purpose of this research project was to identify the effectiveness of the North Las Vegas reverse 911 system to notify affected residents to take appropriate action. The author used several different procedures that proved effective in answering each one of the research questions presented in this applied research project. There were a total of two interviews conducted, one from the City of Las Vegas Office of Emergency Management and the other

from the North Las Vegas Office of Emergency Management. Also, 732 North Las Vegas residents were interviewed.

First research question asked what role does the reverse 911 system play in North Las Vegas's Emergency Operations plans? The City of North Las Vegas's (2016) All Hazard Emergency Operations Plan emphasized the importance of early notification to residents who may be in danger.

> Warning the public of existing or pending emergencies and the protective actions they should take is one of the first steps that must be taken to minimize the impact on people and property in the City of North Las Vegas (p. 2).

During his interview Carlito Rayos, emergency manager for the City of North Las Vegas, stated,

> We know as emergency managers that if we give residents credible and timely information by way of personal action recommendations or PARs, that they believe will increase the chances at life safety and property preservation that they will follow them. Emergency notification systems, to include reverse 911, are the most effective way to reach the masses (personal communication, June 25, 2016).

Similar to the literature review, Mr. Rayos went on to state that the future of mass notification systems is IPAWS. He stated it addresses many of the weaknesses of landlines by using cellular phone towers to notify populations in the immediate danger area. In addition, it also has the potential to send out much more notifications across multiple platforms (personal communication, June 25, 2016).

Second research question asked what percent of North Las Vegas residences have a landline phone? A total of 732 North Las Vegas residents participated in the survey (Appendix I) with 40 percent answering yes in question #2 that they had a landline at home (Table 1).

Table 1

What percent of North Las Vegas residences have a landline phone?

	# Responded	Percentage
Yes	290	40%
No	442	60%

Table notes. Answered by 732 North Las Vegas Residents (all four areas).

Further analysis of the data illustrates that the Southeast area (Appendix H) of North Las Vegas, at 30 percent, has a significantly lower percentage of landline phones compared to the rest of the city (Table 2).

Table 2

What percent of North Las Vegas residences have a landline phone?

	# Responded	Percentage
Yes	82	30%
No	192	70%

Table notes. Southeast location only.

Third research question asked what percent of North Las Vegas residences have registered their cellular phone to the reverse 911 system? According to the data retrieved from question #3 of the survey (Appendix I), two percent of the 732 respondents had registered their cellular phones (Table 3). Additionally, the author retrieved a report (Appendix C) from Emergency Management Specialist Rick Diebold that identified 379 North Las Vegas households with a cellular phone registered to their address. Compared to the 66,499 households identified in the literature review, a mere .006 percent of North Las Vegas households have registered their cellular phones to the reverse 911 system. Further analysis demonstrates that the

rest of Clark County is experiencing the same challenges with only 2,926 registered cellular phones (personal communication, June 30, 2016).

Table 3

What percent of North Las Vegas residences have registered their cellular phone to the reverse 911 system?

	# Responded	Percentage
Yes	15	2%
No	717	98%

Table notes. Answered by 732 North Las Vegas Residents (all four areas).

Final research question asked what are the barriers for North Las Vegas residents to register their cellular phones to the reverse 911 system? Question #4 of the survey (Appendix D) asked all respondents that stated they had not registered their cellular phones to identify the reason why. It was apparent that nearly all the respondents had no idea about reverse 911 or the registration process; however, most seemed very interested in registering and took a pamphlet for directions to register or utilized NLVFD IPADs at survey sites to register. A total of 693 out of the 711 that answered the question responded that they had no idea about the system. Five people answered that they did not register for privacy reasons, and 11 people answered they knew about the system but had failed to take the time to register prior to being surveyed. Another two respondents gave responses that did not fit into any of the three aforementioned categories (Table 4).

Table 4

If you have not registered cellular phone, why?

	# Responded	Percentage
Did Not Know About System	699	97.5%
Just Had Not Registered Yet	11	1.5%
Privacy Reasons	5	.7%
Others	2	.3%

Table notes. Answered by 717 respondents (all four areas), the rest skipped because they had already registered their cellular phone.

Discussion

The literature review along with North Las Vegas's use of reverse 911 has detailed the importance of the system during a disaster. The *North Las Vegas Emergency Operations Plan* argued that early notification along with protective measures to take is one of the first steps that must be addressed during a disaster or potential disaster (City of North Las Vegas, 2016). Strawderman et al. (2012) and Sorenson et al. (2009) conducted two of the most comprehensive studies on emergency mass notifications after the 2007 wildfires in San Diego. Their research concluded that the reverse 911 system was by far the most dominant form of initial warning to evacuate reaching 42 percent of the households. The next closest warning came from television at a mere eight percent. In addition to sounding the first alarm, their research also demonstrated that it was the most persuasive method to get those in harms way to evacuate.

The North Las Vegas emergency manager also agreed that early notification along with credible information is essential during a disaster. Mr. Rayos stated in his interview,

> We know as emergency managers that if we give residents credible and timely information by way of personal action recommendations or PARs, that they believe will

> increase the chances at life safety and property preservation that they will follow them (personal communication, June 25, 2016).

According to the emergency services director for San Diego County (as cited in McKay, 2008), there was no doubt the reverse 911 system saved lives during the 2007 wildfires. "There's no way we would have been able to notify everyone, especially during the first night of the fires" (p.21).

In 2006, the NLVFD found themselves in a similar situation where they needed to notify thousands of residents to evacuate their homes in the middle of the night due to the potential of a BLEVE at a propane tank distribution fire. The reverse 911 system was activated and over a thousand residents evacuated to the identified shelter. Most of the police and fire resources were committed handling the blaze and controlling roads; it would have been extremely taxing to evacuate the neighborhoods using police or fire units.

The author also found his research on landline use consistent with the information obtained from the literature review. According to the data retrieved from the 732 residents surveyed, only 40 percent have landline phones at their place of residence. This is consistent with the literature review, which stated Nevada had a 40 percent decrease in landlines from 2008 to 2014. In the United States, research also identified that only 53 percent of the households had a residential landline in 2015. According to the literature review, this number consistently drops five percent annually, which would place the national average just higher than North Las Vegas at 48 percent in 2016 (Stobbe, 2015).

North Las Vegas is a diverse city with extremely different demographics in its four regions. Primary data from each region was gathered to not only obtain a true picture of the entire city, but to also identify specific areas that may need special attention. The data above

demonstrates that North Las Vegas, as a whole, is experiencing a greater decline of landline phones than the national average; however, the Southeast region of North Las Vegas specifically stands out at 30 percent (Appendix H). This area was identified as a high-risk population during the pre-course work for the Executive Fire Officer Course Executive Analysis of Community Risk Reduction, which this research project is being completed for. Specifically, the census tract data shows this area as 80 percent Hispanic, poverty level at 37 percent, and 60.5 percent of residents over the age of 25 have less than a high school education (North Las Vegas, 2016). Additionally, this area accounts for nearly 40 percent of all emergency responses in the City of North Las Vegas. As expected, the more affluent Northwest side has the highest rate of landlines at 49 percent (Appendix E).

As previously identified, the Southern Nevada emergency managers procured a system in September 2011 that would allow residents to register their cellular phones to the reverse 911 system (Guillermo, 2011). Data obtained, with only 40 percent of North Las Vegas residents having landlines (Appendix I), clearly indicates a need for this "opt-in" cellular phone registration system. Unfortunately, the data retrieved shows only 379 households have a cellular phone registered to their residence (Appendix B and C). With 66,499 households in North Las Vegas, less than .006 percent have "opted-in." According to the literature review, North Las Vegas is not alone in this challenge. While the "opt-in" system addressed the landline problem, it created an entirely different challenge in getting the message out for residence to "opt-in" as well as keep their information updated (Schmitz, 2011).

The literature review identified IPAWS, and specifically WEA, as a possible solution to the challenges created by the cellular phone era. In his interview, the emergency manager for North Las Vegas agreed with much of the literature stating,

> IPAWS combats all of these weaknesses by sending messages with phones that are communicating with a cell phone tower, so you can triangulate and pin point populations that are in imminent danger of interfacing with the present hazard, both manmade and natural. This means that members within a certain residential radius within NLV could be notified to stay out of the area during a hazmat or SWAT event. Another strength, IPAWS can send out many more notifications across multiple platforms simultaneously (personal communication, June 25, 2016).

While IPAWS might be the future of emergency mass notification systems, there are still some deficiencies that preclude it from replacing the reverse 911 system. First, the airwaves are unpredictable, and it is highly unlikely that the cellular tower's reach will parallel the impact area resulting in either overshooting or undershooting the targeted recipients. Second, the research and literature review all emphasized the importance of detailed and credible information to motivate people to take action; this cannot be accomplished within the 90-character limit with WEA. Third, cellular carriers are not required to participate in WEA and, at anytime, the end user can simple "opt-out" of retrieving the messages (Wimberly, 2012). Last, the City of North Las Vegas is not an authorized group to issue emergency alerts over the IPAWS system (Federal Emergency Management Agency, 2016).

The greatest implication of the author's research is the lack of focus on marketing the *Southern Nevada On The Alert* "opt-in" system. It was established five years ago with a federal grant of over $100,000 and continues to cost about $25,000 a year to maintain. With only 2,926 households in Clark County registered, which includes the 379 in North Las Vegas, it begs the question of whether taxpayer's money is being spent wisely. The author's research has concluded that the only outreach for North Las Vegas, prior to this applied research project, was

a press release back in 2011. While it was not the emphasis of this applied research project to increase the "opt-in" rate, the author of this applied research project created a flyer that was handed out to residents as they were surveyed explaining the importance of the system and how to register. The following week showed a 13 percent increase in the number of North Las Vegas residents registered to *Southern Nevada On The Alert* according to the City of Las Vegas Emergency Manager Carolyn Levering (personal communication, August 5, 2016).

Recommendations

Based upon the information obtained through literature review and primary research, the author recommends the NLVFD continue to invest in the reverse 911 system, as well as the "opt-in" system *Southern Nevada On The Alert*. History has demonstrated the impact on life safety and risk mitigation that early notification with detailed information can have. As previously identified in the propane incident, resources will be busy mitigating the emergency, and North Las Vegas should not expect to have enough resources to facilitate evacuations. The reverse 911 system was designed to be initiated by a single individual from a computer or smart phone freeing up valuable resources. Additionally, the system can isolate through geotargeting a specific area, transmitting a detailed recording with specific protective measures to take without the fear of overshooting and panic.

However, the results of this study demonstrate that the current system would fail to notify 60 percent of the residence in North Las Vegas. The NLVFD has a vested interest in increasing the number of residents enrolled in the reverse 911 system and needs to take a more proactive approach in this program. The "opt-in" system *Southern Nevada On The Alert* has been in operation for over five years. It was evident while conducting the surveys that nearly all respondents knew nothing about the reverse 911 system or the need to register their cellular

phones. Data retrieved identified that less than three percent of respondents knew about the *Southern Nevada On The Alert* program. In a single day, the author and a volunteer force of 13 fire explorers increased the enrollment rate by 13 percent by simply handing out flyers while completing surveys. Results of this study will be shared with the NLVFD's executive staff, the North Las Vegas Office of Emergency Management, as well as the NLVFD's Public Education Division to garner support for more resources to promote the program.

While the research identified that all of North Las Vegas needs to be addressed, it specifically identified the Southeast portion of the city as the most problematic with a 30 percent landline rate. This specific area is predominantly Hispanic with a high rate of poverty. The NLVFD should tailor a specific program to reach this target audience. The NLVFD can start with utilizing the flyers created by the author of this applied research project, as they were printed in English and Spanish and proved to be extremely effective in explaining the program and increasing the registration rate. Additionally, the NLVFD should educate all their members on the importance of the reverse 911 system, and take advantage of every opportunity to get the message out during community events.

A final recommendation is for the NLVFD to become designated as a Collaborative Operating Group by the IPAWS Program Management Office. This will provide a back up to the reverse 911 system as well as an avenue to transmit alerts across multiple platforms if needed. According to Schmitz, "Relying on a database of reverse 911 numbers alone is not a sufficient emergency management plan, and while these data points are certainly helpful, they should be just one piece of information in a redundant multi-modal communication plan" (2011, p. 42). In order to be designated as a Collaborative Group, NLVFD must complete five steps:

1. Select IPAWS compatible software

2. Apply for a memorandum of agreement with FEMA
3. Apply for public alerting permission
4. Complete IPAWS web-based training
5. Complete application

Reduction in landlines is a national trend and can significantly reduce the effectiveness of the reverse 911 system. Throughout the research, it was identified that many municipalities rely on reverse 911 as their primary emergency mass notification system. Like North Las Vegas, most agencies are not designated as a Collaborative Operating Group by the IPAWS Program Management Office and therefore could not use the IPAWS system to deliver alerts. The author of this applied research project would advise future readers to analyze their emergency mass notification system to determine its effectiveness.

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Appendix A

Emergency Manager Carlito Rayos Interview

1. *What role does the reverse 911 system play in North Las Vegas's Emergency Operations Plan and how important is it?*

   Information is power, that is never more true than in an emergency. We know as emergency managers that if we give residents credible and timely information by way of personal action recommendations or PARs, that they believe will increase the chances at life safety and property preservation that they will follow them. Emergency notification systems, to include reverse 9-11, are the most effective way to reach the masses. We do have the capability of using iPAWS but would rely on the cities of Las Vegas and/or Henderson to execute at this time whereas we have not established a POD, which may never be the case due to redundant capability already.

2. *What are the strengths and weakness to the current system?*

   Weaknesses to the current primary system would be that less than 10,000 our of 300,000+ CNLV residents have signed up to receive specific protective action recommendations. We are also limited in partially on how many phone numbers we can dial through CLV at a time without requiring assistance from an out of state service. We also are only able to put a single number and address, so although you can associate a cell phone with a physical address, a resident will only be notified of hazards that impact their homes not where they shop, work or play. A general weakness of emergency notification system in general is apathy, whereas people simply start to tune out the tone on their car radios and or crawlers on their television sets because the last ten emergency broadcasts were only immediate to Mojave or some other county an hour or more away, simply because the emergency broadcasting system is dissected.

   iPAWS combats all of these weaknesses by sending messages with phones that are communicating with a cell phone tower, so you can triangulate and pin point populations that are in imminent danger of interfacing with the present hazard, both manmade and natural. This means that members within a certain residential radius within NLV could be notified to stay out of the area during a hazmat or SWAT event. Another strength, IPAWS can send out many more notifications across multiple platforms simultaneously.

Appendix B

City of Las Vegas Emergency Management Specialist Rick Diebold Interview

1. *What reverse 911 system do we use?*

   We use AIRBUS Communicator NXT and Vesta Alert. Communicator NXT is the list driven Scenario based system and Vesta Alert is the geographic based system.

2. *How many North Las Vegas residents have signed up for reverse 911 on LVAlert?*

   In Clark County there are a total of 2,926 people registered for the Southern Nevada On The Alert. Of those registered 379 are within the limits of North Las Vegas. See attached map.

3. *What is the process a battalion chief in the field would utilize to implement reverse 911 for an isolated neighborhood(s) In NLV? What is the process for implementing large alert through IPAWS?*

   Contact your Emergency Manager for system access and/or the Fire alarm Office to contact a user. The City of North Las Vegas had 5 individuals attend the most recent training.

4. *When was the last time the reverse 911 system was tested and to what depth?*

   Reverse 911 is tested weekly but only to one address; however, the equipment and telephone line are tested daily (small), weekly (mid), monthly (very large). The number of line tested and calls made determines size. We test all lines weekly. Daily we will test the system by calling a single individual. Every Saturday we will test the system by calling 50 individuals. And on a monthly basis we will perform a larger test calling 100 individuals. There are 18 agencies on the system and each of those has a separate testing schedule.

5. *Who/ how many are trained that could put the reverse 911 system to work?*

   There were 62 individuals that attended the last class. Your Emergency Manager should have the names for North Las Vegas. You can also contact the City of Las Vegas Office of Emergency Management, for a launch.

6. *What do you see as the strengths of the system?*

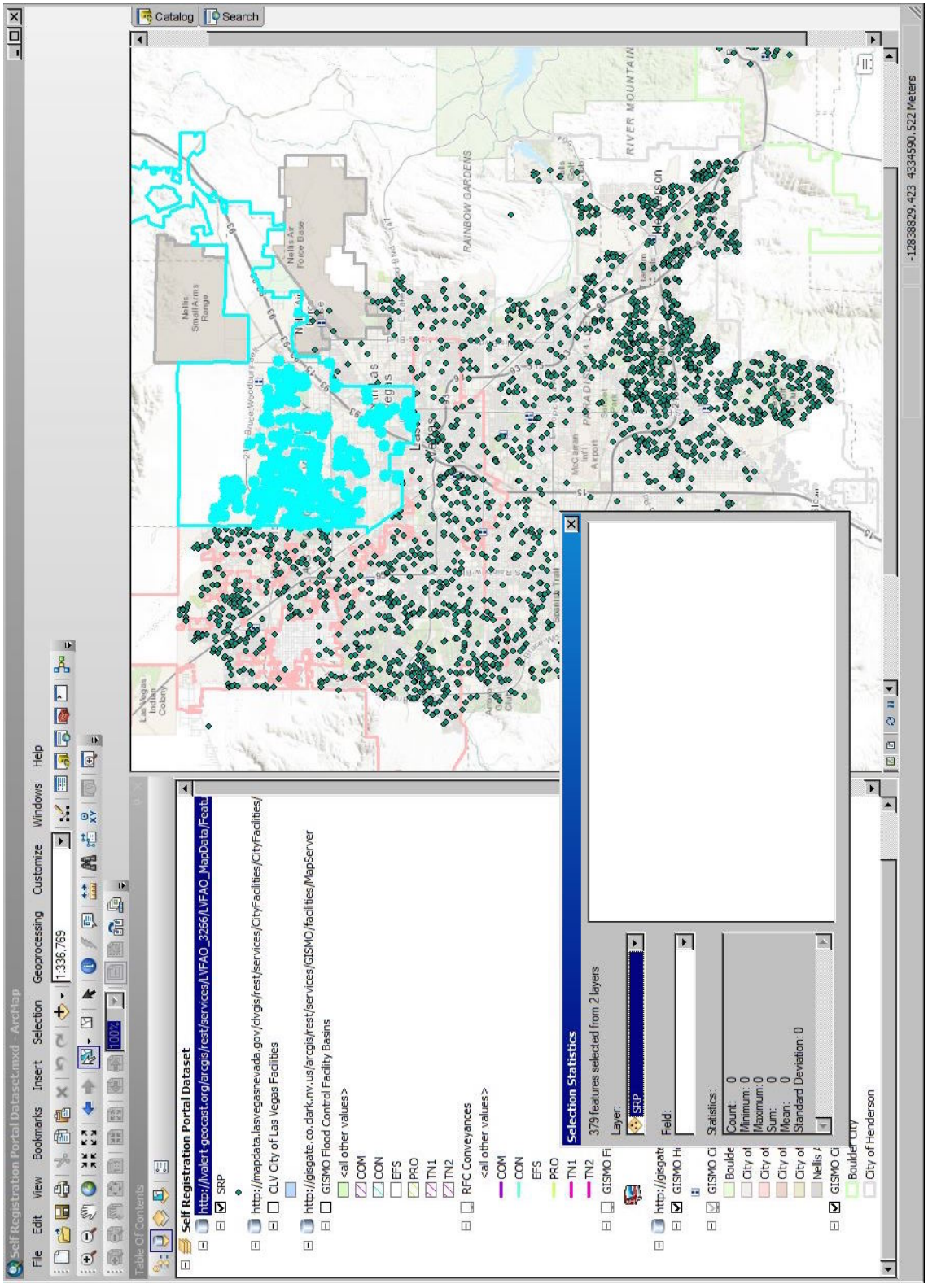
   The system is in-house with a triplicate backup- two offsite out-of-state and one offsite in-state. You can launch the system from communicator, computer, or smartphone. Additionally, you have access to 20,000 plus phone lines and immediate notification if the system goes down.

7. *What are the weakness/improvements that need to be made to the system?*

   Number of lines locally. We have 24 and could use 48-96 but that gets expensive.

Appendix C

Self-Registration Portal Database



Appendix D

Survey - Reverse 911

Reverse 911 Survey _____ Region				
Resp.#	**Question #1** **Resident**	**Question #2** **Resident Landline**	**Question #3** **Cell Registered**	**Question #4** **If not registered, why not?**
1	Yes No	Yes No	Yes No	Didn't know about / Privacy / Other _____
2	Yes No	Yes No	Yes No	Didn't know about / Privacy / Other _____
3	Yes No	Yes No	Yes No	Didn't know about / Privacy / Other _____
4	Yes No	Yes No	Yes No	Didn't know about / Privacy / Other _____
5	Yes No	Yes No	Yes No	Didn't know about / Privacy / Other _____
6	Yes No	Yes No	Yes No	Didn't know about / Privacy / Other _____
7	Yes No	Yes No	Yes No	Didn't know about / Privacy / Other _____
8	Yes No	Yes No	Yes No	Didn't know about / Privacy / Other _____
9	Yes No	Yes No	Yes No	Didn't know about / Privacy / Other _____
10	Yes No	Yes No	Yes No	Didn't know about / Privacy / Other _____
11	Yes No	Yes No	Yes No	Didn't know about / Privacy / Other _____
12	Yes No	Yes No	Yes No	Didn't know about / Privacy / Other _____
13	Yes No	Yes No	Yes No	Didn't know about / Privacy / Other _____
14	Yes No	Yes No	Yes No	Didn't know about / Privacy / Other _____
15	Yes No	Yes No	Yes No	Didn't know about / Privacy / Other _____
16	Yes No	Yes No	Yes No	Didn't know about / Privacy / Other _____
17	Yes No	Yes No	Yes No	Didn't know about / Privacy / Other _____
18	Yes No	Yes No	Yes No	Didn't know about / Privacy / Other _____
19	Yes No	Yes No	Yes No	Didn't know about / Privacy / Other _____
20	Yes No	Yes No	Yes No	Didn't know about / Privacy / Other _____
21	Yes No	Yes No	Yes No	Didn't know about / Privacy / Other _____

Appendix E

Reverse 911 Survey Northwest Region

Table of results

Total Number of people interviewed: 103
Total Number of North Las Vegas Residents: 100

Question # 2: Do you have a residential landline in your home?

	# Responded	Percentage
Yes	49	49%
No	51	51%

* Excluded non-residents

Question #3: Have you registered your cell phone to the Southern Nevada on the alert notification system?

	# Responded	Percentage
Yes	2	2%
No	98	98%

* Excluded non-residents

Question #4: If you have not registered cell phone, why?

	# Responded	Percentage
Did not know about system	96	98%
Privacy Reasons	0	0%
Other	2**	2%

* Excluded non-residents
** Two respondents answered they just had not done it yet but knew about it.

Appendix F

Reverse 911 Survey Northeast Region

Table of results

Total Number of people interviewed: 120
Total Number of North Las Vegas Residents: 119

Question # 2: Do you have a residential landline in your home?

	# Responded	Percentage
Yes	50	42%
No	69	58%

* Excluded non-residents

Question #3: Have you registered your cell phone to the Southern Nevada on the alert notification system?

	# Responded	Percentage
Yes	0	0%
No	119	100%

* Excluded non-residents

Question #4: If you have not registered cell phone, why?

	# Responded	Percentage
Did not know about system	118	99%
Privacy Reasons	0	0%
Other	1**	1%

* Excluded non-residents
** One respondent answered they just had not done it yet but knew about it.

Appendix G

Reverse 911 Survey Southwest Region

Table of results

Total Number of people interviewed: 255
Total Number of North Las Vegas Residents: 239

Question # 2: Do you have a residential landline in your home?

	# Responded	Percentage
Yes	109	46%
No	130	54%

* Excluded non-residents

Question #3: Have you registered your cell phone to the Southern Nevada on the alert notification system?

	# Responded	Percentage
Yes	6	2.5%
No	233	97.5%

* Excluded non-residents

Question #4: If you have not registered cell phone, why?

	# Responded	Percentage
Did not know about system	221	97%
Privacy Reasons	3	1.5%
Other	3**	1.5%

* Excluded non-residents
** Three respondent answered they just had not done it yet but knew about it.

Appendix H

Reverse 911 Survey Southeast Region

Table of results

Total Number of people interviewed: 285
Total Number of North Las Vegas Residents: 274

Question # 2: Do you have a residential landline in your home?

	# Responded	Percentage
Yes	82	30%
No	192	70%

* Excluded non-residents

Question #3: Have you registered your cell phone to the Southern Nevada on the alert notification system?

	# Responded	Percentage
Yes	7	2.5%
No	267	97.5%

* Excluded non-residents

Question #4: If you have not registered cell phone, why?

	# Responded	Percentage
Did not know about system	258	97%
Privacy Reasons	2	.5%
Other	7**	2.5%

* Excluded non-residents
** Five respondent answered they just had not done it yet but knew about it. One answered did not like system and another answered poor service.

Appendix I

Reverse 911 Survey All North Las Vegas (All 4 Locations Combined)

Table of results

Total Number of people interviewed: 763
Total Number of North Las Vegas Residents: 732

Question # 2: Do you have a residential landline in your home?

	# Responded	Percentage
Yes	290	40%
No	442	60%

* Excluded non-residents

Question #3: Have you registered your cell phone to the Southern Nevada on the alert notification system?

	# Responded	Percentage
Yes	15	2%
No	717	98%

* Excluded non-residents

Question #4: If you have not registered cell phone, why?

	# Responded	Percentage
Did not know about system	699	97.5%
Privacy Reasons	5	.5%
Other	13**	2%

* Excluded non-residents
** 11 of the 13 respondents answered they just had not done it yet but knew about it.